ITB 23-001 – UTILITY INFRASTRUCTURE
12" water main/ 6" sewer main

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PART 1 – GENERAL

1.01 SCHEDULES

A. The Contractor shall be responsible for preparing a Progress or Work Schedule for the entire project.

1.02 SHOP DRAWINGS, SAMPLES AND MANUALS

A. The Contractor shall process the Shop Drawings required by the Contract to the Engineer and Contractor shall be responsible for their timely submission in accordance with the Shop Drawing schedule which is included in the overall progress or work schedule as described in Part 2 of this Section.

B. Any proposed deviations/substitutions from that specified shall be clearly noted on the cover letter transmitting the shop drawing. Failure to so note will be cause for rejection of equipment, materials, etc., after installation.

C. All submissions shall be marked with the Specification Section Number containing the item submitted for review, or Drawing number for items specified on Drawings only.

D. Revised shop drawings submitted for review shall be marked "RESUBMISSION."

1.03 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall be responsible for all construction progress photographs.

1.04 SUBMITTAL PROCEDURES

All “Hard Copy” submittals shall be delivered to the Owner’s responsible party.

A. The submittals shall have been properly certified and identified by the Contractor. If they are submitted properly, the items will be processed for review.

B. The processed submittals will be returned to the respective Contractor.

C. In the event of a conflict between this Section and other Sections of the Specifications regarding the number of copies to be submitted; the requirements of this Section govern.

D. Electronic transmittal of submittal per the Standard General Provisions is permissible. Delivery shall be by email or via a FTP site.

PART 2 – SCHEDULE

2.01 PREPARATION

A. The Contractor shall prepare a Progress or Work Schedule for the entire Project, using CPM, showing the order in which the Contractor proposes to carry on Contractor's work and salient features, including submissions of shop drawings and samples and procurement of materials, to meet date of completion.

B. Each activity in the Progress or Work Schedule shall be identified and a time for the performance of such activity indicated. Each activity shall be preceded by all work that must be accomplished prior to that activity. All abbreviations, codes and/ or symbols used shall be described on the Schedule.

C. The Contractor, in preparing proposed Progress or Work Schedules, shall prepare a narrative highlighting the recommended sequence of construction. Any subsequent change to the Progress or Work Schedule that alters the sequence of construction shall include a narrative from the Contractor highlighting those subsequent changes.

D. In addition to the schedule described above, the Contractor shall submit a list of shop drawings proposed to submit for review which shall include the following:
   1. Specification Section Number
      a. Description of all items within section.
      b. Approximate date of each submittal.
   2. Contract Drawing Number
      a. Description of all items on each Contract Drawing, if not previously covered by the Specifications.
      b. Approximate date of each submittal.

2.02 SUBMISSION

A. Submit six copies of Schedule to the Engineer for review within 30 days after award of Contract. Update and resubmit Schedule monthly thereafter until completion of the work. Updated Schedule shall have completed activities removed or indicated as such. Whenever modifications are made to the Contract which add or delete activities and/or revise time of completion, Schedule shall be revised and resubmitted to the Engineer within ten days after such modification is authorized.

B. In the event that the work is behind schedule, the Schedule shall be revised, through the use of overtime work or by other means, to ensure that the work is completed

within the Contract time. Under these circumstances, overtime work shall be performed at no additional cost to the Owner.

PART 3 – SHOP DRAWINGS AND MANUALS

3.01 GENERAL

A. Shop drawings are defined as drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by the Contractor which illustrate how specific portions of the work shall be fabricated and/or installed.

B. Shop drawings are not part of the Contract Documents, but are a supplementary means of communication to assist in the understanding of what the Contractor proposes to provide and to establish that whatever he intends to install either does or does not conform to the Drawings and Specifications.

C. In the instance of a request for a substituted item, the Contractor shall verify that it will fit into the space allocated to the originally required item giving due regard to all other trades' requirements. Where modifications to the Contract Documents are proposed, the Contractor must clearly indicate such deviation in writing in Contractor’s transmittal letter. If the modification and/ or substitutions are agreed to by the Engineer, the Contract Documents will be appropriately modified. However when additional work is required, the Contractor is advised that Contractor must pay the Engineer for redesign to accommodate the revised substitution as well as pay other contractors for extra work required by them for the change. No increase in Owner's construction cost will be allowed.

3.02 CATALOG SHEETS

A. For standard manufactured items considered by the Engineer as not requiring special Shop Drawings, the Contractor shall submit six (6) copies of manufacturer's catalog sheets showing model numbers and illustrated cuts of the items to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring and control diagrams and all other pertinent information. This information shall be highlighted on all six (6) copies when appropriate.

B. The Engineer will retain three (3) copies and return three (3) copies to the Contractor submitting the catalog sheets.

3.03 SHOP DRAWINGS

A. The Contractor shall submit for review six white prints of shop and working drawings of materials fabricated especially for this Contract, and of equipment and materials for which such drawings are specifically requested.

1. The Contractor shall submit six copies of a letter with the Shop Drawings for each piece of equipment signed and certified by an authorized representative of the Equipment Manufacturer which certifies that the subject equipment meets or exceeds the current OSHA/ ANSI and local industrial codes for safety. The letter shall also specifically identify any exceptions that the Equipment Manufacturer has taken in not providing the required safety devices as they relate to the above codes.

B. Coordinate all equipment systems with the Drawings and submit a complete and coordinated shop drawing submission of the specific equipment system. All shop drawings related to the specific equipment system shall be submitted at the same time for review. The shop drawing submission shall provide the coordination of concrete foundations, piping, relative elevations, electrical, chemical facilities, instrumentation facilities, dimensions, structural changes, etc. in sufficient detail that the Engineer can adequately review the shop drawing. Equipment systems submitted which are incomplete and uncoordinated shall be returned to the respective Contractor, unchecked. A resubmission shall be made after equipment system shop drawings have been completed and coordinated. Any required changes in the equipment system layout vs. the equipment system shown on the Drawings shall be provided by the respective Contractor at no added expense to the Owner or Engineer.

C. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter conforms to the Drawings and Specifications in all respects. Drawings which are correct shall be marked with the date, checker's name and certification of the Contractor's approval, and then shall be submitted to the Resident Project Representative. Any Shop Drawings submitted without the Contractor's certification will be returned without review.

D. The Engineer will retain three copies and return three copies to the Contractor.

E. Shop Drawings shall show the principal dimensions, weight, structural and operating features, performance characteristics and wiring diagrams, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for this Contract.

F. When so specified or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted for review in place of shop and working drawings. In such case the requirements shall be as specified for shop and working drawings, insofar as applicable.

G. The Contractor shall be responsible for the prompt submission of all shop and working drawings in accordance with the shop drawing schedule so that there shall be no delay to the work due to the absence of such drawings.

H. No material shall be purchased or fabricated especially for this Contract until the required shop and working drawings have been submitted and reviewed as conforming to the Contract requirements. All materials and work involved in the construction shall then be as represented by said drawings.

I. The Engineer's review of shop and working drawings will follow a general check made to ascertain conformance with the design concept and functional result of the project and compliance with the information given in the Contract Documents. The Contractor is responsible for details and accuracy, for conforming and correlating all quantities and dimensions at the job site; for information that pertains solely to the fabrication processes or to techniques of construction; and for coordination of the work of all trades.

3.04 MANUALS

A. The Contractor shall submit for review three (3) hard copies and one (1) electronic copy of all requested operating and maintenance manuals with the shop drawing submittals.

B. The Engineer will retain one (1) hard copy and one (1) electronic copy and return two (2) hard copies to the Contractor.

C. Prior to final payment, provide two (2) updated operating, maintenance manuals and parts list for the Owner's use.

3.05 FIELD DISTRIBUTION

A. The Contractor shall be responsible for the required number of processed drawings or catalog cuts for field distribution to all necessary Contractors.

B. The Contractor shall be responsible for the prompt distribution of processed Shop Drawings to all other Contractors whose work must be coordinated with the work progress.

PART 4 – SAMPLES

4.01 SUBMISSION OF SAMPLES

A. Unless otherwise specified, the Contractor shall provide samples in duplicate and identify each sample by an appropriate tag or label listing the names of the Project, the Owner, the Engineer and the Contractor and/or Subcontractor as well as the exact identification of the sample. Tag or label shall be large enough to provide a blank space for review stamps.

B. Samples of items submitted for destruction tests or for use in testing mixture with other materials will not be returned. Review of these items will be given by letter.

C. When reviewed, one sample of each item, not submitted for destruction, will be returned to the Contractor and shall be kept and maintained in good condition in the submitting Contractor's office at the project site for later use in comparison with material actually delivered for the work. When samples of large fabricated items or of costly items are required, reviewed samples may be installed in the work if the exact location of such samples is recorded on the Engineer's Record Drawings.

PART 5 – CERTIFICATION AND TESTS

5.01 GENERAL

A. Six (6) copies of certifications and reports of tests when required under the various sections of the Specifications shall be submitted.

PART 6 – CONSTRUCTION PHOTOGRAPHS

6.01 GENERAL

A. The Contractor shall provide pre-construction views, submitted in duplicate of the entire construction area before any work begins. Views shall be in the form of DVDs or External Storage Devices such as non returnable USB flash drives or hard drives.

B. The Contractor shall provide, from commencement of Project through completion of all Work, 8 inch by 10 inch photographs, in duplicate. The photographs shall be clear, sharp, and in color, Digital pictures are also acceptable. These progress photographs shall be submitted to the Engineer each month in conjunction with the current Monthly Estimate. Interior and/or exterior views shall be made as requested by the Engineer.

C. Each photograph or digital photograph shall have the following information clearly noted on the picture. The information shall be typed or neatly printed on a label and placed on the face of the picture, and not obliterate important construction features.
   1. Date Photo was taken and photo number.
   2. Client/ Owner.
   3. Project Title and Contract number.

4. Contractor.
5. Description of what is shown on the photo including direction.

6.02 NUMBER OF VIEWS

A. Provide a minimum of ten views each month from preselected locations clearly showing the progress of the Work.

END OF SECTION 00905

SECTION 01000 – MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 Scope Of Work

A. This Section further defines the items included in each Bid Item in the Bid Proposal. Payment will be made based on the specified items included in the description for each Bid Item.

B. All Contract Prices included in the Bid Proposal section will be full compensation for all labor, materials, tools, equipment and incidentals necessary to complete the work as shown on the drawings and/ or as specified in the Contract Documents. Actual quantities of unit-price Bid Items will be determined upon completion of the construction in the manner specified for each item in this Section. Payment for all items listed in the Bid Form will constitute full compensation for all work shown and/ or specified to be performed for this project.

1.02 Estimated Quantities

A. The quantities shown are approximate and are given only as a basis of calculation upon which the award of the Contract is to be made. The Owner and Engineer do not assume any responsibility for the final quantities, nor shall the Contractor claim any misunderstanding because of such estimate of quantities. Final payment will be made only for satisfactorily completed quantities of each item.

1.03 Work Outside Authorized Limits

A. No payment will be made for work constructed outside the authorized limits of work unless approved by the Owner in writing prior to the work being performed.

1.04 Measurement Standards

A. Unless otherwise specified for the particular items involved, all measurements of distance shall be taken horizontally or vertically.

1.05 Area Measurements

A. In the measurement of items to be paid on the basis of area of finished work, the lengths and/ or widths to be used in the calculations shall be the final dimensions measured along the surface of the completed work within the neat lines shown or designated.

1.06 Lump Sum Items

A. Where payment for items is shown to be paid on a lump-sum basis, no separate payment will be made for any item of work required to complete the lump-sum item. Lump sum Bid Items shall be complete, tested, and fully operable prior to request for final payment. The lump-sum price bid for various items shall be compensation in full for furnishing all materials, labor, equipment, dewatering and incidentals necessary to install

these items complete and operable in every detail and in accordance with the drawings and specifications.

1.07 Unit Price Items

A. Payment will be made for unit-price items of work described herein and listed on the Bid Form. Any related work not specifically listed but required for satisfactory completion of the work shall be considered to be included in the scope of the appropriate Bid Items. The unit price bid for the various items shall be compensation in full for furnishing all materials, labor, equipment, and incidentals for the item in place, complete in every detail. There will be no direct payment for clearing, grubbing, excavation, bracing, dewatering, backfilling, clean-up, sheeting, shoring, restoration of property, testing or other items of work necessary for installation of the item.

1.08 Other Provisions

A. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work. Reduction in retainage shall not be requested by the Contractor or made by the Owner until as-built (record) drawings have been approved by the Engineer.

1. Trench excavation, including necessary pavement removal, rock removal, and muck removal.
2. Sheeting and shoring.
3. Clearing, grubbing and grading.
4. Removal and disposal of excess materials remaining after excavation.
5. Dewatering and disposal of surplus water.
6. Structural fill, backfill and grading.
7. Testing and placing system in operation.
8. Any material and equipment required to be installed and utilized for tests.
9. Disposing excess water used for pressure testing.
10. Maintaining the existing level of service during construction.
11. Appurtenant work as required for a complete and operable system.

1.09 Application For Payment

A. Refer to Article 15 of the General Conditions.

PART 2 – NOT APPLICABLE

PART 3 – EXECUTION

3.01 Mobilization/ Demobilization

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for mobilization and demobilization of all labor, equipment, materials, and appurtenances

necessary for execution of the project. Mobilization shall include all items detailed in Section 101-1 of the FDOT Standard Specifications, latest edition. Also included, but not limited to, as part of this Bid Item is the cost for project performance indemnifications, photographs, schedules, coordination, and phasing and other miscellaneous items associated with the work. Payment for this Bid Item will be lump sum. Sixty percent of the lump sum amount minus retainage will be payable upon mobilization, only after all applicable documentation has been submitted to the Engineer. The remaining 40 percent plus retainage will be payable upon project closeout.

3.02 Closeout Documentation (including Record Drawings)

A. Payment for all work included under this Bid Item will be made at the lump sum amount for the work covered by this item and shall be full and complete compensation for the entire work. The work covered by this item includes furnishing closeout documentation as specified in the contract documents, including, but not limited to, warranty information, Warranty Bond, final release of lien, and record drawings shall be compensation in full for all material, labor, equipment and incidentals necessary to prepare and furnish all engineer-approved documentation required by the contract documents. The Owner shall make no additional payment for draft or preliminary submittals initially made or resubmitted due to incompleteness or rejection by the Engineer. Payment for work included under this Bid Item shall be made in full with the Contractor's final payment.

3.03 Performance and Payment Bonds

A. Payment for work included under this Bid Item will be made at the lump sum amount for the work covered by this item and shall be full and complete compensation for providing valid Performance and Payment Bonds. Completion of the applicable forms per the instructions provided is required.

3.04 Prevention, Control and Abatement of Erosion and Water Pollution

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for all work associated with the prevention, control, and abatement of erosion and water pollution in accordance with the contract documents. Payment shall include all items and incidentals necessary to complete the work. Payment for work included under this Bid Item will be lump sum. Contractor is advised that erosion control measures shown on the plans are the minimum; additional erosion control measures shall be included in the Contractor's lump sum price.

B. Additional erosion control measures may be required along existing slopes to properly contain drilling fluid used during HDD operations, particularly in the areas adjacent to the southerly 6-in HDD wetland crossing, to prevent sediment transfer and erosion into wetland areas. No separate payment shall be made for these specific measures.

3.05 Maintenance Of Traffic

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for the work covered by this item, and shall be full and complete compensation for the entire work. The work covered by this item includes all costs associated with Traffic

Maintenance, as defined in Section 102-1 of the FDOT Standard Specifications, latest edition. This Bid Item shall include, but is not limited to, flaggers, signs, and all other appurtenances and requirements to provide fully functional Traffic Maintenance in accordance with the Contract Documents and agencies having jurisdiction.

3.06 Manhole Rehabilitation and Lining

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for the work covered by this item and shall be full and complete compensation for the entire work. The work covered by this item includes all work required for rehabilitation and internal lining of existing sanitary manhole MH1799 in Park View Rd, where the new 6-inch force main will terminate. The work will include resetting the existing manhole frame and cover to match finished grade of paving/ patching of Park View Rd following force main installation.

3.07 6-inch DR18 PVC Force Main (Open trench installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing sanitary sewer force main via open trench. This Bid Item shall include, but is not limited to, clearing and grubbing; protection of existing trees; trench excavation, backfill and compaction; temporary dewatering of pipe trench; temporary pavement patching; tracer wire; utility markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including golf course irrigation lines, and gas, water and sewer services; connecting to existing manhole; flushing; pressure testing; and all other appurtenances and requirements to provide a fully functional 6-inch PVC force main, in accordance with the Contract Documents.

3.08 6-inch DR18 Fusible PVC Force Main (Trenchless installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing fusible PVC sanitary sewer force main via trenchless method (i.e., horizontal directional drilling). The work covered by this item includes all work required for the construction of 6-inch force main via horizontal directional drilling. Items included in this Bid Item shall include, but are not limited to, site clearing, grubbing and restoration at the HDD launch and receiving sites; flushing; pressure testing; connection to PVC force mains on either side of the HDD operation; and all other appurtenances and requirements to provide a fully functional 6-inch PVC force main, in accordance with the Contract Documents.

B. No additional cost will be paid to the Contractor should any existing utility be damaged by the HDD operation, including, but not limited to, gas, water, sewer, reclaimed, irrigation, and telecommunications facilities.

C. The Contractor’s attention is drawn to specific notes on the Drawings requiring onsite pre-drill meetings with owners of utilities which may be affected by the HDD operations.

3.09 12-inch DR18 PVC Water Main (Open trench installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing water main via open trench. This Bid Item shall

include, but is not limited to, clearing and grubbing; protection of existing trees; trench excavation, backfill and compaction; temporary dewatering of pipe trench; tracer wire; utility markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including golf course irrigation lines, and gas, water and sewer services; flushing, pressure testing and disinfection; and all other appurtenances and requirements to provide a fully functional 12-inch PVC water main, in accordance with the Contract Documents.

3.10 12-inch DR18 Fusible PVC Water Main (Trenchless installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing fusible PVC water main via trenchless method (i.e., horizontal directional drilling).. The work covered by this item includes all work required for the construction of 12-inch water main via horizontal directional drilling. Items included in this Bid Item shall include, but are not limited to, site clearing, grubbing and restoration at the HDD launch and receiving sites; flushing, pressure testing and disinfection; connection to water mains on either side of the HDD operation; and all other appurtenances and requirements to provide a fully functional 12-inch PVC water main, in accordance with the Contract Documents.

B. No additional cost will be paid to the Contractor should any existing utility be damaged by the HDD operation, including, but not limited to, gas, water, sewer, reclaimed, irrigation, and telecommunications facilities.

C. The Contractor's attention is drawn to specific notes on the Drawings requiring onsite pre-drill meetings with owners of utilities which may be affected by the HDD operations.

3.11 12-inch by 12-inch Stainless Steel Tapping Sleeve and Gate Valve

A. Payment for all work included under this Bid Item will be made at the lump sum amount bid for the work covered by this item and shall be full and complete compensation for the entire work. This item includes all work required for furnishing, installing, and pressure testing a tapping sleeve and tapping gate valve on the existing water main, including valve box, lid and concrete collar; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, reclaimed, irrigation, water and sewer services; and all other appurtenances and requirements to provide fully functional tapping sleeve and gate valve assembly, in accordance with the Contract Documents.

B. Coupon removed from the existing water main shall be delivered to the Owner's representative upon completion of installation.

3.12 6-inch Resilient-seated Gate Valve and Box

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing 6-inch resilient-seated gate valves on the new force main at the locations shown on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; tracer wire; valve boxes, lids and concrete collars; electronic locate ball markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas,

reclaimed, irrigation, water and sewer services; and all other appurtenances and requirements to provide fully functional gate valve assemblies, in accordance with the Contract Documents.

3.13 12-inch Resilient-seated Gate Valve and Box

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing 12-inch resilient-seated gate valves on the new water main at the locations shown on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; tracer wire; valve boxes, lids and concrete collars; electronic locate ball markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, reclaimed, irrigation, water and sewer services; and all other appurtenances and requirements to provide fully functional gate valve assemblies, in accordance with the Contract Documents.

3.14 8-inch DR18 PVC Water Main (Open trench installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing water main via open trench. This Bid Item shall include, but is not limited to, clearing and grubbing; protection of existing trees; trench excavation, backfill and compaction; temporary dewatering of pipe trench; tracer wire; utility markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, water and sewer services; pressure testing; disinfection; and all other appurtenances and requirements to provide a fully functional 8-inch PVC water main, in accordance with the Contract Documents.

3.15 8-inch Resilient-seated Gate Valve and Box

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing 8-inch resilient-seated gate valves on the new water main at the locations shown on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; tracer wire; valve boxes, lids and concrete collars; electronic locate ball markers; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, reclaimed, irrigation, water and sewer services; and all other appurtenances and requirements to provide fully functional gate valve assemblies, in accordance with the Contract Documents.

3.16 Ductile Iron Fittings (without joint accessories)

A. Payment for all work included under this Bid Item will be made at the unit price per pound bid for the work covered by this item, and shall be full and complete compensation for the entire work. This item includes all work required for furnishing and installing ductile iron pipe fittings and properly compacted bedding for fittings. Payment will be based on catalog weight of the manufacturer supplying the fittings. Joint accessories such as bolts, gaskets, glands or other miscellaneous items will not be included in the weights.

3.17 Ductile Iron Retainer Glands & Joint Accessories (Mechanical Joints)

A. Payment for all work included under this Bid Item will be made at the unit price per pound bid for the work covered by this item, and shall be full and complete compensation for the entire work. This item includes all work required for furnishing and installing ductile iron restrained-joint retainer glands for mechanical-joint connections between ductile iron fittings and valves, and PVC pipe, including nuts, bolts and gaskets required for watertight operation. Payment amount will be based on the manufacturer's catalog weight of the materials provided.

3.18 Ductile Iron Split Restraint Harnesses (Push-on Joint PVC)

A. Payment for all work included under this Bid Item will be made at the lump sum amount bid for the work covered by this item, and shall be full and complete compensation for the entire work. This item includes all work required for furnishing and installing ductile iron split restrained harnesses for push-on pipe joint C900 PVC pipe restraint.

B. Contractor shall use the Pipe Joint Restraint Tabulation in the Contract Drawings to develop Contractor's lump-price for this Bid Item. Payment amount will be based on the percentage of linear feet of pipe installed requiring joint restraint.

3.19 Pipe Bedding (#57 crushed gravel, 6-in thick)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for the work covered by this item, and shall be full and complete compensation for the entire work. This item includes all work required for furnishing, installing and compacting #57 crushed gravel for pipe and valve bedding. The contract measurement for a "linear foot" shall be the length authorized by the Engineer. The bedding shall be installed to a width of the inside diameter of the pipe plus 36 inches, and to a thickness of six inches or as detailed on the plans. The contract unit price shall also include any incidentals necessary to complete the work.

3.20 Remove and Replace Existing Chain Link Fence

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for the work covered by this item, and shall be full and complete compensation for the entire work. The work covered by this item includes all work required for temporary removal of existing chain link fencing and barbed wire at Force Main Sta. 0±75, maintenance of temporary construction (orange) fencing, and final restoration of fencing to pre-construction conditions following final review and acceptance of the pipe trench restoration by the Owner's Engineer. This item includes all labor and materials to remove existing fencing and fence posts as required to construct the force main, and those required to restore same in accordance with the Contract Documents.

3.21 2-inch Air and Vacuum Valve Assembly (Type I)

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing a "Type I" 2-inch air and vacuum valve assembly on the new force main at the locations shown and as detailed on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; tracer wire; locating, supporting and protecting existing utilities and utility poles; replacement of

any damaged utilities, including gas, water and sewer services; pressure testing; and all other appurtenances and requirements to provide a fully functional air and vacuum valve assemblies, in accordance with the Contract Documents.

B. This Bid Item shall include all Sch 80 PVCP, fittings, joints, valve enclosure, and concrete bottom required to construct and set the vent piping between the force main and the ARV, as shown and as detailed on the drawings.

3.22 2-inch Air and Vacuum Valve Assembly (Type II)

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing a “Type II” 2-inch air and vacuum valve assembly on the new force main at the locations shown and as detailed on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; tracer wire; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, water and sewer services; pressure testing; and all other appurtenances and requirements to provide a fully functional air and vacuum valve assemblies, in accordance with the Contract Documents.

3.23 Inline Sample Tap

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing an inline sample tap assembly at the locations shown and as detailed on the Contract Drawings. This Bid Item shall include, but is not limited to, excavation; backfill and compaction; locating, supporting and protecting existing utilities and utility poles; replacement of any damaged utilities, including gas, water and sewer services; pressure testing; and all other appurtenances and requirements to provide a fully functional inline sample tap assemblies, in accordance with the Contract Documents.

3.24 Misc. golf course irrigation line repair (≤ 2-in dia.)

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for supporting/ repairing miscellaneous golf course irrigation lines which may be encountered/ damaged during the Contractor’s operations. This Bid Item shall include, but is not limited to, replacing damaged PVC irrigation lines and spray heads in-kind as recommended by the City’s Golf Course Manager.

3.25 Concrete Walk Removal and Restoration (6-inch thick)

A. Payment for all work included under this Bid Item will be made at the unit price per square foot bid for removing and replacing concrete walks/ cart paths at the locations shown on the Contract Drawings. This Bid Item shall include, but is not limited to, saw-cutting, removal and disposal of existing concrete walks where indicated; excavation; backfill and compaction; replacement of any damaged utilities, including gas, reclaimed, irrigation, water and sewer services; and all other appurtenances and requirements to restore concrete walks to their original condition, in accordance with the Contract Documents.

3.26 Asphalt Pavement Restoration

A. Payment for all work included under this Bid Item will be made at the unit price per square yard bid for work covered by this item, and shall be full and complete compensation for the entire work. The work covered by this item includes all work required to restore pavement in Park View Rd to its preconstruction condition, following satisfactory installation, testing, backfill and compaction of the force main trench within the pavement limits, in accordance with the Construction Documents.

3.27 Sod

A. Payment for all work included under this Bid Item will be made at the unit price per square yard bid for furnishing and installing sod as part of finished restoration of all disturbed areas (except for paved areas). This Bid Item shall include, but is not limited to, final grading in preparation for sod placement, placing sod to the limits shown in the trench details, and proper watering and maintenance of all sod before and after installation, in accordance with the Contract Documents.

B. Types of sod to be used:

1. Areas outside of golf course green areas : Tifway 419 Bermudagrass.

2. Golf course green areas: TifEagle™ Bermudagrass.

3.28 Remove, protect and reset Golf Course Marker

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for removal, protection and resetting a granite golf cart path marker at pipeline Sta. 4±60. This Bid Item shall include all labor and materials required to remove the marker and reset it in accordance with the details on the Drawings.

3.29 Putting Green and Sand Trap Protection and Restoration

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for protection and restoration of the golf course putting green and sand traps near pipeline Sta. 20+00. Work shall include all soil, sand, filter fabric, flag, cup and any other items necessary to restore the green to preconstruction conditions and standard per USGA Specifications (sod shall be furnished and installed separately).

3.30 Miscellaneous Tree Trimming and Removal

A. Payment for all work included under this Bid Item will be made at the lump sum price bid for trimming and removal of trees as necessary to accommodate the work. This Bid Item shall include all labor, tools and materials required for proper trimming and removal of trees and stumps as approved by the Owner and Golf Course Maintenance Manager.

B. All debris generated as part of this Bid Item shall be removed and disposed offsite. No burning of tree debris is allowed.

3.31 Certified Arborist Consultant

Payment for all work included under this Bid Item will be made at the lump sum price bid for retaining the services of a certified arborist. Contractor shall utilize the services of a certified arborist for guidance and recommendations for the Contractor's tree-trimming, protection and removal operations over the course of the project.

BID ALTERNATES

3.32 Bid Item No. A1 – 6-inch (I.D.) DR11 (PE4710) HDPE Force Main (Trenchless installation)

A. Payment for all work included under this Bid Item will be made at the unit price per linear foot bid for furnishing and installing high-density polyethylene (HDPE) sanitary sewer force main via trenchless method (i.e., horizontal directional drilling). The work covered by this item includes all work required for the construction of 6-inch force main via horizontal directional drilling. Items included in this Bid Item shall include, but are not limited to, site clearing, grubbing, and restoration at the HDD launch and receiving sites; flushing; pressure testing; connection to C900 DR18 PVC force mains on either side of the HDD operation; and all other appurtenances and requirements to provide a fully functional 6-inch PVC force main, in accordance with the Contract Documents.

B. No additional cost will be paid to the Contractor should any existing utility be damaged by the HDD operation, including, but not limited to, gas, water, sewer, reclaimed, irrigation, and telecommunications facilities.

C. The Contractor's attention is drawn to specific notes on the Drawings requiring onsite pre-drill meetings with owners of utilities which may be affected by the HDD operations.

3.33 Bid Item No. A2 - 6-inch HDPE to PVCP Transition Coupling with Restrained Joints

A. Payment for all work included under this Bid Item will be made at the unit price per each bid for furnishing and installing HDPE to PVC transition couplings at each end of a directional drill installation of HDPE force main. Transition couplings shall be compatible for making a watertight, restrained, reliable transition from PE4710 DR11 HDPE to C900 DR18 PVC, and all other appurtenances and requirements to provide a fully functional connection, in accordance with the Contract Documents.

END OF SECTION 01000

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The work specified in this Section consists of providing, maintaining and removing temporary and permanent erosion and sedimentation controls.

B. Land disturbance activity requiring a Development Order will not commence until the order is approved.

C. Basic Principles
   1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and conditions.
   2. Minimize the disturbed area and duration of exposure to erosion elements.
   3. Stabilize disturbed areas immediately.
   4. Safely convey run-off from the site to an outlet such that erosion will not be increased off site.
   5. Retain sediment on site that was generated on site.
   6. Minimize encroachment upon watercourses.

D. Temporary Erosion and Sedimentation Control; In general, temporary erosion and sedimentation control procedures shall be directed toward:
   1. Preventing soil erosion at the source.
   2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
   3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

E. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of the waterways and to prevent erosion of the Project site.

1.02 DESCRIPTION OF WORK (for projects that disturb one acre or less)

A. The work of this section consists of the necessary erosion control and environmental protection measures required to control erosion and provide environmental protection on the project and areas outside the limits of the project, so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project, damage to work on the project, and to satisfy the specific or general conditions of applicable permits and regulations. The need for temporary erosion control and environmental protection shall be considered as an anticipated condition of construction for compliance with state and federal laws and it is the Contractor's responsibility to provide the necessary solutions as part of these contract documents.

B. Erosion control work includes, but is not limited to, the following:
   1. Temporary erosion control
   2. Permanent erosion control

C. Environmental protection work includes, but is not limited to, the following:

1. Staked hay bales
2. Staked Geobales
3. Sediment control fence
4. Sedimentation basins
5. Turbidity barriers
6. Temporary gravel construction entrance

1.03 DESCRIPTION OF WORK (for projects that disturb more than one acre)

A. If construction activities associated with this project will disturb more than one acre of land, the Contractor shall obtain coverage under a NPDES Stormwater Permit and implement appropriate pollution prevention techniques to minimize erosion and sedimentation and properly manage stormwater. The Florida Department of Environmental Protection adopted under Rule 62-621.300(4), *F.A.C.*, the General Permit for Stormwater Discharge from Large and Small Construction Activities (CGP). The CGP requires:
   1. A CGP Notice of Intent (NOI) [DEP Form 62-621.300(4)(b)] must be submitted to DEP. There is an application fee for the NOI.
   2. A Notice of Termination (NOT) [DEP Form 62-621.300(6)] must be submitted to DEP to discontinue permit coverage. A NOT may be submitted only when the site meets the eligibility requirements for termination specified in the CGP.

B. The Stormwater Pollution Prevention Plan (SWPPP) must be developed and implemented to be in compliance with the permit. The Plan must include the following:
   1. A site evaluation of how and where pollutants may be mobilized by stormwater.
   2. A site plan for managing stormwater runoff.
   3. Identification of appropriate erosion and sediment controls and Stormwater Best Management Practices (BMPs) to reduce erosion, sedimentation, and stormwater pollution.
   4. A maintenance and inspection schedule.
   5. A record keeping process.
   6. Identification of stormwater exit areas.

C. A copy of the SWPPP must be available at the immediate site of the construction activity. Best Management Practices (BMPs) must be identified to fit the specific project. Both structural and non-structural controls will be applicable. Some of the commonly used controls are:
   1. Structural Controls
      a. Retention Ponds: Permanent structures designed to allow time for sediments to settle and water to infiltrate the ground.
      b. Temporary Sediment Basins: Structures designed to detain sediment-laden runoff from disturbed areas long enough for sediments to settle out and control the release of stormwater.
      c. Entrance/Exit Controls: Temporary controls, such as gravel, used to stabilize the entrances/exits to the site to reduce the amount of soils transported onto paved roads by vehicles (known as “track-out”).

d. Silt Fencing: A temporary erosion and sediment control used to prevent dirt from entering waterways before bare soil is stabilized with vegetation.
e. Berms: A temporary erosion and sediment control that physically prevents polluted runoff from entering nearby storm drain inlets and waters

2. Non-Structural Controls
a. Stabilization: Techniques such as sodding, seeding/ mulching, and stone cover, which reduce the erosion of exposed soils and steep grades.
b. Phased Construction: Scheduling construction to occur during the dry season or to minimize the amount of land cleared at any one time.
c. Good Housekeeping: Techniques such as oil and fuel containment, spill prevention and clean-up, and street sweeping of “tracked-out” soils, which help prevent the contamination of stormwater runoff.

D. Detailed information and guidance for SWPPP development and for compliance inspections is available at the following web sites:

http://www.dep.state.fl.us/water/stormwater/npdes/construction3.htm

http://www.floridadep.org/water/nonpoint/erosion.htm

1.04 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.
1. Comply with the provisions of the following codes and standards (latest edition), except as shown or specified:
a. "Standard Specifications for Road and Bridge Construction," Florida Department of Transportation, latest edition. Herein specified or shown on the plans as "Section XXX, FDOT Standard Specifications.”
b. "Roadway and Traffic Design Standards,” Florida Department of Transportation, latest edition. Herein specified as "FDOT Standard Index No. XXX.”
c. "American Society for Testing and Materials (ASTM) Publications" as follows:

D123	Standard Terminology Relating to Textiles
D1683	Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics
D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D3786	Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
D3787	Standard Test Method for Bursting Strength of Textiles-Constant-Rate-of-Traverse (CRT) Ball Burst Test
D4439	Standard Terminology for Geosynthetics
D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
D5141	Standard Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration Component of a Sediment Retention Device

B. Certification
   1. The Contractor shall be responsible for providing the required material certifications prior to construction. Failure to provide certification may result in rejection of the material and replacement at no cost to the Owner.

1.05 SUBMITTALS

A. Material Certificates
   1. Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements. When test requirements are specified, the Contractor shall supply results performed by a certified testing laboratory.

PART 2 – MATERIALS

2.01 TEMPORARY EROSION CONTROL (Vegetation and Coverings)

A. General
   1. Temporary erosion control features shall consist of, but not be limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, artificial coverings, berms, and baled hay or straw.

B. Temporary Grassing
   1. Grassing shall be as specified in Section 01300 except as modified herein. Perennial grass seed may be omitted if permanent erosion control will be placed prior to death of annual grass.

C. Temporary Sod
   1. Sod shall be as specified in Section 01200.

D. Temporary Mulch
   1. Mulch shall be as specified in Section 01300.

E. Sandbagging
   1. Sandbagging shall consist of furnishing and placing sandbags in configurations, so as to control erosion and siltation.

F. Artificial Coverings
   1. This work shall consist of furnishing and applying fiber mats, netting, plastic sheeting, or other approved covering to the earth surfaces.

G. Baled Hay, Straw or Geo Hay
   1. This work shall consist of construction of baled hay, geo hay, or straw dams to protect against downstream accumulations of silt.

2. The baled hay, geo hay or straw dams shall be constructed in accordance with the details shown in the construction drawings.

2.02 TEMPORARY EROSION CONTROL (Silt Fences and Turbidity Barriers)

A. General
1. Temporary erosion control features shall consist of, but not be limited to, silt fences, floating turbidity barriers, and staked turbidity barriers.
2. The work shall consist of furnishing, installing, maintaining, and removing temporary fences and barriers in accordance with the manufacturer's recommendations, these specifications, and the standard details.
3. Turbidity barriers in waters of the State may be either floating or staked types or any combinations of types that will suit site conditions and meet erosion control and water quality requirements.
4. The barrier type(s) will be at the Contractor's option unless otherwise specified in the plans.

B. Silt Fence
1. Silt fence or sediment control fence shall consist of a geotextile fabric attached to posts.
2. The geotextile fabric shall be a woven or non-woven fabric as specified herein.
3. The silt fence shall be constructed in accordance with the standard details.

C. Staked Turbidity Barrier
1. In addition to the requirements for a temporary silt fence contained herein, the fabric used for staked turbidity barrier shall have a double stitched hem at the top of the fabric into which has been sewn a braided nylon cord with a minimum diameter of 1/8 inch running the full length of that section of fabric.
2. Supports for staked turbidity barriers shall be a minimum length of three feet seasoned two-inch by four-inch wood, 2-1/2 inch minimum diameter wood, or steel at least 1.33 pounds per linear foot.

D. Floating Turbidity Barrier
1. Floating turbidity barrier, if applicable, shall be in accordance with the details shown.
2. The type barrier used will be such as to minimize dispersion of turbid waters from the construction site.
3. Alternate materials may be approved provided that compliance with applicable permit conditions and State water quality standards are maintained.

2.03 GEOTEXTILES

A. Filter Fabric
1. The geotextile fabric shall be a woven or non-woven fabric consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamides, or polyvinyl chloride formed into a stable network such that the filaments or yarns retain their relative position to each other.

2. The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration from ultraviolet light, heat exposure, and commonly encountered chemicals.
3. The edges of the fabric shall be salvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric.

B. The fabric shall conform to the following physical requirements:

PROPERTIES	TEST METHOD	ACCEPTABLE VALUES
Seam Strength	ASTM D1683	120 lbs. (min)
Mullen Burst	ASTM D3786	200 psi strength (min)
Puncture Strength	ASTM D3787	60 lbs. (min)
Trapezoidal Tear	ASTM D4533	50 lbs. strength (min)
Grab Tensile	ASTM D4632	120 lbs. strength (min)
Elongation (max)	ASTM D4632	25%
Filtration	ASTM D5141	75% efficiency (min)
Slurry Flow Rate	ASTM D5141	0.3 gpm/ sf (min)

C. Seams
1. The seams of the fabric shall be sewn with thread of a material meeting the chemical requirements for the fabric.
2. The minimum seam strength shall comply with the property requirements contained herein.

D. Shipment and Storage
1. During shipment and periods of storage, the geotextile shall be protected from direct sunlight, ultraviolet rays, and temperatures greater than 140 degrees Fahrenheit, mud, dirt, dust, and debris. Stockpiled materials shall be kept covered at all times.

2.04 CONSTRUCTION EXIT STONE

A. Use sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall conform to FDOT No. 1 Coarse Aggregate (1.5 to 3.5-inch stone).

2.05 RIP RAP

B. Stone Rip Rap
1. Rip Rap Rubble Stone shall be in accordance with Section 530-2.1.3.2 (Rubble-Ditch Lining) of the FDOT Standard Specifications for Road and Bridge Construction, latest edition.

PART 3 – EXECUTION

3.01 GENERAL

A. The installation of temporary erosion control features shall be coordinated with the construction of the permanent erosion control features to the extent necessary to

assure effective and continuous control of erosion and water pollution throughout the life of the contract.

B. The Contractor shall take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments, with fuels, oils, bitumens, calcium chloride, or other harmful materials. Also, the operations shall be conducted and scheduled so as to avoid pollution or siltation of such streams, etc.

C. Except as necessary for construction, excavated material shall not be deposited in rivers, streams, canals, or impoundments, or in a position close enough thereto to be washed away by high water or runoff.

D. Where de-watering methods are used, the water shall be treated by one or more of the following methods prior to discharge off-site or into environmentally sensitive areas:
   1. Pumping into grassed swales or appropriate vegetated areas, sediment basins, or confined by an appropriate enclosure such as siltation curtains when other methods are not considered appropriate.
   2. The contractor shall be responsible for obtaining and complying with permits required for de-watering.

E. The Contractor shall not disturb lands or waters outside the limits of construction, except as may be found necessary and authorized by the Engineer.

F. The locations of and methods of operation in all detention areas, excavation areas, stockpile areas, and disposal areas shall be such that erosion during and after completion of the work will not likely result in detrimental conditions, siltation, or water pollution.

G. Limitation of Exposure or Erodible Earth
   1. The Contractor shall limit the surface areas of unprotected erodible earth exposed by clearing and grubbing, excavation, or filling operations and shall provide immediate permanent or temporary erosion or pollution control measures to prevent contamination of any river, stream, lake, tidal water, reservoir, canal, or other impoundment or to prevent detrimental effects on property outside the project and damage to the project.
   2. The limitation of area in which excavation and filling operations may be underway shall be commensurate with the contractor's capability and progress in keeping the finish grading, grassing, sodding, and other such permanent erosion control measures current in accordance with the accepted schedule.
   3. Under no conditions shall the surface area or erodible earth exposed by clearing and grubbing operations or by excavation and filling operations exceed one-half acre without specific prior approval by the Engineer. This limitation applies separately to clearing and grubbing operations and excavation and filling operations.

4. The Engineer may increase or decrease the amount of surface area allowed to be exposed at any one time, on the basis of his analysis of conditions on the project.
5. Permanent erosion control features shall be incorporated into the project at the earliest practical time. Temporary erosion control features will be used to control erosion prior to the time it is practical to construct permanent control features or to provide immediate temporary control of erosion that develops during normal construction operations, but is not associated with permanent erosion control features on the project. In no case shall exposure of erodible earth be for more than five days without erosion control features being implemented.
6. Temporary erosion control features may be authorized for use in controlling erosion in areas where staged construction or other conditions not under the control of the Contractor preclude completion of a section of work in a continuous manner and in areas where construction operations which must be performed subsequently will cause damage to permanent erosion control features constructed.
7. When the item of Topsoil or Muck Blanket is included in the contract, the rate of construction of these items may be limited by the availability of topsoil or muck from the normal grading operations. The existence of this condition will be considered as precluding completion of a section or roadway in a continuous manner, and use of temporary erosion control features will be used in areas so affected.
8. The Contractor shall schedule operations such that the area of unprotected erodible earth exposed at any one time is not larger than the minimum area necessary for efficient construction operations, and the duration of exposed, uncompleted construction to the elements shall be as short as practicable.
9. Clearing and grubbing shall be so scheduled and performed that grading or utility construction operations can follow immediately thereafter, and grading operations shall be so scheduled and performed that permanent erosion control features can follow immediately thereafter if conditions on the project permit.

3.02 TEMPORARY EROSION CONTROL (Vegetation and Coverings)

A. Temporary vegetative erosion control features shall be installed in accordance with Section 01300.

B. Temporary coverings shall be installed in accordance with the manufacturer's recommendations.

3.03 TEMPORARY EROSION CONTROL (Silt Fences and Turbidity Barriers)

A. Temporary Silt Fence
1. Temporary silt fence shall be erected at locations as shown on the plans, as dictated by the SWPPP, as approved by the Engineer, or as required to prevent erosion.

2. If required, the wire reinforcement shall be installed so that the filter fabric is on the upstream side of the fence, and both the wire fence and the filter fabric are on the upstream side of the posts.
3. Posts shall be uniformly installed with approximately 20 degrees inclination toward the potential silt load (upstream) area.
4. The silt fence shall be maintained in an effective condition at all times while in use.

B. Filter fabric shall be secured to the post or fence by suitable staples, tie wire, or hog rings in such a manner as to prevent tearing of the fabric. The bottom of the filter fabric shall be entrenched into the ground a minimum of eight inches to prevent water from flowing under the fence. Filter fabric shall be spliced together only at support posts with a minimum of six-inch overlap and securely sealed.

C. Staked Turbidity Barrier
1. Staked turbidity barrier shall be securely fastened to wood or steel supports which are spaced at maximum intervals of six feet and driven a minimum of 12 inches into the ground.
2. A minimum of three supports shall be used.
3. The bottom of the fabric shall be entrenched into the existing ground a minimum of eight inches.
4. The staked turbidity barrier shall be a minimum of 15 inches in height and shall not exceed 18 inches in height.

D. The support line sewn in the top hem of the filter fabric shall be used at each post location to secure the fabric to the post at an appropriate height.

E. Staked turbidity barriers shall be installed across ditch lines and at temporary locations as shown on the plans or approved by the Engineer where continuous construction activities change the natural contour and drainage runoff.

F. Posts in staked turbidity barriers shall be installed in the vertical position unless otherwise directed by the Engineer.

G. Floating Turbidity Barrier
1. This work shall consist of the installation and removal of floating turbidity barriers to contain silt and other deleterious materials that may occur as the result of dredging, filling, or other construction activities in waters of the State.
2. The type of barrier used will be installed in accordance with the details contained in the plans, or, when details are not shown, in accordance with the SWPPP, or as approved by the Engineer.
3. Alternate methods may be approved provided that compliance with applicable permit conditions and State water quality standards are maintained.

H. All temporary erosion control features and devices shall be removed and disposed by the Contractor when permanent erosion control features and devices (e.g., grassing, sodding, etc.) have reached the point of final acceptance.

I. Refer to the standard drawing of this manual for additional details.

3.04 RIP RAP

A. Rip rap shall be placed where shown on the Drawings and / or approved Erosion Control Plan. Carefully compact backfill and place filter fabric under rip rap in wire baskets to prevent subsequent settlement and erosion.

B. Preparation of Foundations
   1. The ground surface upon which the rip rap is to be placed shall be brought in reasonably close conformity to the correct lines and grades before placement is commenced.
   2. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers.

C. Placement of Filter Fabric
   1. The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions and debris. The fabric shall be placed with the long dimension running up the slope and shall be placed to provide a minimum number of overlaps.
   2. The strips shall be placed to provide a minimum width of one foot of overlap for each joint.
   3. The filter fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be on or within 3-inches of the centerline of the overlap.
   4. The fabric shall be placed so that the upstream strip overlaps the downstream strip.
   5. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during construction.
   6. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants.
   7. Any contaminated fabric or any fabric damaged during its installation or during placement of rip rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the Owner.

D. Placement of Rip Rap
   1. The rip rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric.
   2. Rip rap shall be placed with its top elevation conforming with the natural slope of the stream bank and stream bottom.
   3. Stone rip rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings.
   4. The thickness tolerance for the course shall be -6-inches and +12-inches. If the Drawings or Bid do not specify a thickness, the rip rap stone shall be placed to a thickness of not less than 12-inches.

3.05 INSPECTION AND MAINTENANCE

A. General
   1. The Contractor shall, at his expense, provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted.
   2. The Contractor shall inspect all erosion and sediment control facilities within 24 hours of a ¼" rain or greater or a minimum of once weekly. Any deficiencies shall be immediately corrected by the Contractor.

B. Silt Fences and Turbidity Barriers
   1. The Contractor shall make a daily review of the location of silt fences and turbidity barriers to ensure that the silt fence or turbidity barriers are properly located for effectiveness and contain no breaches. Where deficiencies exist, additional silt fences or turbidity barriers shall be installed as directed.

C. Sediment deposits shall be removed when the deposit reaches approximately one-half of the volume capacity of the temporary silt fence or turbidity barrier as directed. Any sediment deposits remaining in place after the temporary silt fence or turbidity barrier is no longer required shall be dressed to conform with the finished grade, prepared and finished.

D. Inspections shall be made by qualified inspectors using the Florida Stormwater, Erosion and Sedimentation Control Inspection Manual. Referenced manual can be downloaded from:

   http://www.floridadep.org/water/nonpoint/erosion.htm

   1. All inspections shall be formally documented using the forms contained in the Appendix to this section of the specifications.

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

INSPECTION AND MAINTENANCE REPORT

PROJECT NAME:_____ PROJECT NO._____

INSPECTION DATE:_____ INSPECTOR_____

INSPECTOR'S QUALIFICATIONS:_____

_____

DATE OF LAST RAINFALL:_____

AMOUNT OF LAST RAINFALL:_____ INCHES

TYPE OF INSPECTION:

Monthly (Final Stabilization Completed) _____

Weekly (Disturbed Areas Pending Final Stabilization) _____

Response to 0.25 inch event _____

INSPECTION LOCATION(S): (Check all that are applicable)

Disturbed Areas _____

Point Source Surface Waters _____

Point Source MS4 _____

Construction Operation Areas _____

Vehicle Entry/Exit Points _____

Structural Controls _____

Sediment Basin(s) _____

Other (_____) _____

INSPECTION SUMMARY

OVERALL RATING OF SWPPP COMPLIANCE: (circle one)

EXCELLENT GOOD FAIR POOR

SUMMARY OF CORRECTIVE ACTIONS REQUIRED TO COMPLY WITH APPROVED SWPPP:

_____

_____

_____

SUMMARY OF REQUIRED CHANGES TO THE SWPPP:

_____

_____

_____

REASONS FOR CHANGES TO THE SWPPP:

_____

_____

_____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitted false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____

Title: _____

Date: _____

ROUTINE MAINTENANCE INSPECTION CHECKLIST FOR
BMPS FOR EROSION AND SEDIMENT CONTROL

Control Measure	Problems to look for	Possible Remedies
Vegetation	Rills or gullies forming	Check for top-of-slope diversion and install if needed.
	Bare Soil patches	Fill rills and regrade gullied slopes, revegetate.
	Sediment at toe of slope	Remove sediments, revegetate using site appropriate methods.
Dikes	Gully on slope below dike breach; wheel track or low spot in dike	Add soil to breaches or low spots and compact.
	Loose soil	Compact loose soil.
	Erosion of dike face	Line upslope face with riprap, or revegetate using site appropriate methods.
Swales	Gully on slope below swale	Repair breaches.
	Wheel track, low point (water ponded in swale)	Build up low areas with compacted soil or sandbags or rebuild swales w/positive slope.
	Sediment or debris in channel	Remove obstructions.
	Erosion of unlined channel surface	Mulch and install anchored sod or erosion control blanket; or line swale w/riprap; or install check dams/ or realign swale on gentler gradient; or divert some or all stormwater to a more stable facility.
	Erosion of channel lining	Install larger riprap; or reseed, mulch and anchor w/netting; or install check dams; or pave swale.
Pipe, slope drain or flume	Blocked inlet or outlet	Remove sediment and debris.
	Runoff bypassing inlet	Enlarge headwall or flare out entrance section.
	Erosion at outlet	Enlarge riprap apron and use larger riprap; or convey runoff to a more stable outlet.

Control Measure	Problems to look for	Possible Remedies
Grassed waterways	Bare areas	Revegetate w/anchored sod or erosion control blanket; divert flow during establishment period.
	Channel capacity reduced to tall growth	Mow grass
Riprap lined waterway	Scour beneath stones	Install proper geotextile or graded bedding. Make sure edges of geotextile are buried.
	Dislodged stones	Replace w/larger stones.
Outlet protection	Erosion below outlet	Enlarge riprap apron; or line receiving channel below outlet; or convey runoff directly to a more stable outlet; make sure discharge point is on level or nearly level grade.
	Outlet scour	Install proper geotextile or graded bedding beneath riprap apron.
	Dislodged stones	Replace w/larger stones.
Sediment traps and basins	Sediment level near outlet Elevation	In traps, remove sediment if less than 1 ft. (0.3 m) below outlet elevation; in basins, remove sediments if less than 2 ft (0.6 m) below top of riser.
	Obstructed outlet	Remove debris from trash rack.
	Basin not dewatering between storms	Clear holes. Clear or replace sediment-choked gravel surrounding dewatering hole or subsurface drain.
	Damaged embankments	Rebuild and compact damaged areas.
	Spillway erosion	Line spillway w/rock, geotextile or pavement.
	Outlet erosion	Make sure outlet is flush w/ground and on level grade. Install, extend or repair riprap apron as required; or convey discharge directly to a more stable outlet.

Control Measure	Problems to look for	Possible Remedies
	Riser flotation	Anchor riser in concrete footing.
	Excessive discharge to and from basin or trap	Check runoff patterns for consistency w/plans. Reroute part of volume to another basin or enlarge the basin.
	Sediment storage zone fills too quickly	Increase size of basin; or stabilize more of the contributing area.
Straw bale barrier	Bale displacement	Anchor bales securely w/proper stakes or rebar. Check drainage area, slope length and gradient behind each barrier.
	Undercutting of bales	Entrench bales to proper depth, backfill, and compact the soil.
	Gaps between bales	Re-stake bales. Drive first stake in each bale at an angle to force it snug against the adjacent bale.
	Baling wire broken	Retie bale or replace w/fresh bale.
	Bale disintegrating	Replace w/fresh bale.
	Runoff escaping around barrier	Extend barrier or reposition in center of flow path.
	Sediment level near top of fence	Remove sediment when level reaches half of barrier height.
Silt Fence	Undercutting of fence	Entrench wire mesh and fabric to proper depth, backfill, and compact.
	Fence collapsing	Check post size and spacing, gauge of wire mesh and fabric strength. Check drainage area, slope length and gradient behind barrier. Correct any substandard condition.
	Torn fabric	Replace w/continuous piece of fabric from post to post, attach w/proper staples.
	Runoff escaping around fence.	Extend fence.
	Sediment level near top of fence	Remove sediment after each storm.

Control Measure	Problems to look for	Possible Remedies
Check dam	Sediment accumulation	Entrench wire mesh and fabric to proper depth, backfill, and compact.
	Flow escaping around sides of check dam	Build up ends of dam and provide low center area for spillway.
	Displacement of sandbags, stones, or straw bales.	Check drainage areas and peak flows. Reinforce dam w/larger stones, etc.; or divert part of flow to another outlet.
Inlet protection	Flooding around or below Inlet	Remove accumulated sediment; or convert sediment barrier to an excavated sediment trap; or reroute runoff to a more suitable area.
	Undercutting of bales or silt fence, bale displacement, torn fabric, etc.	See remedies for straw bale barriers and silt fences.

SITE STABILIZATION
INSPECTION SUMMARY

PROJECT: _____

DATE: _____

	Yes	No
Included in SWPPP	( )	( )

List Specific Area Inspected	Date Surface Disturbed	Stabilized? Yes/No	Stabilization Code (see below)	Deficiencies Noted:

Maintenance Required: _____

Plan Revisions Required: _____

Action Agency: _____

Corrective Action Suspense Date: _____

Stabilization Key	
Type	Code
Surface Roughening	A
Topsoiling	B
Temporary Seeding	C
Permanent Seeding	D
Mulching	E
Groundwater	F
Vegetative streambank	G

CONSTRUCTION OPERATION AREAS
INSPECTION SUMMARY

PROJECT: _____
DATE: _____

Included in SWPPP Yes ( ) No ( )

PARAMETER	Compliance			Deficiencies Noted
	Yes	No	N/A	
Equipment Maintenance and Repair Area				
Waste Collection and Disposal Practices				
Demolition Areas				
Washing Areas				
Storage of Construction Materials, Chemicals, etc.				
Sanitary Facilities				
Dust Control				
Dewatering Control				
Other:				

Corrective Action Required: _____

Plan Revisions Required: _____

Action Agency: _____

Corrective Action Suspense Date: _____

VEHICLE ENTRANCE / EXIT POINTS PROJECT: _____

INSPECTION SUMMARY DATE: _____

	Yes	No
Included in SWPPP	( )	( )

PARAMETERS	Yes	No	N/A	Deficiencies Noted
Installed Per Plans				
Aggregate Pad Clean				
Traffic Using Pad				
Evidence of Corner Cutting				
Evidence of Sediment on Road				
Functional Drainage				
Wheel Washing Implemented				

Maintenance Required: _____

_____

Plan Revisions Required: _____

_____

Action Agency: _____

_____

Corrective Action Suspense Date: _____

END OF SECTION 01100

PART 1 – GENERAL

1.01 SCOPE

A. It is the intent of these specifications to provide supplemental information to the content of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Engineer for clarification.

1.02 DESCRIPTION OF WORK

A. Sodding includes, but is not limited to, ground preparation, fertilization, sodding, watering, mowing and maintenance as required to promote growth.

1.03 QUALITY ASSURANCE

A. Codes and Standard
   1. Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing
   1. An independent testing and inspection service will not be required for the work of this section.

C. Inspection
   1. Inspection shall be performed by the Owner or an independent inspector hired by the Owner.

PART 2 – MATERIALS

2.01 SOD

A. Unless otherwise approved by the Golf Course Maintenance Manager and the Engineer, all sod grass shall be as follows:
   1. For sod restoration outside of golf course green areas: Tifway 419 Bermudagrass.
   2. For sod restoration of golf course green areas: TifEagle™ Bermudagrass.

B. The sod shall be harvested in rectangles, preferably 12 inch by 24 inch, shall be a minimum of two inches in thickness and shall be live, fresh and uninjured at the time of planting. It shall be reasonably free of weeds and other grasses and shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. The sod shall be planted as soon as possible after being dug and shall be shaded and kept moist until it is planted.

C. Dumping from vehicles will not be permitted.

D. Damaged sod will be rejected.
E. Replanting shall be done within 48 hours after time of harvesting or sod shall be kept damp until planted

2.02 WATER

A. The water used in the grassing operations may be obtained from any approved spring, pond, lake, stream or metered municipal water system.

B. The water shall be free of excess and harmful chemicals, acids, alkalies or any substance which might be harmful to plant growth or obnoxious to traffic.

C. Saltwater shall not be used.

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. General
1. The limits of sod shall be as shown on the drawings, described herein or as directed by the Engineer.
2. Areas which are disturbed due to construction activities but which are not shown within the limits of sod shall be stabilized in accordance with this specification at no cost to the Owner.
3. In these areas, the Owner shall reserve the right to determine which method and materials shall be used for stabilization.

B. Preparation of Ground
1. The area over which the sod is to be planted shall be scarified or loosened to a suitable depth and then raked smooth and free from rocks or stones.
2. Where the soil is sufficiently loose, the Engineer, may authorize the elimination of ground preparation.
3. No subsequent operations shall be commenced until the Engineer has approved the condition of the prepared areas.
4. Water the soil before planting sod.

C. Fertilization
1. Fertilizer shall be spread at a rate per thousand square feet of area, in accordance with the following table:

5N-10P-5K	30 LBS.
6N-12P-2K	25 LBS.
7N-7P-6K	22 LBS.
8N-8P-8K	20 LBS.
10N-6P-4K	15 LBS.
10N-5P-5K	15 LBS.

2. Fertilizer shall be mixed in the soil to a depth of at least two inches by discing or harrowing.

D. Sodding
1. Soft spots and inequalities in grade shall be corrected before starting sod work.
2. Lay sod without voids, tamp or roll. Broom screen topsoil over entire area. Sod shall be thoroughly watered. The surface shall be true to finished grade lines, even and firm at all points.
3. Place sod with staggered joints closely butted, tamped or rolled to an even surface to the required finished grade. Avoid continuous seam along line of water flow in swales. Place sod in rows at right angles to slope.
4. In areas with slopes steeper than 4:1, the Contractor shall use sod staples, wooden stakes or other means approved by the Engineer, to prevent movement of the sod during rainfall events.

E. Watering
1. The areas on which the sod is to be placed shall contain sufficient moisture, for optimum results. After being placed, the sod shall be kept in a moist condition to the full depth of the root zone for at least two weeks. Thereafter, the Contractor shall apply water as needed until the sod takes root and starts to grow. It is the Contractor's responsibility to furnish water for preparation, installation and maintenance of sod.

3.02 MAINTENANCE

A. The Contractor shall at Contractor expense maintain the sodded areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include mowing, repairing of any damaged areas and replacing areas in which the establishment of the grass stand does not appear to be developing satisfactorily.

B. Replanting or repair necessary due to the Contractor's negligence, carelessness or failure to provide routine maintenance shall be at the Contractor's expense. Replanting necessary due to factors determined to be beyond the control of the Contractor shall be paid under the appropriate contract pay items.

3.03 GUARANTEE

A. The Contractor shall guarantee all sodding for the duration of the project and for a minimum period of 90 days should the sodding occur near the completion date. During the guarantee period, the Contractor shall replace at no cost to the Owner, any sod required under the Contract that is poor sod, dies or is not established 90 days after sodding if the causes for such defects are traced to negligence or poor workmanship by the Contractor.

B. Any sod missing or defective due to the Contractor's negligence shall be furnished or replaced in a manner satisfactory to the Engineer. In case of any doubt as to the

condition and satisfactory establishment of the sod, the Owner may allow the sod to remain through another 60 day establishment after which time the sod in question, if found to be dead or in an unhealthy or badly impaired condition, shall be replaced by the Contractor at no cost to the Owner.

3.04 TESTING AND INSPECTION REQUIREMENTS

A. Areas to receive sod will be subject to a visual inspection by the Engineer upon completion of ground preparation and prior to placement of sod.

B. Upon completion of sodding and prior to commencement of the guarantee period, the area will be subject to a visual inspection by the Engineer.

C. At the end of the guarantee period, final inspection of the sod will be made by the Engineer upon written notice requesting such inspection submitted by the Contractor at least three days before the anticipated inspection. All defects discovered shall be repaired or replaced by the Contractor before final acceptance.

END OF SECTION 01200

SECTION 02105 – TREE PRESERVATION AND PROTECTION

PART 1 – GENERAL REQUIREMENTS

1.01 General

A. The objective of this section is to identify and protect tree roots, branches and tree systems that are within the limits of construction and disturbance on this project to reduce the negative impacts of the project construction on the trees to a less than significant level. The Contractor shall be responsible to implement the protection of all tree systems within the project area prior to project mobilization, continuously until all work required under this project has been completed and accepted by the project Owner. The Contractor shall comply with the requirements of this section and the recommendations of the National Arbor Day Foundation, International Society of Arboriculture, Tree Care Industry Association, City of Fort Walton Beach Land Development Code and other applicable standards for tree protection, maintenance, pruning and removal during utility construction.

PART 2 – PRECONSTRUCTION PREPARATION

2.01 Determining Trees Protected Under the City of Fort Walton Beach Land Development Code

A. Table 4.08.04.A of the City of Fort Walton Beach Land Development Code indicates trees that are to be protected.

2.02 Protection of Trees

A. In addition to the trees specifically identified on the contract plans, the Contractor shall identify the trees located within all staging areas. Contractor and sub-contractor employee parking areas, equipment and material storage areas, adjacent properties and within the limits of construction and disturbance as shown on the project plans to be protected for the duration of the project.

B. The Contractor shall designate areas at least 100 feet from the drip line of any trees to be protected for storage of materials that may be toxic to a tree system. These materials include fuels, lubricants, paints, chemicals, concrete, asphalt, bare metals, etc., which can leak, leach, or dissolve into the soil.

C. The Contractor shall inspect the limits of construction prior to the start of work and identify those trees whose branches/ limbs over the limits of construction are dead, diseased, rubbing other limbs, previously damaged by others, or in direct conflict with the proposed construction means and methods. The identified branches/ limbs shall be removed or pruned, prior to the start of construction, in accordance with the American National Standards Institute (ANSI) A300 Part 1 Pruning Standards, and Tree Care Industry Association (TCIA) BMP –Tree Pruning. All cuts should be made at the preceding branch junction, leaving the branch collar intact but not leaving a long protruding stub.

2.03 Tree Fencing and Markings

A. Prior to construction mobilization, all individual trees determined to be protected shall be initially marked with bright color paint or a surveyor’s ribbon at the height visible to equipment operators.

B. Fencing shall then be immediately erected around identified trees to be protected. Fencing shall be in place at the outer edge of the drip line of the tree prior to construction mobilization.

C. Refer to plan details for fencing details. Fencing shall be maintained until all site work has been completed.

2.04 Tree Root System Protection

A. Where construction equipment and vehicle traffic must travel over the root system (drip line) of trees to be protected, the Contractor shall provide and maintain a root buffer of a minimum of six inches of shredded, non-toxic, wood chips over the root system with temporary hardwood timber, or HDPE (DuraDeck DD1) matting on the mulch prior to the start of construction traffic. The mulch shall not be placed against the tree trunk.

B. No filling or cutting of existing ground shall be permitted within the root system area of a tree identified for protection.

PART 3 – ACTIVITIES DURING CONSTRUCTION

3.01 Trenching and Excavation

A. The limits of trenching shall be as indicated on the plans to minimize the amount of root system damaged.

B. During trench excavation, pile the excavated soil on the side away from the tree. If this is not possible, place soil on a 6-inch bed of mulch to prevent cutting into the soil surface when backfilling the trench.

C. When excavation will occur near a tree to be protected, the roots should first be pruned to sever them cleanly with appropriate equipment. When 1-inch diameter roots or larger are encountered they shall be cut cleanly with a sharp saw to the edge of the trench on the tree side of the excavation. Cut to a lateral root when possible. Exposed roots should be kept continuously moist during utility installation by water spray/ mist, wrapping in moist burlap and peat moss, or other approved means until trench backfilling is completed.

D. Backfill open trenches containing exposed tree roots the same day, if this is not possible take steps to keep root ends moist until backfilling can be completed.

E. Utility installation, trench backfilling and compaction in paved areas shall be in accordance with Sections 02221 and 02576 of this document and the right of way restoration requirements of the City of Fort Walton Beach, Okaloosa County and the FDOT. In unimproved, open areas where utility installation is completed, backfill placed above the specified pipe backfill envelope shall not be compacted to a density more than 85% Proctor Density.

F. The top three feet of backfill material shall be moistened to the maximum moisture content allowable for the soil prior to placement and compaction, especially in paved areas.

3.02 Tree Maintenance During Construction

A. Upon completion of the utility installation in unpaved areas, supplemental, deep irrigation shall be supplied to the protected trees to compensate for root loss and deter water stress. Irrigation should wet/ saturate the soil within the tree protection zone to the depth of the root system (3± feet). A 6-inch high, temporary berm filled with four to six inches of mulch around the tree protection area will increase the root system repair and irrigation process. Mulch shall not be placed against the tree trunk. Light, frequent irrigations are not permitted.

B. If soil has become compacted over the root zone of any tree, the ground ball shall be aerated by drilling holes from two to four inches in diameter, three feet apart throughout the root zone of the

tree. Depth should be at least 12 inches, but may need to be deeper if the soil grade has been raised.

C. During periods of extended drought, wind or earth excavation/ disturbance, the impacted tree trunks, limbs and foliage should be sprayed with water to remove accumulated construction dust.

3.03 Repair and Removal of Damaged Trees

A. General

1. Any damage to the branch/ limb, trunk, bark or root system of protected trees on site during construction shall be pruned. All pruning shall be done in accordance with the American National Standards Institute (ANSI) A300 Part 1 Pruning Standards and Tree Care Industry Association (TCIA) BMP –Tree Pruning. All cuts should be made at the preceding branch junction, leaving the branch collar intact but not leaving a long protruding stub.

2. To treat bark damage, carefully cut away all damaged and loosened bark back into the undamaged area with a sharp knife or pruning shears, taking care not to cut into living tissue or to increase the depth or width of the wound.

3. Should a tree intended to be protected is determined during the Contractor's two year project warranty period to be damaged seriously enough that survival and normal growth are not possible, the tree shall be removed by the Contractor at no additional cost to the Owner.

4. Tree removal and pruning of branches over four inches in diameter shall be performed by a TCIA accredited tree care/service company.

END OF SECTION 02105

PART 1 – GENERAL

1.01 SCOPE

A. Description of Work
   1. Provide all labor, material and equipment to perform all clearing and grubbing as required to perform all the construction on the Drawings and as specified herein.
   2. Clearing and grubbing includes, but is not limited to, removing from the project site, trees, stumps, roots, brush, structures, abandoned utilities, trash, debris and all other materials found on or near the surface of the ground in the construction area and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated. Precautionary measures that prevent damage to existing features to remain are part of the Work.
   3. Clearing and grubbing operations shall be coordinated with temporary and permanent erosion and sedimentation control procedures.

1.02 QUALITY ASSURANCE

A. The Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction over the Project. All required permits of a temporary nature shall be obtained for construction operations by the Contractor.

1.03 JOB CONDITIONS

A. Location of the Work: The area to be cleared and grubbed is shown schematically on the Drawings or specified below. It includes all areas designated for construction.

1.04 PROTECTION

A. Streets, roads, adjacent property and other works to remain shall be protected throughout the Work, as defined in the General Conditions.

B. Existing trees, shrubs and bushes
   1. Trees shall be protected by fencing, barricades, or wrapping as may be required.
   2. Shrubs and bushes shall be protected by fences or barricades as may be required.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. The Contractor shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, tractors, trucks and loaders.

PART 3 – EXECUTION

3.01 GENERAL

B. It is the intent of these Specifications that all desirable natural growth within the right-of-way and easement areas be preserved where practicable, and that all things which detract from the aesthetic value of the completed work, unnecessarily interfere with construction, or would unnecessarily interfere with future maintenance be removed. The Contractor shall be responsible for preserving all things designated to be salvaged or to remain. In areas where desirable natural growth is designated to remain, the Contactor shall thin or trim shrubbery and live trees to the extent consistent with the intent of these Specifications. Use of methods or equipment which might mar or destroy vegetation designated for preservation will not be permitted.

C. All clearing and grubbing necessary for setting construction stakes shall be completed a satisfactory distance ahead of grading operations.

3.02 SCHEDULING OF CLEARING

A. The Contractor shall clear at each construction site only that length of the right-of-way, permanent or construction easement, which would be the equivalent of one month's pipe laying. This length shall be determined from the Contractor's Progress Schedule.

B. The Owner's Engineer may permit clearing for additional lengths of the pipe line provided that temporary erosion and sedimentation controls are in place and a satisfactory stand of temporary grass is established. Should a satisfactory stand of grass not be possible, no additional clearing shall be permitted beyond that specified above.

C. A satisfactory stand of temporary grass shall have no bare spots larger than one square yard. Bare spots shall be scattered and the bare area shall not comprise more than one percent of any given area.

3.03 CLEARING AND GRUBBING

A. All excavation and embankment areas associated with new structures, slabs, roadway, and general grading areas which are disturbed shall be cleared and grubbed. Each side of a pipeline shall be cleared and grubbed as required.

B. Surface objects, trees, stumps, roots, grass, weeds, deteriorated vegetation, brush, debris and other protruding or underground obstructions, not designated to remain, shall be cleared and grubbed. Undisturbed stumps and roots and non-perishable solid objects which will be a minimum of three feet below subgrade or slope of embankment may be left when authorized by the Owner's Engineer.

C. Grubbing shall consist of completely removing roots, stumps, trash and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.

D. All stumps, roots, foundations and planking embedded in the ground shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of two feet below the limits of excavation for structures, trenches and roadways or two feet below finish grade, whichever is lower.

E. Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable materials thoroughly compacted.

F. Landscaping features shall include, but are to necessarily limited to, fences, cultivated trees, cultivated shrubbery, property corners, man-made improvements, subdivision and other signs within the right-of-way and easement. The Contractor shall exercise extreme care in moving landscape features and promptly re-establishing these features.

G. Surface rocks and boulders shall be grubbed from the soil and removed from the site if not suitable as rip rap.

H. All operations shall be conducted in such a manner as to prevent damage to anything that is to remain on the right-of-way or to adjacent property. The Contractor shall be responsible for all damages to existing improvements resulting from Contractor's operations.

I. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.

J. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored and replaced. Any fencing that, in the Engineer's opinion, is significantly damaged shall be replaced with new fence material.

K. The Contractor shall exercise special precautions for the protection and preservation of tees, cultivated shrubs, sod, fences, etc., situated within the limits of the construction area but not directly within excavation and/ or fill limits. The Contractor shall be held liable for any damage the Contractor's operations have inflicted on such property.

L. Following the clearing and grubbing operations, the Contractor shall slope the existing ground surface and fill depressions and stump holes to encourage drainage utilizing existing material within the limits of clearing and grubbing and to the specified grades.

M. After sloping the ground surface to ensure positive drainage over the entire site, the Contractor shall rake the entire area to remove surface roots and objects and to provide a final dressing for the project area.

N. Low hanging and unsound or unsightly branches on trees or shrubs to remain, but extending over the clearing and grubbing limits shall be trimmed.

3.04 STRIPPING

A. Contractor shall remove topsoil prior to the placement of new fill material. The depth of topsoil to be removed shall be that depth required to expose suitable subgrade material.

B. Contractor shall set aside a sufficient quantity of topsoil material to vegetate those areas requiring topsoil throughout the project. Said stockpile shall be located so as to not interfere with the work in progress. Any additional topsoil generated above and beyond the quantities needed for the project shall be hauled away at the Contractor's expense.

3.05 DISPOSAL OF MATERIAL

A. The debris resulting from the clearing and grubbing operation shall be hauled to a disposal site secured by the Contractor and shall be disposed in accordance with all requirements of Federal, State, County and municipal regulations. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley. No debris shall be deposited upon any private property except with written consent of the property owner. A copy of written consent shall be provided to the Owner for

permanent records. In no case shall any material or debris be left on the Project, shoved onto abutting private properties or buried on the Project.

B. No burning is allowed.

C. The use of herbicides or blasting in clearing and grubbing is prohibited.

END OF SECTION 02110

PART 1 – GENERAL

1.01 REGULATORY REQUIREMENTS

A. State Standard: The Occupational Safety and Health Administration's excavation safety standards, 29 CFR Part 1926, Subpart P, are hereby incorporated as the state standard. The Department of Labor and Employment Security may, by rule, adopt updated or revised versions of those standards, provided the updated or revised versions are consistent with the intent expressed in this act and 553.72, and are not otherwise inconsistent with state law. Any rule adopted as provided in this section shall be complied with upon its effective date.

1.02 SUBMITTALS

A. The Contractor who will perform the excavation on the Project shall submit the following:
   1. A reference to the trench safety standards that will be in effect during the period of construction of the project.
   2. Written assurance by the Contractor performing the trench excavation that such contractor will comply with the applicable trench safety standards.
   3. A separate item identifying the cost of compliance with the applicable trench safety standards. The separate item identifying the cost of compliance with trench safety standards shall be based on the linear feet of trench to be excavated. The separate item for special shoring requirements, if any, shall be based on the square feet of shoring used. Every separate item shall indicate the specific method of compliance as well as the cost of that method.

1.03 COMPLIANCE

A. The Contractor performing trench excavation shall:
   1. As a minimum, comply with the excavation safety standards which are applicable to a project.
   2. Adhere to any special shoring requirements, if any, of the State of other political subdivisions which may be applicable to such a project.
   3. If any geotechnical information is available from the Owner, the Contractor, or otherwise, the contractor performing trench excavation, shall consider this information in the Contractor's design of the trench safety system which it will employ on the project. This paragraph shall not require the Owner to obtain geotechnical information.

1.04 Contract Bid Requirements

A. The separate item identifying the cost of compliance with trench safety standards shall be based on the linear feet of trench to be excavated. The separate item for special shoring requirements, if any, shall be based on the square feet of shoring used. Every separate item shall indicate the specific method of compliance as well as the cost of that method.

END OF SECTION 02300

PART 1 – GENERAL

1.01 SCOPE

A. The work under this Section consists of furnishing all labor, equipment and materials and performing all operations in connection with the trench excavation and backfill required to install the pipelines and associated structures shown on the Drawings and as specified.

B. Excavation shall include the removal of any trees, stumps, brush, debris or other obstacles which remain after the clearing and grubbing operations, which may obstruct the work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install pipe and appurtenances in conformance with the lines and grades shown on the Drawings and as specified.

C. Backfill shall include the refilling and compacting fill in the trenches and excavations up to the surrounding ground surface or road grade at crossing.

D. The trench is divided into five specific areas:
   1. Foundation: The area beneath the bedding, also referenced as trench stabilization and is required when the native trench bottom is unstable.
   2. Bedding: The bedding directly supports the pipe and brings the trench bottom to the required grade. The purpose of the bedding is to provide a firm, stable, and uniform support of the pipe.
   3. Haunching: The haunching area begins at the bottom of the pipe and ends at the springline of the pipe. This area is important in terms of limiting pipe deflection.
   4. Initial Backfill: The area above the haunching material and below a plane 12 inches above the top of the barrel of the pipe.
   5. Final Backfill: The area above the initial backfill to a level below that required for the trench restoration.

E. The choice of method, means, techniques and equipment rests with the Contractor, subject to the approval of the Engineer. The Contractor shall select the method and equipment for trench excavation and backfill depending upon the type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected, available easement or right-of-way and prevailing practice in the area.

1.02 DESCRIPTION OF WORK

A. Codes and Standards
   1. Perform all work in compliance with applicable codes and requirements of governing authorities having jurisdiction.

B. Testing and Inspection

1. Contractor must employ, at Contractor's expense, an independent testing laboratory approved by the Engineer.
2. Contractor will engage a geotechnical firm with a certified testing laboratory for quality control testing during earth work operations.
3. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner's Engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.
4. The geotechnical firm will submit the following reports directly to Engineer: Test reports on borrow material; field density; optimum moisture-maximum density curves; graduation curves.
5. Density
    a. All references to “maximum dry density” shall mean the maximum dry density defined by the “Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort” (ASTM D1557).
    b. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet the requirements of
        i. ASTM D1556, “Density of Soil in Place by the Sand Cone Method”
        ii. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method” or
        iii. ASTM D 6938, “Nuclear Density Method”
6. All costs associated with compaction testing ordered by the Engineer shall be borne by the Contractor. The extent of testing required shall be reasonable, but shall also be dependent upon soil conditions, Contractor’s means and methods of operation, and regulatory requirements. As a minimum, compaction tests shall be performed in alternating fill lifts at a single location per each 500 LF of pipeline, or 750 square yards of excavation, but in no case less than three test locations.

1.03 SAFETY

A. Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P “Excavation, Trenching & Shoring” as described in OSHA publication 2226. The Contractor is responsible for safety.

1.04 JOB CONDITIONS

A. Site Information
    1. Any data provided regarding subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Engineer and Owner will not be responsible for interpretations or conclusions drawn by Contractor from data provided by the Engineer and Owner.
    2. Any data provided is made available for convenience of Contractor.
    3. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. Underground Utilities
   1. The plans show certain features of topography and certain underground utilities, but they do not purport to show in complete detail all such lines or obstructions. Such topography and notes on the plans were inserted from records available, are for the Contractor's convenience only, and shall not be used as a basis for claims of extra compensation.
   2. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose.
   3. Any damage to existing facilities resulting from the Contractor's operations shall be immediately repaired by the Contractor at no cost to the Owner.

C. Existing Utilities
   1. The Contractor shall be responsible to locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
   2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate fully with Owner and utility companies in keeping respective services and facilities in operation.
   3. Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted in writing by Engineer, and then only after acceptable temporary utility services have been provided. Provide minimum of 48 hours' notice to Engineer and receive written notice to proceed before interrupting a utility.
   4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

D. Protection of Persons and Property
   1. Open excavations occurring as part of this work shall be barricaded and posted with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
   2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
   3. Perform excavation by hand within drip line of large trees to remain and protect the root system from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap.

PART 2 – MATERIALS

2.01 SOIL MATERIALS

A. Definitions
   1. Satisfactory soil materials are defined as those complying with unified soil classification groups SP, SP-SM.

2. Unsatisfactory soil materials are defined as those complying with unified soil classification groups SC, SC-SM, SM, CL, ML, CH, MH and PT.
3. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than two inches.
4. Unyielding material shall consist of rock and gravelly soils with stones greater than three inches.
5. Unstable material shall consist of material too wet to properly support the utility pipe, conduit, or appurtenance structure.

B. Bedding, Haunching, and Initial Backfill Material
1. Satisfactory soil materials free of clay, rock, or gravel larger than one inch in any dimension, debris, waste, vegetable, and other deleterious matter and less than 12% passing No. 200 sieve.

C. Final Backfill Material
1. In areas not subject to vehicular or pedestrian traffic, the final backfill material shall be general excavated earth materials, and shall not contain cinders, stumps, limbs, man-made wastes, other materials and shall not contain more than 33% broken rock, of which no stone of boulder shall weight more than 50 pounds.
2. If materials excavated from the trench are not suitable for use as final backfill material, as determined by the Engineer, provide select material conforming to the requirements of this Section.
3. In areas where the backfill is beneath a roadway or sidewalk and subject to vehicular or pedestrian traffic, the backfill shall meet the requirements for select backfill.

D. Trench Foundation Material
1. Crushed stone shall be utilized for trench foundation (trench stabilization) when required, and shall conform to the Florida Department of Transportation Specification 900 with the exception that slag or crushed slag shall not be used.
2. Stone sizes shall be No. 57.

E. Select Backfill Material
1. Select backfill shall be materials which meet the requirements as specified for bedding, haunching and initial backfill, including compaction requirements.

F. Select Granular Material
1. Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough, and durable particles and shall contain no more than 12% by weight of material passing a No. 200 mesh sieve and not less than 95% by weight passing the one inch sieve.
2. The maximum allowable aggregate size shall be one inch or the maximum size recommended by the pipe manufacturer, whichever is smaller.

G. Concrete
   1. Concrete for bedding, haunching, initial backfill or encasement shall have a compressive strength of no less than 3,000 psi, with no less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. Where this requirement conflicts with other requirements in the project plans and specifications, the more stringent requirement shall apply.
   2. Ready mixed-concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavation includes excavation to the required subgrade elevations and includes excavation of pavements and other obstructions visible on ground surface, underground structures, utilities, and other items indicated to be demolished and removed, together with earth and other materials encountered.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

C. Unsuitable Materials
   1. Where muck, rock, clay or other material within the limits of the roadway or other work is unsuitable (unsatisfactory soils and materials) in its original position, the Contractor shall excavate each material to the cross sections indicated on the plans or as directed by the Engineer.
   2. The unsuitable material shall be disposed off-site in accordance with applicable codes and regulations and the excavated area backfilled with suitable material to the lines, grades, and elevations indicated on the plans or as directed by the Engineer.

D. Stability of Excavations
   1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction.
   2. Shore and brace where sloping is not possible because of space restrictions or instability of material excavated.
   3. Maintain sides and slopes of excavations in safe condition until completion of backfilling

E. Dewatering
   1. Excavation shall be free from water, at Contractor’s expense, before bedding, pipe, or structures are installed. To insure that bottom of trench can be adequately compacted, maintain groundwater level two feet below bottom of trench.

2. Provide all necessary pumps, under drains, well point systems, and other means for removing water from trenches and other parts of the work. Continue de-watering operations until the backfill has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the trench and so that it is above the natural water table.
3. Water from the trenches and excavations shall be disposed in such a manner as will not cause injury to public health, to public or private property, to the work completed or in progress, to the surface of the streets, or cause any interference with the use of same by the public.
4. The Contractor is responsible for obtaining any FDEP permits required for dewatering.

F. Trench Excavation
1. Top Soil and grass shall be stripped a minimum of six inches over the trench excavation site and stockpiled separately for replacement over the non-paved, finished grading areas.
2. Trenches shall be excavated to the lines and grades shown on the Drawings with the centerlines of the trenches on the centerlines of the pipes.

G. Trench Width for Pipeline
1. The sides of all trenches shall be as vertical as is practical from the bottom of the trench to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the Drawings, the trench width shall be equal to the sum of the outside diameter of the pipe plus two feet.
2. Excavate the top portion of the trench to any width within the construction easement or right-of-way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.
3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide a minimum of 6 inches clearance between the rock and any part of the pipe or appurtenance.

H. Depth
1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the proposed grade or to provide minimum cover.
2. For sanitary sewer force mains, re-use water mains and potable water mains excavate trenches to provide a minimum cover of 36 inches. Within the right-of-way of highways, streets or roadways; also excavate to place the top of the pipe a minimum of 36 inches below the nearest pavement edge or drainage ditch.
3. Increase the depth of cover where specifically shown on the Drawings and where necessary to avoid interference with underground utilities and obstructions.
4. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide clearance below the pipe barrel of 8 inches for pipe

21 inches in diameter and smaller and 12 inches for larger pipe, valves and manholes. Remove boulders and stones to provide a minimum of 6-inches clearance between the rock and any part of the pipe, manhole or accessory.

I. Bottom Preparation
   1. Trench bottom shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe.
   2. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing.
   3. Stones of two inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

II. Excavated Materials
   1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.
   2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause drainage problems. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements.

III. Removal of Unyielding Material
   1. Where unyielding material is encountered in the bottom of the trench, such material shall be removed four inches below the required grade and replaced with select materials.

IV. Removal of Unstable Material
   1. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the proper grade as hereinbefore described.
   2. When removal of unstable material is required due to the fault or neglect of the Contractor in Contractor's performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Owner.

V. Excavation for Appurtenances
   1. Excavation for manholes, catch-basins, inlets, or similar structures shall be at least 12 inches clear between the outer structure surfaces and the face of the excavation, or support members shall be of sufficient size to permit placement and removal of forms for the full length and width of structure footings and foundations as shown.
   2. Removal of unstable material shall be as specified above.
   3. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation.
   4. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.02 SHEETING, BRACING AND SHORING

A. Sheeting, bracing and shoring shall be performed in the following instances:
   1. Where sloping of the trench walls do not adequately protect persons within the trench from slides or cave-ins.
   2. In wet, saturated, flowing or otherwise unstable materials.
   3. Where necessary to prevent damage to adjoining buildings, structures, roadways, pavement, utilities, trees or private properties which are required to remain.
   4. Where necessary to maintain the top of the trench within the available construction easement or right-of-way.

B. In all cases, excavation protection shall strictly conform to the requirements of the Occupational Safety and Health Act of 1970, as amended.

C. Timber
   1. Timber for shoring, sheeting, or bracing shall be sound and free of large or loose knots and in good, serviceable condition.
   2. Size and spacing shall be in accordance with OSHA regulations.

D. Steel Sheeting and Sheet Piling
   1. Steel sheet piling shall be the continuous interlock type. The weight, depth and section modulus of the sheet piling shall be sufficient to restrain the loads of earth pressure and surcharge from existing foundations and live loads.
   2. Procedure for installation and bracing shall be so scheduled and coordinated with the removal of the earth that the ground under existing structures shall be protected against lateral movement at all times.
   3. The Contractor shall provide closure and sealing between sheet piling and existing facilities.

E. Trench Shield
   1. A trench shield or box may be used to support the trench walls. The use of a trench shield does not necessarily preclude the additional use of bracing and sheeting. When trench shields are used, care must be taken to avoid disturbing the alignment and grade of the pipe or disrupting the haunching of the pipe as the shield is moved. When the bottom of the trench shield extends below the top of the pipe, the trench shield will be raised in 6-inch increments with specified backfilling occurring simultaneously. At no time shall the trench shield be “dragged” with the bottom of the shield extending below the top of the pipe or utility.

F. Remove bracing and sheeting in units when backfill reaches the point necessary to protect the pipe and adjacent property. Leave sheeting in place when in the opinion of the Engineer it cannot be safely removed or is within three feet of an existing structure, utility, or pipeline. Cut off any sheeting left in place at least two feet below the surface.

3.03 ROCK EXCAVATION

A. Definition of Rock
   1. Any material which cannot be excavated with conventional excavating equipment, and is removed by drilling and blasting, or mechanically fracturing by means other than a trench excavator, and occupies an original volume of at least one-half cubic yard

B. Blasting
   1. Provide licensed, experienced workmen to perform blasting.
   2. Conduct blasting operations in accordance with all existing ordinances and regulations.
   3. Protect all buildings and structures from the effects of the blast. Repair any resulting damage.
   4. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

C. Removal of Rock
   1. Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.

D. The Contractor shall notify the Engineer prior to any blasting. Additionally, the Contractor shall notify the Owner and local fire department before any charge is set.

E. The Contractor shall conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

3.04 BACKFILLING

A. General
   1. Control soil compaction during backfilling operations providing minimum percentage of density specified for each area classification indicated below.

B. Percentage of Maximum Density Requirements
   1. Compact soil to not less than the required percentages of maximum density determined in accordance with ASTM D 1557.

C. Replacement of Unyielding Material
   1. Unyielding material removed from the bottom of the trench shall be replaced with satisfactory material placed in layers not exceeding six inches loose thickness.

D. Replacement of Unstable Material

1. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding six inches loose thickness.

E. Bedding and Haunching
   1. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders or large dirt clods.
   2. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.
   3. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.
   4. After the pipe section is properly placed, add the haunching material to the springline of the pipe. The haunching material shall be shovel sliced, tamped, vigorously chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders or dirt clods.
   5. The types of trench bedding are identified as follows:
      a. Class “A” (Bedding Factor – 2.8): Excavate the bottom of the trench flat at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. Lay pipe to line and grade on concrete block. Place concrete to the full width of the trench and to a height of one-fourth of the outside diameter of the pipe above the invert.
      b. Class “B” (Bedding Factor – 1.9): Excavate the bottom of the trench at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. The bottom of the trench shall be rounded such that at least the bottom quadrant of the pipe rests firmly on the bedding. The bedding shall be undisturbed soil if suitable or placed material. Haunching material shall then be carefully placed by hand and compacted to provide full support under and up to the centerline of the pipe.
      c. Class “C” (Bedding Factor – 1.5): Excavate the bottom of the trench at a minimum depth as shown on the Drawings, below the bottom of the pipe barrel. The bottom of the trench shall be rounded such that at least the bottom quadrant of the pipe rests firmly on the bedding. The bedding shall be undisturbed soil if suitable or placed material. Haunching material shall then be carefully placed by hand and compacted to provide full

support under and up to a height of one-fourth the outside diameter of the pipe above the bottom of the pipe barrel.

6. PVC and HDPE pipe shall be installed with Class “B” bedding, unless shown otherwise herein or on the drawings. The bedding and haunching shall be hand tamped to achieve a compaction of approximately 90% maximum density.
7. Ductile Iron and other non-plastic pipes shall be installed with Class “C” bedding, unless shown otherwise herein or on the drawings. The bedding and haunching shall be hand tamped to achieve a compaction of approximately 90% maximum density.
8. Manholes: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole. Place and compact crushed stone bedding material to the required grade before constructing the manhole.

F. Initial Backfill

1. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.
2. Initial backfill material shall be placed in layers of a maximum of six inches loose thickness and compacted with approved tampers to 95% maximum density and to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate compaction, free from stones larger than two inches in any dimension, except where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than one inch in any dimension.
3. If materials excavated from the trench are not suitable for use as backfill materials, provide select backfill material conforming to the requirements of this section.

G. Concrete Encasement for Pipelines

1. Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 4-inches clearance from the bell of the pipe. Lay the pipe to line and grade on concrete blocks. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 4 inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

H. Final Backfill

1. Backfill carefully to restore the ground surface to its original condition. For earth or vegetated areas, replace the top 6 inches of the trench with top soil that was stock piled during excavation.
2. Excavated material which is unsuitable for backfilling, excess material and rock shall be disposed of, at no additional cost to the Owner, in a manner approved by the Engineer.

3. If materials excavated from the trench are not suitable for use as backfill materials, provide select material conforming to the requirements of this Section.
4. After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:
    a. In 6 inch layers, if using light power tamping equipment*
    b. In 12 inch layers, if using medium sized tamping equipment*
    c. In 24 inch layers, if using heavy tamping equipment*
    d. *The allowable layer thickness for different compaction equipment is dependent on the soil conditions. The Engineer of Record shall give project specific instruction related to the compaction equipment proposed for use by the contractor

I. Final backfill shall be compacted as follows:
1. Under proposed or existing pavement, dirt roads, sidewalks, or within four feet of pavement edge, compact to a minimum of 98% of the maximum density. Type of material and compaction effort may vary within the top 12” under areas designated for pavement replacement as reflected on the Drawings.
2. Around structures (manholes, inlets) compaction shall be 98% of the maximum density.
3. Seeded areas, or non-traffic areas, compact to a minimum of 90% of the maximum density.

J. Settlement
1. If trench settles, re-fill and grade the surface to conform to the adjacent surfaces.

3.05 ADDITIONAL MATERIAL

A. Where final grades above the pre-construction grades are required to maintain minimum cover, additional fill material will be as shown on the Drawings. Utilize excess material excavated from the trench, if the material is suitable. If excess excavated materials are not suitable, or if the quantity available is not sufficient, provide suitable fill material.

3.06 TESTING AND INSPECTION REQUIREMENTS

A. Quality Control Testing During Construction
1. Contractor shall engage geotechnical firm to inspect and approve subgrades and fill layers before further construction work is performed.
2. In alternating compacted fill lifts, make one field density test for every 500 linear feet horizontally or 750 square yards, but in no case less than three tests. The Engineer has the right to select the location of compaction test.
3. If, in the opinion of the Engineer, geotechnical firm reports indicate inspection, subgrade, or fill which have been placed are below specified density, the Contractor shall provide additional compaction and testing at no additional expense to the Owner.

4. The Contractor shall provide excavation as necessary for geotechnical personnel to conduct test.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Off-Site Disposal

1. Remove all waste materials, including unacceptable excavated material, trash, and debris, and properly dispose at a location selected by the Contractor in accordance with local, state and federal criteria.

END OF SECTION 02340

PART 1 - GENERAL

1.01 SCOPE

A. This Section describes products to be incorporated into the water distribution system and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

B. It is the intent of these specifications to provide information supplemental to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Engineer for clarification.

1.02 DESCRIPTION OF WORK

A. Extent of work is shown on the drawings.

B. Domestic water system work includes but is not limited to: Water mains, fire hydrants, valves, service connections and appurtenances.

C. Comply with the requirements of applicable sections for excavation and backfilling required in connection with water distribution system work.

D. Contractor is advised that existing water mains may be of various pipe materials, including asbestos cement. The Contractor shall be responsible for protection of existing water mains during construction and shall be responsible for repairing any pipes damaged during construction. Repair sections shall be PVC or ductile iron. The Contractor shall comply with all work site, air emission, solid waste and personal safety and protection regulations as related to the excavation, exposure, cutting, handling, containment and disposal of existing water main pipe material.

E. The removal, encapsulation or enclosure, storage and disposal of pipe materials containing asbestos shall be in accordance with 62-204.800 of the Florida Administrative Code; OSHA 29 CFR 1910; OSHA 29 CFR 1926.1101; Asbestos NESHAP (40 CFR 61, Subpart M); 40 CFR 763; and all other industry and regulatory requirements.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA).

B. Testing and Inspection Service

1. Employ, at Contractor's expense, testing laboratory to perform bacteriological testing of water mains.

2. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.

3. Hydrostatic test shall be completed by the Contractor in the presence of the Engineer or Owner’s representative.

C. The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

1.04 SUBMITTALS

A. Prior to construction commencing, the Contractor shall submit for approval, by the Engineer, manufacturer's certifications and cut sheets for the following items:

1. Fire hydrant assemblies
2. Valves
3. Water main pipe
4. Fittings
5. Water services
6. Water meters
7. Tapping sleeves
8. Other appurtenances

B. Qualifications: If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

C. Test Reports: Submit Bacteriological Test Reports directly to the Owner’s Engineer from the testing services with copy to Contractor.

1.05 EXISTING UTILITIES AND OBSTRUCTIONS

A. The Drawings indicate utilities or obstructions that are known to exist according to the information available to the Engineer. The Contractor shall call the Sunshine State One Call of Florida, Inc. (811), as required by Florida Law and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.

B. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the water main by the use of sheeting, shoring, tie-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water main to avoid horizontal conflicts, if the new alignment remains within the available right-of-way or easement, complies with regulatory agency requirements, and after a written request to, and subsequent approval by the Engineer. If, in the opinion of the Engineer, the water main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Engineer will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed water main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water main. The Contractor may change the proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. If, in the opinion of the Engineer, the water main's proposed location cannot

be adjusted, thus requiring the relocation of an existing utility, the Engineer will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.

C. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

D. Water Main Separation Requirements

1. Water mains constructed as part of this project shall be laid to provide a minimum horizontal distance of at least three feet between the outside of the water main and the outside of any existing or proposed vacuum-type sanitary sewer, storm sewer, storm water force main, or pipeline conveying reclaimed water. A horizontal distance of at least 10 feet shall be provided between the outside of the water main and the outside of any existing or proposed gravity-type sanitary sewer, pressure-type sanitary sewer, wastewater force main, or pipeline conveying reclaimed water. A horizontal distance of at least 10 feet shall be provided between the outside of the water main and all parts of any existing or proposed “on-site sewage treatment and disposal system.”

2. Water mains constructed as part of this project, that will cross any existing or proposed gravity- or vacuum-type sanitary sewer or storm sewer will be laid so the outside of the water main is at least six inches above the other pipeline or at least 12 inches below the other pipeline. Water mains that will cross any existing or proposed pressure-type sanitary sewer, wastewater or storm water force main, or pipeline conveying reclaimed water will be laid so the outside of the water main is at least 12 inches above or below the other pipeline.

3. At the utility crossings described above, one full length of water main pipe will be centered above or below the other pipeline so the water main joints will be as far as possible from the other pipeline or the pipes will be arranged so that all water main joints are at least three feet from all joints in vacuum-type sanitary sewers, storm sewers, or storm water force mains, and at least six feet from all joints in gravity or pressure-type sanitary sewers, wastewater force mains, or pipelines conveying reclaimed water.

4. The above requirements are intended to be used in conjunction with F.A.C. 62-555.314. In the case of discrepancies between the requirements of this specification and the requirements of the administrative code, the requirements of the Florida Administrative Code shall govern.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall be new and unused. They shall be of standard, first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified, or required, will not be accepted.

2.02 WATER MAINS

A. Ductile Iron Pipe (DIP)

1. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipes, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipes shall be Pressure Class 250 and have corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings.

2. Pipe and fittings shall be cement lined in accordance with AWWA C104. Pipe and fittings shall be furnished with a bituminous outside coating. Use of Protecto 401 is strictly prohibited.

3. Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi.

4. Joints: Unless shown or specified otherwise, joints shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Push-on and mechanical joints shall conform to AWWA C111. No field welding of restrained joint pipe will be permitted. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or US Pipe FIELD LOK gasket.

5. Provide the appropriate gaskets for mechanical and flange joints. Gaskets for flange joints shall be made of 1/8-inch thick, cloth reinforced rubber; gaskets may be ring type or full face type. The gasket for a standard push-on or mechanical joint, shall be of BUNA-5, vulcanized styrene rubber (SBR) and in accordance with AWWA C111.

6. Bolts and Nuts

   a. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.

   b. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A242 to the dimensions shown in AWWA C111/ANSI A21.11.

   c. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A563. Zinc plating shall conform to ASTM B633, Type II.

7. Mechanical joint glands shall be ductile iron.

8. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end.

9. Ductile iron pipe shall be encased in polyethylene film where shown on the Drawings. Polyethylene film shall have a minimum thickness of 8 mils and shall meet the requirements of AWWA C105.

10. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

11. Ductile iron pipe exterior shall have continuous blue stripe if applied during manufacturing, the stripe is parallel that runs parallel to the axis of the pipe, that is located at no greater than 90 degree intervals around the circumference of the pipe, and that will remain intact during and after pipe installation. If tape or paint is used to stripe pipe during installation of the pipe, the tape or paint shall be applied in a continuous line that runs parallel to the axis of the pipe and that is located along the top of the pipe.

B. Polyvinyl Chloride (PVC) Pipe

1. Smaller than 4-inch Pipe: All PVC pipe and fittings less than four inches in diameter shall be manufactured in accordance with ASTM D2241, with a standard dimension ratio (DR) of 21, rated pressure 200 psi, and bear the National Sanitation Foundation Seal for potable water pipe.

2. 4-inch – and Larger: PVC pipe shall be manufactured in accordance with AWWA C900, latest edition. Pipe shall be pressure class 235 and must meet dimension requirements of dimension ratio (DR) 18 and shall bear the National Sanitation Foundation seal for potable water pipe.

3. Joints: Joints shall be "push-on" and shall meet all requirements of ASTM D3139. Each bell shall be an integral wall section joint assembly using elastomeric gasket seals. All gaskets shall meet all requirements for performance as specified by ASTM F477.

4. Pipe Identification: All pipe shall be marked as prescribed in ASTM D2241 (e.g., nominal pipe size, type of plastic pipe material, pipe dimension ratio, pressure rating, ASTM specification designation number, manufacturer's name and code), and the National Sanitation Foundation Seal for potable water.

5. PVC Pipe for waterlines shall be blue.

6. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards, including the National Sanitation Foundation. Additionally, each piece of pipe shall be stamped "NSF Approved".

7. All plastic pipe shall be marked using solid copper wire with vinyl insulation.

C. Push-on Restraints

1. Push-on joint restraints shall be Fast-Grip Gasket by American Ductile Iron Pipe Co., TR Flex by U.S. Pipe, or equal.

2. Bell harness restraints shall be Series 1900 split serrated restraint harness by EBBA Iron or approved equal.

2.03 FITTINGS (3-inch and Larger)

A. General: Fittings three inches and larger shall be ductile iron manufactured in accordance with ANSI/ AWWA C110/ A21.10 or C153/ A21.53. The minimum pressure rating for fittings shall be 250 psi.

B. Exterior Coating: All fittings shall be furnished with factory-applied bituminous outside coating in compliance with AWWA standards.

C. Interior Coating

a. Interior of ductile iron fittings and specials shall be lined with a high-performance amine cured or modified polyamine ceramic epoxy for water and sewage applications. Provide epoxy containing at least 20 percent by volume of ceramic hollow micro-spheres. Total pigment volume concentration shall be less than 22 percent by volume.

b. Interior lining shall be Tnemec Series 431 Perma-Shield PL as manufactured by Tnemec Company, Inc. (Kansas City, MO); or Permox-CTF as manufactured by The Permite Corp. (Stone Mountain, GA).

c. Application shall be performed by an applicator approved by the lining manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

d. Properties:

i. Color shall be safety blue for potable water service.

ii. Color shall be safety green for sewer service.

iii. Solids by Volume: 97 percent min.

iv. Hazardous Air Pollutants: Zero

v. Ceramic Hollow Micro-spheres: 20 percent by volume (no silica fume, fly ash, or alumina dust)

vi. Pigment Volume Concentration: Less than 22 percent

vii. Coal-Tar Content: Zero

e. Prior to shipment, visually examine all ceramic epoxy lined pipe and fittings for film defects, including any runs, sags, and debris in the film. Shop repairs shall be made in accordance with the manufacturer's instructions.

f. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic dry film thickness gauge. The thickness testing shall be in according with SSPC-PA2 film thickness rating.

g. The interior lining of all pipe and fittings shall be tested for holidays, pinholes, and discontinuities in accordance with NACE SP0188. All holidays shall be properly repaired in accordance with the manufacturer's instructions and retested at no additional cost to the Owner.

h. Each pipe joint and fitting shall be marked with the date of application of the ceramic epoxy lining system and with its numerical sequent of application on that date.

D. Anchoring Devices

1. All anchoring devices shall be suitable for use with mechanical joint fittings meeting AWWA C110 and / or AWWA C111.

2. All anchoring devices shall be constructed of ductile iron (at least ASTM A536 Grade 70-50-05) and manufactured in accordance with AWWA C110 and / or C111.

3. All anchoring devices shall have a sufficient number of set screws so as to properly restrain various fittings or pipes at the rated pressure without the need for additional thrust restraint.

E. Retainer Glands

1. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C153/ A21.53, latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devises.

2. Retainer glands shall be Megalug with Mega-Bond coating, as manufactured by EBAA Iron or equal.

2.04 GATE AND TAPPING VALVES

A. Smaller than 2-Inches in Diameter: Gate valves shall be bronze, heavy duty, rising stem, wedge type with screwed or union bonnet. Valve ends shall be threaded type. Valves shall have a minimum 200 psi working pressure for water (125 psi working pressure for steam). Valves shall be made in the U.S.A. Gate valves shall be Crane No. 428 (threaded) or equal.

B. Two inches through 36-Inches in Diameter: Gate valves shall be resilient seat wedge encapsulated with EPDM rubber type conforming to the requirements of AWWA C509 or AWWA C515 rated for 200 psi working pressure.

1. Valves shall be provided with two O-ring stem seals with one O-ring located above and one O-ring below the stem collar. The area between the O-rings shall be filled with lubricant to provide lubrication to the thrust collar bearing surfaces each time the valve is operated. At least one anti-friction washer shall be utilized to further minimize operating torque. All seals between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be flat gaskets or O-rings.

2. The valve gate shall be made of cast or ductile iron having a vulcanized, synthetic rubber coating, or a seat ring attached to the disc with retaining screws. Sliding of the rubber on the seating surfaces to compress the rubber will not be allowed. The design shall be such that compression-set

of the rubber shall not affect the ability of the valve to seal when pressure is applied to either side of the gate. The sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.

3. All internal ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall be non-toxic, impart no taste to the water and shall conform to AWWA C550.

4. Stem nuts shall be independent of wedge and shall be of solid bronze conforming to ASTM B62.

5. All valves shall open by turning a two-inch square operating nut counterclockwise.

6. Gate Valve: Joints shall be mechanical joints and shall conform to AWWA C111, and all bolts and nuts for mechanical joints shall be high-strength, low-alloy steel in accordance with AWWA C111. All gaskets shall be for a standard mechanical joint of BUNA-S (SBR Buna) in accordance with ANSI/ AWWA C111/ A21.4. All mechanical joint accessories shall be furnished with the valves.

7. All tapping valves shall have flange-by-mechanical joint ends.

8. All valves shall be furnished with operating nuts.

9. One operating wrench will be provided for each five valves furnished; at least one wrench shall be supplied.

10. All tapping valves shall be interchangeable with other makes of tapping sleeves.

11. Approved models are:

a. AVK Resilient Seated Gate Valve Series 65

b. Engineer Approved

2.05 BUTTERFLY VALVES

A. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B.

B. Valve bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A126, Grade B cast iron. Shafts shall be ASTM A276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A536, Grade 65-45-12 or ASTM A126, Grade B cast iron. The valve shall have an EPDM seat.

C. Valves shall be installed with the valve shafts horizontal. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.

D. Actuators

1. Valves shall be equipped with traveling nut, self-locking type actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc.

2. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.

3. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.

E. Operators: Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension, as required.

F. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125.

G. Butterfly valves shall be manufactured by Mueller, M & H Valve, DeZurik, Val-Matic, or Pratt.

2.06 TAPPING SLEEVES

A. General

1. Tapping sleeves shall be full circle, constructed of stainless steel and in two halves.

2. All tapping sleeves shall be Smith Blair #662 or equal.

B. The Contractor shall be responsible for determining the outside diameter of the pipe to be connected to prior to ordering the sleeve.

2.07 TAPPING SADDLES

A. General

1. Tapping saddles shall be constructed of heavy gray cast iron or ductile iron, with the attachment straps, nuts, and washers constructed of corrosion-resistant, alloy steel in accordance with AWWA C111.

2. All tapping saddles shall be Smith Blair #317 or equal.

3. Tapping saddles 3-inch and larger shall have a ¾" threaded test port with plug for pressure testing on the tapping saddle and the tap valve.

2.08 FIRE HYDRANT

A. All fire hydrants shall conform to the requirements of AWWA C502 for 150 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 5-1/4-inches.

B. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.

C. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.

D. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer.

E. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.

F. The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or an oil reservoir.

G. Hydrant shall be a non-freezing design and be provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.

H. Each hydrant shall have one 4-1/2-inch Storz pumper nozzle and two, 2-1/2-inch hose connections. Hose connections shall be sufficient to seal them into the hydrant barrel.

I. Hydrants shall be furnished with a mechanical joint connection to the spigot of the 6-inch hydrant lead.

J. Minimum depth of bury shall be 3.5 feet. Provide extension section where necessary for proper vertical installation and in accordance with manufacturer's recommendations.

K. All outside surfaces of the barrel above grade shall be painted with enamel equal to Koppers Glamortex 501 in a color to be selected by the Owner.

L. Hydrants shall be traffic model and shall be American Flow Control B-84-B, Mueller Super Centurion, AVK Dry Barrel Hydrant Series 2780, or M & H Valve 929.

M. Placements of fire hydrants

1. Residential area; spacing shall be every 500 ft.

2. Rural area; spacing shall be every 1,000 ft., or determined on a case by case basis.

2.09 VALVE BOXES AND EXTENSION STEMS

A. Valve Boxes

1. Unless shown otherwise on the Drawings, all valves shall be equipped with valve boxes. The valve boxes shall be cast iron two-piece screw type with drop covers. Valve boxes shall have a 5.25-inch inside diameter. Valve box covers shall weigh a minimum of 13 pounds. The valve boxes shall be adjustable to 6-inches up or down from the nominal required cover over the pipe. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut. Ductile or cast iron extensions shall be provided as necessary. Covers shall have "WATER" cast into them. Valve boxes shall be manufactured in the United States.

2. PVC extensions shall not be used.

3. Valve box collars shall be poured in place concrete

B. Extension Stems

1. Extension stems shall be provided to raise the operating nut to a minimum of 24” below grade. Connection to the valve shall be with a wrench flush to the nut coupling and a set screw to secure the coupling to the valve's operating nut. The coupling and square wrench nut shall be welded to the extension stem. The stem assembly shall be of a telescoping design that allows for variable adjustment length. The material shall be galvanized square steel tubing. The stem assembly shall have a built-in device that prevents the stem assembly from disengaging at its fully extended length. The extension stem must be capable of surviving a torque test to 1000 ft-lb without failure.

2.10 VALVE MARKERS

A. The Contractor shall provide a Carsonite Utility Markers or approved equivalent with UV resistant decal for each valve installed. Valve decal shall be stamped "CAUTION WATER VALVE.”

2.11 HYDRANT TEES

A. Hydrant tees shall be equal to ACIPCO A10180 or U.S. Pipe U-592.

2.12 ANCHOR COUPLINGS

A. Lengths and sizes shall be as shown on the Drawings. Anchor couplings shall be equal to ACIPCO A 10895 or U.S. Pipe U-591.

2.13 CONCRETE

A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3- and 5-inches.

1. For job mixed concrete, submit the concrete mix design for approval by the Engineer.

2. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60. The thrust box shall not be poured over bolts or in such a way to prevent bolt removal.

3. If the requirements of this section conflict with other requirements contained in the project plans and specifications, the more stringent requirement shall apply.

2.14 DETECTION TAPE

A. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket.

B. Tapes shall be color coded in accordance with APWA color codes with the following legends: Water Systems, Safety Precaution Blue, "Caution: Water Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed.

C. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches.

D. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.

E. In addition, the Contractor shall furnish and install copper tracing wire.

2.15 FLUSHING HYDRANTS

A. Flushing hydrants shall be Safety-Guard Bacteriological Sampling Station model SG-BSS-01 or equal.

2.16 WATER SERVICES

A. It is the intent of these Specifications that the water service connections shall be compatible with their service maintenance procedures. All materials shall be NSF 61 “Approved”.

B. All materials installed under this Section shall have the approval of the NSF for water services.

C. Residential Service
1. Contractor will install water service lines between the water main and existing right-of-way, terminating at the right-of-way with a curb stop. Water service separations between storm sewer and sanitary sewer shall be the same as for water mains.
2. Tubing: Water service tubing shall be crosslinked polyethylene, SDR9, manufactured in accordance with AWWA C904.
3. Curb Stop shall be BXX-XXXWNL Ball Valve as manufactured by Ford Meter Box Company, Inc. of the size shown on the plans. Curb stop shall have wings for locking the valve in the closed position.
4. Corporation Stop shall be Ford FXXXXX-GNL of the size shown on the plans.

5. Gate Valve
    a. Gate valves shall be bronze, heavy duty, rising stem, wedge type with screwed or union bonnet.
    b. Valve ends shall be threaded or solder type as appropriate.
    c. Valves shall have a minimum 200 psi working pressure for water (125 psi working pressure for steam).
    d. Valves shall be made in the U.S.A.
    e. Gate valves shall be equal to Crane No. 428 (threaded) or Crane No. 1334 (solder end).
6. Fittings for tubing shall be manufactured of brass, cast with full port of full open valve and machined in accordance with AWWA C800.
7. Service Saddle shall be Smith Blair 317, Double Strap.
8. Meter Box
    a. Meter boxes shall be provided by the Owner
9. Water meters shall be provided by the Owner.

D. Commercial Service
1. A commercial service shall be constructed similar to a watermain or residential service base on the size requirement. Regardless of size, a commercial service shall include a backflow preventer.
2. Provide isolation valves on the inlet and outlet of each backflow preventer for maintenance.

2.17 VALVE AND METER VAULTS

A. Valve and meter vault walls shall be made up of precast concrete sections. The top and bottom sections shall also be precast unless shown otherwise or approved by the Engineer.

B. All coarse aggregate shall be made from 100 percent calcareous rocks. The contractor shall furnish manufacturer's certificate stating the type of aggregate used in the manufacture of the valve vault.

C. The materials shall conform to the following standards:
1. Concrete shall be 4000 psi using ASTM C150 Type II cement.
2. Wire mesh shall conform to ASTM A1064.
3. Reinforcing rods shall be ASTM A615 grade 60.

D. The top slab shall be cast with the access hatch in place. Access hatch shall be as specified on the drawings.

2.18 INSULATION

A. All aboveground pipe shall be insulated with 6 lb. fiberglass, minimum "K" of 0.23 @ 75º F and nominal thickness of 1". The fiberglass shall be SSL II, ASJ with a double sealing lap seal, as manufactured by Owens-Corning or Equal. Cover the fiberglass with a 0.016"-0.040" thick (depending on pipe diameter) corrugated aluminum jacket with poly-weld linings, as manufactured by Pabco / Childers, or equal. In lieu of insulation wrap, an approved, insulated enclosure shall be provided as indicated in the plans.

PART 3 – EXECUTION

3.01 HANDLING PIPE

A. General
1. All material, unless otherwise directed, shall be unloaded at the job site and distributed at the site of the project by the Contractor.

2. Materials shall be handled with care to avoid damage. In loading and unloading, pipe shall be lifted by hoists or slid or rolled on skids in such a manner as to avoid shock. Under no circumstances shall pipe be dropped.
3. Pipe handled on skids must not be allowed to roll against pipe already on the ground.
4. The Contractor shall be responsible for the safe handling of all materials. Damaged materials will be rejected by the Owner and / or Engineer.

B. Pipe shall be handled so as to avoid damage to the coating and lining. If, however, any part of the coating or lining is damaged by the Contractor, the repair shall be made by the Contractor at Contractor's expense in a manner satisfactory to the Engineer before installation.

C. Pipe shall be distributed on the site of the work parallel with and opposite or near the place it is to be laid in the trench, and with bell ends facing the directions in which the installation will proceed unless otherwise directed.

D. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

E. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Engineer. The Engineer reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.

F. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.

G. No distributed pipe shall be placed inside drainage ditches.

H. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge-to-edge.

3.02 INSTALLATION OF PIPE

A. General
1. Upon satisfactory installation of the pipe bedding, as specified in the "Earthwork for Utilities" section of these specifications, a continuous trough for the pipe barrel and recesses for the pipe joints shall be excavated by hand digging so that, when the pipe is laid in the trench true to line and grade, the pipe barrel will receive continuous, uniform support, and the joint will receive no pressure from the trench bottom.

B. The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods.

C. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench, piece by piece, by means of hoisting apparatus, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipe, pipe coating, and pipe lining. Under no circumstances shall pipe or accessories be dropped, dumped or rolled into the trench from finished ground level.

D. The gasket material for each joint shall be properly positioned before the pipe is lowered into the trench. The joining of the pipe shall proceed in accordance with the manufacturer's requirements.

E. Watertight plugs shall be installed in the open ends of the pipe at all times when pipe laying is not in progress. At no time shall trench water be permitted to enter pipe.

F. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Wherever it is necessary to cut gray or ductile cast iron pipe which is equipped with a push-on joint type bell end, the cut end of the pipe shall be adequately beveled so as to prevent the edge of the cut pipe from cutting or tearing the gasket as the plain end is inserted into the bell of the adjoining pipe or fitting. All field-cut pipe shall be beveled by the Contractor.

G. Whenever necessary to deflect pipe after proper homing from a straight line, either in the vertical or horizontal plane to avoid obstructions, the maximum allowable deflection shall be 50% of the manufacturer's maximum allowable deflection.

1. Only after the pipe has been properly homed will it be allowed to deflect.

H. No pipe shall be laid in water or when the trench conditions or the weather is unsuitable for such work.

I. All water lines and services shall be located a minimum of 36 inches below grade unless noted otherwise on the drawings.

J. Any pipe which is disturbed or found to be defective after laying shall be removed and re-laid or replaced.

K. Prior to connecting new work to existing lines or appurtenances, the Contractor shall verify location and elevation of existing connection point and notify Engineer of any conflicts or discrepancies.

L. Joints

1. Before laying the pipe, all lumps, blisters, and excess coal tar coating shall be removed from the bell and plain ends of each length of pipe. The pipe ends shall then be wire brushed and wiped until clean and dry. Where mechanical joints or push-on joints are specified, oil and grease also shall be removed. Pipe ends shall be kept clean until joints are made. The plain end of pipe for mechanical joints shall be lubricated with a soapy solution before installing the gaskets.
2. In making up the push-on type joint, the gasket shall be placed in the socket per manufacturer's recommendation. A thin film of lubricant (approved by the pipe manufacturer) shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. The plain end of the pipe to be entered shall be thoroughly cleaned and placed in alignment with the bell of the pipe to which it is to be joined. The joint shall be made by exerting sufficient force on the entering pipe so that the plain end is moved past the gasket until it seats as per manufacturer's recommendation.
    a. Pipe lubricant shall be Ease-On Pipe Joint Lubricant or equivalent.
    b. Pipe lubricant shall be brushed over the gasket and the plain end of the pipe for push on joints and mechanical joints, where needed.
3. Backhoe buckets or excavation equipment are not to be applied directly to the pipe.
4. Mechanical joints shall be assembled in accordance with AWWA Standards. Mechanical joints shall be centered in the bells. Soapy water shall be brushed over the gasket just prior to installation. The gasket and gland shall be placed in position, the bolts inserted, and the nuts tightened by hand.
5. The bolts shall be tightened on opposite sides of the pipes by means of a torque wrench in such a manner that the gland shall be brought up evenly into the joint. Bolt torques shall be applied at the manufacturer's specified values.

6. If effective seal is not obtained at a maximum torque listed by the manufacturer, the joint shall be disassembled and reassembled after thorough cleaning.
7. If a joint is defective, it shall be cut out and entirely replaced or, if permission is given by the Engineer, it may be repaired by a suitable clamp.

M. Expediting of Work
1. Excavate, lay the pipe, and backfill as closely together as possible.
2. Do not leave un-joined pipe in the trench overnight.
3. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress.
4. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the Engineer.

N. Polyethylene Encasement
1. Installation shall be in accordance with AWWA C105 and the manufacturer's instructions.
2. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Engineer.
3. Installation shall be at locations shown on the Drawings.

O. Conflict with Existing Utilities
1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the water main by the use of sheeting, shoring, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water main to avoid horizontal conflicts if the new alignment remains within the available right-of-way or easement, complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. If, in the opinion of the Engineer, the water main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Engineer will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed water main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water main. The Contractor may change the proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. If, in the opinion of the Engineer, the water main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Engineer will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.

P. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

Q. Water Main Separation Requirements
1. Water main installation requirements shall follow the guidelines as set forth in Florida Administrative Code 62-555.

3.03 INSTALLATION OF FITTINGS, VALVES AND TAPS

A. Fittings shall be handled with care to avoid damage. All fittings shall be loaded and unloaded by lifting, and under no circumstances shall fittings be dropped, skidded, or rolled.

Under no circumstances shall fittings be placed against pipe or other fittings in such a manner that damage could result. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior lining of fittings. If any part of the fittings' coating or lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at Contractor's expense and in a manner satisfactory to the Engineer before installing. Fittings shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All fitting gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

B. Fittings shall be set and joined to the pipe in a manner specified previously for joint assembly. When conditions warrant, fittings should be provided with special support trussing and blocking. Valves that are 12 inches and larger shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valves shall be installed in the closed position.

C. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Defective valves shall be corrected or held for inspection by the Engineer.

D. A valve box shall be provided on each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed to set the top of the operating nut 24-inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as directed by the Engineer.

E. All valve boxes set in non-paved areas shall have concrete pads poured around the top section of the valve box. The pad shall be a 24-inch square and shall be centered on the valve box. All water valve covers shall be painted safety blue as prescribed by the American Public Works Association (APWA) uniform color code for utility systems. All valve covers shall be cast with the word WATER. A 3-inch brass monument will be set on the north east corner of each 24-inch poured pad of the valve box indicating the valve size, type, and number of turns required.

F. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

G. A valve marker shall be provided for each underground valve. Unless otherwise detailed on the Drawings or directed by the Engineer, valve markers shall be installed 6 inches inside the right of way or easement. Raised pavement markers (RPM’s) shall be provided and installed along the appropriate roadway centerline for each in-line valve installed. RPM’s for in-line valves shall be Type I, two-way, and white in color.

H. Blow-Offs: Blow-offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back-siphoning of contaminated water.

I. The valve and valve box shall be installed so water department personnel can insert a valve key through the valve box and completely open and close the valve.

3.04 CONNECTIONS TO WATER MAINS

A. Make connections to existing pipe lines with tapping sleeves and valves, unless specifically shown otherwise on the Drawings.

B. Location
   1. Before laying pipe, locate the points of connection to existing water mains and uncover as necessary for the Engineer to confirm the nature of the connection to be made.

C. Interruption of Services
   1. Make connections to existing water mains only when system operations permit. Operate existing valves only with the specific authorization and direct supervision of the Owner.

D. Testing
   1. The Engineer or their Representative must be present for the pressure test of the tapping saddle and tapping valve before the tap is allowed.
   2. Test shall be done through the saddle and the test machine or the saddle and tap valve.

E. Tapping Saddles and Tapping sleeves
   1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted. The coupon shall be delivered to the Owner or their Representative.
   2. Prior to attaching the saddle or sleeve, the pipe shall be thoroughly cleaned, utilizing a brush and rag, as required.
   3. Before performing field machine cut, the water tightness of the saddle or sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water. Then using a hydro-static hand pump, pump to a pressure of 150 psi to insure all air is expelled. No leakage shall be permitted for a period of thirty minutes.
   4. After attaching the saddle or sleeve to an existing main, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent hypochlorite solution.

F. Connections and Repairs
   1. Where connections or repairs are required, Contractor shall only use solid sleeves and provide all materials and labor necessary to make the connection or repair to the existing pipeline, excluding service lines 2” or smaller.

3.05 INSTALLATION OF FIRE HYDRANTS

A. Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating nut and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow, handling damage and cracks. Defective hydrants shall be corrected or held for inspection by the Engineer.

B. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the roadway, with pumper nozzle facing the roadway, except that hydrants having two-hose nozzles 90 degrees apart shall be set with each nozzle facing the roadway at an angle of 45 degrees.

C. Hydrants shall be set to the established grade, with the centerline of the lowest nozzle at least 12-inches above the ground or as directed by the Engineer.

D. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch valve. When a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by first wrapping the weephole/drainhole with a felt/mesh material that will allow the hydrant to drain. Then place coarse gravel or crushed stone mixed

with coarse sand from the bottom of the trench to at least 6-inches above the drain port opening in the hydrant to a distance of 12-inches around the elbow.

E. When a hydrant is set in clay or other impervious soil, a drainage pit 2 x 2 x 2 feet shall be excavated below each hydrant and filled with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant and to a level of 6-inches above the drain port.

F. Hydrants shall be located as shown on the Drawings or as directed by the Engineer. In the case of hydrants that are intended to fail at the ground-line joint upon vehicle impact, specific care must be taken to provide adequate soil resistance to avoid transmitting shock moment to the lower barrel and inlet connection. In loose or poor load bearing soil, this may be accomplished by pouring a concrete collar approximately 6-inches thick to a diameter of 24-inches at or near the ground line around the hydrant barrel.

G. Raised pavement markers (RPM's) shall be provided and installed along the appropriate roadway centerline for each fire hydrant installed. RPM's for inline valves shall be Type I, two-way, and blue in color.

3.06 THRUST RESTRAINT

A. Retainer Glands
1. Provide retainer glands at all points where hydraulic thrust may develop and on fire hydrants and all associated fittings, valves and related piping.
2. Retainer glands shall be installed in accordance with the manufacturer's recommendations, particularly the required torque of the set screws.
3. The Contractor shall furnish a torque wrench to verify the torque on all set screws which do not have inherent torque indicators.

B. Thrust Collars
1. Concrete collars shall be constructed as shown on the Drawings.
2. The welded-on collar shall be attached to the pipe by the pipe manufacturer.
3. Filter fabric shall be installed between the thrust collar and the adjacent soil.

C. Concrete Blocking
1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings. Filter fabric shall be installed between the concrete blocking and the adjacent soil.
2. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

D. Bell Restraints
1. Place bell restraints on every joint of pipe greater than 6" diameter and within 50 feet of a mechanical joint fitting or tapping valve.

3.07 DETECTION TAPE AND LOCATE WIRE

A. Provide detection tape and locate wire for all water mains.

B. Locate wire shall not be wrapped around the pipe.

C. Locate wire shall be laid parallel to the 12 o'clock position of the main with at least 4" of separation.

D. Locate wire shall be looped into each valve box and pulled out a minimum of two feet from the top of the valve box.

E. Locating wire splices shall be heat sealed or made via waterproof splicing connectors. Splicing connectors shall be “Snakebite Locking Connectors” by Copperhead or equal.

3.08 WATER SERVICE CONNECTIONS

A. Water service connections shall be installed to the properties adjacent to the water transmission mains both to the same side of the roadway (Short Side Service) and to the opposite side of the roadway (Long Side Service) as directed by the Engineer.

B. Water service connections installed under roadway shall be pulled through a casing. Casings shall be installed through a bored hole approximately equal in diameter to the external diameter of the casing. Minimum cover under roadway shall be four feet. At other locations, minimum cover shall be three feet.

C. Installation shall conform to the details for water service connections appearing schematically on the Drawings. Contractor shall provide any and all appurtenant work required to provide the intended water service connections.

D. Transfer Service
   1. Immediately before connecting to the relocated or existing meter, all service lines shall be flushed to remove any foreign matter.
   2. Any special fittings required to reconnect the existing meter, to the new service line, or the existing private service line, shall be provided by the Contractor.
   3. To minimize out of service time, the Contractor shall determine the connections to be made and have all the required pipe and fittings on hand before shutting off the existing service.
   4. After completing the connection, the new corporation stop shall be opened and all visible leaks shall be repaired.

E. Backflow preventers shall be provided on all water services. Please refer to Paragraph 2.16(C)10 for further backflow specifications.

F. GPS coordinates shall be provided for each service connection and lateral.

3.09 TESTING AND INSPECTION REQUIREMENTS

A. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Engineer and applicable agency inspectors 48 hours in advance of testing and inspections.

3.10 HYDROSTATIC TEST

A. All sections of the water main subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.

B. All tests shall be in the presence of the Engineer or their Representative.

C. Each segment of water main between main valves shall be tested individually.

D. Test Preparation
   1. Flush sections thoroughly at flow velocities, greater than 2.5 feet per second, adequate to remove debris from pipe and valve seats.

2. Partially operate valves and hydrants to clean out seats.
3. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipes, valves and appurtenances will be pressure tested.
4. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation cocks at highpoints to expel air as main is filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed as detailed on the Drawings with a meter box.
5. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.
6. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.
7. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

E. Test Pressure
1. Test the pipeline at 150 psi or 1.5 times the operating pressure, whichever is greater, measured at the lowest point for at least two hours.
2. Maintain the test pressure within 5 psi of the specified test pressure for the test duration (at least two hours).
3. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure.
4. Provide an accurate pressure gauge with graduation not greater than 5 psi.

F. Leakage
1. Leakage shall be defined as the sum of the quantity of water that must be pumped into the test section, to maintain pressure within 5 psi of the specified test pressure for the test duration. Leakage shall be the total cumulative amount measured on a water meter.
2. The Owner assumes no responsibility for leakage occurring through existing valves.

G. Test Results
1. No test section shall be accepted if the leakage exceeds the limits determined by the following formula:

$$L = \frac{SD\sqrt{(P)}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test in pounds per square inch (gauge)

As determined under Section 4 of AWWA C600.

Allowable leakage at various pressures and pipe sizes is shown in the Table below (from AWWA C600 – Table 4.A) for 1000' of Pipe: *

Avg.	Pipe Diameter (inches)												
Average Pressure (PSI)	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43

* If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.

H. Completion
   1. After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.

I. Re-Testing
   1. Any alterations made to pipeline performed after initial testing shall be re-tested and passed again, regardless of initial test results.

J. Notification
   1. Engineer shall be notified 48-hours in advance prior to Contractor performing pressure and leakage testing.

3.11 DISINFECTING PIPELINE

A. After successfully pressure testing each pipeline section, disinfect in accordance with AWWA C651 for the continuous-feed method and these Specifications.

B. Disinfection
   1. Before disinfection is performed, the Contractor shall submit a written procedure for approval before being permitted to proceed with the disinfection. This plan shall also include the steps to be taken for the neutralization of the chlorinated water.

C. Chlorination
   1. Adhere to the requirements of AWWA C651 "Disinfecting Water Mains".

D. Disposal of Chlorinated Water
   1. Reduce chlorine residual by following the requirements of AWWA C655 "Field Dechlorination".
   2. Flush all lines until the residual is equal to the existing system.
   3. Disposal of the chlorinated effluent shall be in compliance with applicable regulations.

E. Bacteriological Testing
   1. After final flushing and prior to DEP approval and the water main being placed into service, the Contractor shall collect samples from the line and have tested for

bacteriological quality in accordance with the rules of the Florida Department of Environmental Protection.

2. The Contractor shall give the Engineer 48-hour written notice of the planned bacteriological testing to facilitate public notification, if required. The Owner's representative must be present when samples are taken. Immediately after samples are taken, the Contractor shall give the samples to the Owner's representative for handling. The Owner's representative shall be responsible for delivering the samples to the laboratory for testing. The bacteriological samples shall be analyzed for both coliform and non-coliform growth. Testing shall be performed by a laboratory certified by the State of Florida and approved by the Engineer.
3. All sampling and testing costs shall be paid for by the Contractor prior to final acceptance.
4. Re-chlorinate lines until required results are obtained.

END OF SECTION 02400

PART 1 – GENERAL

1.01 SCOPE

A. This Section describes products to be incorporated into force mains, pressure sewers, and accessories and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

1.02 DESCRIPTION OF WORK

A. Extent of work is shown on the drawings.

B. Sewage force main system work includes, but is not limited to: Piping, valves, fittings, appurtenances.

C. Comply with the requirements of applicable sections for excavation and backfilling required in connection with sewage force main system work.

D. Comply with requirements of applicable sections for concrete work required in connection with sewage force main system work.

1.03 QUALITY ASSURANCE

A. Codes and Standards
   1. Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA). American National Standards Institute (ANSI), and the American Society for Testing and Materials (ASTM), latest editions.

B. Testing and Inspection Services
   1. Employ, at Contractor's expense, testing laboratory to perform necessary testing.
   2. It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner, testing service and applicable agency inspectors 48 hours in advance of testing and inspection.
   3. Hydrostatic test shall be completed by the Contractor in the presence of the Owner.

1.04 SUBMITTALS

A. Prior to beginning construction, the Contractor shall submit for approval by the Owner, manufacturer's certifications and cut sheets for the following items:
   1. piping
   2. valves
   3. fittings
   4. appurtenances

B. Testing Reports
   1. Submit applicable reports directly to Owner from the testing service with copy to Contractor.

PART 2 – PRODUCTS

2.01 GENERAL

A. All materials shall be new, unused and correctly designed. They shall be of standard first grade quality and intended for the use for which they are offered. Materials or equipment

which, in the opinion of the Owner, are inferior or of a lower grade than indicated, specified or required, will not be accepted.

B. HDPE pipe for force mains shall have a green stripe at third points around the pipe for its full length.

C. PVC pipe for force mains shall be green.

2.02 HDPE PIPE

A. Pipe of various sizes shall be DIPS SDR 11 High Density Polyethylene (HDPE) Pipe, AWWA C906 compliant, NSF 61 Standard Listed, furnished in 50-foot lengths.

B. The HDPE pipe shall be manufactured in a plant capable of providing continuous quality control through inspection. The facility shall have the necessary testing equipment to verify that the pipe meets the requirements of AWWA C901 or C906, NSF Standard #61 and ASTM standards.

C. Materials
1. Polyethylene pipe and fittings shall be made from resin meeting the requirements of the Plastic Pipe Institute as PE3608.
2. The resin shall meet the requirements of ASTM D3350 with a cell classification of 345464C.

D. All pipes shall be suitable for use as pressure conduits, listed as NSF 61 and per AWWA C906 Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe. Peak flow water velocity of 6.5 ft./sec shall be used in the hydraulics engineering design.

E. Butt Fusion Fittings: HDPE fittings shall be PE3608 HDPE, Cell Classification of 345464C as determined by ASTM D3350, and approved for AWWA use. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans.

F. Pipe Manufacturer’s Quality Control
1. The pipe manufacturer shall have an on-going Quality Control program for incoming and outgoing materials. High-density polyethylene (HDPE) resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The manufacturer of the HDPE resin shall certify the Cell Classification as indicated above. These incoming resins shall be approved by plant Quality Control and verified to be approved by NSF before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness, and surface finish on the inside and outside and end cut.

G. Butt Fusion Joining
1. Plain end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer or the PPI. The fusion equipment operator shall receive training using the recommended procedure. The Contractor shall be responsible to verify that the fusion equipment is in good operating condition and that the operator has been trained within the past twelve months. The fusion equipment shall be equipped with a Data-logger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five years. Fusion beads shall not be removed.

H. Other Joining Methods Mechanical Joining

1. Polyethylene pipe and fittings may be joined together using Flanges or Mechanical Joint (MJ) adapters. These fittings shall be made from PE3608 HDPE, with a Cell Classification of 345464C as determined by ASTM D3350. Flanged and MJ adapters shall have a manufacturing standard of ASTM D3261. They shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All mechanical joints transitioning HDPE to another material shall be restrained using MegaLug or an approved equal.

2.03 POLYVINYL CHLORIDE (PVC) PIPE

A. Smaller than 4" Pipe: All PVC pipe and fittings less than four inches in diameter shall be manufactured in accordance with ASTM D2241, with a standard dimension ration (SDR) of 26, rated pressure 160 psi.

B. 4" – 12" Pipe: PVC pipe shall be manufactured in accordance with AWWA C900, latest edition. Pipe shall be pressure Class 235 and must meet dimension requirements of standard dimension ratio (SDR) 18.

C. 14" and Larger Pipe: PVC pipe shall be manufactured in accordance with AWWA C905, Latest Edition. Pipe shall be Pressure Class 165 and meet the dimension requirements of dimension ratio (DR) 25.

D. Joints: Joints shall be "push-on" and shall meet all requirements of ASTM D3139 or locking type. Each bell shall be an integral wall section joint assembly using elastomeric-gasket seals. All gaskets shall meet all requirements for performance as specified by ASTM F477.

E. All plastic pipe shall be marked using a solid No. 10 copper wire with green vinyl insulation, buried between 3 and 6 inches above the top of the pipe over the entire length of the pipe. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the wire is secured in place over the pipe. It is the intent of this paragraph to provide a means to locate PVC pipe using standard pipe location equipment. The wire shall be carried up through valve boxes and terminated at least 2 feet above the ground line to permit connection of location equipment. Excess wire at valve boxes shall be neatly rolled and stored in the valve box for easy accessibility. Locating wire splices shall be heat sealed or made via waterproof splicing connectors.

F. Push-on joint bell harness restraints shall be Series 1900 split serrated restraint harness by EBBA Iron or approved equal.

2.04 FITTINGS (3-Inches and Larger)

A. General

1. Fittings three inches and larger shall be ductile iron manufactured in accordance with ANSI/ AWWA C110/ A21.10 or C153/ A21.53. The minimum pressure rating for fittings shall be 250 psi.

B. Joints

1. Fitting joints shall meet the specifications of the pipe joints as specified under DUCTILE IRON PIPE for the appropriate joint, push on joints, mechanical joints or flange joints.

C. Coating
   1. All ductile iron fittings and specials shall receive an interior lining and exterior bituminous coating as specified in Section 02400 of these Specifications.

D. Retainer Glands
   1. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/ AWWA C153/ A21.53, latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices.
   2. The mechanical joint restraining device shall have a working pressure of at least 350 psi with a minimum safety factor of 2:1, and shall be EBAA Iron, Inc., MEGALUG Series 2000 or 19MJ00 or equal.
   3. Coatings: Coatings shall be as follows:
      a. Flange adapters shall be provided with a painted "shop coat."
      b. Retainer glands shall be provided with a bituminous coat.
      c. Push-on restraints shall be provided with a bituminous coat.

2.05 DETECTION TAPE

A. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Sanitary Sewerage Systems, Safety Green, "Caution: Sewer Line Buried Below." Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be minimum 2-inches when buried less than 10-inches below the surface. Tape width shall be minimum 3-inches when buried greater than 10-inches and less than 20-inches. Detection tape shall be equal to Lineguard Type III Detectable or Allen Systems Detectatape.

2.06 ANCHOR COUPLINGS

A. Lengths and sizes of anchor couplings shall be as shown on the Drawings. Anchor couplings shall be equal to Tyler Pipe 5-198.

2.07 FLANGE ADAPTER

A. The flange adapter shall permit the connection of unthreaded, un-grooved, open-ended ductile iron pipe to ANSI/ASME B16.1, Class 125 flanges. The flange adapter shall meet the test requirements of ANSI/ASME B16.1 for Class 125 flanges. The adapter shall be a ductile iron casting incorporating a flange with extended throat, set screws and gasket. The gasket shall provide a compression seal between the adapter, the pipe and the adjacent flange. Flange adapters shall be used only in locations specifically shown on the Drawings or at the direction of the Owner, and in accordance with the manufacturer's recommendations. The flange adapter shall be equal to EBAA Iron “Mega Flange”. Additionally, flange adapters shall be provided with 304 stainless steel harness rods of the diameter and quantity shown on the Drawings or directed by the Owner.

2.08 GATE AND TAPPING VALVES

A. General
   1. Gate and tapping valves shall be resilient seat and shall comply with all requirements of AWWA C509 and the following supplemental requirements:

a. Valves 12 inches and smaller shall be bubble-tight at 200 psi water working pressure. Test pressure shall be twice the rated working pressure and at all times zero leakage will be maintained.
b. All valves shall be Class B gray iron body, non-rising stem, suitable for buried vertical mounting.
c. Non-rising stems shall be in full compliance with AWWA specifications with cast integral stem collar and furnished of bronze conforming to ASTM B132 Alloy A.
d. Stem nuts shall be independent of wedge and shall be of solid bronze conforming to ASTM B62.
e. Sealing mechanism shall be either a replaceable internally reinforced, specially contoured, molded rubber discs seat ring attached to the face of the disc with self-locking stainless steel screws or a sealing surface permanently bonded with resilient material to meet ASTM D429. Replaceable seat rings shall be designed such that sealing mechanism cannot be installed improperly.
f. Stuffing boxes shall be O-ring seal type with two rings located in the stem.
g. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.
h. All valves shall open by turning a two inch square operating nut counterclockwise.
i. All valves shall be furnished with operating nuts, unless noted otherwise.
j. All tapping valves shall have flange-by-mechanical joint ends.
k. All tapping valves shall be interchangeable with other makes of tapping sleeves.

B. Joints
1. Joints shall be mechanical joints and shall conform to AWWA C111, and all bolts and nuts for mechanical joints shall be high-strength, low-alloy steel in accordance with AWWA C111. All gaskets shall be for a standard mechanical joint of BUNA-S (SBR Buna) in accordance with ANSI/ AWWA C111/ A21.4. All mechanical joint accessories shall be furnished with the valves.

C. Coating
1. Body and cover bolts and nuts shall meet specifications ASTM A307 and be corrosion-proof. Valve interior shall have protective coating meeting AWWA C550.

D. Approved modes are as follows:

1.	American Flow Control	Series 2500 Resilient Wedge Valve
2.	Muller Company	A-2362-78 Resilient Wedge Gate Valve
3.	AVK	Resilient Seated Gate Valve

2.09 TAPPING SLEEVES

A. Tapping sleeves shall be constructed of stainless steel, and in two halves. All tapping sleeves shall be Smith-Blair #662 or equal. Bolts in the tapping sleeve shall be stainless steel.

2.10 TAPPING SADDLES

A. Tapping saddles shall be constructed of heavy, ductile cast iron, with the attachment straps, nuts and washers constructed of corrosion resistant alloy steel in accordance with AWWA C111. All tapping saddles shall be Smith-Blair #317 or equal.

2.11 CONCRETE

A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. For job mixed concrete,

submit the concrete mix design for approval by the Owner. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.12 PLUG VALVES

A. Valves shall be 90 degree turn, non-lubricated, eccentric type with resilient faced plugs. Design of the valve shall provide that contact between the seat and the plug shall only occur in the final degrees of plug movement. Valves shall be suitable for throttling service and service where valve operation is infrequent.

B. Valves shall provide drip-tight shut-off up to the full pressure rating with pressure in either direction. Pressure ratings shall be established by hydrostatic tests conducted in accordance with ANSI B16.1. Valves shall be rated at a minimum of 150 psi.

C. Valves shall have a port area equal to at least 80 percent of the full pipe area.

D. Bodies shall be cast-iron, conforming to ASTM A 126, Class B (carbon steel for 2-inch valves).

E. Valve ends shall be a mechanical joint type, except where flanged or restrained joint ends are shown on the Drawings. Mechanical joint valves shall have bell ends conforming to applicable requirements of AWWA C111/ANSI A21.11. Flanged joints shall meet the requirements of ANSI B16.1, Class 125. Flanged valves with flange-to-MJ adapters shall not be acceptable in lieu of MJ valves.

F. Valve seats shall be a raised, welded-in overlay of not less than 90 percent pure nickel, machined to mate with the resilient faced plug. Overlay shall be a minimum of 1/8-inch thick. Seats shall be EPDM rubber seats.

G. The plug shall be of semi-steel, conforming to ASTM A 126, Class B. The plug facing shall be a synthetic rubber compound of approximately 70 durometer hardness bonded to the plug. Facing material shall be abrasion resistant and suitable for service in sewage and sludge applications.

H. Valves shall be furnished with replaceable, sleeve-type bearings in the upper and lower journals. Bearings shall comply with applicable requirements of AWWA C507. Bearing materials shall have a proven record of service of not less than five years.

I. The valve body shall be fitted with a bolted bonnet incorporating a stuffing box and pull-down packing gland. Packing shall be the split chevron type. Design of exposed valves shall allow visible inspection of the shaft seal, adjustment of the packing, and replacement of the packing, all without disturbing the bonnet or valve operator. The shaft seal shall comply with the requirements of AWWA C504.

J. Actuators
   1. Valves for exposed service, 3 through 8-inches in diameter, shall be lever operated. Hand levers shall be steel with a non-metallic grip.
   2. Actuators for buried service and valves 10 inches and larger, shall be equipped with manual operated geared actuators. Geared actuators shall be totally enclosed, oil lubricated, worm and gear type. Geared actuators shall turn in the same direction as non-geared actuators. Shaft seals shall be provided to prevent entry of dirt and water into the actuator. All shaft bearings shall be permanently lubricated bronze bushings. Actuators shall clearly indicate valve position and an adjustable stop shall be

provided to set closing torque. Construction of actuator housing shall be semi steel. Gear actuators shall comply with requirements of AWWA C504.

3. Gear actuators for buried valves 10 inches and larger in diameter shall be mounted above ground on an extended bonnet.
4. Motorized actuators shall be provided where shown on the Drawings and as specified in this Section. Motorized actuators shall be Rotorq, EIM, or AUMA.
5. Valves and operators for submerged or buried service shall have seals on all shafts and gaskets on valve operator covers to prevent the entry of water. Operator mounting brackets for submerged service shall be totally enclosed and shall have gasket seals.

K. Operators

1. Valves for non buried service, six feet or more above the operating floor shall be furnished with a chainwheel operator and chain for operation from floor level. All other valves shall be equipped with a handwheel operator.
2. Valves, 3 through 8 inches, for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension required to bring the operation nut within 6 inches of finished grade. Valve boxes and extension stems shall be as specified in this Section.

L. All exposed bolts, nuts, and washers for buried or submerged valves shall be stainless steel.

M. The exterior of all buried valves shall have a factory applied, two coat coal tar epoxy coating system. The coal tar epoxy shall be Tnemec Tneme-Tar 46-413, Indurall Ruffstuff 2100 Coal Tar Epoxy or Kop-Coat Bitumastic No. 300-M. Each coating shall have a minimum dry film thickness of 8-10 mils.

N. All ferrous metal interior surfaces of plug valves shall be provided with a factory applied epoxy interior coating conforming to the requirements of AWWA C550. The coating shall be either TNEMEC Series 20 Pota Pox, Valspar Series 78 or Kopcoat Hi Gard Epoxy. Each coating shall have a minimum dry film thickness of 4 to 6 mils.

O. Acceptable Manufacturers: All plug valves shall be products of a single manufacturer who must submit evidence of five years satisfactory service in sewage applications of the same design and of the sizes required. Valves shall be manufactured by DeZurik, Pratt or Val-Matic.

2.13 AIR VALVES FOR SEWERAGE SERVICE

A. General: Unless specifically approved by the Owner, combination air valves shall be installed in accordance with these Specifications. In areas of high water table, valve shall be located above ground in insulated boxes.

B. Air Release Valves: Valves shall be automatic air release valves designed to allow escape of air under pressure and close water-tight when liquid enters the valve. Valve shall have a 1-inch NPT inlet and a maximum orifice diameter of 3/32-inch. The valve body shall be plastic, designed to facilitate disassembly for cleaning and maintenance. The float shall be stainless steel; the valve seat and all working parts shall be of corrosion-resistant materials. Valves shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without dismantling the valve. ARI or an approved equivalent shall be used.

C. Air/Vacuum Valves: Valves shall be automatic air and vacuum valves designed to allow escape of air, close water-tight when liquid enters the valve, and allow air to enter in the event

of a vacuum. The valve body shall be plastic, designed to facilitate disassembly for cleaning and maintenance. The float shall be stainless steel; the valve seat and all working parts shall be of corrosion-resistant materials. Valves shall be equipped with the necessary attachments, including valves, quick disconnect couplings and hose, to permit back flushing after installation without dismantling the valve. The valves shall have an orifice diameter of 2-inches and NPT inlet and outlet diameters of 2 x 2-inches. ARI or an approved equivalent shall be used.

D. Combination air valve shall consist of an air release valve tapped into the body of an air and vacuum valve.

E. Single Body Valve: In lieu of D. above, a single body, double orifice, sewage combination valve may be used. Materials of construction, orifice size, venting capacity and accessories shall meet the requirements of B. and C. above.

2.14 CHECK VALVES

A. Check valves shall be hinged disc type with cast iron body and low zinc bronze or bronze-fitted disc. Valves shall not slam shut on pump shutdown. Valves shall be equipped with a 1/2-inch stop cock at the high point of the valve for bleeding air from the line.

B. Valves shall be outside weight and lever cushioned type. The cushion chamber shall be attached to the side of the valve body externally and constructed with a piston operating in a chamber that will effectively prevent hammering action at the pump discharge heads specified. The cushioning shall be by air and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

C. Valves shall be of the globe design with ANSI 125 pound flanges.

D. Valves shall be Valvematic “Swingflex” or equivalent.

2.15 VALVE BOXES AND EXTENSION STEMS

A. Valve Boxes
1. Unless shown otherwise on the Drawings, all valves shall be equipped with valve boxes. The valve boxes shall be cast iron two-piece screw type with drop covers. Valve boxes shall have a 5.25-inch inside diameter. Valve box covers shall weigh a minimum of 13 pounds. The valve boxes shall be adjustable to 6-inches up or down from the nominal required cover over the pipe. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut. Ductile or cast iron extensions shall be provided as necessary. Covers shall have "SEWER" cast into them. Valve boxes shall be manufactured in the United States.
2. Valve boxes shall be manufactured by American Flow Control Trench Adapter and Retrofit box insert.

B. Extension Stems
1. Extension stems shall always be provided. Connection to the valve shall be with a wrench flush to the nut coupling and a set screw to secure the coupling to the valve's operating nut. The coupling and square wrench nut shall be welded to the extension stem. Extension stems shall be equal to M & H Valve, Style 3801.
2. The extension stem shall be a fully adjustable valve box and extension stem system that is available in trench depths ranging from 3 feet to 20 feet. Both the valve box and the extension stem shall adjust to grade in a matter of seconds, completely eliminating the

need to cut extension stems in the field. It shall be able to raise the upper pipe to the proper height and lock it into the new position.

3. The extension stem product that shall be used is an AMERICAN Trench Adapter, or equivalent.

2.16 CORPORATION COCKS AND CURB STOPS

A. Corporation cocks and curb stops shall be ground key type, shall be made of stainless steel conforming to ASTM B 61 or B 62, and shall be suitable for the working pressure of the system. Ends shall be suitable for grip type joint. Threaded ends for inlet and outlet of corporation cocks shall conform to AWWA C800; coupling nut for connection to HDPE or stainless steel tubing shall conform to ANSI B16.26. Corporation cocks and curb stops shall be manufactured by Mueller or Ford.

PART 3 – EXECUTION

3.01 GENERAL

A. Pipe, fittings, valves and appurtenances shall be installed in accordance with the manufacturer's recommendation and the applicable sections of the codes and standards listed in the quality and assurance section of these specifications.

3.02 EXISTING UTILITIES AND OBSTRUCTIONS

A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call the Sunshine State One Call of Florida, Inc. (1-800-432-4470), as required by Florida law and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.

B. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed pressure main does not permit safe installation of the pressure main by the use of sheeting, shoring, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the pressure main to avoid horizontal conflicts if the new alignment remains within the available right of way or easement and complies with regulatory agency requirements after a written request to and subsequent approval by the Owner. If, in the opinion of the Owner, the pressure main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Owner will direct the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed pressure main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the pressure main. The Contractor may change the proposed grade of the pressure main to avoid vertical conflicts if the changed grade provides minimum required capacity, maintains adequate cover and complies with regulatory agencies requirements, after written request to and subsequent approval by the Owner. If, in the opinion of the Owner, the pressure main's proposed location cannot be adjusted, thus requiring the relocation of an existing utility, the Owner will direct

the Contractor to relocate the utility as part of the Contract with the costs of such relocation being paid for as part of a change order.

C. Water and Sewer Separation
   1. Sewers should maintain a minimum 10 foot edge to edge separation from water mains. Where the sewer crosses a water main, an 18 inch vertical separation shall be maintained where possible. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Owner.
   2. Where the sewer crosses over a water main, the water main shall be encased in concrete to the first joint in each direction.
   3. No water main shall be permitted to pass through or come in contact with any part of a manhole.

3.03 HANDLING PIPE

A. General: All material, unless otherwise directed, shall be unloaded at the job site and distributed at the site of the project by the Contractor. Materials shall be handled with care to avoid damage. In loading and unloading, pipe shall be lifted by hoists or slid or rolled on skids in such a manner as to avoid shock. Under no circumstances shall pipe be dropped. Pipe handled on skids must not be allowed to roll against pipe already on the ground. The Contractor shall be responsible for the safe handling of all materials. Damaged materials will be rejected by the Owner.

B. Pipe shall be handled so as to avoid damage to the coating and lining. If, however, any part of the coating or lining is damaged by the Contractor, the repair shall be made by the Contractor at Contractor's expense in a manner satisfactory to the Owner before installation.

C. Pipe shall be distributed on the site of the work parallel with and opposite or near the place it is to be laid in the trench, and with bell ends facing the directions in which the installation will proceed unless otherwise directed.

3.04 PIPE DISTRIBUTION

A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.

C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.

D. No distributed pipe shall be placed inside drainage ditches.

E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge-to-edge.

F. No pipe shall be dropped or rolled off from the truck. Pipe that has been dropped or rolled from the truck will be considered damaged and will not be used.

3.05 INSTALLATION OF PIPE

A. General

1. Upon satisfactory installation of the pipe bedding, as specified in the "Earthwork for Utilities" section of these specifications, a continuous trough for the pipe barrel and recesses for the pipe joints shall be excavated by hand digging so that when the pipe is laid in the trench true to line and grade, the pipe barrel will receive continuous uniform support and the joint will receive no pressure from the trench bottom.
2. The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods.
3. All pipe, fittings, and valves shall be carefully lowered into the trench by means of derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe coatings, and lining. Under no circumstances shall pipe or accessories be dropped, dumped or rolled into the trench from finished ground level.
4. The gasket material for the joint shall be properly positioned before the pipe is lowered into the trench. The joining of the pipe shall proceed in accordance with the manufacturer's recommendations.
5. Watertight plugs shall be installed in open ends of the pipe at all times when pipe laying is not in progress. At no time shall trench water be permitted to enter pipe.
6. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Wherever it is necessary to cut gray or ductile cast iron pipe which is equipped with a push-on joint type bell end, the cut end of the pipe shall be adequately beveled so as to prevent the edge of the cut pipe from cutting or tearing the gasket as the plain end is inserted into the bell of the adjoining pipe or fitting. All field-cut pipe shall be beveled by the Contractor and the pipe "short" shall be used as part of the pipeline construction.
7. Whenever necessary to deflect pipe after proper homing from a straight line, either in the vertical or horizontal plane to avoid obstructions, the maximum allowable deflection shall be in accordance with the pipe manufacturer's recommendations. Only after the pipe has been properly homed will it be allowed to deflect.
8. No pipe shall be laid in water or when the trench conditions or the weather is unsuitable for such work.
9. All sewer Force Main shall be located a minimum of 30 inches below grade and 36 inches below top of pavement. Any pipe which is disturbed or found to be defective after laying shall be removed and relayed or replaced.
10. Prior to connecting new work to existing lines or appurtenances, the Contractor shall verify location and elevation of existing connection point and notify Owner of any conflicts or discrepancies.

B. Joints

1. Before laying the pipe, all lumps, blisters, and excess coal tar coating shall be removed from the bell and plain ends of each length of pipe. The pipe ends shall then be wire brushed and wiped until clean and dry. Where mechanical joints or push-on joints are specified, oil and grease also shall be removed. Pipe ends shall be kept clean until joints are made. The plain end of pipe for mechanical joints shall be lubricated with a soapy solution before installing the gaskets.
2. In making up the push-on type joint, the gasket shall be placed in the socket per manufacturer's recommendation. A thin film of lubricant (approved by the pipe manufacturer) shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. The plain end of the pipe to be entered shall be thoroughly cleaned and placed in alignment with the bell of the pipe to which it is to be joined. The joint shall be made by exerting sufficient force on the entering pipe so

that the plain end is moved past the gasket until it seats as per manufacturer's recommendation.

3. Backhoe buckets or excavation equipment are not to be applied directly to the pipe.
4. Mechanical joints shall be assembled in accordance with AWWA Standards. Mechanical joints shall be centered in the bells. Soapy water shall be brushed over the gasket just prior to installation. The gasket and gland shall be placed in position, the bolts inserted, and the nuts tightened by hand.
5. The bolts shall be tightened on opposite sides of the pipes by means of a torque wrench in such a manner that the gland shall be brought up evenly into the joint. The following range of bolt torques shall be applied:

Bolt Size (inches)	Range of Torque
3/4" Diameter	85 to 95 ft.-lbs.
1" Diameter	95 to 100 ft.-lbs.

6. If effective seal is not obtained at a maximum torque listed above, the joint shall be disassembled and reassembled after thorough cleaning.
7. If a joint is defective, it shall be cut out and entirely replaced or, if approved by the Owner, it may be repaired by a suitable clamp.

3.06 INSTALLATION OF FITTINGS

A. Fittings shall be handled with care to avoid damage. All fittings shall be loaded and unloaded by lifting, and under no circumstances shall fittings be dropped, skidded, or rolled. Under no circumstances shall fittings be placed against pipe or other fittings in such a manner that damage could result. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior lining of fittings. If any part of the fittings' coating or lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at Contractor's expense and in a manner satisfactory to the Owner before installing. Fittings shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All fitting gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

B. Fittings shall be set and joined to the pipe in a manner specified previously for joint assembly. When conditions warrant, fittings should be provided with special support trussing and blocking.

3.07 ANCHORAGE OF BENDS, TEES AND PLUGS

A. General: Adequate precautions shall be taken to prevent the separation of joints at bends, tees and plugged ends.

B. Retainer glands shall be installed in accordance with manufacturer's recommendations.

C. Thrust Blocking

1. Where reaction or thrust blocking is required, it shall be of concrete of a mix not leaner than one cement, two and one-half sand, five stone, having a compressive strength of not less than 3,000 pounds per square inch after 28 days and shall have a minimum curing time of three days. The poured concrete shall be left exposed for a minimum of 24 hours before backfilling, but not more than 48 hours. Before concrete thrust blocks are covered, contractor will have the Owner inspect the

installation. Concrete thrust blocking shall not cover bolts or prevent access in such a way to prevent bolt removal or effect repair.

2. Blocking shall be placed between undisturbed earth and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that shown in the Construction Details. The blocking shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repair.
3. Concrete shall not cover pipe or bolts.

3.08 INSTALLATION OF VALVES

A. General
   1. Valves shall be handled with care to avoid damage. All valves shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded or rolled. Valves shall not be placed, under any circumstances, against pipe or other fittings in such a manner that damage could result. Slings, hooks or tongs used for lifting shall be padded in such a manner as to prevent damage.
   2. If any part of the valve coating and lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor at Contractor's expense in a manner satisfactory to the Owner before installing.
   3. Valves shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud or other foreign matter. All valve gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

B. Gate valves shall be set and joined to new pipe in the manner previously specified for cleaning, laying and joining pipe.

C. Valve Boxes
   1. Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the operating nut of the valve by the Contractor with box cover flush with the surface of the finished pavement or at such other level as may be directed.
   2. All valve boxes set in non-paved areas shall have concrete pads poured around the top section of the valve box. The pad shall be a 24 inch square pad and shall be centered on the valve box.
   3. All sewer valve covers shall be painted safety green as defined by the American Public Works Association (APWA) uniform color code for utility systems.
   4. All valve covers shall be cast with the word SEWER. A welder shall burn the number of turns to open/close the valve, into the cover.

D. The Contractor shall provide a Carsonite Utility Markers or approved equivalent with U.V. resistant decal for each valve installed. Valve decal shall be stamped "CAUTION SEWER VALVE".

3.09 INSTALLATION OF TAPS

A. General
   1. All drilling and tapping equipment used and material supplied to make taps will be in accordance with AWWA Standards.

B. After the tapping sleeve and valve have been installed and before the tap is made, the sleeve will be tested to ensure a watertight joint. A test plug will be provided in the sleeve and after the sleeve has been installed it will be filled with water and the pressure increased between 150 psi and 190 psi. All leaking joints will be repaired to the satisfaction of the Owner at the Contractor's expense.

C. All pipe coupons removed as a result of taps to any pipeline shall be retained for presentation to the Owner.

3.10 TESTING AND INSPECTION REQUIREMENTS

A. The Contractor shall coordinate all testing and inspections with the Owner. The Contractor shall notify the Owner and applicable agency inspectors 48 hours in advance of testing and inspections.

3.11 HYDROSTATIC TEST

A. Hydrostatic Test: A hydrostatic test shall be performed on all mains and fittings for a minimum of two hours at 100 psi in accordance with AWWA Manual of Water Supply Practices M23. Test shall occur at any convenient time upon backfill of lines and after all piping has been thoroughly cleaned and flushed to clear the lines of all foreign matter. Prior to test, allow adequate curing time for reaction blocking.

B. Gages and Recorders: The Contractor shall, upon request of the Owner, furnish certified test data for pressure gauges and recorders used on hydrostatic test equipment. At the option of the Owner, flow meters and/ or pressure gauges used for hydrostatic testing shall be equipped by the Contractor with approved strip or round chart recorders. Tests shall be made in sections not exceeding one-half mile.

C. Each valved section of pipe to be tested shall be slowly filled with water and a test pump shall be installed at the low point of the section being tested. All air in the line will be expelled before applying specified test pressure. To accomplish this, taps will be made, if necessary, at the point of highest elevation and afterward tightly stopped with tapered brass plugs, all at the Contractor's expense.

D. After installation and filling of the line as specified, the Contractor will pump the line to a pressure greater than 100 psi. At no time shall the test or line pressure exceed 140 psi. If required by the Owner, pump test equipment shall be equipped with pressure relief valves pre-set to 140 psi.

E. Throughout the duration of the test, the Contractor is required to maintain a minimum pressure in excess of 100 psi. The Contractor is advised that, should the line pressure fall to or below 100 psi at any time during the two hour test, the test will be considered invalid and a retest in accordance with this procedure will be required. Therefore, it is advisable to pump water into the line as the line pressure approaches 100 psi. The test will be conducted with a pressure variation of not more than 5 psi for the duration of the test.

F. At the end of the two hour test period, the Contractor will be required to pump the pipe lines back up to the highest pressure obtained during the duration of the test period. If chart records are required for the hydrostatic test, the Contractor shall furnish flow and/ or pressure charts as a condition of concluding the test.

G. The allowable leakage, as specified below, will be defined as any volume of water required to maintain a minimum pressure in excess of 100 psi during the duration of the test period plus that volume of water required at the conclusion of the test to bring the line pressure back up to the highest pressure obtained during the duration of the test period.

1. Two Hour Hydrostatic Test Allowable Leakage (Gallons) for 100 LF or 5 Joints Allowable Leakage for AWWA PVC Pipe:

Nominal pipe size (in.)	Average Test Pressure	
	100 PSI	150 PSI
4”	0.027	0.033
6”	0.041	0.050
8”	0.054	0.066
10”	0.068	0.083
12”	0.081	0.099

H. Leakage detection at mechanical joints shall be stopped by tightening the gland (not to exceed required torque) and leaking at slip joints shall be cut out and entirely replaced or, if approved by the Owner, it may be repaired by a suitable clamp. Any cracked or defective pipes, fittings or valves discovered as a result of this pressure test shall be removed and replaced by the Contractor with sound material and the test shall then be repeated until satisfactory.

I. The Contractor is warned that pressure testing against existing "end-of-line" valves is done at Contractor's own risk. Failure of these valves to hold test pressure will not relieve the Contractor of the pressure testing nor will it entitle him to any additional compensation for the extra work performed.

END OF SECTION 02580

PART 1 - GENERAL

1.01 SCOPE

A. This Section details the methods, procedures, materials and equipment required to install a spray-on watertight liner for sanitary sewer manholes. The completed system will provide a corrosion resistant liner that restores the surface profile and eliminates water infiltration and exfiltration. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

B. It is the intent of these specifications to provide information supplemental to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Engineer for clarification.

1.02 REFERENCES

A. ASTM D7234 - Adhesion

B. ASTM D412 - Tensile Strength (PSI)

C. ASTM D412 - Elongation (%)

D. ASTM D624 - Tear Strength (PLI)

E. ASTM D2240 – Hardness

F. ASTM D522 - Flexibility (1/8” mandrel)

G. ASTM D4060 - Taber Abrasion (mg loss)

1.03 SUBMITTALS

A. All materials and procedures required to establish compliance with the specifications shall be submitted upon request to the owner/ engineer for review/ approval. Submittals shall include at least the following:

1. Technical Data Sheet on each product used.
2. Safety Data Sheet (SDS) for each product used.
3. Manufacturer’s Certification of Applicator.
4. Certified Applicator Minimum Qualifications (Section 1.04 D).
5. Descriptive literature, bulletins and or catalogs of materials.
6. Work procedures including flow diversion plan, method of repair, etc.
7. Material and method for repair of leaks or cracks in the structure.
8. Applicator and Manufacturer warranty forms (Section 1.05)

1.04 QUALITY ASSURANCE

A. The manufacturer of the total lining system for wastewater structures shall be a company that specializes in the design and manufacture of corrosion protection materials/ systems for wastewater structures.

B. The applicator (company performing the installation) shall be completely trained in leak repair, surface preparation and application of the lining system.

C. The materials/ products shall be suitable for installation in a wastewater environment without any deterioration of the liner.

D. The applicator shall be trained and provide a letter of certification from the manufacturer for the handling, mixing, application, and inspection of the liner system as described herein.

E. To ensure total unit responsibility, all materials and installation thereof shall be furnished and coordinated by manufacturer/certified applicator.

1.05 WARRANTY

A. Applicator and Manufacturer must warrant the liner system installation against failure for a period of 10 years from the installation date. Applicator shall correct failures any time prior to 10 years after the acceptance date. Failure will be deemed to have occurred if the protective liner fails to:

1. Prevent the internal corrosion of the structure or
2. Prevent groundwater infiltration.

B. Failure does not include damage resulting from mechanical force or the presence of chemical substances not customarily present or used in wastewater structures.

C. The liner must be installed in accordance with Manufacturer’s instructions, by Applicators certified by Manufacturer.

D. Executed 10-year Applicator and Manufacturer warranties are to be provided upon completion of work.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall be new and unused. They shall be of standard, first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified, or required, will not be accepted.

2.02 MANHOLES

A. The materials to be utilized in the lining of wastewater structures shall be designed and manufactured to withstand the severe effects a wastewater environment. The manufacturer of the corrosion protection products shall have at least 10 years of experience in the production of the lining products utilized, and the products shall have satisfactory installation record.

B. Equipment for installation of lining materials shall be of high quality and as recommended by the manufacturer.

C. The lining system to be utilized for wastewater structures shall be a multi-layer “stress skin panel” liner system as described below:

1. Liner.

Installation	Liner
Moisture barrier	Modified Polymer (Silicone modified polyurea)
Surfacer	Polyurethane/ Polymeric blend foam
Final corrosion barrier	Modified polymer (Silicone modified polyurea)

2. The Modified polymer (silicone modified polyurea) shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.

3. The Polyurethane Rigid Structure Foam, shall be low viscosity two-component, containing flame retardants.

4. Total thickness of multi-layer liner system shall be a minimum of 500 mils.

D. The product shall be SPECTRASHIELD, manufactured by CCI Spectrum, Inc., or approved equal.

PART 3 – EXECUTION

3.01 INITIAL INSPECTION

A. Applicator shall take appropriate action to comply with all local, state, and federal regulations including those set forth by OSHA, EPA, the Owner and any other applicable authorities.

B. Prior to conducting any work, an initial inspection of the structure shall be performed to determine need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.

C. If required, submit a plan for flow control or bypass to the owner/ engineer for approval prior to conducting the work.

D. New Portland cement structures shall have endured a minimum of 28 days since manufacture prior to commencing installation of the liner system.

3.02 SURFACE PREPARATION

A. The surface preparation program will include checking the atmosphere for hydrogen sulfide, methane, low oxygen, or other gases, approved flow control equipment, and surface preparation equipment.

B. Surface preparation for standard manhole structures shall be in accordance with the manufacturer’s recommendations, and may include high pressure water cleaning and shall provide a surface compatible for installation of the liner system.

C. Surface preparation and methods for other structures shall be in accordance with the manufacturer’s recommendations, and may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, or detergent water cleaning, and shall be suited to provide a surface compatible for installation of the liner system.

D. The surface preparation method shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, loose brick, loose mortar, contaminants or debris, and shall display a surface profile suitable for application of the liner system in accordance with the manufacturer's recommendations.

E. After completion of surface preparation, perform the seven point check list, inspecting for:

1. Leaks
2. Cracks
3. Holes
4. Exposed rebar
5. Rind and cover condition
6. Invert condition
7. Inlet and outlet pipe condition

F. After all defects in the structure are identified, repair all leaks and severe cracks with a hydrophilic polyurethane grout or other methods approved by the material manufacturer.

G. Upon completion of leak and crack repair, the surface shall be primed in accordance with the manufacturer's recommendations.

3.03 MATERIAL INSTALLATION

A. Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment.

B. Spray equipment shall be specifically designed to accurately ratio and apply the liner system.

C. Application of multi-component liner system shall be in strict accordance with manufacturer's recommendation. Final installation minimum total thickness shall be 500 mils. A permanent identification and date of work performed shall be affixed to the structure in a readily visible location.

D. A final written report may be provided to the owner/ engineer detailing the location, date of work and description of the work.

3.04 FINAL INSPECTION

A. Final liner system shall be completely free of pinholes or voids. Liner thickness shall be the minimum value as described herein.

B. Visual inspection may be made by the Owner/ Engineer. Any deficiencies in the finished liner system shall be marked and repaired according to the procedures set forth by the manufacturer.

END OF SECTION 02590

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

1. This section specifies fusible polyvinyl chloride (FPVC) pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by horizontal directional drilling, directional boring, or guided boring.

B. REQUIREMENTS

1. Contractor shall provide FPVC pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by horizontal directional drilling, directional boring, or guided boring.

2. Contractor shall be responsible for all installation processes and procedures associated with the installation by horizontal directional drilling, directional boring, or guided boring in accordance with this specification.

C. PIPE DESCRIPTION

1. Pipe supplier shall furnish FPVC pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.

2. Pipe shall conform to AWWA C900 dimensions and designations for DR18 pipe.

1.02 QUALITY ASSURANCE

A. REFERENCES

1. This section contains references to the following documents. They are a part of this section as specified and modified. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall govern.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design.

Reference	Title
ANSI/AWWA C110/A21.10	Standard for Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C111/A21.11	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900[1]	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100mm Through 1,500mm)

[1] Prior to 2017, AWWA C905 was the standard for PVC pipe and fabricated fittings larger than 12 in. (300 mm). “AWWA C905” marking on pipe larger than 12-inch is acceptable.

Reference	Title
AWWA C907	Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service
AWWA M23	AWWA Manual of Practices for PVC Pipe—Design and Installation
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-PUB-08	PVC Pressure Pipe Tapping Guide
NSF/ANSI – 61-G	Drinking Water System Components--Health Effects
PPI TR-2	PVC Range Composition Listing of Qualified Ingredients

B. MANUFACTURER REQUIREMENTS

1. All piping shall be made from PVC compound having a minimum cell classification of 12454 per ASTM D1784.

C. FUSION TECHNICIAN REQUIREMENTS

1. Fusion technician shall be qualified by the pipe supplier to install FPVC pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

D. SPECIFIED FUSION PROCESS AND PIPE SUPPLIERS

1. The pipe fusion joining process shall be that of Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.

2. The pipe manufacturers shall be fully experienced, reputable, and qualified in the manufacture of FPVC products for Underground Solutions, Inc., Poway, CA, (858) 679-9551. FPVC pipe marking shall include either Fusible PVC®, Fusible C900®, or FPVC®.

E. WARRANTY

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.

2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

F. PRE-CONSTRUCTION SUBMITTALS

1. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:

    a. Pipe Size

    b. Dimensionality

    c. Pressure Class or Pressure Rating per applicable standard

    d. Color

    e. Recommended Minimum Bending Radius

    f. Recommended Maximum Safe Pull Force

    g. Fusion technician qualification indicating conformance with this specification

2. The following WORK PLAN AND INFORMATION is required from the contractor and /or horizontal directional drilling Contractor. This WORK PLAN AND INFORMATION shall also be supplied to the pipe supplier upon request:

    a. Work plan for each HDD installation shall include any excavation locations and dimensions, interfering utilities, bore dimensions and locations including bend radii used, and traffic control schematics.

    b. A project safety and contingency plan shall include, but shall not be limited to, drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, water, wastewater and any other subsurface utility in the area.

    c. An HDD schedule identifying daily work hours and working dates for each installation.

G. POST-CONSTRUCTION SUBMITTALS

1. The following is required from the contractor and/ or fusion provider to the owner or pipe supplier upon request:

    a. Approved datalogger device reports

    b. Fusion joint documentation containing the following information:

        i. Pipe Size (Diameter) and Wall Thickness

        ii. Fusion Machine Size (Make & Model Number)

        iii. Fusion Technician Identification

        iv. Job Identification (Name, location & project number)

v. Fusion Joint Number

vi. Fusion, Heating, Cool Down and Drag Pressure Settings

vii. Heat Plate Temperature

viii. Time Stamp

ix. Fusion Heating and Cool Down Time

x. Ambient Temperature and Weather Conditions

c. As-recorded Information

i. The as-recorded plan and profile will reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.

ii. All fittings, valves, or other appurtenances will also be referenced and shown.

iii. A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

PART 2 – PRODUCTS

2.01 FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE FOR POTABLE WATER, RECLAIMED WATER, AND WASTEWATER

A. FPVC pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785, as applicable. Testing shall be in accordance with the test methods provided or referenced in the applicable pipe standard.

B. FPVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and without any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe unless specified for connections with appurtenances or for connections at the fusible pipeline termination locations.

C. FPVC pipe shall be manufactured in a standard 40-FT or 45-FT nominal length, or custom lengths as specified.

D. FPVC pipe for potable water use shall be blue in color.

E. Marking on the pipe shall include:

1. Pipe size (nominal diameter)

2. PVC:

a. Pipe Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule (SCH).

b. AWWA pressure class, or ASTM pressure rating, as applicable.

c. Designation of the applicable AWWA or ASTM standard, (e.g., “AWWA C900”).

d. Extrusion production-record code.

e. Trademark or trade name.

f. Cell Classification 12454 and/ or PVC material designation code 1120 may also be included.

g. NSF-61-G (designating suitability for potable water service, including the lead-free requirements of the Safe Drinking Water Act) on all potable water pipe.

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.02 FUSION JOINTS

A. Unless otherwise specified, FPVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

2.03 CONNECTIONS AND FITTINGS

A. DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

1. Acceptable fittings for use with FPVC pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

2. Connections to FPVC pipe shall be made using a restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.

3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

B. PVC GASKETED, PUSH-ON FITTINGS

1. Fittings for use with FPVC pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C907.

2. Fittings for use joining FPVC pipe with other sections of FPVC pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the construction documents.

3. PVC gasketed, push-on fittings and mechanical restraints, if used, shall be installed per the manufacturer's guidelines.

C. FUSIBLE POLYVINYL CHLORIDE (PVC) SWEEPS OR BENDS

1. FPVC sweeps or bends shall be manufactured from the same FPVC pipe being used for the installation and be of the same sizing convention, diameter, wall thickness and pressure class of the pipe being joined using the sweep or bend.

2. FPVC sweeps or bends shall have at least two feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. Unless otherwise specified, there shall be no gasketed connections utilized with a FPVC sweep.

3. Standard FPVC sweep or bend angles shall not be greater than 22.5 degrees, and unless otherwise specified, shall be used in nominal diameters ranging from 4-inch through 16-inch.

D. SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe.

2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

E. EXPANSION AND FLEXIBLE COUPLINGS

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

F. CONNECTION HARDWARE

1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.04 DRILLING SYSTEM EQUIPMENT

A. GENERAL

1. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All required equipment shall be included in the emergency and contingency plan as submitted per these specifications.

B. DRILLING RIG

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.

2. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.

3. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.

C. DRILL HEAD

1. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.

2. The system must be able to control the depth and direction of the drilling operation.

3. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

D. DRILLING FLUID SYSTEM

1. DRILLING FLUID (DRILLING MUD)

   a. Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s).

   b. The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.

   c. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).

   d. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.

   e. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.

2. MIXING SYSTEM

   a. A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.

   b. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.

   c. The mixing system shall continually agitate the drilling fluid during drilling operations.

3. DRILLING FLUID DELIVERY AND RECOVERY SYSTEM

   a. The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.

   b. The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.

   c. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.

   d. A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.

E. DRILLING CONTROL SYSTEM

1. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.

2. The drilling head shall be remotely steer-able by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions:

    a. Offset from the baseline,

    b. Distance along the baseline, and

    c. Depth of cover.

3. Point of rotation of the head shall also be monitored.

4. For gravity application and on-grade drilling, sonde/beacon or approved equipment applicable for grade increments of 0.1 percent shall be used.

2.05 PIPE PULL HEADS

A. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.

B. Pipe pull heads shall be specifically designed for use with FPVC pipe, and shall be as recommended by the pipe supplier.

2.06 PIPE ROLLERS

A. Pipe rollers, if used, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.

B. A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and excessive sagging of the product pipe.

PART 3 – EXECUTION

3.01 DELIVERY AND OFF-LOADING

A. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.

B. Each pipe shipment shall be inspected for damage and to determine if the load has shifted prior to unloading. The owner or engineer shall be notified immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, and type.

C. Pipe should be loaded, off-loaded, and otherwise handled following all of the pipe supplier's guidelines.

D. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

E. During off-loading and handling, care shall be taken to avoid the pipe striking hard objects. Significant impact could cause damage, particularly during cold weather.

F. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.02 HANDLING AND STORAGE

A. Visibly damaged pipe sections, or sections with suspected damage shall be cut out and removed. Cutting shall be performed per the pipe supplier's recommendations.

B. Any scratch or gouge greater than 10 percent of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.

C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

E. If pipe is to be stored for periods of one year or longer, the pipe should be shielded from direct sunlight. The pipe cover should be opaque and provide for adequate air circulation above and around the pipe to prevent excess heat accumulation.

F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

3.03 FUSION PROCESS

A. GENERAL

1. FPVC pipe will be handled in a safe manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.

2. FPVC pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

a. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.

b. CARRIAGE – Carriage shall travel smoothly with no binding at low pressure. Jaws shall be in good condition with proper and clean inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

c. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, hydraulic leaks or potential safety issues prior to fusion.

d. DATA LOGGING DEVICE – An approved, fully functional datalogging device, with the current version of the pipe supplier's software shall be used. Datalogging device operations and maintenance manual shall be kept with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to

extend battery life.

5. Other equipment specifically required for the fusion process shall include the following:

    a. Pipe rollers shall be used for support of pipe to either side of the machine

    b. An infrared (IR) pyrometer, with an accuracy of 1 percent or better, for checking pipe and heat plate temperatures.

    c. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

    d. Facing blades specifically designed for cutting FPVC pipe shall be used.

    e. For fusion in inclement weather, and/or windy conditions; a weather protection canopy with sides that allow full machine motion of the heat plate, fusion assembly and carriage shall be provided per the pipe supplier's recommendations. When the pipe temperature is below 40°F, the pipe supplier's cold weather operating procedures shall be followed.

B. JOINT RECORDING

1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine hydraulic system. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of FPVC pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Required data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.04 DRILLING OPERATIONS

A. GENERAL

1. Bore path and alignment are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the contract documents.

2. Bend radii shown in the contract documents are minimum allowable radii and shall not be reduced.

B. LOCATION AND PROTECTION OF UNDERGROUND UTILITIES

1. Correct location of all underground utilities that may impact the HDD installation is the responsibility of the Contractor, regardless of any locations shown on the drawings or previous surveys completed.

2. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.

3. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of HDD installation as determined for the project specific site conditions. It is the Contractor and HDD system operator's responsibility to determine this envelope of safe offset from existing utilities. This will include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.

C. SITE LOCATION PREPARATION

1. Work site as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made

2. Contractor shall confine all activities to designated work areas.

D. DRILLING LAYOUT AND TOLERANCES

1. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.

2. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.

3. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.

E. PILOT HOLE BORE

1. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.

2. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.

F. REAMING

1. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed. The following table is offered as an estimated guide:

Nominal Pipe Diameter	**Bore Hole Diameter**
< 8 inches	Pipe Dia. + 4 inches
8 inches to 24 inches	Pipe Dia. x 1.5
> 24 inches	Pipe Dia. + 12 inches

2. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.

3. In the event of a drilling fluid fracture, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.

3.05 PIPE PULL-BACK AND INSERTION

A. Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.

B. Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier's minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced.

C. The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.

   1. The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.

   2. The FPVC pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.

   3. A swivel shall be used between the reaming head and the FPVC pipe to minimize torsion stress on the pipe assembly.

D. Buoyancy modification shall be at the sole discretion of the Contractor, and shall not exceed the pipe supplier's guidelines in regards to maximum pull force or minimum bend radius of the pipe. Damage caused by buoyancy modifications shall be the responsibility of the Contractor.

E. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.

F. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, or movement and distortion of surface features. Any damages caused by the Contractor's operations shall be corrected by the Contractor.

G. Pneumatic hammer shall not be used to dislodge a stuck pipe.

3.06 INSTALLATION CLEANUP

A. Following the installation, the project site shall be returned to a condition as required in the construction documents. All excavations will be backfilled and compacted per the construction documents and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards. All drilling fluid shall be properly disposed of per these specifications and all applicable jurisdictional laws.

B. Contractor shall verify that all utilities, structures, and surface features in the immediate project area are sound.

3.07 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

A. Prior to making connections into existing piping systems, the contractor shall:

   1. Field verify location, size, piping material, and piping system of the existing pipe.

   2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, mechanical restraints, tees, or others as shown in the construction documents.

   3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.08 PIPE SYSTEM CONNECTIONS

A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

B. If possible, pipe installed via HDD shall be filled with water prior to making any connections to the existing system or other portions of the project.

3.09 TAPPING FOR POTABLE AND NON-POTABLE PRESSURE WATER APPLICATIONS

A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per UNI-PUB-08, "PVC Pressure Pipe Tapping Guide."

B. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

C. Equipment used for tapping shall be made specifically for tapping PVC pipe:

1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' and drill bits made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.

2. Manually operated or power operated drilling machines may be used.

D. Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

3.10 TESTING

A. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

B. HYDROSTATIC TESTING AND LEAKAGE TESTING FOR FPVC PRESSURE PIPING

1. For water main, see Section 02400 of these Specifications

2. For force main, see Section 02580 of these Specifications.

C. INTERMEDIATE TESTING

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer. Testing of each HDD installation prior to connection to the system or other piping is preferred.

3.11 DISINFECTION OF POTABLE WATER PIPING

1. For water main disinfection, see Section 02400 of these Specifications.

END OF SECTION 02600

PART 1- GENERAL

1.01 SCOPE OF WORK

A. Description of scope and intent:
1. Contractor shall provide all material, labor, and tools required to complete the installation of specified system.
2. Any omission of reference to items required to complete the full operational and functional system specified in the section does not relieve the Contractor of the obligation to provide same.
3. To provide installation of all items, including delivery, dispersing to the proper locations within the building, and affixing in place.
4. Installation shall be accomplished by workers skilled in their craft that will perform their work in a professional manner and will leave the premises safe, orderly and clean.
5. Drawings and general provisions of Contract, including EJCDC General and Supplemental Conditions and Division 1 Specification Sections, apply to this Section.
6. Contractor is responsible for coordination of work included in this specification with all other specification sections related to furnishing of all materials, labor, permits, fees and services necessary for completion of work in this section.

B. Section Includes:
1. Formwork for cast in place concrete, with shoring, bracing, and anchorage.
2. Formwork accessories.
3. Form stripping.
4. Reinforcing steel for cast in place concrete.
5. Grout.
6. Cast in place concrete, including concrete for the following:
   a. Foundations, footings.
   b. Slabs on grade.
   c. Supported slabs.
   d. Foundation and structural walls.
   e. Equipment pads and bases.
7. Concrete curing.
8. Shoring and reshoring.

1.02 REFERENCES

A. All referenced standards refer to the edition in force at the time these plans and Specifications are issued for bidding.
1. AASHTO M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf; American Association of State Highway and Transportation Officials.
2. ACI 117 Standard Tolerances for Concrete Construction and Materials; American Concrete Institute.
3. ACI 201.2R Guide to Durable Concrete; American Concrete Institute.
4. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute.
5. ACI 214 Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
6. ACI 301 Specifications for Structural Concrete for Buildings; American Concrete Institute.
7. ACI 302.1R Guide for Concrete Floor and Slab Construction; American Concrete Institute.

8. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute.
9. ACI 305R Hot Weather Concreting; American Concrete Institute.
10. ACI 306R Cold Weather Concreting; American Concrete Institute.
11. ACI 318 Building Code Requirements for Reinforced Concrete; American Concrete Institute.
12. ACI 347R Guide to Formwork for Concrete; American Concrete Institute.
13. ACI 350 Concrete Sanitary Engineer Structures.
14. ACI SP 66 ACI Detailing Manual; American Concrete Institute.
15. ASTM A185 Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
16. ASTM A615 Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
17. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
18. ASTM C33 Standard Specification for Concrete Aggregates.
19. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
20. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
21. ASTM C94 Standard Specification for Ready Mixed Concrete.
22. ASTM C143 Standard Test Method for Slump of Hydraulic Cement Concrete.
23. ASTM C150 Standard Specification for Portland Cement.
24. ASTM C171 Standard Specifications for Sheet Materials for Curing Concrete.
25. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete.
26. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
27. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
28. ASTM C260 Standard Specifications for Air Entraining Admixtures for Concrete.
29. ASTM C494 Standard Specifications for Chemical Admixtures for Concrete.
30. ASTM C618 Standard Specifications for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
31. ASTM C685 Standard Specifications for Concrete Made by Volumetric Batching and Continuous Mixing.
32. ASTM C881 Standard Specification for Epoxy Resin Base Bonding Systems for Concrete.
33. ASTM C1059 Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
34. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink).
35. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
36. ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
37. ASTM E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.
38. ASTM 329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
39. CRSI Manual of Standard Practice; Concrete Reinforcing Steel Institute.
40. Florida Building Code – FBC

1.03 DEFINITIONS

A. Unexposed Finish: A general use finish, with no appearance criteria, applicable to all formed concrete concealed from view after completion of construction.

B. Exposed Finish: A general use finish applicable to all formed concrete exposed to view except those indicated to receive textured finish, and including surfaces which may receive a paint coating (if any).

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data for the following:
   1. Formwork accessories.
   2. Form liners.
   3. Concrete admixtures.
   4. Grout.
   5. Bonding compound.
   6. Epoxy bonding system

B. Aggregates: Submit test reports showing compliance with specified quality and gradation.

C. Shop Drawings: Submit shop drawings for fabrication and placement of the following:
   1. Reinforcement: Comply with ACI SP 66. Include bar schedules, diagrams of bent bars, arrangement of concrete reinforcement, and splices.
      a. Show construction joints.
      b. Include details of reinforcement at openings through concrete structures.
      c. Include elevations of reinforcement in walls.
      d. Show stirrup spacing.
      e. Concrete embedments.
   2. Shoring and reshoring for elevated concrete placement shall include:
      a. Location, size, and type of all shoring members.
      b. Location, size, and type of all reshoring members.
      c. Location, size, and type of all mud sills, blocking, temporary lateral bracing and other accessories necessary to safely support and brace the structure during construction.
      d. Prepare shop drawings under seal of Professional Structural Engineer registered in the state of Florida.

D. Quality Control Submittals: Submit the following information related to quality assurance requirements specified:
   1. Design data: Submit proposed mix designs and test data before concrete operations begin. Identify for each mix submitted the method by which proportions have been selected.
      a. For mix designs based on trial mixtures, include trial mix proportions, test results, and graphical analysis and show required average compressive strength f(cr).
      b. Indicate quantity of each ingredient per cubic yard of concrete.
      c. Indicate type and quantity of admixtures proposed or required.
   2. Test reports: Submit laboratory test reports for all testing specified.
   3. Certifications: Submit affidavits from an independent testing agency certifying that all materials furnished under this section conform to specifications.
   4. Certifications: Provide certification from manufacturers of concrete admixtures that chloride content complies with specified requirements.

5. Certifications: Submit mill test certificates for all reinforcing steel furnished under this section, showing physical and chemical analysis.
6. Placement schedule: Submit concrete placement schedule prior to start of any concrete placement operations. Include location of all joints indicated on drawings, plus anticipated construction joints.
7. Submit batch tickets complying with ASTM C685 or delivery tickets complying with ASTM C94, as applicable, for each load of concrete used in the work.
    a. Include on the tickets the additional information specified in the ASTM document.
8. Cold weather concreting: Submit description of planned protective measures.
9. Hot weather concreting: Submit description of planned protective measures.

1.05 QUALITY ASSURANCE

A. Codes and Standards: Comply with the following documents, except where requirements of the contract documents or of governing codes and governing authorities are more stringent:
    1. ACI 301
    2. ACI 318
    3. ACI 350
    4. CRSI Manual of Standard Practice.

B. Testing Agency Services:
    1. Employ, at Contractor's expense, an independent testing agency acceptable to the DESIGN BUILDER to perform specified tests and other services required for quality assurance.
        a. Testing agency shall meet ASTM E329 requirements.

C. Source of Materials: Obtain materials of each type from same source for the entire project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcement to project site bundled and tagged with metal tags indicating bar size, lengths, and other data corresponding to information shown on placement drawings.
    1. Concrete reinforcement materials stored on the site shall be kept on concrete blocks and supported off the ground to prevent damage and accumulation of water, dirt, or rust.

B. Store cementitious materials in a dry, weather tight location. Maintain accurate records of shipment and use.

C. Store aggregates to permit free drainage and to avoid contamination with deleterious matter or other aggregates. When stockpiled on ground, discard bottom 6 inches of pile.

D. Handle aggregates to avoid segregation.

1.07 PROJECT CONDITIONS

A. Cold Weather Concreting: Comply fully with the recommendations of ACI 306.
    1. Well in advance of proposed concreting operations, advise the Engineer of planned protective measures including but not limited to heating of materials, heated enclosures, and insulating blankets.

B. Hot Weather Concreting: Comply fully with the recommendations of ACI 05R.
   1. Well in advance of proposed concreting operations, advise the Engineer of planned protective measures including but not limited to cooling of materials before or during mixing, placement during evening to dawn hours, fogging during finishing and curing, shading, and windbreaks.

PART 2- PRODUCTS

2.01 FORMWORK

A. Facing Materials:
   1. Unexposed finish concrete: Any standard form materials that produce structurally sound concrete.
   2. Exposed finish concrete: Materials selected to offer optimum smooth, stain free final appearance and minimum number of joints. Provide materials with sufficient strength to resist hydrostatic head without bow or deflection in excess of allowable tolerances.
   3. Textured finish concrete: Materials or linings as indicated on the drawings, or as required to match Engineer's control sample.

B. Formwork Accessories:
   1. Form coating: Form release agent that will not adversely affect concrete surfaces or prevent subsequent application of concrete coatings.
   2. Metal ties: Commercially manufactured types; cone snap ties, taper removable bolt, or other type which will leave no metal closer than 1-1/2 inches from surface of concrete when forms are removed, leaving not more than a 1 inch diameter hole in concrete surface.
   3. Fillets: Wood or plastic fillets for chamfered corners, in maximum lengths possible.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: Provide deformed bars complying with the following, except where otherwise indicated:
   1. ASTM A615, Grade 60.

B. Welded Wire Fabric: ASTM A185, cold drawn steel, plain.

C. Reinforcing Accessories:
   1. Tie wire: Black annealed type, 16 1/2 gage or heavier.
   2. Supports: Bar supports conforming to specifications of CRSI "Manual of Standard Practice."
      a. Class 1 (plastic protected) at all formed surfaces which will be exposed to weather.
      b. Class 1 (plastic protected) or Class 2 (stainless steel protected) at all formed surfaces which will be exposed to view but not to weather.
      c. Precast concrete blocks of strength equal to or greater than specified strength of concrete or Class 3 supports equipped with sand plates, where concrete will be cast against earth. Concrete masonry units will not be accepted.

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, and as follows:
   1. Type I, except where other type is specifically permitted or required.

2. Type II shall be used for moderate sulfate resistance conditions, retaining walls and exposed concrete not included in Type V below and when hot weather concreting is required.
3. Type III shall be used for high early strength and when cold weather concreting is required.
4. Type IV shall be used for low heat of hydration when mass concreting is required.
5. Type V shall be used for high sulfate resistance conditions, all environmental and all water or wastewater liquid retaining structures (includes all wet well surfaces). (An alternate Type V cement mixture shall be a Type I/II. The Contractor shall submit the Type I/II cement for review, concrete mix design where the Type I/II was utilized and 30 concrete break test results of where the Type I/II cement was implemented).

B. Fly Ash: ASTM C618, Type C or F.

C. Water: ASTM C1602, Potable.

D. Aggregates:
1. Normal weight concrete: ASTM C33.
   a. Class 5M.
   b. Gradation as specified below under mix design.

E. Admixtures General: Admixtures which result in more than 0.1 percent of soluble chloride ions by weight of cement are prohibited.

F. Air Entraining Admixture: ASTM C 260 and certified by manufacturer for compatibility with other mix components.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
   a. “Air Mix"; The Euclid Chemical Company.
   b. “Sika Aer"; Sika Corporation.
   c. “Micro Air"; Master Builders, Inc.
   d. “Darex AEA"; W. R. Grace & Co.

G. Water-Reducing Admixtures: ASTM C494, Type A.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
   a. "MasterPozzolith"; BASF Corporation.
   b. “MasterPolyheed”; BASF Corporation.
   c. Approved equal

H. Accelerating Admixtures: ASTM C494, Type C.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
   a. “MasterSet FP 20”; BASF Corporation.
   b. “MasterSet AC 534”; BASF Corporation.
   c. Approved equal

I. Water Reducing, Retarding Admixture: ASTM C 494, Type D.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
   a. “MasterSet R” Series; BASF Corporation.
   b. “MasterSet DELVO” Series; BASF Corporation.
   c. "Eucon Retarder 75"; The Euclid Chemical Company.

d. "WRDA 60"; GCP Applied Technologies
e. "Plastiment"; Sika Corporation.

J. Water Reducing and Accelerating Admixtures: ASTM C494, Type E.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
a. “Accelguard 80"; The Euclid Chemical Company.
b. “Pozzutec 20"; Master Builders, Inc.
c. “Gilco Accelerator"; Cormix Construction Chemicals.

K. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
a. "ADVA 140M"; GCP Applied Technologies
b. "Eucon 37"; The Euclid Chemical Company.
c. "MasterRheobuild 1000"; BASF Corporation.
d. “MasterGlenium” Series; BASF Corporation.

L. Workability-Retaining Admixtures: ASTM C494, Type S.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those acceptable:
a. “MasterSure Z 60”; BASF Corporation.
b. Approved equal.

M. Shrinkage-Reducing Admixtures: ASTM C494, Type S.
1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
a. “MasterLife SRA” Series; BASF Corporation.
b. “MasterLife CRA 007”; BASF Corporation.
c. Approved equal.

N. Corrosion-Inhibiting Admixtures:
1. Shall be a nominal 30 percent solution of calcium nitrite or an amine/ester-based organic corrosion-inhibiting admixture.
2. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
a. “MasterLife CI 30”; BASF Corporation.
b. “MasterLife CI 222”; BASF Corporation.
c. Approved equal.

O. Permeability-Reducing Admixtures: ASTM C494, Type S.
1. Shall be a portland cement-based crystalline capillary waterproofing admixture that reacts in concrete to form non-soluble crystalline hydration products in the capillary pores of the concrete.
2. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
a. “MasterLife 300D”; BASF Corporation.
b. Approved equal.

2.04 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Vapor Retarder: Membrane for installation beneath slabs on grade, resistant to decay when tested in accordance with ASTM E 154, and as follows:

1. Polyethylene sheet, not less than 8 mils thick.

B. Nonshrink Grout: ASTM C1107.
   1. Minimum 4000 psi grout compressive strength
   2. Type: Provide nonmetallic type only.
   3. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
      a. Nonmetallic type:
         1) “Masterflow 928"; Master Builders, Inc.
         2) “Euco N S Grout"; The Euclid Chemical Company.
         3) “Five Star Grout"; Five Star Products, Inc.

C. Burlap: AASHTO M182, Class 2 jute or kenaf cloth.

D. Moisture Retaining Cover: ASTM C171, and as follows:
   1. Curing paper.
   2. Plyethylene film.
   3. White burlap polyethylene sheeting.

E. Bonding Compound: Non redispersable acrylic bonding admixture, ASTM C1059, Type II.
   1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
      a. “Everbond"; L & M Construction Chemicals, Inc.
      b. “Flex Con"; The Euclid Chemical Company.

F. Epoxy Bonding Systems: Epoxy adhesive for bonding fresh concrete to hardened concrete and for grouting wall pipes, bolts and reinforcing dowels. ASTM C881; type, grade, and class as required for project conditions.
   1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
      a. "MasterEmaco ADH" Series; BASF Corporation.
      b. "Sikadur 32 Hi-Mod"; Sika Corporation
      c. "Euco #452 Epoxy System"; The Euclid Chemical Company
      d. Five Star Epoxy Grout.

G. Expansion Joint Filler
   1. Expansion Joint Filler shall be performed non-extruding and resilient type meeting the Specifications of ASTM D1751, or D1752, unless otherwise specified.
   2. All expansion joints in base slabs on grade other than hydraulic structures shall be fiber expansion joints of required slab depth meeting the requirement of ASTM D1751, Type I and AASHTO M213. Exposed joints shall be sealed as specified below.
   3. All expansion joints in hydraulic structures shall be ¾ inch sponge rubber expansion joints of required wall thickness meeting the requirements of ASTM D1752, Type I and AASHTO M153, Type I. Joints shall be sealed on both sides as specified below.
      a. Nonextruding bituminous type: ASTM D1751.
      b. Sponge rubber type: ASTM D1752, Type I.

H. Expansion Joint Sealer
   1. Joint sealants for hydraulic structures shall be one of the following, or approved equal:
      a. The sealant shall be “Tammsflex NS” by the Euclid Chemical Company or “Duoflex NS” by Sika Chemical Company. Joint width should be 4 times the

expected joint movement, but not less than ¼ inch. All joints shall be primed with “Tammsflex” Primer by the Euclid Chemical Company or “Duoflex 5050” by Sika Chemical Company.

I. PVC Waterstops
1. PVC (polyvinyl chloride) waterstops shall be manufactured from all virgin materials and shall meet or exceed the requirements of U.S. Corps of Engineer’s Specification CRD-C-572. Waterstops shall be ribbed with a center bulb as manufactured by Greenstreak Plastic Products, Vinylex Corporation, or Vulcan Metal Products.
2. The dimensions of the waterstops shall be as shown on the Drawings.
3. Splicing of the PVC waterstops shall be done with a special thermostatically controlled splicer, furnished by the manufacturer, and shall be done strictly in accordance with the manufacturer's instructions.

2.05 CONCRETE MIX DESIGN

A. Review: Do not begin concrete operations until proposed mix has been reviewed by the Engineer.

B. Proportioning of Normal Weight Concrete: Comply with recommendations of ACI 211.1.

C. Required Average Strength: Establish the required average strength f(cr) of the design mix on the basis of trial mixtures as specified in ACI 301, and proportion mixes accordingly. Employ an independent testing agency acceptable to the Engineer for preparing and reporting proposed mix design.

D. Proportion normal-weight concrete mix to produce an average strength at 28 day as follows unless otherwise indicated on the drawings:
1. Columns, beams, walls, footings and slabs: 4000 psi
2. Masonry Filled Grout: 3000 psi
3. Prestressed and precast elements: 5000 psi

E. Fly Ash:
1. The Contractor may elect to replace a portion of the Portland cement with fly ash up to a maximum of 25 percent by weight of cement plus fly ash.

F. Admixtures:
1. Air entraining admixture: Add at rate to achieve specified air content.
a. Do not use in slabs on grade scheduled to receive topping, unless manufacturer of topping recommends use over air entrained concrete.
2. Water reducing and retarding admixture: Add as required in concrete mixes to be placed at ambient temperatures above 90 degrees F.
3. Water reducing and accelerating admixture: Add as required in concrete mixes to be placed at ambient temperatures below 50 degrees F.
4. High range water reducing admixture (superplasticizer): Add as required for placement and workability.
5. Do not use admixtures not specified or approved.

G. Design mix to meet or exceed each requirement specified. Where more than one criterion is specified, the most stringent shall apply. For example, a minimum cement content or maximum water cement ratio might result in strengths greater than the minimum specified; likewise, a greater cement content or lower water cement ratio may be required in order to achieve the required strength.

1. Specified compressive strength f'(c) (ASTM C 39): As noted
2. Maximum water cement ratio by weight:
   a. 0.4 for concrete toppings subject to traffic
   b. 0.45 for all other concrete
3. Maximum slump: As recommended in ACI 211.1. and ACI 350 as applicable.
4. Gradation of coarse aggregate: ASTM C 33 standard gradation with maximum nominal size of 3/4 inches.
5. Total air content (ASTM C 173 or ASTM C 231): 5 percent.

H. Mix Adjustments: Provided that no additional expense to OWNER is involved, Contractor may submit for Engineer's approval requests for adjustment to approved concrete mixes when circumstances such as changed project conditions, weather, or unfavorable test results occur. Include laboratory test data substantiating specified properties with mix adjustment requests.

2.06 CONTROL OF MIX IN THE FIELD

A. Slump: A tolerance of up to 1 inch above that specified will be permitted for 1 batch in 5 consecutive batches tested. Concrete of lower slump than that specified may be used, provided proper placing and consolidation is obtained.
   1. If slump upon arrival at the site is lower than 1 inch below the value specified, one addition of water in accordance with ASTM C 94 will be permitted to bring slump within tolerance, provided that:
      a. A positive means is available to measure the amount of water added at the site.
      b. The specified (or approved) maximum water cement ratio is not exceeded.
      c. Not more than 45 minutes have elapsed since batching.

B. Total Air Content: A tolerance of plus or minus 1 1/2 percent of that specified will be allowed for field measurements.

C. Do not use batches that exceed tolerances.

2.07 CONCRETE MIXING

A. On Site Equipment: Mix concrete materials in appropriate drum type batch machine mixer, in compliance with ASTM C685. Mix each batch minimum of 1.5 minutes and maximum of 5 minutes before discharging concrete. Clean thoroughly at end of day and before changing concrete type.

B. Transit Mixers: Mix concrete materials in transit mixers, complying with requirements of ASTM C94.
   1. At ambient temperatures of 85 to 90 degrees F, reduce mixing and delivery time to 75 minutes.
   2. At ambient temperatures above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3- EXECUTION

3.01 CONCRETE FORM PREPARATION

A. General: Comply with requirements of ACI 301 for formwork, and as herein specified. The Contractor is responsible for the design, Engineering, and construction of formwork, and for

its timely removal.

B. Earth Forms: Hand trim bottoms and sides of earth forms to profiles indicated on the drawings. Remove loose dirt before placing concrete.

C. Design: Design and fabricate forms for easy removal, without impact, shock, or damage to concrete surfaces or other portions of the work. Design to support all applied loads until concrete is adequately cured, within allowable tolerances and deflection limits.

D. Construction: Construct and brace formwork to accurately achieve end results required by contract documents, with all elements properly located and free of distortion. Provide for necessary openings, inserts, anchorages, and other features shown or otherwise required.
   1. Joints: Minimize form joints and make watertight to prevent leakage of concrete.
      a. Align joints symmetrically at exposed conditions.
   2. Chamfers: Provide chamfered edges and corners at exposed locations, unless specifically indicated otherwise on the drawings.
   3. Permanent openings: Provide openings to accommodate work of other trades, sized and located accurately. Securely support items built into forms; provide additional bracing at openings and discontinuities in formwork.
   4. Temporary openings: Provide temporary openings for cleaning and inspection in most inconspicuous locations at base of forms, closed with tight fitting panels designed to minimize appearance of joints in finished concrete work.

E. Tolerances for Formed Surfaces: Comply with minimum tolerances established in ACI 117, unless more stringent requirements are indicated on the drawings.

F. Release Agent: Provide either form materials with factory applied non-absorptive liner or field applied form coating. If field applied coating is employed, thoroughly clean and recondition formwork and reapply coating before each use. Rust on form surfaces is unacceptable.

3.02 VAPOR RETARDER INSTALLATION

A. General: Place vapor retarder sheet over prepared base material, aligning longer dimension parallel to direction of pour and lapped 6 inches. Seal joints with appropriate tape. Cover with sand to depth shown on drawings.

3.03 PLACING REINFORCEMENT

A. General: Comply with requirements of ACI 301 and as herein specified.

B. Preparation: Clean reinforcement of loose rust and mill scale, soil, and other materials which adversely affect bond with concrete.

C. Placement: Place reinforcement to achieve not less than minimum concrete coverages required for protection. Accurately position, support, and secure reinforcement against displacement. Provide Class B tension lap splices complying with ACI 318 unless otherwise indicated. Do not field bend partially embedded bars unless otherwise indicated or approved.
   1. Use approved bar supports and tie wire, as required. Set wire ties to avoid contact with or penetration of exposed concrete surfaces. Tack welding of reinforcing is not permitted.
   2. Wire fabric: Install in maximum lengths possible, lapping adjoining pieces not less

than one full mesh. Offset end laps to prevent continuous laps in either direction, and splice laps with tie wire.

D. Welding: Welding of reinforcement is not permitted.

3.04 JOINT CONSTRUCTION

A. Construction Joints: Locate and install construction joints as indicated on drawings. If construction joints are not indicated, locate in manner which will not impair strength and will have least impact on appearance, as acceptable to the Engineer. Construction joints in retaining walls and walls of concrete tanks or structures subject to hydrostatic pressure shall be intentionally roughened to a full amplitude of approximately ¼ inch.
   1. Keyways: Provide keyways not less than 1 1/2 inches deep.
   2. Reinforcement: Continue reinforcement across and perpendicular to construction joints, unless details specifically indicate otherwise.

B. Isolation Joints: Construct isolation joints in slabs poured on grade at points of contact with vertical components, such as foundation walls and column pedestals. Install expansion joint filler to full concrete depth. Recess top edge of filler 1/8 inch where joints are unsealed.

C. Expansion Joints: Construct expansion joints where indicated. Install expansion joint filler to full depth of concrete. Recess edge of filler to depth indicated to receive joint sealant and backer rod as specified herein and detailed on drawings.

D. Control Joints: Construct contraction joints in building slabs poured on grade to form panels of sizes indicated on drawings, but not more than 20 feet apart in either direction.
   1. Saw cuts: Form control joints by means of saw cuts one fourth the depth of the slab, performed as soon as possible after slab finishing without dislodging aggregate.

3.05 INSTALLATION OF EMBEDDED ITEMS

A. General: Set anchorage devices and other items required for other work connected to or supported by cast in place concrete, using templates, setting drawings, and instructions from suppliers of items to be embedded.
   1. Edge Forms and Screeds: Set edge forms and intermediate screeds as necessary to achieve final elevations indicated for finished slab surfaces.

3.06 WATERSTOPS

A. Waterstops shall be provided at all joints to seal off leakage of liquid from or into concrete tanks or structures subject to hydrostatic pressures. The type of waterstops used shall be as shown on the Drawings and as specified herein. The Contractor shall submit to the Engineer for approval the proposed procedure and schedule of Contractor's concrete placing operations along with a detailed layout of the waterstop materials required showing sizes, lengths and types of joints.

B. Where required for proper location of waterstops, whether shown on the Drawings or not, starter walls of up to 1-1/2 inches in height and monolithic with slabs shall be provided at all wall construction joints. Reinforcing steel shall not be depressed at waterstops, but shall have only the amount of concrete covering shown or specified. Starter walls as specified shall be required whether shown on the Drawings or not, unless specified concrete cover over reinforcing steel is 3 inches or greater.

3.07 CONCRETE PLACEMENT

A. Preparation: Provide materials necessary to ensure adequate protection of concrete during inclement weather before beginning installation of concrete.

B. Inspection: Before beginning concrete placement, inspect formwork, reinforcing steel, and items to be embedded, verifying that all such work has been completed.
   1. Wood forms: Moisten immediately before placing concrete in locations where form coatings are not used.

C. Placement General: Comply with requirements of ACI 304 and as follows:
   1. Concreting should be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.
   2. Schedule continuous placement of concrete to prevent the formation of cold joints.
   3. Provide construction joints if concrete for a particular element or component cannot be placed in a continuous operation.
   4. Deposit concrete as close as possible to its final location, to avoid segregation.
   5. Concrete shall be worked around reinforcement and embedded fixtures and into corners of forms.
   6. The following shall be prohibited from use:
      a. Partially hardened concrete.
      b. Contaminated concrete.
      c. Re-tempered concrete.
      d. Re-mixed concrete after initial set has occurred.

D. Placement in Forms: Limit horizontal layers to depths which can be properly consolidated, but in no event greater than 24 inches.
   1. Consolidate concrete by means of mechanical vibrators, inserted vertically in freshly placed concrete in a systematic pattern at close intervals. Penetrate previously placed concrete to ensure that separate concrete layers are knitted together.
   2. Vibrate concrete sufficiently to achieve consistent consolidation without segregation of coarse aggregates.
   3. Do not use vibrators to move concrete laterally.

E. Slab Placement: Schedule continuous placement and consolidation of concrete within planned construction joints.
   1. Thoroughly consolidate concrete without displacing reinforcement or embedded items, using internal vibrators, vibrating screeds, roller pipe screeds, or other means acceptable to Engineer.
   2. Strike off and level concrete slab surfaces, using highway straightedges, darbies, or bull floats before bleed water can collect on surface. Do not work concrete further until finishing operations are commenced.

F. Cold Weather Placement: Comply with recommendations of ACI 306 when air temperatures are expected to drop below 40 degrees F either during concrete placement operations or before concrete has cured.
   1. Do not use frozen or ice laden materials.
   2. Do not place concrete on frozen substrates.

G. Hot Weather Placement: Comply with recommendations of ACI 305R when ambient temperature before, during, or after concrete placement is expected to exceed 90 degrees F or when combinations of high air temperature, low relative humidity, and wind speed are

such that the rate of evaporation from freshly poured concrete would otherwise exceed 0.2 pounds per square foot per hour.

1. Do not add water to approved concrete mixes under hot weather conditions.
2. Provide mixing water at lowest feasible temperature, and provide adequate protection of poured concrete to reduce rate of evaporation.
3. Use fog nozzle to cool formwork and reinforcing steel immediately prior to placing concrete.

3.08 FINISHING FORMED SURFACES

A. Repairs, General: Repair surface defects, including tie holes, immediately after removing formwork.

1. Remove honeycombed areas and other defective concrete down to sound concrete, cutting perpendicular to surface or slightly undercutting. Dampen patch location and area immediately surrounding it prior to applying bonding compound or patching mortar.
2. Before bonding compound has dried, apply patching mixture matching original concrete in materials and mix except for omission of coarse aggregate, and using a blend of white and normal portland cement as necessary to achieve color match. Consolidate thoroughly and strike off slightly higher than surrounding surface.

B. Textured Form Finish: Repair tie holes and patch defective areas to match pattern created by form construction or form liners.

C. Unexposed Form Finish: Repair tie holes and patch defective areas. Rub down or chip off fins or other raised areas exceeding ¼-inch height.

D. Exposed Form Finish: Repair and patch defective areas, with fins or other projections completely removed and smoothed.

1. Smooth rubbed finish: Apply to surfaces indicated no later than 24 hours after form removal.
   a. Wet concrete surfaces to be finished and rub with Carborundum brick or other abrasive until uniform color and texture are achieved.
   b. Do not apply separate grout mixture.
2. Contiguous unformed surfaces: Strike smooth and float to a similar texture tops of walls, horizontal offsets, and other unformed surfaces adjacent to or contiguous with formed surfaces. Continue final finish of formed surfaces across unformed surfaces, unless otherwise specifically indicated.

3.09 FINISHING SLABS

A. Finishing Operations General:

1. Do not directly apply water to slab surface or dust with cement.
2. Use hand or powered equipment only as recommended in ACI 302.1R.
3. Screeding: Strike off to required grade and within surface tolerances indicated. Verify conformance to surface tolerances. Correct deficiencies while concrete is still plastic.
4. Bull Floating: Immediately following screeding, bull float or darby before bleed water appears to eliminate ridges, fill in voids, and embed coarse aggregate. Recheck and correct surface tolerances.
5. Do not perform subsequent finishing until excess moisture or bleed water has disappeared and concrete will support either foot pressure with less than ¼-inch indentation or weight of power floats without damaging flatness.
6. Final floating: Float to embed coarse aggregate, to eliminate ridges, to compact

concrete, to consolidate mortar at surface, and to achieve uniform, sandy texture. Recheck and correct surface tolerances.

B. Coordinate appearance and texture of required final finishes with the Engineer before application.
   1. Apply final finishes in the locations indicated on the drawings.

C. Float Finish: As specified above.

D. Broomed Float Finish: After floating and when water sheen has practically disappeared, apply uniform transverse corrugations approximately 1/16-inch deep, without tearing surface.

E. Slab Surface Tolerances:
   1. Achieve flat, level planes except where grades are indicated. Slope uniformly to drains.
   2. Floated finishes: Depressions between high spots shall not exceed 5/16 inch under a 10-foot straightedge.

F. Repair of Slab Surfaces: Test slab surfaces for smoothness and to verify surface plane to tolerance specified. Repair defects as follows:
   1. High areas: Correct by grinding after concrete has cured for not less than 14 days.
   2. Low areas: Immediately after completion of surface finishing operations, cut out low areas and replace with fresh concrete. Finish repaired areas to blend with adjacent concrete. Proprietary patching compounds may be used when approved by the Engineer.
   3. Crazed or cracked areas: Cut out defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts. Dampen exposed concrete and apply bonding compound. Mix, place, compact, and finish patching concrete to match adjacent concrete.
   4. Isolated cracks and holes: Groove top of cracks and cut out holes not over 1 inch in diameter. Dampen cleaned concrete surfaces and apply bonding compound; place dry pack or proprietary repair compound acceptable to Engineer while bonding compound is still active:
      a. Dry pack mix: One part Portland cement to 2-1/2 parts fine aggregate and enough water as required for handling and placing.
      b. Install patching mixture and consolidate thoroughly, striking off level with and matching surrounding surface. Do not allow patched areas to dry out prematurely.

3.10 CONCRETE CURING AND PROTECTION

A. General:
   1. Prevent premature drying of freshly placed concrete, and protect from excessively cold or hot temperatures until concrete has cured.
   2. Provide curing of concrete by one of the methods listed and as appropriate to service conditions and type of applied finish in each case.

B. Curing Period:
   1. Not less than 7 days for standard cements and mixes.
   2. Not less than 4 days for high early strength concrete using Type III cement.

C. Curing Temperature:
   1. Concrete shall be maintained above 50 degrees F and in moist condition during the entire curing period.

D. Formed Surfaces: Cure formed concrete surfaces by moist curing with forms in place for full curing period.
   1. Keep wooden or metal forms moist when exposed to heat of the sun.
   2. If forms are removed prior to completion of curing process, continue curing by one of the applicable methods specified.

E. Surfaces Not in Contact with Forms:
   1. Start initial curing as soon as free water has disappeared, but before surface is dry.
   2. Keep continuously moist for not less than 3 days by uninterrupted use of any of the following:
      a. Water ponding.
      b. Water saturated sand.
      c. Water fog spray.
      d. Saturated burlap: Provide 4-inch minimum overlap at joints.
   3. Begin final curing procedures immediately following initial curing and before concrete has dried.
      a. Moisture retaining cover: Lap not less than 3-inches at edges and ends, and seal with waterproof tape or adhesive. Repair holes or tears during curing period with same tape or adhesive. Maintain covering in intimate contact with concrete surface. Secure to avoid displacement.
         1) Extend covering past slab edges at least twice the thickness of slab.
         2) Do not use plastic sheeting on surfaces which will be exposed to view when in service.
         3) Continue final curing to end of curing period.

F. Avoid rapid drying at end of curing period.

G. During and following curing period, protect concrete from temperature changes of adjacent air in excess of 5 degrees F per hour and 50 degrees F per 24 hours. Progressively adjust protective measures to provide uniform temperature changes over entire concrete surface.

3.11 SHORES AND SUPPORTS

A. General: Comply with recommendations of ACI 347 for shoring and reshoring in multistory construction.

B. Low Rise Construction: Extend shoring from ground to roof for structures 4 stories or less in height.

C. Reshoring: Remove shores and reshore in a planned sequence, to avoid damage to partly cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

D. Provide as a package, shoring and reshoring drawings prepared by or under the direct supervision of a Specialty Engineer registered in the State of Florida.

3.12 REMOVAL OF FORMS AND SUPPORTS

A. Non Load Bearing Formwork: Provided that concrete has hardened sufficiently that it will

not be damaged, forms not actually supporting weight of concrete or weight of soffit forms may be removed after concrete has cured at not less than 50 degrees F for 24 hours. Maintain curing and protection operations after form removal.

B. Load Bearing Formwork: Do not remove shoring and forms supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, until concrete has attained at least the specified compressive strength f'(c) and until the Contractor has determined that the actual compressive strength attained is adequate to support the weight of the concrete and superimposed loads.

C. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained at least the specified compressive strength f'(c) and until the CONTRACTOR has determined that the actual compressive strength attained is adequate to support the weight of the concrete and superimposed loads.

D. Keep supports in place until heavy loads due to construction operations have been removed.

E. Test field cured specimens to determine potential compressive strength of concrete for specific locations.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Fill in: Fill in holes and openings left in concrete structures for passage of work by other trades after such work is in place. Place such fill in concrete to blend with existing construction, using same mix and curing methods.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as indicated on Drawings. Set anchor bolts at correct elevations, complying with diagrams or templates of equipment manufacturer.
   1. Grout base plates and foundations as indicated with non-shrink grout.
   2. Use nonmetallic grout for exposed conditions, unless otherwise indicated.

C. Reinforced Masonry: Provide concrete grout for reinforced masonry where indicated on Drawings and as scheduled.

3.14 CONCRETE REPAIRS

A. General: Repairs due to poor workmanship shall be made by the Contractor at the Contractor’s expense and shall be approved by the Engineer prior to repair procedure being implicated.

B. Perform cosmetic repairs of concrete surfaces as specified under concrete application.

C. Perform structural repairs with prior approval of the Engineer for method and procedure, using epoxy bonding systems. The Engineer's approval is required for repair methods using materials other than those specified.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Testing Agency Services: Employ at Contractor’s expense an independent testing agency acceptable to the Owner and Engineer to perform the specified tests and other services required for quality assurance as listed below.

B. Composite Sampling, and Making and Curing of Specimens: ASTM C172 and ASTM C31.
   1. Take samples at point of discharge.
   2. For pumped concrete, perform sampling and testing at the frequencies specified herein at point of delivery to pump, and perform additional sampling and testing at the same frequency at discharge from line.
   3. Results obtained at discharge from line shall be used for acceptance of concrete.

C. Slump: ASTM C 143. One test per strength test and additional tests if concrete consistency changes.
   1. Modify sampling to comply with ASTM C94.

D. Air Content of Normal Weight Concrete: ASTM C173 or ASTM C231. One test per strength test performed on air entrained concrete.

E. Concrete Temperature:
   1. Test hourly when air temperature is 40 degrees F or below.
   2. Test hourly when air temperature is 90 degrees F or above.
   3. Test each time a set of strength test specimens is made.

F. Compressive Strength Tests: ASTM C39.
   1. Compression test specimens: Mold and cure one set of 4 standard cylinders for each compressive strength test required.
   2. Testing for acceptance of potential strength of as delivered concrete:
      a. Obtain samples on a statistically sound, random basis.
      b. Minimum frequency:
         1) One set per 100 cubic yards or fraction thereof for each day's pour of each concrete class.
         2) One set per 3500 square feet of slab or wall area or fraction thereof for each day's pour of each concrete class.
         3) When the above testing frequency would provide fewer than 5 strength tests for a given class of concrete during the project, conduct testing from not less than 5 randomly selected batches, or from each batch if fewer than 5.
      c. Test one specimen per set at 7 days for information unless an earlier age is required.
      d. Test 2 specimens per set for acceptance of strength potential; test at 28 days unless other age is specified. The test result shall be the average of the two specimens. If one specimen shows evidence of improper sampling, molding, or testing, the test result shall be the result of the remaining specimen; if both show such evidence, discard the test result and inform the Engineer.
      e. Retain one specimen from each set for later testing, if required.
      f. Strength potential of as delivered concrete will be considered acceptable if all of the following criteria are met:
         1) No individual test result falls below specified compressive strength by more than 500 psi.
         2) Average of any 3 consecutive strength test results equals or exceeds specified compressive strength f'c.
   3. Testing for evaluation of field curing:
      a. Frequency: 1 field set of specimens per strength acceptance test.
      b. Mold specimens from same sample used for strength acceptance tests. Field cure, and test at same age as for strength acceptance tests.
      c. Evaluate construction and curing procedures and implement corrective action

when strength results for field cured specimens are less than 85 percent of test values for companion laboratory cured specimens.

4. Removal of forms or supports: Mold additional specimens and field cure with concrete represented; test to determine strength of concrete at proposed time of form or support removal.

G. Test Results: Testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.
   1. Test reports shall contain the following data:
      a. Project name, number, and other identification.
      b. Name of concrete testing agency.
      c. Date and time of sampling.
      d. Concrete type and class.
      e. Location of concrete batch in the completed work.
      f. All information required by respective ASTM test methods.
   2. Nondestructive testing devices such as impact hammer or sonoscope may be used at Engineer's option for assistance in determining probable concrete strength at various locations or for selecting areas to be cored, but such tests shall not be the sole basis for acceptance or rejection.
   3. The testing agency shall make additional tests of in place concrete as directed by the Engineer when test results indicate that specified strength and other concrete characteristics have not been attained.

H. Water Tightness of Water Containing Walls
   1. All basins and tanks are hydraulic structures and shall be watertight. Each tank or basin shall be filled with water, full depth, prior to backfilling (unless otherwise noted) and kept full 24 hours for observation. The Contractor shall exercise every precaution to secure water tightness by careful mixing and placing of the concrete so as to obtain a homogeneous mixture at maximum density, without air pockets or voids, using the minimum practical amount of water in the mix. Extreme care shall be used to secure continuity of water stops at expansion and construction joints, to seal off holes from wall ties, and when placing concrete about wall sleeves, wall pipes and other obstructions. The Contractor shall fix all leaks. The Contractor shall furnish test water at Contractor's own expense.
   2. All below grade dry structures shall be watertight. Contractor shall fix all leaks.

END OF SECTION 03300

PART 1 – GENERAL

1.01 SCOPE

A. Description of Work

1. The work consists of furnishing all labor, materials, equipment, tools and services necessary to furnish and install all miscellaneous metal items to include hatches, aluminum stairs, railing and other incidental miscellaneous metal items as shown on the Drawings and/or specified herein.

1.02 REFERENCES AND STANDARDS

A. The following references and standards are hereby made a part of this Section and miscellaneous metal work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements or governing rules and regulations.

1. "Code For Arc And Gas Welding In Building Construction" of American Welding Society, AWS D1.0, latest edition with current supplements and addenda.

2. "Specification For Structural Steel Buildings - Allowable Stress Design and Plastic Design" and "Code of Standard Practice" of the AISC.

3. "Metal Bar Grating Manual", published by National Assn. of Architectural Metal Manufacturers (NAAMM).

4. "Metal Stairs Manual" published by National Assn. of Architectural Metal Manufacturers (NAAMM).

5. "Metal Finishes Manual", published by National Assn. of Architectural Metal Manufacturers (NAAMM).

6. Steel Structures Painting Council (SSPC) Surface Preparation Specification (Vol. 2).

7. Aluminum Association Publications:

a. Aluminum Standards and Data

b. Designation System For Aluminum Finishes

c. Standards For Aluminum Sand and Permanent Mold Castings

d. Standards For Anodized Architectural Aluminum

e. Welding Aluminum

f. Care of Aluminum

1.03 SUBMITTALS

A. All submittals shall be made in accordance with Section 01300, SUBMITTALS.

B. Shop Drawings:

1. Shop drawings shall show dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work. Where welded connectors, concrete, or masonry inserts are required to receive work, shop drawings shall show exact locations required, and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts. Catalog work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.

C. Samples:

1. Submit samples of color anodized aluminum work which shall show proposed nominal colors and maximum color ranges as well as texture intended for the project. Such ranges are subject to review of the Engineer.

2. Identify all samples as to pretreatment, anodizing process, alloy, color, and portion of the work to which sample applies.

3. Do not proceed with processing of anodized aluminum until Engineer's review has been obtained.

PART 2 - PRODUCTS

2.01 BASIC MATERIALS AND ACCESSORIES

A. Standard Structural Steel Shapes and Plates: ASTM A36

B. Architectural and Miscellaneous Steel Items: ASTM A283, grade optional

C. Anchor bolts shall conform to "Specification for Low Carbon Steel Externally and Internally Threaded Standard Fasteners" (ASTM A307).

D. Steel Tubing: ASTM A501 (hot formed), welded or seamless

E. Steel Pipe: ASTM A53, Type E or S, Grade A or B

F. Aluminum Items:

1. Aluminum Extrusions

a. Color anodized finish. Alloys specially produced to best achieve the color anodized finish specified

b. Clear anodized finish: 6063 alloy

c. Structural shapes, anchors and clips: 6061 alloy

2. Aluminum Sheet and Plate

a. Color anodized finish: Alloys specially produced to best achieve the color anodized finish specified

b. Clear anodized finish: 6063 alloy

c. Plate used in all process units: Alclad 3003

d. Miscellaneous Plate: 6061

3. Aluminum Castings

a. Anodized finish: 214 alloy

b. Structural castings: 214 or 356 alloy as per strength requirements

G. Stainless Steel Items (unless noted otherwise):

1. AISI Type 302, or Type 304

2. Type 316 shall be provided where indicated.

H. Cast Iron: ASTM A48, Class 30 unless otherwise indicated.

I. Fastenings (General): Furnish all bolts, nuts, screws, clips, washers, and any other fastenings necessary for proper erection of items specified herein.

1. For ferrous metal: Use stainless steel or galvanized on exterior. On interior, match adjacent material.

2. For aluminum: Exposed fasteners shall match adjacent material in color and appearance.

a. Color anodized finish: 6061-T6 alloy

b. Clear anodized finish: 2024 alloy

c. All other fastenings not otherwise specified or noted. 2024 or 6061 alloy except AISI Type 304 or 316 stainless steel shall be used for concealed fasteners and may be used for exposed fasteners if heat tempered to match color of anodized surface.

3. For stainless steel and galvanized structural steel: AISI Type 304 or 316 stainless steel. Unless noted otherwise, exposed screws shall be Phillips flat head, countersunk.

4. For painted structural steel: ASTM A325 high strength bolts, minimum diameter to be 3/4".

J. Welding Electrodes: As permitted by AWS Code D1.0; use E70XX for structural steel.

K. Paint: All painting shall be in accordance with Section 09900 PAINTING.

2.02 MISCELLANEOUS MATERIALS

A. Grout: Nonmetallic, non-corrodible, non-shrink, factory blended and packaged; complying with ASTM C1107; recommended by manufacturer for exterior use.

B. Concrete Inserts: Style as required for application.

C. Fasteners: Use fasteners suitable for the material being fastened and for the type of connection required.

1. For exterior use or built into exterior walls: Nonferrous stainless steel, zinc coated or cadmium plated.

D. Galvanizing Repair Paint: Zinc dust paint complying with SSPC-Paint 20 or MIL P-21035B, Type I or II.

E Shop Primer: Rust-inhibitive, lead and chromate free, low VOC primer, complying with FS TT-P-664, or equivalent.

2.03 SPECIALLY FABRICATED AND CATALOG ITEMS

All metal specialties shall be supplied as detailed and specified on the plan sheets. In the absence of plan details, metal specialties shall comply with the specified requirements herein.

A. Railings:

1. Aluminum Railing (Unless otherwise shown on Drawings)

a. Design Requirements

1.) Aluminum railings as shown on the Drawings shall be component type made to meet the conditions shown and as required to meet the as-built conditions.

2.) Railings shall be an all welded aluminum pipe rail with a 1.9 inch O.D. and minimum wall thickness of .145 inch, rails and posts shall be alloy 6063-T6.

3.) All joints shall be coped, mitered, etc; butt welded and ground smooth. Welding wire shall be Type 40-43 if mill finish. For anodized, use welding wire specified by Aluminum Association for color match. Crystallized joints will not be permitted. Welding requirements are as specified elsewhere in this Section.

4.) Railings shall be designed to meet requirements of OSHA regulations.

5.) Slip joints in handrail and toe plate shall be provided every 20 feet and at structure expansion joints.

6.) Toe plates shall be 6061-T6 aluminum.

7.) Aluminum rail shall have anodized finish.

b. All aluminum rail on walkways, platforms, and miscellaneous walking surfaces where the surface is 4 feet or more above the adjacent ground or walking surface, or as called for on the drawings, shall be furnished with a 4 inch universal extruded aluminum channel toe plate. Toe plate shall be a minimum of 0.09 inch thick with a minimum weight of 0.475 lb/ft. Toe plate shall be attached to an extruded aluminum toe plate bracket located on the post. Bracket shall be a minimum of 0.125 inch thick with a minimum weight of 0.528 lb/ft. Bottom of toe plate shall be 1/4 inch above structure surface.

2. Rail and Post Spacing

a. Post spacing shall not exceed five feet on center.

b. Unless shown otherwise on the drawings, the top rail shall be located at a height of 3 feet-6 inches except as follows:

1.) Stair runs shall have top rail at a height of 2 feet-9 inches.

2.) Enclosed stair landings shall have top rail at a height of 3 feet-6 inches.

3.) Open stair landings shall have top rail at a height of 3 feet-6 inches except that this may be reduced to 3 feet-0 inches when the landing is 4 feet-0 inches or less above any adjacent surface.

c. Intermediate rails shall be located half of height of top rail.

B. Gratings:

1. Aluminum

a. Aluminum grating shall be a plank type grating extruded from aluminum alloy 6063-T6. Plank shall be extruded in 6 inches wide units with integral I-Beam ribs with approximately 3 inches x 5/8 inch cutouts on 4 inch centers between ribs. Top flange of the I-Beam Ribs shall have integral longitudinal ribs. Transverse ribs or an upset pattern along edges of cutouts shall be formed in the grating tread surface to prevent skidding in the longitudinal direction. Six-inch units shall be welded together to form panels of 3 feet width unless shown otherwise on the plans. Banding bars shall be welded to ends and around all openings. Acceptable type is rectangular upset pattern Style B, by IKG Industries, a Division of the Harsco Corporation and Rectangular Upset Punch Pattern Style, as manufactured by Ohio Gratings, Inc., Canton, Ohio, or equal.

b. Aluminum grating frames for embedded concrete applications shall be an extruded frame with continuous ledge to accommodate clips or other fasteners. Acceptable type is by Ohio Gratings, Inc., Canton Ohio, or equal.

c. Grating supported by structural members shall be connected to them using standard clips recessed below top of grating, and using bolted stainless steel fasteners.

C. Metal Stairs and Platforms:

1. Metal stairs and platforms shall conform to requirements of NAAMM "Metal Stairs Manual" where same covers points not otherwise detailed or specified.

a. Grating treads for aluminum stairs shall be aluminum with a cast abrasive nosing. Approved types are by those manufacturers specified in Paragraph 2.03 B, 2, above.

b. For aluminum stairs, treads, stringers and miscellaneous framing members shall be mill finish, unless noted otherwise.

D. Metal Ladders:

1. Aluminum

a. Aluminum ladders shall have 3 inches by 1/2 inch flat bar rails approximately 18 inches apart with one-inch square grooved, non-slip, aluminum bar rungs. Ladders shall be aluminum alloy 6061-T6. All necessary anchor bolts will be stainless steel Type 304 or 316 and furnished with ladder. Provide cages as detailed on the Drawings. Finish to be clear anodized.

b. Support brackets for aluminum ladders shall be as shown on the Drawings.

E. Guards and Metal Nosings:

1. Provide all guards with anchors suitable for construction indicated. Guards set in concrete shall finish flush with adjacent finished surface. Nosings and guards used in various process units shall be hot dipped galvanized.

F. Miscellaneous Structural Steel:

1. Construct to sizes indicated using rolled shapes and/or plates as detailed. Fabricate and erect in accordance with AISC Specifications and standards referenced in Paragraph 1.02.

G. Grab Bars:

1. Bars shall be constructed of 1 inch round aluminum bars of Alloy 6061-T6. Width shall be 16 inches. Bar shall project 6 inches above top of concrete surface and be embedded a minimum of 8 inches into concrete.

H. Stair Nosings:

1. Cast aluminum cross-hatch abrasive "Alumogrit" nosings shall be furnished and installed into concrete stair construction. One nosing for each tread and each landing with welded wing anchor fastener depth of 1 inch, 12 inches O.C. and a minimum of three (3) per tread. Nosing shall be single, one piece 4 inches wide, full width of stair except on exterior concrete steps where nosing is 14 inches less than the full tread width and set centered on the tread 7 inches clear of each end. Threaded fasteners shall be stainless steel. Nosings shall be Wooster Products, Inc., Wooster, Ohio, or equal as follows:

a. Concrete steps with 1 inch sloping concrete risers shall receive Wooster, Model No. 101.

b. Where steel or aluminum stair stringers with steel, aluminum or fiberglass grated treads, with no risers, meet a concrete floor or landing, concrete shall receive Wooster, Model 104, full width of adjacent stair tread.

I. Expansion Bolts:

1. Expansion bolts shall be that type requiring a drilled hole diameter equal to the bolt diameter such as Hilti Inc. "Kwik-Bolt," or equal.

2. All expansion bolts shall be stainless steel, Type 304 or 316.

3. As a condition for approval, certified test results shall be submitted to the Engineer for approval. Tests shall have been conducted on concrete of strength equal to specified strength and a minimum of 4 tests for each diameter anchor shall be submitted. Ultimate loads in shear and tension shall be in excess of 4 times the allowable working loads shown on the Contract Drawings.

J. Anchor Bolts:

1. Anchor bolts shall be as detailed on the Drawings. Bolts, nuts and washers shall be stainless steel.

K. Epoxy Anchors:

1. Epoxy anchors shall be a non-expansion anchor using a 100% solid stress free, two component epoxy anchoring system consisting of a resin and hardener. The resin shall be an amine based material meeting the requirements of ASTM C881.

2. The resin and hardener shall be contained in individual sealed units, premeasured for field installation.

3. Anchor rods shall be threaded and manufactured from Type 304 stainless steel with matching heavy hex nut and washers.

4. The entire system, epoxy, injection tool system and hardware shall be supplied by one manufacturer.

5. Acceptable manufacturer is the Rawl/Sika foil-fast epoxy injection gel system available from the Rawl Plug Company Inc.

6. As a condition for acceptance, certified test results shall be submitted to the Engineer for review. Tests shall have been conducted on concrete of strength equal to specified strength and a minimum of 4 tests for each diameter anchor shall be submitted. Ultimate loads in shear and tension shall be in excess of 4 times the allowable working loads shown on the Drawings.

2.04 ACCESS HATCHES

A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lb/ft^2 with a maximum deflection of 1/150th of the span or AASHTO H20 wheel load if indicated on the plans. Hatches shall have a 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open.

B. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-in drainage coupling to the channel frame. Access hatches shall be sizes as indicated on the Drawings by Bilco Company, New Haven, CT or equal.

2.05 MANHOLE RUNGS

A. Manhole rungs for cast-in-place concrete work shall be 12-3/4-in wide with a drop front design and a serrated step surface and comply with the requirements of OSHA, steel roads encased in polypropylene plastic.

2.06 FINISHES (Except as Otherwise Noted on the Drawings or Specified)

A. Ferrous metals shall be painted in accordance with Section 09900 PAINTING.

B. Exposed Aluminum Items:

1. All aluminum finishing shall conform to requirements and recommendations of the References and Standards previously listed. Where color anodized finishes are required, all finishing shall be done in strict accordance with procedures established by the manufacturer of the alloy.

2. Where more than one color anodized process is utilized on the project for the same desired color and finish, such processes shall be coordinated by the Contractor to achieve matching finishes within the approved range.

3. Commence no finishing operations until all fabrication and forming operations have been completed.

4. Take all precautions necessary to prevent "rack" marks on exposed aluminum surfaces caused by the anodizing process. Where edges of aluminum items are exposed, the finish shall be uniform from face onto such edges.

5. Required finishes are as specified below. Finish designations are those of the Aluminum Association. Pre-anodic finishes (mechanical and/or chemical) shall be applied before application of any anodic treatment.

a. Stair nosings, process items, misc. structural shall have mill finish, Aluminum Assoc. Designation M10.

b. Handrail, toeplate, ladders and cages shall be anodized.

C. All Exposed Fastenings: To match color and finish of adjacent material.

PART 3 – EXECUTION

3.01 CONDITION OF SURFACES

A. Inspect all surfaces to receive miscellaneous metal work and report all defects which would interfere with this installation. Starting work implies acceptance of surfaces as satisfactory.

3.02 WORKMANSHIP

A. General Requirements:

1. Verify all measurements at job.

2. Coordinate all metal work with adjoining work for details of attachment, fittings, etc. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for miscellaneous metal or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.

3. Conceal all fastenings where practical. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.

4. Make all permanent connections in ferrous metal surfaces using welds where at all possible; do not use bolts or screws where they can be avoided.

5. The self-tapping screws or nuts for steel studs holding removable grating shall be snug tight only.

6. Provide all lugs, clips, anchors, and miscellaneous fastenings necessary for the complete assembly and installation.

7. Set all work plumb, true, rigid, and neatly trimmed out. Miter corners and angles of exposed moldings and frames unless otherwise noted.

8. Do all grouting of frames, plates, sills, bolts, and similar items with non-shrink grout.

9. Set all items shown or required to be set in sleeves or cans with epoxy grout. Unless otherwise noted, size sleeves for a minimum ¼-inch clearance all around.

10. All forming operations on aluminum except on painted sheet products, shall be done prior to finishing or anodizing.

11. For expansion and contraction the work shall be so designed and anchored that there will be no objectionable distortion or serious stress of fastenings as the metal expands and contracts.

12. Make all trim in longest lengths possible. Where joints are not otherwise shown, make pieces of equal length or locate joints symmetrically. Fit adjacent pieces with hairline joints and aligned surfaces. Where exposed screws are required, space evenly and symmetrically.

13. Castings subject to foot or street traffic shall have bearing surfaces machined to prevent rocking and rattling.

14. Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.

15. Protect all dissimilar metals from galvanic corrosion by pressure tapes, coatings or isolators as specified herein.

B. Welding:

1. Ferrous Metals

a. Perform all welding in accordance with AWS Code D1.0.

b. Only prequalified welding procedures in accordance with AWS shall be used.

c. Welds shall be made only by operators experienced in performing the type of work indicated.

d. Welds normally exposed to view in the finished work shall be uniformly made and shall be ground smooth.

e. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

2. Aluminum

a. All aluminum welding shall be done by the inert gas shielded arc of fluxless resistance techniques.

b. Welded assemblies to be anodized shall be designed so that laying surfaces are free-rinsing and will not trap anodizing solutions.

c. Where at all possible, welds in assemblies to be anodized shall be located so as to conceal visible discoloration in the heat-affected zone.

d. Where weld metal must be exposed after anodizing, filler alloys shall be selected to closely match the composition of the base metal. Follow parent metal manufacturer's recommendations for such filler alloys.

e. Where weldments are to be made on materials that have been previously anodized, the area of fusion shall be free of the anodic film prior to welding. Parts to be so welded shall be masked during anodizing, or sanded clean in the weld areas. Only weldments that will be concealed may be so made. Crazing or discoloring of the anodic coating in the weld area will not be acceptable in exposed areas.

f. Weldments on exposed finished surfaces shall be ground and/or polished to match and blend with finish of adjacent parent metal.

g. Structural welds shall be made by qualified welders and shall conform to the general recommendations and regulations of the referenced Aluminum Association Publications.

1.) Dirt, grease, lubricant, or other organic material shall be removed by vapor degreasing or suitable solvent.

2.) Joints rejected because of welding defects may be repaired only by rewelding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be used.

h. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

C. Bolted, Screwed, and Riveted Connections:

1. In general, use bolts for field connections only and then only as detailed. Provide washers under all heads and nuts bearing on wood. Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.

2. Where screws must be used for permanent connections in ferrous metal, use flat head type, countersunk, with screw slots filled and finished smooth and flush.

3. Where rivets are used, they shall be machine driven, tight, heads centered, countersunk and finished flush and smooth.

D. Surface Treatment and Protective Coatings:

1. Cleaning

a. Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, hot phosphate treatment or painting. Conditions which are too severe to be removed by hand cleaning methods shall be cleaned as per SSPC "Surface Preparation Specifications," "Solvent Cleaning, SSPC-SP 1-63," "Power Tool Cleaning, SSPC-SP-63," or "Brush-Off Blast Cleaning, SSPC-SP 7-63"; as required.

2. Hot phosphate treatment

a. Conform to SSPC-PT-4.

3. Painting

a. Refer to Section 09900, PAINTING.

4. Galvanizing

a. Conform to ASTM A123 for rolled, pressed and forged shapes, plates, bar and strip; A153 for hardware items and A386 for assembled steel products. Conform to ASTM A384 and A385 (Recommended Practices)

pertaining to galvanizing assembled steel products. Unless otherwise permitted, do all galvanizing after fabrication, in largest sections practicable. Where galvanizing is removed by welding or other assembly procedure, touch-up abraded areas with molten zinc or zinc-rich paint.

5. Dissimilar Materials

a. Dissimilar Metals: Where aluminum is placed in contact with or fastened to dissimilar metals (excepting galvanized steel, zinc, or small areas of stainless steel or nickel silver), treat the contact surfaces by one of the following methods. If drainage from dissimilar metals passes over aluminum work, paint the dissimilar metal as specified in paragraph (1) below.

1.) Apply prime coat of zinc chromate primer to the dissimilar metal followed by one or two coats of aluminum metal and masonry paint.

2.) Apply a coat of bituminous paint to the dissimilar metal.
3.) Separate contact surfaces with pressure tape or approved non-absorptive gaskets.

b. Concrete, masonry, and plaster

1.) Where aluminum is placed in contact with, or built with, or will receive drainage from masonry, including lime mortar, concrete, or plaster, apply a clear coat of alkali-resistant lacquer or a heavy coat of bituminous paint, to the aluminum areas affected.

c. Moisture-absorbent materials

1.) Where aluminum is placed in contact with wood or other absorptive materials subject to repeated wetting, or wood treated with a preservative which is not compatible with aluminum, apply two coats of approved aluminum house paint to such materials. Seal joints with non-drying, non-skinning polyisobutylene caulking compound.

d. Uncoated Steel

1.) Paint all uncoated steel items provided as accessories to aluminum work with one heavy coat of rust inhibitive primer.

e. Protection materials applied to architecturally exposed surfaces are subject to review of Engineer.

E. Protection of Surfaces:

1. Protection of work and initial cleaning shall be the responsibility of each installer or erector until the installation is finally completed, whereupon the responsibility for subsequent protection and final cleaning shall pass to the Contractor for the entire project.

2. Protection shall be provided by strippable coating, protective sleeves, polyethylene sheets, boarding, or other suitable means during fabrication, shipment, site storage, and erection to prevent damage to the finished work due to stains, discoloration's, scratches, or any other cause. Damaged elements shall be replaced as damages occur.

3. After installation, and after danger of subsequent damage has passed, remove all protective coverings from all exposed surfaces, and clean those surfaces of all soil and discoloration, ready for acceptance.

END OF SECTION 05500

PART 1 - GENERAL

1.01 SCOPE

A. Description of Work

1. Perform all work necessary and required for completion of the project as indicated. Work includes furnishing all materials and equipment and the application and completion of all painting and painter's finish on all piping and appurtenances as shown and noted on the Drawings and specified herein.

1.02 PRODUCT HANDLING

A. All painting materials shall be delivered to the site in the manufacturer's original containers with labels intact and seals unbroken. They shall be kept in a locked, well-ventilated storage place assigned for this purpose. Receiving, opening, and mixing of all paint materials shall be done in this room. Storage space shall be kept clean and neat. Oily rags shall be removed and disposed of each day, and all other necessary precautions shall be taken to avoid danger of fires.

1.03 ENVIRONMENTAL CONDITIONS

A. Surfaces shall be painted only when they are free from moisture. No painting on exterior surfaces shall be done less than 72 hours of actual drying weather after a rain, nor during periods of dew or fog. Receiving surfaces shall be properly dried before proceeding with the work. No painting shall be done when temperature is below 50 degrees F, except when specifically authorized otherwise in writing by the Engineer. Clear sealer shall not be applied when air temperature is less than 70 Degrees F.

1.04 WORK IN CONFINED SPACES

A. The Contractor shall, when work is located in confined spaces provide and maintain safe working conditions for all employees. Fresh air ventilation shall be provided to continuously remove paint fumes from the confined space through the combined use of existing openings, forced-draft fans and temporary ducts to the outside. Paint fumes shall, if possible, be exhausted to the outside from the lowest level in the confined space. Electrical fan motors shall, if located in the confined space, be explosion proof. No smoking or open fires will be permitted in the confined space.

1.05 COMPATIBILITY OF SHOP AND FIELD PAINTS

A. To insure a satisfactory painting job, it is essential that the paints applied in the shop and in the field be mutually compatible. The shop coats to be applied by others shall be suitable for the field coats to be applied under this Contract.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The paints and paint products of the *Tnemec Company, Inc.,* mentioned in the following specifications are set as standards of quality. The "or engineer approved equal" clause shall apply. No request for substitution will be considered which decreases the film thickness and/ or the number of coats to be applied, or which offers a change from the generic type of coating specified. Request for substitution shall contain the following:

1. FULL NAME OF EACH PRODUCT

2. DESCRIPTIVE LITERATURE
3. DIRECTIONS FOR USE
4. GENERIC TYPE
5. NON VOLATILE CONTENT BY VOLUME
6. PERFORMANCE DATA LISTED IN SECTION 2.03.

B. Bidders desiring to use coating materials other than those specified shall submit their proposal based on the specified materials. Submittals shall include a side by side comparison of the performance attributes of the proposed materials as compared to the specified coatings. In no case will the request be considered unless all information is received, in writing, ten days prior to the bid opening date.

C. Products of other manufacturers may be acceptable provided that they meet the generic type of material specified and the performance requirements outline in Section 2.03 of these specifications.

2.02 SUBSTITUTIONS

A. Comply with the General Conditions, and the requirements of Section 2.01 and Section 2.03 when requesting substitutions.

B. Obtain review prior to purchase and delivery.

2.03 COATING MATERIALS

A. Tnemec Series 1 Omnithane
1. Generic Type: NSF Approved Aromatic Moisture Cured Urethane Primer
2. Special Qualifications: Certified in accordance with NSF/ANSI std 61 for potable water applications.
3. Performance Criteria
a. Adhesion: ASTM D4541.
b. Humidity: ASTM D4585. 5,000 hours exposure.
c. Salt Spray (Fog): ASTM B117. 10,250 hours exposure
d. Impact: ASTM D2794.

B. Tnemec Series 22 Epoxoline
1. Generic Type: Polyamide Epoxy
2. Performance Criteria:
a. Abrasion; ASTM D4060, (CS-17 Wheel, 1,000 grams load, 1,000 cycles):
b. Adhesion: ASTM D4541 (Elcometer):
c. Immersion: ASTM D870. 7 years
d. Exterior Exposure (45 degrees facing south): 6 years
e. Humidity: ASTM D4585. 4,500 hours exposure.
f. Salt Spray (Fog): ASTM B117: 10,000 hours exposure.
g. Moisture Vapor Transmission: ASTM D1653
h. Prohesion: ASTM G85. 5,000 hours.

2.04 MIXING AND TINTING

A. Deliver paints and enamels ready-mixed to job site except epoxies.

B. Mix only in mixing pails placed in suitably sized non-ferrous or oxide resistant metal pans.

C. Use tinting colors recommended by manufacturer for the specific type of finish.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Paragraph 3.02, PREPARATION OF SURFACES.

B. Do not proceed with surface preparation or coating application until conditions are suitable.

3.02 PREPARATION OF SURFACES

A. Steel Surfaces

1. Remove any oil or grease from surfaces to be coated by solvent cleaning in accordance with Steel Structures Painting Council Specification SP 1-65. Any chemical contamination shall be eliminated by means of neutralization or flushing or both prior to additional surface preparation.

2. For immersion service, all sharp edges and welds shall be ground smooth to a rounded contour and all weld splatter shall be removed prior to sandblasting.

3. For non-immersion service, all sharp edges and welds shall be ground and all weld splatter shall be removed prior to sandblasting.

4. For immersion service, all surfaces to be coated shall be sandblasted to white metal in accordance with Steel Structures Painting Council Specification SP 5-63 or National Association of Corrosion Engineers Specification NACE No. 1 unless otherwise stated in the coating manufacturer's most recent printed Application Instructions or material shall be pickled in accordance with SP-8-63.

5. For non-immersion or intermittent service in a moist area or wherever specified in the coating manufacturer's most recent printed Application Instructions for other services, all surfaces to be coated shall be sandblasted to a finish near white in accordance with Steel Structures Painting Council Specifications SP 10-63 or National Association of Corrosion Engineers Specification NACE No. 2.

6. For non-immersion service, or wherever specified in the coating manufacturer's most recent printed Application Instructions, all surfaces to be coated shall be sandblasted to a commercial sandblast in accordance with Steel Structures Painting Council Specification SP 6-63 or National Association of Corrosion Engineers Specification NACE No. 3.

7. Steel surfaces previously exposed to sulfides shall be sandblasted, flame cleaned, and sandblasted again in accordance with the recommended surface preparation for the particular service in question.

8. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon as possible after the blasting preparation is finished and always before the surface starts to rust. No sandblasted surface shall stand overnight before coating.

3.03 APPLICATION

A. General Requirements

1. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

    a. Test with moisture meter

2. Apply paint, enamel, stain and varnish with suitable brushes, rollers, or spraying equipment.

    a. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved less ten percent allowance.

    b. Keep brushes, rollers and spraying equipment clean, dry, free from contaminates and suitable for the finish required.

    c. Apply stain by brush.

3. Comply with recommendations of product manufacturer for drying time between succeeding coats.

4. Where possible, vary slightly the color of successive coats.

5. Sand and dust between each coat to remove defects visible from a distance of 5 feet.

6. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints, and skipped or missed areas.

    a. Finished metal surface shall be free of skips, voids or pinholes in any coat when tested with a low voltage detector.

7. Inspection

    a. Do not apply additional coats until completed coat has been inspected by the Engineer.

    b. Only inspected coats of paint will be considered in determining number of coats applied.

8. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

9. Make edge of paint adjoining other materials or colors clean and sharp with no overlapping.

10. Apply primer on all work before glazing.

11. Change colors at doors where colors differ between adjoining spaces or rooms and where door frames match wall colors.

12. Refinish whole wall where portion of finish has been damaged or is not acceptable.

13. Hardware, trim and other items shall be removed as required for proper application of coatings.

14. Field Touch-Up Painting:

a. Prior to applying finish coats of paint, areas where prime coat has been damaged shall be sanded smooth and touched up with the same primer applied at the shop.

b. Remove rust before above specified touch-up is applied.

c. Touch-up shall not be obvious.

B. Painted Work

1. Back prime all exterior woodwork with oil base primer.
2. Runs on face not permitted.

C. All painting of tank walls to elevations indicated shall be taped to provide straight level edge.

3.04 CLEANING

A. Remove spilled, splashed, or splattered paint from all surfaces.

B. Do not mar surface finish of item being cleaned.

C. Leave storage space clean and in condition required for equivalent spaces in project.

D. Oily rags, waste, etc., shall be removed at end of each working day.

3.05 PAINTING SCHEDULE

A. Standard Color Schedule

1. The following color scheme in pipe painting is recommended for purposes of standardization:

a. Potable water: Blue
b. Sewage: Green

2. In situations where two colors do not have sufficient contrast to easily differentiate between them, a six inch band of contrasting color shall be placed on one of the pipes at approximately 30 inch intervals.

END OF SECTION 09900