

T200411209.01

APPENDIX A – SUSSEX COUNTY TECHNICAL SPECIFICATIONS

The following Technical Specifications are included as referenced in Supplemental Condition 711501 Sanitary Sewer System:

- 01050 Field Services
- 01106 Construction Scheduling, Coordination and Sequencing
- 01300 Submittals
- 01740 Warranties and Bonds
- 02731 Forcemains and Appurtenances

SECTION 01050

FIELD SERVICES

PARAGRAPH INDEX

Page No.

PART 1 - GENERAL

1.01	Description	01050-1
1.02	Qualifications of Surveyor or Engineer	01050-1
1.03	Survey Reference Points	01050-2
1.04	Project Survey Requirements	01050-2
1.05	Records	01050-2
1.06	Submittals	01050-3
1.07	Record Documents	01050-3

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01050

FIELD SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

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

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

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

1.03 SURVEY REFERENCE POINTS

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

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

1.04 PROJECT SURVEY REQUIREMENTS

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

1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.

- B. Surveys for Record Drawings. A copy of all survey information shall be submitted in an electronic format AutoCAD 2012™ (.DWG).

1.06 SUBMITTALS

- A. Submit name and address of Surveyor and professional engineer to the Engineer.
- B. On request of the Engineer, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or surveyor, licensed in the State of Delaware, certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.
- D. Submit drawings showing locations of all structures constructed. This drawing shall be included with the project record documents.
- E. Submit cut sheets for all gravity sewers and forcemains 4-inches and greater to the Project Engineer for review. Cut sheets shall include all required invert and rim information, indicate the applicable vertical datum and benchmark used, and be signed and sealed by Qualified engineer or registered land surveyor registered in the State of Delaware. All invert information shall be provided at a minimum 50' interval. For gravity sewers, one cutsheet shall be provided per manhole run.

1.07 RECORD DOCUMENTS

- A. All work shall be measured, by the CONTRACTOR, during installation and before covering and backfilling. All measurements shall be referenced to project vertical datum and stationing shown on the drawings. All measurements will be recorded and kept current until completion of the Work. Such measurement records shall be transmitted to the ENGINEER to check requests for payment. The Contractor shall field survey inverts for installed gravity sewer pipelines and submit the results along with the payment request for that particular section of sewer. All field measurements for all forcemain record documents shall be updated each month and shall also be submitted with the payment request for that particular section of forcemain. The surveys shall indicate the pipeline in question has been installed in accordance with the Contract Documents.
- B. CONTRACTOR shall be responsible for recording, keeping and monitoring Record Drawings of work constructed in the field. Record Drawings will be kept on hand in the CONTRACTOR's field office for inspection by the ENGINEER. Two sets of initial draft Record Drawings shall be issued to the ENGINEER no later than 14-days from the date of substantial completion.

C. After restoration and substantial completion, the CONTRACTOR shall field survey, and record on the drawings the following information:

1. Gravity Sewers

All rim and invert elevations and stationing for all manholes, gravity sewers, gravity sewer extensions for future connections and laterals. There shall be at a station and offset shown on the Record Drawings to locate each lateral clean out. This station and offset shall be provided directly adjacent to the cleanout for each individual cleanout. All gravity sewer record drawing information must be provided in plan. Tabular forms of record drawing information is not permitted. All surveys shall be performed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR. CONTRACTOR shall deliver complete Record Drawings to OWNER for review and approval prior to Final Completion.

2. Forcemains

All forcemain inverts at valves, fittings, and every 100' stations. Field measurements off of existing utility poles, edge of pavement or other permanent structures shall be provided. There shall be at least two measurements shown on the Record Drawings to locate each valve and bend. All valve and toning wire box locations shall be surveyed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR.

3. Pump Stations

Dimensions for all finished concrete pads with locations of equipment shall also be provided along with record drawings of control and electrical cabinets. Permanent monuments will be set by the OWNER after construction is complete. All forcemain and sewer inverts into and out of station wetwell and the top of wetwell elevation shall be surveyed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01106

CONSTRUCTION SCHEDULING, COORDINATION AND SEQUENCING

PARAGRAPH INDEX

Page No.

PART 1 - GENERAL

1.01	General Requirements	01106 - 1
1.02	Facility Shutdowns	01106 - 2
1.03	Temporary Pumping	01106 - 3
1.04	Coordination	01106 - 3

PART 2 - PRODUCTS **Not used.**

PART 3 - EXECUTION **Not used.**

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SECTION 01106

CONSTRUCTION SCHEDULING, COORDINATION AND SEQUENCING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Construction work under this contract shall have the least amount of interferences with the operations of the various facilities.
- B. All operations of valves and gates required to perform the work shall be done by the Owner. The Owner or his designated agent shall be informed in writing at least 24 hours, or longer where specified, in advance of the need to operate valves or gates or other actions which could affect facility operations.
- C. To achieve reliable, continuous facilities operation, all new facilities shall be tested and in operating condition before final tie-ins are made which connect new facilities to existing facilities.
- D. The Contractor shall submit to the Engineer, drawings showing details of all temporary connections or facilities as required.
- E. When removing a facility from service, the Contractor shall allow the facility to drain naturally or be pumped to its lowest level. All remaining fluids shall be removed by the Contractor at his expense. Solids shall be disposed of off-site by the Contractor at his expense. Disposal of these solids must be in accordance with federal, state and local codes.
- F. There may be other Contractors working at these facilities at the same time. The Contractor shall schedule and perform his work in a manner that shall not interfere or delay the performance of other Contractors or consultants engaged in other County projects. If the Contractor becomes aware of any circumstances whereby the Project shall adversely affect any other project on site or vice versa, he will immediately notify the Engineer and indicate what actions, if any, are needed to coordinate the work of the various projects.
- G. No extra payment shall be made for any labor, materials, tools, equipment or temporary facilities required during the construction of facilities. All costs therefore shall be considered to have been included in the price bid of the Proposal.

1.02 FACILITY SHUTDOWNS

- A. Complete facility shutdown without supplemental services to maintain facility operation are not permitted. Individual facilities may be taken out of service for replacement but must be complete and put back into service before another back-up facility or other piece of equipment is removed from service. Temporary shutdown periods (periods without supplemental services to maintain facility operation) shall not extend more than 4 hours.
- B. Scheduled shut down, temporary shutdown and coordination of supplemental services to maintain facility operation shall be mutually agreed upon by the Owner and the Contractor, with the Engineer's approval.
- C. In order to reduce each shutdown period to a minimum, the Contractor shall, prior to each shutdown request, expedite completion of the work to the fullest extent. The Contractor shall have completed all necessary preparatory work including testing and shall have adequate personnel available to keep each shutdown period to a minimum. All equipment and materials required to complete the work during a shutdown period shall be on the job site before the shutdown is commenced.
- D. The Contractor shall carefully coordinate all work and schedules and shall provide the Owner and Engineer with 10 calendar days minimum written notice prior to each shutdown period, unless otherwise approved by the Owner.
- E. Prior to each shutdown period, the Contractor shall submit to the Engineer and Owner in writing, detailed descriptions and schedules of the proposed construction procedures during the shutdown period. Information submitted to the Engineer shall include a complete inventory of materials and equipment needed to perform the work. No shutdown of a facility or operation will be permitted until the Engineer has reviewed and approved, in writing, the proposed construction plans and procedures.
- F. If, during any temporary shutdown periods, the work performed is not satisfactory, as planned, or not completed with the maximum time allocated, the Owner may order the Contractor to place the facility or operation back in service and reschedule the work, or he may order the work required to place the facility or operation back in service to be performed with other forces.
- G. During scheduled shut downs the Contractor shall be responsible for all damages and costs thereof due to negligence and failure to maintain supplemental services.

1.03 TEMPORARY PUMPING

- A. The Contractor shall be responsible for maintaining the continuous operation of existing facilities and shall be responsible for damages caused by the overflows due to his negligence. The Contractor shall protect the temporary pumps and appurtenances from vandalism.
- B. The Owner and Engineer shall consider alternative methods suggested by the Contractor which are believed to accomplish the intended goals of the bypass pumping. In the event the Owner and Engineer do not accept the Contractor's proposed alternative methods, the construction sequence outlined herein must be followed by the Contractor, at no increase in contract cost or time.
- C. The Contractor shall submit to the Owner and Engineer, detailed equipment, controls and facility configuration data for approval prior to shut-down scheduling.
- D. The Contractor shall provide temporary pumping units, if necessary, with all necessary piping, hoses, valves, controls and power. The type and style of the temporary pumping units shall be of the Contractor's choosing with approval by the Owner. Pumping equipment shall be suitable for intended service. Method of pump drive source shall be of the Contractor's choosing with approval by the Owner, but the Contractor must maintain continuous operation of the facilities. The Contractor shall provide and maintain all necessary appurtenances such as temporary power or fuel at no additional cost to the Contract.
- E. The pumps shall be provided with automatic controls to start and stop the pumps and maintain existing maximum pumping rates. As a minimum, pump controls shall include level control floats providing alarm and control features, automatic alternation and auxiliary power. Complete redundancy shall be provided for the Temporary Pumping System. The Contractor shall coordinate with the Owner in **installing and maintaining an alarm indication** that will communicate to the Sussex County SCADA system. Said alarm shall monitor all necessary points to prevent an overflow condition. All alarms will be transmitted directly to the Contractor's cell phone. The Contractor shall be solely responsible for responding to and making any correcting the alarm condition. The Contractor's response time to the site shall not exceed 30 minutes. A list of emergency contacts shall be supplied to the county for 24 hours a day 7 days a week response.

1.04 COORDINATION

- A. Contractor, Subcontractors and Owner Personnel

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

B. Subcontractors

1. Where the work of any subcontractor will be installed in close proximity to work of other subcontractors, or where there is evidence that the work of any subcontractor will interfere with the work of other subcontractors, the Contractor shall work out space allocations to make a satisfactory adjustment. If so ordered by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1/4 inch equals 1 foot, clearly showing how work is to be installed in relation to the work of others. If the Contractor permits any work to be installed before coordinating with the various subcontractors; or so as to cause interference with work of other subcontractors, he shall make necessary changes in the work to correct the condition without extra cost to the Owner.
2. The Contractor shall arrange that each subcontractor determines the location, size and arrangement of all chases and openings and shall establish clearances in concealed spaces required for the proper installation of its work and shall see that such are provided.

PART 2 - PRODUCTS Not used.

PART 3 - EXECUTION Not used.

END OF SECTION

SECTION 01300

SUBMITTALS

PARAGRAPH INDEX

Page No.

PART 1 - GENERAL

1.01	General	01300-1
1.02	Types of Submittals	01300-2
1.03	Procedure for Submittals	01300-2
1.04	Contractor's Responsibility	01300-2
1.05	Engineer's Review of Shop Drawings	01300-4
1.06	Shop Drawings	01300-5
1.07	Samples	01300-7
1.08	Manufacturer's List	01300-8
1.09	Operating and Maintenance Instructional Periods	01300-8
1.10	Operation and Maintenance Manuals for Equipment and Products	01300-8
1.11	Manufacturers Certificates	01300-11
1.12	Mix Designs	01300-12
1.13	Design Calculations	01300-12
1.14	Mill Test Reports	01300-12
1.15	Record Drawings	01300-12
Form A	Equipment Registration	01300-13
Form B	Parts List	01300-14
Form C	Maintenance Procedures Sheet	01300-15

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SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall submit to the Engineer for review and approval such shop drawings, test reports and product data on materials and equipment (hereinafter in this article called data), and material samples (hereinafter in this article called samples) as are required for the proper control of work, including but not limited to those shop drawings product data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.
- B. Within thirty (30) days after the effective date of the Agreement, the Contractor shall submit to the Engineer a complete list of preliminary data on items for which Shop Drawings are to be submitted. Included in this list shall be the names of all proposed manufacturers furnishing specified items. Review of this list by the Engineer shall in no way expressed or implied relieve the Contractor from submitting complete Shop Drawings and providing materials, equipment, etc., fully in accordance with the Specifications. The procedure is required in order to expedite final review of Shop Drawings.
- C. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:
 1. Submittal-Description and Number assigned.
 2. Date to Engineer.
 3. Date returned to Contractor (from Engineer).
 4. Status of Submittal (Approved, Approved as Noted, Revise and Return, Rejected).
 5. Date of Resubmittal and Return (as applicable).
 6. Date material release (for fabrication).
 7. Projected date of fabrication.
 8. Projected date of delivery to site.
 9. Status of O&M manuals submittal.
 10. Specification Section.
 11. Drawings Sheet Number.

1.02 TYPES OF SUBMITTALS

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

1.03 PROCEDURE FOR SUBMITTALS

- A. General
 - 1. Except where specifically stated otherwise all submittals shall be made to the Engineer for his approval. Submittals of all but administrative data shall be made in at least seven (7) copies. Four copies of the submittal will be retained by the Engineer / Owner and the other copies returned to the Contractor. Submittals shall be complete for each component of work or system and shall include all inter-related portions of a system. At the completion of the project, the Contractor shall furnish the Engineer one revised record copy as described in Paragraph 1.06.
 - 2. Administrative data shall be submitted in triplicate (3 copies).

1.04 CONTRACTOR'S RESPONSIBILITY

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

- C. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with Specifications.

- D. The Contractor shall furnish the Engineer a schedule of Shop Drawings submittals fixing the respective dates for the submission of shop drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment. This schedule shall indicate those submittals that are critical to the progress schedule.

- E. The Contractor shall ensure that no work is begun on any item of work requiring an approved submittal until such approval is obtained.

- F. The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned marked "REVISE AND RETURN / AMEND AND RESUBMIT" OR "REJECTED" until a revision or correction thereof has been reviewed and returned to him, by the Engineer, with approval.

- G. One approved copy of all submittals shall be held by the Contractor at the construction site.

- H. Each submittal shall be assigned a sequential number by the Contractor, for purposes of easy identification, and shall retain its assigned number with appropriate subscript, on required resubmissions. The assigned number shall consist of the Contract Number, followed by the specification section number where the item is specified, followed by a sequential number indicating the number of submittals in that Section (e.g., BV-03300-11 is the 11th separate submittal for items specified in Section 03300). Resubmittals shall be identified with the same number as the original submittal, followed by the subscript R1, R2, etc. All products and materials submitted shall be clearly identified with the appropriate equipment name and number as it appears in the Contract Document.

- I. The Contractor shall submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than 30 calendar days for reviewing and appropriate action from the time the Engineer receives them.

- J. All submittals shall be accompanied with a transmittal letter prepared in triplicate containing the following information:
 - 1. Date.
 - 2. Project Title and Number.
 - 3. Contractor's name and address.

4. The Number of each Shop Drawing, Project Data, and Sample submitted.
 5. Notification of Deviations from Contract Documents.
 6. Submittal Log Number conforming to Specification Section Numbers.
- K. The Contractor shall submit a minimum of seven (7) copies of shop drawing submittals to the Engineer, four of which will not be returned to the Contractor.
- L. The Contractor shall be responsible for and bear all costs of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by Engineer of the necessary Shop Drawings.
- M. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposed to supply both as pertains to his work and any work affected under other parts, heading, or divisions of drawings and specifications at no cost to the Owner.

1.05 ENGINEER'S REVIEW OF SHOP DRAWINGS

- A. The Engineer's review of drawings, data and samples submitted by the Contractor will be only for conformance with the design concept of the Project and for general compliance with the information given in the Contract Documents. The Engineer's review and approval will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown.
- B. The review of drawings and schedules will be general, and shall not be construed:
1. as permitting any departure from the Contract requirements;
 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
 4. as approving Contractor's means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto.
- C. If the drawings or schedules as submitted describe variations and show departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in

Contract Price or time for performance, the Engineer may return the reviewed drawings without noting and exception.

- D. When reviewed by the Engineer, each of the Shop Drawings will be identified as having received such review being so stamped and dated. Shop Drawings stamped "AMEND AND RESUBMIT" and with required corrections shown will be returned to the Contractor for correction and resubmittal.
- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by the Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.
- F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.
- G. Shop drawings and submittal data shall be reviewed by the ENGINEER for each original submittal and first resubmittal; thereafter review time for subsequent resubmittals will be charged to the CONTRACTOR at the rate of \$75 per hour.
- H. When the Shop Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items for:
 - 1. Systems
 - 2. Processes
 - 3. As indicated in specific specifications sections.

1.06 SHOP DRAWINGS

- A. When used in the Contract Documents, the term "Shop Drawings" shall be all drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a Supplier and

submitted by Contractor to illustrate material or equipment for some portion of the Work.

- B. Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data shall be CLEARLY MARKED TO IDENTIFY PERTINENT MATERIALS, PRODUCT OR MODELS. Delete information which is not applicable to the Work by striking or cross-hatching.
- C. Drawings and schedules shall be checked and coordinated with the work of all trades involved, before they are submitted for review by the Engineer and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.
- D. Each Shop Drawing shall have a blank area 3-1/2 inches by 3-1/2 inches, located adjacent to the title block. The title block shall display the following:
 - 1. Project Title and Number
 - 2. Name of project building or structure
 - 3. Number and title of the shop drawing
 - 4. Date of shop drawing or revision
 - 5. Name of contractor and subcontractor submitting drawing
 - 6. Supplier/manufacturer.
 - 7. Separate detailer when pertinent
 - 8. Specification title and number
 - 9. Specification section
 - 10. Application Contract Drawing Number
- E. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the CONTRACTOR SHALL DESCRIBE SUCH VARIATIONS IN HIS LETTER OF TRANSMITTAL. The transmittal letter shall delineate compliance and exceptions taken to Specifications and Contract Drawings. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been reviewed.
- F. Data on materials and equipment include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.

- G. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.
- H. All manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Engineer along with the required shop drawings. The installation list shall include at least five installations where similar equipment has been installed and has been in operation for a period of at least one (1) year.
- I. Only the Engineer will utilize the color "red" in marking Shop Drawing submittals.
- J. Before the final payment is made, the Contractor shall furnish to Engineer one (1) set of record shop drawings all clearly revised, complete and up to date showing the permanent construction as actually made for all reinforcing and structural steel, miscellaneous metals, process and mechanical equipment, yard piping, electrical system and instrumentation system.

1.07 SAMPLES

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

(Samples of finished materials shall have additional marking that will identify them under the finished schedules).

- D. The Contractor shall prepare a transmittal letter in triplicate for each shipment of samples containing the information required in subparagraph 1.04J above. He shall enclose a copy of this letter with the shipment and send a copy of this letter to the Engineer. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be constructed to change or modify any Contract requirements.

1.08 MANUFACTURER'S LIST

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

1.09 OPERATING AND MAINTENANCE INSTRUCTIONAL PERIODS

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

1.10 OPERATION AND MAINTENANCE MANUALS FOR EQUIPMENT AND PRODUCTS

A. General:

1. The Contractor shall furnish Operation and Maintenance Manuals for all products and equipment provided under this Contract.
2. Prior to completion of the work, and at least 30 days prior to the 50 percent payment, the Contractor shall furnish for the Engineer's review three (3) Operation and Maintenance Manual draft copies.

3. Prior to completion of the work, and at least 60 days prior the 85 percent payment, the Contractor shall furnish for the Engineer's review three copies of the final Operation and Maintenance Manual. The final manual must be approved by the Engineer before a final inspection of the work will be conducted, and prior to the issuance of the Certificate of Substantial Completion.

B. Manual Preparation:

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

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

- i. Instructions with easily understood schematics or diagrams for disassembling and assembling the equipment for overhaul or repair.
 - j. The Contractor shall complete the three Forms A, B and C entitled "Equipment Registration, Parts List, and Maintenance Procedures Sheet" for each piece of equipment furnished under the contract. These forms shall be included in the Operations and Maintenance Manual at the proper place. Example Forms A, B and C are included at the end of this section.
2. All items listed above that are of a sheet size of 8-1/2 inches by 11 inches or can be folded (no more than twice) to this size shall be bound in 4-inch maximum loose-leaf three-ring d-post type binders with black plastic-coated covers. The contents shall be fully indexed. Binders shall be Vernon Line Royal No. R-6372 or R-372, Sparco Brand Slanted Ring Presentation Binder 68140, Universal D-Ring View Binder 20747, K & M Division VS11-40 "or equal". PAGES SHALL BE LINEN REINFORCED ON BINDING EDGE.
 3. Shop Drawings 24 inches by 36 inches in size shall be folded to approximately 12 inches by 9 inches with drawing title box exposed along either edge. Shop Drawings descriptive of a single item of equipment shall be grouped together. All Shop Drawings shall be placed in accordion-type folders similar to File Pocket No. 74CG (9-1/2 inches x 14-3/4 inches) as manufactured by the Cooke and Cobb Company, "or equal", and fully indexed on the outside of the folders in a neat and uniform manner.
 4. All Shop Drawings included in the binders and/or folders shall be those copies previously submitted for review and approval and shall bear the Engineer's stamp of approval and comments as originally noted thereon.

C. Approval:

1. Subsequent to the Engineer's approval and return of the final manual, the Contractor shall submit four complete sets of manuals to the Engineer.

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

1.11 MANUFACTURER'S CERTIFICATES

A. General:

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

B. Manufacturer's Representative:

1. The definition of "manufacturer's representative" shall be as follows: a representative familiar with the actual problems of manufacturing, installing and operating the particular equipment or product and with enough years of experience in this field to determine the successful operation of the equipment or product.
2. As related to his obtaining the manufacturer's certificates, the Contractor shall include in this contract price the cost of furnishing competent and experienced manufacturer's representatives who shall represent the manufacturer on equipment and products furnished and installed under this Contract, to assist the Contractor to install, adjust, start up, and test the equipment and products in conformity with the Contract Documents. After the equipment and products have been operated through the trial period for each phase of construction and

before being put into permanent service the Engineer, such manufacturer's representatives shall make all adjustments and tests required to provide that such equipment and products are in proper and satisfactory.

C. Engineer's Responsibility

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

1.12 MIX DESIGNS

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

1.13 DESIGN CALCULATIONS

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

1.14 MILL TEST REPORTS

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

1.15 RECORD DRAWINGS

The Contractor will keep one copy of all Specifications, Drawings, Addenda, Change Orders and Shop Drawings in the field office at the site, in good order and annotated to show all changes made during the construction process. These shall be available to the Engineer and shall be delivered to him upon completion of the project. If the Contractor fails to maintain the record drawings as required herein, final payment with respect to the Contract as a whole, will be withheld until proper record drawings have been furnished to the Engineer.

FORM A - EQUIPMENT REGISTRATION

EQUIPMENT NAME _____ NUMBER _____

LOCATION _____

MANUFACTURER _____ TELEPHONE _____

ADDRESS _____

SALES REPRESENTATIVE _____ TELEPHONE _____

MANUFACTURER'S MANUAL NUMBER _____

NAME PLATE DATA _____ MOTOR DATA _____

ADDITIONAL EQUIPMENT DATA _____ ADDITIONAL MOTOR DATA _____

CONTRACT NO _____

DRAWING NOS: _____ SPECIFICATION SECTION _____

FORM C- MAINTENANCE PROCEDURES SHEET

No.

EQUIPMENT NAME:

CRAFT

PLANT AREA

LEVEL

LOCATION

MAINTENANCE DESCRIPTION

FREQUENCY

ANNUALLY

SAFETY PRECAUTIONS

TOOLS, PARTS, MATERIALS TEST EQUIPMENT

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

END OF SECTION

SECTION 01740
WARRANTIES AND BONDS

PARAGRAPH INDEX

Page No.

PART 1 - GENERAL

1.01	Description	01740-1
1.02	Submittal Requirements	01740-1
1.03	Form of Submittals	01740-2
1.04	Warranty Submittals Requirements	01740-2

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 DESCRIPTION

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

1.02 SUBMITTAL REQUIREMENTS

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

1.03 FORM OF SUBMITTALS

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

1.04 WARRANTY SUBMITTALS REQUIREMENTS

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for one (1) year, unless otherwise specified, commencing at the time of the completion of the conditional acceptance period.
- B. The Contractor shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under all Divisions and which have at least a 1 hp motor or which lists for more than \$1,000. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's one year warranty period even though certificates of warranty may not be required.
- C. In the event that the equipment manufacturer or supplier is unwilling to provide a one year warranty commencing at the time of the completion of the conditional acceptance period, the Contractor shall obtain from the manufacturer, a two (2) year warranty commencing at the time of equipment delivery to the job site. This two year warranty from the manufacturer shall not relieve the Contractor of the one year warranty starting at the time of the completion of the conditional acceptance period.
- D. All work shall be guaranteed for a period of one year as described in paragraph SC-7.17 of specification section 00800. In addition, all work within Delaware Department of Transportation (DelDOT) and County Sub-division rights-of-way shall have a warranty period of three (3) years, commencing at the time the roads are

accepted by DelDOT. The warranty shall be in the form of a Maintenance Bond which shall represent 15% of the installed pipeline costs (including final pavement restoration) for all pipelines installed within roadways within the rights of ways as described above for a three-year period.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02731

FORCE MAINS AND APPURTENANCES

PARAGRAPH INDEX

		<u>Page No.</u>
PART 1 - GENERAL		
1.01	Description	02731 - 1
1.02	Submittals	02731 - 1
1.03	Manufacturer's Certificates	02731 - 1
1.04	Quality Assurance	02731 - 1
1.05	General Notes - Piping	02731 - 3
1.06	General Notes - Fittings	02731 - 3
1.07	References	02731 - 3
PART 2 - PRODUCTS		
2.01	General	02731 - 5
2.02	Pipe Schedule	02731 - 6
2.03	Ductile Iron Pipe and Fittings	02731 - 6
2.04	PVC Pressure Pipe and Fittings	02731 - 8
2.05	High Density Polyethylene (HDPE) Pressure Pipe and Fittings	02731 - 10
2.06	Fusible PVC Pipe	02731 - 11
2.07	Mechanical Joint/HDPE Adapter	02731 - 11
2.08	Air / Vacuum Combination Valves	02731 - 12
2.09	Pipeline Detection System	02731 - 12
2.10	Concrete Thrust Blocks	02731 - 13
2.11	Valves and Valve Boxes	02731 - 13
2.12	Gate Valves	02731 - 13
2.13	Plug Valves	02731 - 14
PART 3 - EXECUTION		
3.01	Pipe Installation - General	02731 - 16
3.02	Ductile Iron Buried Pipe Installation	02731 - 16
3.03	PVC Pipe Installation	02731 - 17
3.04	HDPE Piping and Fittings	02731 - 18
3.05	Testing of Pipe	02731 - 19
3.06	Testing of Pressure PVC/DIP Pipe	02731 - 19
3.07	Testing of Pressure HDPE Pipe	02731 - 20
3.08	Testing Forcemain Tone Wire	02731 - 21
3.09	Defects to Be Made Good	02731 - 22
3.10	Existing Utilities	02731 - 22
3.11	Laying Fittings, Valves and Valve Boxes	02731 - 22

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SECTION 02731

FORCE MAINS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish all labor and provide all materials and equipment necessary for the complete and satisfactory installation of all pipe, fittings and appurtenances to the lines, grades and elevations shown on the Contract Drawings and as specified herein.

1.02 SUBMITTALS

Shop drawings, shall be submitted for items specified herein as specified under section 01300 SUBMITTALS. Shop drawings shall be submitted for, but not limited to, the following materials, and shall include the following information:

- A. All pipe and fittings: Product information and dimensions; DR, pressure class and operating pressure rating; storage, handling and installation recommendations, manufacturer's recommended testing procedures, and jointing methods and procedures.
- B. MJ and HDPE adapters for connecting the different pipe materials shown on the drawings; for connecting pipes with different outside diameters; or for connecting pipes, fittings or valves with different end conditions.
- C. All isolation valves, valve boxes, air release valves.
- D. Other items to be used in the work that is not specifically identified above shall be subject to shop drawing review at the option of the County.

1.03 MANUFACTURER'S CERTIFICATES

Certificates of Compliance and certified test results shall be submitted for all pipe and fittings stating the item supplied is in accordance with the requirements specified herein.

1.04 QUALITY ASSURANCE

- A. The County Engineer Representative will inspect all materials before, during and after installation to ensure compliance with these Contract Documents. When specific material tests are called for in the referenced standards and specifications, the County shall have the option of requiring

that any or all of these tests be performed on materials furnished for a specified project.

- B. The Contractor shall schedule all tests with the Engineer at least 48 hours in advance and shall conduct all acceptance testing in the presence of the Engineer.
- C. Field Tests
 - 1. After installation, the Engineer will initially inspect outside piping and shall be Contractor tested for compliance with these Specifications. The contractor shall furnish all labor, tools, materials, water, and equipment, including pumps, compressors, stopwatch, gauges, and meters, for testing in accordance with these specifications.
 - 2. All defects revealed by the tests shall be corrected without cost to the County. Tests and repairs shall be continued until test requirements are met. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks, or holes will be acceptable. When it is necessary to replace any piece of pipe, fitting, valve, etc., the replacement shall be of the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good.
 - 3. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage will result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests.
 - 4. All equipment used in testing shall be provided by the Contractor and subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure hydrostatic test pressures and leakage rates. Where devices such as meters, recorders, charts, plugs, caps, blind flanges, corporation stops or bulkheads are required to develop, maintain and measure test pressures these devices shall be furnished and installed by the Contractor.
 - 5. All required testing will be witnessed by the Sussex County Engineering Department and the Engineer.

1.05 GENERAL NOTES - PIPING

- A. Miscellaneous piping systems which may not be described specifically by any section of these specifications shall be of the type of pipe and fittings as shown on the drawings.
- B. The Contractor shall verify all dimensions of valves, special castings and fittings, pipe equipment, etc., so that all of the pipe work performed will fit together properly and will conform to the arrangement as shown on the drawings. In selecting laying lengths of fittings, the Contractor shall be guided by the indicated dimensions on the drawings. All pipe and specials shall be accurate to the dimensions shown.

1.06 GENERAL NOTES - FITTINGS

- A. All fittings shall be of the type indicated on the drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings.
- B. All flanges shall come fairly (regularly and evenly) face to face with the pipe in perfect alignment. The pipes shall not be sprung to make a joint. Gaskets for flanged joints shall be as specified under "Joints." All joints shall be made neatly and with great care.

1.07 REFERENCES

- A. Ductile Iron Pipe
 - 1. ANSI/AWWA C104/A21.4 Standard for Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
 - 2. ANSI/AWWA C110/A21.10 Standard for Ductile Iron and Gray Iron Fittings, 3 through 48 inches, for Water and Other Liquids.
 - 3. ANSI/AWWA C111/A21.11 Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 - 4. ANSI/AWWA C115/A21.15 Standard for Flanged Ductile Iron Pipe with Threaded Flanges.
 - 5. ANSI/AWWA C150/A21.50 Standard for the Thickness Design of Ductile Iron Pipe.
 - 6. ANSI/AWWA C151/A21.51 Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids.
 - 7. ANSI/AWWA C153/A21.53 Standard for Ductile Iron Compact Fittings, 3 Inches Through 12 Inches (75 MM through 300 MM),

and 54-inches through 64-inches (1400 mm through 1600 mm) for Water Service

8. ANSI/AWWA C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
9. AWWA C504 Standard for Rubber-Seated Butterfly Valves.
10. AWWA C507 Standard for ball valves 6-inch through 48-inch (150mm through 1200 mm).
11. ANSI/AWWA C512, Standard for Air Release, Air Vacuum, and Combination Air Valves for Waterworks Service.
12. ASTM A536 Standard Specification for Ductile Iron Castings

B. Polyvinyl Chloride Pipe (PVC)

1. ANSI/AWWA C900 AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 through 12 inches for water.
2. ANSI/AWWA C905 AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 through 48 inches for Water Transmission and Distribution.
3. AWWA Manual M23; PVC Pipe - Design and Installation.
4. ASTM D1784 Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
5. ASTM D2241 - Standard Specification for Polyvinyl Chloride (PVC) Pressure Rated Pipe (SDR Series).
6. ASTM D2412 - Test Methods for Determination of External loading Characteristics of Plastic Pipe by Parallel Plate Loading.
7. ASTM D2321 - Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
8. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
9. ANSI/ASTM D2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.

10. ASTM D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
11. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes using flexible elastomeric seals.
12. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. High Density Polyethylene Pipe (HDPE)

1. ANSI/AWWA C906 AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 Inches Through 63 Inches, for Water Distribution.
2. ANSI/AWWA C213 AWWA Standard for Fusion Bonded Coating for interior and Exterior of Steel Water Lines.
3. ASTM D1248 Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
4. ASTM D3350 Standard Specification for Polyethylene Plastic Pipe and Fitting Materials.
5. ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
6. ASTM D2657 Standard Practice for Heat Fusion Joints of Polyolefin Pipe and Fittings.

Note: All references listed shall be the latest version thereof.

PART 2 - PRODUCTS

2.01 GENERAL

All pipe and fittings shall be new, of the sizes indicated on the drawings or specified.

2.02 PIPE SCHEDULE

See Drawings.

2.03 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe for buried service shall be furnished in accordance with ANSI/AWWA C151/A21.51-96 or latest revision thereof. All ductile iron pipe shall be Protecto 401 lined. The pipe thickness shall be Special Thickness Class 52.
- B. Joints for buried pipe, fittings and specials shall conform to ANSI/AWWA C-111/A21.11-95 or latest revision thereof and may be either a "Mechanical Joint" or a "Push-On Joint." Push-on joints shall be the "Tyton" joints of the U.S. Pipe and Foundry Company, the "Fastite" joint of American Cast Iron Pipe Company, the Tyton joint of Griffin Pipe Products Company, "or equal". All pipe furnished with push on joints shall be jointed in accordance with the manufacturer's recommendations.
- C. Joint restraints for gasketed push on joint shall be "TR-Flex" of U.S. Pipe and Foundry Company, "Flex-Ring" or "LOK RING" of American Cast Iron Pipe Company, "Snap-Lok" or "Bolt-Lok" by Griffin Pipe Products Company, "or equal," designed for a maximum water working pressure of 250 psi.
- D. Mechanical joint restraints for use with mechanical joint pipe and fittings shall be Ebba Iron Megalug 1100 Series, "or approved equal." The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint and its wedging components shall be made of grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Torque limiting twist off nuts shall be provided to insure proper actuation of the restraining wedges. The mechanical joint restraint shall have a rated working pressure of 350 psi in sizes 16" and smaller and 250 psi in sizes 18" and larger. The device shall be listed by Underwriters Laboratory through the 24" size and approved by Factory Mutual up through the 12" size. All wedge assemblies shall be coated with a minimum of two coats of liquid Xylan fluoropolymer coating with heat cure to follow each coat. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. All casting surfaces shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV

resistance. The coating system for all mechanical joint restraints shall be mega-bond by Ebba Iron “or approved equal”.

- E. Fittings and specials shall be manufactured in accordance with ANSI/AWWA C110/A21.10-98 or latest revision thereof and shall be pressure rated for 250 psi for ductile iron. The ductile iron used in the manufacture of ductile iron fittings and specials shall have a minimum tensile strength of 70,000 psi. Compact fittings manufactured in accordance with ANSI/AWWA C153/A21.53-94 or latest revision thereof will be permitted. All ductile iron fittings shall be domestically manufactured
 - F. Unless otherwise specified, the inside of pipe and fittings shall be ceramic epoxy (Protecto 401) lined in accordance with manufacturer recommendations. Lining shall meet all manufacturer recommendations including materials, application, testing, handling, inspection and certification. The outside of buried pipe and fittings shall be bituminous coated. All exposed ductile iron pipe and fittings shall be shop primed (with primer compatible with field painting) on exterior surfaces and given required finish coats in the field.
 - G. Where required or shown, the Contractor shall provide ductile iron specials. Specials shall in general, consist of spool pieces, less than standard lengths of flanged, spigot end, or bell end pipe, or combination of ends, and non-standard fittings. The specials shall conform in material, thickness and finish to the pipe in which they are installed. Tapped reinforced bosses shall be provided as an integral part of fittings when shown or specified.
 - H. Each piece of pressure ductile iron pipe shall have the weight and class designation conspicuously painted on it as near as possible to the flanged or bell end of the pipe and these designations shall be clearly legible.
 - I. The Mechanical Joint shall consist of a rubber or composition tapered gasket, a cast iron gland ring and cast iron T- Head bolts. The joint shall be affected in accordance with AWWA C600-99 or latest revision thereof.
 - J. Bell joint clamps shall be style 60 as manufactured by Dresser Industries, “or equal,” for push on type joints
- 2.04 PVC PRESSURE PIPE AND FITTINGS
- A. All PVC pressure pipe shall be unplasticized polyvinyl chloride normal impact type in conformance with ASTM D-1784. The 1 1/2" -3" diameter PVC pressure pipe shall conform to the requirements of ASTM D2241 and have a minimum SDR of 21. All 4-inch and greater PVC pressure pipe

shall be a minimum of DR18 and conform to AWWA C-900/C-905. All pipe shall be rated for a working pressure of at least 150 psi plus a surge allowance of at least 35 psi and shall have a minimum hydrostatic strength of 600 psi when tested in accordance with AWWA C-900/C-905.

- B. All PVC pipe shall be manufactured with integral wall bell and spigot which shall utilize a flexible O-ring gasket conforming to ASTM F-477. All pipe ends shall be beveled to accept the gasketed fittings. Gaskets for push on joints and compression type joints, and mechanical joints for joint connections between pipe and metal fittings, valves and other accessories shall be as specified in AWWA C111/A21.11 for push on joints and mechanical joints.
- C. All fittings for PVC pressure pipe 4-inches and greater shall be ductile iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall be rated for 250 psi working pressure. Fittings shall be provided with mechanical joint retainer glands in accordance with ANSI A 21.11, except where noted on the plans. All fittings shall have a ceramic epoxy (Protecto 401) lining in accordance with manufacturer recommendations. Lining shall meet all manufacturer recommendations including materials, application, testing, handling, inspection and certification..
- D. All fittings for 1 1/2"-3" PVC pressure pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM 1784. Fittings shall be class 200 and have a minimum SDR of 21. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F., tested in accordance with ASTM D 1599. Bells shall be gasketed joint conforming to ASTM D 3139 with gaskets conforming to ASTM F477.
- E. Each pipe section including bell or coupling shall be subjected to a hydrostatic test of more than 500 psi for at least five seconds. Pipe shall be tested in accordance with conditions in ASTM D618. Any pipe that leaks or is unable to withstand the test pressure shall be rejected. The test shall be conducted at the factory and certification stating that the operation has been conducted as specified and the pipe meets all conditions of this specification shall be submitted to the Engineer.
- F. Pipe shall be manufactured in lengths not exceeding 20 feet.
- G. Mechanical joint restraint gland for use with PVC AWWA C900/C905 pipe shall be EBAA Iron Sales, Inc., Series 2000 PV mechanical joint restraint, "or equal." The restraint mechanism shall consist of a plurality of individually activated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. The gland shall be such that it can replace the standard mechanical

joint gland and be used with a standard mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Twist off nuts, sized same as t-head bolts, shall be used to insure proper actuating of the restraining device. The restraining gland shall be pressure rated equal to that of the pipe on which it is used. The restraining glands shall have been tested to and meet the requirements of ASTM F1674-96, be listed by Underwriters Laboratories, and be approved by Factory Mutual. All wedge assemblies shall be coated with a minimum of two coats of liquid Xylan flouropolymer coating with heat cure to follow each coat. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. All casting surfaces shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact an UV resistance. The coating system for all mechanical joint restraints shall be mega-bond by Ebba Iron "or approved equal".

- H. Restraint for PVC pipe bells (AWWA C900) for C900 pipe 4"-12" shall be EBAA Iron Sales, Inc., Series 1600, "or equal." Restraint for PVC bells (AWWA C900) for C905 pipe shall be EBAA Iron Sales, Inc., Series 2800, "or equal." All such restraints shall have the same coating system as the described for the mechanical joint restraint gland.
 - I. For sections where restrained joints are required within casing pipes, all PVC joints shall be Diamond Lok-21 as manufactured by Diamond Plastics or approved equal, with bulldog restraint system and Rieber gasket per ASTM F477.
 - J. Cert-lok PVC and FPVC is acceptable for use as a restrained joint. Cert-lok PVC
- 2.05 HIGH DENSITY POLYETHYLENE (HDPE) PRESSURE PIPE AND FITTINGS
- A. HPDE pipe and fittings shall be supplied in accordance with AWWA C-901 and C-906
 - B. The high density polyethylene pipe and fittings shall be a PE 4710, with a minimum pressure rating of 200 psi. All HDPE pipe shall be black with a green strip. The pipe shall conform to ASTM F714 and ASTM 3035. All HDPE pipe shall be Driscoplex series 4100, "or equal," where Iron Pipe Sizes (IPS) are required. All HDPE pipe shall be Driscoplex series 4000, "or equal," where Ductile Iron Pipe (DIP) sizes are required. All wall stops for concrete thrust collars shall be manufactured by Driscopipe, "or equal."

- C. The pipe, fittings and specials shall be from the same manufacturer. All fittings and specials shall have the same pressure rating as the pipe.
- D. All pipe and fittings joints shall be fully restrained from movement due to thermal expansion/contraction forces.
- E. The Contractor shall be permitted to arc the pipe in lieu of utilizing fittings for bends. The minimum bending radius and other pipe installation requirements shall be as specified in PART 3, EXECUTION, of this specification.
- F. Joints for the pipe and fittings shall be by butt fusion joining techniques in accordance with the manufacture's recommendations. Where joining pipe is required within the trench, electrofusion techniques may be used in lieu of butt fusion. Electrofusion couplings and saddles may be used where necessary. All Electrofusion couplings shall be made using a computer controlled automatic electrofusion system. The electrofusion system shall consist of couplings containing an integral heating source which is computer controlled for time, temperature, and, jointing pressure for a consistent joint. Couplings shall be rated for the same working pressure as the pipe and shall have a built in identification feature to automatically set fusion times. The electrofusion system shall include a current monitoring feature. All joints shall be made in accordance with the manufacture's instructions. The use of mechanical couplings for making joints is prohibited.
- G. All HDPE fittings shall be of the type indicated on the drawings or specified. They shall be of the same material and fully pressure rated to meet or exceed the pressure rating of the pipe.
- I. Fusible PVC shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind.

2.06 FUSIBLE POLYVINYLCHLORIDE (FPVC) PIPE

- A. FPVC shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign materials, blisters or other defects.
- B. FPVC shall be manufactured in standard 20', 30' or 40' nominal lengths.
- C. Pipe shall be marked per AWWA C900-C905.

- D. Restrained connections for FPVC to valves or fittings shall be as specified for bell and spigot PVC pressure pipe.
- E. All fusion technicians shall be fully qualified by the pipe supplier to install FPVC of the type and sizes being used. Qualification shall be current as of the actual date of fusion performance on the project. All fusion processes shall be performed in accordance with the manufacturer's recommendations.
- F. All FPVC shall be Fusible C-900 or C-905 pipe as manufactured by Underground Solutions.

2.07 MECHANICAL JOINT/ HDPE ADAPTER

- A. HDPE mechanical joint adapters for making connections to mechanical joint fittings and valves shall be acceptable. The adapter shall provide for a restrained joint. The adapter shall be suitable for connecting HDPE to any ANSI/AWWA C153 ductile iron fitting or valve and comply with AWWA 906. The Mechanical Joint Adaptor shall be as manufactured by Driscopipe, "or equal."
- B. Mechanical couplings shall not be permitted to join HDPE to HDPE, PVC or DIP.

2.08 AIR / VACUUM COMBINATION VALVES AND MANHOLES

- A. Combination air / vacuum combination valves shall be 2", ARI Model D-025 manufactured by the A.R.I. Flow Control Assemblies "or equal." All combination valves shall be suitable for sewage force main applications with working pressures to 150 psi. All inner metal parts shall be made of stainless steel. All combination valves shall be of conical body design and shall not require the use of flushing attachments for removal and cleaning of the valve. The valve design shall incorporate a rolling seal mechanism for the release of air.
- B. All combination valves shall be connected to the pipeline with a stainless steel service saddle. Tapping saddle shells, tapping outlets, bolts, nuts and washers shall be T-304 stainless steel. A pad with O-ring gasket, NBR per ASTM D 2000 MBC 610 shall be provided between the saddle and pipe. Service saddle shall be model 305 for PVC pipe and model 305H for HDPE as manufactured by Romac Industries Inc. or approved equal.
- C. Stainless steel ball valves shall be installed in manholes in accordance with the Standard Detail. All ball valves shall be full port stainless steel model 76-F 100 series as manufactured by Apollo or approved equal.

- D. All combination valves shall be install in reinforced concrete manhole sections as indicated on the Standard Details. All manhole structures shall meet the requirements of ASTM C-478. Access to manholes shall be provided through a Sussex County hinged frame and cover. Frames and covers shall be traffic bearing, H20 heavy duty loaded, solid gasketed lid R-1743-LM by Neenah, or approved equal.

2.09 PIPELINE DETECTION SYSTEM

- A. Pipeline detectable tape shall be installed continuously along all force mains. The tape shall be Lineguard type III Detectable Tape as manufactured by Lineguard, Inc., "or equal." The tape shall be a minimum of three (3) inches wide, brown in color, imprinted with the words, "CAUTION – FORCE MAIN BELOW".
- B. Pipeline detectable wire shall be installed along the full length of the installed pipe. The wire shall be insulated (green in color), solid copper, #12 AWG, 600 volt, of not less that 98% conductivity, conforming to ASTM Designation B.58. Splicing of wires shall be by a solderless, split bolt bug connector as Manufactured by ILSCO type DBK-1 connector. Removal of the insulation at the splice is required, so a metal connection is made. Placement of the wire shall be on top of the pipe. The wire shall be so placed that it and the force main will not be separate by more than 3 inches. The wire shall be attached to the top of the pipe as indicated on the details prior to any backfilling. The wire shall be brought up to the surface of the ground at the beginning and termination of the pipe, at any in line valving (interior of the valve box) or any other appropriate location, or as directed by the Engineer.

2.10 CONCRETE THRUST BLOCKS

The Contractor shall provide concrete thrust blocks on all non-fused (or otherwise unrestrained) bends, tees, plugs and caps in accordance with the contract drawings. The Contractor shall also provide concrete anchors immediately prior to transitions from HDPE to other pipe materials or structures, as well as all locations where HDPE segments of pipe terminate at non-flanged, non-threaded or non-fusion bonded valves, fittings or couplings to resist thermal expansion and contraction.

2.11 VALVE BOXES

- A. Valve boxes for force main isolation valves 3" and smaller shall be three piece screw type with 5-1/4-inch shafts and N-6 round bases. Valve boxes shall be adjustable to the depth of the force main. Each valve shall have a two foot square concrete collar poured around it if not located within pavement. Lids shall be extra deep with two holes and the word "SEWER" cast in the upper surface.

2.12 GATE VALVES

- A. Gate valves shall be of the solid wedge, rubber encapsulated, resilient seat type. Valves shall be rated for 250 psi working pressure and hydrostatically tested to 500 psi in accordance with AWWA C-515. Valve bodies, bonnets and seal plates shall be ductile iron, with wedges totally encapsulated in rubber. Stems shall be manganese bronze. Bolts and hex heads shall be stainless steel.
- B. Resilient Seated Gate Valves shall be operated to open left of the non-rising stem type (NRS) in accordance with AWWA-C-515. NRS stem thrust collars shall be cast integral with the stem and machined to size. A stainless steel thrust bearing shall be incorporated, as required, to optimize operating torques. Operating stems for NRS Resilient Seat Gate Valves shall be equipped with O-Ring seals to prevent leakage past stem. All valves shall have two O-Rings above the stem thrust collar and one o-ring below.
- C. The internal and external iron surfaces of the valve body and bonnet shall be coated with fusion bonded epoxy to AWWA C-550 Standards. Gates for all valve sizes shall be completely encapsulated with elastomer including stem bore, and shall be field replaceable and provide a dual seal on the mating body seat. Valve shall be capable of installation in any position with rated sealing in both directions. Elastomer seats of specially compounded material shall be utilized and be capable of sealing under normal conditions. The valve body shall have integral guides engaging integral lugs in the gate in a tongue and groove manner, supporting the gate throughout the entire open/close travel. The inside and outside of valve body, bonnet and seal plate shall be coated with fusion bonded epoxy meeting AWWA-C-550 latest revision.
- D. Gate valves 18-inch and above shall be provided with spur gearing. All gate valves 18-inch and larger where the depth of cover prohibits installation of valve and valve box below grade shall be provided with bevel gearing.
- E. Buried valves shall be furnished with mechanical joint ends as indicated on the drawings. All tapping valves shall be supplied with flanged connection as required for connection to tapping sleeve.
- F. Marking shall be in accordance with AWWA-C-515 Standards, to include name of manufacturer, the year of manufacture, maximum working pressure and size of valve. Resilient seated gate valves shall be covered by a ten year limited warranty against defective materials or workmanship.

- G. Resilient seated gate valves shall be Mueller 2300 series, American flow control Series 2500 “or equal”.

2.13 PLUG VALVES

- A. Plug Valves shall be non-lubricated, eccentric, resilient-faced plug type and shall be furnished with end connections as shown on the Contract Drawings with mechanical joint ends in accordance with AWWA Standard C111. All plug valves shall be furnished by one manufacturer.
- B. Valve bodies shall be of cast iron in compliance with ASTM A126 Class B and AWWA C-507, Section 5.1 Standards. All exposed nuts, bolts, springs and washers shall be stainless steel. Valve plug shall be ductile iron with integral upper and lower shaft. The plug shaft seal shall utilize a stuffing box and split pull-down packing ring. Resilient plug facing shall be of neoprene and shall be compliant with ASTM D429 method B. Port areas of plug valves shall be nominal 100 percent of full pipe area.
- C. Valves shall be furnished with corrosion resistant seats of a welded in and machined overlay of at least 90 percent pure nickel which comply with AWWA C507, Section 3. Valves shall be furnished with replaceable 316 stainless steel sleeve type bearings in upper and lower journals. These bearings shall comply with AWWA Standard C504, Section 3.6. Valve shaft packing seals shall comply with AWWA Standard C504, Section 4.5.7.4 and shall be of buna(vee). Nowhere in the valve or actuators shall the valve shaft be exposed to iron on iron contact. The valve shall be repackable without removing the bonnet or operator. Repacking shall be able to done while valve is still in service.
- D. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16.1. Pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 inches and larger. Valves shall provide drip tight shut off up to the full pressure rating with the pressure applied to the valve from either direction.
- E. All plug valves 6-inch and larger shall be furnished with geared operators. All plug valves 6 feet or higher above floor, regardless of valve size, shall have geared operators with chain wheel. All plug valves utilizing stem extensions shall have geared operators. All hand wheel operated valves shall open with counter-clockwise rotation of the hand wheel. The diameter of the hand wheels or chain wheels shall under no conditions be greater than twice the diameter of the gear sector, and the gears shall be made of bronze or be mounted on bronze bearings. Buried valves shall be supplied with a valve box and stem extensions to grade with a 2 inch operating nut. Each buried operator shall have external valve position indicator.F. Actuators shall be designed to produce the required torque

with a maximum pull of 80 lb. on the hand wheel or chain wheel, and a maximum input of 150 ft. lb. on operating nuts. Geared valve operators shall be of the worm gear type and shall be enclosed in cast iron housing suitable for running in oil and with sets on all shafts to prevent dirt or water entry. Actuator shaft and quadrant shall be supported on permanently lubricated bronze bushings. Actuators without bronze bushings are not acceptable. Actuators shall clearly indicate valve position and shall be provided with an adjustable stop to set closing position. Actuators for submerged or buried service shall have seals on all shafts and cover gaskets to prevent entry of dirt and water. All exposed bolts, nuts, springs and washers shall be stainless steel.

- G. Plug valves shall be DeZurik Series 100, similar models of Valmatic, or approved equal.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION - GENERAL

- A. Contractor shall adhere to the manufacturer's recommended installation procedures.
- B. The pipe and accessories shall be inspected for defects prior to installation. Any defective, damaged or unsound material shall be repaired or replaced as directed by the County.
- C. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipelines shall be covered to keep dirt and other substances from entering. The cover shall be kept in the end of the pipelines at all times when laying is not in actual progress.
- D. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of debris into the line. If water enters the trench, the Contractor shall prevent the pipe from floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installation as determined by the County.
- E. The pipe shall be cut in accordance with the manufacturer's recommended procedures. Cuts shall be completed in a neat and workmanlike manner without damage to the pipe so as to have a smooth end at right angles to the axis of the pipe.
- F. No pipe shall be laid upon the foundation into which frost has penetrated nor at any time when the Engineer shall deem that there is danger of formation of ice or the penetration of frost at the bottom of the excavation.

- G. Pipe bedding shall be in accordance with Section 02200, EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING.

3.02 DUCTILE IRON BURIED PIPE INSTALLATION

- A. Ductile iron pipe, fittings, valves and appurtenances shall be handled, stored and installed in accordance with AWWA C600-99 or the latest version thereof.
- B. All piping and restrained joints shall be joined in full conformance with the manufacturer's recommendations. The rubber gasket shall be the sole element depended upon to make the joint watertight.
- C. The maximum joint deflection allowed shall not exceed 70% of the values shown in Table 4, AWWA 600-99 for mechanical joint pipe and 70% of the manufacturer's maximum allowable deflection for restrained joint push on pipe.
- D. Before joints are made, such pipe shall be well bedded on a solid foundation in compliance with the trench details and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secure in place. Any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug large enough to insure the making of proper joints.
- E. Couplings or sleeves are to be placed as needed.
- F. Whenever ductile iron pipe requires cutting in the field, the work shall be done in a satisfactory manner which will leave a smooth end and not otherwise damage the pipe or lining.

3.03 PVC PIPE INSTALLATION

- A. PVC pipe shall be installed in accordance with the Standard Details and AWWA Manual M23: PVC Pipe-Design and Installation. All pipe, fittings, valves and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench.
- B. The pipe and accessories shall be inspected for defects prior to lowering into trench. Bowed sections of PVC pipe will not be acceptable. Any installation of pipe which has been bowed, whether or not the bow has been corrected, will not be allowed. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Engineer.

- C. The sealing surface of the pipe, the bell to be joined, and the elastomeric gaskets shall be cleaned immediately before assembly, and assembly shall be made as recommended by the manufacturer. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installation as determined by the Engineer.
- D. The pipe shall be cut in a neat and workmanlike manner without damage to the pipe so as to have a smooth end at right angles to the axis of the pipe.
- E. The push on joint is assembled by positioning the elastomeric gasket(s) in the annular groove(s) of the bell or coupler and inserting the spigot end of the pipe into the bell compressing the gasket radially to form a positive seal. The gasket and annular groove are designed, sized and shaped so that the gasket will resist displacement. Care shall be taken so that only the correct elastomeric gasket compatible with the annular groove(s) of the bell or coupler is used. Insertion of the elastomeric gasket in the annular groove must be in accordance with the manufacturer's recommendations.
- F. PVC pipe shall be delivered and stockpiled in unit pallets. No stacking of pallets above 5' will be allowed. If pipe is stockpiled for more than 30 days prior to installation, it must be suitably covered with reflective material to protect the pipe from ultraviolet rays resulting from sunlight. Plastic sheets shall not be used for protection. Air circulation shall be allowed under any covering.

3.04 HDPE PIPING AND FITTINGS

- A. All directional drilling of pipelines shall be in accordance with Section 02800, DIRECTIONAL DRILLING.
- B. The minimum allowable bending radii shall be as determined by the manufacturers recommendations. Bends in HDPE pipe shall not be permitted to occur closer than 10 diameters from any fitting or valve. Bending of coiled pipe against the coil shall not go beyond straight. Polyethylene pipe that becomes kinked during handling or installation shall not be used, and care should be taken to ensure that kinking does not develop after installation.

- C. The Contractor shall demonstrate to the full satisfaction of the County, that his personnel are adequately skilled in making the joints specified, prior to installation of any piping.
- D. Field cutting and fusion bonding of HDPE pipe and fittings shall be done in accordance with the manufacturers recommended procedures.
- E. Joints shall be made either pipe end to pipe end, pipe end to fitting, or between a saddle fitting and pipe by heat-fusion methods. These methods involve preparation of surfaces, heating of the surfaces to proper fusion temperatures, and bringing the surfaces together in a prescribed manner to effect the fusion bond as described in ASTM D2657-97 and in accordance with the pipe manufacturer's recommendations. Special tools to provide proper heat and alignment shall be used for heat-fusion connections. Detailed written procedures and visual aids provided by the pipe manufacturer shall be supplied to the Engineer prior to heat fusing any pipe. The information shall include specific recommendations for time, temperature, and pressure required to make the joint as well as criteria used to evaluate the quality of a fusion bonded joint.

3.05 TESTING OF PIPE

- A. The Contractor shall schedule all tests with the Engineer at least 48 hours in advance, and shall conduct all acceptance testing in the presence of the Engineer.
- B. When installed within pavement, all performance testing of pipe shall be initiated with 45 days of initial pavement disturbance.
- C. Generally, piping, fittings and appurtenances will be tested from end to end. Pressure and leakage tests shall be performed.
- D. The Contractor shall be responsible for the testing of all pipelines. The Contractor shall furnish all labor, tools, material, including water and equipment, pumps, compressors, stopwatch, gauges and meters, subject to the approval of the Engineer for testing in accordance with these Specifications. All testing shall be performed at the expense of the Contractor.
- E. If the piping or any section or component thereof fails the tests and/or inspection, the Contractor shall, at his own expense, repair and replace any defective component and retest until all requirements are met. The County will furnish personnel to witness tests, one time only. Any required repairs to the various systems shall be made with new materials. When it is necessary to replace any piece of pipe, fitting, valve, etc., the replacement shall be of the same material and thickness as the defective piece.

3.06 TESTING OF PRESSURE PVC/DIP PIPE

- A. Pressure Test - After backfilling has been completed, all newly laid pipe and any valved section thereof shall be subject to a hydrostatic pressure test of 150 psi for a duration of two hours with the pressure measured at the highest elevation on the line. The procedure for the pressure test shall be as follows:
1. Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.
 2. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so the air can be expelled.
- B. Leakage Test - After satisfactory completion of the pressure test, the Contractor shall conduct a leakage test. The Contractor shall furnish the gauge and measuring device for the leakage test. The Contractor shall furnish the pump, pipe connections, and other necessary apparatus. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section, to maintain the specified leakage test pressure. After the air in the pipeline has been expressed and the pipe has been filled with water, the allowable leakage shall not be more than 25 gallons of water per inch diameter of pipe per mile of pipe tested per 24 hours at a pressure of 100 psi, measured at the highest elevation. Leakage test shall be carried out for not less than a four hour duration and the allowable leakage prorated accordingly. Failure of the line to pass either the pressure or leakage test shall be cause for the test failure. The Contractor shall effect the necessary repairs and retest the line until it passes both tests. All tests shall be conducted in the presence of the County Representative.

3.07 TESTING OF PRESSURE HDPE PIPE

- A. Pressure Test - After backfilling has been completed, all newly laid pipe and any valved section thereof shall be subject to a hydrostatic pressure test at 150 psi as measured at the highest elevation on the line. The procedure for the pressure test shall be as follows:
1. Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer.

2. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so the air can be expelled.
 3. Allow the pipeline to contract for a minimum of two hours. During this time, the pipeline shall be left alone with no water added. This allows the pipeline to expand under first pressurization.
 4. After allowing for pipeline expansion, the pressure in the pipeline shall be raised to the required test pressure for a minimum duration of 3 hours.
- B. Leakage Test - After satisfactory completion of the pressure test, the Contractor shall conduct a leakage test. The Contractor shall furnish the gauge and measuring device for the leakage test. The Contractor shall furnish the pump, pipe connections, and other necessary apparatus. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section, to maintain the specified leakage test pressure. After the air in the pipeline has been expressed and the pipe has been filled with water, the allowable leakage shall be not more than 25 gallons of water per inch diameter of pipe per mile of pipe tested per 24 hours at a pressure of 100 psi, measured at the highest elevation. Leakage test shall be carried out for not less than a four hour duration and the allowable leakage prorated accordingly. Failure of the line to pass either the pressure or leakage test shall be cause for the test failure. The Contractor shall effect the necessary repairs and retest the line until it passes both tests. All tests shall be conducted in the presence of the Engineer
- C. All visible leaks shall be immediately repaired and the line retested. Any section of the line in which the leakage occurs shall be repaired by the Contractor at his expense to the complete satisfaction of the Engineer. Any pipe, fitting valve, etc. which gives evidence under test of being defective, shall be replaced by the Contractor at his own expense. If the line shows an excessive number of leaks in any phase of the test, the Contractor shall re-test the line after initial correction until all leaks have been remedied.
- D. Leaks and defects shall be repaired or otherwise remedied by the Contractor at no expense to the County, and to the complete satisfaction of the Engineer whatever time they become apparent prior to the final acceptance of the work under this contract.

3.08 TESTING FORCEMAIN TONE WIRE

The Contractor shall coordinate with the Sussex County Engineering Department to tone all forcemain wire after final pressure testing has been completed. All inadequacies in the toning wire shall be immediately repaired by the Contractor at his expense to the complete satisfaction of the Engineer.

3.09 DEFECTS TO BE MADE GOOD

If at any time before the expiration of the guarantee period under this contract, any broken pipes or any other defects are found in any of the lines or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act, default, or negligence on the part of the Contractor. All materials shall be carefully examined by the Contractor for defects just before placing and any found to be defective shall not be placed in the line.

3.10 EXISTING UTILITIES

- A. Existing utilities have been indicated on the drawings in accordance with the information shown on record drawings. The County expressly disclaims any responsibility for the accuracy or completeness of information shown. It shall be the Contractor's responsibility to verify the location and size of existing piping.
- B. Existing utilities and service shall be carefully protected; all damage to utilities by the work shall be immediately repaired by the Contractor to the satisfaction of the Engineer, using materials of the kinds damaged. No additional payment will be made for such repair work. The County assumes no responsibility for damages or downtime for the Contractor or their subcontractors resulting from the inadequate or negligent performance by utility locators.
- C. The Contractor shall bear the entire cost of all monetary penalties which may be assessed by utility companies whose facilities are damaged and/or put out of service by the Contractor during the prosecution of the work.
- D. Where new piping is to be connected to existing piping, the Contractor shall drain or purge the existing piping, cut, grind and prepare the existing piping in every respect in order that it be suitable for connecting to the new piping.
- E. Where existing piping is to be abandoned and removed, the Contractor shall not reuse the piping on the project. Abandoned piping remaining in

place shall be plugged and capped using retainer glands. Piping that has been removed shall be hauled offsite and disposed by the Contractor.

3.11 LAYING FITTINGS, VALVES AND VALVE BOXES

- A. Fittings, valves, and valve boxes shall be placed along the sewer force mains where shown on the drawings or where designated by the Engineer.
- B. A valve box shall be carefully placed over the bonnet of each plug valve with the top at finished grade and it shall be set exactly plumb. In tamping and backfilling around the box, special care shall be taken to keep the box plumb and to have it firmly supported so as to avoid settlement. Any box which is found out of plumb, or which is not firmly supported, shall be dug up and reset in a satisfactory manner, at the Contractor's expense.

END OF SECTION

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