

APPENDIX A

Technical Specifications for Sanitary Sewer Work

Item 753516 – Sanitary Sewer System

and

Item 753558 – Relocate Force Main

TABLE OF CONTENTS

<u>Section Number</u>	<u>Section Title</u>	<u>Page</u>
00810	Supplemental General Conditions	3
01050	Field Services	5
01106	Construction Scheduling, Coordination, and Sequencing	7
01380	Construction Photographs	11
01400	Quality Control	12
02200	Earthwork, Excavation, Trenching, and Backfilling	15
02300	Jacking and Boring	20
02730	Gravity Sewers, Laterals, and Appurtenances	25
02731	Forcemains and Appurtenances	39
02732	Linestop and By-Pass	55
02733	Manholes	62
03410	Precast Concrete Wetwell Structures	67

SECTION 00810

SUPPLEMENTAL GENERAL CONDITIONS

4.01 GENERAL

When referenced in these Special Provisions, or the Technical Specifications, the Owner is intended to be represented by a Sussex County employee or their Consultant; [Whitman, Requardt and Associates (WRA)]. The Engineer is intended to be represented by a DelDOT employee or their Consultant.

4.04 UNDERGROUND FACILITIES

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

6.19 CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

The CONTRACTOR hereby guarantees all of the work performed under this Contract for a period of one year, unless otherwise noted. The guarantee period begins upon Substantial Completion of Items 753516 and 753558. The guarantee shall be as follows:

1. Against all faulty or imperfect materials and against all imperfect, careless and/or unskilled workmanship, as evidenced by excessive pipe settlement, cracked pavement, failure of structures, and/or equipment, etc.
2. That the entire equipment and each and every part thereof, shall operate with proper care and attention in a satisfactory manner, and in accordance with the requirements of these Contract Documents.
3. That the entire structure in the vicinity of work done shall be watertight and leak-proof, at every point and in every particular.

4. The CONTRACTOR agrees to replace with proper workmanship and materials, and to execute, correct or repair, without cost to the OWNER, any Work which may be found to be improper or imperfect.
5. The guarantee obligations assumed by the CONTRACTOR under these Contract Documents shall not be held or taken to be in any way impaired because of the specification, indication or approval by or on behalf of the OWNER of any articles, materials, means, combinations or things used or to be used in the construction, performance and completion of the Work, or any part thereof.
6. No use or acceptance by the OWNER of the Work or any part thereof, nor any failure to use the same, nor any repairs, adjustments, replacements or corrections made by the OWNER due to the CONTRACTOR'S failure to comply with any of the obligations under the Contract Documents, shall impair in any way the guarantee obligations assumed by the CONTRACTOR under these Contract Documents.
7. All work shall be guaranteed for a period of one year as described above. In addition, all work within Delaware Department of Transportation (DelDOT) rights-of-way covered by existing DelDOT Franchise Agreements and Utility Construction Permits 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 total of the prices bid for Items 753516 and 753558 for all pipelines installed within roadways covered by the existing DelDOT Franchise Agreements and Utility Construction Permits for a three-year period.

SECTION 01050

FIELD SERVICES

1.06 SUBMITTALS

- A. Submit name and address of Professional Surveyor to the OWNER.
- B. On request of the OWNER, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or surveyor, licensed in the State of Delaware, certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.
- D. Submit drawings showing locations of all structures constructed. This drawing shall be included with the project record documents.
- E. Submit cut sheets for all utility work to the OWNER 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. 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 and/or OWNER. Two sets of initial draft Record Drawings shall be issued to the ENGINEER for submission to the OWNER no later than 14-days from the date of substantial completion.
- B. 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 or OWNER 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 locations shall be surveyed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR.

3. All costs to gather the data and prepare the required record drawings for contract Items 753516 and 753558 are to be included in the Lump Sum price bid for Item 763501, Construction Engineering.

C. If contract drawings are provided to the Contractor in electronic format, the information listed in Article B above shall be provided to the Owner on the electronic drawings in the same format, unless otherwise approved by the Owner.

SECTION 01106

CONSTRUCTION SCHEDULING, COORDINATION AND SEQUENCING

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.
- 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 prices bid for Items 753516 and 753558.

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 judgment of the Owner will interfere with operation of the various facilities.
3. Should an emergency condition arise at the various facilities, the Owner has the authority to require the Contractor and his subcontractors to suspend their operations temporarily until conditions return to normal, without claim for extra cost or contract time extension by the Contractor and his subcontractors.

B. Subcontractors

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

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

1.01 GENERAL REQUIREMENTS

The Contractor shall provide representative construction photographs on a monthly basis to support the work completed and included for payment on each estimate. A minimum of four sets of 8"x10" photographs shall be provided for distribution to the Owner, Engineer, and Funding Agency. The photos are required only for the work associated with Item 753516, Sanitary Sewer System. The photos must be submitted to the engineer no later than each month's estimate cut-off date. No payment will be made for Item 753516 until the required photographs have been submitted. Cost to provide the construction photographs are incidental to Item 753516.

SECTION 01400

QUALITY CONTROL

1.03 STANDARDS

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

Abbreviation Organization

AA	-	Aluminum Association
AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ACS	-	American Chemical Society
AFBMA	-	Anti-Friction Bearing Manufacturers Association
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
DGA	-	American Hot Dip Galvanizers Association
AICHE	-	American Institute of Chemical Engineers
AISC	-	American Institute of Steel Construction
AASHO	-	The American Association of State Highway Officials
ABPA	-	Acoustical and Board Products Association
AI	-	The Asphalt Institute
AIEE	-	American Institute of Electrical Engineers (Now IEEE)
AIMA	-	Acoustical and Insulating Materials Association
AISI	-	American Iron and Steel Institute
AMCA	-	Air Moving and Conditioning Association
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
APWA	-	American Public Works Association
AREA	-	American Railway Engineering Association
ASA	-	American Standards Association (Now ANSI)
ASCE	-	American Society of Civil Engineering
ASHRAE	-	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASSCBC	-	American Standard Safety Code for Building Construction
ASTM	-	American Society of Testing and Materials
AWPA	-	American Wood Preservers Association
AWPB	-	American Wood Preservers Bureau
AWS	-	American Welding Society
AWWA	-	American Water Works Association

BIA	-	Brick Institute of America
CBRA	-	Copper and Brass Research Association
CRSI	-	Concrete Reinforcing Steel Institute
CS	-	Commercial Standard (U.S. Department of Commerce)
DIPRA	-	Ductile Iron Pipe Research Association
E/A	-	Engineer and/or Architect
EEI	-	Edison Electric Institute
EPA	-	U.S. Environmental Protection Agency
FM	-	Factory Mutual
FTI	-	Facing Tile Institute
FS	-	Federal Specifications
GPM	-	Gallons Per Minute
HP	-	Horsepower
IEEE	-	Institute of Electrical and Electronic Engineers
ID	-	Inside Diameter
IPCEA	-	Insulated Power Cable Engineers Association
MBE	-	Minority Business Enterprise
MBMA	-	Metal Building Manufacturers Association
MSS	-	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	-	National Association of Architectural Metal Manufacturers
NBFU	-	National Bureau of Fire Underwriters
NBS	-	National Bureau of Standards
NCPI	-	National Clay Pipe Institute
NCMA	-	National Concrete Masonry Association
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NPT	-	National Pipe Threads
NSF	-	National Science Foundation
OD	-	Outside Diameter
OFCCP	-	Office of Federal Contracts Compliance Programs
OSHA	-	U. S. Department of Labor, Occupational Safety and Health Administration
PCA	-	Portland Cement Association
PCI	-	Prestressed Concrete Institute
PS	-	United States Products Standards
PSIG	-	Pounds Per Square Inch Gauge
RPM	-	Revolutions Per Minutes
SAE	-	Society of Automotive Engineers
SCPI	-	Structural Clay Products Institute
SDI	-	Steel Decks Institute
SJI	-	Steel Joists Institute
SPIB	-	Southern Pine Inspection Board
SMACNA	-	Sheet Metal and Air Conditioning National Association
SMSA	-	Standard Metropolitan Statistical Area
SSPC	-	Steel Structures Painting Council
STA	-	Station (100 feet)
TDH	-	Total Dynamic Head
TEMA	-	Tubular Exchanger Manufacturers Association

- UL - Underwriter's Laboratories
- USASI or - United States of America Standards Institute
- USAS - (Now ANSI)
- USGS - United States Geological Survey
- USC&GS - United States Coast and Geodetic Survey

SECTION 02200

EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING

1.05 JOB CONDITIONS

A. Subsurface Investigations

1. DelDOT has had a number of subsurface test borings made at various locations shown on the Drawings. The borings are shown on the profile sheets and are included for informational purposes to the Contractor. The Contractor shall be responsible for making any interpretations or conclusions drawn from the information contained therein. Neither the Engineer nor the County will be responsible for the conclusions drawn by the Contractor from the information presented or implied.
2. The Contractor shall be responsible for reading the borings and shall become familiar with the site and the subsurface conditions. Ignorance of conditions will not be accepted as a basis of claim for additional compensation. DelDOT does not warrant or guarantee that the conditions actually encountered in the prosecution of the work under this contract will be the same as the conditions indicated by the borings. No additional compensation will be allowed the Contractor because of subsurface conditions actually encountered in the work.
3. The Contractor shall determine to its own satisfaction the ground water conditions and character and type of soil, decomposed rock, rock and other material to be encountered in the work to be done under this Contract.
4. If the Bidder determines, after visiting the site and reviewing the borings, that the data is not sufficient for bid preparation, the bidder may make its own investigation and tests, at a time acceptable to DelDOT. All government and private approvals and/or permits shall be obtained in writing by the Contractor prior to performing any investigations or tests. Any costs associated with obtaining additional site information related to the sanitary sewer work are incidental to Items 753516 and 753558 as applicable.

B. Existing Utilities

1. The existing utilities shown on the Drawings are from available records and field surveys. The Contractor shall verify all information to its own satisfaction, and shall notify the Engineer of any impact to the work. The Contractor shall test pit existing utilities that impact construction, at no additional expense to the Contract. These test pits shall be performed two

weeks in advance of excavation and are considered to be part of the lump sum or unit price bid items.

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

1.06 DEWATERING, DRAINAGE AND PUMPING

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

- F. Methods of dewatering excavations shall be at the Contractor's discretion. Continuous investigations and checks shall be made by the Contractor to assure that the dewatering system employed is functioning properly, not causing damage or settlement to adjacent surfaces or structures. Temporary pipes or flumes shall be used to carry surface water across open and/or unstabilized construction areas. The system shall be modified as required and repairs for damage caused by the system shall be the responsibility of the Contractor. Any required Permits to implement the Contractor's dewatering system shall be the responsibility of the Contractor to procure. Costs for permits to be incidental to Items 753516 or 753558 as applicable.
- G. Should the Contractor's dewatering operations affect any existing private water supply well or spring used as a potable water source, the Contractor shall, at no additional cost to DeIDOT, take whatever steps are necessary to provide uninterrupted water service, including the installation of temporary water lines or the installation of permanent wells with treatment systems, if required. Bottled water shall be provided immediately to residents whose private wells are damaged during construction.

1.07 TEMPORARY EXCAVATION SUPPORT SYSTEMS

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

1.08 RESPONSIBILITY FOR CONDITION OF EXCAVATIONS

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

1.10 SUBMITTALS

Excavation Support Systems and Dewatering Systems

1. For all excavations requiring excavation support systems and dewatering systems, the Contractor shall submit working drawings and calculations for the design of the systems. The working drawings and calculations shall be performed by an engineer and a licensed well driller obtained and paid for by the Contractor. The Contractor's engineer shall be a professional engineer and to practice in the State of Delaware and shall sign and seal all excavation support drawings and calculations. All dewatering systems shall be signed by a licensed Delaware well driller. Signed and sealed Drawings or calculations submitted will be for information only.
2. The working drawings and calculations for the dewatering systems shall include the following information:
 - a. Planned method of dewatering.
 - b. Excavation plan.
 - c. Location of the water table before and during dewatering.
 - d. Location and capacity of such facilities as dewatering wells, well points, sumps, collection and discharge lines, proposed standby unit, and protective fills and ditches required for control of ground water and surface water.
3. The Contractor shall obtain and submit copies of all permits that may be required for installation of well points and dewatering wells.

4. The Contractor shall be responsible for determining the existing subsurface conditions for the excavation support systems and dewatering systems. DelDOT does not guarantee or warrant the conditions actually encountered on this project. DelDOT will not be held responsible for the basis of claims by the Contractor or any other parties in the execution of these systems. The Contractor's submittals of the excavation support systems and dewatering systems, prepared by the Contractor's engineer, are for information purposes only.

SECTION 02300

JACKING AND BORING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification includes the requirements for furnishing all labor, materials, equipment and services necessary for and incidental to jacking and boring casing pipe and installing carrier pipe, in accordance with these Specifications and with the details and dimensions shown on the Contract Drawings or as directed by the Engineer.
- B. Definitions
 - 1. Carrier pipe is the sanitary sewer or force main pipe.
 - 2. Casing pipe is the sleeve through which the sewer pipe will be placed.
 - 3. Jacking and Boring is a method of installing a casing pipe by means of cutting, hand mining or boring an opening in soils material while simultaneously forcing the casing pipe through the opening with hydraulic jacks.

1.02 RELATED WORK INCLUDED ELSEWHERE

Section 02200 EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING

Section 02730 GRAVITY SEWERS, LATERALS AND APPURTENANCES

1.03 SUBMITTALS

Submit Contractor's drawings in accordance with the requirements provided elsewhere in these Specifications.

- A. Working drawings and a written procedure describing in detail the proposed jack and bore method and the entire operation to be used. This shall include, but not be limited to, jacking and receiving pits; dewatering; method of removing soils material and installation of casing and carrier pipe; size, capacity and arrangement of equipment; backstop; pit base material; type of cutter head; method of monitoring and controlling line and grade, and detection of surface movement. If in the opinion of the Contractor modifications to the methods are required during construction, working drawings shall be submitted delineating such modifications, including reasons for the modifications.

- B. Submittals for Excavation Support Systems and Dewatering Systems shall be in accordance with the requirements of Section 02200 EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING of this Specification.
- C. Bulkhead details and proposed positive method of anchoring carrier pipe to prevent flotation.
- D. The Contractor shall be responsible for extending the line grade, elevation, etc., in the casing from the boring or tunnel pits. The Contractor shall submit to the Engineer for approval, the method it proposes to use for extending controls within the casing. No work in these areas will be allowed to be performed prior to such approval. The Engineer may make periodic checks on the lines, grade elevation, etc., established by the Contractor.

1.04 JOB CONDITIONS

- A. Bore so as not to interfere with, interrupt or endanger the surface and activity thereon.
- B. Comply with all applicable jurisdictional codes and OSHA requirements.
- C. The Contractor shall become familiar with and meet the requirements of Section 02200 EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING of this Specification.

PART 2 - PRODUCTS

2.01 CASING PIPE

The casing pipe shall be located as indicated on the Drawings. The casing pipe shall be smooth-walled steel pipe, and shall have a minimum yield strength of 35,000 psi (ASTM A-139 Grade B). Minimum wall thickness shall be ½-inch. Joints shall be fully welded around the circumference of the pipe with a complete penetration weld. Pipe shall conform to AWWA C-200. Paint pipe with 2 coats (10 mil each) of bitumastic coal tar epoxy inside and out. Bitumastic coal tar epoxy shall be 300M as manufactured by Kop Coat, Series 46H-413 by Tnemec, or equal.

2.02 CARRIER PIPE APPURTENANCES

- A. Carrier pipe shall be in accordance with the requirements provided elsewhere in these Specifications.
- B. The ends of the casing pipe and carrier pipe shall be sealed by end seals that include a seamless wrap of 1/8" thick synthetic rubber and secured with a minimum of two T304 stainless minimum 1-inch wide steel banding straps with

integral non-magnetic worm gear to be located at each joint. Each end of both the carrier and casing pipe shall be fully sealed with a single seamless wrap and equipped with pressure sensitive butyl mastic strips on both the carrier and casing pipe. End seals shall be as furnished by Advance Products & Systems, Inc., Cascade Waterworks Mfg., or equal.

- C. Casing Spacers shall be two piece shell made from T-304 stainless steel of a minimum 14 gauge thickness. The shell shall be lined with PVC extrusion that overlaps the shell and prevents slippage. Bearing surfaces (runners) shall be ultra-high molecular weight polymer for abrasion resistance and a low coefficient of friction. The runners shall be attached to the support structure (risers) at appropriate positions to properly support the carrier within the casing. All runners shall be field replaceable for field adjustment if necessary. The riser shall be minimum 10 gage T304 stainless steel. All risers 6" and over in height shall be reinforced. All fasteners shall be 5/16" T-304 stainless steel. The interior surfaces of all stainless steel bands shall be lined with EPDM, or PVC alternate, having a minimum thickness of .090" with a hardness of Durometer "A" 85-90. All casing spacers shall be supplied to center the carrier pipe inside the casing pipe. Casings Spacers shall be model CCS as manufactured by Cascade Waterworks Mfg. Advance Product Systems, Inc., or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor is responsible for making his own investigation and determination of the work site soil conditions prior to bidding. Rock, if encountered, shall not entitle the Contractor to additional compensation.
- B. If an obstruction is encountered during installation which stops the forward motion of the operation, notify the Engineer immediately. When the Engineer determines that it is impossible to advance the bore hole or pipe, the operation shall be discontinued and the completed portion abandoned in place and filled with grout or plugged, unless otherwise directed by the Engineer.
- C. Methods of dewatering shall be at the option and responsibility of the Contractor. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24-hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soils particles is held to a minimum. Dewater into a sediment trap and comply with all sediment and erosion control requirements.
- D. Maintain close observation to detect settlement or displacement of surface facilities. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.

- E. The Contractor shall keep the air in the excavations in a condition suitable for preserving and protecting the health of the workers and clear enough for surveying operations and the taking of photographs. Pure, fresh air shall be provided and maintained at all times in all places underground sufficient for such purposes and adequate provisions shall be made for the quick removal of dust and gas produced by the Contractor's operations or any other cause. Sufficient ventilation shall be provided to prevent the accumulation of carbon dioxide to a greater amount than one part in one thousand by volume. The temperature in all headings shall be kept within reasonable limits and as equitable as possible and the Contractor shall provide such facilities as may be required for this purpose.
- F. The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.

3.02 PREPARATION

- A. Excavate pits as required in accordance with the approved Working Drawing, and these Specifications.
- B. Perform preliminary work including constructing backstop, placing guide timbers and placing boring apparatus.
- C. When shown on the Drawings or otherwise specified for jack and bore operations, install, maintain, and make observation measurements at regular time intervals acceptable to the Engineer, on surface settlement markers placed as specified or as directed by the Engineer. Tie settlement markers to bench marks and indices sufficiently remote as not to be affected by the bore and jack operations. Take readings and permanently record prior to start of dewatering operations and/or shaft excavation. Make all elevation measurements to the nearest 0.01 foot. All readings shall be reported to the Engineer within one hour of the reading. Settlement detected shall be corrected by the Contractor at no additional expense to DelDOT.

Settlement markers for crossing State Highway and other roads shall consist of P-K nails on the paved areas and wood hubs in unpaved areas. In the event settlement or heave on any marker exceeds two inches, the Contractor shall immediately cease work and take immediate action to restore the surface elevation that existed prior to start of the jack and bore operation.

3.03 JACKING AND BORING OPERATION

- A. The auger and cutting head arrangement shall be removable from within the pipe in the event that an obstruction is encountered. If the obstruction cannot be

removed without excavation in advance of the pipe, the pipe shall be abandoned in place and immediately filled with grout.

- B. The front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that no unsupported excavation is ahead of the pipe.
- C. The boring operation shall be progressed on a 24 hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the pipe has reached the receiving pit.
- D. Jack casing pipe with auger rotating within the pipe to remove spoil. Hand mining is an option for large bore casing pipe provided method is submitted in detail and is acceptable to the Engineer.
- E. The face of the cutting head shall be arranged to provide a reasonable obstruction to the free flow of running sand, or soft or poor material.
- F. The overcut by the cutting head shall not exceed the outside diameter of the casing pipe by more than ½-inch (13 mm). If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately 1 inch (25 mm), grouting (see section 3.04) or other methods approved by the engineer, shall be employed to fill such voids. For hand mining no overcut will be permitted.
- G. Provide positive means for continuous monitoring and controlling grade of casing pipe during boring operation.
- H. Weld steel pipe casing as required herein and when coating is required, repair coating damage each side of weld and recoat complete weld area. Grind welds smooth. Paint shall be applied as recommended by the manufacturer.

3.04 FIELD QUALITY CONTROL

Jack and bore casing pipe shall maintain line and grade indicated on the Drawings to within a tolerance of 0.50 inches.

3.05 INSTALLATION OF CARRIER PIPE

Lay the carrier pipe to the true line, grade and elevations called for on the Contract Drawings. Install the carrier pipe in accordance with the details as shown on the contract drawings. The annulus between casing pipe and carrier pipe shall not be encased, with concrete or grout. Provide and install end-seals at each end of the casing to prevent soil displacement into the annulus.

SECTION 02730

GRAVITY SEWERS, LATERALS 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. For material and equipment readily identified in standard publications of equipment manufacturers, it will be sufficient to submit only the manufacturer's standard catalog cut in the submission.

1.03 QUALITY ASSURANCE

- A. The Engineer and/or Owner will inspect all materials before, during and after installation to ensure compliance with these Contract Documents. When specific material tests are called for in the referenced standards and specifications, the Owner shall have the option of requiring that any or all of these tests be performed for materials furnished for a specified project.
- B. The Contractor shall schedule all tests with the Engineer and Owner at least 48 hours in advance, and shall conduct all acceptance testing in the presence of the Engineer and Owner.
- C. Field Tests
 - 1. After installation, outside piping will be initially inspected by the Engineer and shall be Contractor tested for compliance with these Specifications. The Contractor shall furnish all labor, tools, materials, water, and equipment, including pumps, compressors, stopwatch, gauges, and meters, for testing in accordance with these specifications.
 - 2. All defects revealed by the tests shall be corrected without cost to the Owner. Tests and repairs shall be continued until test requirements are met. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks, or holes will be acceptable. When it is necessary to replace any piece of pipe, fitting, valve, etc., the replacement shall be of the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good.

3. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage will result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests.
4. All equipment used in testing shall be provided by the Contractor, shall be 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 shall be witnessed by the Sussex County Engineering Department or their designated representative.

1.04 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.

1.05 REFERENCES

- A. UNI-B-5 - Unibell Plastic Pipe Association recommended Practice for Installation of PVC sewer pipe.
- B. AWWA Manual M23; PVC Pipe - Design and Installation.
- C. ASTM D1784 - Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (C PVC) Compounds.
- D. ASTM D2412 - Test Methods for Determination of External loading Characteristics of Plastic Pipe by Parallel - Plate Loading.
- E. ASTM D3034 - Standard Specification for Type PSM Polyvinyl Chloride (PVC) - Sewer Pipe and Fittings, SDR 35, and SDR 26 in sizes 4" - 15".

- F. ASTM D2321 - Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- G. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- H. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- I. ASTM F-679 - Standard Specification for Polyvinyl Chloride (PVC) Large - Diameter Plastic Gravity Sewer 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 as specified.

2.02 PVC PIPE, LATERALS AND FITTINGS FOR GRAVITY SEWER

- A. PVC used for sewer construction shall meet or exceed the requirements of ASTM D-3034 for all PVC pipe less than 18" and ASTM F-679 for pipe 18" and larger. Pipe shall be polyvinyl chloride gravity sewer pipe with integral wall bell and spigot rubber gasketed joints in standard lengths not exceeding 20'. All pipe for PVC gravity sewers and laterals shall be SDR 35 unless otherwise noted as requiring the installation of PVC meeting AWWA C-900. All gaskets shall conform to ASTM F 477.
- B. All bells shall consist of an integral wall section with a flexible elastomeric O-ring gasket joint assembled in accordance with the manufacturer's recommendations. All seals shall be securely locked in place to prevent displacement. Pipe length shall be either 12.5 or 20 feet.
- C. Pipe shall be designed to have a minimum pipe stiffness of 46 psi when measured under a 5% deflection at 73 degrees F, as tested in accordance with ASTM D-2412.
- D. PVC laterals shall be manufactured in accordance with the same specifications, and have the same thickness, depth of socket, and annular space as the pipe.
- E. Wye branches shall be complete pipe sections. Saddles will not be permitted for new construction. Gaskets for fittings shall conform to ASTM F-477. All PVC sewer fittings shall be SDR26 Heavy Duty fittings unless otherwise noted on the

plans as requiring C-900 PVC fittings. All sewer fittings shall be as manufactured by Harco, Plastic Trends, or Multi Fittings “or equal”.

- F. All PVC sewer pipe shall be J-M, Certain Teed PVC sewer pipe, North American Pipe Corp., “or equal”.

2.03 CLEANOUTS

- A. Cleanout frames and covers shall be constructed as indicated on the construction drawings. All cleanout frames and covers shall be cast iron. Cleanout frames and covers shall be watertight with recessed lifting holes.
- B. Sewer Lateral Cleanout Frames and Covers - Cleanout frames and covers shall be cast iron. Cleanout frames and covers shall be watertight with recessed lifting holes. Terminal Sewer cleanout frames and covers shall be East Jordan Iron Works Model MHR 1180, Neenah Foundry equivalent, “or equal,” for use with PVC pipe. House lateral cleanout frames and covers shall be East Jordan Iron Works Models 1565, or 1566, Neenah Foundry equivalent, “or equal,” for use with PVC pipe. Cleanout frames and cover shall be manufactured in the United States of America using American steel. See drawings for details.
- C. Each lot whether developed or undeveloped shall receive one sewer lateral and cleanout unless otherwise directed by the Engineer.

2.04 PIPELINE DETECTION SYSTEM

Pipeline detectable tape shall be installed continuously along all gravity sewers. The tape shall be Lineguard type III Detectable Tape as manufactured by Lineguard, Inc., Proline Safety Products, “or equal”. The tape shall be a minimum of three (3) inches wide, green in color, imprinted with the words, "CAUTION - SEWER LINE BELOW" and be capable of being detected with inductive methods.

PART 3 - EXECUTION

3.01 PVC PIPE INSTALLATION

- A. Gravity Sewer Pipe shall be installed in accordance with ASTM D-2321, applicable manufacturer's installation manuals and UNI-BELL Plastic Pipe Association Recommended Practice for the Installation of PVC Sewer Pipe UNI-B-5.
- B. All pipe, fittings, valves and accessories shall be carefully lowered into the trench using suitable equipment in such manner as to prevent damage to pipes and fittings. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench.

- C. The pipe and accessories shall be inspected for defects prior to lowering into the 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.
- D. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. The open ends of all pipe lines shall be provided with a stopper carefully fitted, so as to keep dirt and other substances from entering.
- E. 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 is unsuitable for proper installation as determined by the Engineer.
- F. Whenever a pipe requires cutting, 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.
- G. 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.
- H. 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.
- I. In laying pipe, special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipeline. No wedging or blocking will be permitted in laying pipe unless by written order or permission from the Engineer.

- J. Before joints are made, each pipe shall be well bedded on a solid foundation, and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Any defects due to settlement shall be made good by the Contractor. Bell holes shall be dug large enough to insure that the pipe is firmly bedded on the full length of the barrel. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes shall be used.
- K. All excavations in which the pipe is being laid shall be kept free from water and no joint shall be made under water. Water shall not be allowed to rise in the excavation until the joint material has received its set. The greatest care shall be used to secure water tightness and to prevent damage to or disturbance of the joints during the backfill process, or at any time.
- L. After pipes have been laid and the joints have been made, there shall be no walking on or working over them except such as may be necessary in tamping, until there is a covering of at least two (2) feet in depth over the pipe crown.
- M. No pipe shall be laid upon a foundation into which frost has penetrated nor at any time that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation.
- N. Pipe bedding depth shall be as indicated on the Drawing details. Pipe bedding material shall be on-site material excavated from the trench or borrow material, either material meeting the requirements of DelDOT Borrow Type "B" (Special Fill), or DelDOT Coarse Aggregate # 57 stone, as defined in DelDOT Standard Specifications 209.04 and 813 respectively, and as indicated on the Drawing details for each trench condition. The bedding material shall be thoroughly compacted by approved hand-operated mechanical tampers or approved compaction equipment before laying the pipe to provide a uniform and continuous bearing and support for the pipe. Bell holes shall be excavated in the bottom wherever necessary to permit the proper making of joints.
- O. Backfill material for excavations made below the designed bottom of pipe bedding shall be suitable, on-site backfill material excavated from the trench, or borrow material, either material meeting the requirements of DelDOT Borrow Type "B" (Special Fill) or DelDOT Coarse Aggregate SP-57 stone.
- P. Backfill material for the trench above bedding material to the bottom of roadway or shoulder patch materials shall be suitable, on-site backfill material excavated from the trench, or borrow material, either material meeting the requirements of DelDOT Borrow Type "B" (Special Fill) or Borrow Type "C" (Backfill).
- Q. For trenches outside the roadway or shoulder areas (either existing or proposed), borrow meeting Type B or Type C requirements need only be placed to an elevation 1 foot above the top of the pipe. Existing excavated material may be

used to complete the backfill provided it is clean, dry soil having no organic content.

- R. All material shall be installed and compacted in accordance with DelDOT Standard Specification 208.04.
- S. The Contractor shall have on the site, at all times, factory approved equipment to machine cut the end of short pieces of pipe to standard couplings and jointing materials.
- T. Sewers shall be laid at least 10 feet horizontally from any existing or proposed water mains. The distance shall be measured outside edge to outside edge.
- U. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equal distance and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
- V. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, concrete encasement shall be required to be installed a minimum of 5-feet each side of the crossing point on the lowest utility. See drawings for the encasement detail.

3.02 LATERALS

- A. All sewer house laterals shall be laid as detailed on the drawings.
- B. All sewer house laterals shall be constructed to terminate at an angle perpendicular to the property lines unless otherwise noted on the plans.
- C. All PVC branches shall be located in the position designated by the Engineer or his representative. Short pieces of lateral sewer shall be field cut to meet this condition. The Contractor shall have on the site, at all times, factory approved equipment to machine cut the end of short pieces of pipe to fit standard couplings and jointing materials.
- D. All sewer house laterals shall be installed as described in section 3.01 PVC Pipe Installation.
- E. All laterals shall be installed at a depth of 4-5' at the property line unless otherwise indicated on the plans with a critical depth lateral elevation. In such cases where obtaining 4-5' depth at the property line is not possible due to the elevation of the mainline sewer, all laterals shall be laid at 2% to achieve the

maximum depth possible at the property line. The minimum depth of such laterals shall be 3-feet as measured from top of pipe to finished grade. The minimum depth of any lateral under ditches shall be 2.5-feet as measured from the top of the pipe to finished grade. 3-foot cover shall be maintained under ditchlines wherever possible. All laterals not meeting the above specified criteria under ditch lines shall be concrete encased. See drawings for the encasement detail

- F. Laterals shall be laid at least 10-feet horizontally from any existing or proposed water mains. The distance shall be measured outside edge to outside edge.
- G. Laterals crossing water mains shall be laid to provide a minimum vertical distance of 18-inches between the outside of the water main and the outside of the laterals. This shall be the case where the water main is either above or below the laterals. The crossing shall be arranged so that the laterals joints will be equal distance and as far as possible from the water main joints. Where a water main crosses under a lateral, adequate structural support shall be provided for the lateral to prevent damage to the water main.
- H. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, concrete encasement shall be required to be installed a minimum of 5-feet each side of the crossing point on the lowest utility. See drawings for the encasement detail.

3.03 TESTING

- A. The Contractor shall schedule all tests with the Engineer and Owner at least 48 hours in advance, and shall conduct all acceptance testing in the presence of the Engineer.
- B. Generally, piping, fittings and appurtenances will be tested from end to end. Pressure and leakage tests shall be performed.
- C. The Contractor shall be responsible for the testing of all pipelines. The Contractor is responsible for supplying all labor and materials involved for all tests. All testing shall be performed at the expense of the contractor.
- D. If the piping or any section or component thereof fails the tests and/or inspection, the Contractor shall, at his own expense, repair and replace any defective component and retest until all requirements are met. The County will furnish personnel to witness tests, one time only. If additional tests are required, all costs of County personnel and equipment will be deducted from amounts to be paid the Contractor.

3.04 TESTING OF SANITARY SEWERS

- A. Prior to the request for Substantial Completion, it shall be the Contractor's responsibility to examine all completed pipelines to insure that they are laid at the proper alignment and grade and free from foreign material. After this has been done to the satisfaction of the Engineer and/or Owner, he will order the tests on all sewers built under the contract. The Contractor shall cooperate and furnish all assistance and materials necessary to perform the tests specified herein and as directed by, and under the direction of the Owner.
- B. All sanitary sewers installed shall be subject to Mirror Testing and Deflection testing as specified below. In addition, the Contractor shall provide either Air or Exfiltration / Infiltration testing as specified below.

1. Mirror Testing of Sanitary Sewers

Upon Completion of Pipe laying and backfilling, the Owner will conduct a mirror test to check for defects, or leakage, and for horizontal or vertical misplacement. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through the completed section of pipeline, which, in order to be accepted, shall be true and straight in horizontal and vertical alignment to allow full passage for the reflected light.

2. Deflection Testing of Sanitary Sewers

a. Sanitary sewers shall be tested in the presence of the Engineer, Owner, and the Contractor's representative to determine the amount of vertical deflection in the completed pipeline. Deflection testing as specified hereinafter shall be accomplished by the Contractor on all sanitary sewers installed. Should significant failures be detected, additional deflection testing shall be performed by the Contractor. Installation of Sanitary sewers shall be complete prior to the start of deflection testing. All sheeting shall be removed except where written approval by the Engineer has been obtained. All backfill shall be placed, consolidated and dewatering operations ceased 30 days prior to the start of deflection testing. The following method of testing shall be utilized.

b. A mandrel with a diameter equivalent to 95% of the inside diameter of the pipe to be tested shall be pulled through the pipeline, from manhole to manhole, by hand. If it is unable to pass through the pipe without applying excessive force (as judged by the Owner), it will be considered as evidence that the pipe has deflected more than 5% of the inside pipe diameter. A permanent record of all testing locations where excessive pipeline deflections occur shall be kept by the Contractor and forwarded to the Engineer after the completion of testing of each line. The mandrel

shall be approved by the Engineer and/or Owner prior to use. Mandrels shall have an odd number of gaging plates. The minimum number of plates shall be nine (9) with a contact surface length equal to the inside diameter plus two (2) inches for pipelines 10 inches in diameter and smaller. On larger diameters, the contact surface length shall equal the inside pipe diameter. The Contractor shall immediately replace all sections of pipe which deflect more than 5% as measured by the foregoing method.

3. Air Testing

- a. All sanitary sewers shall be tested with air under low pressure in accordance with subsequent designated procedures, and will not be accepted by the Owner until the sewers meet with the specified criteria. Pressure gauges, stop watches, air compressor, hoses, plugs, and test supervision shall be furnished by the Contractor. All tests shall be conducted by the Contractor in the presence of the Engineer and Owner. The Contractor shall not be permitted to place air under pressure in any sewer under any circumstances except those explicitly mentioned herein.
- b. All sanitary sewers, including manholes, shall be inspected prior to air testing and any water leakage into the system sufficient to constitute any noticeable trickle or dribble shall be corrected and eliminated prior to undertaking the low pressure air test.
- c. Whenever it has been necessary to construct underdrains or place gravel under pipelines in order to dewater the trench during construction of the sewers, the air test shall not be made until any pumps which have been used in the dewatering process have been removed from the site.
- d. Before any air test is scheduled, the Contractor shall have completed all backfill operations including compaction testing.
- e. The Contractor shall schedule all air tests with the Engineer and Owner at least 48 hours in advance thereof. Each section of completed sewer shall be tested. Generally, the sewers will be tested from manhole to manhole or from a manhole to the terminus of the sewer if there is no manhole at the other extremity.
- f. The test procedure shall be conducted in the following manner:
 - i. The Contractor shall thoroughly clean and remove all debris, silt, earth, or other material from the sewer prior to air testing. The pipe may be cleaned with water in a

manner approved by the Owner. None of this water or debris shall be allowed to enter the existing sewer.

- ii. All branch fittings and end of laterals stubs shall be securely plugged to withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced when required.
- iii. If the pipe to be tested is expected to be below the groundwater table, the Contractor shall install either a small diameter perforated vertical pipe from the invert elevation of the sewer to the surface prior to backfilling or shall insert a pipe probe by boring or driving into the backfill material adjacent to the invert elevation of the pipe and shall determine the depth of the groundwater level above the pipe invert immediately prior to air testing the sewer. All gauge pressures in the test shall be increased by the amount of this back pressure due to groundwater submergence over the end of the probe.
- iv. The Contractor shall add air slowly through a single control panel to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.
- v. As a safety precaution, no one shall be allowed in a manhole after the air pressure is increased in the sewer line. If the Engineer or Owner suspects that the test plug may be leaking, the pressure first shall be relieved before any adjustments are made to eliminate air leakage at the plug. The Contractor may precoat the plug with a soap solution to check the plug for leakage.
- vi. The Contractor shall allow the air temperature to stabilize for at least 2 minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain this pressure.

- vii. After a 2-minute period, the Contractor shall completely disconnect the hose and compressor from the pipe being tested to assure that no additional air is added therein.
- viii. The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease 1 lb/square inch.
- ix. The line shall be considered acceptable if the time, in seconds required for a 1 psi pressure drop is not less than the following:

$$T = 0.0850 DQ/K$$

Where;

K= 0.000419 DL, but not less than 1.0

Q= rate of loss of 0.0015 cu. ft/min/sq. Ft. of internal surface.

D= Pipe Diameter, in.

L = Length of line being tested, ft.

See table 1 (to be provided by the Owner upon request) for specification time required for a 1 psig pressure drop for size and length of pipe indicated for Q=0.0015.

A sample air test data sheet will also be provided for the Contractors use.

- x. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section.
- xi. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the tables shall be deemed to have failed to pass the low pressure air test and is unsatisfactory for acceptance by the Owner. Any sewer that fails to pass this test shall be repaired by the Contractor at his own expense. Following repairs, the sanitary sewer shall be tested again in accordance with the designated procedures.

4. Infiltration and Exfiltration Tests

- a. Leakage, whether infiltration or exfiltration shall not exceed a rate of ten gallons per inch of diameter per mile of sewer per twenty-four hours in any section of piping between successive manholes.

- b. Infiltration testing shall take place when the natural ground water table is above the crown of the piping at the higher end of the TEST SECTION. The amount of leakage shall be measured by a suitable weir or other devices as directed. Exfiltration tests shall be made of each section as directed.
- c. A section of sewer line shall be prepared for testing by plugging the upper side of the downstream manhole and all openings in the next upstream manhole except the downstream opening. The maximum head on any section under test will not exceed thirty feet for PVC pipe. Branch sewers running from Y-branches on the MAINS shall be plugged at the upper end (C.O. location) if the test head would cause them to overflow.
- d. A section of sewer line prepared as above shall be tested by filling it with water to an elevation of one foot above the top of the pipe in the upstream manhole, in mains without laterals or the test head must exceed the highest house service elevation, whichever is greater. The water should be introduced into the test section at least four hours in advance of the official test period to allow the pipe and joint material to become saturated with water. All entrapped air shall be removed prior to performance of test.
- e. At the beginning of test the elevation of the water in the upper manhole shall be carefully measured from a point near the water level such as a manhole rung. After a period of six hours or more, with the approval of the Engineer, the water elevation shall be measured from the same point on manhole rung and the LOSS of water during test period calculated. Sewer section showing leakage in excess of that allowed shall be repaired or reconstructed as necessary then retested.

3.05 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 defective shall not be placed in the line.

3.06 EXISTING UTILITIES

- A. Existing utilities have been indicated on the drawings in accordance with the information shown on record drawings. The Owner and DelDOT 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. The Owner and DelDOT assume no responsibility for damages or downtime for the Contractor or their subcontractors resulting from the inadequate or negligent performance by utility locators.
- 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 and Owner, using materials of the kinds damaged. No additional payment will be made for such repair work.
- 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 or 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.

SECTION 02731

FORCEMAINS 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, 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 Owner.

1.03 MANUFACTURER'S CERTIFICATES

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

1.04 QUALITY ASSURANCE

- A. The Engineer and/or Owner will inspect all materials before, during and after installation to ensure compliance with these Contract Documents. When specific material tests are called for in the referenced standards and specifications, the Owner shall have the option of requiring that any or all of these tests be performed on materials furnished for a specified project.

- B. The Contractor shall schedule all tests with the Engineer at least 48 hours in advance, and shall conduct all acceptance testing in the presence of the Owner.
- C. Field Tests
 - 1. After installation, the Engineer and/or Owner will initially inspect outside piping and it 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 DelDOT. 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/or Owner, 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 (Owner) 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/A21.4-95 Standard for Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
 - 2. ANSI/AWWA C110/A21.10-98 Standard for Ductile Iron and Gray Iron Fittings, 3 through 48 inches, for Water and Other Liquids.
 - 3. ANSI/AWWA C111/A21.11-95 Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 - 4. ANSI/AWWA C115/A21.15-99 Standard for Flanged Ductile Iron Pipe with Threaded Flanges.
 - 5. ANSI/AWWA C150/A21.50-96 Standard for the Thickness Design of Ductile Iron Pipe.
 - 6. ANSI/AWWA C151/A21.51-96 Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids.
 - 7. ANSI/AWWA C153/A21.53-94 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 C600-99 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
 - 9. AWWA C504-94 Standard for Rubber-Seated Butterfly Valves.
 - 10. AWWA C507-99 Standard for ball valves 6-inch through 48-inch (150mm through 1200 mm).

11. ANSI/AWWA C512-99, Standard for Air Release, Air Vacuum, and Combination Air Valves for Waterworks Service.
12. ASTM A536-84 Standard Specification for Ductile Iron Castings

B. Polyvinyl Chloride Pipe (PVC)

1. ANSI/AWWA C900-97 AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 through 12 inches for water.
2. ANSI/AWWA C905-97 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 F477-93 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

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

Service	Pipe material	Fittings
24" FM	Class 300 DIP	DI
10" FM	DR 18 C-900 PVC	DI
8" FM	DR 18 C-900 PVC	DI
14" FM	DR 18 C-905 PVC	DI

2.03 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe for buried service shall be furnished in accordance with ANSI/AWWA C151/A21.51-96 or latest revision thereof. All ductile iron pipe shall be double cement mortar lined with a bituminous coated exterior. The pipe thickness shall be Class 300.
- 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, Ford Meter Box, "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, Romac Industries, "or 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.
- F. Unless otherwise specified, the inside of pipe and fittings shall be cement-lined in accordance with ANSI Specifications A21.4 (AWWA C-104). Thickness of cement lining shall be twice the standard thickness specified in the paragraph, "Thickness of Lining," in Section 4.8 of ANSI Specifications A21.4 (AWWA C104) and the curing shall be effected by means of a seal coating. The outside of buried pipe and fittings shall be bituminous coated. All exposed ductile iron pipe and fittings shall be shop primed (with primer compatible with field painting) on exterior surfaces and given required finish coats in the field.
- G. The curing shall be effected by the application of a petroleum base bituminous seal coating which shall continuously cover and seal the cement mortar. After drying for 48 hours, such bituminous seal coating shall have no deleterious effect upon the quality, color, taste, or odor of potable water which has been standing for 48 hours in the pipe. The bituminous seal coating shall be applied to the lining as soon as it is sufficiently dry. No pipe or fittings shall be shipped in less than 12 hours after the lining is thoroughly set and hard
- H. 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.

- I. 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.
- J. 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.
- K. Bell joint clamps shall be style 60 as manufactured by Dresser Industries, Romac, "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 double cement mortar lining conforming to AWWA C104/A21.4.
- D. All fittings for 1 1/2"-3" PVC pressure pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM 1784. Fittings shall be class 200 and have a minimum SDR of 21. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F., tested in accordance with ASTM D 1599. Bells shall be gasketed joint conforming to ASTM D 3139 with gaskets conforming to ASTM F477.
- E. Each pipe section including bell or coupling shall be subjected to a hydrostatic test of more than 500 psi for at least five seconds. Pipe shall be tested in

accordance with conditions in ASTM D618. Any pipe that leaks or is unable to withstand the test pressure shall be rejected. The test shall be conducted at the factory and certification stating that the operation has been conducted as specified and the pipe meets all conditions of this specification shall be submitted to the Engineer.

- F. Pipe shall be manufactured in lengths not exceeding 20 feet.
- G. Mechanical joint restraint gland for use with PVC AWWA C900/C905 pipe shall be EBAA Iron Sales, Inc., Series 2000 PV mechanical joint restraint, Ford Meter Box, "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 and UV resistance. The coating system for all mechanical joint restraints shall be mega-bond by Ebba Iron, E-Coat by Ford Meter Box, "or approved equal".
- H. Restraint for PVC pipe bells (AWWA C900) for C900 pipe 4"-12" shall be EBAA Iron Sales, Inc., Series 1600, Ford Meter Box, "or equal." Restraint for PVC bells (AWWA C900) for C905 pipe shall be EBAA Iron Sales, Inc., Series 2800, Ford Meter Box, "or equal." All such restraints shall have the same coating system as the described for the mechanical joint restraint gland.

2.05 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, Crispin X-Series Model # ux20, "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., Series FS300 by Ford Meter Box, or approved equal.
- C. Stainless steel ball valves shall be installed in manholes in accordance with the detail shown on the plans. All ball valves shall be full port stainless steel model 76-F 100 series as manufactured by Apollo, Series 110 by Valtorc, or approved equal.
- D. All combination valves shall be install in reinforced concrete manhole sections as indicated on the details. All manhole structures shall meet the requirements of ASTM C-478. Access to manholes shall be provided through a Sussex County standard frame and cover. Frames and covers shall be traffic bearing, H20 heavy duty loaded.

2.06 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., Pro-Line, "or equal." The tape shall be a minimum of three (4) 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, Morris, or equal. Removal of the insulation at the splice is required, so a metal connection is made. Placement of the wire shall be on top of the pipe. The wire shall be so placed that it and the force main will not be separate by more than 3 inches. The wire shall be attached to the top of the pipe as indicated on the details prior to any backfilling. The wire shall be brought up to the surface of the ground at the beginning and termination of the pipe, at any in line valving (interior of the valve box) or any other appropriate location, or as directed by the Engineer.

2.07 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.

2.08 VALVE AND 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.
- B. Isolation shall be gate valves and shall be of the solid wedge, rubber encapsulated, resilient seat type. Valves shall be rated for 200 psi working pressure and hydrostatically tested to 400 psi in accordance with AWWA C-509. Valve bodies, bonnets and seal plates shall be cast iron conforming to ASTM-A-126B. Wedges shall be ductile iron conforming to ASTM-A-536. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, and a minimum yield of 20,000 psi. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM-A-307 and A-563, respectively.
- C. Resilient Seated Gate Valves shall be operated to open left of the non-rising stem type (NRS) in accordance with AWWA-C-509. 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.
- D. 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.
- E. Gate valves shall be provided with extension stems with guides and valve boxes as shown on the Contract Drawings.
- F. Valves shall be furnished with mechanical joint ends as indicated on the drawings.
- G. Marking shall be in accordance with AWWA-C-509 Standards, to include name of manufacturer, the year of manufacture, maximum working pressure and size of valve.

- H. Resilient seated gate valves shall be Waterous Series 500, Mueller, “or equal”.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION - GENERAL

- A. Contractor shall adhere to the manufacturer's recommended installation procedures.
- B. The pipe and accessories shall be inspected for defects prior to installation. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Owner.
- C. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipelines shall be covered to keep dirt and other substances from entering. The cover shall be kept in the end of the pipelines at all times when laying is not in actual progress.
- D. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of debris into the line. If water enters the trench, the Contractor shall prevent the pipe from floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installation as determined by the Engineer or Owner.
- E. The pipe shall be cut in accordance with the manufacturer's recommended procedures. Cuts shall be completed in a neat and workmanlike manner without damage to the pipe so as to have a smooth end at right angles to the axis of the pipe.
- F. No pipe shall be laid upon the foundation into which frost has penetrated nor at any time when the Engineer or Owner shall deem that there is danger of formation of ice or the penetration of frost at the bottom of the excavation.
- G. Pipe bedding depth shall be as indicated on the Drawing details. Pipe bedding material shall be on-site material excavated from the trench or borrow material, either material meeting the requirements of DelDOT Borrow Type "B" (Special Fill), or DelDOT Coarse Aggregate # 57 stone, as defined in DelDOT Standard Specifications 209.04 and 813 respectively, and as indicated on the Drawing details for each trench condition. The bedding material shall be thoroughly compacted by approved hand-operated mechanical tampers or approved compaction equipment before laying the pipe to provide a uniform and continuous bearing and support for the pipe. Bell holes shall be excavated in the bottom wherever necessary to permit the proper making of joints.
- H. Backfill material for excavations made below the designed bottom of pipe bedding shall be suitable, on-site backfill material excavated from the trench, or

borrow material, either material meeting the requirements of DeIDOT Borrow Type "B" (Special Fill) or DeIDOT Coarse Aggregate, # 57 stone.

- I. Backfill material for the trench above bedding material to the bottom of roadway or shoulder patch materials shall be suitable, on-site backfill material excavated from the trench, or borrow material, either material meeting the requirements of DeIDOT Borrow Type "B" (Special Fill) or Borrow Type "C" (Backfill).
- J. For trenches outside the roadway or shoulder areas, borrow meeting Type B or Type C requirements need only be placed to an elevation 1 foot above the top of the pipe. Existing excavated material may be used to complete the backfill provided it is clean, dry soil having no organic content.
- K. All material shall be installed and compacted in accordance with DeIDOT Standard Specification 208.04.

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 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 Owner.

- B. Generally, piping, fittings and appurtenances will be tested from end to end. Pressure and leakage tests shall be performed.
- C. 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 Owner for testing in accordance with these Specifications. All testing shall be performed at the expense of the Contractor.
- D. If the piping or any section or component thereof fails the tests and/or inspection, the Contractor shall, at his own expense, repair and replace any defective component and retest until all requirements are met. The County will furnish personnel to witness tests, one time only. If additional tests are required, all costs of County personnel and equipment will be deducted from amounts to be paid the Contractor. 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.

3.05 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 Owner .
 - 2. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so the air can be expelled.
- B. Leakage Test - After satisfactory completion of the pressure test, the Contractor shall conduct a leakage test. The Contractor shall furnish the gauge and measuring device for the leakage test. The Contractor shall furnish the pump, pipe connections, and other necessary apparatus. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section, to maintain the specified leakage test pressure. After the air in the pipeline has been expressed and the pipe has been filled with water, the allowable leakage shall be not more than 25 gallons of water per inch diameter of pipe per mile of pipe tested per 24 hours at a pressure of 100 psi, measured at the highest elevation. Leakage test shall be carried out for not less than a four hour duration and the allowable leakage prorated accordingly. Failure of the line to pass either the pressure or leakage test shall be cause for the test failure. The Contractor shall

effect the necessary repairs and retest the line until it passes both tests. All tests shall be conducted in the presence of the Engineer and Owner .

3.06 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 Owner .

3.07 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.

3.08 EXISTING UTILITIES

- A. Existing utilities have been indicated on the drawings in accordance with the information shown on record drawings. DeIDOT and the Owner expressly disclaim 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. DeIDOT and the Owner assume 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.

3.09 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.

SECTION 02732

LINE STOP AND BY-PASS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all labor, materials, equipment and services necessary for, and incidental to properly install, set, and remove line stops into the existing Ductile Iron Main as required to perform the forcemain realignments as shown on the plans.
- B. The design, installation and operation of the temporary line stop system shall be the Contractor's responsibility. The Contractor shall employ the services of a line stop company who can demonstrate to the Engineer that they specializes in the design and operation of line stop and bypass systems. The line stop and bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. Line stop technician actually operating the machinery will have, as a minimum, a (5) year continuous employment history with the line stop contracting company. The line stop Subcontractor will be required to furnish employment history for this technician along with a safety and other operational training summary. In no case will a technician without proper supporting documentation and qualifications be permitted to work on the jobsite. The lines stop Subcontractor for this specialized work may be Garrison Enterprise Inc., TDW, Furmanite America, Inc., or approved equal.

1.02 SUBMITTALS

- A. During shop drawings, the Contractor shall submit to the Engineer calculations, detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. No construction shall begin until all provisions and requirements have been reviewed by the Engineer and the Owner.
- B. Submit qualifications and supporting employment history for technicians for Line Stop Subcontractor.
- C. Contractor shall submit to Engineer drawings, furnished by manufacturer, fully and distinctly illustrated and describing the Line Stop fittings proposed to be

furnished.

- D. Calculations for all thrust forces and thrust blocks associated with the line stop by-pass and all hydraulic headloss calculations for the entire bypass system shall be signed and sealed by a Delaware licensed professional engineer.

1.03 INTERRUPTION OF FLOW

- A. There are nine sections of 24-inch or 10-inch force main being relocated in the project area. As depicted on the contract drawings, relocations 1 and 2 for the 24-inch force main are for Sussex County's Pump Station (PS #99) in Ocean View, which is operated at less than 75 psi. Relocations 3 through 9 are for Sussex County's PS#43, located in Bethany Beach and operated at less than 50 psi.
- B. Flows from the 10-inch force main can be shut down and removed from service as required for the relocations. Flows from the 24-inch force main cannot be shut down or taken out of service. To insure that the entire operation shall be accomplished without interruption of service or flow, the installation of one or more stopples shall be accomplished for the 24-inch force mains by Contractor personnel skilled and experienced in the procedures specific to Stopples of this size.
- C. The entire operation of making the Line Stop shall be accomplished without reduction of water pressure in the main(s). It shall be the responsibility of the Contractor to verify pressure prior to commencing the installation. At the Contractor's option, one or more line stops may be installed to bypass flows as required for the 24-inch force main relocations. The design capacity of PS#43 and PS#99 is 6,200 gpm and 8,800 gpm for PS#99. Temporary hydraulic restrictions from line stop and bypass operations will be allowed. **However, the total loss in pressure allowed for a line stop (or combination of line stops) and associated bypass systems (bends, temporary piping, etc.) at one time is 15 ft (6.5 psi). This pressure drop shall be based upon a design flowrate of 4,500 gpm for the PS#43 and 7,200 gpm for PS#99.** All stopple operations are seasonally restricted and will not be allowed to be performed from Memorial Day through Labor Day.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. All equipment utilized for the line stop and pipe plugging operations will be designed and manufactured to meet the 150 psi maximum working pressure of the system. The pressure ratings will include a suitable safety factor above the operating pressures in the equipment design calculations.

- B. Hot tapping machinery will be designed and constructed in such a manner that they will withstand the pressure and mechanical forces to be encountered during the hot tapping process. Equipment will be power operated.
- C. Line Stop fitting shall be full encirclement type, split tee. It shall consist of two halves: (1) An upper Stop flange saddle half. The interior of the saddle plate adjacent to and concentric with the O.D. of the nozzle shall be grooved to retain a gasket which shall seal the saddle plate to the exterior of the main. This gasket shall constitute the only seal between the main and the fitting. (2) A lower bottom solid half with bolting arrangement for fastening to upper half.
- D. Stop Flange: The outlet of each fitting shall be machined from a 150 lb. forged steel flange (ASTM A181 or A105) for from pressure vessel quality steel plate (ASTM A285, Grade C); flat faced and drilled per ANSI B16.5). Suitable independently operated locking devices shall be provided in the periphery of the flange to secure the completion plug.
- E. Stop Nozzle: The nozzle, which lies between the saddle and the flange shall be fabricated from steel pipe (ASTM A234). After welding stress relief, the nozzle shall be accurately bored as follows to accommodate the Stop plugged head: Machine an internal circular shoulder to seal against circumferential gasket carried on the plugging head.
- F. Completion Plug: The completion plug shall be machined from a stress relieved carbon steel weldment. It shall contain two (2) circumferential grooves: one to receive the locking devices from the Stop flange, and the second to contain a compressible "O" ring to seal pressure tight against the bore of the flange.
- G. Blind Flange: Each Stop fitting shall be closed with a blind flange. Facing and drilling of the blind flange shall be compatible with that of the Stop flange. Minimum blind flange thickness shall be that of AWWA Spec. 207, Class D.
- H. Saddle Alignment Marking: Each saddle half shall be matched and marked with serial numbers, to insure proper alignment in the field.
- I. Fasteners: All bolts, studs and nuts used on Stop and drain / equalization fittings shall be of the heavy series.
- J. Manufacturer will exercise extreme care to insure that weldments are of adequate strength; properly shaped, securely reinforced and free from distortion that could stress the ductile iron main during installation, pressure tapping, or Stopping operations. All steel shall meet the requirements of ASTM A36, as a minimum. All weldments shall be braced and stress relieved.
- K. Gaskets: Shall be molded from elastomer compounds that resist compression

setting and are compatible with water in the 32 to 140 degree F temperature range.

- L. Upper Line Stop Flange Saddle: Shall consist of a saddle plate, a Stop flange, and a Stop nozzle. The interior of the saddle plate, adjacent to and concentric with the O.D. of the nozzle, shall be grooved to retain a gasket which shall seal the saddle plate to the exterior of the ductile iron main. This gasket shall constitute the only seal between the main and the fitting. Saddle plate shall be of a minimum of 0.375" in thickness. It shall be shaped to be concentric to the outside of the ductile iron main. The smallest I.D. of the saddle and its interior rings shall exceed the O.D. of the main by a minimum of 0.250" to allow for ovality of the main.
- M. A Stop nozzle of 0.375" minimum wall thickness shall be securely welded to the saddle plate.
- N. The Stop flange shall be securely welded to the nozzle. After welding, the assembly shall be braced, stress relieved, and bored to receive the completion plug and the circumferential gasket of the Stop machine plugged head.
- O. Bolt, nut of stud, nit, and washer assemblies shall be furnished to draw the upper and lower saddles together for sealing. Bolting brackets shall be gusseted.
- P. Lower Saddle Plate: Saddle plate shall be of a minimum of 0.375" thickness and shall be shaped to be concentric to the outside brackets shall match upper half.
- Q. Temporary Bypass Piping: Temporary bypass piping installed from line stop ~~stop~~ to line stop shall be self restrained/fused piping. All piping shall be pressure rated to 150 psi.
- R. All line stops shall be installed size on size.

PART 3 – EXECUTION

All line stops shall be executed in accordance with the manufacturer's recommendations.

3.01 INSTALLATION OF STOP FITTINGS, GENERAL

- A. Contractor shall power wire brush and grind the exterior of the main to remove any debris, corrosion deposits, or other surface irregularities that might interfere with proper seating and sealing of each Stop fitting against each main. Any structural defects in main, service connections, appurtenances, adjacent utilities, etc., that could interfere with the Stop installation shall be immediately reported to the Engineer.

- B. All excavations will be in accordance with current O.S.H.A. safety standards. Excavation will include necessary sheeting and shoring, gravel base and site de-watering. Proper pipe support and thrust restraint be in place prior to the start of hot tapping saddle installation. The pipe will be thoroughly cleaned down to the factory supplied outside diameter. The pipe will be carefully inspected, especially at the point where the fitting “O” ring must seal to the pipe surface. Any surface pitting will be filled in with an engineer approved epoxy or the site moved to an acceptable location.
- C. Contractor shall fit upper and lower saddle plate assemblies to main, thoroughly checking for proper fit to main.
- D. Assembly to Main: Under no circumstances shall Contractor attempt to force, reshape, or bend saddle plates by excessive tightening of saddle studs while Stop fitting is assembled around main.
- a. Any retrofitting shall be accomplished with the fitting removed from main.
 - b. Any damage to fitting, accessories, or main shall be repaired at Contractor’s expense to the satisfaction of the Engineer and Owner.

3.02 DRAIN PRESSURE TAPS

Contractor shall provide drain pressure taps between Line Stops. These pressure connections will allow quick determination of shutdown adequacy.

- In order to remove a Line Stop plugging head, equalization will be required.
- Contractor shall have the option of recovering the drain valves by using Line Stop type tapping nozzles with completion plugs, or abandoning the valves by leaving them attached to the nozzles. In either case, the outlet of each nozzle or valve shall be sealed with a blind flange, mechanical joint plug, or a screwed tight manner.
- The interior of the saddle plate, adjacent to and concentric with the O.D. of the nozzle, shall be grooved to retain a gasket which shall seal the saddle plate to the exterior of the ductile iron main. This gasket shall constitute the only seal between the main and fitting.
- At contractor’s option, the saddle plate shall consist of a steel weldment, in general conformity with Section 1.7, below, or a machined ductile iron casting.
- Saddle shall be clamped to main by a minimum of two “U” shaped steel strap/stud assemblies of sufficient cross section to contain a line pressure of 200 psig.

3.03 LINE STOP PROCEDURE

- A. The Line Stopping procedure is a means of temporarily plugging a pressurized pipe without disrupting pressure or service upstream of the Line Stop. A pressure tap is first made into the main, allowing insertion of the Line Stop plugging device into the main under pressure. By using a special Stop Fitting, the tapping

valve can be later recovered after the plugging head has been removed from the main. The following is a suggested sequence of construction:

- The existing ductile iron line is a 24" DIP line installed in 1975. The pipe was specified to be Class 1 DIP, which are equivalent to special thickness class 51. No additional information is available concerning the material actually installed.
- Prior to ordering material: Excavate, dewater, and clean the exterior of the main at location of each Line Stop. If main is heavily corroded; or if utilities will interfere with fittings, support/reaction blocking, or equipment; move location up or downstream to structurally sound pipe.
- Caliper O.D. of all mains to determine ovality
- Verify wall thickness and interior condition
- Backfill; restore as necessary
- Re-excavate; dewater. Assemble split Stop fitting(s) around main. Install drain nozzle(s) and saddle(s) to the main.
- Pressure test to 100 psi.
- Pour concrete support and reaction blocking, curing as required by manufacturer
- Mount temporary tapping valve(s) to Stop fitting(s) and drain nozzle(s).
- Mount tapping machine; open valve; pressure tap; retract cutter; close temporary valve; remove tapping machine.
- Mount Stop machine; open temporary valve; insert Stop plugging head into main.
- If two or more Stops, insert downstream plugging head first.
- Coordinate with Sussex County to shut off flow in the main at time plugging head is inserted into main.
- Test for shutdown at drain nozzle.
- Cut downstream main. Install required fittings.
- Retract Stop plugging head(s), close temporary valve. Remove Stop machine.
- Install completion machine; open valve.
- Insert completion plug into nozzle of Stop fitting.
- Remove completion machine and temporary valve.
- Repeat previous Steps as needed at other Stop fitting(s)
- Install blind flange (s) onto nozzle of Stop fitting(s) and onto drain fitting(s).

3.04 ASSEMBLY OF STOP FITTING, DUCTILE IRON PIPE

- A. The upper and lower saddle plates shall be bolted together.
- B. Main Preparation: The entire periphery of the ductile iron main shall be power ground for the length of the Garrison Stop fitting.
- C. Assembly of Saddle Plates: Upper and Lower saddle halves shall be drawn together by stud assemblies.

D. Saddle Plates shall be bolted together in the horizontal position.

3.05 CUTTING OPERATION

Drilling equipment shall be in good condition, and equipped with power drive to ensure smooth cutting, and to minimize shock vibration. Cutting equipment shall be carbide tipped and capable of being replaced without removal from the jobsite.

3.06 LINE STOP MACHINERY

The equipment shall consist of a full size, solid plugging head attached to a carrier body. The body is advanced and retracted from the main by means of a linear actuator. When retracted, the plugging head and carrier are housed in an adapter, bolted pressure tight between the tapping valve and the actuator.

- **Plugging Head:** The plugging head shall be full size and articulated with a carrier body. When completely seated the head shall lie in a perpendicular plane to the bore of the main.
- **Sealing Element:** The element shall be monolithically molded from a suitable polyurethane compound. The element shall be flat in a plane perpendicular to the flow in the main and shaped so that upstream water pressure shall increase contact between the periphery of the seal and the interior of the main.
- **Deposits in Bore of Main:** The plugging head shall be designed to break and dislodge tuberculation and other deposits in the bore of the main which might interfere with a satisfactory Line Stop

3.07 BYPASS PIPING

All bypass piping installed from line stop to line stop shall be buried or otherwise protected. Installation of bypass piping across residential and commercial entrances shall not limit access to these properties.

3.08 COMPLETION

Final closure shall be accomplished by insertion of a completion plug. A Test of completion plug sealing shall be accomplished though bleed-off in machine housing. The temporary valve shall be removed and installation of blind flange shall be completed.

SECTION 02733

MANHOLES

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 manholes shown on the Contract Drawings and as specified herein.

1.02 SUBMITTALS

Shop drawings, including proposed mix design, pipe openings, and reinforcing details, shall be submitted to the Engineer for review and approval prior to fabricating the manholes.

For material and equipment readily identified in standard publications of equipment manufacturers, it will be sufficient to submit only the manufacturer's standard catalog cut in the submission.

1.03 QUALITY ASSURANCE

- A. The Engineer will inspect all materials before, during and after installation to ensure compliance with these Contract Documents. When specific material tests are called for in the referenced standards and specifications, the Owner shall have the option of requiring that any or all of these tests be performed for materials furnished for a specified project.
- B. Manholes of reinforced concrete sections and manhole bottoms shall be built at all locations indicated on the drawings. The top of all precast sections shall be carried to the elevations shown.

1.04 REFERENCES

- A. ASTM C 32-93 Standard Specification for Sewer and Manhole Brick.
- B. ASTM C 150-97 Standard Specification for Portland Cement
- C. ASTM C 270-97 a Standard Specification for Mortar for Unit Masonry Reinforced Concrete Manhole Sections

- D. ASTM C 443-94 Standard Specification for Joints for Circular Concrete Sewer and Culvert pipe; Using Rubber Gaskets
- E. ASTM C 478-96 Standard Specification for Precast Reinforced Concrete Manhole Sections.
- F. ASTM C-923 Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structure's Pipes and Laterals.
- G. ASTM C 1244-93 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

Note: References listed shall be the latest version thereof.

PART 2 - PRODUCTS

2.01 MANHOLES

- A. Unless otherwise specified, the Contractor shall install precast manholes. Precast manholes shall meet the requirements of ASTM C478. Precast manholes shall be constructed at the locations and to the elevations shown on the plans or as directed by the Engineer or Owner. Installation shall be in accordance with the manufacturer's instructions.
- B. Joints between precast manhole pipe sections shall be a rubber gasket meeting the requirements in ASTM C-443. When assembled the gasket shall be self-centering and make a uniform watertight joint. Rubber gasket joint shall be "D-Lok" as manufactured by A-Lok Products Inc. Rubberman STS by Hail Mary Rubber, "or equal".
- C. The pipe to manhole seal shall be a rubber gasket conforming to ASTM C- 923, cast integrally in manhole wall and located as required. The gasket will be designed to allow a 10° omnidirectional deflection. Gasket shall be "A- Lok" gasket as manufactured by A-Lok Products Inc. Star Seal by Hail Mary Rubber, "or equal".
- D. Manhole grade shall be adjusted to finished grade as shown on the drawings.
- E. All exterior surfaces of manholes shall receive a minimum two coat application of a 68% solids coal tar type protective coating. The total average dry film thickness shall measure 24 mils. Surfaces shall be prepared in accordance with the manufacturers instructions and coatings applied in the factory in a manner acceptable to the Engineer. The coating material shall be Bitumastic Super Service Black manufactured by Kop Coat. Inc., Tar-jet Super Black XX-32-B-22

manufactured by Pennsbury Coatings Corp., “or equal”. Manhole coatings damaged from handling and installation shall be repaired by the Contractor.

- F. The interior joint spaces of all manhole risers shall be mortared. The exterior joint shall be mortared or filled with a joint filler compound. The joint compound shall be Pioneer 301 as manufactured by Daubert Chemical Company, NPC Bidco C-56 by Trelleborg, “or equal”.
- G. All Manholes shall be 4 feet inside diameter unless otherwise indicated on the contract drawings.
- H. Manholes with inside drop connections shall be 5 feet inside diameter within the vertical drop pipe area.
- I. Precast concrete manholes shall be as manufactured by Atlantic Concrete Products, Inc., Gillespie Precast, National Concrete, Terra-Hill, or equal.
- J. Provide benched flow channels in all manholes as indicated on the contract drawings. Precast concrete flow channels shall be allowed in lieu of brick flow channels subject to the approval of the Engineer. Precast concrete flow channels shall be benched to the crown of the pipe.

2.02 MANHOLE BRICK AND MORTAR

- A. All manhole brick shall conform to ASTM C-32, Grade SS, except that the maximum absorption for the average of five bricks shall not exceed 10%; and the individual brick maximum shall not exceed 14%.
- B. The Contractor shall furnish the Engineer with five bricks of the character he proposes using at least one week before bricks are delivered for use.
- C. Cement for mortar shall be in accordance with ASTM C150 for Type II.
- D. All sand for mortar shall be composed of sharp, angular, siliceous grains, coarse, or graded from fine to coarse with the coarser grains predominating, and free from clay, loam, dirt, mica, organic material, or other impurities. Sand containing more than 5% by weight of foreign material shall not be used. Sand exhibiting more than the acceptable amount of fine matter or impurities may be required to be washed after delivery on the work or shall be rejected altogether. Sand shall be screened to reject all particles of a greater diameter than 1/4 inch and shall not contain more than 5% by weight of a very fine material. The Contractor shall submit samples of the sand he proposes to utilize. These shall be retained in the office of the engineer as a standard for comparison during the progress of work, and all sand shall be equal in quality to the accepted samples. Sand obtained from excavations shall not be used.

- E. Unless specified otherwise, all mortar shall be composed of cement and sand of the characteristics previously specified. The proportion by volume shall be one part of cement to two parts sand. One volume of sand shall be 94 lbs net. One volume of sand shall be 0.9 cubic feet, the sand not being packed more closely than being loosely thrown into the mixing container.

2.03 MANHOLE FRAMES, COVERS AND STEPS

- A. Frames and covers shall be heavy duty traffic type cast iron in accordance with ASTM designation A-48 for Class No. 30. Lettering on manholes shall read SUSSEX COUNTY SANITARY SEWER. Manhole frames and covers shall be East Jordan Iron Works Model 1970, Neenah, "or equal".
- B. Manhole steps shall be No. 3 Steel reinforcing bars encased in Propropylene and shall be spaced as indicated on the drawings.
- C. The Contractor shall furnish and install a watertight insert in each manhole frame. The inserts shall be made of non-corrosive materials and be constructed so that the manhole cover can be removed without damage to air and vacuum relief valves mounted on the inserts. The units shall be 25-3/4" O.D. by 24" I.D. NSW (No Side Wall) as manufactured by Inflow Control Co., Parson Environmental Products "or equal". Each unit is to be tested for leakage.

PART 3 - EXECUTION

3.01 MANHOLES

- A. Special care shall be taken in laying brick in inverts of manholes and inlets to insure a uniform flow of water through the sections. In such locations, joints shall not exceed 1/16" in thickness, and each brick shall be laid full mortar joints on bottom side and end performed in one operation: no grouting or working in of mortar after laying the brick will be permitted. Channels for receiving and passing water shall be formed in the bottom of manholes as shown on the drawings. All such channels shall be lined with brick. Channels shall be sloped smoothly and evenly from the main pipe entering the manhole to the outlet pipe. All manhole channels shall be benched to the top of the pipe.
- B. All brickwork shall be laid by competent masons.
- C. All brick shall be laid in a full bed of mortar with all vertical and horizontal joints filled solid with mortar.
- D. No brickwork shall be laid when the temperature is below 40 degrees F. The contractor shall take such measures as may be approved to prevent brickwork from being exposed to freezing temperatures for a period of not less than five days after laying.

- E. Mortar shall be freshly mixed in small batches for the work at hand. The sand and cement shall be thoroughly mixed dry, in the proper proportions, until a uniform color is produced. Afterwards a moderate dose of water shall be added to produce a stiff paste of proper consistency.
- F. The contractor shall construct stub connections as shown on the drawings. The stub connections shall extend 2 feet beyond the outside of the manhole wall and plugged shut with an approved stopper at the outside end of the stub Brick channels for future extensions shall be built into manholes for all stub connections.

3.02 FIELD TEST

Manholes having visible leakage or seepage shall be corrected as directed. Caulking or patching of interior manhole surfaces will not be acceptable.

SECTION 03410

PRECAST CONCRETE WETWELL STRUCTURES

PART 1. GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all labor, materials, tools and equipment necessary for the furnishing and installing of all precast concrete units as shown on the drawings and herein specified.
- B. Precast concrete work shall be supplied by a firm with a minimum of three years of continuous operations and which has performed at least three representative jobs, three years or older, comparable to precast work to be provided for this project.

1.02 QUALITY ASSURANCE

All work related to Precast Concrete Structures shall conform to the requirements and provisions of the latest editions of the following publications:

- A. American Concrete Institute (ACI)
 - 1. ACI 301 - "Specification for Structural Concrete".
 - 2. ACI 318 - "Building Code Requirements for Structural Concrete and Commentary"
- B. ASTM
 - 1. ASTM C857 - "Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures"
 - 2. ASTM C858 - "Specification for Underground Precast Concrete Utility Structures"
 - 3. ASTM C890 - "Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water or Wastewater Structures"

4. ASTM C923 - "Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals."

1.03 DESIGN REQUIREMENTS

- A. Structural design for precast units shall be prepared by a Registered Engineer for the precast concrete manufacturer.
- B. Distribution of earth loading and live load shall be in accordance with ASTM C857, or ASTM C890. Design vertical live load shall not be less than 300 lbs./sq. ft.
- C. The precast units shall be designed for flotation with the water level at the ground surface with a Factor of Safety of at least 1.50. The units shall also be designed to resist all stress encountered during casting, handling and erection. All bases for precast units shall be monolithically cast with the first 3' of the first riser section.
- D. Concrete design shall be in accordance with ACI 318. All design and testing shall be under the supervision of a registered professional engineer.

1.04 SUBMITTALS

- A. Shop drawings and design calculations shall be submitted for approval. The calculations shall be prepared for the units, which are being submitted for approval. Calculations not prepared for this project shall be rejected. The drawings shall be fully dimensioned and shall show all opening reinforcing steel details, joint details, lifting and erection inserts. Fabrication shall not commence until the Engineer has approved the layout, design and dimensions of the drawings.
- B. Calculations shall be certified with seal and signature by a professional engineer licensed in the state of Delaware to meet all contract drawings and specification requirements and to meet the standards herein specified.

1.05 FABRICATION

- A. The precast units shall be factory cast. Job site casting will not be permitted. Concrete in the precast elements shall be continuously placed to prevent formation of seams. The finished units shall be free of voids, cracks and have beveled corners and edges. All inserts shall be securely attached or embedded in their proper location. Concrete strength of all precast units at 28 days shall be 5,000 psi minimum. It shall be the precast unit manufacturer's responsibility to insure that the specified strength is maintained throughout production of the units. Mix designs shall be those previously used by the manufacturer which have proven satisfactory for casting units similar to those specified and producing the

required strength. All precast concrete shall be air entrained. Concrete shall not contain water soluble chloride ions.

- B. Precast concrete units shall be manufactured in accordance with the applicable requirements of ASTM C858; "Underground Precast Concrete Utility Structures" and as modified herein.
- C. Wall sleeves for piping, sump, steps, access hatch and other inserts as shown on the drawings, and specified, shall be cast into the structure at the place of manufacture.

1.06 INSPECTION AND CERTIFICATION

- A. Certification requirements shall be in accordance with paragraph 12 of ASTM C858. Copies of all certificates shall be available to the Engineer upon request.
- B. The Engineer shall be allowed into the casting plant at any time to inspect the fabrication of units for this project.

PART 2. PRODUCTS

2.01 GENERAL

- A. Materials shall be in accordance with ASTM C858 with Type I/II cement.
- B. Joint sealing material shall be performed, flexible joint sealing compound conforming to ASTM C923.

2.02 WETWELL COATINGS

- A. Interior

Surface Preparation: SSPC-SP13/NACE6, ICRI CSP1-3
First Coat: Tnemec, Series 69 Hi-Build Epoxoline at 4.0 - 6.0
mils dft, Carboline, or equal
Second Coat: Tnemec, Series 69 Hi-Build Epoxoline at 4.0 - 6.0
mils dft, Carboline, or equal

- B. Exterior

Surface Preparation: SSPC-SP13/NACE6, ICRI CSP3
First Coat: Tnemec, 46H-413 Hi-Build Tneme-Tar at
14.0 – 20 mils dft, Carboline, or equal

PART 3. EXECUTION

3.01 PRODUCT HANDLING

Precast sections shall be transported and handled with proper equipment to protect the elements from damage. Sections shall be handled by means of lifting inserts embedded in the concrete. Damaged sections that cannot be satisfactorily repaired shall be replaced by new sections at no additional cost to the Owner.

3.02 INSTALLATION

Precast units shall be provided as shown on the drawings. Precast concrete sections shall be set so as to be vertical and with sections in true alignment with a 1/4 inch maximum tolerance to be allowed. The Contractor shall install the precast sections with joint sealing compound in a manner that will result in a watertight joint. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides.

3.03 PAINTING

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
- D. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3. Use only thinners approved by the paint manufacturer and only within recommended limits.
- E. Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.