

Sanitary Sewer Report
for
**Penn Medicine Princeton Health
Cancer Center and Imaging Center**

Township of Plainsboro
Middlesex County, New Jersey
Block 1701, Lot 3.01



Prepared For:

Princeton HealthCare System
A New Jersey Nonprofit Corporation
d/b/a Penn Medicine Princeton Health
1 Plainsboro Road
Plainsboro, NJ 08536

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1.0 INTRODUCTION

The project site is known as Penn Medicine Princeton Medical Center, Block 1701, Lot 3.01 in the township of Plainsboro, Middlesex County, New Jersey. The campus is located at One Plainsboro Road in Plainsboro. Penn Medicine Princeton Health Care is proposing to construct a Cancer Center and Imaging Center (CCIC). The proposed development will include surface parking areas, stormwater management facilities, landscaping, and site lighting. The existing sanitary sewer mains near the proposed CCIC will be utilized for connection.

2.0 EXISTING CONDITIONS

The site currently consists of a hospital, education building, helipad, medical arts pavilion, and associated improvements. The existing fitness center, located to the east of the education building is no longer in use and a portion of it will be demolished for the proposed CCIC. There are existing sanitary sewers located near the proposed CCIC, one on the northwest and the other to the southwest.

3.0 PROPOSED CONDITIONS

The proposed CCIC will be located directly east of the Education Building. A portion of the existing former Fitness Center will be demolished to make way for the CCIC. The proposed CCIC is anticipated to service or treat approximately 211 patients per day and shall employ approximately 210 staff to support the facility. The building shall be four stories with a mechanical level and contain approximately 200,876 gross square feet. As part of this project, 16,101 sf of building space from the fitness center will be demolished. Therefore, the net increase in additional building space is $200,876 - 16,101 = 184,775$ sf. The

CCIC will include a small 460 sf Café to serve patients, visitors, and staff. This Café will provide coffee, bottled beverages, soup and baked goods prepared off-site as well as pre-packaged sandwiches for sale. The serving line is equipped with a refrigerated self-service case, under counter refrigerators for staff use, and a brewed beverage bar. Additionally, there is an icemaker with a storage bin, a soup tureen, and a microwave. There will be no cooking equipment in the Café other than the equipment used only for warming purchased product. Adjacent to the café serving line is the Café Supply room with handwashing and 3 compartment sinks, a refrigerator/freezer unit, shelving racks and trash storage. A Dietary Supply room will be located on the Lower Level where food stuffs will be stored on shelving racks and in a refrigerator or a freezer. The Café will only operate during the normal operating hours of the treatment center. Since no food is being cooked in the Café, and it is similar to having a warming kitchen in an office environment, it is our opinion that the Café does not require a separate flow estimate from the overall CCIC for the sanitary flow generation rate.

Two new sanitary sewer laterals are proposed to service the building. An 8-inch PVC lateral at 0.46% slope is proposed on the north side of the building. This lateral will connect to an existing 10-inch PVC sanitary sewer located to the north of the education building. A 6-inch PVC lateral at 1% slope is proposed at the southwest corner of the building. This lateral will connect to an existing 6-inch sanitary sewer pipe.

The projected sanitary sewer flowrate was determined in accordance with the New Jersey Administrative Code, Section 7:14A.23.3 as follows:

<u>Type of Establishment</u>	<u>Measure Unit</u>	<u>Gallons Per Day</u>
<i>CCIC</i>		
<i>Medical Office Space (no beds or long term stay)</i>	Sq.Ft.	0.100

The total projected increase in sanitary sewer flowrate for the CCIC is calculated as follows:

$$184,775 \text{ sf} \times 0.1 \text{ gpd/sf} = 18,477.5 \text{ gpd, round up to 18,478 gpd}$$

The laterals will convey flow from approximately two equal building areas. Therefore, the pipe capacity calculations are based on the following flow:

$$\frac{1}{2} \text{ of the proposed flow} = 9,239 \text{ gpd} = 0.0143 \text{ cfs}$$

A total of 156 lf of new 10-inch PVC lateral and 39 lf of 6-inch PVC lateral is proposed. In accordance with NJAC 7:14A-23.6(b), sanitary sewers shall be designed to carry twice the capacity of the projected flow when flowing half full.

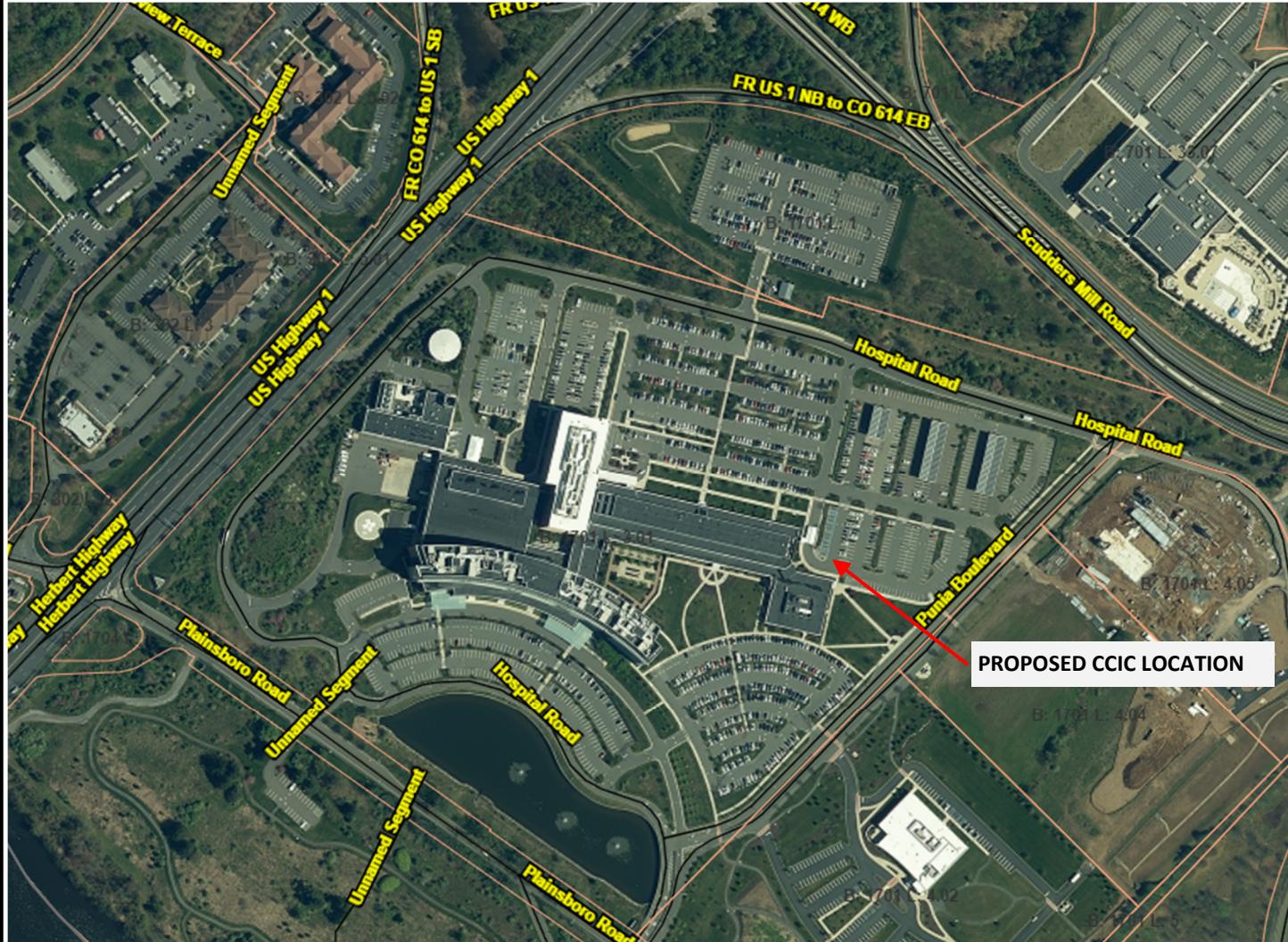
Based on the Manning's Equation, using an n-value of 0.01 for PVC and for pipes flowing half full the capacity is as follows:

Pipe Size (in)	Slope (%)	Q half full (cfs)	Two times Design Flow (cfs)	V max half full (ft/sec)	Actual Q (cfs)	Actual V (ft/sec)
6	1	0.36	0.029	3.71	0.014	1.45
8	0.46	0.53	0.029	3.05	0.014	1.06

As shown in the calculations, the proposed laterals have adequate capacity to carry twice the flow when flowing half full. Therefore, the proposed Gravity Sewer System is in compliance with N.J.A.C. 7-14A-23.6 Gravity Sewer Design.

APPENDIX A

Site Location Map
Tax Map
USGS Map



SOURCE: NJDEP GEOWEB



SITE LOCATION MAP
PENN MEDICINE PRINCETON HEALTH

Township of Plainsboro
Middlesex County, New Jersey

SCALE: AS SHOWN

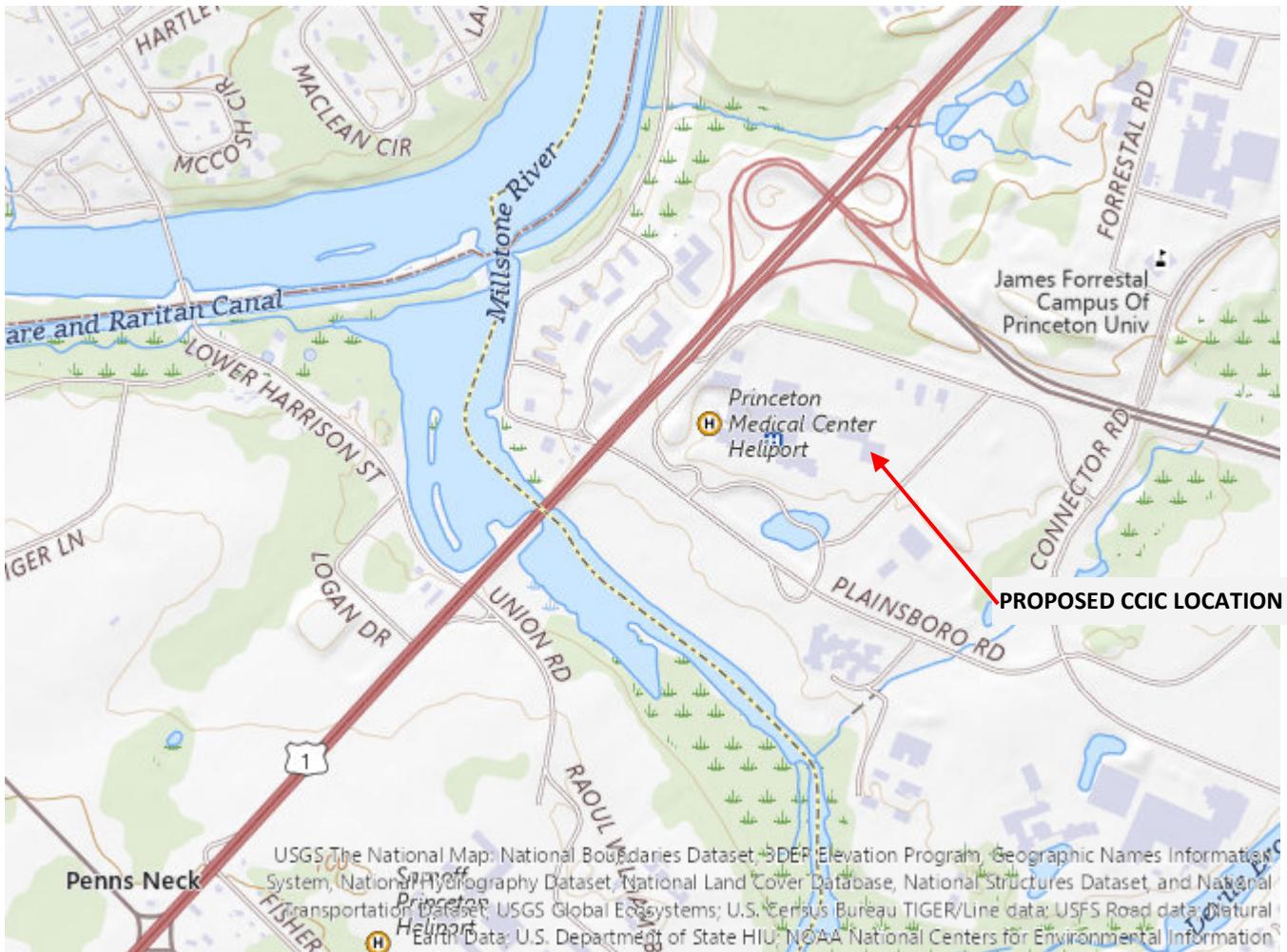
DATE: OCTOBER 2024

JOB No.:

06C028T.003

DRAWING

FIGURE 1



SOURCE: USGS, THE NATIONAL MAP VIEWER



USGS MAP
PENN MEDICINE PRINCETON HEALTH
Township of Plainsboro
Middlesex County, New Jersey

SCALE: AS SHOWN

DATE: OCTOBER 2024

JOB No.:

06C028T.003

DRAWING

FIGURE 2

APPENDIX B

Cost Estimate

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COSTS



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Sheet 1 of 1

DATE:	October 2024	JOB NUMBER :	06C028T.003
PROJECT NAME:	PMPH Cancer Center & Imaging Center	PROJECT TYPE :	Private
PREPARED BY:	LBB	MUNICIPALITY :	Township of Plainsboro
		CHECKED BY:	ALF

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	ESTIMATED COST
Site Improvements					
Earthwork					
1	Trench Backfill, Select Fill	89	CY	\$25.00	\$2,225.00
Sanitary Sewers					
1	6-inch PVC Pipe	39	LF	\$80.00	\$3,120.00
2	8-inch PVC Pipe	156	LF	\$90.00	\$14,040.00
3	Manhole	1	EA	\$7,500.00	\$7,500.00
4	Connect to existing manhole	1	EA	\$6,000.00	\$6,000.00
5	Cleanout	4	EA	\$500.00	\$2,000.00
6	As-built drawings	1	LS	\$1.00	\$10,000.00
7	Air Testing and Inspection	1	LS	\$1.00	\$10,000.00
				Total	\$54,885.00

APPENDIX C

Construction Specifications

SECTION 321318
SANITARY SEWER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including general and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes sanitary sewerage outside the building.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene-monomer rubber.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Force-Main Pressure Rating: At least equal to system operating pressure, but not less than 150 psi. The Contractor must provide pressure pipe manufacturer's recommendation for maximum operating pressure for force main piping and fittings.

1.5 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Connections to sanitary sewer laterals.
2. Connections to existing sanitary sewer main.
3. Manhole structures
4. Cleanouts and pipe material.
5. Pipe and Structure Testing Methodology

- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Coordination Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1-inch equals 5 feet (1:50). Indicate underground structures and pipe. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- D. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Gravity and pressure pipes, joints and fittings. In addition, contractor shall submit the maximum operating pressure for the force-main piping as recommended by the pipe manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied or owned by others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Architect, owner and utility company not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. PVC Backwater Valves and Cleanouts:
 - a. Canplas, Inc.
 - b. IPS Corp.
 - c. NDS, Inc.
 - d. Plastic Oddities, Inc.
 - e. Sioux Chief Manufacturing Co., Inc.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings: According to the following:
 1. PVC Gravity Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D-3034, SDR 35, for solvent-cemented or gasketed joints.
 - a. ASTM F477, elastomeric seals.
 - b. Joints shall be push-on type in accordance with ASTM D-3212.
 - c. Rubber ring gaskets in accordance with ATM D-1869.
 2. PVC pressure pipe and fittings shall be SDR 21 with push-on joints or joints as required by the authority having jurisdiction.
 3. DIP – Ductile Iron Sewer Pipe and Fittings: According to the following:
 - a. Ductile Iron Pipe shall be centrifugally cast in metal or sand-lined molds to latest ANSI/AWWA Designation A21.51/C-151 specifications.
 - b. The joint shall be a type that employs a single elongated grooved gasket to effect the joint seal, such U.S. Pipe and Foundry Company's Tyton Joint," James B. Clow and Sons, Inc. "Bell-Tite," or approved equal, conforming to latest ANSI/AWWA Designation A21.11/C-111.
 - c. Pipe shall be furnished with flanges where connections to flange fittings are required and conform to latest ANSI/AWWA Designation C115/A21.15. Flanged pipe shall be Class 52 (minimum).
 - d. The outside of the ductile iron pipe shall be coated with a uniform thickness of hot applied coal tar coating and the inside shall be lined with cement in accordance with latest ANSI/AWWA Designation A21.4/C-104.

2.4 MANHOLES

- A. Normal-Traffic Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 5-inch (100-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 5-inch (100-mm) minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness that matches frame and cover.
8. Steps: Fiberglass or Aluminum, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch intervals. Steps: ASTM C 478 (ASTM C 478M), individual steps or ladder.
9. Pipe Connectors: Flexible rubber manhole sleeves or boot secured to pipe with stainless steel strapping or equal. PVC pipe to manhole seal shall be A-lok gasket or equal.

B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete, as required to prevent flotation.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness that matches diameter of frame and cover.
3. Steps: Fiberglass or aluminum, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.
4. Steps: Manufactured from deformed, 1/2-inch (13-mm) steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.

C. Manhole Frames and Covers: ASTM A 48, Class 30B, Graycast-iron castings designed for heavy-duty service. Include indented top design with lettering as shown on the detail.

2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - 2. Benches: Concrete, sloped to drain into channel.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

2.6 PROTECTIVE COATINGS

- A. Description: One- or two-coat, coal-tar epoxy; 15-mil (0.38-mm) minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
 - 1. Concrete Manholes: On exterior and interior surfaces.
 - 2. Manhole Frames and Covers: On entire surfaces.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork-Site."
 - 1. PVC pipe shall be installed in accordance with ASTM sewer installation specifications D-2321 "underground installation of flexible thermoplastic sewer pipe". Where requirements contained in this Specification exceed those in the manufacturer's specifications, or the ASTM specifications, this specification shall govern.
 - 2. Pipe shall be protected during construction against possible flotation due to the pouring of concrete cradles or in case the trench becomes flooded prior to placing the backfill. Any flotation which does occur shall be the sole responsibility of the Contractor and shall be corrected by him without additional payment by the Owner.
 - 3. All sewer pipes, including force mains and laterals shall be constructed at least three (3) feet below the proposed grade (as measured from the top of the pipe to the finished elevations).
 - 4. All pipe shall be carefully laid to its true alignment and grade. The Contractor shall carefully excavate the trench bottom to the proper elevations, and the maximum practical solid bearing area shall be provided throughout its entire length, prior to swinging the pipe into place.
 - 5. Care shall be taken not to excavate below grade. Material excavated below adopted grade

shall be replaced by material which meets with the approval of the Engineer, without any further payment.

6. All bedding, cradles and encasements shall be in allowance with the manufacturer's recommendations for each pipe material, depth and soil condition. The bedding shall not be less than the trench bedding as shown on the Construction Details Sheet.
7. All pipe shall be accurately centered and thoroughly driven home, prior to jointing. Where foundation conditions so require, the pipe shall be laid on broken stone, as indicated by the Engineer.
8. All trench excavations shall be dewatered prior to laying pipe. The Contractor shall place backfill materials by methods that will not disturb or damage the pipe. Do not permit compaction equipment to contact and damage the pipe. Before using heavy compaction or construction equipment directly over the pipe, place sufficient backfill. Immediately after the pipe is brought to final position, it shall be thoroughly secured and properly bedded, and ample support shall be provided to prevent settlement or disturbances.
9. The Contractor shall provide and securely install a mechanical plug in the upstream end of the last pipe laid on each working day.
10. The work to be performed in excavation shall include removal of all water to a point at least twenty-four (24") inches below the invert of any pipe laid. Complete dewatering of the trench includes stone or gravel used for control of water in the trench.
11. The price bid shall also include design, furnishing, placing and removal of any sheeting and shoring required, the dewatering, drainage, and pumping of all excavation, the protection of existing pipe lines and structures, and neatly cutting the pavement prior to excavation.
12. Trench Support- The contractor shall furnish, put in place, and maintain such trench support as necessary to support the sides of excavations and to prevent movement which could in any way injure the work or diminish the working spaces sufficiently to delay the work. Trench support shall be constructed as necessary for the protection of the work and for the safety of personnel and shall comply with the safety precautions outlined in the Code of Federal Regulations as required by the Federal Occupational and Safety Health Act of 1970 (OSHA) or latest edition. Sheetling shall be of a material that will not split while being driven. Sheetling and bracing shall conform to the requirements of the "Construction Safety Code" of the Bureau of Engineering and Safety of the New Jersey Department of Labor and Industry. The Contractor shall have sole responsibility for safety measures at the job site.
13. Dewatering – When groundwater elevations are noted to be more than two feet above the trench, such that it may result in groundwater levels above the pipe bed, the contractor shall submit a dewatering plan prepared by a licensed dewatering contractor or New Jersey licensed Professional Engineer during shop print review for review and approval prior to construction.

The Contractor shall provide, operate, and maintain satisfactory facilities and equipment, including well points with which to collect and pump all water entering excavations or other parts of the work, to suitable places for disposal. All excavations shall be kept free of water to a point two feet below the inverts to prevent flooding and flotation until the work or structure to be built therein is completed and will not be damaged by the rising water level. Water shall be discharged through pipe or gutters, or any other suitable artificial means to catch basins, watercourses or ditches in such a manner as to avoid interference with business, pedestrian, and vehicular traffic and so as to prevent damage to property.

Necessary precautions to prevent siltation of streams and watercourses will be required. In no case shall water be permitted to rise into or flow through a completed sanitary sewer.

Dewatering facilities and operations shall comply with all State and Federal laws and regulations governing the activity, including but not limited to, noise control, and discharge of pumped water.

B. Furnishing and placing bedding (including excavation)

1. The Contractor shall furnish, place, grade, and compact all broken stone for bedding and/or drainage as directed by the Engineer. Excavation for stone will be the responsibility of the Contractor.
2. Broken stone shall be clean, hard aggregate as approved by the Engineer; shall be accurately leveled to required grades, and shall be compacted by tamping or approved means.
3. NJDOT Dense Graded Aggregate is required for backfill of the entire trench under pavement areas. In special cases, where large volumes of water are encountered and the greater consolidation effects of broken stone may be considered of less importance, clean, sound screened NJDOT Stone No. 57 may, at the option of the Engineer, be permitted.
4. After compaction, the surface of the stone bedding material shall be thoroughly shaped to receive the pipe or other structure. Spaces shall be hollowed out to clear pipe bells so as to provide for maximum bearing.
5. Broken Stone Bedding shall be installed in accordance with the Bedding Detail or as directed by the Engineer. The Contractor will not be paid for broken stone installed in a trench which has been overexcavated by the Contractor, or for that stone which is being utilized for dewatering purposes, as opposed to bedding requirements, or in areas other than those specified by the Engineer.

C. Backfill- All backfill shall consist of a suitable selected and approved earth generally from storage of approved excavated soil, free from rejected organic matter, boggy or peaty material, humus or other unsuitable material such as silt, rubbish, waste, ashes or cinders. If sufficient suitable material for backfill is not available from the excavated material, as determined by the Engineer, the Contractor shall procure elsewhere a sufficient quantity of suitable material and shall furnish and place such material. No frozen earth shall be used as backfill, and all rocks larger than six (6) inches in the largest dimension shall be removed from acceptable earth and backfill. Unsuitable or excess backfill material shall be promptly removed from the site or spoiled where directed.

1. Placing and Compacting Backfill – Backfill shall be placed to the slopes, grades, and elevations required. Backfill shall be compacted, in an approved manner to a density at least equal to that of the adjacent undisturbed soil, so as to avoid future unequal settlement.

No backfill shall be placed until the structure has been inspected in place and approved. Backfilling shall be carried out as soon as possible after such approval. Trenches shall be backfilled under the pipe haunches, around the pipe and to a point at least twelve inches (12") over the top of the pipe. Material shall be placed in six inch thick (6") layers in a manner that will not disturb or damage the pipe.

Each layer shall be leveled and thoroughly compacted by tamping to ninety-five percent (95%) Modified Proctor Density as determined by the latest ASTM Specification D-1556. In all cases the filling shall be carried up evenly on both sides of the pipe.

In all pavement areas, both existing and proposed, Dense Graded Aggregate must be used for backfill below the pavement surface and shall be placed in successive 12 inch layers. Each layer shall be thoroughly compacted by approved methods and devices to obtain ninety percent (95%) of its Modified Proctor Density in accordance with latest ASTM Specification D-1556.

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

- A. General: Include watertight joints.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.
- C. Gravity-Flow piping. Use the following:
 - 1. NPS 4, NPS 6, NPS 8 and NPS 12 (DN 100 and DN150): PVC sewer pipe SDR-35 and fittings, solvent-cemented joints, or gaskets and gasketed joints.
 - 2. NPS 4 and NPS 6 (DN 100 and DN 150): Ductile-iron sewer pipe; ductile-iron fittings, gaskets and gasketed joints.
- D. Force-main piping: Use the following:
 - 1. NPS 4 and 6 (DN100 and DN 150): PVC pressure pipe, PVC pressure fittings, push-on and gasket joint meeting AWWA C900 class 200 for PVC pressure pipe.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
 - 1. Use the following pipe couplings for nonpressure applications:
 - a. Sleeve type to join piping of same size, or with small difference in OD.
 - b. Increase/reducer-pattern, sleeve type to join piping of different sizes.

- c. Bushings type to join piping of different sizes where annular space between smaller piping's OD and larger piping's OD permits installation.
2. Use pressure-type couplings for force-main joints. Include PE film, pipe encasement.

3.5 INSTALLATION, GENERAL

- A. PVC gravity sewer pipe and fittings shall be installed in accordance with ASTM Standard D-2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe". All pipes shall be laid, jointed and backfilled according to the manufacturer's installation specifications, having been approved by the Engineer, and all of which are made a part of these specifications. In the event the manufacturer has not issued any installation specifications, then the installation specifications of a reputable manufacturer of pipe shall be used, also upon approval by the Engineer. Any conflicts between the manufacturer's specifications and those contained herein shall be resolved by the Engineer
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building's sanitary sewer, of sizes and in locations indicated.
 1. Install piping pitched down in direction of flow, at a minimum slope of 1 percent, unless otherwise indicated.
 2. Install piping with mechanical joints at horizontal and vertical crossings or encase piping in cement as specified on the plans where minimum clearance can not be provided.
- F. Install force-main piping and connect to the sanitary sewer pump and gravity PVC sewer pipe or manhole, of sizes and in locations indicated on the plans. Terminate piping as indicated.
 1. Install piping with restrained joints at horizontal and vertical change in direction. Use cast-in place concrete supports and anchors or corrosion resistant rods and clamps.
- G. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- I. Install PVC force-main piping in accordance with AWWA M23 or as required by authority having jurisdiction.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC sewer pipe and fittings. As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D2321.
- C. PVC pressure pipe and fittings: Join and install according to AWWA M23.
- D. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- F. Install with top surfaces of components, except piping, flush with finished surface.

3.7 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements or concrete areas. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.9 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use PVC SDR 35 soil pipe fittings in sewer pipes at branches for cleanouts and PVC SDR 35 soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface and in accordance with detail on plans.

3.10 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures in accordance with the requirements of the local authority so finished Work complies as nearly as practical with requirements specified for new Work.
- B. Make branch connections to underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connections. Cut end of connection pipe passing through the structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground. Provide rubber boot or other elements as required by authority having jurisdiction.
 - 1. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
 - 2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. Place plug in end of incomplete piping at end of day and when work stops.
 - 2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 93 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. The Contractor shall notify the Engineer, and South Brunswick Sewer Department one (1) week prior to the time the system or any part thereof is ready for testing and/or final inspection. Copies of all test and final inspection reports are to be forwarded to the owner, South Brunswick Sewer Department and the New Jersey Department of Environmental Protection.
4. Schedule tests and inspections by owner's representative at least 24 hours' advance notice.
5. Submit separate reports for each test.
6. Perform tests as follows:
 - a. Gravity Sanitary Sewerage: Perform Infiltration test.
 - 1) The rate of infiltration shall not exceed 50 gallons per mile, per 24 hours, per inch of pipe diameter.
 - 2) The Contractor shall denote the line and conduct a satisfactory test to measure infiltration for at least 24 hours.
 - 3) The Contractor shall be responsible for the satisfactory watertight conditions of the line.
 - 4) The test shall be conducted on sections of pipe not to exceed 2,000 feet of pipe.
 - 5) Close opening in system and fill with water.
 - 6) Purge air and refill with water.
 - 7) Disconnect water supply.
 - 8) Test and inspect joints for leaks.
 - 9) Rates of infiltration shall be determined by means of V-notch weirs or pipe spigot in an approved manner. The Contractor shall provide and install weir plates or other material required and at such times and locations as may be directed by the Engineer.
 - 10) The Contractor shall satisfactorily repair all joints or other parts not sufficiently watertight until the infiltration conforms to the requirements.
 - b. Gravity Sanitary Sewerage: Perform Exfiltration test.
 - 1) The exfiltration tests shall be conducted between manholes.
 - 2) The pipe is to be filled and additional water introduced into the manhole to raise the level two (2) foot above the top of the pipe in the upstream manhole.
 - 3) The quantity of water to maintain this level is to be measured.
 - 4) The test shall be maintained for a 24 hour period.

- 5) The rate of exfiltration shall not exceed 50 gallons per inch of the inside diameter, per mile of pipe, per 24 hours.
- 6) The Contractor shall be responsible for the satisfactory watertight condition of the line.
- 7) The Contractor shall satisfactorily repair all joints or other parts not sufficiently watertight, until the exfiltration conforms to the requirements.

c. Testing for Vertical Deflection in Gravity Mains

All sanitary sewer from manhole to manhole shall be lamped for alignment. The applicants contractor shall pass a device through the pipe that will check for excessive vertical deflection. A pipe that has deflected more than 7% of its diameter has deflected excessively. The test shall be conducted a minimum of 30 days after installation. The device or mandrill for checking deflection shall be provided by the contractor. Details of the deflection device or mandrill shall be submitted to the Engineer and owner for approval, prior to its use and shall be fabricated for example: 8 inch pipe- Mandril size : 7.48 inches I.D.: 7.92 inched O.D. 8.40 inches.

The deflection device shall be pulled through the sanitary sewer pipe using only the force of one (1) man without the aid of any devices other than the rope/chain attached to the deflection device.

Should any test section of the pipe fail to meet the testing criteria, the applicant's contractor shall, at his own expense, locate and replace defective pipe section until specified criteria are met at no additional cost.

d. Gravity Sanitary Sewerage: Perform Low Pressure Air Test.

1. Equipment – Equipment shall be Cherne Air-Loc Equipment, as manufactured by Cherne Industrial, Inc. of Edina, Minnesota or approved equal. Equipment used shall meet the following minimum requirements:
 - i) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - ii) Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - iii) All air used shall pass through a single control panel.
 - iv) Three individual hoses shall be used for the following connections:
 - a. From control panel to pneumatic plugs for inflation.
 - b. From control panel to sealed line for introducing the low pressure air.
 - c. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

2. Procedures:

- i) All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- ii) After a manhole to manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.
- iii) After the stabilization period (3.5 psig minimum pressure in the pipe) the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure decrease from 3.5 to 3.0 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

Pipe Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

- iv) In areas where ground water is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple, approximately 10" long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the groundwater shall be determined by removing the pipe cage, blowing air through the pipe nipple into the ground so as to clear it and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pound of pressure that will be added to all readings. (For example, if the height of water is 11 1/2', then the added pressure will be 5 psig. This increases the psig to 8.5 psig and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same).
- v) If the installation fails to meet this requirement, the Contractor shall, at his own expense, determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship.

e. Testing of Ductile Iron

- 1) Ductile Iron pipe shall be hydrostatically tested in accordance with latest AWWA Standard C-600, Section 4. All necessary plugs, caps or valves for testing shall be installed and suitably braced. The pipe shall be slowly filled with water and all air exhausted. After the pipe is entirely filled with water, the pressure shall be slowly increased to 150 psi. The pressure shall be maintained at test pressure for two (2) hours, with leakage and pressure measurement made continuously during this time period. Any make-up water used shall be measured and the amount recorded. The Contractor shall supply outlets, valves, to make provision for expelling all air from the pipe prior to test.
- 2) Maximum leakage rate at test pressure shall not exceed 100 gallons per day, per mile of pipe, per inch of nominal diameter.
- 3) If the pressure cannot be maintained without the addition of excessive water, the leak or leaks shall be located and repaired.
- 4) The hydrostatic test shall be repeated until leakage within the specified limit is achieved.
- 5) All exposed pipe shall be thoroughly inspected during the test and any source of visible leakage, cracked or defective pipe or fittings replaced.
- 6) After leaks are repaired, the trench shall be backfilled. The Contractor shall make provisions for supplying water for the test.
- 7) All water from hydrostatic testing shall be disposed of by a method to be submitted to and approved by the Engineer.

7. Manholes: Perform hydraulic test according to ASTM C969.
8. Leaks and loss in the pressure constitutes defects that must be repaired.
9. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
10. The contractor must televise all sanitary sewer improvements after the pavement base course has been installed. The televised tape shall be submitted to the South Brunswick Sewer Department for their review and approval.
11. The contractor shall be responsible to coordinate, schedule and perform all testing as required by the South Brunswick Sewer Department and the plumbing code official. In addition, the contractor shall be responsible to coordinate and schedule all required inspections by the authority having jurisdiction.

END OF SECTION 32 13 16