PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:
   1. Cleanouts.
   2. Precast concrete manholes.

1.02 DEFINITIONS
B. EPDM: Ethylene-propylene-diene-monomer rubber.
C. FRP: Fiberglass-reinforced plastic.
D. LLDPE: Linear low-density, polyethylene plastic.
E. PE: Polyethylene plastic.
F. PP: Polypropylene plastic.
G. PVC: Polyvinyl chloride plastic.
J. TPE: Thermoplastic elastomer.

1.03 PERFORMANCE REQUIREMENTS
A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.

1.04 SUBMITTALS
A. Product Data: For the following:
   1. Special pipe fittings.
   2. Pipe, cleanouts, manholes.
B. Shop Drawings: For the following:
   1. Manholes: Include plans, elevations, sections, details, and frames and covers.
C. Field quality-control test reports.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Do not store plastic, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS
A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.02 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS
A. Pipe: ASTM A 746, for push-on joints.
B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.03 ABS PIPE AND FITTINGS

   1. NPS 3 to NPS 6: SDR 35.
   2. NPS 8 to NPS 12: SDR 42.

2.04 PVC PIPE AND FITTINGS

A. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints and using ASTM F 477, elastomeric seals.
   1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
   2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.

B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40, socket-type fittings.

C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 35, socket-type fittings for solvent-cemented joints.


E. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

F. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

2.05 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Concrete Pipes: ASTM C 443, rubber.
   3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
2.06 CLEANOUTS
A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.07 MANHOLES
A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   1. Diameter: 48 inches 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 minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness, and of length 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.
   7. Retain first subparagraph below unless not required.
   8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 30 inches.
   10. Retain one of two subparagraphs below if required.
   11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
   12. Subparagraph below is for precast concrete manholes and is optional. Retain only if required and coating will be plant applied. Verify availability.
   13. Retain subparagraph and associated subparagraphs below only if required. Buried manholes with risers to grade require manhole frames and covers only at the top of riser.
   14. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to “SANITARY SEWER.”

B. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
   1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
   2. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   3. Retain first subparagraph below unless not required.
   4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   5. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step.
Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 30 inches.

6. Retain one of two subparagraphs below if required.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
8. Subparagraph below is for precast concrete manholes and is optional. Retain only if required and coating will be plant applied. Verify availability with manufacturers.
9. Retain subparagraph and associated subparagraphs below only if required. Buried manholes with risers to grade require manhole frames and covers only at the top of riser.
10. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

2.08 CONCRETE
A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.
B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi 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.
      a. Invert Slope: 2 percent through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 4 percent.
D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

PART 3 - EXECUTION
3.01 EARTHWORK
A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.02 PIPING APPLICATIONS
A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
   a. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:
   1. Retain one or more of eight subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
   2. NPS 3: NPS 6 ductile-iron, gravity sewer pipe or NPS 3 or NPS 4 ductile-iron pressure pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
   3. NPS 3: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
   4. NPS 3: PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
   5. NPS 3: NPS 4 PVC sewer pipe and fittings, gaskets, and gasketed joints.
   6. Retain one or more of eight subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
   7. NPS 4: NPS 6 ductile-iron, gravity sewer pipe or NPS 4 ductile-iron pressure pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
   8. NPS 4: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
   9. NPS 4: PVC water-service pipe; PVC Schedule 40, water-service-pipe fittings; and solvent-cemented joints.
  10. NPS 4: PVC sewer pipe and fittings, gaskets, and gasketed joints.
  11. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
  12. NPS 5 and NPS 6: NPS 6 ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
  13. NPS 5 and NPS 6: NPS 6 ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
  14. NPS 5 and NPS 6: NPS 6 cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
  15. NPS 5 and NPS 6: NPS 6 PVC sewer pipe and fittings, gaskets, and gasketed joints.
  16. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
  17. NPS 8 and NPS 10: Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
  18. NPS 8 and NPS 10: ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
19. NPS 8 and NPS 10: Cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
20. NPS 8 and NPS 10: PVC sewer pipe and fittings, gaskets, and gasketed joints.
21. NPS 8 and NPS 10: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
22. Retain one or more of nine subparagraphs below. If more than one type of material and joining method is used, identify various materials on Drawings and show points of transition from one material to another.
23. NPS 12 to NPS 16: Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
24. NPS 12, ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
25. NPS 12 and NPS 15: PVC sewer pipe and fittings, gaskets, and gasketed joints.
26. NPS 12 and NPS 15: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
27. NPS 18 to NPS 24: Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
28. NPS 18 to NPS 24: PVC sewer pipe and fittings, gaskets, and gasketed joints.
29. NPS 18 to NPS 24: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.

3.03 PIPING INSTALLATION

A. 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. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. 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.

C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Install 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. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.

F. Install gravity-flow, nonpressure, drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
   2. Install piping with 36-inch minimum cover.
   3. Install ductile-iron, gravity sewer piping according to ASTM A 746.
   4. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
   5. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
   6. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
   7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Piping according to ASTM A 674 or AWWA C105:
   2. Hubless cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. Special pipe fittings.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.04 PIPE JOINT CONSTRUCTION
A. Basic piping joint construction is specified in Division 22 Section "Common Work Results for Plumbing" Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
B. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
   2. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
   3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
   4. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
   5. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
   6. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.

3.05 MANHOLE INSTALLATION
A. General: Install manholes complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.
C. Form continuous concrete channels and benches between inlets and outlet.
D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 6 inches above finished surface elsewhere, unless otherwise indicated.
E. Install manhole cover inserts in frame and immediately below cover.

3.06 CONCRETE PLACEMENT
A. Place cast-in-place concrete according to ACI 318/318R.

3.07 BACKWATER VALVE INSTALLATION
A. Install horizontal-type backwater valves in piping where indicated.
B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.
C. Install terminal-type backwater valves on end of piping and in manholes where indicated. Secure units to sidewalls.

3.08 CLEANOUT INSTALLATION
A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron 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 concrete pavement with tops flush with pavement surface.

### 3.09 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building’s sanitary building drains.

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole 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.
   a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease interceptors.

### 3.010 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section “Earth Moving.” Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### 3.011 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report 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 95 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.

B. 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 requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours’ advance notice.

4. Submit separate report for each test.

5. Select from first two subparagraphs and associated subparagraphs below.

6. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction.

7. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
   b. Option: Test concrete gravity sewer piping according to ASTM C 924.
   c. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
   d. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

8. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.012 CLEANING

A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION