

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gravity-flow, non pressure storm drainage outside the building, with the following components:

1.3 DEFINITIONS

Retain abbreviations that remain after this Section has been edited.

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- 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.
- H. RTRF: Glass-fiber-reinforced, thermosetting-resin fitting.
- I. RTRP: Glass-fiber-reinforced, thermosetting-resin pipe.
- J. TPE: Thermoplastic elastomer.
- K. HDPE: High Density Polyethylene

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non pressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least silt tight, unless otherwise indicated.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Special pipe fittings.
2. Backwater valves.
3. Drains.
4. Channel drainage systems.
5. Storage and leaching chambers.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers. Include design calculations, and concrete design-mix report for cast-in-place manholes.
2. Catch Basins, Catch Basins and Storm water Inlets, and Storm water Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
3. Storm water Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
4. Separators: Include plans, elevations, sections, details and specifications.

C. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, 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.
- D. Handle catch basins catch basins and storm water inlets storm water inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without Architect's written permission.
 3. Utah State University requires 7-days' written notice for utility interruptions.
 4. Written notice does not guarantee that interruptions will be granted on the requested dates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

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

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

Pipe and fittings in this Article are available in NPS 2 to NPS 15 (DN 50 to DN 375).

- A. Pipe and Fittings: ASTM A 74, [Service class]
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

Pipe, fittings, and couplings in this Article are available in NPS 1-1/2 to NPS 15 (DN 40 to DN 375).

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

Couplings in paragraph and subparagraphs below are economical. They may not be suitable for installation in corrosive soil.

- C. Shielded, Stainless-Steel Couplings: CISPI 310, with ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

Coordinate first subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.

1. Manufacturers:
 - a. ANACO.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Ideal Div.; Stant Corp.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Tyler Pipe; Soil Pipe Div.
2. Couplings for NPS 1-1/2 to NPS 4: 2-1/8-inch- wide shield with 2 bands.
3. Couplings for NPS 5 and NPS 6: 3-inch- wide shield with 4 bands.
4. Couplings for NPS 8 and NPS 10: 4-inch- wide shield with 4 bands.

2.5 PE PIPE AND FITTINGS

Piping in paragraph below is available in NPS 3 to NPS 10 (DN 80 to DN 250). Joints are coupling type.

- A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

Joints made using couplings in subparagraph below are silttight.

1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

Joints made using couplings in subparagraph below are soiltight.

2. Soil tight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

Piping in subparagraph below is available in NPS 12 to NPS 48 (DN 300 to DN 1200). Joints are coupling type.

3. Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

Joints made using couplings in subparagraph below are silttight.

4. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

Joints made using couplings in subparagraph below are soiltight.

5. Soil tight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

Piping in paragraph below is available in NPS 12 to NPS 48 (DN 300 to DN 1200). Joints are coupling type.

- B. Corrugated PE Pipe and Fittings NPS 56 and NPS 60: AASHTO MP7, Type S, with smooth waterway for coupling joints.

Joints made using couplings in subparagraph below are silttight.

1. Silt tight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

Joints made using couplings in subparagraph below are soiltight.

2. Soil tight Couplings: AASHTO MP7, corrugated, matching pipe and fittings.

2.6 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non pressure 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.
2. For Cast-Iron Soil Pipes: ASTM C 564, 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.

2.7 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 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. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 7. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PPJ, 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
 8. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
 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 "STORM SEWER."
 - a. Material: [ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

2.8 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, 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 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, deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi 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, deformed steel.

2.9 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. 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.
 2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
 6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.
1. Size: 18 by 24 inches minimum, unless otherwise indicated.
 2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

Retain paragraph and subparagraphs above or paragraph and subparagraph below.

Retain paragraph below for round, manhole-type structures.

- C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.
1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.10 STORMWATER INLETS

Stormwater inlets are made of precast concrete, cast-in-place concrete, and brick

- A. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

2.11 DRY WELLS

Retain one of three paragraphs and associated subparagraphs below. Detail on Drawings.

- A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:
1. Floor: Cast-in-place concrete.
 2. Cover: Liftoff-type concrete cover with cast-in lift rings.
 3. Wall Thickness: 4 inches minimum with 1-inch diameter or 1-by-3-inch- maximum slotted perforations arranged in rows parallel to axis of ring.

- a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
 - b. Ring Construction: Designed to be self-aligning.
4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.
 5. Side Panels: With knockout ports for piping and seepage holes.
 6. Top Cover: With knockout port for drain.
 7. Filter Fabric: As recommended by unit manufacturer.
 8. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
 9. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
 10. Cover: Precast, reinforced-concrete slab, designed for structural loading according to ASTM C 890 and made according to ASTM C 913. Include slab dimensions that will extend 12 inches (300 mm) minimum beyond edge of excavation, with bituminous coating over entire surface. Cast cover with opening for manhole in center.
 11. Manhole: 24-inch- (610-mm-) diameter, reinforced-concrete access lid with steel lift rings. Include bituminous coating over entire surface.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 Utah State University Requirements

- A. Connect the building storm drainage system to storm water retention sumps located near each building on the central campus.
- B. Connect all surface water to the storm water retention sumps. No storm water shall be connected to the sanitary sewer system.
- C. Provide storm drainage piping, fittings, and accessories from the following:
 1. Storm Drainage: All sizes, Cast Iron, PVC, ABS, HDPE
- D. Sumps: See **Detail No. 14/AE33** for storm drain sumps.
- E. Catch Basin: All catch basins shall be designed to capture sediments and floatables and prohibit them from being discharged. See **Detail No. 15/AE33** for catch basin detail.
- F. Interceptors: Interceptors shall be installed directly upstream of storm water sumps where required. See Detail No. 17/AE33 for interceptor detail.

3.3 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 non pressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. [Unshielded] flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. 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. Gravity-Flow, Non pressure Sewer Piping: Use the following pipe materials for each size range:
1. NPS 3 (DN 80): Corrugated PE drainage pipe and fittings, [silttight] [soiltight] couplings, and coupled joints.
 2. NPS 8 to NPS 12 (DN 200 to DN 300): Corrugated PE drainage pipe and fittings in NPS 8 and NPS 10 (DN 200 and DN 250) and corrugated PE pipe and fittings in NPS 12 (DN 300), [silttight] [soiltight] couplings, and coupled joints.
 3. NPS 15 (DN 375): Corrugated PE pipe and fittings, [silttight] [soiltight] couplings, and coupled joints.
 4. NPS 18 to NPS 36 (DN 450 to DN 900): Corrugated PE pipe and fittings, [silttight] [soiltight] couplings, and coupled joints.

3.4 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage 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 use of 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 a 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 [0.5] percent, unless otherwise indicated.
 2. Install piping with [24-inch (915-mm)] minimum cover.
 3. fittings.
 4. Special pipe fittings.

3.5 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." 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 corrugated PE piping according to CPPA 100 and the following:
 - a. Use silttight couplings for Type 2, silttight joints.
 - b. Use soiltight couplings for Type 1, soiltight joints.
- C. Join dissimilar pipe materials with pressure-type couplings.

3.6 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.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout 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.
 - 1. Use light-duty, top-loading classification cleanouts in [earth or unpaved foot-traffic] areas.
 - 2. Use medium-duty, top-loading classification cleanouts in [paved foot-traffic] areas.
 - 3. Use heavy-duty, top-loading classification cleanouts in [vehicle-traffic service] areas.
 - 4. Use extra-heavy-duty, top-loading classification cleanouts in [roads] areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, [18 by 18 by 12 inches deep. Set with tops [1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement with tops slightly recessed from pavement surface for snow removal.

3.8 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 - 1. Use light-duty, top-loading classification drains in [earth or unpaved foot-traffic] areas.
 - 2. Use medium-duty, top-loading classification drains in [paved foot-traffic].
 - 3. Use heavy-duty, top-loading classification drains in [vehicle-traffic service] areas.
 - 4. Use extra-heavy-duty, top-loading classification drains in [roads] areas.
- B. Embed drains in 4-inch (102-mm) minimum depth of concrete around bottom and sides.
- C. Fasten grates to drains if indicated.

- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.9 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections according to ASTM C 891.

Cast-in-place manholes in paragraph below require data or details on Drawings.

- C. Construct cast-in-place manholes as indicated.

Retain first paragraph below if paint is to be field applied to exterior surfaces of cast-in-place concrete manholes.

- D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
- E. Install FRP manholes according to manufacturer's written instructions.
- F. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops [3 inches (76 mm)] above finished surface elsewhere, unless otherwise indicated.

3.10 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.11 STORMWATER INLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

3.12 DRY WELL INSTALLATION

- A. Excavate hole to diameter of at least 6 inches greater than outside of dry well. Do not extend excavation into ground-water table.
- B. Install precast, concrete-ring dry wells according to the following:

1. Assemble rings to depth indicated.
 2. Extend rings to height where top of cover will be approximately 8 inches (203 mm) below finished grade.
 3. Backfill bottom of inside of rings with filtering material to level at least 12 inches (300 mm) above bottom.
 4. Extend effluent inlet pipe 12 inches (300 mm) into rings and terminate into side of tee fitting.
 5. Backfill around outside of rings with filtering material to top level of rings.
 6. Install cover over top of rings.
- C. Install manufactured, PE dry wells according to manufacturer's written instructions and the following:
1. Assemble and install panels and cover.
 2. Backfill bottom of inside of unit with filtering material to level at least [12 inches (300 mm)] above bottom.
 3. Extend effluent inlet pipe [12 inches (300 mm)] into unit and terminate into side of tee fitting.
 4. Install filter fabric around outside of unit.
 5. Install filtering material around outside of unit.
- D. Install constructed-in-place dry wells according to the following:
1. Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.
 2. Install block lining material dry, with staggered joints and 20 percent minimum of blocks on side for seepage. Install precast concrete rings with notches or weep holes for seepage. Build to diameter and depth indicated.
 3. Extend lining material to height where top of manhole will be approximately [8 inches (203 mm)] below finished grade.
 4. Backfill bottom of inside of lining with filtering material to level at least [12 inches (300 mm)] above bottom.
 5. Extend effluent inlet pipe [12 inches (300 mm)] into lining and terminate into side of tee fitting.
 6. Backfill around outside of lining with filtering material to top level of lining.
 7. Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

3.13 CONCRETE PLACEMENT

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

3.14 DRAINAGE SYSTEM INSTALLATION

- A. Assemble and install components according to manufacturer's written instructions.
- B. Install with top surfaces of components, except piping, flush with finished surface.
- C. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- D. Embed channel sections and drainage specialties in [4-inch (102-mm)] minimum concrete around bottom and sides.
- E. Fasten grates to channel sections if indicated.

- F. Assemble channel sections with flanged or interlocking joints.
- G. Embed channel sections in [4-inch (102-mm)] minimum concrete around bottom and sides.

3.15 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Connect force-main pressure piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.
 - 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 (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting opening into existing unit large enough to allow 3 inches (76 mm) 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, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa), unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to sediment interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.16 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

Revise this Article to suit Project.

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
 - 1. Remove manhole or structure and close open ends of remaining piping.
 - 2. Remove top of manhole or structure down to at least [36 inches (915 mm)] below final grade. Fill to within [12 inches (300 mm)] of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

3.17 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.18 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 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 92.5 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 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.

Retain test in first subparagraph and associated subparagraphs below only if required.

- 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

- a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [150 psig (1035 kPa)]
- a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- 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.

3.19 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334100