802.01 Description. This work consists of constructing conduits, and constructing and reconstructing drainage structures. This work also includes preparing installation plans, performing inspections, and providing reports and other required documentation.

The Contractor may choose to install all or part of the conduit and drainage structures according to this specification instead of C&MS 603 and 604. When using the standard construction drawings in conjunction with this specification, replace all references to C&MS 603 and 604 in the standard construction drawings with a reference to 802.

802.02 Materials. Conduits are listed below by type. Furnish pipe of the specified conduit type and size or one size larger. Furnish conduit of the specified material according to the plans. If the material is not specified in the plans, furnish conduit conforming to any of the material requirements listed for that conduit type. All listed materials for each conduit type can meet the performance requirements. However, different materials may require varying installation procedures.

The Contractor may furnish concrete or plastic pipe of the same type with greater strength than specified. The Contractor may furnish metal pipe with a greater thickness than specified, so long
as the pipe has the same corrugation profile and is the same type. The metric equivalent conduit size may vary with different types of material for the same English size conduit.

A. Type A Conduit – Culverts

- Non-reinforced concrete pipe, Class 3.............................. 706.01
- Reinforced concrete circular pipe .................................... 706.02
- Reinforced concrete pipe, epoxy coated ............................ 706.03
- Reinforced concrete elliptical pipe ................................. 706.04
- Precast reinforced concrete box sections ......................... 706.05
- Precast reinforced concrete 3-sided flat topped culverts .706.051
- Precast reinforced concrete arch sections ....................... 706.052
- Vitrified clay pipe (extra strength only) ......................... 706.08
- Corrugated steel conduits ......................................... 707.01 or 707.02
- Structural plate corrugated steel structures ..................... 707.03
- Precast, galvanized steel culverts .................................. 707.04

Bituminous coated corrugated steel pipe and pipe arches
  with paved invert................................................... 707.05 or 707.07
- Corrugated aluminum alloy pipe ................................. 707.21 or 707.22
- Aluminum alloy structural plate conduits ...................... 707.23
- Corrugated steel box culverts .................................... 707.15
- Corrugated aluminum box culverts ............................... 707.25
- Corrugated polyethylene smooth lined pipe
  .............................................................................. 707.33 with a welded bell inlet
- Steel reinforced thermoplastic ribbed pipe
  .............................................................................SS 938 with a welded bell inlet

B. Type B Conduit – Storm or sanitary sewers under pavement

- Non-reinforced concrete pipe, Class 3.............................. 706.01
- Reinforced concrete circular pipe .................................... 706.02
- Reinforced concrete elliptical pipe ................................. 706.04
- Precast reinforced concrete box sections ......................... 706.05
- Vitrified clay pipe (extra strength only) ......................... 706.08
- Mortar lined corrugated steel pipe .................................. 707.11
- Corrugated steel spiral rib pipe .................................... 707.12
- Bituminous lined corrugated steel pipe ......................... 707.13 or 707.14
- Corrugated aluminum spiral rib pipe ............................ 707.24
- Corrugated polyethylene smooth lined pipe ..................... 707.33
- Polyvinyl chloride corrugated smooth interior pipe .......... 707.42
- Polyvinyl chloride profile wall pipe ................................ 707.43
- Polyvinyl chloride solid wall pipe ................................. 707.45
- Polyvinyl chloride drain waste and vent pipe ................. 707.46
- Polyvinyl chloride ABS composite pipe ....................... 707.47
- Polyvinyl chloride large-diameter solid wall pipe .......... 707.48
- ABS drain waste and vent pipe .................................... 707.51
ABS sewer pipe ................................................................. 707.52
Polypropylene corrugated double wall pipe ......................... 707.65
Polypropylene triple wall pipe........................................... 707.69
Steel reinforced thermoplastic ribbed pipe ........................ SS 938
Ductile iron pipe (sanitary) .................................................. 748.01
Polyvinyl chloride pipe (sanitary) ........................................ 748.02

C. Type C Conduit – Storm or sanitary sewers not under pavement

Non-reinforced concrete circular pipe .................................. 706.01
Reinforced concrete pipe .................................................... 706.02
Reinforced concrete elliptical pipe ...................................... 706.04
Precast reinforced concrete box sections ............................ 706.05
Vitrified clay pipe ............................................................. 706.08
Mortar lined corrugated steel pipe ...................................... 707.11
Corrugated steel spiral rib pipe .......................................... 707.12
Bituminous lined corrugated steel pipe .............................. 707.13 or 707.14
Corrugated aluminum spiral rib pipe .................................. 707.24
Corrugated polyethylene smooth lined pipe ........................ 707.33
Polyvinyl chloride corrugated smooth interior pipe ............... 707.42
Polyvinyl chloride profile wall pipe .................................... 707.43
Polyvinyl chloride solid wall pipe ...................................... 707.45
Polyvinyl chloride drain waste and vent pipe ....................... 707.46
Polyvinyl chloride ABS composite pipe ............................. 707.47
Polyvinyl chloride large-diameter solid wall pipe ................. 707.48
ABS drain waste and vent pipe .......................................... 707.51
ABS sewer pipe .............................................................. 707.52
Polypropylene corrugated double wall pipe ......................... 707.65
Polypropylene triple wall pipe .......................................... 707.69
Steel reinforced thermoplastic ribbed pipe ........................ SS 938
Ductile iron pipe (sanitary) .................................................. 748.01
Polyvinyl chloride pipe (sanitary) ........................................ 748.02

D. Type D Conduit – Drive pipes and bikeways

Non-reinforced concrete pipe, Class 3 .............................. 706.01
Reinforced concrete circular pipe ...................................... 706.02
Reinforced concrete elliptical pipe .................................... 706.04
Vitrified clay pipe (extra strength only) ............................... 706.08
Corrugated steel conduits ............................................... 707.01 or 707.02
Structural plate corrugated steel structures ......................... 707.03
Corrugated aluminum alloy pipe ........................................ 707.21 or 707.22
Aluminum alloy structural plate conduits ............................ 707.23
Corrugated polyethylene smooth lined pipe ......................... 707.33
Polyvinyl chloride corrugated smooth interior pipe .............. 707.42
Polyvinyl chloride profile wall pipe ................................... 707.43
Polyvinyl chloride solid wall pipe ..................................... 707.45
Polyvinyl chloride large-diameter solid wall pipe..........707.48
Polypropylene corrugated single wall pipe...............707.62

E. Type E Conduit – Miscellaneous small drain connections and headers

Non-reinforced concrete pipe .................................. 706.01
Reinforced concrete circular pipe ..............................706.02
Reinforced concrete elliptical pipe ............................ 706.04
Concrete drain tile, extra quality ...............................706.07
Vitrified clay pipe .................................................. 706.08
Clay drain tile, extra quality .....................................706.09
Corrugated steel conduit .........................................707.01 or 707.02
Corrugated aluminum alloy pipe ...............................707.21 or 707.22
Corrugated polyethylene drainage pipe ........................707.32
Corrugated polyethylene smooth lined pipe .................... 707.33
Smooth-wall polyvinyl chloride underdrain pipe
(non-perforated) .....................................................707.41
Polyvinyl chloride corrugated smooth interior pipe .......707.42
Polyvinyl chloride profile wall pipe .............................707.43
Polyvinyl chloride solid wall pipe ...............................707.45
Polyvinyl chloride drain waste and vent pipe ...............707.46
Polyvinyl chloride ABS composite pipe .......................707.47
Polyvinyl chloride large-diameter solid wall pipe .........707.48
ABS drain waste and vent pipe .................................707.51
ABS sewer pipe .....................................................707.52

F. Type F Conduit – Conduit on steep slopes; underdrain outlets

Corrugated steel conduits
(steep slope conduit) ......................... 707.05 Type C or 707.07
Corrugated aluminum alloy pipe
(steep slope conduit) .................................707.21 or 707.22
Corrugated polyethylene
smooth lined pipe (underdrain outlets) .....................707.33
Smooth-wall polyvinyl chloride underdrain pipe (non-perforated underdrain outlets) .........................707.41
Polyvinyl chloride corrugated
smooth interior pipe (underdrain outlets) ................. 707.42
Polyvinyl chloride solid wall pipe (underdrain outlets) ....707.45

G. For constructing or reconstructing drainage structures, furnish materials conforming to:

Concrete, Class C ........................................... 511, 499.04, 499.08
Brick and masonry units ...........................................704
Precast reinforced concrete manhole, catch basin,
and inlet sections ..................................................706.13
Precast reinforced concrete outlet ...............................706.15
Preformed expansion joint filler ........................................705.03
Epoxy coated reinforcing steel ...........................................709.00
Cast frames, grates, and covers........ 711.12, 711.13, or 711.14
Welded frames and grates................................. 711.01 and 513.17
Steps............................................................... 711.13, 711.30, or 711.31
Resilient and flexible gasket joints .........................706.11
Curing materials ..................................................705.05, 705.07
Curing membrane for inlets ..............................705.07, Type 1 or 1-D
Mortar .................................................................602
Nonshrink mortar ...............................................705.22

H. For bedding and backfill, furnish materials conforming to:
   Structural backfill .................................................703.11
   Coarse aggregate ........................................... 703.02 or 703.13
   Fine aggregate .............................................. 703.02, 703.03, 703.04, or 703.05
   Embankment ................................................. 703.16A, 703.16B, or 703.16C
   Aggregate .......................................................703.17
   Low Strength Mortar Backfill (LSM)...............613

I. For concrete collars and encasement, furnish materials conforming to:
   Concrete, Class C ...........................................511, 499.04, 499.08
   Reinforcing steel ...........................................509.02

J. For field paving of conduit inverts, furnish materials conforming to:
   Concrete, Class C ...........................................511, 499.08
   Coarse aggregate, size No. 7, 8, or 78 ...............703.02
   Galvanized welded wire fabric .......................709.08

For material in items not specified above, furnish materials conforming to:
   Mortar ............................................................602
   Nonshrink mortar .........................................705.22
   Bituminous pipe joint filler ................................706.10
   Resilient and flexible gasket joints for:
      Concrete pipe ................................................706.11
      Vitrified clay pipe ...........................................706.12
      Preformed flexible joint sealant ..........................706.14
      Type 2 membrane waterproofing .......................711.25
      Type 3 membrane waterproofing .......................711.29
      Geotextile Fabric ...........................................712.09, Type A
      Joint wrap .................................................. ASTM C 877, Type III
      Buried liner waterproofing membrane ............711.22

For Class C concrete, provide batch plant tickets according to 499.08. The Contractor may use
one of the proportioning options listed in 499.04.
If a precast reinforced concrete box culvert (706.05) is specified, the Engineer may allow the Contractor to substitute either a precast reinforced concrete 3-sided flat topped culvert, a precast reinforced concrete arch culvert, or a precast reinforced concrete round section (706.051, 706.052, or 706.053). If a 706.051, 706.052, or 706.053 is specified, the Engineer may allow the Contractor to substitute one for the other. Refer to 802.04 for submittal requirements.

If bituminous coated corrugated steel pipe or pipe arch with paved invert (707.05 or 707.07) is specified, the Contractor may furnish conduit with a coating conforming to 707.04.

802.03 Definitions. The following terms, when used in this specification, are defined as follows:

Backfill. Material used to fill the trench or excavation, not including the bedding material.

Bed. The bottom of the trench or excavation.

Bedding Material. Material placed above the bed and below the conduit or drainage structure. It is shaped to fit the bell and spigot and typically shaped to fit the conduit. The bedding material may also extend up and around the sides of the conduit or drainage structure.

Conduit. Includes pipe, culverts, sewers, and drains. Conduits are classified as Type A, B C, D, E, and F.

Corrugated Metal Conduit. Includes all conduit made from corrugated steel or corrugated aluminum. Either material may also have coatings. This includes all of the following types of materials: 707.01, 707.02, 707.03, 707.04, 707.05, 707.07, 707.11, 707.12, 707.13, 707.14, 707.15, 707.17, 707.21, 707.22, 707.23, 707.24, and 707.25.

Cut. A situation where the top of the conduit is below the existing ground surface or where a proposed embankment is constructed at least 2 feet (0.6 m) above the top of the conduit before installation.

Deflection. Racking or flattening of the pipe’s cross-section.

Drainage Structures. Manholes, catch basins, inlets, inspection wells, junction chambers, and precast reinforced concrete outlets.

Fill. A situation where the top of the conduit is above the existing ground surface in an area where an embankment will be constructed.

Flexible Conduit. Plastic, corrugated metal, ductile iron (748.01), or steel casing pipe (748.06).

Infiltration. Water or other material that enters the conduit or drainage structure through the joints or conduit connections in excess of the limits for soil tightness or for the type of joint specified.

Lay Length. The length of a standard section of pipe as normally supplied by the manufacturer.
Plastic Conduit. Corrugated polyethylene, polyvinyl chloride, or ABS conduit. This includes all of the following types of materials: 707.31, 707.32, 707.33, 707.41, 707.42, 707.43, 707.44, 707.45, 707.46, 707.47, 707.51, 707.52, 707.62, 707.65, 707.69, SS 938, and 748.02.

Rigid Conduit. Concrete pipe, vitrified clay pipe, or clay drain tile. This includes all of the following types of materials: 706.01, 706.02, 706.03, 706.04, 706.05, 706.051, 706.052, 706.053, 706.08, and 706.09.

Run of Conduit. The conduit placed between drainage structures, between a drainage structure and an open outlet, between an open inlet and a drainage structure, or between the open inlet and open outlet.

Spring Line. A line along the length of the pipe at its maximum span. For circular pipes the spring line is located at mid-height of the pipe (rise divided by two).

802.04 Submittals

A. Shop Drawings. Prepare shop drawings and calculations when required below. Have a Registered Engineer prepare, sign, seal and date all calculations. Submit two copies of the shop drawings and calculations to the Engineer. The Engineer will submit one copy to the Office of Structural Engineering for review and acceptance. Allow at least 28 days for the review.

1. If Reinforced Concrete Circular Pipe, 706.02, is specified as “Special Design” with a specified D-load requirement, submit shop drawings and design calculations for review and acceptance before manufacturing the pipe. Design the pipe to meet the D-load requirement in the plans. Include the following information in the submittal: all structural design and loading information, all material specifications, all dimensions, and the installation plan.

2. Manufacturers who do not have pre-approved designs on file with the Department for precast reinforced concrete 3-sided flat topped culverts, precast reinforced concrete arch culverts, or precast reinforced concrete round sections, (706.051, 706.052, or 706.053) must submit structural analysis methods, structural design criteria and calculations, structure details, and shop drawings for approval. Include details for a precast slab bottom if required.

3. Submit hydraulic calculations from an approved manufacturer if requesting approval to substitute a precast reinforced concrete 3-sided flat topped culvert (706.051), a reinforced concrete arch culvert (706.052), or a precast reinforced concrete round section (706.053) for one another. The proposed culvert must meet or exceed the same hydraulic requirements as the specified culvert and minimum cover requirements. If the specified culvert is on pedestal walls, include the shop drawings for the pedestal wall design in the submittal because 3-sided flat topped culverts, arch culverts, and round sections require different pedestal wall designs.

4. Submit hydraulic calculations from an approved manufacturer if requesting approval to substitute either a precast reinforced concrete 3-sided flat topped culvert, a precast reinforced concrete arch culvert, or a precast reinforced concrete round section (706.051, 706.052, or 706.053) placed on a precast or cast-in-place slab bottom for a precast reinforced concrete box culvert (706.05). The proposed culvert must meet or exceed the same hydraulic requirements as the specified box culvert and minimum cover requirements. The Department may allow the
bottom slab to be cast-in-place but will not issue a time extension for any delays resulting from
the use of a cast-in-place bottom slab.

B. Installation Plan. Submit a written installation plan for installing all conduit and drainage
structures for review and acceptance. Submit the installation plan at least 30 days before any
conduit or drainage structure work begins. Do not perform work without an accepted installation
plan. Include the following required information for each conduit type and size, and type of
drainage structure:

1. Trench and excavation cross-sections with dimensions.
2. Locations where the conduit is installed in a cut situation and where it is installed in
   a fill situation.
3. Type of bedding and backfill material used and maximum lift thickness.
4. Compaction density requirements for bedding and backfill and compaction
   equipment.
5. Identify the starting location (outlet or inlet) for each run of conduit. All conduit
   must be laid from the outlet to the inlet unless approved by the Engineer. Bell or
groove-end Type A conduit must have a bell or groove-end at the inlet.
6. Maximum allowable joint gap between conduit sections.
7. Other installation details as necessary.
8. Provide written confirmation from the conduit manufacturer that the pipe material
   and strength supplied are appropriate for the material and density requirements
described in the installation plan for the backfill and bedding. This confirmation by
the conduit manufacturer will not relieve the Contractor of the responsibility for
obtaining the required results.

Deviations from the installation plan during construction require a revision of the
installation plan. Resubmit all revisions to the installation plan to the Engineer within 5 days of
the change with the conduit manufacturer’s written confirmation that the pipe material and
strength supplied are appropriate for the material and density requirements described in the
newly revised installation plan for the backfill and bedding. If the conduit manufacturer does not
provide this written confirmation to the newly revised installation plan, all the conduit installed
according to the unconfirmed plan must be replaced. No new installation plans will be
considered until all previous installation plans have been confirmed and accepted.

Provide the conduit manufacturer's structural calculations when specified or within 10 days
when requested by the Engineer.

For structural plate and metal pipe arch conduit with a span of 57 inches (1440 mm) or
larger, ensure the manufacturer provides match-marked ends on the conduit. Include a layout
drawing in the installation plan.

For metal conduit with two structural plate thicknesses specified, identify the location of the
thicker plates. For precast concrete 3-sided flat and arch topped structures (706.051 and
706.052) provide a 3 inch (75 mm) deep keyway centered on the leg and at least 6 inches (150
mm) wider than the thickness of the leg at the bottom. For precast concrete round sections
(706.053) provide an 8-inch (200 mm) deep keyway for spans up to 24 feet (7.3 m) and a 10-inch
(254 mm) deep keyway for spans greater than 24 feet, (7.3 m). Center the keyway on the precast
arch base. The width of the keyway must be 8 inches (200 mm) greater than the thickness of the precast arch base. For non-vertical leg arches set on pedestal walls, a one sided keyway is acceptable if the required pedestal wall design thickness is not sufficient for a full keyway.

The Contractor may jack or tunnel any conduit with written approval from the Office of Structural Engineering. Submit a written request to the Office of Structural Engineering and allow at least 28 days for review.

C. Construction Inspection Forms. Perform work only in the presence of the Contractor’s representative doing the inspection. Submit construction inspection forms to the Engineer for each run of conduit and each drainage structure. Use construction inspection form CA-P-1 for conduit and use construction inspection form CA-P-3 for drainage structures. Ensure that all deviations from the installation plan are noted on the construction inspection form. Ensure that the information on the construction inspection form is complete and accurate and that the form is signed by a representative of the Contractor certifying that the information on the form is accurate. The Contractor’s representative must make the following statement on the form:

“I certify that the information on this form is accurate and all deviations from the current installation plan have been noted.”

Submit each day’s construction inspection forms before the start of the next work day. If the Engineer gives notice that the information on the form is incomplete or not accurate, do not continue related work until complete and accurate forms are submitted and accepted by the Engineer.

Construction inspection forms CA-P-1 and CA-P-3 require trench and bedding measurement checks to be taken every 50 feet with a minimum of two per run. Record measurements to the nearest 0.1 foot (30 mm). If these measurements are not taken, do not continue related work until the Contractor submits a plan in writing to the Engineer for approval that explains how these measurements will be determined.

D. Performance Report. Provide a performance report for each performance inspection, and provide separate reports for each change in conduit size or change in material type. Include the following in each performance report:

A. Project number and County-Route-Section
B. Date of performance inspection
C. Type and size of conduit
D. Time of video recording
E. Location (e.g. station and offset) and viewing direction. For Type A conduit, also include the latitude and longitude of the culvert where the culvert centerline and the roadway centerline intersect. Use a Global Positioning System (GPS) unit that is accurate to within 30 feet (10 meters).
F. Summary of all defects including type, measurement, and location
G. For remote inspections using a mandrel, indicate in the performance report the size of the mandrel and whether or not it was successfully pulled through the conduit.
H. For remote inspections using a crawler mounted camera with laser profiler, include:
1. Three dimensional model of the conduit based on the laser profile measurements.
2. Digital profile of conduit extracted from the inspection video
3. Calculations of the ovality, capacity and delta of the conduit
4. Explanation as to why data was unattainable for any section of the conduit

Submit a performance report to the Engineer within 5 days of completing the performance inspection of the conduit run or drainage structure. Submit the performance report in a digital format that allows the Department to make additional copies. Submit the results of the performance survey at the same time as the performance report or earlier.

**802.05 Excavation.** Excavate as described in the installation plan. Record any deviations from the installation plan on the construction inspection forms and revise the installation plan.

Excavate trenches along the centerline of the conduit. When installing conduit in a fill situation, construct the embankment to the elevation of the spring line for the conduit or higher before excavating the trench.

Provide a firm bed for the full width and length of the trench. If bedding material is not provided, loosen the middle third of the bed to seat the conduit. Provide a firm bed beneath the drainage structure.

Remove any unsuitable material exposed in the bed for the width of the trench and a depth of at least 6 inches (150 mm). Replace the unsuitable material with structural backfill, Type 1 or 2. Remove any rock or shale exposed in the bed to a depth of at least 6 inches (150 mm). Replace the rock or shale with structural backfill, Type 1 or 2. The Department will pay for this work according to 109.05, unless otherwise noted in the Contract Documents. If the Engineer changes the flow line by more than one foot (0.3 m), the Department will pay according to 109.05, unless otherwise noted in the Contract Documents.

**802.06 Bedding and Backfill.** Place and compact bedding and backfill as described in the installation plan. Record any deviations from the installation plan on the construction inspection forms and revise the installation plan.

If using coarse aggregate material for bedding and backfill below the ground water elevation, wrap the coarse aggregate with Type A geotextile fabric. Shape the bedding with recesses to receive the bell of bell-and-spigot conduit. Loosen the bedding in the middle third to seat the conduit. If using LSM for bedding, also use LSM for backfill to at least 6 inches (150 mm) over the top of the conduit. Install bedding and backfill for Type F conduits for underdrain outlets according to 605.03.C.

**802.07 Laying Conduit.**

Maintain flows and drainage at all times until the new facilities are completed and in service. Any temporary diversion of flows and drainage is the responsibility of the Contractor. Maintain flows and drainage or provide temporary diversion at no additional cost to the Department.

Visually inspect all conduit in the presence of the Engineer before it is placed in the trench. Replace all conduit that is damaged as determined by the Engineer. Before installation, measure
and record on the CA-P-1 the widest inside dimension of each lay length of conduit. This measurement is to be taken three times along each lay length. For corrugated metal conduit measure to the inside peak of the corrugations.

Lay the conduit in the center of the trench at the invert elevation shown on the plans. Any deviation must be approved by the Engineer. If the Engineer does not approve the deviation, stop all related work until the conduit is relaid. Ensure that the conduit is in contact with the bedding for its full length and maintain the line and grade of the conduit. The Contractor’s representative doing the inspection will visually inspect all conduit before placing any backfill. Rejoin, re-lay, or replace conduits that have settled, or that are damaged.

Lay all conduits as described in the installation plan and according to the following requirements. The installation plan cannot change the following requirements. Meeting these requirements does not relieve the Contractor of the responsibility for obtaining the required results. Record any deviations from the installation plan on the construction inspection forms and revise the installation plan.

A. If the riveted or welded seam in a metal conduit is longitudinal, place the seam at the spring line.
B. For all metal conduit, use only lifting devices that do not require a hole through the material.
C. Lay metal conduit so that match marks align.
D. For all metal conduit that is cut at a drainage structure or headwall, treat the cut end with the same coating as the conduit. Do not treat any cuts within the run.
E. Where two structural plate thicknesses are specified, place the thicker plates according to the installation plan.
F. Set precast reinforced concrete 3-sided flat topped culvert sections (706.051) in the keyway. Place the units in a 1/2-inch (13 mm) bed of mortar. If proper line and grade of the structure cannot be maintained on the bed of mortar, set the sections on 5 × 5-inch (125 × 125 mm) masonite or steel shims. Fill the entire keyway joint with mortar.
G. Set precast reinforced concrete arch sections (706.052) in the keyway. Place the units on 5 × 5-inch (125 × 125 mm) masonite or steel shims to provide a minimum 1/2-inch (13 mm) gap between the footing and the bottom of the leg. Fill the entire keyway joint with mortar.
H. Set the precast reinforced concrete round sections (706.053) in the keyway. Place the units on masonite or steel shims to provide a minimum 1.5-inch (38 mm) gap between the footing and the bottom of the precast arch base. Fill the entire keyway joint with mortar. Provide 5000 psi (34.5 MPa) mortar. For arches that gain structural continuity by a cast-in-place closure at the project site, provide concrete with the same compressive strength as the precast arch.
I. For precast reinforced concrete culverts (706.05, 706.051, 706.052, and 706.053) fill the lifting devices with mortar. Cover the exterior of the lifting devices with joint-wrap material if they are outside the limits of the membrane waterproofing. Use joint-wrap with a minimum
width of 9 inches (225 mm). Use only lifting devices that do not require a hole through the structure.

J. The inlet of all rigid conduit and plastic conduit used in a Type A application (open inlet) must have a bell. If field cutting is necessary to furnish a bell at the inlet, locate the cut end at an interior joint by removing part of a section within the run. Join the conduit as described below and encase the joint with a concrete collar to ensure a stable connection.

K. The top and bottom of reinforced concrete pipe that has elliptical or quadrant mat reinforcing will be clearly marked on the pipe. Handle and place this pipe so that the markings remain in a vertical plane through the center of the pipe.

L. Handle and place reinforced concrete pipe with auxiliary supports (stirrups) with the centerline of the auxiliary support system (stirrups) in a vertical plane through the center of the pipe.

M. Fill all lifting holes in rigid conduit with concrete according to the manufacturer’s recommendations or using a method approved by the Engineer.

N. Immediately after placing conduit, construct the end treatments at both the outlet and inlet ends. Show this activity as part of the conduit construction on the progress schedule. These end treatments include headwalls, concrete riprap, rock channel protection, sod or other erosion control items.

O. When conduit is installed under pavement, perform the following immediately after the completion of backfill placement and compaction: remove and dispose of all surplus material according to 105.17, clear the site, and replace all pavement necessary to restore traffic. Show this activity as part of the conduit construction on the progress schedule.

802.08 Joining Conduit. Ensure the joints are clean and free from dirt or debris. Join the conduit sections as described below. Visually inspect all conduit, joints, and gaskets in the presence of the Engineer before placing any backfill. Rejoin, re-lay, or replace any conduit that does not meet the requirements.

The Engineer may allow joint materials other than those listed below, provided the Contractor demonstrates the proposed material will result in durable, sealed joints.

Join conduit as described in the installation plan and according to the requirements below. For conduit material not listed below, join conduit as recommended by the manufacturer. Record any deviations from the installation plan on the construction inspection forms and revise the installation plan.

A. Corrugated Metal Conduit. Join corrugated metal conduit, Types A, B, C, D, and F, using either coupling bands or bell and spigot joints. Join the conduit according to the following requirements.

1. Coupling bands. Furnish coupling bands conforming to 707.01 or 707.02, and having the same coating as the conduit being joined. Use either coupling bands with gaskets or wrap the joints with Type A geotextile fabric.
2. **Bell and spigot joints.** If using bell and spigot joints, place a gasket in the first corrugation of the spigot end and thoroughly lubricate the gasket and the bell end of the receiving conduit before assembly. Drive the spigot securely into the bell.

**B. Rigid Conduit.** Join rigid conduit, Types A, B, C, D, and F, according to the following requirements.

1. For all concrete pipe (706.01, 706.02, 706.04) that is not epoxy coated and vitrified clay pipe (706.08), seal the joints using one of the following methods:

   a. Fill the joint with bituminous pipe joint filler, providing a smooth transition on the inside and a complete seal on the outside.

   b. Use preformed flexible joint sealant to seal the joint. Before installing the joint sealant, prime both surfaces of the joint with asphalt based primer according to the joint sealant manufacturer’s recommendations.

   c. Use resilient and flexible gasket joints. If the conduit is a sanitary sewer pipe, test the joint for infiltration and exfiltration according to ASTM C 969 or ASTM C 1103. If any joint does not meet the test requirements, make corrections until the joint meets the test requirements.

2. For epoxy coated concrete pipe (706.03), seal the joint using fibrated coal tar joint compound applied according to the conduit manufacturer’s recommendations.

3. For precast reinforced concrete box culverts, precast reinforced concrete 3-sided flat topped culverts, precast reinforced concrete arch culverts, and precast reinforced concrete round sections (706.05, 706.051, 706.052, and 706.053), place the sections according to the installation plan. Clean the joint gap of all debris and apply one of the following:

   a. For joints in precast reinforced concrete box culverts (706.05), fill the top exterior joint gap and the bottom and side interior joint gap with mortar. Next, for any exterior joint not covered by membrane waterproofing, cover the exterior joint with a 9-inch (225 mm) wide strip of joint wrap. Center the joint wrap on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side.

   b. For precast reinforced concrete 3-sided flat topped culverts (706.051), fill the top keyway joint with nonshrink mortar. If the side or leg joints are tongue and groove types, fill the joints as described above for concrete box culverts. If the side or leg joints are keyway types, fill with nonshrink mortar. Prepare, place, and cure the nonshrink mortar according to the nonshrink mortar manufacturer’s recommendations. Wet all surfaces of the keyway joint, but do not allow free standing water in the joint. Next, cover the exterior joint with a 12-inch (300 mm) wide strip of joint wrap. Center the joint wrap on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side. Apply membrane waterproofing to the precast sections after they are installed.
c. For precast reinforced concrete arch culverts and precast reinforced concrete round sections (706.052 and 706.053), install a 7/8 x 1 3/8-inch (24 x 34 mm) preformed flexible joint sealant (706.14) along the outside joint chamfer. Use a continuous length of joint sealant sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side. Before installing the joint sealant, prime the joint chamfer with a primer according to the joint sealant manufacturer’s recommendations. For 706.052 and 706.053, cover all exterior joints with a 12-inch (300 mm) wide strip of joint wrap centered on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side of the structure to the bottom vertical face on the other side. Next, apply all waterproofing as shown on the plans. Apply membrane waterproofing to the precast sections after they are installed.

d. For precast reinforced concrete box culverts, precast reinforced concrete 3-sided flat topped culverts, precast reinforced concrete arch culverts, and precast reinforced concrete round sections (706.05, 706.051, 706.052, and 706.053), apply an approved epoxy-urethane sealer per the plans to all top surfaces not covered by membrane waterproofing. Extend sealer 1 foot (0.3 m) below the backfill on all sides of the culvert sections including the joint.

C. Plastic Conduit. Join plastic conduit, Types A, B, C, D, and F, using either coupling bands, bell and spigot joints, or bell-bell couplers. Join the conduit according to the following requirements.

1. Coupling bands. Furnish coupling bands of the same size as the conduit and that engage at least two full corrugations on each conduit section. Furnish gasketed coupling bands of the same material as the plastic conduit.

2. Bell and spigot joints. If using bell and spigot joints, drive the spigot securely into the bell. For gasketed joints, ensure that the gasket is properly seated after joining.

3. Bell-bell couplers. If using bell-bell couplers, drive the conduit securely into the coupler.

D. Type E Conduit. Join Type E conduits with open joints by butting the ends and wrapping with a minimum 4-inch (100 mm) wide tarred paper or tarred burlap. Place soil around this material to hold it in place during backfilling.

802.09 Exterior Coatings and Membrane Waterproofing. Apply exterior coatings and membrane waterproofing as specified below. Protect the exterior coatings and membrane waterproofing from damage during placing of the bedding, backfill, and embankment.

A. For concrete conduit, clean the surfaces before placing the membrane waterproofing. Apply membrane waterproofing as specified. Apply the membrane waterproofing to all surfaces that will be in contact with the backfill (top and sides) according to the membrane waterproofing manufacturer’s recommendation.
B. For structural plate metal structures and corrugated metal box culverts (707.03, 707.15, 707.23, and 707.25) with less than 8 feet of cover, apply waterproofing by one of the following methods.

1. Coat the exterior of the conduit above the limits of the bedding and within the limits of backfill. Ensure that all plate seams and bolts are thoroughly sealed. Furnish coating material and apply it according to AASHTO M 243. Allow asphalt mastic material to dry 48 hours and tar base material to dry 28 hours before placing the conduit backfill. Rib stiffeners do not need to be coated.

2. Construct buried liner waterproofing membrane protection in the fill according to the manufacturer’s recommendations. The buried liner waterproofing membrane protection must be a continuous sheet placed over the conduit and extend at least 10 feet (3.3m) outside of the paved shoulder and for the width of the trench. Seams constructed in the field are not acceptable.

802.10 Drainage Structure Construction. Install drainage structures as shown on the plans and standard construction drawings. Maintain flows at all times until the new facilities are completed and in service.

Visually inspect all precast drainage structures in the presence of the Engineer before they are placed. Replace all drainage structures that are damaged as determined by the Engineer.

Install each drainage structure casting to the elevation, station, and offset shown on the plans. Any deviations must be approved by the Engineer. If the Engineer does not approve the deviation, stop all related work until the drainage structure is reinstalled. The offset is to the center of the casting. Place each manhole base so that it is in alignment with the pipe and its invert elevation according to the standard construction drawings. Use flat slab top manholes as shown on the standard construction drawing. Do not remove the flat slab top manhole lifting devices.

Locate or cut conduits so any protrusion inside the structure wall is minimized.

Set iron frames, tops, and covers in mortar with a flush joint.

Prevent earth or debris resulting from construction operations from entering the drainage structure. Remove any debris resulting from construction.

Thoroughly grout the underdrain outlet pipe to the precast reinforced concrete outlet with a flush mortar joint.

Take adequate precautions to prevent concrete or mortar from freezing. Preheat the brick, concrete block, or precast concrete structure throughout the entire mass to a temperature between 50 to 80 °F (10 to 27 °C) before placing mortar if the ambient temperature is 40 °F (4 °C) or less.

A. Brick and Block Masonry. For brick and block masonry drainage structure construction thoroughly wet the units before placing in mortar. Lay the units with a flush mortar joint. Cure the exposed surfaces of all brick and block masonry by covering with wet burlap or by applying a curing membrane according to 705.07. Keep burlap wet for at least 48 hours.
B. Modular Precast Concrete. For precast concrete modular drainage structures furnish precast bases on a compacted bed with or without a bedding material as described in the installation plan. Ensure that the bed is level and uniformly supports the entire area of the base. Seal all joints between modules as described above for concrete conduit.

All penetrations through precast drainage structures must be either manufactured or cored.

After placing the conduit, grout all openings less than 4 inches (100 mm) between the pipe and structure with mortar. Grout all openings greater than 4 inches (100 mm) between the pipe and structure with non-shrink mortar. Furnish the same curing membrane for barrier inlets as that used on the barrier. Apply the curing membrane according to 622.07.

C. Reconstruction to grade. When reconstructing an existing manhole, catch basin or inlet to grade, follow the procedure below.

1. Carefully remove and clean the existing castings.

2. Remove the existing walls of manholes down to the spring line of the conduit or below as necessary. Remove existing walls of catch basins and inlets below the window openings, grates, or any points of wall failure.

3. Using the salvaged casting, reconstruct the structure to the new grade, conforming as nearly as practicable to the existing dimension and type of construction.

D. Adjustment to grade. When adjusting an existing manhole, catch basin, or inlet to match grade, follow the procedure below.

1. Carefully remove and clean the existing frame, adjust the height of supporting walls, and reset the existing frame in mortar or concrete to the new grade.

2. Carefully remove the existing cover or grate and install a casting or an acceptable adjusting device on file at the Laboratory or an adjusting device approved by the Engineer to the new grade and install according to the adjusting device manufacturer’s recommendations.

802.11 Field Paving of New or Existing Conduit. Field pave the bottom of the conduit with concrete as shown on the plans.

For new pipe installations, do not pave until at least 4 feet (1.2 m) of fill is placed on top of the conduit or the top of subgrade is reached. If the paving is placed before completion of the entire fill, clean any gaps between the conduit and concrete paving, and then fill with heated bituminous material conforming to 705.04.

Reinforce the paving with $4 \times 4$ W1.4 $\times$ W1.4 galvanized welded wire fabric or comparable. Provide a mesh with a width 4 inches (100 mm) less than the finished paving. Securely fasten the mesh to the conduit near each edge and at the center of the mesh at points not more than 4 feet (1.2 m) apart along the flow line of the culvert. Repair any damage to the galvanizing or other coating material caused by placement or by tack welding. Use wire brushing and zinc rich paint to make the repairs.
For aluminum structural plate, securely fasten the mesh to the circumferential seam bolts with galvanized tie wire.

Construct paving so that it is 3 inches (75 mm) thick measured from the top of the corrugations of the conduit to a height equal to 1/3 of the rise. Provide galvanized reinforcing steel support chairs beneath the mesh where necessary. Maintain the position of the mesh while placing concrete. After placing the concrete, strike it off with a template to produce the proper radius, and finish with a float to produce a smooth finish. Cure the concrete according to 451.10.

802.12 Performance Inspection. Notify the Engineer at least five workdays before conducting a performance inspection. For all Type A, B, and C conduits, inspect all lengths greater than 20 feet with slopes of 25 percent or less and all new drainage structures. Perform the inspection no sooner than 30 days and no later than 90 days after the completion of the finished grade when not below pavement and after the completion of the aggregate base when any portion of the conduit is below pavement. If any corrections are made to the installed pipe after the completion of the finished grade or aggregate base and prior to the performance inspection, wait 30 days after the correction was made to do the performance inspection. If the contract duration will not permit a 30 day waiting period then the Engineer may adjust the waiting period.

Conduct a performance survey to verify that the elevation and location of each Type B and C conduit and drainage structure is within the tolerances listed in 802.14. Conduct a performance survey to verify that the elevation and location of each Type A conduit matches the plan. The 30 day waiting period does not apply to the performance survey. Notify the Engineer at least two workdays before conducting the performance survey.

Ensure that the condition of the conduit will allow an accurate inspection. Perform a manual inspection on drainage structures. Perform either a manual inspection or remote inspection as follows:

Non-circular conduits – Manual inspection

Conduits with a rise of 48 inches (1200 mm) and greater – Manual inspection.

Conduits with a rise of 12 inches or greater up to 48 inches (300 to 1200 mm) – Remote inspection.

Conduits with a rise less than 12 inches (300 mm) and Type D, E, and F conduits – Remote inspection as directed by the Engineer. The Department will pay for this inspection according to 105.10.

A. Manual Inspection. Perform a manual inspection by entering the conduit or drainage structure to record video and to make measurements. If the conduit or drainage structure is considered a confined space, provide entry for all project inspection personnel according to OSHA requirements.

Furnish a video recording of each inspection. On the recording, identify the date and time of the inspection, a description of the conduit or drainage structure being inspected, the location,
and the viewing direction. Record the entire run of conduit being inspected. Provide a source of light that allows all areas of concern to be readily observed on the video recording. Furnish the video recording in a digital, reproducible format on one of the following media types: DVD, CD or other media type approved by the Office of Structural Engineering.

Measure the deflection of the conduit using either a metal or fabric tape and read to the nearest ½ inch (10 mm). Measure crack width using either a crack comparator or a feeler gage capable of measuring 0.01 inch (0.25 mm). Measure joint gaps using a tape or ruler and read to the nearest ½ inch (10 mm). Other measuring devices may be used if approved by the Engineer. Record the measurements and include them in the performance report. Measure the following:

1. For rigid conduit, measure the location, length, and greatest width of each crack.
2. For flexible conduit, measure the smallest inside diameter three times for each conduit section in the run. Take the first measurement vertically from the crown to invert (12 o’clock to 6 o’clock positions). Take the second measurement by rotating 60 degrees from vertical (2 o’clock to 8 o’clock positions). Take the third measurement by rotating 120 degrees from vertical (4 o’clock to 10 o’clock positions). For all measurements, stretch tape to full extent across inside of pipe. For corrugated metal conduit, the inside diameter is defined as the distance between the inside peaks of the corrugations.
3. For all conduits, measure the widest gap at each joint in the run.
4. For conduit with manufactured seams, measure the location, length, and greatest width of any separation at the seam.
5. For drainage structures, measure the location, length and greatest width of each crack and the widest gap at each conduit entering the drainage structure.

Record the location of any other defect not listed above and describe the defect. For each measurement location in a conduit, record the length from the nearest drainage structure.

B. Remote Inspection. Perform a remote inspection by using a crawler mounted camera to record video and using equipment described below to make measurements. Use equipment that meets the requirements of Supplemental Specification 902. Remove all debris from the conduits being inspected according to 107.19. Dewater the conduit if the water level hinders the performance of the laser profiler.

Furnish a video recording of each inspection. On the recording, identify the date and time of the inspection, a description of the conduit or drainage structure being inspected, the location, and the viewing direction. Record the entire run of conduit being inspected. Provide a source of light that allows all areas of concern to be readily observed on the video recording. Furnish the video recording in a digital, reproducible format on one of the following media types: DVD, CD or other media type approved by the Office of Structural Engineering.

Based on the type of conduit, make measurements using the equipment listed in the following table. Also record the location of any other defect not listed below and describe the defect.
**TABLE 802.12.B**

<table>
<thead>
<tr>
<th>Conduit Type</th>
<th>Measurement Equipment</th>
<th>Type of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid conduit and 707.11, mortar lined corrugated steel pipe</td>
<td>Crawler mounted camera according to 902.01 with crack measuring capabilities according to 902.02 C</td>
<td>Joint gaps, Crash widths</td>
</tr>
<tr>
<td>Plastic conduit</td>
<td>Crawler mounted camera with laser profiler according to 902.02 A, B, and C</td>
<td>Joint gaps, Crash widths, Deflection</td>
</tr>
<tr>
<td>748.01, ductile iron pipe and 748.06, steel casing pipe</td>
<td>Crawler mounted camera with laser profiler according to 902.02 A, B, and C</td>
<td>Joint gaps, Crash widths, Deflection</td>
</tr>
<tr>
<td>The following types of corrugated metal conduit:</td>
<td>Crawler mounted camera with laser profiler according to 902.02 A, B, and C</td>
<td>Joint gaps, Crash widths, Deflection</td>
</tr>
<tr>
<td>707.04, precoated, galvanized steel culverts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>707.05 and 707.07, bituminous coated corrugated steel pipe with paved invert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>707.12, corrugated steel spiral rib conduit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>707.13 and 707.14, bituminous lined corrugated steel pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>707.24, corrugated aluminum spiral rib conduit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circular corrugated metal conduit not listed above</td>
<td>Mandrel according to 902.03</td>
<td>Deflection</td>
</tr>
<tr>
<td></td>
<td>Crawler mounted camera according to 902.01 with crack measuring capabilities according to 902.02 C</td>
<td>Joint Gaps</td>
</tr>
</tbody>
</table>

* Note: If the mandrel cannot pass freely through the conduit, then the diameter of the conduit has been reduced by at least five percent.

**802.13 Conduit Evaluation.** Have an independent Registered Engineer evaluate the conduit and any defects as required by AASHTO LRFD Bridge Construction Specifications, Section 26 for metal conduit, Section 27 for concrete conduit, and Section 30 for plastic conduit. The independent Registered Engineer cannot be an employee of the Contractor or the conduit manufacturer.

If the evaluation determines repairs are not necessary and repairs are not required based on the type or size of the defect in Table 802.13, have the independent Registered Engineer make the following statement in the evaluation:
“I certify that repairs are not required for the conduit to function as designed and that the conduit meets the design life requirements described in the version of the Department’s Location and Design Manual, Volume 2, Drainage Design, used in the original design.”

If the evaluation determines repairs are necessary, or if repairs are required based on the type or size of the defect in Table 802.13, have the independent Registered Engineer prepare, sign, seal, and date plans for the repair. The independent Registered Engineer must make the following statement on the repair plans:

“I certify that this repair plan was designed to ensure the repaired conduit will function as designed and will meet the requirements described in the version of the Department’s Location and Design Manual, Volume 2, Drainage Design, used in the original design.”

**TABLE 802.13**

<table>
<thead>
<tr>
<th>Metal Conduit</th>
<th>Evaluate if infiltration is observed. Evaluate all racking or denting. Evaluate if the joint gap exceeds the tolerance* for a length less than 1/3 of the circumference. Repair or replace conduit if the joint gap exceeds the tolerance* for a length greater than or equal to 1/3 of the circumference. Repair all damage to coatings. Evaluate if deflection &gt; 5%. Repair or replace conduit if deflection &gt; 7.5%.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Conduit</td>
<td>Evaluate if infiltration is observed. Evaluate if cracks &gt; 0.01 inch. Evaluate if joint gap exceeds the tolerance* for a length less than 1/3 of the circumference. Repair or replace conduit if the joint gap exceeds the tolerance* for a length greater than or equal to 1/3 of the circumference. Repair or replace conduit if cracks &gt; 0.10 inch. Repair or replace conduit if spalls or slabbing are observed.</td>
</tr>
<tr>
<td>Plastic Conduit</td>
<td>Evaluate if infiltration is observed. Evaluate if joint gap exceeds the tolerance* for a length less than 1/3 of the circumference. Repair or replace conduit if the joint gap exceeds the tolerance* for a length greater than or equal to 1/3 of the circumference. Evaluate if deflection &gt; 5%. Repair or replace conduit if deflection &gt; 7.5%.</td>
</tr>
</tbody>
</table>

* Note: The tolerance is defined as the maximum joint gap listed in the installation plan.

Submit the evaluation, repair plans, and revised installation plan to the Engineer at least 7 days before performing the repairs. Provide written confirmation from the conduit manufacturer that the repair methods are appropriate. The Department may review the submittal, but Department acceptance is not required. If the Department does not review the plan, proceed with the repairs 7 days after delivering the submittal to the Engineer. If the Department reviews the submittal
and determines it does not conform to the Contract, revise, resubmit, and proceed with the repairs only after the Department accepts the resubmittal.

Perform the repair at no additional cost to the Department. Perform an inspection to evaluate the repaired portion of the conduit and any conduit potentially affected by the repair work 30 days after the repair has been made. Perform the inspections according to 802.12 and at no additional cost to the Department.

**802.14 Drainage Structure Evaluation.** Have an independent Registered Engineer evaluate the drainage structures and any defects listed in the table below. The independent Registered Engineer cannot be an employee of the Contractor or drainage structure manufacturer.

**TABLE 802.14**

<table>
<thead>
<tr>
<th>Defects requiring evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection between conduit and drainage structure has free flowing water or infiltration.</td>
</tr>
<tr>
<td>Grate is more than 0.1 ft (30 mm) from horizontal or vertical location documented on construction inspection forms CA-P-1 or CA-P-3.</td>
</tr>
<tr>
<td>Invert elevation is more than 5 percent of the conduit diameter or 0.1 ft (30 mm) from plan elevation, whichever is greater.</td>
</tr>
<tr>
<td>Grates do not properly seat in the frame.</td>
</tr>
<tr>
<td>Grates are not placed on the required slope.</td>
</tr>
<tr>
<td>Grates or frames are broken or cracked.</td>
</tr>
<tr>
<td>Drainage structure does not match the details on the standard construction drawing.</td>
</tr>
<tr>
<td>Steps do not line up.</td>
</tr>
<tr>
<td>Manhole top does not match plans.</td>
</tr>
</tbody>
</table>

If the evaluation determines repairs are not necessary, have the independent Registered Engineer make the following statement in the evaluation:

“I certify that repairs are not required for the drainage structure to function as designed and that the conduit meets the design life requirements described in the version of the Department’s Location and Design Manual, Volume 2, Drainage Design, used in the original design.”

If the evaluation determines repairs are necessary have the independent Registered Engineer prepare, sign, seal, and date plans for the repair. The independent Registered Engineer must make the following statement on the repair plans:

“I certify that this repair plan was designed to ensure the repaired drainage structure will function as designed and will meet the requirements described in the version of the Department’s Location and Design Manual, Volume 2, Drainage Design, used in the original design.”

Perform the repair at no additional cost to the Department. Perform an inspection to evaluate the repaired portion of the drainage structure and any conduit potentially affected by the repair work 30 days after the repair has been made. Perform the inspections according to 802.12 and at no additional cost to the Department.
802.15  **Surface Settlements.** Repair any surface settlement within the trench limits or within 4 feet (1.2 m) of a drainage structure. Have an independent Registered Engineer evaluate the conduit according to 802.13 or the drainage structure according to 802.14. Perform all repair work at no additional cost to the Department.

802.16  **Method of Measurement.** The Department will measure conduit by the number of feet (meters), measured from center-to-center of small drainage structures or between open ends including the length of pipe bends and branches. The Department will not deduct conduit length for catch basins, inlets, or manholes where the distance measured in the direction of flow, including bends, is 6 feet (2 m) or less. Where the location of a drainage structure or an open end is changed with the approval of the Engineer to accommodate full conduit sections, the Department will measure the length placed. Conduits placed on slopes steeper than 3H:1V or with beveled or skewed ends will be measured along the invert.

The Department will measure field paving of existing pipe by the number of feet (meters).

The Department will measure Manholes, Inlets, Catch Basins, Inspection Wells, Junction Chambers, and Precast Reinforced Concrete Outlets, whether new, reconstructed, or adjusted to grade, by the number of each type of structure complete and accepted.

802.17  **Basis of Payment.** Payment for all inspections is included with the contract unit price of the corresponding pay item. When a pay item calls for concrete encasement, the Department will pay for furnishing and placing the concrete encasement and for any additional excavation required under the contract unit price for the encased conduit. When a pay item calls for a new conduit to be field paved, the Department will pay for field paving, including all work and materials necessary for the item, under the contract unit price for the conduit.

All required repairs, including any settlement problems, must be made prior to acceptance. Payment for the repair is included with the contract unit price of the corresponding pay item. The Department will not make additional payment for repair work on conduit installed under this specification.

The Department will pay for accepted quantities at the contract prices shown below according to the following schedule:

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>603</td>
<td>Foot (Meter)</td>
<td>_<em><strong>&quot; (</strong></em> mm) Conduit, Type ___</td>
</tr>
<tr>
<td>603</td>
<td>Foot (Meter)</td>
<td><strong><strong>×</strong></strong> Conduit, Type ___</td>
</tr>
<tr>
<td>603</td>
<td>Foot (Meter)</td>
<td>_<em><strong>&quot; (</strong></em> mm) Conduit Reconstructed, Type ___</td>
</tr>
<tr>
<td>603</td>
<td>Foot (Meter)</td>
<td>Type ___ Precast Reinforced Concrete Three-Sided Flat Topped Culvert, <em><strong>' (</strong></em> mm) Span × <em><strong>' (</strong></em> mm) Rise</td>
</tr>
<tr>
<td>603</td>
<td>Foot (Meter)</td>
<td>Type ___ Precast Reinforced Concrete Arch Sections, <em><strong>' (</strong></em> mm) Span × <em><strong>' (</strong></em> mm) Rise</td>
</tr>
</tbody>
</table>
Foot (Meter) Type ___ Precast Reinforced Concrete Round Sections,
___'(___ mm) Span × ___'(___ mm) Rise
Foot (Meter) ___'(___ mm) Rise × ___'(___ mm) Span Conduit,
Type A Corrugated Steel Box Culvert,
___'(___ mm) Minimum Cover, ___'(___ mm) Maximum Cover
Foot (Meter) ___'(___ mm) Rise × ___'(___ mm) Span Conduit,
Type ___ Corrugated Aluminum Box Culvert,
___'(___ mm) Minimum Cover, ___'(___ mm) Maximum Cover
Foot (Meter) ___"(___ mm) Conduit, Type ___, with Field Paving of Pipe
Foot (Meter) ___"(___ mm) Conduit, Type ___, Field Paving of Existing Pipe
Foot (Meter) Conduit, Type F for underdrain outlets
Each Manholes
Each Inlets
Each Catch Basins
Each Inspection Wells
Each Junction Chambers
Each Manhole, Catch Basin or Inlet Reconstructed to Grade
Each Manhole, Catch Basin, or Inlet Adjusted to Grade
Each Precast Reinforced Concrete Outlet
**Designer Note:** This specification permits the Contractor to install drainage conduit and drainage structures under a performance specification. Add to all jobs that have any Item 603 or Item 604 work. No other changes are required. This specification also incorporates 902 by reference for the remote inspection equipment.