Section 401. PIPE CULVERTS

401.01. Description. This work consists of constructing pipe culverts of the size and class required, including excavation and backfill.

401.02. Materials. Provide materials in accordance with the following:

Concrete, Grade S2	701
Mortar, Type R-2	702
Granular Material, Class II, III, IIIA	902
Aggregate, 6A,17A,34R	902
Asphaltic Materials	904
Culvert Pipe	909
Sealers for Culvert Joints	909
Steel Pipe (for jacking in place)	909
Drainage Marker Post	909
Geosynthetic	910
Culvert, Downspouts	909

Select pipe sections and joint assemblies for use in culverts from the Qualified Products List.

Provide grout for jacked in place steel pipe that consists of a mixture of portland cement and no greater than 50 percent sand by volume.

A. **Pipe Culverts.** Pipe culverts are divided into six classes as shown in Table 401-1.

If the contract only shows the size and class of the culvert, select and provide a culvert pipe specified in Table 401-1.

If a particular type of culvert material is required, instead of the classes designated in Table 401-1, the contract will indicate the type and size of the culvert.

The Engineer will allow the substitution of a higher strength or greater thickness of culvert for the minimum strength or thickness required.

Table 401-1
Pipe Alternates for Culvert Classes

Type of Pipe **Depth of Cover (ft)** (a)	**Class A Culvert 0–10** (l)	**Class B Culvert >10–16**	**Class C Culvert >16–23**	**Class D Culvert >23–33** (i)	**Class E Culvert 0–3** (b)	**Class F Drive Culvert** (c)
Reinforced Concrete Pipe (d)	II	III	IV	V	IV	II
Nonreinforced Concrete Pipe (e)	1	3	No	No	No	1, 3 (f)
Corrugated and Spiral Ribbed Al-Alloy Pipe	Yes	Yes	Yes	Yes	No	Yes
Corrugated and Spiral Ribbed Steel Pipe	Yes	Yes	Yes	Yes	No	Yes
Smooth-Lined Corrugated Plastic Pipe (CPE) (g, j)	Yes (h)	Yes (k)	No	No	No	Yes (h)

a. Cover, including the pavement structure is the height of fill above the top of the pipe.
b. Class E culvert applies if the culvert is beneath the influence of proposed pavement and the depth of cover is 3 ft or less.
c. Class F culvert applies for driveway culverts (residential and commercial).
d. Roman numerals refer to class of reinforced concrete pipe in accordance with AASHTO M 170.
e. Arabic numerals refer to the class of nonreinforced concrete pipe in accordance with AASHTO M 86.
f. Nonreinforced concrete pipe Class 1 is allowed for Class F culverts with a depth of cover up to 10 ft.
Nonreinforced concrete pipe Class 3 is allowed for Class F culverts with a depth of cover from 10 ft to 16 ft.
g. Provide CPE in accordance with AASHTO M 294, Type S polyethylene pipe.
h. Allowed only for no greater than 36 in diameter pipe for CPE pipes
i. Special design is required for fill heights greater than 33 ft.
j. At least 2 ft cover if the culvert is outside the influence of proposed pavement (measured from top of pipe to final grade)
k. Allowed only for 12 in to 24 in diameter CPE pipes. Refer to the Class B Plastic Pipe Qualified Products List for approved manufacturers and products.
l. Class A culvert applies if the culvert is outside the influence of proposed pavement or is beneath the influence of proposed pavement and the depth of cover is from 3 ft to 10 ft.

401.03. Construction.

A. **Excavation and Culvert Bedding.** Excavate in accordance with subsection 206.03.A. Construct pipe culvert bedding using granular material Class IIIA, placed in layers no greater than 10 inches thick. Compact each layer to at least 95 percent of maximum unit weight for the entire length of the culvert. Where rock or hardpan is encountered, excavate the trench to at least 6 inches below the proposed bottom of the pipe; backfill with granular material Class IIIA, and compact.

Where unstable soil conditions, or obstructions other than rock, require excavation of the trench below the elevation detailed on the plans; undercut, backfill, and compact the trench as directed by the engineer. Use 6A, 17A, or 34R aggregate as backfill material for undercutting due to unstable soil conditions. This work will be paid for as trench undercut and backfill according to subsection 402.04.E.

B. **Repair of Damaged Coated Surfaces.** Repair, at no additional cost to the Department, coated culvert surfaces, damaged during transporting, handling, or installing. Complete repair of galvanized culvert surfaces in accordance with subsection 716.03.E. Repair other coated culvert surfaces as directed by the Engineer.

C. **Laying and Jointing Pipe.** Lay culverts with bells or grooves upgrade, ends fully and closely jointed, and with full, firm bearing throughout the length of the culvert. For pipe with diameters greater than 24 inches, wrap pipe joints with geotextile blanket. Use geotextile blanket with a width of at least 22 inches and center it on the joint.

Take up, and relay culvert sections showing signs of settlement or poor horizontal or vertical alignment, as determined by the Engineer. Remove, replace and mandrel test, if required by the Engineer, culverts damaged by the Contractor's operations.

Correct settled, misaligned, or damaged culvert sections at no additional cost to the Department.

1. **Corrugated Plastic Pipe.** Provide homing marks on smooth lined corrugated plastic pipe (CPE) to show the correct alignment of the pipe sections and joint material during field installation.

   After the trench backfill and compaction is complete, the Engineer will select at least 50 percent of the installed length of each CPE size for deformation testing. Provide the labor and equipment required to complete this testing. Use a 9-point mandrel with an effective diameter of 95 percent of the nominal pipe diameter. Pull mandrel through the pipe by hand using non-mechanical means without

damaging the pipe. Provide the Engineer with a proving-ring to verify the mandrel size. Conduct mandrel testing from five to ten working days before pavement surfacing or completion of final grade, unless otherwise approved by the Engineer.

Remove and reinstall, or replace, pipe with a nominal diameter reduced by at least 5 percent at no additional cost to the Department. Only reinstall undamaged pipe. Do not reinstall pipe without the Engineer's prior approval.

The Contractor is responsible for all expenses and delays due to the replacement of deformed or damaged pipe.

2. **Concrete Pipe.** Install reinforced concrete elliptical pipe with the longer axis placed horizontally, unless otherwise required.

   Install Type HE elliptical pipe with the longer axis within 5 degrees of the horizontal.

   Install Type VE elliptical pipe with the longer axis within 5 degrees of the vertical.

   Install elliptically reinforced, circular concrete pipe with the lift holes or manufacturer's marks on top of the pipe. Ensure the lift holes or manufacturer's marks, designating the top and bottom of the pipe, are not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. After installing the pipe, seal the lift holes with concrete plugs and waterproof.

3. **Metal Pipe.** Do not use wedge lock dimple bands for corrugated metal pipe.

   Do not use dissimilar types of base metal (steel or aluminum alloy) or dissimilar types of coatings on steel (zinc or aluminum) in a single line of pipe. However, the Engineer will accept the use of zinc coated steel end sections with aluminum coated steel pipe. Use coupling bands of the same base metal and coating metal as the pipe.

4. **Extending Culverts.** If extending a pipe culvert, cast a concrete collar at least 3 inches thick and extending 6 inches on each side of the joint. Wrap the connecting joint with a 36-inch wide geotextile strip centered on the joint. When extending an existing corrugated metal pipe with a corrugated metal pipe, the Engineer will allow a dimple band with filter wrap instead of a concrete collar on the first connection if the existing culvert is in good condition and has a circular cross section. Other methods of connecting to the existing pipe before construction require approval of the Engineer. Provide

joints tested in accordance with MTM 723 for remaining joints of the extension.

D. **Backfilling.** Backfill culverts, within the limits of the roadbed, with granular material Class II, III, or IIIA. Place backfill in layers no greater than 10 inches thick and compact each layer to at least 95 percent of the maximum unit weight. Backfill culvert downspouts, culverts, or portions of culverts outside the limits of the roadbed with granular or suitable material as detailed on the plans. Compact thoroughly as directed by the Engineer. Maintain at least 3 feet of cover, unless trimming for final grades.

Backfill smooth lined CPE with granular material Class IIIA to at least 1 foot above the pipe and as shown on the plans. The Engineer may allow the use of Class II backfill above this elevation. Place the backfill in layers no greater than 10 inches or half the pipe diameter, whichever is less. Place the backfill equally on opposite sides of the pipe at the same time.

Stake, or use other methods to maintain the line and grade of the culvert during the backfilling operation.

E. **Headwalls and End Sections.** Protect the ends of the culvert using headwalls or end sections constructed in accordance with details on the plans. Construct headwalls in accordance with section 706.

Use precast concrete end sections on concrete culverts in accordance with Standard Plan R-86 Series. If sloped end sections on concrete culverts are required, use either metal or concrete sloped end sections in accordance with Standard Plan R-95 Series. If footings for precast end sections or precast sloped end sections are required, use either precast or cast in place footings. Form or place them at the locations and to the elevations shown on the plans.

Use metal end sections on corrugated metal pipe culverts. Attach metal end sections to the ends of corrugated metal pipe using standard metal bands or other connecting devices as shown on the plans or approved by the Engineer. Provide and install toe plates on the metal end sections if shown on the plans.

Use either precast concrete or metal end sections on CPE. Do not use plastic end sections. Fasten end sections to the pipe as recommended by the pipe manufacturer or as directed by the Engineer. The Engineer will allow the use of a metal end section that is one size larger in diameter than the CPE. Slip the end section over the end of the pipe and securely fasten, making sure that the portion of the plastic pipe left exposed is less than 3 inches. If using a concrete end section, wrap the

joint with a strip of geotextile blanket 36 inches wide and centered on the joint.

Provide and install end section grates for culvert end sections on designated culvert end sections. Fabricate end section grates from weldable grade hot-rolled steel bars, plain or deformed, of the diameter and configuration shown on the plans. Fasten grates securely to the concrete end sections as shown on the plans.

Place salvaged end sections in accordance with specifications for placing new end sections.

Replace end sections damaged by Contractor's operation during salvaging or replacing operations with the same size end section as the original, at no additional cost to the Department.

F. **Drainage Marker Posts.** Place drainage marker posts at headwalls and culvert end sections for culverts with a diameter no greater than 36 inches, and at outlet endings. Ensure drainage marker posts are embedded at least 2 feet, or as recommended by the manufacturer.

G. **Pipe Culverts Jacked in Place.** Jack the culvert into place to the line and grade shown on the plans or established by the Engineer.

If jacking pipe under railroad tracks, submit to the Engineer, sheeting and bracing plans for the jacking pits for approval by the railroad company. Do not begin excavation of the jacking pit until receipt of the approval.

Excavate the approach trench large enough to accommodate jacks and blocking and at least one section of pipe. Lay two rails or sills in the bottom of the trench to keep the pipe at the established line and grade.

Minimize excavation ahead of the pipe to prevent caving of the earth. The Engineer will allow attachment of a steel cutting edge or shield to the front section of pipe to form and cut the required opening for the pipe.

Fill voids between the excavation and the pipe using materials and placing methods approved by the Engineer.

H. **Steel Pipe Jacked in Place.** Jack steel pipe in place to serve as a carrier pipe or a casing for a carrier pipe. Jack steel pipes in place in accordance with subsection 401.03.I.

I. **Steel Casing Pipe.** Install steel casing pipe in a trench as shown on the plans. Provide steel casing pipes placed for future use with a temporary bulkhead at each end to prevent infiltration into the pipe.

J. **Corrugated Steel Culvert.** Do not use dissimilar type of base metal (steel or aluminum alloy) or dissimilar types of coatings on steel (zinc or aluminum) in a single line of pipe.

K. **Disposal of Surplus Material.** Dispose of surplus material in accordance with subsection 205.03.P.

L. **Cleanout.** Maintain culverts installed on the project. Ensure they are free of silt, debris, and other foreign matter above the existing flow line of the drainage course at the time of final acceptance.

M. **Video Inspection.** Video inspect culverts as specified for sewers in subsection 402.03.K. Video inspection is not required for the following:

1. Driveway culverts,
2. Culvert extensions less than 50 feet,
3. New culverts less than 50 feet, or
4. The extension of existing catch basin leads less than 20 feet.

N. **Dewatering and Maintaining Stream Flow During Construction.** During construction, perform dewatering or pumping and temporary drainage to maintain stream flow so as to avoid damaging adjacent property or structures and interfering with the rights of the public, adjacent property owners, vehicular traffic, or other contractors.

Do not disturb the soil under and next to existing structures during dewatering and temporary pumping operations. Direct water from dewatering operations or from maintaining stream flow through a filter bag before discharging to an existing drainage facility. Do not overload or obstruct existing drainage facilities.

401.04. Measurement and Payment.

Pay Item	**Pay Unit**
Culv, Cl __, __ inch	Foot
Culv, Cl __, (material), __ inch	Foot
Culv, Downspout __ inch	Foot
Culv, Reinf Conc Ellip, Cl __, (rise) inch × (span) inch	Foot
Culv, CSP Arch, Cl __, (span) inch × (rise) inch	Foot
Culv, Slp End Sect, (slope), __ inch, Longit	Each
Culv, Slp End Sect, (slope), __ inch, Transv	Each
Culv, Slp End Sect, Arch Pipe, (slope), (span) inch × (rise) inch, Longit	Each
Culv, Slp End Sect, Arch Pipe, (slope), (span) inch × (rise) inch, Transv	Each
Culv, Slp End Sect, Ellip Pipe, (slope), (rise) inch × (span) inch, Longit	Each

Culv, Slp End Sect, Ellip Pipe, (slope), (rise) inch × (span) inch, Transv ..... Each
Culv End Sect, (material), __ inch ..... Each
Culv End Sect, __ inch ..... Each
Culv End Sect, Footing ..... Each
Culv End Sect, Grate ..... Pound
Culv, Cl __, __ inch, Jacked in Place ..... Foot
Steel Casing Pipe, __ inch, Jacked in Place ..... Foot
Steel Casing Pipe, __ inch, Trench Det __ ..... Foot
Dr Marker Post ..... Each
Culv End Sect, Salv, 30 inch or less ..... Each
Culv End Sect, Salv, over 30 inch ..... Each

A. **Culverts.** The Engineer will measure culverts, of the diameter, class, or material required, by length, excluding the length of end sections as shown on the plans. The unit prices for culverts include the cost of the following:

1. Excavating the material down to grade or to the culvert bedding bottom elevation;
2. Dewatering and maintaining the stream flow during construction stages;
3. Providing and placing the culvert and geotextile strip;
4. Providing temporary cover and restraining the pipe to maintain line and grade;
5. Providing, placing, and compacting the backfill;
6. Mandrel testing if required; and
7. Disposing of excess material.

B. **Culvert, Jacked in Place.** The Engineer will measure **Culv, Cl __, __ inch, Jacked in Place** of the size and type required, by length, as determined by multiplying the number of units actually jacked by the commercial laying length. The unit price for **Culv, Cl __, __ inch, Jacked in Place** includes the cost of excavating the pit; providing and installing sheeting, bracing, and other safety devices; providing jacking equipment; drainage and dewatering; and other items associated with the operation.

C. **Culvert End Sections.**

1. **End Sections.** The unit price for **Culv, Slp End Sect** of the size or type required includes the cost of providing and placing end sections, including longitudinal and cross tubes as detailed on Standard Plans R-95 Series.

The unit price for **Culv End Sect** of the size or type required includes the cost of providing and placing the end section.

The unit price for **Culv End Sect, Metal** includes the cost of providing and placing the end sections and toe plates, if shown on the plans. The unit price for **Culv End Sect, Metal** also includes the cost of providing and placing the length of associated culvert represented by the "c" dimension shown on the plans.

If corrugated plastic pipe is provided, the Department will pay for culvert end sections of the diameter required for the culvert, even if the Contractor provides a metal end section larger than the nominal diameter of the pipe.

The unit price for culvert end section includes the cost of fastening the end section to the pipe. The Department will pay for required riprap in accordance with subsection 813.04.

2. **Culvert End Sections, Footing.** The Department will pay for footings required for precast concrete end sections as **Culv End Sect, Footing**. The unit price for **Culv End Sect, Footing** includes the cost of the following, for the footing as shown on the plans:

   a. Excavation and forming;
   b. Providing and placing the steel reinforcement; and
   c. Providing, placing, finishing, and curing the concrete.

3. **Culvert End Sections, Salvage.** The unit price for **Culv End Sect, Salv** includes the cost of removing the existing end section, salvaging and storing, and reinstalling end sections.

4. **Culvert End Section, Grate.** The Engineer will measure **Culv End Sect, Grate** by weight as shown on the plans for the size of grate required.

D. **Headwalls.** The Engineer will measure, and the Department will pay for headwalls as steel reinforcement and concrete, Grade S2, in accordance with subsection 706.04. If using precast wing walls, headwalls, and aprons in lieu of cast-in-place wing walls, headwalls, and aprons, the Department will pay for them as the corresponding pay items for the cast-in-place wing walls, headwalls, and aprons as required by the contract.

E. **Jacked in Place Steel Pipe.** The Department will not pay separately for jacked in place steel pipe used, at the Contractor's discretion, to act as a casing for the carrier pipe. The cost of grouting between the carrier and casing pipes is included in payment for the carrier pipe.

F. **Steel Casing Pipe.** The unit price for steel casing pipe includes the cost of excavation and backfill.

The Department will pay separately for carrier pipe inserted into a steel casing pipe. The unit price for the carrier pipe includes the cost of casing chocks, inserting the carrier pipe, and required grouting.

G. **Videotaping Sewer and Culvert Pipe.** The Engineer will measure, and the Department will pay for videotaping sewer and culvert pipe in accordance with subsection 402.04.

H. **Rock Excavation.** The Engineer will measure and the Department will pay separately for rock excavation in accordance with subsection 205.04.