The temporary bypass shall not be removed until the new structure is opened to traffic and removal is authorized by the Engineer. Removal shall include a full clean-up of the site, complete removal of all structures, etc.; and restoration of the area to its original condition to the satisfaction of the Engineer.

The Contractor shall maintain traffic on the bypass or bypasses; and furnish assistance to traffic, if required.

710.03 METHOD OF MEASUREMENT.

Each temporary bypass shall be designated by its station number; and for the purpose of measurement and payment, it shall be considered as a complete and separate unit.

710.04 BASIS OF PAYMENT.

The basis of payment shall be the Contract Unit Price bid for "Temporary Bypass."

This payment will be full compensation for all labor, materials, and equipment necessary to complete the work.

The furnishing of, maintenance of, and payment for all signs, barricades, warning lights, and other traffic control devices shall be according to Section 704.

Where there is no Contract Unit Price for "Temporary Bypass," each temporary bypass ordered by the Engineer shall be paid for under Section 104.03 D.

SECTION 714
CULVERTS, STORM DRAINS, EDGE DRAINS, AND UNDERDRAINS

714.01 DESCRIPTION.

This work consists of installing culverts, storm drains, edge drains, and underdrains designed to intercept and carry off surface or underground water.

Culverts, storm drains, edge drains, and underdrains of the various types and sizes specified will, at times, be referred to as pipe or conduit in these Specifications.

714.02 MATERIALS.

A. **Culverts and Storm Drains.**

Materials shall meet the following:

Item	Section
Concrete Culvert and Storm Drain Pipe	830.01 A
Reinforced Concrete Culvert and Storm Drain Pipe	830.01 B
Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts, Underdrains, and Storm Drains	830.02 B
Corrugated Aluminum Alloy Culverts	830.02 C
Corrugated Polyethylene Culverts	830.03 F

Mortar shall consist of a mixture of one part Portland Cement to 2 parts mortar sand, and sufficient water to furnish proper consistency.

All materials must be approved by the Department before incorporation into the work.

When shown as conduit in the Contract, the Bidder may choose permissible options in types of pipe for culverts. The options will be shown in the Proposal.

B. **Smooth Wall Steel Pipe Culvert.**

Smooth wall steel pipe culvert shall meet Section 830.02 D.

C. **Underdrains.**

Materials shall meet the following:

Item	**Section**
Perforated, Corrugated Polyethylene, or Plastic Pipe	830.03 A.4
Underdrain Granular Fill Material (Screen Analysis only)	816.02 A.1

D. **Bridge Approach Drains.**

Materials shall meet the following:

Item	**Section**
Concrete Class AE	802
Precast Reinforced Concrete Pipe for Catch Basin	830.01 B
Corrugated Metal Pipe	830.02 B
Grates, Frames, and Boxes	834.02 B, 834.02 C, or 834.02 D
Plastic or PVC Pipe	830.03

E. **Edge Drains**.

Materials shall meet the following:

Item	**Section**
Perforated, Corrugated, P.E. Pipe	830.03 A.4
PVC Discharge Pipe	830.03 A.3
Geotextile Fabric	858
Trench Backfill	
Permeable Trench Backfill Cl.2	816.03
Permeable Base Aggr. Cl.7	816.03
Size 4 or 5 Concrete Aggregate*	816.02
Concrete Sand*	816.01
Class 43 Chips*	816.03

*Sieve analysis only.

714.03 CONSTRUCTION REQUIREMENTS.

A. **Culverts and Storm Drains.**

1. **Excavation.** Trenches shall be excavated to allow for proper jointing of the pipe, and thorough compaction of the bedding and backfill material under and around the pipe.

   The completed trench bottom shall be firm for its full length and width. Where required, the trench shall have a longitudinal camber of the magnitude specified.

   The foundation for each type of bedding shall be adequate to furnish a uniform stable support. Where unstable material is encountered, it shall be removed to the depth directed by the Engineer and replaced with granular backfill. Rock, shale, or hard pan shall be removed to a depth one foot below the bedding elevation and replaced with granular backfill.

   Excavation required in excess of one foot below the specified bedding elevation will be paid for as Common Excavation.

2. **Bedding.** When bedding is required, it shall meet the details shown on the Plans or Standard Drawings.

   Bedding for mainline pipe shall consist of sand or selected sandy soil. The bedding material shall be at least 4 inches thick beneath the pipe, and shall extend up the sides equal to 30% of the vertical outside diameter with 1/2 the bedding preshaped. The pipe shall be laid on bedding material shaped to fit the pipe for at least 15% of its total height. Recesses in the trench bottom shall be shaped to fit the bell when bell and spigot type pipe is used. Fill shall be tamped in place under both haunches of the pipe up to 15% of the total height by hand-held air-operated, mechanical tampers.

   Bedding for approach pipe shall consist of bedding the pipe to a depth of not less than 10% of its total height. The bed shall be shaped to fit the conduit and shall have recesses shaped to receive the bell. Tamping shall be as specified above for mainline pipe.

3. **Laying Pipe.** Laying of pipe shall begin at the downstream end. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing upstream.

4. **Joining Pipe.** Rigid pipe may be of “bell and spigot” or “tongue and groove” design unless one type is specified. Pipe sections shall be joined so the ends are fully entered and the inner surfaces are flush and even.

   When jointing or tying of pipe sections is required, the jointing material and construction methods will be as shown on the Plans or Standard Drawings.

   Flexible pipe shall be firmly joined by coupling bands.

5. **Relaid Pipe.** The Engineer will determine which sections of salvaged pipe are suitable for relaying.

   All salvaged pipe shall be cleaned of foreign material before reinstallation.

6. **Backfilling for Pipe Installed in Embankments.** After installing the pipe on the required bedding, suitable backfill shall be placed along each side of the pipe in layers not exceeding 12 inches. Each layer shall be compacted to the required density. If a specified density is not required, compaction shall be according to Section 203.02 I.

   All suitable excavated material may be used for backfilling, and the balance shall be placed in the roadway embankments. Soft, spongy, or other unsuitable material shall be placed on the slopes of the roadway embankment or wasted at locations acceptable to the Engineer.

   Material around the sides and under the haunches of the conduit shall be thoroughly compacted.

7. **Backfilling for Pipe Installed in Trenches.** After the pipe is installed, the trench shall be backfilled with suitable material according to Section 210.

8. **Imperfect Trench Method of Installation.** The imperfect trench installation method shall be as shown on the Standard Drawings.

9. Corrugated Polyethylene (plastic) Pipe shall be installed as shown on Standard Drawing D-714-14. A minimum of thirty days after the pipe is installed, the Contractor (under the observation of the engineer) shall pass a nine point mandrel or other approved object through the pipe to check for deformation. The mandrel diameter shall not be less than 95% of the inside diameter of the pipe. If the plastic pipe has deformed more than 5%, it shall be replaced at the Contractors expense. Another thirty day waiting period will commence upon installation of the replacement pipe.

B. **Smooth Wall Pipe Culvert.** Smooth wall steel pipe culverts shall be installed using equipment that encases the hole as the earth is removed. Boring without the concurrent installation of the steel pipe will not be permitted. All joints in steel pipe shall be welded according to AWS D1.1. Steel pipe shall extend through the undisturbed fill and shall be installed without disrupting traffic or damaging the roadway grade and surface. Use of water in the process of boring or jacking is prohibited.

   The borings shall be made in straight lines and to the grade and alignment shown. The flow line elevation at the starting point for jacking shall be within 0.1 foot of the staked grade; the flow line shall not be reversed at any point; and the line and grade at any point within the pipe shall not vary by more than 0.5 foot from the line and grade designated.

   Only welders qualified for groove welded pipe position 5G shall be employed to splice smooth wall steel pipe culverts. Welders shall be qualified according to AWS D1.1 except full penetration shall not be required. The root pass and the remaining part of the weld, including the reinforcement, shall meet the requirements of AWS D1.1. Reinforcement shall not exceed 1/8 inch in height. The Department will accept the welding test results administered by an independent testing agency. The cost of welder testing and certification shall be the responsibility of the Contractor. A copy of the welder’s qualification test certificate shall be furnished to the Engineer before the welder performs any welding. The Engineer has the right to require a requalification test at any time.

C. **Underdrains.** Underdrains shall be constructed to the line, grade, and locations shown.

The perforated underdrain shall be encased in a granular fill trench section with the trench section enclosed with filter fabric. The filter fabric shall meet the requirements of Section 709.02, Filter Fabric Underdrain. The trench section shall be 1.5 feet wide and 2.0 feet deep. The underdrain shall rest on the filter fabric at the bottom of the trench, at the desired grade, prior to backfilling with the granular fill. No more than 1 inch of granular material may be used to adjust the pipe to grade. The filter fabric shall overlap approximately 12 inches.

Underdrain size and perforation layout shall be as shown in the Contract.

The PVC joints shall be solvent cemented using the manufacturer's recommendations.

Where a drain connects with a manhole or catch basin, the connection shall be made at the Contractor's expense.

Backfill above the granular fill material shall be ordinary backfill as specified in Section 210.

D. **Bridge Approach Drains.** Construction of bridge approach drains shall be as shown in the Contract.

Excavation shall be according to the details shown. The backfill shall be placed without disturbing the units, and shall be compacted to the same density as the adjacent embankment.

E. **Edge Drains.** Edge Drains shall be constructed along the pavement edge as shown on the Plans. The drains shall be outletted at approximate intervals of 250 feet and at low points in the flow line of the edge drain.

The drains shall be placed by a machine trencher capable of cutting the trench, lining the trench with a geotextile fabric, and laying the pipe in a continuous operation. The drains shall be placed at a minimum grade of 0.2%. Laser grade control will be required on the trenching machine whenever the pipe grades do not follow the pavement grades at a constant depth. The trenching equipment shall be designed and operated so the excavated material does not fall back into the trench. The excavated trench material shall be disposed of by the contractor.

The trench backfill shall be compacted with a vibratory shoe compactor narrower than the trench, but not more than 2 inches less than the trench width. The trench backfill shall be compacted adequately to ensure that additional settlement will not occur.

When edge drains are installed adjacent to a permeable base material, the trench shall be wrapped with a Type D2 geotextile drain fabric. The fabric shall be pinned directly below the flow line of the permeable base material so the flow of water to the drain is not impeded. Concrete sand will not be used for trench backfill on projects using a permeable base material.

When edge drains are installed on a project with a non-permeable base material, the PE pipe shall be enclosed in a geotextile fabric sock. The Contractor may elect to use a Type D3 or Type D4 geotextile drain fabric for the sock.

Edge drains that outlet to the ditch shall be constructed concurrently with the longitudinal edge drains and laid at right angles to the roadway centerline. The discharge pipe shall be a PVC pipe laid at a minimum grade of 2%. The connection to the edge drain pipe shall be made with a non-perforated PE pipe placed with a 3-foot radius. Two drains coming together at a low point shall be connected to separate discharge pipes. The discharge trenches shall be constructed similar to the drains, but shall be backfilled with the existing soil. Headwalls shall be installed a minimum of 6 inches above the ditch grade. The discharge pipe shall be inserted and coupled to the headwall with grout. The uppermost point of the headwall shall be placed flush with the roadway inslope. The inslope shall be shaped to conform to the sides and toe of the headwall. The headwall and rodent screen shall be installed at the same time the outlet pipe is installed.

Each headwall shall be provided with a rodent screen that fits snuggly into the headwall so mice and other rodents are unable to enter the drain. The rodent screens must be removable, the Contractor will not be permitted to grout the screens into place.

Edge drains that outlet to a storm sewer system shall be coupled to the inlet by use of grout, rubber or plastic gaskets, or by a gasket joint inserted into a thermoplastic coupling cast into the inlet. The connections to the storm sewer shall be made concurrently with the installation of the drain. The cost of the connections to the storm sewer shall be incidental to the cost of the edge drains.

Ends of the drainage line where outlets are not required shall be capped.

All joints shall be connected securely according to the manufacturer's recommendations.

Construction equipment will not be allowed on the edge drain until it is properly protected.

714.04 METHOD OF MEASUREMENT.

A. **Culverts and Storm Drains.** Pipe of different types and sizes, both new and relaid, will be measured by the Linear Foot in place.

End sections will be measured by the number of units installed.

Branch connections and elbows will be included in the length measured for pipe.

Excavation and backfill for pipe will not be measured for payment.

Where alternate types of pipe are specified, they will be designated as conduit pipe and will be measured by the Linear Foot along the invert between the outside ends of any flared end section or attached fitting. Flared end sections will not be measured separately but will be considered as part of the conduit. Each conduit will be measured to the nearest foot.

Grates will be measured by the number of units installed.

B. **Smooth Wall Steel Pipe Culvert.** Smooth wall steel pipe culvert will be measured by the Linear Foot of the various sizes in place, complete, and accepted. Any

connectors for adapting other pipe or end sections will not be measured but shall be incidental to the item, Smooth Wall Steel Pipe Culvert.

C. **Underdrains.** Underdrains of different types and sizes will be measured by the Linear Foot in place.

Granular Fill will be measured by the Cubic Yard computed from the width and depth of the trench as specified or approved by the Engineer. The volume displaced by the underdrain will be deducted.

D. **Bridge Approach Drains.** Bridge approach drains, including Headwalls, will be measured by the Unit.

E. **Edge Drains**. Edge drains shall be measured by the Linear Foot (parallel to the roadway) of "Edge Drain Permeable Base" or "Edge Drain Non-Permeable Base" installed and accepted by the Engineer. No deduction in length will be made for outlet structures installed along the drain. The Contract Unit Price bid shall include all costs for trenching, geotextile fabric, trench backfill, compaction, caps, manhole connections, and other associated work.

The headwalls will be measured by the number of "Headwalls, Precast Concrete, 4 In." installed and accepted by the Engineer. The Contract Unit Price bid shall include payment for the headwall, the discharge pipe, the 3 foot radius pipe connection, trenching, backfilling, compaction, rodent screen, connections, and other associated work.

714.05 BASIS OF PAYMENT.

Payment will be made at Contract Unit Prices for the following:

Pay Item	**Pay Unit**
Pipe (Type and Size)	Linear Foot
End Section (Type and Size)	Each
Grates	Each
Relaying Pipe (Type and Size)	Linear Foot
Relaying End Section (Type and Size)	Each
Underdrain Granular Fill Material	Cubic Yard
Bridge Approach Drains	Each
Edge Drain Permeable Base	Linear Foot
Edge Drain Non-Permeable Base	Linear Foot
Headwalls, Precast Concrete, 4 In.	Each

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

Unless otherwise specified, excavation for culverts, storm drains, underdrains, and edge drains, including excavation below flow line grade and excavation for imperfect trench, bedding, and backfill will not be paid for but shall be incidental to the pipe item. Disposal of unsuitable material will not be paid for but shall be incidental to the pipe item.

Geotextile fabric used with underdrains and edge drains will not be paid for separately, but will be incidental to the pipe items.

Granular fill or trench backfill used with underdrains and edge drains will not be paid for separately, but will be incidental to the pipe items.