

APPENDIX C

ROAD AND BRIDGE SPECIFICATIONS

SECTION 301--CLEARING AND GRUBBING**301.01--Description.**

This work shall consist of clearing, grubbing, removing, and disposing of vegetation, debris, and other objects within the construction limits except for vegetation and objects that are designated to be preserved, protected, or removed in accordance with the requirements of other provisions of these specifications.

301.02--Procedures.

If approved by the Engineer, the Contractor may clear and grub to accommodate construction equipment within the right of way up to 5 feet beyond the construction limits at his own expense. The Contractor shall install erosion and siltation control devices prior to beginning clearing and grubbing operations and such devices shall be functional before upland land-disturbing activities take place.

The surface area of earth material exposed by grubbing, stripping topsoil, or excavation shall be limited to that necessary to perform the next operation within a given area. Grubbing of root mat and stumps shall be confined to the area which excavation shall be performed within 15 days following grubbing.

Stumps, roots, other perishable material, and nonperishable objects that will be less than 5 feet below the top of earthwork within the area directly beneath the pavement and shoulders shall be removed. However, such material and objects that will be 5 feet or more than 5 feet below the top of earthwork within the area directly beneath the pavement and shoulders and all such material and objects beneath slopes of embankments shall be left in place unless removal is necessary for installation of a structure. The top of stumps left in place shall be not more than 6 inches above the existing ground surface or low water level.

Branches of trees that overhang the roadway or reduce sight distance and that are less than 20 feet above the elevation of the finished grade shall be trimmed using approved tree surgery practices in accordance with the requirements of Section 601.03(b).

Vegetation, structures, or other items outside the construction limits shall not be damaged. Trees and shrubs in ungraded areas shall not be cut without the approval of the Engineer.

Combustible cleared and grubbed material shall be disposed of in accordance with the following:

- (a) **Trees, limbs, and other timber having a diameter of 3 inches and greater** shall be disposed of as saw logs, pulpwood, firewood, or other usable material; however, treated timber shall not be disposed of as firewood. Not more than 2 feet of trunk shall be left attached to grubbed stumps.

When specified that trees or other timber is to be reserved for the property owner, such material shall be cut in the lengths specified and piled where designated, either within the limits of the right of way or not more than 100 feet from the right-of-way line. When not reserved for the property owner, such material shall become the property of the Contractor.

- (b) **Material less than 3 inches in diameter** shall be used to form brush silt barriers when located within 500 feet of the source of such material when specified on the plans or where directed by the Engineer. Material shall be placed approximately 5 feet beyond the toe of fill in a strip approximately 10 feet wide

to form a continuous barrier on the downhill side of fills. Where selective clearing has been done, material shall be piled, for stability, against trees in the proper location. On the uphill side of fills, brush shall be stacked against fills at approximately 100 foot intervals in piles approximately 5 feet high and 10 feet wide. Any such material not needed to form silt barriers shall be processed into chips having a thickness of not more than 3/8 inch and an area of not more than 6 square inches and may be stockpiled out of sight of any public highway for use as mulch.

- (c) **Stumps and material less than 3 inches in diameter** that are not needed to form silt barriers and that are not processed into wood chips shall be handled in accordance with the requirements of Sections 106 and 107.

301.03--Measurement and Payment.

Clearing and grubbing will be measured and paid for in accordance with one of the following methods, as specified:

- (a) **Lump sum basis:** No measurement of the area to be cleared and grubbed will be made.
- (b) **Acre basis:** The work to be paid for will be the number of acres, computed to the nearest 0.1 of an acre, actually cleared and grubbed. Areas within the limits of any existing roadway or local material pit will not be measured.
- (c) **Unit basis:** The work to be paid for will be determined by the actual count of trees, stumps, structures, or other obstructions removed.

These prices shall include disposing of cleared and grubbed material.

When clearing and grubbing is not a pay item, the cost thereof shall be included in the price for other appropriate pay items. Allowance will not be made for clearing and grubbing borrow pits or other local material pits.

Payment will be made under:

Pay Item	Pay Unit
Clearing and grubbing	Lump sum, acre, or unit

SECTION 302--DRAINAGE STRUCTURES

302.01--Description.

This work shall consist of installing pipe culverts, endwalls, box culverts, precast concrete and metal arches, storm drains, drop inlets, manholes, spring boxes, junction boxes, and intake boxes and removing and replacing existing structures in accordance with the requirements of these specifications and in reasonably close conformity with the lines and grades shown on the plans or as established by the Engineer.

302.02--Materials.

- (a) **Pipe** shall conform to the requirements of Section 232 and shall be furnished in accordance with the diameter, wall thickness, class, and strength or corrugation specified for the maximum height of fill to be encountered along the length of the pipe culvert, storm drain, or sewer.
- (b) **End sections** shall conform to the applicable requirements of Section 232. End sections used with rigid pipe shall be concrete. End sections used with asphalt-coated or paved pipe shall not be asphalt coated or paved.
- (c) **Pipe fittings, such as tees, elbows, wyes, and bends**, shall conform to the applicable requirements of Section 232. Fittings shall be of the same type, class, thickness, gage, and strength as the line in which they are used.
- (d) **Steel grates, steel frames and structural steel** shall conform to the requirements of Section 226 and shall be galvanized in accordance with the requirements of Section 233.
- (e) **Concrete blocks** shall conform to the requirements of Section 222 for masonry blocks.
- (f) **Brick** shall conform to the requirements of Section 222.
- (g) **Hydraulic cement mortar** shall conform to the requirements of Section 218.
- (h) **Cast-in-place concrete** shall conform to the requirements of Section 217 for Class A3.
- (i) **Bedding material** shall conform to the requirements of Section 205.
- (j) **Joint material and gaskets** shall conform to the requirements of Section 212.
- (k) **Gray-iron castings** shall conform to the requirements of Section 224.
- (l) **Reinforcing steel** shall conform to the requirements of Section 223, Grade 40 or 60.
- (m) **Curing materials** shall conform to the requirements of Section 220.

302.03--Procedures.

Excavation and backfill operations shall be performed in accordance with the requirements of Section 303.

Foundation exploration shall be performed in accordance with the requirements of Section 401 unless otherwise provided herein. Concrete construction shall conform to the requirements of Section 404. Reinforcing steel placement shall conform to the requirements of Section 406. Bearing pile operations shall be performed in accordance with the requirements of Section 403. When specified on the plans or directed by the Engineer, a temporary diversion channel shall be constructed to facilitate installation of a pipe or box culvert.

The Contractor shall be responsible for anticipating and locating underground utilities and obstructions in accordance with the requirements of Section 105.08.

When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to determine if changes in line or grade are required for the new work.

When lift holes are provided in concrete pipe or precast box culverts, the Contractor shall install a lift hole plug furnished by the manufacturer in accordance with the requirements of Section 232.02(a)1. After pipe installation and prior to backfilling, plugs shall be installed from the exterior of the pipe or box culvert and snugly seated.

- (a) **Pipe Culverts:** Not more than one type of pipe shall be used in any one pipe line. When the proposal indicates that all types of pipe of one size are combined into one bid item, one bid price shall be submitted for each size of pipe to be used.

When field cutting corrugated metal pipe is permitted by the Engineer, damaged areas of the protective coating shall be repaired in accordance with the requirements of Section 233 for galvanized pipe and in accordance with the manufacturer's recommended procedures for all other metallic or polymer coatings.

1. **Jack and bore method:** The Contractor shall submit to the Engineer a complete plan and schedule for jack and bore pipe installation prior to beginning such work. The submission shall include complete details for dewatering; soil stabilization; jacking and receiving pits; jacks; reaction block; boring equipment; sheeting, shoring, and bracing for protecting the roadbed; installation sequence; materials; and equipment. The Contractor shall not proceed with pipe installation until the plan has been reviewed and accepted by the Engineer.

The jack and bore method shall be applicable for installing concrete pipe 12 through 108 inches in diameter and smooth-wall steel pipe 12 3/4 through 48 inches in diameter.

Pipe shall have a design strength and wall thickness sufficient to withstand the jacking operation and maximum height of fill to be encountered along the length of the pipe.

Construction shall be performed in such a manner that the ground surface above the pipe line will not settle. The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft shall be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. The holes shall be bored mechanically. The boring shall be done by using either a pilot hole or a dry bore method.

In operating jacks, even pressure shall be applied to all jacks used. Suitable bracing between jacks and the jacking head shall be provided so that pressure shall be applied to the pipe uniformly

around the ring of the pipe. The jacking head shall be of such weight and dimensions that it shall not bend or deflect when full pressure is applied to the jack. The jacking head shall be provided with an opening for the removal of excavated material as the jacking proceeds. The pipe to be jacked shall be set on guides that are straight and securely braced together in such manner as to support the section of pipe and to direct it in the proper line and grade.

Installation of the pipeline shall immediately follow heading or tunneling excavation. Voids occurring behind the pipe during installation shall be filled with hydraulic cement grout, placed under pressure, upon completion of the jack and bore operation.

Joint sealant material on concrete pipe shall be placed ahead of the jacking frame. The Contractor shall replace or repair, as directed by the Engineer, pipe that is damaged during jacking operations at his own expense. Joints of steel pipe shall be butt welded, watertight, as installation progresses.

When work is stopped, the heading shall be bulkheaded.

When the contractor encounters an obstruction during the jacking and boring operation that stops the forward progress of the work for more than 60 minutes, the following procedure shall be followed:

- a. The Contractor shall notify the Engineer immediately upon encountering an obstruction that stops the forward progress of the work. The Engineer shall verify that an obstruction has stopped the forward progress of the work in excess of 60 minutes and that the Contractor's efforts to remove or bore through the obstruction have been deliberately and diligently pursued.
- b. The Contractor shall consult with the Engineer and offer appropriate options for consideration. Upon authorization by the Engineer, the Contractor shall proceed with removal of the obstruction by other methods on a force account basis in accordance with the requirements of Section 109.05. Such alternative methods may include tunneling. In the event tunneling is determined to be necessary by the Engineer, the Contractor shall detail a plan for such an operation including all necessary safety and health precautions for workers as required by local, state, and federal regulations as required by the work being performed. Work shall not commence until this plan is received and authorized by the Engineer. The Contractor shall notify the Engineer before resuming work and afford the Engineer the opportunity to witness all work performed by the Contractor. Payment for obstruction removal shall be from the start of removal operations until the successful removal of the obstruction.
- c. Upon removal of the obstruction, the Engineer shall make a determination as to the method to use to proceed with the pipe installation.

2. Open trench method:

- a. **Foundation:** The foundation shall be explored below the bottom of the excavation to determine the type and condition of the foundation. However, explorations need not be

made for routine entrance or crossover pipe 12 through 30 inches in diameter that is to be installed under fills 15 feet or less in height. Foundation exploration shall extend to a depth equal to ½ inch per foot of fill height or 8 inches, whichever is greater. The Contractor shall report the findings of the foundation exploration to the Engineer for approval prior to placing pipe.

Where unsuitable foundation is encountered at the established grade, as determined by the Engineer, such material shall be removed and replaced.

Backfill for areas where unsuitable material has been removed shall be placed and compacted in accordance with the requirements of Section 303.04(g).

- b. **Bedding:** Bedding material for culvert foundations, including foundations in soft, yielding or otherwise unsuitable material, shall be aggregate No. 25 or 26 conforming to the requirements of Section 205. Where standing or running water is present in the pipe foundation excavation, pipe bedding material shall be aggregate No. 57 for the depth specified on the plans or as directed by the Engineer, capped with 4 inches of aggregate No. 25 or 26. Where such conditions are discovered in the field and the Contractor is directed by the Engineer to use No. 57 stone, No. 57 stone will be paid for at the existing contract until price, or if not in the contract, in accordance with Section 109.05.

Pipe bedding shall be lightly and uniformly compacted and shall be carefully shaped so that the lower section of the pipe exterior is in contact with the bedding material for at least ten percent of the overall height of the pipe. Bedding material shall be shaped to accommodate the bell when bell and spigot pipe is used. The depth of bedding material shall be at least 4 inches or as specified on the plans.

- c. **Placing pipe:** Pipe shall be placed beginning at the downstream end of the pipe line. The lower segment of pipe shall be in contact with the shaped bedding for its entire length. Bell or groove ends of rigid pipe shall be placed facing upstream.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Pipe will be inspected before backfill is placed. Pipe found to be out of alignment, unduly settled, or damaged shall be taken up and reinstalled or replaced.

- d. **Joining pipe:**

- (1) **Rigid pipe:** The method of joining pipe sections shall be such that ends are fully entered and inner surfaces are reasonably flush and even so as to permit sealing as specified herein.

Joints shall be sealed with any one or combination of the following to form a leak-resistant joint: rubber, preformed plastic, or mastic gaskets from the Department's approved list; oakum and mortar; oakum and joint compound; or cold-applied pipe joint sealer.

Rubber ring gaskets shall be installed to form a flexible, leak-resistant seal. Where oakum is used, the joint shall be caulked with this material and then sealed with mortar or joint compound.

(2) **Flexible pipe:** Flexible pipe sections shall be aligned and firmly joined by approved coupling bands to form a leak-resistant joint.

- e. **Structural plate pipe, pipe arches, and arches:** Erection shall be in accordance with the manufacturer's assembly diagrams and instruction sheets. Splices in the haunch areas of structural plate pipe arches shall be constructed using the reverse shingle method or the side plates shall be provided without longitudinal seams in the haunch areas. The complete line shall be assembled before backfill is placed. Bolts shall be tightened to a torque of 150 to 250 foot-pounds. If spiraling occurs during installation, bolts shall be loosened and the pipe assembly adjusted to the correct position.
- f. **Arch substructures:** Each side of an arch shall rest in a groove formed into the masonry or on a galvanized angle or channel securely anchored to or embedded in the substructure. Where the span of the arch is more than 15 feet or the skew angle is more than 20 degrees, a metal bearing surface having a width at least equal to the depth of the corrugation shall be provided.

Metal bearings for arches shall be cold-formed galvanized channel conforming to the requirements of ASTM A569 at least 3/16 inch in thickness, with the horizontal leg securely anchored to the substructure at points spaced on centers of not more than 24 inches. When the metal bearing is not embedded in a groove in the substructure, one vertical leg shall be punched to allow bolting to the bottom row of plates.

- g. **Backfilling:** Class I backfill shall be crusher run aggregate size No. 25 or 26, aggregate base material size 21A or 21B, flowable fill, or crushed glass conforming to the size requirements for crusher run aggregate size No. 25 and 26.

Regular backfill material outside of the neatlines of the Class I areas shown on the Standard PB-1 drawings shall be regular excavation conforming to Section 303. Regular and classified backfill shall be placed in uniform layers not more than 6 inches in thickness, loose measurement, before compaction. Each layer of Class I and regular backfill material shall be thoroughly compacted as specified in Section 303.04(g) with the exception that Class I backfill material shall be placed and compacted at a moisture content of optimum to plus 2 percentage points of optimum. Class I backfill material shall be thoroughly compacted under the haunches of pipe culverts. Each layer of Class I and regular backfill material shall be compacted by rolling, tamping with mechanical rammers, or hand tamping with heavy metal tampers with a face of at least 25 square inches. If vibratory rollers are used in the backfill operations, vibratory motors shall not be activated until at least 3 feet of backfill has been placed and compacted over the pipe. Backfill and compaction shall be advanced simultaneously on both sides of the pipe. The fill above the top of the regular backfill shall be installed and completed as specified for embankment construction.

Field density determinations will be performed in accordance with the requirements of VTM-1, VTM-10 or other methods approved by the Engineer.

Concrete pipe with a height of cover greater than that shown in the Standard PC-1 drawings, table for Class V pipe, shall be special design pipe with Method "A" bedding and backfill in accordance with the requirements of Standard PB-1.

Puddling will not be permitted. Rock more than 2 inches in its greatest dimension shall not be placed within 12 inches of pipe.

Backfill and compaction shall be advanced simultaneously on both sides of the pipe. The fill above the top of the pipe shall be completed as specified for embankment construction unless the induced trench method of installation is used.

3. **Tunneling operations:** The jacked tunneling method shall be applicable for installing concrete pipe 30 through 108 inches in diameter and smooth-wall steel pipe 30 through 48 inches in diameter. Where the plans specifically identify tunneling as the means of pipe installation, tunneling shall be performed by the Contractor as follows:

The tunnel shall be excavated in such a manner and to such dimensions that shall permit placing of the proper supports necessary to protect the excavation. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation necessary for the safe and proper installation of the pipe. Damage from excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced by the Contractor at his own expense. Adequate provisions shall be made for the safety and health of the workers required by the work being performed.

No pipe shall be placed until the foundation is in a condition satisfactory to the Engineer. Tunnel dimensions shown on the plans are minimum dimensions. Any excess excavation and subsequent backfill, concrete or grout fill shall be at the Contractor's expense. The pipe shall be laid in the tunnel true to line and grade. If required by the plans or if required for safety, suitable steel or timber sheeting, shoring, and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided they clear the encasement or carrier pipe. No separate payment shall be made for supports left in place. Installation of the pipeline shall immediately follow tunneling excavation.

If indicated or specified, the entire void between the outside of the pipe and the tunnel walls or the inside face of the tunnel lining shall be grouted in accordance with ASTM C476 unless the permanent sheeting, bottom, sides, and roof of the tunnel are in a condition satisfactory to the Engineer. The minimum thickness of grout backfill shall be maintained throughout. Grout required for backfill in excess of the excavation tolerances specified herein shall be at the Contractor's expense.

Any pipe damaged during construction operations shall be repaired, if approved by the Engineer, or removed and replaced by the Contractor at his expense.

If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting

bands, whichever is feasible. When reinforced concrete pipe 24 inches and larger in diameter with tongue-and-groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed, packed with mortar, and finished smooth and even with the adjacent section of pipe.

- (b) **Precast Drainage Structures:** Submittal of designs for precast items included in the standard drawings will not be required provided fabrication is in accordance with the standard details. Submittal of designs for precast box culverts on the Department's approved list will not be required provided the Contractor submits a certification that the item will be fabricated in accordance with the preapproved design drawings.

Requests for approval of a precast design shall include detailed plans and supporting computations that have been reviewed and approved by a registered Professional Engineer having at least 5 years of experience in structural design of the type of precast structures or components proposed and licensed in the Commonwealth. Concrete shall conform to Section 217 unless otherwise specified and have a design strength at 28 days of at least 4000 pounds per square inch and an air content of 6 ± 2 percent. The design of the concrete mixture and the method of casting, curing, handling, and erecting shall be subject to review by the Engineer. Precast units may be shipped after reaching 85 percent of the design strength as determined by control cylinders tested in accordance with the requirements of Section 404. However, units shall retain their structural integrity during shipment and shall be subject to inspection at the job site. Approval to use precast units shall not be construed as waiving the size and weight hauling limitations specified in Section 107.21.

1. **Standard precast drainage units** shall conform to the material requirements of AASHTO M199 and the following:
 - a. If the grade on the adjacent gutter is less than 1.5 percent, the grade on the invert of the throat section of the inlet shall be at least 1.5 percent. Precast throats having flat inverts will be permitted in sag locations provided the total length of the required throat opening does not exceed 6 feet.
 - b. Pipe openings in precast drainage units shall not exceed the outside cross sectional dimensions of the pipes by more than a total of 8 inches regardless of the placement of the pipes, the angles of intersection, or the shapes of the pipes. Pipe openings shall be formed, drilled, or neatly cut.
 - c. The Contractor shall use brick, masonry block, other standard masonry units, or clean, durable, and sound local stone in conjunction with mortar to fill the void between the pipe culverts and the precast drainage structures. Stone or masonry units, areas of the pipe openings, and exterior walls of pipe shall be thoroughly wetted and then bonded with mortar by standard masonry practice in such a manner as to provide a contiguous masonry connection between the precast drainage structures and the pipe culverts. The remaining exterior and interior voids shall be filled with mortar and shaped to the contour of the precast structure.
 - d. When precast units are to be located adjacent to the subbase or base course, units with chambers shall be provided with weep holes 3 inches in diameter and hardware cloth

and shall be located to drain the subbase or base.

- e. Precast units located adjacent to cast-in-place concrete items, such as flumes, ditches, and gutters, shall be connected to the adjacent unit by means of No. 4 smooth steel dowels spaced on approximately 12 inch centers throughout the contact length and extending at least 4 inches into both the precast unit and the cast-in-place item. If holes to receive the dowels are provided in the precast unit, they shall be not more than 5/8 inch in diameter. Other methods of providing the connection, such as keyed joints, shall be approved by the Department prior to fabrication.
- f. The chamber section shall be installed in the plumb position. The throat and top sections shall have positive restraints, such as adjacent concrete, pavement, or soil on all sides to prevent displacement and shall have a positive interlock, such as dowels, with the chamber section. The throat and top sections shall be installed to conform with the normal slope of the finished grade, and may be canted up to a maximum grade of 10%. The chamber may be built up a maximum of 12 inches at any point to provide for complete and uniform bearing of the throat and top sections on the chamber flat slab top or other approved top section. The built up section shall be constructed using whole concrete spacer units where feasible, and partial and whole sections of concrete block or brick with high strength grout and mortar. High strength grout shall be used to provide the final grade adjustment and uniform bearing. The width of the built up section shall match the wall thickness of the chamber section. The concrete block and brick shall be thoroughly bonded with mortar and the inside and outside of the built-up section shall be plastered with mortar except that the concrete spacer unit shall not be plastered.

2. **Precast arches** shall conform to the applicable requirements of AASHTO's Standard Specifications for Highway Bridges with the following modifications:

- a. **Combination of loads:** For service load design: E: vertical loads: 1.00; lateral loads: 1.00 and 0.5 (check both loadings).

For load factor design: E: vertical loads: 1.00; lateral loads: 1.30 and 0.5 (check both loadings).

- b. **Protection against corrosion:** The concrete cover of reinforcement shall be at least 1 ½ inches.

In corrosive or marine environments or other severe exposure conditions, reinforcement shall be epoxy coated in accordance with the requirements of Section 223.

Exposed reinforcing bars, inserts, and plates intended for bonding with future extensions shall be protected from corrosion as directed by the Engineer.

Reinforcement shall be designed and detailed in consideration of fabrication and construction tolerances so that the minimum required cover and proper positioning of reinforcement shall be maintained.

- c. **Anchorage:** Sufficient anchorage shall be provided at the terminus of lines of precast units. Anchorage may consist of a cast-in-place end section at least 3 feet in length with a headwall or collar around the precast unit(s) provided adequate connection can be made between the collar and units.
 - d. **Joints:** Joints between units shall be sealed by preformed plastic or mastic gaskets or grout. When preformed gaskets are used, they shall be of a type listed on the Department's approved products list.
 - e. **Pipe openings:** Pipe openings will not be allowed in the precast arch but may be provided through the wingwalls. When required, openings shall conform to the requirements of 1.b. herein.
3. **Precast box culverts** shall conform to the applicable requirements of AASHTO M259 or M273 and AASHTO's Standard Specifications for Highway Bridges with the following modifications:

- a. Combination of loads: For service load design or load factor design: E: new reinforced concrete boxes: vertical loads: 1.00; lateral loads: 1.00 and 0.5 (check both loadings).
- b. Protection against corrosion: The following minimum concrete cover shall be provided for reinforcement: For boxes with more than 2 feet of fill over the top slab: 1 ½ inches. For boxes with less than 2 feet of fill over the top slab: top reinforcement of top slab: 2 ½ inches; bottom reinforcement of top slab: 2 inches; all other reinforcement: 1 ½ inches.

The minimum cover for reinforcement may be reduced by not more than ½ inch, provided the reinforcement having reduced cover is epoxy coated or the concrete surfaces adjacent to the reinforcement are coated in accordance with the requirements of Section 416.

Reinforcing steel for box culverts used in 0 to 2 foot fills, used in corrosive or marine environments or used in other severe exposure conditions shall be epoxy coated. When epoxy coated reinforcing steel is required due to these conditions, the minimum cover specified shall not be reduced.

- c. The type of sealant used in joints between units shall be from the Department's approved list of preformed plastic or mastic gaskets.

Where double or greater lines of precast units are used, a buffer zone of 3 to 6 inches between lines shall be provided. This buffer zone shall be backfilled with porous backfill conforming to the requirements of Section 204. The porous backfill shall be drained by a 3 inch diameter weep hole, formed by non-rigid tubing, located at the top of the bottom haunch, centered in the outlet end section and at approximately 50 foot intervals along the length of the box. Weep holes shall be covered with a 3 foot square section of filter barrier cloth firmly attached to the outside of the box. A 3 foot width of filter barrier cloth shall also be centered over the buffer zone for the entire length of the structure after placement of the porous backfill material. Filter barrier cloth shall conform to the requirements of Section 245.

Forming weep holes and furnishing and placing of the filter barrier cloth shall be included in the price bid per linear foot for the Precast Box Culvert.

- d. At the terminus of precast units, sufficient anchorage shall be provided. This anchorage may consist of a cast-in-place end section at least 3 feet in length with a headwall and curtain wall or a collar cast-in-place around the units provided adequate connection can be made between the collar and units.

When the ends of precast units are skewed, the end section shall be cast monolithically. The skew may be provided by forming, saw cutting, or other methods approved by the Engineer. Regardless of the method used, the variation in the precast unit from the exact skew shall be not greater than 1 ½ inches at any point.

- e. Pipe openings shall conform to the requirements of 1.b. herein.
- f. Bedding shall be at least 6 inches in thickness.

- (c) **Drop Inlets, Manholes, Spring Boxes, Intake Boxes, and Endwalls:** Masonry construction shall not be initiated when the air temperature is below 40° F in the shade.

The foundation shall be explored below the bottom of the excavation to determine the type and condition of the foundation. Foundation exploration shall extend to a depth equal to 1/2 inch per foot of fill height of 8 inches, whichever is greater. The Contractor shall report the findings of the foundation exploration to the Engineer for approval prior to placing structure.

Where unsuitable foundation is encountered at the established grade, as determined by the Engineer, such material shall be removed and replaced.

Backfill for areas where unsuitable material has been removed shall be placed and compacted in accordance with the requirements of Section 303.04(g).

Bedding material shall be placed in accordance with the Standard Drawings and shall be aggregate No. 25 or 26 conforming to the requirements of Section 205 except where standing or running water is present in the foundation excavation; then, bedding material shall be aggregate No. 57 for the depth specified on the plans or as directed by the Engineer capped with 4 inches of aggregate No. 25 or 26. Where such conditions are discovered in the field and the Contractor is directed by the Engineer to use No. 57 stone, No. 57 stone will be paid for at the existing contract unit price or, if not in the Contract, in accordance with Section 109.05.

Bedding shall be lightly and uniformly compacted. The depth of bedding material shall be as specified on the standard drawings or in the plans.

Brick and concrete block masonry shall be placed so that each unit will be thoroughly bonded with mortar. Joints shall be full-mortar joints not more than ½ inch in width. Where brick masonry is used, headers and stretchers shall be arranged to bond the mass fully. Every seventh course shall be placed entirely with headers. Inside joints shall be neatly pointed, and the outside of such walls shall be

plastered with mortar as they are placed.

Iron fittings entering the masonry shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.

Inlet and outlet pipe connections shall conform to the same requirements as the pipe to which they connect and shall be of the same size and kind. Pipe sections shall be flush on the inside of the structure wall and shall project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe.

Immediately following finishing operations, hydraulic cement concrete shall be cured and protected in accordance with the requirements of Section 316.04(j).

Backfilling shall be performed in accordance with the requirements of Section 303.04(g). Surplus material shall be removed, and the site shall be left in a neat and orderly condition.

When grade adjustment of existing structures is specified, frames, covers, and gratings shall be removed and the walls shall be reconstructed as required. Cleaned frames shall be reset at the required elevation. Upon completion, each structure shall be cleaned of silt, debris, and foreign matter and shall be kept clear of such accumulation until final acceptance.

302.04--Measurement and Payment.

Pipe culverts will be measured in linear feet. The quantity will be determined by counting the number of sections and multiplying by the length of the section used. When a partial section is required, the actual length of the partial section will be measured in place.

Structural plate pipe and pipe arches will be measured in linear feet along the invert line.

Pipe tees and elbows will be measured in linear feet of pipe.

Pipe reducers will be measured in linear feet of pipe for payment at the larger pipe size.

Pipe shall be paid for at the contract unit price per linear foot. This price shall include excavating, when not paid for as Minor Structure Excavation, sheeting, shoring, dewatering, disposing of surplus and unsuitable material and restoring existing surfaces. The upper 4 inches of bedding material and the Class I backfill material within the neatlines shown for each foundation type on the Standard PB-1 Drawings shall be included in the price for the related pipe. When unit prices for extended pipelines are not specified, the unit price for new pipe of the same size shall apply. When not a pay item, the cost of the temporary relocation of a stream to facilitate the installation of the pipe shall be included in the price for the pipe. The cost of fittings, anti-seepage collar and anchor blocks shall be included in the price for the pipe.

Jacked and bored pipe will be measured in linear feet to the nearest 0.1 foot along the centerline of completed jacked and bored pipe for the size indicated and will be paid for at the contract unit price per linear foot. This price shall include excavating and backfilling jacking and receiving pits, sheeting, shoring, bracing, jacking equipment, casing pipe, casing chocks, furnishing and installing carrier pipe, grout to install carrier pipe, drainage, safety equipment, and all other items necessary for this operation.

Tunneled pipe will be measured in linear feet to the nearest 0.1 foot along the centerline of completed tunnel for the size of lining and will be paid for at the contract unit price per linear foot. This item shall include equipment, materials, handling and disposal of all material encountered, drainage, pumping and dewatering, tunnel support, lining, furnishing and installing pipe, grouting, ventilation, lighting and wiring, coordination and planning with the railroad or other specified entity, and all other appurtenances necessary to complete the work.

Reinstalled pipe will be measured in linear feet along a line parallel to the flow line and will be paid for at the contract unit price per linear foot of pipe and per cubic yard of minor structure excavation. This price shall include excavation involved in removing pipe, hauling, cleaning, relaying, backfilling, necessary cutting for joining to other sections of pipe, furnishing new coupling bands, disposing of surplus excavation, and replacing any otherwise usable sections damaged or broken because of the negligence of the Contractor.

End sections and pipe spillouts will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each.

Endwalls and arch substructures will be measured in cubic yards of concrete and pounds of reinforcing steel, except that EW-12 endwalls will be measured in units of each complete-in-place. Endwalls and arch substructures will be paid for at the contract unit price per cubic yard of miscellaneous concrete and per pound of reinforcing steel, except that crack control bars shall be included in the price bid for miscellaneous concrete and standard EW-12 endwalls will be paid for at the contract unit price per each.

Minor structure excavation will be measured and paid for in accordance with the requirements of Section 303.06.

Cast-in-place box culverts will be measured in cubic yards of concrete and pounds of reinforcing steel and will be paid for at the contract unit price per cubic yard of concrete and per pound of reinforcing steel. These prices shall include excavating, sheeting, shoring, dewatering, waterproofing, disposing of surplus and unsuitable material, restoring existing surfaces, the upper 6 inches of bedding material within the neat lines shown on the Standard PB-1 drawings, and all necessary work to key the bottom slab into an existing rock foundation. When not a pay item, the cost of the temporary relocation of a stream to facilitate the installation of the structure shall be included in the price for the concrete and steel.

If the Contractor elects to furnish and install precast box culverts or precast arches, payment will be made for the original quantities shown on the plans for cast-in-place units. No additional compensation will be made for casting, prestressing, or shipping precast units or performing additional work, such as waterproofing, epoxy coating, or joint sealing, required as a result of the substitution.

Precast box culverts will be measured in linear feet along the centerline of the barrel from face of curtain wall to face of curtain wall and will be paid for at the contract unit price per linear foot. This price shall include designing, casting, reinforcing, excavating, sheeting, shoring, dewatering, installing, waterproofing, sealing joints, anchoring, disposing of surplus and unsuitable material, restoring existing surfaces, the upper 6 inches of bedding material within the neatlines shown on the Standard PB-1 Drawings, fittings and providing buffer zones and porous backfill for multiple lines. When not a pay item, the cost of the temporary relocation of a stream to facilitate the installation of the structure shall be included in the price for box culvert.

If the Contractor elects to furnish and install precast box culverts or precast arches, payment will be made for the original quantities shown on the plans for cast-in-place units. No additional compensation will be made for casting, prestressing, or shipping precast units or performing additional work, such as waterproofing, epoxy coating, or joint sealing, required as a result of the substitution.

Grates and frames will be measured in units of each and will be paid for at the contract unit price per each.

Pipe grate will be measured in linear feet and will be paid for at the contract unit price per linear foot. This price shall include fabricating, furnishing, galvanizing, and installing.

Drop inlets and intake boxes will be measured as complete units, including the frame and grate or cover, and will be paid for at the contract unit price per each. The contract unit price for drop inlets will be adjusted at the rate of 5% per foot for increases or decreases in the depth indicated on the plans except that no adjustment will be made for changes amounting to less than 6 inches in the height of a single drop inlet. Where curb or curb and gutter extend along the drop inlet, the contract unit price for drop inlets shall include that part of the curb or gutter within the limits of the structure. Bedding material, except aggregate No. 57, will be included in the price of the structure.

Base sections of pipe tee units used as drop inlets and manholes will be measured in linear feet horizontally and will be paid for at the contract unit price per linear foot of pipe specified. The riser section and additional costs for the tee shall be included in the price for the drop inlet or manhole.

Manholes will be measured in linear feet, vertical measure, from top of foundation slab to top of masonry on which the casting frame is placed. However, when manholes are constructed as tee sections, measurement will be made to the pay limits shown on the plans. Manholes will be paid for at the contract unit price per vertical linear foot exclusive of frame and cover. Bedding material, except aggregate No. 57, will be included in the unit price per foot for the manhole.

Concrete spring boxes will be measured in cubic yards of concrete, pounds of reinforcing steel, and linear feet of pipe and will be paid for at the contract unit price per cubic yard of concrete, per pound of reinforcing steel, and per linear foot of pipe.

Junction boxes will be measured in cubic yards of concrete, pounds of reinforcing steel, pounds of structural steel, and each complete frame and cover assembly and will be paid for at the contract unit price per cubic yard of concrete, per pound of reinforcing steel, per pound of structural steel, and per each frame and cover assembly. Bedding material, except aggregate No. 57, will be included in the price of the structure.

Casting frames and covers will be measured in units of one complete frame and cover and will be paid for at the contract unit price per unit.

Reconstructed manholes will be measured as a complete unit and will be paid for at the contract unit price per each.

Precast arches will be measured in meters along the centerline of the invert from face of headwall to face of headwall. When a pay item, precast arches will be paid for at the contract unit price per linear foot. This price shall include designing, forming, casting, reinforcing, excavating, wingwalls, installing, waterproofing, sealing joints, anchoring and bedding, and providing buffer zones for multiple lines. The cost for cast-in-place work other

than that specified on the plans shall be included in the price for precast arches.

Temporary diversion channel lining will be measured in square yards for the class specified and will be paid for at the contract unit price per square yard. This price shall include installing the channel lining and removal when no longer required.

Temporary diversion channel excavation will be measured in cubic yards and will be paid for at the contract unit price per cubic yard. This price shall include excavation, temporary pipe culverts and removal of pipe culverts when no longer required, backfilling, site restoration including regrading and seeding.

Excavation, backfill, and disposal of unsuitable or surplus material for drop inlets, intake boxes, manholes both new and reconstructed, spring boxes, junction boxes, and base sections of pipe tee units used as drop inlets and manholes will not be measured for separate payment, and the cost thereof shall be included in the bid price for such items. In the event steps or invert shaping are required, the cost thereof shall also be included in the price for such items.

Storm water management drainage structure will be measured in feet, vertical measure, from top of concrete foundation to the top of the concrete cover. The price bid shall include Class A3 concrete, reinforcing steel, concrete cover, debris rack, orifice, steps when required, and class A1 riprap.

Temporary sediment riser pipe will be measured in feet for the size specified and will be paid for at the contract unit price per foot. The price shall include the riser pipe, steel plate, perforated pipe, debris rack, orifice and class A1 riprap, and anti-vortex device when required.

Storm water management dam will be measured and paid for at the contract unit price per cubic yard of concrete and pounds of reinforcing steel.

Payment will be made under:

Pay Item	Pay Unit
Pipe (Size and Type)	Linear foot
Structural plate arch (Size)	Linear foot
Jacked and bored pipe (Size)	Linear foot
Tunneled pipe (Size)	Linear foot
Reinstalled pipe	Linear foot
End section (Standard and size)	Each
Pipe spillout (Standard)	Each
Concrete (Class)	Cubic yard
Reinforcing steel	Pound
End wall grate and frame (Standard)	Each
Precast box culvert (Size)	Linear foot
End wall pipe grate (Type)	Linear foot
Drop inlet (Standard and length)	Each
Intake box (Standard)	Each
Structural steel (Type)	Pound
Manhole (Standard)	Linear foot
Frame and cover (Standard)	Each
Reconstructed manhole	Each
Precast arch (Size)	Linear foot
Temporary diversion channel lining (class)	Square yard
Temporary diversion channel excavation	Cubic yard
Endwall, Standard EW-12	Each
Storm water management drainage structure (type)	Linear foot
Temporary sediment rise pipe (Size)	Linear foot

SECTION 303--EARTHWORK

303.01--Description.

This work shall consist of constructing roadway earthwork in accordance with these specifications and in conformity with the specified tolerances for the lines, grades, typical sections, and cross sections shown on the plans or as established by the Engineer. Earthwork shall include regular, borrow, undercut, and minor structure excavation; constructing embankments; disposing of surplus and unsuitable material; shaping; compaction; sloping; dressing; and temporary erosion and siltation control work.

303.02--Materials.

- (a) **Borrow excavation** shall consist of approved material required for the construction of the roadway and shall be obtained from approved sources outside the project limits. Borrow excavation shall conform to AASHTO M57 and the requirements herein.
- (b) **Materials for temporary silt fences, geotextile fabric silt barriers, and filter barriers** shall conform to the requirements of Sections 242.02(c) and 245.03(a).
- (c) **Geotextile materials used for embankment stabilization** shall conform to the requirements of Section 245.003(e).

303.03--Erosion and Siltation Control.

Erosion and siltation shall be controlled through the use of the devices and methods specified herein or as is otherwise necessary. The Department reserves the right to require other temporary measures not specifically described herein to correct an erosion or siltation condition.

Erosion and siltation control devices and measures shall be maintained in a functional condition at all times. Temporary and permanent erosion and siltation control measures shall be inspected after each rainfall and at least daily during periods of prolonged rainfall. Deficiencies shall be immediately corrected. The Contractor shall make a daily review of the location of silt fences and filter barriers to ensure that they are properly located for effectiveness. Where deficiencies exist, corrections shall be made immediately as approved or directed by the Engineer.

When erosion and siltation control devices function by using wet storage, sediments shall be removed when the wet storage volume has been reduced by 50 percent. Sediments shall be removed from dewatering basins when the excavated volume has been reduced by 50 percent. Sediments shall be removed from all other erosion and siltation control devices when capacity, height, or depth has been reduced by 50 percent. Removed sediment shall be disposed of in accordance with the requirements of Section 106.04. Sediment deposits remaining in place after the device is no longer required shall be dressed to conform with the existing grade, prepared, and seeded in accordance with the requirements of Section 603.

Geotextile fabric that has decomposed or becomes ineffective and is still needed shall be replaced. In addition, temporary erosion and sediment control devices except brush silt barriers shall be removed within 30 days after final site stabilization or after the temporary devices are no longer needed as determined by the Engineer.

- (a) **Earth Berms and Slope Drains:** The top of earthwork shall be shaped to permit runoff of rainwater. Temporary earth berms shall be constructed and compacted along the top edges of embankments to intercept runoff water. Temporary berms and temporary dikes are to be stabilized immediately following installation. Temporary slope drains shall be provided to intercept runoff and adequately secured to prevent movement. Slope drains may be flexible or rigid but shall be capable of being readily shortened or extended. A portable flume shall be provided at the entrance to temporary slope drains.
- (b) **Soil stabilization:** Soil stabilization shall be applied within 7 days after attaining the appropriate grading increment for that stage of the construction operations, or upon suspension of grading operations for an anticipated duration of greater than 15 days, or upon completion of grading operation for a specific areal Areas excluded from this requirement include areas within 100 feet of the limits or ordinary high water or a delineated wetland which shall be continuously prosecuted until completed and stabilized immediately upon completion of the work in each impacted area. Soil stabilization includes: temporary and permanent seeding, riprap, aggregate, sod, mulching, and soil stabilization blankets and matting in conjunction with seeding. The applicable type of soil stabilization shall depend upon the location of areas requiring stabilization, time of year (season), weather conditions and stage of construction operations.

Cut and fill slopes shall be shaped and topsoiled where specified. Seed and mulch shall be applied in accordance with the requirements of Section 603 as the work progresses in the following sequence:

1. Slopes whose vertical height is 20 feet or greater shall be seeded in three equal increments of height. Slopes whose vertical height is more than 75 feet shall be seeded in 25-foot increments.
2. Slopes whose vertical height is less than 20 but more than 5 feet shall be seeded in two equal increments.
3. Slopes whose vertical height is 5 feet or less may be seeded in one operation.

Areas that cannot be seeded because of seasonal or adverse weather conditions should be mulched to provide some protection against erosion to the soil surface. Organic mulch shall be used, and the area then seeded as soon as weather or seasonal conditions permit in accordance with the requirements of Section 303.03(e). Mulch shall be applied in accordance with the requirements of Section 603.04. Organic mulch includes: straw or hay, fiber mulch, wood cellulose, or wood chips conforming to the requirements of Section 244.02(g).

- (c) **Check Dams:** As an initial item of work, required check dams shall be constructed at 25-foot intervals, unless otherwise shown on the plans, below the outfall end of drainage structures.

Synthetic check dams recorded in the Department's Approved List may be substituted for Standard CD-4, Rock Check Dams, Type II, with the approval of the Engineer at no additional cost to the Department. Synthetic check dams shall be installed in accordance with the manufacturer's recommendation.

- (d) **Baled Straw Silt Barriers:** Baled straw silt barriers may be substituted for temporary filter barriers with the approval of the Engineer in noncritical areas, such as pavement areas and rock locations where filter barriers cannot be installed in accordance with the plans and specifications and locations where the Engineer determines that streams and water beds will not be affected.

(e) Temporary Silt Fences, Geotextile Fabric Silt Barriers, and Filter Barriers:

1. **Temporary silt fences:** Fences shall be erected at locations shown on the plans or determined by the Engineer. Geotextile fabric used for silt fences shall be provided, and posts shall not be spaced more than 6 feet apart. Posts shall be uniformly installed with an inclination toward the potential silt load area of at least 2 degrees but not more than 20 degrees. Attaching fabric to existing trees will not be permitted.

Fabric shall be firmly secured to the post or wire fence. The bottom of the fabric shall be entrenched in the ground in a minimum 6-inch by 6-inch trench. Temporary silt fence may also be entrenched using a slicing method with a minimum of 8 inches sliced into the ground. Fabric may be spliced only at support posts and with an overlap of at least 6 inches. The top shall be installed with a 1-inch tuck or reinforced top end section. The height of the finished fence shall be a nominal 29 inches.

2. **Geotextile fabric silt barriers:** Existing fences or brush barriers used along the downhill side of the toe of fills shall have geotextile fabric attached at specified locations as shown on the plans. The bottom of the fabric shall be entrenched in the ground in a minimum 6-inch by 6-inch trench and the top shall be installed with a 1-inch tuck or reinforced top end section. Temporary fabric silt barriers may also be entrenched using a slicing method with a minimum 8 inches sliced into the ground.

Brush barriers shall be installed prior to any major earth-disturbing activity and trimmed sufficiently to prevent tearing or puncturing fabric. Fabric shall be fastened securely to the brush barrier or existing fence. A 6-inch overlap of fabric for vertical and horizontal splicing shall be maintained and tightly sealed.

3. **Temporary filter barriers:** Barriers shall consist of geotextile fabric and shall be securely fastened to wood or metal supports that are spaced at not more than 3-foot intervals and driven at least 12 inches into the ground. At least three supports shall be used. The bottom of the fabric shall be entrenched in the existing ground in a minimum 4-inch by 4-inch trench.

Temporary filter barriers may also be entrenched using a slicing method with a minimum of 6 inches sliced into the ground. The top of the fabric shall be installed with a 1-inch tuck or reinforced top end section. The height of the finished temporary filter barrier shall be a nominal 15 inches.

Temporary filter barriers shall be installed at temporary locations where construction changes the earth contour and drainage runoff as directed by the Engineer.

After removal and disposal of the temporary silt fence, geotextile fabric silt barrier, and temporary filter barrier, the area shall be dressed and stabilized with a permanent vegetative cover or other approved permanent stabilization practice approved by the Engineer.

4. **Sediment Traps and Sediment Basins:** Sediment traps are required if stormwater runoff from less than 3 acres flows across a disturbed area of 10,000 square feet or more. Sediment basins are required if stormwater runoff from three or more acres flows across a disturbed area of

10,000 square feet or more. Once a sediment trap or basin is constructed the dam and all outfall areas shall be stabilized immediately.

5. **Erosion Control Mulch:** This work shall consist of furnishing and applying mulch as a temporary erosion control treatment on slopes exposed to the elements but not at final grade during the period from December 1 to March 1 for periods of up to 30 days prior to final grading or to areas to receive stabilization or paved surfaces within 6 months in accordance with this provision and as directed by the Engineer.

Mulch shall be applied to exposed slopes requiring mulch or to areas to be stabilized or paved, within 48 hours after performance of grading operations. Straw or hay mulch shall be applied on bare slope areas at the rate of approximately 3 tons per acre (1.24 pounds per square yard). Straw or hay mulch shall be applied at a uniform thickness in such a manner that not more than 10 percent of the soil surface will be exposed. Straw or hay mulch shall be anchored to the slope surface by one of the following methods: spraying with cellulose fiber mulch at the rate of 750 pounds per acre (0.15 pound per square yard); diking or punching the mulch partially into the soil; using approved netting; or using other material or methods approved by the Engineer. The Contractor may use more than one method on the same project.

303.04--Procedures.

Loose rock 3 inches or larger shall be removed from the surface of cut slopes.

When slides occur, the Contractor shall remove and dispose of material as directed by the Engineer.

Where required, surface ditches shall be placed at the top of cut slopes or at the foot of fill slopes and at such other points not necessarily confined to the right of way or shown on the plans and shall be of such dimensions and grades as directed by the Engineer.

Allaying dust, when specified, shall be performed in accordance with the requirements of Section 511.

Prior to the beginning of grading operations in the area, necessary clearing and grubbing shall be performed in accordance with the requirements of Section 301.02.

- (a) **Regular Excavation:** Existing foundations and slabs located within the construction limits shall be removed and disposed of in a location approved by the Engineer. In lieu of removal, foundations and slabs located 5 feet or more below the proposed subgrade may be broken into particles not more than 18 inches in any dimension and reoriented to break the shear plane and allow for drainage.

Cisterns, septic tanks, wells and other such structures shall be cleared in accordance with the requirements of Section 516.

Balance points shown on the plans are theoretical and may vary because of actual field conditions.

When the material to be excavated necessitates the use of explosives, the requirements of Section 107.11 relating to the use of explosives shall apply. To prevent damage to newly constructed concrete, the Contractor shall schedule blasting operations in the proximity of proposed concrete structures so that

work will be completed prior to placement of concrete.

Regular excavation shall consist of removing and disposing of material located within the project limits, including widening cuts and shaping slopes necessary for preparing the roadbed; removing root mat; stripping topsoil; cutting ditches, channels, waterways and entrances; and performing other work incidental thereto. The Engineer may require materials in existing pavement structures to be salvaged for use in traffic maintenance.

Undrained areas shall not be left in the surface of the roadway. Grading operations shall be conducted so that material outside construction limits will not be disturbed.

Where rock or boulders are encountered, the Contractor shall excavate and backfill in accordance with the plans and contract documents.

When the presplitting method of excavation is specified for rock cuts, work shall be performed in a manner to produce a uniform plane of rupture in the rock and so that the resulting backslope face will be unaffected by subsequent blasting and excavation operations within the section. Rock shall be presplit along rock slopes at locations, lines, and inclinations shown on the plans or as determined by field conditions. A test section shall be provided to establish the spacing of drill holes and the proper blasting charge to be used in the presplitting operation. Drill holes shall be spaced not more than 3 feet apart and shall extend to the plan grade or in lifts of not more than 25 feet, whichever is less. If drilled in benches, an offset may accommodate the head of the drill, but no offset shall be more than 12 inches. Presplitting shall extend at least 20 feet ahead of the limits of fragmentation blasting within the section.

Where the project has been designed and slopes have been staked on the assumption that solid rock will be encountered and the Contractor fails to encounter solid rock at the depth indicated, he shall cease excavation in the area and immediately notify the Engineer. If it is necessary to redesign and restake slopes, any additional excavation necessary will be paid for at the contract unit price per cubic yard.

Topsoil stockpiled for later use in the work shall be stored within the right of way unless the working area is such that the presence of the material would interfere with orderly prosecution of the work. Stockpile areas outside the right of way shall be located by the Contractor at his expense. Topsoil used in the work shall be removed first from stockpiles located on private property. Surplus topsoil remaining on private property after completion of topsoiling operations shall be moved onto the right of way and stockpiled, shaped, and seeded as directed by the Engineer.

Stripping topsoil shall be confined to the area over which grading is to be actively prosecuted within 15 calendar days following the stripping operation. Grading operations shall be confined to the minimum area necessary to accommodate the Contractor's equipment and work force engaged in the earth moving work.

- (b) **Borrow Excavation:** The Contractor shall make his own arrangements for obtaining borrow and pay all costs involved in accordance with the provisions of Section 106.03.

If the Contractor places an excess of borrow and thereby causes a waste of regular excavation, the amount of such waste, unless authorized, will be deducted from the volume of borrow as measured at the source or computed by vehicle count as specified in Section 109.01.

When borrow is obtained from sources within the right-of-way and the excavation is performed simultaneously with regular excavation, borrow excavation will be designated as regular excavation. Material secured by widening cuts beyond slope stakes, when taken from previously excavated slopes, will be designated as borrow excavation. When such a procedure is approved, slopes shall be uniform and no steeper than shown on the plans.

Borrow excavation areas shall be bladed and left in a shape to permit accurate measurements after excavation has been completed.

CBR values, stipulated for borrow excavation, shall apply to the uppermost three feet of fill below the top of earthwork, as defined in Section 101 of the Specifications. Borrow excavation, installed below the top three feet shall consist of fill material, available from regular excavation or borrow excavation, as defined and of a quality consistent with project requirements.

- (c) **Undercut Excavation:** Undercut excavation shall consist of removing and disposing of unsuitable material located within the construction limits in accordance with Section 303.06(a)3.

Undercut excavation shall be disposed of in accordance with Section 106.04.

- (d) **Minor Structure Excavation:** Minor structure excavation shall consist of removing material necessary to accommodate the structure, such as box or arch culverts, including pipe arches, structural plate arches, structural plate pipe, pipe culverts, and storm drains with span(s) or opening(s) 48 inches or greater. Minor structure excavation shall also include dewatering, sheeting, bracing, removing existing structures, and backfilling. Removing existing structures shall also include foundations that might be necessary to clear the site.

- (e) **Removing Unsuitable Material:** Where excavation to the finished graded section results in a subgrade or slopes of unsuitable material, such material shall be excavated below the grade shown on the plans or as directed by the Engineer. Areas so excavated shall be backfilled with approved material in accordance with (f) herein.

Excavation for structures shall be carried to foundation materials satisfactory to the Engineer regardless of the elevation shown on the plans. If foundation material is rock, the Contractor shall expose solid rock and prepare it in horizontal beds for receiving the structure. Loose or disintegrated rock and thin strata shall be removed. Excavated material, if suitable, shall be used for backfilling around the structure or constructing embankments.

Material shown on the plans as unsuitable and during construction found to be suitable for use shall first be used in embankments where needed in lieu of borrow. However, the use of this material in lieu of borrow shall not alter the provisions of Section 104.02 regarding underruns.

Material shown on the plans as suitable material but found at time of construction to be unsuitable shall be disposed of as unsuitable material.

Unsuitable material shall be disposed of in accordance with Section 106.04.

- (f) **Backfill for Replacing Undercut Excavation:** Backfill shall be comprised of regular excavation, borrow, select material, subbase material, or other material as directed by the Engineer. Backfilling operations shall be performed in accordance with (g) herein.
- (g) **Backfilling Openings Made for Structures:** Backfill shall be suitable material removed for the structure, although the Engineer may require that backfill material be obtained from a source within the construction limits entirely apart from the structure or other approved material. The opening to be backfilled shall be dewatered prior to backfilling. Backfill shall not be placed against or over cast-in-place box culverts or other structures until the top concrete slab section(s) has been in place 14 days, exclusive of days on which the average high-low ambient temperature is below 40 oF in the shade or until the concrete control cylinder(s) has attained a compressive strength equal to 93 percent of the 28-day design compressive strength.

Backfill shall be compacted in horizontal layers not more than 6 inches in thickness, loose measurement, and as specified in (h) herein. Backfill shall be placed in horizontal layers such that there will be a horizontal berm of compacted undisturbed material behind the structure for a distance at least equal to the remaining height of the structure or wall to be backfilled. Backfill shall be placed in a manner to deter impoundment of water and facilitate existing drainage. Backfill around piers in areas not included in the roadway prism shall be constructed in uniformly compacted layers. However, density requirements will be waived.

Box culverts shall not be opened to construction equipment traffic until concrete has attained 100 percent of the 28-day design compressive strength and has a backfill cover of at least 4 feet. The minimum height of backfill cover required to protect pipe culverts from construction equipment shall be in accordance with standard drawing PC-1 for the type and size specified.

Where only one side of abutments, wingwalls, piers, or culvert headwalls can be backfilled, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning or excessive pressure against the structure. When both sides of a concrete wall or box structure is to be backfilled, operations shall be conducted so that the backfill is always at approximately the same elevation on both sides of the structure.

Openings subject to flooding shall be backfilled as soon as practicable or as directed by the Engineer.

- (h) **Embankments:** Work shall consist of constructing roadway embankments, placing and compacting approved material within roadway areas where unsuitable material has been removed; and placing and compacting approved material in holes, pits, utility trenches, basements, and other depressions within the roadway area.

Embankment shall be constructed with approved material and placed so as to be uniformly compacted throughout. Embankment shall be placed adjacent to structures in the same manner as for backfill, as described in (g) herein. Embankment shall not contain muck, frozen material, roots, sod, or other deleterious material. Embankment shall not be placed on frozen ground or areas covered with ice or snow.

Unsuitable material used in widening embankments and flattening embankment slopes shall be placed in uniform layers not more than 18 inches in thickness before compaction. Each layer of material placed

shall be compacted to the extent necessary to produce stable and reasonably even slopes.

Wherever rock excavation is available on the project, an 8 to 15 inch layer of such materials shall be dump spread over the lower region of embankments in the immediate vicinity of stream crossings and used to cover ditches, channels, and other drainage ways leading away from cuts and fills. However, drainage ways shall be prepared to receive the rock excavation to the extent necessary to avoid reducing their cross section. If rock excavation is not available on the project, rip-rap, jute mesh or soil retention mats shall be used as the covering material and shall be installed in accordance with the requirements of Section 606.03(c). Limits of the area to be covered will be as noted on the plans or as directed by the Engineer.

Wherever sufficient right of way exists, surplus materials shall be used to widen embankments and flatten slopes as directed by the Engineer.

Rock excavation may be placed on slopes by uniform end dumping of the material from along the top of the embankment or as directed by the Engineer. Slopes that are covered with rock excavation shall not receive topsoil or seed.

When geotextile drainage fabric is required under rock fills, preparation shall be as specified in Section 245.

The Contractor shall schedule excavation and embankment work in a manner that will minimize the quantity of unsuitable material for which more than one handling is required prior to final placement. Therefore, the provisions for additional payment for each rehandling of material specified in Section 303.06(a) will not apply to placing unsuitable material for widening embankments and flattening embankment slopes.

The surface area directly beneath the pavement and shoulders on which embankments of less than 5 feet in depth are to be constructed shall be denuded of vegetation. These areas shall be scarified and compacted to a depth of 6 inches to the same degree as the material to be placed thereon.

Areas that contain material unsuitable as foundations for embankments shall be undercut and backfilled in accordance with (e) and (f) herein.

Embankments to be placed over saturated areas that will not support the mass of hauling equipment may be constructed by end dumping successive loads in a uniformly distributed layer of a thickness capable of supporting the hauling equipment while subsequent layers are placed. The nose, or leading edge, of the embankment shall be maintained in a wedge shape to facilitate mud displacement in a manner that will prevent its entrapment in the embankment. The front slope of the embankment shall be maintained steeper than 2:1. The use of compacting equipment will not be required on the original course. However, the remainder of the embankment shall be constructed in layers and compacted in accordance with these specifications.

When geotextile for embankment stabilization is required it shall be placed as shown on the plans. Geotextile shall be spliced by sewing double stitched seams with stitching spaced $\frac{1}{4}$ inch to $\frac{1}{2}$ inch apart or as shown on the plans.

Once geotextile for embankment stabilization is placed, the initial lift of material to be placed atop shall be end dumped onto the geotextile and spread to thickness as shown on the plans. Free draining material shall be any material having 15 percent or less of which will pass the No. 200 sieve. If the geotextile becomes punctured or torn, the Contractor shall repair the area with geotextile lapped at least 3 feet all around the damaged area.

When embankment is to be placed and compacted on an existing road, the surface shall be scarified to such degree as will permit an ample bond between old and new material. Hydraulic cement concrete and asphalt concrete pavement structures within the proposed roadway prism shall be demolished in accordance with Section 508.02(a).

Existing slopes shall be continuously benched where embankments are constructed 1/2 width at a time, against slopes of existing embankments or hillsides, or across existing embankments, hillsides, and depressions at a skew angle of 30 degrees or more, or the existing slopes are steeper than 4:1. For slopes steeper than 4:1 but not steeper than 1 1/2:1, the bench shall be at least 6 feet in width. For slopes steeper than 1 1/2:1 but less than 1/2:1, the bench shall be at least 4 feet in width. Benching shall consist of a series of horizontal cuts beginning at the intersection with the original ground and continuing at each vertical intersection of the previous cut. Material removed during benching operations shall be placed and compacted as embankment material.

When excavated material consists predominantly of soil, embankment shall be placed in successive uniform layers not more than 8 inches in thickness before compaction over the entire roadbed area. Each layer shall be compacted within a tolerance of ± 20 percent of optimum moisture content, to a density of at least 95 percent of the theoretical maximum density as defined in Section 101.02.

Material having a moisture content above optimum by more than 30 percent shall not be placed on a previously placed layer for drying unless it is shown that the layer will not become saturated by downward migration of moisture in the material.

Field density determinations will be performed in accordance with the requirements of AASHTO T191, modified to include material sizes used in the laboratory determination of density, with a portable nuclear field density testing device or by other approved methods. When a nuclear divided is used, density determinations for embankment material will be related to the density of the same material tested in accordance with VTM-1 or VTM-12 and a control strip will not be required.

As the compaction of each layer progresses, continuous leveling and manipulating will be required to ensure uniform density. Prior to placement of subsequent layers, construction equipment shall be routed uniformly over the entire surface of each layer or the layer shall be scarified to its full depth in the area where the equipment is routed.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing, or further breaking down the pieces resulting from excavation methods, such material may be placed in the embankment in layers that are not thicker than the approximate average size of the larger rocks. Rock not more than 4 feet in its greatest dimension may be placed in an embankment to within 10 feet of the subgrade. The remainder of the embankment to within 2 feet of the subgrade shall not contain rock more than 2 feet in its greatest dimension. Each layer shall be constructed so that rock voids are filled with rock spalls, rock

finer, and earth. Rock shall be placed, manipulated, and compacted in uniform layers. However, density requirements may be waived. Rock, rock spalls, rock fines, and earth shall be distributed throughout each embankment layer and manipulated as specified herein so that the voids are filled. Rock shall not be end dumped over the edges of the layer being constructed but shall be deposited on the layer and moved ahead so as to advance the layer with a mixture of rock, rock spalls, rock fines, and earth. The 2 feet of the embankment immediately below the subgrade shall be composed of material that can be placed in layers of not more than 8 inches before compaction and compacted as specified herein for embankments. Rock more than 3 inches in its greatest dimension shall not be placed within 12 inches of the subgrade in any embankment.

Rock, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

The best material shall be reserved for finishing and dressing the surface of embankments. Work necessary to ensure the reservation of such material shall be the responsibility of the Contractor. The provisions in Section 303.06(a) will not apply to subsequent handling of capping material.

CBR values, stipulated for embankment, shall apply to the uppermost three feet of fill below the top of earthwork, as defined in Section 101 of the Specifications. Embankment installed below the top three feet shall consist of suitable fill material, available from regular excavation, borrow excavation or embankment, as defined and of a quality consistent with project requirements.

Crushed glass shall be limited within the boundaries of the embankment as follows. Crushed glass shall be a minimum of two feet inside the side slope and contain a minimum of two feet of soil embankment cap. For those areas where crushed glass is to be incorporated into the embankment, glass may constitute up to approximately ninety percent (90%) by weight of that portion of the embankment, except where 100% crushed glass is used for drainage purposes (including blankets).

Crushed glass shall be blended with soil and/or soil like materials as follows:

1. The embankment shall be constructed by placing alternate four inch (4") layers of waste glass and soils and mixing and blending by scarification or other approved methods during compaction. The thickness of uncompacted layers of soil/glass shall be a maximum of 8 inches (loose); or
2. Pugmilled in predetermined ratios to a visually consistent blend and placed in lifts of a maximum of 8 inches (loose); or
3. As directed by the Engineer.

Compaction of the soil/glass embankment shall be to the satisfaction of the Engineer and shall be accomplished with a vibratory compactor or other approved methods. Moisture and density requirements for the soil/glass embankments shall be the same as other conventional soil embankment in accordance with the requirements of Section 303 of the Specifications.

Normal compaction procedures and requirements are to be used for compaction of the soil embankment "cap" above the crushed glass/soil blends.

(i) **Settlement Plates and Surcharge:** The Contractor shall expedite construction of embankment to provide the maximum time possible for settlement prior to completing grading operations.

1. **Settlement plates:** The base of settlement plates shall be firmly seated into original ground for the full depth of the steel fins. The base shall be leveled. The Engineer shall be provided time to obtain the elevation of the seated base and the top elevation of the pipe extensions prior to placement of embankment material. Pipe extensions shall not be more than 4 feet in length and shall be vertically installed as the embankment is constructed such that the top of the pipe is not covered. As each extension is added, the Engineer shall be provided time to obtain the top elevation of the existing pipe and the top elevation of the new pipe extension. Pipe extensions shall be properly flagged at all times. Care shall be taken while placing and compacting embankment material around pipe extensions. Settlement plates shall be maintained until no longer required, as determined by the Engineer. Upon completion of the normal embankment plus 2 feet of the specified surcharge, the Contractor shall immediately commence placing the remaining surcharge to the limits shown on the plans or as directed by the Engineer. The remaining surcharge shall be placed in lifts of not more than 1 foot in depth and compacted uniformly with construction hauling and spreading equipment. Each lift shall be completed over the entire surcharge area before the next lift is begun.

If a settlement plate is damaged, the Contractor shall notify the Engineer immediately and promptly repair it under the observation of the Engineer to the nearest undamaged pipe. Excavation, backfill, compaction, and repair of settlement plates shall be at the Contractor's expense. The Engineer shall be provided time to obtain the top elevation of the undamaged connection and the top elevation of each subsequent pipe extension.

Settlement plates shall remain in place until settlement has been completed as indicated by elevation readings taken by the Department at approximately 2-week intervals. Evaluation of the readings by the Engineer will be the final and sole governing factor for releasing embankments for grading operations. Upon written release by the Engineer, extensions of settlement plate pipe shall be removed to at least 2 feet below the subgrade, the pipe capped, and the area backfilled and compacted.

2. **Surcharge:** When authorized by the Engineer, surcharge shall be removed to the subgrade and embankment slopes graded to the typical section. Removed surcharge shall be placed in roadway embankments not previously brought to grade or shall be disposed of in accordance with Section 106.04 or as directed by the Engineer.

(j) **Hydraulic Embankment:** Hydraulic embankment shall consist of dredging and pumping materials approved by the Engineer from designated areas, placing the material in embankments, and dressing and completing the embankment. Material shall be nonplastic and of such grading that not more than 7 percent will pass the No. 200 sieve.

Unless otherwise shown on the plans, material for the embankment shall not be obtained from sources closer than 300 feet from the toe of the slope of the embankment. The Engineer may reject materials considered to be unsatisfactory for use in the embankment, and such materials shall be stripped at the Contractor's expense before the embankment is built. Muck and unsuitable material shall be removed to the line, grade, and section shown on the plans. Unsatisfactory material brought to the top of the

embankment shall be removed by the Contractor at his own expense, and satisfactory material shall be substituted.

In placing material in the embankment, the Contractor shall begin at the center line and deposit material in either or both directions toward the toe of slopes. Discharge shall always be in the direction of and parallel to the center line. The maximum distance from the bottom of the discharge pipe to the surface on which material is being deposited shall be 5 feet unless otherwise directed by the Engineer. Material shall be deposited in a manner that will maintain a higher elevation at the center of the roadway than on either side. The Contractor will not be permitted to construct retaining levees along the roadway of such dimensions as to cause damage to the foundation of the roadway. The Contractor shall conduct operations so as to ensure the completion of an embankment that will conform to the cross section shown on the plans except that he will be permitted to flatten side slopes. However, if material is deposited on private property, the Contractor shall obtain permission in writing from the affected property owner(s). No payment will be made for material beyond the limits of the net pay section.

The embankment shall be placed so as to ensure a minimum relative density of 80 percent of the theoretical maximum density when tested in accordance with (h) herein. If the method of placing the embankment fails to produce the required density, the Contractor shall use approved methods to obtain the specified density.

The Contractor shall take all necessary precautions to prevent placing material in streams. The Contractor shall be responsible for all damage to or caused by the hydraulic embankment. The Contractor shall provide sufficient material to maintain the embankment in accordance with the typical cross section as shown on the plans or as directed by the Engineer until final acceptance.

The Contractor's plan for support of suction or discharge pipes shall be submitted to and approved by the Engineer. Traffic shall be protected by the display of warning devices both day and night. If dredging operations damage an existing traveled highway, the Contractor shall cease operations and repair damage to the highway.

- (k) **Surplus Material:** Surplus material shall not be wasted or sold by the Contractor unless authorized in writing by the Engineer. When authorization has been given for surplus material to be wasted, it shall be disposed of in accordance with Section 106.04.

Material shown on the plans as surplus material will not be considered for overhaul payment.

1. **Disposal of surplus material within the right of way where the haul distance is 2000 feet or less:** Surplus material shall be used or disposed of where directed within a haul distance of 2000 feet of its origin. Usage in this manner will not be considered a change in the character of the work.
2. **Disposal of surplus material within the right of way where the haul distance is more than 2000 feet:** The Department reserves the right to require the Contractor to use surplus material in lieu of furnishing borrow, or as otherwise directed, where the haul distance from the origin of the material is more than 2000 feet. Disposal of surplus material at locations requiring a haul of more than 2000 feet will be considered a change in the character of work unless otherwise noted on the plans.

When material is declared surplus during construction and must be transported more than 2000 feet from its origin, the Department will pay the Contractor \$0.03 per station per cubic yard for overhaul. The quantity of surplus excavation will be determined by vehicle measurement in accordance with the provisions of Section 109.01 or from cross-section measurements by the average end area method. The haul distance will be measured along a line parallel to the center line of the roadway from the center of the excavated area to the center of the placement area. Overhaul will be the product of the quantity of surplus material in cubic yards and the haul distance in excess of 2000 feet in 100-foot stations.

303.05--Tolerances.

- (a) **Finished grade of subgrade** shall conform to the requirements of Section 305.03(c) of the Specifications.
- (b) **Slopes** shall be graded in the following manner:
 - 1. **Earth excavation slopes:**
 - a. **Slopes steeper than 2:1** shall be grooved in accordance with the standard drawings and shall not deviate from the theoretical plane surface by more than 0.5 foot.
 - b. **Slopes steeper than 3:1** up to and including 2:1 shall be rough graded in a manner to provide horizontal ridges and grooves having no more than 0.5 foot deviation from the theoretical line of the typical cross section as is accomplished by the normal operation of heavy grading equipment.
 - c. **Slopes 3:1 or flatter** shall be uniformly finished and shall not deviate from the theoretical plane surface by more than 0.5 foot.
 - 2. **Earth embankment slopes:**
 - a. **Slopes steeper than 3:1** shall not deviate from the theoretical plane slope by more than 0.5 foot and shall be rough graded in a manner to provide horizontal ridges and grooves not more than 0.5 foot from the theoretical line of the typical cross section as is accomplished by the normal operation of heavy grading equipment.
 - b. **Slopes 3:1 and flatter** shall be uniformly finished and shall not deviate from the theoretical plane surface by more than 0.5 foot.
 - 3. **Rock slopes** shall not deviate from a plane surface by more than 2 feet and shall not deviate from their theoretical location by more than 2 feet measured along any line perpendicular to the theoretical slope line.

Finished excavation and embankment slopes shall not deviate from their theoretical location by more than 0.5 foot measured along any line perpendicular to the theoretical slope line.

303.06--Measurement and Payment.

- (a) **Excavation:** Excavation will be paid for at the contract unit price per cubic yard unless otherwise specified.

Excavation requiring more than one handling prior to final placement will be paid for at the contract unit price for regular excavation for each handling approved by the Engineer unless there is a pay item for the second handling, in which case work will be paid for at the contract price for such handling.

Quantities of regular or borrow excavation used to backfill pipe, pipe culverts and box culverts will not be deducted from quantities due the Contractor for payment.

1. **Regular excavation:** When payment is specified on a cubic yard basis, regular excavation will be measured in its original position by cross sectioning the excavation area. This measurement will include overbreakage or slides not attributable to the carelessness of the Contractor and authorized excavation of rock, muck, root mat, or other unsuitable material except material included in undercut excavation. Volumes will be computed from cross-section measurements by the average end area method.

When it is impractical to measure material by the cross-section method, other acceptable methods involving three-dimensional measurements may be used.

Excavation for benching slopes to accommodate roadway embankments as specified in Section 303.04(h) will not be measured for separate payment. The cost thereof shall be included in the price for the related excavation or embankment item.

Excavation of existing roadways required to incorporate old roadway into new roadway or remove salvageable materials for use in traffic maintenance, other than those covered under Section 508, will be measured as regular excavation.

When presplitting rock cuts is shown on the plans, the work shall be considered incidental to the cost of excavation and will not be measured for separate payment.

In cut sections, excavation of topsoil and root mat and material down to a point 1 foot below the elevation of the top of earthwork or to the depth specified on the plans will be measured as regular excavation. When areas of unsuitable material are shown on the plans, excavation down to a point 1 foot below the elevation of such material shown on the plans will be measured as regular excavation.

In fill sections, excavation of topsoil and root mat and material down to an elevation of 1 foot below the bottom of topsoil and root mat will be measured as regular excavation. When areas of unsuitable material are shown on the plans, excavation down to a point 1 foot below the elevation of such material shown on the plans will be measured as regular excavation.

If slide material approved for measurement cannot be measured accurately, or if the removal of slide material will require different equipment than that being used in the regular excavation operations, payment therefor may be made on a force account basis when authorized by the Engineer.

Excavation of surface ditches specified on the plans or otherwise required by the Engineer will be paid for as regular excavation except that when required after the slopes have been completed and the work cannot be performed with mechanical equipment, the excavation will be paid for as undercut excavation.

2. **Borrow excavation:** Borrow excavation will be measured in its original position by cross sectioning the area excavated. The number of cubic yards will be computed from cross-section measurements by the average end area method. When it is impractical to measure the borrow excavation, vehicular measurement in accordance with Section 109.01 may be used.

Borrow excavation with a stipulated CBR value shall be measured and paid for as borrow excavation with the CBR value as specified.

Borrow excavation without a stipulated CBR value shall be measured and paid for as borrow excavation.

3. **Undercut excavation:** Measurement will be made by cross sectioning the undercut area. The number of cubic yards will be computed by the average end area method. When it is impractical to measure material by the cross-section method because of erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

When unsuitable material must be removed from an area of the project where undercut is not shown on the plans, unsuitable material removed after reaching the depth specified in (a) 1 herein, or 1 foot below original ground in fill sections where topsoil and root mat are not required to be removed, will be measured as undercut excavation.

Excavation of rock or unsuitable material below the elevation of the bottom of the lower theoretical slab or culvert thickness or below the excavation limits shown on the plans or standard drawings for normal earth foundations, whichever is the greater depth, of minor structures having span(s) or opening(s) of less than 48 inches will be measured for payment as undercut excavation. Such excavation for structures having span(s) or opening(s) of 48 inches or greater will be measured as minor structure excavation in accordance with (a)4. herein.

Undercut excavation will be paid for at the contract unit price per cubic yard. This price shall include removal and disposal. When not a pay item, undercut excavation will be paid for at twice the unit price per cubic yard for regular excavation.

4. **Minor structure excavation:** Excavation of material above the elevation of the bottom of the lower theoretical slab or culvert thickness, or above the excavation limits shown on the plans for earth foundations, whichever is the greater depth, for culverts having a maximum span or opening of less than 48 inches will not be measured for payment.

Excavation of material for culverts having span(s) or opening(s) of 48 inches or greater and excavation for minor structures not covered elsewhere in these specifications will be measured in cubic yards of minor structure excavation. The quantity allowed for payment will be the actual volume of material removed as bounded by the bottom of the lower theoretical slab or culvert thickness, or lower excavation limits shown on the plans for earth foundations, whichever is the

greater depth; the original ground or regular excavation pay line, whichever is the lower elevation; and vertical planes 18 inches outside the neat lines of the structure (excluding wingwalls and other appurtenances) or bound by vertical planes coincident with the applicable bedding excavation limits shown on the plans. Payment for excavation for wingwalls and other appurtenances to structures will be based on the ratio of the plan area of the wingwalls or appurtenances to the plan area of the barrel. Once the ratio has been determined, the pay quantity for minor structure excavation will be increased accordingly.

If embankment is placed prior to installation of a minor structure, excavation of the embankment area will not be measured for payment unless the contract requires placement of the embankment prior to the installation of the minor structure.

The volume of the interiors of culverts, drop inlets, and other existing minor structures that must be removed will not be deducted from the overall quantity of minor structure excavation allowed for payment.

The price of minor structure excavation shall include the cost of backfill above the horizontal planes of the neatlines of the Class I or Class II backfill areas to original ground. Class I and Class II backfill shall be measured and paid for in accordance with Section 302.04.

5. **Earthwork:** When a pay item, earthwork will be paid for at the contract lump sum price, wherein no measurement will be made. This price shall include regular excavation, minor structure excavation, and grading.

(b) **Embankments:**

1. **If embankment is not a pay item**, the cost of embankment construction will be considered incidental to other items of excavation.
2. **If embankment is a pay item and regular excavation is to be paid for on a plan quantity basis**, the quantity of embankment for which payment will be made will not be measured separately but will be computed in accordance with the following:
 - a. The regular excavation plan quantity will be adjusted in accordance with (c) herein.
 - b. The quantity of unsuitable material will be measured and subtracted from the adjusted regular excavation quantity determined in 2.a. herein. Quantities of unsuitable material removed from fill areas or below the subgrade in cut areas will be determined by using plan dimensions and may be adjusted for deviations based on actual measurement. Actual dimensions will be used to determine the quantity of any other unsuitable material.
 - c. The total quantity shown on the plans will be adjusted for quantities not anticipated on the plans, such as changes in grade or undercut determined to be necessary during construction.
 - d. The quantity of suitable material determined in 2.b. herein will be subtracted from the

adjusted total fill quantity determined in 2.c. herein. The resultant quantity will be the embankment quantity for which payment will be made.

The Contractor shall be responsible for determining the effect of the shrinkage or swell factor of the material, and no adjustment will be made in pay quantities for this factor.

Hydraulic embankment will be paid for as embankment.

3. **If embankment is a pay item and regular excavation is to be paid for on the basis of measured quantities**, the quantity of embankment will be measured in cubic yards computed by the average end area method from the dimensions of the embankment cross section.

Cross sections of the area to be covered by the embankment will be taken after the denuding or removal of unsuitable material and before any material is placed thereon. These cross sections shall extend laterally from the center line to the toes of slopes as indicated on the typical cross section. The elevations as determined by these sections will be considered the original ground line. The pay quantity to be measured will be the volume of material included in the section above the original ground and below the upper limits of the typical cross section.

When regular excavation is a pay item, the embankment area to be cross-sectioned will exclude that portion of the fill constructed from regular excavation. Material outside the limits of typical cross sections as shown on the plans will not be measured or paid for.

4. **Extra embankment required for subsurface consolidation** will be determined by the use of settlement plates. The total settlement recorded at each settlement plate will be allowed across 75 percent of the lateral width of each section. Volumes will be computed using the average end area method. Embankment quantities will be adjusted as specified herein to include extra embankment for subsurface consolidation.

Settlement plates will be measured and paid for in units of each, complete-in- place. This price shall include furnishing, installing, maintaining, and removing when no longer required.

Surcharge placement and removal will be measured in cubic yards as determined by plan quantity and will be paid for at the contract unit price per cubic yard. This price shall include furnishing, placing, and removing surcharge material and disposing of surplus and unsuitable materials.

5. **If geotextile drainage fabric is a pay item**, measurement and payment will be in accordance with Section 504.
6. **Geotextile for embankment stabilization** will be measured in square yards complete-in-place. Overlaps and seams will not be measured for separate payment. The accepted quantity of geotextile will be paid for at the contract unit price per square yard, which price shall be full compensation for furnishing, placing, lapping or seaming material and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

Embankment with a stipulated CBR value shall be measured and paid for as embankment with the CBR value as specified.

Embankment without a stipulated CBR value shall be measured and paid for as embankment.

- (c) **Plan Quantities:** The quantity of regular excavation for which payment will be made when plan quantities are specified will be that specified in the Contract. However, borrow excavation, excavation for entrances, unsuitable material below the top of earthwork, undercut excavation, slide excavation, rock excavation that changes the slopes or causes undercut, and side, inlet, and outlet ditches not covered by plan cross sections will be measured in its original position by cross sections and computed in cubic yards by the average end area method.

Where there are authorized deviations from the lines, grades, or cross sections, measurements will be made and the volume computed in cubic yards by the average end area method for these deviations. The plan quantity will then be adjusted to include these quantities for payment.

When unauthorized deviations occur, allowances will not be made for overruns. However, if the deviation decreases the quantities specified in the Contract, only the actual volume excavated will be allowed.

- (d) **Backfill:** Furnishing and placing backfill material, including backfill for undercut, will be included in the price for excavation and will not be measured for separate payment unless specific material is a pay item for backfill or unless suitable material is not available within the construction limits. When a specific material is a pay item, the unit of measure of the material will be in accordance with the unit specified in the Contract. When suitable backfill is not available within the construction limits, the material furnished and placed by the Contractor will be paid for in accordance with Section 109.05.

(e) **Erosion Control Items:**

1. **Limiting the scope of construction operations, shaping the top of earthwork, and constructing temporary earth berms and brush silt barriers for temporary erosion and siltation control** will not be measured for payment but shall be included in the price for other appropriate pay items.
2. **Erosion control riprap** will be measured and paid for in accordance with Section 414.04.
3. **Temporary protective covering** will be measured and paid for in accordance with Section 606.04.
4. **Check dams** will be paid for at the contract unit price per each. This price shall include furnishing, excavating, constructing, maintaining, and removing check dams when no longer required.

Synthetic checkdams may be substituted for Type II Rock Checkdams (Standard EC-4) at no additional cost to the Department.

5. **Temporary silt fences** will be measured in linear feet, complete-in-place, excluding laps, and will be paid for at the contract unit price per foot. Decomposed or ineffective geotextile fabric replaced after 6 months from the installation date will be measured in linear feet of temporary silt fence and paid for at 1/2 the contract unit price for temporary silt fence. Decomposed geotextile fabric required to be replaced prior to 6 months after installation will not be measured

- for payment. This price shall include furnishing, installing, and maintaining the silt fence, including wire reinforcement and posts; removing, and disposing of these materials and dressing and stabilizing the area.
6. **Geotextile fabric** attached to brush barriers or existing fence or used for another function specified on the plans and not included in other pay items will be measured in square yards, complete-in-place, excluding laps, and will be paid for at the contract unit price per square yard. The brush barrier will not be measured for payment. The cost thereof shall be included in the price for clearing and grubbing. This price shall include trimming the brush barrier; furnishing, installing, maintaining, removing the fabric and dressing and stabilizing the area.
 7. **Temporary filter barriers** will be measured in linear feet, complete-in-place, excluding laps, and will be paid for at the contract unit price per foot. Decomposed or ineffective geotextile fabric replaced after 6 months from the installation date and decomposed or ineffective burlap fabric replaced after 3 months from the installation date will be measured in feet of temporary filter barrier and paid for at 1/2 the contract unit price for temporary filter barrier. Decomposed geotextile fabric required to be replaced prior to 6 months and decomposed burlap fabric required to be replaced prior to 3 months after installation will not be measured for payment. When permitted, baled straw silt barrier used in lieu of temporary filter barrier will be paid for in linear feet of temporary filter barrier, complete-in-place. This price shall include furnishing, installing, and maintaining the filter barrier, including filter barrier material and posts; removing, disposing of these materials and dressing and stabilizing the area. If the Contractor is permitted to use baled straw silt barrier in lieu of temporary filter barrier, payment will be made at the price for temporary filter barrier.
 8. **Silt cleanout**, when approved or directed by the Engineer, will be measured as siltation control excavation in cubic yards of vehicular measurement in accordance with the requirements of Section 109.01 for the full volume of the vehicle.

Silt removal and sediment cleanout will be paid in cubic yards of siltation control excavation. Payment shall be full compensation for removal of silt and sediment approved or directed by the Engineer and for transportation and disposal of the material.

If approved or directed by the Engineer, the installation of additional temporary silt fence and temporary filter barrier in lieu of silt cleanout will be measured in feet as specified in (e)5. and (e)7. herein.
 9. **Seeding materials** will be measured and paid for in accordance with Section 603.
 10. **Temporary erosion and siltation measures required to correct conditions created because of the Contractor's negligence, carelessness, or failure to install permanent controls in accordance with the plans and sequence for performance of such work** will not be measured for payment.
 11. **Slope drains** will be measured in units of each, per location regardless of size or length and will be paid for at the contract unit price per each. Raising of the slope drain and addition of pipe lengths will not be measured as a new location. This price shall include furnishing, installing, maintaining, and removing the drain and end section or portable flume.

12. **Sediment traps and basins** will be measured in cubic yards of sediment basin excavation and will be paid for at the contract unit price per cubic yard. This price shall include excavation, maintenance, and backfill or removing to original ground when no longer needed.
13. **Storm Water Management Basin Excavation** will be measured in cubic yards and will be paid for at the contract unit price per cubic yard. The price shall include excavation, maintenance, and shaping of basin.
14. **Temporary Sediment Basin Excavation** will be measured in cubic yards and will be paid for at the contract unit price per cubic yard. The price shall include excavation, maintenance and when no longer required the removal of dam, pipe, riser pipe, trash rack, backfill and site restoration.
15. **Drop Inlet Silt Trap** will be measured in units of each and paid for only one time during the life of the project.
16. **Dewatering basin** will be measured and paid for at the contract unit price per each. This price shall include furnishing, installing, maintaining, and when no longer required, removing the dewatering basin, backfill and site restoration.
17. **Erosion control mulch** shall be paid for per square yard or acre. This includes all materials and equipment necessary for the application.

Payment will be made under:

Pay Item	Pay Unit
Regular excavation	Cubic yard
Borrow excavation	Cubic yard
Borrow excavation (CBR value)	Cubic yard
Sediment basin excavation	Cubic yard
Siltation control excavation	Cubic yard
Undercut excavation	Cubic yard
Minor structure excavation (Item)	Cubic yard
Earthwork	Lump sum
Embankment	Cubic yard
Embankment (CBR value)	Cubic yard
Settlement plate	Each
Surcharge placement and removal	Cubic yard
Geotextile (Embankment stabilization)	Square yard
Checkdam(Type)(Log, rock, or straw)	Each
Temporary silt fence	Linear foot
Geotextile fabric	Square yard
Temporary filter barrier	Linear foot
Slope drain	Each
Storm water management basin excavation	Cubic yard
Temporary sediment basin excavation	Cubic yard
Drop Inlet Silt Trap (Type)	Each
Dewatering Basin	Each
Erosion control mulch	Square yard or acre

SECTION 304--CONSTRUCTING DENSITY CONTROL STRIPS

304.01--Description.

This work shall consist of constructing control strips in accordance with the requirements of these specifications for the purpose of determining density requirements.

304.02--Materials.

Materials shall conform to the requirements for the material to be used in the course. Material used in each control strip shall be furnished from the same source and shall be of the same type as the material used in the test sections whose density requirements are established by the control strip.

304.03--Equipment.

Equipment shall be approved by the Engineer prior to use. The type and weight of compaction equipment shall be such that a uniform density is obtained throughout the depth of the layer of material being compacted. Control strips shall be compacted using equipment of the same type and weight to be used on the remainder of the course.

304.04--Procedures.

The subgrade or pavement structure course upon which a control strip is constructed shall be approved by the Engineer prior to construction of the control strip.

One control strip shall be constructed at the beginning of work on each roadway and shoulder course and each lift of each course. An additional control strip shall be constructed when a change is made in the type or source of material or whenever a significant change occurs in the composition of the material from the same source.

The project will be divided into "control strips" and "test sections" by the Engineer for the purpose of defining areas represented by each series of tests. The size of each control strip and test section will be in accordance with the requirements of VTM-10.

Control strips shall be constructed using the same procedure to be used in the construction of the remainder of the course. Rolling of the control strip shall be continued until no appreciable increase in density is obtained by additional roller coverages.

Upon completion of rolling, the mean density of the control strip will be based on 10 tests taken at randomly selected sites within the control strip area using a nuclear testing device. Compaction of the remainder of the course shall be governed by the density obtained in the control strip.

Each test section will be tested for required thickness. Areas that are deficient by more than the specified allowable tolerance shall be corrected in accordance with the applicable requirements of these specifications. The Engineer may require an additional control strip after the completion of each 10 test sections. Each control strip shall remain in place and become a section of the completed roadway.

304.05--Tolerances.

If the mean density of a test section (roadway or shoulder) does not conform to the applicable requirements stated herein, the Contractor shall continue his compactive effort or shall rework the entire test section until the required mean density is obtained. If an individual test value does not conform to the requirements stated herein, the Contractor shall continue his compactive effort or shall rework the entire area represented by that test until the required density is obtained.

(a) **Roadway:** The density of each test section will be evaluated based on the results of five tests performed at randomly selected sites within the test section. The mean density obtained for the five tests in each test section shall be at least 98 percent of the mean density obtained in the approved control strip. In addition, each individual test value obtained within a test section shall be at least 95 percent of the mean density obtained in the approved control strip.

(b) **Shoulders:**

1. **Aggregate shoulders:** The density of each test section of select or aggregate material used in the construction of shoulders will be evaluated based on the results of five tests performed at randomly selected sites within the test section. The mean density obtained for the five tests in each test section shall be within 95 ± 2 percent of the mean density obtained in the approved control strip. In addition, each individual test value obtained in a test section shall be within 95 ± 5 percent of the mean density obtained in the approved control strip.

2. **Asphalt shoulders:** The density of each test section of asphalt concrete used in the construction of shoulders will be evaluated based on the results of five tests performed at randomly selected sites within the test section. The mean density obtained for the five tests in each test section shall be at least 98 percent of the mean density obtained in the approved control strip. In addition, each individual test value obtained within a test section shall be at least 95 percent of the mean density obtained in the approved control strip.

304.06--Measurement and Payment.

This item is considered incidental to the cost of furnishing, placing, and compacting the specified course and will not be measured for payment. The cost of constructing density control strips shall be included in the cost of the material for which the control strip is required.

SECTION 305--SUBGRADE AND SHOULDERS

305.01--Description.

This work shall consist of constructing the subgrade in reasonably close conformity to the cross section shown on the plans and constructing the shoulders in reasonably close conformity with the plans and these specifications.

305.02--Materials.

Materials may consist of material in place, treated material in place, or imported material. Imported material may be borrow material, select material, or other material as shown on the plans or specified in the Contract.

Materials other than regular excavation or borrow material that are shown on the plans or specified in the Contract shall conform to the applicable requirements of these specifications.

Geotextile material used for subgrade stabilization shall conform to the requirements of Section 245.03(d).

305.03--Procedures.

(a) Shaping and Compacting Subgrade:

1. **Subgrade consisting of material in place:** The subgrade area shall be scarified to a depth of 6 inches for a distance of 2 feet beyond the proposed edges of the pavement on each side. If sandy or other soil is encountered that will not compact readily, clay or other suitable material shall be added or water applied in such quantity and within the allowable moisture content specified herein as will permit compaction of the subgrade. Subgrade material shall be compacted at optimum moisture, within ± 20 percent of optimum. The density of the subgrade when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1 shall conform to the following:

% Retained on No. 4 Sieve	Min. % Density
0 – 50	100
51 – 60	95
61 – 70	90

Percentages of material will be reported to the nearest whole number.

The subgrade shall then be shaped and checked to ensure a typical cross section and uniform grade prior to placement of any subsequent courses. If the subgrade becomes eroded or distorted prior to placement of material for subsequent courses, it shall be scarified, reshaped, and recompacted in accordance with the original requirements.

At the time of placing material for subsequent courses, the subgrade shall be compacted to the required density, free from mud and frost, and in a condition that will permit compaction of subsequent courses without distortion.

If the approved subgrade becomes unstable after placement of the subbase or base course and

becomes mixed with the aggregate therein, material from the unstable area and contaminated aggregate shall be removed. The area shall then be backfilled and compacted, and the subsequent course thereon reconstructed.

2. **Subgrade consisting of treated materials in place:** Subgrade shall be treated in accordance with the requirements of the applicable provisions of Sections 306.03 and 307.05 except that the tolerance for depth will be waived when lime or cement is being used to bridge or correct extremely weak areas.

If lime can be satisfactorily manipulated during initial mixing, and bridging of the weak area has been performed satisfactorily, additional mixing and compacting will not be required. Additional layers of fill may be placed without delay.

Field density determinations will be performed in accordance with the requirements of AASHTO T191, modified to include material sizes used in the laboratory determination of density; with a nuclear density testing device; or by other approved methods. When a nuclear device is used, the nuclear density determination for treated in-place subgrade material will be related to the density of the same material tested in accordance with the requirements of VTM-1 or VTM-12 and a control strip will not be required.

3. **Subgrade consisting of imported material:** The area to receive the material shall be graded to a true crown and cross section.

Material shall be placed and compacted in accordance with the requirements of the applicable specifications governing the type of material. When select material is used, material shall be placed and compacted in accordance with the requirements of Section 308.02 except that the provision for mixing will be waived. The top 6 inches of the finished subgrade shall be compacted in accordance with the requirements of the provisions of 1. herein.

The provisions of 1. herein that are not specifically amended herein shall apply. Imported material shall be placed in approximately equal layers not more than 8 inches for commercial material and 6 inches for local material, compacted measure. Material will be tested after compaction for thickness and density. If material fails to conform to thickness requirements, it shall be corrected by scarifying, adding material if necessary, mixing, reshaping and recompacting, or removing and replacing. If the material fails to conform to density requirements, additional rolling will be required until the required density is obtained provided the material is compacted at optimum moisture, within ± 20 percent of optimum. If the moisture content is outside the allowable tolerance, the layer shall be scarified, brought to optimum moisture within the allowable tolerance, and recompacted to the specified density.

An aggregate spreader will not be required in the placement of select material and other imported materials used as subgrade and shoulder courses.

- (b) **Treatment of Unsuitable Subgrade:** When solid rock occurs in cuts or the material is not suitable for subgrade or finishing purposes, the roadbed shall be excavated below the grade shown on the plans in accordance with the standard drawings.

When solid rock or other unsuitable material has been removed, excavated areas shall be backfilled in accordance with the standard drawings.

- (c) **Finishing Subgrade:** The Contractor shall provide effective drainage for the subgrade and maintain it in a satisfactory condition until the next course is placed.

When practicable, the subgrade shall be prepared at least 500 feet ahead of placement of any subbase, base, or surface course. Material for subsequent courses shall not be placed until the subgrade has been checked and approved. The finished subgrade elevation shall be within ± 0.04 foot of the plan elevation unless otherwise specified. When imported material is used, acceptance of the course will be based on the requirements of Section 308.04.

- (d) **Geotextile (Subgrade Stabilization):** When geotextile for subgrade stabilization is required it shall be placed as shown on the plans. Geotextile shall be spliced by an overlap of at least 2 feet or by sewing double stitched seams with stitching spaced $\frac{1}{4}$ inch to $\frac{1}{2}$ inch apart or as shown on the plans.

- (e) **Shoulders:** Aggregate shoulder material shall be placed in accordance with the requirements of the applicable specifications governing the type of material or construction being used and shall be compacted at optimum moisture, within ± 2 percentage points of optimum. Except when aggregate material No. 18 is used, the density of the aggregate shoulder material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1 or VTM-12, shall conform to the following:

% Retained on No. 4 Sieve	Min. % Density
0 – 50	95 – 100
51 – 60	90 – 100
61 – 70	85 – 100

Percentages of material will be reported to the nearest whole number.

When aggregate material No. 18 is used, the density, when compared to the theoretical maximum density, shall be not less than 90 or more than 95 percent.

Aggregate in the guardrail section of fills (1 foot from the roadway side of the guardrail face to the outside of the shoulder) shall be compacted until a density of at least 90 percent of the theoretical maximum density has been obtained. The asphalt mixture in this area shall be sealed immediately after the hot mixture is spread. Rolling of the asphalt mixture shall continue until roller marks are eliminated and a density of at least 85 percent of the theoretical maximum density has been obtained.

Stabilized and paved shoulders shall be constructed in accordance with the requirements of the applicable specifications for pavement stabilization. If the aggregate shoulder material becomes over-consolidated prior to final finishing, it shall be scarified for the approximate depth, reshaped, and recompacted to conform to the specified grade and cross section.

Shoulders shall be constructed simultaneously with nonrigid types of base or surface courses other than asphalt concrete or in advance of the base or surface course so as to prevent spreading of base or surface

materials. The area of shoulders 12 inches adjacent to the pavement shall be rolled simultaneously with the course being deposited.

Where base or surface courses are being constructed under traffic and are more than 1 inch in depth, shoulder material adjacent thereto shall be placed within 72 hours after placement of the base or surface course.

305.04--Measurement and Payment.

When material in place is used for the subgrade and shoulders, no measurement will be made. Treated material in place will be measured in accordance with the method of measurement for the specified stabilizing material. When imported material is specified, it will be measured as follows:

- (a) **Select material, Type I**, will be measured in tons.
- (b) **Select material, Types II and III**, will be measured in cubic yards in its original position.
- (c) **Borrow** will be computed in its original position by cross sectioning the area excavated. If cross sectioning the area excavated is not practical, the quantity will be determined from compacted measurements in the road and then converted to pit volume.

When cubic yard measurement is specified and the plans do not show the thickness of material required, the material will be measured in the original position by the cross-section method. Where it is impractical to cross section the area, measurement will be made in trucks in accordance with the requirements of Section 109.01.

When the ton unit is specified, the quantity shall be determined in accordance with the requirements of Section 109.01.

Moisture in excess of optimum, +2 percentage points, will be deducted from the net weight of both truck and rail shipments.

Allowance will not be made for unauthorized depths beyond those shown on the plans and the allowable tolerances. When tonnage measurement is used, deduction for material exceeding the allowable tolerance will be based on 110 pounds per square yard per inch of depth.

When material in place is used for subgrade and shoulders, no separate payment will be made. The cost thereof shall be included in the price for other applicable pay items.

When imported materials are used, the subgrade and shoulders will be paid for at the contract unit price per cubic yard or per ton as specified. Treated material in place will be paid for in accordance with the requirements of the applicable specification.

Stabilized or paved shoulders shown as a pay item will be measured and paid for in accordance with the requirements of Section 306.04, Section 307.06, Section 312.05, or Section 315.08, as applicable.

(d) **Geotextile for subgrade stabilization** will be measured in square yards complete-in- place. Overlaps and seams will not be measured for separate payment. The accepted quantity of geotextile will be paid for at the contract unit price per square yard, which price shall be full compensation for furnishing, placing, lapping or seaming material and for all materials, labor, tools, equipment and incidentals necessary to complete the work.

These prices shall include furnishing, hauling, placing, manipulating, and compacting material; clearing and grubbing local pits; material royalties; and access roads.

Payment will be made under:

Pay Item	Pay Unit
Borrow excavation	Cubic yard
Select material (Type and min. CBR)	Cubic yard or ton
Aggregate material (No.)	Cubic yard or ton
Aggregate base material (Type and no.)	Cubic yard or ton
Geotextile (Subgrade stabilization)	Square yard

SECTION 306--LIME STABILIZATION**306.01--Description.**

This work shall consist of stabilizing roadbed material by constructing one or more courses of the pavement structure using a mixture of soil or approved aggregates, lime or lime and fly ash, and water.

306.02--Materials.

- (a) **Lime** shall conform to the requirements of Section 240.
- (b) **Fly ash** shall conform to the requirements of Section 241. Bulk fly ash may be transported dry in bulk trucks and stored in tanks or may be transported in the dampened condition (15 percent moisture, maximum) and stockpiled at the job site. Excessively wet or contaminated surface material shall not be used in mixing operations. Stockpiled material shall be covered with a non-absorptive cover material or periodically moistened to prevent moisture loss and becoming airborne.
- (c) **Water** shall conform to the requirements of Section 216.
- (d) **Aggregate** shall conform to the applicable requirements of Sections 205, 207, and 208 or other requirements described in the Contract.

306.03--Procedures.

Lime stabilization will not be permitted when aggregate or the surface on which the course is to be placed is frozen. Manipulation shall not be started until the surface is free from mud and frost and the ambient air temperature is at least 40°F.

- (a) **Preparing the Roadbed:** The surface of the roadbed shall be cut or bladed to the approximate line, grade, and cross section. However, compaction of the roadbed for the depth of the material to be treated will not be required prior to application of lime. When the course placed directly on the roadbed is to be stabilized, the surface of the roadbed shall be prepared in accordance with the requirements of the applicable provisions of Section 305.

Temporary ramps constructed adjacent to existing pavements, bridges, culverts, and similar items shall be removed to the depth necessary to provide the required thickness of pavement structure.

Drains shall be cut through excavated shoulder material on shoulders to drain the roadbed. Drains shall be cut through windrowed base materials at sufficient intervals to prevent ponding of water. Windrowed material shall be moved, when necessary, to permit the subgrade to dry.

- (b) **Preparing Materials:** The prepared roadbed shall be scarified to the depth and width required for stabilization. The material thus prepared shall be partially pulverized. The depth of scarification and the blading operation shall be controlled in such a manner that the surface of the roadbed below the scarified material shall remain undisturbed and shall conform to the established cross section. Prior to the beginning of stabilization work, material retained on the 3-inch sieve shall be removed.

- (c) **Applying Lime:** The application rate of lime shall be as shown on the plans or as directed by the Engineer. Lime may be applied to the partially pulverized material as a slurry or in a dry form. When quicklime is used in a dry form it shall be applied at the same rate as hydrated lime.

Where quicklime is slaked on the project to produce a slurry, measurement will be calculated as indicated herein for each truckload using the certified lime purity for that load. No measurement will be made of any lime added or replaced for corrective measures during construction or for repairing damaged areas.

A = Certified weight of quicklime delivered x % purity x 1.32

B = Certified weight of quicklime delivered x % inert material

A + B = Total hydrated lime produced (pay quantity)

Lime applied by slurry application shall be mixed with water in approved agitating equipment and applied to the roadbed as a thin water suspension or slurry. The distributing equipment shall provide continuous agitation from the mixing site until applied on the roadbed. The proportion of lime shall be such that the "Dry Solids Content" shall be at least 30 percent by mass. A lower percent solid may be authorized by the Engineer provided a uniform suspension of the slurry can be maintained. A weight and purity certification shall accompany each shipment of quicklime to be used in slurry applications.

Spreading equipment shall uniformly distribute the lime without excessive loss. No equipment, except water trucks and equipment used for mixing and spreading, shall pass over the spread lime until it is mixed. Any procedure which results in excessive loss or displacement of the lime shall be immediately discontinued.

When a stationary mixer is used to mix aggregate material, the lime may be added to the mix by an approved feeder.

When applied in dry form, lime shall be spread uniformly over the top of the scarified material by an approved screw-type spreader box or other approved spreading equipment. The spreading operation shall be shrouded to minimize dust. Dry lime shall not be applied pneumatically, dropped from a dump truck, front end loader or bottom dumped. A motor grader shall not be used to spread the dry lime.

Dry lime shall not be applied when, in the opinion of the Engineer, wind conditions are such that the blowing material would become objectionable to adjacent property owners or create potential hazards to traffic.

- (d) **Adding Water:** Sufficient water shall be added by means of pressure water distributors or through the mixing chamber of a rotary mixer to provide a moisture content at the time of compaction of not less than the optimum for the mixture or more than optimum +20 percent of optimum.
- (e) **Mixing:** Lime and water shall be mixed throughout the scarified material as thoroughly as practicable using a self-propelled rotary mixer capable of mixing to a compacted depth of at least 12 inches. Disc harrows or motor graders shall not be used for mixing. The mixture shall then be spread over the roadbed. The surface shall be sealed with a steel wheel or pneumatic tire roller to retard the loss of moisture and then allowed to mellow for 4 to 48 hours. After mellowing, the lime- treated material shall

be remixed with a rotary mixer until at least 60 percent of the material, exclusive of aggregates, will pass a No. 4 sieve. Additional water may be added, if necessary, during the remixing operations to ensure proper moisture for compaction.

When a stationary mixer is used, the material may be placed, compacted, and finished immediately after mixing.

When traveling plants are used, additional mixing with blades, tillers, discs, harrows, or repeated passes of the plant may be required.

During the interval of time between lime application and initial mixing, lime that has been exposed to the open air for 6 hours or more or lime that has been lost because of washing or blowing will not be measured for payment.

- (f) **Compacting and Finishing:** The mixture shall be placed and compacted to a density of at least 95 percent of the maximum density determined in accordance with the requirements of VTM-1 or VTM-12. Light sprinkling may be required during placement operations to maintain the specified moisture content. Compaction shall be accompanied by sufficient blading to eliminate irregularities.

The surface shall be lightly scarified during finishing operations and bladed to eliminate imprints left by the equipment. Final rolling of the completed surface shall be accomplished with a pneumatic tire roller or steel wheel roller. Final compaction and finishing shall be completed within 12 hours after final mixing.

- (g) **Tolerances:** The finished stabilized course shall conform to the specified thickness, subject to the following tolerances: Thickness will be determined in accordance with the requirements of VTM-38A. Areas that are deficient in thickness by more than 1 inch shall be removed or reworked with an additional amount of lime equal to 50 percent of the original amount. In the case of stabilized base courses, the Contractor may correct sections deficient in depth by applying asphalt concrete provided such correction is authorized by the Engineer. Areas that are excessive in thickness by more than 2 inches shall be reworked, and an amount of lime equal to 50 percent of the original amount added to the mixture. Any replacement, corrective work and additional lime required to address deficiencies shall be at the Contractor's expense.

- (h) **Protecting and Curing:** After finishing of the subgrade, no vehicles, except sprinkling equipment, shall be permitted on the subgrade for a curing period of 7 days or until the next course is placed, whichever is less. During the curing period, the subgrade shall be lightly sprinkled with water at frequent intervals to prevent the surface from drying and cracking. The Contractor shall plan and prosecute the work in such a manner as to place the next course during the curing period. If the Contractor has not placed the next course by the end of the curing period, he shall apply liquid asphalt and cover material at the rate specified on the plans.

Damage to the stabilized course attributable to other phases of construction by the Contractor shall be repaired at the Contractor's expense. At least one subsequent course shall be constructed on the stabilized course before hauling operations for the other phases of construction are permitted on the treated course. If the material loses the required stability, density, or finish before the next course is placed or the work accepted, it shall be recompacted and refinished at the Contractor's expense.

306.04--Measurement and Payment.

Lime stabilization will be measured in tons of lime or fly ash, square yards of manipulation, and cubic yards or tons of aggregate material, complete-in-place, and will be paid for at the contract unit price per ton of lime or ton of fly ash, per square yard of manipulation, and per cubic yard or ton of aggregate material. Weighing shall be performed in accordance with the requirements of Section except that transporting vehicles shall be tared prior to each load.

Manipulation shall include preparing the roadbed, scarifying, pulverizing, drying material, mixing, compacting, finishing, protecting, curing, and maintaining the completed course.

Payment will be made under:

Pay Item	Pay Unit
Lime	Ton
Fly Ash	Ton
Manipulation	Square yard
Aggregate material (Type)	Cubic yard or ton

SECTION 307--HYDRAULIC CEMENT STABILIZATION

307.01--Description.

This work shall consist of stabilizing roadbed material as specified or as directed by the Engineer and constructing one or more courses of the pavement structure using a mixture of soil, or approved aggregates and hydraulic cement, on a prepared surface in accordance with the requirements of these specifications and in reasonably close conformity with the lines, grades, typical sections, and cross sections shown on the plans or as established by the Engineer.

307.02--Materials.

- (a) **Cement** shall conform to the requirements of Section 214, Type I, IP, or II. Cement shall be transported, stored, and otherwise protected in accordance with the requirements of Section 217.03.
- (b) **Water** shall conform to the requirements of Section 216.
- (c) **Asphalt** used for curing or priming shall conform to the applicable requirements of Section 210.
- (d) **Aggregate** shall conform to the applicable requirements of Sections 205, 207, or 208 or other contract requirements.
- (e) **Select borrow** shall consist of approved material having the specified CBR.

307.03--Field Laboratory.

When a field laboratory is furnished by the Department, the Contractor shall move the laboratory to various points along the project as necessary.

307.04--Weather Limitations.

Cement stabilization will not be permitted when aggregate or the surface on which the course is to be placed is frozen. Manipulation operations shall not be started until the air temperature is at least 40 oF in the shade and rising. When material may be exposed to freezing temperatures during the first 24 hours of curing, the Contractor shall protect the stabilized material from freezing for 7 days or shall cover the stabilized surface with the next pavement course within 4 hours after the cement stabilization has been finished as specified.

307.05--Procedures.

If full-width paving equipment is to be used in the subsequent placement of asphalt concrete base, the width of the stabilized course upon which the base will be placed may be extended 1 foot beyond the designed typical section on each side.

- (a) **Preparing Existing Surface:** When the roadbed is to be stabilized, its surface shall be cut or bladed to the approximate line, grade, and cross section. However, compaction of the roadbed for the depth of the material to be treated will not be required prior to application of cement. When the course placed directly on the roadbed is to be stabilized, the surface of the roadbed shall be prepared in accordance

with the requirements of the applicable provisions of Section 305.03.

Additional material needed to bring the roadway surface into compliance with the required specifications shall be obtained from within the limits of the right of way, if available. When authorized, the Contractor shall obtain such material from borrow pits as provided for in Section 303.

The surface shall be sufficiently firm to support, without displacement, the construction equipment and shall be in such condition that the compaction can be obtained as specified herein. Soft, yielding, or wet areas shall be corrected and made stable before construction proceeds.

- (b) **Preparing Materials:** When the roadbed is to be stabilized, material to be treated shall be scarified and pulverized prior to application of cement. Pulverizing shall continue during mixing operations until at least 80 percent of the material, exclusive of coarse aggregate, will pass the No. 4 sieve. Any material retained on the 3-inch sieve and other objectionable objects shall be removed.

Applying and mixing cement with material in place or aggregate material shall be performed in accordance with the following methods except that aggregate subbase, aggregate base course, select material, and select borrow specified on the plans shall be mixed in accordance with the requirements of 2. herein. If the closest central mixing plant is located more than 30 road miles from the project, the Contractor may elect to mix cement with aggregate subbase, aggregate base, select material, and select borrow in accordance with the requirements of 1. herein provided an additional 1 percent cement by weight is added to the in-place mixing operation and the cement is mixed to a depth of approximately 1 inch less than the depth of the course being stabilized. No additional compensation will be allowed for the changes described herein.

1. **Mixed-in-place method:** Any additional material required shall be blended with the existing material prior to application of cement.

Cement shall be applied uniformly on the material to be processed. When bulk cement is used, the equipment shall be capable of handling and spreading the cement in the required amount. The moisture content of the material to be processed shall be sufficiently low to permit a uniform mixture of the aggregate material and cement. Spread cement that has been lost shall be replaced without additional compensation before mixing is started.

Mixing shall be accomplished by means of a self-propelled or self-powered machine equipped with a mechanical rotor or other approved type of mixer that will thoroughly blend the aggregate with the cement. Mixing equipment shall be constructed to ensure positive depth control. Care shall be taken to prevent cement from being mixed below the depth specified. Water shall be uniformly incorporated into the mixture. The water supply and distributing equipment shall be capable of supplying the amount of water necessary to obtain optimum moisture in the material within 1 hour. If more than one pass of the mixer is required, at least one pass shall be made before water is added. Mixing shall continue after all water has been applied until a uniform mixture has been obtained for the full depth of the course.

Any mixture that has not been compacted and remains undisturbed for more than 30 minutes shall be remixed. If rain adds excessive moisture to the uncompacted material, the entire section shall be reworked. If the Contractor is unable to finish the section within the same day, the

section shall be reconstructed and an amount equal to 50 percent of the original amount of cement shall be added to the mixture at the Contractor's expense.

2. **Central plant method:** Material shall be proportioned and mixed with cement and water in an approved central mixing plant. The plant shall be equipped with feeding and metering devices that will introduce materials into the mixer in the specified quantities. Mixing shall continue until a uniform mixture has been obtained.

Mixed material shall be transported to the roadway in suitable vehicles and spread on a moistened surface in a uniform layer by a self-propelled or other approved spreader. Not more than 60 minutes shall elapse between the start of mixing and the start of compacting the cement-treated mixture on the prepared subgrade.

- a. **Mixing aggregate subbase and base material:** The cement content will be determined by the titration method as described in VTM-40. Sampling and testing for determining cement content will be performed at the plant. However, nothing herein shall be construed as waiving the requirements of Sections 106.06 and 200.02.

Acceptance for cement content will be based on the mean of the results of tests performed on samples taken in a stratified random manner from each lot. The rate of sampling will be four samples per lot. A lot of material is defined as 2,000 tons, or 4,000 tons for contract items in excess of 50,000 tons, of material unless the project requires less than 2,000 tons, or 4,000 tons when the contract item is in excess of 50,000 tons; a portion of the lot is rejected for deficient cement content, the job-mix formula for the aggregates is modified within a lot, or a portion of the lot is rejected for an excessive liquid limit or plasticity index.

A lot will be considered acceptable for cement content if the mean result of the test(s) is within the following process tolerance(s) of the plan design for the number of tests taken: mean of two tests, -1.1 percent; mean of three tests, -0.9 percent; mean of four tests, -0.8 percent. However, no one sample shall have a cement content more than 1.6 percent below the design cement content.

If an individual test result indicates that the cement content of the material represented by the test is deficient by more than 1.6 percent from the design cement content, the portion of the material represented by the sample will be considered a separate part of the lot and shall be removed from the road.

If the value of the test results falls below the allowable process tolerance, a payment adjustment will be applied to the contract unit price at the rate of 1.0 percent for each 0.1 percent the material is outside the process tolerance. If the total adjustment is 8.0 percent or less and the Contractor does not elect to remove and replace the material, the contract unit price paid for the material will be reduced at the rate specified herein. The adjustment will be applied to the metric tonnage represented by the samples.

- b. **Mixing select borrow:** Cement in the mixture shall not vary more than ± 7.0 percent by mass from that specified. Feeders and meters for introducing cement into the mixer shall

be of such design that the amount of cement can be accurately determined before cement is introduced into the mixer.

- (c) **Compacting and Finishing:** Prior to the beginning of compaction, the mixture shall be brought to a uniformly loose condition for its full depth and shall have a moisture content of not less than optimum or more than optimum +20 percent of optimum. For subgrade stabilization, the mixture shall be compacted to a density of at least 100 percent of the maximum density as determined in accordance with the requirements of VTM-1 or VTM-12. For subbase and base stabilization, the mixture shall be compacted to conform to the density requirements of Section 309.05.

Compaction equipment shall be subject to the approval of the Engineer, and the number of such units shall be sufficient to ensure the specified density and completion of the processed section within 4 hours from the time the water is added to the mixture. Initial compaction of soil mixtures shall be accomplished with a tamping roller.

After the mixture has been compacted, the surface shall be shaped to the required lines, grades, and cross sections.

If the material to be shaped is a type in which surface compaction planes will form, the Contractor shall lightly scarify the surface continuously with a drag harrow or similar equipment during the shaping operation. The surface shall then be rolled with steel wheels or pneumatic tire rollers, or both. The moisture content of the surface material shall be maintained at not less than the specified optimum during finishing operations. Compacting and finishing operations shall be completed within the specified time and carried out in a manner that will produce a smooth, dense surface, free from surface compaction planes, cracks, ridges, or loose material.

- (d) **Construction Joints:** Each day's operation shall tie into the completed work of the previous day by the remixing of approximately 2 feet of the completed course prior to the processing of additional sections. An amount equal to 50 percent of the original amount of cement shall be added to such sections. When the completed section remains undisturbed for more than 24 hours, a transverse construction joint shall be made by cutting back into the completed work to form an approximate vertical face.

- (e) **Tolerances:** The finished stabilized course shall conform to the specified thickness and density, subject to the following tolerances:

1. **Density:** The density of the completed work for each day's operations will be determined at representative locations. Any portion on which the density is more than 5 pounds per cubic foot less than that specified shall be removed and replaced.
2. **Thickness:** Thickness will be determined in accordance with the requirements of VTM-38A. The Contractor shall remove and replace areas that are deficient in thickness by more than 1 inch; or, with the approval of the Engineer, the Contractor shall correct sections on stabilized base courses that are deficient in depth by applying asphalt concrete at his own expense. Mixed-in-place areas that are excessive in thickness by more than 1 inch shall be removed and replaced.

When the central plant method of mixing is used, acceptance of the course will be based on the requirements of Section 308.04 except when the depth is deficient by more than 1 inch. In such

event, correction shall be as specified herein.

- (f) **Protecting and Curing:** The next course may be placed after the cement stabilization has been approved. In the event the next pavement course is not placed immediately, then the cement-treated aggregate course shall be moist cured continually or covered by the application of liquid asphalt to prevent surface drying until the next pavement course is placed. The Contractor shall endeavor to place the next pavement course within 7 days after cement stabilization is finished. In the event this is not possible and a liquid asphalt cover has not been applied then the Contractor shall either seal the cement stabilized layer with approved cover material or continually maintain the surface of the cement stabilized course with moisture until the next pavement course can be successfully applied. The surface of the cement-treated aggregate course shall be maintain in such a manner that the entire surface of the course remains in a moistened condition. If asphalt cover material is used, it shall be applied at the rate of approximately 0.25 gallon per square yard or as shown on the plans. The Engineer shall direct the exact rate of application necessary to produce full coverage without excessive runoff. If asphalt is used, it shall be applied with an approved pressure distributor as specified in Section 314.04 and the asphalt material shall be immediately covered with the specified cover material.

Prior to placing the next course or the application of asphalt cover material the surface of the cement stabilized layer shall be lightly moistened. In no case shall the cement-treated aggregate course be allowed to dry out completely or go uncovered through the winter. The stabilized course shall be tightly knit and free from loose and extraneous material.

The Contractor shall maintain the cement-stabilized course, including shoulders and ditches, within the limits of the Contract in a condition satisfactory to the Engineer from the time work first starts until the work has been officially accepted. Maintenance shall include immediate repairs of defects that may occur either before or after cement is applied, which work shall be performed by the Contractor and repeated as often as is necessary to keep the course continuously intact. Repairs to the course shall be performed in a manner that will ensure the restoration of a uniform surface and stability of the area repaired.

307.06--Measurement and Payment.

Hydraulic cement stabilization will be measured in tons of hydraulic cement, cubic yards or tons of aggregate, and square yards of manipulation in accordance with the requirements of Section 109.01 and will be paid for at the contract unit price per ton of hydraulic cement, per ton or cubic yard of aggregate, and per square yard of manipulation for the depth specified. This price shall include furnishing and applying water for moisture curing and, when grading is not a pay item, restoring shoulders and ditches.

Hydraulic cement-stabilized aggregate material or aggregate base material will be measured in cubic yards or tons and will be paid for at the contract unit price per ton or cubic yard. This price shall include furnishing and installing cement, aggregate, moisture for curing and, when grading is not a pay item, restoring shoulders and ditches.

Cement-stabilized select borrow will be measured in cubic yards, pit measure, in accordance with the requirements of Section 109.01 and will be paid for at the contract unit price per cubic yard. This price shall include furnishing component and curing materials and hauling, placing, and curing the cement stabilized material.

When bulk cement is used, scales capable of determining the mass of loaded cement transports or lesser loads shall be provided at locations approved by the Engineer. Weighing shall be performed in accordance with the requirements of Section 109.01 except that transporting vehicles shall be tared prior to each load.

When **manipulation** is a pay item and the Contractor elects to centrally mix the materials, the quantity of manipulation shown on the plans will be paid for. Manipulation shall include only the mixing operation.

Asphalt and cover material for curing will not be measured for separate payment.

Payment will be made under:

Pay Item	Pay Unit
Hydraulic cement	Ton
Aggregate material (No.)	Cubic yard or ton
Aggregate base material (Type and no.)	Cubic yard or ton
Cement-stabilized borrow (Min. CBR)	Cubic yard
Manipulation (Depth)	Square yard
Cement-stabilized aggregate material (Type and No.)	Cubic yard or ton

SECTION 308--SUBBASE COURSE

308.01--Description.

This work shall consist of furnishing and placing one or more courses of mineral aggregate on a prepared subgrade in accordance with the required tolerances within these specifications and in conformity with the lines, grades, typical sections, and cross sections shown on the plans or as established by the Engineer.

308.02--Materials.

Material shall conform to the requirements of Section 208 except where other types of aggregate material are specified in the Contract, in which case the applicable specifications governing the material shall apply. When material is obtained from local sources, the sources shall conform to the requirements of Section 106.03.

308.03--Procedures.

Prior to placement of the subbase course, the subgrade shall be constructed in accordance with the requirements of the applicable provisions of Sections 304 and 305.

Subbase material shall be mixed in an approved central mixing plant of the pugmill or other mechanical type in accordance with the requirements of Section 208.05. The mixed material shall be placed on the subgrade by means of an approved aggregate spreader, except that the use of such spreader will not be required where the material is being applied solely for the temporary maintenance of traffic or where the width of the course shown on the plans is transitional and impracticable to place with a spreader box.

Where the required thickness is more than 6 inches, the material shall be spread and compacted in two or more layers of approximately equal thickness. The compacted thickness of any one layer shall be not more than 6 inches. When vibrating or other approved types of special compacting equipment are used, the compacted depth of a single layer of subbase course may be increased to 10 inches upon the approval of the Engineer.

Each layer of subbase course shall be compacted at optimum moisture, within ± 2 percentage points of optimum. The density of each layer of subbase aggregate material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1, shall conform to the following:

% Retained on No. 4 Sieve	Min. % Density
0 – 50	100
51 – 60	95
61 – 70	90

Percentages will be reported to the nearest whole number.

Not more than one sample in every five shall have a density less than that specified, and the density of such sample shall be not more than 2 percent below that specified.

If the surface of the subbase becomes uneven or distorted and sets up in that condition, it shall be scarified, reshaped, and recompacted. If the subbase when compacted and shaped shows a deficiency in thickness or if depressions occur in the surface, the Contractor shall scarify such sections at his own expense before additional

material is added.

Field density determinations will be performed with the nuclear field density device using the density control strip as specified in Section 304 and VTM-10 or in accordance with the requirements of AASHTO T191. The method of density determination will be as directed by the Engineer.

308.04--Tolerances.

The thickness of the subbase course will be determined by the depth measurement of holes dug in the subbase in accordance with the requirements of VTM-38B.

Acceptance of the subbase course for the physical property of depth will be based on the mean result of tests performed on samples taken from each lot of material placed. A lot of material is defined as the quantity being tested for acceptance except that the maximum lot size will be 2 miles of paver application width.

A lot will be considered acceptable for depth if the mean result of the tests is within the following tolerance of the plan depth for the number of tests taken except that each individual test shall be within ± 1 inch of the plan depth: mean of two tests, ± 0.75 inch; mean of three tests, ± 0.60 inch; and mean of four tests, ± 0.50 inch.

If an individual depth test exceeds the ± 1 inch tolerance, that portion of the lot represented by the test will be excluded from the lot. If the individual test result indicates that the depth of material represented by the test exceeds 1 inch, the Contractor will not be paid for that material in excess of the tolerance throughout the length and width represented by the test. If the individual test result indicates that the depth of the material represented by the test is deficient by more than 1 inch, correction of the subbase course represented by the test shall be made as specified herein.

If the mean depth of a lot of material is in excess of the allowable tolerance, the Contractor will not be paid for that material in excess of the tolerance throughout the length and width represented by the test.

If the mean depth of a lot of material is deficient by more than the allowable tolerance, correction will not normally be required and the Contractor will be paid for the quantity of material that has been placed in the lot.

For excessive depth subbase courses, when tonnage measurement is used, the rate of deduction from the tonnage allowed for payment as subbase material will be calculated at a weight of 110 pounds per square yard per 1 inch of depth in excess of the tolerance. Areas that are deficient in depth by more than 1 inch and areas that do not provide a smooth uniform surface shall be scarified, material added or removed, reshaped, and recompacted to the specified density so as to conform with the depth tolerance and provide a smooth, uniform surface.

308.05--Measurement and Payment.

Subbase course will be measured in cubic yards or tons as specified and will be paid for at the contract unit price per cubic yard or ton. When the cubic yard unit is specified, the quantity will be determined by compacted measurements on the road unless otherwise specified. When the ton unit is specified, the quantity shall be determined in accordance with the requirements of Section 109.01.

This price shall include furnishing, hauling, placing, manipulating, and compacting subbase course; clearing and grubbing local pits; material royalties; and access roads.

Moisture, in excess of optimum +2 percentage points, will be deducted from the net mass of both truck and rail shipments.

Payment will be made under:

Pay Item	Pay Unit
Aggregate material (No.)	Cubic yard or ton
Aggregate base material (Type and No.)	Cubic yard or ton

SECTION 309--AGGREGATE BASE COURSE

309.01--Description.

This work shall consist of furnishing and placing one or more courses of aggregates and additives, if required, on a prepared surface in accordance with the requirements of these specifications and in conformity with the lines, grades, and typical sections and cross sections shown on the plans or as established by the Engineer.

309.02--Materials.

- (a) **Aggregate material** shall conform to the requirements of Section 208 except where other types of aggregate material are specified, in which case the applicable specifications governing the material shall apply.
- (b) **Calcium chloride and sodium chloride** shall conform to the requirements of Section 239.

309.03--Equipment.

Equipment used for the construction of aggregate base course shall be approved prior to performance of such work. Any machine, combination of machines, or equipment that will handle the material without undue segregation and produce the completed base in accordance with the requirements of these specifications for spreading, moistening, mixing, and compacting will be acceptable.

309.04--Procedures.

The surface or course upon which the base course is to be placed shall be prepared in accordance with the requirements of the applicable provisions of Sections 304 and 305.

Base course material shall be mixed in an approved central mixing plant of the pugmill type. The mixed material shall be placed by means of an approved aggregate spreader.

309.05--Density Requirements.

Where the required thickness is more than 6 inches, the material shall be spread and compacted in two or more layers of approximately equal thickness. The compacted thickness of any one layer shall not exceed 6 inches except when vibrating or other approved types of special compacting equipment are used. In such event, the compacted depth of a single layer of the base course may be increased to 10 inches upon the approval of the Engineer.

After mixing and shaping, each layer shall be compacted at optimum moisture within ± 2 percentage points of optimum. The density of each layer of base aggregate material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1, shall conform to the following:

% Retained on No. 4 Sieve	Min. % Density
0 – 50	100
51 – 60	95
61 – 70	90

Percentages will be reported to the nearest whole number.

Not more than one sample in every five shall have a density less than that specified, and the density of such sample shall be not more than 2 percent below that specified. The surface of each layer shall be maintained during the compaction operations in a manner such that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied over the base materials during compaction in the amount necessary to obtain proper density.

Irregularities in the surface shall be corrected by scarifying, remixing, reshaping, and recompacting until a smooth surface is secured. The surface shall therefore be protected against the loss of fine materials by the addition of moisture, when necessary, and shall be maintained in a satisfactory and smooth condition until accepted by the Engineer.

The base course will be tested in place for depth and density. Field density determinations will be performed with a nuclear field density device, using a density control strip as specified in Section 304 and VTM-10, or in accordance with the requirements of AASHTO T191. The method of density determination will be as directed by the Engineer.

Acceptance of the aggregate base course for depth will be based on the requirements of Section 308.

309.06--Measurement and Payment.

Aggregate base course will be measured in cubic yards or tons, as specified, and will be paid for at the contract unit price per cubic yard or ton. When the cubic yard unit is specified, the quantity will be determined by compacted measurements on the road unless otherwise specified. When the ton unit is specified, the quantity shall be determined in accordance with the requirements of Section 109.01 and moisture, in excess of optimum +2 percentage points, will be deducted from the net mass of both truck and rail shipments.

Calcium chloride and sodium chloride will be measured in tons and will be paid for at the contract unit price per ton.

These prices shall include preparing and shaping the subgrade or subbase and shoulders, adding moisture, removing and replacing unstable subgrade or subbase and constructing the base course thereon, and filling test holes.

Payment will be made under:

Pay Item	Pay Unit
Aggregate material (No.)	Cubic yard or ton
Aggregate base material (Type and No.)	Cubic yard or ton
Calcium chloride	Ton
Sodium chloride	Ton

SECTION 501--UNDERDRAINS**Section 501.01--Description.**

This work shall consist of constructing underdrains, using pipe, aggregate, and geosynthetics, in accordance with these specifications and in reasonably close conformity to the lines and grades shown on the plans or as designated by the Engineer.

501.02--Materials.

- (a) **Pipe** shall conform to the requirements of Section 232.
- (b) **Aggregate** shall conform to the requirements of Section 202 or 203.
- (c) **Geosynthetics, to include geotextile fabric and prefabricated geocomposite pavement edgedrains**, shall conform to the requirements of Section 245.

501.03--Procedures.

- (a) **Excavation:** The trench shall be excavated so that the walls and bottom are free of loose and jagged material. Large depressions shall be filled with sandy material, and sharp contours and rises shall be leveled. Excavated material shall be handled in a way that prevents contamination with the aggregate used to backfill the trench for the underdrain.
- (b) **Placing Geosynthetics:** When geotextile fabric or prefabricated geocomposite pavement edgedrain, PGPE, is required, it shall be placed as shown on the plans. Torn or punctured fabric shall be replaced at the Contractor's expense. Splices, when required for PGPE shall be made using splice kits furnished by the manufacturer and in accordance with the manufacturer's written instructions. Spliced joints shall not damage the panel, shall not impede the open flow area of the panel, and shall maintain the vertical and horizontal alignment of the drain within 5 percent. Splices shall be made in such a manner as to prevent infiltration of the backfill or any fine material into the water flow channel.
- (c) **Installing Pipe:** Perforated pipe shall be placed with the perforations facing downward on a bed of aggregate material. Pipe sections shall be joined with appropriate couplings. Semi-round underdrain pipe shall be placed with the rounded section down.

Wherever the depth of the trench is modified to a lesser depth than shown on the standard drawings, concrete or corrugated pipe shall be used.

Pipe shall be placed with the bell end up grade. Open joints shall be wrapped with the same geotextile used for lining the excavation.

Upgrade ends of pipe, except for combination underdrains, shall be closed with suitable plugs. Where an underdrain connects with a manhole or catch basin, a suitable connection shall be made through the wall of the manhole or catch basin.

After the Engineer has approved the pipe installation, aggregate backfill material shall be placed and compacted. Pipe and covering at open joints shall not be displaced during subsequent operations.

Outlet pipes shall be installed at the low points of sag.

End walls for outlet pipes shall be placed on a prepared surface that has been compacted to meet the requirements of Section 303.04. If settlement of the end wall occurs, the Contractor shall make necessary repairs at his expense.

Prior to final acceptance of the underdrain system, the Contractor shall conduct a video inspection of the installed system in accordance with the requirements of VTM-108.

- (d) **Combination Underdrain Outlets:** Pipe shall be placed in the trench with sections securely joined. After the Engineer has approved pipe installation, the trench shall be backfilled with aggregate material in layers not more than 6 inches in depth and thoroughly compacted.
- (e) **Inspection Ports:** Inspection ports shall be installed on the PGPE at a rate of 2 per mile of installed PGPE or a minimum of 4 per project. Inspection ports shall meet and be installed in accordance with the manufacturer’s specification. The Department will use these ports in conjunction with a borscope camera as part of the basis for acceptance of the PGPE. The Department will perform inspection after PGPE installation, but prior to paving the shoulder. Bends, water flow restrictions, J-shaped panels, tears in the geotextile, debris in pipes and sags are unacceptable and shall be removed and replaced at no cost to the Department.

501.04--Measurement and Payment.

Underdrains and combination underdrains will be measured in linear feet, complete-in-place, and will be paid for at the contract unit price per linear foot. The contract unit price for underdrains installed at depths greater than that shown in the standard drawings will be increased 20 percent for each 1-foot increment of increased depth. No adjustment in the contract unit price will be made for an increment of depth of less than 6 inches. When drains are to be placed under pavement that is not constructed under the Contract, the contract unit price shall include removing and replacing pavement.

Geotextile drainage fabric, when a pay item, will be measured and paid for in accordance with the requirements of Section 504.04.

Outlet pipe for underdrains will be measured in linear feet, complete-in-place, and will be paid for at the contract unit price per linear foot.

These prices shall include geotextile drainage fabric when not a pay item, excavating, aggregate, backfilling, compaction, splicing, inspection ports, if any, disposing of surplus and unsuitable materials, and installing outlet markers.

Payment will be made under:

Pay Item	Pay Unit
Underdrain (Standard)	Linear foot
Combination underdrain (Standard)	Linear foot
Outlet pipe	Linear foot

SECTION 508--DEMOLITION OF PAVEMENT AND OBSCURING ROADWAY**508.01--Description.**

This work shall consist of demolition of pavement and obscuring roadway to restore areas that are no longer needed for highway use in accordance with these specifications and in reasonably close conformity to the lines and contours shown on the plans or as established by the Engineer.

508.02--Procedures.**(a) Demolition of Pavement Structures:**

1. **Hydraulic cement concrete pavement shall be demolished as follows:**
 - a. Pavement shall be broken into pieces and either used in fill areas as rock embankment in accordance with the requirements of Section 303 or disposed of at locations selected by the Contractor and approved by the Engineer; or
 - b. Material within the proposed roadway prism and more than 3 feet below the subgrade may be broken into pieces not more than 18 inches in any dimension, sufficiently displaced to allow for adequate drainage, and left in the roadway prism.
2. **Asphalt concrete pavement** that does not overlay or underlie hydraulic cement concrete pavement shall be removed as follows:
 - a. Pavement shall be removed and used in the work as designated on the plans or as directed by the Engineer; or
 - b. When approved by the Engineer, pavement shall be removed and disposed of at locations selected by the Contractor.
3. **Cement stabilized courses** underlying pavement designated for demolition shall be disposed of in accordance with (a)1.a. or (a)1.b. herein.
4. **Aggregate underlying pavement designated for demolition**, except hydraulic cement concrete pavement disposed of in accordance with (a)1.b. herein, shall be salvaged and used for maintenance of traffic or, when approved by the Engineer, disposed of in accordance with (a)2.a. herein.

(b) Obscuring Roadway:

1. **Areas outside construction limits consisting of asphalt concrete or hydraulic cement concrete pavement demolished in accordance with (a) herein** shall be conditioned in accordance with the following:
 1. Tops of slopes that do not contain rock shall be rounded for a distance of not more than 10 feet but not less than 5 feet (where sufficient right of way exists) beyond the point of

intersection of the existing slope and the natural ground surface. The depth of the rounding shall be not more than 2 feet below the original surface of slopes.

2. Disturbed areas that are to receive vegetation shall be scarified or plowed, harrowed, and shaped.
 3. Clearing and grubbing shall be performed in accordance with the requirements of Section 301.
2. **Areas outside construction limits consisting of pavement structures, other than asphalt concrete or hydraulic cement concrete, that are designated for obscuring roadway** shall be conditioned in accordance with (b)1. herein. Prior to the obscuring, pavement structures shall be removed in accordance with the applicable requirements of (a) herein.

508.03-Measurement and Payment.

Demolition of hydraulic cement concrete pavement and shoulder structure courses or a combination thereof will be measured as demolition of pavement (rigid) and will be paid for in square yards based on the width of the widest course. Such price shall include all demolition, removal and disposal costs of pavement, base, subbase and stabilized subgrade materials.

Demolition of asphalt concrete pavement and shoulder structure courses or a combination thereof will be measured as demolition of pavement (flexible) and paid for in square yards based on the width of the widest course. Such price shall include all demolition, removal and disposal costs of pavement, base, subbase and stabilized subgrade materials.

Demolition of a combination of hydraulic cement concrete pavement and asphalt concrete pavement and shoulder structure courses or a combination thereof will be measured as demolition of pavement (combination) and paid for in square yards based on the width of the widest course. Such price shall include all demolition, removal and disposal costs of pavement, base, subbase and stabilized subgrade materials.

Obscuring roadway will be measured in units of 1,000 square feet computed to the nearest 1/10 unit and will be paid for at the contract unit price per unit. The area measured will be entirely outside the construction limits of the new roadway, as evidenced by slope stakes. Areas disturbed by the operations, including tops of slopes to be rounded, will be included in the measurement. Removing pavement structures other than hydraulic cement-stabilized, hydraulic cement concrete, and asphalt concrete pavement structures in accordance with (b) 2. herein will be measured as regular excavation in accordance with the requirements of Section 303 or as lump sum grading on minimum plan and no plan projects. Clearing and grubbing will be paid for in accordance with the requirements of Section 301.

Payment will be made under:

Pay Item	Pay Unit
Demolition of pavement	Square yard
Demolition of pavement (Type)	Square yard
Obscuring roadway	Unit

