

shall be not continuous over an area of more than 200 square feet. Riprap shall be keyed into the natural ground in an approved manner and to a depth equal to the bed thickness or to solid rock.

The desired distribution of various sizes of stones throughout the mass may be obtained by selective loading at the source, controlled dumping of successive loads during final placement, or a combination of these methods. Placing riprap by dumping into chutes or similar methods likely to cause segregation of the various sizes will not be permitted.

Riprap protection shall be maintained until the riprap is accepted by the Engineer. Displaced material shall be replaced to the lines and grades shown on the plans at the Contractor's expense.

- (b) **Dumped Riprap:** The types of dumped riprap shall be as follows:
- 1 **Type I:** Core riprap shall be composed of compact angular pieces of derrick stone weighing from 3/4 ton to 2 tons each with an average weight of approximately 1 ton. Approximately 10 percent by weight may weigh less than 3/4 ton.
  - 2 **Type II:** Heavy riprap shall be composed of compact angular pieces of derrick stone weighing from 3 to 10 tons each with an average weight of approximately 4 tons. Approximately 10 percent by weight may weigh less than 3 tons.
- Dumped riprap shall be placed in the same manner described for dry riprap in (a) herein. Dumped riprap shall not be placed in layers.
- (c) **Mortared Riprap for Slopes:** Stone shall be the same size as specified for dry riprap, Class II, and shall be selected to secure fairly large, flat-surfaced stones that will produce a true and even surface with a minimum of voids. Stone shall be placed on a slope not steeper than the natural angle of repose of the fill material. Fifty percent of the mass shall be broad flat stones placed with the flat surface uppermost and parallel to the slope. Stones shall be placed first and roughly arranged in close contact, with the larger stones placed near the base of the slope. Spaces between larger stones shall be filled with stones of suitable size, leaving the surface reasonably smooth and tight and conforming to the contour required. Stones shall be placed in a manner so as to ensure for plane surfaces a maximum variation from a true plane of not more than 1/4 inches in 4 feet. Warped and curved surfaces shall have the same accuracy as specified for plane surfaces.
- As each larger stone is placed, it shall be surrounded by fresh mortar, and adjacent stones shall be shoved into contact. After larger stones are in place, spaces or openings between them shall be filled with mortar, and smaller stones shall then be placed by shoving them into position, forcing excess mortar to the surface, ensuring that each stone is carefully and firmly bedded laterally.
- After the work is complete, excess mortar forced up shall be spread uniformly to fill surface voids completely. Surface joints shall then be pointed roughly with flush or shallow smooth-raked joints.
- (d) **Grouted Riprap for Slopes:** Grout shall consist of 1 part hydraulic cement and 3 parts sand, thoroughly mixed with water to produce grout having a thick, creamy consistency.
- Stones shall be of the same sizes and placed in the same manner as specified for dry riprap, Class I. Care shall be taken during placing to keep earth or sand from filling spaces between stones. After stones are in place, spaces between them shall be filled with grout from bottom to top and the surface swept with a stiff broom. Riprap shall not be grouted in freezing weather. In hot, dry weather, the work shall be protected from sunlight and kept moist for at least 3 days after grouting by the use of saturated burlap.
- (e) **Erosion Control Stone for Culvert Outlet Protection:** Erosion Control Stone for Class AI, I, & II culvert outlet protection shall conform to the requirements for Dry Rip Rap Class AI, I, & II respectively of (a) herein for weight and shall be placed in a manner to present an irregular or rough surface.
- (f) **Erosion Control Riprap:** Riprap shall consist of sound, nonerodible shot rock or rock excavation, which may be obtained from within the excavation for the typical sections on the project. Erosion control riprap rock shall be not more than 15 inches in its greatest dimension and shall contain a sufficient percentage of smaller rocks to provide a reasonably dense mass with a thickness of at least 8 inches. Riprap shall be placed where shown on the plans or as directed by the Engineer in accordance with the requirements of Section 303.04(h).
- (g) **Concrete Riprap in Bags:**
- 1 **Wet mixture:** Riprap shall consist of Class C1 concrete in suitable burlap bags except in brackish or tidal water, where concrete shall be Class A3. Bags shall weigh approximately 100 pounds

when 2/3 filled with concrete. Each bag shall be securely tied and immediately placed in the work. When used for foundation protection, bags shall be placed in accordance with the provisions governing placement of stone riprap for foundation protection as specified. When used for slope protection, riprap shall be placed in conformance with the provisions governing placement of dry riprap.

- 2 **Dry mixture:** Riprap shall conform generally to the requirements for wet mixtures except that the mixture shall consist of the dry ingredients and the requirements for water, consistency, and air will be waived.

Burlap or paper bags will be permitted. Riprap shall be a rectangular solid approximately 3 inches in thickness and shall weigh approximately 80 pounds per bag. Paper bags shall be perforated throughout on approximate 1-inch centers and shall be of adequate seal, thickness, and strength to maintain the integrity of the riprap until setting of the concrete mixture. Bag compositions shall be such that bags will disintegrate without presenting environmental problems.

- (h) **Stone Riprap for Foundation Protection:** Riprap for pier, abutment, and bridge spill slope protection shall conform to the requirements of the applicable specifications.

- (i) **Concrete Slab Riprap for Stream Crossings:**

- 1 **Materials:** Riprap shall consist of Class A3 concrete, cast-in-place, 6 inches in thickness. Concrete shall have a consistency that will permit placement without the use of top forms.

Welded wire fabric shall be No. 6 gage wire, spaced 6 inches center to center.

- 2 **Excavation and fine grading:** The finished embankment slope shall be reasonably smooth and dense. A trench shall be dug at the toe of the slope to accommodate the toe of the slab. Slab riprap shall not be placed until the slope has been approved by the Engineer.

- 3 **Construction methods:** Riprap shall be constructed in accordance with the applicable requirements of Section 404 except as modified herein and shall be cured in accordance with the requirements of Section 316.04(j). Welded wire fabric shall be positioned at the center of the slab, shall run continuously throughout the slab, and shall lap approximately 6 inches at the edges of each sheet of fabric.

The berm portion of the slab shall be placed on a slope of approximately 12:1, draining away from the abutment. Where the edge of the slab is placed against the abutment, the joint shall be sealed to a depth of at least 1/2 inch with hot-poured joint sealer conforming to the requirements of Section 212.

The toe of the slab shall extend to an elevation at least 3 feet below the elevation of the toe of fill, and the lower edge of the slab shall be increased approximately 6 inches in thickness, tapering to its nominal thickness 3 feet up the slope from the lower edge of the slab. The tapering shall be on the underside of the slab. The slab shall be placed using one of the following methods:

- a. **Block method:** The slab shall be placed in alternate blocks approximately 4 feet by 4 feet.
- b. **Strip method:** The slab may be placed in alternate, continuous strips having scored or formed joints perpendicular to construction joints. Strips shall be placed in alternating widths of 4 feet and 5 feet, or 4 feet 6 inches each. Joints shall be at least 1 inch in depth and spaced approximately 4 feet 6 inches apart. The width of the joint shall be as small as possible.

Successive courses or strips shall not have joints that line up with the joints in the preceding courses or strips. Horizontal joints shall be normal to the slope. Joints shall be closed without filler.

After concrete is placed, it shall be consolidated and the surface struck off by means of a strike board. Concrete shall be float finished with a wooden or cork float. The surface shall not vary more than 1/2 inch under a 10-foot straightedge.

#### 414.04—Measurement and Payment

**Dry riprap** will be measured in square yards of surface area or tons as specified.

**Mortared riprap** will be measured in square yards of surface area.

**Grouted riprap** will be measured in square yards of surface area or tons as specified.

**Stone riprap for foundation protection** will be measured in square yards of surface area or tons as specified.

**Dumped riprap** will be measured in square yards of surface area or tons as specified.

**Concrete riprap in bags** will be measured in cubic yards.

**Concrete slab riprap** will be measured in square yards. When an optional riprap is used in lieu of concrete slab riprap, bedding material will not be measured for payment and the riprap will be paid for at the contract unit price for concrete slab riprap.

**Erosion control riprap** will be measured in square yards of surface area or tons as specified.

**Riprap** will be paid for at the contract unit price. This price shall include furnishing and placing riprap, including welded wire fabric, mortar, or grout; excavation; and riprap bedding.

These prices shall include geotextile bedding material when required and when not a separate pay item for these purposes. The price bid shall include preparing the surface, furnishing and installing geotextile bedding material, overlaps, repair work, and excavating and backfilling toe-ins.

**Erosion Control Stone used for Culvert Outlet Protection** will be measured in square yards of surface area or tons for the class specified and will be paid for at the contract unit price per square yard or ton. This price shall include excavating, backfilling, preparing the surface, furnishing and installing geotextile bedding material including overlaps, repair work, excavating and backfilling toe-ins, and placing the required materials.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Dry riprap (Class and depth)	Square yard or ton
Mortared riprap (Depth)	Square yard
Grouted riprap (Depth)	Square yard or ton
Stone riprap (Depth)	Square yard or ton
Dumped riprap (Type and depth)	Square yard or ton
Concrete riprap in bags	Cubic yard
Concrete slab riprap	Square yard
Erosion control riprap (Depth)	Square yard or ton
Erosion control stone (Class, st'd)	Square yard or ton

## SECTION 415—CONCRETE SLOPE PROTECTION

### 415.01—Description

This work shall consist of furnishing and installing precast concrete blocks in a bed of coarse sand or installing a concrete slab on embankments at or near bridge abutments as shown on the plans or as specified by the Engineer.

### 415.02—Materials

- (a) **Precast concrete blocks** shall conform to the requirements of Section 222.
- (b) **Mortar** shall be nonshrinking and shall conform to the applicable requirements of Section 218.
- (c) **Foundation course** shall be Grading B sand conforming to the requirements of Section 202 or approved local material similar in nature.
- (d) **Concrete** shall be Class A3 conforming to the requirements of Section 217.
- (e) **Welded wire fabric** shall be No. 6 gage, 6 inches center to center each way, conforming to the requirements of Section 223.
- (f) **Herbicide** shall conform to the requirements of Section 244.

### 415.03—Procedures

- (a) **Precast Concrete Block Slope Protection:** The subgrade shall be constructed at the required distance below the finished surface of the slope. Soft sections and unsuitable material shall be removed and replaced. The subgrade shall be compacted and shaped to a smooth, uniform surface.

The foundation course shall be spread on the subgrade to a depth of 2 inches and treated with an approved highly insoluble soil sterilant. Material shall be in a dry form and have a maximum solubility rate of 250 parts per million. Material shall be uniformly applied at the maximum rate recommended by the manufacturer.

Blocks shall be bedded in the foundation course perpendicular to the finished surface in straight rows, with the longest dimension horizontal. Blocks shall be placed with continuous joints extending horizontally on the face of the slope and with broken (staggered) joints extending perpendicular thereto, up or down the slope. Blocks shall be rammed until the surface is firm and conforms to the finished slope. Joints shall be filled with mortar.

Cast-in-place edging for block slope protection shall be placed as specified in (b) herein.

- (b) **Concrete Slab Slope Protection:** The subgrade shall be prepared as for block slope protection. The cast-in-place concrete slab shall be 4 inches in thickness and shall be placed in accordance with the requirements of Section 414.03(i).

Except at railroad grade separations, the Contractor may provide a combination concrete slab and stone slope protection in lieu of the specified concrete slab slope protection. Protection shall be in accordance with the following:

- 1 Concrete portions, consisting of a paved ditch and a strip of concrete approximately 3 feet in width placed on the berm along the face of the abutment, shall be furnished as required for concrete slab slope protection. Stone shall be placed at a depth of 7 to 9 inches over the remaining area to be covered with slope protection.
- 2 The subgrade for concrete and stone shall be prepared in accordance with the requirements of Section 414.03(i). The portion of the slope to be protected with stone shall be treated with a herbicide in accordance with the requirements of (a) herein. Care shall be taken to confine application to areas designated for sterilization.
- 3 Stone shall be crushed gravel or stone conforming to the requirements of Section 205.02. Sizes furnished shall be not smaller than the sizes specified in Table II-5 for aggregate size No. 1, and the pieces shall be not larger than 8 inches in their greatest dimension. Stone shall be in a sufficient range of sizes to create a stable and reasonably uniform slope.

The condition of the subgrade and method of placing stone shall be such that pieces of stone in contact with the subgrade shall be partially embedded where practicable. Stone immediately adjacent to concrete shall not project more than 3 inches above the concrete.

Approved splash blocks connecting with the paved ditch shall be provided under downspouts draining onto the slope protection.

**415.04—Measurement and Payment**

**Concrete slope protection** will be measured in square yards of surface area and will be paid for at the contract unit price per square yard. If limits are not shown on the plans, measurements will be from the outside edge to outside edge, including curb, and from the edge of slope protection at abutment to the bottom of the curtain wall or outside edge of the paved ditch as appropriate. This price shall include the foundation course and treatment.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Concrete block slope protection	Square yard
Concrete slab slope protection (Depth)	Square yard

## SECTION 418—TIMBER STRUCTURES

### 418.01—Description

This work shall consist of furnishing and erecting timber materials required to complete a structure in accordance with these specifications and in conformity with the lines and grades shown on the plans or as established by the Engineer.

### 418.02—Materials

- (a) **Lumber and Timber:** Lumber and timber shall conform to the requirements of Section 236.
- (b) **Structural Shapes:** Rods, plates, shapes, and eyebars shall conform to the requirements of Section 226.
- (c) **Castings:** Castings shall be cast steel or gray iron, as shown on the plans, conforming to the applicable requirements of Section 224.
- (d) **Hardware:** Machine bolts, drift bolts, and dowels shall conform to the requirements of Section 226. Washers may be ogee gray iron or malleable castings or may be cut from mild steel plate as shown on the plans.  
Machine bolts shall have square heads and nuts. Nails shall be cut or round wire of standard form. Spikes shall be cut, wire, or boat spikes as shown on the plans.  
Nails, spikes, bolts, dowels, washers, and lag screws shall be black or galvanized, as specified on the plans.  
Other hardware, except malleable iron connectors, shall be galvanized in accordance with the requirements of Section 233 or cadmium plated in accordance with the requirements of ASTM A165, Type OS.
- (e) **Paint:** Paint shall conform to the requirements of Section 231.

### 418.03—Procedures

- (a) **Storing Material:** Lumber and timber on the work site shall be stored in stacks or ricks.  
Material shall be stacked at least 12 inches above the ground surface and sloped. It shall be protected from weather by a suitable covering. The ground underneath and in the vicinity of material shall be cleared of weeds and rubbish.  
Untreated material shall be open stacked, and treated material shall be close stacked.
- (b) **Treated Timber:** Treated timber shall be handled with rope slings without sudden dropping, breaking of outer fibers, or bruising or penetrating of the surface with tools such as cant hooks, peaveys, pikes, or hooks.  
Cutting, framing, and boring of treated timbers shall be performed before treatment insofar as is practicable. When treated timbers are to be placed in water infested by marine borers, as determined by the Engineer, untreated cuts, borings, or other joint framings below the high water elevation shall be avoided.  
Cuts in treated piles or timbers and abrasions, after having been carefully trimmed smooth, shall be brush coated with at least two applications of the preservative used in the treatment of the pile.  
Bolt holes bored after treatment shall be treated with a preservative. After being treated, unfilled holes shall be plugged,  
Whenever forms or temporary braces are attached to treated timber with nails or spikes, holes shall be filled by driving galvanized nails or spikes flush with the surface or by plugging as required for bolt holes.
- (c) **Untreated Timber:** Ends, tops, and contact surfaces of sills, caps, floor beams, stringers, and bracing and truss units shall be thoroughly coated with two coats of preservative before assembly. The back faces of bulkheads and other timber that will be in contact with earth, metal, or other timber shall be similarly treated.
- (d) **Treatment of Pile Heads:** After required cutting to receive caps and prior to placement of caps, pile heads shall be treated to prevent decay. Heads of timber piles shall be protected by one of the following methods, as indicated on the plans. If not otherwise indicated, Method A shall be used.
  - 1 **Method A—zinc covering:** The sawed surface shall be brush coated with three applications of a preservative. Before the cap is placed, a sheet of 12 gage (0.028 inch) zinc shall be placed on each

pile head. The sheet shall be of sufficient size to project at least 4 inches outside the pile and shall be bent down, neatly trimmed, and securely fastened to the face of the pile with large-headed galvanized roofing nails.

- 2 **Method B—fabric covering:** Heads of piles shall be covered with alternate layers of hot pitch and cotton fabric for waterproofing, using four applications of pitch and three layers of fabric. The cover shall measure at least 6 inches more in dimension than the diameter of the pile and be neatly folded down over the pile and secured by large-headed galvanized nails or by binding with at least seven complete turns of galvanized wire securely held in place by large-headed galvanized nails and staples. Edges of fabric projecting below the wire wrapping shall be trimmed to present a neat appearance.
- (e) **Holes for Bolts, Dowels, Rods, and Lag Screws:** Holes for round drift bolts and dowels shall be bored with a bit 1/16 inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift holes or dowels shall be equal to the least dimension of the bolt or dowel.

Holes for machine bolts shall be bored with a bit the same diameter as the bolt.

Holes for rods shall be bored with a bit 1/16 inch greater in diameter than the rod.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread.
- (f) **Bolts and Washers:** A washer shall be used under bolt heads and nuts that would otherwise come in contact with wood. Bolts shall be checked after nuts have been finally tightened.
- (g) **Countersinking:** Countersinking shall be performed wherever smooth faces are required. Recesses in horizontal surfaces shall be painted with a preservative and filled with hot pitch after the bolt or screw is in place.
- (h) **Framing:** Lumber and timber shall be cut and framed to a close fit so that the joints will have an even bearing over the contact surfaces. Mortises shall be true to size for their full depth, and tenons shall fit snugly. Shimming will not be permitted in making joints, and open joints will not be accepted.
- (i) **Pile Bents:** Preparing and driving piles shall be in accordance with the requirements of Section 403.

Piles for any one bent shall be carefully selected as to size to avoid undue bending or distortion of the sway bracing. Care shall be taken in distributing piles of varying sizes to secure uniform strength and rigidity in bents of any given structure.

Cutoffs shall be accurately made to ensure a uniform bearing between the cap and piles of a bent.
- (j) **Framed Bents:**
  - 1 **Mud sills:** Untreated timber used for mud sills shall be of heart cedar, heart cypress, redwood, or other durable timber. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place.
  - 2 **Concrete pedestals:** Concrete pedestals for the support of framed bents shall be finished so that sills or posts will take an even bearing. Dowels or anchor bolts at least ¾ inch in diameter shall be set in pedestals when they are cast for anchoring sills or posts.
  - 3 **Sills:** Sills shall have a true and even bearing on mud sills, piles, or pedestals. They shall be drift bolted to mud sills or piles with bolts at least ¾ inch in diameter and extending into the mud sills or piles at least 6 inches. When possible, earth shall be removed from contact with sills so that there will be free air circulation.
  - 4 **Posts:** Posts shall be fastened to pedestals with dowels at least ¾ inch in diameter, extending at least 6 inches into the posts.

Posts shall be fastened to sills by one of the following methods, as indicated on the plans: by dowels at least ¾ inch in diameter extending at least 6 inches into posts and sills or by drift bolts at least ¾ inch in diameter driven diagonally through the base of the post and extending at least 9 inches into the sill.
- (k) **Caps:** Timber caps shall be placed with ends aligned in a manner to secure an even and uniform bearing over the tops of supporting posts or piles. Caps shall be secured by drift bolts at least ¾ inch in diameter extending at least 9 inches into the posts or piles. Drift bolts shall be in the approximate center of the post or pile.

(l) **Bracing:** Ends of bracing shall be bolted through the pile, post, or cap with a bolt at least 5/8 inch in diameter. Intermediate intersections shall be bolted or spiked with wire or boat spikes, as indicated on the plans. In all cases, spikes shall be used in addition to bolts.

(m) **Stringers:** Stringers shall be sized at bearings and placed in position so that knots near edges will be in the top portions of stringers.

Outside stringers may have butt joints with ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. Lapped ends of untreated stringers shall be separated at least 1/2 inch for the circulation of air and securely fastened by drift bolting where specified. Where stringers are two panels in length, joints shall be staggered.

Cross bridging between stringers shall be neatly and accurately framed and securely toenailed with at least two nails in each end. Cross-bridging units shall have full bearing at each end against the side of stringers. Cross bridging shall be placed at the center of each span.

(n) **Plank Floors:** Planks shall be surfaced on four sides (S4S).

Single-plank floors shall consist of a single thickness of plank supported by stringers or joists. Planks shall be carefully graded as to thickness and placed so that no two adjacent planks shall vary in thickness by more than 1/8 inch. Each plank shall be placed heart side down, firmly jacked together, and securely fastened to each joist.

(o) **Wheel Guards and Railings:** Wheel guards and railings shall be erected true to line and grade. Wheel guards, rails, and rail posts shall be surfaced on four sides (S4S). Wheel guards shall be laid in sections at least 12 feet in length.

(p) **Painting:** Rails and rail posts, untreated timber, or timber treated with a preservative shall be painted with three coats of paint.

Metal parts, except hardware, shall be given one coat of shop paint and, after erection, three coats of field paint.

Timber shall be painted with No. 11 paint.

**418.04—Measurement and Payment**

**Lumber and timber** will be measured in units of 1,000 foot-board-measure (MFBM) for materials placed in the finished structure and will be paid for at the contract unit price per MFBM. Computations for lumber quantities will be based on nominal sizes, complete-in-place. No other allowance for waste will be made.

**Structural steel** will be paid for in accordance with the requirements of Section 407.

**Painting timber structures**, when a pay item, will be paid for at the contract lump sum price. When not a pay item, the cost thereof shall be included in the price for other appropriate pay items.

These prices shall include preparing surfaces and preservative treatment.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Lumber (Treated or untreated)	MFBM
Painting timber structures	Lump sum

## SECTION 501—UNDERDRAINS

### 501.01—Description

This work shall consist of constructing underdrains, using pipe, aggregate, and geosynthetics, in accordance with these specifications and in 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 upgrade. 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 a sag.

Endwalls for outlet pipes shall be placed on a prepared surface that has been compacted to comply with the requirements of Section 303.04. If settlement of the endwall 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 two per mile of installed PGPE or a minimum of four 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 of 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 those 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:

<b>Pay Item</b>	<b>Pay Unit</b>
Underdrain (Standard)	Linear foot
Combination underdrain (Standard)	Linear foot
Outlet pipe	Linear foot

## SECTION 506—RETAINING WALLS

### 506.01—Description

This work shall consist of constructing rubble and hydraulic cement concrete retaining walls in accordance with the plans and these specifications and in conformity to the lines and grades shown on the plans or as established by the Engineer.

### 506.02—Materials

- (a) **Dry rubble and mortar rubble retaining walls** shall be constructed of stone conforming to the requirements of Section 204 and mortar conforming to the requirements of Section 218.
- (b) **Hydraulic cement concrete retaining walls** shall be constructed of concrete conforming to the requirements of Section 217.
- (c) **Reinforced concrete crib walls** shall be constructed of precast concrete units. Concrete shall conform to the requirements of Section 217 except that No. 7 aggregate may be used in lieu of No. 57 aggregate. Crib units shall be free from cracks, depressions, spalls, patched or plastered surfaces or edges, and any other defects that might impair their strength or durability.
- (d) **Drain pipe** shall conform to the requirements of Section 232.02.
- (e) **Reinforcing steel** shall conform to the requirements of Section 223, Grade 40 or 60.
- (f) **Porous backfill** shall conform to the requirements of Section 204.02(c).
- (g) **Granular backfill within crib walls** shall be any material available within the project limits consisting of sand, sandy loam, gravel, rock, or a combination thereof. Materials containing a high percentage of fines, such as clay and silt soils, shall not be used.
- (h) **Piles** shall conform to the requirements of Section 403.

### 506.03—Procedures

Excavation, backfill, and foundation exploration shall conform to the requirements of Section 401.

Concrete construction shall be performed in accordance with the requirements of Section 404. Immediately following finishing operations, concrete shall be cured and protected in accordance with the requirements of Section 404.03.

- (a) **Dry Rubble and Mortar Rubble Retaining Walls:** Stones shall not be placed in freezing weather or when stone contains frost.

Each stone shall have a thickness of at least 8 inches; a width of at least 1 1/2 times the thickness; and, except for headers, a length at least equal to 1 1/2 times the width. The thickness of courses if varied shall diminish from the bottom to the top of the wall.

Header stones in the heart of the wall shall be the same size as in the face and shall extend at least 12 inches into the core or backing. They shall occupy at least 1/5 of the face area of the wall and shall be evenly distributed. Header stones in walls 2 feet or less in thickness shall extend entirely through the wall.

Stones shall be roughly squared on joints, beds, and faces. Selected stone, roughly squared and pitched to line, shall be used at angles and ends of walls.

Stones shall be placed to line and in courses roughly leveled. Bottom or foundation courses shall be composed of large, selected stones. Courses shall be placed with bearing beds parallel to the natural bed of the material.

Shaping or dressing of stone shall be performed before stone is placed in the wall. Dressing or hammering that will loosen the stone will not be permitted after placement.

- 1 **Dry rubble retaining walls:** Face joints shall be not more than 1 inch in width.

Each stone shall have a firm bearing on the underlying course at no fewer than three points. Open joints, both front and rear, shall be chinked with spalls fitted to take firm bearing on their top and bottom surfaces and shall have a firm bearing throughout the length of the stone.

- 2 **Mortar rubble retaining walls:** Each stone shall be cleaned and thoroughly wetted with water before it is placed, and the bed that is to receive it shall be cleaned and moistened. Stones shall be bedded in freshly prepared mortar. Mortar joints shall be full, and stones shall be carefully settled in place before mortar has set. Spalls will not be permitted in beds. Joints and beds shall not have an average thickness of more than 1 inch.

Whenever possible, face joints shall be properly pointed before mortar has set. Joints that cannot be pointed shall be prepared for pointing by raking them out to a depth of 2 inches before mortar has set. Face surfaces of stones shall not be smeared with mortar forced out of joints.

Vertical joints in each course shall offset joints with those in adjoining courses by at least 6 inches. A vertical joint shall not be located directly above or below a header.

If a stone is moved or a joint is broken, the stone shall be taken up, mortar shall be thoroughly cleaned from the bed and joints, and stone shall be placed in fresh mortar.

Joints that are not pointed at the time stone is placed shall be thoroughly wetted with clean water and filled with mortar. Mortar shall be driven into joints and finished with an approved pointing tool. The wall shall be kept wet while pointing is being done. In hot or dry weather, pointed masonry shall be protected from the sun and kept wet by saturated burlap for at least 3 days after completion.

After pointing is completed and mortar has set, the wall shall be thoroughly cleaned and left in a neat, orderly condition.

- (b) **Concrete Retaining Walls:** Concrete retaining walls shall be constructed in accordance with the requirements of Sections 403, 404, and 406.
- (c) **Reinforced Concrete Crib Walls:** Crib units that are damaged during erection shall be removed and replaced at the Contractor's expense.

Granular backfill shall be used inside and approximately 2 feet in back of and beyond each end of a crib. Backfilling for the crib wall shall follow closely the erection of successive tiers of units. The wall shall not be placed higher than 3 feet above the backfilled portion. Backfill shall be placed carefully to avoid distorting the crib wall.

**506.04—Measurement and Payment**

**Standard retaining walls** will be measured in cubic yards, complete-in-place, within the limiting dimensions shown on the plans, and will be paid for at the contract unit price per cubic yard. This price shall include rubble stone, concrete, joint material, and weep holes.

**Concrete and reinforcing steel for special design retaining walls** will be measured and paid for in accordance with the requirements of Sections 404.08 and 406.04, respectively.

**Reinforced concrete crib walls** will be measured in cubic feet of the net volume of concrete in crib units, complete-in-place, and will be paid for at the contract unit price per cubic foot. This price shall include concrete and reinforcing steel.

**Granular backfill** will be measured and paid for as regular excavation in accordance with the requirements of Section 303.06.

**Porous backfill for retaining walls** will be measured and paid for in accordance with the requirements of Section 401.04.

**Piles** for retaining walls will be measured and paid for in accordance with the requirements of Section 403.08.

**Excavation for retaining walls** will be measured in accordance with the requirements of Section 401.04 and will be paid for at the contract unit price per cubic yard. This price shall include excavation, foundation exploration, sheeting and shoring, placing and compacting backfill and disposal of surplus material, and porous backfill when not specified as a separate pay item.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Retaining wall (Standard)	Cubic yard
Concrete crib (Standard)	Cubic foot
Retaining wall excavation	Cubic yard

## SECTION 511—ALLAYING DUST

### 511.01—Description

This work shall consist of applying either moisture, calcium chloride, or both on areas designated by the Engineer for the purpose of allaying dust.

### 511.02—Procedures

The Contractor shall furnish a truck(s) equipped with a water tank having a capacity of at least 1,000 gallons and pumps for furnishing, loading, and applying water to the roadway.

Equipment and operators shall be available at all times.

Calcium chloride conforming to the requirements of Section 239 shall be applied at the rate specified on the plans or by the Engineer.

The Contractor shall plan and prosecute the work so as to expedite completion of the pavement structure as soon as is practicable.

### 511.03—Measurement and Payment

**Allaying dust** will be measured and paid for on the basis of the time the truck is in service on this work or per ton of calcium chloride. Loading time allowed for payment shall be not more than 30 minutes per 1,000 gallons of water. Truck hours shall be evidenced by daily time reports submitted by the Contractor and approved by the Engineer. This price shall include water and calcium chloride.

When in-place base material is used as a riding surface to maintain traffic or as a haul route, truck hours or tons of calcium chloride used for allaying dust will be paid for in accordance with the provisions herein.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Allaying dust	Hour or Ton

## SECTION 520—WATER AND SANITARY SEWER FACILITIES

### 520.01—Description

This work shall consist of furnishing and installing necessary materials for water distribution systems and sanitary systems in accordance with these specifications and in conformity to the dimensions, lines, and grades shown on the plans or as established by the Engineer.

### 520.02—Materials

- (a) **Pipe, fittings, and flanges** shall conform to the requirements of Section 232.
- (b) **Gaskets and joint materials** shall conform to the requirements of Section 212.
- (c) **Casing pipe** shall be 14-gage corrugated metal half-circle pipe conforming to the requirements of Section 232 except as modified for securing interlocked or nested connections.
- (d) **Concrete blocks** shall conform to the requirements of Section 222.
- (e) **Bricks** shall conform to the requirements of Section 222.
- (f) **Hydraulic cement mortar** shall conform to the requirements of Section 218.
- (g) **Concrete** shall conform to the requirements of Section 217 and shall be Class A3.
- (h) **Reinforcing steel** shall conform to the requirements of Section 223.
- (i) **Curing material for concrete** shall conform to the requirements of Section 220.
- (j) **Timber skids** shall conform to the requirements of Section 236, and the preservative and treatment shall conform to the requirements of Section 236.
- (k) **Valves** shall conform to the requirements of AWWA C500, C504, C506, C507, C508, or C509 for the types and features specified.
- (l) **Fire hydrants** shall conform to the requirements of AWWA C502 or C503 with the various features specified.
- (m) **Water meters** shall conform to the requirements of AWWA C700, C701, C702, C703, C704, C706, C707, C708, or C710 for the type and features specified. Each meter shall be furnished with a meter box.
- (n) **Corporation stops** shall be made of bronze or red brass conforming to the requirements of ASTM B62. The fitting design and thread dimension shall conform to the requirements of AWWA C800. The working pressure of the corporation stop shall be equal to that of the water main to which it is attached.
- (o) **Castings** shall conform to the requirements of Section 224.
- (p) **Nonshrink waterproof grout** shall conform to the requirements of Section 218.
- (q) **Aggregate** shall conform to the requirements of Section 203. Aggregate for drain fields shall be No. 5.

### 520.03—Procedures

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 allow for changes in line or grade.

Connections to existing lines shall be made only after the proposed line is completed and approved by the Engineer. Connections shall be made in the minimum time possible with minimum interruption of service. Work and interruptions in existing service shall be scheduled with the utility owner.

Existing water and sewer lines and appurtenances and manholes not required in the completed system shall be abandoned as directed by the Engineer. Abandoned materials shall become the property of the Contractor, unless otherwise noted on the plans, upon satisfactory replacement with the new installation. Abandoned pipe that is not removed shall be cleaned of debris and plugged at open ends with Class A3 concrete.

Existing manholes that are not required in the completed system shall be removed to at least 2 feet below the proposed subgrade or natural ground line and shall be filled with approved backfill in accordance with the requirements of Section 302.03 (a)2.g.

Disturbed property shall be restored prior to final acceptance. Restoration shall include, but not be limited to, replacing shrubbery, sod, or topsoil, including lime, fertilizer, seed, and mulch; replacing paved or finished

surfaces with similar materials; and performing other work in accordance with the requirements of Section 107.08.

Sidewalks and streets shall be kept open for passage. The Contractor shall provide and maintain adequate and safe passage over excavations to accommodate pedestrians or vehicles as directed by the Engineer.

- (a) **Protecting Water Supplies:** During the course of construction, the Contractor shall protect water supply facilities within the construction limits from contamination by sewage. The Contractor shall use the following criteria to govern the installation of water and sewer facilities in proximity of each other:

- 1 **Parallel separation:** Except as specified hereinafter, water lines shall be placed at least 10 feet horizontally from existing or proposed sanitary sewer lines, combination sewer lines, and sanitary sewer manholes. Sanitary sewer lines shall be placed at least 10 feet horizontally from existing and proposed water lines. This distance shall be measured from edge to edge. If local conditions prevent a lateral separation of 10 feet, a water line may be placed closer than 10 feet to a sewer or a sewer line may be placed closer than 10 feet to a water line if the top of the sewer pipe is at least 18 inches below the bottom of the water line. Where the vertical separation cannot be obtained, the sewer shall be constructed of mechanical joint water pipe. Gravity sewers shall be pressure tested, in place, to 50 pounds per square inch without leakage prior to backfilling. Force main sanitary sewer shall be pressure tested in accordance with the requirements of Section 520.04(c).
- 2 **Crossings:** Water and sewer lines that cross shall be placed to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer line. Where this vertical separation cannot be obtained, the sewer shall be constructed of mechanical joint or other approved water pipe for at least 10 feet on each side of the crossing.

Sanitary sewers and combined sewers crossing over a water line shall have a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line. The support shall be adequate to prevent excessive deflection of joints and the settling on and breaking of the water line. The water or sewer line shall be centered at the point of the crossing so that joints will be equidistant and as far from each other as practicable.

Water lines shall not pass through or come in contact with any part of a sanitary sewer, combined sewer, or sanitary sewer manhole.

The Contractor shall immediately notify the Engineer if he becomes aware that the work will result in the violation of these criteria. Upon such notification, the Engineer will issue instructions concerning remedial measures.

- (b) **Excavation:** Excavation, backfill, and compaction shall be performed in accordance with the requirements of Section 302 except that stone larger than 1 inch in diameter shall not be used in backfill until the pipe has a cover of at least 1 foot. The remainder of backfill to the original ground or to within 12 inches of the finished subgrade shall not include stone larger than 10 inches in its greatest dimension. Pipelines installed outside the roadway shall be backfilled in 8-inch layers and compacted to approximately 85 percent of the theoretical maximum density.

Trenches for pipelines shall be excavated generally along straight lines, and bottoms shall be uniformly graded as required. Bedding material shall be placed in accordance with the plans. Where the trench bottom is in rock, it shall be excavated to at least 8 inches below the bottom of the pipe and backfilled with approved local or commercial bedding material. Pipe shall have a uniform bearing on a solid foundation for its entire length. Where pipe foundations are yielding, pipe shall be bedded on at least 8 inches of approved local or commercial bedding material. Bell holes, where applicable, shall be of sufficient size to ensure the making of proper joints.

Trenches below the grade line of the pipe shall be dewatered during installation of pipelines.

When work is not in progress for any reason, lines shall be securely closed.

Where adjacent pavements are to be retained, pavement removed for pipeline trenches shall be replaced in kind with equal or better material or as otherwise specified. After backfilling, the Contractor shall maintain a smooth riding surface until pavement repairs are completed.

- (c) **Inspecting Pipe and Fittings:** Pipe and fittings shall be inspected for cracks and defects before they are lowered into the trench. Faulty pipe and fittings shall be removed from the site.
- (d) **Placing Pipe:** Water mains shall have a cover of at least 36 inches, and water service lines shall have a cover of at least 24 inches. Pipe, fittings, valves, hydrants, and accessories shall be carefully lowered

into the trench to prevent damage to materials, protective coatings, and linings. Materials shall not be dropped or dumped into the trench.

If pipe, fittings, valves, hydrants, or accessories are damaged during handling, the damage shall be immediately brought to the Engineer's attention. The Contractor shall then submit to the Engineer, for approval, a method for repairing the damaged item. Damaged items shall be repaired as approved by the Engineer or shall be removed from the project.

Lumps, blisters, and excess coating shall be removed from ends of pipes that are to be joined. The inside of the bell and the outside of the spigot shall be wire brushed, wiped clean, dry, and free from oil and grease before pipe is placed. Foreign material shall be kept from entering pipe during placement.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to the correct line and grade. Pipe shall be secured in place with approved backfill material tamped under it except at bells. Precautions shall be taken to prevent dirt from entering the joint space. If it becomes necessary to deflect water main pipe during construction, the amount of deflection shall not exceed the manufacturer's recommendation.

- (e) **Cutting Pipe:** Pipe for fittings or closure pieces shall be cut in a neat and orderly manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. The lining of the pipe shall not be damaged. Flame cutting of ductile iron or cast iron pipe with an oxyacetylene torch will not be permitted.
- (f) **Joining of Pipe:** Gasket and joint lubricant for water facilities shall be a nontoxic, tasteless, and odorless substance that will not support bacteria. Gasket end joint lubricant for sewer facilities shall be as recommended by the manufacturer or as approved by the Engineer. Pipe that is not furnished with a depth mark shall be marked before assembly to ensure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured.

- 1 **Ductile iron pipe** shall be joined in accordance with AWWA C-111 and AWWA C-600.
- 2 **Steel pipe** shall be joined by field welding unless otherwise specified on the plans. Pipe ends shall comply with the requirements of AWWA C-206 for the type of field joint specified. Field-welded joints shall comply with the requirements of AWWA-206; flanged joints shall comply with the requirements of AWWA C-207, and rubber gasket joints shall comply with the requirements of AWWA M11.
- 3 **Galvanized steel pipe** shall be joined by fittings in accordance with the manufacturer's recommendation.
- 4 **Copper pipe or tubing** shall be joined by fittings in accordance with the manufacturer's recommendation.
- 5 **PVC pipe** shall be joined by gasketed bell and socket joints in accordance with AWWA C-900.
- 6 **Concrete pipe** for water facilities shall have joints of the round rubber gasket type, unless otherwise specified, using either a bell and spigot joint or a double spigot and sleeve joint. Either joint shall be such that when the pipe is laid and the joint completed, the gasket will be confined within a groove or by shoulders on the bell and spigot. The contact surface in the joint shall be such as not to cause cutting of the rubber gasket during installation.

Concrete pipe for sewer facilities shall be joined by using rubber gaskets. The gasket shall be continuous and fit snugly into the annular space between the overlapping surfaces of the assembled pipe joint to form a flexible watertight seal. The annular space between the gasket bearing surface of the assembled and centered joint shall be more than 75 percent of the uncompressed thickness of the applied gasket including the manufacturer's tolerances of the joint and gasket.

- 7 **Vitrified clay pipe** shall be joined with compression joints in accordance with ASTM C-12 and manufacturer's recommendation.
- 8 **PE pipe** shall be joined in accordance with AWWA C-901 and the manufacturer's recommendation.
- 9 **ABS pipe** shall be joined with a solvent cement joint in which pipe solvent cements into a coupling socket to form the joint. Primer for priming solvent cement joints shall be methylethyl ketone (MEK), and the cement shall be MEK containing a minimum of 20 percent by weight of

dissolved ABS. Type OR joint is a mechanical-seal joint in which a gasket shall be compressed between the pipe and the bell coupling to form the joint closure.

- (g) **Plugs, Caps, Tees, and Bends:** Plugs, caps, tees, and bends shall be anchored with reaction backing. Backing shall be concrete reaction blocks, metal reaction harnesses, or a combination thereof. Concrete shall be placed in accordance with the requirements of Section 404 and cured in accordance with the requirements of Section 316.04(j). Metal harness tie rods and clamps shall be of adequate strength to prevent movement and shall be galvanized or rustproofed by approved means.
- (h) **Encasement Pipe:** Encasement pipe shall be installed in accordance with the requirements of Section 302.
- (i) **Casing Pipe and Concrete:** Casing pipe and concrete shall be constructed in accordance with plan details and the applicable requirements of Sections 302, 303, 316, and 406, with the half-circle sections of casing pipe nested or interlocked to obtain a satisfactory union of the two sections of pipe. Prior to installation, existing pipe to be encased shall be cleaned and foreign material removed.
- (j) **Valves, Valve Boxes, and Manholes:** The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve with the box cover flush with the surface of the finished pavement. Manholes shall be constructed to permit minor valve repairs and protect the valve and pipe from impact where they pass through the walls.
- (k) **Fire Hydrants:** Wherever a hydrant is set in pervious soil, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6 inches above the waste opening in the hydrant and to a distance of 1 foot around the elbow.

Wherever a hydrant is set in clay or other impervious soil, a drainage pit 2 feet in diameter and 3 feet in depth shall be excavated below each hydrant. The pit shall be filled compactly with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant to a level 6 inches above the waste opening. The drainage pit shall not be connected to a sewer.

- (l) **Installing Corporation Stops:** Corporation stops shall be installed while the main is under pressure and at a 45-degree angle to the horizontal plane.
- (m) **Concrete Encasement:** Concrete encasement shall be constructed in accordance with the requirements of Sections 302, 303, 316.04(j), 404, and 406.
- (n) **Water Meters and Yokes:** The meter box shall not transmit shock or stress to the meter and shall be centered and plumb over the meter. The top of the box shall be flush with the surrounding surface.
- (o) **Jacked Encasement Pipe:** Jacked encasement pipe shall be installed in accordance with the requirements of Section 302.03(a)1.
- (p) **Sanitary Service Lateral Connection:** Connection shall be performed by approved methods prior to installation using wyes, bends, adapters, cleanouts, and necessary pipe. Existing service laterals shall mate with the new fitting, adapter, or pipe to produce a watertight joint.
- (q) **Sanitary Manholes and Manhole Frames and Covers:** These items shall be constructed in accordance with the requirements of Section 302.03(c). A secure bond between the pipe and manhole wall shall be obtained. Flexible insert gaskets shall be used to obtain a watertight joint. The gasket style and composition shall be subject to the approval of the Engineer. Precast wall sections shall be seated with flexible joint sealant for their full circumference. Lift holes, defects, joints between sections, and frames and covers shall be sealed with nonshrink waterproof grout.
- (r) **Sanitary Drop Connections:** Connections shall be constructed in accordance with the requirements of Sections 302, 303, 404, and 406.
- (s) **Sewer Cleanouts:** Cleanouts shall be constructed in accordance with the requirements of Sections 302, 303, 404, and 406.
- (t) **Conveying Sewage:** When it is necessary to contain or pump sewage during the adjustment of or connection to existing sewers, sewage shall be carried by a watertight conveyor to sewers or manholes approved by the Engineer or shall be disposed of in accordance with local and state health codes. Sewage shall not be allowed to flow onto or over any open surface.
- (u) **Manhole Frame and Covers, Valve Boxes, and Other Castings Located Within the Paved Roadway, Shoulder, or Sidewalk:** These shall be constructed within a tolerance of  $\pm 0.05$  foot of the finished grade.

- (v) **Reconstruct Existing Sanitary Manhole:** This shall consist of the removal of the existing manhole to the point indicated on the plans or directed by the Engineer. Reconstruction shall be accomplished by using existing units and pavement rings or new units and adjustment rings to attain the proposed finished grade.

**520.04—Testing**

Water and sewer mains, appurtenances, and materials shall be tested for leakage after installation. Testing shall be performed in the presence of the Engineer. The Contractor shall provide water, plugs, equipment, tools, labor, materials, and incidentals necessary to perform the testing. If any section of a main or manhole under test shows leakage in excess of that specified, the Contractor shall make necessary repairs or replacements at his own expense. Testing shall be repeated until satisfactory results are obtained. Visible leaks shall be repaired regardless of the amount of allowable leakage.

- (a) **Water Mains and Appurtenances:** New water mains and appurtenances shall be tested for leakage using the hydrostatic pressure test method in accordance with Section 4 of AWWA C600 and the following:
  - 1 The duration of each test shall be at least 2 hours. Sections of main with concrete reaction backing shall not be tested until at least 5 days after the backing is placed. If the backing is high-early-strength concrete, the test may be performed 2 days after backing is placed.
  - 2 Testing of tie-ins with existing mains shall be performed under the normal working pressure of the main involved. Visible leakage at these points will not be allowed during a period of at least 2 hours.
  - 3 The hydrostatic test pressure shall be 100 pounds per square inch or 1.5 times the working pressure, whichever is greater, based on the elevation of the lowest point in the line or section under test and shall be corrected to the elevation of the test gage. The Contractor shall ascertain the specific working pressure of the water main from the utility owner. Leakage loss shall not exceed the allowable leakage (*L*) as determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

*L* = the allowable leakage in gallons per hour;

*N* = the number of joints in the length of pipe line tested;

*D* = the nominal inside diameter of the pipe in inches; and

*P* = the average test pressure during the leakage test in pounds per square inch.

- (b) **Gravity Sanitary Sewers:** Leakage shall be not more than 200 gallons per inch of pipe diameter per mile per day (24 hours) for pipe up to and including 24 inches in diameter and not more than 4,800 gallons per mile per day for pipe more than 24 inches in diameter for any section of the system, including manholes, when subjected to at least 4 feet of head above the line crown at the upstream manhole of the section being tested.
  - 1 **Infiltration test:** When in the opinion of the Engineer the trench or excavation is sufficiently saturated as a result of natural ground water, tests may be made on the basis of infiltration. The Contractor shall measure the flow of water at the nearest downgrade manhole. Three series of measurements shall be made at not less than 1-hour intervals, and the results shall be reduced to an average. The average for a 24-hour period shall then be computed. If the pipeline or manholes fail to meet the test requirements, leaks shall be repaired and defective pipe and manholes shall be replaced at the Contractor's expense. The test shall be repeated until satisfactory results are obtained.
  - 2 **Exfiltration test:** An exfiltration test shall be performed when the trench or excavation is dry and infiltration will not occur. The test shall be conducted as follows: The pipe shall be plugged at the lower manhole. The line and manhole shall be filled with water to a 4-foot level or to the top of the straight section if the manhole is less than 4 feet in height. The water shall stand until the pipe has reached maximum absorption and until trapped air has escaped (at least 4 hours). After maximum absorption has been reached, the manhole shall be filled to the original level. After 1 hour has elapsed, the difference in the level shall be recorded in terms of gallons. The 24-hour loss shall then be computed. If the pipe line system and manholes fail to meet test requirements,

leaks shall be repaired at the Contractor's expense. The test shall be repeated until satisfactory results are obtained.

- 3 **Air test:** In lieu of the infiltration or exfiltration test for leakage, the Contractor may test the sewers by using low air pressures. In the event low air pressure tests are used, the manholes shall be tested by exfiltration. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to ensure testing of those portions of the lines not air tested. The manhole shall then be filled with water to the top and a 12-hour soaking period shall be allowed prior to test measurement. The manhole shall be refilled to a mark, and at the end of 1 hour, the amount of leakage shall be measured. Leakage shall not exceed ½ gallon per hour. If the manhole fails to comply with the test requirements, leaks shall be repaired at the Contractor's expense. The test shall be repeated until satisfactory results are obtained. The low air pressure test shall be conducted in accordance with the following:

- a. After backfilling and prior to air testing, the Contractor shall eliminate discernable water leaks and remove debris. Tests shall be conducted from manhole to manhole or from manhole to terminus. Personnel shall not be allowed in manholes once testing has begun.
- b. Immediately before testing, the Contractor shall provide securely braced test plugs at each manhole and a suitable means of determining the depth of the ground water level above the inverts.
- c. The Contractor shall slowly add air to the portion of the pipe being tested until the internal air pressure is at a test pressure of 4 pounds per square inch above the invert or ground water table, whichever is greater, or until the pressure is equal to the hydraulic gradient, whichever is greater. If the test plug shows leakage, as determined by the Engineer, the Contractor shall relieve the pressure for at least 2 minutes. The Contractor shall then disconnect the hose and compressor. If the pressure decreases to 3.55 pounds per square inch, the time shall be recorded for the amount of time required for the pressure to drop from 3.5 to 2.5 pounds per square inch. The minimum allowable holding times will be as specified herein. Pipes that fail to maintain minimum holding times will not be accepted. Repairs, replacement, and retesting as specified by the Engineer shall be performed at the Contractor's expense.

The minimum allowable holding time for an 8-inch sanitary sewer pipe that is required for the pressure to drop from 3.5 to 2.5 pounds per square inch is:

Line Length	Time (sec)
25	18
50	35
75	53
100	70
125	88
150	106
175	123
200	141
225	158
250	176
275	194
300	211
350	227
400	227

The minimum allowable holding time for a 12-inch sanitary sewer pipe that is required

for the pressure to drop from 3.5 to 2.5 pounds per square inch is:

Line Length	Time (sec)
25	40
50	79
75	119
100	158
125	198
150	238
175	277
200	317
225	340
250	340
275	340
300	340
350	340
400	340

- (c) **Force Main Sanitary Sewers:** Leakage shall not exceed the allowable leakage (*L*) as determined by the following formula:

$$L = \frac{ND \sqrt{P}}{1850}$$

Where:

*L* = the allowable leakage in gallons per hour;

*N* = the number of joints in the length of pipe line tested;

*D* = the nominal inside diameter of the pipe in inches; and

*P* = the average test pressure during the leakage test in pounds per square inch.

The hydrostatic test pressure shall be maintained for at least 30 minutes at 100 pounds per square inch or 1.5 times the working pressure, whichever is greater, based on the elevation of the lowest point in the line or section under test and shall be corrected to the elevation of the test gage. The Contractor shall ascertain the specific working pressure of the force main from the utility owner. Visible leaks shall be satisfactorily repaired regardless of the amount of allowable leakage.

- (d) **Offsets of Existing Pipe:** Offsets will not be subjected to hydrostatic pressure testing unless specified on the plans. After installation and connection to the existing mains, the offset shall be placed in service and left uncovered for visual inspection for at least 2 hours. Visible leaks shall be repaired to the satisfaction of the Engineer prior to acceptance of the offset. Offset of existing pipe for water mains shall be disinfected in accordance with AWWA C-651, Section 9.

#### 520.05—Disinfecting Water Mains

New, relocated, and modified water mains and accessories shall be disinfected prior to tie-ins in accordance with AWWA C651.

If the initial disinfection fails to yield satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. After each group of samples is taken, the Contractor shall submit a written report to the Engineer that states the results of the tests.

#### 520.06—Measurement and Payment

**Excavation and replacement of pavement** removed for pipe trenches will not be measured for separate payment unless otherwise shown. However, minor structure excavation will be measured and paid for in

accordance with the requirements of Section 303.06. When excavation is required below the proposed trench bottom, necessitating additional bedding material, the bedding will be measured and paid for in accordance with the requirements of Section 302.04.

**Water mains, water service lines, sanitary sewer pipe, and sanitary sewer force mains** will be measured in linear feet of pipe through all valves and fittings, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include excavating when not a specific pay item for the utility in question; testing; disinfecting; backfilling; compacting; dewatering; disposing of surplus and unsuitable material; sheeting and shoring; bedding material; installing pipe; connecting to existing lines or manholes; fittings less than 16 inches in diameter; reaction blocking; concrete anchor block; watertight welds; restrained joints; abandoning or removing lines, manholes, and other appurtenances; and restoring property. Pipe of one size, except for cast iron and ductile iron pipe, shall be combined into one contract item for the respective size of water main and sanitary sewer pipe. The salvage value of abandoned materials shall accrue to the Contractor and shall be reflected in the contract unit price for the respective replacement facility.

**Encasement pipe and casing pipe and concrete** will be measured in linear feet, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include excavating, dewatering, sheeting and shoring, blocking, installing pipe, grouting, concrete encasement, reinforcing steel, masonry blocks, watertight bulkheads, backfilling, compacting, disposing of surplus and unsuitable material, and restoring property.

**Jacked encasement pipe** will be measured and paid for in accordance with the requirements of Section 302.04. This price shall include excavating, backfilling, disposing of surplus and unsuitable material, sheeting and shoring, blocking, bulkheads, and jacking.

**Concrete encasement** will be measured in linear feet of encased pipe or cubic yard of concrete, complete-in-place, and will be paid for at the contract unit price per linear foot or cubic yard. This price shall include excavating, sheeting and shoring, concrete, reinforcing steel, backfilling, compacting, and disposing of surplus and unsuitable material.

**Sanitary service lateral connections** will be measured in linear feet, complete-in-place, from the center line of the sewer main to the point of connection of sanitary service lateral and will be paid for at the contract unit price per linear foot. This price shall include excavating, backfilling, compacting, disposing of surplus and unsuitable material, sheeting and shoring, connecting to existing service lateral, and restoring property.

**Sanitary drop connections** will be measured in linear feet, vertical measure, complete-in-place, from the invert of the upper inlet pipe to the invert of the lower inlet pipe and will be paid for at the contract unit price per linear foot. This price shall include pipe and fittings, concrete, reinforcing steel, connections to sewer lines and manholes, excavating, bedding material, backfilling, compacting, disposing of surplus and unsuitable material, and restoring property.

**Sanitary sewer manholes, frames and covers, and watertight frames and covers** will be measured and paid for in accordance with the requirements of Section 302.04.

**Sewer cleanouts** (main or lateral) will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include fittings; riser pipe, frame, cover, and box; excavating; backfilling; compacting; disposing of surplus and unsuitable material; and restoring property.

**Reconstruct existing sanitary manhole** will be measured in linear feet, vertical measure, from the point of the removed section to the top of masonry on which the frame and cover is placed and will be paid for at the contract unit price per linear foot. This price shall include removing, salvaging and resetting frame and cover, reconstruction of manhole, new materials, excavation, backfilling, compaction, disposal of surplus of unsuitable material and restoring property.

**Fire hydrants** will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include excavating, dewatering, backfilling, compacting, connections, concrete blocking, pipe straps, crushed stone drain, disposing of surplus and unsuitable material, restoring property, and testing.

**Water meters and boxes; water meter boxes and yokes; valves and boxes or manholes; and tapping sleeves, valves, and boxes or manholes** will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include excavating, backfilling, and restoring property.

**Bends, plugs or caps, reducers, and branches** (tees, wyes, and crosses) will be measured in units of each

and will be paid for at the contract unit price per each. This price shall include restrained joints, excavating, reaction blocking, testing, backfilling, sheeting and shoring, watertight welds, abandoning or removing existing lines as noted on the plans, and restoring property.

**Offsetting existing pipe** will be measured in linear feet of pipe parallel to the flow line between tie-in points, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include fittings, couplings, restrained joints, excavating, testing, disinfecting, backfilling, compacting, dewatering, disposing of surplus or unsuitable material, sheeting and shoring, bedding material, installing pipe, connecting existing lines as noted on the plans, reaction blocking, watertight welds, abandoning or removing existing lines as noted on the plans, and restoring property.

**Leak detectors** will be measured in units of each. This price shall include pipe, return bends, bird screens, clamps, excavating, backfilling, and restoring property.

These prices shall include containing or pumping sewage during adjusting or connecting existing sewers and providing and maintaining adequate and safe passage over excavations to accommodate pedestrians or vehicles as directed by the Engineer.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Water main (Size and type)	Linear foot
Water service line (Size)	Linear foot
Encasement pipe (Size and type)	Linear foot
Casing pipe and concrete (Size)	Linear foot
Leak detector (Standard)	Each
Bend (Size)	Each
Reducer (Size)	Each
Plug or cap (Size)	Each
Branch (Size)	Each
Offset existing pipe (Size)	Linear foot
Valve and (box or manhole) (Size and type)	Each
Tapping sleeve, valve, and (Box or manhole)	Each
Fire hydrant (Standard and type)	Each
Water meter and box (Size)	Each
Water meter box and yoke (Size)	Each
Jacked encasement pipe (Size and type)	Linear foot
Sanitary sewer pipe (Size and type)	Linear foot
Sanitary service lateral connection (Size)	Linear foot
Sanitary sewer force main (Size)	Linear foot
Bend-force main (Size)	Each
Reducer-force main (Size)	Each
Plug or cap-force main (Size)	Each
Branch-force main (Size)	Each
Offset existing pipe-force main (Size)	Linear foot
Sanitary sewer manhole (Standard)	Linear foot
Manhole frame and cover (Standard)	Each

<b>Pay Item</b>	<b>Pay Unit</b>
Sanitary drop connection	Linear foot
Valve and (box or manhole) (Size and type)-force main	Each
Tapping sleeve, valve, and (box or manhole) (Size)-force main	Each
Concrete encasement (Standard)	Linear foot or Cubic yard
Reconstruct existing sanitary manhole	Linear foot
Watertight manhole frame and cover (Standard)	Each

## SECTION 602—TOPSOIL

### 602.01—Description

This work shall consist of applying topsoil in accordance with the requirements of these specifications and in conformity with the depths and limits shown on the plans or as established by the Engineer.

### 602.02—Materials

- (a) **Class A topsoil** shall conform to the requirements of Section 244.02(b)1.
- (b) **Class B topsoil** shall conform to the requirements of Section 244.02(b)2.

### 602.03—Procedures

- (c) (a) **Submittals:** When Class B topsoil is specified, the Contractor shall submit soil test reports to the Engineer for Class B topsoil in accordance with the requirements of Section 244.02(b).
- (b) **Preparing Areas to Receive Topsoil:** Unless otherwise designated on the plans or directed by the Engineer, areas designated to receive topsoil shall be graded, shaped, and then scarified or tilled by disking, harrowing, or other approved methods to a depth of approximately 2 inches. Topsoil shall be applied only when the subsoil is in a loose, friable condition. Subsoil on slopes that have been horizontally grooved in accordance with the plans shall not be loosened.
- (c) **Applying Topsoil:** The loose depth of topsoil shall be sufficient to allow the area to conform to the elevations shown on the plans after topsoil settles. After topsoil has been applied, large clods, hard lumps, and stones larger than 3 inches in diameter; brush; roots; stumps; litter; and foreign material shall be removed from the area. Where residential or commercial yards exist, the size of the large clods, hard lumps, and stones shall not exceed 3/4 inch in diameter. Such areas shall be hand raked to provide a smooth yard suitable for mowing by a yard mower. When the topsoiling operation is complete, the area shall be in a condition to receive seed, sod, or plants without further soil preparation. Areas shall be seeded within 7 calendar days after topsoiling is completed.

### 602.04—Measurement and Payment

Topsoil will be measured in acres of surface area computed to the nearest 0.1 acre and will be paid for at the contract unit price per acre. For smaller areas, and/or as identified on the plans, topsoil will be measured and paid for at the contract unit price per cubic yard. Such areas will be identified and labeled on the plans for cubic yards of soil to be applied. This price shall include soil testing and provision of test reports; preparing areas to receive topsoil; furnishing, loading, transporting, and applying topsoil; finishing areas; and restoring damaged areas.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Topsoil (Class and depth)	Acre
Topsoil (Class and depth)	Cubic yard

## SECTION 603—SEEDING

### 603.01—Description

This work shall consist of furnishing and applying fertilizer, lime, mulch, and seed in the quantities specified for areas designated on the plans or selected by the Engineer.

### 603.02—Materials

- (a) **Seed** shall conform to the requirements of Section 244.02(c).
- (b) **Fertilizer** shall conform to the requirements of Section 244.02(d).
- (c) **Lime** shall conform to the requirements of Section 244.02(e).
- (d) **Mulch** shall conform to the requirements of Section 244.02(g).

### 603.03—Procedures

Unless otherwise specified, seeding operations shall be performed at the times specified in Sections 303.03(b) and 602.03(b). Seeding operations shall not be performed when the ground is frozen or when soil or weather conditions would prevent proper soil preparation and subsequent operations. When hydroseeding is performed, nozzles or sprays shall not be directed toward the ground in a manner that will cause erosion or runoff. The Contractor shall notify the Engineer at least 48 hours prior to beginning seeding operations.

- (a) **Applying Lime:** Lime shall be uniformly applied to areas to be seeded at the rate of 2 tons per acre. Any approved method may be used.
- (b) **Preparing Soil:** After lime is applied, areas to be seeded shall be prepared in accordance with the following: Slopes 3:1 or flatter shall be loosened to a depth of approximately 3 inches by disking, harrowing, or other approved methods. Loosening of soil on excavated slopes steeper than 3:1 will not be required except to eliminate hard or crusted surfaces. Shoulders and embankment slopes steeper than 3:1 shall be loosened to a depth of approximately 1 inch. Clods, loose stones, and other foreign material larger than 3 inches in any dimension shall be removed and disposed of in accordance with the requirements of Section 106.04 or as approved by the Engineer. Gullies, washes, and disturbed areas that develop subsequent to final dressing shall be repaired before they are seeded.  
Topsoil, when specified, shall be applied in accordance with the requirements of Section 602.
- (c) **Applying Fertilizer:** When dry fertilizer is used, it shall be applied uniformly to the seeding areas at the time of seeding at the rate of 300 pounds of fertilizer per acre (approximately 45 pounds of nitrogen per acre or 1.0 pound of nitrogen per 1,000 square feet) or as directed by the Engineer. Slow release and slowly soluble fertilizer may be applied through a hydraulic seeder except for sulfur-coated urea (SCU). The method of application for fertilizer products will be approved by the Engineer prior to application of the fertilizer. When applied in liquid form or mixed with water, fertilizer shall provide the same value of nutrients per acre as specified for dry fertilizer. Fertilizer applied in liquid form shall be constantly agitated during application.
- (d) **Applying Seed:** Regular seeding shall consist of uniformly applying seed, fertilizer, and mulch on prepared areas.

Overseeding shall consist of applying seed and fertilizer on areas prepared as directed by the Engineer.

Where temporary seeding is employed as a means of soil stabilization it shall consist of applying seed, fertilizer, and mulch in accordance with the rates specified in the plans or in Section 603.03 to stabilize areas on which grading operations are anticipated to be suspended for durations greater than 15 days. Where temporary seeding is required or directed by the Engineer, the cost for removal of vegetation once grading operations resume shall be included in the price of seeding.

For hydroseeding, seed shall be put in the mixture slowly to result in a uniform mixture before application. Hydroseeding mixtures shall be constantly agitated from the time of mixing until application on the seed bed and used within 8 hours from the beginning of mixing.

If special seed is required in addition to the regular mixture, it will be furnished by the Department and shall be applied with the regular mixture at the Contractor's expense.

Leguminous seeds shall be inoculated or treated with approved cultures as specified by the manufacturer or directed by the Engineer before they are applied or mixed with other seeds to be applied. Seed shall be applied within 24 hours after treatment. When the hydroseeding method is used, leguminous seeds shall be treated with 5 times the amount of inoculant recommended by the manufacturer.

- (e) **Applying Mulch:** Mulch shall be applied in a separate application within 48 hours after completion of the seeding operation. When straw or hay mulch is used, it shall be applied on seeded areas at the rate of approximately 2 tons per acre. When wood cellulose fiber mulch is used, it shall be uniformly applied at the rate of approximately 1,500 pounds net dry weight per acre. Mulch will not be required on overseeded areas.

Straw and hay mulch shall be applied to a uniform thickness in such a manner that not more than 10 percent of the soil surface will be exposed at the conclusion of the mulching operations. Wet straw or wet hay shall not be used. Straw or hay mulch shall be anchored to the seeded surface by spraying with wood cellulose fiber mulch at the rate of 750 pounds per acre; spraying with an emulsified asphalt at the rate of at least 100 gallons per ton of mulch in a manner that will protect adjacent property and pedestrian traffic areas; disking or punching the mulch partially into the soil; using approved netting; or using other materials or methods approved by the Engineer. The Contractor may use more than one method on the same project.

**603.04—Measurement and Payment**

**Lime** will be measured in tons and will be paid for at the contract unit price per ton.

**Fertilizer** will be measured in tons and will be paid for at the contract unit price per ton. When a grade different than that specified in the Contract is used, the tonnage quantity will be adjusted to the grade specified.

**Seed** will be measured in pounds of seed used and will be paid for at the contract unit price per pound. When bags of seed are transferred from project to project, certified scales shall be used for weighing the seed. Open bags will not be accepted for use.

Prices for seed, fertilizer, and lime shall include preparing seed beds; furnishing and applying seed; furnishing and applying mulch; and maintaining seeded areas until final acceptance.

**Overseeding** will be paid for at the contract unit price per pound of seed. This price shall include preparing seedbeds and furnishing and applying seed and additional fertilizer.

**Mulch** will not be measured for separate payment. The cost thereof shall be included in the price for seed.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
(____) seed	Pound
(____) overseeding	Pound
Fertilizer (Ratio)	Ton
Lime	Ton

## SECTION 604—SODDING

### 604.01—Description

This work shall consist of preparing sod beds; furnishing and placing sod; and furnishing and applying lime, fertilizer, topsoil, and water at locations designated on the plans or by the Engineer.

### 604.02—Materials

- (a) **Sod** shall conform to the requirements of Section 244.02(h).
- (b) **Fertilizer** shall conform to the requirements of Section 244.02(d).
- (c) **Lime** shall conform to the requirements of Section 244.02(e).

### 604.03—Procedures

- (a) **Preparing Sod Beds:** Soil on which sod is to be placed shall be shaped to an even surface and graded to such an elevation that sod and adjacent surfaces will have a smooth contour.

Lime shall be uniformly applied to areas designated to receive sod at the rate of approximately 2 tons per acre.

Fertilizer shall be uniformly applied to areas designated to receive sod at the rate of 16 1/2 pounds of 15-30-15 fertilizer, or an equivalent quantity of 1-2-1 fertilizer, and 10 pounds of ureaformaldehyde per 1,000 square feet. Following application of lime and fertilizer, the soil shall be thoroughly cultivated to a depth of 2 to 3 inches and sprinkled with sufficient water to moisten the cultivated soil.

- (b) **Placing Sod:** Sod shall not be placed between June 1 and September 1 or at any time the ambient temperature is below 32 degrees F. Frozen sod shall not be placed, and sod shall not be placed on frozen soil. Sod shall be placed by hand, and joints shall tightly abut without overlapping. Open joints and gaps shall be plugged with sod that has been cut to the size and shape of the opening.

Sod shall be placed on sloping areas beginning at the bottom of the slope. Sod shall be placed in horizontal strips with the long edges of rectangular pads parallel to the contour. When practicable, horizontal joints shall be reasonably straight and vertical joints staggered. In areas where sod pads may be displaced by foot traffic during sodding operations, ladders or treaded planks shall be used.

Sod placed on slopes steeper than 2:1 shall be anchored in place with wood stakes driven flush with the top of the sod. Stakes shall be at least 8 inches in length with a cross-sectional area of approximately 1 square inch. The number and spacing of stakes shall be adequate to hold sod securely in place. Special attention shall be given to anchoring sod placed in drainage ditches, channels, and swales.

After sod has been placed, joints and gaps that were too small to be effectively plugged with sod shall be filled with loamy topsoil.

Sodded areas shall be watered thoroughly and rolled or tamped to press the root system of the sod into full contact with underlying soil.

Sodded areas shall be kept watered to maintain the life and growth of the sod until final acceptance.

### 604.04—Measurement and Payment

**Sod** will be measured in square yards of surface area, complete-in-place, and will be paid for at the contract unit price per square yard of surface area. This price shall include preparing sod beds; furnishing and applying lime, fertilizer, sod, and water; and maintaining sodded areas until final acceptance.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Sod	Square yard

## SECTION 605 – PLANTING

### 605.01--Description

This work shall consist of furnishing and planting trees, shrubs, vines, and other plants of the kinds, sizes, and quantities specified on the plans or by the Engineer and maintaining and replacing plants as specified herein.

### 605.02--Materials

- (a) **Plants** shall conform to the requirements of Section 244.02(i).
- (b) **Drainage stone** shall conform to the requirements of Section 204.
- (c) **Composted Yard Waste** shall conform to the requirements of Section 244.02 (j).
- (d) **Geotextile Drainage Fabric** shall conform to the requirements of Section 245.
- (e) **Topsoil** shall conform to the requirements of Section 244.02(b)
- (f) **Horticultural Grade Perlite** shall conform to the requirements of Section 244.02(j).
- (g) **Tree Tubes** shall conform to the requirements of Section 244.02(j)
- (h) **Tree Anchors, Staking and Guying Materials** shall conform to the requirements of Section 244.02(j)
- (i) **All other Misc. Planting Materials** shall conform to the requirements of Section 244.02(j) and 244.02(k).

### 605.03--Procedures

- (a) **Documentation of Confirmed Order:** The Contractor shall submit documentation to the Engineer of a confirmed order of all plant materials 60 days in advance of the proposed planting operation. The documentation shall list the source(s) of supply, all species by common and botanical name, specific variety, and cultivar in the sizes reserved. When special requirements are listed on the planting summary sheet, such as “Specimen Quality,” or “Specimen Street Tree”, etc., the documentation shall certify that the species reserved meet those specific requirements. Once the Documentation of Confirmed Order is received, the Engineer reserves the right to require sample photographs of materials to be supplied. The Engineer also reserves the right to inspect and approve the selection of plant materials at the source of supply prior to delivery. In the event that specific materials are not available, the Contractor shall submit a request for substitutions in accordance with the requirements of (e) herein.
- (b) **Planting Season:** The Planting Season shall be from November 1, through March 31, unless otherwise identified on the plans. The Contractor shall notify the Engineer 48 hours prior to beginning work. All sources of supply, materials, construction schedule, and methods of construction shall be approved by the Engineer prior to beginning work on the project. Plants requiring either spring or fall planting only will be designated on the plans.
- (c) **Sources of Supply:** All plants shall be obtained from a nursery certified by a “Certificate of Registration” in accordance with The Virginia Department of Agriculture and Consumer Services (VDACS), or by a comparable agency responsible for nursery inspection and issuance of a “Certificate of Registration” from the State of origin. A copy of the certification shall accompany each separate delivery of plant materials to the project site, and shall be submitted to the Engineer.
- (d) **Inspecting and Identifying Plants:** Plants will be inspected and identified in accordance with the *Standardized Plant Names* prepared by the Editorial Committee of the American Joint Committee on Horticultural Nomenclature. The Engineer may inspect plants at any time and place. Plants will be inspected immediately prior to being planted. If plants are installed prior to inspection and found to be unsatisfactory, they shall be replaced with approved plants at the Contractor's expense.
- (e) **Substitutions:** No change in the quantity, size, kind, or quality of plants from those specified will be permitted without the written approval of the Engineer. When requesting permission to substitute, the Contractor shall submit to the Engineer written evidence in accordance with the requirements of (a) herein that the specified plants are not available and shall suggest substitute plants that conform to the requirements of the Contract. The Contractor shall indicate the reduced cost, if any, that will accrue to the Department as a result of the substitution. The Engineer may delete plants from the Contract in lieu of approving substitutions.
- (f) **Layout:** Plant locations and outlines of bed areas to receive plants shall be staked or marked by the Contractor and will be inspected by the Engineer for approval prior to plant installation. The

- Contractor shall notify the Engineer a minimum of 48 hours prior to scheduling the inspection. Planting shall not be permitted until the Engineer has approved the staking layout. Unforeseen conditions such as the location of traffic signs, utilities and drainage items may necessitate adjustments in plant locations, and such adjustments will only be permitted when approved in writing by the Engineer.
- (g) **Delivery:** The Contractor shall notify the Engineer at least 48 hours in advance of the anticipated delivery date for plants. A legible copy of the invoice showing the kinds and sizes of plants in each shipment shall be submitted to the Engineer. A copy of the current Certificate of Nursery Inspection from the State of origin shall accompany each shipment of plants.
- (h) **Labeling:** Plant material delivered to the project shall be legibly identified with a waterproof label as to the genus, species, and size of the plants. When plants are in bales, bundles, boxes, or other containers, a legible label indicating the genus, species, size, and quantity of the plants shall be attached to each container. A minimum of 10 percent of each species in each shipment shall be so labeled. Failure to comply with this identification labeling will be cause for rejection.
- (i) **Transporting and Protecting:** Plants transported to the project in open vehicles shall be covered with suitable covers securely fastened to the body of the vehicle. Closed vehicles shall be adequately ventilated to prevent overheating plants. Plants shall be kept moist, fresh, and protected at all times.
- (j) **Storing:** When plants are to be stored, they shall be stored at a location approved by the Engineer. Plants stored for more than 30 days shall not be used unless approved by the Engineer. Unless the Engineer approves other methods of storage, bare-root plants that are not planted within 24 hours after delivery shall be heeled-in in a moist trench dug in the ground. Bundles shall be opened, and plants shall be separated and placed singly in the trench with the roots spread in a natural position. Roots of each layer of plants shall be immediately covered in a manner satisfactory to the Engineer with moist, pulverized soil; moist sawdust; or other approved material. Root-covering materials shall be kept moist at all times. Shade shall be provided as directed by the Engineer. At the discretion of the Engineer, balled material, container-grown material, and plants in plantable pots that are not planted within 48 hours of delivery shall have their root zone protected by wet sawdust or other approved material. Rejected plants shall be removed from the storage area within 24 hours of rejection or, with the written approval of the Engineer, may be marked with yellow paint or otherwise made readily identifiable. If rejected plants have not been removed or acceptably marked within 24 hours, the use of plants from the storage area will not be allowed until rejected plants have been removed or identified by marking.
- (k) **Planting:**
- 1 **Underground and Aboveground Conditions:** It shall be the responsibility of the Contractor to have marked, the location of all underground utilities with Ticket Information Exchange (TIE) / (Miss Utility) and all other applicable underground utility providers such as sewer and water service, and VDOT traffic signal cable prior to digging. The Contractor shall be responsible for locating and working around aboveground utilities. If underground obstructions or any other unforeseen subsurface or above surface conditions that could interfere with a utility or become detrimental to plant growth are encountered, the Engineer may require that plant pits be enlarged or relocated or that the plants be deleted from the contract.
  - 2 **Planting Trees or Shrubs on Slopes Steeper than 3:1:** Drainage requirements for trees or shrubs on slopes steeper than 3:1 will be determined by percolation tests, with no more than 3 tests per slope, as designated by the Engineer. Slopes for this test are determined from cut and fill slopes shown on the cross sections. Percolation testing shall consist of the following: The Contractor shall auger holes that are 12 inches in diameter and 24 inches in depth. Three holes shall be distributed across the slopes vertically and horizontally. The Contractor shall fill the holes with water and allow them to drain. If soil is extremely dry, fill holes twice and allow to drain. Fill holes again and measure rate at which water percolates into the soil. Water in holes should recede at the rate of 2 inches per hour (minimum) or pit modification for improving drainage shall be required.
  - 3 **Preparing Planting Pits for Trees and Shrubs:** Planting pits shall be excavated to meet the minimum requirements VDOT Road and Bridge Standards unless otherwise indicated on the plans by detailed drawings. Sides of pits that become plastered or glazed shall be scarified. Surplus excavation and unsuitable material shall be disposed of in accordance with the requirements of Section 106.04 or as otherwise approved in writing by the Engineer. Preparation

of the planting medium (soil mix) shall utilize 3 parts of the original excavated soil from the digging operation thoroughly mixed with 1 part composted yard waste, except where linear or oversize planting pits are specified on the plans.

If the Contractor determines that the original excavated soil is not suitable for reusing with amendments for achieving an acceptable growing medium, the Contractor shall notify the Engineer. The Engineer shall make a determination as to the quality of the soil, and if found to be unacceptable; will direct the Contractor to use topsoil or composted yard waste for use in the soil mix. In such cases, the planting pit, and unsuitable soils surrounding the pit shall be removed as directed by the Engineer. The Engineer reserves the right to have the original soil tested prior to making a determination for replacement.

- 4 **Preparing Plant Beds:** Plant beds shall be prepared by the Contractor in accordance with the following:
  - a. Plant bed preparation shall only be required on slopes of 3:1 or flatter. Where grass and weeds are present, the Contractor shall treat the designated bed area(s) with a broad spectrum grass and weed killing herbicide at least two weeks prior to beginning bed preparation, or physically remove turf and weeds immediately before bed preparation. The entire area of the plant bed shall be cultivated to a depth of 4 inches by a rotary cultivator or other approved method. The Contractor shall then apply composted yard waste at a depth of three inches over the entire plant bed and re-till to form a homogenous soil medium. Soil shall be cultivated so that there are no clods larger than 2 inches in diameter.
  - b. Any remaining grass, sod, and weeds shall be removed from the bed. Rocks over 3 inches in diameter, clods, roots, and other objectionable material remaining on the surface shall be removed and disposed of in accordance with the requirements of Section 106.04 or as approved in writing by the Engineer. Individual planting pits shall not be dug until after the bed is prepared to the satisfaction of the Engineer.
  - c. Upon completion of planting, the bed shall be hand raked to an even surface and neatly edged with a “V” cut edge located a minimum of 12 inches from the root ball of plants along the outer edge of the bed. Mulch shall be applied to the entire bed area. On certain projects where mulched beds around large quantities of plant materials are used to control weed growth and are not intended as a prepared soil medium, tilling and application of composted organic material throughout the plant bed shall be waived when beds are labeled on the plans as “Bed Preparation Not Required”.
- 5 **Linear Planting Pit:** Areas labeled on the plans and details as “Linear Planting Pit” shall be excavated to the horizontal and vertical dimensions indicated on the plans to receive soil mixture. Soil mixture shall consist of 1 part composted yard waste, and 1 part horticultural grade perlite, unless otherwise indicated in the contract documents, and shall include any necessary excavation required for installation of plant underdrain systems. Plant underdrain system(s), as applicable, shall be indicated on the plans, listed as a pay item and installed in accordance with plan details.

Soil mix for linear planting pits shall be installed in 6 inch lifts, lightly compacted by foot or other approved method, and moistened prior to proceeding with next lift. If settlement occurs prior to planting, additional soil mix shall be added at the direction of the Engineer. Prior to planting the Contractor shall till the linear planting pit to a depth of 4 inches, hand rake the area and adjust the grade adjacent to curb or sidewalk to receive 3 inches of mulch.
- 6 **Oversize Planting Pit:** shall be prepared in accordance with the plan details at locations shown on the plans. Backfill shall consist of one-half part native soil excavated from the plant pit, and one-half part composted yard waste. If native soil is determined by the Engineer to be unsuitable, 100 percent composted yard waste shall be used. If settlement occurs prior to planting, additional soil mix shall be added at the direction of the Engineer. After planting the planting pit shall be neatly edged except when the planting pit falls within a larger bed area.
- 7 **Installing Trees and Shrubs:** Balled and burlapped and containerized plant materials shall be installed in plant pits in accordance with the requirements of the VDOT Road and Bridge Standards, unless otherwise indicated on the plans. Bare roots of plants shall be spread out in a natural position. Broken or bruised roots shall be pruned. After positioning plants in the planting pit and prior to backfilling, root ball wrapping materials, except metal root ball cages shall be cut and dropped to the bottom of the pit. Root ball wrapping materials shall not be removed from

under the root ball. Metal root ball cages shall be cut and removed to a minimum of 6 inches below finished grade. Wrapping materials within root ball cages shall be cut or unwrapped to the same elevation as the cage. All other wrapping materials such as tags, twine and colored marking ribbon shall be removed from the plant unless otherwise directed by the Engineer. The soil mixture shall then be filled in around roots and lightly tamped. Light tamping around root balls shall be performed using a method approved by the Engineer. Foot tamping will be permitted in the bottom of pits before plants are installed, around root balls when there is ample room to accommodate the foot without damage to the ball, and in the planting of bare-root plants after roots have been covered with the soil.

Backfill material in pits shall be saturated with water. The amount of water applied and method of application shall be approved by the Engineer. Failure to water properly at the time each plant is installed will be cause for rejection of the plant. Frozen backfill material shall not be used.

Potted plants shall not be removed from their container until immediately before planting. Containers shall be removed by approved methods that will not damage roots or loosen soil balls. The sides of containerized materials shall be scarified prior to planting.

When planted, watered, and fully settled, plants shall be vertical and shall stand at a height flush with the height of which they were growing.

- 8 **Handling Plants during Planting:** Roots of bare-root plants shall be kept covered with moist burlap or other approved material prior to planting. Forest tree seedlings and forest tree transplants shall be carried in a container filled with sufficient mud to puddle roots. When seedling roots have been coated with a protective material, the seedlings shall be protected in accordance with the U.S. Forest Service's recommendations relative to treatment of seedling roots while seedlings are being planted. Plants will be rejected if their roots are exposed to drying conditions at any time.
  - (l) **Forming Water Rings and Saucers:** Immediately after the installation of each plant, a saucer shall be formed around the plant pit. Soil used to form the saucer shall be compacted by tamping to prevent runoff of water from the pit. Saucers shall measure 4 to 6 inches in width, and 2 to 3 inches in height after tamping. Saucers will not be required for forest tree seedlings, or forest tree transplants. Water rings and saucers shall be formed on the wetland trees and shrubs planted on slopes and upland areas adjacent to the wetland.
  - (m) **Applying Mulch:** Mulch shall be applied uniformly to a 3-inch depth over the entire area of the plant pit or plant bed within 48 hours after completion of planting. Re-mulching at the terminus of the establishment period shall be applied at a depth of 1-1/2 inches. Mulch shall be anchored in a manner satisfactory to the Engineer. Mulch shall not be required for wetland trees and shrubs, or upland forest tree seedlings. Mulch shall be applied to wetland trees and shrubs on slopes and upland areas adjacent to the wetland.
  - (n) **Staking, Guying, Anchoring:** Each plant shall be staked and guyed or secured with below ground tree anchors immediately following planting, unless otherwise indicated in the Planting Plan Summary and General Notes. Below ground tree anchors shall be used when specified on detailed drawings in the plans. Staking and guying shall be required for wetland trees and shrubs on slopes and upland areas adjacent to the wetland.
  - (o) **Pruning:** Plants that have been freshly pruned before delivery will be rejected. If necessary, plants shall be pruned either immediately before or within 48 hours after they are planted. Pruning of trees and shrubs to be planted on projects shall consist of removing dead, diseased, broken or other branches deemed injurious to the health of the plant, and for removal of sprouts and sucker growth. Care shall be taken to preserve the natural character of the plant. Pruning shall be performed with tools and equipment in excellent working condition that are specifically designed for the appropriate work. All pruning shall be performed in accordance with the current American National Standards Institute (ANSI A300) and as directed by the Engineer. All debris removal including disposal from the pruning operation shall be the responsibility of the Contractor.
  - (p) **Pit Drains:** Pit drains or plant underdrain systems shall be installed as shown on the plans.
  - (q) **Tree Tubes:** This work shall consist of installing tree tubes on all seedling trees in accordance with the manufacturer's recommendations, the plans and product specifications.

#### 605.04—Care of Plants

Plant care shall begin immediately after each plant is satisfactorily installed and shall continue until final acceptance. Care shall include but not be limited to replacing displaced mulch, repairing and reshaping water rings or saucers, maintaining stakes and guys as originally installed, watering when needed or as directed by the Engineer, and performing any other work required to keep plants in a healthy condition. Dead, defective, or rejected plants shall be immediately removed and replaced in accordance with the requirements of Section 605.05(b)4.

#### 605.05--Establishment Period

- (a) **Beginning of Establishment Period:** The establishment period shall begin on a date following completion of the planting (spring or fall), when the Contractor receives written confirmation from the Engineer, that all work has been completed in accordance with the requirements of this Section and the plans, and that all plants are living, healthy and in a viable growing condition as determined by the Engineer. Plants that are replaced in order to meet these initial specifications are not considered as “plant replacements.”
- (b) **Establishment Period:** The establishment period shall continue through a minimum of one growing season, and shall terminate on the date determined in writing by the Engineer. During the establishment period, the Contractor shall do all work necessary to keep the plants in a healthy growing condition, including, but not limited to the following:
  - 1 **Watering:** The Contractor shall prepare and submit to the Engineer a schedule for watering in accordance with the frequency listed on the project summary sheet. However, the Contractor shall be responsible for watering as frequently as is necessary to maintain an adequate supply of moisture within the root zone of all plantings at all times or if there is less than 1 inch of rainfall in a seven day period during the months of April through September. Water shall not be applied at a force that will displace soil or mulch. Quantities and frequency of watering shown on the plans are for minimum estimating purposes only.
    - a. The Engineer may require the use of watering needles or other approved methods to prevent displacement of soil, mulch and runoff of water. The Engineer may make periodic inspections to ascertain the adequacy of the Contractor’s watering and the moisture content of the soil.
    - b. The quantity of water supplied shall not be in excess of that normally required to ensure optimum growing conditions. Watering shall not commence until methods and equipment have been approved by the Engineer. The Engineer may require or suspend watering at any time.
  - 2 **Notification and Scheduling:** When notified by the Engineer that watering is required, the Contractor shall begin watering within 48 hours with sufficient labor and equipment and shall continue to water daily where and as directed, without delays or interruptions, to ensure that the root zone does not become dry at any time. In the event the Contractor fails to begin watering operations within 48 hours after notification, the Engineer may proceed with adequate forces, equipment, and materials to perform the watering operations and the entire cost of the watering operations will be deducted from monies due the Contractor.
  - 3 **All establishment period maintenance work**, except watering, shall begin within 7 working days after the Engineer notifies the Contractor that the establishment period has begun.
  - 4 **Plant Replacements:** Between the beginning and ending dates of the establishment period, plants that are dead, defective, or otherwise not in a healthy growing condition as determined by the Engineer shall be removed immediately at the Contractor’s expense. Plant replacements shall be made once in the spring if required (Between March 1 and March 31), and once in the fall if required (Between November 1 and December 31), as necessary to replace dead or defective plant materials as directed by the Engineer. For each plant replaced, the first replacement, if required, shall be at the Contractor’s expense. The second replacement, if required, will be paid for at 35 percent of the original contract unit price per each plant replaced.
  - 5 **Stakes, and Guys, and/or Below Ground Tree Anchors** shall be repaired or replaced immediately as needed. Stakes and Guys shall be removed when no longer required as directed by the Engineer. Tree anchors shall remain in place.

- 6 **Eroded Saucer Rings** shall be repaired or replaced as needed and/or as directed by the Engineer.
  - 7 **Mulch** shall be redressed as needed and/or as directed by the Engineer throughout the establishment period.
  - 8 **Re-mulching:** When established as a separate pay item, remulching shall be reapplied to all individual plants and plant beds prior to the terminus of the establishment period at a rate of approximately 1 1/2 inch depth, uniformly over all individual plant pits and plant beds, and/or as directed by the Engineer.
  - 9 **Vegetation Control** shall consist of the control and/or removal of weeds, grass and root growth from plant beds and mulched areas around individual plants. Such weeding shall be performed once in the month of May, June, July, August, and September for a total of five weeding operations over the duration of the establishment period. The Contractor shall submit a schedule for vegetation control for approval by the Engineer prior to the Contractor beginning vegetative control operations.
    - a. Removal of weeds, grass and root growth may be completed by hand or through the application of “pre-emergent” and “post emergent” herbicides as approved by the Engineer. All herbicide applications shall be performed by certified pesticide applicators in accordance with the requirements of Section 601. Additional weeding may be performed when requested by the Engineer and with written agreement from both parties. The Engineer also reserves the right to delete individual weeding cycles at no cost to the Department when necessary. The Contractor shall be responsible for replacing plants that are damaged or that die due to the application of herbicide treatments.
    - b. When herbicides are used for post emergent weed control, the weeds shall be cut to a height of 6 inches or as recommended by the manufacturer if necessary, prior to applying the herbicide. The Engineer reserves the right to change the frequency or delete specific areas scheduled for weed control. Other pesticides, adjuvants and plant growth regulators may be used when approved by the Engineer.
    - c. Turf maintenance which includes grass and other vegetation around individual plant pits, between groups of plant pits that are 15 feet on center or less, and around the perimeter of plant beds shall be cut to a height of approximately 4 inches. For each individual plant pit, group of plant pits, and plant beds, a perimeter extending 5 feet in width shall be maintained around the outermost plant pits and edge of beds where grass and other vegetation is present, and where such areas exist within the right-of-way or construction easement. Mowing shall be performed once in each month of May through September. Additional mowing may be performed when requested by the Engineer. The Engineer reserves the right to delete individual mowing cycles when deemed necessary by the Engineer.
  - 10 **Additional Work**, including pruning of dead, broken or diseased branches, and seasonal spraying with approved insecticides and fungicides, shall be performed to ensure plant survival as approved or directed by the Engineer.
- (c) **Termination of Establishment Period:** Any dead, missing, or defective plants shall be replaced as directed by the Engineer prior to termination of the establishment period. The Engineer shall be notified within 48 hours prior to beginning the replacement work.
- The establishment period shall end on a date established by the Engineer, when the Contractor receives written notification from the Engineer that confirms all the requirements of (b) herein have been satisfactorily completed.

#### **605.06--Guarantee**

The Contractor's performance bond, furnished in accordance with the requirements of Section 103.05, shall provide for necessary maintenance during the establishment period and replacements in kind, or with a substitute acceptable to the Engineer, for plants that are not in a healthy growing condition or that have died back to the crown or beyond the normal pruning limit.

#### **605.07--Measurement and Payment**

**Plants** will be measured by an actual count of living plants in a healthy growing condition and will be paid for at the contract unit price per each. Plants that the Engineer deleted from the Contract will not be measured for

payment. This price shall include furnishing and delivering plants and miscellaneous planting materials; preparing planting pits, except when established as a separate pay item, forming saucers; installing plant materials; watering, except during establishment period, applying fertilizer; back filling with approved soil mixture; staking; guying; anchoring; pruning; applying mulch, except to areas designated on the plans as plant beds, replacing dead or damaged plants; repairing, replacing and removing stakes and guys when no longer needed; and maintaining plants in a healthy growing condition until final acceptance.

Trees or shrubs planted on a slope steeper than 3:1 with pit modification as indicated in the Department's Road and Bridge Standard Section 1201.06 will be paid for at 125 percent of the price bid. Such price shall also include the cost of pit modification, stone and geotextile filter fabric. Percolation tests shall be included in the price bid for plants.

Replacements for plants lost during the establishment period because of theft, damage, or destruction caused by persons or equipment belonging to persons or organizations other than those engaged in performing the work or during delivery of the plants, or plants lost due to damage from animals either wild or domestic, will be paid for at the rate of 35 percent the contract unit price per each. If vandalism or vehicle damage is determined by the Engineer to be the cause the rate will be 50 percent the contract unit price per each. This price shall include all costs associated with furnishing and installing the replacement. Replacements for plants that die due to other reasons shall be replaced and paid for in accordance with the requirements of Section 605.05(b)4.

**Bed Preparation** will be measured and paid for in units of 100 square feet of surface area. This price shall include herbicide spraying of areas to be prepared for planting or physically removing turf and weeds, restoring areas to original grade with topsoil (as applicable) as directed by the Engineer, tilling soil, furnishing, delivering, and applying composed yard waste at the specified depth, tilling in composted yard waste, hand raking, neatly edging bed, and all incidentals necessary to prepare a healthy growing medium for planting.

**Pit drains** when detailed and established as a separate pay item on the plans will be measured and paid for in units of each, complete-in-place, which price shall include drainage stone, pipe, pipe grate, prefabricated drainage core, drainage/aeration cloth, and geotextile drainage fabric as designated on the plans.

**Linear Planting Pit** will be measured and paid for in units of cubic yards of excavated material required to achieve the horizontal and vertical dimensions indicated on the plans to receive soil mixture, including furnishing, delivering and storage of soil mixture materials to be used, and disposal of surplus excavated materials. Such price shall also include the cost of mixing and installing all components of the soil mix (horticultural grade perlite and composted yard waste), bed preparation, hand raking and adjusting surface to receive mulch, and furnishing and installing underdrain system(s) if indicated on the plans, including drainage stone, drainage/aeration cloth, prefabricated drainage core, geotextile drainage fabric, pipe, and pipe grate in accordance with the plans and detailed drawings, and all necessary incidentals complete in place.

**Oversize Planting Pit** will be measured and paid for in units of each, which price bid shall include excavation and disposal of unsuitable material, provision, and installation of pit drain materials if shown as part of the plan details, installation of approved backfill material and mixing with composted yard waste.

**Mulching** will be measured in units of 100 square feet of surface area. Mulch for plant beds at the time of initial installation will be paid for at the contract unit price per 100 square feet. This price shall include furnishing, delivering, and applying mulch. No separate payment will be made for initial application or maintenance of mulch around plants that are not in continuous mulched plant beds. The cost thereof shall be included in the price for the plant.

**Re-mulching**, when established as a separate pay item, will be measured and paid for in cubic yards. This price shall include furnishing, delivering, and applying mulch to plant beds, and to plants in individual saucer rings prior to the terminus of the establishment period. Remulching does not include regular maintenance of individually mulched plants or plant beds for the duration of the establishment period.

**Watering** during the establishment period will be measured in units of 1000 gallons, and will be paid for at the contract unit price per unit, applied at the rates designated on the plans. This price shall include furnishing, delivering, and applying water and performing all other work in connection therewith and incidental thereto. No payment will be made for watering at the time of original planting or during the installation period until from plant installation until the start of the establishment period or whenever replacements are planted.

**Vegetation Control** will be measured and paid for on a unit basis. Compensation for weeding (removal of weeds, grass, and root growth) and turf maintenance shall be made on a Unit basis consisting of each complete project weeding and turf maintenance operation accomplished by the Contractor, including the removal and disposal of unwanted vegetation, application of pesticides, the performance of mowing around and between individual plants, and as reviewed and approved by the Engineer.

**Tree Tubes** will be measured and paid for at the contract unit price per each which shall include furnishing and installing the tube, including all incidentals necessary to complete the work. This price shall also include the removal and disposal of the tree tube at the end of the establishment period.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
(Name of) Plant (Size)	Each
Bed Preparation	Unit (100 square feet)
Pit Drain	Each
Linear Planting Pit	Cubic Yard
Oversize Planting Pit	Each
Mulching	Unit (100 square feet)
Re-mulching	Cubic Yard
Watering	Unit (1,000 gallons)
Vegetation Control	Unit
Tree Tube	Each

## SECTION 606—SOIL RETENTION COVERINGS

### 606.01—Description.

This work shall consist of furnishing and placing protective coverings for soil retention, including seed, fertilizer, lime, topsoil, and water, in accordance with the requirements of these specifications and in conformity to the dimensions, lines, and grades shown on the plans or as established by the Engineer.

### 606.02—Materials.

Materials shall conform to the requirements of Section 244.02(k).

### 606.03—Procedures.

- (a) **Preparing Areas:** Two inches of topsoil shall be applied to the area to be covered. Drainage channels shall be shaped in accordance with the cross section shown on the plans and shall be rolled or tamped to compact soil in place before final shaping.  
During shaping operations, a seedbed approximately 3/4 inch in depth shall be provided.  
Stones, roots, and other objects that will prevent protective covering from making close contact with the seedbed shall be removed before covering is installed.
- (b) **Applying Seed:** Seed shall be applied in accordance with the requirements of Section 603 except that mulch will not be required. Seed, fertilizer, and lime shall be applied prior to installation of protective coverings.  
Seeded areas adjacent to the channel or ditch that are disturbed during installation of covering shall be uniformly reshaped, reseeded, and mulched at the Contractor's expense.
- (c) **Installing Soil Retention Coverings:** Coverings shall be installed in accordance with the standard drawings and manufacturer's recommendations.
- (d) **Watering:** After coverings are installed, seeded areas shall be watered sufficiently to saturate the seedbed. Water shall be applied in a spray, and no additional watering will be required.

### 606.04—Measurement and Payment.

**Protective coverings and soil stabilization mats** will be measured in square yards of area covered, complete-in-place, in accordance with the nominal plan dimensions and will be paid for at the contract unit price per square yard. Overlaps, overwidths, and cut slots will not be measured for separate payment. This price shall include furnishing, installing, and stapling soil retention coverings; smoothing and shaping ditch channels and waterways; preparing seed beds; and furnishing and applying topsoil, lime, seed, fertilizer, and water.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Protective covering (Standard)	Square yard
Soil stabilization mat (Standard and type)	Square yard

## SECTION 607—HERBICIDE SPRAYING

### 607.01—Description

This work shall consist of applying an approved herbicide for the control of weeds in turfed areas as indicated on the plans or as designated by the Engineer.

### 607.02—Materials

Herbicide shall conform to the requirements of Section 244.02(a).

### 607.03—Procedures

Herbicide shall be applied in accordance with the manufacturer's recommendations. Herbicide shall not be applied when the ambient temperature is above 85 degrees F or below 60 degrees F. The spray pressure shall be at least 20 but not more than 30 pounds per square inch. Spraying shall not be performed when the vegetation is wet, when it appears that rain is imminent within 6 hours, or when the wind is blowing enough to scatter paper or trash.

### 607.04—Measurement and Payment

**Herbicide spraying** will be measured in units of 1,000 gallons of mixture and will be paid for at the contract unit price per 1,000 gallons. This price shall include furnishing and applying herbicide.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Herbicide spraying	Unit (1,000 gallons)

## SECTION 608—MOWING

### 608.01—Description

This work shall consist of mowing designated areas to a height of not less than 4 inches when and as directed by the Engineer until final acceptance.

### 608.02—Equipment

Equipment used for mowing operations shall be mechanical with a cutting width of at least 5 feet.

### 608.03—Measurement and Payment

**Mowing**, when a pay item, will be measured in hours of operation and will be paid for at the contract unit price per hour. This price shall include equipment, operators, fuel, and lubricants.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Mowing	Hour

## SECTION 609—TREE WELLS AND TREE WALLS

### 609.01—Description

This work shall consist of constructing wells and walls to protect the root system of trees, shrubs, or other woody plants at the locations shown on the plans or as designated by the Engineer.

### 609.02—Materials

Aggregate shall conform to the requirements of Section 203.

PVC pipe shall conform to the requirements of Section 232(g).

Geotextile fabric shall conform to the requirements of Section 245.

Rubble for masonry shall conform to the requirements of Section 204.

### 609.03—Procedures

Excavation incidental to and necessary for constructing tree wells and tree walls shall be conducted in a manner that will not damage the root system. Ends and damaged sections of roots shall be cleanly cut. Roots with a diameter of more than 3 inches shall not be cut.

Before any earth fill that will exceed 12 inches in thickness is spread over the feeding root system of trees or shrubs to be protected by tree wells, an aeration layer of coarse gravel or stone ranging from 1/2 to 5 inches in size shall be spread over the entire area for a depth of at least 6 inches or at the rate of 3 inches for every 12 inches of earth fill where such fills will be more than 2 feet in depth. The layer of aggregate shall be covered with sufficient fine screenings to choke the top of the porous fill. Aggregate shall not be placed inside the tree well.

### 609.04—Measurement and Payment

**Tree wells and tree walls** will be measured in cubic yards of masonry, complete-in-place, and will be paid for at the contract unit price per cubic yard of masonry. This price shall include excavation; drainpipe; and backfill, including aggregate.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Tree well (Standard)	Cubic yard
Tree wall (Standard)	Cubic yard

## SECTION 610—GABIONS

### 610.01—Description

This work shall consist of furnishing and installing gabions in accordance with these specifications and in conformity to the lines, dimensions, and grades shown on the plans or as established by the Engineer.

### 610.02—Materials

- (a) **Gabions** shall have a uniform horizontal width of at least 36 inches. Their dimensions shall be within  $\pm 3$  percent of the manufacturer's stated sizes.
- (b) **Wire mesh** shall conform to the requirements of Section 223.02(a).
- (c) **Selvedge (or perimeter) wire** shall be at least 0.148 inch in diameter (9 gage) and shall conform to the requirements of Section 223.02(a) for wire mesh.
- (d) **Tie and connection wire** shall conform to the requirements for the wire used in the mesh except that it shall be not more than two gages smaller.
- (e) **Gabion stone** shall conform to the requirements of Section 204.

### 610.03—Procedures

Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular baskets. Gabions shall be of single-unit construction whereby the base, lid, ends, and sides are woven into a single unit or whereby one edge of these units is connected to the base section of the gabion. The strength and flexibility at the point of connection shall be at least equal to those of the mesh.

If the length of the gabion exceeds its horizontal width, the gabion shall be equally divided into cells by diaphragms of the same mesh and gage as the body of the gabion. The length of each cell shall not exceed its width. The gabion shall be furnished with the necessary diaphragms secured in the proper position on the base so that no additional tying at the junction will be necessary.

Perimeter edges of the mesh forming the gabion shall be securely clip bound or selvedged in such a manner that the joints formed by tying the selvedges will have at least the same strength as the body of the mesh.

Tie and connection wire shall be supplied in sufficient quantity to fasten securely all edges of the gabion and diaphragms. At least two cross-connecting wires shall be in each cell whose height is one-third or one-half the width of the gabion. At least four cross-connecting wires shall be in each cell whose height equals the width of the gabion. The wire shall be secured through two open loops of the cage.

Excavating and backfilling for gabions shall be performed in accordance with the requirements of Section 303. Gabions shall be placed on a smooth foundation, and the final line and grade shall be approved by the Engineer.

Each gabion unit shall be assembled by binding the vertical edges with wire ties at approximately 6-inch intervals or by stitching a continuous piece of connecting wire around the vertical edges with a coil approximately every 4 inches. Wire ties or connecting wire shall be used to join units in the same manner as described for assembling. Internal tie wires shall be uniformly spaced and securely fastened in each cell of the structure.

A standard fence stretcher, chain fall, or iron rod may be used to stretch wire baskets and hold the alignment.

Gabions shall be filled with stone in a manner that will ensure alignment, ensure a minimum of voids, and avoid bulges. Rock and connection wires shall be alternately placed until the gabion is filled. After the gabion is filled, the lid shall be bent over until it meets the sides and edges of the gabion. The lid shall be secured to the sides, ends, and diaphragms with wire ties or connecting wire in the manner described for assembling.

### 610.04—Measurement and Payment

**Gabions** will be measured in cubic yards, complete-in-place, and will be paid for at the contract unit price per cubic yard. This price shall include furnishing and installing gabions; excavating; backfilling with suitable material; compacting; and disposing of surplus or unsuitable material.

**Minor structure excavation for gabions**, when specified on the plans, will be measured and paid for in accordance with the requirements of Section 303.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Gabion	Cubic yard

