DIVISION 600 - MISCELLANEOUS CONSTRUCTION

SECTION 601 - GABIONS AND MATTRESSES

601.01 Description This work shall consist of furnishing, assembling, filling with stones and lacing wire mesh baskets, hereafter called gabions or mattresses, constructed in accordance with these specifications and placed in conformity with the lines, grades and dimensions shown on the plans or established.

601.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Gabion	711.02
Stones for Gabions	711.03
Mattresses	711.07
Stones for Mattresses	711.08

601.03 Fabrication Gabions and mattresses shall be manufactured so that their sides, ends, lid, and diaphragm(s) can be assembled to form rectangular units of the specified dimensions.

Gabions shall be of a single unit construction. The front, base, back and lid shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base.

The base, sides, and two ends of mattresses shall be of a single unit construction woven into a single unit. Diaphragm(s) shall be factory connected to the base. The lid may be a separate unit.

Perimeter edges of the mesh forming the gabion or mattress shall be securely fastened so that joints have at least the same strength as the wire mesh itself.

The wire mesh shall be fabricated to be non-raveling. Non-raveling is defined as the ability to resist pulling apart at any of the twists or connections forming the mesh when a single wire in a section of mesh is cut and the section of mesh then subjected to the load test described in the materials specification.

The gabion length shall be 1½, 2, 3, or 4 times its horizontal width. The horizontal width shall not be less than 36 in. However, all gabions furnished by the manufacturer shall be of uniform width. Where the gabion length exceeds 1½ times its horizontal width, the gabion shall be equally divided into cells by diaphragm(s) of the same mesh and gauge as the gabion body.

Mattresses shall be at least 6 ft by 6 ft and equally divided by transverse diaphragms.

601.04 Assembling Gabions and mattresses shall be supplied folded flat, tied in pairs and packed in bundles. Single units shall be removed from the bundle; unfolded flat on the ground and all kinks and bends flattened.

The units shall be assembled individually by erecting the front side, back side, ends, and diaphragm(s), assuring that all creases are in the correct position and the tops of all sides level.

The four corners of each unit shall be laced first, followed by the edges of internal diaphragm(s) to the sides.

The lacing procedures for lacing corners and units together shall consist of cutting a length of lacing wire approximately 1½ times the distance to be laced, not to exceed 5 ft, securing the wire terminal at the corner by looping and twisting, then proceeding to lace with alternating single and double loops at approximately 5 in intervals and securely fasten the other wire terminal.

The mattresses shall not be assembled in their final location, except as required for lacing adjacent units together. This is to maintain a uniform bedding surface for installation as described in Section 601.051.

At the option of the Contractor, approved locking wire fasteners may be used in lieu of lacing wire provided they are used in every mesh opening along the joint, each ring is formed such that the ends interlock and the fasteners be of stainless steel construction with a minimum thickness of 0.125 in, meeting the requirements of ASTM A213, Type 302.

601.05 Installation of Gabions The assembled gabion units shall be placed in the proper location. All adjoining empty gabions shall be placed along the perimeter of the gabion contact surfaces to obtain a monolithic structure.

Once the gabion units are laced together, they shall be stretched to effective alignment. This operation shall be carried out after several empty gabion units have been positioned. The first gabion in the line shall be partially filled to provide the necessary anchorage prior to stretching. Stretching shall be carried out using a means of stretching of at least 1 ton capacity.

While under tension, the gabion shall be carefully controlled against any possible unraveling.

Whenever gabion structures require more than one tier, the upper empty gabion tier, while under tension, shall be laced to the top of the lower one.

601.051 Installation of Mattresses If the mattress is to be placed in the dry, the assembled unit shall be placed in the proper location after it is assembled as described in Section 601.04. Several empty units shall be laced together along the contact surfaces to obtain a monolithic structure. Care shall be taken to maintain a uniform surface on the bedding material.

If the mattresses are to be placed underwater, they may be laced together, filled in the dry, and then placed in final position.

If the mattresses are polyvinyl chloride coated, they shall not be dragged, but shall be placed in a manner so as not to damage the coating.

601.052 Filter Fabric A filter fabric in accordance with Section 722.02 - Drainage Geotextile, shall be placed on the subgrade, backslope, and sides of the excavation. If earthfill is to be placed over the gabions, filter fabric shall be placed top of the gabions before earthfill placement.

601.06 Filling Gabions and mattresses shall be filled in strict accordance with the manufacturer's recommendations, one copy of these recommendations will be supplied to the Resident. Care shall be taken when placing stones inside gabions and mattresses in an effort to prevent distortion and ensure proper alignment.

Care shall be taken when placing fill material to assure that the sheathing on coated units will not be broken or damaged.

Gabions shall be filled in layers, 1 ft at a time. Two connecting wires shall be placed between each layer in all cells along all exposed faces of the gabion structure. All connecting wires shall be looped around two mesh openings and the wire terminals shall be securely twisted to prevent their loosening.

The cells in any row shall be filled in stages so that local deformation will be avoided. At no time shall any cell be filled to a depth exceeding 1 ft more than the adjoining cell.

Along all exposed gabion faces, the outer layer of stone shall be carefully placed and packed by hand to ensure proper alignment and a neat, compact, square appearance. No sharp edges of stone shall protrude through the wire mesh. The last layer of stone shall be leveled with the top of the gabion or mattress to allow proper closing of the lid and provide an even surface for the next course.

Gabions and mattresses shall be well packed and full without excessive bulging.

601.061 Filling of Hand Filled Gabions The assembled gabion units shall be placed in the proper location. A form shall then be placed along the front face and any side face not adjacent to an already placed gabion, and anchored to formwork on the back face to provide a rigid frame rectangle before filling with stone.

The forms shall be sufficiently braced and tied to prevent distortion while the stones are being placed.

On all exposed gabion faces, the outer layer of stone shall be carefully placed and packed by hand to ensure proper alignment and a neat, compact, square appearance. No sharp edges of stone shall protrude through the wire mesh.

Care shall be taken when placing fill material to assure that the sheathing on coated units will not be broken or damaged.

Gabions shall be filled by hand in 1 ft layers. Two connecting wires shall be placed between each layer in all cells along all exposed faces of the gabion structure. All connecting wires shall be looped around two mesh openings and the wire terminals shall be securely twisted to prevent their loosening.

The cells in any row shall be filled in stages so that local deformation will be avoided. At no time shall any cell be filled to a depth exceeding 1 ft more than the adjoining cell.

The last layer of stone shall be leveled with the top of the gabion or mattress to allow proper closing of the lid and provide an even surface for the next course.

At no time will any stones be placed by machine.

Complete gabions shall have a maximum deviation from the designated shape of 1 inch in 3 ft. Gabions not meeting this tolerance will be emptied, adjustments made, and refilled.

601.07 Lid Closing The lids shall be stretched tightly over the filling, using crowbars or lid closing tools, until the lid meets the perimeter edges of the front and end panels. The lid shall then be tightly laced along all edges, ends, and diaphragms in the same manner as described above for assembly.

601.08 Cutting and Folding Mesh Where shown on the drawings or when otherwise directed, the mesh shall be cut, folded, and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh cut out completely or folded back and neatly wired to an adjacent face. The cut edges of the mesh shall be securely laced together with lacing wire in the manner as described above for assembling.

601.09 Method of Measurement Gabions and mattresses will be measured for payment by the cubic yard to the neat line dimensions shown on the plans.

601.10 Basis of Payment Payment for gabions and mattresses will be made at the contract unit price per cubic yard in place. Payment will be full compensation for excavating to place gabions and backfill material, for preparing and fine grading the foundations area, for furnishing and placing backfill material under and behind the gabions and for furnishing and placing all necessary gabion units including wire mesh baskets, lacing wire, rock fill and all labor and equipment necessary to complete the work.

	Pay Item	Pay Unit
601.21	Gabions, Galvanized	Cubic Yard
601.211	Gabions, Galvanized and Hand Filled	Cubic Yard
601.22	Gabions, PVC Coated	Cubic Yard
601.221	Gabions, PVC Coated and Hand Filled	Cubic Yard
601.23	Mattresses, Galvanized: _____	Cubic Yard
601.24	Mattresses, PVC Coated: _____	Cubic Yard

SECTION 602 - PIPE LINING
Reserved

SECTION 603 - PIPE CULVERTS AND STORM DRAINS

603.01 Description This work shall consist of constructing or reconstructing pipe culverts and storm drains, in accordance with these specifications, the Standard Detail plans and in reasonably close conformity with the lines and grades shown on the plans or established.

The word "pipe" in these specifications shall include both round pipe and pipe arches.

603.02 Materials Meet Sections:

Joint Mortar	705.02
Flexible Gaskets	705.03
Flexible Culvert Polyvinylchloride (PVC) Pipe	706.08
Polypropylene Pipe	706.10
Corrugated Steel, Metallic Coated Pipe	707.02
Corrugated Aluminum Alloy Pipe & Pipe Arches	707.06
Polymer Precoated, Galvanized Corrugated Steel	707.07
Pipe & Pipe Arches	
Aluminum Coated (Type 2) Corrugated Steel Pipe	707.10
Zinc-Coated (Galvanized) Corrugated Steel Pipe	707.11
Rigid Culvert	
Reinforced Concrete Pipe	706.02
Corrugated Polyethylene Pipe	706.06

Flexible culverts with a diameter of 48 inches or more shall have the ends cut to a partial bevel as called for on the plans. The cut ends of galvanized steel pipe shall be regalvanized or painted with a zinc aluminum paint conforming to Federal Specification TT-P-1561A or an approved equal.

Helical corrugated pipe shall be re-rolled to form angular corrugations on the ends.

The corrugated bands for connecting pipe with $2^2/_3$ inches by ½ inch corrugations shall be not less than 10½ inches wide.

Rigid culverts, designated to have the ends shaped to a partial bevel, shall be either cast or cut to the required shape and dimensions. In either case, the edges of the pipe shall be even and true with no exposed reinforcing.

603.03 Construction Requirements

603.031 General Culvert pipe and pipe arches shall be furnished under the following options unless otherwise specified.

Option I The Contractor shall furnish any of the following type of pipe under Option I:

Corrugated Steel, Metallic (zinc or aluminum) Coated Pipe
Reinforced Concrete Pipe
Corrugated Polyethylene Pipe
Any of the metal pipes allowed under Option III.

Option III The Contractor shall furnish any of the following types of pipe under Option III. (Corrugated pipe used under this option shall be adequate to equal the flow capacity of comparable smoothlined pipe):

Corrugated Aluminum Alloy Pipe
Polyvinylchloride (PVC) Pipe
Polymer-Precoated Galvanized Corrugated Steel Pipe
Reinforced Concrete Pipe
Corrugated Polyethylene Pipe
Polypropylene Pipe

Within any single run of culvert pipe, including extensions of existing culverts, the type of pipe shall be the same unless otherwise specified or as directed by the Resident. In a closed drainage system, a run of culvert pipe shall be considered from catch basin to catch basin. In an open drainage system, a run of culvert shall be considered from inlet to outlet.

Option III polyvinylchloride (PVC) pipe shall only be used in closed drainage systems, between catch basins.

603.0311 Corrugated Polyethylene and Polypropylene Pipe for Option III If inspection by the Resident reveals an unsatisfactory installation, the Resident may direct the contractor to test installed Smooth Lined Corrugated Polyethylene and Polypropylene Pipe for Option III to ensure

the vertical deflection does not exceed the maximum allowable deflection. Maximum allowable deflection shall be 5 percent of the sum of the nominal inside diameter minus a 1.5 percent undersize tolerance.

Deflection tests shall not be performed until at least 30 days after completion of installation and compaction of backfill. The pipe shall be cleaned and inspected for offsets and obstructions before testing.

For all pipes 24 inches and smaller, a mandrel shall be pulled through the pipe by hand to ensure the maximum allowable deflections have not been exceeded. The mandrel shall be certified by the Department prior to use. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected.

For pipes greater than 24 inches, deflections shall be determined by a method submitted and approved by the Department. If a mandrel is selected, the minimum diameter and length and other requirements shall conform to the dimensions and requirements stated below. If other methods are used the measurements shall meet the minimum mandrel diameter requirements.

Any overdeflected pipe shall be uncovered and if not damaged as determined by the Department shall be allowed for reinstallation. Damaged pipe shall not be reinstalled and shall be removed from the work site.

The mandrel shall be a rigid non-adjustable, odd numbered-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter and having a minimum diameter at any point along the full length as follows:

Nominal Size inches	Minimum Mandrel Diameter inches
12	11.23
15	14.04
18	16.84
24	22.46
30	28.07
36	33.69
42	39.30
48	44.92
60	56.15

When deflection testing reveals over deflected pipe, all costs incurred by the Contractor including mandrel and deflection testing, reinstallation of pipe and delays shall be the

responsibility of the Contractor. When deflection testing reveals satisfactory pipe, all costs for deflection testing will be paid for by the Department.

603.032 Excavation Trenches shall be excavated in accordance with the requirements of Section 206 - Structural Excavation and wide enough to allow joining the culvert and compacting the bedding and backfill material under and around the culvert. Unless otherwise designated, trench walls shall be as nearly vertical as possible and the trench width no greater than necessary for installation of the culvert.

603.04 Bedding Culverts, less than 42 inches in diameter, shall be bedded on a firm foundation of uniform density. After placing the culvert pipe, backfill material shall be placed along the bottom of the trench, thoroughly tamped against the lower portion of the pipe with special care taken not to move the bedded pipe.

For culverts 42 inches in diameter and larger, the bottom of the trench shall be compacted to uniform density and shaped to fit a template with reasonable closeness for at least 10 percent of the culvert's total height.

On all bedding, when bell and spigot pipe is used, the portion of trench at the joints shall be shaped to fit the bell.

603.05 Laying Culvert The Contractor shall not install nor backfill culverts between December 15th and April 1st without written permission. Installing shall begin at the downstream end of the culvert line. Bell or groove ends of rigid culverts shall be placed facing upstream.

Elliptically shaped culverts shall be placed with the major axis within 5 degrees of vertical. Elliptically reinforced concrete pipe shall be placed with the vertical axis, indicated by the manufacturer, within 5 degrees of vertical.

603.06 Joining Culverts The method of joining rigid culvert sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be made with Portland cement mortar, Portland cement grout, rubber ring gaskets, or flexible plastic gaskets.

The pipe ends shall be thoroughly cleaned before the joint is made. Mortared joints shall be made with an excess of mortar to form a bead around the outside of the culvert and finished smooth inside. For grouted joints, molds or runners shall be used to retain the poured grout.

Joints with rubber ring gasket or flexible plastic gasket shall be made in accordance with the manufacturer's recommended procedures.

When Portland cement mixtures are used, the completed joints shall be covered to protect against drying.

Flexible culvert section and metal end sections shall be firmly jointed by coupling bands. These bands shall meet the same applicable requirements as the flexible culvert being joined.

603.07 Shop Strutting All flexible circular culvert pipe 48 inches in diameter and larger shall be elongated along the vertical diameter in accordance with one of the following two methods:

a) The pipe shall be elongated by the manufacturer after fabrication by increasing the diameter along the vertical axis approximately 3 percent with a corresponding decrease along the horizontal axis. The elongation shall be obtained by installing rods and tightening the rods, uniformly from end to end of the pipe, obtaining approximately one quarter of the required elongation each time throughout the length of the pipe.

The rods shall be ⅝ inch diameter threaded 7 inches at both ends with washers and nuts. The length of the rods shall be the diameter of the pipe plus 8 inches. The rods shall be placed on the horizontal axis of the pipe at 2 foot spacing and located halfway between the circumferential riveting. A block of soft wood 2 inches by 4 inches by 12 inches long, shall be placed over the rods at each end to provide contact against the outside of the pipe. The long dimension of the blocks shall be parallel with the horizontal axis of the pipe. The rods shall be left in the pipe until the fill is completed and compacted, unless for some unusual condition their removal is ordered. The rods shall be removed by cutting from the inside adjacent to the pipe.

(b) The pipe shall be elongated by the manufacturer by increasing the diameter along the vertical axis approximately 5 percent with a corresponding decrease along the horizontal axis by applying sufficient pressure to the sides of the pipe after fabrication to produce the specified distortion. The elongation shall be maintained by drilling holes in the ends of the pipe sections and placing and tightening horizontal wires. After the pipe sections have been installed with coupling bands, the wires shall be removed.

Helically corrugated culvert sections shall be match marked before being elongated by the manufacturer or before the ⅝ inch diameter rods are installed.

603.08 Backfilling Culverts and Storm Drains After the pipe is installed, it will be inspected before any backfill material is placed. All pipe found to be out of alignment, unduly settled or damaged to the extent that full performance is impaired, shall be taken up and re-laid or replaced.

Trenches shall be backfilled in accordance with Section 206.03 and as follows. The backfill material shall be thoroughly rammed under the haunches of the pipe with power or pneumatic operated hand tampers. The remainder of the backfill shall be thoroughly compacted with power tampers or vibratory compactors or other approved equipment or combination of equipment.

When the top of the pipe is exposed above the top of the trench, the embankment material around the pipe shall be placed and compacted on each side of the pipe in the aforementioned manner described for backfilling trenches, for a width of 5 feet measured from the outside diameter of the pipe. Only that portion of the embankment on each side and top of the pipe, for a minimum distance of 15 inches measured from the outside diameter of the pipe, must be of material conforming to the requirements described for backfilling in Section 206.03. Backfill material beyond these limits may contain stones larger than 3 inches but no greater than the thickness of the layer being placed. The embankment construction around the pipe shall continue up to an elevation 15 inches above the top of the pipe. Beyond these limits, the embankment shall be placed and compacted in accordance with the embankment construction requirements specified for the work except where the induced trench method is called for on the plans.

When construction equipment is used or traffic is maintained the Contractor shall provide a minimum cover of 3 feet over all pipes, if possible. Whenever this cover extends above the subgrade the Contractor shall temporarily place earth, which shall be removed when necessary to complete the work in accordance with the plans, or as directed. Any deviation from this practice shall have prior approval.

603.09 Induced Trench Under this method, for designated rigid pipes only, the embankment shall be completed as specified above, to a height above the culvert equal to the vertical outside diameter of the pipe plus 1 foot. A trench, equal in width to the outside horizontal diameter of the pipe, shall then be excavated to within 1 foot of the top of the pipe. Trench walls shall be as nearly vertical as possible. Hay bales shall be used to fill the lower 1/4 to 1/3 of the trench. Construction of the embankment above shall then proceed in a normal manner. The trench shall be loosely filled with highly compressible soil.

603.10 Removing and Relaying Culverts The pipe shall be carefully removed from its existing location, transported to and installed in the new location in accordance with these specifications for the particular type of pipe involved. Pipe damaged by the Contractor shall be replaced with pipe of similar type by the Contractor without additional compensation.

New metal bands or joint material shall be supplied and installed when necessary.

603.11 Method of Measurement Culvert and storm drain pipe of the different types and sizes, both new and re-laid, will be measured by the length in linear feet along the invert, laid as directed, complete in place, and accepted. Pipe laid in excess of the authorized length will not be included.

When the ends of a pipe are sloped or skewed, the amount to be included for payment shall be the length along the invert of the pipe.

When elbows, tees, wyes, or other special fittings are required, each fitting shall be included for payment as 3 additional linear feet of the largest pipeline involved.

Inlet grate units will be measured by each unit installed, complete in place, and accepted.

Concrete pipe ties shall be measured per Group (2 ties per Group).

603.12 Basis of Payment The accepted quantities of pipe for culverts and storm drains will be paid for at the contract unit price per linear foot, for the types and sizes specified, complete in place.

No payment will be made for pipe ordered without written approval of the Resident when such pipe is not required to be installed for completion of the work.

Excavation for culverts and storm drains, including excavation below the pipe, for induced trench and for bedding and backfilling will be considered incidental, except as provided in Section 206 - Structural Excavation.

Whenever minimum cover material extends above the subgrade, removal of the cover material necessary to complete the work will not be paid for directly but shall be considered part of the work specified herein.

Coupling bands and joint material will not be paid for separately but shall be considered included in the unit bid price for the type of pipe being used or re-laid.

Existing culverts to be re-laid, salvaged, or wasted shall be removed and disposed of as directed. The excavation for removal of these culverts that is not paid for under other items or incidental to other items shall be paid for as Common Excavation.

Inlet grate units will be paid for at the contract unit price each for the size specified, complete in place.

The accepted quantity of concrete pipe ties will be paid for at the contract unit price per Group. Such payment will be full compensation for furnishing, installing, and all other necessary incidentals for satisfactory completion of the work. Any grout or mortar necessary to repair chipping shall be incidental to the installation of the pipe ties.

Payment will be made under:

	Pay Item	Pay Unit
603.15	12 inch Culvert Pipe Option I	Linear Foot
603.16	15 inch Culvert Pipe Option I	Linear Foot
603.17	18 inch Culvert Pipe Option I	Linear Foot
603.18	21 inch Culvert Pipe Option I	Linear Foot
603.19	24 inch Culvert Pipe Option I	Linear Foot
603.20	30 inch Culvert Pipe Option I	Linear Foot
603.21	36 inch Culvert Pipe Option I	Linear Foot
603.159	12 inch Culvert Pipe Option III	Linear Foot

603.169	15 inch Culvert Pipe Option III	Linear Foot
603.179	18 inch Culvert Pipe Option III	Linear Foot
603.189	21 inch Culvert Pipe Option III	Linear Foot
603.199	24 inch Culvert Pipe Option III	Linear Foot
603.2009	27 inch Culvert Pipe Option III	Linear Foot
603.209	30 inch Culvert Pipe Option III	Linear Foot
603.2019	33 inch Culvert Pipe Option III	Linear Foot
603.219	36 inch Culvert Pipe Option III	Linear Foot
603.229	42 inch Culvert Pipe Option III	Linear Foot
603.239	48 inch Culvert Pipe Option III	Linear Foot
603.249	54 inch Culvert Pipe Option III	Linear Foot
603.259	60 inch Culvert Pipe Option III	Linear Foot
603.269	66 inch Culvert Pipe Option III	Linear Foot
603.279	72 inch Culvert Pipe Option III	Linear Foot
603.289	84 inch Culvert Pipe Option III	Linear Foot
603.30	21 inch span by 15 inch rise Pipe Arch Option III	Linear Foot
603.31	24 inch span by 18 inch rise Pipe Arch Option III	Linear Foot
603.32	28 inch span by 20 inch rise Pipe Arch Option III	Linear Foot
603.33	35 inch span by 24 inch rise Pipe Arch Option III	Linear Foot
603.34	42 inch span by 29 inch rise Pipe Arch Option III	Linear Foot
603.35	49 inch span by 33 inch rise Pipe Arch Option III	Linear Foot
603.36	57 inch span by 38 inch rise Pipe Arch Option III	Linear Foot
603.37	64 inch span by 43 inch rise Pipe Arch Option III	Linear Foot
603.38	66 inch span by 51 inch rise Pipe Arch Option III	Linear Foot
603.39	73 inch span by 55 inch rise Pipe Arch Option III	Linear Foot
603.40	81 inch span by 59 inch rise Pipe Arch Option III	Linear Foot
603.41	24 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.42	30 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.43	36 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.44	42 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.45	48 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.46	54 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.47	60 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.48	66 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.49	72 inch Reinforced Conc. Pipe Class IV	Linear Foot
603.55	Concrete Pipe Ties	Group
603.73	Remove and Relay Metal Pipe: _____	Linear Foot
603.7315	Remove and Relay 15 inch Metal Pipe	Linear Foot
603.7318	Remove and Relay 18 inch Metal Pipe	Linear Foot
603.7324	Remove and Relay 24 inch Metal Pipe	Linear Foot
603.733	Remove and Relay 30 inch Metal Pipe	Linear Foot
603.7336	Remove and Relay 36 inch Metal Pipe	Linear Foot
603.7348	Remove and Relay 48 inch Metal Pipe	Linear Foot
603.7372	Remove and Relay 72 inch Metal Pipe	Linear Foot
603.74	Remove and Relay Concrete Pipe: _____	Linear Foot

603.7415	Remove and Relay 15 inch Concrete Pipe	Linear Foot
603.7418	Remove and Relay 18 inch Concrete Pipe	Linear Foot
603.7421	Remove and Relay 21 inch Concrete Pipe	Linear Foot
603.7424	Remove and Relay 24 inch Concrete Pipe	Linear Foot
603.743	Remove and Relay 30 inch Concrete Pipe	Linear Foot
603.7436	Remove and Relay 36 inch Concrete Pipe	Linear Foot
603.7442	Remove and Relay 42 inch Concrete Pipe	Linear Foot
603.7448	Remove and Relay 48 inch Concrete Pipe	Linear Foot
603.7454	Remove and Relay 54 inch Concrete Pipe	Linear Foot
603.746	Remove and Relay 60 inch Concrete Pipe	Linear Foot
603.7472	Remove and Relay 72 inch Concrete Pipe	Linear Foot
603.75	6 inch Inlet Grate Unit	Each
603.76	12 inch Inlet Grate Unit	Each
603.77	15 inch Inlet Grate Unit	Each
603.78	18 inch Inlet Grate Unit	Each
603.79	21 inch Inlet Grate Unit	Each
603.80	24 inch Inlet Grate Unit	Each
603.81	30 inch Inlet Grate Unit	Each
603.82	36 inch Inlet Grate Unit	Each

SECTION 604 - MANHOLES, INLETS, AND CATCH BASINS

604.01 Description Construct manholes, inlets, and catch basins.

604.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Portland Cement	701.01
Clay or Shale Brick	704.01
Concrete Masonry Blocks	704.03
Joint Mortar	705.02
Reinforcing Steel	709.01
Stone Curbing and Edging	712.04
Precast Concrete Units	712.06
Tops and Traps	712.07
Corrugated Metal Units	712.08
Catch Basin and Manhole Steps	712.09

Except as otherwise provided on the plans, concrete for these structures shall meet the requirements of Section 502 - Structural Concrete.

Catch basin grates shall be either the type of grate shown on the Standard Details or an approved equal. The corners shall be notched by the Contractor at the project site by grinding the corner to fit the cast iron frames.

604.03 Construction Requirements Concrete catch basins and manholes shall be constructed of precast units, except that concrete blocks may be used around inlet and outlet pipes. Joints for precast concrete units shall be of Portland cement mortar, rubber gaskets, flexible plastic rings, mastic joint filler or other approved types to form a watertight joint. Joints for concrete blocks shall be of Portland cement mortar, not more than ½ inch wide, completely filled and neatly tooled on the inside of the structure.

Metal catch basins shall be corrugated metal pipe units mounted on a Portland cement concrete foundation.

Catch basins and manholes shall be placed to the required grade on a compacted foundation of uniform density. Inlet and outlet pipe elevations may vary from the elevations shown on the plans depending upon field conditions.

Pipe sections entering catch basins shall be firmly connected to the structure wall with no part of the pipe projecting more than 6 inches inside the wall. When a section of culvert is cut, the end shall be finished in a skillful manner.

Metal frames and traps, when called for, shall be set in a bed of clay bricks or shale bricks and mortar, or otherwise secured as shown on the plans. Castings shall be set to the correct elevation before the next final course of paving material has been placed.

Upon completion, each catch basin and manhole shall be cleaned of all accumulation of silt, debris, or foreign matter and shall be kept clean until final acceptance of the work.

604.04 Altering, Adjusting, and Rebuilding Catch Basins and Manholes Existing catch basins and manholes shall be dismantled sufficiently to allow altering, adjusting, or rebuilding in accordance with the applicable requirements as shown on the Standard Detail plans for complete catch basins and manholes. When existing frames, covers, and grates are used, they shall be thoroughly cleaned of existing mortar before placing to the new grade.

a. Altering Catch Basin The existing top assembly shall be removed and replaced with a new Type A or Type B frame and special grate set to the required grade using approved clay brick and mortar.

b. Adjusting Catch Basins and Manholes The existing top assembly shall be removed, thoroughly cleaned, and reset to the new grade using approved clay brick and mortar.

c. Rebuilding Catch Basins and Manholes The existing top assembly, cone section, and barrel section shall be removed down to the outlet flow line grade to the extent required, as determined by the Resident, and shall be rebuilt and a new frame and grate furnished and installed at the required line and grade directed. Concrete blocks may be used to rebuild the barrel section, if necessary, due to existing conditions.

All salvaged material not reused, including grates, and frames, and curb inlets will remain the property of the present owner unless otherwise specified.

Each catch basin and manhole altered, adjusted, or reconstructed, shall be cleaned of all accumulated silt, debris, and other foreign matter before final acceptance of the work.

Resetting the curb inlet will be included in the adjusting or rebuilding catch basin items

604.05 Method of Measurement Catch basins, manholes, and accessories of the respective types will be measured by the number of units, measured as follows, complete, and accepted in place.

a. Complete Structures Each catch basin and manhole having a depth up to 8 feet from the top of the grate or cover to the top of the floor, measured to the nearest foot, will be one unit. ⅛ of a unit will be added for each additional foot over 8 feet measured to the nearest foot. Depth measurements in excess of the dimensions authorized will not be included.

b. Existing Structures Existing catch basins and manholes to be altered, adjusted or rebuilt will be one unit each. Existing catch basins and manholes that are cleaned will be one unit each.

c. Trap Each trap included in the completed structure will be one unit each.

d. Step Each step included in the completed structure will be one unit each.

e. Grate Each grate changed under item 604.167 will be measured by each unit, complete in place and accepted.

604.06 Basis of Payment The accepted quantities of catch basins, manholes, altered grates, traps, and steps, will be paid for at the contract unit price each of the respective types complete in place. Payment for rebuilding, adjusting or altering catch basins and manholes shall include furnishing all materials including new blocks, bricks, mortar, metal tops, covers, and curb inlets when required. Frames, grates, and covers for new or rebuilt catch basins or manholes shall be considered part of the structure and no separate payment will be made. Payment for cleaning existing catch basins and manholes will be paid for at the contract unit price each. There will be no payment for cleaning new, altered, adjusted, or rebuilt catch basins and manholes. Payment will be full compensation for supplying all equipment and labor to clean the basins and manholes and to dispose of the waste.

Excavation and backfill will be considered incidental, except as provided in Section 206 - Structural Excavation.

Payment will be made under:

Pay Item		Pay Unit
604.072	Catch Basin Type A1-C	Each
604.082	Catch Basin Type A2-C	Each
604.09	Catch Basin Type B1	Each
604.092	Catch Basin Type B1-C	Each
604.096	60”Catch Basin Type B1-C	Each
604.097	72”Catch Basin Type B1-C	Each
604.10	Catch Basin Type B2	Each
604.102	Catch Basin Type B2-C	Each
604.11	Catch Basin Type C1	Each
604.12	Catch Basin Type C2	Each
604.13	24 inch Catch Basin Type E	Each
604.14	30 inch Catch Basin Type E	Each
604.15	Manhole	Each
604.16	Altering Catch Basin to Manhole	Each
604.161	Altering Catch Basin	Each
604.164	Rebuilding Catch Basin	Each
604.166	Rebuilding Manhole	Each
604.167	ChangeCatch Basin Grate to Cascade Grate	Each
604.17	Altering Manhole to Catch Basin	Each
604.18	Adjusting Manhole or Catch Basin to Grade	Each
604.182	Cleaning Existing Catch Basin and Manhole	Each
604.19	8 inch Trap	Each
604.20	12 inch Trap	Each
604.21	15 inch Trap	Each
604.22	18 inch Trap	Each
604.23	Step	Each
604.242	Catch Basin Type F3	Each
604.243	Catch Basin Type F3-C	Each
604.244	Catch Basin Type F4	Each
604.245	Catch Basin Type F4-C	Each
604.246	Catch Basin Type F5	Each
604.247	Catch Basin Type F5-C	Each
604.248	Catch Basin Type F6	Each
604.249	Catch Basin Type F6-C	Each
604.25	Catch Basin Type A5	Each
604.252	Catch Basin Type A5-C	Each
604.26	Catch Basin Type B5	Each
604.262	Catch Basin Type B5-C	Each

SECTION 605 - UNDERDRAINS

605.01 Description This work shall consist of the construction of underdrain, using pipe and filter material and pipe outlets in accordance with these specifications and the standard detail plans and in reasonably close conformity with the lines and grades shown on the plans or established.

605.02 Materials. Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Granular Borrow	703.19
Underdrain Backfill Material	703.22
Underdrain Pipe	
Corrugated Polyethylene Pipe	706.06
Polyvinylchloride (PVC) Perforated Pipe	706.09
Corrugated Steel, Metallic Coated Pipe for Underdrain	707.05
Corrugated Aluminum Alloy Pipe for Underdrain	707.08
Underdrain Outlet Pipe	
Corrugated Polyethylene Pipe	706.06
Corrugated Steel, Metallic Coated Pipe for Underdrain	707.02
Corrugated Aluminum Alloy Pipe	707.06

Connections for polyethylene pipe shall be made with external wrap-around split couplings, screw-on type couplings, external snap-on couplings, or bell and spigot and ring gasket. External wrap-around split couplings shall be secured with heavy duty splicing tape or plastic or wire ties placed on each side of the coupling. External snap-on couplings shall comply with the appropriate section of AASHTO Specifications.

Connections for other plastic underdrain pipe shall be made with bell and spigot and ring gasket.

Connections for metallic underdrain pipe shall be made with corrugated metal bands secured with bolts. Dimpled bands shall not be used.

Other types of connectors for underdrain may be used upon approval by the Resident.

605.021 Fittings The material for elbows, tees and wyes for Underdrain pipe shall be at least as thick as the largest size pipe being connected.

605.03 General Underdrain pipe for Underdrain, Type B shall, at the Contractor's option, consist of any one of the following types:

Corrugated Aluminum Alloy Pipe for Underdrain
Corrugated Polyethylene Pipe for Underdrain (Smoothlined)
Metallic Coated (Zinc or Aluminum Coated) Corrugated Steel Pipe for Underdrain

Polyvinylchloride (PVC) Perforated Pipe

At the Contractor's option, underdrain pipe for Underdrain Type C shall consist of any one of the following types:

Corrugated Aluminum Alloy Pipe for Underdrain
Corrugated Polyethylene Pipe (Smoothlined)
Metallic Coated (Zinc or Aluminum Coated) Corrugated Steel Pipe for Under-drain
Polyvinylchloride (PVC) Perforated Pipe

605.04 Underdrain Construction

a. Underdrain, Type B The trench shall be excavated to the required width and depth and a bed of the specified granular material, 3 inches in depth, prepared in the trench. 6 inch perforated pipe shall be laid on this bed with the perforations as shown on the Standard Detail plans.

After the pipe has been firmly bedded and joints securely connected, it will be inspected before any backfill is placed. The remaining backfill shall be granular material meeting the same requirements as that used for bedding the pipe.

For underdrain placed under areas of proposed pavement, the material shall be placed in 8 inch layers, loose measure and thoroughly compacted except that the initial layer of backfill around the pipe may be placed in a layer not exceeding 12 inches. For underdrains placed under areas not proposed to be paved, the initial layer of backfill shall not exceed 12 inches and the remaining material may be placed in one lift to the elevation of the subgrade and compacted with heavy rubber tired or vibratory compaction equipment to the satisfaction of the Resident.

The upstream end of all completed underdrain pipe shall be sealed with cement mortar or other acceptable material. Care shall be taken that soil does not enter the pipe. Pipe contaminated before backfilling shall be removed, cleaned, and re-laid.

b. Underdrain Type C The trench shall be excavated to the width and depth as determined by the size and depth of the pipe to be installed.

The perforated pipe shall be laid to line and grade centered on the bottom of the trench with the perforations as shown on the Standard Detail plans.

After the pipe has been firmly bedded and all joints securely connected, it will be inspected before any backfill is placed. The backfill shall be placed in accordance with Section 603.08 and as shown on the Standard Detail plans using the materials specified.

When Underdrain Type B or Underdrain Type C is constructed, backfill material beyond the underdrain trench lateral limits designated on the plans shall be material conforming to the

requirements of Granular Borrow, Underwater Backfill. Material within the underdrain trench limits shall conform to the requirements of the type underdrain being constructed. The Contractor shall take precautions to prevent the underdrain backfill material from becoming contaminated with clay, silts, organic matter, or other foreign matter. Methods of placing backfill material shall be limited to the use of equipment that will place material directly into the trench. Pushing material into the trench will not be allowed.

When underdrain is to be constructed in embankment fill, the excavation for the trench shall be done after the embankment has been completed to subgrade elevation.

605.05 Underdrain Outlets Trenches for underdrain outlets shall be excavated to the required width and depth. These outlets shall be of the same size and wall thickness used in the underdrain, except that the perforations may be omitted.

The pipe shall be laid in the trench with all ends firmly joined by the applicable methods and means. After inspection and approval of the pipe installation, the trench shall be backfilled with suitable material in layers and compacted as provided for in Section 603.08.

605.06 Method of Measurement Underdrain and underdrain outlets will be measured by the length in linear feet along the centerline of underdrains and underdrain outlets of the types and sizes completed and accepted.

When elbows, tees, wyes, or other special fittings are required in underdrain, each fitting shall be included for payment as 3 additional linear feet of the largest pipe size involved.

605.07 Basis of Payment The accepted quantities of underdrains and underdrain outlets will be paid for at the contract unit price per linear foot of each type and size specified complete in place. Outlet pipe for Underdrain, Type C will be paid for under Section 603 - Pipe Culverts and Storm Drains.

Within and beyond the trench limits, backfill, couplings and bands and other related items will not be paid for separately, but shall be considered included in the unit bid price for the type of underdrain being installed.

Excavation will be considered incidental, except as provided in Section 206 - Structural Excavation. No allowance for payment will be made for excavating or material excavated beyond the horizontal dimensions shown for Underdrain, Type B or Underdrain, Type C.

Payment will be made under:

	Pay Item	Pay Unit
605.09	6 inch Underdrain Type B	Linear Foot
605.10	6 inch Underdrain Outlet	Linear Foot
605.11	12 inch Underdrain Type C	Linear Foot
605.12	15 inch Underdrain Type C	Linear Foot

605.13	18 inch Underdrain Type C	Linear Foot
605.14	21 inch Underdrain Type C	Linear Foot
605.15	24 inch Underdrain Type C	Linear Foot
605.17	30 inch Underdrain Type C	Linear Foot
605.18	36 inch Underdrain Type C	Linear Foot

SECTION 606 – GUARDRAIL

606.01 Description This work shall consist of furnishing and installing guardrail components in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or as established. The types of guardrail are designated as follows:

Type 3-Galvanized steel "w" beam, wood posts or galvanized steel posts.
Type 3a-Galvanized steel "w" beam, wood posts, wood or composite offset blocks.
Type 3aa-Corrosion resistant steel "w" beam, wood posts, wood or composite offset blocks.
Type 3b-Galvanized steel "w" beam, galvanized steel posts, galvanized steel offset blocks.
Type 3c-Galvanized steel "w" beam, wood posts or galvanized steel posts, wood or composite offset blocks. Type 3d-Galvanized steel "w" beam, galvanized steel posts, wood or composite offset blocks.
Thrie Beam-Galvanized steel thrie beam, wood posts or galvanized steel posts, wood or composite offset blocks.

Median barriers shall consist of two beams of the above types, mounted on single posts. Except for thrie beam, median barriers may include rub rails when called for.

Bridge mounted guardrail shall consist of furnishing all labor, materials, and equipment necessary to install guardrail as shown on the plans. This work shall also include drilling for and installation of offset blocks if specified, and incidental hardware necessary for satisfactory completion of the work.

Remove and Reset and Remove, Modify, and Reset guardrail shall consist of removing the existing designated guardrail and resetting in a new location as shown on the plans or directed by the Resident. Remove, Modify, and Reset guardrail and Modify guardrail include the following guardrail modifications: Removing plate washers at all posts, except at anchorage assemblies as noted on the Standard Details, Adding offset blocks, and other modifications as listed in the Construction Notes or General Notes. Modifications shall conform to the guardrail Standard Details.

Bridge Connection shall consist of the installation and attachment of beam guardrail to the existing bridge. This work shall consist of constructing a concrete end post or modifying an existing end post as required, furnishing, and installing a terminal connector, necessary hardware, and incidentals required to complete the work as shown on the plans. Bridge

Transition shall consist of a bridge connection and furnishing and installing guardrail components as shown in the Standard Details.

606.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Timber Preservative	708.05
Metal Beam Rail	710.04
Guardrail Posts	710.07
Guardrail Hardware	710.08

Guardrail components shall meet the applicable standards of "A Guide to Standardized Highway Barrier Hardware" prepared and approved by the AASHTO-AGC-ARTBA Joint Cooperative Committee, Task Force 13 Report.

Posts for underdrain delineators shall be "U" channel steel, 8 ft long, 2 ½ lb/ft minimum and have 3/8 inch round holes, 1 inch center to center for a minimum distance of 2 ft from the top of the post.

Reflectorized Flexible Guardrail Markers shall be mounted on all guardrails. A marker shall be mounted onto guardrail posts at the flared end treatment's terminal and its tangent point, both at the leading and trailing ends of each run of guardrail. The marker's flexible posts shall be grey with either silver-white or yellow reflectors (to match the edge line striping) at the tangents, red at leading ends, and green at trailing ends. Whenever the end treatment is not flared, markers will only be required at the end treatment's terminal. These shall be red or green as appropriate. Markers shall be installed on the protected side of guardrail posts unless otherwise approved by the Resident. Reflectorized flexible guardrail markers shall be from the MaineDOT's Qualified Products List of Guardrail Material. The marker shall be grey, flexible, durable, and of a non-discoloring material to which 3 inch by 9 inch reflectors shall be applied, and capable of recovering from repeated impacts. Reflective material shall meet the requirements of Section 719.01 for ASTM D 4956 Type III reflective sheeting. The marker shall be secured to the guardrail post with two fasteners, as shown in the Standard Details.

Reflectorized beam guardrail ("butterfly"-type) delineators shall be mounted on all "w"-beam guardrail. The delineators shall be mounted within the guardrail beam at guardrail posts. Delineators shall be fabricated from high-impact, ultraviolet & weather resistant thermoplastic. Reflectorized beam guardrail delineators shall be placed at approximately 62.5 ft intervals or every tenth post on tangents and at approximately 31.25 ft intervals or every fifth post on curves. Exact locations of the delineators shall be as directed by the Resident. On divided highways, the left hand delineators shall be yellow and the right hand delineators shall be silver/white. On two directional highways, the right hand side shall be silver/white and no reflectorized delineator used on the left. All reflectors shall have reflective sheeting applied to only one side of the delineator facing the direction of traffic as shown in the Standard Detail 606(07). Reflectorized sheeting for guardrail delineators shall meet the requirements of Section 719.01.

Single wood post shall be of cedar, white oak, or tamarack, well-seasoned, straight, and sound and have been cut from live trees. The outer and inner bark shall be removed and all knots trimmed flush with the surface of the post. Posts shall be uniform taper and free of kinks and bends.

Single steel post shall conform to the requirements of Section 710.07 b.

Single steel pipe post shall be galvanized, seamless steel pipe conforming to the requirements of ASTM A120, Schedule No. 40, Standard Weight.

Acceptable multiple mailbox assemblies shall be listed on the Department's Qualified Products List and shall be NCHRP 350 tested and approved.

The Guardrail 350 Flared Terminal shall be a terminal with a 4 ft offset as shown in the Manufacturer's installation instructions.

Existing materials damaged or lost during adjusting, removing and resetting, or removing, modifying, and resetting, shall be replaced by the Contractor without additional compensation. Existing guardrail posts and guardrail beams found to be unfit for reuse shall be replaced when directed by the Resident.

606.03 Posts Posts for guardrail shall be set plumb in holes or they may be driven if suitable driving equipment is used to prevent battering and distorting the post. When posts are driven through pavement, the damaged area around the post shall be repaired with approved bituminous patching. Damage to lighting and signal conduit and conductors shall be repaired by the Contractor.

When set in holes, posts shall be on a stable foundation and the space around the posts, backfilled in layers with suitable material, thoroughly tamped.

The reflectorized flexible guardrail markers shall be set plumb with the reflective surface facing the oncoming traffic. Markers shall be installed on the protected side of guardrail posts. Markers, which become bent or otherwise damaged, shall be removed and replaced with new markers.

Single wood posts shall be set plumb in holes and backfilled in layers with suitable material, thoroughly tamped. The Resident will designate the elevation and shape of the top. The posts, that are not pressure treated, shall be painted two coats of good quality oil base exterior house paint.

Single steel posts shall be set plumb in holes as specified for single wood posts or they may be driven if suitable driving equipment is used to prevent battering and distorting the post.

Additional bolt holes required in existing posts shall be drilled or punched, but the size of the holes shall not exceed the dimensions given in the Standard Details. Metal around the holes

shall be thoroughly cleaned and painted with two coats of approved aluminum rust resistant paint. Holes shall not be burned.

606.04 Rails Brackets and fittings shall be placed and fastened as shown on the plans. Rail beams shall be erected and aligned to provide a smooth, continuous barrier. Beams shall be lapped with the exposed end away from approaching traffic.

End assemblies shall be installed as shown on the plans and shall be securely attached to the rail section and end post.

All bolts shall be of sufficient length to extend beyond the nuts but not more than ½ inch. Nuts shall be drawn tight.

Additional bolt holes required in existing beams shall be drilled or punched, but the size of the holes shall not exceed the dimensions given in the Standard Details. Metal around the holes shall be thoroughly cleaned and painted with two coats of approved aluminum rust resistant paint. Holes shall not be burned.

606.045 Offset Blocks The same offset block material is to be provided for the entire project unless otherwise specified.

606.05 Shoulder Widening At designated locations the existing shoulder of the roadway shall be widened as shown on the plans. All grading, paving, seeding, and other necessary work shall be in accordance with the Specifications for the type work being done.

606.06 Mail Box Post Single wood post shall be installed at the designated location for the support of the mailbox. The multiple mailbox assemblies shall be installed at the designated location in accordance with the Standard Details and as recommended by the Manufacturer. Attachment of the mailbox to the post will be the responsibility of the home or business owner.

606.07 Abraded Surfaces All galvanized surfaces of new guardrail and posts, which have been abraded so that the base metal is exposed, and the threaded portions of all fittings and fasteners and cut ends of bolts shall be cleaned and painted with two coats of approved rust resistant paint.

606.08 Method of Measurement Guardrail will be measured by the linear foot from center to center of end posts along the gradient of the rail except where end connections are made to masonry or steel structures, in which case measurement will be as shown on the plans.

Terminal section, low volume end, NCHRP 350 end treatments, reflectorized flexible guardrail marker, terminal end, bridge transition, bridge connection, multiple mailbox post, and single post will be measured by each unit of the kind specified and installed.

Widened shoulder will be measured as a unit of grading within the limits shown on the plans.

Excavation in solid rock for placement of posts will be paid under force account unless otherwise indicated in the Bid Documents.

606.09 Basis of Payment The accepted quantities of guardrail will be paid for at the contract unit price per linear foot for the type specified, complete in place. Reflectorized beam guardrail ("butterfly"-type) delineators will not be paid for directly, but will be considered incidental to guardrail items. Terminal section, buffer end, NCHRP 350 end treatment, bridge connection, single post and reflectorized flexible guardrail markers will be paid for at the contract unit price each for the kind specified complete in place.

NCHRP 350 end treatments and low volume guardrail ends will be paid for at the contract price each, complete in place which price shall be full payment for furnishing and installing all components including the terminal section, posts, offset blocks, "w" beam, cable foundation posts, plates and for all incidentals necessary to complete the installation within the limits as shown on the Standard Details or the Manufacturer's installation instructions. Each end treatment will be clearly marked with the manufacturers name and model number to facilitate any future needed repair. Such payment shall also be full compensation for furnishing all material, excavating, backfilling holes, assembling, and all incidentals necessary to complete the work, except that for excavation for posts or anchorages in solid ledge rock, payment will be made under 109.7.5 – Force Account. Type III Retroreflective Adhesive Sheeting shall be applied to the approach buffer end sections and sized to substantially cover the end section. On all roadways, the ends shall be marked with alternating black and retroreflective yellow stripes. The stripes shall be 3 in wide and sloped down at an angle of 45 degrees toward the side on which traffic is to pass the end section. Guardrail 350 flared terminal shall also include a set of installation drawings supplied to the Resident.

Anchorages to bridge end posts will be part of the bridge work. Connections thereto will be considered included in the unit bid price for guardrail.

Guardrail to be placed on a radius of curvature of 150 ft or less will be paid for under the designated radius pay item for the type guardrail being placed.

Widened shoulder will be paid for at the contract unit price each complete in place and will be full compensation for furnishing and placing, grading and compaction of aggregate subbase and any required fill material.

Adjust guardrail will be paid for at the contract unit price per meter and will be full compensation for adjusting to grade. Payment shall also include adjusting terminal end treatments where required.

Modify guardrail will be paid for at the contract unit price per meter and will be full compensation for furnishing and installing offset blocks, additional posts, and other specified modifications; removing, modifying, installing, and adjusting to grade existing posts and beams;

removing plate washers and backup plates, and all incidentals necessary to complete the work. Payment shall also include removing and resetting terminal ends where required.

Remove and Reset guardrail will be paid for at the contract unit price per meter and will be full compensation for removing, transporting, storing, reassembling all parts, necessary cutting, furnishing new parts when necessary, reinstalling at the new location, and all other incidentals necessary to complete the work. Payment shall also include removing and resetting terminal ends when required. No payment will be made for guardrail removed, but not reset and all costs for such removal shall be considered incidental to the various contract pay items.

Remove, Modify, and Reset guardrail will be paid for at the contract unit price per foot and will be full compensation for the requirements listed in Modify guardrail and Remove and Reset guardrail.

Bridge Connections will be paid for at the contract unit price each. Payment shall include, attaching the connection to the endpost including furnishing and placing concrete and reinforcing steel necessary to construct new endposts if required, furnishing and installing the terminal connector, and all miscellaneous hardware, labor, equipment, and incidentals necessary to complete the work.

Bridge Transitions will be paid for at the contract unit price each. Payment shall include furnishing and installing the thrie beam or "w"-beam terminal connector, doubled beam section, and transition section, where called for, posts, hardware, precast concrete transition curb, and any other necessary materials and labor, including the bridge connection as stated in the previous paragraph.

Payment will be made under:

Pay Item		Pay Unit
606.15	Guardrail Type 3a-Single Rail	Linear Foot
606.151	Guardrail Type 3aa-Single Rail	Linear Foot
606.17	Guardrail Type 3b-Single Rail	Linear Foot
606.1721	Bridge Transition - Type I	Each
606.1722	Bridge Transition - Type II	Each
606.1731	Bridge Connection - Type I	Each
606.1732	Bridge Connection - Type II	Each
606.178	Guardrail Beam	Linear foot
606.18	Guardrail Type 3b - Double Rail	Linear foot
606.19	Guardrail Type 3a - 15 ft radius and less	Linear Foot
606.191	Guardrail Type 3aa - 15 ft radius and less	Linear Foot
606.20	Guardrail Type 3a - over 15 ft radius	Linear Foot
606.201	Guardrail Type 3aa - over 15 ft radius	Linear Foot
606.21	Guardrail Type 3b - 15 ft radius and less	Linear Foot

606.22	Guardrail Type 3b - over 15 ft radius	Linear Foot
606.23	Guardrail Type 3c - Single Rail	Linear Foot
606.2301	Guardrail Type 3c - Double Rail	Linear Foot
606.231	Guardrail Type 3c - 15 ft radius and less	Linear Foot
606.232	Guardrail Type 3c - over 15 ft radius	Linear Foot
606.24	Guardrail Type 3d - Single Rail	Linear Foot
606.2401	Guardrail Type 3d - Double Rail	Linear Foot
606.241	Guardrail Type 3d - 15 ft radius and less	Linear Foot
606.242	Guardrail Type 3d - over 15 feet radius	Linear Foot
606.25	Terminal Connector	Each
606.257	Terminal Connector - Thrie Beam	Each
606.265	Terminal End-Single Rail - Galvanized Steel	Each
606.266	Terminal End-Single Rail - Corrosion Resistant Steel	Each
606.275	Terminal End-Double Rail - Galvanized Steel	Each
606.276	Terminal End-Double Rail - Corrosion Resistant Steel	Each
606.353	Reflectorized Flexible Guardrail Marker	Each
606.354	Remove and Reset Reflectorized Flexible Guardrail Marker	Each
606.356	Underdrain Delineator Post	Each
606.358	Guardrail, Modify, Type 3b to 3c	Linear Foot
606.3581	Guardrail, Modify Existing to Type 3d	Linear Foot
606.362	Guardrail, Adjust	Linear Foot
606.365	Guardrail, Remove, Modify, and Reset, Type 3b to 3c	Linear Foot
606.3651	Guardrail, Remove, Modify, and Reset Existing to Type 3d	Linear Foot
606.366	Guardrail, Removed and Reset, Type 3c	Linear Foot
606.367	Replace Unusable Existing Guardrail Posts	Each
606.47	Single Wood Post	Each
606.48	Single Galvanized Steel Post	Each
606.50	Single Steel Pipe Post	Each
606.51	Multiple Mailbox Support	Each
606.55	Guardrail Type 3 - Single Rail	Linear Foot
606.551	Guardrail Type 3 - Single Rail with Rub Rail	Linear Foot
606.56	Guardrail Type 3 - Double Rail	Linear Foot
606.561	Guardrail Type 3 - Double Rail with Rub Rail	Linear Foot
606.568	Guardrail, Modify Type 3c -Double Rail	Linear Foot
606.59	Guardrail Type 3 - 15 ft radius and less	Linear Foot
606.60	Guardrail Type 3 - over 15 ft radius	Linear Foot
606.63	Thrie Beam Rail Beam	Linear Foot
606.64	Guardrail Thrie Beam - Double Rail	Linear Foot
606.65	Guardrail Thrie Beam - Single Rail	Linear Foot
606.66	Terminal End Thrie Beam	Each
606.70	Transition Section - Thrie Beam	Each
606.71	Guardrail Thrie Beam - 15 ft radius and less	Linear Foot
606.72	Guardrail Thrie Beam - over 15 ft radius	Linear Foot
606.73	Guardrail Thrie Beam - Single Rail Bridge Mounted	Linear Foot
606.74	Guardrail Type 3 - Single Rail Bridge Mounted	Linear Foot

606.753	Widen Shoulder for Low Volume Guardrail End - Type 3	Each
606.754	Widen Shoulder for Guardrail 350 Flared Terminal	Each
606.78	Low Volume Guardrail End - Type 3	Each
606.79	Guardrail 350 Flared Terminal	Each

SECTION 607 - FENCES

607.01 Description Construct fence and gates.

607.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Barbed Wire	710.01
Woven Wire	710.02
Chain Link Fabric	710.03
Cedar Rail Fence	710.05
Fence Posts and Braces	710.06

Bars for barways shall be of eastern hemlock, northern white pine, Norway pine, spruce, cedar, or tamarack, equal in quality to the wood posts. The bark shall be removed and all knots hewn flush.

Metal gates shall be of galvanized steel.

Staples shall be of galvanized or aluminum coated steel.

Concrete for anchoring metal posts, metal braces and wooden gate posts shall meet the requirements of Section 502 - Structural Concrete, except air entraining will not be required. The class of concrete shall be optional.

Drive anchors shall be an approved anchorage consisting of two steel angles driven diagonally into the ground through metal clamps bolted to the post. All parts shall be galvanized.

607.03 General The Contractor shall perform clearing and grubbing necessary to construct the fence to the required grade and alignment.

Posts shall be spaced as called for on the plans except that a variation of 2 feet back or ahead on line may be allowed at approved locations. The tops of posts shall be set to the required grade and alignment. Cutting off the posts may be allowed with approval.

Posts for cedar rail fence shall be set plumb in drilled or hand dug holes. After posts are placed, rails installed and the posts aligned, the post holes shall be backfilled. The completed

fence shall have the tops of the posts at uniform height above ground following the gradient of the ground.

Posts for woven wire fence and barbed wire fence shall be braced with Type I or Type II bracing at designated location as hereafter specified. Type I bracing shall include diagonal brace and one post of the designated size. Type II bracing shall include two diagonal braces and one post of the designated size.

When the plans require posts or braces to be anchored into the soil, concrete anchors or metal drive anchors shall be used. If concrete is used, temporary guys to hold the posts in position shall be installed until the concrete has set. Unless otherwise permitted, no material shall be installed on posts or strain placed on guys and bracing set in concrete until 48 hours after the concrete has been placed.

If metal drive anchors are used they shall be installed according to the manufacturer's instructions so all parts will be below the ground surface. One drive anchor shall be used on line posts; two drive anchors shall be used on bracing assemblies. Where two drive anchors are used, they shall be placed perpendicular to each other.

Backfill with earth placed in 8 inch layers, loose measure, and each layer thoroughly tamped.

Metal posts to be set in solid rock shall be placed in drilled holes and grouted with a cement grout composed of 1 part Portland cement and two parts sand mixed with water.

All surplus material and other debris shall be removed and disposed of.

607.04 Woven Wire or Barbed Wire Fencing Wood posts shall be set plumb in holes dug to full depth. Metal posts shall be set plumb by an approved post driver. Posts, which are bent or otherwise damaged, shall be removed and replaced.

a. Bracing At changes in horizontal alignment in excess of 30º, bracing will be required. At changes in horizontal alignment of 15º to 30º, bracing may be called for on the plans or required by the Resident. At changes in horizontal alignment angles of less than 15º, bracing will not be required except at intervals of 660 feet.

In depressions where tension in the fencing may cause lifting, the post will require bracing.

End, corner, gate, barway, and intermediate posts shall be braced and anchored as shown in the Standard Details.

If metal posts are to be placed in concrete, the concrete shall be allowed to set before the space around the base is backfilled. Backfill with satisfactory material thoroughly tamped. If directed, the Contractor shall place a minimum of 6 inches of gravel in the bottom of the post hole.

b. Gates All gates and the bracing assemblies at gates shall be constructed of metal.

c. Barways Barways shall be constructed of posts corresponding to the type of fence posts used. Wood crossbars shall be furnished.

d. Erection of Fabric or Wire Fabric or wire shall be stretched taut. Each strand of barbed wire shall be attached to wood posts with staples. Top and bottom strands of woven wire shall be attached to each post and alternate interior strands of woven wire fencing shall be attached to alternate posts. Staples shall not be driven into line posts to restrict the horizontal movement of wire except at corner posts, end posts and bracing where staples shall be fully driven. When attaching fencing to metal posts, approved stay fasteners shall be used.

Except as otherwise provided, splicing wire will be permitted at posts only with each horizontal strand of wire wrapped completely around the post. The wire strand shall be fastened by winding the wire about the same strand where it leads to the post. This type of fastening shall be used at each end post, corner post, and gate post and at barway posts. Other devices designed specifically to splice fencing wire may be used, subject to approval.

607.05 Chain Link Fence Foundations for posts for chain link fence shall be cast-in-place Portland cement concrete placed in approved forms or shall be approved metal drive anchors. If wood forms are used, they shall be removed before backfilling. If fiber forms are used, they need not be removed.

a. Braces Fences less than 6 feet in height that are installed with a top rail shall not require any brace rails. Fences less than 6 feet in height installed without a top rail and all fences with heights of 6 feet or more shall have brace rails installed midway between the top and bottom of the fabric as shown on the plans. Braces shall be securely fastened to the posts then trussed from the line post to the base of the end, intermediate or corner post with a ⅜ inch diameter truss rod and tightened. At changes in horizontal alignment of less than 15º, bracing will not be required except at intervals of 330 feet. At changes in alignment of 15º to 30º, bracing may be required as called for on the plans or requested. At changes in alignment in excess of 30º, bracing will be required. One brace assembly shall be furnished with each end or gate post and two assemblies with each corner or intermediate post and at grade changes specified above.

b. Gates Where gates are required for chain link fence, they shall be constructed of metal.

c. Erection of Chain Link Fabric The grade of fence shall be approximately parallel with the grade of the ground. When directed, abrupt depressions shall be filled.

Top rails when required, shall pass through post caps and be securely fastened to end, corner, brace and gate posts. Joints in top rails shall be made with expansion sleeve couplings. On curves with a radius of less than 500 feet, the top rail shall be bent to the arc.

The fabric shall be pulled taut, the ends attached to the posts with stretcher bars, and bands or other approved devices. When required, wire fabric shall be joined by weaving a single strand of mesh wire into the ends of the rolls to form a continuous mesh.

d. Tension Wire When called for on the plans, a tension wire of seven gage galvanized wire shall be used in place of the top rail.

607.06 Method of Measurement Fence will be measured by the linear foot accepted in place. Measurement will be along the gradient of the fence from outside to outside of end posts for each continuous run of fence and shall include fence at bracing assemblies but shall not include space at gates and barways. Gates, barways, and bracing assemblies will be measured by the unit of the size and type specified. Excavation in rock for placement of fence posts in drilled holes will be measured by the cubic yard determined from the actual depth of the drilled hole in the rock and a hypothetical circle diameter of 2 feet.

607.07 Basis of Payment The accepted quantities of fence will be paid for at the contract unit price per linear foot of the type and size specified complete in place. Barways, gates, and bracing assemblies will be paid for at the contract unit price for each type specified complete in place. Payment shall be full compensation for furnishing and assembling all materials, for excavating and backfilling holes, and for all incidentals necessary to complete the work except that in rock, payment for drilled holes will be made under 109.7.5 – Force Account. Excavation of earth to exposed rock shall be incidental to the several items for erection of the fence.

Payment for bracing assemblies shall include furnishing and installing the various larger size and longer length posts, diagonal bracing, ties, anchors and all incidental hardware necessary to complete the type of assembly required, all as shown in the Standard Details. At gateways, payment will be made for bracing assemblies and there will be no separate payment for the gate posts. All extra costs incurred for furnishing and installing the oversize posts at gateways shall be considered included with the various contract items.

Clearing or removal of trees, stumps or boulders, required to install the fence shall be included in the work of the respective pay items of this section.

Payment will be made under:

	Pay Item	Pay Unit
607.08	Woven Wire Fence – Wood Posts	Linear Foot
607.09	Woven Wire Fence – Metal Posts	Linear Foot
607.10	Barbed Wire Fence – Wood Posts	Linear Foot
607.11	Barbed Wire Fence – Metal Posts	Linear Foot

607.12	Barway - Wood Posts	Each
607.13	Barway - Wood Posts	Each
607.14	Walk Gateway 4 foot – Metal	Each
607.15	Drive Gateway 16 foot – Metal	Each
607.16	Chain Link Fence – 4 foot	Linear Foot
607.163	Chain Link Fence – 4 foot – PVC Coated	Linear Foot
607.165	Chain Link Fence – 4 foot – without Top Rail	Linear Foot
607.17	Chain Link Fence – 6 foot	Linear Foot
607.173	Chain Link Fence – 6 foot – PVC Coated	Linear Foot
607.175	Chain Link Fence – 6 foot – without Top Rail	Linear Foot
607.22	Cedar Rail Fence	Linear Foot
607.23	Chain Link Fence Gate	Each
607.24	Remove and Reset Fence	Linear Foot
607.25	Remove and Reset Chain Link Fence	Linear Foot
607.30	Bracing Assembly Type I – Wood Posts	Each
607.31	Bracing Assembly Type II – Wood Posts	Each
607.32	Bracing Assembly Type I – Metal Posts	Each
607.33	Bracing Assembly Type II – Metal Posts	Each
607.34	Bracing Assembly Chain Link Fence	Each
607.35	Bracing Assembly Chain Link Fence – PVC Coated	Each

SECTION 608 - SIDEWALKS

608.01 Description This work shall consist of furnishing all materials for and constructing sidewalks of either Hot Mix Asphalt (HMA) pavement, brick or concrete, and curb ramp detectable warning plates with truncated domes, in conformance with this specification and all other applicable Contract Documents.

608.02 Materials, General All new Portland cement concrete surfaces shall have protective coating applied in accordance with Section 515, Protective Coating for Concrete Surfaces.

608.021 Sidewalk Materials Materials for sidewalks shall meet the requirements specified in the following Sections of Division 700, Materials:

Aggregate for Untreated Surface Course and Leveling Course	703.10
Brick for Paving	704.02
Preformed Expansion Joint Filler	705.01
Welded Steel Wire Fabric	709.02

Portland cement concrete shall be Class A and meet the requirements of Section 502, Structural Concrete, with the following modifications: The permeability requirements and the requirements of Section 703.0201, Alkali Silica Reactive Aggregates, are waived; and use of Ground Granulated Blast Furnace Slag shall not be allowed.

HMA pavement shall meet the requirements of Section 403, Hot Bituminous Pavement.

New aggregate required to build new sidewalk shall meet the requirements of Standard Specification 703.06(b), Aggregate for Base and Subbase, Type D. New aggregate for regrading existing sidewalk shall meet the requirements of Section 703.10, Aggregate for Untreated Surface Course and Leveling Course.

Standard compacting will be required for all sidewalk areas where six inches or more of new or disturbed aggregate is placed. Where less than six inches is placed, compaction will be achieved by use of a plate compactor, hand tamp or other means approved by the Resident.

608.022 Detectable Warnings Materials Detectable warning plates shall be new cast iron, as manufactured by one of the manufacturers listed on MaineDOT's Qualified Products List of Cast Iron Detectable Warning Plates. Each plate shall match the width of the ramp, unless otherwise indicated in the Contract Documents, and shall have a natural finish. Prior to starting this work, the Contractor shall submit to the Department the name of the selected supplier, the manufacturer's literature describing the product, installation procedures, and routine maintenance requirements. Concrete shall meet the requirements of Section 608.021, Sidewalk Materials, of this specification.

608.03 Sidewalk Construction

608.031 Portland Cement Concrete Sidewalks

a. Excavation Excavation shall be to the depth and width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown in the Contract Documents. All soft and yielding material shall be removed and replaced with acceptable material.

b. Forms Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be true, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

c. Placing Concrete The foundation shall be thoroughly moistened immediately prior to placing the concrete. The proportioning, mixing and placing of the concrete shall be in accordance with the requirements of Section 502, Structural Concrete.

d. Finishing The sidewalk surface shall receive a float finish, in accordance with Section 502, Structural Concrete. Additionally, a light broom finish shall be applied, perpendicular to the sidewalk. No plastering of the mortar will be permitted. All outside edges of the slab and all joints shall be finished with a sidewalk edging tool, two inches in width, with a ¼ inch radius lip.

e. Joints Joints shall be located as shown in the Contract Documents. Slabs shall be placed alternately and the joints coated with an approved bituminous material before placing the adjacent slab.

When a concrete sidewalk is constructed adjacent to a building, retaining wall, or other fixed structure, preformed joint filler, ¼ inch thick, shall be used between the slab and the structure.

f. Curing Concrete shall be cured for at least 72 hours. Curing shall be by moist burlap or mats, or by application of a curing compound listed on the Department's Qualified Products List. The curing compound shall be applied continuously by approved mechanical pressure spraying or distributing equipment at a rate necessary to obtain an even, continuous membrane, meeting the manufacturer's recommendations, but at a rate of not less than 1 gallon per 200 ft^2 of surface; at a minimum, two coats shall be applied using a pressurized sprayer, with the first coat being applied within 15 minutes after finishing is complete and the second coat being applied within 30 minutes of, and at right angles to, the first; hand-pump sprayers, rollers or brushes shall not be used. During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as may be deemed necessary by the Resident.

608.032 HMA Pavement Sidewalk

a. Excavation Excavation shall be to the required depth and width. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown in the Contract Documents. All soft and yielding material shall be removed and replaced with acceptable material.

b. Base Course Base course material shall be placed as shown in the Contract Documents and each layer thoroughly compacted.

c. Placing HMA Sidewalk Material HMA sidewalk material shall be placed on the compacted base course in two courses to provide the required depth when rolled. Compaction shall be by a power roller having a minimum total weight of 1 ton with a minimum of 65 lb/in of width of the drive roll or by satisfactory power vibratory compaction equipment. In areas inaccessible to other equipment, hand tamping will be permitted. In any case, the HMA sidewalk material shall be uniformly compacted.

608.033 Brick Sidewalk (Remove and Rebuild) This work shall consist of the following, unless otherwise indicated in the Contract Documents: Removal, storage, and disposal, as necessary, of existing brick; shaping and compacting the foundation to a firm, even surface, conforming to the section shown in the Contract Documents- all soft and yielding material shall be removed and replaced with acceptable material; regrading, compacting and furnishing of Aggregate for Untreated Surface Course and Leveling Course, as necessary; furnishing of new or re-used brick to match the existing sidewalk; furnishing and applying joint filler material (sand) and compacting with water and refilling until joint material is at the same surface as the

brick; all necessary grading and restoration at the back edge of sidewalk; removal and disposal of unused materials and debris.

608.034 Brick Sidewalk Excavation shall be to the required depth and width and the foundation shaped and compacted to a firm, even surface, conforming to the section shown in the Contract Documents. All soft and yielding material shall be removed and replaced with acceptable material.

608.035 Construct Sidewalk This work shall consist of excavating the existing ground and placing and compacting new aggregate, as necessary, to build the sidewalk in the new location as shown in the Contract Documents.

608.036 Regrading Sidewalk This work shall consist of removing the existing pavement, adding and compacting new aggregate, as necessary, and regrading the gravel base to conform to the grading limits shown in the Contract Documents.

608.04 Detectable Warnings Construction New plates shall be set square with the curb edge and the base of the truncated domes shall be set flush with adjacent surfaces to allow for proper drainage. All concrete required for detectable warnings shall be cured in accordance with Section 608.031(f), Curing, of this specification.

608.041 Existing Concrete Curb Ramps Existing concrete shall be saw-cut to a dimension 4 inches larger than the detectable warning plates. New concrete shall be placed in the resulting opening and finished, and the new plates set into the wet concrete, according to the manufacturer's recommendations.

608.042 New Concrete Curb Ramps New concrete shall be placed and finished for the ramp, and the new plates set into the wet concrete, according to the manufacturer's recommendations.

608.043 New HMA Pavement Ramps HMA pavement shall be saw cut and removed to provide an opening that will allow for the dimensions of the cast iron plate surrounded by an additional 4 inch border on all sides of the plate. New concrete shall be placed in the resulting opening and finished, and the new plates set into the wet concrete, according to the manufacturer's recommendations.

608.05 Method of Measurement Construct sidewalk, regrading sidewalk, concrete sidewalk, brick sidewalk (remove and rebuild), brick sidewalk and brick driveway aprons will be measured by the square yard of finished surface. HMA pavement sidewalks will be measured by the ton of HMA mixture placed. Detectable warning plates will be measured for payment by the square foot of actual plate area, only, not including the surrounding concrete.

608.06 Basis of Payment The accepted quantities of sidewalk will be paid for at the Contract Unit Price per square yard for concrete sidewalk, brick sidewalk and brick driveway aprons, and per ton for HMA pavement sidewalk, complete and in place. Excavation will be

paid for under Section 203, Excavation and Embankment. Base and subbase material will be paid for under Section 304, Aggregate Base and Subbase Course. HMA mixture for sidewalks will be paid for under Section 403, Hot Bituminous Pavement. Expansion joint material, joint filler, and other related items will not be paid for separately but shall be considered incidental to related Pay Items.

For construct sidewalk, payment will be for excavation, new aggregate and necessary incidentals to bring the grade to pre-pave grade. For regrading sidewalk, payment will be for removing existing pavement, regrading existing gravel base and adding new material, as necessary.

For brick sidewalk (remove and rebuild), payment will be for all work outlined in Section 608.033, Brick Sidewalk (Remove and Rebuild), except that any necessary excavation will be paid for under Section 203, Excavation and Embankment, any necessary base and subbase material will be paid for under Section 304, Aggregate Base and Subbase Course, and any specified HMA mixture will be paid for under Section 403, Hot Bituminous Pavement.

The accepted quantity of detectable warnings will be paid for at the Contract Unit Price per square foot for all labor, materials, and equipment required to install the detectable warning plates, complete and in place. This shall include surface preparation and removal of concrete or HMA pavement, and necessary replacement concrete. For new concrete ramps, concrete shall be paid for under related sidewalk Pay Items.

Welded steel wire fabric for reinforced concrete sidewalks will not be paid for separately, but shall be included in the Contract Unit Price for reinforced concrete sidewalk.

Protective coating shall be paid for under Section 515, Protective Coating for Concrete Surfaces.

Payment will be made under:

	Pay Item	Pay Unit
608.07	Plain Concrete Sidewalk	Square Yard
608.08	Reinforced Concrete Sidewalk	Square Yard
608.10	Brick Sidewalk (Remove and Rebuild)	Square Yard
608.15	Brick Sidewalk with Bituminous Base	Square Yard
608.16	Brick Driveway Aprons with Bituminous Base	Square Yard
608.26	Curb Ramp Detectable Warning Field	Square Foot
608.45	Construct Sidewalk	Square Yard
608.46	Regrading Sidewalk	Square Yard

SECTION 609 - CURB

609.01 Description Construct or reset curb, gutter, or combination curb and gutter, paved ditch, and paved flume. The types of curb are designated as follows:

Type 1 - Stone curbing of quarried granite stone
Type 3 - Bituminous curbing
Type 5 - Stone edging of quarried granite stone

609.02 Materials Except as provided below, the materials used shall meet the requirements of the following Sections of Division 700 - Materials:

Joint Mortar	705.02
Reinforcing Steel	709.01
Concrete Curb	712.061
Stone Curbing and Edging	712.04
Epoxy Resin	712.35
Bituminous Curbing	712.36

Circular curb, terminal sections and transition sections shall be in reasonably close conformity with the shape and dimensions shown on the plans and to the applicable material requirements herein for the type of curb specified.

Dowels shall be reinforcing steel deformed bars.

609.03 Vertical Stone Curb, Terminal Section and Transition Sections and Portland Cement Concrete Curb, Terminal Sections and Transition Sections

a. Installation The curb stone shall be set on a compacted foundation so that the front top arris line conforms to the lines and grades required. The foundation shall be prepared in advance of setting the stone by grading the proper elevation and shaping to conform as closely as possible to the shape of the bottom of the stone. The required spacing between stones shall be assured by the use of an approved spacing device to provide an open joint between stones of at least ¼ inch and no greater than ⅝ inch.

b. Backfilling All remaining spaces under the curb shall be filled with approved material and thoroughly hand tamped so the stones will have a firm uniform bearing on the foundation for the entire length and width. Any remaining excavated areas surrounding the curb shall be filled to the required grade with approved materials. This material shall be placed in layers not exceeding 8 inches in depth, loose measure and thoroughly tamped.

When backfill material infiltrates through the joints between the stones, small amounts of joint mortar or other approved material shall be placed in the back portion of the joint to prevent such infiltrating.

c. Protection The curb shall be protected and kept in good condition. All exposed surfaces smeared or discolored shall be cleaned and restored to a satisfactory condition or the curb stone removed and replaced.

d. Curb Inlets Curb placed adjacent to curb inlets shall be installed with steel dowels cemented into each stone with epoxy grout as shown in the Standard Details.

The epoxy grout shall be used in accordance with the manufacturer's instructions. The grout shall be forced into the hole, after which the dowel shall be coated with grout for one-half its length and inserted into the grout filled hole. The hole shall be completely filled with grout around the dowel. All tools and containers must be clean before using.

609.04 Bituminous Curb

a. Preparation of Base Before placing the curb, the foundation course shall be thoroughly cleaned of all foreign and objectionable material. String or chalk lines shall be positioned on the prepared base to provide guide lines. The foundation shall be uniformly painted with tack coat at a rate of 0.04 to 0.14 gal/yd^2.

b. Placing The curb shall be placed by an approved power operated extruding type machine using the shape mold called for. A tight bond shall be obtained between the base and the curb. The Resident may permit the placing of curbing by other than mechanical curb placing machines when short sections or sections with short radii are required. The resulting curbing shall conform in all respects to the curbing produced by the machine.

c. When required, the curb shall be painted and coated with glass beads in accordance with Section 627 - Pavement Marking. Curb designated to be painted shall not be sealed with bituminous sealing compound.

d. Acceptance Curb may be accepted or rejected based on appearance concerning texture, alignment, or both. All damaged curb shall be removed and replaced at the Contractor's expense.

e. Polyester fibers shall be uniformly incorporated into the dry mix at a rate of 0.25 percent of the total batch weight. Certification shall be provided from the supplier with each shipment meeting the following requirements:

Average Length	0.25 inches ± 0.005
Average Diameter	0.0008 inches ± 0.0001
Specific Gravity	1.32-1.40
Melting Temperature	480 °F Minimum

609.06 Stone Edging The curb shall be installed, backfilled and protected in accordance with Section 609.03, except as follows:

a. Slope The edging shall be set on a slope as shown on the plans or as directed.

b. Joints Joints shall be open and not greater than 1½ inch in width.

609.07 Stone Bridge Curb

a. Installation Each stone and the bed upon which it is to be placed shall be cleaned and thoroughly wetted with water before placing the mortar for bedding and setting the stone. The stone shall be set on a fresh bed of joint mortar and well bedded before the mortar has set so that the front top arris line conforms to the line and grade required. Whenever temporary supporting wedges or other devices are used in setting the stones, they shall be removed before the mortar in the bed has become set, and the holes left by them shall be filled with mortar. Concrete behind the stones shall not be placed until the stones have been in place at least two days. Bedding and pointing mortar for joints shall be cured as required under Section 502 - Structural Concrete.

b. Joints Vertical joints shall be ½ inch in width plus or minus ⅛ inch. Whenever possible, the face and top of the joint shall be pointed with joint mortar to a depth of 1½ inch, before the bedding mortar has set. Joints which cannot be so pointed, shall be prepared for pointing by raking them to a depth of 1½ inch before the mortar has set. Joints not pointed at the time the stone is laid shall be thoroughly wetted with clean water and filled with mortar. The mortar shall be well driven into the joint and finished with an approved pointing tool, flush with the pitch line of the stones.

609.08 Resetting Stone or Portland Cement Concrete Curb, Including Terminal Sections and Transitions

The curb shall be installed, backfilled and protected in accordance with Section 609.03, except as follows:

a. Removal of Curbing The Contractor shall carefully remove and store curb specified on the plans or designated for resetting. Curb damaged or destroyed, because of the Contractor's operations or because of their failure to store and protect it in a manner that would prevent its loss or damage, shall be replaced with curbing of equal quality at the Contractor's expense.

b. Cutting and Fitting Cutting or fitting necessary in order to install the curbing at the locations directed shall be done by the Contractor.

609.09 Method of Measurement Curb, both new and reset, will be measured by the linear foot along the front face of the curb at the elevation of the finished pavement, complete in place and accepted. Curb inlets at catch basins, including doweling, will not be measured for payment but shall be considered included in the cost of the catch basin. New transition sections and terminal curb will be measured by the unit. Reset transition sections and terminal curb will be included in the measurement for resetting curb.

609.10 Basis of Payment The accepted quantities of curbing will be paid for at the contract unit price per linear foot for each kind and type of curbing as specified.

Payment for terminal curb shall include only that portion of the curbing modified for installation at ends of curb runs shown in the Standard Details. Curb adjacent to terminal ends shall be paid for at the contract unit price per linear foot for the type of curb installed.

Vertical Curb Type 1 is required to have a radius of 60 feet or less, will be paid for as Vertical Curb Type 1 - Circular.

Curb, Type 5 required to have a radius of 30 feet or less will be paid for as Curb Type 5 - Circular.

There will be no separate payment for cement, reinforcing steel, anchors, tack coat, drilling for and grouting anchors, pointing and bedding of curbing, and for cutting and fitting, but these will be considered included in the work of the related curb.

Removal of existing curb and necessary excavation for installing new or reset curbing will not be paid for directly, but shall be considered to be included in the appropriate new or reset curb pay item. Base and Subbase material will be paid for under Section 304 - Aggregate Base and Subbase Course. Backing up bituminous curb is incidental to the curb items. Loam, as directed, will be paid under 615 – Loam.

Payment will be made under:

	Pay Item	Pay Unit
609.11	Vertical Curb Type 1	Linear Foot
609.12	Vertical Curb Type 1 - Circular	Linear Foot
609.13	Vertical Bridge Curb Type 1	Linear Foot
609.131	Vertical Bridge Curb Type 1A	Linear Foot
609.132	Vertical Bridge Curb Type 1B	Linear Foot
609.142	Vertical Bridge Curb Type 1B - Circular	Linear Foot
609.15	Sloped Curb Type 1	Linear Foot
609.151	Sloped Curb Type 1 - Circular	Linear Foot
609.23	Terminal Curb Type 1	Each
609.234	Terminal Curb Type 1 - 4 foot	Each
609.237	Terminal Curb Type 1 - 7 foot	Each
609.2371	Terminal Curb Type 1 - 7 foot – Circular	Each
609.238	Terminal Curb Type 1 - 8 foot	Each
609.26	Curb Transition Section B Type 1	Each
609.31	Curb Type 3	Linear Foot
609.34	Curb Type 5	Linear Foot
609.35	Curb-Type 5 - Circular	Linear Foot

609.38	Reset Curb Type 1	Linear Foot
609.39	Reset Curb Type 2	Linear Foot
609.40	Reset Curb Type 5	Linear Foot

SECTION 610 - STONE FILL, RIPRAP, STONE BLANKET, AND STONE DITCH PROTECTION

610.01 Description This work shall consist of excavating for and constructing a protective covering of stone. The types of protective covering of stone are designated as follows:

a. Stone fill Machine placed embankment for fill slope
b. Plain Riprap Machine placed stones on earth bedding
c. Hand Laid Riprap Hand placed stones on earth bedding
d. Stone Blanket Machine placed stones around piers and Abutments
e. Heavy Riprap Machine placed stones on earth bedding
f. Stone Ditch Protection Machine placed ditch protection of rock

610.02 Materials Materials shall meet the requirements of the following Sections of Division 700 - Materials:

Stone Fill	703.25
Plain and Hand Laid Riprap	703.26
Stone Blanket	703.27
Heavy Riprap	703.28

610.031 General Suitable material removed when excavating for the placing of riprap, stone fill, stone blanket or stone ditch protection shall be used in the formation of embankments, subgrade and for backfilling as shown on the plans or as directed.

610.032 Placing Stones

a. Stone Fill and Stone Blanket Material for stone fill shall be deposited to provide a compact mass. The exposed slope shall be finished to the line and grade required without special handling or handwork. Material for stone blanket shall be deposited for protection around piers or abutments as shown on the plans. The stones shall be placed individually to form a reasonably compact mass. Spaces between the larger stones shall be filled with stone or spall of suitable size to leave an even surface conforming to the contour required. Stone fill and stone blanket shall be placed on the slope in a well-knit, compact and uniform layer. The surface stones shall be chinked with smaller stone from the same source.

b. Riprap Stones for riprap shall be placed upon a slope properly graded and compacted as called for. When required, the bottom of the riprap shall be placed in a trench at the toe of the slope. Plain riprap shall be placed full depth in one operation without special handwork

and shall be placed approximately true to the required slope line and grade and be uniform in appearance. Hand laid riprap shall be random rubble, hand laid stones for the full depth placed in one operation to secure interlocking of all face stones and stones placed as backing. Larger stones shall be laid at the base of the slope. The stones shall be laid in close contact with the longer axis perpendicular to the plane of the slope to stagger joints. Except when required to be grouted the openings between the stones in all riprap shall be filled with spall, or rocks securely rammed into place. Riprap shall be placed on the slope in a well-knit, compact and uniform layer. The surface stones shall be chinked with smaller stone from the same source.

Stones for heavy riprap shall be placed to the full depth in one operation without special handwork or machine work upon a properly graded and compacted slope. Above the low water elevation, stones shall be placed to form an approximate uniform surface, free from humps or depressions, with no excessively large stones projecting from the general surface. Loose stones or excessively large stones tending to extend above the average general surface shall be embedded, reoriented, or discarded. The openings between stones on the face of heavy riprap shall be filled with spall or small rocks, securely rammed into place.

c. Stone Ditch Protection The ditch shall be excavated below the flow line to allow placement of the rock material to the specified depth. The stone ditch protection shall be placed, full depth, in one operation without special handwork, shall be approximately true to line and grade and shall be uniform in appearance.

d. Inspection The grading of riprap, stone fill, stone blanket and stone ditch protection shall be determined by the Resident by visual inspection of the load before it is dumped into place, or, if ordered by the Resident, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load. A separate, reference pile of stone with the required gradation will be placed by the Contractor at a convenient location where the Resident can see and judge by eye the suitability of the rock being placed during the duration of the project. The Resident reserves the right to reject stone at the job site or stockpile, and in place. Stone rejected at the job site or in place shall be removed from the site at no additional cost to the Department.

610.05 Method of Measurement Stone fill, plain riprap, hand laid riprap, stone blanket, heavy riprap and stone ditch protection will be measured by the cubic yard, complete in place, except that when placed under water the quantity may be measured by truck load count with no reduction in volume.

610.06 Basis of Payment The accepted quantities of stone fill, plain riprap, hand laid riprap, stone blanket, heavy riprap and stone ditch protection and materials to fill the voids will be paid for at the contract unit price per cubic yard complete in place.

Costs of all required excavation below the slope line for the placement of bedding, riprap, stone fill, stone blanket, stone ditch protection and for furnishing and placing the bedding material itself, will be considered incidental to the contract items and no separate payment will be made.

Payment will be made under:

Pay Item		Pay Unit
610.07	Stone Fill	Cubic Yard
610.08	Plain Riprap	Cubic Yard
610.09	Hand Laid Riprap	Cubic Yard
610.11	Stone Blanket	Cubic Yard
610.16	Heavy Riprap	Cubic Yard
610.18	Stone Ditch Protection	Cubic Yard

SECTION 611- Reserved

SECTION 612 - BITUMINOUS SEALING

612.01 Description This work shall consist of sealing bituminous mix surfaces with emulsified bituminous sealing compound of the specified color, applied at locations shown on the plans or designated.

612.02 Materials Bituminous material for sealing shall conform to the requirements of Emulsified Bituminous Sealing Compound, Section 702.12.

612.03 General The sealing compound shall be applied in two coats. The first coat shall be diluted by the addition of up to 50% water to a liquid consistency and applied with brooms or other approved methods at a rate of 0.25 gal to 0.50 gal of diluted sealer per square yard. The second coat shall be diluted only to the extent necessary to obtain workability and applied at a rate of 0.25 gal to 0.50 gal of diluted sealer per square yard.

612.04 Method of Measurement Bituminous sealing will be measured by the square yard of surface sealed measured parallel to the surface.

612.05 Basis of Payment The accepted quantities of bituminous sealing will be paid for at the contract unit price per square yard complete in place.

Pay Item		Pay Unit
612.06	Bituminous Sealing-Black	Square Yard

SECTION 613 - EROSION CONTROL BLANKETS

613.01 Description This work shall consist of furnishing and installing erosion control blankets on previously prepared areas in accordance with the manufacturer instructions or as called for on the plans or otherwise authorized.

Erosion control blankets shall be installed on critical slopes, shoulder berms, esplanade strips, curb sections, in ditches and drainage ways, and other previously prepared areas or as shown.

613.02 Materials Erosion control blanket shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Erosion Control Blankets	717.061
Ground Anchors	717.063

613.03 Site Preparation The area for erosion control blankets shall be prepared as follows:

Soil must be loose or scarified, smoothly raked and free of stones, litter, and any abrupt ground surface roughness under the blanket.

613.04 Seeding All seed shall be sown before installing erosion control blankets. No loam will be required for Seeding, unless called for on plans or designated. Seeding, Method Number 2 will be used unless otherwise specified.

613.05 Installation On Slopes and in ditches, blankets shall be aligned in the direction of water flow and along the contours of berms. The uphill end of blanket shall be anchored in a trench no less than 6 inches deep and overlapped on the adjoining ends no less than 3 inches. Parallel strips shall be overlapped 4 inches on the sides. Approved anchor staples shall be placed at a maximum spacing of 3 feet on center or as required by the manufacturer, whichever is closer.

613.08 Method of Measurement Erosion control blanket will be measured by the square yard based on the width and length of the blanket measured on the ground.

613.09 Basis of Payment Erosion control blankets of the type specified will be paid for at the contract unit price per square yard complete in place and accepted. Such payment shall be full compensation for furnishing and installing the blankets and initial seeding under blanket in accordance with this specification and for all required maintenance.

Payment will be made under:

	Pay Item	Pay Unit
613.319	Erosion Control Blanket	Square Yard

SECTION 614 GEOCELL SLOPE PROTECTION

614.01 Description

This work shall consist of furnishing and placing a geocell slope protection system, in reasonably close conformity with the lines and grades shown on the plans, as specified herein, and as directed by the Resident. The geocell slope protection system consists of geocell material into which select infill material is placed. It is referred here after as geocell confinement system.

614.02 Submittals

Submittals shall comply with MaineDOT Section 105-General Scope of Work. All information shall be submitted to the Resident thirty (30) days prior to the geocell section installation.

A. Product Data. Submit manufacturer's product data.

B. Supplier Design. Submit manufacturer's project-specific design recommendations or engineering design for cell size, stake anchor length and stake anchor spacing.

C. Shop Drawings. Submit manufacturer's shop drawings including section layout, direction of expansion, and anchor stake locations.

D. Samples. Submit manufacturer's samples of geocell sections, anchors, and end caps.

E. Material Certification. Submit manufacturer certification of polyethylene used to make geocell material including percentage of carbon black, polyethylene density, and ESCR.

MATERIALS

614.03 Geocell Confinement System

The complete geocell confinement system includes the geocell sections, cell infill, anchors, and a surface treatment.

A. Geocell Sections. The geocell sections shall be a polyethylene sheet strip assembly connected by a series of offset, full depth, ultrasonic welded seams aligned perpendicular to the longitudinal axis of the strips, which, when expanded, form walls of flexible 3-dimensional, cellular confinement system. The geocell material shall be manufactured by Presto Products Company, Appleton, Wisconsin, Webtec Geosynthetics, Charlotte, North Carolina, or an approved equal. Sections shall be in conformance with manufacturers design recommendations or engineering design for this project.

1. Geocell base material

    a. The geocell material shall be polyethylene stabilized with black carbon, with the following properties:

        i. Density, ASTM D 1505: 58-60 pcf.

ii. Environmental stress crack resistance (ESCR) ASTM D 1693: 3000 hours.
iii. Ultraviolet light stabilization: carbon black.
iv. Carbon Black Content: 1.5 to 2 percent by weight, through the addition of a carrier with a certified carbon black content.
v. Homogeneously distributed through material.

2. Geocell Strip Properties and Assembly

a. Perforated Strip/Cell:
i. Strip sheet thickness, ASTM D 5199: 50 mil minus 5%, plus 10%. Determine thickness in the flat before surface disruption.
ii. Sheet thickness: 60 mil +/- 6 mil.
iii. Polyethylene Strips: Perforated with horizontal rows of 0.40 in diameter holes.
iv. Perforation Within Each Row: 0.65 to 0.75 in on center.
v. Horizontal Rows: staggered and separated 0.50 in relative to hole centers.
vi. Edge of strip nearest edge of perforation: 0.24 in minimum.
vii. Centerline of spot welds to nearest edge of perforation: 0.70 in minimum.

b. Assembly of Cell sections:
i. Fabricated using strips of sheet polyethylene each with a length of 12 ft and a width equal to cell depth.
ii. Connect strips using full-depth, ultrasonic spot-welds align perpendicular to longitudinal axis of strip.
iii. Ultrasonic weld melt-pool width: 1.0 in maximum.

3. Geocell Properties

a. Individual Cells: Uniform in shape and size when expanded. Over- or under-expansion of uniform individual cells will be allowed on curved slopes.

b. Individual Cell Dimensions:
i. Length: 8.8 in +/- 10%
ii. Width: 10.2 in +/- 10%
iii. Nominal area 44.8 sq in +/- 1%
iv. Nominal depth: 4 in

4. Cell Seam Strength Tests

a. The seams for geocell sections shall consist of 2 carbon-black stabilized strips welded together.

b. Short Term Seam Peel Strength Test:
i. Cell Seam Strength: Uniform over full depth of cell.
ii. Minimum seam peel strength: 320 lbf for 4 in depth.

c. Long Term Seam Peel Strength Test:

i. Conditions: Minimum of 168 hours (7 days) in a temperature-controlled environment that undergoes change on a 1-hour cycle from room temperature to 130º F.
ii. Room temperature: ASTM E 41.
iii. Test Samples: Weld two 4 in wide strips together.
iv. Test: Test sample consisting of 2 carbon black stabilized strips shall support a 160 lb load for the test period.

B. Anchoring Components. The anchoring system shall consist of Straight No. 4 steel reinforcing rods with an ATRA clip, or an approved equal, as end cap. Length shall be as specified in the manufacturer's recommendations or an engineering design.

C. Granular Borrow. Granular Borrow shall meet the requirements of MaineDOT Section 703.19 - Granular Borrow, Material for Embankment Construction.

D. Geocell Infill Material. Geocell infill material shall be as specified in the Notes or shown on the plans and shall meet the requirements of the following specifications:

Dirty Borrow	615.10
Loam	615
Aggregate for crushed stone surface	703.12

E. Surface Treatment. For slopes with Loam infill, the surface treatment shall consist of seed and an erosion control blanket. The seed shall meet the requirements MaineDOT Section 618-Seeding, Method Number 2, or as indicated on the plans and notes. The erosion control blanket shall meet the requirements of MaineDOT Section 613-Erosion Control Blanket. When infill other than loam is specified, the surface treatment shall be as indicated on the plans or details.

CONSTRUCTION

614.04 Construction Requirements

A. Subgrade Preparation.

1. Prepare the subgrade by removing the all existing vegetation and loose surficial soils from the slope.
2. Excavate and the slope section as needed.
3. Place, compact, and shape Granular Borrow as needed, so that when placed the top of installed geocell section is flush with or slightly lower that the final grade as indicated on the plans.
4. Install non-woven erosion control geotextile underlayer, if required, on the prepared surface, ensuring required overlaps are maintained and outer edge of geotextile are buried a minimum of 6 in. below grade.

B. Placement and Anchoring.

1. Anchor geocell sections at the crest of the slope or as per manufacturer's recommendations. Use type of anchor and frequency of anchoring as indicated on the shop drawings.
2. Expand geocell sections down slope. Confirm each geocell section is expanded uniformly to required dimensions and outer cells of each layer are correctly aligned.
3. Interleaf edges of adjacent sections. Ensure that the upper surface of adjoining geocell sections are flush at the joint and adjoining cells are fully anchored. Anchor with specified anchors in prescribed pattern throughout the slope surface.

C. Placement of Infill.

1. Place infill in expanded cells with suitable material handling equipment, such as a backhoe, front-end loader, conveyor, or crane mounted skip. Limit drop height to a maximum of 3 ft. Avoid displacement of the geocell sections by infilling from crest to toe of slope.
2. Overfill and compact infill in accordance with consistency of material and cell depth as follows:
    a. For geocell slopes with loam infill, overfill the geocell with 1 to 2 in loam and lightly tamp or roll to leave soil flush with top edge of cell walls.
    b. For geocell slopes with Aggregate for Crushed Stone Surface or Dirty Borrow infill, overfill the cells approximately 1 inch and compact with a plate tamper or backhoe bucket. Remove loose surface material so infill is flush with top edges of cells.
3. Apply specified surface treatment.

614.05 Delivery Storage and Handling

A. Delivery. Deliver material to site in manufacturer's original unopened containers and packaging, with labels clearly identifying product name and manufacture.

B. Storage. Store materials in accordance with the manufacturer's instructions. Store material out of direct sunlight.

C. Handling. Protect materials during handling and installation to prevent damage.

614.06 Method of Measurement

The Geocell Confinement System measurement will be by the square foot of material installed.

614.07 Basis of Payment

The Geocell Confinement System will be paid for at the Contract unit price per square foot which shall be full compensation for all labor and materials, including the geocell sections, anchoring components, granular borrow, infill, and surface treatments. The unit price shall be full compensation for subgrade preparation, and placing and compacting Granular Borrow to the subgrade.

Pay Item		Pay Unit
614.30	Geocell Confinement System for Slope Protection	Square Foot

SECTION 615 - LOAM

615.01 Description This work shall consist of furnishing and placing loam or dirty borrow for seeding or sodding, in reasonably close conformity with the thicknesses called for on the plans or as authorized.

615.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials:

Common Borrow	703.18
Humus	717.09

Loam shall meet the following requirements:

Organic Content	Percent by Volume
Humus	5% - 10%, as determined by Ignition Test
pH	5.5 – 7.5

Mineral Content
Percent passing sieve

85-100% #10
35-85% #40
10-35% #200

The loam shall be screened, loose, friable, and shall be free from admixture of subsoil, refuse, large stones, clods, roots, or other undesirable foreign matter. It shall be reasonably free of weeds, roots, or rhizomes.

Dirty Borrow shall meet the requirements of Section 703.18 Common Borrow with the following addition and deletions:

703.18 Second sentence delete the word peat

Dirty Borrow shall contain no particles or fragments with a maximum dimension in excess of the compacted thickness of the layer being placed.

Mineral Content
Percent passing sieve
75-100% #10

5- 40% #200

Dirty Borrow must have an organic content of 3% to 8% as determined by ignition test.

The Contractor may elect to manufacture loam or dirty borrow from a combination of project materials that the Contractor is entitled to use, combined with other suitable materials furnished by the Contractor.

The Resident shall obtain a sample from loam stockpiles identified by the Contractor Samples will be submitted to MaineDOT testing facility. Only loam from passing stockpiles shall be used.

The Contractor may elect to manufacture loam from a combination of project materials that the Contractor is entitled to use, combined with other suitable materials furnished by the Contractor.

615.03 Preparing Areas All slopes and other areas where loam or dirty borrow is to be placed shall be shaped to the required grade. Before placing the loam on hard or compacted soils, the areas under preparation shall be scarified and loosened to a depth of at least 2 inches.

615.04 Placement of Loam Loam shall be spread uniformly on prepared areas to the depth shown on the plans or as directed. Any remaining clods, roots, stones over 2 inches in its greatest diameter and all other foreign matter, shall be removed. On areas to be seeded under Method Number 1, all rocks over 1 inch in diameter shall be removed. All loam shall be brought to a true, even surface, meeting the required grade. The Contractor shall compact the loam with a 100 pound roller or other approved means. Loam thickness shall meet the specified depth after compaction.

Dirty Borrow shall be spread evenly and uniformly on prepared areas to the depth shown on the plans or as directed, and shall be brought to a true, even surface, meeting the required grade.

615.05 Method of Measurement Loam or dirty borrow will be measured by the cubic yard complete in place after finishing to the required depths as shown on the plans or directed. Lateral measurements will be parallel with the slope of the ground.

Removal of existing topsoil salvaged from within the lines of improvement will be measured for payment in accordance with Section 203.18. The depth of the salvaged topsoil to be included for payment shall be the depth authorized. There will be no deduction from borrow quantities resulting from the authorized excavation of salvaged topsoil.

615.06 Basis of Payment The accepted quantities of loam or dirty borrow will be paid for at the contract unit price per cubic yard complete in place. Existing topsoil removed from within the lines of improvement and stockpiled for later use as dirty borrow will be paid for under Pay Item 203.20, Common Excavation, after removal and stockpiling, and will be paid for under Pay

Item 615.10, Dirty Borrow, when placed in its final position. Grading surplus topsoil, salvaged but not required for use on slopes as loam or dirty borrow, will be paid for under the appropriate items of Section 631 - Equipment Rental, Section 618 - Seeding, and Section 619 - Mulch.

Payment will be made under:

Pay Item		Pay Unit
615.07	Loam	Cubic Yard
615.0701	Loam - Plan Quantity	Cubic Yard
615.10	Dirty Borrow	Cubic Yard

SECTION 616 - SODDING

616.01 Description This work shall consist of furnishing and placing approved live sod on a bed of friable soil for the replacement of lawns or other areas called for on the plans or authorized.

616.02 Materials Materials shall meet the requirements in the following Sections of Division 700 - Materials:

Fertilizer	717.01(b)
Agricultural Ground Limestone	717.02

Sod may be either field sod or cultivated sod as approved by the Resident.

Field sod shall consist of a dense, well-rooted, vigorous growth of turf forming perennials indigenous to the locality where it is to be used. Field sod shall be taken from approved sources where the sod will not break or crumble during cutting, transporting and laying. Field sod shall be reasonably free from noxious weeds, large stones, tree roots, or other materials harmful to growth or subsequent maintenance of the sod. Field sod shall be cut to a uniform thickness of not less than 2 inches.

Cultivated sod shall consist of a Kentucky Bluegrass/Red Fescue turf obtained from an approved commercial sod farm and shall be substantially free from objectionable grassy and broadleaf weeds. Cultivated sod shall be cut to a uniform minimum thickness of not less than ¾ inch.

Pegs for holding sod shall be of approved sound wood and at least ¾ inch in thickness and at least 8 inches in length or approved equal.

616.03 Cutting and Transporting The area from which sod is to be cut shall be mowed and cleared of excess clippings and other foreign matter shortly before cutting starts. The sod shall be freshly cut with an approved sod cutter into strips of uniform thickness having a minimum width of 12 inches and a minimum length of 12 inches and transported in an unbroken condition

to the area to be sodded. Sod shall be placed in its final position within 24 hours after cutting. No storage of sod will be allowed unless specifically authorized by the Resident. Cut sod shall be protected from drying during the time between cutting and placing.

616.04 Site Preparation Sod shall be placed over 4 inches of moist loam in accordance with Section 615. The areas to be sodded shall be brought to the grades shown on the plans, allowing for the thickness of the sod. Areas to be sodded shall be cleared of stones, roots, clods, and other debris that might interfere with laying sod or subsequent maintenance of the sodded area. The fertilizer shall be incorporated into the soil by a mechanical spreader or other approved method capable of maintaining a uniform, measurable rate of application. Fertilizer shall be applied before laying sod, at the rate of 4 lb/1000 ft^2. On hard packed soil, the areas under preparation shall be scarified or otherwise loosened to a depth of at least 4 inches before placing loam and laying sod, unless otherwise directed.

616.05 Laying Sod Sod shall be moist when laid and shall be placed on a moist soil bed. The sod shall be placed at a right angle to the slope, commencing at the lower end and tightly fitted, edge to edge, to provide a uniform surface. Transverse joints shall be staggered. Sod shall be fitted to produce a tight surface without gaps.

The sod shall be compacted and bonded to the soil with an approved tamper or light roller. After tamping or rolling, the sod shall have a smooth, even surface free from humps and depressions.

Unless otherwise directed, on areas with a gradient of 2 horizontal to 1 vertical or steeper, the sod shall be anchored with wooden pegs or staples as approved by the Resident. The pegs shall be spaced no more than 2 feet apart in any direction and driven through the sod into the ground perpendicular to the ground surface. The top of the pegs shall be driven flush with the surface of the sod.

The Contractor shall water the sod as necessary and shall insure continued growth of the sod. Sod not surviving for 3 months after installation shall be removed and replaced by the contractor at their expense until established.

Frozen sod shall not be used nor shall sod be placed on frozen soil.

616.06 Method of Measurement Sodding will be measured by the square yard, measured along the slope, complete in place, or as otherwise directed.

616.07 Basis of Payment The accepted quantities of sodding will be paid for at the contract unit price per square yard completed and accepted in place, which shall include supplying and installing sod, fertilizer, limestone and watering. Necessary excavation for placing sod will not be paid for separately but will be considered incidental to the contract unit price for sodding.

Payment will be made under:

Pay Item		Pay Unit
616.08	Sodding	Square Yard

SECTION 617 - SOIL CONDITIONERS
Reserved

SECTION 618 - SEEDING

618.01 Description This work shall consist of furnishing and applying seed, and other materials to areas shown on the plans or as authorized by the Resident.

a. Seeding Method Number 1 shall consist of the application of "Park Mixture", fertilizer, lime or liquid lime, and humic acid soil conditioner to loamed areas which are expected to be maintained by frequent mowing: i.e. private lawns.

b. Seeding Method Number 2 shall consist of the application of "Roadside Mixture Number 2", lime or liquid lime, humic acid soil conditioner and fertilizer to existing soils, dirty borrow or loamed areas which are expected to be maintained by infrequent mowing: i.e. inslopes, ditches, and rural lawns.

c. Seeding Method Number 3 shall consist of the application of "Roadside Mixture Number 3," inoculant and lime or liquid lime, humic acid soil conditioner to existing soils, erosion control mix, or riprap areas which are not expected to be mowed: i.e. backslopes, guardrail areas.

d. Special Seeding shall consist of the application of a special seed mix and amendments as defined by Special Provision.

e. Temporary Seeding shall consist of the application of seed to control erosion to slopes and stockpiles that have been disturbed during construction and will be left incomplete for more than 30 days. Seed for Temporary Seeding shall be oats, winter wheat, buckwheat, or rye.

f. Crown Vetch Seeding shall consist of the application of seed, inoculant, lime or liquid lime, and humic acid soil conditioner to areas that will not be mowed: i.e. riprap or erosion control mix.

618.02 Materials Materials shall meet the requirements of the following Sections of Division 700 - Materials:

Fertilizer	717.01
Humic Acid	717.011
Agricultural Ground Limestone and Liquid Lime	717.02
Seed	717.03

618.03 Rates of Application Application rates are set forth below. One unit is defined as 1000 ft^2.

a. The Contractor shall apply agricultural ground limestone at the rate of 33 pounds per unit. For hydroseeding, liquid lime shall be applied at the rate of 1 pound (dry weight) per unit, hydraulic method. These rates shall apply to all Seeding Methods and Crown Vetch.

b. The fertilizer application rate for seed establishment shall be 4 ½ pounds / unit, Seeding Method 1 and 2 only.

c. Humic acid soil conditioner shall be applied at the rate of 2 pounds / unit, hydraulic method for Seeding Methods 1, 2, 3, and Crown Vetch.

d. The seed mixture sowing rate for Seeding Method 1 and 2 shall be 4 pounds/unit.

e. The seed mixture sowing rate for Seeding Method 3 shall be 1 pound unit.

f. The Temporary Seed sowing rate shall be 3 pounds / unit.

g. The Crown Vetch Seed sowing rate shall be 1/2 pound / unit.

618.04 Time of Initial Seeding The Contractor shall not seed during January, February, or March, or when the ground is frozen or snow covered, or at other times as the Department may direct.

618.05 Applying Fertilizer and Agricultural Ground Limestone - Conventional Method The Contractor shall apply fertilizer and agricultural ground limestone when the soil is moist and before sowing the seed. The Contractor shall apply these materials to the soil by an approved method capable of maintaining a measured rate of application, thoroughly incorporating materials into the soil to a depth of not less than 1 inch. The Contractor shall not apply these materials simultaneously unless using an approved hydraulic method.

618.06 Sowing Seed - Conventional Method The Contractor shall sow seeding materials uniformly at the required rate and mulch seeded areas the same day as sown. The Contractor shall roll lawn areas with a light lawn roller after seeding but before mulch is applied.

618.07 Sowing Seed and Applying Fertilizer and Agricultural Ground Limestone - Hydraulic Method The Contractor may use the hydraulic spray method of sowing seed where approved. The Contractor shall use a commercial machine designed for the hydraulic application of seed, fertilizer, humic acid soil conditioners, liquid lime or limestone and mulch in slurry. The

Contractor shall mix seed and added materials with sufficient water in the tank of the machine and keep the slurry thoroughly agitated, so the materials are uniformly mixed and suspended in the water at all times during operation. The Contractor shall uniformly distribute the seed slurry on the designated areas at the required rate.

618.08 Mulching After seeding, the Contractor shall place hay mulch straw mulch or erosion control blanket unless cellulose fiber mulch is applied with the seed by the hydraulic method. The Contractor shall place Mulch as specified in Section 619 and Erosion Control Blankets as specified in Section 613. Mulch for Seeding Method Number 1 shall only be cellulose fiber mulch Section 619.04(c) or straw mulch Section 619.04(b). For other seeding methods where hay mulch has been previously applied for erosion control and there is adequate hay mulch still present on the area at the time of seeding, the Department may direct the Contractor to seed over the hay mulch. Cellulose fiber mulch may be used with Method 2.

618.09 Construction Method

a. Seeding Method Numbers 1 and 2

1. After the loamed or unloamed areas to be seeded have been brought to grade, the Contractor shall scarify all ground not sufficiently loose and friable to provide bedding for the seed to a depth of at least 2 inches immediately before seeding or mulching. The Contractor shall remove all stones over 1 inch (Method 1 areas) and 2 inches (Method 2 areas) in the greatest dimension, tree roots, and refuse and dispose of as directed by the Department. The surface shall be a uniform grade but not smooth.

2. The Contractor shall apply fertilizer and agricultural ground limestone to the prepared areas as specified in Sections 618.05 and 618.07.

3. The Contractor shall sow the seed as specified in Sections 618.06 and 618.07.

4. The Contractor shall apply mulch as specified in Section 618.08.

b. Temporary Seeding

1. The Contractor may place seed and limestone directly over existing ground without site preparation.

2. The Contractor shall apply agricultural ground limestone as specified in Sections 618.05 and 618.07.

3. The Contractor shall sow seed onto existing ground as specified in Sections 618.06 and 618.07.

4. The Contractor shall apply mulch as specified in Section 618.08.

c. Seeding Method 3 and Crown Vetch Seeding

1. The Contractor may place seed and limestone directly over existing ground without site preparation.

2. The Contractor shall apply agricultural ground limestone to the areas as specified in Section 618.07.

3. The Contractor shall sow seed as specified in Section 618.07.

4. The Contractor shall apply mulch as specified in Section 618.07. The Contractor shall not apply mulch if seeding riprap or erosion control mix.

618.10 Maintenance and Acceptance The Department will accept areas seeded with Seeding Method 1or 2 upon attainment of a reasonably thick uniform stand of permanent grass species with at least 90 percent coverage, free from sizable thin or bare spots. The Contractor shall perform final reseeding as follows: Upon completion of all other work on the project, seeded areas that have not been accepted shall, within 60 calendar days, meet the 90 percent coverage requirement or be reseeded a final time. Final reseeding shall be done at the end of the 60-day period or at any time within the 60 days, as directed by the Resident. The Contractor will not be allowed to perform final reseeding between September 15th and April 15th, and the Department will not count this time as part of the 60-day period. All reseeding shall comply with Sections 618.03 through 618.09.

The Department will accept areas sown with Method 3, Temporary Seed, Special Seed, or Crown Vetch at the time that areas are satisfactorily completed.

The Contractor shall maintain and protect all seeded areas until acceptance.

618.101 Applied Water The Contractor shall use Applied Water to aid in the establishment of newly planted shrubs, trees, seedlings, and sod during an abnormal drought that requires excessive watering beyond what is expected with each planting in accordance with Sections 621.0024 and 616.05. Applied Water shall be authorized by the Department. The Contractor shall use Applied Water from approved sources and in a manner to allow the soil to absorb the water without runoff.

618.11 Method of Measurement The Department will measure Seeding for payment by the area of seeded surface in Units of 1000 ft^2 along the slope of the ground.

The Department will measure Applied Water for payment by the gallon in calibrated tanks or by accurate water meters. Delivery slips, as specified in Section 108.1.3-f will be required. Watering deemed necessary by the Contractor to assure a growth of grass under the guarantee provisions of Section 618.10, Maintenance and Acceptance, will not be measured for payment.

618.12 Basis of Payment The Department will pay for the accepted quantities of seeding at the Contract price per Unit for the method specified, which price shall be full compensation for furnishing and spreading seed, limestone, fertilizer, and inoculant. The price shall also include any reseeding, watering, and maintenance necessary to meet the requirements of Section 618.10, Maintenance and Acceptance.

When fertilizer is omitted from Seeding Method Number 1 or Number 2 at the direction of the Department, payment for such seeding will be 85 percent of the Contract price for the appropriate item.

When authorized, the Department will pay for Applied Water at the Contract price per gallon.

When seeding is completed, amounts due for these items will be payable.

The Department will pay for Loam and Mulch as provided in Section 615 - Loam and Section 619 - Mulch.

Payment will be made under:

	Pay Item	Pay Unit
618.13	Seeding Method Number 1	Unit
618.14	Seeding Method Number 2	Unit
618.141	Seeding Method Number 3	Unit
618.143	Special Seeding	Unit
618.15	Temporary Seeding	Pound
618.16	Crown Vetch Seeding	Unit
618.25	Applied Water	Gallon

SECTION 619 - MULCH

619.01 Description This work shall consist of furnishing and applying hay, straw, bark, erosion control mix, or cellulose fiber for covering slopes and other areas with a mulch as shown on the plans or authorized.

619.02 Mulch Material shall conform to the requirements specified in the following Sections of Division 700 - Materials:

Mulch	717.04
Mulch Binder	717.05

619.03 General Cellulose fiber mulch shall be used with Seeding Method 1 and may be used with Seeding Method 2 in approved areas, which may include, but are not limited to, lawns

adjacent to developed property, areas subject to high air blasts created by moving vehicles, and areas where hay mulch would create a hazard.

619.04 Applying Mulch Mulch shall be any of the following types of material.

a. Hay or straw mulch for both seeded and unseeded areas shall be spread evenly and uniformly over the designated areas. Unless otherwise directed, mulch shall be applied at the rate of 70 to 90 lbs/unit. Too heavy an application of mulch shall be avoided. Lumps and thick mulch material shall be thinned.

Unless otherwise authorized, hay or straw mulch shall be anchored in place by uniformly applying an acceptable mulch binder. Mulch binder shall be applied as soon as the mulch is placed. Application of a concentrated stream of mulch binder will not be allowed. Mulch binder will be paper fiber mulch applied at 5 lbs/Unit or approved equal. Water spray may be used as a temporary binder.

Temporary mulching shall be applied as per the Contractor's SEWPCP, spread immediately to protect soil from erosion during all stages of construction throughout all seasons of the year.

b. Cellulose Fiber Mulch shall be applied as a waterborne slurry. The cellulose fiber and water shall be thoroughly mixed and sprayed on the area to be covered so as to form a uniform mat of mulch at the rate of not less than 40 pounds of mulch material per 1000 ft^2 unit of area.

Cellulose fiber mulch may be mixed with the proper quantities of seed, fertilizer, and agricultural limestone as required under Section 618 - Seeding or may be applied separately the same day as seeding.

c. Bark mulch not incidental to plantings and erosion control mix shall be placed to cover the slope with a 4 inch deep blanket or as called for on the Plans or by the Resident.

619.05 Maintenance The Contractor shall maintain the hay, straw, or fiber mulch by repairing all damaged mulch and by correcting all shifting of the mulch due to wind, water, or other causes, until an acceptable growth of grass has been achieved.

If cellulose fiber mulch is used, any reseeding will require additional cellulose fiber mulch.

Bark mulch and erosion control mix will be accepted upon completion. Upon acceptance of each area, the Contractor will be relieved of further responsibility for maintaining that area or repairing damage except that resulting from their own or subcontractor's operations.

If water spray is used as a temporary binder, it shall be maintained in a manner acceptable to the Resident.

619.06 Method of Measurement The Department will measure Mulch for payment by the area of surface in Units of 1000 ft^2 along the slope of the ground.

The quantity of bark mulch and erosion control mix measured and accepted for payment will be the number of cubic yards each, delivered and installed to the required depth as shown on the plans or as directed. Measurement will be parallel with the slope of the ground.

619.07 Basis of Payment The accepted areas mulched will be paid for at the contract price per unit, which shall be full compensation for furnishing and spreading the hay or straw and mulch binder , cellulose fiber mulch, bark mulch or erosion control mix.

When mulch is measured by bales, each bale will be paid for at 60% of the contract price per unit for Pay Item 619.1201.

Payment will be made under:

Pay Item		Pay Unit
619.12 01	Mulch	Unit
619.1301	Bark Mulch	Cubic Yard
619.1401	Erosion Control Mix	Cubic Yard

SECTION 620 – GEOTEXTILES

620.01 Description This work shall consist of the furnishing and installing of woven geotextile fabric or non-woven geotechnical fabric, hereinafter called fabric, as shown in the Contract, or otherwise directed. This Section is intended for use in conjunction with Section 722 - Geotextiles.

620.02 Materials Fibers used in the manufacture of geotextiles, and the threads used in joining geotextile by sewing, shall consist of long-chain synthetic polymers, composed of 95 percent by weight of polyolefins or polyesters. They shall be formed into a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including salvages.

Geotextiles shall meet the requirements in the following Sections of Division 700 - Materials:

Stabilization/Reinforcement Geotextile	722.01
Drainage Geotextile	722.02
Erosion Control Geotextile	722.03
Separation Geotextile	722.04

620.03 Placement

A. Stabilization/Reinforcement and Separation Geotextile The installation site shall be prepared by clearing, grubbing, and excavating or filling the area to the design grade. This includes the removal of topsoil and vegetation. Soft spots and unsuitable areas identified during site preparation shall be excavated and backfilled with select material and compacted using normal procedures, as directed.

The geotextile shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. Construction vehicles shall not be allowed directly on the geotextile. The subbase shall be placed such that at least the minimum specified lift thickness shall be between the geotextile and equipment tires or tracks at all times. Turning of vehicles shall not be permitted on the first lift above the geotextile. Any ruts occurring during construction shall be filled with additional subbase material and compacted to the specified density. In stabilization applications, the use of vibratory compaction equipment is not recommended with the initial lift of subbase as it may cause damage to the geotextile.

When fabric is to be used as a reinforcement geotextile, care shall be taken to tension the fabric before completely covering with aggregate. Cover material shall be placed starting on one edge of the fabric and progress toward the opposite edge, in order to maintain tension in the fabric.

When sloped riprap is to be placed on fabric, the site shall be prepared to provide an undulating and uneven surface, as much as is practical. The fabric shall be placed loosely to prevent any bridging of the uneven surface. Fabric to be placed on slopes shall have the long direction oriented up and down the slope as shown on the Standard Detail.

The armor system placement shall begin at the toe and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile. Riprap and heavy stone fill shall not be dropped from a height of more than 1 foot. Stone with a mass of more than 220 pounds shall not be allowed to roll down the slope. Slope protection and smaller sizes of stone filling shall not be dropped from a height exceeding 3 feet, or a demonstration provided showing that the placement procedures will not damage the geotextile. Following placement of the armor stone, grading of the slope shall not be permitted if the grading results in movement of the stone directly above the geotextile.

For Separation Geotextile, when the fabric is to be placed in the roadway, the cover material shall be dumped on previously placed cover material or at the edges of the fabric and then pushed onto the fabric. The first layer of cover material shall be greater than 8 inches and first compacted by a track bulldozer. At no time shall construction equipment be allowed on the fabric when the fabric is covered with less than 8 inches of compacted cover material. Ruts shall be filled with additional cover material to maintain the minimum 8 inch cover over the fabric. When fabric is placed in the roadway, the fabric roll widths shall be chosen so that there will be a minimum number of overlaps of parallel rolls. The total width of surface covered is shown on the Standard Details

B. Drainage Geotextile Trench excavation shall be done in accordance with details of the project plans. In all instances excavation shall be done in such a way as to prevent large voids from occurring in the sides and bottom of the trench. The graded surface shall be smooth and free of debris. The fabric shall be placed loosely with no wrinkles or folds and with no void spaces between the geotextile and the ground surface.

Placement of the drainage aggregate should proceed immediately following placement of the geotextile. The geotextile shall be covered with a minimum of 1 foot of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, a bedding layer of drainage aggregate should be placed below the pipe, with the remainder of the aggregate placed to the minimum required construction depth. The aggregate should be compacted with vibratory equipment to a minimum of 95% Standard AASHTO density unless the trench is required for structural support. If higher compactive effort is required, a Class 1 geotextile as described in Section 722 - Geotextiles is needed.

C. Erosion Control Geotextile The geotextile shall be placed in intimate contact with the soils without wrinkles or folds and anchored on a smooth graded surface approved by the Resident. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch the geotextile, tearing it.

Anchoring of the terminal ends of the geotextile shall be accomplished using key trenches or aprons at the crest and toe of slope. The geotextile shall be placed with the machine direction parallel to the direction of water flow which is normally parallel to the slope of erosion control runoff and wave action and parallel to the stream or channel in the case of stream bank and channel protection. When riprap or stone ditch protection is placed on fabric, the stones shall be placed so that they do not puncture or otherwise damage the fabric.

When sloped riprap is to be placed on fabric, the site shall be prepared to provide an undulating and uneven surface, as much as is practical. The fabric shall be placed loosely to prevent any bridging of the uneven surface. Fabric to be placed on slopes shall have the long direction oriented up and down the slope as shown in the Standard Details.

The armor system placement shall begin at the toe and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile. Riprap and heavy stone fill shall not be dropped from a height of more than 1 foot. Stone with a mass of more than 220 pounds shall not be allowed to roll down the slope. Slope protection and smaller sizes of stone filling shall not be dropped from a height exceeding 3 feet, or a demonstration provided showing that the placement procedures will not damage the geotextile. Following placement of the armor stone, grading of the slope shall not be permitted if the grading results in movement of the stone directly above the geotextile.

In underwater applications, the geotextile and backfill material shall be placed the same day. All void spaces in the armor stone shall be backfilled with small stone to ensure full coverage.

620.04 Overlap Adjacent lengths of fabric shall be joined by overlapping a minimum of 18 inches at the ends and sides except when sewing is specified or fabric is placed on slopes. All overlaps on slopes shall be placed as follows:

A. For slopes steeper than 3H:1V - Sewn seams or minimum 3 foot overlaps with no pinning or staking allowed.

B. For slopes flatter than 3H:1V - Sewn seams or minimum 18 inch overlaps and pins or stakes may be used to anchor the overlaps per the manufacturer's recommended spacing.

C. Overlaps shall be in the direction of flow.

When fabric is placed in the roadway, the fabric roll widths shall be chosen so that there will be a minimum number of overlaps of parallel rolls. The total width of surface covered is shown on the Standard Details.

A. Stabilization/Reinforcement and Separation Geotextile Adjacent geotextile rolls shall be overlapped shingle style, sewn, or joined as required in the plans. Overlaps shall be in the direction shown on the plans. On curves the geotextile may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and held in place by pins, staples, or piles of fill or rock. The following Table summarizes the minimum overlap for geotextiles in this application:

AASHTO Classification	Minimum Overlap
A-1, A-2, A-3, A-4	18 inches
A-5, A-6, A-7	3 feet or sewn[a]
All roll ends	3 feet or sewn[a]
[a]Seams shall be sewn when the soils have a CBR equal to or less than 1, unless otherwise specified.	

B. Drainage Geotextile Successive sheets of geotextiles shall be overlapped a minimum of 1 foot, with the upstream sheet overlapping the downstream sheet. In trenches equal to or greater than 1 foot in width, after placing the drainage aggregate the geotextile shall be folded over the top of the backfill material in a manner to produce a minimum overlap of 1 foot. In trenches of less than 1 foot but greater than 4 inches wide, the overlap shall be equal to the width of the trench. Where the trench is less than 4 inches, the geotextile overlap shall be sewn or otherwise bonded. All seams shall be subject to the approval of the Resident.

C. Erosion Control Geotextile Adjacent geotextile sheets shall be joined by either sewing or overlapping shingle style. Overlapped seams of roll ends shall be a minimum of 18 inches except where placed under water. In such instances the overlap shall be a minimum of 3 feet. Overlaps of adjacent rolls shall be a minimum of 18 inches in all instances. When overlapping, successive sheets of the geotextile shall be overlapped

upstream over downstream, and/or upslope over downslope. In cases where wave action or multidirectional flow is anticipated, all seams perpendicular to the direction of flow shall be sewn. For Erosion Control applications, the thread shall also be resistant to ultraviolet radiation.

620.05 Seams When sewn seams are to be used, field or factory seaming by machine will be allowed. If a sewn seam is to be used for the seaming of the geotextile, the thread used shall consist of high strength polyethylene or polyester and shall have the same or greater durability as the geosynthetic being seamed. Nylon thread shall not be used. The thread shall be adjusted in the field to be sufficiently tight but not cut the geotextile. For Erosion Control applications, the thread shall also be resistant to ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile itself. Flat/prayer seams or J-/Double J-type seams shall be used with double-locked stitches (Class 40l), except the "flat" seam may be used for repair of damaged in-place fabric. A stitch density of 70 to 140 per foot shall be used for lighter-weight geotextiles while heavier geotextiles shall have 50 to 70 per foot. All field seams shall be double stitched with two parallel passes and the 2 rows of stitching shall be approximately ½ in apart and shall not cross at any point. All stitching shall be at least 1 inch from the fabric edge.

For seams that are sewn in the field, the Contractor shall provide at least a 6.5 foot length of sewn seam for sampling by the Resident before the geotextile is installed. For seams that are sewn in the factory, the Resident shall obtain samples of the factory seams at random from any roll of geotextile that is used on the project. For seams that are field sewn, the seams sewn for sampling shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided.

When sewn seams are required, the seam strength, as measured in accordance with ASTM D 4632, shall be equal to or greater than 90 percent of the specified grab strength. The Contractor shall submit the seam assembly description along with the sample of the seam. The description shall include the seam type, stitch type, sewing thread, and stitch density. To facilitate inspection all seams shall be placed with the seam up so that repairs can easily be made if faulty seams are encountered during inspection, as shown on the Standard Detail. Procedures for testing sewn seams are given in ASTM D 4884 - Standard Test Method for Seam Strength of Sewn Geotextiles.

620.06 Certification The Contractor shall provide to the Resident a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. This information shall be furnished to the Resident for approval of the fabric before installation. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of Section 722 - Geotextiles. Documentation describing the quality control program shall be made available upon request. The Manufacturer’s certificate shall state that the furnished geotextile meets Minimum Average Roll Value (MARV) requirements of the specification as evaluated under the Manufacturer’s quality control program. A person having

legal authority to bind the Manufacturer shall attest to the certificate. Either mislabeling or misrepresentation of materials shall be reason to reject those geotextile products.

620.07 Sampling and Acceptance Geotextiles shall be subject to sampling and testing to verify conformance with this specification. Sampling for testing shall be in accordance with the most current ASTM D 4354, using the section titled, "Procedure for Sampling for Purchaser's Specification Conformance Testing." In the absence of purchaser's testing, verification may be based on manufacturer's certifications as a result of testing by the manufacturer of quality assurance samples obtained using the procedure for Sampling for Manufacturer's Quality Assurance (MQA) Testing. A lot size for conformance or quality assurance sampling shall be considered the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

Testing shall be performed in accordance with the methods referenced in Section 722 - Geotextiles for the indicated application. The number of specimens to test per sample is specified by each test method. Geotextile product acceptance shall be based on ASTM D 4759. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the specification MARV. Refer to ASTM D 4759 for more details regarding geotextile acceptance procedures.

620.08 Shipment, Storage, Protection, and Repair of Fabric Geotextile labeling, shipment and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style number, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures in excess of 160°F, and any other environmental condition that may damage the physical property values of the geotextile.

To prevent damaging the fabric, the Contractor shall exercise necessary care while transporting, storing, and installing the fabric. Atmospheric exposure of geotextiles to the elements following laydown shall be a maximum of 5 days to minimize damage potential. At no time shall riprap stones be rolled down the slope where fabric has been placed.

Before installation, the fabric shall be protected from rain, from sunlight or other ultraviolet exposure and from dust, mud, debris, or other elements that may affect its performance. Fabric that is torn, punctured, or otherwise damaged shall not be placed. During installation, direct weather exposure of the fabric shall be limited to a maximum of 5 days, from laydown to covering of the fabric.

A. Stabilization/Reinforcement Geotextile Before covering, the geotextile shall be inspected by the Resident to ensure that the geotextile has not been damaged during

installation. Damaged geotextiles, as identified by the Resident, shall be repaired immediately. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area. If placement of the backfill material causes damage to the geotextile, the damaged area shall be repaired as previously described. The placement procedure shall then be modified to eliminate further damage from taking place.

B. Drainage Geotextile Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed extending beyond the damaged area by a distance of 18 inches, or the specified seam overlap, whichever is greater.

C. Erosion Control Geotextile The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch the geotextile, tearing it. Care shall be taken during installation so as to avoid damage occurring to the geotextile as a result of the installation process. Should the geotextile be damaged during installation, a geotextile patch shall be placed over the damaged area extending 3 feet beyond the perimeter of the damage. When riprap or stone ditch protection is placed on fabric, the stones shall be placed so that they do not puncture or otherwise damage the fabric. Field monitoring shall be performed to verify that the armor system placement does not damage the geotextile. Any geotextile damaged during backfill placement shall be replaced as directed by the Resident at the Contractor's expense.

620.09 Method of Measurement The quantity of geotextile will be measured by the number of square yards of surface area covered and in direct contact with the cover material. Measurement will not be made for overlaps, patches and repairs of damaged geotextile unless additional overlap width is required by the Resident in which case measurement will be made for that added overlap area.

620.10 Basis of Payment Geotextiles will be paid for at the contract unit price per square yard. Such payment shall be full compensation for furnishing and placing geotextile fabric; for all required surface preparation; for all labor, tools, materials and equipment; for repairing torn and damaged geotextile; and when required, for sewing seams and for furnishing and placing all pins or stakes or other hold down devices; for excavation for and furnishing and placing protective aggregate cushion; and for all other incidentals necessary to complete the work.

Payment will be made under:

	Pay Item	Pay Unit
620.54	Stabilization/Reinforcement Geotextile	Square Yard
620.55	Stabilization/Reinforcement Geotextile (sewn seams)	Square Yard
620.56	Drainage Geotextile	Square Yard
620.57	Drainage Geotextile (sewn seams)	Square Yard
620.58	Erosion Control Geotextile	Square Yard
620.59	Erosion Control Geotextile (sewn seams)	Square Yard
620.60	Separation Geotextile	Square Yard

620.61 Separation Geotextile (sewn seams) Square Yard

SECTION 621 - LANDSCAPING

621.0001 Description This work shall consist of the Contractor furnishing and planting trees, shrubs, vines, and other plants and shall include all planting operations and material as well as the care and replacement of the plants during the Maintenance Period, all in accordance with the specifications, Standard Details, planting plans and schedules and the directions of the Resident. Planting operations will be divided into two classes.

a. Class A Planting will consist of planting into the existing soil that has been amended with organic humus, peatmoss, compost, and/or other standard horticultural soil amendments as approved by the Resident.

b. Class B Planting will consists of planting into the existing soil without amendments.

Unless otherwise specified, all planting shall be Class A.

621.0002 Materials - General All non-plant material shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Fertilizer	717.01
Mulch	717.04
Organic Humus	717.09

Water shall be free from oil, acids, alkalines, salts, or any other substances harmful to plantings.

621.0003 Plant Material-All Classes

a. All plants shall conform to the current edition of the "American Standard for Nursery Stock" (ANSI Z60.1) unless otherwise indicated in the plans or specifications.

b. All plants shall be first class representatives of their normal species or varieties, unless otherwise specified. All plants must have a good, healthy, well-formed upper growth and a large, fibrous, compact root system. Plants sheared into stiff or formal shapes will be rejected unless they have outgrown such shearing.

Large-growing, deciduous trees shall have straight trunks and a single leader or as may be characteristic of the species. Tops shall be thickly branched, densely foliated, well balanced and in good proportion to the height of the tree. Trees with weak trunks, thinly or irregularly branched or with unnatural shape of proportions due to undesirable pruning or for

any other cause will be rejected. Trees with leaders or branches too severely cut back or with bottom limbs trimmed too high will be rejected.

Small-growing deciduous trees shall be thickly branched with a well-balanced, natural shape. Plants which are poorly furnished or have grown or been pruned into unnatural shapes will be rejected.

Tree "Clumps" shall have three or more main stems starting from the ground.

c. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such conditions for at least two years. All plants must have been grown in a latitude north of Washington, D.C. The Resident may require a sworn affidavit from the contractor stating the source where all plants were grown. Payment for plants may be withheld until this affidavit is received.

All plants shall be nursery grown unless otherwise stipulated. No plant will be considered nursery grown unless it has been transplanted at least once and has been growing in a nursery for at least 2 years. Where collected stock is allowed, all plants in addition to meeting all other requirements for nursery-grown stock, shall have a diameter of ball or root spread at least one-third greater than that required for nursery stock. Plants showing signs of lack of root pruning, cultivation or other proper nursery care will be classified as collected stock regardless of their source.

d. All plants must be healthy and vigorous; free from disease, injurious insects and their eggs or larva, mechanical wounds, broken branches, decay, or any other defects.

e. All plants shall be true to name. Each bundle or each plant when not tied in bundles shall be labeled legibly and securely. The current edition of "Standardized Plant Names" prepared by the Editorial Committee of the American Joint Committee on Horticultural Nomenclature shall be the authority for all plant names.

Care shall be taken throughout the operation to keep each plant species or variety segregated and labeled. The Resident will reject any plants concerning any doubt or confusion arising about nomenclature, either at the time of delivery or at any subsequent time.

f. The Contractor shall take all precautions that are customary in good trade practice to insure upon arrival at the planting site the plants are in good condition for successful growth. All plants must show appearance of normal health and vigor. Plants with loose or broken balls; dried out roots, twigs or needles; or plants which have become overheated in transit or are found not to comply with these specifications in any way will be rejected. The Resident will not assume responsibility for such rejected material.

The Resident reserves the right to plainly mark all rejected plants with paint or by other means to ensure that they are not used on the job. Rejected plants may not be used on the project, will not be paid for, and must be replaced by the contractor with approved plants. If plants with communicable diseases are not removed or destroyed immediately, upon discovery of the disease, all plants that were left in contact will also be rejected.

621.0004 Plant Size and Root Balls

Class A Plants The plant sizes specified in the "American Standards for Nursery Stock" are the minimum sizes acceptable. (ANSI Z60.1) Plants, which meet the sizes specified but do not have a normal shape and balance between height and spread, will be rejected. Thin, poorly branched, or sparsely rooted plants will be rejected, regardless of whether they meet the minimum technical requirements of the American Standard for Nursery Stock .

Where bare roots are irregular, the size of the root spread will be the average root spread considering all sides of the plant and not the maximum root spread. The Resident may allow moderate deviations from exact sizes of plants that normally have irregular root systems.

Coarse-rooted plants, which lack sufficient fibrous feeding roots, will be rejected.

Recently cut stubs of large roots on either balled or bare root stock will be considered evidence of lack of proper nursery care and root-pruning and will be sufficient grounds for rejecting such plants or classifying them as collected stock. Acceptable roots will retain sufficient fibrous feeding roots.

Where a size range with a maximum and minimum is given, an average size is required. At least 40 percent of the plants in a size range shall be at or above the average for this size range.

A solid ball is referred to as one encompassing the roots of a plant. A solid ball shall consist of the soil in which the plant was originally grown. The ball shall have been dug up in such a manner as not to disturb the roots. Where such a ball is required the designation B and B, Balled and Burlapped, will be used. No B and B stock will be accepted if this solid soil ball has disintegrated or if loose soil apparently has been packed around the roots.

Peat Balls and other fiber material will not be acceptable where B and B stock is called for, but said root balls may be furnished where bare root stock is called for if approved by the Resident.

Per ASNS Standards, the caliper of trees shall be the diameter of the trunk taken 6 inches above the root collar for up to and including four-inch caliper size . If the caliper at 6 inches exceeds 4 inches in diameter, the caliper will be measured at 12 inches above the ground.

Class B Plants Unless otherwise specified, plants used in Class B plantings shall be seedlings, plugs or lining out stock with heavy, fibrous, compact root systems. The

comparative size of the plants shall be as stated under the heading "Seedling Trees and Shrubs" in the "American Standard for Nursery Stock". All conifers must have dormant buds and secondary needles. Where B and B plants are designated, ball sizes shall be the same as Class A plants.

621.0006 Inspection A preliminary check of the plants may be made at the time of delivery for condition of the plants and conformity to the specifications. The Contractor shall inform the Resident at least 48 hours in advance, as to what plants are to be planted and in what location. Inspection will continue throughout the life of the contract up to the time of Final Acceptance. Plants which are not true to name, do not conform to the specifications, show evidence of improper handling or lack of proper care or which appear to be in a seriously unhealthy condition must be removed by the Contractor at once and replaced by acceptable plants as soon as the planting season allows. Any unacceptable plants when pointed out to the Contractor by the Resident shall be removed at once. If this occurs during the planting season, these plants shall be replaced at once; if between planting seasons, they shall be replaced at the next subsequent planting season, unless conditionally directed by the Resident for evergreens and other preferred spring planted items.

621.0017 General Construction Requirements Planting operations shall be performed in accordance with the plans and specifications and as directed by the Resident.

621.0018 Layout The location of plants as shown on the plans shall be considered approximate only. The exact locations will be designated on the ground by the Resident, making such changes as may be required to adjust the planting to local conditions. Plant quantities may, in some cases, be increased or decreased as provided in Section 109.1 - Changes in Quantities. Locations for trees and shrubs shall be staked out on the ground by the Resident before herbicides are applied and any plant pits or beds are dug.

The Contractor shall furnish the stakes for use in marking plant locations. Stakes shall be wire survey flags at least 21 inches tall. Layout stakes shall be approved by the Resident before the Contractor commences any work on the project.

The Contractor shall mark the stakes legibly with indelible marking material and may also be required to furnish personnel, capable of locating plants from plans, to carry out the staking under the direction of the Resident.

Before actively starting work on the project, the Contractor shall provide the Resident with a planting sequence schedule to be used in establishing priorities in staking plant locations. The Contractor shall give the Resident at least four days advance notice of any deviations from this schedule. The Resident will not be responsible for any delay or inconvenience caused by unfinished staking resulting from the Contractors failure to follow the above procedure.

All stakes used to locate plants shall be replaced in the correct plant pits after each operation and shall remain there until the Resident directs their removal. When plants are set out in wrong locations due to stakes being misplaced during digging and planting operations, the Contractor

shall be required to move the misplaced plants to the proper location at their own risk and expense.

621.0019 Plant Pits and Beds

a. Plant Beds Areas designated as plant beds must have the entire surface cultivated, cleared of weeds and be completely covered with mulch. Actual mulch limit will extend 2½ feet out from the center of plant or to the pavement edge, bridge wall, and roadside face of guardrail. Cultivation must include complete removal of all weed and grass roots, loose stones over 3 inches maximum diameter and any other debris. Approved herbicides are permitted for weed control in place of sod removal.

b. Rock Excavation When ledge or boulders over ¼ yd^3 in size are encountered in digging plant pits, the Contractor shall notify the Resident who will change the location of the plants. No excavation of ledge or boulders over ¼ yd^3 in volume will be required and no extra payment will be made for rock excavation or for shifting of plant holes due to rock.

c. Class A Planting Size of plant pits shall bear the following relationship to the spread of roots or root ball diameter of the plants to be planted in them:

For all plant materials, the holes shall be 2 times the diameter of the ball or container size.

The plant pit shall be deep enough so that when installed the top of the root ball is even with to ½ inch higher than the existing ground. In all cases, the depth shall be sufficient to contain all the roots of the plant without crowding.

In certain areas of poor drainage or heavy soil, the Resident may require raising the plant elevation. When required, the raising of the plants shall be included as a part of the cost of the plant.

Excavated soil mixed with organic humus shall be used as backfill around the roots. Stones larger than 2 inches in maximum diameter, large roots, roots or rhizomes of weeds or other injurious materials shall be removed and not used as backfill. Any additional material needed to fill plant pits to the level of the surrounding ground shall be loam (Section 615) furnished by the Contractor at their own expense.

d. Class B Planting Class B plants will be planted in the existing soil. Plant holes must be deep enough to allow room, for the full depth of the root without doubling or folding and wide enough to allow room for its normal spread. Plants must be set straight and at the same depth at which they were previously growing. Soil must be firmly compacted about the roots leaving no air pockets.

621.0020 Planting Seasons Seasons for planting, unless otherwise directed, shall be within the following dates:

Bare Root Plants	Spring	April 1st to May 31st
	Fall	Sept. 15th to Oct. 15th

Evergreens Container or Balled and Burlapped

Spring	April 1st to June 15th
Fall	August 15th to September 30th

Potted & Container Grown Deciduous Plants

Spring	April 1st to June 30th
Fall	August 15th to Nov. 30th

Balled & Burlapped Deciduous Plants

Spring	April 1st to June 15th
Fall	August 15th to Nov. 30th

Plants will not be planted in frozen soil, soil that is excessively wet, or excessively dry.

Preparations for planting may begin earlier than the specified season and planting work may continue beyond the specified time limits if approved by the Resident. However, the Resident may require that all plants planted out-of-season shall receive special attention as directed. Any out-of-season planting shall be at the Contractor's risk and expense.

621.0023 Setting Plants

a. Placement Plants shall be set plumb and straight in the prepared pits and beds and at a level such as will result, after settlement, in the top of the root ball being level with or to within 1 inch above the surrounding ground surface.
b. Staking If the Resident or Landscape Architect determines a tree requires staking, the Landscape Contractor will provide staking incidental to the cost of the plant. Tree staking shall be done in accordance with horticultural industry standards; trees shall be staked to allow slight sway and movement all the way to the ground. Stakes shall not extend into tree branches. Stakes shall be driven into undisturbed soil and not permitted to penetrate root balls.

   Staked trees shall remain in a plumb position throughout the Maintenance Period. Staking materials shall be removed after one growing season or if longer time is needed at the end of the Maintenance Period.

621.0024 Backfill Class A For all Class A plants backfill shall consist of 3 parts of soil excavated from the plant pit thoroughly mixed with one part of organic humus and/or horticultural amendments as approved by the Resident. Sods or clods may not be used as backfill. The backfill material shall be placed and compacted in the bottom of the planting pit and shall be worked around the roots and thoroughly compacted as the backfilling proceeds, leaving no air

pockets. The backfill shall be filled in around the root ball to half the depth of the ball, and the remaining wire basket shall be removed and the remaining burlap around the ball shall be loosened and spread out away from the plant or if it is too bulky, cut away and removed. The backfilling shall then be completed, watered and tamped firm. Plastic film wraps shall be completely removed during planting. Nursery containers shall be completely removed before planting. The roots of bare root plant materials shall be placed in their natural arrangement with the backfilling carefully performed to prevent damage to the plant's root system. Broken or bruised roots shall be pruned immediately, making a clean cut. Shallow basins or saucers of earth will be required to be placed around each plant. However, when drainage conditions are poor, as in heavy clay soil, the Resident may require that such saucers be omitted or used only temporarily. All plants shall be thoroughly watered and liquid fed the day they are planted and as often thereafter as necessary for the plants to become safely established.

621.0025 Fertilizing

a. Water Soluble Fertilizer The Contractor shall liquid feed all class A plantings as the first watering, unless otherwise directed by the Resident.

Liquid fertilizer shall be completely dissolved and mixed in water at the rate of 6 pounds of the fertilizer concentrate to 100 gallons of water.

The resulting solution shall be poured around the plant in the plant saucer. The solution shall be applied at the following rates for each application:

Containerized plants shall receive watering-in fertilizer solution of volume equal to container size.

Plant materials including B&B shrubs and deciduous trees specified by height/spread shall receive one (1) gallon of water per each 1 foot (12 inches) of height/spread.

Plant materials specified by caliper shall receive one (1) gallon of water per each ¼ inch (one-quarter inch) of caliper measurement.

Evergreen plant materials shall receive two (2) gallons of water per each 1 foot (12 inches) of height.

b. Slow Release Fertilizer Tablets All Class A plantings shall be fertilized with slow release fertilizer tablets or equivalent as approved by the Resident, at the time of planting, unless otherwise directed by the Resident. Fertilizer tablets shall be placed equidistantly within the planting pit adjacent to the ball or root mass, but not in direct contact with roots. Placement depth shall be 6 to 8 inches below ground level.

The application rates shall be as follows:
Deciduous and Evergreen Shrubs shall receive one (1) tablet per each 1 foot (12 inches) of size.

Deciduous Trees and Evergreen Trees specified by height shall receive one (1) tablet for two

foot height, plus 1 additional tablet for each additional 1 foot (12 inches) of size.

Deciduous Trees specified by caliper shall receive one (1) tablets for each ½ inch (one-half inch) caliper.

Specification	Plant size	Tablets
Height/Spread	12" - 23"	1
Height/Spread	2' - 3'	2
Height/Spread	3' – 4'	3
Evergreen/Ht.	3' – 4'	3
Evergreen/Ht.	5' – 6'	5
Caliper	2" – 3"	4
Caliper	3" – 4"	6

Perennials, Vines and Ground Covers shall receive 1 tablet or appropriately proportioned equivalent.

621.0026 Mulching The disturbed surface area of plant beds and pits shall be evenly and uniformly covered to a depth 4 inches with bark mulch or as directed by the Resident. All plant pits and beds must be entirely free of weed or grass growth and free of live roots of all weeds and grasses prior to the time mulch is applied. Mulch shall be removed from or installed with no contact to trunk or bark surfaces.

Mulching will not be required on Class B plantings, unless otherwise specified on a project specific basis.

Measurement of the depth of mulch will be made after one heavy rain or after a three-week period without heavy rain.

All plant pits and beds must be entirely free of weed or grass growth and free of live roots of all weeds and grasses at the time mulch is applied.

When plant beds are installed near guardrails, or as stated in Section 621.0019(a), the space between the plants and the guardrail or the nearest pavement when it extends behind the guardrail, shall be treated as a part of the plant bed and shall be weeded and mulched.

Plants shall not be damaged when the mulch is applied. Smothered or otherwise damaged plants must be replaced. Mulch, in place, will not be permitted to be directly in contact with the base of plant trunks or stems. Plants shall be mulched at the time of installation.

621.0027 Cultivation All plant pits and beds shall be kept free of weeds and grass by the Contractor from the time the plants are planted until final acceptance. This shall be accomplished by manual weeding, cultivation, or use of approved herbicides. Application of herbicides to control weeds or grass shall be performed only by a Maine licensed pesticide

applicator with an appropriate category as determined by the Board of Pesticide Control. There will be no payment for unsatisfactory work.

621.0030 Pruning Pruning shall be done to each plant individually in such a manner as to preserve the natural character of the plant and shall be done only after delivery and inspection. All pruning shall be done with sharp tools by experienced persons in accordance with the best horticultural practice. Plants pruned in such a manner as to seriously impair the appearance or character of the plant will be rejected. Bench pruning with knives or axes will not be permitted. Broken or badly bruised branches, soft wood, and sucker growth shall be removed with clean cuts.

Excessive pruning shall not be accepted as a means of disposing of dead wood or unhealthy plants. Plants in such poor condition that they can only be revived by pruning of more than 1/3 or more of the growth will be considered unsatisfactory and will be rejected. At the time of final acceptance, all plants must be at least the size called for in the specification.

621.0031 Potted and Container Grown Plants Plants supplied in Containers must have been established in containers at least one full growing season before planting and shall have a well rooted condition evidenced by the firmness of the mass of soil and roots. The outside of the ball of soil shall be well matted with healthy working roots, but shall not be pot bound. Plants shall be adequately hardened off before planting. Root growth shall be loosened prior to planting.

Containers shall be of such shape as to permit easy removal of the plant.

No plant will be accepted if the container ball is cracked or broken upon removal from the container.

621.0033 Protection of Plants It will be the responsibility of the Contractor to take necessary steps to protect all plants from rodents during the Maintenance Period. Protection from rodents will be included in the cost of the individual plants and the Contractor will receive no extra compensation for this work.

621.0034 Cleanup and Repair All excess excavated material and debris resulting from the planting operation shall be promptly disposed of outside of and out of sight of the project, unless otherwise directed by the Resident. Any areas disturbed by the Contractor showing bare earth, that do not require mulching, shall be seeded with approved grass seed, fertilized and mulched, as directed by the Resident.

The Contractor shall be responsible for any damage caused by their operations and shall restore the disturbed areas to their original condition. Cost of cleanup and repair shall be incidental to the work.

621.0035 Prosecution and Progress It is essential that each portion of the planting work in any area be promptly followed by cleanup of subsoil and debris, fertilization, watering, cultivation, pruning, mulching, spraying as needed, repair and restoration of damage caused by

the Contractor, etc. The Contractor shall provide sufficient labor and supervisory personnel to carry out this work without undue delay. Any delay in carrying out this phase of the work which, results either in danger to the health or growth of the plants or a poor appearance of the project from the point of view of the public will be considered due cause for withholding all or part of any payment due the Contractor for plants delivered and planted or for any other work done.

Partial payments on the contract do not constitute approval or acceptance of any specific plants or work operations. The right is reserved to reject any plants or work, which are discovered to be unsatisfactory at any time before the end of the Maintenance Period..

621.0036 Maintenance Period

The acceptability of the plant material furnished and planted under this contract shall be at the end of the Maintenance Period, during which the Contractor, as necessary, shall employ all possible means to preserve the plants in a healthy and vigorously growing condition and to insure their successful establishment. During this period, the Contractor shall water, cultivate and prune the plants, and do any other work necessary to maintain the plants in a healthy growing condition. This shall include seasonal spraying with approved insecticides or fungicides as may be required. The Contractor shall also be responsible for protecting the plants from rodents. All dead or rejected plants shall be promptly removed from the project and replaced by live healthy plants meeting the same specifications. If such plants are declared unacceptable during the planting season, they shall be replaced during this planting season, otherwise, they shall be replaced during the next subsequent planting season.

Such replacement plants are subject to the same requirements as the original plants and must be replaced in turn if they fail to meet the required standards. Plants designated for spring planting only, will be replaced only during the spring planting season unless otherwise directed by the Resident.

The Maintenance Period shall commence after Physical Work Complete but not before the Landscape Warranty Bond has been received by the Resident if required by Special Provision and shall extend for two years after that date unless otherwise directed. Necessary replacements shall be made so that at the end of the Maintenance Period all plants shall be in a healthy, vigorous growing condition and free from sizable die-back.

Replacements will be required for plants lost, damaged, or rejected, whatever the cause. The Contractor will be considered responsible for the plants until the end of the Maintenance Period.

It shall be the sole responsibility of the Contractor to replace any unsatisfactory plants on the project regardless of whether they are specifically designated by the Resident. In the case of individual doubtful plants, the Contractor may call upon the Resident to make a determination as to their acceptability, but it shall not be incumbent on the Resident to furnish the Contractor with exact lists of replacements.

All replacements of plants shall be completed by the end of the planting season before the end of the Maintenance Period. All replacement planting shall conform in every way to the requirements of the original planting. The Resident may require that any replacement plants that are not dormant, or that are planted late in the season, be sprayed, as directed with an approved anti-desiccant.

621.0037 Method of Measurement The quantity of plants to be measured for payment will be the number of individual plants furnished and planted as required and accepted, excluding replacements.

621.0038 Basis of Payment Each item of "Planting" will be paid for at the contract unit price for each accepted plant furnished and planted. Payment shall constitute full compensation for; furnishing and placing plants, digging, delivering, rodent protection, preparing plant pits, beds and drains; planting, watering, fertilizing, mulching, pruning, and the cleanup of planting areas; for all, fertilizer, mulch and other necessary materials; all labor, equipment, tools, Maintenance Period work, Replacement and Bonding (if required by Special Provision) and any other incidentals necessary to complete the work.

When a bid item calls for a "Group" of trees, shrubs, vines or other plants, the Contractor shall furnish each individual species within this "Group" for the same unit bid price.

The name and estimated number of individual species within each "Group" will be shown on the estimated quantities sheet of the plans.

Payment will be made under:

	Pay Item	Pay Unit
621.XX	Name plant or plant group as detailed in Schedule of Items in Proposal Book	Each

SECTION 622 - TRANSPLANTING SHRUBS, HEDGES, AND TREES

622.01 Description This work shall consist of digging, moving and replanting existing shrubs, hedges, and trees in accordance with these specifications and in conformity with the plans or as directed.

622.02 Materials – General All non-plant materials shall conform to the requirements specified in the following Sections of division 700 – Materials

Fertilizer	717.01
Mulch	717.04
Humus	717.09

622.03 Shrubs and Hedges

a. Digging The earth of shrubs and hedges to be moved shall be carefully encompassing the roots as is customary in good nursery practice. Minimum size of the rootball shall be as indicated in the current edition of the "American Standards for Nursery Stock" (ANSI Z60.1)

b. Moving The earth rootball shall be maintained as a solid unit during the moving of the shrubs and hedges and must be protected from breaking or cracking by careful handling. The rootball shall be tightly wrapped with burlap or similar material. Earth rootballs greater than 18 inches in diameter shall be tightly bound with cord or rope placed over the burlap unless the shrubs or hedges are to be replanted immediately after digging.

c. Planting The plants shall be planted in the designated new location at the same depth below ground surface as before they were moved. Backfill consisting of 3 parts excavated soil and one part organic humus shall be placed under and around the rootball to eliminate all air pockets and to support the plant. Insofar as feasible, when hedges are to be transplanted, the individual plants shall be replanted in the same relationship to each other that existed before they were moved.

Fertilizer tablets shall be placed into the backfill at the following rates.

Shrubs to 2 foot high or spread	1 tablet
Shrubs to 4 foot high or spread	2 tablets
Shrubs to 6 foot high or spread	3 tablets

d. Time of Transplanting Plants shall be dug and transplanted only when dormant, unless otherwise directed by the Resident. When dug, shrubs and hedges shall be moved directly to the final planting site and planted immediately, if possible. The rootball must be kept moist at all times during transplanting operations. If construction makes it impossible to replant the plants immediately after digging, the rootballs of the plants shall be kept completely covered with a thick layer of earth, straw, bark mulch, peat moss, or similar material which shall be kept moist at all times while the plants remain unplanted. Shrubs may be held in approved pots under conditions of delayed replanting.

e. Pruning All pruning shall be done in accordance with the best horticultural practice. Dead, diseased, or injured shoots and branches shall be removed. In order to restore a normal balance between top and roots, deciduous shrubs shall be thinned by removing uniformly scattered, selected branches which shall be cut back to the main stem, as directed. The Resident may also require tip pruning. Tip pruning may also be required for evergreens. In the case of hedges, the Resident may require shearing to uniform, even surfaces.

f. Watering As soon as the plants are planted they shall be thoroughly watered to the point where the roots and the surrounding earth are well saturated. The first application of liquid fertilizer shall be made during planting.

g. Mulching After removing all weeds and grass, the ground surface over the entire area of the planting pit shall be covered to a depth of 4 inches with bark mulch.

622.04 Trees

a. Digging All trees to be moved and replanted shall be dug with a solid ball of earth around the roots as is customary in good nursery practice. The diameter of the ball shall be not less than 10 times the diameter of the trunk of the tree measured 1 foot above the surface of the ground. Depth of the ball shall be not less than 60% of its diameter for balls up to 48 inch diameter. For balls over 48 inch diameter the ball shall have sufficient depth to maintain a solid structure and to encompass all the feeding roots under the ball area.

b. Moving The ball must be maintained as a solid unit during the moving of the tree. The ball must be protected from breaking or cracking by careful handling and by being tightly bound with cord or rope over canvas, burlap, or similar wrapping. The ball shall be firmly attached to a tree platform of suitable size during moving operation, as required.

c. Planting The trees shall be planted in the designated new location at the same depth in relation to the ground surface as before they were moved. Backfill consisting of 3 parts excavated soil and one part humus shall be placed under the ball and around the periphery of the ball. Backfill shall be puddled and firmed in place to eliminate all air pockets and give adequate support to the ball. Fertilizer shall be applied as specified in Section 621.0025.

d. Protection Every care shall be taken to prevent injury to the tree during the transplanting operation. All parts of the tree shall be carefully protected. Branches shall be tied out of the way of possible injury. No chain, cable, or heavy rope may be attached to the trunk or branches without protective padding adequate to prevent bruising or other injury.

e. Time of Transplanting Trees shall be dug and transplanted only when dormant, unless otherwise directed. When dug, trees shall be moved directly to the final planting site and planted immediately if possible. The ball must be kept moist at all times during transplanting operations. If construction problems make it impossible to replant the tree immediately after digging, the ball of the tree must be completely covered with a thick layer of earth, bark mulch, peat moss or similar material which shall be kept moist at all times while the tree remains unplanted. Pruning, watering, fertilizing, mulching, and supporting shall be as specified in the applicable Sections of Section 621 - Landscaping.

622.05 Maintenance It shall be the Contractor's responsibility to protect and care for transplants. They shall be watered weekly during dry weather or as otherwise directed. The Contractor shall take steps required to protect the plants from damage and from diseases and pests. Should damage occur it shall be repaired by the Contractor, according to the best horticultural practice. The Contractor shall be responsible for transplants through one growing season.

622.06 Replacement If the ball is badly broken or the plants are otherwise badly damaged or if, in the opinion of the Resident, during the life of the contract the plants show such signs of loss of health or appear to be in danger of dying, the Contractor will be required to replace the plants with others of the same size and variety or approved plants of equal value, at the proper season.

622.07 Method of Measurement

Transplanting shrubs or trees will be measured in place after transplanting by the single shrub or tree unit.

622.08 Basis of Payment

The accepted quantities of transplanting shrubs or trees will be paid for at the contract unit price for each plant properly transplanted and accepted, which payment shall include digging, binding, moving, replanting, pruning, mulching, care and maintenance and if required, replacement of the shrubs, and for all fertilizer, mulch and other materials, and for all incidentals necessary to complete the item.

Payment will be made under:

Pay Item		Pay Unit
622.10	Transplanting Shrub	Each
622.11	Transplanting Tree	Each

SECTION 623 – MONUMENTS

Reserved

SECTION 624 - VACANT

SECTION 625 - WATER SERVICE SUPPLY LINES

625.01 Description This work shall consist of installing water pipe and pipe sleeve in reasonably close conformity with the lines and grades shown on the plans or established. The installation shall include the assembly of all components and materials shown on the plans or as directed.

625.02 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Copper Tubing	712.32
Non-metallic Pipe, Flexible	712.33
Non-metallic Pipe, Rigid	712.34
Metallic Pipe	712.341

625.03 General This work shall be done with as little interruption of water service as possible. Ample notification shall be given to the users of the water before any disruption of water service.

625.04 Sleeve Pipe for sleeves shall be metallic or non-metallic rigid and be laid on a firm foundation at the line and grade designated. When the pipe installation is in a trench all excavating and backfilling shall be in accordance with Section 206 - Structural Excavation.

After installation of the pipe, special care shall be taken to protect the pipe from heavy hauling equipment loads, rocks or any other damage caused by the Contractor's work. All pipe broken from such causes shall be removed and replaced at the Contractor's expense.

Pipe sleeves to be placed in concrete shall be supported during placement of concrete. Special care shall be taken while placing and compacting concrete around the sleeves to prevent voids around the outside of the sleeves. Ends of the sleeves shall be capped with end plates until the water pipes are installed through the sleeves.

625.05 Water Pipe Water pipe shall be copper tubing or non-metallic flexible pipe, as called for. After the sleeve has been placed, the water pipe shall be inserted into the sleeve and connected to the existing pipes at each end. All connections to existing pipes shall be done in accordance with recognized plumbing practices.

Necessary fittings, adapters, and reducers shall be furnished as required.

625.06 Method of Measurement Pipe sleeve, copper tubing, and non-metallic pipe will be measured by the linear foot.

625.07 Basis of Payment The accepted quantities of pipe sleeve, copper tubing and non-metallic pipe will be paid for at the contract unit price per linear foot for the types and sizes specified complete in place, which payment will be compensation for furnishing and installing all necessary fittings, for connecting to existing systems and for capping the ends of the pipe sleeve.

Excavation will not be paid for separately but will be considered included in the work of the contract items.

Payment will be made under:

	Pay Item	Pay Unit
625.081	¾ inch Copper Tubing	Linear Foot
625.082	1 inch Copper Tubing	Linear Foot
625.083	1¼ inch Copper Tubing	Linear Foot
625.084	1½ inch Copper Tubing	Linear Foot

625.085	1¾ inch Copper Tubing	Linear Foot
625.086	2 inch Copper Tubing	Linear Foot
625.101	¾ inch Non-metallic Pipe-Flexible	Linear Foot
625.102	1 inch Non-metallic Pipe-Flexible	Linear Foot
625.103	1¼ inch Non-metallic Pipe-Flexible	Linear Foot
625.104	1½ inch Non-metallic Pipe-Flexible	Linear Foot
625.105	1¾ inch Non-metallic Pipe-Flexible	Linear Foot
625.141	2 inch Pipe Sleeve	Linear Foot
625.142	3 inch Pipe Sleeve	Linear Foot
625.143	4 inch Pipe Sleeve	Linear Foot
625.144	6 inch Pipe Sleeve	Linear Foot
625.145	8 inch Pipe Sleeve	Linear Foot

SECTION 626 - FOUNDATIONS, CONDUIT, AND JUNCTION BOXES FOR HIGHWAY SIGNING, LIGHTING, AND SIGNALS

626.01 Description This work shall consist of furnishing, installing, modifying, or removing concrete foundations, conduits, and junction boxes for highway lighting, highway signing, and traffic signal installations in accordance with these specifications and in reasonably close conformity with the plans.

626.02 General The materials furnished by the Contractor shall be new. Where an existing system is to be modified, the existing material shall be removed and abandoned or salvaged as shown on the plans or as directed.

All electrical equipment shall conform to NEMA or UL standards, wherever applicable. In addition to these requirements, all materials and workmanship shall conform to the requirements of: NEC, ASTM Standards, the ANSI, the local electrical Utility Company, and any local ordinances that may apply.

Materials shall meet the requirements specified in the following Sections of Division 700, Material Details.

Reinforcing Steel	709.01
Precast Concrete Units	712.06
Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Anchor Bolts	720.07

626.021 Miscellaneous Material Gravel backfill shall meet the requirements for Aggregate Base-Screened, Section 703.06 a., Type A.

Transformer pads shall conform to the requirements of the local electrical Utility Company.

If grouting is necessary to correct surface irregularities in the top of the concrete foundations, a non-shrink material satisfactory to the Resident shall be used.

All concrete foundations shall be constructed of Class LP concrete in accordance with the applicable requirements of Section 502 – Structural Concrete.

626.022 Equipment List and Drawings Unless otherwise permitted in writing, the Contractor shall within 30 days following execution of the contract, submit a list of equipment and materials which are to be installed. The list shall include the name of manufacturer, size, and identifying number of each item. The list shall be supplemented by such other data as may be required, including detailed scale drawings of proposed minor deviations from the plans. If requested, the Contractor shall submit for review, design data and sample articles of the material proposed for use. All of the above data shall be submitted in duplicate except samples for testing. Following checking, correcting, and reviewing, two complete sets of drawings shall be submitted. The Department will not be liable for material purchased, labor performed, or work delayed before such review.

Upon completion of the work, the Contractor shall submit three complete sets of corrected plans showing all construction changes.

626.03 General All work shall conform to NEC and NESC standards as set forth in the NIST Handbook H-32, except when otherwise noted on the plans or in the Special Provisions.

The Contractor shall be responsible for and shall repair all damage caused to underground drainage structures, utilities or lighting conduit, which are encountered during construction.

626.031 Conduit If the trench for conduit is located in wet, spongy or otherwise unsuitable ground, the trench shall be further excavated to a depth sufficient to overcome this condition and shall be backfilled with approved gravel. The gravel shall be compacted in layers not exceeding 8 inches, loose measure. The grade of the bottom of the trench shall be parallel to the proposed grade of the conduit.

Trenches for conduits shall be excavated to a width that will permit proper installation of the conduit and to the depth shown on the plans or as directed.

All junction or pull boxes shall be vehicle rated (22,000lbs) and concrete junction boxes shall be Class LP and installed as shown on the plans

Where conduits enter exposed junction boxes, they shall be sloped to drain towards the conduit entrance holes, unless otherwise directed. Weep holes of ¼ inch diameter shall be placed in all pull boxes, junction boxes, and fuse boxes.

After the trench has been excavated as specified, the bottom of the trench shall be prepared with a sand bedding material. After placing the conduit, sand shall be placed around the sides and over the top of the conduit, when shown in the special details. The entire trench shall then be backfilled with approved material, placed in layers not exceeding 8 inches, and thoroughly tamped.

All underground conduit shall be placed to at least the depth shown on the plans and shall not interfere with poles, guardrail posts, sign foundations or other objects.

All conduit ends shall be capped with conduit caps until wiring has begun. Prewired conduit shall be sealed during construction to prevent entry of moisture, dirt, or rocks.

All conduit shall be sealed to prevent rodent ingress after cables have been installed. Any blocking material shall be removable without use of tools.

The size and type of conduit required will be noted on the plans, except that the minimum size of conduit risers required for traffic signal installations shall be determined by percentage fill in a single conduit, as specified in the latest revision of the NEC. Where more than one conduit is required to be installed in the same location, the conduits may be placed in the same trench.

The weather head on conduit risers on Utility Company poles shall not be less than 1 foot from any utility wires. Conduit risers on Utility Company poles shall be located as required by the Utility Company.

Within 10 days after completion of each section of conduit, the Contractor, in the presence of the Resident, shall rod and pull through each duct a mandrel and brush of a pattern satisfactory to the Resident, but which shall not be more than ⅛ inch smaller than the bore of the ducts. Where obstructions in the ducts prevent passage of the mandrel, the Contractor shall, at their own expense, remove and relay those portions of the ducts necessary to clear the obstruction.

The Contractor shall install a suitable nylon pulling string with a rated 210 lb. tensile strength in all unused conduits. The ends of the string shall be secured in such manner as to prevent accidental withdrawal of the string

626.032 Metallic Conduit Installation Conduits shall be of the sizes noted on the plans, which are indicated as the nominal inside diameter. All conduits shall be joined with threaded couplings using approved thread sealant. Conduit shall be installed so that it is continuous and watertight between boxes or equipment. Running threads will not be permitted. When necessary, the Contractor shall use an approved electrical union-type coupling. Conduits shall

be protected at all times from the entrance of water or other foreign matter. Conduit runs shall be made with as few couplings as standard lengths will permit. The total angle of all bends in one run and the radius of conduit bends shall conform to the NEC requirements. All field bends and offsets shall be made with approved hickey or conduit benders. Pull boxes shall be used wherever necessary to facilitate the installation of the wires.

In making up a run of conduits, all cut ends shall be reamed to remove rough edges and cut threads shall be painted with an approved thread sealant in such a manner that there will be no unprotected surfaces and joints will be watertight. All conduits shall have electrical continuity and shall be adequately grounded.

Conduits to be placed in the concrete superstructure of bridges and similar structures shall be securely supported and fastened, in order to maintain the conduits' position within the concrete superstructure, as shown on the plans. Pull boxes shall be located as shown on the plans. Clearance between conduit runs shall preferably be 2 inches, but at no time shall be less than the maximum size of the aggregate used in the embedding concrete. At all joints where relative movement between adjacent parts of a structure can occur, a double "O"-ring expansion coupling, or other approved expansion device shall be installed.

Exposed conduit shall be rigidly and securely fastened with acceptable fasteners or supports, as indicated on the plans or approved. Fasteners or supports shall not be placed more than 6 feet apart on centers, except as otherwise authorized. Conduits shall generally be supported by an approved spacer at the point of support, so that there is an air space between the conduit and the supporting surface. Ends of conduit runs terminating in a metallic box without a threaded hub shall be provided with a metallic locknut on the outside of the box, and a metallic locknut and insulated bushings on the inside. A lock washer and a galvanized steel flat washer shall be installed between the outside locknut and face of the box.

626.033 Polyvinylchloride Conduit Installation Polyvinylchloride conduit and High Density Polyethylene, hereafter called PVC conduit, shall be installed in accordance with the applicable methods as specified in Section 626.032 for metallic conduits.

PVC conduit shall be made watertight by joining with solvent or in accordance with the manufacturer's specifications.

Conduit shall be bent carefully to avoid damage and without the use of an open flame. Bends sharper than 45º [⅛ bend] will not be permitted in PVC conduit. The total angle of all bends in one run and the radius of bends shall conform to the NEC requirements.

Conduits to be placed in the concrete superstructure of bridges and similar structures shall be securely supported and fastened, in order to maintain the conduits' position within the concrete superstructure, as shown on the plans. Pull boxes shall be located as shown on the plans. Clearance between conduit runs shall preferably be 2 inches, but at no time shall be less than the maximum size of the aggregate used in the embedding concrete. At all joints where relative

movement between adjacent parts of a structure can occur, a double "O"-ring expansion coupling, or other approved expansion device shall be installed.

To allow for expansion and contraction of PVC conduit during installation of long runs, one end shall be left unconnected or a double "O"-ring expansion coupling shall be inserted near one end of the run until final covering of the conduit is in progress.

Where PVC conduit runs are placed parallel to other conduit runs or cross one over another, they shall be separated by a minimum of 3 inches of sand or soil cushion. The bottom of trenches for PVC conduit shall be lined with a 3 inch minimum bedding of tamped sand or soil before laying the conduit. Backfill to a compacted depth of 6 inches above the top of the conduit shall be sand or soil, free from rocks or hard lumps.

No aluminum wire shall be allowed underground. No pre-wired conduit shall be allowed. Conduit and wire sizes shall be as shown on the plans.

626.034 Concrete Foundations

If noted on the plans, the Department has completed an appropriate test boring program to evaluate subsurface conditions in the general vicinity of proposed foundations for traffic signal dual purpose and mast arm poles and highway sign bridge, cantilever, and butterfly support structures. The associated boring log(s), as well as foundation requirements and any foundation-specific information are provided on the plans. Unless another foundation type is specified on the plans, foundations shall consist of cast-in-place reinforced concrete drilled shafts. Supplier shall determine the bending moment, shear force, torsion and axial load at the top of each mast arm or dual purpose pole or sign support structure foundation. Foundation size (diameter and length) shall depend on the Bending Moment and Torsion at the top of the foundation and shall be taken off of the specified charts that are provided in Standard Detail 626, as set forth on the plans. The larger of the foundation sizes shown for Bending Moment or Torsion shall be the required foundation size. Length shall be added in accordance with the plans to account for embankment fill or sloping ground conditions. Lengths are depths below lowest adjacent (proposed) grade. Reinforcing shall be as specified on the associated chart in Standard Detail 626.

The Contractor is responsible for final design of the above-grade components of the mast arm or sign support structure. Design computations that are part of the Contractor’s design submittal shall include the actual loads (bending moment, shear force, torsion and axial load) at the top of each foundation. These actual design loads at the top of each foundation that are provided by the Contractor as part of their submittal will be used by the Department to check the Contractor’s proposed size of the drilled shafts. The Contractor shall not commence foundation construction prior to receiving approval from the Department’s geotechnical group.

In the absence of design requirements being provided on the plans, the Contractor shall prepare and submit the foundation design(s) to the Department for approval. Likewise, the Contractor may propose an alternate shallow spread footing or drilled shaft configuration/ design than that

set forth on the drawings. In either case, any Contractor-prepared foundation design shall meet the design criteria of Section 13 of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Sign, Luminaires and Traffic Signals", unless otherwise specified by the Department. Geotechnical design of the foundations shall be in accordance with Section 13 of the afore-mentioned AASHTO code and AASHTO Standard Specifications for Highway Bridges,17th Edition, as well as FHWA-IF-99-025, Drilled Shafts, Construction Procedures and Design Methods. In addition to other design requirements, foundation design shall account for Torsion for which a minimum Factor of Safety equal to 1.2 shall be achieved. In evaluating axial capacity and torsional resistance in cohesionless soils, load transfer coefficient or side resistance coefficient (beta, β) will be used in accordance with Subsection 13.3.5.1 of FHWA-NHI-10-016, with beta determined in accordance with Equations 13-13 and 13-11 for silty sands to sandy silts (with varying amounts of gravel). Reference is made to Illinois DOT for additional torsional design methodology. The design criteria for the resistance of drilled shaft and spread footing foundations against overturning, sliding and bearing capacity failure shall meet the requirements of Section 4 of AASHTO Standard Specifications, 17th Edition. The structural design of foundations shall meet the requirements of AASHTO Standard Specifications, 17th Edition. The Contractor shall submit to the Department for approval, three (3) copies of detailed plans and calculations, prepared by a State of Maine licensed Professional Engineer, of the proposed foundation. Construction of foundation(s) shall not commence until the Department has approved the foundation design.

If a test boring program has not been completed by the Department, Contractor may use the assumed soil properties provided on the plans to develop foundation designs for the sole purpose of preparing a bid. Prior to construction, the Contractor shall engage a qualified geotechnical firm or person to complete test boring(s) in the vicinity of the foundations, including standard penetration tests and soil sampling, determine soil properties for use in the foundation design, and complete geotechnical analyses and geotechnical foundation design for review and approval by the Department. All costs associated with the work required to sample, classify and analyze the soil, design the foundation and prepare submittals shall be incidental to related Contract items. The Contractor shall submit 3 copies of all foundation design work, structural and geotechnical, together with computations and plans used for design purposes. The computations shall be sufficiently detailed to allow the Department to check and approve the computations. Design calculations that consist of computer generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties. Design submittals not meeting these criteria will be rejected.

Drilled shafts shall not be permanently cased, except for the top 3.0 feet; concrete shall be cast directly against the surrounding soil. Shallow spread footings shall be founded at least 5.0 feet below the lowest surrounding proposed grade for frost protection. If soil conditions differ materially from those described on the boring logs, the contractor shall stop work on that foundation and contact the Resident.

All unsuitable material (including but not limited to peat, organic material, and material that has been disturbed and/or dumped) within the limits of a foundation shall be removed to the limits

directed by the Resident. Drilled shaft depths shall be increased as directed by the Department to account for the unsuitable material. Unsuitable material removed from below subgrade for spread footing foundations shall be replaced with compacted material, as set forth below for foundation backfill. Drilled shaft foundation holes, except in ledge, shall be excavated by auger method to the neat line of the outside dimensions of the footing without disturbing the soil around or below the proposed footing. Drilled shafts shall not be permanently cased, except for the top 3 feet; concrete shall be cast directly against the surrounding soil. In areas where rock or ledge is encountered above the proposed bottom of foundation, the Contractor will have the option of removing rock and placing the foundation at the design depth shown on the plans, or constructing a grouted rock-anchored foundation system. Rock-anchored foundations shall be constructed according to Standard Detail 626(06) Foundations for Traffic Signals, Highway Signing and Lighting, or as approved by the Department for drilled shafts greater than 30 inches in diameter.

Concrete for drilled shafts shall be placed as soon after excavation as practicable to prevent debris from collecting in the excavated area. The Contractor shall provide temporary dewatering of excavations for foundations such that concrete is placed in the dry. Concrete for drilled shafts shall be placed by tremie methods as temporary casing is withdrawn to prevent debris from contaminating the foundation and to ensure concrete is cast against the surrounding soil. Concrete for drilled shafts and spread footings shall be Class A in accordance with Section 502 - Structural Concrete. Precast foundations will not be permitted. Back fill for spread footing foundations shall be Gravel Borrow meeting the requirements of Section 703.20 - Gravel Borrow. Gravel Borrow shall be placed in layers not exceeding 8 inches in depth before compaction. Each layer of back fill shall be thoroughly compacted by use of power tampers to at least 95% of the material's maximum dry density as measured in the field per AASHTO T191 or by an approved method using calibrated nuclear device. All back filling and compacting shall be in accordance with the applicable provisions of Section 206 – Structural Excavation.

Before placing concrete, the required elbows of entrance conduits, reinforcing steel and anchor bolts shall be carefully positioned. The anchor bolt size and the bolt circle diameter shall be determined from data furnished by the supplier of the poles or as shown on the plans. Anchor bolts for use with breakaway couplings, longitudinally grooved-type, shall be 1 inch diameter and shall project between 2½ and 3 inches above the top of the foundation. All other anchor bolts shall be a minimum of 1 inch diameter and shall project sufficiently to accommodate the thickness of the base plus all nuts and washers. The bolt length shall also be sufficient to allow clearances of approximately ½ inch below the leveling nut and ¼ inch above the top nut. At least two threads on each anchor bolt shall project beyond the outside of the nuts holding the plumbed pole.

All foundations shall be warranteed against leaning and corrosion for two years after the project is completed. If the lean is greater than 2 degrees from normal or the foundation is spalling within the first two years, the Contractor shall replace the foundation at no extra cost.

The finished ground at each foundation shall be graded flush with the top of the foundation, except at locations where the foundation is protected by guardrail, by curb, or is outside the clear

zone. If required, approved backfill material shall be added to grade the slopes as specified. There will be no additional compensation for furnishing, placing and compacting material flush around the foundation. In all cases, the surface area around the foundations shall be graded to drain away from the foundation and loamed and seeded in accordance with the requirements of Section 615 and Section 618.

Concrete foundations designated to be modified or removed shall be modified or removed as shown on the plans. Debris resulting from the modification or removal shall be removed from the project. Once removal has been completed, the area shall be brought to grade by addition of granular material and loam, or by loam only, depending on the extent of modification or removal. The area shall then be seeded in accordance with Section 618.

The concrete portion of the foundations exposed to view shall have a troweled finish. A drainage groove shall be formed in the horizontal surface of the foundation. The top of the concrete foundation shall be horizontal.

When the anchor bolt template is removed, the threads of the anchor bolts shall be greased and protected with a metal sleeve, held in position with nuts and washers to be furnished with the bolts. This thread protection shall remain in place until the pole or other equipment is installed.

A copper-clad steel ground rod shall be installed when shown on the plans.

626.04 Method of Measurement Precast Concrete Junction Box, and Remove or Modify Concrete Foundation will be measured by each unit.

Foundation items 626.31, 626.32, and 626.33 will be measured by each unit. The following drilled shaft foundations will be measured by the theoretical cubic yard volume of foundation based upon approved diameters and lengths: 30-inch-diameter in excess of 8 feet long, and all drilled shafts 36 inches or greater in diameter.

All conduit will be measured by the number of linear feet.

The quantity of structural earth excavation to be measured for payment below grade will be the amount actually excavated from 1 foot below the bottom of the foundation, junction box or sand bedding to the required elevation, provided the maximum allowable horizontal dimensions do not exceed those bounded by vertical surfaces 9 inches each side of the installation, as shown on the plans. The quantity of structural rock excavation to be measured for payment will be the number of cubic yards actually removed, provided the maximum allowable horizontal dimensions do not exceed those bounded by vertical surfaces specified herein.

626.05 Basis of Payment The accepted quantity and/or volume of foundations will be paid for at the contract unit price for each type of foundation. This payment shall include: anchor bolts, reinforcing steel, conduit within the foundation and extending 12 inches from the foundation, loam, seeding, mulching and all incidentals necessary to complete the work.

The accepted quantity of junction boxes will be paid for at the contract unit price each. Payment for junction boxes shall include furnishing and installing precast concrete or bituminized fiber boxes as designated, including that portion of conduit extending 12 inches outside the box.

Payment will be made for the total number of linear feet of each type of underground or exposed conduit actually furnished, installed, and accepted at the contract price per linear foot. This price shall include the cost of: furnishing and installing the conduit; excavating; furnishing special backfilling materials, pull wire, fittings, groundings and bonding; test cleaning interiors of conduits and all materials, labor, equipment and incidentals necessary to complete the work.

Excavating and backfilling for junction boxes, foundations and excavating, backfilling and sand bedding for conduit ducts will be considered included in the respective contract unit prices and no separate payment will be made, except as hereafter provided.

Excavating and backfilling as shown on the plans, or as required to overcome soft or otherwise unsuitable material, or for excavating rock will be paid for as provided in Section 206. Required backfill material, except sand bedding as shown on the detail plan, will be paid for as provided in Section 304.

Payment will be made for the total number of linear feet of prewired conduit actually furnished, installed, and accepted at the contract price per linear foot. This price shall include the cost of hand digging, trenching, or plowing; furnishing and installing the prewired conduit; and all labor, equipment and incidentals necessary to complete the work.

The accepted quantity of ground mounted cabinet foundations will be paid for at the contract unit price each, which payment shall include conduit within the foundation and extending 12 inches from the foundation and for loam, seeding, mulching and all incidentals necessary to complete the work.

Prewired conduit within the foundations and extending 12 inches from the foundation, and prewired conduit within the junction box and extending 12 inches outside the junction box, shall be considered incidental to the respective contract unit prices for light standard foundations and junction boxes and no additional payment will be made.

The accepted quantity of Remove or Modify Concrete Foundations will be paid for at the contract unit price each. Such price shall include disposing of concrete removed, backfilling with granular material, loaming, seeding, and all incidentals necessary to complete the work.

Payment for restoration of roadway pavement, sidewalks, grass areas and resetting curbing removed in conjunction with this work, shall be considered incidental to the respective contract prices for each related item, except as otherwise provided.

Payment will be made under:

	Pay Item	Pay Unit
626.11	Precast Concrete Junction Box	Each
626.21	Metallic Conduit	Linear Foot
626.22	Non-metallic Conduit	Linear Foot
626.23	Prewired Conduit Secondary Wiring	Linear Foot
626.24	Prewired Conduit Primary Wiring	Linear Foot
626.31	18 inch Diameter Foundation	Each
626.32	24 inch Diameter Foundation	Each
626.33	30 inch Diameter, 8 feet or less Foundation	Each
626.332	30-inch Diameter, greater than 8-feet long, and all 36-inch and 42-inch Diameter foundations	Cubic yard
626.333	48-inch Diameter, 54-inch Diameter, 60-inch Diameter Foundations	Cubic yard
626.35	Controller Cabinet Foundation	Each
626.36	Remove or Modify Concrete Foundation	Each
626.37	Special Foundation	Each
626.38	Ground Mounted Cabinet Foundation	Each

SECTION 627 - PAVEMENT MARKINGS

627.01 Description This work shall consist of furnishing and placing reflectorized pavement lines and markings, removing pavement lines and markings, and furnishing and applying reflectorized paint to curbing in reasonably close conformity with the plans and as designated.

627.02 Materials Materials shall conform to the requirements specified in the following Sections of Division 700 - Materials.

Pavement Marking Paint	708.03
Reflectorized Plastic Pavement Marking	712.05

Temporary Bi-directional Yellow Delineators shall be Temporary Object Markers (T.O.M.) as manufactured by the Davidson Plastic Company, 18726 East Valley Highway, Kent, WA 98031 or an approved equal.

627.04 General All pavement lines and markings shall be applied in accordance with the Manual on Uniform Traffic Control Devices.

Longitudinal lines placed on tangent roadway segments shall be straight and true. Longitudinal lines placed on curves shall be continuous smoothly curved lines consistent with

the roadway alignment. All pavement markings placed shall meet the tolerance limits shown on the plans.

Broken lines shall consist of alternate 10 foot painted line segments and 30 foot gaps.

Temporary pavement marking lines, defined in Special Provision Section 652, Maintenance of Traffic, Temporary Centerline**,** will be applied as many times as necessary to properly delineate traffic lanes for the safe passage of traffic. Bi-directional delineators may be used in place of temporary lines, except where specified otherwise in Special Provision 652 Maintenance of Traffic, Temporary Centerline. Delineators will be applied at 40 foot intervals.

In overnight lane closure areas that are not to be overlaid, temporary plastic lines or raised pavement markers shall be used through the length of the taper.

Newly painted lines, markings and curb shall be protected from traffic by the use of cones, stationary vehicles or other approved methods until the paint is dry.

627.05 Preparation of Surface Immediately before applying the pavement marking paint to the pavement or curb, the surface shall be dry and entirely free from dirt, grease, oil, or other foreign matter.

Surface preparation for application of plastic markings shall conform to the manufacturer's recommendations.

627.06 Application Prior to applying paint for final pavement lines, the Contractor shall perform a test for paint thickness by furnishing and placing a piece of smooth, clean metal with an area of at least 144 in^2 in the path of the striping truck. The striping truck shall be passed over the piece of metal, painting the surface as it passes, without applying beads. The result of this test will be used to determine the pressure setting and speed of the truck when applying paint to obtain the specified thickness. Additional paint thickness testing may be required on the final paint markings. The wet thickness of paint without beads on final pavement lines shall be a minimum of 16 mils.

On other final pavement markings and on curb, where the paint is applied by hand painting or spraying, application shall be in two uniform covering coats, each at least 10 mils thick. Before the second coat of paint has dried, the glass beads shall be applied by a pressure system that will force the glass beads onto the undried paint as uniformly as possible.

Glass beads shall be applied to the final and temporary pavement lines, marking and curb at the rate of 8 lbs./gal of paint and in sufficient quantity to assure complete and uniform coverage of hand painted surfaces.

Temporary painted lines and markings shall be applied as specified for permanent painted lines, except that the thickness shall be a minimum of 16 mils.

Temporary pliant polymer marking material shall be used for temporary markings on the final pavement and on pavements not to be resurfaced when such pavement markings do not conform to the final pavement markings pattern.

The plastic final pavement lines and markings shall be applied in accordance with the manufacturer's recommendations by the inlay method of application.

627.07 Establishment Period Inlaid plastic pavement lines and marking material furnished and installed under this contract for final pavement markings shall still be subject to a six-month period of establishment.

The period of establishment shall commence as soon as the plastic pavement lines and markings are complete and in place and shall continue for six months. At the end of the establishment period, a minimum of 95% of the plastic pavement lines and markings shall still be in place to be acceptable.

If less than 95% of the plastic pavement lines and markings are in place after six months, the Contractor shall replace all unsatisfactory plastic pavement lines and markings on the project without additional payment. Plastic pavement lines and markings designated for replacement shall be installed according to these specifications, unless otherwise directed. Plastic pavement lines and markings replaced at the end of the six month establishment period will not be subject to a further establishment period.

627.08 Removing Lines and Markings When it is necessary to remove pavement lines and markings, it shall be done by high pressure water, sand blasting, solvent or other acceptable means. The method chosen must be capable of completely eradicating the existing line or marking without damage to the pavement. Burning and grinding to remove temporary markings from final pavement or from existing pavement not to be resurfaced will not be permitted.

627.09 Method of Measurement The quantity of permanent pavement marking lines measured for payment will be the number of feet shown in the Schedule of Items in the contract. This quantity will be considered final and no adjustments will be made except when changes resulting in increases or decreases are made by the Resident.

Double yellow centerline, broken or solid, will be considered one line for measurement purposes. The measurement of broken lines will include the gaps when painted and will not include the gaps when plastic. Temporary pavement marking lines will be measured as one lump sum for work accepted. All other pavement markings will be measured by the square foot for work actually done.

Reflectorized curb will be measured or computed by the square foot of curb surface actually painted and reflectorized.

The accepted quantity of removing existing pavement markings will be measured by the square foot.

Temporary Bi-directional Yellow Delineators will be measured by each unit, complete in place, maintained, and accepted.

627.10 Basis of Payment The accepted quantity of permanent pavement marking lines will be paid for at the contract unit price per foot. No adjustment will be made to the quantity for payment, except as described under Method of Measurement above. All other permanent pavement markings will be paid for at the contract unit price per square foot.

Payment for final plastic pavement lines and markings will be made in two parts. The first payment of 75% will be made when plastic pavement lines and markings are placed. The payment of the remaining 25% will be made at the end of the establishment period for all plastic line and pavement markings accepted.

The accepted quantity of temporary pavement marking lines will be paid for at the contract lump sum price and will include as many applications as required and removal when required. If allowed by Special Provision, the Contractor may utilize Temporary Bi-Directional Yellow and White (As required) Delineators as temporary pavement marking lines and paid for at the contract lump sum price. Such payment will include as many applications as required and removal.

The accepted quantity of Temporary Bi-directional Yellow Delineators will be paid for at the contract unit price.

Payment will be made under:

Pay Item		Pay Unit
627.18	12 inch Solid White Pavement Marking Line	Linear Foot
627.711	White or Yellow Pavement Marking Line - Plan Quantity	Linear Foot
627.733	4” White or Yellow Painted Pavement Marking Line	Linear Foot
627.744	6” White or Yellow Painted Pavement Marking Line	Linear Foot
627.75	White or Yellow Pavement & Curb Marking	Square Foot
627.76	Temporary Pavement Marking Line, White or Yellow	Lump Sum
627.77	Removing Existing Pavement Marking	Square Foot
627.78	Temporary Pavement Marking Line, White or Yellow	Linear Foot
627.407	Reflectorized Plastic, White or Yellow Pavement Marking	Square Foot
627.4071	Reflectorized Plastic, White or Yellow Pavement Marking Line - Plan Quantity	Linear Foot
627.811	Temporary Bi-directional Yellow Delineators	Each

SECTION 628 - VACANT

SECTION 629 - HAND LABOR

629.01 Description This work shall consist of furnishing and supervising laborers when authorized or directed by the Resident in accordance with these specifications.

629.02 General Work under this section shall require no special skill but shall be accomplished in a competent manner. The personnel shall be physically and mentally capable of efficiently performing the assigned duties.

Nothing in this section shall be construed to relieve the Contractor of their responsibility for furnishing personnel under other contract items. The intent is that this item shall be used to perform necessary work not covered or provided for under existing contract items or other sections of the specifications.

629.03 Method of Measurement Hand labor will be measured by the hours of work actually performed, measured to the nearest ¼ hour.

629.04 Basis of Payment The accepted quantities of labor will be paid for at the contract unit price per hour

The contract unit price shall be full compensation for hiring, transporting, supervising, payment of workmen's compensation, social security taxes, unemployment insurance, overtime, benefits and for all hand tools, protective clothing and all incidentals necessary to complete the work.

Payment will be made under:

	Pay Item	Pay Unit
629.05	Hand Labor, Straight Time	Hour

SECTION 630 - VACANT

SECTION 631 - EQUIPMENT RENTAL

631.01 Description This work shall consist of furnishing and operating construction equipment as directed by the Resident.

631.02 General Equipment used for work under this section shall conform to the following minimum sets of requirements:

Equipment	Description	Minimum Size

Air Compressor - Gasoline or diesel powered unit with compressor, receiver and adequate air hose	85 ft^3 per minute at 100 psi
Air Tool - Single compressed air driven hand drill, tamper, hammer, chipper, or pavement breaker	
All Purpose Excavator - Approved truck, mounted type class	3 ton capacity lifting at 15 foot radius
Heavy Duty Purpose Excavator - Approved truck, mounted type class	7 ton capacity lifting at 15 foot radius
Mini All Purpose Excavator - Approved truck, mounted type class	89 hp; 27,100 operating weight 0.5 to 1.0 yd^3 rated capacity
Mini-All Purpose Excavator - Track mounted	89hp; 27,100 operating weight 0.5 to 1.0 yd^3 rated capacity
Bulldozer - Crawler or pneumatic tired tractor with pushing blade	93 hp (flywheel), Weight(tractor) 8.75 ton
Small Bulldozer - Crawler with pushing blade	30 hp
Skid Steer – Pneumatic tired with push blade	46 hp
Chain Saw - Gasoline or electric powered with endless chain type blade	18 inch cutting blade
Culvert Cleaner - Water Jet nozzle, pump and tank	35 gallons per minute at 1,250 psi
Front End Loader - Front end scoop mounted on pneumatic tires	2 yd^3 rated capacity
Small Front End Loader - Front end scoop mounted on crawler or pneumatic tires	6 ft^3 minimum rated capacity
Grader - Tandem drive	7 ton
Road Broom - Engine driven rotary broom	7 foot broom
Roller (earth or base course) - Self-propelled pneumatic tire type	Gross wt. 2,500 lbs/ft of rolling width. 40 inch width Tire ground pressure 65 psi
Roller (pavement) - Self-propelled pneumatic	Gross weight 28 ton

minimum, 7 wheels	12 inch by 24 inch smooth tread tires capable of 110 psi inflation pressure; pressure fully ballasted wheel loads = 8,000 pounds or more
Brush Chipper – Disk Style	30 inch diameter disk
Rototiller - Rotary cultivator mounted on pneumatic tired tractor	25 hp
Stump Chipper - Gasoline powered stump chipping machine	60 hp
Truck, small - Pneumatic tired with dump body rated capacity	5 yd^3 to 8 yd^3 manufacturers rating
Truck, large - Pneumatic tired with dump body rated capacity	8 yd^3 or greater manufacturers rated
Tractor Mounted Hydraulic Hammer Hydraulic hammer to be mounted on a Heavy Duty All Purpose Excavator	2.5 Ton minimum weight 0.5 ft minimum hammer Dia. 8,000 Ft-lbs minimum impact energy

631.03 General Nothing in this section shall be construed to relieve the Contractor of the responsibility for completing work under other contract items. These items shall be used to perform only such work as directed by the Resident.

631.05 Grading All grading shall be done in a manner to leave the area smooth and suitable for machine mowing and to provide proper drainage or as otherwise directed by the Resident. Suitable excavated material shall be placed and compacted on embankment slopes or other areas as directed. Unsuitable material shall be disposed of in approved waste areas.

631.06 Rolling All material under this item shall be compacted to the satisfaction of the Resident. Only those portions of roadway designated for rolling shall be rolled. The work shall be performed under such conditions that maximum compaction can be obtained.

631.07 Method of Measurement Equipment rental will be measured by the hour to the nearest ¼-hour. Time spent moving to and from the site within the project limits and from beyond the project limits, servicing, maintaining, and changing attachments will not be measured for payment.

Supervision required in the performance of hourly equipment rental work will be measured for payment only when called for on the Plans. This item does not relieve the Contractor of the responsibility to supervise other contract items. Foreman will be measured by the hour to the

nearest ¼ hour of time actually spent supervising operators of hourly equipment rental pay items. The name of the supervisor will be supplied to the Resident.

631.08 Basis of Payment The accepted quantities of equipment rental will be paid for at the contract unit price per hour for each type of equipment used. Payment shall include operators, fuel, grease, oil, and other incidentals necessary to operate the equipment.

No separate payment will be made to direct work done under these items, except when called for on the Plans. Payment will then be made under Pay Item 631.36. Payment made will be limited to the grade of foreman and limited to hours spent in actually supervising equipment operators. Such related costs as use of pickup truck, meal and room expenses, benefits, insurance, retirement, travel time, and overtime will not be paid for separately but will be considered incidental to the unit price bid for this pay item.

Payment for equipment rental will be based on experienced operators, familiar with the work being performed. Operators, determined to be below normal acceptable standards of production or workmanship, will be paid for at reduced hours as determined by the Resident.

Payment will be made under:

	Pay Item	Pay Unit
631.10	Air Compressor (including operator)	Hour
631.11	Air Tool (including operator)	Hour
631.111	Tractor Mounted Hydraulic Hammer	Hour
631.12	All Purpose Excavator (including operator)	Hour
631.121	Heavy Duty All Purpose Excavator (including operator)	Hour
631.122	Mini All Purpose Excavator (including operator)	Hour
631.13	Bulldozer (including operator)	Hour
631.131	Small Bulldozer - Grader (including operator)	Hour
631.132	Small Bulldozer (including operator)	Hour
631.133	Skid Steer (including operator)	Hour
631.14	Grader (including operator)	Hour
631.15	Roller, earth and base operator)	Hour
631.16	Roller, Pavement (including operator)	Hour
631.171	Truck-small (including operator)	Hour
631.172	Truck-large (including operator)	Hour
631.18	Chain Saw Rental (including operator	Hour
631.20	Stump Chipper Rental (including operator)	Hour
631.21	Road Broom (including operators and hauler)	Hour
631.22	Front End Loader (including operator)	Hour
631.221	Small Front End Loader (including operator)	Hour
631.28	Brush Chipper (including operator)	Hour
631.29	Rototiller (including operator)	Hour
631.32	Culvert Cleaner (including operators)	Hour

631.36 Foreman Hour

SECTION 632 and 633 - VACANT

SECTION 634 - HIGHWAY LIGHTING

634.01 Description This work shall consist of furnishing and installing a highway lighting system or modifying or removing an existing highway lighting system in accordance with these specifications and in reasonably close conformity with the plans.

634.02 General All material furnished by the Contractor shall be new unless otherwise specified. Substitutes for specified material may be accepted, upon approval of the Fabrication Engineer. Substitutes shall provide equal or better service. Where an existing system is to be modified, the existing material shall be removed, upgraded, or disposed of as shown on the plans or as directed.

All electrical equipment shall conform to NEMA, UL, or EIA standards, wherever applicable. In addition, all materials and workmanship shall conform to the requirements of the NEC, the local electrical Utility Company, and all local ordinances, which may apply.

634.021 Materials Materials shall meet the requirements specified in the following Section of Division 700 - Materials:

Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Secondary Wiring	715.07
Luminaires, Lamps and Ballast	715.08
Luminaires, Lamp and Ballast for High Mast Lighting	715.09
Photo Electric Control	715.10
Service Equipment	715.11
Lowering System for High Mast Lighting	715.12
Aluminum Supports	720.01
Aluminum Mast Arm and Bracket Arm	720.02
Steel Supports	720.03
Steel Mast Arm and Bracket Arm	720.04
High Mast Light Standard	720.05
Steel H-beam Poles	720.06
Anchor Bolts	720.07
Wood Ornamental Light Standard	720.09
Wood Utility Pole	720.10
Mast Arm for Wood Utility Pole	720.11
Breakaway Devices	721.01

Transformer enclosures shall conform to NESC requirements. They shall be approximately 46 inches high, 42 inches wide and 42 inches deep. Dimensions should be verified with the electrical Utility Company before ordering. Clearances shall be provided as required by the NESC. The enclosure shall be painted inside and outside with one coat of red iron-oxide primer and a finish coat of gray baked enamel. Doors shall be furnished with padlock lugs.

The electric portable power unit shall be a heavy-duty reversing electric motor for the voltage and frequency shown on the plans and shall have a remote control.

The following are the minimum requirements for the high mast lighting lowering system:

Ball bearing motor
Grounded frame
Torque limiter
Power unit mounting frame
Coupling to winch drive shaft
Remote control unit with cable
Cable with twist lock receptacle and plug for operator of power unit

All bolts for mounting lighting fixtures under bridge structures shall conform to the requirements of ASTM A307. These bolts and other fastening hardware shall be hot-dipped galvanized in accordance with ASTM A153.

Screened sand for bedding and covering direct buried cables shall meet the requirements of Section 703.14, except that there shall be 0-10% passing the No. 200 sieve.

634.022 Equipment List and Drawings Unless otherwise permitted in writing, the Contractor shall submit for review a list of equipment and materials which is proposed to be furnished. The list shall include the name of manufacturer, size, and identifying number of each item and other necessary data, including detailed scale drawings, wiring diagrams of special equipment and any proposed minor deviations from the plans. If requested, the Contractor shall submit sample articles of the material proposed for use. All of the above data except sample articles, shall be submitted in duplicate. Following checking, correction, and approval, not less than two complete sets of approved drawings shall be submitted. The Department will not be liable for material purchased, labor performed, or work delayed before such review. Where electrical equipment is to be constructed as shown on the plans, the submission of detailed drawings and diagrams will not be required.

Upon completion of the work, the Contractor shall submit three complete sets of corrected plans showing all construction changes.

634.023 Miscellaneous Material Insulating tape shall be of the self-bonding type. Jacket tape shall be of the water- resisting type. Friction tape shall be rubber-impregnated, woven cotton fabric.

634.024 Light Standards The terms "conventional standard" or "conventional light standard" shall mean the assembled metal base flange, transformer base or breakaway device, metal columnar shaft, metal overhanging bracket arm and incidental hardware.

The term "high mast pole" shall mean the assembled base plate flange, metal columnar shaft, luminaire tenon, mounting and lowering device and incidental hardware. For purposes of this specification, a structure shall be considered a high mast pole if the pole height, from base plate to the center of the luminaire, exceeds 50 feet.

The design materials and fabrication of structural supports for luminaires shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the contract plans. Light standards with a luminaire mounting height in excess of 50 feet shall be designed using wind speeds based on a 50-year mean recurrence interval. Minimum design default values for these structures shall be: $I_r = 1.00$; $C_v = 1.00$; K_z = as specified in Table 3-5 in the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto; and G = 1.14. Light standards with a luminaire mounting height of 50 feet or less shall be designed using wind speeds based on a 25-year mean recurrence interval. Minimum design default values for these structures shall be: $I_r = 0.87$; $C_v = 0.93$; K_z = as specified in Table 3-5 in the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and interims thereto; and G = 1.14. High mast poles" exceeding 50 feet but less than 100 feet in height shall be classified as Fatigue Category II with Fatigue Importance Factors (I_f) of 0.65 for Vortex Shedding and 0.72 for Natural Wind Gusts. "High mast poles" of 100 feet or more in height, shall be classified as Fatigue Category I with Fatigue Importance Factors (I_f) of 1.0 for Vortex Shedding and 1.0 for Natural Wind Gusts. For structural design purposes the luminaire mounting height for roadside installation is defined as the distance from the center of luminaire to the base plate bottom. For luminaire supports mounted on structures and approaches to structures, the luminaire mounting height shall be defined and measured as the distance of the center of the luminaire to one of the following:

a. For bridges over bodies of water Above the prevailing water level or, in the case of tidal waters, above mean high tide.

b. For overpass structures Above the lower roadway level.

c. For approach ramps Above the average adjacent ground level, if said ground level is more than 10 feet below the base of the light standard.

The design weight of luminaires shall be 60 pounds with an effective projected area of 2.5 ft^2, except that pole top-mounted luminaires shall have an effective projected area of 5.0 ft^2.

Light standards mounted on a bridge structure or light standards fabricated with aluminum shall be equipped with an approved damping or energy-absorbing device.

Deflections of light standards and bracket arms shall be limited as follows:

a. Conventional Light standards shall be able to support a 500 pound transverse load, applied at 18 inches below the pole top with a maximum deflection of 5% of the nominal pole length. A computer simulation or detailed computation using full design load (as specified in the AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals) establishing a maximum of 7% deflection of the nominal pole length may be used as an alternate method.

b. Bracket arms shall be able to support a horizontal load, perpendicular to the axial vector of the arm, of 50 pounds and a concurrent vertical load of 100 pounds, both loads applied at the luminaire tenon, without developing a measurable permanent set.

c. High mast light standards shall have a maximum deflection of 7% of the nominal pole length under full design load when equipped with four luminaires.

Conformance to the above deflection criteria for light standards, bracket arms and high mast light standards shall be substantiated by detailed computations or computer simulation, accompanied by written methodology, or actual tests on materials produced for delivery under a Maine Department of Transportation contract.

The base plates of light standards shall have workable leveling nuts beneath and above them with flat washers against both nuts, when erected. The distance between the bottom of the base plate and top of the foundation shall not exceed twice the diameter of the anchor bolts. Grout, or other material, shall not be placed between the base plate and foundations.

Approval for deviations from the contract drawings and/or specifications shall be requested in writing and shall be approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings. Requests for substitution for all specified material shall be submitted in writing with full documentation (specifications, mill certifications, etc.) enabling the Department to evaluate the proposal.

A Certificate of Compliance shall be provided for all material in accordance with the requirements of the General Statement of Division 700 - Materials. Shop certification in accordance with Section 504.04 is required.

634.025 Conventional Light Standards After execution of the contract for conventional light standard(s), and before any shop work is commenced, the Contractor shall submit 3 sets of the manufacturer's drawings of all standards and accessories proposed to be furnished and erected under this contract. The drawings shall be of sufficient detail to indicate material and/or dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and certification that the design criteria have been

met for the light standards, bracket arms and associated hardware, fittings and breakaway devices, as submitted. A Licensed Professional Engineer shall sign the certification under their official seal. The drawings shall use the same units as found in the project plans.

It is the intent of these specifications that the Contractor shall be fully responsible for the adequacy of the sizes, wall thickness, materials and connections of the standards, bracket arms and associated hardware, fittings and breakaway devices. Approval of the drawings will signify only approval of the material(s), mounting heights(s) and bracket arm length(s).

634.026 High Mast Light Standard For all high mast light standards, as defined in this Section, the Contractor shall submit, in addition to the manufacturer's drawings, 3 sets of the design computations, including fatigue considerations consistent with AASHTO requirements. Approval of the drawings and computations will signify approval of all structurally significant details of the light standard and if any, the luminaire mounting and lowering device. All drawings and computations shall be signed by a Registered Professional Engineer. Approval will be based on the applicable provisions of Section 105.7.

The shaft shall be provided with an equipment access opening approximately 2 ft^2 and centered approximately 2 feet above the base. The access opening shall be reinforced to maintain the full design strength of the shaft and shall be provided with a hinged, removable, access door equipped with a vandal proof means of being locked in place. A positive means of internal grounding shall be provided inside of the access door.

All shaft sections shall be one plate thickness, except that a doubler plate may be used around the equipment access opening. The walls of polygonal shafts shall have an inside corner radius to wall thickness ratio not less than 2.

The Contractor may propose a galvanized and painted pole, in lieu of using weathering type steel. The steel shall be a base metal listed in the current edition of the AWS Structural Welding Code, D1.1. Paint color will be designated by the Fabrication Engineer. Galvanizing and surface preparation shall be in accordance with Section 504 and paint shall be a two-coat system designed for use on galvanized surfaces approved by the Engineer. The Contractor shall supply sufficient additional coating material and instructions for touchup work.

634.027 Breakaway Supports Breakaway supports, approved by the Engineer, shall be supplied for use at all locations designated as breakaway. Breakaway Support Certification of both, breakaway and structural adequacy shall be provided by the Manufacturer. Design calculations or test data of production samples to support certification shall be provided. Breakaway support components shall provide the same or greater structural strength than the support post or pole utilizing the breakaway device. Breakaway couplings shall not be used in conjunction with transformer bases. Breakaway devices must include a reaction plate connecting all anchor bolts under the breakaway device. Poles containing conductors must contain a fusible breakaway device disconnecting all ungrounded conductors simultaneously

Breakaway devices are subject to the applicable provisions of Section 721 - Breakaway Devices.

634.03 General The location of the roadway lighting systems and other incidental work will be shown on the plans. They are diagrammatic only, but shall be followed as closely as actual conditions at the site and the work of other Contractors will permit. As the work progresses, the drawings may be revised or supplemented by the Resident, and the Contractor shall perform the work required by such revisions or supplements without additional compensation, except as provided in Section 109.

Work shall be scheduled to assure that each highway lighting system shall be completed and ready for operation upon completion of the corresponding section of the roadway or as specified in Special Provision 107.

Before proceeding with any work under this Contract, the Contractor shall conduct continuity and insulating tests to establish the integrity of cable runs already in place. The Contractor shall report all cable faults to the Resident. In cases faults are located while contract work is in progress and the Contractor does not report them, the Contractor will be responsible for correcting those faults without extra compensation.

634.04 Cable Installation The Contractor shall pull all wires through conduits without overstressing or stretching any wire or scoring, cutting, twisting or damaging the protective covering or insulation. When pulling cable into conduits, if the strain on the cables is likely to prove excessive, the Contractor shall use soapstone powder or listed cable pulling lubricant as a lubricant. Where two or more cables are to occupy the same conduit, they shall be drawn in together and kept parallel to each other by the use of a pulling head. No aluminum wire shall be installed underground for primary and secondary wiring.

Both ends of each length of cable shall be sealed to prevent the entrance of moisture during shipment or during outdoor storage. Defective and damaged cable will be rejected and shall be replaced at no cost to the State.

Secondary wiring shall be installed as shown on the plans. Secondary wiring shall not be spliced underground. Splicing shall only occur in above ground hand holes and transformer bases. The wire for secondary circuits, which is pulled through ducts, shall be fed slack from the feed end. Secondary wiring being pulled through a junction box shall be provided with enough slack for the center of the cable to be positioned a minimum of one (1) foot outside the top of the junction box

Cables in junction boxes shall be provided with enough slack for the center of the cable to be positioned a minimum of one (1) foot outside the top of the junction box and shall be arranged as directed. After cables have been installed, the end of each section of cable in light standards and panel boxes shall be carefully sealed with DAC Heavy Duty KWIK Foam Polyurethane Sealant, Minimum Expanding or an approved equal . Sealant shall penetrate a minimum of four (4) inches into the conduit. All wiring shall be finished to provide a neat and orderly appearance. Ends of cable not connected to any device shall be insulated and sealed.

There will be no underground splicing of power conductors.

The trench for direct-buried cable shall be excavated to the width and depth shown on the plans or as directed.

Placement of the sand bedding shall be coordinated with the installation of the cables. After the cables and screened sand have been placed, the remainder of the trench shall be promptly backfilled with selected excavated material. Surplus material shall be disposed of as directed and the surface of the trench shall be loamed and seeded in accordance with Sections 615 and 618.

When connecting sockets, outlets and other similar equipment, the most accessible bare parts of each piece of equipment shall be connected to the grounded neutral. In order to ensure this has been done, each piece of equipment shall be tested after installation, under the supervision of the Resident, with a test lamp or other instrument, one leg of which has been connected to a definite ground, or by other approved means of testing.

All cables in junction boxes and light standards shall be tested for circuit connections, which shall be in conformity with those indicated on the plans. After verification of circuit connections, all cables in junction boxes, light standards and service panels shall be provided with individual metal tags, die-stamped with a phase designated A or B, as applicable. The tags shall be securely attached to the cables.

Splices to form continuous circuits shall be made by the Contractor and will only be permitted in accessible above ground locations. All other splices shall be made with approved crimp-type connectors.

Conductors shall not be pulled into conduit until pull boxes are set to grade, crushed rock sumps installed, grout placed around the conduit, concrete bottom of pull boxes placed and the metallic conduit bonded.

Where roadways are to remain open to traffic and existing lighting systems are to be modified, the existing lighting system shall remain in operation and the final connection to the modified circuit shall be made so that the modified circuit will be in operation by nightfall of the same day.

634.05 Light Standard To provide continuously aligned lamp post installations, light standards shall be located in accordance with the details governing the spacings and setbacks shown on the plans, unless otherwise directed.

The bracket arms shall be set normal to the edge of the roadway, unless otherwise directed. The bracket shall be assembled and attached to the shaft before the light standard is erected. If it is anticipated that there will be a period in excess of 24 hours between the erection of the light standards and the installation of the luminaires, the Contractor shall install a weight, weighing between 50 to 75 pounds, at the outboard end of each bracket arm. This weight shall be designed and fastened in such a way that it will not pose a hazard to persons passing beneath it.

Light standards shall be erected in a vertical position, with a maximum deviation from the vertical of ¼ inch in 5 feet, using either the leveling nuts provided with the anchor bolts or the breakaway couplings. Once the light standard is in its final position, the top nuts shall be tightened as follows:

a. Anchor Bolts with Breakaway Couplings The manufacturer's recommendation shall be used.

b. Anchor Bolts without Breakaway Couplings the nut shall be tightened to snug tight condition by utilizing the full effort of a worker using a standard spud wrench or comparable tool. After all nuts have been brought to a snug tight condition, each nut shall be tightened an additional 1/3 turn using an impact wrench, torque wrench or large crescent wrench.

A minimum of 2 bolt threads shall project beyond the outside face of the nut.

Nuts for bolts other than anchor bolts shall be tightened as outlined under b. above, for anchor bolts.

The bottom of all transformer bases shall be coated with a bitumen-mastic, epoxy paint.

When foundations and anchor bolts for light standards have been installed by others, the Contractor shall verify the anchor bolt dimensions at each location so that bases will be furnished with the proper bolt holes.

Wires in the shaft shall be supported with a Kellum-type, braided, strain-relief grip attached to a "J" hook mounted inside the shaft near the top.

Wood Ornamental Light Standards shall be installed as shown on the plans.

634.051 Removing Light Standards Before removing light standards, the luminaires shall be removed from the light standards and disposed of as noted on the plans.

Care shall be exercised in removing and transporting the light standards. The Contractor will be required to replace, at their expense, all equipment damaged or destroyed by their operations.

634.052 Portable Power Unit for Lowering Luminaires The number of portable electric power units with remote control required for operation of the high mast luminaire lowering system, will be 1 for every 10 high mast poles, or as shown on the plans.

634.06 Luminaires Luminaires shall not be installed until the lamp socket position has been inspected and approved for conformance with the manufacturer's recommended position for the specified distribution. All luminaires shall be adjusted to produce the maximum illumination on the roadway surface and shall be full IES cutoff.

The connections between the luminaires and connector kits shall be made with single conductor, number 12 wires AWG copper stranded THHN, minimum size. A 14 inch long Teflon sleeve shall be placed over each end of each conductor in the luminaire.

Installation of a connector kit, fused or non-fused, shall be in accordance with the manufacturer's instructions to provide watertight connections.

634.061 Under-Bridge Lighting Under-bridge lighting shall be installed in accordance with the plans and specifications, or as directed.

Circuits shall be fused in fuse boxes with 5-ampere cartridge-type, midget fuses, ⅜ inch diameter and 1½ inches long, unless otherwise indicated on the plans. Wiring connections in the under-bridge lighting units shall be made with 300°F wire.

All under bridge lighting, luminaires shall be installed and adjusted for maximum illumination of the roadway surface. The beam angle shall be adjusted as indicated on the plans.

In vehicular undercrossings, underpass lights shall be placed in operation as soon as practicable after falsework has been removed from the structure. Lighting for pedestrian structures shall be placed in operation before opening the structure to pedestrian traffic.

634.08 Service The Contractor shall install metal conduit riser with entrance cap, entrance switch, multiple control relay, and other equipment as shown on the plans.

The lighting system will be supplied with electrical power by the local power company. The type of service will be single phase, three wire, 240/480 volt or the voltage indicated on the plans, 60 hertz, alternating current. The meter trim will include a bypass handle to allow the power company to change the meter without disconnecting the power. An external, standalone breaker capable of shutting off the lighting control cabinet or signals will be provided to disconnect power to the control cabinet. No power shall be routed in or out of the control cabinet before this breaker The power company will make all connections of the roadway lighting system cables at the power company's service pole. The Contractor shall notify the power company at least two weeks in advance of the time they intend to start construction at each of the sites and shall make all necessary arrangements with the power company for the required installation.

Roadway lighting cabinets shall be installed on stub poles with doors accessible from the roadway. All connections to equipment and terminals shall be neat and orderly conforming to the requirements specified.

Details for the fabrication and installation of service poles with cabinets and other equipment are shown on the plans.

Transformer enclosures used to protect overhead type transformers mounted on concrete pads shall be installed as shown on the plans. Transformers will be furnished by the power company.

All meter mounting devices shall be installed so that the meters will be upright (plumb). They shall be installed with the top of the meter not less than 48 inches nor more than 60 inches from the floor to the final grade. Exceptions to this height requirement will be made where special permission has been given to install group or modular metering, overall metering enclosures, or pole-mounted meters. Level grade shall be maintained for a minimum of 3 feet in front of the meter enclosure to provide a safe working space. In order to meet this requirement on uneven terrain, as an option, the Contractor may install a pressure-treated wood platform.

For any non-residential (industrial or commercial) self-contained meter socket the by-pass requirements are single phase, 100 or 150 amp, single handle lever operated.

The Contractor shall meet all requirements and regulations of Utility Companies when installing equipment on their poles and for the service connection. It is the responsibility of the Contractor to contact the appropriate Utility to determine their specific requirements.

634.081 Bonding and Grounding All metal conduit ends, light standards, luminaires, control cabinets, and exposed noncurrent carrying metal parts of fixed equipment shall be connected to the grounding conductor. All grounding and bonding shall conform to the current provisions of the NEC.

634.09 Testing Before acceptance of the work the Contractor shall cause the following tests to be made on all lighting circuits, by a licensed electrician. The tests do not need to be performed in the presence of the Resident, but the test results shall be recorded on the Highway Lighting Quality Control Check List and submitted to the Resident by the Contractor for acceptance. The form shall be signed by the license electrician certifying that the highway lighting meet the requirements of section 634.09.

a. Continuity Each circuit shall be tested for continuity.

b. Ground Each circuit shall be tested for grounds.

c. Resistance The resistance to ground on non-ground conductors shall be at least five megaohm at 60°F measured with a 1,000 volt megger. The ground resistance shall not be more than 25 ohms.

d. Voltage Voltage readings shall be made at each service pole, in the load contractor, with load and without load, and at each fixture with load.

e. Current Current readings shall be made on the load side of each load contractor phase and neutral. Readings shall be made at night with lighting systems in normal operation.

f. Test Data Electrical test data obtained from the above tests shall be furnished in writing.

g. Operational Test The Contractor shall conduct an operational test for the completed installation under normal operating conditions. This operational test shall have a duration of not less than two full days. The Resident shall be the sole authority to judge the adequacy of the length of the testing period in order to assure the satisfactory operation of the entire system or any of its sections. The work will not be accepted until the operational test has been successfully completed.

h. Functional Test With all equipment connected to the wiring system, a functional test shall be performed by the Contractor, in the presence of the Resident, to demonstrate that the system and all parts thereof function as specified. All defective materials or faulty installations shall be corrected by repairs or replacements by the Contractor to the satisfaction of the Resident at no additional cost.

Lighting circuits shall be subjected to such other tests as may be required and it shall be the responsibility of the Contractor to ascertain what tests are required and to perform these tests in the presence of the Resident. All tests shall be performed at the expense of the Contractor. Cost for power to conduct tests shall be paid by the Contractor.

634.091 Acceptance All systems shall be complete and in operation to the satisfaction of the Resident at the time of acceptance of the work.

The Contractor shall be responsible for the proper performance in service, in whole or in part, of the various lighting systems and all other electrical installations furnished and installed under this Contract and shall correct, at their own expense, all deficiencies in the operation which may arise prior to acceptance of the work. The Contractor shall be responsible for the cost of power until the work is accepted.

634.092 Method of Measurement Highway lighting system will be measured by the lump sum.

Light standards will be measured by the single unit, complete in place and accepted.

The quantity of luminaires for high mast lighting will be measured by each single unit.

634.093 Basis of Payment The accepted quantity of light standards will be paid for at the contract unit price each for the number of units of the respective types. Payment shall be full compensation for the light standard and breakaway transformer base or breakaway device, bracket arm and all incidentals necessary to complete the work.

Payment for furnishing and installing luminaires for high mast lighting will be made for the accepted quantity at the contract unit price each, which shall include luminaire, ballast, lamp, and incidentals necessary to complete the work.

The accepted highway lighting system will be paid for at the contract lump sum price for the complete lighting system shown on the plans, except that luminaires for high mast lighting and light standards will be paid for at the contract unit price each.

Lump sum payment for highway lighting system shall be full compensation for furnishing, installing and erecting: ballast, lamps, wiring in underground conduit, pole wiring, and all other wiring (except prewired conduit), transformer enclosures, luminaires (except luminaires for high mast lighting), break-away devices when applicable, all identification tags, and all materials, labor, equipment, tools, miscellaneous hardware and incidentals necessary to complete the work. Payment shall also include removing and resetting light standards, installing breakaway devices on existing poles, disposing of unused light standards, as noted on the plans, and for furnishing portable electric power units.

No separate payment will be made for bonding, grounding and ground rods; these costs shall be included in the contract price for conduit, light standards, service panels, or other items requiring bonding and grounding.

Trenching for direct buried cable will be incidental to highway lighting system and shall include excavating, furnishing and placing screened sand and backfilling.

Payment will be made under:

Pay Item		Pay Unit
634.160	Highway Lighting	Lump Sum
634.164	Luminaires for High Mast Lighting	Each
634.2041	Luminaires	Each
634.206	Light Standard for Post Top Luminaire	Each
634.207	High Mast Light Standard	Each
634.209	Wood Ornamental Light Standard	Each
634.210	Conventional Light Standard	Each

SECTION 637 - DUST CONTROL

637.01 Description This work shall consist of controlling dust that results from traffic on the project and the Contractor's operations by applying water and/or calcium chloride as directed by the Resident. The requirements of Special Provision 656 and other pertinent Sections of the Standard Specifications will apply.

637.02 Materials The water shall not be salt or brackish and shall be free from oil, acid and injurious alkali or vegetable matter.

The calcium chloride shall conform to Subsection 712.02 except that the requirements for total alkali chloride and impurities shall not apply.

637.03 Sprinkling Water shall be applied by approved methods and with equipment including a tank with a pressure pump and a nozzle-equipped spray bar.

637.04 Calcium Chloride Calcium chloride shall be used when authorized for controlling dust on the roadway under construction and on approved haul roads from the pits to the project or in the area of dwellings and where dust constitutes a hazard to traffic. Calcium chloride shall be applied by mechanical spreaders or by hand at the rate designated.

637.05 Method of Measurement Water for sprinkling will be measured by the 1,000 gal in calibrated tanks or distributors or by accurate water meters.

Calcium chloride will be measured for payment by the number of tons satisfactorily applied.

Delivery slips as specified in Section 108.1.3-f will be required except that weight for calcium chloride shall be determined from the weight stated on each bag and the number of bags used.

Water and calcium chloride acceptably applied for the item Dust Control will be measured for payment as one lump sum.

637.06 Basis of Payment Water for sprinkling will be paid for at the contract unit price per Thousand Gallons.

Calcium chloride will be paid for at the contract unit price per ton.

Water and calcium chloride for the item Dust Control will be paid for at the contract lump sum price. Payment will be full compensation for furnishing and applying water and calcium chloride as required. Failure by the Contractor to follow Standard Specification or Special Provision - Section 637 and/or the Contractor's own Soil Erosion and Pollution Control Plan concerning Dust Control and/or the Contractor's own Traffic Control Plan concerning Dust Control and/or visible evidence of excessive dust problems, as determined by the Resident, will result in a reduction in payment, computed by reducing the Lump Sum Total by 5% per occurrence per day. The Department's Resident or any other representative of the Department reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. The Department shall not be held responsible for any delay in the work due to any suspension under this item. Additional penalties may also be assessed in accordance with Special Provision 652 - Work Zone Traffic Control and Standard Specification 656 - Temporary Soil Erosion and Water Pollution Control. When no item for Dust Control item or individual items are included in the schedule of items, payment for the work will be considered incidental to the contract.

Payment will be made under:

	Pay Item	Pay Unit
637.07	Sprinkling	1000 Gallon
637.08	Calcium Chloride	Ton
637.071	Dust Control	Lump Sum

SECTION 638 - BRIDGE LIGHTING
Reserved

SECTION 639 - ENGINEERING FACILITIES

639.01 Description This work shall consist of providing, erecting, lighting, equipping and maintaining buildings to be used by the Resident as field offices Upon completion of the work, the buildings and equipment shall remain the property of the Contractor.

639.02 Materials Materials for buildings shall be of good quality customarily used in standard frame house or office trailer construction.

639.03 General The building of the type called for shall be provided before the start of work, and shall remain until work is completed and accepted, unless earlier removal is authorized. The location shall be approved by the Resident.

A fire extinguisher shall be provided in each building or office trailer for electrical and chemical fires and effective on all solvents used in the building.

Walls, roof, floor, windows, and doors shall be tightly constructed to the required area.

Furnishings shall be supplied as called for. Doors shall be equipped with locks and all keys shall be in the possession of the Resident. Windows shall be equipped with latches so they may be locked on the inside. Window screens and screen doors shall be supplied when necessary. Adequate desk and desk space shall be provided. If a portable table is supplied, it should be adjustable to accommodate the various heights of employees. A proper office chair that is 5-way adjustable is needed.

639.04 Field Offices Field Offices are designated Type A, Type B, or Type C. Buildings, including trailers, may be provided if they substantially equal or exceed the following requirements. Air conditioning shall be provided in all field offices.

The walls, roof, and floor of the building shall be completely insulated with a minimum insulation value of R-15. Office trailers shall be either new or in very good used condition. The interior walls shall be covered with suitable wall paneling. The entire office trailer shall be for

the exclusive use of the Resident. The office trailer shall be winterized and completely enclosed at the bottom, if the trailer will be used in cold weather.

Other types of buildings and facilities may be furnished of equal or better quality.

A public work area will be provided in the field office that shall be designed and constructed so that individuals with disabilities can approach, enter, and exit this area.

At least one accessible route to the field office shall be provided from accessible parking. The accessible route shall comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and this specification.

The minimum clear width of an accessible route shall be 36 inches except at doors. The least possible slope shall be used for an accessible route. An accessible route with a running slope greater than 1:20 shall be considered a ramp. Maximum ramp slope is 1:12. The maximum rise for any run of a ramp shall be 30 inches and the minimum clear width shall be 36 inches. Nowhere shall the cross slope of an accessible route exceed 1:50. Changes in level up to ¼ inch may be vertical and without edge treatment. Changes in level between ¼ inch and ½ inch shall be beveled with a slope no greater than 1:2. Ramp floor surfaces shall be stable, firm, and slip-resistant.

Ground floor surfaces along accessible routes and in accessible rooms and spaces including floors, walks, ramps, stairs, and curb ramps, shall be stable, firm, and slip-resistant.

The main door to the public work area shall have a minimum clear opening of 32 inches with the door opened 90 degrees, measured between the face of door and the opposite stop. Minimum maneuvering clearances at doors shall be provided. The floor or ground area within the required clearances shall be level and clear.

The handle and other operating devices on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping. Lever-operated mechanisms push type mechanisms, and U-shaped handles are acceptable designs. Hardware required for accessible door passage shall be mounted no higher than 48 inches above finished floor.

When parking space is designated, then all related requirements will conform to the following: One accessible parking space shall be located on the shortest accessible route of travel from adjacent parking to an accessible entrance.

Level landings shall be provided at bottom and top of each run. The landing shall be at least as wide as the ramp run leading to it with a minimum length of 60 inches.

If a ramp run has a rise greater than 6 inches or a horizontal projection greater than 72 inches, then it shall have handrails on both sides. Handrails shall have the following features:

1) Handrails shall be provided along both sides of ramp segments. The inside handrail on switchback ramps shall always be continuous.

2) If handrails are not continuous, they shall extend at least 12 inches beyond the top and bottom of the ramp segment and shall be parallel with the floor or ground surface.

3) The clear space between the handrail and the wall shall be 1½ inch.

4) Gripping surfaces shall be continuous.

5) Top of handrail gripping surfaces shall be mounted between 34 and 38 inches above ramp surfaces.

6) Ends of handrails shall be either rounded or returned smoothly to floor, wall, or post.

7) Handrails shall not rotate within their fittings.

8) The diameter or width of the gripping surfaces of a handrail shall be 1¼ to 1½ inch, or the shape shall provide an equivalent gripping surface.

Firm and sturdy steps shall also be provided with 7 inch maximum riser and 11 inch minimum depth, and at least one handrail extending from the top of the steps to a minimum 12 inches beyond the bottom of the steps.

The Contractor will make reasonable effort(s) to provide wheelchair accessible toilet facilities when "portable" facilities are provided.

The Contractor shall provide wheelchair accessible toilet facilities when flush type facilities, that is, those with running water, are provided; and the Contractor shall provide wheelchair accessible portable facilities, if used, when the contract duration exceeds two continuous construction seasons.

In addition to the facilities previously specified in this subsection, each field office shall meet the following minimum requirements:

Description	Quantity		
	Type A	Type B	Type C
Floor Area (Outside Dimension) - ft^2	312	220	125
Inside Wall Height – feet	7	7	7
Window Area - ft^2	55	35	35
Drafting Table Surface Area - ft^2	15	15	15
Drafting Stools - each	2	1	1
Office Desks - each	2	1	1
Ergonomic Swivel Chairs -ea (5-way adjustable)	3	2	2
Folding Chairs - each	3	2	2

Lighting Units - each	4	2	2
Electric Wall Outlets - each	6	4	3
Electrical Surge Protectors - each	2	1	1
Wall Closets - each	1	1	1
Plan Rack for minimum of 6 sets of plans	1	1	0
Toilet Facility	1	1	1
Wastebaskets - each	2	2	1

All windows shall be provided with shades or blinds.

The toilet facility shall be for the exclusive use of State personnel.

The Resident will have the option to reject any furniture or supplies provided to the field office based on general condition.

One hundred ten volt, 60 cycle, continuous electric service shall be supplied for lighting and 15 amp duplex wall outlets. Lighting shall consist of florescent light units with rapid start bulbs located over the work areas for a minimum of 50 foot candles overall.

Drafting surfaces shall be 40 inches above the floor and have shelves beneath. Shelves for plans and rolls shall also be furnished overhead. Drafting stools shall be approximately 28 inches high.

Desks shall be single or double pedestal standard office type, and shall be in addition to "built-in" type desks in the office trailer.

Field offices shall be furnished with one four-drawer letter size metal filing cabinet.

Wall closets shall be 21 inches wide, 15 inches deep, and at least 4 feet high.

Each office shall be furnished with a broom, dustpan, sweeping compound, trash bags, and with cleaning material for cleaning glass. If the field office is carpeted, then a vacuum cleaner will be provided. The contractor will be responsible for disposing of trash from the field office.

The Contractor shall provide a fully functional desktop copier/scanner, capable of copying field books, for the Resident's use during the project. All maintenance and supplies, except paper, shall be the responsibility of the Contractor.

The Contractor shall provide a water cooler, with hot and cold dispenser, and shall be responsible for supplying bottled water compatible with the water cooler to maintain a constant potable water supply for the duration of the project. All maintenance and supplies shall be the responsibility of the Contractor. Alternate source of water, such as individual bottled water, may be provided as approved by resident.

The Contractor shall provide a 4 cubic-foot refrigerator in the field office for the duration of the project.

Each office shall be furnished with a 10-person general-purpose first aid kit. The first aid kit shall be periodically inspected and refilled as necessary.

639.08 Heat Heat shall be supplied by the Contractor to maintain an acceptable room temperature during occupancy.

639.09 Telephone The Contractor shall provide two telephone lines and two telephones, touch-tone models in areas where touch-tone service is available, in all field offices for the exclusive use of the State personnel. At least one phone shall be cordless. These telephones shall be on a private line, if available and shall be listed under "State of Maine, Maine Department of Transportation". One telephone line shall have "Call Waiting" installed, if available. Each line shall have jacks installed at each end of the field office. The Contractor shall be responsible for the installation charges and all reinstallation charges following suspended periods. Monthly service and maintenance charges shall be billed by the telephone company directly to the Contractor. During seasonal suspension periods, the telephone company shall be notified to discontinue or suspend the services and the Contractor shall assume all charges. Upon resumption of work, the telephone service shall be reinstated.

The Contractor shall also provide a telephone-answering device in all field offices where a telephone is provided capable of answering calls and recording incoming messages. The Contractor shall be responsible for all maintenance costs for the answering device.

639.091 Broadband Connection In addition the contractor will supply one computer broadband connection, modem lease and router. The router shall have wireless access and be 802.11n or 802.11g capable and wireless. The type of connection supplied will be contingent upon the availability of services (i.e. DSL or Cable Broadband). It shall be the contractor's option to provide dynamic or static IP addresses through the service. **The selected service will have a minimum downstream connection of 1.5 Mbps and 384 Kbps upstream.** The contractor shall be responsible for the installation charges and all reinstallation charges following suspended periods. Monthly service and maintenance charges shall be billed by the Internet Service Provider (ISP) directly to the contractor.

639.10 Method of Measurement Field office will be measured by the unit or lump sum for each building provided, equipped and maintained satisfactorily.

639.11 Basis of Payment The accepted quantity of field office will be paid for at the contract unit price each or lump sum which payment shall be full compensation for furnishing, erecting, equipping, maintaining, furnishing electricity, heating, installing and maintaining toilet facilities and if necessary removing the buildings or office trailers.

Payment for these items will be made in 3 parts; the first payment of ½ to be made after the Contractor has supplied the building or office trailer and it has been approved. The remaining payments shall be made at intervals as follows:

A second payment of ¼ shall be made when one-half of the anticipated work has been completed.

The final payment of the remaining ¼ shall be made upon completion of the work.

Payment will be made under:

Pay Item		Pay Unit
639.18	Field Office, Type A	Each
639.19	Field Office, Type B	Each
639.20	Field Office, Type C	Each

SECTION 640 - VACANT

SECTION 641 - REST AREA FACILITIES
Reserved

SECTION 642 - STEPS

642.01 Description This work shall consist of the construction of wooden steps, precast concrete steps or cast-in-place concrete steps in accordance with these specifications and in reasonably close conformity with dimensions and designs shown on the plans.

642.02 Materials Materials for the steps shall meet the requirements as specified in the following Sections of Division 700 - Materials:

Exterior Ready Mixed Paint	708.01
Timber Preservative	708.05
Precast Concrete Units	712.06

Wood shall be well-seasoned spruce or pine, Number 1 dimension lumber. Nails and hardware shall be galvanized.

Precast concrete steps shall conform to the specifications of precast units except as modified herein and shall be of the dimensions detailed on the plans or as otherwise approved. Exposed surfaces shall have a rubbed finish as specified in Section 502.14-d-2.

Cast-in-place concrete steps, shall conform to the requirements of Section 502 - Structural Concrete, Class A.

642.03 Wooden Steps Wooden steps shall be fabricated and fastened in accordance with standard commercial building practices.

After members have been cut to size, the ends shall be soaked in an approved timber preservative. Before assembling the steps, all contact surfaces shall be painted 2 coats of paint, color to be designated. The first coat of paint shall be thinned.

642.04 Precast Concrete Steps Precast concrete steps shall be placed on a compacted gravel bed with horizontal joints level and vertical joints plumb. The foundation shall be prepared in advance of setting the steps by grading and compacting the aggregate subbase to the proper elevation. The steps shall be set with a uniform tread width to match the finish grade of the slope. All remaining excavated areas surrounding the steps shall be filled to the required grade with approved materials and thoroughly tamped.

642.05 Cast-in-place Concrete Steps Cast-in-place concrete steps shall conform to the applicable requirements of Section 502 - Structural Concrete.

642.06 Method of Measurement Wooden steps and precast Portland cement concrete steps will be measured by each unit, complete in place and accepted.

Cast-in-place concrete steps will be measured for payment by the cubic yard in place.

642.07 Basis of Payment The accepted wooden steps will be paid for at the contract unit price each, complete and accepted in place which price shall be full compensation for furnishing all materials, labor and other incidentals necessary to complete the work.

The accepted quantity of precast concrete steps will be paid for at the contract unit price each, complete in place, which price shall be full compensation for furnishing and placing all materials including reinforcing steel.

Excavation and backfill will be measured and paid for as provided in Section 206 - Structural Excavation.

The accepted quantity for cast-in-place concrete steps will be paid for at the unit contract price per cubic yard complete in place which price shall be full compensation for furnishing and placing all materials including reinforcing steel.

Payment will be made under:

Pay Item		Pay Unit
642.12	Wooden Steps	Each
642.15	Precast Concrete Steps	Each
642.17	Cast-in-place Concrete Steps	Cubic Yard

SECTION 643 - TRAFFIC SIGNALS

643.01 Description This work shall consist of furnishing and installing all equipment necessary for the erection and operation of a traffic signal, flashing beacon, temporary traffic signal or modification of a traffic signal, all in reasonably close conformity with the plans.

643.02 General All equipment shall be new unless otherwise specified. Requests for substitution of any specified material shall be submitted in writing with all documentation (specifications, mill certifications, etc.) in order to enable the Department to evaluate the proposal. Substitutes for specified material may be accepted upon approval by the Fabrication Engineer. Functionally, any substitute shall give equal or better service than the specified material. Existing signal equipment to be used shall be cleaned, repainted, and reconditioned as noted on the plans. All equipment, installation of equipment and other incidental work shall conform to the latest applicable provisions of: NEC, MUTCD, NESC, NEMA, and the ITE Standards for traffic control equipment. All work shall be done to the satisfaction of the Resident. The meaning of specific terms shall be as defined in MUTCD, NESC, and the ITE Standards for traffic control equipment.

643.021 Materials Material shall meet the requirements specified in the following Sections of Division 700 - Materials:

Steel Conduit	715.02
Non-metallic Conduit	715.03
Prewired Conduit	715.04
Metallic Junction and Fuse Box	715.05
Secondary Wiring	715.07
Vehicular Signal Indications	718.01
Pedestrian Signal Indications	718.02
Signal Mounting	718.03
Vehicular Loop Detectors	718.04
Microwave Detectors	718.05
Pedestrian Detectors	718.06
Controllers	718.07
Controller Cabinet	718.08
Flasher	718.09
Program Selection	718.10
Contacts and Relays	718.11
Conductors	718.12
Aluminum Supports	720.01
Aluminum Mast Arm and Bracket Arm	720.02
Steel Supports	720.03
Steel Mast Arm and Bracket Arm	720.04
Anchor Bolts	720.07

643.022 Paint Aluminum paint shall conform to AASHTO M69, Type II. Green or yellow enamel paint, as indicated on the plans, shall meet or exceed the latest Federal Specification TT-E-489. The color shall match Federal Color Standard Number 14062.

643.023 Design and Fabrication The design and fabrication of traffic signal support structures shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and interims thereto, except as otherwise indicated within these specifications or on the contract plans. All poles and mast arms shall be designed to withstand the maximum forces generated on the design configuration by the loads specified in Section 3 of the "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", using the 50-year mean recurrence interval for wind speeds. Minimum design default values for these structures shall be: $I_r = 1.00$; $C_v = 1.00$; $K_z = 0.94$; and $G = 1.14$. Cantilevered signal support structures with mast arms shall be classified as Fatigue Category III with Fatigue Importance Factors (I_f) of 0.59 for Natural Wind Gusts and 0.68 for Truck-Induced Gusts unless specified otherwise on the contract plans.

If Category II is specified on the contract plans, the Fatigue Importance Factors (I_f) shall be 0.80 for Natural Wind Gusts and 0.84 for Truck-Induced Gusts. If Category I is specified on the contract plans, the Fatigue Importance Factors (I_f) shall be 1.0 for Natural Wind Gusts and 1.0 for Truck-Induced Gusts.

Designing for fatigue induced by Galloping or Vortex Shedding is not required for traffic signal structures with mast or bracket arms.

All traffic signal structures with mast or bracket arms shall be equipped with an approved damping or energy-absorbing device.

After execution of the contract and before any shop work is commenced, the Contractor shall submit 3 sets of the manufacturer's drawings of all poles proposed to furnished and erected under this Contract. The drawings shall be of sufficient detail to indicate material and dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and a certification that the design criteria have been met by the poles, mast arms and associated hardware and fittings, as submitted. The certification shall be signed by a Licensed Professional Engineer under their official seal.

It is the intent of these specifications that the Contractor shall be fully responsible for the adequacy of the sizes, wall thicknesses, materials and connections of the poles, mast arms and associated hardware and fittings. Approval of the drawings by the Fabrication Engineer will signify only approval of the materials, mounting height(s) and mast arm length(s). Approval of deviations from the contract drawings and/or specifications shall be requested in writing and approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings.

The Contractor shall furnish and install all electrical fittings, pipe, switches, fuses, and such other material necessary to install the equipment properly and securely. All equipment shall conform to the applicable code and be of first-class workmanship. All electrical fittings shall be complete with weatherproof gaskets.

643.024 Miscellaneous Materials Span wire shall be minimum $^{5}/_{16}$ inch diameter, minimum, 7 strand, extra-high strength, galvanized steel wire. Anchors shall be power installed and sized according to strain and soil conditions. All hardware, such as strand vise feed-thru dead ends, preforming guy grip dead ends and angle thimble-eye bolts, shall be standard pole line hardware.

Guying of poles shall meet the requirements of Grade "B" Construction as defined in the NESC. Guys shall be installed in line with the direction of pull. Anchors shall be power installed so that the centerline of the anchor rod will be within 10° of the line of the guy wire. The holding capacity of the anchor shall be 1.25 times the calculated load on the guy wire. Guy wires shall be utility grade and the maximum working stress shall not exceed half of the maximum ultimate tensile strength of utility grade guy strand. Where bedrock is encountered, rock anchors shall be used.

Pipe standoffs for sidewalk anchors shall be galvanized steel pipe sized according to the offset distance from anchor to pole and shall be fitted with standard guying hardware.

Messenger wire shall be ¼ inch diameter, 7 strand, extra-high strength, galvanized steel wire, unless otherwise specified.

LED lamps shall have a regulated power supply designed to electrically protect the diodes. The lamp shall be watertight and sealed to eliminate contaminants. The lamps shall be capable of operating at ambient air temperatures of -40°F to 140°F.

Lamp life shall be a minimum of 100,000 hours of continuous operation. They shall be manufactured using the Allen Gap Technology. Power consumption for 12 inch indications including power supply shall not exceed 20w.

643.03 General Installation details will be shown on the plans. The location shown for all equipment and vehicle detectors is approximate; final locations will be determined in the field.

During installation, all heads installed but not operating shall be covered or otherwise concealed from view.

The requirements of certain Sections of this specification may be waived for temporary traffic signals and traffic signal modifications, if so noted on the plans.

643.04 Poles Wood poles shall be placed in the ground to a depth of 20% of their overall length, with a maximum deviation from the vertical of ¼ inch in 5 feet.

After each wood pole has been set in the ground and plumbed, the space around the pole shall be backfilled with selected earth or sand, free of rocks and other deleterious material, placed in layers approximately 4 inches thick. Each layer shall be moistened and thoroughly compacted.

Strain poles, pedestal poles and mast arm poles shall be erected in a vertical position, with a maximum deviation from the vertical of ¼ inch in 5 feet using the leveling nuts provided with the anchor bolts. Once the poles have been plumbed, the top nuts shall be tightened by bringing the nut to a snug tight condition using the full effort of a worker using a spud wrench or compatible tool. After all nuts have been brought to a snug, tight condition, each nut shall be tightened an additional one-third turn, using an impact wrench, torque wrench or large crescent wrench. A minimum of two full threads shall project beyond the outside face of the nut. Nuts and bolts, other than anchor bolts, shall also be tightened by the above procedure.

When foundation and anchor bolts have been installed by others, the Contractor shall verify the anchor bolt dimensions at each location so that bases will be furnished with properly located and sized bolt holes.

Wires in poles shall be supported with a Kellum-type, braided, strain-relief grip attached to a "J" hook mounted inside the pole near the top.

643.041 Foundations If noted on the plans, the Department has completed an appropriate test boring program to evaluate subsurface conditions in the general vicinity of proposed foundations for traffic signal dual purpose and mast arm poles. The associated boring log(s), as well as foundation requirements and any foundation-specific information are provided on the plans. Unless another foundation type is specified on the plans, foundations shall consist of cast-in-place reinforced concrete drilled shafts. Drilled shafts shall not be permanently cased, except for the top 3.0 feet; concrete shall be cast directly against the surrounding soil. Supplier shall determine the Bending Moment, Shear Force, Torsion and Axial Load at the top of each mast arm or dual purpose pole foundation. Foundation size (diameter and length) shall be based on Bending Moment and Torsion at the top of the foundation and determined by Supplier in accordance with Section 626.034 – Concrete Foundations. In the absence of design requirements being provided on the plans, the Contractor shall prepare and submit the foundation design(s) to the Department for approval. Likewise, the Contractor may propose an alternate shallow spread footing or drilled shaft design than that set forth on the drawings. In either case, any Contractor-prepared foundation design shall meet the requirements set forth in Section 626.034 – Concrete Foundations.

643.05 Loop Detector and Loop Detector Wire Installation The detector unit shall be located in the controller. No more than four loops shall be connected to a single detector amplifier.

Detectors shall be installed according to the manufacturer's recommendation, subject to approval. Each detector shall be supplied complete with comprehensive installation instructions. The pavement slot for wire shall be 2 to 3 inches below the finished surface and

not closer than 18 inches from the edge of pavement or the curb. The right-angle corners of the pavement slot shall be chamfered to eliminate sharp bends in the loop wires.

Loop detector wire shall be number 14 or number 12 AWG copper conductors drawn through vinyl plastic tubing approximately ¼ inch in diameter. All pulse loop "approach" wiring shall be insulated red and shall be permanently marked "A", "B", "C", or "D", according to the "approach" guidelines in the controller cabinet. All pulse loop "presence" wiring shall be insulated black and shall be permanently marked according to the "presence" guidelines in the controller cabinet. All loop lead-ins shall be of the same conductor with no splicing. The lead-in from the amplifier to the beginning of the loop shall be shielded pairs, as shown on the plans.

All debris and moisture shall be removed from the loop pavement slot before installation of loop wires. The pavement slot shall be filled to the road surface with an approved sealing compound to form a waterproof bond with the pavement after installing the wire loop.

Detector conductors shall not be housed in the same jacket as the signal conductors.

643.06 Microwave Detector Installation The microwave detector shall be installed in accordance with the manufacturer's recommendations. A four-conductor wire shall be installed from the microwave unit to the controller. All angles and adjustment of patterns shall be the responsibility of the Contractor. The detectors shall operate in either pulse or presence mode.

643.07 Span Wire, Messenger Wire, and Guy Wire All span wire, messenger wire, and guy wire installations shall be in conformance with the requirements of the Utility Companies, when installed on Utility Facilities.

All span wire hanging traffic signals permanent or temporary will have a bottom tether wire to prevent the signal from excessive swinging

All span wires, messenger wires, guy wires, terminal boxes, controller cabinets, or any other metallic surface that might be contacted by people, shall be bonded to ground.

All sidewalk guy wires and slant guy wires installed in a sidewalk area shall be equipped with full-round or half-round guy guards.

643.08 Conduit All conductors under roadways from the controller to the mast arm poles shall be 3 inch schedule 80 PVC.

643.09 Service Connection The Contractor shall furnish and install the necessary electrical service as directed by the Utility Company. The Contractor shall make all arrangements for the service connection and be responsible for all charges incurred thereby.

Under no condition shall any equipment, except that shown on the plans, be installed on any Utility Facilities.

Traffic signal services shall have an automatic transfer switch such as a GENERLINK model MA23/24 – S installed, this will be required on traffic signals only not beacons or dynamic signs.

Whenever a service connection is to be made, the Contractor shall contact the Utility Company involved and inform them of the location, pole number, and time proposed for the service connection.

The traffic cabinet shall be marked with:

an appropriate arc flash plaque or decal with the following information
Flash hazard boundary
Cal/cm2 hazard at 18 inches
PPE level
Shock hazard when cover is off
Limited approach boundary
Restricted approach boundary
The prohibited approach boundary

This shall be located on the outside of the equipment and shall be visible, weatherproof, and fade resistant, and not easily removed.

The Contractor shall be responsible for all outstanding bills for preliminary work done by the Utility Company during the installation of the traffic signal system, to facilitate the service connection.

A service ground rod shall be installed if the service meter trim is not grounded.

The Contractor shall be responsible for grounding the system to 5 OHMS or less. The grounding shall be performed using a ground meter with reference grounds. All testing will be done in the presence of the Resident.

All meter mounting devices shall be installed so that the meters will be upright (plumb). They shall be installed with the top of the meter not less than 48 inches nor more than 60 inches from the floor to the final grade. Exceptions to this height requirement will be made where special permission has been given to install group or modular metering, overall metering enclosures, or pole-mounted meters. Level grade shall be maintained for a minimum of 3 feet in front of the meter enclosure to provide a safe working space. In order to meet this requirement on uneven terrain, as an option, the Contractor may install a pressure-treated wood platform.

For any non-residential (industrial or commercial) self-contained meter socket the by-pass requirements are single phase, 100 or 150 amp, single handle lever operated.

The Contractor shall meet all requirements and regulations of Utility Companies when installing equipment on their poles and for the service connection. It is the responsibility of the Contractor to contact the appropriate Utility to determine their specific requirements.

643.10 Wiring The Contractor shall furnish and install sufficient cable and wire to operate the system properly as shown on the plans and as directed.

The following color code shall be used where possible:

Red Wire	Red, artery
Orange Wire	Yellow, artery
Green Wire	Red, side street
Orange with Tracer	Yellow, side street
Green with Tracer	Green, side street
White and white with tracer	Common for all signals and bond
Blue	All steady burning arrows
Blue with Tracer	Intermittent arrows
Remaining	Detectors and pedestrian signals

The white wire and white wire with tracer shall be used for all common connections and it shall be continuously connected to ground at the controller.

There shall be no wire splices. Connections shall be made on a terminal board inside a watertight galvanized steel or aluminum junction box or in an aerial terminal enclosure with protective cover rated for 600 volts.

Spade type copper terminal ends shall be used to attach all conductors to terminals. All exposed metal parts, including service conduit and the controller cabinet shall be bonded and grounded.

Not more than 3 conductors shall be brought to any one terminal. Terminals shall be mounted to face the cabinet door.

The number and size of conductors required in each cable will be indicated on the plans.

643.11 Vertical Clearance Vertical clearances for vehicular and pedestrian heads shall be in conformity with the MUTCD. All clearances shall be uniform among each type of head or mounting scheme. Clearance for span wire mounted flashing beacon heads shall be a minimum of 17 feet and a maximum of 18 feet.

643.12 Painting Unless otherwise indicated, all exterior parts of the following equipment shall be delivered to the project finished with green or yellow enamel:

Vehicular Signal Heads
Pedestrian Signal Heads
Pedestrian Push Button Detectors

The outside of the steel controller cabinet shall be painted with aluminum paint.

The Contractor shall apply one coat of green enamel to all existing equipment designated on the plans to be painted. The Contractor shall touch up all scratches on exposed surfaces of new equipment with matching enamel after the equipment has been installed.

All exposed signal parts to be painted shall be cleaned and shall be dry when the paint is applied. No painting shall be done in damp weather nor when the air temperature is below 40°F, unless otherwise permitted.

The Contractor shall identify recently painted equipment with "Wet Paint" signs, and shall be responsible for all claims for damages resulting from contact with wet paint surfaces.

643.13 Power Factor In the event that the equipment is of such design that the power factor is reduced below the requirement of the Utility Company, the Contractor shall furnish and install, without further charge, all equipment necessary to restore the power factor to a satisfactory percentage. Such equipment shall be accessible and shall not be mounted on the Utility Facilities.

643.14 Field Tests Before acceptance of the work, the Contractor shall conduct the following tests on all traffic signal equipment and circuits, by a licensed electrician. The tests do not need to be performed in the presence of the Resident, but the test results shall be recorded on the Traffic Signal Quality Control Check List and submitted to the Resident by the Contractor for acceptance. The form shall be signed by the licensed electrician certifying that the signal equipment and circuits meet the requirements of section 634.14.

a. Continuity Each circuit shall be tested for continuity.

b. Ground Each circuit shall be tested for grounds.

c. Megger Megger tests at 500 volts DC shall be made on each circuit between the circuit and a ground. The insulation resistance shall not be less than 10 megaohms on all circuits, except for inductive loop detector circuits, which shall have an insulation resistance value of not less than 100 megaohms.

d. Loop Inductance A loop test meter shall be used to determine that the inductance of the installed loop and lead-in are within the tuning range recommended by the loop detector manufacturer.

e. Functional A functional test shall be made in which it is demonstrated that each part of the system functions as specified.

The functional test for each new or modified traffic signal and flashing beacon shall consist of not less than 10 days of continuous satisfactory operation. If unsatisfactory performance of the system develops, the condition shall be corrected and the test shall be repeated until the 10 days of continuous satisfactory operation is obtained.

The initial operation shall be made between 9:00 A.M. and 2:00 P.M. unless specified otherwise. Before initial operation, all equipment shown on the plans shall be installed and operable.

Initial operation of new or modified traffic signal systems shall be made only after all traffic signal circuits have been thoroughly tested as specified above.

During the test period all costs except electrical energy shall be the Contractor's responsibility.

Functional tests shall start on any working day except Monday, Friday , Saturday, Sunday or the day preceding a legal holiday.

Shutdown caused by a power interruption shall not constitute discontinuity of the functional test, however, the test shall continue after power is restored.

643.15 Timing The controller shall be timed as noted on the plans. The Contractor shall notify the Resident, at least 1 week in advance, of their intention to initially operate the signals.

At the time of initial operation of the new signals, the Contractor shall provide police protection from the local police department at the Contractor's expense until the Contractor demonstrates to the Resident that the signal operates in conformance with the specification.

643.16 Final Cleaning Up After all work has been completed, the Contractor shall remove all barriers, "Wet Paint" signs, equipment and all debris which has accumulated during the work.

Unless otherwise specified in the plans, the Contractor shall remove and deliver all unused signal equipment and wiring to the State of Maine, Department of Transportation, as directed by the Resident. The Contractor shall notify the State Traffic Engineer (207-624-3620) as to time and date of such delivery. (Deliveries will be accepted Monday through Friday between the hours of 7:00 A.M. and 4:00 P.M. only.) Notification shall precede delivery by a minimum of 24 hours.

643.17 Documents The Contractor shall furnish two operation and maintenance manuals for all controller units, auxiliary equipment, vehicle detector sensor units, control units, and amplifiers. Documents shall be delivered with the controller at the time of testing. Each manual must include, but need not be limited to the following:

a. An explanation of the theory of operation, including a functional description and a detailed circuit description.

b. A schematic diagram of each unit. A cabinet wiring diagram including all field wiring and pin locations and designations for all plug type connectors. If any circuit changes are made in the field, the changes shall be noted on the schematic diagrams.

c. A trouble shooting and preventive maintenance procedure including both field and bench trouble shooting analysis.

d. A parts list including a pictorial diagram showing the location and identification of each component on the chassis or circuit board.

e. A drawing of the controller cabinet interior showing the location of all shelves, terminal blocks, relays, timers, loop amplifiers.

In addition, manufacturer's warranties and guarantees for materials shall be delivered to the Resident before acceptance of the project.

643.18 Method of Measurement Traffic signals, traffic signal modifications, interconnect wire, video detection system, traffic signal control system, and flashing beacons will each be measured for payment by the lump sum in place. Temporary traffic signals will be measured for payment by the lump sum, satisfactorily installed, operated, and removed.

Pedestal poles, strain poles, combination poles, and mast arm poles with mast arms will be measured by each unit.

Each loop detector installed, connected to appropriate phases in the controller cabinet, complete and operational will be measured by the unit.

Excavation in solid ledge rock for replacement of wood poles will be measured by the cubic yard. The depth of measurement will be to the bottom of the pole, and the diameter of measurement will be the pole diameter plus 30 inches.

643.19 Basis of Payment Traffic signal modifications, traffic signals, interconnect wire and flashing beacons will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, both new and reused, including, but not limited to wood poles, span wire, tether wires, backplates, visors, guys, controllers, vehicular heads, pedestrian heads, flashing beacons, wiring, cable, pole risers, LED lamps, and all appurtenances and incidentals required for a complete functioning installation and for furnishing all tools and labor necessary for completing the installation. Conduits, junction boxes, and foundations will be paid for under Section 626.

Pedestal poles, strain poles, combination poles and mast arm poles with mast arms will be paid for at the contract unit price each which payment shall be full compensation for furnishing and installing all materials, tools and labor necessary to erect the poles.

Payment for temporary traffic signals shall include compensation for the removal of the system upon completion of the work. All materials used for temporary traffic signals will remain the property of the Contractor. Operating the controller by hand will be paid for under Section 629.

Payment will be made for each Loop Detector at contract price, which will be full compensation for materials, labor, and equipment for each loop installed and fully operational.

Traffic signal control system will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, including, but not limited to local intersection traffic signal controller, controller cabinets, on-street master controller, supervisory PC software, and all appurtenances and incidentals required for a complete functioning installation.

Video detection system will be paid for at the contract lump sum price, which payment will be full compensation for furnishing and installing all materials, including, but not limited to video processing unit, video cameras, supervisory PC software, and all appurtenances and incidentals required for a complete functioning installation.

Payment for excavation of solid ledge rock for the placement of wood poles will be made under Section 206.07.

Payment will be made under:

Pay Item		Pay Unit
643.60	Flashing Beacon at:	Lump Sum
643.71	Traffic Signal Modification:	Lump Sum
643.72	Temporary Traffic Signal:	Lump Sum
643.80	Traffic Signals at:	Lump Sum
643.81	Traffic Signal Control System	Lump Sum
643.83	Video Detection System	Lump Sum
643.86	Traffic Signal Loop Detector	Each
643.90	Interconnect Wire Between:	Lump Sum
643.91	Mast Arm Pole	Each
643.92	Pedestal Pole	Each
643.93	Strain Pole	Each
643.94	Dual Purpose Pole	Each

SECTION 644 - GLARE BARRIER

Reserved

SECTION 645 - HIGHWAY SIGNING

645.01 Description This work shall consist of furnishing and installing new signs, sign supports, delineators, Polyvinylchloride (PVC) Pipe and breakaway devices and removing, relocating and/or modifying existing signs and sign supports, in accordance with these specifications and in reasonably close conformity with the plans.

645.02 General All equipment shall be new unless otherwise specified. Requests for substitution of any specified material shall be submitted in writing with all documentation (specifications, mill certifications, etc.) in order to enable the Department to evaluate the proposal. Substitutes for specified material may be accepted, upon approval of the Fabrication Engineer. Substitutes shall give equal or better service than the specified material. Where an existing system is to be modified, the existing material shall be removed, upgraded, or disposed of as directed by the contract documents.

645.021 Materials Materials shall meet the requirements specified in the following Sections of Division 700 - Materials:

Polyvinylchloride (PVC) Pipe	706.08
Reflective Sheeting	719.01
Demountable High Intensity Reflectorized Letters, Numerals, Symbols and Borders	719.02
Aluminum Extrusions	719.03
Aluminum Sheets	719.04
Plywood	719.05
Demountable Reflectorized Delineators	719.06
Assembly Hardware	719.07
Aluminum Supports	720.01
Steel Supports	720.03
Steel H-beam Poles	720.06
Anchor Bolts	720.07
U-Channel Posts	720.08
Wood Sign Posts	720.12

Paint for the edge and back of plywood and field coat paint for wood sign posts shall be an exterior grade dark green enamel conforming to Federal Specifications TT-P-71b.

Materials shall meet the gradation requirements only of the following:

Aggregate for Untreated Surface Course and Leveling Course 703.10

Underdrain Backfill Material 703.22

645.022 Sign Layout Drawings The Contractor shall submit 3 sets of sign-face, layout-detail, and scale drawings. Fabrication of the signs shall not begin until the Contractor has received approval of these drawings. The drawings shall contain complete detailed information and dimensions. One set of drawings will be returned to the Contractor, who will submit corrected drawings, if required. The drawings shall be detailed using the same units used on the plans.

645.023 Support Structures The design, materials and fabrication of sign support structures and foundations shall meet the requirements of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" and

interims thereto, except as otherwise indicated within these specifications or on the plans. Beam mounted signs and their supports shall be designed using wind speeds as determined from the 25-year mean recurrence interval isotach map. Minimum design default values for these structures shall be: I_r = 0.87; C_v = 0.93; K_z = 0.87; and G = 1.14. Bridge, cantilever, and butterfly sign supports and associated signs and hardware shall be designed using the wind speeds as determined from the 50 year mean recurrence interval isotach map, as contained in the above referenced AASHTO Specifications. Minimum design default values for these structures shall be: I_r = 1.00; C_v = 1.00; K_z = 0.94; and G = 1.14. Minimum fatigue design default values for cantilever & butterfly sign support structures shall be classified as Fatigue Category I with Fatigue Importance Factors (I_f) of 1.0 for Galloping, 1.0 for Natural Wind Gusts and 1.0 for Truck-Induced Gusts. Bridge type sign support structures supporting variable message signs (VMS) shall also use this fatigue criteria in their design. Foundations for sign support structures shall be as set forth on the plans and in Sections 626.034 – Concrete Foundations and 645.024 - Bridge, Cantilever and Butterfly Support Structure Foundations.

Minimum fatigue design default values for bridge type structures, without VMS, shall be classified as Fatigue Category II with Importance Factors (I_f) of 0.65 for Galloping, 0.75 for Natural Wind Gusts and 0.89 for Truck-Induced Gusts. For sign supports mounted on bridge structures and approaches to bridge structures, the mounting height shall be measured as the distance of the mounted sign(s) center of gravity to one of the following:

For bridges over bodies of water: above the prevailing water level or, in the case of tidal waters, above mean high tide.

For overpass structures: above the lower roadway level.

For approach ramps: above the average adjacent ground level, if said ground level is more than 10 feet below the base of the structure.

All cantilever and butterfly type sign support structures shall be equipped with an approved damping or energy-absorbing device.

For aluminum construction, welding shall conform to the current edition of AWS Structural Welding Code, Aluminum, D1.2 for aluminum construction.

After execution of the contract and before any shop work has commenced, the Contractor shall submit 3 sets of drawings, and computations if prescribed below, of all sign supports proposed to be furnished and erected under this contract. The drawings shall be of sufficient detail to indicate material and/or dimensional conformance with these specifications and the contract drawings and, in the case of bridge, cantilever and butterfly type sign supports, shall be sufficiently detailed to show all structural significant details.

Approval for deviations from the contract drawings and/or specifications shall be requested in writing and shall be approved by the Fabrication Engineer before being incorporated in the manufacturer's drawings. Requests for substitution of all specified material shall be submitted

in writing, with full documentation (specifications, mill certification, etc.) enabling the Department to evaluate the proposal.

Sign support structures and anchor bolts shall meet the requirements specified in Section 720 as well as the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

A Certificate of Compliance shall be provided for all material in accordance with the requirements of the General Statement of Division 700 - Materials.

a. Beam Mounted Signs The beams for beam-mounted signs shall be of the size, material and shape designated in the contract documents. The Contractor shall be fully responsible for the adequacy and design of any structural details not shown on the plans, and each drawing shall contain a reference to the design criteria and a certification by a Professional Engineer licensed in accordance with the State of Maine regulations, over their official stamp, that said design criteria have been met by all parts of the structure designed and/or detailed by the Contractor. Approval of the drawings will signify only approval of the size, material and length of the beam.

b. Bridge, Cantilever, and Butterfly Type Sign Supports The Contractor shall be responsible for the design of the support structure including its foundation. Foundation design shall follow requirements of Sections 626.034 – Concrete Foundations and 645.024 - Bridge, Cantilever, and Butterfly Support Structure Foundations, as well as this Section.

Signs shall be placed on the support structure such that the bottom edges are aligned (unless written consent from the Fabrication Engineer is obtained), while accommodating the minimum height requirement - see Section 645.06. The Contractor shall use the Contract Drawings in order to determine the approximate horizontal placement of signs. Installation shall be in accordance with Section 645.06 - Installation of Type I Signs. The structure and foundation shall be designed to accommodate a minimum of 1.5 times the sign area on each structure as shown on the contract documents. This additional theoretical sign load shall be computed by: For single signs increasing the sign widths an additional 25% without changing the horizontal midpoint of the sign; for multiple signs the sign widths shall be increased 25% toward the outside sign edges. The height shall be increased 25% without changing the bottom edge elevation of the signs.

Bridge type structures shall be designed using either a tri-chord or four-chord truss structure as the overhead member. Each of the two upright members supporting the bridge type overhead truss member shall consist of a minimum of two vertical legs. A four chord truss configuration shall be required if the contract documents specify placing signs on both sides of the overhead structure (two way traffic beneath structure). Cantilever and butterfly type structures shall be designed using either a tri-chord or four-chord overhead truss member. The upright member of a cantilever or butterfly-type support structure shall have a maximum horizontal deflection of L/40, where L is the length of upright member, as

determined from design loads calculated in accordance with the AASHTO "Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals".

The base plates of uprights for all types of support structures shall have heavy hex leveling nut with 2 hardened flat washers. The distance between the bottom of the base plates to the top of the foundations shall not exceed twice the diameter of the anchor bolts. Grout, or other materials, shall not be placed between base plates and the top of foundations. In addition to the required detail drawings, the Contractor shall submit 3 copies of the design computations, including fatigue considerations, in accordance with Section 11, Fatigue Design, in the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", and interims thereto, for the entire structure. Erection lifting points shall be clearly depicted on the shop drawing.

The computations shall be sufficiently detailed to allow the Engineer to check and approve the computations. Computer printouts will not be accepted unless they meet the above criteria. All plans and design calculations, sign support structure and foundation, shall be signed by a Professional Engineer licensed in accordance with the State of Maine regulations. Approval will be based on the applicable provisions of Section 105.7 - Working Drawings.

Overhead sign panel mounting devices shall be designed accommodating the requirements of appropriate sign panel tilting included in this specification. The design of this assembly shall include fastening sign panels directly to steel or aluminum members as further described in Section 719.07, as well as other applicable Sections, plans and specifications.

c. Bridge Overpass Mounted Sign Supports Overpass mounted sign supports shall be constructed to the configuration and sizes and of the material shown on the contract documents. Approval will be based on the applicable provisions of Section 105.7 - Working Drawings. Fastening sign panels directly to steel or aluminum members shall be as described in Section 719.07, as well as other applicable Sections, plans and specifications.

d. Breakaway Supports for Sign Supports Breakaway supports for sign supports will be required only for those locations indicated on the contract plans. Breakaway supports, approved by the Resident, using load-concentrating couplings shall be supplied for use at all locations designated as breakaway. Breakaway Support Certification of both breakaway and structural adequacy shall be provided by the Manufacturer. Design calculations or test data of production samples to support certification shall be provided. Breakaway support components shall provide the same or greater structural strength as the support post or pole utilizing the breakaway device. On multi-pole sign supports designated as breakaway, each pole shall be equipped with breakaway hinges immediately below the lower edge of the sign. Hinges relying on the friction between the hinge and the pole face for transmitting the design moment will not be accepted for use. Breakaway devices are subject to the applicable provisions of Section 721.

645.024 Bridge, Cantilever and Butterfly Support Structure Foundations If noted on the plans, the Department has completed an appropriate test boring program to evaluate subsurface conditions in the general vicinity of proposed foundations for traffic signal dual purpose and mast arm poles. The associated boring log(s), as well as foundation requirements and any foundation-specific information are provided on the plans. Unless another foundation type is specified on the plans, foundations shall consist of cast-in-place reinforced concrete drilled shafts. Drilled shafts shall not be permanently cased, except for the top 3.0 feet; concrete shall be cast directly against the surrounding soil. Supplier shall determine the Bending Moment, Shear Force, Torsion and Axial Load at the top of each mast arm or dual purpose pole foundation. Foundation size (diameter and length) shall be based on Bending Moment and Torsion at the top of the foundation and determined by Supplier in accordance with Section 626.034 – Concrete Foundations. In the absence of design requirements being provided on the plans, the Contractor shall prepare and submit the foundation design(s) to the Department for approval. Likewise, the Contractor may propose an alternate shallow spread footing or drilled shaft design than that set forth on the drawings. In either case, any Contractor-prepared foundation design shall meet the requirements set forth in Section 626.034 – Concrete Foundations.

645.03 Classification of Signs Sign sizes, color and legend designs shall conform to these specifications, the plans, and MUTCD requirements. The signs are classed according to the intended use as follows:

a. Sign Type I guide signs shall consist of high intensity prismatic, reflectorized sheeting or reflectorized, demountable letters, numerals, symbols and border mounted on a high intensity prismatic, reflective sheeting background adhered to a sign panel constructed of extruded aluminum planks.

b. Sign Type I regulatory, warning, and route marker assembly signs shall consist of high intensity prismatic, reflective sheeting letters, numerals, symbols, and border on a high intensity prismatic, reflective sheeting background adhered to a sign panel constructed of sheet aluminum.

c. Sign Type II guide signs shall consist of high intensity prismatic, reflective sheeting letters, numerals, symbols and border on an high intensity prismatic, reflective sheeting background attached to a sign panel constructed of plywood.

d. Sign Type II regulatory, warning and route marker assembly signs shall consist of high intensity prismatic reflective sheeting letters, numerals, symbols and border on an high intensity prismatic reflective sheeting background adhered to a sign panel constructed of sheet aluminum or plywood.

645.04 Fabrication of Type I Guide Signs

a. Panels The panels for this type sign shall be shop-fabricated from aluminum planks to the sizes designated on the approved shop drawings. Cut edges shall be true, smooth, and free from burrs or ragged breaks. Flame cutting will not be permitted. Bolt holes may be drilled to finished size or punched to finished size, provided the diameter of the punched hole is at least twice the thickness of the metal being punched.

Fabrication of extruded aluminum sign planks, including punching or drilling holes and cutting to length, shall be completed before the metal degreasing and the application of the reflective sheeting. The bolts required for fastening the extruded aluminum planks together shall conform to the designs used in standard commercial processes for the type of extruded aluminum panels to be used as approved.

All route shields shall be on an overlay aluminum sheet of 0.080 inch minimum thickness and shall be in full color with reflective background; they shall not have demountable numerals and borders.

b. Reflective Sheeting The high intensity prismatic reflective sheeting shall be applied to the extruded aluminum plank in accordance with the current recommendations of the sheeting Manufacturer.

The reflective sheeting shall cover the complete panel and shall not be trimmed to conform to the border. The reflective sheeting shall overlap into the side recess of the individual planks. There shall be no paint applied to the sign panels. The surface of all completed sign panels shall be flat and free of defects. Extruded aluminum molding shall be placed on the edges of the extruded panels, as shown on the plans.

c. Text The design of upper and lower case letters, numerals and symbols, and the arrangement and spacing of texts shall be as provided on the plans and in conformance with the MUTCD and Standard Highway Signs.

Text for Guide Signs shall be composed of demountable letters, numerals, symbols, and borders and shall be high-intensity prismatic, reflective sheeting. The demountable text shall be applied to the panels by use of aluminum pop rivets, in accordance with standard commercial processes, as approved. All demountable letters, numerals, symbols, and borders shall be the same manufacturer's make for the entire project. Cutout high-intensity, reflective sheeting text shall be applied to the sign panel with a pre-coated, adhesive backing.

645.041 Fabrication of Type I Regulatory, Warning and Route Marker Assembly Signs and Type II Sheet Aluminum Regulatory, Warning and Route Marker Assembly Signs

a. Panels Sheet aluminum sign panels shall be shop-fabricated to the size shown on the plans. The corners shall be rounded to the indicated radius where shown.

Bolt holes may be drilled or punched to finished size provided the diameter of the punched hole is at least twice the thickness of the metal being punched. Cut edges shall be true, smooth, and free from burrs or ragged breaks. Flame cutting will not be permitted. Punching or drilling of holes and cutting to size shall be completed before metal degreasing and the application of reflective sheeting.

b. Reflective Sheeting The high intensity prismatic reflective sheeting shall be applied to the sheet aluminum sign panels in accordance with the current recommendations of the sheeting Manufacturer. The reflective sheeting colors shall conform to the MUTCD standard highway sign colors for each type of sign. Surface of all panels shall be flat and free from defects.

c. Text The text for regulatory, warning, confirmation and route marker assembly signs shall be composed of: High intensity prismatic, reflective sheeting letters, numerals, symbols and borders; or the silver letters may be formed by applying transparent ink to the reflective sheeting background where the silk screen process is used; or other methods to form the text may be used, when approved in advance.

645.042 Fabrication of Type II Guide Signs and Type II Plywood, Regulatory, Warning and Route Marker Assembly Signs

a. Panels Fabrication of all sign panels from high-density, overlaid plywood shall be performed in a uniform manner. All fabrication, including cutting, drilling, and edge routing, shall be completed prior to painting and application of reflective sheeting to the high-density, overlaid plywood. Panels shall be cut to size and shall be plywood. Panels shall be cut to size and shall be free of warping, open checks, open splits, open joints, open cracks, loose knots and other defects resulting from fabrication. Corners shall be left square. The surface of all sign panels shall be flat.

The edge and back of the plywood shall be painted with an exterior grade dark green paint.

b. Blanks Sign blanks shall be cut to shape using a saw blade that does not tear plywood grain. Holes shall be clean-cut and uniform. All cracks, open checks, open splits and other defects occurring on the edge surfaces shall be filled with a synthetic wood filler and sanded smooth prior to sealing and painting. The sign blank edges shall be sealed using an approved sealer/primer. The edges shall then be painted with an exterior grade, dark green paint.

The surface shall not be painted before application of reflective sheeting. Before applying reflective sheeting, dirt or wax shall be removed by one of the following methods:

1. The surface shall be buffed lightly with solvent-soaked steel wool, fine or medium, using organic solvents, such as lacquer thinner, xylol, heptane, benzene or naphtha, and wiped dry with clean cloths.

2. The panel shall be sanded lightly with fine-grade paper, cleaned with solvent, and wiped dry using clean cloths.

c. Reflective Sheeting The High intensity prismatic reflective sheeting shall be applied directly to the cleaned high-density surface in accordance with the recommendations of the reflective sheeting manufacturer.

d. Text The text for regulatory, warning, confirmation and route marker assembly signs shall be composed of cutout, High intensity prismatic reflective sheeting letters, numerals, symbols and borders or the silver letters may be formed by applying transparent ink to the reflective sheeting background where the silk screen process is used. Other methods to form the text may be used when approved in advance.

The design of the letters, numerals, and symbols, the spacing of the text and the size and spacing of the border shall conform to the MUTCD and Standard Highway Signs.

645.06 Installation of Type I Signs The sign locations shown on the plans are approximate; exact locations will be determined in the field by the Resident. Signs stockpiled before erection shall be stored in a vertical position and completely covered to avoid staining, weathering, and dirt accumulation.

a. Sign Supports Poles for single and multiple support roadside signs shall be erected plumb, using the leveling nuts supplied with the anchor bolts. When signs are supported by more than one pole, all poles shall be carefully aligned to avoid warping of the sign panel.

Bridge, butterfly and cantilever type sign supports and their foundations shall be constructed, assembled and erected, in accordance with the manufacturer's details, as approved. All horizontal supports spanning the roadway shall be level and shall have permanent camber as described in Section 10 of the current edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", and interims thereto. If, at any time after their erection, bridge, butterfly or cantilever type sign supports are to remain for a period in excess of 72 hours without the sign(s) for which they were designed being in place, suitable vibration damping devices, approved by the Resident, shall be installed until such time as the sign(s) can be erected.

Bridge-mounted sign supports shall be fabricated and assembled in accordance with the details as shown on the contract drawings and with Section 504. Additionally, if required to be painted, bridge-mounted sign supports shall be painted in accordance with Section 506.

Where aluminum surfaces are in contact with concrete or dissimilar metals, the contacting surface shall be thoroughly coated with an approved, aluminum impregnated

caulking compound or the surfaces shall be separated by another approved material. Before signs are attached, aluminum sign supports shall be cleaned of all dirt and discoloration using methods recommended by the manufacturer.

b. Sign Panels Extruded aluminum planks for sign panels shall be bolted together, as indicated on the plans. Extruded aluminum molding shall be placed on the edges of the extruded panels. Sign panels shall be attached to the posts to provide the vertical and horizontal clearances from the roadway as indicated on the plans. Sign panels on overhead structures shall provide a minimum vertical clearance of 18 feet to the highest point of the roadway surface under the sign(s). Sign panels on bridge-mounted sign supports shall be installed with the bottom edge of the sign approximately 4 inches above the bottom of the bridge beam.

Sign panels mounted over the roadway shall tilt in the direction of the approaching traffic in such a manner that the angle between the sign face and the roadway grade, at the sign location shall be 85º +/- 3º.

Ground-mounted signs located 4 to 30 feet from the edge of shoulder shall form an angle of 93º between the approach roadway and the sign.

Signs located more than 30 feet from the edge of the shoulder shall form an angle between the approach roadway and the sign face equal to 87º -1º for each additional 10 feet beyond 30 feet.

Unless otherwise shown on the plans, or designated by the Resident, a minimum lateral clearance of 4 feet shall be provided between the edge of the shoulder and the edge of any sign panel.

The elevation of the bottom edge of guide sign panels shall be 7 feet above the elevation of the edge of the traveled way, at the sign location, or in case of a curb section, 7 feet above the elevation of the outer edge of the roadway, unless authorized otherwise.

Signs located 30 feet or more from the edge of traveled way shall be 5 feet above the elevation of the edge of shoulder.

In the event that a second sign is to be placed under the main sign, the elevation of the bottom edge of the principal sign shall be a minimum of 8 feet above the outer edge of the traveled way, or a minimum of 8 feet above the edge of the traveled way, in curbed sections; the bottom edge of the second sign must be at least 5 feet above the edge of the traveled way.

The elevation of the bottom edge of the regulatory, warning and route marker sign panels shall be 6 feet above the elevation of the edge of the pavement, or edge of roadway in curbed sections, at the sign location. The elevation of the bottom edge of these sign panels above the elevation of the edge of the pavement on all crossing or connecting roadways shall be 5 feet in

rural areas or 7 feet in urban areas. Field conditions may require some variation in elevations, as directed.

Each sign shall have at least two fasteners connecting it to the sign poles, except signs of 1 foot or less in height may have one fastener.

645.061 Installation of Type II Signs The exact sign locations will be determined in the field. Signs stockpiled before erection shall be stored in a vertical position and completely covered to avoid staining, weathering, and dirt accumulation.

When a steel pole is to be used, before any shop work is commenced, the Contractor shall submit 3 sets of the manufacturer's drawings of all standards and accessories proposed to be furnished and erected under this contract. The drawings shall be of sufficient detail to indicate material and/or dimensional conformance with these specifications and the contract drawings. Each drawing shall contain a reference to the design criteria and certification that the design criteria have been met for current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, bracket arms and associated hardware, fittings and breakaway devices, as submitted. A Licensed Professional Engineer shall sign the certification under their official seal. The drawings shall use the same units as found in the project plans. It is the intent of these specifications that the Contractor shall be fully responsible for the adequacy of the sizes, wall thickness, materials and connections of the standards, bracket arms and associated hardware, fittings and breakaway devices. Approval of the drawings will signify only approval of the material(s), mounting heights(s) and bracket arm length(s).

a. Sign Supports Support posts for Type II signs shall be U-channel posts weighing 2½ pounds per foot for signs of less than 6.24 ft² in area, 4 inch by 4 inch wood posts or two U-channel posts weighing 2½ lb/ft for signs of area 6.24 ft² to 9 ft², 4 inch by 6 inch wood posts for signs of area 9 ft² to 16 ft², and 6 inch by 6 inch wood posts for signs of area over 16 ft². All signs 60 inches wide or wider shall be mounted on two wood posts. Wood posts shall be set to a depth of 4 feet. U-channel posts shall be set to a minimum depth of 30 inches. Leading signs less than 9 ft² on the apex of islands will be installed on U-channel posts. Solar powered sign mounted beacon arrays shall be mounted on galvanized steel poles. Any signs installed on/in an island, shall be installed in a PVC sleeve of the appropriate size for the type of post being installed, as shown in the standard details.

When it is necessary to set sign posts in bedrock, holes shall be excavated to the required depth and size at the locations indicated on the plans. The excavated material will be satisfactorily disposed of, as directed, and the posts set to the required depth.

When installing pressure-treated sign posts, the cut end of the posts shall not be buried in the ground.

Backfilling around the posts shall be with excavated material unless the excavated material is considered unsatisfactory, in which case the backfill shall be granular material

conforming to the requirements of Section 703.19 - Granular Borrow. Backfill shall be thoroughly tamped in layers not exceeding 8 inches in depth.

When directed, the area around the posts shall be loamed and seeded in accordance with the applicable provisions of Section 615 and Section 618.

The Contractor shall be responsible for and shall repair all damage to underground drainage structures, utilities, or lighting conduits encountered during placing the posts.

b. Mounting Type II signs shall be mounted using assembly hardware specified in Section 719.07.

PVC pipe shall be installed in all locations where sign posts are to be placed in paved islands and shall have an inside diameter of 12 inches. For sleeves that are to be utilized for U-channel posts, the PVC pipe shall have a minimum length of 3 feet. For sleeves that are to be utilized for wood posts, the PVC pipe shall have a minimum length of 5 feet.

Installation of the PVC pipe shall occur prior to paving of the island. The pipe shall be placed at a depth so that the top of the pipe shall have no more than a 1 inch reveal from finished surface pavement. Once placed, the pipe shall be backfilled around the outside diameter in layers that are thoroughly compacted and that do not exceed a depth of 8 inches.

Once installed and backfilled, the pipe shall be completely filled to the top of the pipe with material that meets the gradation requirements of Aggregate for Untreated Surface Course and Leveling Course or Underdrain Backfill Material.

645.062 Installation of Delineators Posts for delineators shall be erected so that posts and assemblies will be plumb. All posts, which are bent or otherwise damaged, shall be removed and properly replaced. Posts shall be driven 4 feet from the outside edge of shoulder, 4 feet from the face of curb and 4 feet from the normal edge of shoulder in guardrail sections. A suitable driving cap shall be used and after driving, the top of the post shall have substantially the same cross sectional dimensions as the body of the post.

When bedrock is encountered in erecting posts, the depth to be drilled into the rock shall be determined by the Resident.

After the posts are driven, delineators shall be mounted 4 feet above the elevation of the edge of the traveled way. In the event that a delineator is required to be installed on a bridge structure, it shall be installed by use of a bracket as shown on the plans.

Sign support posts to be installed in the sleeve shall be plumbed and set in the material which shall be compacted or tamped around the post. The posts shall be placed so that there is a 2 foot maximum distance from the bottom of the retro-reflective strip on the sign post to the paved travelway or shoulder surface. For wooden posts only, 4 feet of the post shall be placed in the

sleeve. Other sign support post installation requirements shall be followed as per Section 645 of the Standard Specifications.

645.063 Installation of Breakaway Devices Breakaway devices shall be installed at locations indicated on the plans by an approved method. Each sign and pole shall be carefully demounted for reinstallation at the same or at a new location. Manufacturer's installation information shall be provided on the project.

If required, poles shall be cut in such a manner that no rough edges will remain. No flame cutting will be permitted. Cut edges on steel poles shall be painted in accordance with Section 645.07.

Existing foundations shall be modified for attachment of the breakaway device as shown on the plans or approved.

Breakaway devices shall be attached to new foundations in accordance with the recommendations of the breakaway device manufacturer and as approved.

645.064 Installation of Sign Mounted Beacon Array:

Beacons installation shall conform to current MUTCD standards.

Battery and solar assembly shall be of sufficient size to power sign for 7 days without solar charging. Batteries shall be gel cell or absorbed glass mat (AGM) batteries. Solar panel shall be installed facing true south and 60 degrees from vertical.

Connections to service shall be in accordance with section 643.09.

The cabinet should be positioned on the side of the pole farthest from traffic. Only aluminum and steel cabinets will be accepted. All exposed wiring shall be in accordance with section 715.11.

All wiring shall be in accordance with section 718.01-c.

Beacon Array shall meet testing requirements outlined in sections 643.14 a, b, and e.

645.07 Demounting and Reinstalling Existing Signs and Poles Signs and poles designated to be demounted and not designated to be reinstalled, except those designated to be demounted by others, shall be delivered to the Resident.

Existing sign panels, poles, foundations, and sign hardware, damaged because of the Contractor's operations shall be replaced or repaired by the Contractor to the satisfaction of the Resident.

New or relocated regulatory, warning, confirmation or route marker assembly signs shall be installed the same working day as the corresponding existing signs are demounted. All new or relocated guide signs shall be installed within two working days of the time the corresponding existing sign is demounted. Before the Contractor demounts any regulatory or warning sign, they shall erect a similar easel mounted sign at a designated location. The Contractor shall maintain this temporary sign in place until the permanent sign is installed.

Existing signs and poles shall be reinstalled in accordance with the applicable requirements for installing new signs and poles.

Relocated steel posts and clamps shall be field painted two coats after the posts have been erected. The first coat shall be a zinc-dust primer paint meeting Federal Specification TT-P-641B Type II. The second coat shall be bright aluminum paint, aluminum-dust Type II, Class 3 brightness, meeting Federal Specification TT-A-468 with a minimum of 2 lb/gal, with vehicle meeting or exceeding Federal Specification TT-V-109. Scratches shall be touched up after the erection of the sign panels. The touchup shall be with both primer and finish coat. Sign pole surfaces to be painted shall be cleaned and dry when the paint is applied. No painting shall be done in damp weather nor when the air temperature is below 40°F.

645.08 Method of Measurement Demount Signs, Demount Poles, Reinstall Signs, and Reinstall Poles will be measured by each unit.

Bridge, cantilever and butterfly type sign supports, including the foundations, support structures and sign panels, complete in place, as called for on the plans, will be measured by each unit.

Bridge Overpass-Mounted Guide Signs, including supports, will be measured by each unit in place.

Breakaway devices (1 per pole) shall be measured by the unit complete in place and accepted.

The area of roadside guide signs, regulatory, warning, confirmation and route marker assembly signs of the respective types, will be measured by the area in square feet, computed to nearest hundredth of a square foot, as determined by the overall height multiplied by the overall width.

Aluminum poles for roadside guide signs, Type I will be measured by the number of units of each diameter, complete in place. Steel H-beam poles will be measured for payment by the pound, determined from the nominal weight per foot for each size and the lengths as indicated on the plans.

Demountable reflectorized delineators will be measured by the number of units of each type in place.

All beacons installed on an individual post/pole shall constitute a single installation. Each installation will be measured for payment by the lump sum in place

645.09 Basis of Payment The accepted demounted signs and demounted poles will be paid for at the contract unit price each for the respective item specified. Such price will be full compensation for delivering signs and poles not to be reinstalled to a site designated by the Resident, and all other incidentals necessary to complete the work.

The accepted reinstalled signs or reinstalled poles will be paid for at the contract unit price each. Such price will be full compensation for furnishing new hardware, when required, and all incidentals necessary to complete the installations. All signs or poles designated to be reinstalled that are damaged by the Contractor shall be replaced by the Contractor with new signs or poles conforming to the applicable Specifications at no additional cost to the State.

The accepted bridge, cantilever and butterfly type sign supports will be paid for at the contract lump sum price for the respective items. Such price will be full compensation for the signs, support structures, foundations, and incidentals necessary to complete the work.

The accepted guide signs-overpass mounted, will be paid for at the contract lump sum price for the respective items, which price will be full compensation for the signs, supports and incidentals necessary to complete the work.

The accepted roadside guide signs and regulatory, warning, confirmation, and route marker assembly signs will be paid for at the contract unit price per square foot. Such payment will be full compensation for furnishing and installing signs, assembly hardware, and all incidentals necessary to complete the work.

The accepted aluminum poles will be paid for at the contract unit price each for the specified diameter, complete in place.

The accepted demountable reflectorized delineators will be paid for at the contract unit price each for the type specified, which payment will be full compensation for delineator and post or bridge rail mounting, complete in place.

Payment for breakaway devices shall be full compensation for furnishing and installing the device, all required pole cutting, for adapting the pole to the breakaway device, for adapting the concrete base to the breakaway device and all other incidentals necessary to complete the work. Separate payment will be made at the respective contract unit prices for demounting and reinstalling the signs and the poles at multi-pole installations. At single-pole installations, separate payment will be made at the respective contract unit prices for demounting and reinstalling the poles only.

The accepted quantity of steel H-beam poles will be paid for at the contract unit price per pound, complete in place as shown on the plans or as designated.

Furnishing and installing posts for Type II signs, including earth excavation and backfilling, furnishing and placing assembly hardware, backfilling material, loam, seed and other incidentals, will not be paid for directly but will be considered incidental to the cost of the signs they support.

Sign Mounted Beacon Arrays will be paid for at the contract lump sum price, which payment will be full compensation for furnishing all materials including, but not limited to the LED-arrays, flasher, timer, controller cabinets, wiring, pedestrian push buttons, solar panels, batteries, radio devices, radar units, and all appurtenances and incidentals required for a complete and functioning installation and for furnishing all tools and labor necessary for completing the installation. Array must meet all testing and connection requirements of this section

All work, PVC Pipe, Aggregate for Untreated Surface Course and Leveling Course, Underdrain Backfill Material and other materials furnished to install, backfill around, and fill the sleeve in the island and place the sign post in the sleeve shall be incidental to the Section 645 Items.

Excavating rock will be paid for as provided in Section 206.

Payment will be made under:

Pay Item		Pay Unit
645.103	Demount Guide Sign	Each
645.106	Demount Regulatory, Warning, Confirmation and Route Marker Assembly Sign	Each
645.108	Demount Pole	Each
645.113	Reinstall Guide Sign	Each
645.116	Reinstall Regulatory, Warning, Confirmation and Route Marker Assembly Sign	Each
645.118	Reinstall Pole	Each
645.12	Overhead Guide Sign: (STA X + XXX)	Lump Sum
645.13	Bridge Overpass-Mounted Guide Sign: (STA X + XXX) (Left/Right XX)	Lump Sum
645.14	Special Work No.: ___	Lump Sum
645.15	Cantilever Guide Sign: (STA X + XXX)	Lump Sum
645.161	Breakaway Device Single Pole	Each
645.162	Breakaway Device Multi Pole	Each
645.251	Roadside Guide Signs, Type I	Square Foot
645.261	Bridge Guide Sign, Type I	Square Foot
645.271	Regulatory, Warning, Confirmation and Route Assembly Sign, Type I	Square Foot
645.281	5 Inch Aluminum Pole	Each
645.282	6 Inch Aluminum Pole	Each
645.283	7 Inch Aluminum Pole	Each
645.284	8 Inch Aluminum Pole	Each

645.285	10 Inch Aluminum Pole	Each
645.286	12 Inch Aluminum Pole	Each
645.289	Steel H-Beam Poles	Pounds
645.291	Roadside Guide Signs Type II	Square Foot
645.292	Regulatory, Warning, Confirmation and Route Marker Assembly Signs Type II	Square Foot
645.301	Demountable Reflectorized Delineator, Single	Each
645.302	Demountable Reflectorized Delineator, Double	Each
645.305	Sign Mounted Beacon Array	Lump Sum

SECTION 646 through 651 VACANT

SECTION 652 - MAINTENANCE OF TRAFFIC

652.1 Description This work shall consist of furnishing, installing, maintaining and removing traffic control devices necessary to provide reasonable protection for motorists, pedestrians and construction workers in accordance with these Specifications, the applicable provisions of Section 105.4.5 - Special Detours, and the plans.

Traffic control devices include signs, signals, lighting devices, markings, barricades, channelizing, and hand signaling devices, traffic officers, and flaggers.

652.2 Materials All traffic control devices shall conform to the requirements of Part VI of the latest edition of the MUTCD, and NCHRP 350 guidelines.

All signs shall be fabricated with high intensity fluorescent retroreflective sheeting conforming to ASTM D 4956 - Type VII, Type VIII, or Type IX (prismatic). All barricades, drums, and vertical panel markers shall be fabricated with high intensity orange and white fluorescent retroreflective sheeting conforming ASTM D 4956 - Type VII, Type VIII, or Type IX (prismatic).

Construction signs shall be fabricated from materials that are flat, free from defects, retroreflectorized, and of sufficient strength to withstand deflections using a wind speed of 80 miles/hr.

All barricades, cones, drums, and construction signs may be constructed from new or recycled plastic.

652.2.2 Signs Only signs with symbol messages conforming to the design of the Manual of Uniform Traffic Control Devices shall be used unless the Resident approves the substitution of word messages.

652.2.3 Flashing Arrow Board Flashing Arrow Panels (FAP) must be of a type that has been submitted to AASHTO's National Transportation Product Evaluation Program (NTPEP) for

evaluation and placed on the Maine Department of Transportations' Approved Products List of Portable Changeable Message Signs & Flashing Arrow Panels.

FAP units shall meet requirements of the current Manual on Uniform Traffic Control Devices (MUTCD) for Type "C" panels as described in Section 6F.56 - Temporary Traffic Control Devices. An FAP shall have matrix of a minimum of 15 low-glare, sealed beam, Par 46 elements capable of either flashing or sequential displays as well as the various operating modes as described in the MUTCD, Chapter 6-F. If an FAP consisting of a bulb matrix is used, each element should be recess-mounted or equipped with an upper hood of not less than 180 degrees. The color presented by the elements shall be yellow.

FAP elements shall be capable of at least a 50 percent dimming from full brilliance. Full brilliance should be used for daytime operation and the dimmed mode shall be used for nighttime operation. FAP shall be at least 96 inches x 48 inches and finished in non-reflective black. The FAP shall be interpretable for a distance not less than 1 mile.

Operating modes shall include, flashing arrow, sequential arrow, sequential chevron, flashing double arrow, and flashing caution. In the three arrow signals, the second light from the arrow point shall not operate.

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Operating modes shall include, flashing arrow, sequential arrow, sequential chevron, flashing double arrow, and flashing caution. In the three arrow signals, the second light from the arrow point shall not operate.

The minimum element on-time shall be 50 percent for the flashing mode, with equal intervals of 25 percent for each sequential phase. The flashing rate shall be not less than 25 nor more than 40 flashes per minute. All on-board circuitry shall be solid state.

Primary power source shall be 12 volt solar with a battery back-up to provide continuous operation when failure of the primary power source occurs, up to 30 days with fully charged batteries. Batteries must be capable of being charged from an onboard 110 volt AC power source and the unit shall be equipped with a cable for this purpose.

Controller and battery compartments shall be enclosed in lockable, weather-tight boxes.

The FAP shall be mounted on a pneumatic-tired trailer or other suitable support for hauling to various locations, as directed. The minimum mounting height of an arrow panel should be 7 feet from the roadway to the bottom of the panel.

The face of the trailer shall be delineated on a permanent basis by affixing retro-reflective material, known as conspicuity material, in a continuous line as seen by oncoming drivers.

A portable changeable message sign may be used to simulate an arrow panel display.

652.2.4 Other Devices Vertical panel markers shall be orange and white striped, 8 inches wide by 24 inches high. On the Interstate System, vertical panel markers shall be orange and white striped, 12 inches wide by 36 inches high.

Cones shall be orange in color, at least 28 inches high, and retro-reflectorized. Retro-reflection shall be provided by a white band of retro-reflective sheeting conforming to Section 719.01, 6 inches wide, no more than 3 to 4 inches from the top of the cone, and a 4 inch wide white band at least 2 inches below the 6 inch band.

Drums shall be of plastic or other yielding material, and shall be approximately 36 inches high and a minimum of 18 inches in diameter. There shall be at least two retro-reflectorized orange and at least two retro-reflectorized white stripes at least 4 inches wide on each drum. Metal drums shall not be used.

Warning lights and battery operated flashing and steady burn lights shall conform to the requirements Section 712.23 - Flashing Lights.

STOP/SLOW paddles shall be the primary and preferred hand-signaling device. Flags shall be limited to emergencies. The paddle shall have an octagonal shape and be at least 18 inches wide with letters at least 6 inches high and should be fabricated from light semi-rigid material.

Type I barricades shall be 2 feet minimum, 8 feet maximum in length with an 8 inch wide rail mounted 3 feet minimum above the ground. Type II barricades shall be 2 feet in length with two 8 inch wide rails, and the top rail shall be mounted 3 feet minimum above the roadway. Type III barricades shall be 8 feet in length with three 8 inch wide rails, and the top rail shall be mounted 5 feet minimum above the roadway. The cross members of all barricades shall be of ½ or ⅝ inch thick plywood or other lightweight rigid material such as plastic, fiberglass or fiber wood as approved by the Resident. The predominant color for supports and other barricade

components shall be white, except that unpainted galvanized metal or aluminum components may be used.

652.2.5 Portable Changeable Message Sign Trailer mounted Portable Changeable Message Signs (PCMS) must be of a type that has been submitted to AASHTO's National Transportation Product Evaluation Program (NTPEP) for evaluation and placed on the Maine Department of Transportations' Approved Products List of Portable Changeable Message Signs & Flashing Arrow Panels. The PCMS unit shall meet or exceed the current specifications of the Manual on Uniform Traffic Control Devices (MUTCD), 6F.55.

The front face of the sign should be covered with a low-glare protective material. The color of the LED elements shall be amber on a black background. The PCMS should be visible from a distance of 0.5 mile day and night and have a minimum 15º viewing angle. Characters must be legible from a distance of at least 650 feet.

The message panel should have adjustable display rates (minimum of 3 seconds per phase), so that the entire message can be read at least twice at the posted speed, the off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed. Each message shall consist of either one or two phases. A phase shall consist of up to eight characters per line. The unit must be capable of displaying at least three lines of text with eight characters per line. Each character shall be 18 inches high. Each character module shall use at least a five wide and seven high pixel matrix. The text of the messages shall not scroll or travel horizontally or vertically across the face of the sign.

Units shall automatically adjust their brightness under varying light conditions to maintain legibility.

The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable. Message must be changeable with either a notebook computer or an on-board keypad. The controller shall have the capability to store a minimum of 200 user-defined and 200 pre-programmed messages. Controller and battery compartments shall be enclosed in lockable, weather-tight boxes.

PCMS units shall have the capability of being made programmable by means of wireless communications. PCMS units shall also be fully capable of having an on-board radar system installed if required for a particular application.

PCMS' primary power source shall be solar with a battery back-up to provide continuous operation when failure of the primary power source occurs. Batteries must be capable of being charged from a 110 volt AC power source. The unit must also be capable of being operated solely from a 110 volt AC power source and be equipped with a cable for this purpose.

The PCMS shall be mounted on a trailer in such a way that the bottom of the message sign panel shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the

roadway in rural areas when it is in the operating mode. PCMS trailers should be of a heavy duty type with a 2 inch ball hitch and a minimum of four leveling jacks (at each corner). The sign shall be capable of being rotated 360° relative to the trailer. The face of the trailer shall be delineated on a permanent basis by affixing retro-reflective material, known as conspicuity material, in a continuous line as seen by oncoming drivers.

CONSTRUCTION REQUIREMENTS

652.3.1 Responsibility of the Department The Department will provide Project traffic requirements such as allowable lane or road closures, minimum temporary lane widths, work zone speed limits, timing limitations, and allowable special detours and temporary structures. No revisions to these requirements will be permitted unless the Contractor can thoroughly demonstrate an overall benefit to the public and a Contract Modification is approved.

652.3.2 Responsibility of the Contractor The Contractor shall provide continuous and effective traffic control and management for the Project that is appropriate to the construction means, methods, and sequencing allowed by the Contract and selected by the Contractor.

652.3.3 Submittal of Traffic Control Plan The Contractor shall submit, at or before the Preconstruction Meeting, a Traffic Control Plan (TCP) that provides the following information to the Department:

a. The name, telephone number, and other contact numbers (cellular phone, pager, if any) of the Contractor's Traffic Control Supervisor (TCS). The TCS is the person with overall responsibility for insuring the contractor follows the TCP. and who has received Work Zone Traffic Control Training commensurate with the level of responsibility shown in the requirements of the Contract, and who is empowered to immediately resolve any work zone traffic control deficiencies or issues. Provide documentation that the Traffic Control Supervisor has completed a Work Zone Traffic Control Training Course (AGC, ATSSA, or other industry-recognized training), and a Supervisory refresher training every 5 years thereafter. Submit training certificates or attendance roster that includes the course name, training entity, and date of training.

Traffic Control Training Course curriculum must be based on the standards and guidelines of the MUTCD and must include, at a minimum, the following:

1. Parts of Temporary Traffic Control Zone
2. Appropriate use and spacing of signs
3. Use and spacing of channelizing devices
4. Flagging basics
5. Typical examples and applications

The Traffic Control Supervisor, or designee directly overseeing physical installation, adjustment, and dismantling of work zone traffic control, will ensure all personnel

performing those activities are trained to execute the work in a safe and proper manner, in accordance with their level of decision-making and responsibility.

b. Proposed construction phasing or sequencing that reasonably minimizes traffic impacts. The Contractor shall conduct the Work such that traffic delays do not exceed 5 minutes unless longer periods are authorized by the Department. The Contractor shall provide advance signing to warn motorists of expected traffic backups or queues.

c. A written narrative and/or plan explaining how traffic and pedestrians will be moved through the Project Limits, including transitions during the change from one phase of construction to the next, as applicable.

d. Temporary traffic control treatments at all intersections with roads, rail crossings, businesses, parking lots, pedestrian ways, bike paths, trails, residences, garages, farms, and other access points, as applicable.

e. A list of all Contractor or Subcontractor certified flaggers to be used on the Project, together with the number of flaggers which will be used for each type of operation that flagging is needed. If the Contractor is using a flagging Subcontractor, then the name and address of the Subcontractor may be provided instead of a list of flaggers.

f. A procedure for notifying the Resident, local emergency officials, and local government officials (including the name and phone numbers of such officials) whenever significant traffic impacts are anticipated or occur and the plan for removing all lane restrictions in case of emergency or significant traffic impact. For a related provision, see Section 105.2.2 - Project Specific Emergency Planning.

g. A description of any special detours including provisions for constructing, maintaining, signing, and removing the detour or detours, including all temporary bridges and accessory features and complete restoration of the impacted land.

h. The maximum length of requested contiguous lane closure. The Contractor shall not close excessive lengths of traffic lane to avoid moving traffic control devices.

i. The proposed temporary roadway surface conditions and treatments. The Contractor shall provide an adequate roadway surface at all times; taking into account traffic speed, volume, and duration.

j. The coordination of appropriate temporary items (drainage, concrete barriers, barrier end treatments, impact attenuators, and traffic signals) with the TCP.

k. The plan for unexpected nighttime work, the contractor shall provide a list of emergency nighttime lighting equipment and safety personnel available on-site or have the ability to have them on site within an hour of the time of need.

l. The plan for meeting any project specific requirements contained in special provision 105 and/or 107

m. The lighting plan if night work is anticipated.

The Department will review the TCP for completeness and conformity with Federal requirements, Contract provisions, the current edition of the MUTCD, and Department policy and procedures. The Department will review and provide comments to the Contractor within 14 days of receipt of the TCP. No review or comment by the Department, or any failure to review or comment, shall operate to absolve the contractor of its responsibility to design and implement the plan in accordance with the Contract, or to shift any responsibility to the Department. If the TCP is determined by the Department to be operationally ineffective, the Contractor shall submit modifications of the TCP to the Department for review, and shall implement these changes at no additional cost to the Contract. Nothing in this Section shall negate the Contractor's obligations set forth in Section 110 - Indemnification, Bonding, and Insurance. The creation and modification of the TCP will be considered incidental to the related 652 items.

652.3.4 General Prior to starting any work on any part of the project adjacent to or being used by the traveling public, the Contractor shall install the appropriate traffic control devices in accordance with the plans, specifications and the latest edition of Manual of Uniform Traffic Control Devices, Part VI. The Contractor shall continuously maintain the traffic control devices in their proper position, and they shall be kept clean, legible and in good repair throughout the duration of the work. If notified that the traffic control devices are not in place or not properly maintained, the Contractor may be ordered to immediately suspend work until all deficiencies are corrected.

No equipment or vehicles of the Contractor, their subcontractors, or employees engaged in work on this contract shall be parked or stopped on lanes carrying traffic, or on lanes or shoulders adjacent to lanes carrying traffic, at any time, except as required by ongoing work operations. Contractor equipment or vehicles shall never be used to stop, block, or channelize traffic.

The Contractor shall not store material or park equipment within 15 feet of the edge of the established travel lanes. Equipment parked overnight between 15 and 30 feet of the edge of the travel lane shall be placed behind positive barriers if feasible, or clearly marked by channelizing devices or other reflective devices.

Channelization devices shall include Vertical Panel Markers, Barricades, Cones, and Drums. These devices shall be installed and maintained at the spacing determined by the MUTCD through the work area.

Channelization devices consisting of barricades or drums, at a maximum spacing of 50 feet, shall be used in guardrail areas when neither the existing guardrail nor the new guardrail is in place.

The Contractor shall maintain existing guardrails and/or barriers until removal is necessary for construction. The Contractor shall use a temporary barrier or appropriate channelizing devices while the guardrails and/or barriers are absent. Permanent guardrails and barriers shall be installed as soon as possible to minimize risk to the public.

All excavation areas adjacent to the roadway shall be channelized continuously in both directions for the length of the project in all areas where the centerline strip is not effective in accordance with the latest edition of the MUTCD.

Where the roadway is adjacent to an area being excavated, a minimum 2 foot shoulder should be maintained and the effective slope of the earth excavation beyond the 2 foot shoulder shall not be steeper than a 1½ horizontal to 1 vertical. The effective slope of rock excavation shall not be steeper than 1 horizontal to 1 vertical beyond the 2 foot shoulder. In the case of cuts over 5 feet deep, an earth berm or other approved barrier shall be placed between the travel lane and the excavated area.

In this instance, travel speeds shall be limited by specific advisory signing to 20 miles per hour in all cases. When excavation does not leave sufficient usable widths to maintain two-way traffic as provided in Section 105.4 - Maintenance of Work, one-lane traffic controlled by a traffic signal or continuous flagging may be considered. Closely spaced vertical panels, drums or other channelizing devices shall be used on any of these types of areas that are left exposed for short durations.

When paving operations or shoulder grading leave a 3 inch or less exposed vertical face at the edge of the traveled way, channelization devices shall be placed 2 feet outside the edge of the pavement at intervals not exceeding 600 feet and a 48 inch by 48 inch W8-9 Low Shoulder sign shall be placed at a maximum spacing of ½ mile. When paving operations or shoulder grading leave greater than a 3 inch exposed vertical face at the edge of the traveled way, the Contractor shall place shoulder material for a width of at least 4 feet to meet the pavement grade, and place channelizing devices as above, before the lane is opened to traffic.

Special Detours and temporary structures, if used, shall meet applicable AASHTO standards, including curve radii and grade.

652.3.5 Installation of Traffic Control Devices All traffic control devices shall be in conformance with NCHRP 350 requirements and installed as per manufactures recommendations.

Portable signs shall be erected on temporary sign supports approved crashworthy devices so that the bottom of the sign is either 1) 12 inches or 2) greater than 5 feet above the traveled way. Post-mounted signs shall be erected so the bottom of the sign is no less than 5 feet above the traveled way, and 7 feet above the traveled way in business, commercial, and residential areas. Post-mounted signs must be erected so that the sign face is in a true vertical position. All signs shall be placed so that they are not obstructed in any manner and immediately modified to ensure proper visibility if obstructed. Signs may be mounted lower or higher to fit the situation when authorized by the Resident. Cones shall be either weighted or nailed. Tires will not be allowed as weights.

Vertical panel markers shall be mounted with the top at least 4 feet above the traveled way.

Drums shall not be weighted on the top. Drain holes shall be provided to prevent water from accumulating in the drums. Drums may be weighted with up to 6 inches of loose dry sand.

The Contractor shall operate and maintain the flashing arrow board unit and trailer and shall continuously supply fuel and lubrication for dependable service during the life of the contract. The units shall remain in continuous night and day service at locations designated until the Resident designates a new location or discontinuance of service.

The Contractor shall maintain the devices in proper position and clean them as necessary. Maintenance shall include the covering and uncovering of all signs when no longer applicable (even if for a very short duration). The sign shall be considered adequately covered when no part of the sign face is visible either around or through the covering.

The Contractor shall replace damaged traffic control devices with devices of acceptable quality, as directed by the Resident.

652.3.6 Traffic Control The Contractor shall provide a minimum roadway width of 22 feet for two-way traffic and 11 feet for one-way traffic. The existing travel way width shall be maintained to the maximum extent practical. Vertical panel markers, drums, cones, or striping shall be used to clearly delineate the roadway through the construction area. Two-way traffic operation shall be provided at all times that the Contractor is not working on the project. One-way traffic shall be controlled through work areas by flaggers, utilizing radios, field telephones, or other means of direct communication.

The traffic control devices shall be moved or removed as the work progresses to assure compatibility between the uses of the traffic control devices and the traffic flow. Traffic control devices that become unnecessary shall be immediately removed from use.

Pavement markings shall be altered as required to conform to the existing traffic flow pattern. Repainting of pavement marking line, if required to maintain the effectiveness of the line, shall be considered maintenance of traffic control devices. No separate payment will be made. Inappropriate existing pavement markings shall be removed whenever traffic is rerouted, and temporary construction pavement markings shall be placed. Obliteration and removal of non-applicable markings and placement of temporary construction pavement markings shall be considered maintenance of traffic control devices and will be paid for under the appropriate Contract item. Traffic changes shall not be made unless there is sufficient time, equipment, materials, and personnel available to complete the change properly before the end of the workday. This provision will not be required when traffic is rerouted for brief periods during daylight hours and the route can be clearly defined by channelizing devices, or flaggers, or both.

652.4 Flaggers The Contractor shall furnish flaggers as required by the TCP or as otherwise specified by the Resident. All flaggers must have successfully completed a flagger test approved

by the Department and administered by a Department-approved Flagger-Certifier who is employing that flagger. All flaggers must carry an official certification card with them while flagging that has been issued by their employer. Flaggers shall wear safety apparel meeting ANSI 107-2004 Class 2 risk exposure that clearly identifies the wearer as a person, and is visible at a minimum distance of 1000 ft and shall wear a hardhat with 360° retro-reflectivity. For nighttime conditions, Class 3 apparel, meeting ANSI 107-2004, shall be worn along with a hardhat with 360° retro-reflectivity. Retro-reflective or flashing SLOW/STOP paddles shall be used, and the flagger station shall be illuminated to assure visibility in accordance with 652.6.2.

Flagger stations shall be located far enough in advance of the workspace so that approaching road users will have sufficient distance to stop at the intended stopping point. While flagging, the flagger should stand either on the shoulder adjacent to the traffic being controlled, or in the closed lane. At a spot obstruction with adequate sight distance, the flagger may stand on the shoulder opposite the closed sections to operate effectively. Under no circumstances shall the flagger stand in the lane being used by moving traffic or have their back to oncoming traffic. The flagger should be clearly visible to approaching traffic at all times and should have a clear escape route.

When conditions do not allow for proper approach sight distance of a flagger or storage space for waiting vehicles, additional flaggers shall be used at the rear of the backlogged traffic or at a point where approaching vehicles have adequate stopping sight distance to the rear of the backlogged traffic. All flagger stations shall be signed, even when in close proximity. The signs shall be removed or covered when flagger operations are not in place, even if it is for a very short duration.

Flaggers shall be provided as a minimum, a 10 minute break, every 2 hours and a 30 minute or longer lunch period away from the work station. Flaggers may only receive 1 unpaid break per day; all other breaks must be paid. Sufficient certified flaggers shall be available onsite to provide for continuous flagging operations during break periods. If the flaggers are receiving the appropriate breaks, breaker flagger(s) shall be paid starting 2 hours after the work begins and ending 2 hours before the work ends. A maximum of 1 breaker per 6 flaggers will be paid. (1 breaker flagger for 2 to 6 flaggers, 2 breaker flaggers for 7 to 12 flaggers, etc). If a flagger station is manned for 10 hours or more, then ½ hour for lunch will be deducted from billable breaker flagger hours.

652.41 Traffic Officers Traffic officers will be uniformed police officers.

652.5 Warning Lights Warning lights shall be installed at locations designated by the Resident before any work is done on the portions of roadway being used by traffic. Upon installation, all warning lights shall remain in continuous operation during the life of the project, unless otherwise authorized by the Resident.

When a suitable 120-volt AC power service source is available within 500 feet of the designated warning light location, power operated flashing lights shall be installed. Two

alternately flashing lamps shall be mounted approximately 24 inches above the sign, spaced approximately 24 inches apart.

When a suitable 120-volt AC power service source is not available, battery operated flashing lights may be erected. Four flashing lamps shall be mounted approximately 6 inches above the sign, spaced approximately 12 inches apart.

The power service connections shall be installed to the satisfaction of both the power company and the Resident. The Contractor shall make all necessary arrangements for the power service connections and be responsible for all charges incurred thereby, including power charges. The Contractor shall also be responsible for all outstanding bills from the electric power company for preliminary work done by the electric company for the power service connection.

When batteries are required for battery operated flashing lights, they shall be provided and replaced by the Contractor as necessary.

652.5.1 Rumble Strip Crossing When lane shifts or lane closures require traffic to cross a permanent longitudinal rumble strip for 7 calendar days or less, the Contractor shall install warning signs that read "RUMBLE STRIP CROSSING" with a supplemental Motorcycle Plaque, (W8-15P).

When lane shifts or lane closures require traffic to cross a permanent longitudinal rumble strip for more than 7 calendar days, the Contractor shall pave in the rumble strips in the area that traffic will cross, unless otherwise directed by the Resident. Rumble strips shall be replaced prior to the end of the project, when it is no longer necessary to cross them.

652.6.1 Daylight Work Times Unless otherwise described in the Contract, the Contractor is allowed to commence work and end work daily according to the Sunrise/Sunset Table at: http://www.sunrisesunset.com/usa/Maine.asp . If the Project town is not listed, the closest town on the list will be used as agreed at the Preconstruction Meeting. Any work conducted before sunrise or after sunset will be considered Night Work.

652.6.2 Night Work When Night Work occurs (either scheduled or unscheduled), the Contractor shall provide and maintain lighting on all equipment, at all work stations, and all flagger stations.

The lighting facilities shall be capable of providing light of sufficient intensity to permit good workmanship, safety and proper inspection at all times. The lighting shall be cut off and arranged on stanchions at a height that will provide perimeter lighting for each piece of equipment and will not interfere with traffic, including commercial vehicles, approaching the work site from either direction.

The Contractor shall have available portable floodlights for special areas.

The Contractor shall utilize padding, shielding or other insulation of mechanical and electrical equipment, if necessary, to minimize noise, and shall provide sufficient fuel, spare lamps, generators, etc. to maintain lighting of the work site.

The Contractor shall submit, as a subset of the Traffic Control Plan, a lighting plan at the Preconstruction Conference, showing the type and location of lights to be used for night work. The Resident may require modifications be made to the lighting set up in actual field conditions.

Prior to beginning any Night Work, the Contractor shall furnish a light meter for the Residents use that is capable of measuring the range of light levels from 5 to 20 foot-candles.

Horizontal illumination, for activities on the ground, shall be measured with the photometer parallel to the road surface. For purposes of roadway lighting, the photometer is placed on the pavement. Vertical illumination, for overhead activities, shall be measured with the photometer perpendicular to the road surface. Measurements shall be taken at the height and location of the overhead activity.

Night Work lighting requirements:

Mobile Operations: For mobile-type operations, each piece of equipment (paver, roller, milling machine, etc) will carry indirect (i.e. balloon type) lights capable of producing at least 10 foot-candles of lighting around the work area of the equipment.

Fixed Operations: For fixed-type operations (flaggers, curb, bridge, pipes, etc.), direct (i.e. tower) lighting will be utilized capable of illuminating the work area with at least 10 foot-candles of light.

Hybrid Operations: For hybrid-type operations (guardrail, sweeping, Inslope excavation, etc.), either direct or indirect lighting may be utilized. The chosen lights must be capable of producing at least 10 foot-candles of light around the work area of the equipment
Inspection Operations: Areas required to be inspected by the Department will require a minimum of 5 foot-candles of lighting. This may be accomplished through direct or indirect means.

All workers shall wear safety apparel labeled as meeting the ANSI 107-2004 standard performance for Class 3 risk exposure.

The Contractor shall apply 2- inch wide retro-reflective tape, with alternating red and white segments, to outline the front back and sides of construction vehicles and equipment, to define their shape and size to the extent practicable. Pickup trucks and personal vehicles are exempt from this requirement. The Contractor shall furnish approved signs reading "Construction Vehicle - Keep Back" to be used on trucks hauling to the project when such signs are deemed necessary by the Resident. The signs shall be a minimum of 30 inches by 60 inches, Black and Orange, ASTM D 4956 - Type VII, Type VIII, or Type IX (prismatic).

All vehicles used on the project, including pickup trucks and personal vehicles, shall be equipped with amber flashing lights, visible from both front and rear, or by means of single, approved type, revolving, flashing or strobe lights mounted so as to be visible 360º. The vehicle flashing system shall be in continuous operation while the vehicle is on any part of the project.

The Resident or any other representative of the Department reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. The Department shall not be held responsible for any delay in the work due to any suspension under this item. Failure to follow the approved Lighting Plan will result in a Traffic Control violation.

Payment for lighting, vehicle mounted signs and other costs accrued because of night work will not be made directly but will be considered incidental to the related contract items.

652.7 Method of Measurement Signs and panel markers will be measured by the square foot for all signs authorized and installed. Flashing arrow boards, portable-changeable message signs, and flashing and steady burn lights, will be measured by each unit authorized and installed on the project. Barricades, drums, and cones will be measured by each unit authorized. No additional payment will be made for devices that require replacement due to poor condition or inadequate retroreflectivity.

The accepted quantity of traffic officer and flagger time will be the number of hours the designated station is occupied. The number of hours authorized for payment will be measured to the nearest ¼ hour.

Maintenance of traffic control devices will be measured by the calendar day or as one lump sum for all authorized and installed traffic control devices.

Warning lights will be measured by the group of lights furnished.

652.8 Basis of Payment The accepted quantity of signs and panel markers will be paid for at the contract unit price per square foot. Such payment will be full compensation for furnishing and installing all signs, sign supports, and all incidentals necessary to complete the installation of the signs.

The accepted quantity of flashing arrow boards, portable-changeable message signs, barricades, battery operated flashing and steady burn lights, drums, and cones will be paid for at the contract unit price each for the actual number of devices authorized, furnished, and installed. Such payment shall be full compensation for all incidentals necessary to install and maintain the respective devices.

Failure by the contractor to follow the Contracts 652 Special Provisions and Standard Specification and/or the Manual on Uniform Traffic Control Devices (MUTCD) and/or the Contractors own Traffic Control Plan will result in a violation letter and result in a reduction in payment as shown in the schedule below. The Resident or any other representative of the Department reserves the right to suspend the work at any time and request a meeting to discuss

violations and remedies. The Department shall not be held responsible for any delay in the work due to any suspension under this item. Any reduction in payment under this Special Provision will be in addition to forfeiting payment of maintenance of traffic control devices for that day.

ORIGINAL CONTRACT AMOUNT				
From	Up to and	Amount of Penalty Damages per Violation		
More Than	Including	1st	2nd	3rd & Subsequent
$0	$1,000,000	$250	$500	$1,250
$1,000,000	$2,000,000	$500	$1,000	$2,500
$2,000,000	$4,000,000	$1,000	$2,000	$5,000
$4,000,000	and more	$2,000	$4,000	$10,000

652.8.1 Maintenance of Traffic Control Devices

652.8.1.1 Payment by Calendar Day Maintenance of Traffic Control Devices will be paid for at the contract unit price per calendar day for each calendar day that the Contractor maintains traffic as specified herein. Such payment will be full compensation for moving devices as many times as necessary; for replacing devices damaged, lost, or stolen; and for cleaning, maintaining, and removing all devices used for traffic control, including replacing temporary pavement marking lines.

The contract unit price per calendar day for Maintenance of Traffic Control Devices shall be full payment each day for such maintenance, encompassing all areas of the contract, regardless of whether or not the work areas or projects are geographically separated.

652.8.1.2 Payment by Lump Sum Maintenance of Traffic Control Devices will be paid at the contract lump sum price. Such payment will be full compensation all days that the Contractor maintains traffic as specified herein, and for moving devices as many times as necessary; for replacing devices damaged, lost, or stolen; and for cleaning, maintaining, and removing all devices used for traffic control, including replacing temporary pavement marking lines.

The contract lump sum price for Maintenance of Traffic Control Devices shall be full compensation for all days for such maintenance, encompassing all areas of the contract, regardless of whether or not the work areas or projects are geographically separated.

652.8.2 Other Items

The accepted quantities of flagger hours will be paid for at the contract unit price per hour for each flagging station occupied excluding lunch breaks, and for each approved breaker flagger. Overtime hours, as reported on the certified payrolls, will be paid an additional 30% of the bid price for 652.38. The computation and additional payment for overtime hours will occur during the project close-out process and will be paid as additional hours of 652.38 to the nearest ¼ hour. The contract unit price shall be full compensation for hiring, transporting, equipping,

supervising, and the payment of flaggers and all overhead and incidentals necessary to complete the work.

There will be no payment made under any 652 pay items after the expiration of the adjusted total contract time.

The accepted quantities of traffic officer hours will be paid for at the contract unit price per hour for each station occupied, with no additional payment for overtime. This price shall be full compensation for supplying uniformed officers with police cruisers, and all incidentals necessary to complete the work; including transportation, equipment, and supervision.

The accepted quantities of warning lights will be paid for at the contract unit price, per group, complete in place including the necessary power, and remaining in operation during active work of the project or as otherwise directed. Upon completion of the work, the lamps, fixtures, and the framework required to properly mount the lamps shall remain the property of the Contractor.

Payment for temporary pavement marking lines and pavement marking removal will be made under the respective pay item in Section 627 - Pavement Markings.

Payment for temporary traffic signals will be made under Section 643 - Traffic Signals.

There will be no payment made under any 652 pay items after the expiration of the adjusted total contract time.

Payment will be made under:

Pay Item		Pay Unit
652.30	Flashing Arrow	Each
652.31	Type I Barricade	Each
652.311	Type II Barricade	Each
652.312	Type III Barricades	Each
652.32	Battery Operated Light	Each
652.33	Drum	Each
652.34	Cone	Each
652.35	Construction Signs	Square Foot
652.36	Maintenance of Traffic Control Devices	Calendar Day
652.361	Maintenance of Traffic Control Devices	Lump Sum
652.37	Warning Lights	Group
652.38	Flaggers	Hour
652.381	Traffic Officers	Hour
652.41	Portable-Changeable Message Sign	Each

SECTION 653 - POLYSTYRENE PLASTIC INSULATION

653.01 Description This work shall consist of furnishing and installing a polystyrene plastic insulating layer at locations designated on the plans in accordance with these specifications.

653.02 General Insulating material shall be extruded polystyrene insulating board conforming to the requirements of AASHTO M230.

Pegs shall be hard wood, approximately 6 inches by ¼ inch round, pointed on one end.

653.03 Preparation of Foundation The insulating boards shall be placed on a compacted layer of granular material graded to a tolerance of ½ inch above or below the required grade and cross section. The surface shall be free of rocks that would cause damage to the insulating boards. The type and thickness of the granular material will be as shown on the plans.

653.04 Placing Insulating Boards The insulating boards shall be secured to the ground with pegs placed at each corner or where directed by the Resident, and driven flush with the surface of the insulating board. Joints between the insulating boards shall be staggered. The openings in all joint shall be kept to a minimum.

653.05 Placing Backfill After the insulating boards have been placed, granular material shall be placed using care to avoid pushing or puncturing the boards. The depth of the first layer of aggregate subbase sand shall not be less than 10 inches loose measure. The aggregate subbase sand shall be spread with a crawler type bulldozer of not more than 2000 lb/ft² ground contact pressure or with other approved equipment but not supported directly on the insulating boards. Trucks and other heavy construction equipment shall not be operated directly on the insulating boards. The type and thickness of granular material will be shown on the plans.

653.06 Compaction Compaction of the first layer of aggregate subbase sand shall be by vibratory methods to the satisfaction of the Resident. After the first layer has been compacted, normal construction practices may be followed providing no loads are placed on the area that produce more than 2000 lb/ft² ground contact pressure.

653.07 Protection of Polystyrene Since gasoline, oil, heat, and sunlight will damage polystyrene, all precautions shall be taken to prevent them from damaging the insulating board. The insulating boards shall not be stored in sunlight for more than one day.

653.08 Method of Measurement Polystyrene plastic insulation will be measured by the square yard in place.

653.09 Basis of Payment The accepted quantities of polystyrene plastic insulation will be paid for at the contract unit price per square yard complete in place. Payment shall be full compensation for and for furnishing and placing the insulating boards of pegs.

Payment will be made under:

	Pay Item	Pay Unit
653.20	1 inch Polystyrene Plastic Insulation	Square Yard
653.21	1½ inch Polystyrene Plastic Insulation	Square Yard
653.22	2 inch Polystyrene Plastic Insulation	Square Yard
653.23	3 inch Polystyrene Plastic Insulation	Square Yard

SECTION 654 - VACANT

SECTION 655 - ELECTRICAL WORK
Reserved

SECTION 656 - TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL

656.1 Responsibility of the Contractor-Prepare and Follow Plan The Contractor shall provide continuous and effective temporary soil erosion and water pollution control for the Project that is appropriate to the construction means, methods and sequencing allowed by the Contract and selected by the Contractor. To do so, the Contractor shall prepare and submit a Soil Erosion and Water Pollution Control Plan (SEWPCP) and properly implement its approved SEWPCP. The Contractor shall have its SEWPCP approved, perform a preconstruction field review, and install and certify initial controls before commencing any Work, which could disturb soils or impact water quality.

If the Contractor properly implements its approved SEWPCP, then (1) any Work required in excess of that required by the SEWPCP will be Extra Work, (2) any Delay resulting from any such excess Work will be analyzed in accordance with Section 109.5 - Adjustments for Delay, and (3) the Contractor will not be responsible for damages relating to insufficient soil erosion and water pollution control including the cost of all environmental enforcement actions, penalties, or monetary settlements assessed any environmental regulatory entity and all costs incurred by or through the Department.

If the Contractor fails to prepare, submit, or seek approval of a SEWPCP or fails to properly implement its approved SEWPCP, then (1) the Department may suspend all Work, (2) the Department may withhold all Progress Payments or any portion thereof until the Contractor remedies all deficiencies; (3) the Department may remedy deficiencies with Departmental or contracted forces and deduct the cost thereof from payments otherwise due the Contractor; (4) any delay resulting from such failure or non-compliance will be a Non-excusable Delay; and (5) the Contractor will be responsible for all damages arising from or related to such failure or non-compliance including the cost of all environmental enforcement actions, penalties, or monetary

settlements assessed by any environmental regulatory entity and all costs incurred by or through the Department including legal and consulting fees.

656.2 Submittal and Approval of the SEWPCP Within 21 calendar days of Contract Execution, the Contractor must submit two copies of its SEWPCP to the Resident.

Within 14 days of receipt, the Department will determine if the SEWPCP is in accordance with the Contract requirements and (1) notify the Contractor that the SEWPCP is approved or (2) return it for any needed revisions. If returned for revision, the Contractor must resubmit two copies of its revised SEWPCP as provided above within 7 days and the Department will have 7 days from receipt of the revised plan to notify the Contractor whether its SEWPCP is approved or again requires revision. Additional iterations will occur in a like manner until the Department approves the Contractor's SEWPCP. The Contractor must have its SEWPCP approved and implemented before commencing any Work, which could disturb soils or impact water quality.

SEWPCP REQUIREMENTS

656.3.1 Qualifications of Preparer The preparer of the SEWPCP must be knowledgeable and experienced in erosion and pollution control and must (1) be a "DEP Certified Contractor" as designated by the Maine Department of Environmental Protection (MDEP), or (2) be licensed in Maine as a Professional Engineer, Landscape Architect, or Soil Scientist.

656.3.2 Standards The SEWPCP must be in accordance with all applicable laws, rules, regulations, permit requirements and conditions, this specification, all other contractual provisions, and the latest version of Department's "Best Management Practices for Erosion & Sedimentation Control" (the "BMP Manual"). In the event of conflicting provisions, the SEWPCP must utilize the more restrictive requirements.

656.3.3 General SEWPCP Elements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include the following elements.

a. The name and qualifications of the person preparing the SEWPCP.

b. The name of the on-site person, the "Environmental Coordinator", responsible for implementation of the SEWPCP, who must be the Prime Contractor's Superintendent or other supervisory employee with the authority to immediately remedy any deficient controls, with their phone number and emergency number (personal cellular phone or pager).

c. The schedule and sequence of all activities that involve soil disturbance including work on sites outside the right-of-way such as borrow pit operations, haul roads, staging areas, equipment storage sites, mixing plants, and Waste Areas including expansion of existing sites.

d. Incorporation of permanent erosion and sedimentation control features into the project at the earliest practicable time.

e. Identification of steep slopes and highly erodible soils, with the method and frequency of soil stabilization. Temporary slope stabilization is required on a daily basis. Permanent slope stabilization measures shall be applied within one week of the last soil disturbance.

f. Emergency procedures for storms, including availability of Materials and procedures and time frames for corrective action if controls fail.

g. If water is flowing within the drainage system, the water shall be diverted to a stable area or conduit and work shall be conducted in the dry. The Contractor's plan shall address when and where the diversions will be necessary

h. Type and location of all temporary erosion and sedimentation control measures. Temporary winter stabilization must be used between November 1st and April 1st, or outside of said time period if the ground is frozen or snow covered. Temporary winter stabilization involves, at a minimum, covering all disturbed soils and seeded ground that is not "Acceptable Work" with an approved method other than using unanchored hay or straw mulch. Such other methods may include the use of Erosion Control Mix or other covers that are not susceptible to erosion or wind movement, as described within the "Winter Stabilization" section of the most recent MaineDOT BMP Manual. If temporary winter stabilization practices are used, spring procedures for permanent stabilization shall also be described in the SEWPCP. Use of these methods for over-winter temporary erosion control will be incidental to the contract and be paid for as part of Pay Item 656.75

i. Mulching type and frequency of application for disturbed soil areas. Newly disturbed earth shall be mulched by the end of each workday. Mulch shall be maintained on a daily basis. All disturbed ditches/slopes shall be stabilized by the end of each workday. Stabilization shall be maintained on a daily basis. Erosion control blanket shall be installed in the bottoms of all ditches except where a stone lining is planned or otherwise stated in the contract document. Seed shall be applied prior to the placement of the blanket.

j. Location and frequency of application of temporary seeding. Permanent seeding shall be performed in accordance with the most current 618 specification, unless otherwise stated in the contract document.

k. Description of all dust control procedures for roadways, haul roads, work areas, and all other contractor activities.

l. Location and method of temporary erosion and sediment control for existing and proposed catch basins and all other drainage inlet and outlet areas. Culvert inlet and

outlet protection shall be installed within 48 hours of culvert installation, or prior to a storm event, whichever is sooner.

m. Describe all in-stream work, with timing and plans for temporary stream diversions and cofferdams. Water flow must be maintained at all times unless otherwise stated in the contract document.

n. Describe the design, location, and plans for sedimentation basins used for dewatering cofferdams. If a cofferdam sedimentation basin is used, it shall be located in an upland area where the water can settle and sink into the ground or be released slowly to the resource in a manner that will not cause erosion. The location of such a cofferdam sedimentation basin shall be addressed in the SEWPCP.

o. Inspection and maintenance schedules for all erosion and water pollution control measures - temporary and permanent - including the method, frequency and disposal location for sediment removal.

p. Demolition debris (including debris from wearing surface removal, saw cut slurry, dust, concrete debris, etc.) shall be contained and shall not be allowed to discharge to any resource. All demolition debris shall be disposed of in accordance with Standard Specifications, Section 202.03, Removing Existing Superstructure, Structural Concrete, Railings, Curbs, Sidewalks and Bridges. Containment and disposal of demolition debris shall be addressed in the Contractor's SEWPCP

q. Procedures for removal of temporary erosion and pollution controls.

656.3.4 Water Pollution Control Requirements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include all of the following requirements applicable to water pollution control.

a. The Contractor must comply with the applicable federal, state, and local laws, and regulations relating to prevention and abatement of water pollution.

b. Except as allowed by an approved permit or otherwise authorized by the Department in writing, pollutants and construction debris including excavated material, aggregate, residue from cleaning, sandblasting, or painting, cement mixtures, chemicals, fuels, lubricants, bitumens, raw sewage, wood chips, and other debris shall not be discharged into waterbodies, wetlands, or natural or man-made channels leading thereto and such materials shall not be located alongside waterbodies, wetlands, or such channels such that it will be washed away by high water or runoff.

c. Construction operations in waterbodies or wetlands shall be restricted to the construction limits shown on the plans and to those areas that must be entered for the construction of temporary or permanent structures, except as allowed by approved permit or otherwise authorized by the Department in writing.

d. Mechanized equipment shall not be operated in waterbodies or wetlands, except as allowed by approved permit or otherwise authorized by the Department in writing.

e. Upon completion of the work, waterbodies or wetlands shall be promptly cleared of all falsework, piling, debris or other obstructions caused by the construction operations, except as otherwise authorized by the Department in writing.

f. Spill Prevention If the Work includes the handling, use, or storage of petroleum products or hazardous Matter/Substances including the onsite fueling of Equipment, the SEWPCP must include a Spill Prevention Control and Countermeasure Plan (SPCCP). At a minimum, the SPCCP must include:

1. The name and emergency response numbers (telephone number, cellular phone and pager numbers, if applicable) of the Contractor's representative responsible for spill prevention and response;

2. General description and location of (1) handling, transfer, storage, and containment facilities of such products or hazardous Matter/Substances ("activities and facilities") and (2) potential receptors of such products or hazardous Matter/Substances including oceans, lakes, ponds, rivers, streams, wetlands, and sand and gravel aquifers ("sensitive resources") including the distances between said activities and facilities and said sensitive resources;

3. Description of preventative measures to be used to minimize the possibility of a spill including Equipment and/or Materials to be used to prevent discharges including containment and diversionary structures, inspections and personnel training;

4. A contingency response plan to be implemented if spill should occur including a list of emergency phone/pager numbers including the Contractor's representative, MDEP Spill Response, the National Response Center (if spill enters the water), the Resident, and local police and fire authorities, a list of emergency response equipment and locations and a description of the capabilities of the equipment, a description of the general response and clean up protocols by product or Matter/Substances and an overview of the verbal and written notification procedures for federal, state and local officials. For a related provision, see 105.2.2 - "Project Specific Emergency Planning".

For a related provision, see Section 105.8.3 - "Wetland and Waterbody Impacts".

656.3.5 Material Requirements Unless otherwise approved by the Department, the Contractor must use temporary erosion control Materials contained on the Department's Preapproved List of Erosion Control Materials if such a list is established, the Department's latest BMP Manual, or Section 717 - Roadside Improvement Materials.

656.3.6 Construction Requirements In addition to other requirements provided for or referenced in this specification, the SEWPCP must include all of the following requirements applicable during construction.

a. The Contractor shall install and maintain all temporary erosion control Materials in accordance with the manufacturer's recommendations, or the Department's latest BMP's or Standard Specifications where applicable.

b. The Contractor shall perform in-stream work during low flow conditions, except as allowed by a specific Permit requirement. During in-stream work, the Contractor shall maintain water flow at all times except in ponded water or where specifically authorized. The Contractor, to the maximum extent practicable, shall place pipes in dry conditions.

c. The Contractor, to the maximum extent practicable, shall install temporary and permanent erosion control measures prior to conducting clearing and grubbing operations. Clearing shall be minimized as shown on the design plans (if provided). The Contractor shall not conduct clearing operations within any protected vegetative buffer area indicated in the plans, notes, or special provisions. The Contractor shall limit excavation, borrow and embankment operations commensurate with its capability and progress in keeping the finish grading, mulching, seeding, and other such temporary and permanent erosion control measures current in accordance with its schedule. Should seasonal limitations make such coordination impractical, temporary erosion control measures shall be provided immediately.

d. The Contractor shall not work in a wetland, except as allowed by a specific permit provision. All equipment which must work in a wetland shall travel and work on platforms or mats that protect vegetation which the Department has designated to remain. The Contractor shall not store or stockpile materials in a wetland. The Contractor shall contain and immediately remove from the wetland or waterbody any debris generated by the Work.

e. The Contractor shall not place uncured concrete directly into a waterbody. The Contractor shall not wash tools, forms, or other items in or adjacent to a waterbody or wetland. Prior to release to a natural resource, any impounded water that has been in contact with concrete placed during construction must have a pH between 6.0 and 8.5, must be within one pH unit of the background pH level of the resource and shall have a turbidity no greater than the receiving resource. This requirement is applicable to concrete that is placed or spilled (including leakage from forms) as well as indirect contact via tools or equipment. Water not meeting release criteria shall be addressed in the SEWPCP. Discharging impounded water to the stream must take place in a manner that does not disturb the stream bottom or cause erosion. The Contractor shall be responsible for monitoring pH with a calibrated meter accurate to 0.1 units. A record of pH measurements shall be kept in the Environmental Coordinator's log.

f. The Contractor shall contain all demolition debris (including debris from wearing surface removal, saw cut slurry, dust, etc.) and shall not allow it to discharge to any resource. All demolition debris shall be disposed of in accordance with Section 202.03 - Removing Existing Superstructure, Structural Concrete, Railings, Curbs, Sidewalks and Bridges. The

Contractor shall dispose of debris in accordance with the Maine Solid Waste Law, Title 38 M.R.S.A., Section 1301 et. seq. Containment and disposal of demolition debris shall be addressed in the Contractor's SEWPCP.

g. The Contractor shall air dry all treated lumber for at least 21 days before use. All treated timber surfaces shall be exposed during air-drying.

h. The Contractor shall place all permanent seeding in accordance with Section 618 - Seeding unless the Contract states otherwise. The Contractor shall state what additional measures they will employ for soil stabilization between November 1st and April 1st.

i. The Contractor shall not remove rocks from below the normal high water line of any wetland, great pond, river, stream, or brook, except to the extent necessary for completion of the Work and as allowed by environmental permits. The Contractor shall not work below the high water line of a great pond, river, stream, or brook during periods of elevated water, except as necessary to protect work in progress or for emergency flood control and as allowed by environmental permits.

j. During periods of approved suspension, the Contractor shall inspect and maintain temporary and permanent erosion controls in accordance with its approved SEWPCP.

k. All sites of disturbed soil outside the right-of-way such as haul roads, staging areas, Equipment storage sites, mixing plants, and waste disposal sites including expansion of existing sites shall be graded smooth, loamed, seeded, and mulched upon completion of the work. For a related provision, see Section 105.8.6 - Pit Requirements.

IMPLEMENTATION OF SEWPCP

656.4.3 Follow Plan Until Acceptance of the Work, the Contractor must continuously provide soil erosion and water pollution controls in compliance with its approved SEWPCP as amended, if necessary, and in compliance with Section 656.4.5 - Additional Measures/Amendment of SEWPCP.

656.4.4 Inspection and Record Keeping The Environmental Coordinator must inspect and monitor all controls for the duration of the project and keep a written log. This log must include daily on-site precipitation and air temperature, as well as the performance, failure, and any corrective action for all controls in place. The log must be updated at least weekly and after all significant storm runoff and flood events. The Environmental Coordinator must make this log available to the Department upon request. The Contractor will retain the log for three years after the completion of the project.

656.4.5 Additional Measures/Amendment of SEWPCP If there exists observable evidence of erosion or sedimentation despite the installation of all controls in compliance with the Contractor's approved SEWPCP, then the Contractor must undertake such additional measures as are necessary to stop such erosion and prevent further erosion or sedimentation. Observable

evidence of erosion or sedimentation includes visible sheet, rill, or gully erosion, discoloration of water by suspended particles, areas of sediment accumulation, slumping of banks, deposition of soil, and visible dust. Such additional measures must be undertaken within 24 hours and completed within 48 hours from the time such evidence is observed, unless otherwise authorized by the Department. Within 7 days of that time, the Contractor must submit an amendment to its SEWPCP setting forth the apparent cause of the erosion or sedimentation and the additional measures undertaken and that will continue to be undertaken. If the Contractor complies with the requirements of this Section, all additional measures and the amendment of the SEWPCP will be Extra Work and any Delay resulting from the additional measures will be analyzed in accordance with Section 109.5 - Adjustments for Delay.

656.4.6 Duration of Contractor's Responsibility The Contractor shall provide temporary soil erosion and water pollution controls in compliance with its SEWPCP and maintain all permanent control features until Acceptance of the Work. Once final surface treatments are established, the Contractor is responsible for removal of all temporary sedimentation control practices such as silt fence. Notwithstanding the preceding sentence, all work needed to remedy damage to properly installed and maintained permanent control features caused by a weather-related Uncontrollable Event shall be Extra Work.

PAYMENT

656.5.1 If Pay Item 656.75 Provided If the Schedule of Items contains Pay Item 656.75 for Temporary Soil Erosion and Water Pollution Control, payment will be made on a Lump Sum basis, payment of which will constitute full and complete compensation for all labor, equipment, materials, inspection, professional services, and incidentals necessary to prepare, submit, obtain approval of, and properly implement the Contractor's SEWPCP. The Lump Sum will be payable in installments as follows: 10% of the Lump Sum once the final SEWPCP is approved and the initial soil erosion and water pollution controls are in place and certified by the Contractor, with the 90% balance to be paid as the Work progresses at a rate proportional to the percentage completion of the Contract.

Failure by the Contractor to follow Standard Specification or Special Provision - Section 656 and/or the Contractor's own Soil Erosion and Water Pollution Control Plan (SEWPCP) will result in a violation letter and a reduction in payment as shown in the schedule below. The Department's Resident or any other representative of The Department reserves the right to suspend the work at any time and request a meeting to discuss violations and remedies. The Department shall not be held responsible for any delay in the work due to any suspension under this item.

ORIGINAL CONTRACT AMOUNT

From More Than	Up to and Including	Amount of Penalty Damages per Violation 1st	2nd	3rd & Subsequent
$0	$1,000,000	$250	$500	$1,250
$1,000,000	$2,000,000	$500	$1,000	$2,500
$2,000,000	$4,000,000	$1,000	$2,000	$5,000
$4,000,000	and more	$2,000	$4,000	$10,000

Cofferdams and related temporary soil erosion and water pollution controls are incidental to the Pay Item 656.75, unless a specific pay item for cofferdams is included in the Schedule of Items. If a specific pay item for cofferdams is included, then related temporary soil erosion and water pollution controls, including inspection and maintenance, are incidental to the pay item for cofferdams.

656.5.2 If No Pay Item If Pay Item 656.75 is not provided in the Schedule of Items, then the cost related thereto shall be Incidental to the Contract.

Payment will be made under:

Pay Item		Pay Unit
656.75	Temporary Soil Erosion and Water Pollution Control	Lump Sum

SECTION 657 - REHABILITATION OF PITS

Reserved

SECTION 658 - ACRYLIC LATEX COLOR FINISH

658.01 Description This work shall consist of applying a color finish to asphaltic or Portland cement concrete surfaces designated on the plans for median strips, islands, and certain crosswalks, color-coated with an acrylic latex finish system.

658.02 Materials The color finish shall be a green acrylic latex emulsion type, containing only inert mineral pigment colorants, fade-resistant for exterior use. The color coating shall contain insoluble mineral fillers suitable for uniform application, tack free, and shall show no deterioration due to temperature, salts, moisture, and ultraviolet rays of sun for a period of at least one year.

Only materials on the Qualified Products List for acrylic latex color finish shall be used.

658.03 Surface Preparation The bituminous or Portland cement concrete shall be carefully laid, free of depressions and ridges and at the pitch or grade shown on the plans to provide flow of water from the surface. The pavement shall be free of all loose dirt, dust particles, grease, oil,

or any other contaminant. Grease and oils shall be removed by a detergent wash, flushed with water, and followed by high-pressure water, air broom, or hand sweep.

The surface course of bituminous concrete pavement shall be a tight mix of thoroughly compacted material. The pavement shall be placed a minimum of 7 days before the application of the coating.

The surface of Portland cement concrete pavement shall be a medium broom finish. New concrete must cure a minimum of 30 days before application of coating. The concrete surface shall be first washed with phosphoric acid solution [8 parts water to 1 part acid], then coated with a tie-coat before the green finish coat can be applied.

The surface shall be accepted by the Resident and the coating subcontractor before the application of the color coating.

The Contractor shall add sand to the acrylic latex in the crosswalk area as directed by the Resident.

658.04 Application of Color Coating The coating shall be applied according to the Manufacturer's recommendations, which can be found in the technical bulletin of the product.

The paint shall be stored in an area where freezing or overheating will not occur.

The acrylic coatings are waterborne and cannot cure in cold temperatures or when subject to moisture. Care shall be taken not to apply coatings when rain is forecast or sudden drop in temperature is expected.

Two coats shall be applied over the area in a thickness sufficient to give uniform texture, appearance, and color, per Manufacturer's recommendation. The second coat shall not be applied until the first coat is completely dried to touch and the Manufacturer's minimum time is requirement for top coating has elapsed.

No color coating shall be allowed to run, drop, or otherwise color adjacent areas.

If the Contractor elects to apply the coating after the above date, the Contractor is responsible for the performance of the coating. In this case, the payment will be withheld until the following spring.

658.05 Method of Measurement Acrylic Latex Color Finish will be measured by the square yard of surface sealed, measured parallel to the surface. Furnishing and adding sand at designated locations will be incidental.

658.06 Basis of Payment The accepted quantity of Acrylic Latex Color Finish will be paid for at the contract unit price per square yard complete in place, including furnishing, and adding sand, where required.

Payment will be made under:

Pay Item		Pay Unit
658.20	Acrylic Latex Color Finish	Square Yard

SECTION 659 - MOBILIZATION

659.01 Description When this item is listed as a Pay Item in the Bid, it shall consist of preparatory work and operations including, but not limited to those necessary to the movement of personnel, equipment, supplies and incidentals to the project site; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site.

659.02 Basis of Payment Partial payments will be made in accordance with Section 108.2.3 Mobilization

The total sum of payments under this item shall not exceed the original Contract amount bid regardless of the fact that the Contractor may shut down their work on the Project or move equipment away from the Project and then back again.

Payment will be made under:

Pay Item		Pay Unit
659.10	Mobilization	Lump Sum

SECTION 660 ON-THE-JOB TRAINING

660.01 Description On-The-Job Training programs (OJT) are required as part of the Contractor's equal employment opportunity affirmative action program. The primary objective of on the job training shall be to train and upgrade women, minorities, and disadvantaged workers toward journey worker status in the type of trade or job classification involved.

660.02 Requirements Contractors shall begin training in accordance with OJT Special Provision 660 as follows for all projects with assigned trainee slots.

Total number of trainee slots required will be the amount listed in the Schedule of Items. All On-The-Job Training will be performed in accordance with 23 CFR 230, Subpart A, Appendix B and MaineDOT On-The-Job Training Program Manual. Training classifications shall be distributed among work classifications needed by the Contractor in the skilled and semi-skilled craft levels identified on the Letter of Intent. These classifications must be needed on

that specific project and have sufficient work hours available to meet the training plan activities and duration.

The Contractor shall receive credit for training hours only after, the Department, or its representative, has approved the program. For this reason, contractors are reminded to register candidates at the onset of project work in order to guarantee the maximum training time for the enrollee to complete the OJT program. Contractors will be reimbursed for such approved trainee slots upon successful completion of the training.

The Contractor shall make every effort to enroll minority and women trainees (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield women, minorities, and disadvantaged trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor shall be responsible for demonstrating to the Department the steps taken in pursuance thereof, before determination as to whether the Contractor is in compliance with this program. These semi-skilled and skilled craft employment goals set by this office of Federal Contractor Compliance Programs are as follows: 6.9 percent women and 0.05 percent minorities, and 10 percent for women, and 0.05 percent for minorities in un-skilled classes respectively statewide. For this reason, whether a Contractor meets these goals or not, the Department will require all contractors to participate in the program until such time that the goals are met as a whole. If any Contractor falls below these standards, it shall immediately implement an Affirmative Action Program to increase the employment and retention of women, minorities and the disadvantaged.

Trainees shall not be enrolled in a classification in which they have successfully completed a training course leading to journey-level status, or for which they have held employment as a journey level worker. No Contractor shall enroll trainees who possess post-secondary degrees, certification, or diploma without first securing written approval from the Civil Rights Office. Only individuals with non-construction oriented credentials, except those who are upgraded will be considered. Upgrades from semi-skilled to skilled crafts is acceptable but must be approved by the Department or its representative.

The minimum length and type of training for each classification will be as established in the training program selected by the Contractor and approved by the Department. Nothing in this section limits a Contractor to only the curriculum found in the OJT Manual. The Department will consider a training curriculum if it meets the equal employment opportunity obligations that bring women, minorities, and the disadvantaged in to the industry and to retain them in the industry at the journey level of the classification of the training. Contractors are encouraged to examine training opportunities, which fit their needs for the project and for the company.

The Contractor shall complete and forward to the Department's OJT or its representative, the Letter of Intent, the OJT Registration Form, and the Workforce Breakdown Form for approval by the Department. The Contractor shall maintain records of trainee activities and performance and furnish the department or its representative with documentation of each trainee's progress using the Weekly Evaluation Form. Requests for changes in the number of trainee's shall be handled as other bid items. The Contractor must submit a change order with

justification to the resident. The Resident will then forward that request to the Civil Rights Office for consideration.

Once an OJT is approved by the Department, The Contractor shall begin training at the onset of employment for the trade classification. Trainees are expected to remain in status as long as training opportunities exist in the work classification, or until the training program is completed.

Section 660 shall be included directly in all contracts to subcontractors. Subcontractors are expected to comply with craft goals. As with other Sections applied to a Subcontractor, the Contractor retains obligations accordingly.

660.03 Payment to the Trainee. Trainees will be paid at least 60 percent of the appropriate minimum journeyman's rate specified in the contract for the first half of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees in an approved existing program are enrolled as trainees on this project. In that case, the appropriate rates approved by the Departments of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provision.

The contractor shall furnish the trainee a copy of the program manual he will follow in providing the training. Once the Department has determined that the trainee has completed the required hours of training a certificate showing the type and length of training satisfactorily completed will be issued.

660.04 Submittals The Contractor shall complete and forward to the Department's OJT and Contract Compliance Consultant, the Letter of Intent, the OJT Registration Form, and the Workforce Breakdown Form. The Contractor shall maintain records of trainee activities and performance and furnish the department or its representative with documentation of each trainee's progress using the Weekly Evaluation Form. Requests for changes in the number of trainee's shall be handled as other bid items. The Contractor must submit a change order with justification to the resident. The Resident will then forward that request to the Civil Rights Office for consideration.

660.05 Off-Site Training Some offsite training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training. The Contractor must forward a completed Off-Site OJT Request/Approval Form with a cover letter explaining the intent of the transfer to the Civil Rights Office.

Provided the Contractor has Department approval, training may be conducted off –site. Verification of training hours shall be determined for credit on off-site work by reviewing the Weekly OJT Evaluation Form.

660.06 Method of Measurement The OJT item will be measured by the number of OJT trainees who successfully complete an approved training program. A trainee will be considered

successfully complete for purposes of payment when the trainee receives a certificate of completion from the Department.

660.07 Basis of Payment to the Contractor. The OJT shall be paid for once successfully completed at the contract unit price per each. Payment will be made even though the Contractor may have received additional training program funds from other sources, provided such other source does not prohibit the Contractor from receiving other payment. No payment will be made for training not completed in accordance with this specification, the OJT Manual, and the Code of Federal Regulations. No payment will be made to the Contractor if the Department determines the Contractor failed to provide the required training. The Department shall work with any Contractor whose efforts have been deemed not consistent with the spirit or intent of the Program.

660.08 Sanctions. When the Department determines the Contractor has not complied with this Section, the Department shall move within 10 days of the ruling to advise the Contractor, in writing, that documentation of good faith effort will be required. If the Department determines that good faith effort was not met, sanctions will be imposed as follows: the number of training hours remaining to be completed for each training hour required will be multiplied by the prevailing wage rate plus fringes for that particular trainee's classification. The resulting figure may be deducted from any monies due the contractor, as determined by the Department. A corrective action plan may be developed in order to avoid similar future findings.

Payment will be made under:

Pay Item	Pay Unit
660.22 On-The-Job Training	Each

SECTION 670 – GABION WALL
Reserved

SECTION 671 – DRY CAST SEGMENTAL BLOCK WALL
Reserved

SECTION 672 - PRECAST CONCRETE BLOCK GRAVITY WALL

672.01 Description The work under this item shall consist of design, fabrication, furnishing and construction of a Precast Concrete Block Gravity Wall in accordance with these specifications and in close conformance with the lines and grades shown on the Plans, or established by the Resident. The Precast Concrete Block Gravity Wall shall consist of facing blocks made of wet cast concrete made from Portland cement, water, chemical admixtures, and aggregates, supported on concrete leveling pads, and if required, geosynthetic-reinforced backfill.

Included in the scope of the precast gravity wall construction are**:** geotechnical design of any wall with a exposed height greater than 4.5 feet or as specified on the Plans, all grading necessary for wall construction, compaction of the wall foundation soil, backfill, piped drainage, construction of leveling pads, and block wall installation. The top of the upper row of blocks shall be at or above the top of the face elevation shown on the Plans.

672.02 Quality Assurance The wall system shall be one of the approved combinations of facing block and soil reinforcement systems noted in the Plans or on the Department's Qualified Products List (QPL). Alternate wall systems will not be considered for this Item.

All design calculations and Shop Drawings shall be signed and sealed by a Professional Engineer licensed in the State of Maine.

The Contractor shall require the wall design-supplier to provide an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Resident.

672.03 Materials Materials for walls shall meet the requirements of the following sections of Division 700:

Gravel Borrow	703.20
Crushed Stone, ¾ -Inch	703.13
Underdrain Pipe	706.06 or 706.09
Reinforcing Steel	709.01
Reinforcement Geotextile	722.01
Drainage Geotextile	722.02

The Contractor is cautioned that all of the materials listed are not required for every Precast Concrete Block Gravity Wall. The Contractor shall furnish the Resident a Materials Certification Letter certifying that the applicable materials comply with this section of the specifications. Materials shall meet the following additional requirements:

672.031 Concrete Units The Materials Certification Letter described above shall contain the date of concrete casting, a lot identification number, compressive strength results, and entrained air results. All prefabricated concrete units shall conform to the requirements of 712.061 with the following exceptions:

A. Materials Materials are modified as follows: the maximum water cement ratio shall be 0.42, use of calcium nitrite is not required, and the minimum 28 day compressive strength shall be 4600 psi.

B. Quality Control and Quality Assurance. Quality Control and Quality Assurance is modified as follows: delete the paragraph that begins with " The contractor shall provide a private office…"

C. Construction. Construction requirements are modified as follows:

Replace the first sentence in the paragraph which begins "Forms shall remain …" with the following:
The forms shall remain in place until the concrete has gained sufficient strength such that removal of the forms and subsequent handling will not damage the units.

Add the following paragraph at the end of the Construction section:
Face texture of the units shall be a formed finish on all exposed surfaces. Pigment shall be added during the casting process of the concrete unit to achieve a consistent shade of gray or other color as determined by the Resident.

D. Concrete Testing. Concrete testing requirements are modified as follows:
Replace the paragraph which begins "The Contractor shall cast a minimum of 8 …." With the following:
The Contractor shall make and test at least one set of cylinders for every 50 CY of production concrete used to cast the concrete units.

Replace the paragraph which begins "At least once …" with the following:
The Contractor shall make four cylinders for use by the Department to represent every 200 CY or fraction thereof.

E. Tolerances. Maximum dimensional deviation of formed unit dimensions shall be ½ -inch or 2 percent or the manufacturer's published tolerances, whichever is less. Units not meeting the specified tolerances will be rejected.

672.032 Geosynthetic Reinforcement Geosynthetic reinforcement shall be as required by the proprietary wall system manufacturer or wall designer. Geosynthetic reinforcement shall consist of a geotextile or geogrid approved by the Geotechnical Engineer. Substitution of a geosynthetic other than that required by the proprietary wall system manufacturer shall not be allowed unless approved by the Geotechnical Engineer after submittal of shop drawings and pullout and interface friction test data.

A. Geotextiles and Thread for Sewing. Woven or nonwoven geotextiles shall consist of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during handling, placement, and design life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. Geotextiles used for reinforcement shall conform as a minimum to the properties indicated for 722.01, Stabilization/Reinforcement Geotextile and shall meet the requirements of part D and E

below. Geotextiles shall have a minimum permeability greater or equal to that shown on the Shop Drawings and the reinforced soil permeability.

B. Geogrids. The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall conform as a minimum to the criteria specified in part D and E below.

C. Required Properties. The specific geosynthetic materials shall be preapproved and shall the have the ultimate tensile strength (T_{ult}) shown on the approved Shop Drawings for the geosynthetic specified and for the fill type shown. T_{ult} shall be determined from wide width tests specified in ASTM D 4595 for geotextiles and ASTM D 6637 or GRI:GG1 for geogrids. The ultimate tensile strength value is based on the minimum average roll values (MARV) for the product.

D. The geosynthetic shall conform to the following criteria:
   1. PP and HDPE: Min. retained strength of 70 percent after 150 hours, per ASTM D-4355.
   2. HDPE: Grade = E-4, E-5, E-8, E-9, E-10, E-11, J-3, J-4, or J-5, per ASTM D-1248.
   3. PET: Molecular weight (Mn) > 25,000, per GRI:GG8 and ASTM D-4603.
   4. PET: Carboxyl end group (CEG) <30 mmol/kg, GRI:GG7.
   5. All polymers: Minimum Weight per Unit Area of 8 oz/yd^2, per ASTM D-5261.
   6. All Polymers: Maximum 0 percent post consumer recycled material by weight.
   7. A default total reduction factor for creep, durability, and installation damage of RF = 7 may be used in design, provided the criteria of 2 through 6 are satisfied and 1 is adjusted to 70 percent after 500 hours is satisfied.

E. Manufacturer Quality Control. The geosynthetic reinforcements shall be manufactured with a high degree of quality control. The Manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the specification. The purpose of the QC testing program is to verify that the reinforcement geosynthetic being supplied to the project is representative of the material used for performance testing and approval. Conformance testing shall be performed as part of the manufacturing process and may vary for each type of product. As a minimum the following index tests shall be considered as applicable for an acceptable QA/QC program:

	Property	Test Procedure
1.	Specific Gravity (HDPE only)	ASTM D-1505
2.	Ultimate Tensile Strength	ASTM D-4595 GRI:GG1
3.	Melt Flow (HDPE and PP only)	ASTM D-1238
4.	Intrinsic Viscosity (PET only)	ASTM D-4603

5. Carboxyl End Group (PET only) ASTM D-2455

F. Sampling Testing and Acceptance. Sampling and conformance testing shall be in accordance with ASTM D-4354. Conformance testing procedures are established above. Geosynthetic product acceptance shall be based on ASTM D-4759. The quality control certificate shall include:

1. Roll numbers and identification
2. Sampling procedures
3. Results of quality control tests, including a description of test methods used.

G. Certification. The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved, measured in full accordance with all test methods and standards specified, or referenced, in this specification.

The manufacturer's certificate shall state that the furnished geosynthetic meets the requirements of these specifications as evaluated by the manufacturer's quality control program. The values submitted shall be certified by a person having legal authority to bond the manufacturer. In case of dispute over validity of values, the Resident can require the Contractor to supply test data from an agency approved laboratory to support the values submitted, at the Contractor's cost.

672.033 Geosynthetic Connection Reinforcing bar used in the geosynthetic connection shall be a minimum ½-inch diameter corrosion resistant reinforcing bar, coated on the ends and meeting the requirements of Section 503, Reinforcing Steel. Installation shall be in accordance with manufacturer's recommendations.

672.034 Concrete Leveling Pad Concrete for leveling pads shall be Fill Concrete conforming to the requirements of Section 502 Structural Concrete. Unless otherwise specified, concrete for leveling pads shall be accepted under Method "C" requirements.

672.035 Backfill Material Backfill material placed behind the concrete units shall meet the requirements of Section 703.20 Gravel Borrow, except that the backfill material shall only contain particles that will pass the 3-inch square mesh sieve. The contractor is required to submit a grain size distribution curve (ASTM D 422) and a moisture-density relationship curve (AASHTO T-180) for acceptance of the proposed backfill material and determination of the appropriate installation damage reduction factor (RF_{ID}).

Walls with reinforced backfill require that the backfill material be subjected to pH testing to determine the appropriate durability reduction factor (RF_D).

Material between blocks must be Gravel Borrow, or Crushed Stone, ¾ -Inch.

672.036 Materials Certification Letter The Contractor, or the supplier as his agent, shall furnish the Resident a Materials Certification Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications. A copy of all test results performed by the Contractor or his supplier necessary to assure contract compliance shall also be furnished to the Resident. The Resident will base acceptance upon the materials Certificate Letter, accompanying test reports, and visual inspection.

672.04 Design Requirements The wall shall be designed with a service life of not less than 75 years. The Precast Concrete Block Gravity Wall shall be designed and sealed by a Professional Engineer licensed in the State of Maine. The wall shall be designed in accordance with the following:

1. AASHTO LRFD Bridge Design Specifications, current edition, herein referred to as LRFD
2. FHWA-NHI-10-024 and FHWA-NHI-10-025, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volumes I and II, 2009
3. FHWA-NHI-09-087 Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, 2009
4. The Contract Plans
5. The requirements specified herein
6. The manufacturer's requirements

Where conflicting requirements occur, the more stringent requirements shall govern.

Forty-five days prior to beginning construction of the wall, the design computations shall be submitted to the Resident for review by the Geotechnical Engineer. Any additional design or costs arising as a result of rejection of a wall design by the Geotechnical Engineer shall be borne by the Contractor.

Design calculations that consist of computer program generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties. The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

A. Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined in accordance with LRFD Article 11 and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass to stabilize the material.

B. External Loads External loads which affect the internal and external stability such as those applied through traffic loadings, impact on traffic barrier posts, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design. Traffic surcharge and traffic impact loads shall be calculated and applied in compliance with LRFD Section 11.

C. External Stability Loads and load combinations selected for design shall be consistent with LRFD. Application of load factors shall be taken as specified in LRFD Section 11. Sliding resistance factors and bearing resistance factors shall be consistent with LRFD. Overturning and sliding provisions of LRFD shall apply.

D. Internal Stability Evaluation of reinforcement pullout, reinforcement rupture and reinforcement/block connection pullout or rupture shall be consistent with LRFD Section 11, and checked at each level. Loads, load combinations and load factors shall be as specified in LRFD Section 11. Resistance factors for internal design are specified in LRFD Section 11. Maximum reinforcement loads shall be calculated using the Simplified Method approach. Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life.

a. Geosynthetic Reinforcement Design Tensile Resistance The nominal long term reinforcement design strength (T_{al}) shall be determined by reducing T_{ult} by reduction factors (RF) in accordance with the documents referenced above. The designer shall procure and use the manufacturers tested and certified geosynthetic reinforcement reduction factors for creep (RF_{CR}), durability (RF_D), and installation damage (RF_{ID}) to determine T_{al}. In absence of manufacturers tested and certified reduction factors, a combined default reduction factor RF = 7 shall be used in accordance with the referenced documents. For RF_{ID}, the installation damage reduction factor shall be checked in accordance with LRFD and FHWA-NHI-09-087 .

b. Reinforcement/Facing Connection Design Strength The nominal long-term connection strength between the geosynthetic reinforcement and the concrete blocks shall be checked in accordance with LRFD and FHWA-NHI-10-024 and FHWA-NHI-10-025.

c. Reinforcement Pullout The pullout resistance factor, (F*), and scale effect correction factor (α) used in pullout design, shall be determined from project specific pullout tests using the proposed geosynthetic in the specified project backfill material or equivalent soil. The pullout resistance factors shall be determined in accordance with LRFD and FHWA-NHI-10-024 and FHWA-NHI-10-025. In the absence of test data, empirical relationships may be used to determine the pullout resistance factors, any empirical relationships used in design shall be referenced in the design calculations.

E. Backfill and Foundation Soils Parameters The friction angle of the backfill used in the reinforced fill zone for internal stability design shall be assumed have a friction angle of 34 degrees unless specific project select backfill is tested for frictional strength. The friction angle of the foundation soils and random backfill shall be assumed to be 30 degrees unless otherwise shown on the plans.

F. Reinforcement Length The soil reinforcement shall be the same length from the bottom to the top of each wall section. The minimum length of the soil reinforcement shall be 8 ft, but shall not be less than 70 percent of the wall height, H, for walls with level surcharges, or 70 percent of H1 for walls with a sloped surcharge or walls supporting an abutment. The mechanical wall height, H or H1, shall be the vertical difference between the top of the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

G. Bearing Resistance The factored bearing pressures under the Precast Concrete Block Gravity Wall shall be clearly indicated on the Shop Drawings. Walls shall be dimensioned so that the factored bearing resistance of the foundation soils, as noted on the Plans, is not exceeded.

H. Facing Stability Stability calculations for the concrete facing blocks shall be in accordance with LRFD, and shall include an evaluation of the maximum vertical spacing between reinforcement layers.

I. Stability During Construction Walls shall be designed to resist failure by instability of temporary construction slope. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes.

J. Design Life The wall design life shall be a minimum of 75 years.

K. Depth of Embedment The depth of embedment for frost protection and stability shall be at or below the elevation shown on the Plans and the approved Shop Drawings.

L. Drainage System Piped drainage shall be designed to collect and dispose of water from the base of the reinforced soil zone and backfill soil. This shall outlet into surrounding drainage systems or ditches.

672.05 Submittals The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall. A sample hand calculation including all equations, parameter values used, units, theory, free-body diagram, comparison to design requirements, etc. shall be provided. Spread sheet calculations alone are not acceptable.

Forty-five days prior to beginning construction of the wall, four (4) sets of the wall design computations and Shop Drawings shall be submitted to the Resident for review by the Geotechnical Engineer. Mix design information shall be submitted at the same time, including aggregate source, current gradation, aggregate quality information and concrete unit weight.

The contractor shall also submit backfill material test results as part of the wall submittal package. Backfill material test results shall include grain size distribution curve, moisture-density relationship curve, and pH test results required for reinforced backfill only.

If geotechnical design is required, the fully detailed plans shall be prepared in conformance with Section 105 and shall include, but not be limited to the following items:

A. A plan and elevation sheet or sheets for each wall, containing the following: elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the location of the original and final ground line.

B. All details for foundations and leveling pads, including details for steps in the leveling pads, as well as allowable and actual maximum bearing pressures shall be provided.

C. Details for the barriers, posts, curbs and facing as required by the project conditions.

D. Design computations prepared and sealed by a licensed Professional Engineer.

E. Prior to the beginning of construction, the contractor shall supply the Resident with two copies of the design-supplier's Installation Manual. In addition, the Contractor shall have two copies of the Installation Manual on the project site.

672.06 Construction Requirements The Precast Concrete Block Gravity Wall shall have the following construction requirements:

A. Excavation. The excavation and use as fill or disposal of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein.

B. Foundation. The area upon which the prefabricated block gravity wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the blocks. Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density (AASHTO T-180 Method C or D). Frozen and unsuitable soil shall be removed and replaced with gravel borrow compacted to 95 percent of AASHTO T-180.

   A concrete leveling pad shall be constructed as indicated on the plans. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Geotechnical Engineer. The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Geotechnical Engineer. The allowable elevation tolerances from the design elevations are +0.01 feet and -0.02 feet. Leveling pads which do not meet this requirement shall be repaired or replaced as directed by the Resident at no additional cost to the Department. Placement of wall units may begin after the strength of the concrete leveling pad reaches 1000 psi or is adequate to support the proposed loads. Contractor may begin placement of concrete block units after 12 hours at his own risk.

C. Method and Equipment. Prior to erection of the prefabricated concrete block wall, the Contractor shall furnish the Resident with detailed information concerning the proposed construction method and equipment to be used. The erection procedure shall be in accordance with the manufacturer's instructions. Any units that are damaged due to handling will be replaced at the Contractor's expense.

D. Installation of Wall Units. A field representative from the wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project. Horizontal joint fillers shall be installed as needed.

The maximum offset in any unit horizontal joint shall be 1/4 inch. The prefabricated wall blocks shall be installed to a tolerance of plus or minus 3/4 inch in 10 feet in vertical alignment and horizontal alignment.

E. Backfill Placement. Backfill placement shall closely follow the erection of each row of prefabricated wall units. The Contractor shall decrease the lift thickness if necessary to obtain the specified density. The maximum lift thickness shall be 8 inches loose. Gravel borrow backfill shall be compacted in accordance with Section 203.12 except that the minimum required compaction shall be at least 92 percent of maximum density as determined by AASHTO T-180 Method C or D. Backfill compaction shall be accomplished without disturbance or displacement of the wall blocks. Sheepsfoot rollers will not be allowed. Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved.

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T-180, Method C or D. At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rain water away from the wall face.

Material between blocks must be Gravel Borrow or Crushed Stone, ¾ -Inch, meeting the requirements of Section 703.13. If Gravel Borrow is used between blocks, 722.02 drainage geotextile shall be placed behind vertical joints to prevent loss of granular material between blocks. Compliance with the gradation requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction. If crushed stone, 3/4-inch is used between blocks, no geotextile is required behind vertical joints.

672.07 Method of Measurement Precast Concrete Block Gravity Wall will be measured by the square foot of front surface not to exceed the dimensions shown on the Contract Plans unless authorized by the Resident. Vertical and horizontal dimensions will be from the edges of the

blocks. No field measurements for computations will be made unless the Resident specifies, in writing, a change in the limits indicated on the Plans.

672.08 Basis of Payment The accepted quantity of Precast Concrete Block Gravity Wall will be paid for at the contract unit price per square foot complete in place. Payment shall be full compensation for furnishing geotechnical design as required, all labor, equipment and materials including all precast concrete units, hardware, joint fillers, geosynthetics, reinforcing steel, drainage pipe, backfill materials and technical field representative. Excavation, foundation material and backfill material will all be incidental to the Precast Concrete Block Gravity Wall.

Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Precast Concrete Block Gravity Wall.

There will be no allowance for excavating and backfilling for the Precast Concrete Block Gravity Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation. Payment for excavating unsuitable subsoil shall be full compensation for all costs of pumping, drainage, sheeting, bracing and incidentals for proper execution of the work, and will be paid as Common Excavation in accordance with Section 203.

Payment will be made under:

Pay Item	Pay Unit
672.10 Precast Concrete Block Gravity Wall	Square Foot

SECTION 673 - WET CAST SMALL LANDSCAPE BLOCK WALL

673.01 Description The work under this item shall consist of the design, fabrication, furnishing and construction of a Wet Cast Small Landscape Block Wall in accordance with these specifications and in conformance with the lines and grades shown on the Plans, or established by the Resident. The Wet Cast Small Landscape Block Wall shall consist of blocks made of Structural Precast concrete made from Portland cement, water, chemical admixtures, and aggregates, supported on concrete leveling pads, and if required, geosynthetic reinforced backfill. The concrete blocks used in this system should have dimensions 18 inches or less wide and 6.5 inches high at the face, with a pattern to simulate small stones or cobbles.

Included in the scope of the wall construction are**;** geotechnical design of any wall with an exposed height greater than 2.5 ft or as specified on the Plans, all grading necessary for wall construction, compaction of the wall foundation soil, backfill, piped drainage, construction of

leveling pads, and concrete wall unit installation. The top of the upper row of concrete wall units shall be at or above the top of the face elevation shown on the Plans.

673.02 Quality Assurance The wall system shall be one of the approved combinations of facing block and soil reinforcement systems noted in the Plans or on the Department's Qualified Products List (QPL). Alternate wall systems will not be considered for this item.

All design calculations and Shop Drawings shall be signed and sealed by a Professional Engineer licensed in the State of Maine.

The Contractor shall require the wall design-supplier to provide an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Resident.

673.03 Materials Materials for walls shall meet the requirements of the following sections of Division 700:

Gravel Borrow	703.20
Crushed Stone, ¾ -Inch	703.13
Underdrain Pipe	706.06 or 706.09
Reinforcing Steel	709.01
Structural Precast Concrete Units	712.061
Reinforcement Geotextile	722.01
Drainage Geosynthetic	722.02

The Contractor is cautioned that all of the materials listed are not required for every Wet Cast Small Landscape Block Wall. The Contractor shall furnish the Resident a Materials Certification Letter certifying that the applicable materials comply with this section of the specifications. Materials shall meet the following additional requirements:

673.031 Concrete Units The Materials Certification Letter described above shall contain the date of concrete casting, a lot identification number, compressive strength results, and entrained air results. All prefabricated concrete units shall conform to the requirements of 712.061 with the following exceptions:

A. Materials Materials are modified as follows: the maximum water cement ratio shall be 0.42, use of calcium nitrite is not required, and the minimum 28 day compressive strength shall be 4600 psi.

B. Quality Control and Quality Assurance Quality Control and Quality Assurance is modified as follows: delete the paragraph which begins with "The contractor shall provide a private office…"

C. Construction Construction requirements are modified as follows:

Replace the first sentence in the paragraph which begins "Forms shall remain …" with the following:
The forms shall remain in place until the concrete has gained sufficient strength such that removal of the forms and subsequent handling will not damage the units.

D. Concrete Testing Concrete testing requirements are modified as follows:

Replace the paragraph which begins "A minimum of 8 …." With the following:
The Contractor shall make and test at least one set of cylinders for every 50 yd^3 of production concrete used to cast the concrete units.

Replace the paragraph which begins "At least once …" with the following:
The Contractor shall make four cylinders for use by the Department for every 200 yd^3.

Add the following paragraph at the end of the Construction section:
Face texture of the units shall be a formed finish on all exposed surfaces. Pigment shall be added during the casting process of the concrete unit to achieve a consistent shade of gray or other color as determined by the Resident.

E. Tolerances Maximum dimensional deviation of formed unit dimensions shall not vary more than 1/2-inch or 2 percent or the manufacturer's published tolerances, whichever is less. Units not meeting the specified tolerances will be rejected.

673.032 Geosynthetic Reinforcement Geosynthetic Reinforcement shall be as required by the proprietary wall system manufacturer or wall designer. Geosynthetic reinforcement shall consist of a geotextile or geogrid approved by the Geotechnical Engineer. Substitution of a geosynthetic other than that required by the proprietary wall system manufacturer shall not be allowed unless approved by the Geotechnical Engineer after submittal of shop drawings and pullout and interface friction test data.

A. Geotextiles and Thread for Sewing. Woven or nonwoven geotextiles shall consist of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during handling, placement, and design life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. Geotextiles used for reinforcement shall conform as a minimum to the properties indicated for 722.01, Stabilization/Reinforcement Geotextile and shall meet the requirements of part D and E below. Geotextiles shall have a minimum permeability greater or equal to that shown on the Shop Drawings and the reinforced soil permeability.

B. Geogrids. The geogrid shall be a regular network of integrally formed polymeric tensile elements with aperture geometry sufficient to permit significant mechanical interlock

with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall conform as a minimum to the criteria specified in part D and E below.

C. Required Properties. The specific geosynthetic materials shall be preapproved and shall the have the ultimate tensile strength (T_{ult}) shown on the approved Shop Drawings for the geosynthetic specified and for the fill type shown. T_{ult} shall be determined from wide width tests specified in ASTM D 4595 for geotextiles and ASTM D 6637 or GRI:GG1 for geogrids. The ultimate tensile strength value is based on the minimum average roll values (MARV) for the product.

D. The geosynthetic shall conform to the following criteria:
   1. PP and HDPE: Min. retained strength of 70 percent after 150 hours, per ASTM D-4355.
   2. HDPE: Grade = E-4, E-5, E-8, E-9, E-10, E-11, J-3, J-4, or J-5, per ASTM D-1248.
   3. PET: Molecular weight (Mn) > 25,000, per GRI:GG8 and ASTM D-4603.
   4. PET: Carboxyl end group (CEG) <30 mmol/kg, GRI:GG7.
   5. All polymers: Minimum Weight per Unit Area of 8 oz/yd^2, per ASTM D-5261.
   6. All Polymers: Maximum 0 percent post consumer recycled material by weight.
   7. A default total reduction factor for creep, durability, and installation damage of RF = 7 may be used in design, provided the criteria of 2 through 6 are satisfied and 1 is adjusted to 70 percent after 500 hours is satisfied.

E. Manufacturer Quality Control. The geosynthetic reinforcements shall be manufactured with a high degree of quality control. The Manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the specification. The purpose of the QC testing program is to verify that the reinforcement geosynthetic being supplied to the project is representative of the material used for performance testing and approval. Conformance testing shall be performed as part of the manufacturing process and may vary for each type of product. As a minimum the following index tests shall be considered as applicable for an acceptable QA/QC program:

Property	Test Procedure
1. Specific Gravity (HDPE only)	ASTM D-1505
2. Ultimate Tensile Strength	ASTM D-4595 GRI:GG1
3. Melt Flow (HDPE and PP only)	ASTM D-1238
4. Intrinsic Viscosity (PET only)	ASTM D-4603
5. Carboxyl End Group (PET only)	ASTM D-2455

F.Sampling Testing and Acceptance. Sampling and conformance testing shall be in accordance with ASTM D-4354. Conformance testing procedures are established above. Geosynthetic product acceptance shall be based on ASTM D-4759. The quality control certificate shall include:

1. Roll numbers and identification
2. Sampling procedures
3. Results of quality control tests, including a description of test methods used.

G. Certification. The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved, measured in full accordance with all test methods and standards specified, or referenced, in this specification.

The manufacturer's certificate shall state that the furnished geosynthetic meets the requirements of these specifications as evaluated by the manufacturer's quality control program. The values submitted shall be certified by a person having legal authority to bond the manufacturer. In case of dispute over validity of values, the Resident can require the Contractor to supply test data from an agency approved laboratory to support the values submitted, at the Contractor's cost.

673.033 Concrete Leveling Pad Concrete for leveling pads shall be Fill Concrete conforming to the requirements of Section 502 Structural Concrete. Unless otherwise specified, concrete for leveling pads shall be accepted under Method "C" requirements.

673.034 Drainage Stone Fill Concrete wall unit voids shall be filled with material that conforms to the requirements of Standard Specification Crushed Stone, ¾ -Inch, meeting the requirements of Section 703.13. Compaction of the stone fill will be required before the block surfaces are cleaned to ensure good interface connection strength between geogrids and blocks.

673.035 Backfill Material Backfill material placed behind the concrete wall units shall meet the requirements of Section 703.20 Gravel Borrow, except that the backfill material shall only contain particles that will pass the 3-inch square mesh sieve. The contractor is required to submit a grain size distribution curve (ASTM D 422) and a moisture-density relationship curve (AASHTO T-180) for acceptance of the proposed backfill material and determination of the appropriate installation damage reduction factor (RF_{ID}).

Walls with reinforced backfill also require that the backfill material be subjected to pH testing to determine the appropriate durability reduction factor (RF_D).

673.036 Materials Certificate Letter The Contractor, or the supplier as their agent, shall furnish the Resident a Materials Certificate Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications. A copy of all test results performed by the Contractor or their supplier necessary to assure contract compliance shall also be furnished to the Resident. The Resident will base acceptance upon the materials Certificate Letter, accompanying test reports, and visual inspection.

673.04 Design Requirements The wall shall be designed with a service life of not less than 75 years. The Wet Cast Small Landscape Block Wall shall be designed and sealed by a

Professional Engineer licensed in the State of Maine. The wall shall be designed in accordance with the following:

1. AASHTO LRFD Bridge Design Specifications, current edition, herein referred to as LRFD
2. FHWA-NHI-10-024 and FHWA-NHI-10-025, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes,
   Volumes 1 and 2, 2009
3. FHWA-NHI-09-087 Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, 2009
4. The Contract Plans
5. The requirements specified herein
6. The manufacturer's requirements

Where conflicting requirements occur, the more stringent requirements shall govern.

Forty-five days prior to beginning construction of the wall, the design computations shall be submitted to the Resident for review by the Geotechnical Engineer. Any additional design or costs arising as a result of rejection of a wall design by the Geotechnical Engineer shall be borne by the Contractor.

Design calculations that consist of computer program generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties. The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

A. Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined in accordance with LRFD Article 11 and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass to stabilize the material.

B. External Loads External loads which affect the internal and external stability such as those applied through traffic loadings, impact on traffic barrier posts, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design. Traffic surcharge and traffic impact loads shall be calculated and applied in compliance with LRFD Section 11.

C. External Stability Loads and load combinations selected for design shall be consistent with LRFD. Application of load factors shall be taken as specified in LRFD Section 11. Sliding resistance factors and bearing resistance factors shall be consistent with LRFD. Overturning and sliding provisions of LRFD shall apply.

D. Internal Stability Evaluation of reinforcement pullout, reinforcement rupture and reinforcement/block connection pullout or rupture shall be consistent with LRFD Section 11, and checked at each level. Loads, load combinations and load factors shall be as specified in LRFD Section 11. Resistance factors for internal design are specified in

LRFD Section 11. Maximum reinforcement loads shall be calculated using the Simplified Method approach. Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life.

a. Geosynthetic Reinforcement Design Tensile Resistance The nominal long term reinforcement design strength (T_{al}) shall be determined by reducing T_{ult} by reduction factors (RF) in accordance with the documents referenced above. The designer shall procure and use the manufacturers tested and certified geosynthetic reinforcement reduction factors for creep (RF_{CR}), durability (RF_D), and installation damage (RF_{ID}) to determine T_{al}. In absence of manufacturers tested and certified reduction factors, a combined default reduction factor RF = 7 shall be used in accordance with the referenced documents. For RF_{ID}, the installation damage reduction factor shall be checked in accordance with LRFD and FHWA-NHI-09-087.

b. Reinforcement/Facing Connection Design Strength The nominal long-term connection strength between the geosynthetic reinforcement and the concrete blocks shall be checked in accordance with LRFD and FHWA-NHI-10-024 and FHWA-NHI-10-025, Volumes 1 and 2.

c. Reinforcement Pullout The pullout resistance factor, (F*), and scale effect correction factor (α) used in pullout design, shall be determined from project specific pullout tests using the proposed geosynthetic in the specified project backfill material or equivalent soil. The pullout resistance factors shall be determined in accordance with LRFD and FHWA-NHI-10-024 and FHWA-NHI-10-025, Volumes 1 and 2. In the absence of test data, empirical relationships may be used to determine the pullout resistance factors, any empirical relationships used in design shall be referenced in the design calculations.

E. Backfill and Foundation Soils Parameters The friction angle of the backfill used in the reinforced fill zone for internal stability design shall be assumed have a friction angle of 34 degrees unless specific project select backfill is tested for frictional strength. The friction angle of the foundation soils and random backfill shall be assumed to be 30 degrees unless otherwise shown on the plans.

F. Reinforcement Length The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 5 ft, but shall not be less than 70 percent of the wall height, H, for walls with level surcharges, or 70 percent of H1 for walls with a sloped surcharge. Reinforcement length will be determined by the geotechnical wall designer. The mechanical wall height, H or H1, shall be the vertical difference between the top of the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

G. Bearing Resistance The factored bearing pressures under the Wet Cast Small Landscape Block Wall shall be clearly indicated on the Shop Drawings. Walls shall be dimensioned so that the factored bearing resistance of the foundation soils, as noted on the Plans, is not exceeded.

H. Facing Stability Stability calculations for the concrete facing blocks shall be in accordance with LRFD, and shall include an evaluation of the maximum vertical spacing between reinforcement layers.

I. Stability During Construction Walls shall be designed to resist failure by instability of temporary construction slope. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes.

J. Design Life The wall design life shall be a minimum of 75 years.

K. Depth of Embedment The depth of embedment for frost protection and stability shall be at or below the elevation shown on the Plans and the approved Shop Drawings.

L. Drainage System Piped drainage shall be designed to collect and dispose of water from the base of the reinforced soil zone and backfill soil. This shall outlet into surrounding drainage systems or ditches.

673.05 Submittals. The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall. A sample hand calculation including all equations, parameter values used, units, theory, free-body diagram, comparison to design requirements, etc. shall be provided. Spreadsheet calculations alone are not acceptable.

Forty-five (45) days prior to beginning construction of the wall, four (4) sets of the wall design computations and Shop Drawings shall be submitted to the Resident for review by the Geotechnical Engineer. Mix design information shall be submitted at the same time, including aggregate source, current gradation, aggregate quality information and concrete unit weight.

The contractor shall also submit backfill material test results as part of the wall submittal package. Backfill material test results shall include grain size distribution curve, moisture-density relationship curve, and pH test results required for reinforced backfill only.

If geotechnical design is required, the fully detailed plans shall be prepared in conformance with Section 105 and shall include, but not be limited to the following items:

A. A plan and elevation sheet or sheets for each wall, containing the following: elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the location of the original and final ground line.

B. All details for foundations and leveling pads, including details for steps in the leveling pads, as well as allowable and actual maximum bearing pressures shall be provided.

C. Details for the barriers, posts, curbs, steps and facing as required by the project conditions.

D. Design computations prepared and sealed by a licensed Professional Engineer.

E. Prior to the beginning of construction, the contractor shall supply the Resident with two copies of the design-supplier's Installation Manual. In addition, the Contractor shall have two copies of the Installation Manual on the project site.

673.06 Construction Requirements The Wet Cast Small Landscape Block Wall shall have the following construction requirements:

A. Excavation The excavation and use as fill of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein.

B. Foundation The area upon which the Wet Cast Small Landscape Block Wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the blocks. Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density (AASHTO T-180 Method C or D). Frozen and unsuitable soil shall be removed and replaced with gravel borrow compacted to 95 percent of AASHTO T-180, or as shown on the plans.

   A concrete leveling pad shall be constructed a minimum width of 6 inches beyond the front and back of the concrete wall units, or as indicated on the plans. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Geotechnical Engineer. The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Geotechnical Engineer.

   The allowable elevation tolerances from the design elevations are +0.01 ft and -0.02 ft. Leveling pads which do not meet this requirement shall be repaired or replaced as directed by the Resident at no additional cost to the Department. Placement of wall units may begin after the strength of the concrete leveling pad reaches 1000 psi or is adequate to support the proposed loads. Contractor may begin placement of concrete block units after 12 hours at their own risk.

C. Method and Equipment Prior to erection of the wall, the Contractor shall furnish the Resident with detailed information concerning the proposed construction method and equipment to be used. The erection procedure shall be in accordance with the manufacturer's instructions. Any units that are damaged due to handling will be replaced at the Contractor's expense.

D. Installation of Concrete Wall Units A field representative from the wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

The contractor shall place the first course of wall units directly on the leveling pad and check for level and alignment. Adjacent units should be in contact. The prefabricated concrete wall units shall be installed to a tolerance of plus or minus 3/4 inch in 10 ft in vertical and horizontal alignment.

Fill all voids between and within the wall units with drainage stone as described in this specification. Stone infill shall be compacted by hand tamping with a rod. The drainage stone fill shall extend a minimum of 6 in behind the tails of the wall units unless a geotextile filter is placed over the inside joint at the back of adjacent wall units. If used, the drainage geotextile shall conform to the requirements of Section 722.02.

The top course of blocks and all coping units shall be installed using adhesive or other method of permanent attachment as recommended by the manufacturer.

E. Backfill Placement Backfill placement shall closely follow the erection of each row of prefabricated wall units. The maximum lift thickness shall be 8 inches loose. The Contractor shall decrease the lift thickness if necessary to obtain the specified density. The backfill shall be compacted in accordance with Section 203.12 except that the minimum required compaction shall be at least 92 percent of maximum density as determined by AASHTO T-180 Method C or D. Backfill compaction shall be accomplished without disturbance or displacement of the concrete wall units. Sheepsfoot rollers will not be allowed. Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved.

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T-180, Method C or D. At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rainwater away from the wall face.

F. Construction Certification Letter The Contractor shall furnish the Resident a Construction Certification Letter describing how adequate compaction of the block infill material was accomplished and what QA/QC procedures were followed to ensure that this effort was continued throughout construction of the wall.

673.07 Method of Measurement Wet Cast Small Landscape Block Wall will be measured by the square foot of front surface not to exceed the dimensions shown on the Contract Plans unless authorized by the Resident. Vertical and horizontal dimensions will be from the edges of the blocks. No field measurements for computations will be made unless the Resident specifies, in writing, a change in the limits indicated on the Plans.

673.08 Basis of Payment The accepted quantity of Wet Cast Small Landscape Block Wall will be paid for at the contract unit price per square foot complete in place. Payment shall be full compensation for furnishing geotechnical design as required, all labor, equipment and materials including all precast concrete units, aggregate fill, hardware, joint fillers, geosynthetic, drainage pipe, and technical field representative. Excavation, foundation material and backfill material will all be incidental to the Wet Cast Small Landscape Block Wall.

Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Wet Cast Small Landscape Block Wall.

There will be no allowance for excavating and backfilling for the Wet Cast Small Landscape Block Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation. Payment for excavating unsuitable subsoil shall be full compensation for all costs of pumping, drainage, sheeting, bracing and incidentals for proper execution of the work, and will be paid as common excavation in accordance with Section 203.

Payment will be made under:

Pay Item	Pay Unit
673.10 Wet Cast Small Landscape Block Wall	Square Foot

SECTION 674 - PREFABRICATED CONCRETE MODULAR GRAVITY WALL

674.01 Description This work shall consist of the construction of a prefabricated modular reinforced concrete gravity wall in accordance with these specifications and in reasonably close conformance with the lines and grades shown on the plans, or established by the Resident.

Included in the scope of the Prefabricated Concrete Modular Gravity Wall construction are: all grading necessary for wall construction, excavation, compaction of the wall foundation, backfill, construction of leveling pads, placement of geotextile, segmental unit erection, and all incidentals necessity to complete the work.

The Prefabricated Concrete Modular Gravity Wall design shall follow the general dimensions of the wall envelope shown in the contract plans. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment

shall be at or below the elevation shown on the plans. The top of the face panels shall be at or above the top of the panel elevation shown on the plans.

The Contractor shall require the design-supplier to supply an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Resident. The work done by this representative is incidental.

674.02 Materials Materials shall meet the requirements of the following subsections of Division 700 - Materials:

Gravel Borrow	703.20
Preformed Expansion Joint Material	705.01
Reinforcing Steel	709.01
Structural Pre-cast Concrete Units	712.061
Drainage Geotextile	722.02

The Contractor is cautioned that all of the materials listed are not required for every Prefabricated Concrete Modular Gravity Wall. The Contractor shall furnish the Resident a Certificate of Compliance certifying that the applicable materials comply with this section of the specifications. Materials shall meet the following additional requirements:

Concrete Units:

Tolerances In addition to meeting the requirements of 712.061, all prefabricated units shall be manufactured with the following tolerances. All units not meeting the listed tolerances will be rejected.

1. All dimensions shall be within (edge to edge of concrete) ±3/16 in.
2. Squareness The length differences between the two diagonals shall not exceed 5/16 in.
3. Surface Tolerances For steel formed surfaces, and other formed surface, any surface defects in excess of 0.08 in. in 4 ft will be rejected. For textured surfaces, any surface defects in excess of 5/16 in. in 5 ft shall be rejected.

Joint Filler (where applicable) Joints shall be filled with material approved by the Resident and supplied by the approved Prefabricated Concrete Modular Gravity Wall supplier. 4 in. wide, by 0.5 in. preformed expansion joint filler shall be placed in all horizontal joints between facing units. In all vertical joints, a space of 0.25 in. shall be provided. All Preformed Expansion Joint Material shall meet the requirements of subsection 502.03.

Woven Drainage Geotextile Woven drainage geotextile 12 in. wide shall be bonded with an approved adhesive compound to the back face, covering all joints between units, including joints abutting concrete structures. Geotextile seam laps shall be 6 in., minimum. The fabric shall be secured to the concrete with an adhesive satisfactory to the Resident.

Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident.

Concrete Shear Keys (where applicable) Shear keys shall have a thickness at least equal to the pre-cast concrete stem.

Concrete Leveling Pad Cast-in-place concrete shall be Fill Concrete conforming to the requirements of Section 502 Structural Concrete. The horizontal tolerance on the surface of the pad shall be 0.25 in. in 10 ft. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Resident.

Backfill and Bedding Material Bedding and backfill material placed behind and within the reinforced concrete modules shall be gravel borrow conforming to the requirements of Subsection 703.20. The backfill materials shall conform to the following additional requirements: backfill and bedding material shall only contain particles that will pass the 3-inch square mesh sieve and the plasticity index (PI) as determined by AASHTO T90 shall not exceed 6. Compliance with the gradation and plasticity requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

Materials Certificate Letter The Contractor, or the supplier as his agent, shall furnish the Resident a Materials Certificate Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications. A copy of all test results performed by the Contractor or his supplier necessary to assure contract compliance shall also be furnished to the Resident. Acceptance will be based upon the materials Certificate Letter, accompanying test reports, and visual inspection by the Resident.

674.03 Design Requirements The Prefabricated Concrete Modular Gravity Wall shall be designed and sealed by a Professional Engineer licensed in the State of Maine. The design to be performed by the wall system supplier shall be in accordance with AASHTO LRFD Bridge Design Specifications, current edition, except as required herein. Design calculations that consist of computer generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties. The design by the wall system supplier shall consider the stability of the wall as outlined below:

A. Stability Analyses Wall systems shall be investigated for bearing resistance failure, lateral sliding and overturning failure in accordance with LRFD

Pullout resistance shall be investigated at every module level using nominal resistances and forces in accordance with Paragraph C., below. The ratio of the sum of the nominal resistances to the sum of the nominal forces shall be greater than, or equal to, 1.5.

Traffic impact loads transmitted to the wall through guardrail posts shall be calculated and applied in compliance with LRFD with the exception that Article 11.10.10.2 is modified such that the upper 3.5 ft of concrete modular units shall be designed for an additional horizontal load of $\gamma P_{H1,}$ where γP_{H1}=300 lbs per linear ft of wall.

B. Backfill and Wall Unit Soil Parameters For overturning and sliding stability calculations, earth pressure shall be assumed acting on a vertical plane rising from the back of the lowest wall stem. For overturning, the unit weight of the backfill within the wall units shall be limited to 96 pcf. For sliding analyses, the unit weight of the backfill within the wall units can be assumed to be 120 pcf. Both analyses may assume a friction angle of 34 degrees for backfill within the wall units.

These unit weights and friction angles are based on a wall unit backfill meeting the requirements for select backfill in this specification. Backfill behind the wall units shall be assumed to have a unit weight of 120 pcf and a friction angle of 30 degrees. The friction angle of the foundation soils shall be assumed to be 30 degrees unless otherwise noted on the plans.

C. Internal Stability Internal stability of the wall shall be demonstrated using accepted methods, such as Elias' Method, 1991. Shear keys shall not contribute to pullout resistance. Soil-to-soil frictional component along stem shall not contribute to pullout resistance. The failure plane used to determine pullout resistance shall be found by the Rankine theory only for vertical walls with level backfills. When walls are battered or with backslopes greater than 0 degrees are considered, the angle of the failure plane shall be per Jumikus Method. For computation of pullout force, the width of the backface of each unit shall be no greater than 4.5 ft. A unit weight of the soil inside the units shall be assumed no greater than 120 pcf when computing pullout. Coulomb theory may be used.

D. Safety against Structural Failure Prefabricated units shall be designed for all strength and reinforcement requirements in accordance with LRFD.

E. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic and seismic loads shall be accounted for in the design.

F. Stability During Construction Stability during construction shall be considered during design, and shall meet the requirements of the AASHTO LRFD Bridge Design Specifications, Extreme Limit State.

G. Hydrostatic forces Unless specified otherwise, when a design high water surface is shown on the plans at the face of the wall, the design stresses calculated from that elevation to the bottom of wall must include a 3 ft minimum differential head of

saturated backfill. In addition, the buoyant weight of saturated soil shall be used in the calculation of pullout resistance.

H. Not more than two vertically consecutive units shall have the same stem length, or the same unit depth. Walls with units with extended height curbs shall be designed for the added earth pressure. A separate computation for pullout of each unit with extended height curbs, or extended height coping, shall be prepared and submitted in the design package described above.

674.04 Submittals. The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall. Thirty (30) days prior to beginning construction of the wall, the design computations and wall details shall be submitted to the Resident for review by the Department. The fully detailed plans shall be prepared in conformance with Subsection 105.7 of the Standard Specifications and shall include, but not be limited to the following items:

A. A plan and elevation sheet or sheets for each wall, containing the following: elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the designation as to the type of prefabricated module, the distance along the face of the wall to where changes in length of the units occur, the location of the original and final ground line.

B. All details, including reinforcing bar bending details, shall be provided. Bar bending details shall be in accordance with Department standards.

C. All details for foundations and leveling pads, including details for steps in the leveling pads shall be provided. The maximum calculated factored bearing pressure under the Prefabricated Concrete Modular Gravity wall shall be indicated on the wall plans.

D. All prefabricated modules shall be detailed. The details shall show all dimensions necessary to construct the element, and all reinforcing steel in the element.

E. The wall plans shall be prepared and stamped by a Professional Engineer.

F. Four weeks prior to the beginning of construction, the contractor shall supply the Resident with two copies of the design-supplier's Installation Manual. In addition, the Contractor shall have two copies of the Installation Manual on the project site.

674.05 Construction Requirements

Excavation The excavation and use as fill or disposal of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein.

Foundation The area upon which the modular gravity wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the module. Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density, determined using AASHTO T180, Method C or D. Frozen soils and soils unsuitable or incapable of sustaining the required compaction, shall be removed and replaced.

A concrete leveling pad shall be constructed as indicated on the plans. The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Resident. Allowable elevation tolerances are +0.01 ft and -0.02 ft from the design elevations. Leveling pads which do not meet this requirement shall be repaired or replaced as directed by the Resident at no additional cost to the Department. Placement of wall units may begin after 24 hours curing time of the concrete leveling pad.

Method and Equipment Prior to erection of the Prefabricated Concrete Modular Gravity Wall, the Contractor shall furnish the Resident with detailed information concerning the proposed construction method and equipment to be used. The erection procedure shall be in accordance with the manufacturer's instructions. Any pre-cast units that are damaged due to handling will be replaced at the Contractor's expense.

Installation of Wall Units A field representative from the wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the Department. Vertical and horizontal joint fillers shall be installed as shown on the plans.

The maximum offset in any unit joint shall be 3/4 in. The overall vertical tolerance of the wall, plumb from top to bottom, shall not exceed 1/2 in per 10 ft of wall height. The prefabricated wall units shall be installed to a tolerance of plus or minus ¾-in in 10 ft in vertical alignment and horizontal alignment.

Select Backfill Placement Backfill placement in the interior of the wall units and behind the wall shall progress simultaneously following the erection of each row of prefabricated wall units. The maximum lift thickness shall be 8 in., loose measure, and be thoroughly compacted by mechanical or vibratory compactors. The Contractor shall decrease the lift thickness if necessary to obtain the specified density. Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 92 percent of maximum density as determined by AASHTO T180 Method C or D. Backfill compaction shall be accomplished without disturbance or displacement of the wall units. Sheepsfoot rollers will not be allowed. Puddling for compaction will not be allowed. Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved.

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content less

than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T180, Method C or D. At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rain water away from the wall face.

674.06 Method of Measurement Prefabricated Concrete Modular Gravity Wall will be measured by the square foot of front surface not to exceed the dimensions shown on the contract plans or authorized by the Resident. Vertical and horizontal dimensions will be from the edges of the facing units. No field measurements for computations will be made unless the Resident specifies, in writing, a change in the limits indicated on the plans.

674.07 Basis of Payment The accepted quantity of Prefabricated Concrete Modular Gravity Retaining Wall will be paid for at the contract unit price per square foot complete in place. Payment shall be full compensation for furnishing all labor, equipment and materials including excavation, foundation material, backfill material, pre-cast concrete units hardware, joint fillers, woven drainage geotextile, cast-in-place coping or traffic barrier and technical field representative. Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Prefabricated Concrete Modular Gravity Wall.

There will be no allowance for excavating and backfilling for the Prefabricated Concrete Modular Gravity Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation, as approved by the Resident. Payment for excavating unsuitable material shall be full compensation for all costs of pumping, drainage, sheeting, bracing and incidentals for proper execution of the work.

Payment will be made under:

Pay Item	Pay Unit
674.10 Prefabricated Concrete Modular Gravity Wall	Square Foot

SECTION 675 – SOIL NAIL WALL

SECTION 676 - SOLDIER PILE AND LAGGING WALL
Reserved

SECTION 677 - MECHANICALLY STABILIZED EARTH RETAINING WALL

677.01 Description The work under this item shall consist of design, fabrication, furnishing, transportation, and erection of Mechanically Stabilized Earth (MSE) retaining wall system of the required type, including miscellaneous items necessary for a complete installation.

The MSE retaining walls shall consist of reinforcing strips or reinforcing mesh earth wall systems utilizing architectural precast concrete facing panels supported on cast-in-place concrete leveling pads. All reinforcing strips or mesh material shall consist of galvanized steel. The wall structures shall be dimensioned to achieve the design criteria shown on the plans and specified herein.

The MSE retaining walls shall be constructed in accordance with these specifications and in conformity with the lines, grades, design criteria, and dimensions shown on the plans or established by the Geotechnical Engineer.

677.02 Quality Assurance. The MSE retaining wall system shall be one of the approved wall systems noted in the Plans or on the Department's Qualified Product List (QPL).

All necessary materials, except backfill and cast in-place concrete shall be obtained from the approved system designer.

Mechanically Stabilized Earth (MSE) retaining walls shall be designed and constructed as specified herein. The design shall be subject to review and acceptance by the Geotechnical Engineer. The acceptability of a MSE retaining wall design shall be at the sole discretion of the Geotechnical Engineer. Any additional design, construction or other costs arising as a result of rejection of a retaining wall design by the Geotechnical Engineer shall be borne by the Contractor.

Precast facing panels shall be manufactured in a concrete products plant with approved facilities. Before proceeding with production, precast sample units shall be provided for the Resident's acceptance. These samples shall be kept at the plant to be used for comparison purposes during production.

All calculations and Shop Drawings shall be signed and sealed by a licensed Professional Engineer registered in accordance with the laws of the State of Maine and specializing in geotechnical construction.

The Contractor installing the MSE retaining walls shall have demonstrated experience constructing MSE walls and shall use personnel having demonstrated experience in the installation procedures recommended by the manufacturer and as specified herein.

All MSE walls shall be built in accordance with the plans and accepted shop drawings for the proposed wall systems.

A qualified representative from the wall design-supplier shall be present during construction of the MSE walls. The services of the qualified representative shall be at no additional cost to the project. The qualified experienced technical representative will advise the Contractor and the Resident concerning proper installation procedures.

The vendor's representative shall specify the required back-batter so that the final position of the wall is vertical. Furthermore, footing berms shall be placed in front of the first three (3) levels of panels erected, to maintain verticality.

677.03 Design Requirements The MSE retaining walls shall be designed to provide the grade separation shown on the plans with a service life of not less than 100 years.

The MSE wall system shall be designed in accordance with:

1. The manufacturer's requirements
2. The Contract Plans
3. The requirements specified herein
4. AASHTO LRFD Bridge Design Specifications, current edition
5. AASHTO LRFD Bridge Construction Specifications, current edition
6. FHWA-NHI-10-024, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume I, November 2009,
7. FHWA-NHI-10-025, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume II, November 2009,
8. FHWA-NHI-09-087, Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, November 2009.

Where conflicting requirements occur, the more stringent requirements shall govern.

The MSE wall design shall follow the general dimensions of the wall envelope shown on the plans. Base of footing elevation shall be as shown on the plans, or may be lower. All wall elements shall be within the right-of-way limits shown on the plans. The panels shall be placed so as not to interfere with drainage or other utilities, or other potential obstructions.

All appurtenances behind in front of, under, mounted upon, or passing through the wall such as drainage structures, utilities, fences, concrete parapet wall or other appurtenances shown on the plans shall be accounted for in the stability design of the wall.

Facing panels shall have tongue and groove, ship lap or similar approved connections along all joints, both vertical and horizontal. Where foundation conditions indicate large differential settlements, vertical full-height slip joints shall be provided. The shape of the panels shall be such that adjacent panels will have continuous, vertical joints, or as noted on the plans.

MSE facing panels shall be installed on cast-in-place concrete leveling pads. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be 4.0 ft as measured to the top of the leveling pad, or as shown on the plans, whichever is greater. The top of the face panels shall be at or above the top of the panel elevation shown on the plans. Where coping or barrier is used, the wall face shall extend up into the coping or barrier a minimum of 2 in.

The MSE walls shall be dimensioned so that the factored bearing pressure resistance of the foundation soils, as noted on the plans, is not exceeded. Requirements for over excavation of native foundation soils and replacement with compacted structural fill are detailed on the plans.

The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

(a) Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined per LRFD Section 11 and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass to stabilize the material. External loads which affect the internal stability such as those applied through piling, bridge footings, traffic, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design.

(b) External Stability - Load and Resistance Factors Loads and load combinations selected for design shall be consistent with AASHTO LRFD. Application of load factors shall be taken as specified in AASHTO LRFD. Sliding resistance factors and bearing resistance factors shall be consistent with LRFD Section 10. Overturning provisions of LRFD Section 11 shall apply.

MSE walls shall be designed to resist failure by instability of temporary construction slope. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes. The factored applied bearing pressures under the MSE mass for each reinforced length shall be clearly indicated on the design drawing.

(c) Internal Stability - Load and Resistance Factors Evaluation of reinforcement pullout, reinforcement rupture and panel connection pullout or rupture shall be consistent with LRFD Section 11. Loads, load combinations and load factors shall be as specified in LRFD Article 11. Resistance factors for internal design shall be consistent with LRFD Article 11. Maximum reinforcement loads shall be calculated using the Simplified Method approach. Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life. The design life of steel soil reinforcements shall comply with LRFD Section 11.

(d) Backfill and Foundation Soils Parameters. The friction angle of the select backfill used in the reinforced fill zone for the internal stability design of the wall shall be assumed to be 34° unless noted otherwise. The friction angle of the foundation soils and random backfill shall be assumed to be 30° unless otherwise shown on the plans.

(e) Reinforcement Length. The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 8 ft, but shall not be less than 70 percent of the wall height, H, for walls with level surcharges, or 70 percent of H1 for walls with a sloped surcharge or walls supporting an abutment. The mechanical wall height, H or H1, shall be the vertical

difference between the top of the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

(f) Steel Reinforcement For steel reinforcements, all structural connections, tie strips and loop inserts, the following galvanization and carbon steel loss rates shall be assumed:

	Mil./year/side
Zinc galvanizing (first 2 years)	0.58
Zinc galvanizing (subsequent years to depletion):	0.16
Carbon Steel (after zinc depletion to 100 yrs):	0.47

Calculations for factored stresses and resistances in steel reinforcements and connections, including tie-strips and loop inserts, shall be based upon assumed conditions at the end of the design life. (or: The nominal long-term design strength in steel reinforcements and connections, including tie-strips and loop inserts shall be determined at the end of the service life.) The applied factored reinforcement loads shall be calculated in accordance with LRFD Section 11.10.6.2, and shall be checked against the nominal tensile strength multiplied by a resistance factor per LRFD Table 11.5.7-1. Transverse and longitudinal grid members shall be sized in accordance with ASTM A 185.

When the expected differential settlement normal to the wall exceeds 3 in, the lower level reinforcement facing connections shall be designed to accommodate the increased tensile forces due to settlement.

(g) Facing Panel Requirements

1. Facing panels shall be designed to resist compaction stresses that occur during wall erection.

2. The minimum thickness for concrete panels in the zone of embedded connections shall be 5.5 in and 3.5 in elsewhere. The minimum concrete cover shall be 1.5 in. Facing panels shall meet the design requirements of LRFD 11.10.2.3

3. The wall facing shall be designed to accommodate differential settlements of 1/100 ft.

4. The minimum spacing between adjacent panels shall be ¾ inches in order to accommodate differential settlements without impairing the appearance of the facing or compromising the structural integrity of the individual panels. Joints between panels shall be no more than 0.75 in. Joint between panels shall have a ship lap configuration or tongue and groove connection. There shall be no openings through the wall facing, except for utilities to pass through the wall. Slip joints to accommodate differential settlement shall be included where shown on the plans.

5. Where wall or wall sections intersect with an angle of 130º or less, a special vertical corner element panel shall be used. The corner element panel shall cover the joint of the panels that abut the corner and allow for independent movement of the abutting panels. Corner elements shall not be formed by connecting standard facing panels that abut the acute corner.

677.04 Materials The Contractor shall be responsible for the purchase or manufacture of the precast concrete facing panels, reinforcing mesh or strips, panel/reinforcement connections, bearing pads, joint filler, and all other necessary components. The Contractor shall furnish to the Resident the appropriate Certificates of Compliance certifying that the applicable wall materials meet the requirements of the project specifications. All materials used in the construction of the MSE retaining walls shall meet the requirements specified in the following subsections of the Maine Standard Specifications and as specified herein.

Materials not conforming to this section of the specifications, or from sources not listed in the contract documents, shall not be used without written consent from the Resident.

636.041 Reinforced Concrete Facing Panels Reinforced concrete facing panels shall meet the requirements specified in the following subsections:

Structural Precast Concrete Units	712.061
Drainage Geotextile	722.02

677.042 Precast Panel Tolerances and Surface Finish Concrete surface for the front face shall have a smooth steel formed finish, or as noted on the plans. The rear face shall have an unformed surface finish. The rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of ¼ in. All uncoated steel projecting from the panel unit shall be galvanized in accordance with ASTM A 123/A 123M (AASHTO M 111) with a minimum coating thickness of 2 oz/ft^2.

Precast panel tolerances shall comply with the following; units that do not meet the listed tolerances will be rejected.

1. Panel dimensions (edge to edge of concrete) within ±3/16 in.
2. Panel thickness: ± ¼ in.
3. Squareness The length difference between the two diagonals shall not exceed ½ in.
4. Distance between the centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 1/8 in.
5. Face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel shall be ± 1/8 in.
6. Position of panel connection devices (Tie Strip) shall be ± 1 in.
7. Location of Coil and loop Imbeds shall be ± 1/8 in.
8. Warping of the exposed panel face shall not exceed 1/4 in. in 5 ft.
9. Surface defects on smooth-formed surfaces measured over a length of 5 ft shall

not exceed 1/8 in. Surface defects on textured-finished surfaces measured over a length of 5 ft shall not exceed 5/16 in.

677.043 Reinforcing All reinforcing, tie strips, and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

A. Reinforcing Mesh shall be shop fabricated from cold drawn steel wire conforming to the requirements of AASHTO M 32 (ASTM A 82-97) yield strength minimum of 65 ksi and shall be welded into the finished mesh fabric in accordance with AASHTO M 55 (ASTM A 185). Galvanizing shall be in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum coating thickness shall be 2 oz/ft^2. Any damage done to the mesh galvanization prior to the installation shall be repaired in an acceptable manner and provide a minimum galvanized coating of 2 oz/ft^2.

B. Reinforcing Strips shall be fabricated from hot rolled bars to the required shape and dimensions. Their physical and mechanical properties shall conform to AASHTO M 223 (ASTM A 572/A572M) Grade 65, or approved equal. Reinforcing strips shall be hot dipped galvanized in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum galvanization coating thickness shall be 2 oz/ft^2. Any damage done to the mesh galvanization prior to the installation shall be repaired 2 oz/ft^2.

C. Tie strips shall be fabricated of hot rolled steel conforming to ~~ASTM A570~~ ASTM A 1011/A1011M, Grade 50 or equivalent. Tie strips shall be hot dipped galvanized in accordance with AASHTO M 111 (ASTM A 123/A123M) after fabrication. The minimum coating thickness shall be 2 oz/ft^2.

D. The tie strips and reinforcing strips shall be cut to lengths and tolerances shown on the submitted plans. Holes for bolts shall be punched in the locations shown.

677.044 Attachment Devices

A. Steel clevis loop embeds shall be fabricated of cold drawn steel wire conforming to ASTM A 510, UNS G 10350 or AASHTO M 32 (ASTM A 82). Loop embeds shall be welded in accordance with AASHTO M 55 (ASTM A 185). Both shall have electrodeposited coatings of zinc applied in accordance with ASTM B 633.

B. Fasteners shall consist of hexagonal cap screw bolts and nuts, which are galvanized and conform to the requirements of AASHTO M 164 (ASTM A 325) or equivalent.

C. Connector pins and mat bars shall be fabricated from AASHTO M 183 (ASTM A 36/A36M) steel and welded to the soil reinforcement mats as shown on the plans. Galvanization shall conform to AASHTO M111 (ASTM A 123/A123M) with a minimum coating thickness of 2 oz/ft^2. Connector bars shall be fabricated of cold drawn steel wire

conforming to the requirements of ASTM A 82 (AASHTO M 32) and galvanized in accordance with ASTM A 123/A123M.

D. Structural plate connectors and fasteners used for yokes to connect reinforcements to wall panels around pile or utility conflicts shall conform to the material requirements for reinforcing strips and fasteners in 677.042 (c).

677.045 Joint Materials Joint material shall be installed to the dimensions and thicknesses specified below, or in accordance with the plans or approved shop drawings.

A. Provide flexible foam strips for filler for vertical joints between panels, and in horizontal joints where pads are used.

B. Provide in horizontal joints between panels either preformed EPDM rubber pads conforming to ASTM D 2000 for 4AA, or 812 rubbers or neoprene elastomeric pads having a Durometer Hardness of 55±5, or high density polyethylene pads with a minimum density of 0.946 g/cm3 in accordance with ASTM D 1505

677.046 Nonwoven Drainage Geotextile Cover all joints between panels on the back side of the wall with a geotextile fabric meeting the minimum requirements of 722.02 Class 2. Slit film and multifilament woven and resin bonded woven geotextile fabrics are not allowed for this application. The minimum width of the fabric shall be 12 in. Lap fabric at least 12 in. where splices are required. Nonwoven Drainage Geotextile shall be bonded with an approved adhesive compound to the back face covering all joints between panels. Adhesives used to hold the geotextile filter fabric material to the rear of the facing panels prior to backfill placement shall be supplied by the wall supplier and approved by the Resident.

677.047 Concrete Leveling Pad The cast-in-place leveling pad shall be constructed of Class A concrete conforming to the requirements of Section 502 - Structural Concrete. Leveling pad shall have minimum dimensions of 6 in thickness and 12 in width and be placed at the design elevation shown on the shop drawings within a 1/8 in tolerance.

677.048 Backfill Materials All backfill materials used in the MSE Walls volume shall conform to Gravel Borrow conforming to the requirements of Section 703.20, with and the following additional requirements:

A. The maximum aggregate size is limited to 4 in (U.S Sieve Size - 102 mm)

B. Soundness The material shall be substantially free of shale or other soft, poor durability particles. The materials shall have a magnesium sulfate soundness loss, as determined by AASHTO T104 (ASTM C 88), of less than 30 percent after four cycles.

C. Electrochemical Requirements The backfill materials shall meet the following criteria:

Requirements		Test Methods
Resistivity	>3,000 ohm-centimeters	AASHTO T 288
pH between	Between 5 and 10, inclusive	AASHTO T 289
Chlorides	<100 parts per million	AASHTO T 291
Sulfates	<200 parts per million	AASHTO T 290
Organic Content	<1%	AASHTO T 267-86

D. The plasticity index (PI) as determined by AASHTO T90 shall not exceed 6.

E. The select backfill material shall exhibit a peak angle of internal friction of not less than 34 degrees, as determined by the standard Direct Shear Test, AASHTO T236 (ASTM D3080-72), on the portion finer than the 2 mm [#10 sieve], compacted to 95 percent of AASHTO T99, Methods C or D (with oversized correction as outlined in Note 7) at optimum moisture content. No testing is required for backfills where 80 percent of sizes are greater than 3/4 in. (19 mm) Before construction begins, the borrow material selected shall be subject to show conformance with this frictional requirement. Compliance with the test requirements shall be the responsibility of the Contractor, who shall furnish a copy of the backfill test results prior to construction.

677.050 Crushed Stone for Abutment Foundation Crushed stone for use in the foundation layer below the abutment shall be crushed stone conforming to the requirements of MaineDOT Standard Specification Section 703.13 Crushed Stone, 3/4-inch.

677.051 Impervious Membrane An impervious geomembrane shall be installed near the top of the reinforced backfill to reduce the chance of water infiltrating into the reinforced backfill. The geomembrane shall be bonded to the inside face of the wall panels and extend perpendicularly from the wall face into the fill, while being parallel to the top of the wall. The membrane should be sloped to drain away from the facing and outlet beyond the reinforcing zone. The impervious geomembrane shall extend into the fill a distance of 1 ft beyond the MSE reinforcement. The geomembrane shall have a minimum thickness of 0.76 mm, 30 mil (0.03 in, 1/32 in)

The geomembrane shall have both sides textured with a rough finish to improve resistance against sliding. The texture shall be approved by the Resident before installation. The geomembrane shall be shown on the design drawings of the MSE submittal of the Contractor.

677.052 Acceptance of Material The Contractor shall furnish to the Resident a Certificate of Compliance certifying that the above materials comply with the applicable contract specifications including the backfill material, in accordance with Section 700. A copy of all test results performed by the Contractor necessary to assure contract compliance shall also be

furnished to the Resident. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Resident.

677.06 Submittals

A. Design computations demonstrating compliance with the criteria specified herein and shown on the plans, shall be prepared, signed and stamped by a licensed Professional Engineer licensed in the State of Maine and specializing in geotechnical engineering. Design calculations that consist of computer generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of equations used and material properties.

The design calculations shall include:

1. Statement of all assumptions made and copies of all references used in the calculations.

2. Analyses demonstrating compliance with all applicable earth, water, surcharges, seismic, or other loads, as specified herein and required by AASHTO LRFD.

3. Analyses or studies demonstrating durability and corrosion resistance of retaining wall systems for the proposed location and environment. The designer shall provide all corrosion protection devices necessary for the retaining wall to have a minimum service life of 100 years in the proposed location and environment.

B. A detailed resume of the wall designer listing similar projects with references, and demonstrating necessary experience to perform the MSE retaining wall design, including a brief description of each project that is similar in scope.

C. A detailed listing of MSE walls that the Contractor has constructed including a brief description of each project and a listing of personnel who will construct the walls demonstrating their experience in construction of MSE retaining walls. A reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, address and current phone number.

D. Manufacturer's product data for the MSE wall system, including material, manufacture and erection specifications, all specified erection equipment necessary, details of buried MSE wall elements, special details required of reinforcing layout around drainage structures and sign foundations, structures design properties, type of backfill and details for connections between facing panels.

E. Details of precast yard and concrete mix design.

F. Shop drawing showing the configuration and all details, dimensions, quantities and cross sections necessary to construct the MSE wall, including but not limited to the following:

1. A plan view of the wall, which shall include Contract limits, stations and offsets, and the face of wall line shown on the plans.

2. An elevation view of the wall which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 50 ft along the face of the wall, all steps in the leveling pads, the designation as to the type of retaining wall system(s), and an indication of the final ground line and calculated factored bearing pressures. The face of wall shown on the plans shall be indicated.

3. A typical cross section or cross sections showing the elevation relationship between existing ground conditions and proposed grades, and the proposed wall configuration, including details for the proposed methods for connecting to existing conditions. The sections shall also indicate the location of the face of wall shown on the plans.

4. General notes pertaining to design criteria and wall construction.

5. A listing of material quantities for each wall.

6. Details of sleeves and pipes and other embedded items to be installed through the walls.

7. Clearly indicated details for construction of walls or reinforcing elements around drainage, foundations, utilities or any other potential obstructions.

8. Details of the architectural treatment of facing panels.

9. Drainage design detail and design scheme.

10. Location of utilities.

11. Sequence and schedule of construction, including overall construction schedule.

12. Methods of excavation and backfill.

13. Method of maintaining stability of excavated trenches.

14. Method of monitoring plumbness and deviation of wall.

15. Excavation support system, if any.

16. Any acceptance testing and frequency.

17. Details and location of all necessary construction and expansion joints along the wall.

18. Connection details at the interface of the wall and any adjacent proposed cast in place retaining wall or abutment structure.

19. Details of impermeable membrane connection to abutment in roadway runoff collection system.

677.07 Delivery, Storage and Handling

A. Contractor shall check the material upon delivery to assure that the proper material has been received. A product certification should be provided with each shipment.

B. Material shall be stored above -20º F

C. Contractor shall prevent excessive mud, wet cement, epoxy and like substances which may affix themselves to the material from coming in contact with the material.

D. Material may be laid flat and stored outside for 30 days. For extended storage, material shall be stored in or beneath a trailer or covered with a colored tarpaulin to prevent long-term exposure.

677.08 Wall Excavation The excavation and use as fill disposal of all excavated material shall meet the requirements of Section 203 - Excavation and Embankment, except as modified herein. Temporary excavation support as required shall be the responsibility of the contractor.

677.09 Foundation Preparation. The foundation for the structure shall be graded level for a width equal to the length of reinforcement elements plus 5 ft, or as shown on the plans. Prior to wall construction the foundation shall be compacted with at least 10 passes of a smooth wheel vibratory roller weighing at least 10,000 lbs. Any foundation soils found to be unsuitable or incapable of sustaining the required compaction shall be removed and replaced with Special Borrow Material. The foundation for the structure shall be approved by the Resident before erection is started.

A concrete leveling pad shall be constructed as indicated on the submitted plans. The leveling pad shall be cast to the design elevations as shown on the plans. Allowable elevation tolerances are +0.01 ft and -0.02 ft from the design elevations. Placement of wall panels may begin after 24 hours curing time of the concrete leveling pad.

677.10 Wall Erection A field representative from the proprietary wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

Precast concrete panels shall be placed so that their final position is vertical or battered as shown on the plans. The vendor representative shall specify the required back-batter so that the final position of the wall is vertical. Earth berms at the footing shall be placed to maintain the desired position of panels. For erection, panels are handled by means of lifting devices connected to the upper edge of the panel. Panels should be placed in successive horizontal lifts in the sequence shown on the approved shop drawings as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in position by means of temporary wedges or bracing according to the wall supplier's recommendations.

Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed ¾ inch when measured with a 10 ft straightedge (¼ in/yd). During construction, the maximum allowable offset in any panel joint shall be ¾ in. The overall vertical tolerance of the wall (from top to bottom) shall not exceed ½ inch per 10 ft of wall height.

677.11 Backfill Placement Backfill shall not be placed between November 1st and April 1st. Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed and compacted in such a manner as to avoid any damage or disturbance of the wall materials or misalignment of the facing panels or reinforcing elements. Any wall materials which become damaged during backfill placement shall be removed and replaced at the Contractor's expense. Any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this specification shall be corrected by the Contractor at his expense. Prior to the placement of the soil reinforcement, the backfill elevation after compaction shall be at the required elevation of the reinforcements. At each reinforcement level, the backfill shall be placed to the level of the connection. Backfill placement methods near the panels shall assure that no voids exist directly beneath the reinforcing element.

Gravel borrow backfill shall be compacted in accordance with Subsection 203.12 except that the minimum required compaction shall be 92 percent of maximum density as determined by AASHTO T180, Method C or D (with oversize correction, as outlined in Note 7 of that test). If 30 percent or more of the backfill material is greater than 3/4 in. in size, AASHTO T180 is not applicable, and the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D4253 and D4254, or a method of compaction consisting of at least 4 (four) passes by a heavy roller.

Where spread footings support bridge or other structural loads, the top 5 ft below the bottom of footing elevation shall be compacted to 98 percent of the maximum density as determined by AASHTO T180, Method C or D (with oversize correction, as outlined in Note 7 of that test).

The moisture content (determined in accordance with AASHTO T180, Method C or D) of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have be placed at a moisture content not more than 2 percentage points less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

At each reinforcing level, backfill shall be leveled before placing and bolting the reinforcing. The maximum lift thickness after compaction shall not exceed 12 in. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Heavy compaction equipment shall not be used to compact backfill within 3 ft of the wall face. Compaction within 3 ft of the back face of the wall shall be achieved by at least three (3) passes of lightweight mechanical tamper, lightweight roller, or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used. No vehicular equipment shall be operated within 3 ft of the panels.

The frequency of sampling of the backfill material necessary to assure gradation control throughout construction shall be as directed by the Resident.

At the end of each day's operation, the Contractor shall slope the last level of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

677.12 Reinforcement Placement Prior to placing the first layer of reinforcements (strips, mats or grids), backfill shall be placed and compacted in accordance with Subsection 677.11, Backfill Placement.

Bending of reinforcements in the horizontal plane resulting in a permanent deformation in their alignment shall not be allowed. Gradual bending in the vertical direction that does not result in permanent deformations is allowable.

Cutting of longitudinal or transverse reinforcement bars to avoid conflicts with utility obstructions or piles will not be allowed. A structural connection (yokes) from the wall panel to the reinforcement shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcement due to pile or utility conflicts.

Soil reinforcements shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Resident. If skewing of the soil reinforcements is required due to obstructions in the reinforced fill, rotatable bolted connections shall be used and the maximum skew angle shall not exceed 15º from the normal position except in the case of acute corner where redundant reinforcements are used. The tensile capacity of splayed reinforcement shall be reduced by the cosine of the splay angle.

677.13 Method of Measurement Mechanically Stabilized Earth Retaining Wall will be measured by the square foot of face area computed using the plan dimensions. No adjustment in the pay quantity will be made if the computed quantity, based on the working drawings, varies from the plan quantity.

Vertical dimension limits will be from the top of leveling pad to the top of the wall facing units, as shown on the plans. The horizontal dimension limits will be from the edges of the facing units at each end of a wall, as shown on the plans. No field measurements will be made unless the Resident specifies, in writing, a change to the limits indicated on the plans.

The wall surface area, as shown on the plans, includes the surface area of nominal panel joint openings and wall penetrations such as pipes and other utilities.

677.14 Basis of Payment The accepted quantity of Mechanically Stabilized Earth Retaining Wall will be paid for at the contract unit price per square foot. Payment shall be full compensation for design, fabrication and erection of MSE retaining walls, furnishing all labor, equipment and materials including concrete face panels, fasteners, reinforcing mesh, reinforcing strips, tie strips, hardware, joint fillers, coping, woven drainage geotextile, impervious membrane, select granular backfill and technical field representative. Cost of cast-in-place concrete for leveling pad will not be paid for separately but will be considered incidental to the Mechanically Stabilized Earth Retaining Wall.

Excavation, including extra excavation due to unsuitable foundation material, will be measured and paid for under Item 203.20 - Common Excavation. Foundation material and select backfill material will be considered incidental to the Mechanically Stabilized Earth Retaining Walls.

The unit price for Mechanically Stabilized Earth Wall shall include costs for:

1. All design work, preparation of written submittals and plans, revision of submittals, sample submittals and any other necessary preliminary work prior to and after acceptance of the retaining wall by the Resident.

2. All materials, including transportation, for the MSE walls, including facing panels, MSE reinforcing elements, attachment devices, fasteners, bearing blocks and shims, joint materials, copings, vertical corner elements, concrete masonry, reinforcing steel, crushed stone, select backfill and incidentals.

3. All labor and equipment required to excavate and prepare the wall foundation, form and cast the leveling pad, erect the MSE wall to the lines and grades shown on the plans, place and compact backfill, place and compact the drainage layer, and construct any other items necessary to complete the MSE wall.

4. All temporary sheeting, temporary excavation, and temporary dewatering necessary to perform the other work in this section.

There will be no allowance for excavating and backfilling for the Mechanically Stabilized Earth Retaining Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation.

Payment will be made under:

Pay Item		Pay Unit
677.20	Mechanically Stabilized Earth Retaining Wall	Square foot

SECTION 678 – GEOSYNTHETIC REINFORCED MECHANICALLY STABILIZED EARTH RETAINING WALL

Reserved

SECTION 679 – FIELDSTONE RETAINING WALL

679.01 Description. This work shall consist of supplying material for and constructing a FieldStone Retaining Wall (FSRW) in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans and Special Details, or as directed by the Resident.

An FSRW will consist of the following components:

A leveling pad - an 8 in thick bed of crushed stone used to provide a level surface to place wall stones.
Wall stones - hard, durable, flat quarried stones or fieldstones with flat faces in a mixture of sizes to be stacked in a compact and stable mass.
Filter Fabric - drainage geotextile meeting the requirements of Section 722, as shown on the plans.
Backfill - soil is placed behind the FSRW and crushed stone fill.
Foundation - soil mass supporting the FSRW.
Drainage - underdrain pipe or other positive drainage system approved by the Resident.

679.02 Design Requirements. Drainage System - A positive drainage system to drain water from behind the wall and reduce freeze-thaw action of subsurface soils shall be included in the design of the FSRW.

Crushed Stone Drainage Layer - A vertical layer of crushed stone shall be placed between the back of the wall stones and the backfill to promote drainage and prevent ice damage to the FSRW.

Design Life - The design life of the wall shall be 50 years unless otherwise noted on the plans.

Leveling Pad Location - The top of the leveling pad shall be designed so that the embedment depth of the FSRW is adequate to maintain stability. The minimum embedment depth to the top of the pad shall be 12 in.

679.03 Design Approval The wall must be similar in appearance to that shown in the attached photograph.

679.04 Construction The FSRW shall be built by a skilled mason thoroughly experienced in this type of wall construction.

1. The foundation shall have sufficient strength to maintain global stability of the FSRW. The in-situ soils may be used at the direction of the Geotechnical Engineer. Foundation soils shall be brought to the desired grade as required for footing and base dimensions shown on the construction drawings or as directed by the Resident.

2. The leveling pad shall be placed to the lines and grades as shown on the construction drawings, and shall have a minimum thickness of 18 in. The leveling pad shall extend at least 3 in beyond the wall stones in all directions. Steps in the leveling pad shall have a minimum overlap of 8 in.

3. The backfill used behind the wall shall meet the requirements of Granular Borrow, Section 703.19 - Material for Embankment Construction. Backfill shall be placed, spread,

and compacted from the back of the crushed stone drainage layer toward the limits of the excavation. Backfill shall be placed in lifts not to exceed 8 in and compacted with lightweight, hand operated compaction equipment. Backfill beyond 3 ft from the back of the crushed stone shall be compacted to 95% of the maximum density as determined by AASHTO T-180, Method C or D. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be within 2 percentage points dry of optimum.

4. The filter fabric shall be a geotextile meeting the requirements of Section 722.02, Drainage Geotextile. It shall be placed between the native soils and the leveling pad and backfill.

5. The wall shall be constructed of hand fitted fieldstone or quarried stone. The stones shall be placed such that a minimum of 1.5 tons of palletized stone is used for each cubic yard of wall.

6. Joints shall be level and horizontal; only short vertical joints will be allowed and no more than two vertical joints may be stacked above each other. Stones shall be stacked in a manner such that diagonal joints are kept to a minimum. Joint size in the face of the wall should be kept to a minimum and should not exceed 1.5 in.

7. The top of the wall should be at least 16 in wide. The width of the base should be approximately 2/3 of the wall height, with a gradual taper from the base to the top of the wall. Stones shall be placed so the face of the wall has a minimum batter of 1:12.

8. A hand fitted course of cap stones shall be placed on top of the wall. This shall be constructed of stones of similar size and thickness. Each stone in the cap shall be of sufficient size to withstand accidental movement.

Method of Measurement Field Stone Retaining Wall will be measured by the square foot of front surface not to exceed the measurements shown on the plans or as authorized by the Resident. Vertical dimension limits will be from the top of the leveling pad to the top of the cap stone layer. Horizontal dimension limits will be from each end of the wall.

Basis of Payment The accepted quantity of Field Stone Retaining Wall will be paid for at the contract unit price per square foot, complete, cleaned of debris and accepted in place. The unit price shall be full compensation for excavation, backfill, and grading beyond the face of the wall and furnishing all materials, labor, equipment, and other incidentals including drainage necessary to complete the work.

Payment will be made under:

	Pay Item	Pay Unit
679.10	Field Stone Retaining Wall	Square foot

SECTION 680 – ROCKERY WALL
Reserved

SECTION 681 – PRECAST AGGREGATE-FILLED, CONCRETE BLOCK GRAVITY WALL

681.01 Description The work under this item shall consist of the design, fabrication, furnishing and construction of a Precast Aggregate-filled Concrete Block Gravity Wall in accordance with these specifications and in conformance with the lines and grades shown on the Plans, or established by the Resident. The Precast Aggregate-filled Concrete Block Gravity Wall shall consist of blocks made of Structural Precast concrete made from Portland cement, water, chemical admixtures, and aggregates, supported on concrete leveling pads, and if required, geosynthetic reinforced backfill.

Included in the scope of the precast gravity wall construction are**:** geotechnical design of any wall with an exposed height greater than 4.5 ft or as specified on the Plans, all grading necessary for wall construction, compaction of the wall foundation soil, backfill, piped drainage, construction of leveling pads, and concrete wall unit installation. The top of the upper row of concrete wall units shall be at or above the top of the face elevation shown on the Plans.

681.02 Quality Assurance The wall system shall be one of the approved combinations of facing block and soil reinforcement systems noted in the Plans or on the Department's Qualified Products List (QPL). Alternate wall systems will not be considered for this Item.

All design calculations and Shop Drawings shall be signed and sealed by a Professional Engineer licensed in the State of Maine.

The Contractor shall require the wall design-supplier to provide an on-site, qualified experienced technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Resident.

681.03 Materials Materials for walls shall meet the requirements of the following sections of Division 700:

Gravel Borrow	703.20
Crushed Stone, ¾ -Inch	703.13
Underdrain Pipe	706.06 or 706.09

Reinforcing Steel	709.01
Structural Precast Concrete Units	712.061
Reinforcement Geotextile	722.01
Drainage Geosynthetic	722.02

The Contractor is cautioned that all of the materials listed are not required for every Precast Aggregate-filled Concrete Block Gravity Wall. The Contractor shall furnish the Resident a Materials Certification Letter certifying that the applicable materials comply with this section of the specifications. Materials shall meet the following additional requirements:

681.031 Concrete Units The Materials Certification Letter described above shall contain the date of concrete casting, a lot identification number, compressive strength results, and entrained air results. All prefabricated concrete units shall conform to the requirements of 712.061 with the following exceptions:

A. Materials Materials are modified as follows: the maximum water cement ratio shall be 0.42, use of calcium nitrite is not required unless the design of the concrete wall units requires fabrication with reinforcing steel, the minimum 28 day compressive strength shall be 4600 psi.

B. Quality Control and Quality Assurance Quality Control and Quality Assurance is modified as follows: delete the paragraph which begins with " The contractor shall provide a private office…"

C. Construction Construction requirements are modified as follows:

Replace the first sentence in the paragraph which begins "Forms shall remain …" with the following:
The forms shall remain in place until the concrete has gained sufficient strength such that removal of the forms and subsequent handling will not damage the units.

Add the following paragraph at the end of the Construction section:
Face texture of the units shall be a formed finish on all exposed surfaces. Pigment shall be added during the casting process of the concrete unit to achieve a consistent shade of gray or other color as determined by the Resident.

D. Concrete Testing The concrete testing requirements are modified as follows:

Replace the paragraph which begins "The Contractor shall cast a minimum of 8 …." With the following:
The Contractor shall make and test at least one set of cylinders for every 50 CY of production concrete used to cast the concrete units.

Replace the paragraph which begins "At least once …" with the following:
The Contractor shall make four cylinders for use by the Department to represent every 200 CY or fraction thereof.

E. Tolerances Maximum dimensional deviation of formed unit dimensions shall not vary more than ½-inch or 2 percent of the unit dimension or the manufacturer's published tolerances, whichever is less. Units not meeting the specified tolerances will be rejected.

681.032 Geosynthetic Reinforcement Geosynthetic Reinforcement shall be as required by the proprietary wall system manufacturer or wall designer. Geosynthetic reinforcement shall consist of a geotextile or geogrid approved by the Geotechnical Engineer. Substitution of a geosynthetic other than that required by the proprietary wall system manufacturer shall not be allowed unless approved by the Geotechnical Engineer after submittal of shop drawings and pullout and interface friction test data.

A. Geotextiles and Thread for Sewing Woven or nonwoven geotextiles shall consist of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during handling, placement, and design life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. Geotextiles used for reinforcement shall conform as a minimum to the properties indicated for 722.01, Stabilization/Reinforcement Geotextile and shall meet the requirements of part D and E below. Geotextiles shall have a minimum permeability greater or equal to that shown on the Shop Drawings and the reinforced soil permeability.

B. Geogrids The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall conform as a minimum to the criteria specified in part D and E below.

C. Required Properties The specific geosynthetic materials shall be preapproved and shall the have the ultimate tensile strength (T_{ult}) shown on the approved Shop Drawings for the geosynthetic specified and for the fill type shown. T_{ult} shall be determined from wide width tests specified in ASTM D 4595 for geotextiles and ASTM D 6637 or GRI:GG1 for geogrids. The ultimate tensile strength value is based on the minimum average roll values (MARV) for the product.

D. The geosynthetic shall conform to the following criteria:
    1. PP and HDPE: Min. retained strength of 70 percent after 150 hours, per ASTM D-4355.
    2. HDPE: Grade = E-4, E-5, E-8, E-9, E-10, E-11, J-3, J-4, or J-5, per ASTM D-1248.
    3. PET: Molecular weight (Mn) > 25,000, per GRI:GG8 and ASTM D-4603.
    4. PET: Carboxyl end group (CEG) <30 mmol/kg, GRI:GG7.
    5. All polymers: Minimum Weight per Unit Area of 8 oz/yd^2, per ASTM D-5261.
    6. All Polymers: Maximum 0 percent post consumer recycled material by weight.

7. A default total reduction factor for creep, durability, and installation damage of RF = 7 may be used in design, provided the criteria of 2 through 6 are satisfied and 1 is adjusted to 70 percent after 500 hours is satisfied.

E.Manufacturer Quality Control. The geosynthetic reinforcements shall be manufactured with a high degree of quality control. The Manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the specification. The purpose of the QC testing program is to verify that the reinforcement geosynthetic being supplied to the project is representative of the material used for performance testing and approval. Conformance testing shall be performed as part of the manufacturing process and may vary for each type of product. As a minimum the following index tests shall be considered as applicable for an acceptable QA/QC program:

	Property	Test Procedure
1.	Specific Gravity (HDPE only)	ASTM D-1505
2.	Ultimate Tensile Strength	ASTM D-4595 GRI:GG1
3.	Melt Flow (HDPE and PP only)	ASTM D-1238
4.	Intrinsic Viscosity (PET only)	ASTM D-4603
5.	Carboxyl End Group (PET only)	ASTM D-2455

F. Sampling Testing and Acceptance Sampling and conformance testing shall be in accordance with ASTM D-4354. Conformance testing procedures are established above. Geosynthetic product acceptance shall be based on ASTM D-4759. The quality control certificate shall include:

1. Roll numbers and identification
2. Sampling procedures
3. Results of quality control tests, including a description of test methods used.

G. Certification The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved, measured in full accordance with all test methods and standards specified, or referenced, in this specification.

The manufacturer's certificate shall state that the furnished geosynthetic meets the requirements of these specifications as evaluated by the manufacturer's quality control program. The values submitted shall be certified by a person having legal authority to bond the manufacturer. In case of dispute over validity of values, the Resident can require the Contractor to supply test data from an agency approved laboratory to support the values submitted, at the Contractor's cost.

681.033 Concrete Leveling Pad Concrete for leveling pads shall be Fill Concrete conforming to the requirements of Section 502 Structural Concrete. Unless otherwise specified, concrete for leveling pads shall be accepted under Method "C" requirements.

681.034 Drainage Stone Fill Concrete wall unit voids shall be filled with drainage stone material that conforms to the requirements of 703.13, Crushed Stone, ¾ -Inch.

681.035 Backfill Material Backfill material placed behind the concrete wall units shall meet the requirements of Section 703.20 Gravel Borrow, except that the backfill material shall only contain particles that will pass the 3-inch square mesh sieve. The contractor is required to submit a grain size distribution curve (ASTM D 422) and a moisture-density relationship curve (AASHTO T-180) for acceptance of the proposed backfill material and determination of the appropriate installation damage reduction factor (RF_{ID}).

Walls with reinforced backfill also require that the backfill material be subjected to pH testing to determine the appropriate durability reduction factor (RF_D).

681.036 Materials Certificate Letter The Contractor, or the supplier as their agent, shall furnish the Resident a Materials Certificate Letter for the above materials, including the backfill material, in accordance with Section 700 of the Standard Specifications. A copy of all test results performed by the Contractor or their supplier necessary to assure contract compliance shall also be furnished to the Resident. The Resident will base acceptance upon the materials Certificate Letter, accompanying test reports, and visual inspection.

681.04 Design Requirements The wall shall be designed with a service life of not less than 75 years. The Precast Aggregate-filled Concrete Block Gravity Wall shall be designed and sealed by a Professional Engineer licensed in the State of Maine. The wall shall be designed in accordance with the following:

1. AASHTO LRFD Bridge Design Specifications, current edition, herein referred to as LRFD
2. FHWA-NHI-10-024 and FHWA-NHI-10-025 Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Volumes I and II, 2009
3. FHWA-NHI-09-087, Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, 2009
4. The Contract Plans
5. The requirements specified herein
6. The manufacturer's requirements

Where conflicting requirements occur, the more stringent requirements shall govern.

Forty-five days prior to beginning construction of the wall, the design computations shall be submitted to the Resident for review by the Geotechnical Engineer. Any additional design or costs arising as a result of rejection of a wall design by the Geotechnical Engineer shall be borne by the Contractor.

Design calculations that consist of computer program generated output shall be supplemented with at least one hand calculation and graphic demonstrating the design methodology used. Design calculations shall provide thorough documentation of the sources of

equations used and material properties. The design by the wall system supplier shall consider the stability of the wall as outlined below and in the Contract Documents:

A. Failure Plane The theoretical failure plane within the reinforced soil mass shall be determined in accordance with LRFD Article 11 and be analyzed so that the soil stabilizing components extend sufficiently beyond the failure plane within the reinforced soil mass to stabilize the material.

B. External Loads External loads which affect the internal and external stability such as those applied through traffic loadings, impact on traffic barrier posts, slope surcharge, hydrostatic, and seismic loads shall be accounted for in the design. Traffic surcharge and traffic impact loads shall be calculated and applied in compliance with LRFD Section 11.

C. External Stability Loads and load combinations selected for design shall be consistent with LRFD. Application of load factors shall be taken as specified in LRFD Section 11. Sliding resistance factors and bearing resistance factors shall be consistent with LRFD. Overturning and sliding provisions of LRFD shall apply.

D. Internal Stability Evaluation of reinforcement pullout, reinforcement rupture and reinforcement/block connection pullout or rupture shall be consistent with LRFD Section 11, and checked at each level. Loads, load combinations and load factors shall be as specified in LRFD Section 11. Resistance factors for internal design are specified in LRFD Section 11. Maximum reinforcement loads shall be calculated using the Simplified Method approach. Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life.

a. Geosynthetic Reinforcement Design Tensile Resistance The nominal long term reinforcement design strength (T_{al}) shall be determined by reducing T_{ult} by reduction factors (RF) in accordance with the documents referenced above. The designer shall procure and use the manufacturers tested and certified geosynthetic reinforcement reduction factors for creep (RF_{CR}), durability (RF_D), and installation damage (RF_{ID}) to determine T_{al}. In absence of manufacturers tested and certified reduction factors, a combined default reduction factor RF = 7 shall be used in accordance with the referenced documents. For RF_{ID}, the installation damage reduction factor shall be checked in accordance with LRFD and FHWA-NHI—09-087.

b. Reinforcement/Facing Connection Design Strength The nominal long-term connection strength between the geosynthetic reinforcement and the concrete blocks shall be checked in accordance with LRFD and FHWA-NHI-10-024 and FHWA –NHI -10-025.

c. Reinforcement Pullout The pullout resistance factor, (F*), and scale effect correction factor (α) used in pullout design, shall be determined from

project specific pullout tests using the proposed geosynthetic in the specified project backfill material or equivalent soil. The pullout resistance factors shall be determined in accordance with LRFD and FHWA-NHI--10-024 and FHWA –NHI -10-025. In the absence of test data, empirical relationships may be used to determine the pullout resistance factors, any empirical relationships used in design shall be referenced in the design calculations.

E. Backfill and Foundation Soils Parameters The friction angle of the backfill used in the reinforced fill zone for internal stability design shall be assumed have a friction angle of 34 degrees unless specific project select backfill is tested for frictional strength. The friction angle of the foundation soils and random backfill shall be assumed to be 30 degrees unless otherwise shown on the plans.

F. Reinforcement Length The soil reinforcement shall be the same length from the bottom to the top of each wall section. The reinforcement length defining the width of the entire reinforced soil mass may vary with wall height. The minimum length of the soil reinforcement shall be 8 ft, but shall not be less than 70 percent of the wall height, H, for walls with level surcharges, or 70 percent of H1 for walls with a sloped surcharge or walls supporting an abutment. The mechanical wall height, H or H1, shall be the vertical difference between the top of the leveling footing and the elevation at which the failure surface, as described above, intercepts the ground surface supported by the wall.

G. Bearing Resistance The factored bearing pressures under the Precast Aggregate-filled Concrete Block Gravity Wall shall be clearly indicated on the Shop Drawings. Walls shall be dimensioned so that the factored bearing resistance of the foundation soils, as noted on the Plans, is not exceeded.

H. Facing Stability Stability calculations for the concrete facing blocks shall be in accordance with LRFD, and shall include an evaluation of the maximum vertical spacing between reinforcement layers.

I. Stability During Construction Walls shall be designed to resist failure by instability of temporary construction slope. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes.

J. Design Life The wall design life shall be a minimum of 75 years.

K. Depth of Embedment The depth of embedment for frost protection and stability shall be at or below the elevation shown on the Plans and the approved Shop Drawings.

L. Drainage System Piped drainage shall be designed to collect and dispose of water from the base of the reinforced soil zone and backfill soil. This shall outlet into surrounding drainage systems or ditches.

681.05 Submittals The Contractor shall supply wall design computations, wall details, dimensions, quantities, and cross sections necessary to construct the wall. A sample hand calculation including all equations, parameter values used, units, theory, free-body diagram, comparison to design requirements, etc. shall be provided. Spreadsheet calculations alone are not acceptable.

Forty-five (45) days prior to beginning construction of the wall, four (4) sets of the wall design computations and Shop Drawings shall be submitted to the Resident for review by the Geotechnical Engineer. Mix design information shall be submitted at the same time, including aggregate source, current gradation, aggregate quality information and concrete unit weight.

The contractor shall also submit backfill material test results as part of the wall submittal package. Backfill material test results shall include grain size distribution curve, moisture-density relationship curve, and pH test results required for reinforced backfill only.

If geotechnical design is required, the fully detailed plans shall be prepared in conformance with Section 105 and shall include, but not be limited to the following items:

A. A plan and elevation sheet or sheets for each wall, containing the following: elevations at the top of leveling pads, the distance along the face of the wall to all steps in the leveling pads, the location of the original and final ground line.

B. All details for foundations and leveling pads, including details for steps in the leveling pads, as well as allowable and actual maximum bearing pressures shall be provided.

C. Details for the barriers, posts, curbs and facing as required by the project conditions.

D. Design computations prepared and sealed by a licensed Professional Engineer.

E. Prior to the beginning of construction, the contractor shall supply the Resident with two copies of the design-supplier's Installation Manual. In addition, the Contractor shall have two copies of the Installation Manual on the project site.

681.06 Construction Requirements The Precast Aggregate-Filled Concrete Block Gravity Wall shall have the following construction requirements:

A. Excavation. The excavation and use as fill or disposal of all excavated material shall meet the requirements of Section 203 -- Excavation and Embankment, except as modified herein.

B. Foundation. The area upon which the prefabricated, aggregate-filled concrete block gravity wall structure is to rest, and within the limits shown on the submitted plans, shall be graded for a width equal to, or exceeding, the length of the blocks. Prior to wall and leveling pad construction, this foundation material shall be compacted to at least 95 percent of maximum laboratory dry density (AASHTO T-180 Method C or D). Frozen

and unsuitable soil shall be removed and replaced with gravel borrow compacted to 95 percent of AASHTO T-180, or as shown on the plans.

A concrete leveling pad shall be constructed a minimum of 6 inches beyond the front and back of the concrete wall units, or as indicated on the plans. Dimensions may be modified per the wall supplier's recommendations, with written approval of the Geotechnical Engineer. The leveling pad shall be cast to the design elevations as shown on the plans, or as required by the wall supplier upon written approval of the Geotechnical Engineer.

The allowable elevation tolerances from the design elevations are +0.01 ft and -0.02 ft. Leveling pads which do not meet this requirement shall be repaired or replaced as directed by the Resident at no additional cost to the Department. Placement of wall units may begin after the strength of the concrete leveling pad reaches 1000 psi or is adequate to support the proposed loads. Contractor may begin placement of concrete block units after 12 hours at their own risk.

C. Method and Equipment. Prior to erection of the wall, the Contractor shall furnish the Resident with detailed information concerning the proposed construction method and equipment to be used. The erection procedure shall be in accordance with the manufacturer's instructions. Any units that are damaged due to handling will be replaced at the Contractor's expense.

D. Installation of Concrete Wall Units. A field representative from the wall system being used shall be available, as needed, during the erection of the wall. The services of the representative shall be at no additional cost to the project.

The contractor shall place the first course of wall units directly on the leveling pad and check for level and alignment. Adjacent units should be in contact. The prefabricated concrete wall units shall be installed to a tolerance of plus or minus 3/4 inch in 10 ft in vertical and horizontal alignment.

Fill all voids between and within the wall units with drainage stone as described in this specification. The drainage stone fill shall extend a minimum of 6 in behind the tails of the wall units unless a geotextile filter is placed over the inside joint at the back of adjacent wall units. If used, the drainage geotextile shall conform to the requirements of Section 722.02.

E. Backfill Placement. Backfill placement shall closely follow the erection of each row of prefabricated wall units. The maximum lift thickness shall be 8 inches loose. The Contractor shall decrease the lift thickness if necessary to obtain the specified density. The backfill shall be compacted in accordance with Section 203.12 except that the minimum required compaction shall be at least 92 percent of maximum density as determined by AASHTO T-180 Method C or D. Backfill compaction shall be accomplished without disturbance or displacement of the concrete wall units.

Sheepsfoot rollers will not be allowed. Whenever a compaction test fails, no additional backfill shall be placed over the area until the lift is recompacted and a passing test achieved.

The moisture content of the backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T-180, Method C or D. At the end of the day's operations, the Contractor shall shape the last level of backfill so as to direct runoff of rainwater away from the wall face.

681.07 Method of Measurement Precast Aggregate-filled Concrete Block Gravity Wall will be measured by the square foot of front surface not to exceed the dimensions shown on the Contract Plans unless authorized by the Resident. Vertical and horizontal dimensions will be from the edges of the blocks. No field measurements for computations will be made unless the Resident specifies, in writing, a change in the limits indicated on the Plans.

681.08 Basis of Payment The accepted quantity of Precast Aggregate-Filled Concrete Block Gravity Wall will be paid for at the contract unit price per square foot complete in place. Payment shall be full compensation for furnishing geotechnical design as required, all labor, equipment and materials including all precast concrete units, hardware, joint fillers, geosynthetic, drainage pipe, and technical field representative. Excavation, foundation material and backfill material will all be incidental to the Precast Aggregate-Filled Concrete Block Gravity Wall.

Cost of cast-in-place concrete for leveling pad will not be paid for separately, but will be considered incidental to the Precast Aggregate-Filled Concrete Block Gravity Wall.

There will be no allowance for excavating and backfilling for the Precast Aggregate-Filled Concrete Block Gravity Wall beyond the limits shown on the approved submitted plans, except for excavation required to remove unsuitable subsoil in preparation for the foundation. Payment for excavating unsuitable subsoil shall be full compensation for all costs of pumping, drainage, sheeting, bracing and incidentals for proper execution of the work, and will be paid as common excavation in accordance with Section 203.

Payment will be made under:

Pay Item	Pay Unit
681.10 Precast Aggregate-Filled Concrete Block Gravity Wall	Square Foot

DIVISION 700 - MATERIALS

GENERAL STATEMENT
MATERIALS CERTIFICATION LETTER

For all materials used in the work for which there is no specified acceptance testing by the project Inspectors or the Laboratory, the Contractor shall submit a Materials Certification Letter similar to the following, prior to acceptance as specified in Section 107.9.4.

Company Letterhead

Mr./Mrs._____, Resident Date _____

Address _____ Project No. _____

Town _____

This is to certify that all materials incorporated into the project for which there is no specified acceptance testing by project inspectors or the laboratory, comply with the pertinent specified material requirements of the contract. Processing, project testing, and inspection control of raw materials shall be in conformity with the applicable drawings and/or standards for all articles furnished.

All records and documents pertinent to this letter and not submitted herewith will be maintained and will be available by the undersigned for a period of not less than three years from the date of completion of the project.

The Materials Certification letter must be signed by a person having legal authority to bind the Contractor.

Materials listed in the above Certificate may be subject to random sampling and testing by the Department at any time. When random verification samples are obtained from the project, they shall be provided by the Contractor at no cost to the Department. Certified materials, which fail to meet specification requirements, may not be accepted and may require replacement with materials that do meet the specifications.

The Contractor may be required to submit to the Resident, for inclusion in the project records, certification and other data from the Manufacturer pertaining to materials used on the project.

The Certificate shall include the actual test results of the material in storage from which the shipments are being made. Certificates shall be supplied for each lot, batch, or blend of each type and grade of material. A new certificate shall be issued at least every 30 days or upon receiving or manufacture of a new material.