

Item C-102 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

DESCRIPTION

102-1. This item shall consist of temporary control measures as shown on the plans or as ordered by the Resident Project Representative (RPR) during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

MATERIALS

102-2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901 shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

102-2.2 Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.

102-2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

102-2.4 Slope drains. Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.

102-2.5 Silt fence. Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

102-2.6 Other. All other materials shall meet commercial grade standards and shall be approved by the RPR before being incorporated into the project.

CONSTRUCTION REQUIREMENTS

102-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The RPR shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

102-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust

control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the RPR.

102-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The RPR shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the RPR.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the RPR. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the RPR, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The RPR may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

102-3.4 Installation, maintenance and removal of silt fence. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the RPR.

METHOD OF MEASUREMENT

102-4.1 Temporary erosion and pollution control work required will be performed as scheduled or directed by the RPR. Completed and accepted work will be measured as follows:

- a. Temporary seeding and mulching will be measured by the square yard (square meter).
- b. Temporary slope drains will be measured by the linear foot (meter).
- c. Temporary benches, dikes, dams, and sediment basins will be measured by the cubic yard (cubic meter) of excavation performed, including necessary cleaning of sediment basins, and the cubic yard (cubic meter) of embankment placed as directed by the RPR.
- d. All fertilizing will be measured by the ton (kg).
- e. Installation and removal of silt fence will be measured by the linear foot

102-4.2 Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

BASIS OF PAYMENT

102-5.1 Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the RPR and measured as provided in paragraph 102-4.1 will be paid for under:

Item C-102-5.1 Temporary erosion control – lump sum

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the RPR will be paid for in accordance with Section 90, paragraph 90-05 *Payment for Extra Work*.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5200-33 *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2 *Operational Safety on Airports During Construction*

ASTM International (ASTM)

ASTM D6461 *Standard Specification for Silt Fence Materials*

United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM C-102

Item C-105 Mobilization

105-1 Description. This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-2 Mobilization limit. Mobilization shall be limited to 10 percent of the total project cost.

105-3 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-4 Engineer/RPR field office. An Engineer/RPR field office is not required.

METHOD OF MEASUREMENT

105-5 Basis of measurement and payment. Based upon the contract lump sum price for “Mobilization” partial payments will be allowed as follows:

- a. With first pay request, 25%.
- b. When 25% or more of the original contract is earned, an additional 25%.
- c. When 50% or more of the original contract is earned, an additional 40%.
- d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, paragraph 90-11, *Contractor Final Project Documentation*, the final 10%.

BASIS OF PAYMENT

105-6 Payment will be made under:

Item C-105 Mobilization

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Office of Federal Contract Compliance Programs (OFCCP)

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

United States Department of Labor, Wage and Hour Division (WHD)

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

END OF ITEM C-105

Item D-701 Pipe for Storm Drains and Culverts

DESCRIPTION

701-1.1 This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

MATERIALS

701-2.1 Materials shall meet the requirements shown on the plans and specified below. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.

701-2.2 Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:

AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO R73	Standard Practice for Evaluation of Precast Concrete Drainage Productions
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM C1840	Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe

701-2.3 Concrete. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi (13.8 MPa) at 28 days and conform to the requirements of ASTM C94.

701-2.4 Rubber gaskets. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and pre-coated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

701-2.5 Joint mortar. Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

701-2.6 Joint fillers. Poured filler for joints shall conform to the requirements of ASTM D6690.

701-2.7 Plastic gaskets. Not used.

701-2.8. Controlled low-strength material (CLSM). Not used.

701-2.9 Precast box culverts. Manufactured in accordance with and conforming to ASTM C1433.

701-2.10 Precast concrete pipe. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or American Concrete Pipe Association QCast Plant Certification program.

CONSTRUCTION METHODS

701-3.1 Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 12 inches (300 mm) on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inch (200 mm) or 1/2 inch (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade should be filled with granular material to form a uniform foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The RPR shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

701-3.2 Bedding. The bedding surface for the pipe shall provide a foundation of uniform density to support the pipe throughout its entire length.

a. Rigid pipe. The pipe bedding shall be constructed uniformly for the full length of the pipe barrel,

as required on the plans. The maximum aggregate size shall be 1 in when the bedding thickness is less than 6 inches, and 1-1/2 in when the bedding thickness is greater than 6 inches. Bedding shall be loosely placed uncompacted material under the middle third of the pipe prior to placement of the pipe.

b. Flexible pipe. For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Flexible Pipe Bedding

Pipe Corrugation Depth		Minimum Bedding Depth	
inch	mm	inch	mm
1/2	12	1	25
1	25	2	50
2	50	3	75
2-1/2	60	3-1/2	90

c. Other pipe materials. For PVC, polyethylene, polypropylene, or fiberglass pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inches (19 mm). For pipes installed under paved areas, no more than 12% of the material shall pass the No. 200 (0.075 mm) sieve. For all other areas, no more than 50% of the material shall pass the No. 200 (0.075 mm) sieve. The bedding shall have a thickness of at least 6 inches (150 mm) below the bottom of the pipe and extend up around the pipe for a depth of not less than 50% of the pipe's vertical outside diameter.

701-3.3 Laying pipe. The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

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

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

701-3.4 Joining pipe. Joints shall be made with (1) cement mortar, (2) cement grout, (3) rubber gaskets, (4) plastic gaskets or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete pipe. Concrete pipe may be either bell and spigot or tongue and groove. Pipe sections at joints shall be fully seated and the inner surfaces flush and even. Concrete pipe joints shall be sealed with rubber gaskets meeting ASTM C443 when leak resistant joints are required.

b. Metal pipe. Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of ASTM A760 for steel pipe and AASHTO M196 for aluminum pipe.

c. PVC, Polyethylene, or Polypropylene pipe. Not used

d. Fiberglass pipe. Not used

701-3.5 Embedment and Overfill. Pipes shall be inspected before any fill material is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

701-3.5-1 Embedment Material Requirements

a. Concrete Pipe. Embedment material and compaction requirements shall be in accordance with the applicable Type of Standard Installation (Types 1, 2, 3, or 4) per ASTM C1479. If a concrete cradle or CLSM embedment material is used, it shall conform to the plan details.

b. Plastic and fiberglass Pipe. Not used.

c. Metal Pipe. Embedment material shall be granular as specified in the contract document and specifications, and shall be free of organic material, rock fragments larger than 1.5 inches in the greatest dimension and frozen lumps. As a minimum, backfill materials shall meet the requirements of ASTM D3282, A-1, A-2, or A-3. Embedment material shall extend to 12 inches above the top of the pipe.

701-3.5-2 Placement of Embedment Material

The embedment material shall be compacted in layers not exceeding 6 inches (150 mm) on each side of the pipe and shall be brought up one foot (30 cm) above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the embedment material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

When the top of the pipe is above the top of the trench, the embedment material shall be compacted in layers not exceeding 6 inches (150 mm) and shall be brought up evenly on each side of the pipe to one foot (30 cm) above the top of the pipe. All embedment material shall be compacted to a density required under Item P-152.

Concrete cradles and flowable fills, such as controlled low strength material (CLSM) or controlled density fill (CDF), may be used for embedment provided adequate flotation resistance can be achieved by restraints, weighing, or placement technique.

It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

701-3.6 Overfill

Pipes shall be inspected before any overfill is in place. Any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor's expense. Evaluation of any damage to RCP shall be evaluated based on AASHTO R73.

Overfill material shall be placed and compacted in layers as required to achieve compaction to at least 95 percent standard proctor per ASTM D698. The soil shall contain no debris, organic matter, frozen material, or stones with a diameter greater than one half the thickness of the compacted layers being placed.

701-3.7 Inspection Requirements

An initial post installation inspection shall be performed by the RPR no sooner than 30 days after completion of installation and final backfill. Clean or flush all lines prior to inspection.

For pipe sizes larger than 48 inches, a walk-through visual inspection shall be performed.

Flexible pipes shall be inspected for rips, tears, joint separations, soil migration, cracks, localized buckling, settlement, alignment, and deflection. Determine whether the allowable deflection has been exceeded by use of a laser profiler for internal pipe diameters of 48 inches or less, or direct measurement for internal pipe diameters greater than 48 inches. Laser profile equipment shall utilize low barrel

distortion video equipment. Deflection of installed pipe shall not exceed the limits provided in the table below, as a percentage of the average inside diameter of the pipe.

Maximum Allowable Pipe Deflection

Type of Pipe	Maximum Allowable Deflection (%)
Corrugated Metal Pipe	5
Concrete Lined CMP	3
Thermoplastic Pipe	5
Fiberglass	5

If deflection readings in excess of the allowable deflection are obtained, remove the pipe with excessive deflection and replace with new pipe. Isolated areas may exceed allowable by 2.5% with concurrence of RPR. Repair or replace any pipe with cracks exhibiting displacement across the crack, bulges, creases, tears, spalls, or delaminations. The report for flexible pipe shall include as a minimum, the deflection results and final post installation inspection report. The inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design line and grade, and inspector’s notes.

METHOD OF MEASUREMENT

701-4.1 The length of pipe shall be measured in linear feet (m) of pipe in place, completed, and accepted. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The 24 inch RCP, 24 inch CMP, and 48 inch CMP shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

701-4.2. Precast 8 foot by 8 foot box culverts shall be measured in linear feet in place, completed, and accepted.

BASIS OF PAYMENT

701-5.0 These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

701-5.1 Payment will be made at the contract unit price per linear foot (meter) for 24 inch RCP, 24 inch CMP, and 48 inch CMP and 8 foot by 8 foot box storm sewer.

Payment will be made under:

- Item 701-5.1 24 inch RCP Storm Sewer per linear foot
- Item 701-5.2 24 inch CMP Storm Sewer per linear foot
- Item 701-5.3 48 inch CMP Storm Sewer per linear foot
- Item 701-5.4 8 foot by 8 foot Box Storm Sewer per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter

ASTM International (ASTM)

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A761	Standard Specification for Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D3282	Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter

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ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

National Fire Protection Association (NFPA)

NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
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END ITEM D-701

Item D-751 Manholes, Catch Basins, Inlets and Inspection Holes

DESCRIPTION

751-1.1 This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the RPR.

MATERIALS

751-2.1 Brick. The brick shall conform to the requirements of ASTM C32, Grade MS.

751-2.2 Mortar. Mortar shall consist of one part Portland cement and two parts sand. The cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

751-2.3 Concrete. Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item P-610.

751-2.4 Precast concrete pipe manhole rings. Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (90 cm) nor more than 48 inches (120 cm). There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.

751-2.5 Corrugated metal. Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M36.

751-2.6 Frames, covers, and grates. The castings shall conform to one of the following requirements:

- a. ASTM A48, Class 35B: Gray iron castings
- b. ASTM A47: Malleable iron castings
- c. ASTM A27: Steel castings
- d. ASTM A283, Grade D: Structural steel for grates and frames
- e. ASTM A536, Grade 65-45-12: Ductile iron castings
- f. ASTM A897: Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

751-2.7 Steps. The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of asphalt paint, when directed.

751-2.8 Precast inlet structures. Manufactured in accordance with and conforming to ASTM C913.

CONSTRUCTION METHODS

751-3.1 Unclassified excavation.

a. The Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the plans, or as staked by the RPR. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the RPR may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the RPR. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

d. All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.

e. After excavation is completed for each structure, the Contractor shall notify the RPR. No concrete or reinforcing steel shall be placed until the RPR has approved the depth of the excavation and the character of the foundation material.

751-3.2 Brick structures.

Not Used.

751-3.3 Concrete structures. Concrete structures which are to be cast-in-place within the project boundaries shall be built on prepared foundations, conforming to the dimensions and shape indicated on the plans. The construction shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the RPR before the concrete is placed.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

751-3.4 Precast concrete structures. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program.

Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall: (1) be smoothed to a uniform surface on both interior and exterior of the structure or (2) utilize a rubber gasket per ASTM C443. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance to ASTM C478. When a metal ladder replaces the steps, it shall be securely fastened into position.

751-3.5 Corrugated metal structures. Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the plans. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the plans. When indicated, the structures shall be placed on a reinforced concrete base.

751-3.6 Inlet and outlet pipes. Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

751-3.7 Placement and treatment of castings, frames, and fittings. All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the RPR, and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed by the RPR. All units shall set firm and secure.

After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

751-3.8 Installation of steps. Not Used.

751-3.9 Backfilling.

a. After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Item P-152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the RPR.

b. Backfill shall not be placed against any structure until approved by the RPR. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

c. Backfill shall not be measured for direct payment. Performance of this work shall be considered an obligation of the Contractor covered under the contract unit price for the structure involved.

751-3.10 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the RPR. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

751-4.1 Manholes, catch basins, inlets, and inspection holes shall be measured by the unit.

BASIS OF PAYMENT

751-5.1 The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item D-751-5.1 Inlets – per each

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
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END OF ITEM D-751

Item D-752 Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures

DESCRIPTION

752-1.1 This item shall consist of reinforced concrete culverts, headwalls, and miscellaneous drainage structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the RPR.

MATERIALS

752-2.1 Concrete. Reinforced concrete shall meet the requirements of Item P-610.

CONSTRUCTION METHODS

752-3.1 Unclassified excavation.

a. Trenches and foundation pits for structures or structure footings shall be excavated to the lines and grades and elevations shown on the plans. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only; and the RPR may approve, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the RPR. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for excavation.

d. All bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage the finished concrete. The cost of removal shall be included in the unit price bid for excavation.

e. After each excavation is completed, the Contractor shall notify the RPR. No concrete or reinforcing steel shall be placed until the RPR has approved the depth of the excavation and the character of the foundation material.

752-3.2 Backfilling.

a. After a structure has been completed, backfilling with approved material shall be accomplished by applying the fill in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted. The field density of the compacted material shall be at least 90% of the maximum density for cohesive soils and 95% of the maximum density for noncohesive soils. The maximum density shall be determined in accordance with ASTM D698. The field density shall be determined in accordance with ASTM D1556.

b. No backfilling shall be placed against any structure until approved by the RPR. For concrete, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill or the placement methods.

c. Fill placed around concrete culverts shall be deposited on each side at the same time and to approximately the same elevation. All slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action against the structure.

d. Backfill will not be measured for direct payment. Performance of this work shall be considered as a subsidiary obligation of the Contractor, covered under the contract unit price for “unclassified excavation for structures.”

752-3.3 Weep holes. Weep holes shall be constructed as shown on the plans.

752-3.4 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as approved by the RPR. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

752-4.1 Cast-in-place concrete headwalls and wingwalls shall be measured per each completed and accepted structure including all concrete and reinforcing steel.

BASIS OF PAYMENT

752-5.1 Payment will be made at the contract unit price per each for concrete structures.

These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure.

Payment will be made under:

Item D-752-5.1	Headwall including wingwalls (North)
Item D-752-5.2	Headwall including wingwalls (South)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft ³ (600 kN-m/m ³))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

END OF ITEM D-752

Item P-101 Preparation/Removal of Existing Pavements

DESCRIPTION

101-1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

EQUIPMENT AND MATERIALS

101-2 All equipment and materials shall be specified here and in the following paragraphs or approved by the Resident Project Representative (RPR). The equipment shall not cause damage to the pavement to remain in place.

CONSTRUCTION

101-3.1 Removal of existing pavement.

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

a. Concrete pavement removal. Not used.

b. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed. The removed material shall be legally disposed of off-site in a timely manner following removal.

c. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the RPR. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

101-3.2 Preparation of joints and cracks prior to overlay/surface treatment. Not used.

101-3.3 Removal of Foreign Substances/contaminates Not Used.

101-3.4 Concrete spall or failed asphaltic concrete pavement repair.

a. Repair of concrete spalls in areas to be overlaid with asphalt. Not Used.

b. Asphalt pavement repair. Not Used.

101-3.5 Cold milling. Not Used.

101-3.6. Preparation of asphalt pavement surfaces prior to surface treatment. Not Used.

101-3.7 Maintenance. The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the RPR. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

101-3.8 Preparation of Joints in Rigid Pavement prior to resealing. Not Used.

101-3.8.1 Removal of Existing Joint Sealant. Not Used.

101-3.8.2 Cleaning prior to sealing. Not Used.

101-3.8.3 Joint sealant. Not Used.

101-3.9 Preparation of Cracks in Flexible Pavement prior to sealing. Not Used.

101-3.9.1 Preparation of Crack. Not Used.

101-3.9.2 Removal of Existing Crack Sealant. Not Used.

101-3.9.3 Crack Sealant. Not Used.

101-3.9.4 Removal of Pipe and other Buried Structures.

a. Removal of Existing Pipe Material. Remove the types of pipe as indicated on the plans. The pipe material shall be legally disposed of off-site in a timely manner following removal. Trenches shall be backfilled with material equal to or better in quality than adjacent embankment. Trenches under paved areas must be compacted to 95% of ASTM D698.

METHOD OF MEASUREMENT

101-4.1 Pavement removal. The unit of measurement for pavement removal shall be the number of square yards (square meters) removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal. Dowel bar installation shall be incidental to pavement removal.

101-4.7 Removal of Pipe and other Buried Structures. The unit of measurement for removal of pipe and other buried structures will be made at the contract unit price for each completed and accepted item. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with paragraph 101-3.9.4.

BASIS OF PAYMENT

101-5.1 Payment. Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

Item P 101-5.1 Pavement Removal - per square yard

Item P 101-5.2 Removal of 24-inch Pipe – per linear foot

Item P 101-5.3 Removal of 48-inch Pipe – per linear foot

Item P-101-5.4 Removal of 60-inch Pipe – per linear foot

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

AC 150/5380-6 Guidelines and Procedures for Maintenance of Airport Pavements.

ASTM International (ASTM)

ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF ITEM P-101

Item P-151 Clearing and Grubbing

DESCRIPTION

151-1.1 This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the Resident Project Representative (RPR).

a. Clearing shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas. The grubbing of stumps and roots will not be required.

b. Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the RPR is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

c. Tree Removal. Tree Removal shall consist of the cutting and removal of isolated single trees or isolated groups of trees, and the grubbing of stumps and roots. The removal of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared.

CONSTRUCTION METHODS

151-2.1 General. The areas denoted on the plans to be cleared and grubbed shall be staked on the ground by the Contractor as indicated on the plans.

The removal of existing structures and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the plans. Whenever a telephone pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the RPR who will notify the proper local authority or owner to secure prompt action.

151-2.1.1 Disposal. All materials removed by clearing or by clearing and grubbing shall be disposed of outside the Airport's limits at the Contractor's responsibility except when otherwise directed by the RPR. As far as practicable, waste concrete and masonry shall be placed on slopes of embankments or channels. When embankments are constructed of such material, this material shall be placed in accordance with requirements for formation of embankments. Any broken concrete or masonry that cannot be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case, shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the RPR and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits, the Contractor shall obtain and file with the RPR permission in writing from the property owner for the use of private property for this purpose.

151-2.1.2 Blasting. Blasting shall not be allowed.

151-2.2 Clearing. Not Used.

Fences shall be removed and disposed of as directed by the RPR. Fence wire shall be neatly rolled and the wire and posts stored on the airport if they are to be used again, or stored at a location designated by the RPR if the fence is to remain the property of a local owner or authority.

151-2.3 Clearing and grubbing. In areas designated to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials as indicated on the plans, shall be removed, except where embankments exceeding 3-1/2 feet (105 cm) in depth will be constructed outside of paved areas. For embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees, stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other projections over 1-1/2 inches (38 mm) in diameter shall be grubbed out to a depth of at least 18 inches (0.5 m) below the finished subgrade or slope elevation.

Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to this item. The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least 2 feet (60 cm) below the existing surrounding ground. Any broken concrete, blocks, or other objectionable material that cannot be used in backfill shall be removed and disposed of at the Contractor's expense. The holes or openings shall be backfilled with acceptable material and properly compacted.

All holes in embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacting as required in Item P-152. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

151-2.4 Removal of Wood Debris. Areas of existing wood shoring designated to be removed on the design plans shall be removed in their entirety. All removed materials shall be disposed of off EFD airport property in a timely manner after removal.

151-2.5 Removal of Existing Concrete Structures. Removal of concrete structures includes the existing headwall structures and concrete channel lining as designated on the design plans. All material shall be removed and disposed of off EFD airport property in a timely manner after removal.

METHOD OF MEASUREMENT

151-3.1 The quantities of clearing and grubbing as shown by the limits on the plans shall be the number of acres (square meters) or fractions thereof of land specifically cleared and grubbed.

151-3.2 The quantities of wood debris removal as indicated on the plans shall be in cubic yards of removed and disposed material.

151-3.3 The quantities of concrete structure removal as indicated on the plans shall be in cubic yards of removed and disposed material.

BASIS OF PAYMENT

151-4.1 Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-151-4.1	Clearing and grubbing - per acre (square meter) or fractions thereof
Item P-151-4.2	Removal of Wood Debris – per cubic yard
Item P-151-4.3	Removal of Concrete Structures – per cubic yard

END OF ITEM P-151

Item P-152 Excavation, Subgrade, and Embankment

DESCRIPTION

152-1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

152-1.2 Classification. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature.

152-1.3 Unsuitable excavation. Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the RPR.

CONSTRUCTION METHODS

152-2.1 General. Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the RPR. All unsuitable material shall be disposed of in waste areas as shown on the plans. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the RPR.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the RPR notified per Section 70, paragraph 70-20. At the direction of the RPR, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches (150 mm) of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the RPR, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

a. Blasting. Blasting shall not be allowed.

152-2.2 Excavation. No excavation shall be started until the work has been staked out by the Contractor and the RPR has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines. All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material

shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

a. Selective grading. When selective grading is indicated on the plans, the more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.

b. Undercutting. Not Used.

c. Over-break. Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."

d. Removal of utilities. The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by the Contractor as indicated on the plans. All existing foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the RPR. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

152-2.3 Borrow excavation. Borrow areas are not required.

152-2.4 Drainage excavation. Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the RPR. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

152-2.5 Preparation of cut areas or areas where existing pavement has been removed. In those areas on which a subbase or base course is to be placed, the top 12 inches (300 mm) of subgrade shall be compacted to not less than 100 % of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D698 As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

152-2.6 Preparation of embankment area. All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches (150 mm) and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

152-2.7 Control Strip. The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

152-2.8 Formation of embankments. The material shall be constructed in lifts as established in the control strip, but not less than 6 inches (150 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the RPR. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within $\pm 2\%$ of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The contractor will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D698. A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the contractor for every 1,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the RPR.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D698. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches which shall be prepared for a seedbed in accordance with Item T-901.

The in-place field density shall be determined in accordance with ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. The RPR shall perform all density tests. If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re- compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches (100 mm) in their greatest dimensions will not be allowed in the top 12 inches (300 mm) of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the RPR and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the RPR.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet (60 cm) in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet (1.2 m) below the finished subgrade.

Payment for compacted embankment will be made under embankment in-place and no payment will be made for excavation, borrow, or other items.

152-2.9 Proof rolling. Not Used

152-2.10 Compaction requirements. The subgrade under areas to be paved shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 100 percent of the maximum dry density as determined by ASTM D698. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches (300 mm) and to a density of not less than 95 percent of the maximum density as determined by ASTM D698.

The material to be compacted shall be within $\pm 2\%$ of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the $\frac{3}{4}$ inch (19.0 mm) sieve, follow the methods in ASTM D698 Tests for moisture content and compaction will be taken at a minimum of 100 S.Y. of subgrade. All quality assurance testing shall be done by the RPR.

The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the

material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the RPR and the finished subgrade shall be maintained.

152-2.11 Finishing and protection of subgrade. Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the RPR.

152-2.12 Haul. All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining and removing haul roads or routes.

152-2.13 Surface Tolerances. In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

- a. **Smoothness.** The finished surface shall not vary more than +/- 1/2 inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/- 0.05 feet (15 mm) of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to be placed, grade shall not vary more than 0.10 feet (30 mm) from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.14 Topsoil. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of
Item P-152 Excavation, Subgrade, and Embankment

finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the RPR, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.

METHOD OF MEASUREMENT

152-3.1 The quantity of unclassified excavation to be paid for shall be the number of cubic yards (cubic meters) measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

BASIS OF PAYMENT

152-4.1 Unclassified excavation payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-152-4.1 Unclassified - per cubic yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

ASTM International (ASTM)

ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2700 kN-m/m³))

ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Advisory Circulars (AC)

AC 150/5370-2 Operational Safety on Airports During Construction Software

Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

U.S. Department of Transportation

FAA RD-76-66 Design and Construction of Airport Pavements on Expansive Soils

END OF ITEM P-152

Item P-155 Lime-Treated Subgrade

DESCRIPTION

155-1.1 This item shall be used for soil modification that require strength gain to a specific level. This item shall consist of constructing one or more courses of a mixture of soil, lime, and water in accordance with this specification, and in conformity with the lines, grades, thicknesses, and typical cross-sections shown on the plans.

MATERIALS

155-2.1 Lime. Quicklime, hydrated lime, and either high-calcium dolomitic, or magnesium lime, as defined by ASTM C51, shall conform to the requirements of ASTM C977. Lime not produced from calcining limestone is not permitted.

155-2.2 Commercial lime slurry. Commercial lime slurry shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material injurious or objectionable for the intended purpose. The solids portion of the mixture, when considered on the basis of “solids content,” shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following chemical composition and residue requirements.

a. Chemical composition. The “solids content” of the lime slurry shall consist of a minimum of 70%, by weight, of calcium and magnesium oxides.

b. Residue. The percent by weight of residue retained in the “solids content” of lime slurry shall conform to the following requirements:

- Residue retained on a No. 6 (3.35 μm) sieve = maximum 0.0%
- Residue retained on a No. 10 (2.00 μm) sieve = maximum 1.0%
- Residue retained on a No. 30 (600 μm) sieve = maximum 2.5%

c. Grade. Commercial lime slurry shall conform to one of the following two grades:

- Grade 1. The “dry solids content” shall be at least 31% by weight, of the slurry.
- Grade 2. The “dry solids content” shall be at least 35%, by weight, of the slurry.

155-2.3 Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

155-2.4 Soil. The soil for this work shall consist of on-site materials free of roots, sod, weeds, and stones larger than 2-1/2 inches (60 mm) and have a sulfate content of less than 0.3%.

COMPOSITION

155-3.1 Soil-lime mixture. Lime shall be applied at minimum 8 % dry unit weight of soil for the depth of subgrade treatment as shown on the plans.

155-3.2 Tolerances. At final compaction, the lime and water content for each course of subgrade treatment shall conform to the following tolerances:

Tolerances

Material	Tolerance
Lime	+ 0.5%
Water	+ 2%, -0%

WEATHER LIMITATIONS

155-4.1 Weather limitation. Subgrade shall not be constructed when weather conditions detrimentally affect the quality of the materials. Lime shall not be applied unless the air temperature is at least 40°F (4°C) and rising. Lime shall not be applied to soils that are frozen or contain frost. Protect completed lime-treated areas by approved methods against the detrimental effects of freezing if the air temperature falls below 35°F (2°C). Remove and replace any damaged portion of the completed soil-lime treated area with new soil-lime material in accordance with this specification.

EQUIPMENT

155-5.1 Equipment. All equipment necessary to grade, scarify, spread, mix and compact the material shall be provided. The Resident Project Representative (RPR) must approve the Contractor's proposed equipment prior to the start of the treatment.

CONSTRUCTION METHODS

155-6.1 General. This specification is to construct a subgrade consisting of a uniform lime mixture which shall be free from loose or segregated areas. The subgrade shall be of uniform density and moisture content, well mixed for its full depth, and have a smooth surface suitable for placing subsequent lifts. The Contractor shall be responsible to meet the above requirements.

Prior to any treatment, the subgrade shall be constructed as specified in Item P-152, Excavation, Subgrade and Embankment, and shaped to conform to the typical sections, lines, and grades as shown on the plans.

The mixing equipment must give visible indication at all times that it is cutting, pulverizing and mixing the material uniformly to the proper depth over the full width of the cut.

155-6.2 Application. Lime shall be uniformly spread only over an area where the initial mixing operations can be completed during the same work day. Lime shall not be applied when wind conditions are detrimental to proper application. A motor grader shall not be used to spread the lime. Adequate moisture shall be added to the cement/soil mixture to maintain the proper moisture content. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

155-6.3 Mixing. The mixing procedure shall be as described below:

a. Preliminary mixing. The full depth of the treated subgrade shall be mixed with an approved mixing machine. Lime shall not be left exposed for more than six (6) hours. The mixing machine shall make two coverages. Water shall be added to the subgrade during mixing to provide a moisture content approximately 3% to 5% above the optimum moisture of the material and to ensure chemical reaction of the lime and subgrade. After mixing, the subgrade shall be lightly rolled to seal the surface and help prevent evaporation of moisture. The water content of the subgrade mixture shall be maintained at a moisture content above the optimum moisture content for a minimum of 4 to 24 hours or until the material becomes friable. During the mellowing period, the material shall be sprinkled as directed by the RPR.

b. Final mixing. After the required mellowing time, the material shall be uniformly mixed by approved methods. Any clods shall be reduced in size by blading, discing, harrowing, scarifying, or by the use of other approved pulverization methods. After curing, pulverize lime treated material until 100% of soil particles pass a one-inch (25.0 mm) sieve and 60% pass the No. 4 (4.75 mm) sieve when tested dry by laboratory sieves. If resultant mixture contains clods, reduce their size by scarifying, remixing, or

pulverization to meet specified gradation.

155-6.4 Control Strip. The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the RPR. Upon acceptance of the control strip by the RPR, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

155-6.5 Treatment Application and Depth Checks. The depth and amount of stabilization shall be measured by the Contractor with no less than 2 tests per day of material placed; test shall be witnessed by the RPR. Measurements shall be made in test holes excavated to show the full depth of mixing and the pH checked by spraying the side of the test hole with a pH indicator such as phenolphthalein. Phenolphthalein changes from clear to red between pH 8.3 and 10. The color change indicates the location of the bottom of the mixing zone. pH indicators other than phenolphthalein can be used to measure pH levels. If the pH is not at least 8.3 and/or if the depth of the treated subgrade is more than ½ inch (12 mm) deficient, additional lime treatment shall be added and the material remixed. The Contractor shall correct all such areas in a manner satisfactory to the RPR.

155-6.6 Compaction. Compaction of the mixture shall immediately follow the final mixing operation with the mixture compacted within 1 to 4 hours after final mixing. The material shall be at the moisture content specified in paragraph 155-3.2 during compaction. The field density of the compacted mixture shall be at least 95% of the maximum density as specified in paragraph 155-6.10. Perform in-place density test to determine degree of compaction between 24 and 72 hours after final compaction and the 24-hour moist cure period. If the material fails to meet the density requirements, it shall be reworked to meet the density requirements. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

155-6.7 Finishing and curing. After the final lift or course of lime-treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling, as directed by the RPR, with a pneumatic or other suitable roller sufficiently light to prevent hairline cracking. The finished surface shall not vary more than 1/2-inch (12 mm) when tested with a 12-foot (3.7 m) straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be corrected by the Contractor at the Contractor's expense in a manner satisfactory to the RPR.

The completed section shall be moist-cured for a minimum of seven (7) days before further courses are added or any traffic is permitted, unless otherwise directed by the RPR. The final lift should not be exposed for more than 14 days without protection or the placement of a base course material.

155-6.8 Maintenance. The Contractor shall protect and maintain the lime-treated subgrade from yielding until the lime-treated subgrade is covered by placement of the next lift. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. The maintenance cost shall be incidental to this item.

155-6.9 Surface tolerance. In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

a. Smoothness. The finished surface shall not vary more than +/- 1/2 inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

b. Grade. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/- 0.05 feet (15 mm) of the specified grade.

155-6.10 Acceptance sampling and testing. The lime treated subgrade shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one compaction and thickness test per 1000 square yards of lime treated subgrade, but not less than four (4) tests per day of production. Sampling locations will be determined on a random basis per ASTM D3665.

a. Density. All testing shall be done by the Contractor's laboratory in the presence of the RPR and density test results shall be furnished upon completion to the RPR for acceptance determination. The field density of the compacted mixture shall be at least 95% of the maximum density of laboratory specimens prepared from samples taken from the material in place. The specimens shall be compacted and tested in accordance with ASTM D698 to determine maximum density and optimum moisture content. The in-place field density shall be determined in accordance with ASTM D1556. If the material fails to meet the density requirements, the area represented by the failed test shall be reworked to meet the density requirements. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

b. Thickness. The thickness of the course shall be within +0 and -1/2 inch (12 mm) of the specified thickness as determined by depth tests taken by the Contractor in the presence of the RPR for each area. Where the thickness is deficient by more than 1/2-inch (12 mm), the Contractor shall correct such areas at no additional cost. The Contractor shall replace, at his expense, material where depth tests have been taken.

155-6.11 Handling and safety. The Contractor shall obtain and enforce the lime supplier's instructions for proper safety and handling of the lime to prevent physical eye or skin contact with lime during transport or application.

METHOD OF MEASUREMENT

155-7.1 Lime-treated subgrade shall be paid for by the square yard in the completed and accepted work.

155-7.2 Lime shall be paid by the number of tons of Hydrated Lime applied at the application rate specified in paragraph 155-3.1.

a. Hydrated lime delivered to the project in dry form will be measured according to the actual tonnage either spread on the subgrade or batched on site into a slurry, whichever is applicable.

BASIS OF PAYMENT

155-8.1 Payment shall be made at the contract unit price per square yard (square meter) for the lime-treated subgrade at the thickness specified. The price shall be full compensation for furnishing all material, except the lime, and for all preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete this item.

155-8.2 Payment shall be made at the contract unit price per ton (kg). This price shall be full compensation for furnishing, delivery, and placing this material.

Payment will be made under:

Item P-155-8.1	Lime-treated subgrade - per square yard (m ²)
Item P-155-8.2	Lime - per pound (kg)

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C51	Standard Terminology Relating to Lime and Limestone (as used by the Industry)
ASTM C977	Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³) (600 kN-m/m ³)
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

END OF ITEM P-155

Item P-219 Recycled Concrete Aggregate Base Course

DESCRIPTION

219-1.1 This item consists of a base course composed of recycled concrete aggregate, crushed to meet a particular gradation, constructed on a prepared course per these specifications and in conformity to the dimensions and typical cross-sections shown on the plans.

MATERIALS

219-2.1 Aggregate. Recycled concrete aggregate shall consist of cement concrete. The recycled concrete material shall be free of reinforcing steel and expansion material. Asphalt overlays and any full slab asphalt panels shall be removed from the concrete surface prior to removal and crushing.

Recycled concrete aggregate shall consist of at least 90%, by weight, cement concrete; virgin aggregates may be added to meet the 90% minimum concrete requirement. The remaining 10% may consist of the following materials:

Deleterious Materials

Material	Quantity
Wood	0.1% maximum
Brick, mica, schist, or other friable materials	4% maximum
Asphalt concrete	10% maximum
Total	10 % maximum

Recycled Concrete Aggregate Base Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate		
Resistance to Degradation	Loss: 45% maximum	ASTM C131
Flat Particles, Elongated Particles, or Flat and Elongated Particles ¹	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than four (4)	ASTM D4318

¹ A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

The fine aggregate shall be produced by crushing stone, gravel, slag, or recycled concrete that meet the requirements for wear and soundness specified for coarse aggregate. Fine aggregate may be added to produce the correct gradation.

Each source of recycled concrete aggregate shall meet the above requirements.

Recycled concrete aggregate shape depends on the characteristics of the recycled concrete, plant type, and plant operation speed. This may require a number of trial batches before crushed recycled concrete aggregate meeting the shape and gradation requirements can be produced.

219-2.2 Gradation requirements. The gradation (job mix) of the final mixture shall fall within the design range indicated in the following table, when tested per ASTM C117 and ASTM C136. The final gradation shall be continuously graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

Gradation of Recycled Concrete Aggregate Base

Sieve Size	Percentage by Weight Passing Sieves	Contractor's Final Gradation	Job Mix Tolerances Percent
2 inch (50 mm)	100		--
1-1/2 inch (37.5 mm)	95 - 100		±5
1 inch (25.0 mm)	70 - 95		±8
3/4 inch (19.0 mm)	55 - 85		±8
No. 4 (4.75 mm)	30 - 60		±8
No. 30 (600 µm)	12 - 30		±5
No. 200 (75 µm)	0 - 10		±3

The job mix tolerances in the table shall be applied to the job mix gradation to establish a job control gradation band. The full tolerance still will apply if application of the tolerances results in a job control

gradation band outside the design range.

219-2.3 Sampling and testing.

a. Aggregate base materials. The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 219-2.1 and 219-2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

b. Gradation requirements. The Contractor shall take at least two aggregate base samples per day in the presence of the Resident Project Representative (RPR) to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 219-2.2. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the RPR.

219-2.4 Separation Geotextile. Separation Geotextile shall be class 2, 0.02 sec-1 permittivity per ASTM D4491, Apparent opening size per ASTM D4751 with 0.60 mm maximum average roll value.

CONSTRUCTION METHODS

219-3.1 Control Strip. The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the RPR, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the RPR.

219-3.2 Preparing underlying course. The underlying course shall be checked by the RPR before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor's expense before the base course is placed there. Material shall not be placed on frozen material.

To protect the existing layers and to ensure proper drainage, the spreading of the recycled concrete aggregate base course shall begin along the centerline of the pavement on a crowned section or on the greatest contour elevation of a pavement with a variable uniform cross slope.

219-3.3 Placement. The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the RPR, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The aggregate shall meet gradation and moisture requirements prior to compaction. The subbase course shall be constructed in lifts as established in the control strip, but not less than 4 inches (100 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

219-3.4 Compaction. Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The field density of each compacted lift of material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D698. The moisture content of the material during placing operations shall be within ± 2 percentage points of the optimum moisture content as determined by ASTM D698. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

219-3.5 Weather limitations. Material shall not be placed unless the ambient air temperature is at least 40°F (4°C) and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

219-3.6 Maintenance. The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at their expense.

219-3.7 Surface tolerances. After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

a. Smoothness. The finished surface shall not vary more than 3/8-inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

b. Grade. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +0 and 1/2 inch (12 mm) of the specified grade.

219-3.8 Acceptance sampling and testing for density. Recycled Concrete Aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each [1200 square yds (1000 m²)]. Sampling locations will be determined on a random basis per ASTM D3665

a. Density. The RPR shall perform all density tests.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per ASTM D698. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

b. Thickness. Depth tests shall be made by test holes at least 3 inches (75 mm) in diameter that

extend through the base. The thickness of the base course shall be within +0 and -1/2 inch (12 mm) of the specified thickness as determined by depth tests taken by the Contractor in the presence of the RPR for each area. Where the thickness is deficient by more than 1/2-inch (12 mm), the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches (75 mm), adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

METHOD OF MEASUREMENT

219-4.1 The quantity of recycled concrete aggregate base course will be determined by plan quantity for the number tons of material constructed and accepted as complying with the plans and specifications. No separate payment shall be made for geotextile fabric.

BASIS OF PAYMENT

219-5.1 Payment shall be made at the contract unit price per ton for recycled concrete aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-219-5.1	Recycled Concrete Aggregate Base Course per ton
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REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2700 kN-m/m ³))
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials

EFD Drainage Rehabilitation and Upgrade
HAS No. 954

ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF ITEM P-219

Item T-901 Seeding

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding the areas shown on the plans or as directed by the RPR in accordance with these specifications.

MATERIALS

901-2.1 Seed. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the RPR duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be certified 90 percent pure and furnish 80 percent germination, and shall be applied as follows:

Seed Properties and Rate of Application

Seed	Application Rate (lb/Acre)	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf	30	

901-2.2 Lime. Not required.

901-2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of 10% total nitrogen, 20% available phosphoric acid, and 10% water-soluble potash. They shall be applied at the rate and to the depth specified by the manufacturer, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

- a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
- b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
- c. A granular or pellet form suitable for application by blower equipment.

901-2.4 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the RPR before being placed.

CONSTRUCTION METHODS

901-3.1 Advance preparation and cleanup. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 Dry application method.

a. Liming. Not required.

b. Fertilizing. Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3.

c. Seeding. Grass seed shall be sown at the rate specified in paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.

d. Rolling. After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter) of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot (223 to 298 kg per meter) of width for sandy or light soils.

901-3.3 Wet application method.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall

also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. The Contractor shall identify to the RPR all sources of water at least two (2) weeks prior to use. The RPR may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the RPR following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the RPR, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 Maintenance of seeded areas. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the RPR. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the RPR. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded.

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be paid for shall be the number of units acre measured on the ground surface, completed and accepted.

BASIS OF PAYMENT

901-5.1 Payment shall be made at the contract unit price per acre or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item 901-5.1	Seeding – per acre
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REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C602	Standard Specification for Agricultural Liming Materials
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Federal Specifications (FED SPEC)

FED SPEC	JJJ-S-181, Federal Specification, Seeds, Agricultural
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Advisory Circulars (AC)

AC 150/5200-33	Hazardous Wildlife Attractants on or Near Airports
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EFD Drainage Rehabilitation and Upgrade
HAS No. 954

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM T-901

Item T-904 Sodding

DESCRIPTION

904-1.1 This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the RPR.

MATERIALS

904-2.1 Sod. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 6 inches (150 mm) in height shall be mowed to a height of 3 inches (75 mm) or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions.

904-2.2 Lime. Not required.

904-2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of 10% total nitrogen, 20% available phosphoric acid, and 10% water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

- a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
- b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
- c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be commercial fertilizer and shall be spread at the manufacturer's recommended rate.

904-2.4 Water. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass.

904-2.5 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the RPR before being placed.

CONSTRUCTION METHODS

904-3.1 General. Areas to be solid, strip, or spot sodded shall be shown on the plans. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition that are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the RPR before the various operations are started. The Contractor shall demonstrate to the RPR before starting the various operations that the application of required materials will be made at the specified rates.

904-3.2 Preparing the ground surface. After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

904-3.3 Applying fertilizer and ground limestone. Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 inches (50 mm) by discing, raking, or other suitable methods. Any stones larger than 2 inches (50 mm) in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

904-3.4 Obtaining and delivering sod. After inspection and approval of the source of sod by the RPR, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches (50 mm). Sod sections or strips shall be cut in uniform widths, not less than 10 inches (250 mm), and in lengths of not less than 18 inches (0.5 m), but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, approval to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

904-3.5 Laying sod. Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the RPR, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches (100 mm) immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and ensure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen, when replacing it, shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately one inch (25 mm) below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than one (1) vertical to 2-1/2 horizontal and in v-shaped or flat-bottom ditches or

gutters, the sod shall be pegged with wooden pegs not less than 12 inches (300 mm) in length and have a cross-sectional area of not less than 3/4 sq inch (18 sq mm). The pegs shall be driven flush with the surface of the sod.

904-3.6 Watering. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

904-3.7 Establishing turf. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the RPR. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. Weeds or other undesirable vegetation shall be mowed and the clippings raked and removed from the area.

904-3.8 Repairing. When the surface has become gullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the RPR, and shall then be sodded as specified in paragraph 904-3.5.

METHOD OF MEASUREMENT

904-4.1 This item shall be measured on the basis of the area in square yards of the surface covered with sod and accepted.

BASIS OF PAYMENT

904-5.1 This item will be paid for on the basis of the contract unit price per square yard for sodding, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

Payment will be made under:

Item T-904-5.1 Sodding - per square yard

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

ASTM C602 Standard Specification for Agricultural Liming Materials

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM T-904

SECTION 02233

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for clearing and grubbing is on per acre basis.
 - 2. No separate payment will be made for clearing and grubbing of wastewater projects, include payment in unit prices for related items.
 - 3. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life and features designated to remain are identified and tagged.

3.02 PROTECTION

- A. Protect following from damage or displacement:
 - 1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
 - 2. Plants other than trees and landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Bench marks, monuments, and existing structures designated to remain.

3.03 CLEARING

- A. Remove stumps, main root ball, and root system to:
 - 1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.
 - 2. Depth of 24 inches below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

3.04 REMOVAL

- A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Section 01576 - Waste Material Disposal.
- B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION

SECTION 02260

TRENCH SAFETY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Trench safety system for the construction of trench excavations.
- B. Trench safety system for excavations which fall under provisions of State and Federal trench safety laws.
- C. This Standard Specification Section replaces previously published Section 01561-Trench Safety System.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement for trench safety systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures.
 - 2. No payment will be made under this section for trench safety systems for structural excavations, tunnel shafts, auger pits, or excavation for trenchless installations, and also for any necessary non trenchless installations included in the aforementioned methods of construction unless included as a bid item in Documents 00410 – Bid Form. Include payment for trench safety systems in applicable structural or utility installation sections.
 - 3. Refer to Section 01270 - Measurement and payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 DEFINITIONS

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The trench safety system requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and these installation to dimensions equivalent of a trench as defined.

- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.
- D. Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- D. Review of the safety program by the City Engineer will only be in regard to compliance with this specification and will not constitute approval by the City Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.
- E. Submit certification that trench safety system will not be subjected to loads exceeding those which the system was designed to withstand according to the available construction and geotechnical information.

1.05 REGULATORY REQUIREMENTS

- A. Install and maintain trench safety systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. A reproduction of the OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on City projects. The City assumes no responsibility for the accuracy of the reproduction. The Contractor is responsible for obtaining a copy of this section of the Federal Register.
- C. Legislation that has been enacted by the Texas Legislature with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).
- D. Reference materials, if developed for a specific project, will be issued with the Bid Documents, including the following:

1. Document 00830 - Trench Safety Geotechnical Information:
Geotechnical information obtained for use in design of the trench safety system.

1.06 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the City, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the City in case the City is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.
- B. Install specially designed trench safety systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's Trench Safety Program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.02 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until the necessary precautions have been taken by Contractor to safeguard personnel entering the trench.
- C. Maintain a permanent record of daily inspections.

3.03 FIELD QUALITY CONTROL

- A. Contractor shall verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

END OF SECTION

SECTION 02711

HOT MIX ASPHALT BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foundation course of compacted mixture of coarse and fine aggregates, and asphalt binder.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. Payment for hot mix asphalt base is on a per ton basis.
2. Payment for hot mix asphalt base for transitions and base repairs is on a per ton basis.
3. No separate payment will be made for hot mix asphaltic base for temporary driveway, temporary detour pavement, temporary roadway shoulders, etc. Include payment in unit price for respective driveway (Section 02714 – Flexible Base Course for Temporary Driveways) or temporary pavement (Section 02741 – Asphaltic Concrete Pavement) section.
4. Measurement:
 - a. Match actual pavement area placed or replaced but no greater than maximum pavement replacement limits and thickness designated or shown on Drawings.
 - b. Include installed hot mix asphalt base course material that extends one foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common edge with existing pavement section.
 - c. Actual quantity for payment purpose as measured and calculated in this section shall not exceed the maximum volume-weight conversion rate of 105 pounds per square yard area per inch thickness.
5. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. AASHTO T201 - Standard Specification for Kinematic Viscosity of Asphalts (Bitumens).
- B. AASHTO T202 - Standard Specification for Viscosity of Asphalt by Vacuum Capillary Viscometer.
- C. ASTM C 33 - Standard Specifications for Concrete Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM D 4402 - Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using Rotational Viscometer.
- G. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils.
- H. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material.
- I. TxDOT Tex-200-F- Sieve Analysis of Fine and Coarse Aggregates.
- J. TxDOT Tex-203-F - Sand Equivalent Test.
- K. TxDOT Tex-204-F - Design of Bituminous Mixtures.
- L. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.
- M. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.
- N. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
- C. Submit proposed mix and test data for each type of base course in Work.
- D. Submit manufacturer's description and characteristics of mixing plant for approval.
- E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 PRODUCTS

2.01 MATERIALS

A. Coarse Aggregate:

1. Use crushed gravel or crushed stone, or combination retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious material occurring either free or as coating on aggregate. Conform aggregate to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
2. Reclaimed asphalt pavement (RAP) or reclaimed Portland cement concrete pavement (RPCCP) are permitted as aggregates for hot mix asphalt base course if combined aggregate criteria, gradation, and mixture properties are met.

B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Conform aggregate to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other deleterious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex-106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

C. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C 136. Provide either coarse or fine aggregate where designated on the Drawings.

GRADATION OF COMPOSITE AGGREGATE Percent Passing by Weight or Volume		
Sieve Size	Type A Coarse	Type B Fine Base
1 1/2"	98.0-100.0	-
1 1/4"	-	-
1"	78.0-94.0	98.0-100.0
3/4"	64.0-85.0	84.0-98.0
1/2"	50.0-70.0	-
3/8"	-	60.0 to 80.0
#4	30.0-50.0	40.0 to 60.0
#8	22.0-36.0	29.0-43.0
#30	8.0-23.0	13.0-28.0
# 50	3.0-19.0	6.0-20.0
#200	2.0-7.0	2.0-7.0
VMA % Minimum	12.0	13.0
*2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.		

D. Asphalt Binder: Moisture-free homogeneous material meeting following requirements:

SPECIFICATION	PG 64 – 22
Average 7-day Maximum Pavement Design Temperature, degrees C ^a	<64
Minimum Pavement Design Temperature, degrees C ^a	>-22
Original Binder	
Flash Point Temperature, T48, Minimum degrees C	230
Viscosity, ASTM D 4402, ^b Maximum 3 Pa.s (3000cP), Test Temperature, degrees C	135
Dynamic Shear, TP5; °G*/sine[], Minimum, 1.00kPa Test Temperature @ 10rad/sec, degrees C	64
Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue	
Mass Loss, Maximum, %	- 1.00
Dynamic Shear, TP5; G*/sine[], Minimum, 2.20 kPa Test Temperature @ 10rad/sec, degrees C	64
Pressure Aging Vessel Residue (PPI)	
PAV Aging Temperature, degrees C ^d	100
Dynamic Shear, TP5; G*/sine[], Maximum, 5000 kPa Test Temperature @ 10rad/sec, degrees C	25
Physical Hardening ^e	Report
Creep Stiffness, TP1; ^f S, Maximum, 300 Mpa; m-value, Minimum, 0.300 Test Temperature @ 60 sec, degrees C	-12
Direct Tension, TP3; ^f Failure Strain, Minimum, 1.0%; Test Temperature @ 1.0 mm/min, degrees C	-12
Notes:	
^a Pavement temperature can be estimated from air temperatures using algorithm contained in TxDOT testing procedures.	
^b The requirement may be waived at discretion of Project Manager if supplier warrants that asphalt binder can be adequately pumped and mixed at temperatures that meet applicable safety standards.	
^c For quality control of unmodified asphalt cement production, measurement of viscosity of original asphalt cement may be substituted for dynamic shear measurements of G*/sine [] at test temperature where asphalt is Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometry (AASHTO T 201 or T202).	
^d The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90 C, 100 C, or 110 C. The PAV aging temperature is 100 C for PG64 and PG70.	
^e Physical Hardening - TP 1 is performed on a set of asphalt beams according to Section 13.1, except conditioning time is extended to 24 hours plus or minus 10 minutes at 10 C above minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.	
^f If creep stiffness is below 300 MPa, the direct tension test is not required. If creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of creep stiffness requirement. The m-value requirement must be satisfied in both cases.	

E. Reclaimed asphalt pavement (RAP) may be used at a rate no greater than 20 percent.

2.02 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, the plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
 - 1. Cold aggregate bins and proportioning device
 - 2. Dryer
 - 3. Screens
 - 4. Aggregate weight box and batching scales
 - 5. Mixer
 - 6. Asphalt storage and heating devices
 - 7. Asphalt measuring devices
 - 8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. One cold feet bin per stockpile is required.

2.03 MIXES

- A. Employ certified testing laboratory to prepare design mixes.
 - 1. Test in accordance with TxDOT Tex-126-E, TxDOT Tex-204-F, TxDOT Tex-208-F, and TxDOT Tex-227-F.
 - 2. Verify mixture design properties for plant-produced mixture. Demonstrate that asphalt plant is capable of producing mixture meeting design volumetric and stability requirements before placement begins.
- B. Density, Stability, and Air Voids Requirements. Select asphalt binder content for base courses to result in 3 to 5 percent air voids in laboratory molded specimens, while meeting minimum VMA requirement for selected mixture classification.

Percent Density		Percent	HVEEM Stability Percent	Percent Asphalt Content	
<u>Min</u>	<u>Max.</u>	<u>Optimum</u>	Not Less Than	<u>Min.</u>	<u>Max.</u>
94.5	97.5	96	35	3.5	7

PART 3 EXECUTION

3.01 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Verify lines and grades are correct.
- C. Prepare subgrade in accordance with requirements of Section 02330 - Embankment and Section 02315 - Roadway Excavation or Section 02336 - Lime Stabilized Subgrade and Section 02337 - Lime/Fly-Ash Stabilized Subgrade, and Section 02338 - Portland Cement Stabilized Subgrade. Subgrade preparation may also refer to Section 02321 - Cement Stabilized Sand or Section 02713 - Recycled Crushed Concrete Base Course.
- D. Correct subgrade deviations in excess of plus or minus 1/4 inch in cross section, or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

3.02 PLACEMENT

- A. Place base when surface temperature taken in shade and away from artificial heat is above 40 degrees F and rising. Do not place asphalt base when temperature of surface to receive base course is below 50 degrees F and falling.
- B. Haul prepared and heated asphalt base mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.
- C. Place hot mix asphalt base course in compacted lifts no greater than 4 inches thick, unless permitted in writing by Engineer.
- D. Place courses as nearly continuously as possible. Place material with approved mechanical spreading and finishing machine of screeding or tamping type. Spread lifts to attain smooth course of uniform density to section, line, and grades as indicated on Drawings.
- E. In areas with limited space where use of paver or front-end loader is impractical, spread by hand and compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix; do not broadcast material. Remove lumps that do not break down readily.

3.03 JOINTS

- A. Transverse Joints. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back placed material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- B. Existing pavement. When new asphalt is laid against existing asphalt pavement, saw cut existing asphalt to full depth creating vertical face. Clean joint and apply tack coat before placement.

3.04 COMPACTION

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids. Prepare test strip at least 500 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair line cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water; do not use petroleum by-products.
- C. Compact surface thoroughly and uniformly with power-driven equipment capable of obtaining required compaction. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 175 degrees F.
- D. Along walls, curbs, headers, similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- E. Compact base course to a minimum density of 91 percent (TxDOT Tex-227-F).

3.05 TOLERANCES

- A. Pavement Repairs.
 - 1. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/4 inch.
 - 2. Completed surface, when tested with 10 foot straight edge laid parallel to center line of pavement, shall show no deviation in excess of 1/4 inch in 10 feet. Correct surface not meeting this requirement.

3.06 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Section 01454 - Testing Laboratory Services. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.
- B. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Project Manager.
- C. Request, at option, three additional cores within a 5-foot radius of core indicating nonconforming in-place depth at no additional cost to City. In-place depth at these locations shall be average depth of four cores.
- D. Fill cores and density test sections with new compacted asphalt base or cold patch material.

3.07 NONCONFORMING PAVEMENT

- A. Re-compact and retest nonconforming street sections not meeting surface test requirements. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the City.
- B. Remove and replace areas of asphalt base found deficient in thickness by more than 10 percent. Remove and replace areas of asphalt base found deficient in density. Use new asphalt base of thickness shown on Drawings.
- C. Replace or correct nonconforming pavement sections at no additional cost to City.

3.08 PROTECTION

- A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Drawings.
- B. Maintain asphalt base in good condition until completion of Work.
- C. Repair defects immediately by replacing base to full depth.

END OF SECTION

SECTION 02712

CEMENT STABILIZED BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Foundation course of cement stabilized crushed stone.
- B. Foundation course of cement stabilized bank run gravel.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for cement stabilized base course is on square yard basis. Separate pay items are used for each different required thickness of base course.
 - 2. Payment for asphaltic seal cure is by gallon.
 - 3. Refer to Section 01270 - Measurement and Payment for unit price procedures.
 - 4. Refer to Paragraph 3.09, Unit Price Adjustment.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in Los Angeles Machine.
- B. ASTM C 150 - Standard Specification for Portland Cement.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN kN-m/m³)).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- E. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

- F. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- G. ASTM D 6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- H. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- I. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- J. TxDOT Tex-120-E - Soil-Cement Testing.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit samples of crushed stone, gravel, and soil binder for testing.
- C. Submit manufacturer's description and characteristics for pug mill and associated equipment, spreading machine, and compaction equipment for approval.

1.05 TESTS

- A. Perform testing under provisions of Section 01454 - Testing Laboratory Services.
- B. Perform tests and analysis of aggregate and binder materials in accordance with ASTM D 1557 and ASTM D 4318.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Make stockpiles from layers of processed aggregate to eliminate segregation of materials. Load material by making successive vertical cuts through entire depth of stockpile.
- B. Store cement in weatherproof enclosures. Protect from ground dampness.

PART 2 PRODUCTS

2.01 CEMENT

- A. ASTM C 150 Type I; bulk or sacked.

2.02 WATER

- A. Clean, clear; and free from oil, acids, alkali, or vegetable matter.

2.03 AGGREGATE

- A. Crushed Stone: Material retained on No. 40 Sieve meeting following requirements:
 - 1. Durable particles of crusher-run broken limestone, sandstone, or granite obtained from approved source.
 - 2. Los Angeles abrasion test percent of wear not to exceed 40 when tested in accordance with ASTM C 131.
- B. Gravel: Durable particles of bank run gravel or processed material.
- C. Soil Binder: Material passing No. 40 Sieve meeting following requirements when tested in accordance with ASTM D 4318:
 - 1. Maximum Liquid limit: 35.
 - 2. Maximum Plasticity index: 10.
- D. Mixed aggregate and soil binder shall meet the following requirements:
 - 1. Grading in accordance with TxDOT Tex-101-E and Tex-110-E within the following limits:

Sieve	Percent Retained			
	Crushed Stone	Processed G. 1	Gravel G. 2	Bank run Gravel
1 3/4 inch	0 to 10	0 to 5	-	0 to 5
1/2 inch	-	-	0	-
No. 4	45 to 75	30 to 75	15 to 35	30 to 75
No. 40	55 to 80	60 to 85	55 to 85	65 to 85

- 2. Obtain prior permission from Project Manager for use of additives to meet above requirements.

2.04 ASPHALT SEAL CURE

- A. Cutback Asphalt: MC30 conforming to requirements of Section 02742 - Prime Coat.
- B. Emulsified Petroleum Resin: EPR-1 Prime conforming to requirements of Section 02742 - Prime Coat.

2.05 MATERIAL MIX

- A. Design mix for minimum average compressive strength of 200 psi at 48 hours using TxDOT Tex-120-E unconfined compressive strength testing procedures. Provide minimum cement content of 1 1/2 sacks, weighing 94 pounds each, per ton of mix.
- B. Increase cement content when average compressive strength of tests on field samples fall below 200 psi. Refer to Part 3 concerning field samples and tests.
- C. Mix in stationary pug mill equipped with feeding and metering devices for adding specified quantities of base material, cement, and water into mixer. Dry mix base material and cement sufficiently to prevent cement balls from forming when water is added.
- D. Resulting mixture shall be homogeneous and uniform in appearance.

2.06 SOURCE QUALITY CONTROL

- A. Perform testing under provisions of Section 01454 - Testing Laboratory Services.
- B. Perform testing for unconfined compressive strength by TxDOT Test Method Tex-120-E as follows:
 - 1. Mold three samples each day or for each 300 tons of production.
 - 2. Compressive strength shall be average of three tests for each production lot.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Prepare subgrade in accordance with requirements of Section 02330 - Embankment and Section 02315 - Roadway Excavation.

- C. Correct subgrade deviations in excess of plus or minus 1/4 inch in cross section or in 16 foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
- D. Prepare sufficient subgrade in advance of base course for efficient operations.

3.03 PLACEMENT

- A. Do not mix and place cement stabilized base when temperature is below 40 degrees F and falling. Place base when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.
- B. Place material on prepared subgrade in uniform layers to produce thickness indicated on Drawings. Depth of layers shall not exceed 6 inches.
- C. Spread with approved spreading machine. Conduct spreading so as to eliminate planes of weakness or pockets of non-uniformly graded material resulting from hauling and dumping operations.
- D. Provide construction joints between new material and stabilized base that has been in place 4 hours or longer. Joints shall be approximately vertical. Form joint with temporary header or make vertical cut of previous base immediately before placing subsequent base.
- E. Use only one longitudinal joint at center line under main lanes and shoulder unless shown otherwise on Drawings. Do not use longitudinal joints under frontage roads and ramps unless indicated on Drawings.
- F. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure firm bond between reinforcement and base.

3.04 COMPACTION

- A. Start compaction as soon as possible but not more than 60 minutes from start of moist mixing. Compact loose mixture with approved tamping rollers until entire depth is uniformly compacted. Do not allow stabilized base to mix with underlying material.
- B. Correct irregularities or weak spots immediately by replacing material and recompacting.
- C. Apply water to maintain moisture between optimum and 2 percent above optimum moisture as determined by ASTM D 698. Mix in with spiked tooth harrow or equal. Reshape surface and lightly scarify to loosen imprints made by equipment.
- D. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.

- E. Finish by blading surface to final grade after compacting final course. Seal with approved pneumatic tired rollers which are sufficiently light to prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.
- F. Compact to minimum density of 95 percent of maximum dry density at moisture content of treated material between optimum and 2 percent above optimum as determined by ASTM D 1557, unless otherwise indicated on Drawings.
- G. Maintain surface to required lines and grades throughout operation.

3.05 CURING

- A. Moist cure for minimum of 7 days before adding pavement courses. Restrict traffic on base to local property access. Keep subgrade surface damp by sprinkling.
- B. If indicated on Drawings, cover base surface with curing membrane as soon as finishing operation is complete. Apply with approved self-propelled pressure distributor at following rates, or as indicated on Drawings:
 - 1. MC30: 0.1 gallon per square yard.
 - 2. EPR-1 Prime: 0.15 gallon per square yard.
- C. Do not use cutback asphalt during period of April 16 to September 15.

3.06 TOLERANCES

- A. Smooth and conform completed surface to typical section and established lines and grades.
- B. Top surface of base course: Plus or minus 1 1/4 inch in cross section, or in 16 foot length.

3.07 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Section 01454 - Testing Laboratory Services.
- B. Take minimum of one core at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- C. Request additional cores in vicinity of cores indicating nonconforming in-place depths at no extra cost to City. When average of tests fall below required depth, place additional material and compact at no additional cost to City.
- D. Perform compaction testing in accordance with ASTM D 698 or ASTM D 6938 at randomly selected locations. Remove and replace areas that do not conform to compaction requirements at no additional cost to City.

- E. Fill cores and density test sections with new compacted cement stabilized base.

3.08 NONCONFORMING BASE COURSE

- A. Remove and replace areas of base course found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with cement-stabilized base of thickness shown on Drawings.
- B. Replace nonconforming base course sections at no additional cost to City.

3.09 UNIT PRICE ADJUSTMENT

- A. Make unit price adjustments for in-place depth determined by cores as follows:
 - 1. Adjusted unit price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
 - 2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.

3.10 PROTECTION

- A. Maintain stabilized base in good condition until completion of Work. Repair defects immediately by replacing base to full depth.
- B. Protect asphalt membrane, when used, from being picked up by traffic. Membrane may remain in place when proposed surface courses or other base courses are to be applied.

END OF SECTION

SECTION 02741

ASPHALTIC CONCRETE PAVEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface course of compacted mixture of coarse and fine aggregates and asphaltic binder.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for hot-mix asphalt concrete pavement is on a per ton basis. Separate pay items are used for each different required thickness of pavement.
2. Payment for hot-mix asphalt concrete pavement includes payment for associated work performed in accordance with Section 02743 - Tack Coat.
3. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and includes surface and base materials in accordance with Section 02951 - Pavement Repairs and Restoration.
4. Payment for temporary detour pavement or temporary roadway and shoulder is on a square yard basis and includes surface and base materials, associated grading, maintenance and removal as well as restoration of ditches.
5. Payment for speed humps is on linear foot basis, and includes milling of existing pavement, tack coat, and placement and compaction of asphalt. Measurement of speed hump is along length of 12 foot wide speed hump, measured transverse to centerline of road. Separate payment is made for thermoplastic markings applied to speed hump.
6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates.
- B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

- C. ASTM D 4022 - Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer.
 - D. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils
 - E. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material.
 - F. TxDOT Tex-200-F - Sieve Analysis of Fine and Course Aggregates.
 - G. TxDOT Tex-203-F - Sand Equivalent Test.
 - H. TxDOT Tex-204-F - Design of Bituminous Mixtures.
 - I. TxDOT Tex 206-F - Compacting Test Specimens of Bituminous Mixtures.
 - J. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.
 - K. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.
 - L. TxDOT Tex-217-F - Determining Deleterious Material and Decantation Test for Coarse Aggregates.
 - M. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.
 - N. TxDOT Tex-530-C - Effect of Water on Bituminous Paving Mixtures.
 - O. TxDOT Tex-531-C - Prediction of Moisture Induced Damage to Bituminous Paving Materials Using Molded Specimens.
- 1.04 SUBMITTALS
- A. Conform to requirements of Section 01330 - Submittal Procedures.
 - B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
 - C. Submit proposed design mix and test data for surface course.
 - D. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 PRODUCTS

2.01 MATERIALS

A. Coarse Aggregate:

1. Use gravel, crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Use aggregate conforming to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
2. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay- like particles, or silt when tested in accordance with Tex-217-F, Part II.

B. Fine Aggregate: Sand, stone screenings or combination of both passing No. 10 sieve. Use aggregate conforming to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex-106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

C. Composite Aggregate: Conform to following limits when graded in accordance with TxDOT Tex-200-F. Use type specified on Drawings:

GRADATION OF COMPOSITE AGGREGATE		
SIEVE SIZE	PERCENT PASSING	
	Course Surface (TxDOT Type C)	Fine Surface (TxDOT Type D)
-	-	-
3/4 "	95 to 100	-
1/2"	-	98.0-100.0
3/8"	70.0-85.0	85.0-100.0
#4	43 to 63	50.0 to 70.0
#8	32.0-44.0	35.0-46.0
#30	14.0-28.0	15.0-29.0
# 50	7.0-21.0	7.0-20.0
#200	2.0-7.0	2.0-7.0
VMA % minimum	14.0	15.0

* 2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used.

- D. Asphalt Binder: Moisture-free homogeneous material which will not foam when heated to 347 F, meeting the following requirements.

PERFORMANCE GRADED BINDER	
CRITERIA / TEST	PERFORMANCE GRADE (PG64-22)
Average 7-day Maximum Pavement Design Temperature, C	< 64
Minimum Pavement Design Temperature, C	> -22
ORIGINAL BINDER	
Flash Point Temperature, T48; Minimum C	230
Viscosity, ASTM D 4402; Maximum, 3Pa*s (3000 cP) Test Temperature, C	135
Dynamic Shear, TP5; G*/sin[], Minimum, 1.00 kPa Test Temperature @ 10 rad/sec., C	64
ROLLING THIN FILM OVEN (T240) OR THIN FILM OVEN (T179) RESIDUE	
Mass Loss, Maximum , %	1.00
Dynamic Shear, TP5; G*/sin [], Minimum, 2.20 kPa Test Temperature @ 10 rad/sec., C	64
PRESSURE AGING VESSEL RESIDUE (PP1)	
PAV Aging Temperature, C	100
Dynamic Shear, TP5; G*/sin [], Minimum, 5000 kPa Test Temperature @ 10 rad/sec., C	25
Physical hardening	Report
Creep Stiffness, TP1; S, Maximum, 300 Mpa -value, Minimum, 0.300 Test Temperature @ 60 sec., C	-12
Direct Tension, TP3; Failure Strain, Minimum, 1.0% Test Temperature @ 1.0 mm/min, C	-12

E. Anti-stripping Agent:

1. Evaluate mixture of aggregate, asphalt, and additives proposed for use for moisture susceptibility and requirement for anti-stripping agents. To substantiate mix design, produce and test trial mixtures using proposed project materials and equipment prior to placement. Test for susceptibility to moisture and trial mixture may be waived by Project Manager when similar designs using same material have previously proven satisfactory.
2. Liquid Anti-stripping Agent. Use anti-stripping agent with uniform liquid with no evidence of crystallization, settling, or separation of components. Submit sample of anti-stripping agent proposed for use and manufacturer's product data, including recommended dosage range, handling and storage, and application instructions.

F. Pavement markings for speed humps: Conform to requirements of Section 02767 - Thermoplastic Pavement Markings.

2.02 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
 1. Cold aggregate bins and proportioning device
 2. Dryer
 3. Screens
 4. Aggregate weight box and batching scales
 5. Mixer
 6. Asphalt storage and heating devices
 7. Asphalt measuring devices
 8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. Provide one cold feed bin per stockpile.

2.03 MIXES

A. Employ certified testing laboratory to prepare design mixes. Test in accordance with TxDOT Tex-126-E or Tex-204-F, Tex-206-F, Tex-208-F, Tex-530-C and Tex-531-C.

B. Density, Stability and Air Void Requirements:

Percent Density		Percent	HVEEM Stability Percent
Min	<u>Max.</u>	<u>Optimum</u>	Not Less Than
94.5	97.5	96	35

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted base course is ready to support imposed loads.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Tack Coat: Conform to requirements of Section 02743 - Tack Coat. Where mixture will adhere to surface on which it is to be placed without use of tack coat, tack coat may be eliminated when approved by Project Manager.

B. Prepare subgrade in accordance with requirements of Section 02711 - Hot Mix Asphalt Base Course, Section 02712 - Cement Stabilized Base Course, or Section 02713 - Recycled Crushed Concrete Base Course.

C. Prepare subgrade in advance of asphalt concrete paving operation.

D. Perform pavement repair and resurfacing as indicated in Section 02951 - Pavement Repair and Restoration.

E. Do not use cutback asphalt.

F. Milling of pavement for speed humps: Mill pavement (concrete or asphalt) to depth of one inch and width between 18 and 24 inches around entire perimeter of proposed hump, as shown in detail for speed hump design.

3.03 PLACEMENT

- A. Do not place asphalt pavement less than 2 inches thick when surface temperature taken in shade and away from artificial heat is below 50 F and falling. Asphalt may be placed when temperature is above 40 F and rising.
- B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture temperature shall be between 250 F and 325 F when laid.
- C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.
- D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such a manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Place construction joints on surface courses to coincide with lane lines or as directed by Project Manager.
- E. Joints: Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- F. When new asphalt is laid against existing or old asphalt, saw cut existing or old asphalt to full depth to provide straight smooth joint.
- G. In smaller restricted areas where use of paver is impractical spread material by hand. Compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove lumps that do not break down readily.

3.04 COMPACTION

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids when directed by the Project Manager. Prepare test strip at least 1,000 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without shoving, displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water or petroleum by-products.
- C. Compact surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing a minimum of 8 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length.
- D. Continue rolling until no further compression can be obtained and rolling marks are

eliminated. Complete rolling before mat temperature drops below 185 F.

- E. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.
- F. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- G. Compact binder course and surface course to a minimum density of 91 percent of maximum possible density of voidless mixture composed of same materials in like proportions.

3.05 TOLERANCES

- A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.
- B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct surface not meeting this requirement.
- C. Dimensions of speed humps shall conform to details for speed hump design and speed hump height tolerances.

3.06 QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.
- C. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Project Manager. Average densities for each street placed in a single day to determine compliance.

- D. Contractor may request three additional cores in vicinity of cores indicating nonconforming in-place depths or density at no additional cost to City. In-place depth and density at these locations shall be average of four cores.
- E. Fill cores and density test sections with new compacted asphaltic concrete.
- F. Speed humps: Measure dimensions of completed speed hump, before applying pavement markings, at locations shown on Speed Hump Height Measurement Worksheet. Complete one worksheet for each speed hump, and send completed worksheets to City of Houston, Houston Public Works, Traffic Management and Maintenance Branch, P.O. Box 1562, Houston, Texas, 77251-1562.

3.07 NONCONFORMING PAVEMENT

- A. Recompact and retest nonconforming street sections not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the City.
- B. Remove and replace areas of asphalt surface found deficient in thickness by more than 10 percent. Use new asphaltic surface of thickness shown on Drawings. Remove and replace areas of asphalt surface found deficient in average density.
- C. Replace speed humps which do not conform to requirements of details, or which are rejected by Project Manager.

3.08 PROTECTION

- A. Do not open pavement to traffic until completion of rolling and temperature has cooled to set asphaltic concrete surface, or as shown on Drawings.
- B. Maintain asphalt pavement in good condition until completion of Work.
- C. Repair defects immediately by replacing asphalt pavement to full depth.

3.09 PAVEMENT MARKINGS FOR SPEED HUMPS

- A. Apply pavement markings to speed humps in conformance with dimensions shown on detail for speed hump design.

END OF SECTION

SECTION 02376
CONCRETE CHANNEL LINING AND
CONCRETE INTERCEPTOR STRUCTURES



PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes requirements for constructing concrete channel lining and concrete interceptor structures.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement and payment is as noted on the Unit Price Schedule.
- B. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- C. Toewalls, seal slab, grade beams, joint materials, weep holes, saw cutting, welded connection studs (nelson studs), architectural finishes, and appurtenances will not be measured separately, but are incidental to surface measurement.
- D. Modifications to existing subsurface drainage system to include cutting, removal, piping, non-structural concrete, geotextile, etc. will not be measured separately, but shall be incidental to the surface measurement.
- E. Excavation for concrete channel lining and concrete interceptor structures as measured from finished grade will not be measured separately, but is incidental to concrete channel lining and concrete interceptor structure unit price measurement.

1.3 SUBMITTALS

- A. Refer to Section 01330 - Submittals.
- B. Refer to Section 03310 - Concrete.
- C. Submit shop drawings and/or manufacturer's data for any items noted in Section 1.2 - C.

PART 2 – PRODUCTS

2.1 CONCRETE

- A. Refer to Section 03310 - Concrete.
- B. Provide structural concrete for concrete channel lining and interceptor structures. Refer to Section 03310 - Concrete.
- C. Provide non-structural concrete for the seal slab. Refer to Section 03310 - Concrete.

PART 3 – EXECUTION

3.1 EXCAVATION AND FILL

- A. Excavate the Channel: Refer to Section 02315 - Excavating and Backfilling.
- B. Excavate for Concrete Channel Lining and Concrete Interceptor Structures. Refer to Section 02316 - Structural Excavating and Backfilling.
- C. Refer to Section 03310 - Concrete.

3.2 PREPARATION FOR CONCRETE PLACEMENT

- A. The prepared subgrade or seal slab which forms the base of a concrete placement area should normally be dry at the time of concreting. If the concrete is placed in hot, dry conditions, the base should be lightly dampened with water in advance of concreting. There should be no free water standing on the base, nor water seeping into the placement area, nor should there be any muddy or soft spots when the concrete is placed.

END OF SECTION

Item 169

Soil Retention Blankets



1. DESCRIPTION

Provide and install soil retention blankets (SRB) as shown on the plans or as directed.

2. MATERIALS

Provide only SRB that meet the requirements of [DMS-6370](#), "Soil Retention Blankets," and are on the Approved Products List, *Erosion Control Approved Products*. (<http://www.txdot.gov/business/resources/erosion-control.html>) Use material of the following class and type as shown on the plans and provide a copy of the manufacturer's label for the selected product.

2.1. Class 1: Slope Protection.

2.1.1. Type A. Slopes 3:1 or flatter—clay soils,

2.1.2. Type B. Slopes 3:1 or flatter—sandy soils,

2.1.3. Type C. Slopes steeper than 3:1—clay soils, and

2.1.4. Type D. Slopes steeper than 3:1—sandy soils.

2.2. Class 2: Flexible Channel Liners.

2.2.1. Type E. Biodegradable materials with shear stress less than 2.0 psf,

2.2.2. Type F. Biodegradable materials with shear stress less than 4.0 psf,

2.2.3. Type G. Nonbiodegradable materials with shear stress less than 6.0 psf, and

2.2.4. Type H. Nonbiodegradable materials with shear stress less than 8.0 lb. psf.

3. CONSTRUCTION

Provide a copy of the manufacturer's installation instructions to the Engineer before placement of the material. Place the SRB within 24 hr. after the seeding or sodding operation, or when directed. Install and anchor the SRB in strict accordance with the recommendations contained within the manufacturer's published literature. Installation includes the repair of ruts, reseeding or resodding, and the removal of rocks, clods, and other foreign materials which may prevent contact of the blanket with the soil.

4. MEASUREMENT

This Item will be measured by the square yard of surface area covered.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Soil Retention Blankets" of the class and type specified. This price is full compensation for equipment, materials, labor, tools, and incidentals.

Item 432

Riprap



1. DESCRIPTION

Furnish and place concrete, stone, cement-stabilized, or special riprap.

2. MATERIALS

Furnish materials in accordance with the following Items.

- Item 420, "Concrete Substructures,"
- Item 421, "Hydraulic Cement Concrete,"
- Item 431, "Pneumatically Placed Concrete,"
- Item 440, "Reinforcement for Concrete," and
- [DMS-6200](#), "Filter Fabric."

2.1. **Concrete Riprap.** Use Class B Concrete unless otherwise shown on the plans.

2.2. **Pneumatically Placed Concrete Riprap.** Use Class II concrete that meets Item 431, "Pneumatically Placed Concrete," unless otherwise shown on the plans.

2.3. **Stone Riprap.** Use durable natural stone with a bulk specific gravity of at least 2.50 as determined by [Tex-403-A](#) unless otherwise shown on the plans. Provide stone that, when tested in accordance with [Tex-411-A](#), has weight loss of no more than 18% after 5 cycles of magnesium sulfate solution.

Perform a size verification test on the first 5,000 sq. yd. of finished riprap stone for all types of stone riprap at a location determined by the Engineer. Test the riprap stone in accordance with ASTM D5519. Additional tests may be required. Do not place additional riprap until the initial 5,000 sq. yd. of riprap has been approved.

Provide grout or mortar in accordance with Item 421, "Hydraulic Cement Concrete," when specified. Provide grout with a consistency that will flow into and fill all voids.

Provide filter fabric in accordance with [DMS-6200](#), "Filter Fabric." Provide Type 2 filter fabric for protection stone riprap unless otherwise shown on the plans. Provide Type 2 filter fabric for Type R, F, or Common stone riprap when shown on the plans.

2.3.1. **Type R.** Use stones between 50 and 250 lb. with at least 50% of the stones heavier than 100 lb.

2.3.2. **Type F.** Use stones between 50 and 250 lb. with at least 40% of the stones heavier than 100 lb. Use stones with at least 1 broad flat surface.

2.3.3. **Common.** Use stones between 50 and 250 lb. Use stones that are at least 3 in. in their least dimension. Use stones that are at least twice as wide as they are thick. When shown on the plans or approved, material may consist of broken concrete removed under the Contract or from other approved sources. Cut exposed reinforcement flush with all surfaces before placement of each piece of broken concrete.

2.3.4. **Protection.** Use boulders or quarried rock that meets the gradation requirements of Table 1. Both the width and the thickness of each piece of riprap must be at least 1/3 of the length. When shown on the plans or as approved, material may consist of broken concrete removed under the Contract or from other approved sources. Cut exposed reinforcement flush with all surfaces before placement of each piece of broken

concrete. Determine gradation of the finished, in-place, riprap stone under the direct supervision of the Engineer in accordance with ASTM D5519.

Table 1
In-Place Protection Riprap Gradation Requirements

Size	Maximum Size (lb.)	90% Size ¹ (lb.)	50% Size ² (lb.)	8% Size ³ Minimum (lb.)
12 in.	200	80–180	30–75	3
15 in.	320	170–300	60–165	20
18 in.	530	290–475	105–220	22
21 in.	800	460–720	175–300	25
24 in.	1,000	550–850	200–325	30
30 in.	2,600	1,150–2,250	400–900	40

1. Defined as that size such that 10% of the total riprap stone, by weight, is larger and 90% is smaller.
2. Defined as that size such that 50% of the total riprap stone, by weight, is larger and 50% is smaller.
3. Defined as that size such that 92% of the total riprap stone, by weight, is larger and 8% is smaller.

The Engineer may require in-place verification of the stone size. Determine the in-place size of the riprap stone by taking linear transects along the riprap and measuring the intermediate axis of the stone at select intervals. Place a tape measure along the riprap and determine the intermediate axis size of the stone at 2 ft intervals. Measure a minimum of 100 stones, either in a single transect or in multiple transects, then follow ASTM D5519 Test Procedure Part B to determine the gradation. Table 2 is a guide for comparing the stone size in inches to the stone weight shown in Table 1.

Table 2
Protection Riprap Stone Size¹

Size	Dmax (in.)	D90 (in.)	D50 (in.)	D8 (in.)
12 in.	13.76	10.14–13.29	7.31–9.92	3.39
15 in.	16.10	13.04–15.75	9.21–12.91	6.39
18 in.	19.04	15.58–18.36	11.10–14.21	6.59
21 in.	21.85	18.17–21.09	13.16–15.75	6.88
24 in.	23.53	19.28–22.29	13.76–16.18	7.31
30 in.	32.36	24.65–30.84	17.34–22.72	8.05

1. Based on a Specific Gravity of 2.5 and using the following equation for the intermediate axis diameter $D = \{(12 \cdot W) / (Gs \cdot 62.4 \cdot 0.85)\}^{1/3}$

where:

D = intermediate axis diameter in in.;

W = weight of stone in lbs.;

Gs = Specific Gravity of stone.

Note—If the Specific Gravity of the stone is different than 2.5, then the above equation can be used to determine the appropriate size using the actual Specific Gravity.

If required, provide bedding stone that, in-place, meets the gradation requirements shown in Table 3 or as otherwise shown on the plans. Determine the size distribution in Table 3 in accordance with ASTM D6913.

Table 3
Protection Riprap Bedding Material Gradation Requirements

Sieve Size (Sq. Mesh)	% by Weight Passing
3"	100
1-1/2"	50–80
3/4"	20–60
#4	0–15
#10	0–5

- 2.4. **Cement-Stabilized Riprap.** Provide aggregate that meets Item 247, "Flexible Base," for the type and grade shown on the plans. Use cement-stabilized riprap with 7% hydraulic cement by dry weight of the aggregate.

- 2.5. **Special Riprap.** Furnish materials for special riprap according to the plans.

3. CONSTRUCTION

Dress slopes and protected areas to the line and grade shown on the plans before the placement of riprap. Place riprap and toe walls according to details and dimensions shown on the plans or as directed.

- 3.1. **Concrete Riprap.** Reinforce concrete riprap with 6 × 6 – W2.9 × W2.9 welded wire fabric or with No. 3 or No. 4 reinforcing bars spaced at a maximum of 18 in. in each direction unless otherwise shown. Alternative styles of welded wire fabric that provide at least 0.058 sq. in. of steel per foot in both directions may be used if approved. A combination of welded wire fabric and reinforcing bars may be provided when both are permitted. Provide a minimum 6-in. lap at all splices. Provide horizontal cover of at least 1 in. and no more than 3 in. at the edge of the riprap. Place the first parallel bar no more than 6 in. from the edge of concrete. Use approved supports to hold the reinforcement approximately equidistant from the top and bottom surface of the slab. Adjust reinforcement during concrete placement to maintain correct position.

Sprinkle or sprinkle and consolidate the subgrade before the concrete is placed as directed. All surfaces must be moist when concrete is placed.

Compact and shape the concrete once it has been placed to conform to the dimensions shown on the plans. Finish the surface with a wood float after it has set sufficiently to avoid slumping to secure a smooth surface or broom finish as approved.

Cure the riprap immediately after the finishing operation according to Item 420, "Concrete Substructures."

- 3.2. **Stone Riprap.** Provide the following types of stone riprap when shown on the plans:

- **Dry Riprap.** Stone riprap with voids filled with only spalls or small stones.
- **Grouted Riprap.** Type R, F, or Common stone riprap with voids grouted after all the stones are in place.
- **Mortared Riprap.** Type F stone riprap laid and mortared as each stone is placed.

Use spalls and small stones lighter than 25 lb. to fill open joints and voids in stone riprap, and place to a tight fit.

Place mortar or grout only when the air temperature is above 35°F. Protect work from rapid drying for at least 3 days after placement.

Place filter fabric with the length running up and down the slope unless otherwise approved. Ensure fabric has a minimum overlap of 2 ft. Secure fabric with nails or pins. Use nails at least 2 in. long with washers or U-shaped pins with legs at least 9 in. long. Space nails or pins at a maximum of 10 ft. in each direction and 5 ft. along the seams. Alternative anchorage and spacing may be used when approved.

- 3.2.1. **Type R.** Construct riprap as shown in Figure 1 on the *Stone Riprap Standard* and as shown on the plans. Place stones in a single layer with close joints so most of their weight is carried by the earth and not the adjacent stones. Place the upright axis of the stones at an angle of approximately 90° to the embankment slope. Place each course from the bottom of the embankment upward with the larger stones in the lower courses.

Fill open joints between stones with spalls. Place stones to create a uniform finished top surface. Do not exceed a 6-in. variation between the tops of adjacent stones. Replace, embed deeper, or chip away stones that project more than the allowable amount above the finished surface.

Prevent earth, sand, or foreign material from filling the spaces between the stones when the plans require Type R stone riprap to be grouted. Wet the stones thoroughly after they are in place, fill the spaces between the stones with grout, and pack. Sweep the surface of the riprap with a stiff broom after grouting.

3.2.2. Type F.

3.2.2.1. **Dry Placement.** Construct riprap as shown in Figure 2 on the *Stone Riprap Standard*. Set the flat surface on a prepared horizontal earth bed, and overlap the underlying course to secure a lapped surface. Place the large stones first, roughly arranged in close contact. Fill the spaces between the large stones with suitably sized stones placed to leave the surface evenly stepped and conforming to the contour required. Place stone to drain water down the face of the slope.

3.2.2.2. **Grouting.** Construct riprap as shown in Figure 3 on the *Stone Riprap Standard*. Size, shape, and lay large flat-surfaced stones to produce an even surface with minimal voids. Place stones with the flat surface facing upward parallel to the slope. Place the largest stones near the base of the slope. Fill spaces between the larger stones with stones of suitable size, leaving the surface smooth, tight, and conforming to the contour required. Place the stones to create a plane surface with a variation no more than 6 in. in 10 ft. from true plane. Provide the same degree of accuracy for warped and curved surfaces. Prevent earth, sand, or foreign material from filling the spaces between the stones. Wet the stones thoroughly after they are in place, fill the spaces between them with grout, and pack. Sweep the surface with a stiff broom after grouting.

3.2.2.3. **Mortaring.** Construct riprap as shown in Figure 2 on the *Stone Riprap Standard*. Lap courses as described for dry placement. Wet the stones thoroughly before placing mortar. Bed the larger stones in fresh mortar as they are being placed and shove adjacent stones into contact with one another. Spread excess mortar forced out during placement of the stones uniformly over them to fill all voids completely. Point up all joints roughly either with flush joints or shallow, smooth-raked joints as directed.

3.2.3. **Common.** Construct riprap as shown in Figure 4 on the *Stone Riprap Standard*. Place stones on a bed excavated for the base course. Bed the base course of stone well into the ground with the edges in contact. Bed and place each succeeding course in even contact with the preceding course. Use spalls and small stones to fill any open joints and voids in the riprap. Ensure the finished surface presents an even, tight surface, true to the line and grades of the typical sections.

Prevent earth, sand, or foreign material from filling the spaces between the stones when the plans require grouting common stone riprap. Wet the stones thoroughly after they are in place; fill the spaces between them with grout; and pack. Sweep the surface with a stiff broom after grouting.

3.2.4. **Protection.** Construct riprap as shown in Figure 5 on the *Stone Riprap Standard*. Place riprap stone on the slopes within the limits shown on the plans. Place stone for riprap on the filter fabric to produce a reasonably well-graded mass of riprap with the minimum practicable percentage of voids. Construct the riprap to the lines and grades shown on the plans or staked in the field. A tolerance of +6 in. and -0 in. from the slope line and grades shown on the plans is allowed in the finished surface of the riprap. Place riprap to its full thickness in a single operation. Avoid displacing the filter fabric. Ensure the entire mass of stones in their final position is free from objectionable pockets of small stones and clusters of larger stones. Do not place riprap in layers, and do not place it by dumping it into chutes, dumping it from the top of the slope, pushing it from the top of the slope, or any method likely to cause segregation of the various sizes. Obtain the desired distribution of the various sizes of stones throughout the mass by selective loading of material at the quarry or other source or by other methods of placement that will produce the specified results. Rearrange individual stones by mechanical equipment or by hand if necessary to obtain a reasonably well-graded distribution of stone sizes. Use the bedding thickness shown and place stone for riprap on the bedding material to produce a reasonably well-graded mass of riprap with the minimum practicable percentage of voids if required on the plans.

3.3. **Pneumatically Placed Concrete Riprap, Class II.** Meet Item 431, "Pneumatically Placed Concrete." Provide reinforcement following the details on the plans and Item 440, "Reinforcement for Concrete." Support reinforcement with approved supports throughout placement of concrete.

Give the surface a wood-float finish or a gun finish as directed. Cure the riprap with membrane-curing compound immediately after the finishing operation in accordance with Item 420, "Concrete Substructures."

- 3.4. **Cement-Stabilized Riprap.** Follow the requirements of the plans and the provisions for concrete riprap except when reinforcement is not required. The Engineer will approve the design and mixing of the cement-stabilized riprap.
- 3.5. **Special Riprap.** Construct special riprap according to the plans.

4. MEASUREMENT

This Item will be measured by the cubic yard of material complete in place. Volume will be computed on the basis of the measured area in place and the thickness and toe wall width shown on the plans.

If required on the plans, the pay quantity of the bedding material for stone riprap for protection to be paid for will be measured by the cubic yard as computed from the measured area in place and the bedding thickness shown on the plans.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Riprap" of the type, thickness, and void-filling technique (Dry, Grout, Mortar) specified, as applicable. This price is full compensation for furnishing, hauling, and placing riprap and for filter fabric, expansion joint material, concrete and reinforcing steel, grout and mortar, scales, test weights, equipment, labor, tools, and incidentals.

Payment for excavation of toe wall trenches, for all necessary excavation below natural ground or bottom of excavated channel, and for shaping of slopes for riprap will be included in the unit price bid per cubic yard of riprap.

When bedding is required for protection stone riprap, payment will be made at the unit price for "Bedding Material" of the thickness specified. This price is full compensation for furnishing, hauling, placing, and maintaining the bedding material until placement of the riprap cover is completed and accepted; excavation required for placement of bedding material; and equipment, scales, test weights, labor, tools, and incidentals. No payment will be made for excess thickness of bedding nor for material required to replace embankment material lost by rain wash, wind erosion, or otherwise.

Item 506

Temporary Erosion, Sedimentation, and Environmental Controls



1. DESCRIPTION

Install, maintain, and remove erosion, sedimentation, and environmental control measures to prevent or reduce the discharge of pollutants in accordance with the Storm Water Pollution Prevention Plan (SWP3) on the plans and the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000. Control measures are defined as Best Management Practices used to prevent or reduce the discharge of pollutants. Control measures include, but are not limited to, rock filter dams, temporary pipe slope drains, temporary paved flumes, construction exits, earthwork for erosion control, pipe, construction perimeter fence, sandbags, temporary sediment control fence, biodegradable erosion control logs, vertical tracking, temporary or permanent seeding, and other measures. Erosion and sediment control devices must be selected from the *Erosion Control Approved Products* or *Sediment Control Approved Products* lists. Perform work in a manner to prevent degradation of receiving waters, facilitate project construction, and comply with applicable federal, state, and local regulations. Ensure the installation and maintenance of control measures is performed in accordance with the manufacturer's or designer's specifications.

Provide the Contractor Certification of Compliance before performing SWP3 or soil disturbing activities. By signing the Contractor Certification of Compliance, the Contractor certifies they have read and understand the requirements applicable to this project pertaining to the SWP3, the plans, and the TPDES General Permit TXR150000. The Contractor is responsible for any penalties associated with non-performance of installation or maintenance activities required for compliance. Ensure the most current version of the certificate is executed for this project.

2. MATERIALS

Furnish materials in accordance with the following:

- Item 161, "Compost,"
- Item 432, "Riprap," and
- Item 556, "Pipe Underdrains."

2.1. Rock Filter Dams.

2.1.1. **Aggregate.** Furnish aggregate with approved hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding. Provide the following:

- Types 1, 2, and 4 Rock Filter Dams. Use 3 to 6 in. aggregate.
- Type 3 Rock Filter Dams. Use 4 to 8 in. aggregate.

2.1.2. **Wire.** Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

- a double-twisted, hexagonal weave with a nominal mesh opening of 2-1/2 × 3-1/4 in.;
- minimum 0.0866 in. steel wire for netting;
- minimum 0.1063 in. steel wire for selvages and corners; and
- minimum 0.0866 in. for binding or tie wire.

2.1.3. **Sandbag Material.** Furnish sandbags meeting Section 506.2.8., "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

- 2.2. **Temporary Pipe Slope Drains.** Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans. Recycled and other materials meeting these requirements are allowed if approved.
- Furnish concrete in accordance with Item 432, "Riprap."
- 2.3. **Temporary Paved Flumes.** Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of 1/2 cu. ft. for the construction of energy dissipaters.
- 2.4. **Construction Exits.** Provide materials that meet the details shown on the plans and this Section.
- 2.4.1. **Rock Construction Exit.** Provide crushed aggregate for long- and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft or flaky materials, and organic and injurious matter. Use 4- to 8-in. aggregate for Type 1. Use 2- to 4-in. aggregate for Type 3.
- 2.4.2. **Timber Construction Exit.** Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed. Provide plywood or pressed wafer board at least 1/2 in. thick for short-term exits.
- 2.4.3. **Foundation Course.** Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.
- 2.5. **Embankment for Erosion Control.** Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.
- 2.6. **Pipe.** Provide pipe outlet material in accordance with Item 556, "Pipe Underdrains," and details shown on the plans.
- 2.7. **Construction Perimeter Fence.**
- 2.7.1. **Posts.** Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in., or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.
- 2.7.2. **Fence.** Provide orange construction fencing as approved.
- 2.7.3. **Fence Wire.** Provide 14 gauge or larger galvanized smooth or twisted wire. Provide 16 gauge or larger tie wire.
- 2.7.4. **Flagging.** Provide brightly-colored flagging that is fade-resistant and at least 3/4 in. wide to provide maximum visibility both day and night.
- 2.7.5. **Staples.** Provide staples with a crown at least 1/2 in. wide and legs at least 1/2 in. long.
- 2.7.6. **Used Materials.** Previously used materials meeting the applicable requirements may be used if approved.
- 2.8. **Sandbags.** Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%.

Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags. Filled sandbags must be 24 to 30 in. long, 16 to 18 in. wide, and 6 to 8 in. thick.

Table 1
Sand Gradation

Sieve Size	Retained (% by Weight)
#4	Maximum 3%
#100	Minimum 80%
#200	Minimum 95%

Aggregate may be used instead of sand for situations where sandbags are not adjacent to traffic. The aggregate size must not exceed 3/8 in.

- 2.9. **Temporary Sediment Control Fence.** Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed.
- 2.9.1. **Fabric.** Provide fabric materials in accordance with [DMS-6230](#), "Temporary Sediment Control Fence Fabric."
- 2.9.2. **Posts.** Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Furnish soft wood posts at least 3 in. in diameter, or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/2 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.
- 2.9.3. **Net Reinforcement.** Provide net reinforcement of at least 12.5 gauge (SWG) galvanized welded wire mesh, with a maximum opening size of 2 × 4 in., at least 24 in. wide, unless otherwise shown on the plans.
- 2.9.4. **Staples.** Provide staples with a crown at least 3/4 in. wide and legs 1/2 in. long.
- 2.9.5. **Used Materials.** Use recycled material meeting the applicable requirements if approved.
- 2.10. **Biodegradable Erosion Control Logs.**
- 2.10.1. **Core Material.** Furnish core material that is biodegradable or recyclable. Use compost, mulch, aspen excelsior wood fibers, chipped site vegetation, agricultural rice or wheat straw, coconut fiber, 100% recyclable fibers, or any other acceptable material unless specifically called out on the plans. Permit no more than 5% of the material to escape from the containment mesh. Furnish compost meeting the requirements of Item 161, "Compost."
- 2.10.2. **Containment Mesh.** Furnish containment mesh that is 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material.
- Furnish biodegradable or photodegradable containment mesh when log will remain in place as part of a vegetative system.
- Furnish recyclable containment mesh for temporary installations.
- 2.10.3. **Size.** Furnish biodegradable erosion control logs with diameters shown on the plans or as directed. Stuff containment mesh densely so logs do not deform.

3. QUALIFICATIONS, TRAINING, AND EMPLOYEE REQUIREMENTS

- 3.1. **Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities.** Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for the storm water management program. The CRPE will implement storm water and erosion control practices; will oversee and observe storm water control measure monitoring and management; will monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or on contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on

how to improve the effectiveness of control measures. Attend the Department's preconstruction conference for the project. Ensure training is completed as identified in Section 506.3.3., "Training," by all applicable personnel before employees work on the project. Document and submit a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and date the employee completed the training. Provide the most current list at the preconstruction conference or before SWP3 or soil disturbing activities. Update the list as needed and provide the updated list when updated.

- 3.2. **Contractor Superintendent Qualifications and Responsibilities.** Provide a superintendent that is competent, has experience with and knowledge of storm water management, and is knowledgeable of the requirements and the conditions of the TPDES General Permit TXR150000. The superintendent will manage and oversee the day to day operations and activities at the project site; work with the CRPE to provide effective storm water management at the project site; represent and act on behalf of the Contractor; and attend the Department's preconstruction conference for the project.
- 3.3. **Training.** All Contractor and subcontractor employees involved in soil disturbing activities, small or large structures, storm water control measures, and seeding activities must complete training as prescribed by the Department.

4. CONSTRUCTION

- 4.1. **Contractor Responsibilities.** Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed. Coordinate storm water management with all other work on the project. Develop and implement an SWP3 for project-specific material supply plants within and outside of the Department's right of way in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site.
- 4.2. **Implementation.** The CRPE, or alternate CRPE, must be accessible by phone and able to respond to project-related storm water management or other environmental emergencies 24 hr. per day.
- 4.2.1. **Commencement.** Implement the SWP3 as shown and as directed. Contractor-proposed recommendations for changes will be allowed as approved. Conform to the established guidelines in the TPDES General Permit TXR150000 to make changes. Do not implement changes until approval has been received and changes have been incorporated into the plans. Minor adjustments to meet field conditions are allowed and will be recorded in the SWP3.
- 4.2.2. **Phasing.** Implement control measures before the commencement of activities that result in soil disturbance. Phase and minimize the soil disturbance to the areas shown on the plans. Coordinate temporary control measures with permanent control measures and all other work activities on the project to assure economical, effective, safe, and continuous water pollution prevention. Provide control measures that are appropriate to the construction means, methods, and sequencing allowed by the Contract. Exercise precaution throughout the life of the project to prevent pollution of ground waters and surface waters. Schedule and perform clearing and grubbing operations so that stabilization measures will follow immediately thereafter if project conditions permit. Bring all grading sections to final grade as soon as possible and implement temporary and permanent control measures at the earliest time possible. Implement temporary control measures when required by the TPDES General Permit TXR150000 or otherwise necessitated by project conditions.
- Do not prolong final grading and shaping. Preserve vegetation where possible throughout the project, and minimize clearing, grubbing, and excavation within stream banks, bed, and approach sections.
- 4.3. **General.**
- 4.3.1. **Temporary Alterations or Control Measure Removal.** Altering or removal of control measures is allowed when control measures are restored within the same working day.

- 4.3.2. **Stabilization.** Initiate stabilization for disturbed areas no more than 14 days after the construction activities in that portion of the site have temporarily or permanently ceased. Establish a uniform vegetative cover or use another stabilization practice in accordance with the TPDES General Permit TXR150000.
- 4.3.3. **Finished Work.** Remove and dispose of all temporary control measures upon acceptance of vegetative cover or other stabilization practice unless otherwise directed. Complete soil disturbing activities and establish a uniform perennial vegetative cover. A project will not be considered for acceptance until a vegetative cover of 70% density of existing adjacent undisturbed areas is obtained or equivalent permanent stabilization is obtained in accordance with the TPDES General Permit TXR150000. An exception will be allowed in arid areas as defined in the TPDES General Permit TXR150000.
- 4.3.4. **Restricted Activities and Required Precautions.** Do not discharge onto the ground or surface waters any pollutants such as chemicals, raw sewage, fuels, lubricants, coolants, hydraulic fluids, bitumens, or any other petroleum product. Operate and maintain equipment on-site to prevent actual or potential water pollution. Manage, control, and dispose of litter on-site such that no adverse impacts to water quality occur. Prevent dust from creating a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. Wash out concrete trucks only as described in the TPDES General Permit TXR150000. Use appropriate controls to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water (i.e., dewatering). Prevent discharges that would contribute to a violation of Edwards Aquifer Rules, water quality standards, the impairment of a listed water body, or other state or federal law.
- 4.4. **Installation, Maintenance, and Removal Work.** Perform work in accordance with the SWP3, according to manufacturers' guidelines, and in accordance with the TPDES General Permit TXR150000. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until soil disturbing activities are completed and permanent erosion control features are in place or the disturbed area has been adequately stabilized as approved.

The Department will inspect and document the condition of the control measures at the frequency shown on the plans and will provide the Construction SWP3 Field Inspection and Maintenance Reports to the Contractor. Make corrections as soon as possible before the next anticipated rain event or within 7 calendar days after being able to enter the worksite for each control measure. The only acceptable reason for not accomplishing the corrections with the time frame specified is when site conditions are "Too Wet to Work." Take immediate action if a correction is deemed critical as directed. When corrections are not made within the established time frame, all work will cease on the project and time charges will continue while the control measures are brought into compliance. Commence work once the Engineer reviews and documents the project is in compliance. Commencing work does not release the Contractor of the liability for noncompliance of the SWP3, plans, or TPDES General Permit TXR150000.

The Engineer may limit the disturbed area if the Contractor cannot control soil erosion and sedimentation resulting from the Contractor's operations. Implement additional controls as directed.

Remove devices upon approval or as directed. Finish-grade and dress the area upon removal. Stabilize disturbed areas in accordance with the permit, and as shown on the plans or directed. Materials removed are considered consumed by the project. Retain ownership of stockpiled material and remove it from the project when new installations or replacements are no longer required.

- 4.4.1. **Rock Filter Dams for Erosion Control.** Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor's option.

Place the aggregate to the lines, height, and slopes specified, without undue voids for Types 1, 2, 3, and 5. Place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings for Types 2 and 3, or as directed. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams according to the following criteria unless otherwise shown on the plans:

- 4.4.1.1. **Type 1 (Non-Reinforced).**
- **Height.** At least 18 in. measured vertically from existing ground to top of filter dam.
 - **Top Width.** At least 2 ft.
 - **Slopes.** No steeper than 2:1.
- 4.4.1.2. **Type 2 (Reinforced).**
- **Height.** At least 18 in. measured vertically from existing ground to top of filter dam.
 - **Top Width.** At least 2 ft.
 - **Slopes.** No steeper than 2:1.
- 4.4.1.3. **Type 3 (Reinforced).**
- **Height.** At least 36 in. measured vertically from existing ground to top of filter dam.
 - **Top Width.** At least 2 ft.
 - **Slopes.** No steeper than 2:1.
- 4.4.1.4. **Type 4 (Sack Gabions).** Unfold sack gabions and smooth out kinks and bends. Connect the sides by lacing in a single loop–double loop pattern on 4- to 5-in. spacing for vertical filling. Pull the end lacing rod at one end until tight, wrap around the end, and twist 4 times. Fill with stone at the filling end, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires 4 times.
- Place the sack flat in a filling trough, fill with stone, connect sides, and secure ends as described above for horizontal filling.
- Lift and place without damaging the gabion. Shape sack gabions to existing contours.
- 4.4.1.5. **Type 5.** Provide rock filter dams as shown on the plans.
- 4.4.2. **Temporary Pipe Slope Drains.** Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in. lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed. Form the top of the embankment or earth dike over the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points. Secure the pipe with hold-downs or hold-down grommets spaced a maximum of 10 ft. on center. Construct the energy dissipaters or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete or rubble riprap in accordance with Item 432, "Riprap," when designated on the plans.
- 4.4.3. **Temporary Paved Flumes.** Construct paved flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above, to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.
- 4.4.4. **Construction Exits.** Prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits when tracking conditions exist. Construct exits for either long- or short-term use.
- 4.4.4.1. **Long-Term.** Place the exit over a foundation course as required. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.
- 4.4.4.1.1. **Type 1.** Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.
- 4.4.4.1.2. **Type 2.** Construct using railroad ties and timbers as shown on the plans or as directed.

- 4.4.4.2. **Short-Term.**
- 4.4.4.2.1. **Type 3.** Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.
- 4.4.4.2.2. **Type 4.** Construct as shown on the plans or as directed.
- 4.4.5. **Earthwork for Erosion Control.** Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.
- 4.4.5.1. **Excavation and Embankment for Erosion Control Features.** Place earth dikes, swales, or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed.
- Create a sediment basin, where required, providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.
- 4.4.5.2. **Excavation of Sediment and Debris.** Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.
- 4.4.6. **Construction Perimeter Fence.** Construct, align, and locate fencing as shown on the plans or as directed.
- 4.4.6.1. **Installation of Posts.** Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8 to 10 ft.
- 4.4.6.2. **Wire Attachment.** Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.
- 4.4.6.3. **Flag Attachment.** Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.
- 4.4.7. **Sandbags for Erosion Control.** Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags 1/2 the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.
- 4.4.8. **Temporary Sediment-Control Fence.** Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.
- 4.4.8.1. **Installation of Posts.** Embed posts at least 18 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the runoff source.
- 4.4.8.2. **Fabric Anchoring.** Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 × 6 in. Place the fabric against the side of the trench and align approximately 2 in. of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.
- 4.4.8.3. **Fabric and Net Reinforcement Attachment.** Attach the reinforcement to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced unless otherwise shown on the plans. Sewn

vertical pockets may be used to attach reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.

- 4.4.8.4. **Fabric and Net Splices.** Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced unless otherwise shown on the plans. Do not locate splices in concentrated flow areas.

Requirements for installation of used temporary sediment-control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than 1 patch every 15 to 20 ft.),
- posts without bends, and
- backing without holes.

- 4.4.9. **Biodegradable Erosion Control Logs.** Install biodegradable erosion control logs near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the biodegradable erosion control logs into the erosion measures used to control sediment in areas of higher flow. Install, align, and locate the biodegradable erosion control logs as specified below, as shown on the plans, or as directed.

Secure biodegradable erosion control logs in a method adequate to prevent displacement as a result of normal rain events, prevent damage to the logs, and as approved, such that flow is not allowed under the logs. Temporarily removing and replacing biodegradable erosion logs as to facilitate daily work is allowed at the Contractor's expense.

- 4.4.10. **Vertical Tracking.** Perform vertical tracking on slopes to temporarily stabilize soil. Provide equipment with a track undercarriage capable of producing a linear soil impression measuring a minimum of 12 in. long × 2 to 4 in. wide × 1/2 to 2 in. deep. Do not exceed 12 in. between track impressions. Install continuous linear track impressions where the 12 in. length impressions are perpendicular to the slope. Vertical tracking is required on projects where soil disturbing activities have occurred unless otherwise approved.

- 4.5. **Monitoring and Documentation.** Monitor the control measures on a daily basis as long as there are BMPs in place and/or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or contract non-work days, daily inspections are not required unless a rain event has occurred. Monitoring will consist of, but is not limited to, observing, inspecting, and documenting site locations with control measures and discharge points to provide maintenance and inspection of controls as described in the SWP3. Keep written records of daily monitoring. Document in the daily monitoring report the control measure condition, the date of inspection, required corrective actions, responsible person for making the corrections, and the date corrective actions were completed. Maintain records of all monitoring reports at the project site or at an approved place. Provide copies within 7 days. Together, the CRPE and an Engineer's representative will complete the Construction Stage Gate Checklist on a periodic basis as directed.

5. MEASUREMENT

- 5.1. **Rock Filter Dams.** Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.
- 5.1.1. **Linear Measurement.** When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.
- 5.1.2. **Volume Measurement.** When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.
- 5.1.2.1. **Installation.** Measurement will be made in final position.
- 5.1.2.2. **Removal.** Measurement will be made at the point of removal.

- 5.2. **Temporary Pipe Slope Drains.** Temporary pipe slope drains will be measured by the foot.
- 5.3. **Temporary Paved Flumes.** Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.
- 5.4. **Construction Exits.** Construction exits will be measured by the square yard of surface area.
- 5.5. **Earthwork for Erosion and Sediment Control.**
- 5.5.1. **Equipment and Labor Measurement.** Equipment and labor used will be measured by the actual number of hours the equipment is operated and the labor is engaged in the work.
- 5.5.2. **Volume Measurement.**
- 5.5.2.1. **In Place.**
- 5.5.2.1.1. **Excavation.** Excavation will be measured by the cubic yard in its original position and the volume computed by the method of average end areas.
- 5.5.2.1.2. **Embankment.** Embankment will be measured by the cubic yard in its final position by the method of average end areas. The volume of embankment will be determined between:
- the original ground surfaces or the surface upon that the embankment is to be constructed for the feature and
 - the lines, grades and slopes of the accepted embankment for the feature.
- 5.5.2.2. **In Vehicles.** Excavation and embankment quantities will be combined and paid for under "Earthwork (Erosion and Sediment Control, In Vehicle)." Excavation will be measured by the cubic yard in vehicles at the point of removal. Embankment will be measured by the cubic yard in vehicles measured at the point of delivery. Shrinkage or swelling factors will not be considered in determining the calculated quantities.
- 5.6. **Construction Perimeter Fence.** Construction perimeter fence will be measured by the foot.
- 5.7. **Sandbags for Erosion Control.** Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.
- 5.8. **Temporary Sediment-Control Fence.** Installation or removal of temporary sediment-control fence will be measured by the foot.
- 5.9. **Biodegradable Erosion Control Logs.** Installation or removal of biodegradable erosion control logs will be measured by the foot along the centerline of the top of the control logs.
- 5.10. **Vertical Tracking.** Vertical tracking will not be measured or paid for directly but is considered subsidiary to this item.

6. PAYMENT

The following will not be paid for directly but are subsidiary to pertinent items:

- erosion-control measures for Contractor project-specific locations (PSLs) inside and outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, plants, and material sources);
- removal of litter, unless a separate pay item is shown on the plans;
- repair to devices and features damaged by Contractor operations;
- added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;

- removal and reinstallation of devices and features needed for the convenience of the Contractor;
- finish grading and dressing upon removal of the device; and
- minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

Stabilization of disturbed areas will be paid for under pertinent Items except vertical tacking which is subsidiary.

Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly but is subsidiary to the excavation and embankment under this Item.

6.1. **Rock Filter Dams.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.1.1. **Installation.** Installation will be paid for as "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.1.2. **Removal.** Removal will be paid for as "Rock Filter Dams (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for "Rock Filter Dams (Remove)" and for "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.2. **Temporary Pipe Slope Drains.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Pipe Slope Drains" of the size specified. This price is full compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for "Temporary Pipe Slope Drains" of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 432, "Riprap."

6.3. **Temporary Paved Flumes.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Paved Flume (Install)" or "Temporary Paved Flume (Remove)." This price is full compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for "Temporary Paved Flume (Remove)" and "Temporary Paved Flume (Install)." These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

- 6.4. **Construction Exits.** Contractor-required construction exits from off right of way locations or on-right of way PSLs will not be paid for directly but are subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for construction exits needed on right of way access to work areas required by the Department will be paid for at the unit price bid for "Construction Exits (Install)" of the type specified or "Construction Exits (Remove)." This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for "Construction Exit (Remove)" and "Construction Exit (Install)" of the type specified. These prices are full compensation for the removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be measured and paid for under "Earthwork for Erosion and Sediment Control."

- 6.5. **Earthwork for Erosion and Sediment Control.**

- 6.5.1. **Initial Earthwork for Erosion and Sediment Control.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Erosion and Sediment Control, In Place)," "Embankment (Erosion and Sediment Control, In Place)," "Excavation (Erosion and Sediment Control, In Vehicle)," "Embankment (Erosion and Sediment Control, (In Vehicle)," or "Earthwork (Erosion and Sediment Control, In Vehicle)."

This price is full compensation for excavation and embankment including hauling, disposal of material not used elsewhere on the project; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

- 6.5.2. **Maintenance Earthwork for Erosion and Sediment Control for Cleaning and Restoring Control Measures.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid under a Contractor Force Account Item from invoice provided to the Engineer.

This price is full compensation for excavation, embankment, and re-grading including removal of accumulated sediment in various erosion control installations as directed, hauling, and disposal of material not used elsewhere on the project; excavation for construction of erosion-control features; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Earthwork needed to remove and obliterate erosion-control features will not be paid for directly but is subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

- 6.6. **Construction Perimeter Fence.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Construction Perimeter Fence." This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will be not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and replaced, payment will be made at the unit price bid for "Construction Perimeter Fence," which is full compensation for the removal and reinstallation of the construction perimeter fence.

- 6.7. **Sandbags for Erosion Control.** Sandbags will be paid for at the unit price bid for “Sandbags for Erosion Control” (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.
- Removal of sandbags will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for “Sandbags for Erosion Control,” which is full compensation for the reinstallation of the sandbags.
- 6.8. **Temporary Sediment-Control Fence.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid as follows:
- 6.8.1. **Installation.** Installation will be paid for as “Temporary Sediment-Control Fence (Install).” This price is full compensation for furnishing and operating equipment finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.
- 6.8.2. **Removal.** Removal will be paid for as “Temporary Sediment-Control Fence (Remove).” This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.
- 6.9. **Biodegradable Erosion Control Logs.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid as follows:
- 6.9.1. **Installation.** Installation will be paid for as “Biodegradable Erosion Control Logs (Install)” of the size specified. This price is full compensation for furnishing and operating equipment finish backfill and grading, staking, proper disposal, labor, materials, tools, and incidentals.
- 6.9.2. **Removal.** Removal will be paid for as “Biodegradable Erosion Control Logs (Remove).” This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.
- 6.10. **Vertical Tracking.** Vertical tracking will not be measured or paid for directly but is considered subsidiary to this Item.

Item 540

Metal Beam Guard Fence



1. DESCRIPTION

Furnish, install, replace, or adjust metal beam guard fence consisting of metal beam rail elements, hardware, blocks, and support posts.

2. MATERIALS

Provide samples of metal beam rail elements, terminal sections, bolts, and nuts for compliance testing according to [Tex-708-I](#) and [Tex-713-I](#) to verify physical and chemical properties meet AASHTO M 180 when directed.

Obtain materials at the locations shown on the plans when the plans designate that the Department will furnish materials.

- 2.1. **Metal Beam Rail Elements.** Furnish new metal beam rail elements, transitions, anchor sections, and terminals that meet the requirements of Table 1 and are from a manufacturer on the Department's MPL of rail element manufacturers.

Type I or II is required, unless otherwise shown on the plans. Base metal for metal beam rail elements must not contain more than 0.04% phosphorous or more than 0.05% sulfur.

Warped or deformed rail elements will be rejected.

Table 1
Rail Element Requirements

Specification	AASHTO M 180
Class	A— Base metal nominal thickness 0.105 in. B— Base metal nominal thickness 0.135 in.
Type	I— Zinc-coated 1.80 oz. per square foot minimum single-spot. II— Zinc-coated 3.60 oz. per square foot minimum single-spot. IV— Weathering Steel (required when shown on the plans).
Shape	W-Beam Thrie Beam W-Beam to Thrie Beam Transition
Markings	Permanently mark each metal beam rail element with the information required in AASHTO M 180. In addition, permanently mark all curved sections of metal beam rail element with the radius of the curved section in the format "R=XX ft." Markings must be on the back of the metal beam rail section away from traffic and visible after erection.

- 2.2. **Posts.** Furnish new round timber, rectangular timber, or rolled steel section posts in accordance with details shown on the plans and the following requirements:

- 2.2.1. **Timber Posts.** Meet the requirements of [DMS-7200](#), "Timber Posts and Blocks for Metal Beam Guard Fence." Purchase from a manufacturer or supplier on the Department's MPL of timber treating plants and suppliers.

- 2.2.2. **Steel Posts.** Provide rolled sections conforming to the material requirements of ASTM A36. Drill or punch posts for standard rail attachment as shown on the plans. Galvanize according to Item 445, "Galvanizing." Low-fill culvert posts may be fabricated as galvanized "blanks" with the rail hole and the final height field

fabricated. Treat all exposed post surfaces caused by the field fabrication in accordance with Section 445.3.5., "Repairs."

- 2.3. **Blocks.** Furnish new rectangular timber or composite blocks in accordance with details shown on the plans and the following requirements:
- 2.3.1. **Timber.** Meet the requirements of [DMS-7200](#), "Timber Posts and Blocks for Metal Beam Guard Fence." Purchase from a manufacturer or supplier on the Department's MPL of timber treating plants and suppliers.
- 2.3.2. **Composite.** Meet the requirements of [DMS-7210](#), "Composite Material Posts and Blocks for Metal Beam Guard Fence." Purchase from a manufacturer on the Department's MPL of composite material blocks and posts.
- 2.4. **Fittings.** Furnish new fittings (bolts, nuts, and washers) according to the details shown on the plans and galvanized according to Item 445, "Galvanizing."
- 2.5. **Terminal Connectors.** Furnish new terminal connectors, where required, meeting the material and galvanizing requirements specified for metal beam rail elements.
- 2.6. **Concrete.** Furnish concrete for terminal anchor posts meeting the requirements for Class A concrete as required in Item 421, "Hydraulic Cement Concrete."
- 2.7. **Curb.** If indicated in the details, furnish the curb shown with metal beam guard fence transition as required by Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."
- 2.8. **Terminal Anchor Posts.** Furnish new terminal anchor posts from steel conforming to the material requirements of ASTM A36. Fabricate posts according to Item 441, "Steel Structures." Galvanize terminal anchor posts after fabrication according to Item 445, "Galvanizing."
- 2.9. **Driveway Terminal Anchor Posts.** Furnish new terminal anchor posts from steel conforming to the material requirements of ASTM A36. Fabricate posts according to Item 441, "Steel Structures." Galvanize terminal anchor posts after fabrication according to Item 445, "Galvanizing."
- 2.10. **Downstream Anchor Posts.** Furnish new terminal anchor posts consisting of new rectangular timber and new steel foundation tubes according to details shown on the plans.
- 2.11. **Downstream Anchor Hardware.** Furnish new hardware (brackets, plates, struts, cable, etc.) according to the details shown on the plans and galvanized according to Item 445, "Galvanizing."
- 2.12. **Controlled Released Terminal (CRT) Posts.** Furnish new CRT posts according to the details shown on the plans and conforming to the requirements of [DMS-7200](#), "Timber Posts and Blocks for Metal Beam Guard Fence." Purchase from a manufacturer or supplier on the Department's MPL of timber treating plants and suppliers.

3. CONSTRUCTION

Install posts and rail elements according to details shown on the plans.

- 3.1. **Posts.** Install posts by either drilling or driving.
- 3.1.1. **Drilling.** Drill holes and set posts plumb and firm to the line and grade shown. Backfill posts by thoroughly compacting material to the density of adjacent undisturbed material.
- 3.1.2. **Driving.** Drive posts plumb with approved power hammers (steam, compressed air, vibratory, or diesel) or gravity hammers to the line and grade shown while preventing damage to the post. Use pilot holes when required and approved. Determine the size and depth of pilot holes based on results of the first few posts

driven. Thoroughly tamp loosened soil around the post, fill voids with suitable material, and thoroughly compact to the density of adjacent undisturbed material.

- 3.2. **Rail Elements.** Erect metal beam rail elements to produce a smooth, continuous rail paralleling the line and grade of the roadway surface or as shown on the plans. Bolt rail elements end-to-end and lap splices in the direction of traffic. Field-drill or punch holes in rail elements for special details, only when approved.
- 3.3. **Short Radius.** Special rail fabrication with a required radius must be as shown on the plans.
- 3.4. **Terminal Anchor Posts.** Embed terminal anchor posts in concrete, unless otherwise shown on the plans.
- 3.5. **Galvanizing Repair.** Repair all parts of galvanized steel posts, washers, bolts, and rail elements after erection where galvanizing has become scratched, chipped, or otherwise damaged. Repair in accordance with Section 445.3.5., "Repairs."
- 3.6. **Guardrail Adjustment.** Work includes vertical adjustment, horizontal shift, and overlap of the rail element to meet the detail shown on the plans.
- 3.7. **Curb.** If indicated in the details, construct the curb shown with metal beam guard fence transition as required by Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter."
- 3.8. **Driveway Terminal Anchor Posts.** Embed terminal anchor posts in concrete, unless otherwise shown on the plans.

4. MEASUREMENT

- 4.1. **Guard Fence.** Measurement will be by the foot of fence. Fence will be measured on the face of the rail in place, from center-to-center of end splice locations.
- 4.2. **Terminal Anchor Sections.** Measurement will be by each section, complete in place, consisting of a terminal anchor post and one 25-ft. section of rail element.
- 4.3. **Transitions.** Transitions for rail connection will be measured by each transition.
- 4.4. **Short Radius.** Measurement will be by the foot to the nearest whole foot along the face of the rail in place, from beginning of radius (first CRT post) to the end of radius.
- 4.5. **Driveway Terminal Anchor Section.** Measurement will be by each section, complete in place, consisting of a driveway terminal anchor post and one 6-ft. section of rail element.
- 4.6. **Downstream Anchor Terminal.** Measurement will be by each section, complete in place, consisting of one W-Beam end section, 2 downstream anchor posts, and one rail section.
- 4.7. **Long Span System.** Measurement will be by the foot of fence. Fence will be measured on the face of the rail, in place, between the first CRT and last CRT posts in the system.

5. PAYMENT

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid at the unit price bid for "Metal W-Beam Guard Fence" of the post type specified; "Metal Thrie Beam Guard Fence" of the post type specified; "Terminal Anchor Section"; "Metal Beam Guard Fence Transition" of the type specified; "Metal W-Beam Guard Fence Adjustment"; "Metal Thrie Beam Guard Fence Adjustment"; "Terminal Anchor Section Adjustment"; "Transition Adjustment"; "Short Radius"; "Driveway Terminal Anchor Section"; "Downstream Anchor Terminal"; or "Metal Beam Guard Fence (Long Span System)." When weathering steel is required, Type IV will be specified.

Samples furnished to the Department for testing purposes, special backfill materials, and concrete curbs will not be paid directly but are subsidiary to this Item.

- 5.1. **Guard Fence.** The price bid for “Metal W-Beam Guard Fence” or “Metal Thrie Beam Guard Fence” is full compensation for materials, hauling, erection, setting posts in concrete, blocks, driving posts, excavating, backfilling, equipment, labor, tools, and incidentals.
- 5.2. **Terminal Anchor Section.** When a separate bid item is specified, the price bid for “Terminal Anchor Section” is full compensation for furnishing the rail element, anchor assembly, terminal anchor post, and foundations; installing the rail element anchor assembly and the terminal anchor post and foundations; excavation and backfilling; and equipment, labor, tools, and incidentals.
- 5.3. **Transition.** The price bid for “Metal Beam Guard Fence Transition” is full compensation for furnishing nested sections of Thrie Beam; nested sections of W-Beam; Thrie Beam to W-Beam transitional rail piece, posts, concrete, curb, and connections to W-Beam guard fence and bridge rails; Thrie Beam terminal connectors; excavation and backfilling; and equipment, labor, tools, and incidentals.
- 5.4. **Guardrail Adjustment.** The price bid for “Metal W-Beam Guard Fence Adjustment,” “Metal Thrie Beam Guard Fence Adjustment,” “Terminal Anchor Section Adjustment,” and “Transition Adjustment” is full compensation for furnishing materials not supplied by the Department, drilling holes in posts, hauling, erection, blocks, excavation, backfill, cleaning, salvaging materials, setting rail element anchor assembly and terminal anchor post, removal of rail element, concrete, curb, equipment, labor, tools, and incidentals.
- 5.5. **Short Radius.** The price bid for “Short Radius” is full compensation for furnishing special rail fabricated metal beam guard fence, CRT posts, steel posts, sand barrels, end terminal, cable anchor, materials, hauling, erection, blocks, driving posts, excavating, backfilling, equipment, labor, tools, and incidentals.
- 5.6. **Driveway Terminal Anchor Section.** The price bid for “Driveway Terminal Anchor Section” is full compensation for furnishing the rail element, driveway anchor assembly, driveway terminal anchor post, and foundations; installing the rail element anchor assembly and the driveway terminal anchor post and foundations; excavation and backfilling; and equipment, labor, tools, and incidentals.
- 5.7. **Downstream Anchor Terminal.** The price bid for “Downstream Anchor Terminal” is full compensation for furnishing the rail element, W-Beam end section, guardrail anchor bracket, shelf angle bracket, channel strut, downstream anchor posts, breakaway cable terminal (BCT) cable anchor assembly, and foundations; installing the BCT cable anchor assembly and the downstream anchor post and foundations; excavation and backfilling; and equipment, labor, tools, and incidentals.
- 5.8. **Long Span System.** The price bid for “Metal Beam Guard Fence (Long Span System)” is full compensation for furnishing the rail element, CRT posts, materials, hauling, erection, blocks, driving posts, excavating, backfilling, equipment, labor, tools, and incidentals.