

ITEM NO. 591S - RIPRAP FOR SLOPE PROTECTION ~~12-31-13~~

591S.1 - Description

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses. The work conducted under this item pertains to riprap for protection of slopes, cuts, fills, drainage facilities and other features susceptible to erosion.

591S.2 - Submittals

The submittal requirements for this specification item shall include:

- A. The type, size, gradation, physical properties and source of rock riprap material; ~~test~~ Test data for specific gravity, absorption, soundness; and field verification of the rock riprap gradation including a size distribution plot and a list of the measured D15, D50, D85, and D100 (refer to Item No. 591S.3.A). ~~verification plots with measurements for the gradation of the rock riprap.~~
- B. The type, size, and source of broken concrete riprap material.
- C. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- D. Proposed proportioning of materials for the mortar mix,
- E. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors,
- F. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.
- G. The type, size, gradation and source of granular filter material.
Where vegetated soil-riprap is used, and proposed materials differ from the materials already approved for use elsewhere on the project, the submittal requirements also include:
- H. Identification of the seed species, source, mixture, pure live seed (PLS) as listed on the analysis tags, certification tags from all seed bags, and seed calculation worksheet per Item No. 604S, Table 9.
- I. Soil retention blanket material type, evidence that the material is listed on the TxDOT Approved Products List, one (1) full set of manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

J. Identification of fill soil class, source, and characteristics of proposed borrow material as described in Item No. 130S Borrow.

K. Identification of top soil source and characteristics including textural (clay/silt/sand) percentage.

591S.3 - Materials

A. Rock

The rock shall be suitable in all respects for the purpose intended. Rock sources shall be selected well in advance of the time the rock will be required and shall be pre-approved by the Engineer. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. Neither the width nor the thickness of a single rock shall be less than one third of its length. The rocks shall be dense, resistant to weathering and water action, and free of overburden, spoils, shale, and organic material. Shale, chalk, and limestone with shale or chalk seams shall not be acceptable. Rounded rock (river rock) shall not be acceptable.

The rock durability shall be evaluated by laboratory tests for specific gravity, absorption, and soundness. The minimum specific gravity shall be 2.4 (150 pounds per cubic foot) and the maximum absorption 4.2% using ASTM D 6473 or Tex-403-A. Soundness shall be tested in accordance with ASTM D 5240 or Tex-411-A and weight loss shall not exceed 18% after 5 cycles of magnesium sulfate solution, nor 14% after 5 cycles of sodium sulfate solution.

The rock riprap material shall be provided as a gradation of larger and smaller rock sizes associated with a rock class or median diameter (D50) as specified in the drawings. Rock diameter for angular material represents the length of the intermediate axis of an individual rock. The material gradation shall conform to table below for the class sizes corresponding to the D50. The D15, D50, D85, and D100 are the rock sizes for which 15%, 50%, 85%, and 100% of the total sample are of equal size or smaller, respectively.

Rock Riprap Gradation Table							
Rock Riprap Class by Median Particle Diameter (D50)		50 (in)		D		D100 (in)	
Class	Diameter (in)	Min	Max	Min	Max	Min	Max
I	6	3.7	5.2	5.7	6.9	7.8	

II	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0

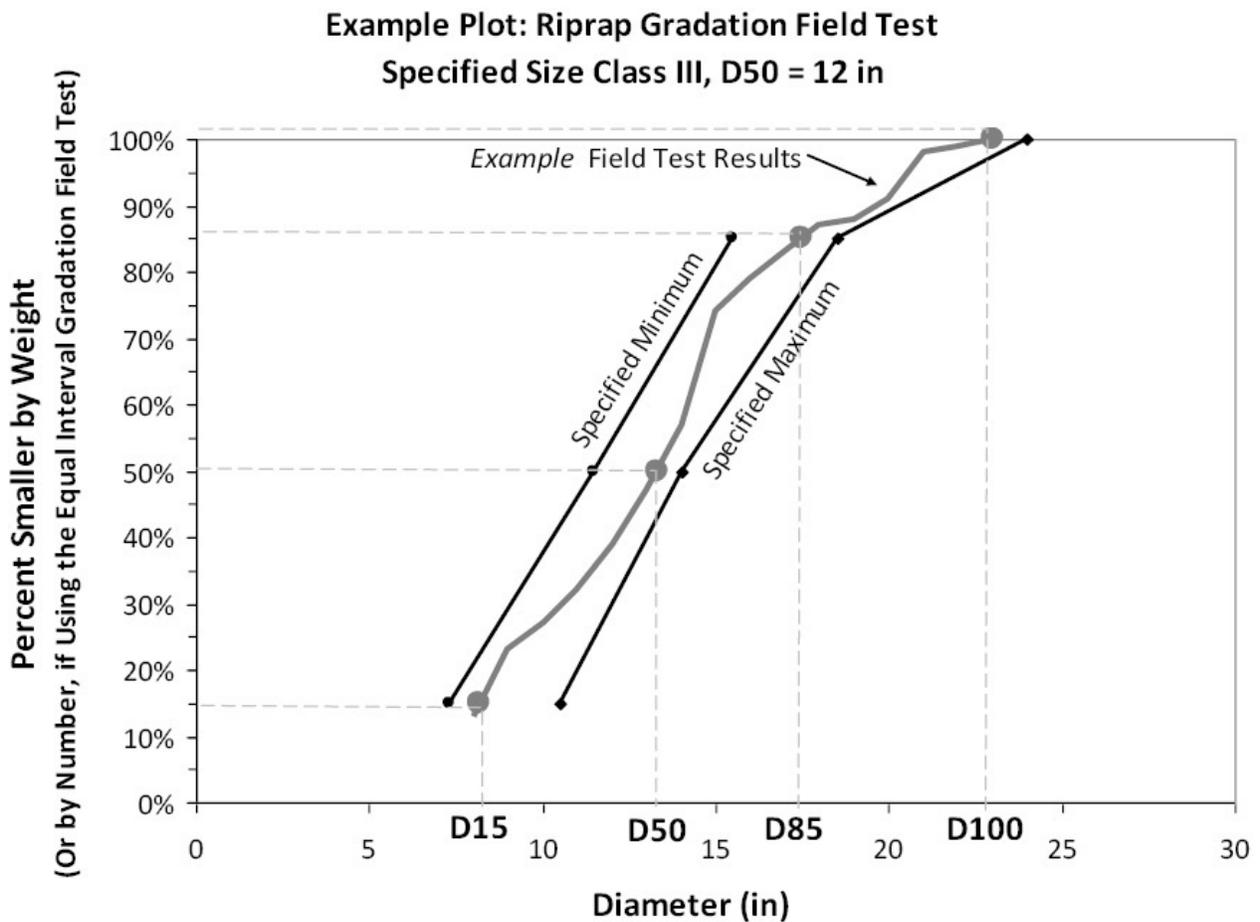
1. Reference: NCHRP Report 568
2. Conversion to weight-based gradation: $W = 0.0275D^3S_g$ where W is rock size in lbs, D is diameter in inches and S_g is the specific gravity of the rock.

Conformance of rock riprap to the gradation requirements shall be accomplished by field tests for rock sizes that cannot be analyzed via sieve or mechanical sorting machines. In order to perform a field test, the contractor shall provide a sample of the proposed rock riprap material meeting the gradation for the specified size class. Gradation field tests shall follow the equal interval test procedure in NCHRP Report 568, Section 3.2.3, ~~or~~ ASTM D 5519, or the modified equal interval method. ~~Gradation test results shall be plotted with the acceptable range values for the specified rock class (example below):~~ The general steps of the modified equal interval method are:

1. Spread a representative, well-mixed sample of riprap to form a flat, rectangular pile. The thickness of the pile should be approximately equal to the D100. The length and width of the footprint should be determined based on the rock size and the minimum sample size that is requested by the Engineer.
2. With a tape measure, create a linear transect across the sample pile. Mark each rock that falls directly under the tape measure at an equal interval. The interval should be two feet or greater, depending on the D50, such that no rock is marked more than once.
3. Lay additional transects parallel to the first transect, at a spacing equal to the interval between marked rocks. Repeat Step B for each transect such that the marked rocks form an equally spaced grid across the pile.

4. Measure the diameter of each marked rock across the intermediate (middle or B) axis. The number of rocks measured shall be equal or greater than the minimum sample size.
5. Analyze the data by sorting and plotting a curve of percent smaller by number vs diameter. Identify the diameters.

Gradation tests shall result in: (1) a size distribution plot comparing the measured sample data with the specified diameter ranges for the rock size class (example below), and (2) the calculated D100, D85, D50, and D15 of the rock sample. The sample gradation is acceptable if the calculated diameters fall within the specified ranges of the applicable gradation. The acceptability of rock that falls outside the specified gradation ranges shall be at the discretion of the Engineer.



~~The contractor shall provide a sample of the rock riprap material meeting the gradation for the size class specified. An approved sample~~ Approved rock riprap samples shall be stored onsite as a reference for ongoing visual inspection of additional materials supplied. Supplementary tests may be required for supply materials where visual inspection determines their may be a deviation from the required gradation. Labor, equipment and site

location needed to assist in checking gradation shall be provided by the contractor at no additional cost to the owner.

B. Broken Concrete

The rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in Section 591S.5, "Dry Riprap".

C. Concrete

Cast in place concrete shall be Class A Concrete and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

D. Grout and Mortar

Grout and mortar shall consist of 1 part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.

E. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

F. Joints

Premolded expansion joint material shall conform to Standard Specification Item No. 408, "Concrete Joint Material".

G. Tie Backs and Anchors

Galvanized tie backs and anchors shall be as indicated on the Drawings.

H. Filter Fabric

Filter Fabric shall conform to Standard Specification Item No. 620S, "Filter Fabric".

I. Granular Filter

Aggregate used for granular filters shall conform to Standard Specification Item No. 403S "Concrete for Structures".

J. Soils

For vegetated soil-rock riprap, soil shall be integrated with the rock riprap at 30% soil to 70% rock by volume with minimal voids. Unless specified otherwise in the Drawings, soil that is placed below six inches (6") below the riprap top surface shall be Class A Select Borrow material, as described in Item No. 130S Borrow, and referred to herein as "fill soil." Soil that is placed within the top six inches (6") of the riprap top surface shall be topsoil material as described in Item No. 601S Salvaging and Placing Topsoil, Section 3.

K. Seed

For vegetated soil-rock riprap, the type of seed mix and application rates shall be as specified on the Drawings and within the referenced Standard Specification. If no seed mix is specified, apply according to Item No. 604S Seeding for Erosion Control, Section 6.

L. Soil retention blanket

For vegetated soil-rock riprap, soil retention blanket shall be a TxDOT-approved Class 1 Type C or D, shall be made of 100% biodegradable fibers, unless specified otherwise in the Drawings. Blanket shall comply with the requirements of Item No. 605S Soil Retention Blanket, Section 3.

591S.4 - Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures (Standard Specification Item 610S, "Preservation of Trees and Other Vegetation") shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells (Standard Detail Number 610S-6, "Tree Protection, Tree Wells") are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

All blasting shall conform to 01550, "Public Safety and Convenience." The Contractor shall comply with all laws, ordinances, applicable safety code requirements, International Fire Code Chapter 27 "Hazardous Materials General Provisions" and Chapter 33 "Explosives and Fireworks" and any other regulations relative to handling, storage and use of explosives. In all cases, a Blasting Permit must be obtained in advance from the appropriate City agency.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with 132S - Embankment. Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

~~591S.5 - Dry Rock Riprap~~

A. Dry Rock Riprap

The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings.

When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches (102 mm). Geotextile filter fabric shall conform to Standard Specification No. 620 and be installed with sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the specified maximum stone size (D100) or 1.5 times the D50, which ever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches (75 mm). Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

~~591S.6 – Mortared Rock Riprap~~

B. Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds (45 and 69 kilograms) each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet (no more than 60 mm per meter). Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled

with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

C. Vegetated Soil-Rock Riprap

Adjacent stockpiles of rock riprap, fill soil, and topsoil shall be created and there shall be no premixing of fill soil, topsoil and rock prior to placement. Sufficient soil volume shall be provided to result in a final, complete-in-place ratio of 30% soil to 70% rock riprap by volume.

Place underlying filter material and first layer of rock riprap in accordance with 591S.5 to a thickness equivalent to the D50 rock size or half the design rock layer thickness, whichever is greater. Place a layer of soil over and within the rock voids such that the top of the soil layer is approximately 75% of the rock layer thickness. Work the soil into the rock layer voids by wetting, prodding with a rock bar, and/or vibratory compaction until the soil height is approximately 50% of the rock height. If the soil height becomes less than 50% of the rock height then repeat the previous steps.

Place the second layer of rock riprap per 591S.5 up to the final design grade. Place soil over and within the rock riprap, working it into the voids as in the previous step and repeating application as needed until the top of the soil layer approximately matches the top surface of the rock riprap. Excess soil shall not be placed in the voids to the extent that the rock riprap is displaced. The resulting soil-riprap surface shall be smooth, with no lumps or depressions greater than two inches ($\pm 2''$) from the final design grade.

Once the soil-rock matrix is placed, the surface of the soil-rock riprap shall be seeded per the Drawings and covered with biodegradable erosion control fabric.

591S.7 – Concrete Riprap

D. Concrete Riprap

Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

When welded wire reinforcement is indicated, it shall be a minimum of 6×6 W1.4 \times W1.4 (150 x 150 MW9 x MW9) with a minimum lap of 6 inches (150 mm) at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch (25 mm) nor more than 3 inches (75 mm) from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches (450 mm) in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches (150 mm).

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet (12.2 meters) and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8 inch (9.5 mm) deep at 10 foot (3 meter) intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

~~591S.8 – Pneumatically Placed Concrete Riprap, Type I and Type II~~

E. Pneumatically Placed Concrete Riprap, Type I and Type II

Pneumatically placed concrete for riprap shall be placed as indicated on the Drawings or as established by the Engineer or designated representative. Pneumatically placed concrete shall conform to Standard Specification Item No. 404S, "Pneumatically Placed Concrete". Reinforcement shall conform to the details indicated on the Drawings and Standard Specification Item No. 406S, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. All subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as indicated on the Drawings.

The strength and design of Pneumatically Placed Concrete Riprap shall be either Type I or if indicated, Type II conforming to Standard Specification Item No. 404S, "Pneumatically Placed Concrete".

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

~~591S.5 591S.9~~ - Measurement

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards (square meters: 1 square meter equals 1.196 square yards) indicated on the Drawings, complete

in place or (b) the volume of concrete placed in cubic yards (cubic meters: 1 cubic meters equals 1.308 cubic yards), complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be included in the unit price bid for riprap of the type with which it is placed.

591S.6 591S.10- Payment

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications. The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, geotextile filter fabric, granular filter material, fill soil and top soil, seed, erosion control fabric, granular cushion, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or the bottom of excavated drainage channels will be included in the unit bid price for riprap. Excavation, grading and fill materials required to shape drainage channels shall not be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Standard Specification Item No. 401, "Structural Excavation and Backfill".

Payment will be made under one of the following:

Pay Item No. 591S-A:	Dry Rock Riprap	Per Square Yard.
Pay Item No. 591S-B:	Dry Rock Riprap	Per Cubic Yard.
Pay Item No. 591S-D:	Mortared Rock Riprap	Per Square Yard.
Pay Item No. 591S-F:	Concrete Riprap, ___ In.	Per Square Yard.
Pay Item No. 591S-G:	Concrete Riprap	Per Cubic Yard.
<u>Pay Item No. 591S-I:</u>	<u>Vegetated Soil-Rock Riprap</u>	<u>Per Square Yard</u>
<u>Pay Item No. 591S-J:</u>	<u>Vegetated Soil-Rock Riprap</u>	<u>Per Cubic Yard</u>
Pay Item No. 591S-P:	Pneumatically Placed Concrete Riprap, In.	Per Square Yard

End

SPECIFIC CROSS REFERENCE MATERIALS	
_____ Specification 591S, "Riprap for Slope Protection"	
International Fire Code	

Designation	Description
Chapter 27	Hazardous Materials
Chapter 33	Explosives and Fireworks
City of Austin Standard Contract Documents	
Designation	Description
01550	Public Safety and Convenience
City of Austin Standard Specifications	
Designation	Description
<u>Item No.</u> <u>130S</u>	<u>Borrow</u>
Item No. 403S	Concrete for Structures
Item No. 404S	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
<u>Item No.</u>	<u>Salvaging and Placing Topsoil</u>

<u>601S</u>	
Item No. <u>604S</u>	<u>Seeding for Erosion Control</u>
Item No. <u>605S</u>	<u>Soil Retention Blanket</u>
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

American Society for Testing and Materials, ASTM

Designation	Description
ASTM D 5240	Standard Test Method for Evaluation of Durability of Rock for Erosion Control Using Sodium Sulfate or Magnesium Sulfate
ASTM D 5519	Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials
ASTM D 6473	Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-403-A	Test Procedure for Saturated Surface-Dry Specific Gravity and Absorption of Aggregates
Tex-411-A	Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

Designation	Description
Item No. 432	Riprap

RELATED CROSS REFERENCE MATERIALS	
Specification 591S, "Riprap for Slope Protection"	
City of Austin Standard Specifications	
Designation	Description
Item No. 623S	Dry Stack Rock Wall

Engineering Design Manuals

Federal Highway Administration, 1989, Design of Riprap Revetment, Hydraulic Engineering Circular HEC-11, FHWA-1P-89-016.

National Cooperative Highway Research Program, 2006, Riprap Design Criteria, Recommended Specifications, and Design Criteria, NCHRP Report 568.

United States Bureau of Reclamation, 1983, Hydraulic Design of Stilling Basins and Energy Dissipators, Engineering Monograph No. 25.

U.S Department of Agriculture, 1983, Soil Conservation Service, Riprap for Slope Protection Against Wave Action, Technical Release No. 69, February.

US Army Corps of Engineers, 1994. Hydraulic Design of Flood Control Channels, US Army Corps of Engineers Engineer Manual EM 1110-2-1601.

Federal Highway Administration, 1998. "Geosynthetic Design and Construction Guidelines," FHWA-HI-95-038.

ITEM NO. 604S
SEEDING FOR EROSION CONTROL

604S.1 Description

This item shall govern the preparation of a seed bed for temporary or permanent erosion control; sowing of seeds; fertilizing; mulching with straw, cellulose fiber wood chips, and recycled paper mulch; and other management practices along and across such areas as indicated in the Drawings or as directed by the Landscape Architect, Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses. Source: Rule No. R161-14.29, 12-30-2014.

604S.2 Submittals

The following submittal items are required in writing during construction:

- A. Identification of the seed species, source, mixture, and pure live seed (PLS) the seed as listed on the analysis tags and certification tags from all seed bags. Seed calculation worksheet per Table 7. PLS is the percentage of seed purity multiplied by the percentage of germination, plus dormant seed. The analysis tag, required on all seed sold in Texas, includes information on quality: kind and variety of seed, lot number, percent pure live seed, percent other crop seed, percent inert matter, percent weed seeds, germination percentage, and date of test. The certification tag also verifies seed quality, an assurance of seed variety and attesting to standards for germination and purity. Information provided includes class of certification, kind of crop, variety, lot number, and name and address of the owner.
- B. If fertilizer is proposed, results of a recent soil test (6 months old or less) of the area to be seeded, before fertilization. Soil samples shall be collected after final grading, when topsoil has been placed. The test results must include soil lab recommended additions of Nitrogen (N), Phosphorus (P), and Potassium (K) for the type of vegetation proposed, as well as soil organic matter percentage and textural class.
- C. Fertilizer formulation and release rate based on a soil test (see B above).
- D. For hydromulch applications, proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.
- E. Type of hydraulic seeding equipment and nozzles proposed for use.
- F. If pesticide use is proposed, an IPM plan for pest removal including pesticide label, proposed application rate and timing, and MSDS sheets.

G. One gallon sample of proposed vegetative mulch.

The following submittal items are required before Substantial Completion:

- A. For hydromulch applications, the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an application log is provided in Table 2. This log may be requested at any time during construction by the Landscape Architect, Engineer, ~~or~~—designated representative, or inspector.
- B. Pesticide application tracking log. As of January 1, 2012, documentation of all outdoor pesticide use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program

Table 1: Example of proposed hydromulch application rates

Hydro Mix	Sheet No.	Seed Mix	Acres	Hydro Slurry Unit (per acre rates)				
				Seed (Bags/AC ac)	Tackifier (Buckets/AC ac)	Mulch (Bales/AC ac)	Fertilizer (Bags/AC ac)	Addl. Amendments (Bags/AC ac)
1	L2	A	1.0	1	100	1000	50	5
2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

Date	Start Time	Finish Time	AC a / Tank	Water (gal)	Seed Mix	Hydro Slurry Unit (per acre rates)				
						Seed (Bags/AC ac)	Tackifier (Buckets/AC ac)	Mulch (Bales/AC ac)	Fertilizer (Bags/AC ac)	Addl. Amendments (Bags/AC ac)
4/13	10:30	11:15	1.0	3300	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	3300	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	3300	B	3	300	3000	50	5
Totals						6	600	5500	127	15

Source: Rule No. R161-14.29, 12-30-2014.

604S.3. Materials

- A. **Seed.** All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing PLS, name and type of seed, and all other required elements of the Analysis and Certification Tags.

The seed furnished shall be of the previous season's crop and the date of analysis shown on

each bag shall be within twelve (12) months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted per square yard (0.84 square meters) or acre (hectare [ha]) shall be of the type specified in Sections 604S.5 and 604S.6.

- B. **Water.** Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant material or the area irrigated.
- C. **Topsoil.** Topsoil shall conform to Item No. 601S.3(A).
- D. **Fertilizer.** The fertilizer shall conform to Item No. 606S, "Fertilizer". The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during: 1) seed germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.
- E. **Straw Mulch or Hay Mulch.** Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, or other hay approved by the Landscape Architect, Engineer or designated representative. The straw or hay shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be moldy or rotted.
- F. **Tackifier** The tackifier shall be a biodegradable tacking agent, approved by the Landscape Architect, Engineer or designated representative.
- G. **Cellulose Fiber Mulch (Natural Wood).** Cellulose Fiber Mulch shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.
- H. **Recycled Paper Mulch.** Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer (see "fertilizer" above) for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.
- I. **Mulch.** Mulches, acting as seed coverings, can enhance seed germination and seedling establishment. Characteristics of ideal mulches for seeding are those that protect seeds from wind (drying), excessive solar radiation, high evapotranspiration rates, and erosion, while allowing germination and growth. Relatively coarsely shredded, weed-free vegetative mulch should be used on seed installations, especially in open, sunny areas. These materials shall be clean, free of foreign matter, and dry enough to spread evenly.
- J. **Pesticide.** A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control products and materials

shall be submitted to the City of Austin Watershed Protection Department (ERM) IPM program coordinator (512-974-2581) for approval. Additional information can be found at <http://www.austintexas.gov/ipm>.

Source: Rule No. R161-14.29, 12-30-2014.

604S.4 Construction Methods

- A. **General.** The Contractor shall limit preparation of the seedbed to areas that will be seeded immediately. When seeding for permanent erosion control, weed species listed in Table 3 shall be managed by application of an appropriate herbicide and/or by physical removal by the roots before the seeding operation. The goal of weed management is to facilitate establishment of the permanent vegetative cover. Additionally, the Owner may require removal of any plant species that appears to be out-competing seeded or planted species during the construction period.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Annual Grass	<i>Cenchrus spp.</i>	Sandbur
Herb	<i>Cnidoscolus texanus</i>	Bull Nettle
Herb	<i>Urtica spp.</i>	Stinging Nettle
Vine	<i>Toxicodendron radicans</i>	Poison Ivy
Perennial Grass	<i>Sorghum halapense</i>	Johnson Grass
Perennial Grass	<i>Arundo donax</i>	Giant Cane
Perennial Grass	<i>Phyllostachys aurea</i>	Golden Bamboo
Summer Annual Herb	<i>Ambrosia trifida</i>	Ragweed
Winter Annual Herb	<i>Rapistrum rugosum</i>	Bastard Cabbage
Winter Annual Herb	<i>Bromus arvensis</i>	Japanese Brome
Winter Annual Herb	<i>Lolium multiflorum</i>	Annual Ryegrass

- B. **Preparing Seed Bed.** After the designated areas have been rough graded to the lines, grades and typical sections indicated in the Drawings or as provided for in other items of this contract and for any other soil area disturbed by the construction, a suitable seedbed shall be prepared. The seedbed shall consist of a minimum of either 6 inches (150 millimeters) of approved topsoil or 6 inches (150 millimeters) of approved salvaged topsoil.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Rippers and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening and incorporating amendments. ~~A roughened soil surface of micro-ridges and valleys is an optimal seed bed with a microenvironment of increased moisture, higher humidity, wind protection, and shelter from the sun for seeds.~~ If tracked machinery is used in seedbed

preparation, cleat marks should run with the contour to prevent rills. The optimum depth for seeding shall be 1/8 to 1/4 inch (3 to 6 millimeters).

Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements described below.

- C. **Watering.** All watering shall comply with City Code Chapter 6-4 (Water Conservation). All seeded areas regardless of seed type and method of seeding (e.g., broadcast, hydroseed) shall be watered immediately after installation. For seed germination and establishment it is important to keep the seedbed in a moist condition favorable for the growth of plant materials.

Watering applications shall constantly maintain the seedbed in a moist condition favorable for the growth of plant materials. Watering shall continue until the plant material is at least 1 -1/2 inches (40 mm) in height and accepted by the Engineer or designated representative. Supplemental watering can be postponed immediately after a half-inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

- D. **Cool Season Cover Crop.** From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Table 6. Cool season cover crops are not permanent erosion control. If installed separately from the permanently erosion control seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for non-native or native warm-season species (March 1 to September 15).

Source: Rule No. R161-14.29, 12-30-2014.

604S.5 Non-Native Seeding

- A. Method A - Broadcast Seeding. The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer (if required), may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding:

From March 1 to September 15, seeding shall be with hulled Bermuda Grass at a rate of at least 45 lbs/ac (5.0 kilograms per hectare) with a minimum PLS = 0.83. Fertilizer shall be applied if warranted by a soil test, and shall conform to Item No. 606S, "Fertilizer". Bermuda grass is a warm-season grass and is therefore considered permanent erosion control once established.

Method B - Hydraulic Planting. The seedbed shall be prepared as specified above and hydraulic planting equipment, which is capable of placing all materials in a single operation, shall be used. Information about hydromulching for temporary and permanent vegetation stabilization is in the Environmental Criteria Manual (ECM) Section 1.4.7.

Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.

From March 1 to September 15

Hydraulic planting mixture and minimum rate of application pounds per acre or square yard (kilograms per ha):

	Fiber Mulch		Soil Tackifier
	Cellulose	Wood	
45 lbs/ <u>ACac</u> (50.44 kg/ha)	2000 lbs/ <u>ACac</u> (2242 kg/ha)		60.98 lbs/ <u>ACac</u> (68.36 kg/ha)
		2500 lbs/ <u>ACac</u> (2803 kg/ha)	65.34 lbs/ <u>ACac</u> (73.25 kg/ha)

Source: Rule No. R161-14.29, 12-30-2014.

604S.6 Native Grass and Forb Seeding

The seed mixture shall include both a diversity of grasses and wildflowers forbs. The dry and moist sites grass mix shall be seeded at a rates of at least 13.1 ~~146.85~~ 23.5 and 17.0 ~~26.32~~ lb/ac (14.6 ~~146.85~~ 26.32 ~~lb~~ and 19.04 ~~26.32~~ kg/ha), respectively and the dry and wet site forb mix shall be seeded at a rate of at least 65.34 ~~11.5~~ 11.5 and 9.0 ~~73.25~~ lb/ac (12.88 ~~73.25~~ 12.88 and 10.08 ~~10.08~~ kg/ha), for total application rates of 193.34 ~~35.00~~ 35.00 ~~220.1~~ lb/ac (220.1 ~~39.20~~ 39.20 and 29.12 ~~29.12~~ kg/ha) [dry site] and 26 ~~29.12~~ lb/ac (29.12 ~~29.12~~ kg/ha) [wet site]. ~~shall include a minimum of 8 species from Table 4 (dry, open sites) or 6 species from Table 5 (wet, open sites).~~ Minimum diversity for dry sites (Table 4) is eight species of grasses and 10 species of forbs. Minimum diversity for wet sites (Table 5) is six species of grasses and seven species of forbs. The species indicated with an asterisk shall be included in all proposed mixes. Application rates may be modified, but No species shall constitute more than 20% of a seed mix. Any species proposed for installation and not included in Tables 4 or 5 shall be approved by City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative or landscape architect or other qualified landscape professional, and shall be native to Central Texas as referenced by the LBJ Wildflower Center plant database (www.wildflower.org) or USDA plant database.

Table 4: Native Grasses and Forbs: Dry, Open Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				Lbs/Acre	kg/ha
Grass Seed Mix	Sideoats grama *	<i>Bouteloua curtipendula</i>	Full-part sun	7.0	7.8
	Green sprangletop*	<i>Leptochloa dubia</i>	Full sun	6.0	6.7
	Buffalograss	<i>Buchloe dactyloides</i>	Full sun	24.0	27.0
	Blue Grama Grass	<i>Bouteloua gracilis</i>	Full-part sun	10.0	11.2
	Canada Wild Rye	<i>Elymus canadensis</i>	Full-part sun	10.0	11.2
	Purple Three-Awn	<i>Aristida purpurea</i>	Full sun	4.0	4.5
	Cane Bluestem	<i>Bothriochloa barbinodis</i>	Full sun	3.0	3.3
	Galleta	<i>Pleuraphis jamesii</i>	Full sun	10.0	11.2
	Black Grama *	<i>Bouteloua eripoda</i>	Full sun	10.0	11.2
	Sand Dropseed *	<i>Sporobolus cryptandrus</i>	Full sun	1.0	1.1
	Alkali Sacaton	<i>Sporobolus airoides</i>	Full sun	0.5	1.7
	Curly Mesquite	<i>Hilaria belangeri</i>	Full sun	2.0	2.2
	Sand Lovegrass	<i>Eragrostis trichodes</i>	Full sun	2.0	2.2
	Forb Seed Mix	Black-Eyed Susan	<i>Rudbeckia hirta</i>	Full-part sun; dappled	2.0
Illinois		<i>Desmanthus illinoensis</i>	Full-part sun; dappled	15.0	16.8
Scarlet Sage		<i>Salvia coccinea</i>	Full-part sun; dappled	8.0	9.0
Pink Evening		<i>Oenothera speciosa</i>	Full-part sun; dappled	1.0	1.1
Drummond Phlox		<i>Phlox drummondii</i>	Full-part sun	8.0	9.0
Plains Coreopsis		<i>Coreopsis tinctoria</i>	Full-part sun	2.0	2.2
Greenthread		<i>Thelesperma filifolium</i>	Full sun	6.0	6.7
Purple Prairie Clover*		<i>Dalea purpurea</i>	Full sun	4.0	4.5
Cutleaf Daisy		<i>Engelmannia pinnatifida</i>	Full-part sun; dappled	18.0	20.1
Partridge Pea*		<i>Chamaecrista fasciculata</i>	Full-part sun	20.0	22.4
Indian Blanket		<i>Gaillardia pulchella</i>	Full-part sun	10.0	11.2
Bluebonnet *		<i>Lupinus texensis</i>	Full sun	20.0	22.4
Mexican Hat		<i>Ratibida columnaris</i>	Full-part sun	2.0	2.2
Maximilian		<i>Helianthus maximiliana</i>	Full-part sun	5.0	5.6
Prairie Coneflower		<i>Ratibida columnifera</i>	Full-part sun	2.0	2.2
Clasping Coneflower		<i>Dracopis amplexicaulis</i>	Full-part sun	3.0	3.4
Purple Coneflower		<i>Echinacea purpurea</i>	Full-part sun; dappled	10.0	11.2
Lemon Mint		<i>Monarda citriodora</i>	Full-part sun	3.0	3.4
Huisache Daisy		<i>Amblyolepis setigera</i>	Full-part sun	8.0	9.0
Texas Yellow Star		<i>Lindheimera texana</i>	Full-part sun	12.0	13.5
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	Full-part sun; dappled	10.0	11.2	
Bush Sunflower	<i>Simsia calva</i>	Full-part sun	3.0	3.4	

Winecup	<i>Callirhoe involucrata</i>	Full-part sun; dappled	5.0	5.6
Antelope horns	<i>Asclepias asperula</i>	Full sun	0.1	0.04
Green milkweed	<i>Asclepias viridis</i>	Full sun	0.1	0.04
TOTAL				
Total seed mix application rate is 35.0 lb/ac (23.5 lb/ac grasses and 11.5 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.				

*Required species that must be included in the mix

*~~These species must be included in the mix, plus an additional three (3) species from the list or other approved species, for a total of eight (8) species.~~

Table 5: Native Grasses and Forbs: Wet, Open Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				Lbs/Ac	kg/ha
Grass Seed Mix	White Tridens	<i>Tridens albescens</i>	Full-part sun	0.5	0.56
	Plains Bristlegrass	<i>Setaria leucopila</i>	Full-part sun	6.0	6.7
	Switchgrass	<i>Panicum virgatum</i>	Full-part sun	4.0	4.5
	Inland Sea Oats	<i>Chasmanthium latifolium</i>	Shade	12.0	13.5
	Canada Wild Rye	<i>Elymus canadensis</i>	Full sun - shade	10.0	11.2
	Big Bluestem	<i>Andropogon gerardii</i>	Full sun	4.0	4.5
	Bushy Bluestem	<i>Andropogon glomeratus</i>	Full sun	3.0	3.4
	Green Sprangletop*	<i>Leptochloa dubia</i>	Full sun	2.0	2.2
	Eastern Gamagrass	<i>Tripsacum dactyloides</i>	Full sun - shade	3.0	3.4
Forb Seed Mix	American Basketflower	<i>Centaurea americana</i>	Full sun	10.0	11.2
	Common milkweed	<i>Asclepias syriaca</i>	Full sun	0.1	0.04
	Butterfly weed	<i>Asclepias tuberosa</i>	Full sun	0.1	0.04
	Blue Mistflower	<i>Conoclinium coelestinum</i>	Full-part sun	0.5	0.6
	Clasping Coneflower	<i>Dracopis amplexicaulis</i>	Full-part sun	3.0	3.4
	Maximilian Sunflower	<i>Helianthus maximiliani</i>	Full-part sun	4.0	4.5
	Prairie Blazing Star	<i>Liatris pycnostachya</i>	Full sun	2.0	2.2
	Pink Evening Primrose	<i>Oenothera speciosa</i>	Full sun-dappled shade	1.0	1.1
	Mexican Hat	<i>Ratibida columnifera</i>	Full-part sun	2.0	2.2
	Black-eyed Susan	<i>Rudbeckia hirta</i>	Full sun-dappled shade	2.0	2.2
	Illinois Bundleflower	<i>Desmanthus illinoensis</i>	Full sun-dappled shade	15.0	16.8
	Obedient Plant	<i>Physostegia virginiana</i>	Full sun-	4.0	4.5
	Partridge Pea *	<i>Camaecrista fasciculata</i>	Full-part sun	20.0	22.4

Purple Prairie Clover	<i>Dalea purpurea</i> var <i>purpurea</i>	Full sun	4.0	4.5
Pitcher Sage	<i>Salvia azurea</i>	Full-part sun	3.0	3.4
Showy Tick Trefoil	<i>Desmodium canadense</i>	Full sun	0.5	0.6
Winecup *	<i>Callirhoe involucrata</i>	Full-part sun	5.0	5.6
TOTAL				
Total seed mix application rate is 26.0 lb/ac (17.0 lb/ac grasses and 9.0 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.				

The native forb mix shall be seeded at a rate of at least 65.34 lbs/ ACac (73.25 kg/ha) and shall include a minimum of two legumes and eight (8) other forbs from Table 6 (open, dry sites) or a minimum of two legumes and five (5) species of forbs from Table 7 (open, wet sites).

Table 6: Native Forbs: Dry, Open Sites

Common Name	Botanical Name	Exposure	Application Rates	
			Lbs/ACac	kg/ha
Black-Eyed Susan	<i>Rudbeckia hirta</i>	Full pt sun; dappled shade	2.0	2.2
Illinois Bundleflower*	<i>Desmanthus illinoensis</i> (legume)	Full pt sun; dappled shade	15.0	16.8
Scarlet Sage	<i>Salvia coccinea</i>	Full pt sun; dappled shade	8.0	9.0
Pink Evening Primrose	<i>Oenothera speciosa</i>	Full pt sun; dappled shade	1.0	1.1
Drummond Phlox	<i>Phlox drummondii</i>	Full pt sun	8.0	9.0
Plains Coreopsis	<i>Coreopsis tinctoria</i>	Full pt sun	2.0	2.2
Greenthread	<i>Thelesperma filifolium</i>	Full sun	6.0	6.7
Purple Prairie Clover*	<i>Dalea purpurea</i> (legume)	Full sun	4.0	4.5
Cutleaf Daisy	<i>Engelmannia pinnatifida</i>	Full pt sun; dappled shade	18.0	20.1 0.19
Partridge Pea*	<i>Chamaecrista fasciculata</i> (legume)	Full pt sun	20.0	22.4
Indian Blanket	<i>Gaillardia pulchella</i>	Full pt sun	10.0	11.2
Bluebonnet *	<i>Lupinus texensis</i> (legume)	Full sun	20.0	22.4
Mexican Hat	<i>Ratibida columnaris</i>	Full pt sun	2.0	2.2
Maximilian Sunflower	<i>Helianthus maximiliana</i>	Full pt sun	5.0	5.6
Prairie Coneflower	<i>Ratibida columnifera</i>	Full pt sun	2.0	2.2
Clasping Coneflower	<i>Dracopis amplexicaula</i>	Full pt sun	3.0	3.4

Purple Coneflower	<i>Echinacea purpurea</i>	Full-pt sun; dappled shade	10.0	11.2
Lemon Mint	<i>Monarda citriodora</i>	Full-pt sun	3.0	3.4
Huisache Daisy	<i>Amblyolepis setigera</i>	Full-pt sun	8.0	9.0
Texas Yellow Star	<i>Lindheimera texana</i>	Full-pt sun	12.0	13.5
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	Full-pt sun; dappled shade	10.0	11.2
Bush Sunflower	<i>Simsia calva</i>	Full-pt sun	3.0	3.4
Winecup	<i>Callirhoe involucrata</i>	Full-pt sun; dappled shade	5.0	5.6
Milkweed (Antelope Horn or Green milkweed)	<i>Asclepias asperula</i> or <i>Asclepias viridis</i>	Full sun	<u>0.1</u>	<u>0.04</u>
*These species must be included in the mix.				

Table 7: Native Forbs: Wet, Open Sites

Common Name	Botanical Name	Exposure	Application Rates	
			Lbs/AC ae	kg/ha
American-Basketflower	<i>Centaurea americana</i>	Full sun	10.0	11.2
Antelope Horns	<i>Asclepias asperula</i>	Full sun	7.0-12.0	7.8-13.4
Green Antelope Hor	<i>Asclepias viridis</i>	Full sun	7.0-12.0	7.8-13.4
Milkweed- (Common milkweed or butterfly weed)	<i>Asclepias- syriaca or Asclepias- tuberosa</i>	Full sun	0.1	0.04
Blue Mistflower	<i>Conoclinium coelestinum</i>	Full-pt sun	0.5	0.6
Clasping Coneflowe	<i>Dracopis amplexicaulis</i>	Full-pt sun	3.0	3.4
Maximilian Sunflower	<i>Helianthus maximiliani</i>	Full-pt sun	4.0	4.5
Prairie Blazing Star	<i>Liatris pycnostachya</i>	Full sun	2.0	2.2
Pink Evening Primrose	<i>Oenothera speciosa</i>	Full sun-dappled shade	1.0	1.1
Mexican Hat	<i>Ratibida columnifera</i>	Full-pt sun	2.0	2.2
Black-eyed Susan	<i>Rudbeckia hirta</i>	Full sun-dappled shade	2.0	2.2
Illinois-Bundleflower	<i>Desmanthus illinoensis- (legume)</i>	Full sun-dappled shade	15.0	16.8
Obedient Plant	<i>Physostegia virginiana</i>	Full sun-dappled shade	4.0	4.5
Partridge Pea *	<i>Camaecrista fasciculata- (legume)</i>	Full-pt sun	20.0	22.4
Purple Prairie Clover	<i>Dalea purpurea var purpurea- (legume)</i>	Full sun	4.0	4.5
Pitcher Sage	<i>Salvia azurea</i>	Full-pt sun	3.0	3.4
Showy Tick Trefoil	<i>Desmodium canadense</i>	Full sun	0.5	0.6
Winecup *	<i>Callirhoe involucrata</i>	Full-pt sun	5.0	5.6
*This species must be included in the mix.				

Table 8 6: Cool Season Cover Crop

Common Name	Botanical	Exposure	Application rates	
			Lbs/ A/Cac	kg/ ha
Western Wheatgrass	<i>Pascopyrum smithii</i>	Full-pt sun; dappled shade	5.6	6.28
Oats	<i>Avena sativa</i>	Full sun	4.0	4.48
Cereal Rye Grain	<i>Secale cereale</i>	Full sun	34.0	38.11

One cover crop species of the listed species is required to be planted between September 15 to March 1. Contractor must ensure that any seed application requiring a cool season cover crop does not utilize annual ryegrass (*Lolium multiflorum*) or perennial ryegrass (*Lolium perenne*). Only cereal rye grain (*Secale cereale*), oats (*Avena sativa*) and western wheatgrass (*Pascopyrum smithii*) are approved as cool season cover crop.

Species substitution as necessary due to availability shall be approved by the Landscape Architect, Engineer or designated representative. Watering and fertilizer application shall follow procedures outlined above or as otherwise specified on the Drawings.

Seed shall be applied by broadcast, hydromulch, blown compost, or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application for broadcast and hydromulch applications.

Seed Rate Calculations

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 9 7 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Table 9 7. Seed Calculation Worksheet

Plant Group	Desired Seeding Rate (lbs/ <u>ACac</u>)	PLS (pure live seed)	Bulk Rate (lbs/ <u>ACac</u>)	Seeding Area (<u>ACac</u>)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAE:

PLS (pure live seed) = (Purity x Germination) x 100. Can also use average PLS from seed tags. Bulk Rate (lbs/ ACac) = Desired Seed Rate (lbs/ ACac)/PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/ ACac) x Seeding Area (ACac)

Example:

Plant Group	Desired Seeding Rate (lbs/ <u>ACac</u>)	PLS [pure live seed] (% decimal)	Bulk Rate (lbs/ <u>ACac</u>)	Seeding Area (<u>ACac</u>)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

*applied over the same 1.5 ACac area

Source: Rule No. R161-14.29, 12-30-2014.

604S.7 Mulch

Mulches may be used to help prevent soil erosion until final stabilization is achieved. Mulch shall be used to cover broadcasted seeds, especially in sunny, open areas, to protect them from drying out during germination.

A. Straw Mulch.

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 2 to 2 1/2 tons of straw per acre (4.5 to 5.6 megagrams of straw per hectare). The actual rate of application will be designated by the Landscape Architect, Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. Hydromulch

Refer to ECM Section 1.4.7 for hydromulching applications.

C. Shredded Brush Mulch.

Small brush or tree limbs, which have been shredded, may be used for mulching Native Grass seeding.

Source: Rule No. R161-14.29, 12-30-2014.

604S.8 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so than 90 percent of the revegetation area is free of weeds listed in Table 3, and (2) reseeding areas of poor germination to achieve coverage and height per 604S.9, with no bare areas greater than 10 46-s.f.

Ninety (90) percent of a permanent revegetation area must be free of weeds listed in Table 3. Weeds shall be controlled in the most efficient manner possible. Management of weed species should begin early in the project, before seeding for permanent control, and extend into plant establishment, especially for perennial weeds. Manual removal or application of an appropriate herbicide may be required after the initial seeding if emergence of an annual weed species threatens establishment of sufficient preferred plant cover. Disturbance due to weed management after the initial seeding may necessitate re-seeding of the area to establish sufficient preferred plant coverage. Care should be taken to temporarily stabilize areas where physical removal of weeds has been performed to prevent erosion and sediment runoff.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than eight mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs for erosion control should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;

- Minimum of 95% cover; and
- No exposed soil greater than 10 16-s.f. in aerial extent.
The Contractor shall meet the requirements of the initial seeding, including seeding method, seed mix, and application rates, unless otherwise agreed to in writing by the Owner. Corrected deficiencies will be re-inspected and approved by the Owner, and final acceptance will be granted upon satisfactory completion.

Source: Rule No. R161-14.29, 12-30-2014.

604S.9 Measurement

Work and acceptable material for Seeding for Erosion Control will be measured by the square yard (meter: 1 meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place so that all areas of a site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage for the non-native or native mixes. Bare areas shall not exceed 16 square feet (1.5 square meters), and the average height of vegetation shall stand at a minimum of 1-1/2 inch (40 millimeters). Ninety (90) percent of the re-vegetated area, whether native or non-native re-vegetation, must be free of weeds listed in Table 3. Bare areas greater than 10 16-s.f. shall be re-prepared and reseeded as required to develop an acceptable stand of plant material.

Source: Rule No. R161-14.29, 12-30-2014.

604S.10 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for Seeding for Erosion Control of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

All fertilizer will be measured and paid for conforming to Item No. 606S, "Fertilizer".

Payment will be made under one of the following:

- Pay Item No. 604S-A:** Non-Native Seeding for Erosion Control Method, Hydraulic Planting Per Square Yard
- Pay Item No. 604S-B:** Non-Native Seeding for Erosion Control, Broadcast Seeding, Per Square Yard
- Pay Item No. 604S-C:** Non-Native Seeding for Erosion Control Method, Hydraulic Planting Per Acre
- Pay Item No. 604S-D:** Native Seeding for Erosion Control Method, Hydraulic Planting Per Square Yard
- Pay Item No. 604S-E:** Native Seeding for Erosion Control, Broadcast Seeding, Per Square Yard
- Pay Item No. 604S-F:** Native Seeding for Erosion Control Method, Hydraulic Planting Per Acre

Pay Item No. 604S-G: Mulch, Per Square Yard
Pay Item No. 604S-H: Mulch, Per Acre
Pay Item No. 604S-I: Topsoil and Seedbed Preparation, Per Square Yard
Pay Item No. 604S-J: Topsoil and Seedbed Preparation, Per Acre
Pay Item No. 604S-K: Watering, Per 1000 gal (Kgal)
Pay Item No. 604S-L: Management Practices, Per Square Yard
Pay Item No. 604S-M: Management Practices, Per Acre

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer

City of Austin Land Development Code

<u>Designation</u>	<u>Description</u>
Section 6-4	Water Conservation

Specification Item 604S "Seeding for Erosion Control"

City of Austin Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standards (Details)

<u>Designation</u>	<u>Description</u>
627S-1	Grass Lined Swale
633S-1	Landgrading

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
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Item No. 160
Item No. 162
Item No. 164
Item No. 166
Item No. 168
Item No. 169
Item No. 180
Item No. 192

Topsoil
Sodding for Erosion Control
Seeding for Erosion Control
Fertilizer
Vegetative Watering
Soil Retention Blanket
Wildflower Seeding

ITEM NO. 609S NATIVE SEEDING AND PLANTING FOR RESTORATION

609S.1 Description

This item shall govern the preparation of a seeding and planting area to the lines and grades indicated on the Drawings. This may include seedbed preparation, sowing of seeds, planting of rooted plants, watering, hydromulch, compost and other management practices, as indicated in the Drawings or as directed by the Landscape Architect, Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

Source: Rule No. R161-14.29, 12-30-2014.

609S.2 Submittals

The following submittal items are required in writing during construction:

- A. For seed, provide identification of the species, source, mixture, and pure live seed (PLS) of the seed as listed on each seed bag to be used. Copies of the analysis tags and certification tags from all seed bags shall be submitted.
- B. Type of mulch or compost.
- C. Watering frequency and amount as shown on an irrigation watering schedule.
- D. Type of management practices (e.g., hand-weeding, pesticide application, etc.) proposed, with a proposed schedule for observation and treatment.
- E. For hydromulch applications, the proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.
- F. Type of hydraulic seeding equipment and nozzles proposed for use.
- G. If pesticide use is proposed, an IPM plan for pest control including pesticide label, proposed application rate and timing, and MSDS sheets.
- H. One gallon sample of proposed mulch or compost.

I. The following submittal items are required before Substantial Completion:

- A. For hydromulch applications, submit the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an application log is in Table 2.
- B. Pesticide and fertilizer application tracking log. As of January 1, 2012, documentation of all outdoor pesticide and fertilizer use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

Table 1: Example of proposed hydromulch application rates

Hydro Mix	Sheet No.	Seed	Acres	Hydro Slurry Unit (per acre rates)				Addl. Amendments (Bags/ACac)
				Seed (Bags/ACac)	Tackifier (Buckets/ACac)	Mulch (Bales/ACac)	Fertilizer (Bags/ACac)	
1	L2	A	1.0	1	100	1000	50	5
2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

Date	Start Time	Finish Time	ac/Tank	Water (gal)	Seed Mix	Hydro Slurry Unit (per acre rates)				Addl. Amendments (Bags/ACac)
						Seed (Bags/ACac)	Tackifier (Buckets/ACac)	Mulch (Bales/ACac)	Fertilizer (Bags/ACac)	
4/13	10:30	11:15	1.0	3300	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	3300	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	3300	B	3	300	3000	50	5
Totals						6	600	5500	127	15

609S.3. Materials

A. Seed.

All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing PLS, name and type of seed, and all other required elements of the Analysis and Certification Tags. The seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within 12 months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed

shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted per square yard (.84 square meters) or acre (hectare) shall be of the type specified in Section 609S.5.

- B. **Water.** Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant materials in the area irrigated.
- C. **Topsoil.** Topsoil shall conform to Standard Specification Item No. 601S.3 (A).
- D. **Pesticide.** A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control product(s) and/or materials shall be submitted to the City of Austin Watershed Protection Department (ERM) IPM program coordinator (512-974-2581) for approval. Additional information can be found at <http://www.austintexas.gov/ipm>.
- E. **Fertilizer.** If fertilizer used in deemed necessary, the fertilizer shall conform to Standard Specification Item No. 606S, “Fertilizer.” The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during:
1) seed germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.
- F. **Tackifier.** The tacking agent shall be a biodegradable material approved by the Landscape Architect, Engineer, or designated representative.
- G. **Mulch.** Mulch may be used to help prevent soil erosion until preferred plant establishment, whether the mulch be hydraulically applied or shredded vegetative matter. Hydromulching for temporary and permanent vegetation stabilization shall conform to Environmental Criteria Section 1.4.7.
- H. **Hydroseeding Equipment.** Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.
- I. **Rooted Plants.** ~~When~~Where proposed, rooted plants shall conform to the requirements of Standard Specification 608S, Planting.

Source: Rule No. R161-14.29, 12-30-2014.

609S.4 Construction Methods

A. General.

The Contractor shall limit preparation to areas that will be seeded/planted immediately. All weedy species (Table 3) shall be controlled by application of an herbicide and/or by physical removal (by the roots) prior to, during the planting operation, and through establishment. The specified weedy species shall be maintained at ten (10) percent or less of total cover after seeding. Additionally, the ~~Owner~~Owner-Landscape Architect, Engineer, or qualified landscape professional may require removal of any plant species that appears to be out-competing seeded or planted species during construction or the establishment period.

Seeds and fruits of non-native woody invasive species should be separated from the rest of the removed plants before mulching or hauling off the material. It must be bagged and disposed of in a landfill to prevent unintentional reintroduction to the site or elsewhere.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Summer Annual Herb	<i>Ambrosia spp.</i>	Ragweed
Perennial Grass	<i>Bothriochloa ischaemum</i>	K.R. Bluestem
Annual Grass	<i>Cenchrus spp.</i>	Sandbur
Herb	<i>Cnidocolus texanus</i>	Bull Nettle
Perennial Grass	<i>Sorghum halapense</i>	Johnson Grass
Perennial Grass	<i>Arundo donax</i>	Giant Cane
Perennial Grass	<i>Phllostachys aurea</i>	Golden Bamboo
Vine	<i>Toxicodendron radicans</i>	Poison Ivy
Herb	<i>Urtica spp.</i>	Stinging Nettle
Winter Annual Herb	<i>Rapistrum rugosum</i>	Bastard Cabbage
Winter Annual Grass	<i>Bromus arvensis</i>	Japanese Brome
Winter Annual Grass	<i>Lolium multiflorum</i>	Annual Ryegrass
Tree	<i>Triadica sebifera</i>	Chinese Tallow
Tree	<i>Ligustrum sp.</i>	Privet
Tree	<i>Melia azedarach</i>	Chinaberry
Tree	<i>Lonicera japonica</i>	Japanese Honeysuckle
Shrub	<i>Nandina domestica</i>	Heavenly Bamboo
Shrub	<i>Photinia sp.</i>	Photinia

B. Seed-Plant Bed Preparation.

After the designated seeding/planting areas have been rough graded, a suitable ~~seedbed~~ planting area shall be prepared. In areas where cut or fill is required, a minimum of 6 inches (150 mm) of topsoil (see Section 609S.3.C) shall be placed or use approved existing soil (that is not infested with ~~weeds or weed~~ invasive or noxious plant rootstock [e.g., *Arundo donax* rhizomes]) stockpiled over the entire planting area.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Ripper and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening, and for incorporating amendments. ~~A roughened soil surface of micro ridges and valleys is an optimal seed bed with a microenvironment of increased moisture, higher humidity, wind protection, and shelter from the sun for seeds.~~ If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills.

In areas with no soil disturbance, the weeds shall be eliminated and a minimum of ~~2 (50 mm)~~ 6 inches (150 mm) of topsoil, if none currently exists, shall be placed. The seedbed shall be prepared with limited irregularities, lumps or soil clods and the surface shall be raked or rolled to facilitate seed to soil contact.

Water shall be gently applied as required to prepare the seedbed before the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements hereinafter described.

Watering.

All watering shall comply with City Code Chapter 6-4 (Water Conservation). Water the seeded/planted areas immediately after installation to achieve germination and a healthy stand of native plants that can ultimately survive without supplemental water.

Apply the water uniformly to the planted areas without causing displacement or erosion of the materials or soil.

Watering applications shall insure that the plantbed seedbed is maintained in a moist condition favorable for the growth of plant materials. Watering shall continue until minimum coverage is achieved and accepted by the Landscape Architect, Engineer or designated representative.

Watering may be postponed immediately after a half-inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

C. Cool Season Cover Crop.

From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Tables 8-4, 5, or 6. Cool season cover crops are not permanent erosion control. If installed separately from the proposed seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for native warm-season species (March 1 to September 15).

Source: Rule No. R161-14.29, 12-30-2014.

609S.5 Native Seeding and Planting

Seeding and planting shall be performed in accordance with the requirements described below. The optimum depth for seeding shall be 1/4 inch (6 millimeters). Seed shall be applied by a method that achieves consistent distribution across a site and proper seed to soil contact (i.e. hand broadcasting, hydromulch, or drill method). ~~Installation of rooted plants shall comply to Standard Specification 608S. Mulching is not required, but it is a good technique for protecting seeds during germination and establishment.~~

Rooted plants should be strategically and thoughtfully placed on a site. They need not be installed at a consistent, regular pattern across the plantable area(s) of a site but can be clustered or placed irregularly. The goal is to place the rooted plants where they will have the greatest or best effect or impact, and where there is sufficient space (e.g., root space, space off of utilities) and proper conditions (e.g., soil depth, moisture, light) for their long-term success. Installation of rooted plants shall comply with Standard Specification 608S, but rooted plants must not be spaced closer than three-feet (3') on center. Mulching around seed and rooted plants is not required, but it is a good technique for protecting plants during germination and establishment.

Figure 609S.5-1 is an example of rooted plant layout on a hypothetical site.

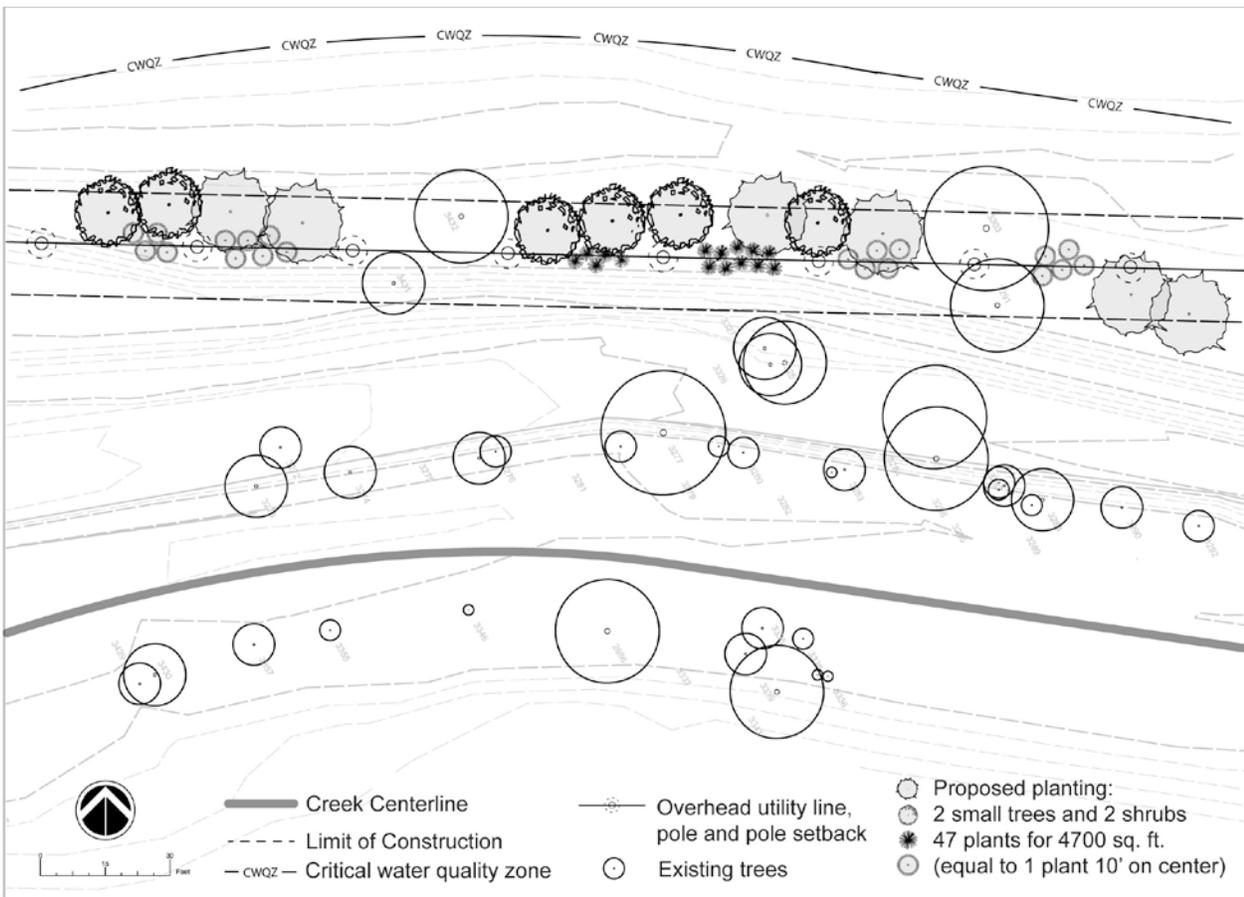


Figure 609S.5-1: Example of Rooted Plant Layout and Calculation

Species substitution, when necessary due to availability, shall be approved by ~~the Landscape Architect, Engineer or designated representative~~ City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. Only native or adapted species suitable for the designated environmental conditions shall be allowed as substitutes. Shorter growing natives such as Buffalograss should be sodded around manholes or other structures requiring higher visibility for access.

If the plant materials are being installed during the cool season (September 15 to March 1), a cool season cover crop species (as listed below) shall be included in the seed mix or installed separately.

The seed and rooted plant mixtures shall be applied in accordance with appropriate growing environments (Upland Full Sun-Table 24, Upland Shade-Dappled-Table 35 and Facultative Moderate to High Moisture-Table 46). Grasses shall constitute ~~65~~ 67 percent of the seed mix, with forbs comprising ~~35~~ 33 percent. No species shall constitute more than 20% of a seed mix.

Table 4. Upland Species, Full Sun Areas

Type	Common Name	Plant Type	Botanical Name	Recommended Seed Application rate lbs/Ac (kg/ha)	Rooted Plants Species, Diversity, Quantity & Size
Grass Seed Mix	Buffalograss	grass	<i>Buchloe dactyloides</i>	24.0 (27.0)	A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with Very Low or Low (VL or L) water needs and Sun or Sun/Part Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document***. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.
	Blue Grama	grass	<i>Bouteloua gracilis</i>	10.0 (11.2)	
	Green Sprangletop	grass	<i>Leptochloa dubia</i>	2.0 (2.2)	
	Sand Dropseed	grass	<i>Sporobolus cryptandrus</i>	1.0 (1.1)	
	Galleta	grass	<i>Pleuraphis jamesii</i>	10.0 (11.2)	
	Canada Wild Rye	grass	<i>Elymus canadensis</i>	10.0 (11.2)	
	Purple Threeawn	grass	<i>Aristida purpurea</i>	4.0 (4.5)	
	Sideoats Grama	grass	<i>Bouteloua curtipendula</i>	7.0 (7.8)	
Forb Seed Mix	Bluebonnet	wildflower	<i>Lupinus texensis</i>	20.0 (22.4)	
	Purple Prairie Clover	wildflower	<i>Dalea purpurea</i>	4.0 (4.5)	
	Plains Coreopsis	wildflower	<i>Coreopsis tinctoria</i>	2.0 (2.2)	
	Partridge Pea	wildflower	<i>Chamaecrista fasciculata</i>	20.0 (22.4)	
	Greenthread	wildflower	<i>Thelesperma filifolium</i>	6.0 (6.7)	
	Indian Blanket	wildflower	<i>Gaillardia pulchella</i>	10.0 (11.2)	
	Lemon Mint	wildflower	<i>Monarda citriodora</i>	3.0 (3.4)	
	Mexican Hat	wildflower	<i>Ratibida columnaris</i>	2.0 (2.2)	
	Pink Evening Primrose	wildflower	<i>Oenothera speciosa</i>	1.0 (1.1)	
	Sunflower (Common)	wildflower	<i>Helianthus annuus</i>	5.0 (5.6)	
	Milkweed (Antelope Horn or Green milkweed)	wildflower	<i>Asclepias asperula</i> or <i>Asclepias viridis</i>	0.1 (0.04)	
<u>Total</u> Total recommended seed mix application rate is 35 lbs/ac (23.5 lbs/ac grass, 11.5 lbs/ac forbs).					
Cool Season Cover Grasses	Cereal rye grain*	cool season cover crop	<i>Secale cereale</i>	34.0 (38.1)	Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.
	Oats*	cool season cover crop	<i>Avena sativa</i>	4.0 (4.5)	
	Western Wheatgrass*	cool season cover crop	<i>Pascopyrum smithii</i>	5.6 (6.3)	

*Plant only between September 15 to March 1. Non-persistent winter cover crop for erosion control. Only one cool season species is required per installation.

**Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by ~~the Landscape Architect, Engineer or designated representative~~ City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. The total pounds/acre (lbs/ac) of the proposed seed mix ~~shall~~can be calculated based on the desired percentage of each seed in a mix.

***www.austintexas.gov/department/grow-green/plant-guide

Table 5. Upland Species, Shade-Dappled Light Areas

Type	Common Name	Plant Type	Botanical Name	Recommended Seed Application Rate lbs/ACac (kg/ha)	Rooted Plants Species, Diversity, Quantity &
<u>Grass Seed Mix</u>	Inland Sea oats**	<u>grass</u>	<i>Chasmanthium latifolium</i>	12.0 (13.5)	A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with very low (VL), low (L), or low-medium (L-M) water needs and Sun /Part Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document***. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.
	Canada Wildrye	<u>grass</u>	<i>Elymus canadensis</i>	10.0 (11.2)	
	Sideoats Grama	<u>grass</u>	<i>Bouteloua curtipendula</i>	7.0 (7.8)	
<u>Forb Seed Mix</u>	Purple Coneflower	<u>wildflower</u>	<i>Echinacea purpurea</i>	10.0 (11.2)	
	Lanceleaf Coreopsis	<u>wildflower</u>	<i>Coreopsis lanceolata</i>	10.0 (11.2)	
	Scarlet Sage	<u>wildflower</u>	<i>Salvia coccinea</i>	8.0 (9.0)	
	Drummond Phlox	<u>wildflower</u>	<i>Phlox drummondii</i>	8.0 (9.0)	
	Black-Eyed Susan	<u>wildflower</u>	<i>Rudbeckia hirta</i>	2.0 (2.2)	
	Cutleaf Daisy	<u>wildflower</u>	<i>Engelmannia pinnatifida</i>	18.0 (20.2)	
	Tall Aster	<u>wildflower</u>	<i>Aster praealtus</i>	1.0 (1.1)	
	Illinois bundleflower	<u>wildflower</u> (<u>Legume</u>)	<i>Desmanthus illinoensis</i>	15.0 (16.8)	
	Standing cypress	<u>wildflower</u>	<i>Ipomopsis rubra</i>	6.0 (6.7)	
	Winecup	<u>wildflower</u>	<i>Callirhoe involucrata</i>	5 (5.6)	
Milkweed (Butterfly Weed or Showy Milkweed)	<u>wildflower</u>	<i>Asclepias tuberosa or Asclepias speciosa</i>	<u>0.1 (0.04)</u>		
<u>Total</u>					
Total recommended seed mix application rate is 35 lbs/ac (23.5 lbs/ac grass, 11.5 lbs/ac forbs).					

<u>Cool Season Cover Grasses</u>	Cereal rye grain***	<u>cool season cover crop</u>	<i>Secale cereale</i>	34.0 (38.1)	Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.
	Oats***	<u>cool season cover crop</u>	<i>Avena sativa</i>	4.0 (4.5)	
	Western Wheatgrass**	<u>cool season cover crop</u>	<i>Pascopyrum smithii</i>	5.6 (6.3)	
	<u>TOTAL****</u>				

** If unavailable replace with Prairie Wild Rye.

*** Plant only between September 15 to March 1. Non-persistent winter cover crop for erosion control. Only one cool-season species is required per installation.

**** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by the Landscape Architect, Engineer or designated representative City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative.

The total pounds/acre (lbs/ac) of the proposed seed mix ~~shall~~ can be calculated based on the desired percentage of each seed in a mix.

***www.austintexas.gov/department/grow-green/plant-guide

Table 6. Facultative Species, Moderate – High Moisture Areas

Type	Common Name	Plant Type	Botanical Name	Recommended Seed application Rate (lbs/ ac ac (Kg/ha)	Rooted Plants Species, Diversity, Quantity &
<u>Grass Seed Mix</u>	Big Bluestem	grass	<i>Andropogon gerardii</i>	8.0 (9.0)	<u>A minimum of two (2) native species of small or large trees, and two (2) native species of shrubs with low (L), low-medium (L-M), or medium (M) water needs and Sun/Part Shade or Shade light needs as listed in the current Grow Green Native and Adapted Landscape Plants guidance document ***. Plants must be a minimum size of 1-gallon (see Table 8, equivalency chart) and minimum of 1 plant per 100 square feet.</u>
	Big Muhly (Lindhiemers)	grass	<i>Muhlenbergia lindheimeri</i>	6.0 (6.7)	
	Bushy Bluestem	grass	<i>Andropogon glomeratus</i>	6.0 (6.7)	
	Eastern Gamagrass	grass	<i>Tripsacum dactyloides</i>	12.0 (13.5)	
	Indiangrass	grass	<i>Sorghastrum nutans</i>	6.0 (6.7)	
	Inland Seoats	grass	<i>Chasmanthium latifolium</i>	12.0 (13.5)	
	Canada Wildrye	grass	<i>Elymus canadensis</i>	10.0 (11.2)	
	Sand Lovegrass	grass	<i>Eragrostis trichodes</i>	2.0 (2.2)	
	Switchgrass	grass	<i>Panicum virgatum</i>	4.0 (4.5)	
<u>Forb Seed Mix</u>	Black-Eyed Susan	wildflower	<i>Rudbeckia hirta</i>	2.0 (2.2)	
	Illinois Bundleflower	wildflower	<i>Desmanthus illinoensis</i>	15.0 (16.8)	
	Purple Prairie Clover	wildflower	<i>Dalea purpurea</i>	4.0 (4.5)	
	Clasping Coneflower	Wildflower (legume)	<i>Dracopis amplexicaulis</i>	3.0 (3.4)	
	Plains Coreopsis	Wildflower	<i>Coreopsis tinctoria</i>	2.0 (2.2)	
	Goldenrod	wildflower	<i>Solidago altissima</i>	1.0 (1.1)	
	Lazy Daisy	wildflower	<i>Aphanostephus sp.</i>	1.0 (1.1)	
	Lemon Mint	wildflower	<i>Monarda citriodora</i>	3.0 (3.4)	
	Sunflower (Common)	wildflower	<i>Helianthus annuus</i>	5.0 (5.6)	
	Sunflower (Maximilian)	Wildflower	<i>Helianthus maximiliana</i>	4.0 (4.5)	
	Milkweed (common or Butterfly Milkweed)	wildflower	<i>Asclepias syriaca or Asclepia tuberosa</i>	0.1 (0.04)	
<u>Total</u>					
Total recommended seed mix application rate is 26.0 lbs/ac (17.0 lbs/ac grass, 9.0 lbs/ac forbs).					
<u>Cool Season Cover Grasses</u>	Cereal rye grain*	cool season cover crop	<i>Secale cereale</i>	34.0 (38.1)	<u>Add at least one of the cool season grasses to the warm-season mix between September 15 and March 1.</u>
	Oats*	cool season cover crop	<i>Avena sativa</i>	4.0 (4.5)	
	Western Wheatgrass*	cool season cover crop	<i>Pascopyrum smithii</i>	5.6 (6.3)	

TOTAL **				
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* Plant only between September 15 to March 1. Non-persistent winter cover crop for erosion control.

** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by ~~the Landscape Architect, Engineer or designated representative~~ City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative. The total pounds/acre (lbs/ac) of the proposed seed mix ~~shall~~ can be calculated based on the desired percentage of each seed in a mix.

*** www.austintexas.gov/department/grow-green/plant-guide

Table 7. Rooted Plant Size Equivalents

Potential Substitute		Equivalent To	
Quantity	Plant Size	Quantity	Plant Size
<u>1</u>	<u>5 gallon</u>	<u>4</u>	<u>One-gallon</u>
<u>1</u>	<u>Two or Three-gallon</u>	<u>2</u>	<u>One-gallon</u>
<u>4</u>	<u>4" pots or quarts</u>	<u>1</u>	<u>One-gallon</u>
<u>8</u>	<u>Plugs, live roots, saplings</u>	<u>1</u>	<u>One-gallon</u>

Table 8. Seed Rate Calculation

Multiple species native seed mixes require careful calculations to ensure proper planting rates. The example below is for illustrative purposes only.

Species	Seeding Rate (lbs/ AC ac)	Desired proportion of a species in the total mix (%)	Total quantity of seed in mix (lbs/ AC ac)
Grass 1	7	.20	1.40
Grass 2	2	.20	0.40
Grass 3	24	.20	4.80
Forb 1	10	.20	2.00
Forb 2	8	.20	1.60
TOTALS	---	1.0 (100%)	10.2

Table 9. Seed Calculation Worksheet

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 9-10 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Plant Group	Desired Seeding Rate (lbs/ <u>ACac</u>)	PLS (pure live seed)	Bulk Rate (lbs/ <u>ACac</u>)	Seeding Area (<u>ACac</u>)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAS:

PLS (pure live seed) = (Purity x Germination) x 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/ac) = Desired Seed Rate (lbs/ac)/PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/ac) x Seeding Area (ac)

Example:

Plant Group	Desired Seeding Rate (lbs/ <u>ACac</u>)	PLS [pure live seed] (% decimal)	Bulk Rate (lbs/ <u>ACac</u>)	Seeding Area (<u>ACac</u>)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

*applied over the same 1.5 ac area.

Source: Rule No. R161-14.29, 12-30-2014.

609S.6 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so that 90 percent of the revegetation area is free of weeds listed in Table 3, ~~and~~ (2) reseeding areas of poor germination to achieve coverage and height per 609S.8, with no bare areas greater than 10 16-s.f., and (3) replacement and replanting of rooted plants per 608S.5(O) [Plant Material Removal and Replacement] and 608S.7 (Acceptability of Plants).

Weeds, as defined in the Weed List (Table 3), shall be controlled in the most efficient manner possible. The timing of weed control may occur prior to soil disturbance, just before the installation of seed, and/or during the period of plant establishment. Weed control shall be introduced at one or all of these times, so that the greatest control is achieved. The preferred method of control is to remove weeds, either by physical or mechanical means, when the site is conducive (e.g. when the ground is moist) to this approach.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Table 9 provides management practices for woody invasive vegetation. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

Table 9 10. Management Practices for Woody Invasive Vegetation

Before Seeding	
Stems ≤ 1 inch	Pull with weed wrench
Stems > 1 inch	Cut at base and spray stump with appropriate herbicide within five minutes. Bag and dispose of seeds and fruit in landfill.
After Seeding	
Seedlings	Hand pull
Sprouts	Foliar application of appropriate herbicide

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature). Source: Rule No. R161-14.29, 12-30-2014.

609S.7 Reseeding/Replanting

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed, replant locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;
- Minimum of 95% cover; and
- No patches of exposed soil greater than 10 ~~16~~ s.f. in aerial extent.

The Owner or designated representative will inspect the seeding/planting during April of the calendar year following the year of initial seeding/planting and determine the necessity and extent of over-seeding, ~~or~~ re-seeding, or replanting required. Contractor shall ideally complete any required re-seeding/replanting before May 15 of that year. This date may be extended if, in the opinion of the Owner and qualified landscape professional, the weather conditions before May 15 are not suitable for re-seeding work. If the timing is bad, an annual cover crop can be over-seeded in a deficient area to temporarily provide coverage until a suitable time for seeding or planting perennials seed or rooted plants. If vegetation fails to grow and thrive, the soil must be tested to

determine whether nutrient imbalances are responsible and, if so, an appropriate course of nutrient remediation (e.g., fertilizers, composts, topsoils, or other organic amendments) as recommended by a landscape professional must be implemented by the Contractor.

The Contractor shall meet the requirements for initial seeding and planting, including seeding method, seed mix, application rates, and slope texturing as applicable, unless otherwise agreed to in writing by the Owner and/or City staff. Corrected deficiencies will be re-inspected and approved by the Owner and designated representative, and final acceptance will be granted only upon satisfactory completion.

Source: Rule No. R161-14.29, 12-30-2014.

609S.8 Measurement

Work and acceptable material for Native ~~Grasslands for Erosion Control~~ Seed and Planting for Restoration will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, so that all areas of a site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage ~~(90 percent of that must be free of weedy and invasive plant species listed in Table 3)~~ with no bare areas exceeding 10 16 square feet (1.5 square meters) and a 1 1/2 inch tall (40 millimeters) successful stand of plant materials. Ninety (90) percent of the overall planted area ~~which~~ must be free of weeds listed in Table 3. Bare areas shall be re-prepared and reseeded as required by the

Landscape Architect, Engineer or designated representative to develop an acceptable stand of vegetation.

Source: Rule No. R161-14.29, 12-30-2014.

609S.9 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for Native Seeding and Planting for Restoration of the method specified on the Drawings.

The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, or fertilizer or mulch and for performing all operations necessary to complete the work.

Payment will be made under one or more of the following pay items:

Pay Item No. 609S-A:	Topsoil and Seedbed Preparation	Per Square Yard.
Pay Item No. 609S-B:	Topsoil and Seedbed Preparation	Per Acre.
Pay Item No. 609S-C:	Native Seeding	Per Square Yard.
Pay Item No. 609S-D:	Native Seeding	Per Acre.
<u>Pay Item No. 609S-E:</u>	<u>Rooted Plants</u>	<u>Per each.</u>
Pay Item No. 609S-<u>E-F</u>:	Watering	Per 1000 Gallons (Kgal).
Pay Item No. 609S-<u>F-G</u>:	Management Practices	Per Square Yard.
Pay Item No. 609S-<u>G-H</u>:	Management Practices	Per Acre.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 609S "Native Grassland Seeding and Planting for Erosion

Control" City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer

City of Austin Land Development Code

<u>Designation</u>	<u>Description</u>
Section 6-4	Water Conservation

RELATED CROSS REFERENCE MATERIALS

Specification Item 609S "Native Grassland Seeding and Planting for Erosion Control"

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting

City of Austin Standards (Details)

<u>Standard No.</u>	<u>Description</u>
627S-1	Grass Lined Swale
627S-2 Center	Grass Lined Swale W/ Stone
633S-1	Landgrading

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 160	Topsoil
Item No. 162	Sodding for Erosion Control

Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blankets
Item No. 180	Wildflower Seeding
Item No. 192	Landscape Planting

ITEM NO. 620S - FILTER FABRIC

620S.1 - Description

This item shall govern the furnishing of materials and for placement of filter fabric as indicated on the Drawings or directed by the Engineer or designated representative. Filter Fabric shall have the capability for allowing the passage of ground water or stormwater through it without transporting the soil or medium placed around the filter fabric.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

620S.2 - Submittals

The submittal requirements of this specification item include:

- A. catalog cuts,
- B. samples of material selected,
- C. testing results,
- D. Manufacturer's recommended installation procedures, and
- E. Manufacturer certification of compliance with this specification.

620S.3 - Materials

A. General

The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

B. Physical Requirements

The fabric shall meet the requirements of table 1, when sampled and tested in accordance with the methods indicated in the table below.

For applications such as water quality facility underdrain wrappings that require a high flow-through rate, or when specified by the engineer, the fabric shall be woven monofilament and meet the requirements of Table 2.

All material shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

620S.4 - Construction Methods

The submittal requirements shall be completed before any materials are ordered.

The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated on the Drawings or as directed by the Engineer or designated representative. When lapping is required, it shall be in accordance with the manufacturer's recommendations. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

TABLE 1: FILTER FABRIC REQUIREMENTS		
Original Physical Properties	Test Method	Requirements
Fabric weight (mass), on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd (grams/square meter)	TxDoT Tex-616-J*	Underdrains/Slope Stabilization 4.0 (135) minimum
		Gabions and Revet Mattresses 6.0 (200) minimum
Water flow rate by falling head method, 7.9 inches (20 cm) to 3.9 inches (10 cm) on 2 inch (50 mm) ID cylinder with 1 inch (25 mm) diameter orifice, with flow rate expressed in gal/sq.ft/minute (liters/square meter/minute).	TxDoT Tex-616-J*	80 (3,260) minimum
Breaking load in either machine or cross-machine direction, expressed in pounds (newtons)	ASTM D-1682 grab method G**	100 (445) minimum
Equivalent opening size for US Standard (SI) sieves.	CW-02215	70 to 100 (212 to 150mm)
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

* TxDoT Tex-616-J, "Testing of Construction Fibers"

** ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics"* as modified by TxDoT Test Method Tex-616-J

*** CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

ADD NEW TABLE

<u>TABLE 2: HIGH FLOW FILTER FABRIC REQUIREMENTS</u>		
<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
<u>Fabric Weight</u>	<u>D 3776</u>	<u>3.0 ounces/square yard minimum</u>
<u>Ultraviolet (UV) Radiation Stability</u>	<u>D 4355</u>	<u>70% strength retained minimum , After 500 hours in xenon arc device</u>
<u>Mullen Burst Strength</u>	<u>D 3786</u>	<u>120 pound per square inch minimum</u>
<u>Water Flow Rate</u>	<u>D 4491</u>	<u>275 gallons/minute/square feet minimum</u>

620S.5 - Measurement

Work and acceptable material for "Filter Fabric" and "High Flow Filter Fabric" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards), complete in place.

620S.6 - Payment

The work performed and the materials furnished and measured as provided under "Measurement" will be paid at the unit bid price for "Filter Fabric". The unit bid price, when included in the contract as a pay item, shall include full compensation for all materials, excavation and backfilling and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item No. 620S - A:</u>	Filter Fabric	Per Square Yard.
<u>Pay Item No. 620S - B</u>	<u>High Flow Filter Fabric</u>	<u>Per Square Yard.</u>

End

<i>SPECIFIC CROSS REFERENCE MATERIALS</i>	
<i>Specification 620S, "Filter Fabric"</i>	
<i>American Society for Testing and Materials (ASTM)</i>	
<i>Designation</i>	<i>Description</i>
D 1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
<u>D 3776</u>	<u>Standard Test Method for Mass Per Unit Area (Weight) of Fabric</u>
<u>D 4355</u>	<u>Test Method for Deterioration of Geotextiles by Exposure to Ultraviolet Light, Moisture, and Heat in a Xenon Arc Type Apparatus</u>
D 3786	<u>Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method</u>
D 4491	<u>Standard Test Method for Water Permeability of Geotextiles by Permittivity</u>
<i>Texas Department of Transportation Manual of Testing Procedures</i>	
<i>Designation</i>	<i>Description</i>
Tex-616-J	Testing of Construction Fabrics

<i>RELATED CROSS REFERENCE MATERIALS</i>	
<i>Specification 620S, "Filter Fabric"</i>	
<i>City of Austin Environmental Criteria Manual</i>	
<i>Designation</i>	<i>Description</i>
Section 1.4.2.E	Rock Berm
<u>Section 1.6.5.A.4</u>	<u>Sand Filtration Bed Details</u>

<u>Section 1.6.7.C</u>	<u>Biofiltration</u>
<i>City of Austin Standard Details</i>	
<i>Designation</i>	<i>Description</i>
Number 639S-1	Rock Berm
<u>Number 661-1</u>	<u>Sand Bed Filtration Configurations Using Geomembrane Liner</u>
<u>Number 661-2</u>	<u>Sand Bed Filtration Configurations Using Clay Liner/No Liner Required</u>
<u>Number 661-3</u>	<u>Biofiltration Bed Configurations Using Geomembrane/Clay Liner</u>
<i>City of Austin Standard Specifications</i>	
<i>Designation</i>	<i>Description</i>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<i>Designation</i>	<i>Description</i>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

Item No. 660S - Biofiltration Medium

660S.1 Description

This item shall govern mixing and placing medium for a biofiltration basin intended to treat storm runoff. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

(1)Submittals

The submittal requirements of this specification item

include: A. A signed statement provided by the

Contractor that:

1.A laboratory analysis has been conducted by of the actual mixture being proposed, and has been verified as meeting the specifications below. The date of the laboratory analysis must be no more than six months prior to the date of installation of the biofiltration medium. A copy of the laboratory results must be provided.

2.No “sandy loam” fill material (aka “red death”) is included in the mixture 3. Report the source of organic matter.

B.Laboratory reports of analyses results documenting that the mixture meets the following specifications:

1.Particle size distribution performed per ASTM D-422:

- Coarse fragments + sand content of 70 – 90% by weight
- Clay content of 3 – 10% by weight
- Silt + clay content ≤ 27% by weight

2.Percent organic matter of 0.5 – 5% by weight per ASTM D2974 Method C

C.Contractor’s statement that the biofiltration medium has been tested by a laboratory using approved procedures (copy of lab results provided below) and meets the criteria as noted in Table 1 below:

Table 1 – Biofiltration Medium Characteristics

<u>Parameter</u>	<u>Results*</u>	<u>Criteria</u>	<u>Criteria Met?*</u>
<u>Percent Sand + Coarse Fragments (ASTMD-422)</u>		<u>70 – 90%</u>	
<u>Percent Clay (< 0.002 mm)</u>		<u>3 – 10%</u>	
<u>Percent Silt + Clay (< 0.05 mm)</u>		<u>≤ 27%</u>	
<u>Percent Organic Matter (ASTM D-2974)</u>		<u>0.5 – 5%</u>	
<u>Is any “Red Death” included in medium?</u>		<u>None allowed</u>	

<u>Is the mixture free of trash, stones, weeds, or other undesirable material?</u>		<u>None allowed</u>	
<u>Is the medium well-mixed and homogenous?</u>		<u>Must be homogenous</u>	

*** Laboratory Must Fill In These Cells**

Table 2 – Biofiltration Medium Testing and Installation Dates

<u>Date of Laboratory Analysis (earliest)*</u>	
<u>Date of Medium Installation*</u>	
<u>Time between Dates (months)*</u>	
<u>Criteria for Time Between Dates (months)</u>	<u>6</u>
<u>Is Criteria Met?*</u>	

*** Contractor Must Fill In These Cells**

660S.2 Materials

(1)Acceptable Materials

The following mixture (% by volume) should create an appropriate biofiltration medium, subject to specific characteristics of the topsoil, which may exhibit considerable variability:

- 70-80% concrete sand per ASTM C33 and/or screened decomposed granite sand
- 20-30% screened bulk topsoil (chocolate loam is also acceptable)
- The source materials must be free of stones, roots, or other similar objects larger than two inches. Additionally, it should be free of trash, other undesirable material, and should not contain weeds or weed seeds.
- The ingredients shall be well-mixed to create a homogenous medium.

(2)Unacceptable Materials

A commercially available fill material that should not be used is typically marketed as “sandy loam.” This product is often referred to by landscapers as “red death”, which refers to the color of the material, and is an infertile fill material that has poor drainage characteristics. All materials shall be free of Bermuda grass, Quackgrass, Johnson grass, or other noxious weeds, their roots or seeds.

660S.3 Construction

Methods (1) Erosion

Control

Prior to commencing this work, all required erosion control and environmental measures shall be in place as indicated on the approved site plan and/or modified.

(2)Scheduling, Delivery, Storage and Signage

The biofiltration medium must be delivered to, or mixed at, the site prior to the mid-construction conference. The medium must be certified as meeting the required specifications by the project Engineer, and approved by the City Inspector. The medium must be stored on-site separate from other materials, and covered to prevent erosion of the mixture by rainfall and runoff. The medium must have a prominent tag affixed that reads "BIOFILTRATION MEDIUM FOR WATER QUALITY POND."

(3)Placement

Complete construction and stabilize all areas draining to the biofiltration basin. Permanent controls will be cleaned out and filter medium will be installed after stabilization of the site. Install geotextile fabric per the Biofiltration Bed detail provided in Standard Detail 661-3. Biofiltration medium shall be placed in lifts of 12 to 18 inches without using heavy operating equipment or compaction. Lifts should be lightly watered to encourage soil settling. The final surface must be raked flat. The project Engineer must be notified 24 hours prior to installation of the biofiltration medium and approve and certify the installation.

(4)Shrinkage

Some shrinkage of the medium is to be expected after installation, in the range of 5-15%. As a general recommendation about 20 inches of medium should be installed to achieve a depth of 18 inches.

660S.4 Measurement

Biofiltration medium will be measured by the cubic yard (cubic meters: 1 cubic meter is equal to 1.196 cubic yards) in its final position based upon the average end areas, calculated from pre- construction cross sections and plan grades. The plan quantities for biofiltration medium will be used as the measurement for payment of this item.

660S.5 Payment

All work performed as required herein and measured as provided under "Measurement" will be paid for at the unit bid price. The bid prices shall include full compensation for furnishing all labor; all materials; all royalty and freight involved; all hauling and delivering on the road; and all tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

Payment will be made under the following:

<u>Pay Item No. 660S: Biofiltration Medium.</u>	<u>Per Cubic</u>
<u>Yard</u>	

END OF SECTION

SPECIFIC CROSS REFERENCE MATERIALS

Specification Biofiltration Medium

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
<u>Section 1.6.7.C</u>	<u>Biofiltration</u>

RELATED CROSS REFERENCE MATERIALS

Specification Biofiltration Medium

City of Austin Environmental Criteria Manual

<u>Designation</u>	<u>Description</u>
<u>Section 1.6.5.A.4</u>	<u>Sand Filtration Basin Details</u>

City of Austin Standards Details

<u>Designation</u>	<u>Description</u>
<u>Item No. 661-3</u>	<u>Biofiltration Bed Configurations Using Geomembrane/Clay Liner</u>

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
<u>Item No. 620S</u>	<u>Filter Fabric</u>