ITEM NO. 601S - SALVAGING AND PLACING TOPSOIL

601S.1 - Description

This item shall govern the removal, storage and placement of approved on-site naturally occurring topsoil and topsoil mix (see 601S.3.A) to the depths and area shown on the Drawings or as directed by the Engineer or Landscape Architect ~~designated representative~~.

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

601S.2 - Submittals

A. ~~The submittal requirements of this specification item shall include~~ Submittals required before construction:

1. Soil test results and soil classification necessary for approval of material as suitable topsoil. ~~and presence of deleterious material, and recommendations on amendments.~~ Soil test results should include, at minimum, texture; percentage organic matter (OM); salinity (soil salt) level; pH; and amounts of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), nitrate-nitrogen (NO_3-N), and sulfate-sulfur (SO_4-S).

2. For topsoil mixes containing compost, the soil test for shall also include moisture content, C:N ratio and Solvita compost maturity index.

3. A sample (~~2~~1-gallon) of proposed topsoil or topsoil mix shall be submitted to the Owner or their representative 30 calendar days before installation and be approved before installation. Sample should be labeled including type of material, specification number; name, address, and telephone number of manufacturer or supplier; and address of the location of the source or material stockpile.

B. Submittals/Inspection required during construction:

1. Delivery tickets indicating type/product name, source and quantities of imported topsoil mix or compost (for mixing with salvaged soil).

2. Deliveries of soil to a job site shall be inspected by the project Engineer or Landscape Architect or Owner's construction inspector before placement to verify product compliance with specification.

601S.3 - Materials

A. Topsoil Mix

1. ~~The t~~Topsoil mix shall be composed of 4 parts of soil mixed with 1 part compost, by volume. ~~The compost shall meet TxDOT Specification Item 161.~~ The soil shall be locally available native soil that meets the following specifications:

a) Shall be free of trash, weeds, deleterious materials, rocks and debris.

b) 100% shall pass through a ~~1.5-inch (38-mm)~~ 3/8-inch (9.5 mm) screen.

c) Soil to be a black or dark brown loamy material that meets the requirements of the table below in accordance with the USDA textural triangle. Soil known locally as "red death" is not an allowable soil. Textural composition shall meet the following criteria:

Textural Class	Minimum	Maximum
Clay	5%	50%
Silt	10%	50%
Sand	15%	67%

d) Organic matter percentage shall be at least 5.0% after the addition of compost,

e) Salinity shall be below 6.00 mmhos/cm.

f) An owner/~~engineer~~ project designer(s) may propose use of onsite salvaged topsoil which does not meet the soil texture class required above by providing a soil analysis and a written statement from a qualified professional in soils, landscape architecture, or agronomy indicating the onsite topsoil will provide an equivalent growth media and specifying what, if any, soil amendments are required.

2. The compost shall be locally available and shall meet the following specifications:

a) Shall be well decomposed, stable to very stable, weed-free plant-based material source derived from yard trimmings or City approved alternate source. The Carbon/Nitrogen (C/N) ratio shall be less than 25:1 and trace metals test results should “pass”.

b) Shall be blended and ground leaf, wood and other plant-based material, composted for a minimum of nine (9) months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plants or other materials designed to produce compost high in fungal material. Non-vegetal source materials may be acceptable upon approval by the Owner. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.

c) Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria or as modified in this section for “Compost as a

Landscape Backfill Mix Component".

http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

d) Compost shall comply with the following parameters:

PARAMETERS[1]	**REPORTED AS (UNITS OF MEASURE)**	**GENERAL RANGE**
pH	pH units	6.0 – 8.5
Salinity (electric conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, net weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through ¾ inch screen
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	<8
Solvita Compost Maturity Test	Solvita units	>6
Physical Contaminants (inerts)	%, dry weight basis	<1%
Chemical Contaminants[2]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants Select pathogens Fecal coliform bacteria or Salmonella[3]	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council).

2 US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

3 US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

e) Compost and other soil amendments shall be worked into the existing on-site topsoil with a disc or tiller to create a well-blended material.

2. All disturbed areas to be revegetated are required to provide a minimum of six (6) inches of topsoil. The topsoil shall be able to support the growth of planting (Standard Specification Item No. 608S), ~~seeding~~ Seeding for Erosion Control (Standard Specification Item No. 604S), sodding (Standard Specification Item No. 602S) and ~~native grassland seeding and planting~~ Native Seeding and Planting for Restoration (Standard Specification Item No. 609S).

B. Water

Water shall be furnished by the Contractor and shall be clean and free from seed source, pesticide, fertilizer, industrial wastes and other objectionable matter.

601S.4 - Sources

The salvaged topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Drawings or identified by the Engineer or Landscape Architect ~~designated representative~~. The approximate quantity of acceptable topsoil to be salvaged from the project will be shown on the Drawings. The topsoil or topsoil mix may also be obtained from approved sources, which are located outside the right-of-way and have been secured by the Contractor.

601S.5 - Construction Methods

~~Precautions will be maintained at all times to protect all trees in the area of construction~~. Tree protection fencing will be maintained at all times to protect all trees in the limits of construction. Where removal of trees is indicated on the Drawings, they shall be marked as directed by the Engineer, ~~or~~ Landscape Architect, or certified arborist ~~designated representative.~~

~~Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents.~~ Construction equipment shall not be operated nor construction materials stockpiled within the critical root zone of trees. Tree protection fencing shall remain in place per tree protection plan. Topsoil materials shall not be placed within the ~~drip line of trees~~ critical root zones of trees until tree wells are constructed that conform to Item No. 610S, "Preservation of Trees and Other Vegetation " and Standard Details 591S-1 and 610S-6. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal

The existing topsoil shall be removed from the area indicated on the Drawings, stockpiled in designated area on the site plan, windrow along the right of way or other designated area outside the 100-year floodplain (as defined in the Drainage Criteria Manual and Land Development Code) or spread over an area that is ready for topsoil application in accordance with the Drawings or as directed by the Engineer or Landscape Architect ~~designated representative~~.

Trash, wood, brush, stumps, rocks over 1 ½ inches (37.5 mm) in size and other objectionable material encountered shall be removed and disposed of as directed by the Engineer or Landscape

Architect ~~designated representative~~ prior to beginning of work required by this item. Grass and other herbaceous plant materials may remain. Large clumps shall be broken up.

Where the proposed planting area is compacted more than 85% proctor or 225 p.s.i., the existing soil should be tilled to a minimum depth of six inches before installation of the salvaged topsoil or topsoil mix. In the critical root zone of trees reference 661S.

The topsoil should not be placed if the ground is muddy, saturated, or frozen.

The topsoil should not be placed if the ground is extremely dry. Wet soil enough to prevent dust from leaving the site.

After the grading has been completed to the required alignment, grades and cross-sections and prior to the spreading of the salvaged topsoil, any clay or tight soil surfaces shall be scarified by plowing furrows approximately 4 inches (100 mm) deep along horizontal slope lines at 2 foot (600 mm) vertical intervals. The spreading of the salvaged topsoil or topsoil mix shall be undertaken as soon as the grading has been completed. The topsoil shall be spread so as to form a cover of uniform thickness indicated. After the topsoil has been placed and shaped, it shall be sprinkled with water and rolled to provide a suitable seed bed.

601S.6 - Measurement and Payment

Salvaging, removal and/or placing topsoil materials will not be measured for payment, but shall be included in the unit price bid for the item of construction in which these activities are used.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification 601S, "Salvaging and Placing Topsoil"	
City of Austin Standard Specification Items	
Designation	Description
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 608S	Planting

Item No. 609S	~~Native Grassland Seeding and Planting For Erosion Control~~ Native Seeding and Planting for Restoration
Item No. 610S	Preservation of Trees and Other Vegetation

City of Austin Standard Details	
Designation	Description
591S-1	Dry Stack Rock Wall
610S-6	Typical Tree Well Applications

RELATED CROSS REFERENCE MATERIALS	
Specification 601S, "Salvaging and Placing Topsoil"	

City of Austin Standard Specification Items	
Designation	Description
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer

City of Austin Standard Details	
Designation	Description
610S-1	Tree Protection Fence Locations
610S-2	Tree Protection Fence, Type B Chainlink
610S-3	Tree Protection Fence, Type B Wood
610S-4	Tree Protection Fence, Modified Type A
610S-5	Tree Protection Fence, Modified Type B

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges	
Designation	Description
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling

Texas Department of Transportation: Manual of Testing Procedures	
Designation	Description
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils

Tex-106-E	Method of Calculating the Plasticity Index of Soils

ITEM NO. 661S – SOIL DECOMPACTION

661S.1 Description

This work shall consist of performing all required activities for soil decompaction in areas shown on the Drawings or as directed by the Engineer, Landscape Architect, or authorized City of Austin representative. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with Soil Decompaction, complete as shown on the drawings and as specified herein.

A. The scope of work in this section includes, but is not limited to, the following:

1. Modify existing site soil.
   a. Modify existing in-situ site soil in place for use as Planting Soil.
   b. Install existing or modified existing stockpiled soil for use as Planting Soil.
2. Install compost and/or other amendments into existing site soil as part of decompaction.
3. Clean up and disposal of all excess and surplus material.

B. Definitions

1. Air tillage, fertilizer, mulch (AFM), as coined by Fite, Smiley, McIntyre & Wells (2011[1]), is a soil decompaction and amendment process for trees involving decompaction with a pneumatic air tool while simultaneously incorporating organic matter and fertilizer into the soil.
2. **A** horizon: Mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material.
3. Bulk Density Method: a method for measuring soil compaction where bulk density is an indicator of compaction, calculated as the dry weight of soil divided by its volume. Bulk density reflects a soil's ability to function for structural support, water and solute movement, and soil aeration. Threshold results that determine critical bulk density are different for each soil texture. Typical measurement is done with bulk density cores, and the units are in lb./cf or g/cc^3 dry weight.
4. Compacted soil: high density soil lacking structure and porosity and characterized by restricted water infiltration and percolation (drainage), and limited root penetration.

5. Critical Root Zone (CRZ): the amount of ground around a tree protected from impacts by the City ordinance. This is defined as a radius around the tree trunk equal to one (1) foot of ground for every one (1) inch of tree trunk diameter when measured four-and-a-half (4.5) feet above the ground (DBH). This area is depicted in the plan as a circle centered on the location of the tree's base.
6. Diameter Breast Height (DBH): tree diameter measured at breast height, defined as 4.5 feet above average ground level. Field Capacity: the amount of water held in the soil after drainage due to the force of gravity. The volumetric soil moisture content remaining at field capacity is about 15-20% for sandy soils, 35-45% for loam soils, and 45-55% for clay soils.
7. Graded soil: Soil where the A horizon has been stripped and relocated or re-spread; cuts and fills deeper than twelve (12) inches.
8. Penetration Resistance Method: a method for measuring soil compaction based on penetrometry, or soil strength, measuring the resistance of soil surface to vertical force by inserting a rod or penetrometer into the soil. Threshold results that determine critical bulk density are somewhat the same for each soil texture. The typical measurement tool is a penetrometer, and the units are PSI (pounds of pressure per square inch).
9. Permanent Wilting Point: water content of a soil when most plants growing in that soil wilt and fail to recover their turgor upon rewetting.

Soil type	**Permanent wilt point v/v**	**Field capacity v/v**
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

Volumetric soil moisture shall be measured with a digital, electric conductivity meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent meter
Source: 015639 Tree and Plant Protection Specification (www.isa-arbor.com)

Table 661S.1 Wilting Point and Field Capacity by Soil Type

10. Planting Soil: approved topsoil and topsoil mix as defined in Standard Specification 601S.
11. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top.
12. Soil Ripping: Loosening the soil by dragging a ripping shank or chisel through the soil to the depths and spacing specified.

13. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, or spade tiller.
14. Solvita compost maturity test: A patented environmental measurement system for carbon dioxide and ammonia, the results of which can be used to assess soil health (biology), compost maturity, ammonia volatilization in manure, or grain spoilage due to fungal respiration.
15. Standard Proctor Method ASTM D 698: a method for measuring soil compaction, determining the optimal moisture content at which a given soil type will become most dense, achieving its maximum dry density. Threshold results that determine critical bulk density are the same for each soil texture. A proctor test will typically also provide results as bulk density lb /cf dry weight. Typical measurement tool is a densitometer, and the units are percentage maximum dry bulk density as tested by the standard proctor method.
16. Subgrade: surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing Planting Soil.
17. Subsoiling: A soil decompaction method that fractures compacted soil without adversely disturbing plants or topsoil.
18. Surface Soil Compaction: a maximum of six (6) inches deep and the result of traffic, light grading, or other impacts. The original A horizon may have been previously removed or graded but the lower profile is intact with acceptable compaction levels and limited grading. The soil organic matter, pH and chemistry in the A horizon may not be suitable for the proposed plant and may need to be modified.
19. Subsoil or Deep Soil Compaction: deeper than six (6) inches, and may be the result of previous grading, filling and dynamic or static compaction forces.
20. Topsoil: naturally produced and harvested soil from the A horizon or upper layers or the soil.
21. Vertical Mulching: a soil decompaction method for tree root zones involving drilling or air spading a series of shallow holes in the root zone and filling them with compost or other materials.
22. Undisturbed, ungraded soil: Soils with the original A horizon intact that have not been graded or compacted. Examples of undisturbed soils are those that have been farmed by no-till methods; those subjected to fire or logged but not graded; and natural forested land.

661S.2 Submittals

The submittal requirements of this specification item shall include the test results, information about proposed equipment, and samples necessary for approval of decompaction techniques and methods.

A. Soil compaction testing shall be performed both before and after modification of soil, unless otherwise specified by the Engineer or Landscape Architect.

1. Soil compaction testing shall include written results and mapped locations of tests provided to the Owner. A minimum of two tests per 1000 square feet are required. Test results shall be reported in PSI or bulk density (g/cm3) unless otherwise specified by the Engineer or Landscape Architect. For surface decompaction, measure at both the surface and at six (6) inches depth. For subsurface decompaction, measure at both six (6) inches depth and three-quarters of the maximum depth of decompaction. For example, if maximum depth of desired decompaction is 15 inches, measure at both 6 inches and 11 inches below finished grade.

B. Provide written information on type and size of equipment proposed to produce the desired decompaction.

C. For any required compost and mulch, provide a one gallon sample of the material with a lab analysis supplied by the producer to the inspector showing that the product(s) meets the requirements. Lab analyses for compost shall be no older than ninety (90) calendar days at the time of submittal.

1. Submit samples a minimum of two (2) weeks before the anticipated date of the start of the compost installation.

2. Samples shall be submitted at the same time as the lab analysis of the material.

3. Producer shall provide a letter stating the length of the composting period for compost, and listing the source materials by volume for compost and mulch.

D. For decompaction work under trees, provide qualified arborist credentials, including proof of certification from the lnternational Society of Arboriculture, licenses, resume and/or references.

661S.3 Materials

The Contractor shall be responsible for supplying all supplies and equipment in sufficient quantities so as to perform soil decompaction as necessary without delaying construction progress.

A. Compost: Blended and ground leaf, wood and other plant based material, composted for a minimum of nine (9) months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plants or other materials designed to produce compost high in fungal material. Non-vegetal source materials may be acceptable upon approval by the

Owner. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.

1. Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria or as modified in this section for "Compost as a Landscape Backfill Mix Component".

   http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

2. Compost shall comply with the following parameters:

PARAMETERS[1]	**REPORTED AS (UNITS OF MEASURE)**	**GENERAL RANGE**
pH	pH units	6.0 – 8.5
Soil Salt (electric conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, net weight basis	30 – 60%
Organic Matter Content	%, dry weight basis	30 – 65%
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through ¾ inch screen
Stability Carbon Dioxide Evolution Rate	mg CO2-C per g OM per day	<8
Solvita Compost Maturity Test	Solvita units	>6
Physical Contaminants (inerts)	%, dry weight basis	<1%
Chemical Contaminants[2]	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants Select pathogens Fecal coliform bacteria or Salmonella[3]	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

[1] Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council).

2 US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

3 US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

B. Mulch (hardwood): Mulch shall be coarse-ground and derived from hardwood (e.g., oak, elm) trees and woody brush sources. No more that 25% of the total volume shall be fine particles and no more than 20% of total volume shall be large pieces, where fine particles are defined as less than 3/8 inch in size and large pieces are defined as either larger than 1-1/2 inch in diameter or longer than eight (8) inches. The mulch shall be free from foreign materials.

661S.4 Construction Methods

A. General

Before initiation of decompaction activities, all required erosion control and environmental measures shall be in place as indicated on the drawings, and the depth(s) and location(s) of underground utilities shall be verified. The surface of the subgrade shall be shaped in general conformity with the typical sections, lines, and grades indicated on the drawings by the removal of existing material or by the addition of approved material as established by the Engineer or Landscape Architect.

This specification covers decompaction of (1) surface soils (0-6 inches) and/or (2) subsoil (below 7 inches) as show on the drawings. Requirements for decompaction of soils within the critical root zones of existing trees are also described.

B. The following are general threshold levels of compaction as determined by three compaction testing methods, including the bulk density method, standard proctor method, and penetration resistance method. The penetration resistance values were derived from the measurement of reference and degraded riparian sites across Austin, Texas studied in the Watershed Protection Department's Riparian Functional Assessment project.

Compaction levels that are detrimental to root growth are dependent on soil type, which typically varies from site to site and must be determined by an Engineer or Landscape Architect before testing occurs.

Excellent to Good Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.

Fair Compaction: Root growth is limited with fewer, shorter and slower growing roots.
Poor Compaction: Roots not likely to grow but may penetrate soil when soil is above field capacity.

COMPACTION RATING	**BULK DENSITY[1] (g/cm^3)**	**STANDARD PROCTOR (%)**	**PENETRATION RESISTANCE (PSI)[2]**
Excellent	<1.10 to	75-85%	75-125[3]

Good	<1.60		126-175
Fair	1.39 to 1.69	>85%	176-225
Poor	> 1.47 to > 1.80		>225

[1] Root limiting bulk density varies by soil type. See Table SS-661.4.2 for specifics.

[2] Acceptable test methods include ASTM D3441 Standard Test Method for Mechanical Cone Penetration or methods described in references such as Methods for Soil Analysis, Part 1, Physical and Mineralogical Methods, 2nd ed., EA Klute, ed. (Soil Science Society of America: Madison, WI 1986).

[3] Penetration resistance method: below 75 psi soil becomes increasingly unstable and will settle excessively.

Table 661S.4.1 Comparison of Compaction limits by various methods.

Soil texture	Ideal bulk densities (g/cm3)	Bulk densities that may affect root growth (g/cm3)	Bulk densities that restrict root growth (g/ cm3)
Sands, loamy sands	<1.60	1.69	>1.80
Sandy loams, loams	<1.40	1.63	>1.80
Sandy clay loams, loams, clay loams	<1.40	1.60	>1.75
Silts, silt loams	<1.30	1.60	>1.75
Silt loams, silty clay loams	<1.10	1.55	>1.65
Sandy clays, silty clays, some clay loams (35-45% clay)	<1.10	1.49	>1.58
Clays (>45% clay)	<1.10	1.39	>1.47

Table 661S.4.2 Comparison of Root Limiting Bulk Density for Different Soil Types. Source: NRCS 1998 in Dallas and Lewandowski (2003).

C. All soil management activities including amendment and/or decompaction must occur at a soil moisture content between 5-20% measured at the depth of the work.

D. Compacted Surface Soil **(0-6 inches):** Tilling

Surface tilling shall not be considered adequate to reduce compaction at depths seven (7) inches or greater below finished grade.

1. After rough grading and removing all plants and debris from the surface, till top six (6) inches with a *roto tiller, spade tiller,* or other equipment approved by the Engineer or Landscape Architect. Spread three (3) inches of compost on the

surface of the tilled soil.

2. Till the compost into the loosened soil. Smooth out grades with a drag rake or drag slip. An even bed, with limited irregularities, lumps or soil clods shall be prepared. Clods or rocks larger than two (2) inches shall be removed.

E. Compacted Subsoil **(7-24 inches):** Soil Ripping

1. After rough grading and removing all plants and debris from the surface, loosen the soil by dragging a ripping shank or chisel through the soil to depths of twenty-four (24) inches maximum. The Engineer or Landscape Architect shall specify the appropriate depth of ripping based on site conditions. Shank spacing varies with soil moisture, soil type, and degree and depth of compaction. Shank spacing shall be as specified by the Engineer or Landscape Architect.
2. At least three (3) separate series or patterns of movement are required.
   (1). The first series or pattern of passes is applied lengthwise, parallel with the longest spread of the site; gradually progressing across the site's width, with each successive pass.
   (2). The second series runs obliquely, crossing the first series at an angle of about 45 degrees.
   (3). The third series runs at right angle or 90 degrees to the first series.

3. Spread three (3) inches of compost or other specified amendment over the ripped area and till the material into the top six (6) inches of the soil surface using a roto-tiller or other approved method. An even bed, with limited irregularities, lumps or soil clods shall be prepared. Clods or rocks larger than 2" shall be removed.

F. Compacted Subsoil **(7-24 inches):** Subsoiling

1. Drag a ripping shank or chisel thru the soil to depths of twenty-four (24) inches maximum. The Engineer or Landscape Architect shall specify the appropriate depth of ripping based on site conditions. Shank spacing varies with soil moisture, soil type, and degree and depth of compaction. Shank spacing shall be as specified by the Engineer or Landscape Architect. Do not disturb soil or plants in the areas between subsoiled trenches.

2. Fill subsoiled trenches with compost to create a uniform surface grade.

G. Compacted Soil within the critical root zone of existing established trees: Full AFM or Vertical Mulching

Two techniques are described based on tree location relative to the floodplain and potential for adverse erosion. An International Society of Arboriculture (ISA) certified arborist should oversee work under trees at all times.

Under no circumstances should decompaction work be done in the one-quarter (1/4) critical root zone.

1. Remove the tops of all plants to be removed from the root zone. Remove sod with a walk behind sod cutter. Do not grub out the roots of plants to be removed.

2. Prior to beginning work, the proposed area shall be sufficiently wetted twenty-four (24) hours in advance to minimize dust to the greatest extent possible.
3. Use a pneumatic air tool such as an air knife or air spade.
4. Method 1 - Full AFM: In a location outside the floodplain and on slopes of 3:1 or less, use a pneumatic air tool to loosen the top nine (9) to twelve (12) inches of the soil in the entire dripline. In cases where nine (9) to twelve (12) inches is not attainable (i.e., shallow soil), apply aeration to the depth of soil present. Surface roots may move and separate from soil during this process but the bark on roots should not be broken. Make chemical adjustment as recommended by the soil test and as recommended by an ISA arborist or Landscape Architect. Any fertilizer treatment should be per a certified arborist. Add three (3) inches of compost over the soil immediately after aeration. Use a pneumatic air tool to mix the compost into the top six (6) to eight (8) inches of the loosened soil. Apply a minimum of three (3) inches of shredded hardwood mulch across the entire treatment area, but kept back one (1) foot from the trunk.
5. Method 2 – Vertical Mulching: This technique is suitable for a floodplain or other location subject to adverse erosion. Use a pneumatic air tool to make one (1) inch minimum diameter holes to a depth of ten (10) to twelve (12) inches with holes three (3) feet on center from the half critical root zone (CRZ) to the dripline. Funnel compost into the holes. Apply three (3) inches of shredded hardwood mulch across the entire treatment area, but kept back one (1) foot from the trunk.
6. Work in sections such that the entire process - including any proposed irrigation - can be completed in one day for each section. Apply ten (10) gallons of water per inch in diameter of DBH over the loosened soil at the completion of each day's work except during precipitation events of half inch or greater. During drought or other prolonged dry periods, continue to provide supplemental water for one (1) to three (3) weeks minimum after treatment.
7. Decompacted tree root zones should be access-restricted for one year using aluminum posts and chain barriers, at minimum, or approved equal. The barriers shall be erected at the edge of the decompacted zones around an entire tree or tree cluster, per the plans, without driving posts into major roots (3-inches diameter or greater).

H. Protection of Decompacted Soils: After any decompaction activities have taken place do not pass motorized equipment or stockpile construction materials or equipment on previously decompacted soil.

The Contractor shall protect decompacted soil from damage including contamination and re-compaction due to other soil installation, planting operations, and operations by other Contractors. Maintain protection of decompacted areas until project acceptance. Utilize fencing and matting as required or directed to protect the finished soil work. Treat, repair or replace damaged decompacted soil immediately.

I. Repair of Re-compacted Soils: After decompaction has taken place, any soil that becomes re-compacted to a density greater than 225 psi shall be decompacted again.

1. Loosen compacted soil and replace soil that has become contaminated as

determined by the Engineer or Landscape Architect. Re-compacted and/or contaminated soil shall be loosened or replaced at no expense to the Owner.

2. Where modified existing soil has become compacted or contaminated and needs to be replaced, provide imported soil that is of similar composition, depth and density as the soil that was removed.

661S.5 Measurement

All acceptable surface and subsurface decompaction will be measured by the square yard.

Existing soil that is modified by tilling, or ripping shall have a density to the depth of the modification, after completion of the loosening, such that the compaction readings at each tested location are in the Excellent to Fair ranges as defined above, at soil moisture approximately the mid-point between wilting point and field capacity. Soil that is modified by subsoiling shall have trenches of uniform depth and spacing throughout the subsoiled area.

661S.6 Payment

Payment for Soil Decompaction shall be made according to the unit price for completion of all components necessary to decompact work areas, and shall include all labor, tools, equipment, water, measuring devices, testing, materials, supplies, and incidentals to complete the work:

Item No. 661S-A Compacted Surface Soil: Tilling Per Square Yard

Item No. 661S-B Compacted Subsoil: Ripping to a depth of (x) inches Per Square Yard

Item No. 661S-C Compacted Subsoil: Subsoiling to a depth of (x) inches Per Square Yard

Item No. 661S-D Compacted Surface Soil: Root Zone – AFM Per Square Yard

Item No. 661S-E Compacted Surface Soil: Root Zone – Vertical Mulching Per Square Yard

Item No. 661S-F Aluminum post and chain barriers for trees Per Linear Foot

END

[i] Fite, K., E. Thomas Smiley, J. McIntyre, & C. E. Wells. 2011. Evaluation of a Soil Decompaction and Amendment Process for Urban Trees. *Arboriculture & Urban Forestry* 37(6).

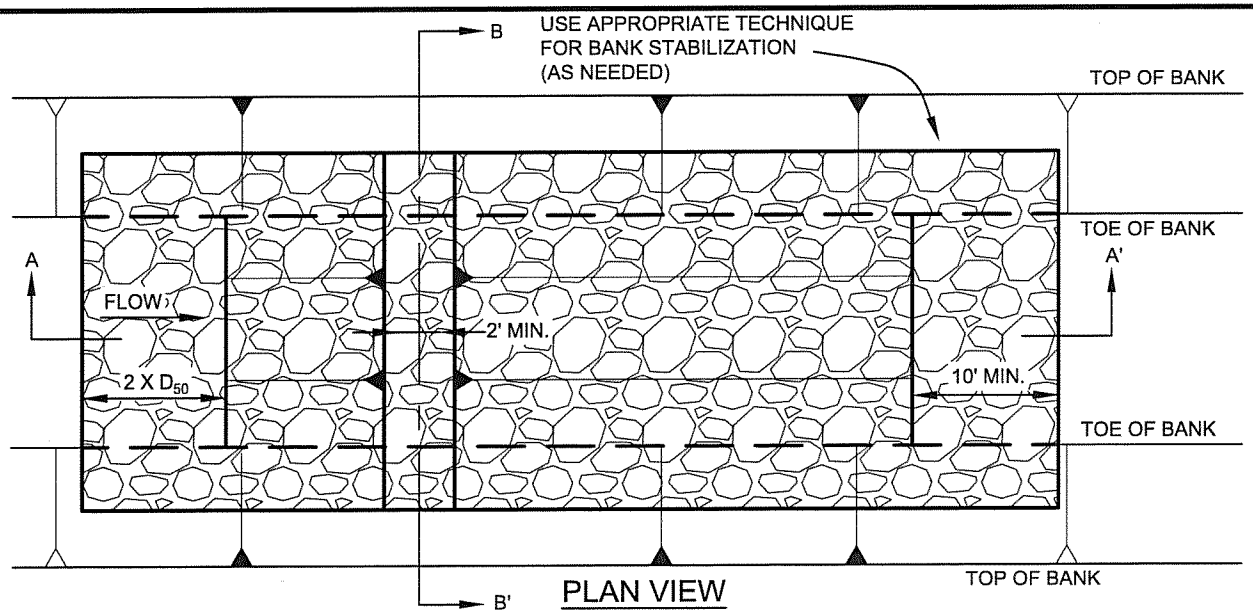
CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT

E. J. Rourke 11/14/16

GRADE CONTROL RIFFLE STRUCTURE WITH EMBEDDED TOE

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

STANDARD NO. 625S-2 A



PLAN VIEW

NOTES:

1. ROCK RIPRAP SHALL BE SOUND MATERIAL AND GRADED PER REQUIREMENTS SPECIFIED IN STANDARD SPECIFICATION ITEM NUMBER 591S.

2. ROCK RIPRAP D_{50} AND CLASS SIZE SHALL BE NOTED ON PLANS. GRADATION SHALL BE STABLE FOR THE DESIGN HYDRAULIC CONDITIONS AND IN ACCORDANCE WITH ECM 1.4.6.D ROCK RIPRAP, OR OTHER ENGINEERING STANDARD OF PRACTICE FOR SIZING ROCK RIPRAP.

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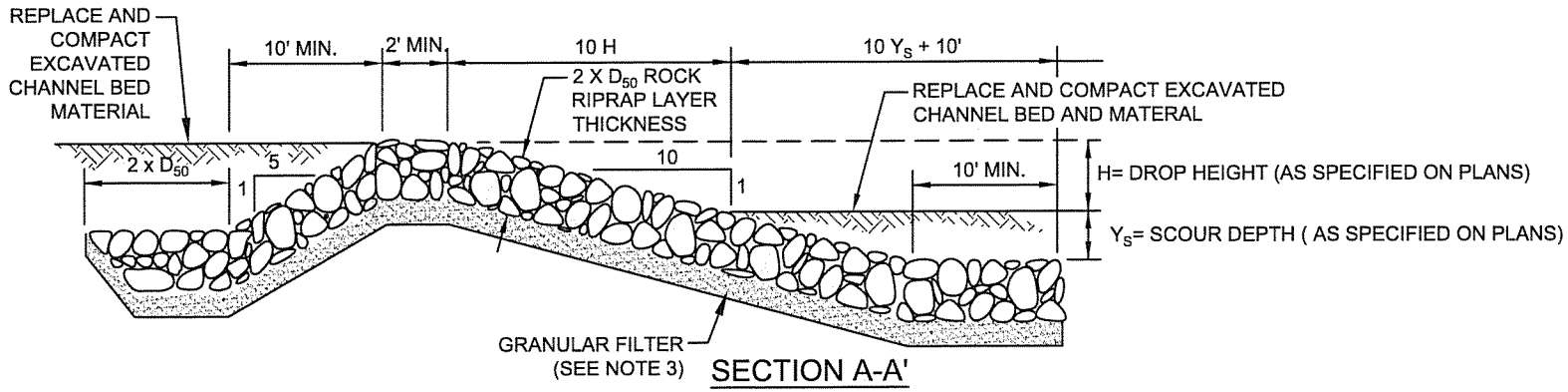
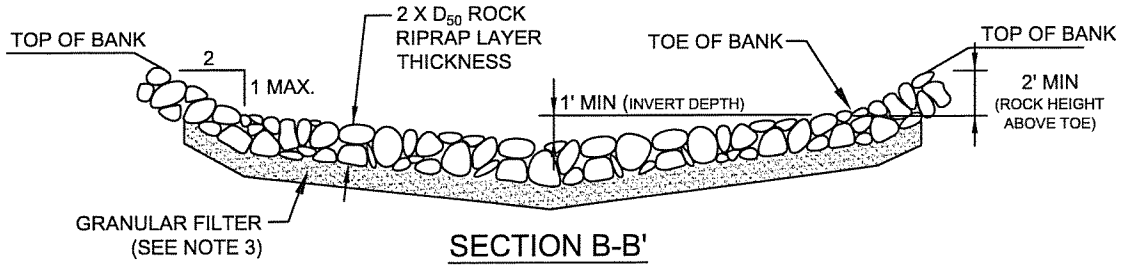


SECTION A-A'



SECTION B-B'

CITY OF AUSTIN

WATERSHED PROTECTION DEPARTMENT

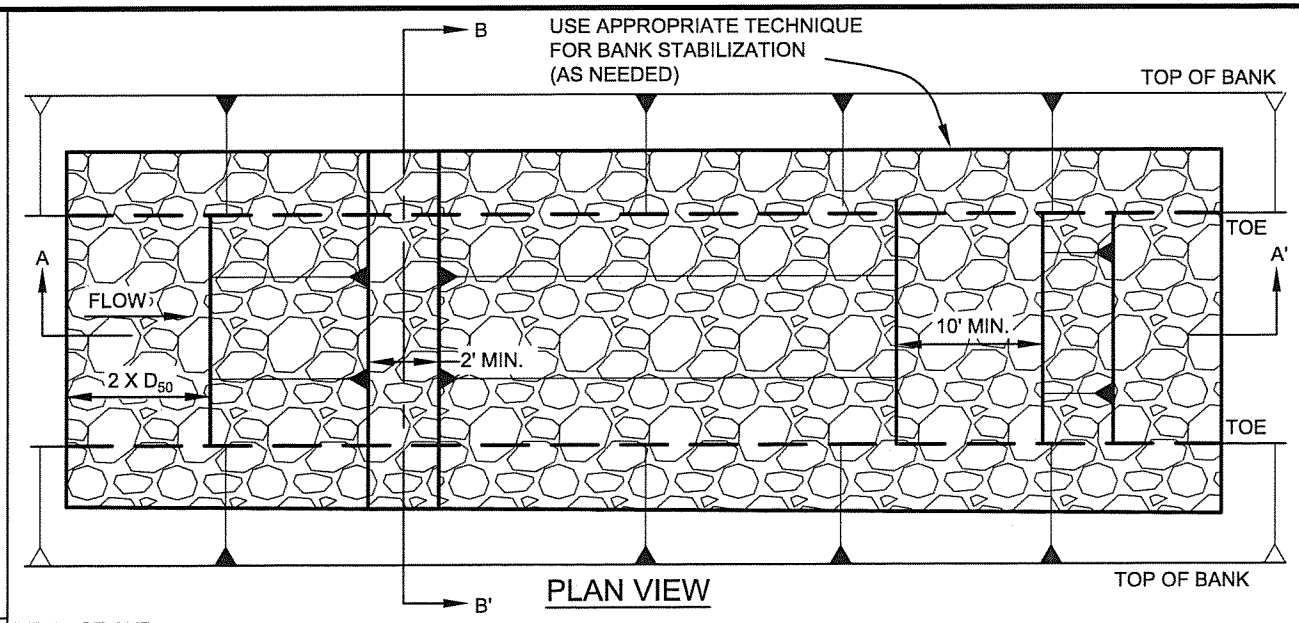
GRADE CONTROL STRUCTURE

ROCK RIFFLE WITH PREFORMED SCOUR POOL

STANDARD NO. 625S-2 B

11/14/16

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.



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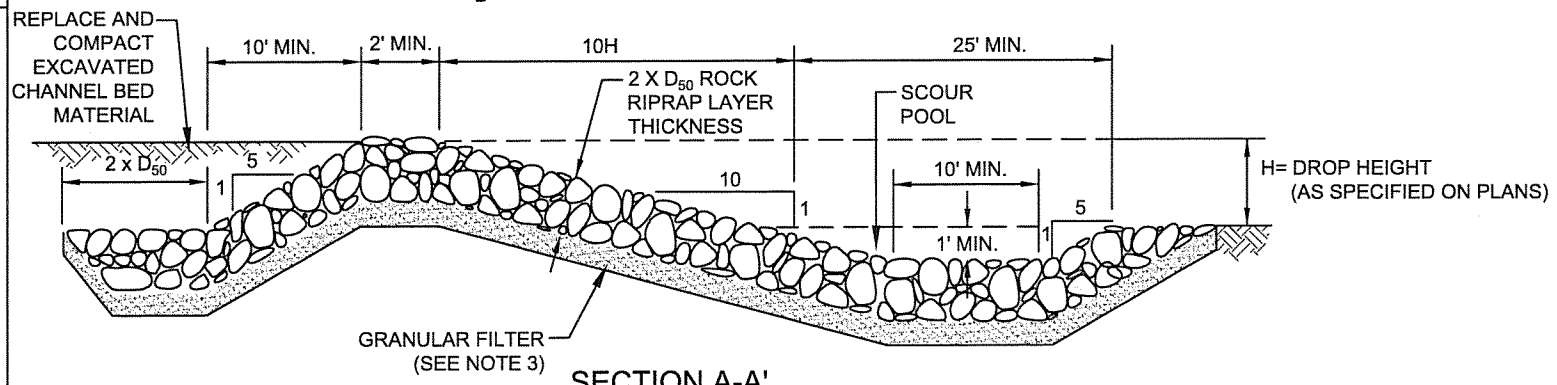
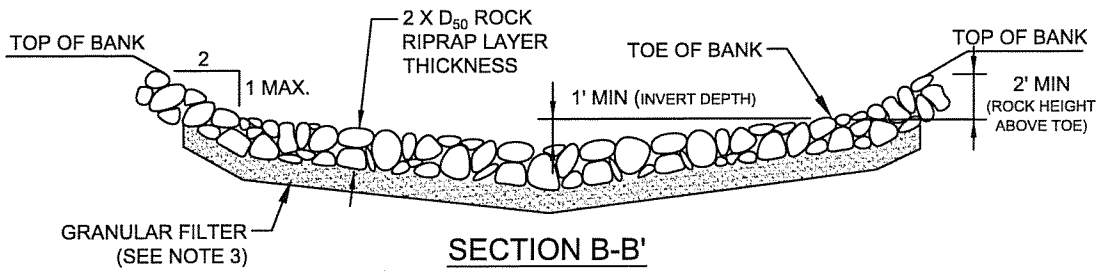


SECTION A-A'



SECTION B-B'

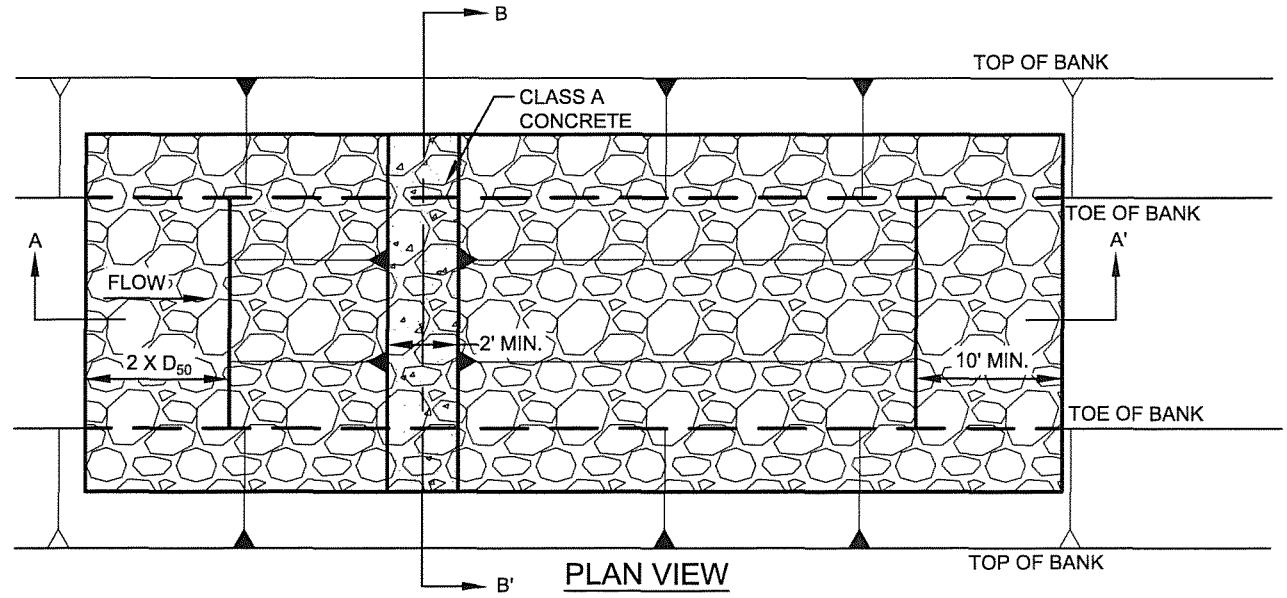
CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT

11/14/16

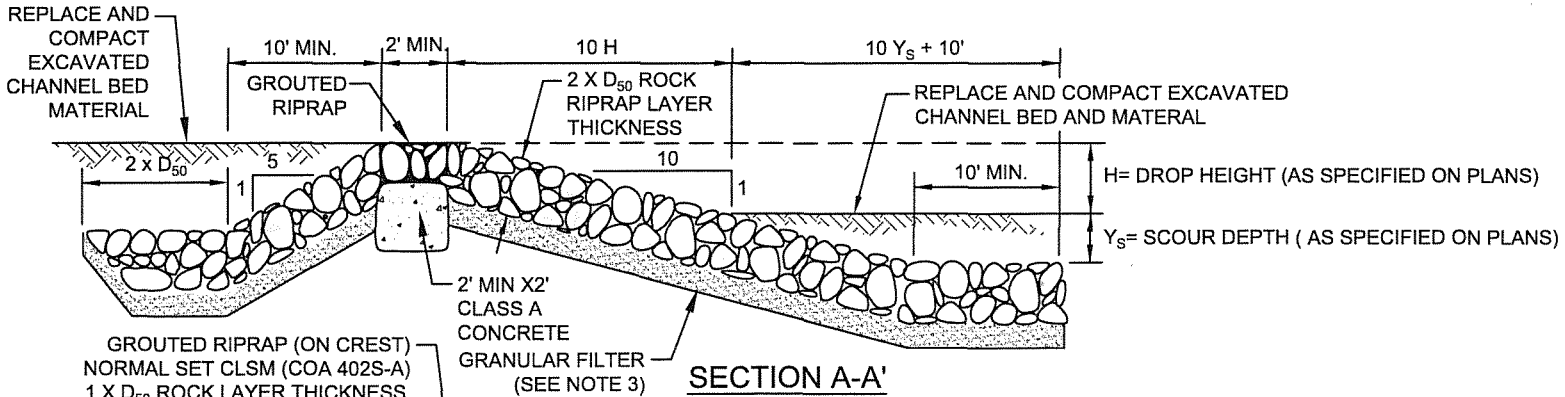
THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

GRADE CONTROL STRUCTURE
ROCK RIFFLE WITH CONCRETE CREST AND EMBEDDED TOE

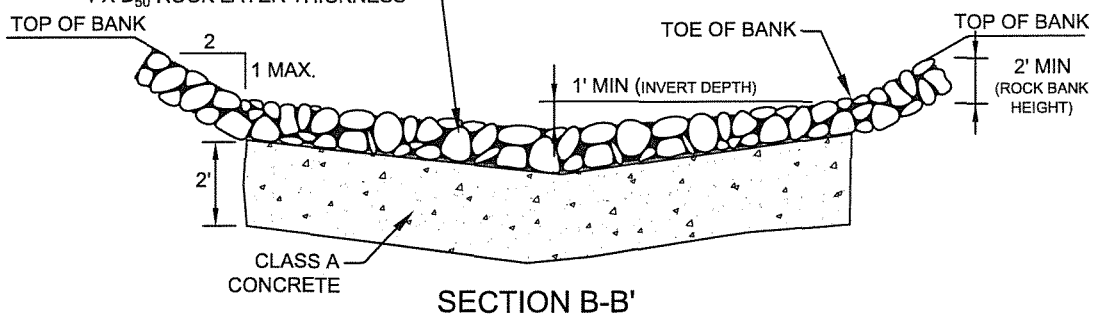
STANDARD NO.
625S-3 A



PLAN VIEW



SECTION A-A'



SECTION B-B'

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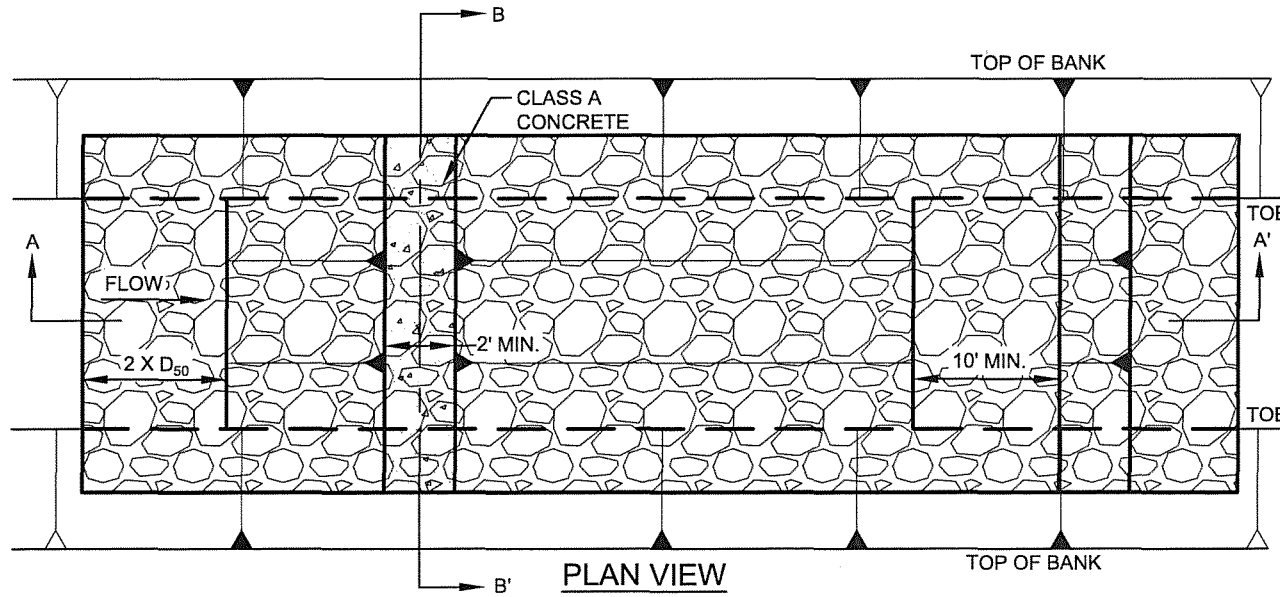
CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT

11/14/16

GRADE CONTROL STRUCTURE
ROCK RIFFLE WITH CONCRETE CREST AND PREFORMED SCOUR POOL

STANDARD NO. 625S-3 B

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.



PLAN VIEW

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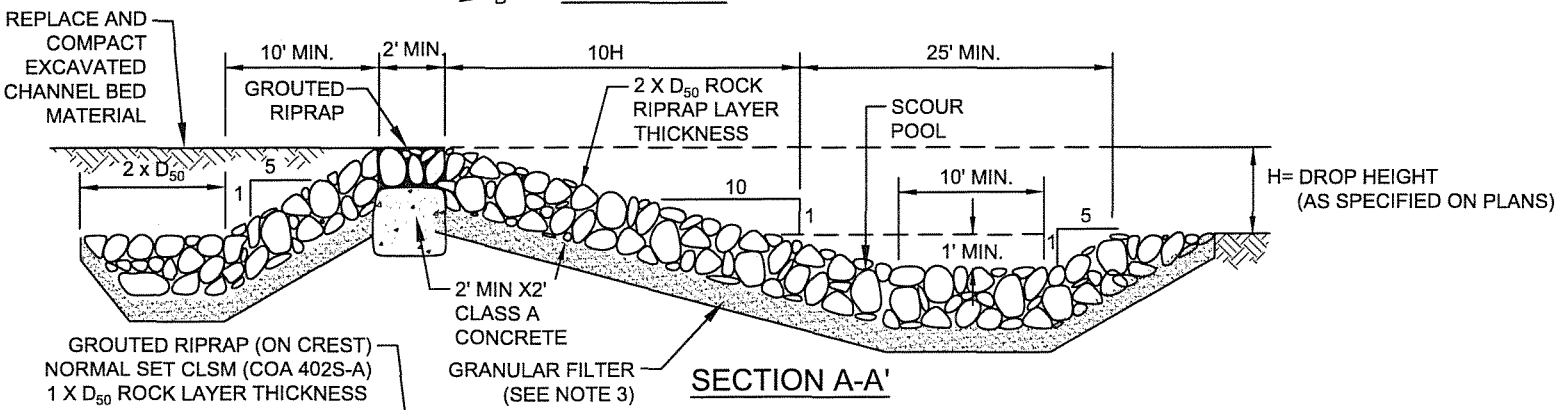
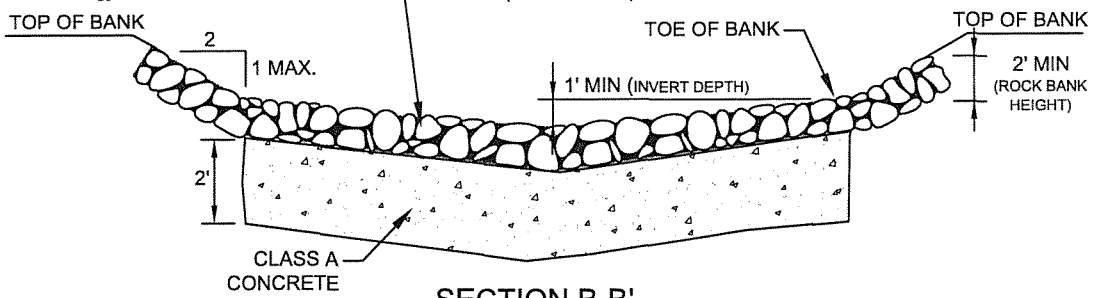


SECTION A-A'



SECTION B-B'

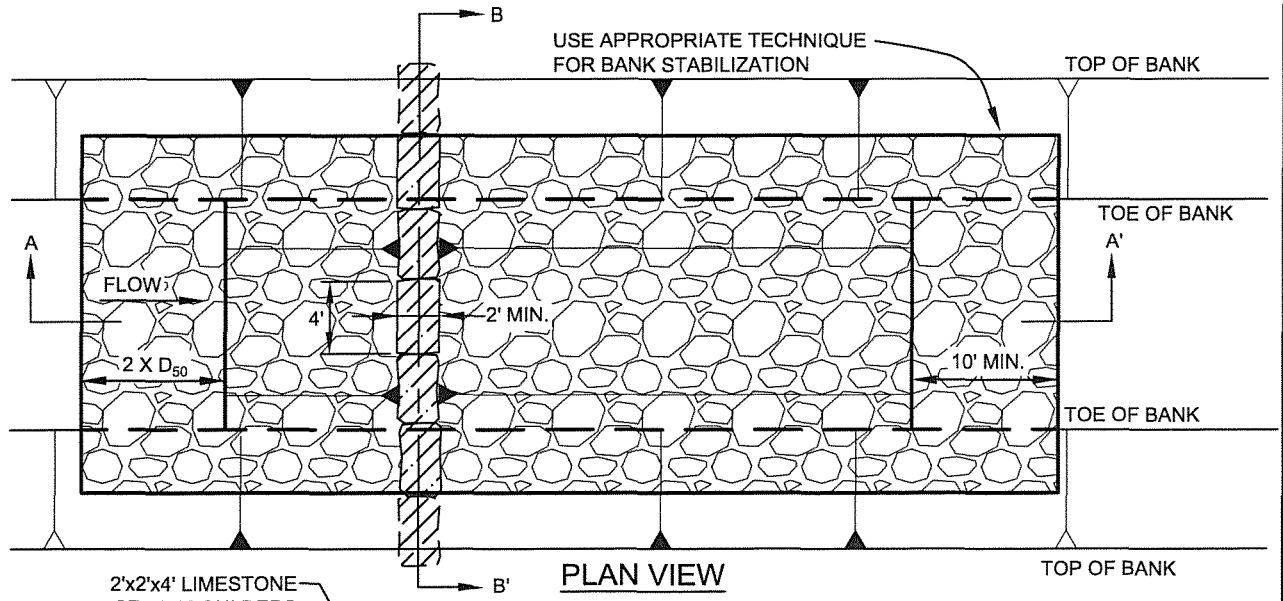
CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT

11/14/16

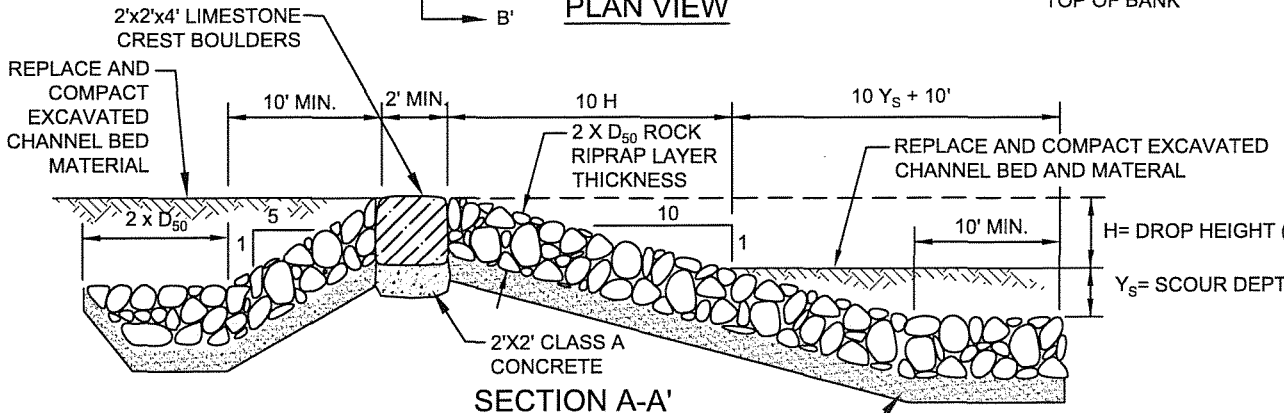
THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

GRADE CONTROL STRUCTURE
ROCK RIFFLE WITH BOULDER CREST AND EMBEDDED TOE

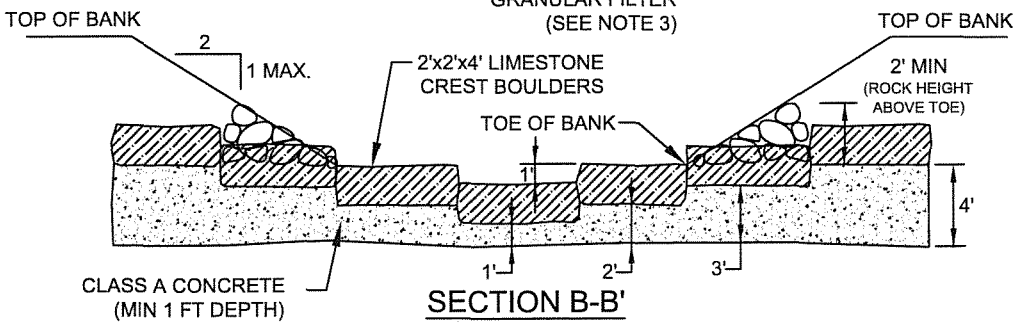
STANDARD NO.
625S-4 A



PLAN VIEW



SECTION A-A'



SECTION B-B'

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NOTES (BOULDERS):

1. BOULDERS SHALL BE DERIVED FROM NATURAL QUARRY LIMESTONE AND BE SPECIFIED AS EITHER "CUT" OR "NATURAL" PER THE PLANS. NATURAL BOULDERS SHALL HAVE A ROUGH SURFACE ON ALL EDGES, BUT THE TOP AND BOTTOM PARALLEL AND STACKABLE.

2. BOULDERS SHALL BE COMPRISED OF SOLID ROCK WITHOUT EXCESSIVE FRACTURES OR WEAK LAYERS AND HAVE A MINIMUM SPECIFIC GRAVITY OF 2.3

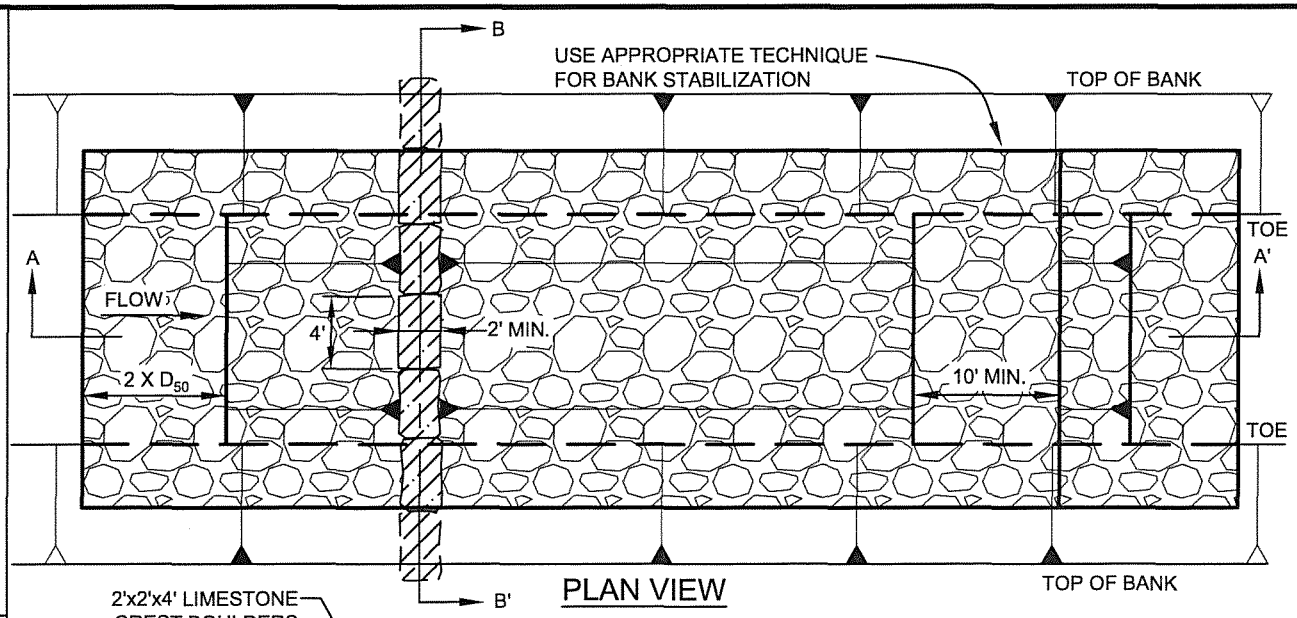
CITY OF AUSTIN
WATERSHED PROTECTION DEPARTMENT

GRADE CONTROL STRUCTURE
ROCK RIFFLE WITH BOULDER CREST AND PREFORMED SCOUR POOL

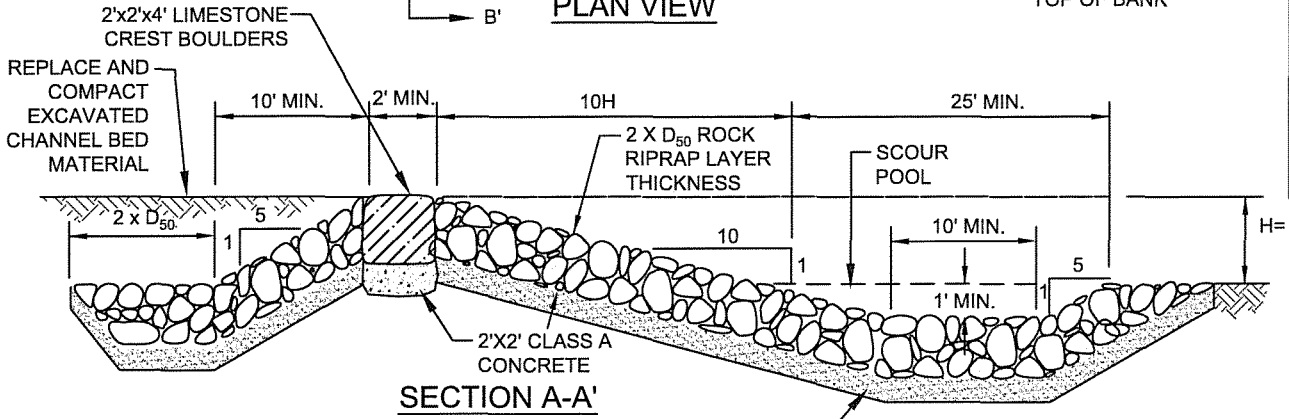
E. J. Rusch 11/14/16

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

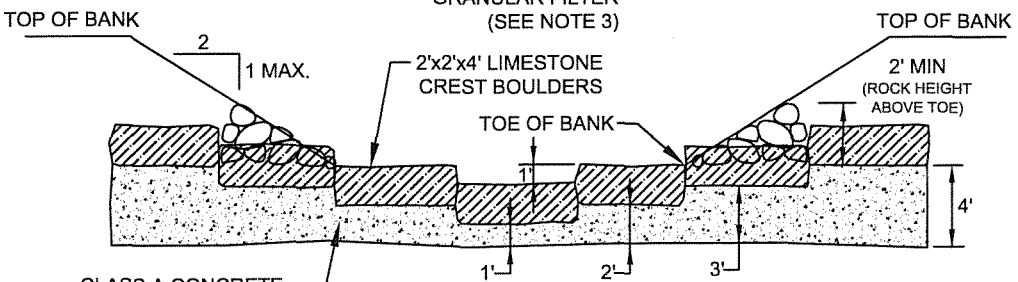
STANDARD NO. 625S-4 B



PLAN VIEW



SECTION A-A'



SECTION B-B'

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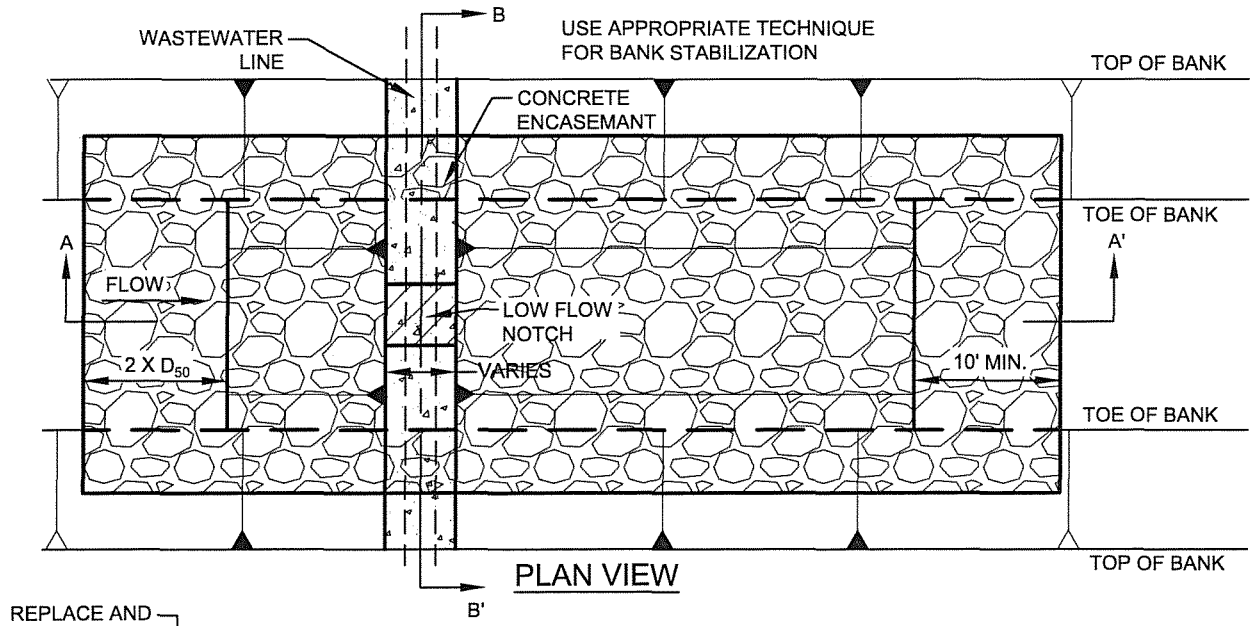
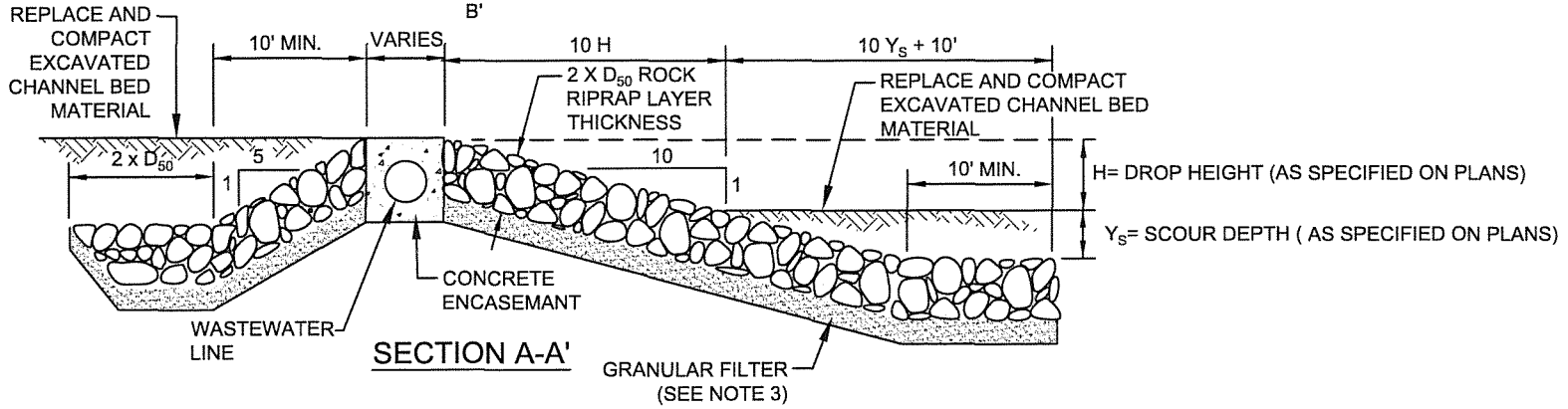
CITY OF AUSTIN

WATERSHED PROTECTION DEPARTMENT

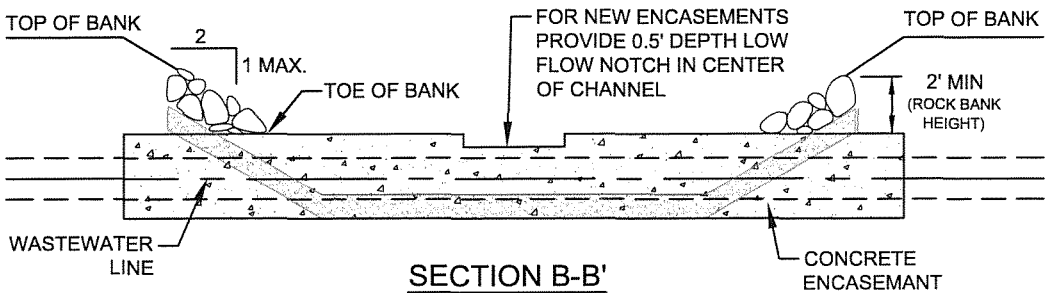
GRADE CONTROL STRUCTURE
ROCK RIFFLE AT WASTEWATER CROSSING
WITH EMBEDDED TOE



PLAN VIEW



SECTION A-A'



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11/14/11

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

STANDARD NO.

625S-5 A

CITY OF AUSTIN

WATERSHED PROTECTION DEPARTMENT

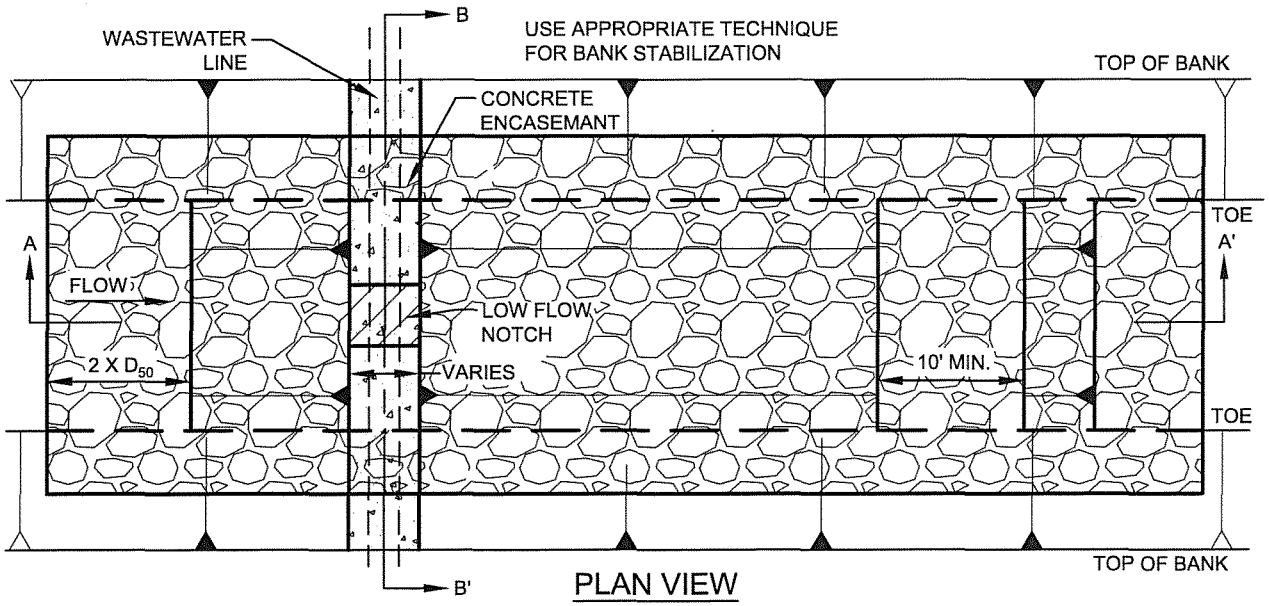
11/4/16

GRADE CONTROL STRUCTURE
ROCK RIFFLE AT WASTEWATER CROSSING
WITH PREFORMED SCOUR POOL

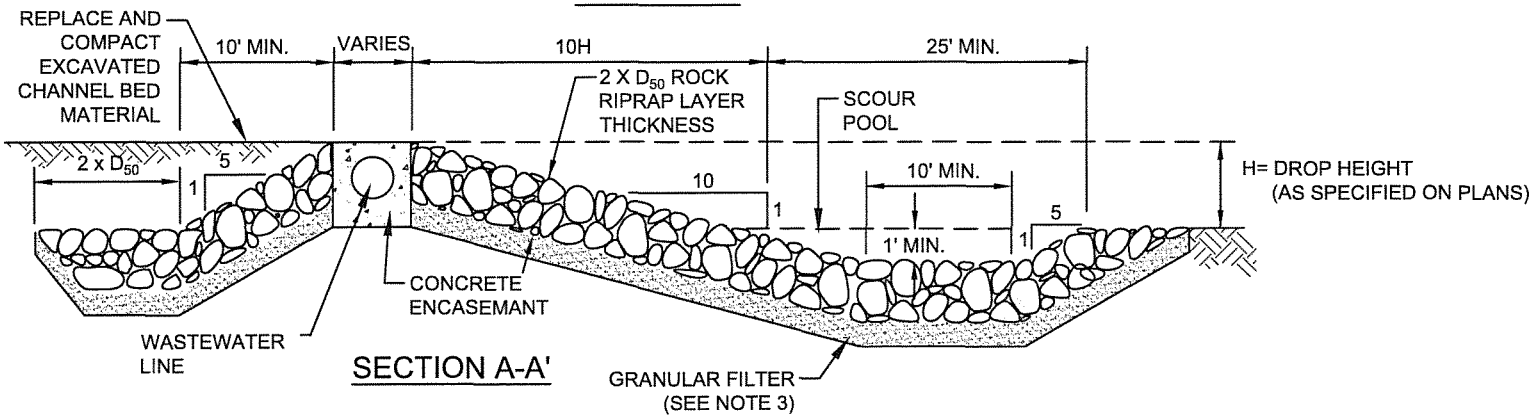
STANDARD NO.

625S-5 B

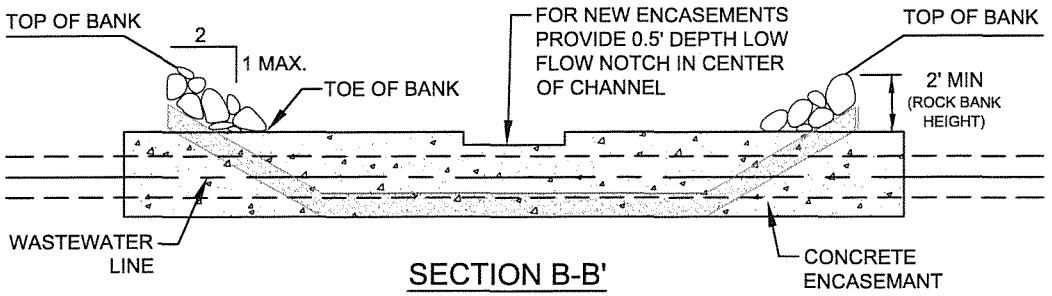
THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.



PLAN VIEW



SECTION A-A'



SECTION B-B'

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CITY OF AUSTIN

WATERSHED PROTECTION DEPARTMENT

9/14/16

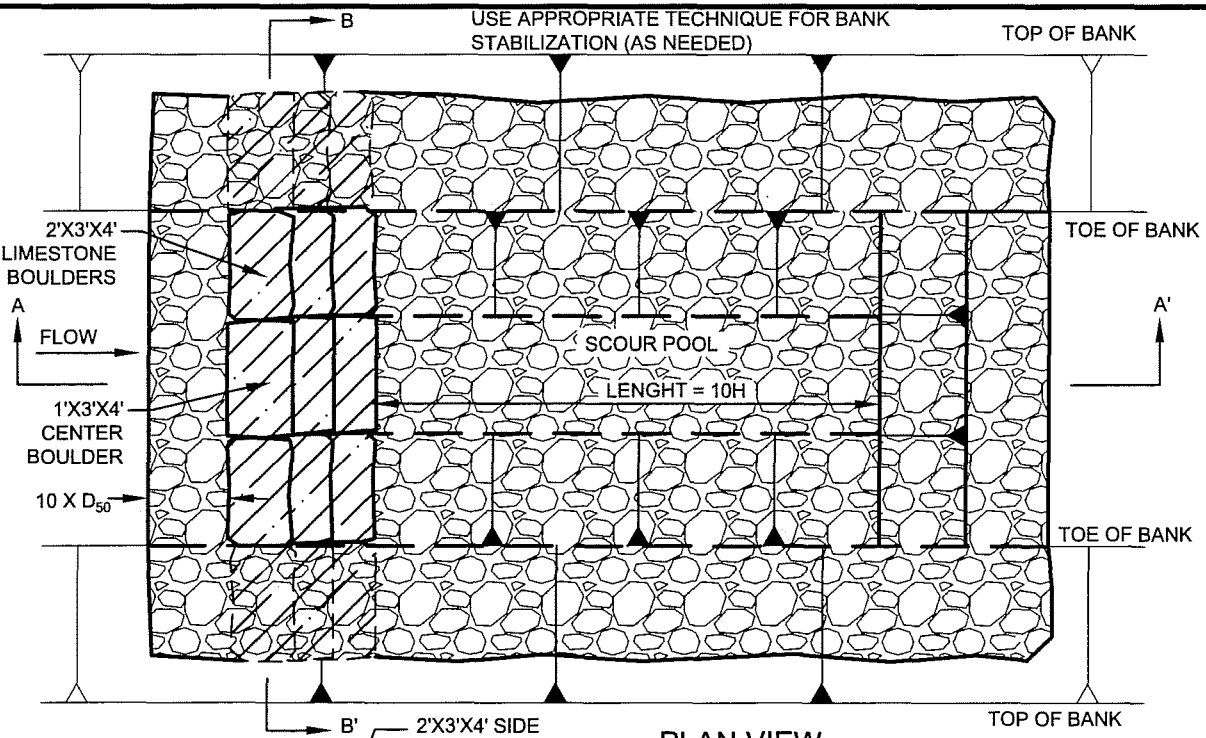
THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

GRADE CONTROL STRUCTURE

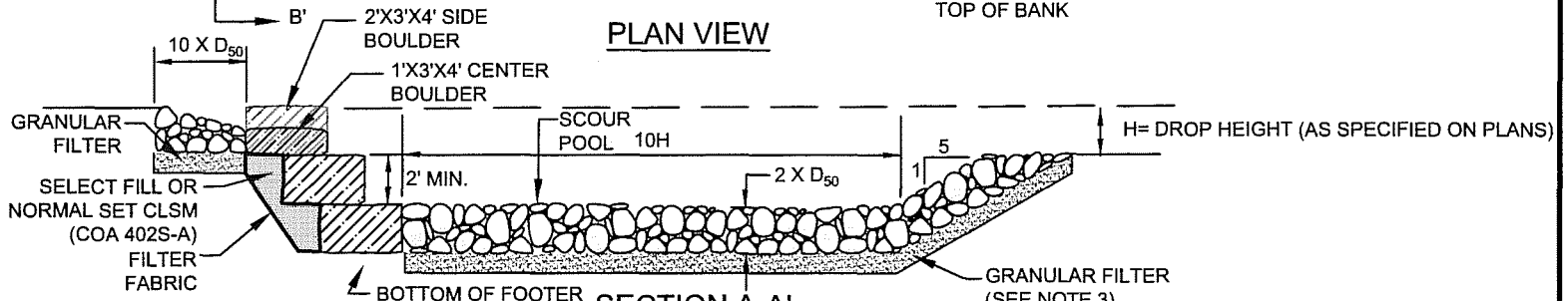
STRAIGHT STEPPED ROCK DROP

STANDARD NO.

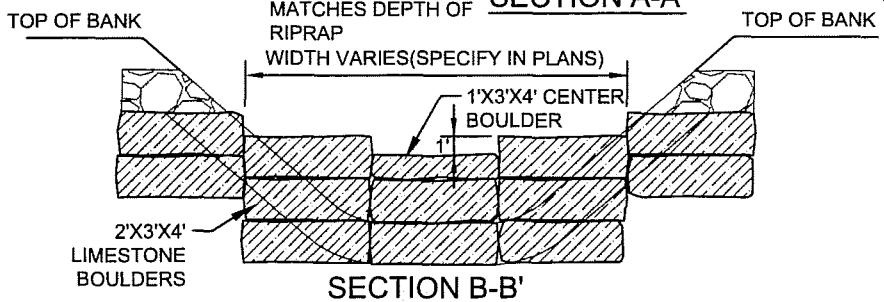
625S-6



PLAN VIEW



SECTION A-A'



SECTION B-B'

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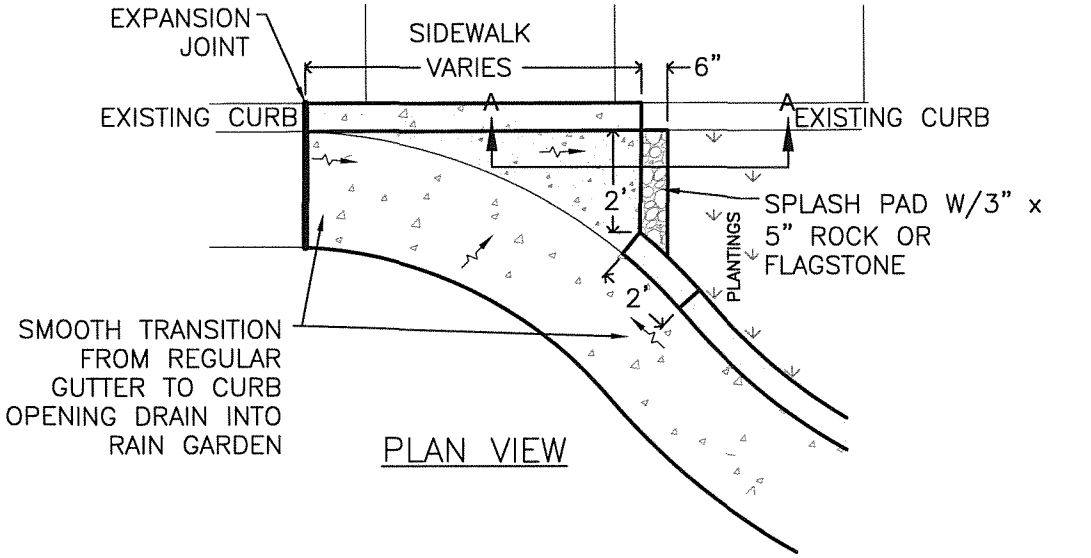
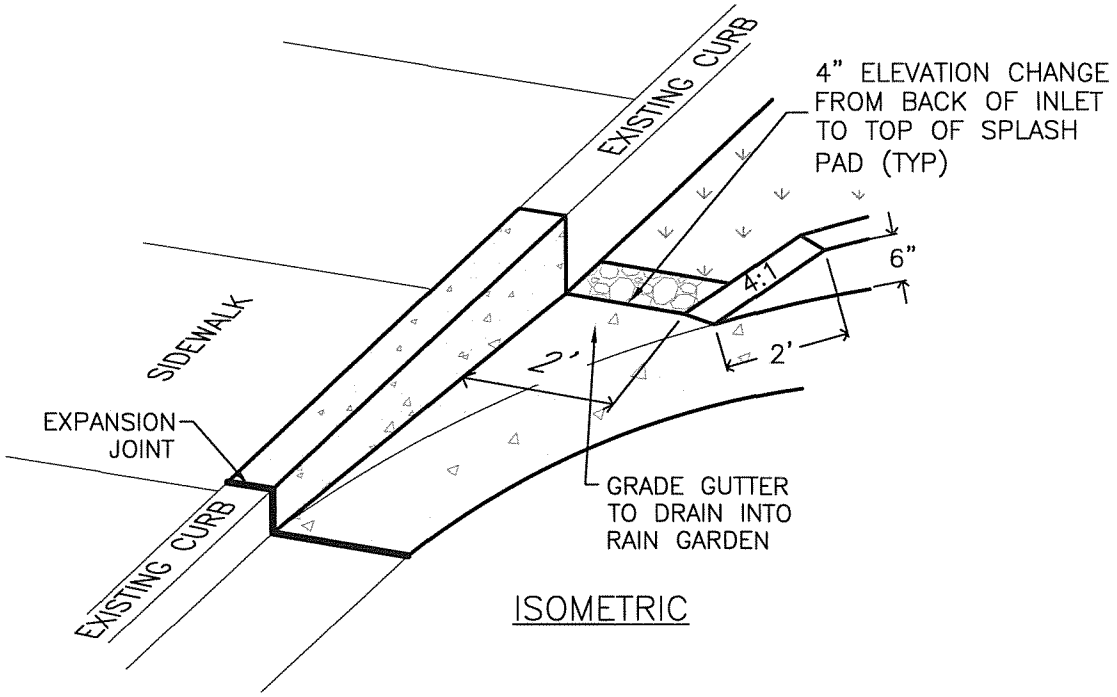
NOTES (BOULDERS):

1. BOULDERS SHALL BE DERIVED FROM NATURAL QUARRY LIMESTONE AND BE SPECIFIED AS EITHER "CUT" OR "NATURAL" PER THE PLANS. NATURAL BOULDERS SHALL HAVE A ROUGH SURFACE ON ALL EDGES, BUT THE TOP AND BOTTOM PARALLEL AND STACKABLE.

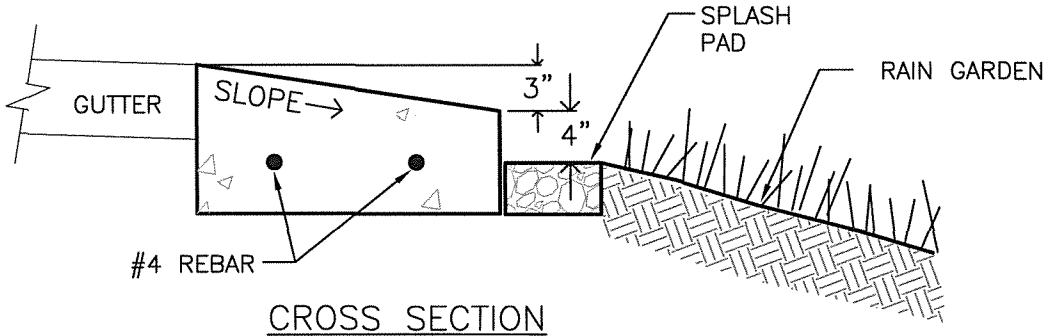
2. BOULDERS SHALL BE COMPRISED OF SOLID ROCK WITHOUT EXCESSIVE FRACTURES OR WEAK LAYERS AND HAVE A MINIMUM SPECIFIC GRAVITY OF 2.3



PLAN VIEW

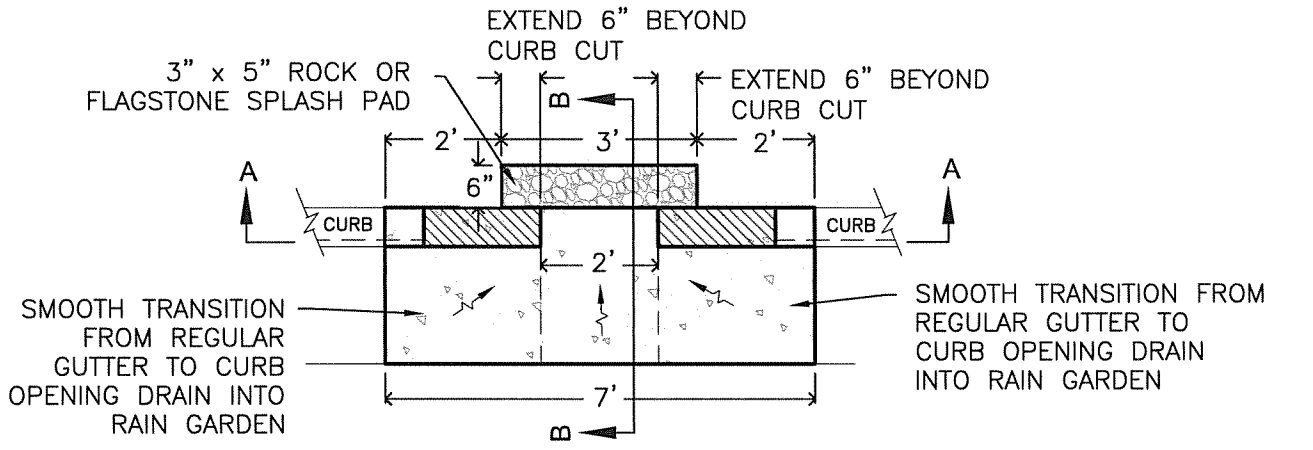


ISOMETRIC



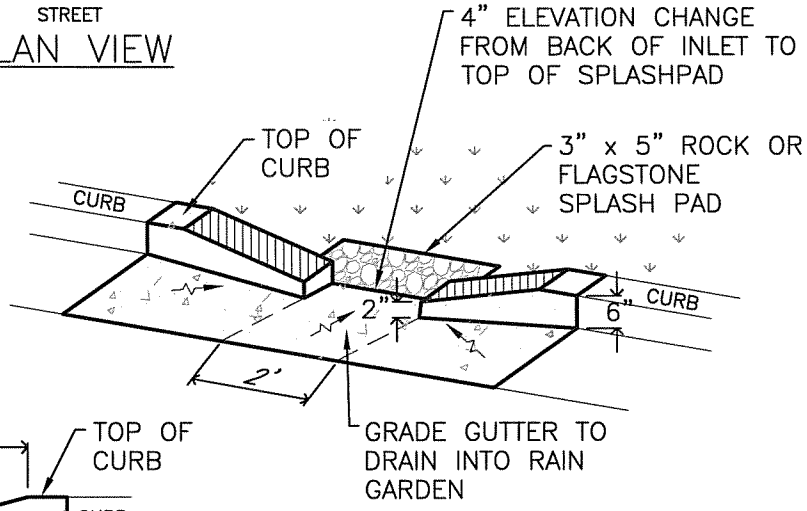
CROSS SECTION
A–A

CITY OF AUSTIN WATERSHED PROTECTION DEPARTMENT	RAIN GARDEN TYPICAL INLET DETAIL 1	
E. Rantz 11/14/16	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	STANDARD NO. SPD 660-3



STREET

PLAN VIEW



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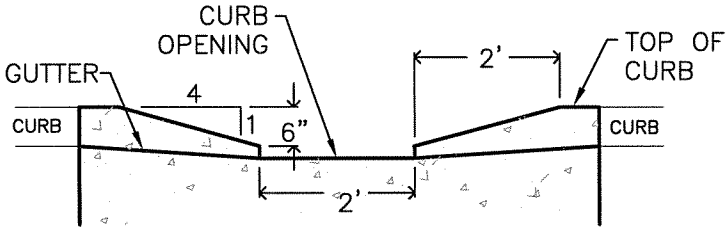
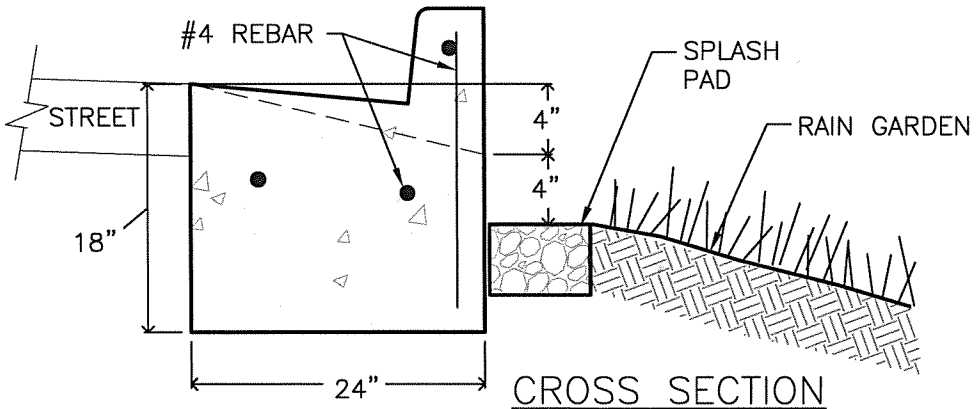


CROSS SECTION
A–A



CROSS SECTION
B–B

CITY OF AUSTIN WATERSHED PROTECTION DEPARTMENT	RAIN GARDEN TYPICAL INLET DETAIL 2
11/14/16	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.
	STANDARD NO. SPD 660-4