

SECTION 02941 - PLANTING SOILS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this Section and are hereby made a part of this Section.

1.2 SUMMARY

A. Scope of Work:

The work of this Section consists of all site preparation work and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to the following:

1. Evaluation of rough subgrade water infiltration.
2. Planting soil material acquisition.
3. Testing and analysis for specification conformance.
4. Inspection and testing of subgrade for preparation of subgrade.
5. Preparation of mixes and testing for conformance.
6. Installation and placement of soils.
7. Installation and placement of landscape underdrainage piping
8. Decompaction of soils.
9. Mock-up of planting soil profiles.
10. Final in-place testing of soils.
11. Coordination with other trades.
12. Clean-up.

B. Related Work Under Other Sections:

Carefully examine all of the Contract Documents for the requirements that affect the work of this Section. Other specification Sections that directly relate to the work of this Section include, but are not limited to, the following:

1. Section 02720 – Drainage Utilities
2. Section 02725 – Subsurface Infiltration Bed
3. Section 02930 – Exterior Plants
4. Section 02920 – Lawns and Grasses

C. Definitions:

1. *Compaction*: Compaction of the soil fabric is any force applied to the soil that reduces porosity and where 90 percent of all compaction can be accomplished with only three applications of force under optimum soil moisture conditions.
2. *Dry Soil*: The condition of the soil at or below the wilting point of plant available water in which the soil is powdery and subject to blowing.
3. *Frozen Soil*: The point at which the soil water has frozen and the soil has become very hard and cloddy. Ice crystals can be seen in the pore spaces of the soil.
4. *Field Capacity*: The percentage of water remaining in a soil two or three days after having been saturated and after free gravimetric drainage has ceased.

5. *Moist Soil*: The condition of the soil in where it can be formed into a ball and maintain its shape. Deformation of the soil is difficult with hand pressure. Free water is not visible and is usually considered the point between the wilting point and field capacity of the soil.
6. *Saturated*: All the pore space within a soil is filled with water and the remaining water is under gravitational forces to drain through the profile.
7. *Scarification*: The loosening of the surface of a soil lift by mechanical or manual means to alleviate compaction of the soil surface. Depth of scarification is dependent on material and extent of compaction. Depths are noted within the specifications.
8. *Subsoil*: The soil horizon directly below topsoil that provides water holding and structural support to plants. Source of the majority of micro-nutrients.
9. *Subgrade*: The in-situ soil material that the planting soil will be installed upon.
10. *Topsoil*: The mineral surface layer of soil that exhibit obliteration of all or much of the original rock structure and must show the following: (1) an accumulation of humified organic matter closely mixed with the mineral fraction and not dominated by properties characteristic of subsurface horizons; (2) has reasonable tilth (biological, chemical and physical properties) to support plant growth; and have two or more of the following:
 - a. a bulk density of less than 1.5g/cc installed
 - b. less than 15 percent by weight coarse fragments greater than 2mm
 - c. identifiable structure between clods called peds, no massive structure
 - d. no contamination (ie. Toxic weeds, chemicals, heavy metals, construction debris)
11. *Wet Soils*: Soils that are considered wet will easily be deformed by hand pressure, maintain their shape, and free water will be visible within the pore spaces. The water content at this soil condition is considered at field capacity or wetter.

D. Qualifications and Quality Assurance:

1. *Analysis and Testing of Materials Qualifications*: For each type of packaged material required for the work of this Section, provide manufacturer's certified analysis. For all other materials, provide complete analysis by a recognized laboratory made in strict compliance with the standards and procedures of the following:

American Society of Testing Materials (ASTM)
 American Society of Agronomy
 Soil Science Society of America
 Association of Official Agricultural Chemists.
 U.S Composting Council

2. *Quality Assurance Qualifications*: Work and materials shall meet the standards of the following references:

International Society of Arboriculture (ISA)
 American Society for Testing Materials (ASTM)
 Environmental Protection Agency (EPA)
 New York Department of Conservation (NYDEC)

3. *Installer Qualifications*: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
 - a. *Installer's Field Supervision*: Require Installer to maintain an experienced full-time supervisor on Project site who has at least 5 years experience with projects of similar scale and complexity.
 - b. The Landscape Contractor shall have experience in the proper and safe transportation and installation of soil material.

- c. The Landscape Contractor shall have adequate supervision, staff, equipment and experience needed to complete a project of this magnitude..
- d. The Landscape Contractor shall prepare and present to the Engineer required soil submittals, and their associated specified test results at a absolute minimum of four weeks prior to the scheduled soil and plant installation.
- e. The Landscape Contractor shall have at between 3 to 5 years experience in installing designed soil mixes.

4. *Soil Mixing Contractor Qualifications:*

- a. Shall be able to provide soil mixes that meet the specifications within tolerances assigned.
- b. Shall be able to produce enough consistently uniform soil material for the project to meet the scheduled demands.
- c. The soil mixing contractor shall be engaged at least six weeks prior to scheduled soil installation to allow for sufficient time for material searches and initial planting mix approval.

5. *Testing Laboratory Qualifications:* An independent laboratory, recognized as an agricultural based testing agency, with experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

- a. Employ a qualified independent testing and inspection laboratory acceptable to the Engineer and Owner to perform tests and certifications indicated.
- b. It is the responsibility of Landscape Contractor in conjunction with the Soil Supplier to submit material for the soil and compost tests.
- c. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from ASTM, EPA, and/or Methods of Soil Analysis, Soil Science Society of America.
- d. Approved Laboratories, other equivalent laboratories can be substituted, but require approval by the Soil Scientist:
- e. *Testing Laboratories:* These are some examples of testing facilities that can accomplish part of or complete testing of all soil mixes:

Atlantic Testing Laboratories	6085 Court St., Syracuse, NY	315-699-5281
Norm Hummel (Hummel & Co.)	35 King Street, PO Box 606 Trumansburg, NY	607-387-5694
CME Associates, Inc.	PO Box 1824, 8560 Brewerton Rd., Cicero, NY	315-698-9315
PW Laboratories, Inc.	6544 Fremont Road, East Syracuse, NY	315-437-1420

1.3 SUBMITTALS AND TESTING

- A. *Certificates:* Provide certificates required by authorities having jurisdiction, including any composted materials containing sewage sludge and material sources as defined by the Sites documentation. Approval as EPA Type 1 “exceptional quality” is required as well standards for application of composted organic material by state or local regulations.

- B. *Testing Intervals for Organic Amendments, Planting Soil Mixes:* Testing is required at the following intervals:
1. Testing of the organic compost material: Test certificates required for producers of municipal yard waste composts or composted biosolids are described within this Section 02941 Part 1 and shall follow criteria listed within Part 2 of this section.
 2. Submit complete test results and samples of the S3, S2, S1, and organic soil amendment materials for approval as described within Part 1 following criteria of Part 2 of this section.
 3. After test results for the composted organic material have been accepted the Contractor shall create sample soil mixes for the S1 layer for the planting soil mix and perform the complete tests described in Section 02941, Part 1.
 4. In-place planting soil testing shall follow methods specified in Part 1 of this section for the layers and intervals noted following the specific ranges and limits noted within Part 2 of this section. Incomplete test results shall not be reviewed delaying the approval process.
- C. *Test Procedures and Reporting:* Submit certified report for each test required. Each test report shall have its associated soil layer clearly marked along with the name of the soil supplier and soil material product name or designation. Only complete submittals with all corresponding test results and samples as list within Part 1 will be reviewed. Submit test results for compost and S3, then after approval, mix and submit the S1 layer.
1. *Compost:* Analyses of composted organic materials, including composted biosolids, are required prior to initial soil mix acceptance. Analyses shall include all tests specified below and meet the criteria listed in Part 2 of this section. Incomplete test results will not be reviewed, delaying submittal approval.
 - a. Maturity index either by Solvita, Dewar Self Heating or CO₂ evolution sometimes called respirometry.
 - b. Reaction in 1:1 water
 - c. Carbon/Nitrogen ratio
 - d. Foreign Material on a dry weight basis
 - e. Organic Mater percent on a dry weight basis
 - f. Ammonium-N using an extract method
 - g. Salinity using a 1:1 water paste method
 - h. Basic Nutrient content of macro nutrients (P, K, Ca, Mg)
 - i. If the compost material contains any biosolids, heavy metals must be tested to meet EPA Chapter 503 and/or the New York State levels for human use.
 2. *Soil Mixes and Topsoil:* Testing shall be performed and reported for particle size requiring percent of gravel (>2.0 mm), very coarse sand (2.0 – 1.0 mm), coarse sand (1.0 – 0.5 mm), medium sand (0.5 – 0.25 mm), fine sand (0.25 – 0.10 mm), very fine sand (0.10 – 0.05 mm), silt (0.05 – 0.002 mm) and clay (< 0.002 mm). Ammonium-N content, conductivity, soil reaction (pH), basic macro nutrients, CEC and organic matter percentage on a dry weight basis shall also be tested as specifically noted below.
 - a. Particle size distribution by ASTM F1632-03 for all soil layers and topsoil. Fines passing the #270 sieve are to be measured using the hydrometer method as outlined in ASTM F1632. If any alternate method is used, the results still must be reported at the specified particle size breaks listed above or by plotting as a particle size distribution curve on a five cycle semi-log graph.
 - b. Organic matter content by ASTM F 1647, commonly known as loss on ignition.
 - c. Salts and Ammonium test using Woods End Research Laboratory # 104 Soluble Ion Test or 1:2 soil/water extract test as specified in *Methods of Soil Analysis, Part 3* and must be

tested and made available to the Engineer or Soil Scientist within two weeks of planned soil installation.

- d. Plant available Phosphorous, Potassium, Magnesium, Calcium and Cation Exchange Capacity tested for the S1 Planting Soil Mix. Quality Assurance samples shall complete only particle size distribution, conductivity (EC), organic matter content, pH, ammonium-N for the S1 material.
 - e. Quality Assurance testing for S3 shall consist of particle size distribution by ASTM F1632, organic matter content, pH and conductivity (EC).
- D. *Sources for Soil Components and Planting Soil Mixes:* Submit information identifying sources for all soil components and the contractor responsible for mixing of planting soil mixes.
1. Owner or Engineer shall have the right to reject any soil supplier that cannot meet the testing requirements in a timely fashion, cannot provide timely deliveries, or cannot provide required quantities and/or uniform material.
 2. Soil mix supplier shall have a minimum of five years experience at supplying custom planting soil mixes.
 3. Submit supplier name, address, telephone and fax numbers and contact name.
 4. Submit certification that accepted supplier is able to provide sufficient quantities of materials and mixes for the entire project. Indicate quantity and type of material from each supplier.

1.4 QUALITY ASSURANCE / ACCEPTANCE

- A. *Planting Soil QA:* During the placement of planting soils, test every 200 cubic yards (or one test for every planting area) of planting soil mix delivered to the job site. Tests shall be for soil mix quality assurance. Required tests for all layers include particle size distribution, pH, and organic matter. Report organic matter content on a percent by weight basis. Additional tests for salts (EC) and Ammonium-N shall be completed for S1 soil layer only. Testing procedures are described in Part 1 of this section.
- B. *Samples:* Planting soils requires a long lead time. Prior to ordering the listed materials, submit representative samples of the same organic batches and soil mixes that will be used to the Soil Scientist for selection and approval. Do not order materials until the Owner's approval has been obtained. Schedule at least 4 months for soil ingredient search and initial submittal approval. Delivered materials shall closely match the approved samples.
1. *Organic amendment:* duplicate samples of 1 quart.
 2. *Planting Soils:* duplicate samples of 1 quart for each soil layer after mixing organic material and soil. The Soil Mix shall match the material being placed as closely as possible.
 3. A duplicate 1 quart sample of the soil layers and compost shall be sent to the soil consultant for review.
- C. *In-place Designed Soil Testing:*
1. General planting soil installation for planting beds and bio-retention areas shall be tested using a cone penetrometer or equivalent for approximately one point every 100 ft² at an interval after S3 layer installation and again after complete soil profile installation. The planting soil penetration resistance shall be uniformly increasing in density with depth, not exceeding 275 lbs/in². There shall not be any compacted dense layers within the soil profile greater than 50 lbs/in² than the background resistance. Specific penetration resistance rates are given in Part 2 of this section for each soil layer. Infiltration rates of the soil surface (not in mulch) of the Bio-retention areas shall be tested at one test per basin at the lowest point

- using ASTM 3385 to determine saturated hydraulic conductivity at installation. Records of initial testing will be used to monitor long term performance of the basins with other conductivity testing over time. The soil scientist will also conduct additional investigations on compaction and conductivity based on observed installed soil geomorphological parameters for all Bioretention Basins.
2. In-place Density Tests for any designed soils prescribed under sidewalks and pervious paving surfaces shall be conducted for at least three tests of surface soil density per segment as noted on the drawings. The surface that is to support pavement construction is to be tested. Density testing shall conform to ASTM standards using either ASTM D1556-07 or ASTM D6938-10 and shall be between 88 to 92% of Standard Proctor measured at below optimum moisture content (do not compact planting soils at moisture contents above the "Optimum" line)
- D. *Planting Soil and Compost Submittal Acceptance:* Submittals for planting soil approval must have complete test results attached as specified for each soil, results shall be clearly marked for their corresponding soil layer, clearly labeled with the soil supplier's name, and receipt of soil samples by the Soil Scientist before review of the submittal can take place. Incomplete test results will not be reviewed delaying the approval process.
- E. *Soil Installation Acceptance:* Notify the soil scientist at least 10 days in advance of date of soil placement. Inspection of the soil installation shall take place during placement of the S3 layer while some of the subgrade is visible and another inspection during the placement of the S3 layer before placement of the S1 layer. Final inspection shall take place during S1 installation.
- F. *Partial Acceptance:* Acceptance of partial areas or portions of the total work may be granted at the option of the Engineer or Landscape Architect only if the area to be inspected for acceptance is large, well defined and easily described. The Engineer or Landscape Architect is not obligated to provide partial acceptance of the work.
- G. *Final Acceptance:* Final acceptance shall be defined as the date after which the Engineer and Soil Scientist determine that all work, including Punch List items has been satisfactorily completed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.
- B. Sequence deliveries to avoid delay. On-site storage space is permissible only with written notice from Owner. Deliver soil materials only after preparations for placement of planting soil have been completed.
- C. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.
- D. Install planting soil layers directly before planting is to commence. Do not install planting soils so that they over-winter without vegetation. Failure to vegetate the planting soil or allowing partial planting soil installation allows for extensive erosion, compaction, and overall degradation of the planting soil system requiring extensive refurbishment before spring planting.
- E. Soil that is to be stockpiled longer than two weeks, whether on or off site, shall not be placed in mounds greater than six feet high. If soil stockpiles greater than six feet high are to be stored for more than two weeks, the contractor shall break down and disperse soil so that mounds do not exceed the six-foot height restriction or thoroughly mix the stockpile once a month.

- F. Vehicular access to the site is restricted. Prior to construction the Contractor shall submit for approval a plan showing proposed routing for deliveries and site access which shall include, but not limited to equipment movements and staging locations
- G. Soil materials shall be covered at least two weeks prior to installation to prevent excess moisture from saturating the soil stockpile. Test for the moisture content of the soil mix using the gravimetric oven dry method as described in Soil Science Society of America, *Methods of Soil Analysis*, Part 1, 1986 at least two days prior to soil installation if planting soil moisture content is questionable or at the request of the civil engineer or soil scientist.
- H. Soil materials shall not be handled or hauled, placed or compacted when it is wet, as after precipitation, nor when frozen. Soil shall be handled only when the moisture content is less than 8 percent by volume.
- I. The planting soil shall be mixed in a ball mill or tub mill fitted with proper screening and paddles. Windrowing the materials is not acceptable, as it does not produce uniform mixing of the components.

PART 2 – PRODUCTS

2.1 SOIL LAYERS (HORIZONS):

A. General

1. All plant mix material shall fulfill the requirements as specified and be tested to confirm the specified characteristics.
2. Samples of individual components of plant mixes in addition to blended plant mixes including mulch materials shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Include verification testing of on-site sub soils through the QA testing. Comply with specific materials requirements specified.
 - a. No base component material or soil components for plant soil mixes shall be used until certified test reports by an approved agricultural chemist have been received and approved by the Engineer and Soil Scientist.
 - b. If necessary, testing of the soil material components may be requested by the Soil Scientist to facilitate approval of the plant soil mix.
 - c. As necessary, make any and all plant soil mix amendments and resubmit test reports indicating amendments until approved.
3. The Engineer and Soil Scientist may request additional testing by the Contractor for confirmation of mix quality and/or plant soil mix amendments at any time until completion if quality control samples deviate from the specifications and initially approved submittals.

B. *Planting Soil Supply:*

1. In the event that any of the soil materials are not available from the supplier or are not in compliance with specifications herein, the Contractor shall obtain material from other suppliers and conduct tests specified herein to provide materials in compliance with these specifications.
2. The Engineer and Soil Scientist shall be notified of all soil mix substitutions or problems with the planting soil supply in order to assist with a smooth delivery and installation.

C. *Planting Soils:*

1. *Soil layer (S3):* Planting Soil Drainage Layer consisting of a layer of material with a USDA Texture of coarse sand.
 - a. Soil reaction with a pH between 4.5 – 7.0.
 - b. An estimated saturated conductivity of 10 - 25 cm/hour.
 - c. The S3 layer within the bio-retention swale shall have a, uniformly increasing with depth, penetration resistance of < 250 lbs/in² after installation. No dense layers (+ 50 lbs/in² from background rate) are allowed.
 - d. There shall be no visible organic material present in this layer.
 - e. Material can be a natural sand or finely ground recycled glass meeting the following particle size distribution

S3 Soil Layer Particle Size Distribution

Particle Size Class	Passing Sieve No	Range in Percent Passing ASTM F 1632-03
fine gravel	10	95 – 100
very coarse sand	18	80 – 95
coarse sand	35	60 - 80
medium sand	60	10 – 40
fine sand	140	8 – 15
very fine sand	270	1 – 10
silt*		1 – 6
clay*		0 – 4
Chemical		
Organic Matter %	ASTM F 1647-02a	<0.25
pH	1:1 Water	4.5 – 7.0

*determined by hydrometer method in ASTM F1632-03.

2. *Soil layer (S1):* Planting Soil Surface layer. A layer consisting of material with a USDA Texture of sand to loamy sand amended with organic matter (must be tested to meet specs after compost is approved and added).
 - a. The soil specifications shall be that the minimum infiltration rate for planting soil areas stays above 5 cm/hour (2 in/hr) after installation.
 - b. The soil shall have soil moisture content less than 8% by weight for installation.
 - c. The S1 layer shall have a uniformly increasing with depth, penetration resistance of < 120 lbs/in² after installation. No dense layers (+ 25 lbs/in² from background rate) are allowed.
 - d. The particle size distribution shall be:

S1 Soil Layer Particle Size Distribution

Particle Size Class	Passing Sieve No	Range in Percent Passing ASTM F 1632-03
fine gravel	10	95 – 100

very coarse sand	18	90 – 100
coarse sand	35	65 – 85
medium sand	60	30 – 40
fine sand	140	15 – 25
very fine sand	270	9 – 18
silt*		6 – 12
clay*		3 – 6
Chemical		
Organic Matter %	ASTM F 1647-02a	2 – 4%
pH	1:1 water	5.5 – 6.5
EC	1:1 paste	1.5 dS/m
Phosphorous (P)	extract	20 – 100 ppm
Potassium (K)	extract	200 – 600 ppm
Cation Exchange (CEC)	Extract	>8 Meq/100g

*determined by hydrometer method in ASTM F1632-03

D. *Organic Amendment:*

1. Composted Biosolid and municipal yard waste compost producers shall provide the heavy metal certificate of the material delivered as per EPA and state or local standards. Composted organic matter shall have the following criteria:

Criteria	Test Method	Acceptable Range
Type		brewer's waste, or leaf mulches are also acceptable. Composted municipal waste (chipped, shredded and screened wood, leaves, bark, etc.) alone is not acceptable unless it meets all of the criteria noted
Carbon/Nitrogen Ratio		11:1 – 22:1
Degree of Maturity	Dewer Self Heating <u>or</u>	VI – V
	Solvita Maturity Index <u>or</u>	6 – 8
	CO ₂ Evolution	1.2 % C/day
Foreign Material	Dry wt.	< 1" dia. And < 2% (of total)
Organic Matter %	Dry wt.	25 – 75%
Reaction	1:1 water	5.5 – 8.0
Ammonium	extract	< 200 ppm
Nutrient Content	extract	Contains some nitrogen, phosphorus, potassium, calcium, magnesium, sodium and micronutrients including iron, copper, boron, and manganese. Nutrients shall be present in appropriate agricultural and horticultural proportions to prevent ion antagonism.
Heavy Metals	extract	Concentrations of zinc, mercury, cadmium, lead, nickel, chromium, and copper must be below EPA and the state standards for biosolid applications to soils with human activity.

E. *Planting Soil Mix Equivalency Table:*

The mix ratios are rough estimates based on usual components found in the area and their physical properties. Slight adjustments to the mix may be needed to achieve the required planting soil properties.

Layer Designation	Base Material or Equivalent	Second Soil Mix Component	Third Soil Mix Component	Mix Ratio (Volume)
S3 Layer	ASTM C33 Fine Aggregate, non-calcareous Masonry Sand, or fine ground recycled glass	None	None	None
S1 Layer	Approved S3 material	sandy loam*	Approved Compost	3:1:1
		sandy clay loam*	Approved Compost	5:1:1
		loam*	Approved Compost	4:1:1

*USDA soil textures

2.2 SOIL PROFILES

- A. *PROFILE SP-1 – Structural Planting Soil Profile:* This planting soil profile consists of one soil horizon. This soil profile shall be areas noted on the drawings that shall receive tree and/or shrub plantings where tree and/or shrub roots are encouraged to grow under pavement. The pavement layers are separated by geotextile above a compacted S3 layer with a maximum of 30 inches over a scarified and correctly pitched subgrade or underdrainage gravel where noted on the drawings. The S3 layer is variable and shall be thinned based on underground utilities or obstructions to achieve final grade. The basis for the S3 layer is the sand specified in Part 2.
- B. *PROFILE SP-3 – Bio-Retention Basins:* This planting soil profile consists of two soil horizons and a landscape underdrainage filtration gravel bed. This soil profile shall be for areas noted on the drawings that are designated as Bio-retention Basins or open shrub pits. The A horizon (S1 layer) of 6 - 8 inches covered with 2-3 inches of specified approved mulch over a 24 inch layer of S3 material placed on landscape filtration gravel within a excavation correctly pitched to the underdrainage piping. The basis for the S1 is the soil mix specified in Part 2. The S3 layer is coarse sand specified in Part 2 of this section.

PART 3 – EXECUTION

3.1 COORDINATION

- A. *Pre-Installation Examination Required:* The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and shall notify the Owner in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means the Contractor accepts substrates, previous work, and conditions. The Contractor shall not place any planting soil until all work in adjacent areas is complete and approved by the Owner.
- B. *Planting Soil Preparation:* Examine soil and remove foreign materials, stones over 1”, and organic debris over 2” in length. Mix-in amendments as required by tests and as approved by the

Owner. All preparation and mixing shall be accomplished when the soil moisture content is less than 8 percent by volume.

- C. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

3.2 EXCAVATION AND SCARIFICATION

- A. Excavation of the soils shall be accomplished to a depths noted for each soil profile area. All construction debris shall be removed from the planting areas prior to placement of the soil layers. Care shall be taken to avoid working the soil when it has 8 percent moisture content or above.

- 1. *Excavation Depths:* (of the subgrade below final grade where applicable)

- a. All Areas shall be excavated a minimum of 36 inches below final grade or as noted on the drawings for specific locations.

- 2. *Subgrade pitch:* The subgrade shall be pitched toward the underdrainage with an average around 1 percent or about 1.25 inches fall per 10 feet or as noted on the drawings.

- A. Scarification of the Subgrade: Scarification must loosen the compacted surface of the subgrade following final rough grade to a depth of 4 to 6 inches prior to the designed soil placement. Scarify the surface of any compacted soil. If the surface is smooth, smeared, or exhibits a shiny appearance it has been compacted and the surface must be loosened.

- 1. Bare soil areas close to the construction site and areas where traffic was most intense will require deep ripping to a depth of 8 inches with a dozer mounted ripper or other equipment before placing any soil material over them (see location drawings). This will reduce effects of perched water within rooting zones, and decrease the likelihood of down slope seeps.

- a. Lawn areas outside of main construction traffic patterns will only require loosening to a depth of around 5 inches using agricultural or other mechanical equipment.
 - b. Areas of compaction containing existing trees will require careful scarification using air spading to a depth of 5-6 inches.
 - c. Locations where topsoil was stockpiled or construction material was stored with minor soil compaction should be also loosened using mechanical equipment when areas are cleaned up and renovated.

- 2. Scarify the subgrade after engineered compaction to a depth of 3 to 4 inches. Scarify parallel to the contour of the slope when possible, especially on slopes greater than 4:1. This is to provide teeth to stabilize the sandier soil above.

- 3. The subgrade should be graded so that water will flow away from foundations, have no depressions, or areas where water can collect within the subsoil to cause internal soil drainage issues for plant roots.

- 4. Any gravel, shale, asphalt, concrete, or stone should be removed from the subgrade areas if it will fall within 12 inches of the final grade.

- B. Soil Removal and Stockpiling:

1. Make sure the contractor separates the surface topsoil from the subsoil during excavation. The topsoil should be stockpiled separately from the subsoil. This is to insure that the correct soil layers are placed back in the excavation in the proper order.
 2. Keep the topsoil covered if the construction is taking place during precipitation events to keep the stockpiled soil at moisture contents below optimum compactive moisture. This is usually below 10 percent on a weight basis for natural soils.
 3. Keep planting soil stockpiles less than 6 feet in height to allow for adequate aeration during the storage period.
- C. Remove all organic and coarse (rocks) fragments over 2 inches in diameter in the topsoil.
- D. Replacing the topsoil. Do not spread the topsoil by excessive driving over it or back grading with a bucket. Use tracked equipment to limit the amount of compactive force applied on the soil. Build up the level of the soil so as to allow natural settling of the surface.
1. Current topsoil may not be sufficient to cover the site at the minimum 6 inches needed for plant growth. Use approved imported additional planting soil (S1) for these areas.
 2. Using a natural soil requires that additional care be used when placing the planting soil. The workable moisture content of the soil must be strictly adhered to (between 5 and 10% by weight), and soil must not be moved, worked, or placed when wet, during precipitation events, frozen, or mixed with snow.
- E. If soil is to be placed or renovated, it must be worked at moisture content below field capacity or between 5 and 10 percent moisture content by weight. The soil is too wet if it has clumps or has surfaces with a polished appearance when tillage equipment is used.
1. If planting soil has been kept dry (undercover) and the subgrade is not saturated and the weather has been sunny, installation of the planting soil shall continue not less than 36 hours after a rain event. If the subgrade is considerably saturated (muddy) or has standing water, planting soils shall not be worked until the soil meets moisture standards/dried out.
 2. Never work planting soils when frozen.
- F. Prevention of compacted soils can be accomplished by beginning the work in corners, against walls, or at the center of isolated beds, and progressing outwards towards the borders.

Once planting soils are completely placed, all traffic is prohibited until establishment of the plants and turf. Until complete landscape establishment, traffic should be restricted only to landscape maintenance personnel. Traffic restrictions are typically one growing season to entire landscape establishment and equilibrium.

3.3 MIXING OF PLANTING SOIL

- A. The planting soil shall be mixed in a ball mill or tub mill fitted with proper screening and paddles. Windrowing the materials is not acceptable, as it does not produce uniform mixing of the components.

- B. Mixing of the compost for the S1 layer (topsoil) shall be accomplished in the same manner as the other mixing procedures. The compost shall be moist, but not overly wet. Compost shall not be so wet as to have water squeezed out by hand or so dry as to be easily blown by wind.

3.4 PLACEMENT OF SOIL LAYERS (HORIZONS)

- A. *Examination of Subgrade:* The subgrade shall be examined by the Contractor prior to the start of soil placement and planting. Any issue shall be noted and related to the Owner in writing prior to acceptance of the subgrade by the Landscape Contractor:

- B. Planting Soil Placement:

- 1. *General Soil Placement Procedures:*

- a. Scarify the subgrade to a depth of 4 to 6 inches.
 - b. Installation of planting soils shall be accomplished with small tracked equipment. Back-blading is strictly forbidden as it will overly compact the delicate planting soil. If planting soil has been kept dry and the subgrade is not saturated, installation of the designed planting soil can continue the day after a rain event, unless the subgrade is considerably saturated or has standing water.
 - c. Where applicable, place the first layer of S3 in one 6 inch lift. Compaction of this lift shall consist of light tamping by the installers foot traffic. No mechanical compaction shall be allowed except where otherwise noted.
 - d. Trees to be planted within existing soils must have a tree pit excavated using the following criteria:
 - i. Tree pits will be excavated three times the width of the rootball with a slight pedestal in the center of the pit to support the rootball.
 - ii. The sides and bottom of the tree pit shall be scarified 2-3 inches prior to planting and backfilling.
 - iii. The lower subsoil backfill shall be the excavated material lightly tamped by foot in and around the rootball. Additional compaction is forbidden.
 - iv. The surface topsoil shall be amended with approved compost at the rate of 1 part compost to 3 parts topsoil then placed and not compacted.
 - v. Settlement after construction shall be corrected during the warranty period following these specifications.
 - e. For large trees within the designed soil profile. Large tree (rootballs around 36 inches tall that would sit on about 4 inches of compacted S3) (for smaller trees see 'e' below) planting shall follow these procedures for handling the planting soils in and around the rootballs.
 - i. Adjust the subgrade overall depth to allow 4 inches of S3 material and so that the root flair of the tree will be 1 to 2 inches above final grade
 - ii. There shall be a pedestal of compacted subgrade under each of the tree planting areas. Compact this area to 95 percent of standard Proctor at below optimum moisture content then lightly scarify the pedestal surface. The tree pedestal shall be slightly higher in elevation than the surrounding subgrade to allow drainage away from beneath the rootball.
 - iii. Place at least 4 inches of S3 material on the pedestal area to allow support for the rootball and assist with tree leveling.
 - iv. Install the 6 to 8 inches of the S1 layer after all plantings have been completed.

- f. Trees with rootballs less than 36 inches tall to be planting in the designed sand based soil shall follow these procedures for soil installation and planting. These trees and large shrubs shall be planted after the S3 layer is installed, but prior to the S1 layer installation.
 - i. Compact a pedestal of S3 material to about 90 percent of Standard Proctor at below optimum moisture then lightly scarify the pedestal surface.
 - ii. The soil depth shall be so that the root flair of the tree will be 1 to 2 inches above final grade.
 - iii. Install the 6 to 8 inches of the S1 layer after all plantings have been completed.
 - g. Care shall be taken to maintain the separation between the designed soil layers. Do not mix the S1 or S3 with adjacent layers.
 - h. Reducing the amount of compaction to the soils can be accomplished by beginning the work in corners, against walls, or at the center of isolated beds, and progressing outwards. This limits the amount of traffic needed for installation on the placed soil.
 - i. Planting soils shall never be moved or worked when wet or frozen.
 - j. Penetration resistance shall not exceed 200 lbs/ft² within the S3 and the resistance for the S1 layer shall be less than 120 lbs/ft² except where otherwise noted (under pavement plantings). The planting soil shall be uniformly increasing in density with depth. There shall not be any compacted layers within the soil profile.
 - k. The Contractor shall place barricades as required to prevent any unnecessary compaction of planting soil layers from vehicles, equipment, or pedestrian traffic during construction and vegetation establishment. Any additional compaction of the planting soils must be loosened satisfactorily to meet penetration resistance specifications.
2. *Under Pavement Soil Profile Placement:* For areas designated PROFILE SP-1
- a. Scarify the subgrade to a depth of 4 to 6 inches.
 - b. Place a variable thickness of S3 drainage layer in 6 inch lifts over the scarified subgrade that is correctly pitched to the underdrainage piping. Compaction of this lift shall consist of light tamping by the installers foot traffic. Compact each remaining lift to between 88 to 92 percent of Standard Proctor below optimum moisture. **DO NOT** compact soils above optimum moisture content.
 - c. Scarify each lift surface before applying additional lifts to a depth of 2-3 inches. The final lift below the Geotextile and pavement subbase shall not be scarified.
3. *Bioretention Basin Soil Profile Placement:* For areas designated PROFILE SP-2
- a. The planting soil media shall be mechanically mixed until a homogenous mixture is obtained.
 - b. No other materials or substances shall be mixed or dumped within the bioretention area that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.
 - c. Install approved Bioretention washed crushed stone in the bottom of the retention basins, install perforated piping as per the drawings.
 - d. The planting soil media (S3 layer) shall be placed in lifts of 12 to 18 inches, and spread out by means of an excavator bucket or other means to minimize compaction. Placement of the soil media should only occur when it is at the correct moisture content (not wet or dry), and only when there is no precipitation present.
 - e. The Bio-Retention Basin profile follows the Profile SP-2 thickness unless otherwise noted on the Drawings.
 - f. There shall be no abrupt changes in textural class between layers, as this will inhibit infiltration. **NO soil interlayer filter fabric or compact soil zones.**

- g. The planting soil media should be left to settle for at least one storm event before the final lift so that it can be adjusted in the field to correspond to the plan elevations.
- h. A 3-inch topdressing of approved mulch shall be placed prior to the establishment of vegetation to protect the swale from construction sedimentation. The mulch can be removed after plantings are established.
- i. If blowing of material is a concern, biodegradable netting can be spread over the surface until the facility has gone through several wetting cycles.
- j. The gravel and sand layers shall extend across the entire length and width of the Bioretention Basin as designated on the drawings.

CONSTRUCTION NOTE: For all utility boxes and structures that will be placed completely within the designed soil shall require compacted pedestals to support the structures.

3.5 PROTECTION AND REPAIRS

A. General:

- 1. Protect newly graded areas from traffic, freezing and erosion. Keep free of trash, debris or construction materials. Landscape contractor shall be the only personnel allowed on areas where planting soil has been installed.
- 2. Within the installation warranty period repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or compacted due to subsequent construction operations or weather conditions.
- 3. Scarify or remove and replace material to a depth as directed by the Owner; reshape and re-compact by only hand tamping at the prescribed moisture content.
- 4. Where settling occurs, before pavement installation and final soil installation acceptance, backfill with additional approved material, compact to specified rates, and restore any disturbed areas to a condition acceptable to the Owner.

B. *Bio-Retention Basin Area Protections:* To ensure proper long-term functionality of the Bio-Retention Basins, several procedures and scheduling will need to be followed while handling planting soil installation around these areas.

- 1. Install protective filter socks and erosion controls after excavation and installation of the underdrainage, gravel, and filter fabric to restrict sedimentation of the Bio-filtration areas.
- 2. Do not install the S3 filter sand prior to planting soil installation. Failure to comply will allow excessive sediment to contaminate the filter sand causing decreased functionality.
- 3. Install the S3 filter sand in conjunction with the application of the S3 layer. Install 3 inches of coarse wood chip mulch to the final surface of the Bio-retention swale to help trap sediment and prevent infiltration of sediment into the filter sand until vegetation establishment. It is highly recommended to install the complete Bio-retention swales in the summer or during several weeks of dry weather to ensure that erosion is kept to minimum.
- 4. Maintain effective erosion and sediment controls throughout the vegetation establishment period.
- 5. Vegetate the surrounding catchment areas as quickly as possible.

3.6 POST INSTALLATION MAINTENANCE

- A. Where settling occurs, backfill with additional approved material, compact to specified rates, and restore any disturbed areas to a condition acceptable to the Owner.

1. Any post installation changes or amendments to previously approved soils without the Engineer or Soil Scientist's consent are the responsibility of the owner.
- B. Fertilization of planting areas shall be handled after establishment after soil tests have been taken to determine the optimum fertilizer rates.
- C. The following items are the responsibility of the Owner after the guarantee period to ensure the sustainability of the designed soil and plants for the life of site.
1. After one year, collect soil samples in each of the various soil areas and submit them for laboratory testing for fertilizer and liming recommendations.
 2. Each "type" of soil and planting area shall be sampled separately, but similar areas can be grouped. For example, areas of designed soil in turf areas, planting beds (flower and shrub), and turf areas of pre-existing plantings shall to be sampled and tested separately. Fertilization and liming needs to be tailored to each area for maximum effect and to reduce over fertilizing and liming and possible contamination of ground water and runoff.
 3. Repeat soil sampling for these areas every two years after first sampling and fertilize and lime to test recommendations.
 4. Clean and remove sediment build up within all Bio-Filtration Basins on a minimum of a bi-annual basis or less as needed. Removal of sediment on a yearly basis is recommended during the dry summer months so as not to damage/compact the filtration basins.
 5. Inspect and clean out all drainage trenches and subsurface infiltration and underdrainage piping annually.

END OF SECTION