|  |
| --- |
| This guide specification was prepared utilizing 3-part format recommended by the Construction Specifications Institute (CSI), and generally incorporates recommendations from their SectionFormat™/Page Format™, and MasterFormat®, latest Editions, insofar as practicable.  Carefully review and edit the text to meet the Project requirements and coordinate this Section with the remainder of the Specifications and the Drawings.  Where bracketed text is indicated, e.g. [text], make appropriate selection and delete the remainder of text within additional brackets, highlighting, and bold face type, if any.  This specification defines material and performance requirements for the "Silva Cell 2" system. The Specifier should adapt these specifications to reflect specific project requirements.  Consult the manufacturer for assistance in editing this guide specification for specific Project applications where necessary, including conventional applications, and for assistance evaluating and sizing design elements for Silva Cell stormwater applications.  This Specification was current at the time of publication but is subject to change. Please confirm the accuracy of these specifications with the manufacturer prior to use.  Some elements in these specifications require coordination with Project drawings; these items are noted "as indicated on plans or drawings" or similar phrases.  Refer to the DeepRoot website, www.deeproot.com for additional information. |

**SECTION 32 94 56**

**PLANTING SOIL FOR SOIL CELLS (SILVA CELLS)**

**Part 1 - GENERAL**

* 1. **SUMMARY**

*SPECIFIER: Remove parts of this Work description below that do not apply.*

* + 1. Section Includes:
       1. Labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, and delivery of planting soil and /or the modification of existing site soil for use as planting soil within the Silva Cell system.
    2. The scope of Work in this Section includes, but is not limited to, the following:
       1. Locate, purchase, deliver and install imported planting soil and soil amendments.
       2. Harvest and stockpile existing site soils suitable for planting soil.
       3. Modify existing stockpiled site soil.

*SPECIFIER: Revise Section numbers and titles in subparagraphs below per CSI MasterFormat and Project requirements.*

* + 1. Related Requirements:
       1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 0I Specifications, apply to Work of this Section.
       2. Section 01 33 00 – Submittal Procedures: For administrative and procedural requirement for processing of submittals during the construction phase.
       3. Section 01 77 00 – Closeout Procedures: For administration and procedural requirements for completion of the Work.

*SPECIFIER: Revise Section numbers and titles in subparagraphs below per CSI MasterFormat and Project requirements. Sections listed below are examples only; revise Section numbers and titles in subparagraphs below to suit Project requirements.*

* + - 1. Section [**32 90 00** **Planting**] [**Insert other title**]
      2. Section [**32 94 51 Silva Cells**] [**Insert other title**]

*SPECIFIER****:*** *Remove the paragraph below**if the option of reuse of existing site soil is not permitted. This paragraph is intended for use if, after the Work has begun, it is discovered that some or all of the existing site soil is unsuitable for this purpose. The inclusion of this paragraph requires that a unit price paragraph for this item must be added to the Bid Form or Unit Price Form document.*

* 1. **PRICE AND PAYMENT PROCEDURES**
     1. Unit Prices: Provide unit prices for the following:
        1. Soil Unit Price 1: Remove existing site soil scheduled or otherwise shown for reuse in Silva Cells, and substitute unscreened planting soil specified in Section 32 94 56 - Planting Soil for Silva Cells, including removal of existing site soil determined unsuitable for reuse, and installation of new materials.
  2. **REFERENCES**

*SPECIFIER****:*** *Use the following definitions as needed to define words used in this Specification. Delete words that are not used.*

* + 1. Definitions:
       1. COMPACTION: The density of soil measured as oven dry weight divided by volume.
       2. EXISTING SOIL:Mineral soil existing at the locations of proposed planting of area designated for the installation of Silva Cells after the majority of the construction within and around the planting or Silva Cell site is completed and just prior to the start of Work to excavate the soil

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraph below as applicable.*

* + - 1. LANDSCAPE ARCHITECT [**Landscape Architect**] [**Architect**] [**Engineer**]: The person or entity, employed by the Owner to represent their interest in the review of the Work.
      2. PED: Clump or clod of soil held together by a combination of clay, organic matter, and fungal hyphae, retaining the original structure of the harvested soil.
      3. SCREENED SOIL: Soil that has been processed through a metal screen to remove or break apart soil peds (clumps /clods), roots, rocks and debris and remove larger physical items in the soil not permitted by the specification.

*SPECIFIER****:*** *Revise Section number and title in the paragraph below to suit project requirements.*

* + - 1. SILVA CELLS: Structural paving support system defined in Section [**32 94 51** Silva Cells] [**insert other title**].
      2. SUBGRADE: Surface or elevation of subsoil remaining after completing excavation, or top surface of fill or backfill, before placing planting soil.
    1. Reference Standards:

*SPECIFIER: Use care when indicating the edition date of the referenced standards; these standards are subject to regular review, and updated accordingly.*

* + - 1. ASTM International (ASTM)
         1. ASTM C33, Standard Specification for Concrete Aggregates- Fine Aggregates.
      2. The Soil Science Society of America.
         1. Methods of Soil Analysis, most current edition,

3. United States Composting Council [*www.compostingcouncil.org*](http://www.compostingcouncil.org) *and* [http://compostingcouncil.org/admin/wp-content/plugins/wp-](http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf)*pdfupload/pdf/191/LandscapeArch\_Specs.pdf.*

4. United States Department of Agriculture, Natural Resources Conservation Service

a. National Soil Survey Handbook, title 430-VI. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054242>

* 1. **Submittals**
     1. Action Submittals: Submit in accordance with Section **[01 33 00] [other]**:

*SPECIFIER: Select paragraph A above if detailed submittal requirements are specified in Division 01 and revise Section number if necessary to match that used in the Project Manual, or; select paragraph A below if Division 01 is not a part of the Project Manual; keep subparagraphs 1 through 4 with either paragraph A selected.*

*SPECIFIER****:*** *Confirm the submittal time specified is appropriate for Project schedule. 45 days is a very short lead-time for the soil approval process; 6 to 8 weeks is more appropriate.*

* + 1. Action Submittals: Submit these to the [**Landscape Architect**] [**Architect**] [**Engineer**] for review and acceptance not less than 45 days prior to start of installation of materials and products specified in this Section.
       1. Product Data: For each type of product, submit manufacturer's product literature with technical data sufficient to demonstrate that the product meets these specifications.
          1. For each compost product submit the manufactures certification that the compost meets the requirements for US Compost Council STA/TMECC criteria for “Compost as a Landscape Backfill Mix Component” and other requirements of the Specification.
          2. For coarse sand product submit the following analysis by a recognized laboratory:

pH

Manufactures Fines Modulus Index

Particle size distribution (percent passing the following sieve sizes):

3/8 inch (9.5 mm)

No 4 (4.75 mm)

No 8 (2.36 mm)

No 16 (1.18 mm)

No 30 (0.60 mm)

No 50 (0.30 mm)

No 100 (0.15 mm)

No 200 (0.075 mm)

* + - 1. Test and Evaluation Reports:
         1. Include analysis of bulk materials including soils and aggregates, by a recognized laboratory that demonstrates that the materials meet the Specification requirements.
         2. Submit required soil test analysis report for each sample of imported topsoil, existing site soil, and planting soil mixes from an approved soil-testing laboratory as follows:

Do not submit planting soil mixes, for testing until all topsoil, compost, and coarse sand have been approved.

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraph below as applicable.*

If tests fail to meet the Specifications, obtain other sources of material, retest and resubmit until accepted by the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**].

*SPECIFIER: In the following paragraph and elsewhere in this specification the terms sand, silt, clay, and gravel are defined as sizes within the USDA gradation nomenclature system. There are other nomenclature systems particularly the Unified System and the AASHO system, which are engineering systems. The sizes of sand, silt clay and gravel are different in these other systems and in some instances these differences are significant. It is critical that all testing results for soil particle sizes be reported in USDA units and performed by labs that specialize in agricultural soil testing.*

All testing shall be performed following the requirements of *Methods of Soil Analysis*, The Soil Science Society of America.

Provide a particle size analysis (percent dry weight) and USDA soil texture analysis. Soil testing of planting soil mixes shall also include USDA gradation distribution of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay. Reports of partical size distribution shall use USDA size nomenclature and analysis protocols.

Provide the following other soil properties:

pH and buffer pH.

Percent organic content by oven dried weight.

Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil for optimum growth of the plantings specified.

Soluble salt by electrical conductivity of a 1:2 soil water sample measured in Milliohm per cm.

All soil testing will be at the expense of the Contractor.

*SPECIFIER: Delete references in the paragraphs below for any Products not used in the project.*

* + - 1. Samples:
         1. Each sample shall be double bagged packaged in two plastic zip loc style bags. Each bag shall be clearly marked with the project name, date, contractors name and telephone number, and product name.
         2. Samples of all existing site soil, topsoil, coarse sand and, compost and planting soil mixes shall be submitted at the same time as the particle size and physical analysis of that material.
         3. Samples of the existing site soil that are under existing pavement to be removed may be submitted as soon as possible after the paving is removed.
         4. Samples will be reviewed for appearance only.
         5. Provide samples for the following products.

One-gallon (3.79-liter) sample of each type of existing site soil prior to adding amendments.

One-gallon (3.79-liter) sample of imported topsoil.

One-gallon (3.79-liter) sample of bio-retention topsoil.

One-gallon (3.79-liter) sample of compost.

One-gallon (3.79-liter) sample of bio-retention compost.

One-gallon (3.79-liter) sample of coarse sand.

One-gallon (3.79-liter) sample of unscreened planting soil mix.

One-gallon (3.79-liter) sample of screened planting soil mix.

One-gallon (3.79-liter) sample of bio-retention soil mix.

* + - 1. Qualification Statements:
         1. Soil supplier:

Submit documentation of the qualifications of the planting soil supplier and their field supervisor, sufficient to demonstrate that both meet the requirements specified in Article 1.05 QUALITY ASSURANCE.

Submit list of completed projects of similar scope and scale demonstrating capabilities and experience.

* 1. **QUALITY ASSURANCE**
     1. Supplier: Soil mixes shall be supplied by a firm that specializes in the production of mixes of planting soils and have at least 5 years experience in providing soil mixes soils to projects of similar size and scope to this Work.
     2. Soil Testing Laboratory Qualifications: The testing laboratory shall specialize in agricultural soil testing and be a member of the Soil Science Society of America's, North American Proficiency Testing Program (NAPT). Testing results for soil particle size shall be reported using USDA sizes for sand, silt, and clay.
  2. **DELIVERY, STORAGE, AND HANDLING**
     1. Weather: Do not mix or deliver soil when frozen or muddy.
     2. Protect soil and soil stockpiles, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Confine delivered materials to neat piles in areas coordinated with the site supervisor. Cover stockpiles with plastic sheeting or fabric at the end of each Workday.
     3. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations.
        1. Biological and chemical additives shall be protected from extreme humidity, cold, or heat. All products shall be freshly manufactured and dated for the year in which the products are to be used. Chemical amendments shall have original labels intact and legible, stating the guaranteed chemical analysis.

1. **- PRODUCTS**

*SPECIFIER****:*** *Delete products not applicable to this specific Project. Local conditions for the harvested materials will vary and these Specifications may need to be revised to reflect local source requirements, availability, budgets and plants to be grown.*

* 1. **EXISTING SITE SOIL**

*SPECIFIER****:*** *The following Product Section is to be used when existing site soil may be suitable for use in Silva Cells, typically after adding Compost.**Existing soil may often be retained and reused with minor modifications as a planting soil in Silva cell. Reuse of this resource is the most sustainable option having significant environmental benefits and Project cost reduction.*

*Be sure that this is an acceptable option before allowing this item to remain in the list of acceptable soil products. It is prudent to document the extent (area and depth) of allowable excavation and the condition of this soil prior to the start of construction. Documentation, including a soil report, should be prepared prior to the issuing of Construction Documents and include standard agricultural chemical soil testing, percent soil organic matter, soil profile condition, as well as documenting soil penetration resistance. This testing can be inserted into this Section of the Specification to document the soils that are usable. Observing existing soil under pavement prior to construction may be difficult unless test holes are dug during the design phase.*

*Check the pH limitations and soil requirements of the plants in the Silva Cells before specifying existing site soil.*

*Compacted soil including many subsoils can be restored for use in Silva Cells by loosening compaction, and adding compost up to 20 percent by volume. Soil pH above 7.3 is often a limiting factor but may be suitable if plant types are selected that are adaptable to higher pH soil. Soil pH above 8.0 indicates the soil is not usable in many regions.*

*In dry climates and regions with sandy soils, native plants are often adapted to grow in soil with very low organic matter and high pH. Raising the organic matter too high or lowering the pH may negatively impact native or adapted plant performance.*

* + 1. Existing site soil: Soil at the site including the possibility of subgrade soil under existing paving that is of a texture and chemical composition that can support roots provided that compost and or fertilizer is added and the soil compaction loosened.
    2. Existing site soil shall meet the following criteria:
       1. Soil objects larger than 1/4 inch (6.24 mm) in diameter: Existing site soil shall contain less than 5 percent total volume of the combination of all objects 1 to 8 inches (25 mm – 200 mm) in their largest dimension including clumps/clods of heavy clay, sandy clay or silty clay subsoil, debris, refuse, roots, stones, sticks, brush, and or litter. The soil shall contain less than 8 percent by volume total of the above objects 1/4 inch (6.24 mm) to 1 inch (25 mm) in diameter. Remove objects larger than 8 inches (200 mm) in its longest dimension.
       2. Seedlings that germinated from seeds in the soil shall be removed within one month of germination whether during the period the soil is being stored or after installation including during the plant warranty period.

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraph below as applicable.*

* + - 1. The Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**] shall verify that the soil in the designated areas is suitable at the beginning of planting bed preparation Work. The decisions to specify the use of existing site soils is based on assumptions made during the design phase about the quality of soil which may have been covered by paving at that time or where construction activity earlier in the Project may have altered this soil.
         1. Areas and depths to which existing site soil can be harvested for use in the Silva Cells is indicated on the soil plan.

*SPECIFIER****:*** *Assure that the following information is shown on the soil plan as described above or delete this item.*

* + - 1. Soil testing results and soil observation notes that describe the preconstruction soil conditions in the existing soil areas are included as an appendix to this Specification:

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraph below as applicable.*

* + 1. If the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**] determines the soil to be unacceptable or the Work of this Project has damaged areas designated for use as existing site soil to the point where the soil is no longer suitable to support the plants specified, the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**] may require modification of the damaged soil up to and including removal and replacement with soil of equal quality to the soil that existed prior to construction.
       1. Examples of damage include further compaction, contamination, grading, creation of hardpan or drainage problems, or lack of previously assumed O, A and or B-horizon soils.
       2. Do not begin Work on additional modifications or soil replacement until changes, if any, to the Contract price are approved.

*SPECIFIER****:*** *Note that there is an option for a unit price requirement, in Part 1 above, to cover the contingency of the existing soil not being usable and this is discovered after the contract has begun.*

* + 1. Protect existing soil from contamination, and degradation during the construction process.
    2. Excavation and storage of existing site soil:
       1. Remove existing plants, roots, stumps, paving, and non-soil debris from the surface layers of the soil.

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraphs below as applicable.*

* + - 1. Excavate the soil over the areas and depths indicated on the plan or as directed by the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**]. Utilize techniques and equipment that retains peds (clumps/clods) of soil.

*SPECIFIER****:*** *In the two paragraphs below, confirm that the proper approval entity is referenced for the storage and or reuse of rejected soil. In many Projects the Landscape Architect may not have the authority to direct the Contractor in these types of issues.*

* + - 1. During the excavation process, soils in the approved areas and depths of different color and texture should be loosely mixed to create a more uniform single soil while still retaining soil peds (clumps/clods). The Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**] may request that soils encountered that are not in accordance with the soil assumptions not be included in the mixing process. Such soils should be removed from the site or may be used as fill soils if approved by the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**].
      2. Do not screen the soil unless approved in advance by the Landscape Architect [**Landscape Architect**] [**Architect**] [**Engineer**]. Encountered volumes of soil that do not meet the requirement for soil objects larger than 1/4 inch (6.24 mm) in diameter should be segregated during the excavation process and removed from the site. If approved, soil may be screened through a 2-inch (50 mm) square or larger opening in order to allow the soil to meet the requirements. Isolated large objects shall be removed from the soil by hand.
      3. Stockpile the soil in locations approved in advance by the General Contractor.

*SPECIFIER****:*** *Delete the following sentence if the site has adequate soil storage.*

* + - * 1. Store soil in bulk trash dumpsters with rear access doors if no suitable space exists at the site.
    1. Amending existing site soil:
       1. Amendments for existing site soil should be calculated for a composite mix of all soils to be used.
       2. Add compost to existing site soil, up to 20 percent by moist volume to bring soil organic matter to a minimum of 3 percent by dry weight.
          1. Each 10 percent moist volume of added compost is assumed to raise the percent dry weight soil organic matter by 1.5 percent.
          2. Spread compost over the stockpile in amounts that achieve the required organic matter content. As soil is being scooped from the pile to bring to the Silva Cells, mix the compost loosely into the soil with the loader bucket. Add additional compost to the stockpile as the Work progresses to achieve even compost distribution within the mix.
          3. Do not over mix the soil. Maintain as many large soil peds (clumps/clods) as possible in the mix.
       3. Add fertilizer of the types and quantity recommended by the soil test at the time of mixing.
    2. Submittal Requirements: Provide a one-gallon (3.79-liter) sample of each type of of existing site soil prior to adding amendments with testing data that includes recommendations for compost volumes and chemical additives for the types of plants to be grown. Samples and test samples shall represent the composite mixing of the available soils. Samples and testing data shall be submitted at the same time.
  1. **IMPORTED TOPSOIL**

*SPECIFIER****:*** *Make adjustments to the specification if these ideal soils are not available in your area. Consult with DeepRoot Green Infrastructure or a local soil expert. Regional adjustments to the below requirements may be needed to Work with locally available soil. Soils in regions where sandy soil or silt soil predominate may require adjustment of the following limits. Regionally adapted plants can often grow well in the local soil.*

* + 1. Imported topsoil: Fertile, friable soil loam topsoil suitable for the germination of seeds and the support of vegetative growth meeting the following criteria:
       1. Soil texture: USDA loam, sandy clay loam or sandy loam with clay content between 15 and 35 percent; a combined clay/silt content of no more than 60 percent; and sand between 35 and 65 percent.

*SPECIFIER****:*** *Modify the following paragraphs as needed.**Soil screening damages important soil peds (clumps/clods). However, the practice of soil screening is the most common way to process soil. Be sure you can enforce this requirement. Discussions with the Contractor and the soil supplier on this topic are recommended. The unscreened planting soil mix ratios that follow in this Specification are based on the presence of soil peds (clumps/clods) and no fine screening of the topsoil. If screening of the soil through screens finer than 2 inches (50 mm) occurs, the coarse sand amount in the planting soil mix ratios must be modified to include more sand. Note that the screening prohibition above should be eliminated if the screened planting soil mix or the screened bio-retention mix options are utilized.*

* + - 1. Except where noted, imported topsoil shall NOT have been screened and shall retain soil peds (clumps/clods) larger than 2 inches (50 mm) in diameter throughout the stockpile after harvesting.
         1. Light screening through a 2-inch (50 mm) square or larger opening will be permissible in soils with clay content of 20 percent or greater if required to break up large peds (clumps/clods) or remove coarse roots and stones.
         2. Retained soil peds (clumps/clods) shall be the same color on the inside as is visible on the outside surface of the ped.

*SPECIFIER****:*** *The following limits to soil objects is quite broad and is intended to allow the use of soils where rocky topsoil is normal, (mountain or glacial soil areas) or to allow the use of recycled soil. Allowing larger objects also permits soils to not be finely screened so soil peds (clumps/clods) in can be retained, a critical basis for this Specification. Make adjustments to the following to account for the fact that these idea soils may not be available in your area. Soil peds (clumps/clods) may not normally occur, especially where soils have a high silt or sand content. It is advisable to contact local soil suppliers to discuss available soil options and how this Specification may Work with their production capability.*

* + - 1. Soil objects larger than 1/4 inch (6.24 mm) in diameter: Imported topsoil shall contain less than 5 percent total volume of the combination of all objects 1 to 8 inch (25 mm to 200 mm) in their largest dimension including clumps/clods of heavy clay, sandy clay or silty clay subsoil, debris, refuse, roots, stones, sticks, brush, and or litter. The soil shall contain less than 8 percent by volume total of the above objects 1/4 inch to 1 inch (6.24 mm to 25 mm) in diameter. Remove all objects larger than 8 inch (200 mm) in its longest dimension.
         1. Meet the above requirement by utilizing acceptable soils sources rather than soil screening.
      2. Imported topsoil may be a harvested soil from fields or development sites or purchased from suppliers who collect and process soil. The organic content and particle size distribution shall be the result of natural soil formation. Manufactured soils where sand, composted organic material or other additives have been added to the soil to meet the requirements of imported topsoil shall not be acceptable.

*SPECIFIER****:*** Regions with higher pH in the base soils may increase the following pH level. Locally adapted plants often grow well with a higher pH. Adjust the following paragraph as needed.

* + - 1. pH value shall be between 5.5 and 7.5.

*SPECIFIER****:*** *Organic matter limits are highly regional. In dry areas soil organic matter may be much lower and in very wet areas particularly the Pacific Northwest, higher organic matter is common. However, when soil OM exceeds 5 percent excess water holding in the soil may create drainage problems particularly if the majority of the OM is the result of adding compost. Adjust the following paragraph as needed.*

* + - 1. Percent Organic Matter (OM): 3 to 5 percent, by dry weight.
      2. Soluble Salt Level: Less than 2 mmho/cm.
      3. Soil nutrient chemistry suitable for growing the plants specified or after modification.
      4. Germinating seedlings from seeds in the soil shall be removed within one month of germination whether during the period the soil is being stored or after installation, including during the warranty period of the plants.

*SPECIFIER****:*** *Delete the following sentence if there is no existing topsoil stockpiled. If existing topsoil is available, add statement here about the extent and quality of the soil.*

* + 1. Stockpiled existing topsoil at the site meeting the above criteria may be acceptable.
    2. Submittal Requirements: Provide a one-gallon (3.79-liter) sample from each imported topsoil source with required soil testing results. The sample shall be a mixture of the random samples taken around the source stockpile or field. The soil sample shall be delivered with soil peds (clumps/clods) intact that represent the size and quantity of expected peds (clumps/clods) in the final delivered soil. The sample shall represent the expected amount of objects larger than 1/4 inch (6.24 mm).

*SPECIFIER****:*** *The following**Bio-retention topsoil is being used in the Bio-Retention soil mix to reduce phosphorus leaching. In many market areas finding low phosphorous topsoil may be difficult. Consult local soil expert or DeepRoot Green Infrastructure and make the appropriate adjustments to the requirements.*

* 1. **BIO-retention Topsoil**
     1. Topsoil meeting the requirements of imported topsoil and with phosphorous less than 36mg/kg (ppm) per Mehlich III test.
     2. Submittal Requirements: Follow the submittal requirements for imported topsoil.
  2. **COMPOST**
     1. Compost: Blended and ground leaf, wood and other plant based material, composted for a minimum of 9 months and at temperatures sufficient to break down woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Compost feed stock shall be yard waste trimmings, blended with other plant and or manure feed stock designed to produce compost high in fungal material.
        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>

* + - 1. Submittal Requirements: Provide one-gallon (3.79-liter) sample with manufacturer’s literature and material certification that the product meets the requirements.

*SPECIFIER****:*** *The following**Bio-retention compost is not actually true compost but is being used in the Bio-Retention soil mix to reduce phosphorus leaching. Consult local soil expert or DeepRoot Green Infrastructure.*

* 1. **BIO-RETENTION Compost**
     1. Aged triple-shredded hardwood bark or aged pine fines.
        1. 1 to 3 inch (25 mm to 75 mm) typical fiber length.
     2. Material shall be aged 6 months or more with dark brown color.
     3. Submittal Requirements: Provide one-gallon (3.79-liter) sample with manufacturer’s literature and material certification that the product meets the requirements.
  2. **COARSE SAND**

*SPECIFIER****:*** *The following requirement for Fines Modulus Index may be deleted if coarse sand is being used at rates less than 50 percent by volume.*

* + 1. Clean, washed, natural sand, free of toxic materials.
       1. Coarse concrete sand, ASTM C33 Fine Aggregate, with a Fines Modulus Index of 2.8 and 3.2.

*SPECIFIER****:*** *In some regions limestone, shale or slate free sand may not be normally available. If higher pH soil is acceptable for the plants, delete the following requirement for limestone free sand and raise the maximum sand pH requirement to 8.0.*

* + - 1. Coarse sand, free of limestone, shale and slate particles. Manufactured Sand shall not be permitted.
      2. pH shall be lower than 7.4.
      3. Provide coarse sand with the following particle size distribution:

Sieve Percent passing

3/8 inch (9.5 mm) 100

No 4 (4.75 mm) 95 to100

No 8 (2.36 mm) 80 to100

No 16 (1.18 mm) 50 to 85

No 30 (0.60 mm) 25 to 60

No 50 (0.30 mm) 10 to 30

No 100 (0.15 mm) 2 to 10

No 200 (0.75 mm) 2 to 5

* + 1. Submittal Requirements: Provide a one-gallon (3.79-liter) sample with manufacturer’s literature and material certification that the product meets the requirements.
  1. **FERTILIZER**
     1. If noted by the soil test recommendations, add slow-release, organic fertilizer based on soil test and plant requirements.
     2. Fertilizers should NOT be added to Bio-retention soils.
     3. Submittal Requirements: Provide manufacturer’s literature that the product meets the requirements.

*SPECIFIER****:*** *Specialty biological amendment products such as mycorrhizal amendments or compost tea are not included in this Specification. Compost tea amendments may be beneficial to the soil but are currently too complex to include in this Specification. Consult a soil expert or DeepRoot Green Infrastructure. If the Project team would like to add any of these amendments to the soil, add the product descriptions below and other references noted in Part 1 and 3. These types of amendments, if used, should never be applied without a soil test that documents their need and application rate.*

* 1. **BIOLOGICAL AMENDMENTS**
     1. Amendments such as Mycorrhizal additives, compost tea or other products intended to change the soil biology.

SPECIFIER**:** The following unscreened planting soil mix is not to be screened or mixed in a soil-blending machine. Screening and blending breaks down important topsoil peds (clumps/clods) and reduces drainage in the soil. Machine blended and screened mixes typically.

* 1. **Unscreened Planting soil Mix**
     1. A mixture of imported topsoil, coarse sand, and compost to make a new soil that meets the Project goals for the indicated planting area.

*SPECIFIER****:*** *The following mix ratio is designed to be made with topsoil with strong enough peds (clumps/clods) to allow the mixing and installation process to retain significant ped size. This is typically topsoil with higher soil organic matter and or sufficient clay to create strong structure in the soil. As silt and fine sand increases in the topsoil, peds (clumps/clods) become weaker and more coarse sand is required to maintain soil drainage. As the amount of coarse/ medium sand in the topsoil increases over about 55 percent, less coarse sand is needed. In these soils* ***slightly*** *more compost may be beneficial. The proportion of coarse sand and topsoil is altered by the amount of clay, silt and sand, the size of the sand, and the amount of organic matter in the available topsoil. In regions where sand in the topsoil exceeds about 65 percent, do not add sand to this mix. Consult a local soil expert or DeepRoot Green Infrastructure.*

* + - 1. The approximate mix ratio of imported topsoil, coarse sand and compost shall be:

Mix component Percent by moist volume

Imported topsoil unscreened 50 to 60 percent

Coarse sand 30 to 40 percent

Compost 10 percent

* + - 1. Final Tested Soil Organic Matter (OM): 2.75 to 4 percent (by dry weight loss ash burn).
    1. Mix the coarse sand and compost together first and then add to the topsoil. Mix with a loader bucket to loosely incorporate the topsoil into the coarse sand/compost Mix. DO NOT OVER MIX. Do not mix with a soil-blending machine. Do not screen the soil. Peds (clumps/clods) of Soil, and loosely mixed Compost and coarse sand will be permitted in the overall mix.
    2. At the time of soil installation, add fertilizer or biological amendments, if required, to the planting soil mix at rates recommended by the testing results for the plants to be grown.
    3. Submittal Requirements: Provide a one-gallon (3.79-liter) sample with testing data that includes recommendations for chemical additives for the types of plants to be grown. Samples and testing data shall be submitted at the same time. The sample shall be a mixture of the random samples taken around the source stockpile or field. The sample shall be delivered with soil peds (clumps/clods) intact that represent the size and quantity of expected peds (clumps/clods) in the final delivered soil mix.

*SPECIFIER****:*** *The following screened planting soil mix is included in this Specification because this is the standard method of making manufactured soils. Screening and blending of the soil breaks down the soil peds (clumps/clods), which clogs the drainage and significant amounts of coarse sand is needed to restore the drainage. Additional compost is then required to boost the water-holding capacity and organic matter in the soil. In some markets, areas with limited soil suppliers, or Projects with insufficient quality controls, this alternative may be a better choice, but the trees will have a greater reliance on irrigation or harvested water.*

* 1. **screened Planting soil Mix**
     1. A mixture of imported topsoil, coarse sand, and compost mixed off site to make a new soil that meets the Project goals for the indicated planting area.

*SPECIFIER****:*** *Soil mix ratios vary from market to market. Consult a local soil expert or DeepRoot Green Infrastructure.*

* + - 1. A mix of imported topsoil, coarse sand and compost. The approximate Mix ratio shall be:

Mix component Percent by moist volume

Imported topsoil screened 40 to 45 percent

Coarse Sand 40 to 50 percent

Compost 10 to 15 percent

*SPECIFIER****:*** *The following organic matter range is slightly higher than the unscreened soil to compensate for the increased sand content.*

* + - 1. Final Tested Organic Matter: 3 to 4.5 percent (by dry weight loss ash burn).
      2. Final mix shall be thoroughly screened, mixed and blended.
    1. At the time of soil installation, add fertilizer or biological amendments, if required, to the planting soil mix at rates recommended by the testing results for the plants to be grown.
    2. Submittal Requirements: Provide a one-gallon (3.79-liter) sample with testing data that includes recommendations for chemical additives for the types of plants to be grown. Samples and testing data shall be submitted at the same time. The sample shall be a mixture of the random samples taken around the source stockpile or field.

*SPECIFIER****:*** *Silva Cells are used as below-paving bio-retention treatment beds. The soil in these zones must meet the requirements for storm water treatment in the local jurisdiction. Where there is a regulation-required soil mix, use the locally acceptable mix and substitute the local Specification here. If there is no required mix, the following is modeled after the North Carolina State Bio-retention soil media BMP.*

*If low phosphorous in the soil mix is not a requirement allow regular compost and imported topsoil in the following mix.*

**2.11 Bio-retention soil Mix**

* + 1. A mixture of Un-screened imported Bio-retention topsoil, coarse sand, and bio-retention compost to make a new soil that meets the following Specification:

*SPECIFIER****:*** *In many regions, phosphorous leaching from bio-retention soil is a problem. To attain the low phosphorous levels in the overall mix, specialty topsoil and compost with low levels phosphorous may be needed. Bio-retention topsoil and bio-retention compost is different than the topsoil and compost used in the other soil mixes in this Specification. They are designed to reduce phosphorous leaching. Sand may also have high levels of leachable phosphorous but to a lesser extent than topsoil of compost. Specifying these products is very regional and will require consulting with a local soils expert.*

*SPECIFIER****:*** *Note that the specification below is NOT a mix proportion ratio of the component parts of soil, sand and compost. The range percent dry weight is indicating the particle size distribution in the* ***final*** *mix. Note that USDA particle size testing removes all gravel size particles before the distribution range percent is calculated. This means that there will likely be significant amounts of gravel (particles larger than 2.0mm) in the final mixes, which are not reflected in the range percent dry weight. This is why the sand, silt, clay will equal 100% even though some amount of gravel will be observed. Note that the results are percent dry weight not percent moist volume, which differs from the other mixes in this specification. Finally, the particles in the compost will be read and sorted in this test procedure as clay, silt, sand and gravel even though they are actually pieces of organic material.*

*SPECIFIER: In regions where the available topsoil has high sand content, particularly with mostly finer sand fractions, the mix below may not be practical to produce. Consult with a local soils expert or contact DeepRoot for recommendations.*

*SPECIFIER: The below mix will drain adequately if not compacted above 85% standard proctor. It is difficult to compact this soil above 85% within the Silva Cell structure. However, if this mix is also used in open bioretention beds, where larger equipment can access the soil, assure that the soil is not compacted above 85% throughout the depth of the soil profile. Bioretention soil mixes with high sand content are not recommended. However, specifiers of Silva Cells are not prohibited from installing any soil they wish with the understanding that many soil mix concepts in the market are not the best compromise between tree health and storm water goals.*

*SPECIFIER: In some jurisdictions the below mix may not meet local codes for bio-retention soil. Follow local codes for soil mixes if it is not possible to obtain a variance to the local requirements. Contact DeepRoot for recommendations.*

*SPECIFIER: The topsoil specified may have limited amounts of clumps/clods of heavy clay, sandy clay or silty clay subsoil, debris, refuse, roots, stones, sticks, brush, and or litter up to 8" (203 mm) in its largest dimension. The bioretention compost specified will have significant amounts of fibers up to 3" (76 mm) in length. These objects are permissible in the final mix to the extent that they come from the approved topsoil or compost.*

*SPECIFIER: The following specification requires a minimum of 55% of the total sand be sand sizes 0.5 to 2.0mm.  For example, if the total sand is 60%, the minimum amount of sand 0.5 to 2.0mm must be 33%; or if the total amount of sand is 75%, the minimum amount of sand 0.5 to 2.0mm must be 42%.*

* + - 1. Mix proportions are based on actual amounts of sand, silt and clay in each of the 3 mix components. Adjust the proportion of each component so that the final mix, after blending, has the following ranges of particle sizes when tested using USDA testing protocol for soil particle size distribution.

Particle size Range percent dry weight

Total Sand 0.05 to 2.0 mm 60 to 75 percent

Sand fractions 0.25 to 2.0mm Min 55% of the above total sand

Combined silt and clay 25 to 40 percent

Allowable gravel up to 10%

* + - 1. Final Tested Soil Organic Matter: 2.0 to 4.0 percent (by dry weight loss ash burn).

*SPECIFIER: In some regions developing a soil with pH less than 7.5 may not be possible. Soils with higher pH may be acceptable provided that plant choices are tolerant of the higher pH.*

* + - 1. Final pH: between 5.5 and 7.5.

*SPECIFIER****:*** *If low phosphorous in the soil mix is not a requirement, delete or modify the following sentence and allow regular compost and imported topsoil.*

* + - 1. Phosphorus in overall mix: 12 to 36 mg/kg (ppm) per Mehlich III test.

*SPECIFIER: The inclusion of biochar is included as a placeholder in the event that the specifications writer wants to add this material to the soil. A product specification for the biochar must be developed and added to part 2 of this specification.*

* + 1. Mix biochar at a rate of 5% by volume into the top 6-8 inches (152mm – 203mm) of the soil profile at the time of soil installation.
    2. Mix the coarse sand and compost together first and then add to the topsoil. Mix with a loader bucket to loosely incorporate the topsoil into the coarse sand/compost Mix. DO NOT OVER MIX. Do not mix with a soil-blending machine. Do not screen the soil. Peds (clumps/clods) of Soil, and loosely mixed Compost and coarse sand will be permitted in the overall mix.

*SPECIFIER****:*** *Adding fertilizer to these soils is not recommended, due to leaching of chemicals, unless allowed by local regulations. If fertilize is required, add to this Section and to the product description.*

* + 1. Submittal Requirements: Provide a one-gallon (3.79-liter) sample with testing data. Samples and testing data shall be submitted at the same time.

1. **- EXECUTION**
   1. **INSTALLATION OF PLANTING SOIL IN SILVA CELLS** 
      1. Refer to Section [32 94 51 - Silva Cells] [**Insert other title**].

END OF SECTION

*SPECIFIER****:*** *If existing soil test data is available, add testing reports in this location. Include a plan of the site designating the extent of the different soil types identified and the location of soil test pits. If no testing was completed, remove the Appendix.*

**Appendix to 32 94 56 Planting soil**

**Existing Soil Test Data**

**Submittal Checklist for Reference Only**

*SPECIFIER: Select either "Landscape Architect", "Architect" or "Engineer" in paragraphs below as applicable.*

Provide submittals required to the Landscape Architect[**Landscape Architect**] [**Architect**] [**Engineer**] for review and approval. The Submittal process may take up to 2 months prior to installation of the Silva Cell system and should be executed as soon as possible after the Contract is awarded. Testing will be at the expense of the Contractor.

**SOIL COMPONENT SUBMITTALS – SUBMITTED PRIOR TO SOIL MIXING**

* + - EXISTING SITE SOIL
      * + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample
        + IMPORTED TOPSOIL
        + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample
        + BIO-RETENTION TOPSOIL
        + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample
        + COMPOST
        + Manufacturer’s literature
        + Certificate of compliance with US Composting Council STA/TMECC requirements
        + One-gallon (3.79-liter) sample
        + BIO-RETENTION COMPOST
        + Manufacturer’s literature
        + One-gallon (3.79-liter) sample
        + COARSE SAND
        + Manufacturer’s literature
        + Lab analysis for physical and chemical composition
        + Manufactures Fines Modulus Index
        + One-gallon (3.79-liter) sample
        + FERTILIZER
        + Manufacturer’s literature

**SOIL MIX SUBMITTALS**

* + - UNSCREENED PLANTING SOIL MIX
      * + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample
    - SCREENED PLANTING SOIL MIX
      * + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample
    - BIO-RETENTION SOIL MIX
      * + Lab analysis for physical and chemical composition
        + One-gallon (3.79-liter) sample