

SOIL PREPARATION (PERFORMANCE SPECIFICATION) for Bioretention Systems

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes soil media for the bioretention systems and rain gardens specified according to performance requirements of the mixes. In general, the media is suitable for a variety of plant species however, careful consideration of system hydrology and solar radiation should be included in plant selection.

1.2 ALLOWANCES

- A. Preconstruction and field quality-control testing are part of testing and inspecting allowance.

1.3 DEFINITIONS

- A. Bioretention Soil Mix (BSM): Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments. A soil mixture best for media filtration.
- B. Cation exchange capacity (CEC): a measure of the soil's ability to hold positively charged ions.
- C. Organic Matter: The total organic materials in soil and the soil biomass; also called "humus" or "soil organic matter."
- D. Subgrade: Surface and/or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill above which a bioretention system is constructed.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at **the Project site prior to commencement of construction activities**

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil, soil amendment and/or fertilizer, before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of nonstandard materials, by a qualified testing agency.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
 - 1. Laboratories: Subject to compliance with requirements.

1.8 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 - 1. Soil samples must be obtained during the soil characterization field analysis and classified according to ASTM D2487 (Standard Practice for Classification of Soils for Engineering Purposes [Unified Soil Classification System]) and ASTM D2488 (Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]).
 - 2. Soil samples must undergo laboratory particle size analysis according to ASTM D422 (Standard Test Method for Particle-Size Analysis of Soils).
- C. Chemical Testing:
 - 1. Cation Exchange Capacity (CEC): Analysis by sodium saturation at pH 7
- D. Fertility Testing: Soil fertility analysis according to standard laboratory protocols including the following:
 - 1. Percentage of organic matter.
 - 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 - 3. Soil reaction (acidity/alkalinity pH value).
 - 4. Nitrogen ppm.
 - 5. Phosphorous ppm.
 - 6. Copper ppm.
- E. Organic-Matter Content: Using ASTM D 2974-00 Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils. Analysis using loss-by-ignition method.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Do not move or handle materials when they are wet or frozen.

PART 2 - PRODUCTS

2.1 SOIL MEDIA SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

Particle Size Distribution according to ASTM D422 (Standard Test Method for Particle-Size Analysis of Soils).

1. Particle Size Distribution by Separates:
 - a. Exclude any material > 4.76 mm - 0%
 - b. Very Coarse Sand/Gravel: Gravel (2.0 to 4.76 mm) 5% maximum (percent by dry weight).
 - c. Sand* (0.42 to 2.0 mm) 90 - 80% (percent by dry weight).
 - d. Silt/Clay (less than 0.075mm) 5% maximum (percent by dry weight).

* It should be noted that the "sand" fraction is an ASTM derived particle size specification and does not necessarily refer to the ASTM C-33 sand requirement often included in generic BSM mix requirements. This is a performance specification that allows for a variety of soil mixes that ultimately meets the fractions outlined in table 1).

Table 1: Acceptable particle size distribution of final bioretention soil mix

Sieve #	Sieve Size in (mm)	% Passing
4	0.187 (4.76)	100
10	0.079 (2)	95
40	0.017 (0.42)	10 – 20
200	0.003 (0.075)	< 5

2. Fragment Size Distribution:
 - a. Sticks and Roots: should be minimized and preferably limited to nothing larger than 4.76 mm
 - b. Debris and Other Foreign Materials: should be minimized
3. Percentage of Organic Matter: Minimum 3 percent by volume and maximum 10 percent by volume.
4. Soil Reaction: pH of 6 to 7.
5. CEC of Total Soil: Minimum 10 meq/100 mL at pH of 7.0.
6. Basis-of-Design Product: Subject to compliance with requirements indicated on Drawings
7. Basic Properties: Manufactured soil **SHALL NOT** contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, asphalt, bricks, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, solid waste, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.

- c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 0.187 inches (4.76 mm) in any dimension.

2.2 ACCEPTABLE ORGANIC SOIL AMENDMENTS

- A. No compost should be used in the planting mix unless specified by the engineer.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch (13-mm) sieve, a pH of 3.4 to 4.8.
- C. Wood Derivatives: Shredded wood, wood chips, ground bark, or wood waste; of uniform texture and free of stones, sticks, soil, or toxic materials.
- D. Media amendments such as zero-valent iron and/or drinking water treatment residuals (alum) to enhance phosphorus sorption as specified by the engineer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place soil media according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, asphalt/concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, solid waste, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.
- D. Compaction: Compact each blended lift of soil media to 75 percent of maximum Standard Proctor density according to ASTM D 698
- E. Finish Grading: Grade soil media to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698.
 - 2. Retain "Performance Testing" Subparagraph below if required; revise to suit Project.
 - 3. Performance Testing: For each amended soil media type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
- C. Soil media will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.3 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- B. If soil media or subgrade is over compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the soil media and contamination; restore the subgrade as directed by Engineer and replace contaminated soil media with new soil media.

3.4 CLEANING

- A. Protect areas adjacent to soil media preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.