Summary
Soil quality is directly related to stormwater detention capacity, and so to the health of streams and aquatic resources in the Pacific Northwest. Soil quality also determines landscape success: plant survival, growth, disease resistance, and maintenance needs.

This publication provides guidance for landscape designers, builders, planners, and inspectors to implement soil quality “Best Management Practices” (or BMPs), in order to protect and restore soil functions. The guide describes techniques for construction site soil handling, reducing soil compaction, and amending site soils with compost to meet BMP T5.13 “Post Construction Soil Quality and Depth” in the WA Dept. of Ecology’s Stormwater Management Manual for Western Washington. This guide also includes field inspection techniques, WA suppliers of compost and soil testing laboratories, and specification language in APWA and CSI formats.
This publication is provided to help professionals in the land development and landscape industries understand and implement the new Washington State Department of Ecology “Best Management Practice” (BMP) for soil quality, designed to improve stormwater retention and water quality.

The specifications, procedures and forms contained in this publication were developed by a team of landscape professionals, municipal inspectors, soil scientists and public agency staff. They are provided as examples of the tools needed to implement the State’s soil quality BMP.

This manual, specifications, and resources are available online at

www.SoilsforSalmon.org

and (new in 2008) along with factsheets for builders at

www.BuildingSoil.org
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The Role of Soil Quality in Stormwater Management

The Benefits of Healthy Soil

Healthy soil provides important stormwater management functions including efficient water infiltration and storage, adsorption of excess nutrients, filtration of sediments, biological decomposition of pollutants, and moderation of peak stream flows and temperatures. In addition, healthy soils support vigorous plant growth that intercepts rainfall, returning much of it to the sky through evaporation and transpiration.

Rapid urbanization of forest and farmland in the Puget Sound basin has severely degraded soil capacity to absorb, filter and store rainwater; and support vigorous plant growth. Common development practices include removal of topsoil during grading and clearing, compaction of remaining soil, and planting into unimproved soil or shallow depths of poor quality imported topsoil. These conditions typically produce unhealthy plants that require excessive fertilizers and pesticides, further contaminating runoff.

Stormwater management functions of healthy soils:
- Provides high rates of water infiltration and retention
- Minimizes surface water runoff and erosion
- Traps sediments, heavy metals and excess nutrients; and biodegrades chemical contaminants
- Encourages vigorous protective vegetative cover
- Supports beneficial soil life that fight pests and disease, and supply plant nutrients — reducing need for fertilizers and pesticides that may contaminate waterways.

During development, soil functions are often impaired by topsoil loss and compaction:
- Decreases surface water infiltration and storage
- Increases surface water runoff, including contamination from roadways and yards.
- Increases erosion and flooding.
- Reduces beneficial soil life
- Impairs plant growth, pest and disease resistance
- Increases landscape needs for irrigation, fertilizers, and pesticides, which further increases surface water pollution.
These changes, plus the listing of some Puget Sound salmon runs as "threatened" under the Endangered Species Act, has stimulated examination of alternative practices to preserve and restore the soil’s stormwater and water quality functions.

Low Impact Development (LID) practices that improve on-site management of storm water runoff include:

- Minimizing impervious surfaces,
- Preserving native soil and vegetation, and
- Establishing minimum soil quality and depth standards in landscaped areas.

Illustrations for this section were created by the King County Department of Natural Resources and Parks.

Amending soils with compost or other organic materials can restore soil functions:

- Restores soil water infiltration and storage capacities
- Decreases surface water runoff and erosion
- Traps sediments, heavy metals and excess nutrients; and biodegrades chemical contaminants
- Rebuilds the beneficial soil life that fights pests and disease, and supplies plants with nutrients and water
- Improves plant health, with reduced need for additional water, fertilizers and pesticides
- Aids deep plant root growth and vigorous vegetative cover.
Purpose and Definition

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves become pollution-generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Applications and Limitations

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved onsite management of stormwater flow and water quality.

Soil organic matter can be attained through numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to meet the soil quality and depth BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoils improve soil conditions and do not have an excessive percent of clay fines.

Design Guidelines

**Soil retention.** The duff layer and native topsoil should be retained in an undisturbed state to the maximum extent practicable. In any areas requiring grading remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.

**Soil quality.** All areas subject to clearing and grading that have not been covered by impervious surface, incorporated into a drainage facility or engineered as structural fill or slope shall, at project completion, demonstrate the following:

1) A topsoil layer with a minimum organic matter content of ten percent dry weight in planting beds, and 5% organic matter content in turf areas, and a pH from 6.0 to 8.0 or matching the pH of the original undisturbed soil. The topsoil layer shall have a minimum depth of eight inches except where tree roots limit the depth of incorporation of amendments needed to meet the criteria. Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.

2) Planting beds must be mulched with 2 inches of organic material.

3) Quality of compost and other materials used to meet the organic content requirements:

   a) The organic content for “pre-approved” amendment rates can be met only using compost that meets the definition of “composted materials” in WAC 173-350 section 220. This code is available at the Dept. of Ecology’s website: [www.ecy.wa.gov/programs/swfa/organics/soil.html](http://www.ecy.wa.gov/programs/swfa/organics/soil.html)

   The compost must also have an organic matter content of 35% to 65%, and a carbon to nitrogen ratio below 25:1. The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.

   b) Calculated amendment rates may be met through use of composted materials as defined above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and meeting the contaminant standards of Grade A Compost.

   The resulting soil should be conducive to the type of vegetation to be established.
Implementation Options. The soil quality design guidelines listed above can be met by using one of the methods listed below:

1) Leave undisturbed native vegetation and soil, and protect from compaction during construction.

2) Amend existing site topsoil or subsoil either at default “pre-approved” rates, or at custom calculated rates based on specifiers tests of the soil and amendment.

3) Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default “pre-approved” rate or at a custom calculated rate.

4) Import topsoil mix of sufficient organic content and depth to meet the requirements.

More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

Planning/Permitting/Inspection/Verification Guidelines & Procedures

Local governments are encouraged to adopt guidelines and procedures similar to those recommended in Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington. [This document.] which is available at http://www.soilsforsalmon.org.

Maintenance

- Soil quality and depth should be established toward the end of construction and once established, should be protected from compaction, such as from large machinery use, and from erosion.

- Soil should be planted and mulched after installation.

- Plant debris or its equivalent should be left on the soil surface to replenish organic matter.

- It should be possible to reduce use of irrigation, fertilizers, herbicides and pesticides. These activities should be adjusted where possible, rather than continuing to implement formerly established practices.

Flow Reduction Credits

Flow reduction credits can be taken in runoff modeling when BMP T5.13 is used as part of a dispersion design under the conditions described in:

- BMP T5.10 Downspout Diversion
- BMP T5.11 Concentrated Flow Dispersion
- BMP T5.12 Sheet Flow Dispersion

Chapter III, Appendix III-C, Section 7.5: Reverse Slope Sidewalks

Chapter III, Appendix III-C, Section 7.2.4: Road projects

Related BMP’s in the same volume (Vol. V, Ch. 5) of the Stormwater Management Manual for Western Washington available online at www.ecy.wa.gov/programs/wq/stormwater/manual.html

- BMP T5.20 Preserving Natural Vegetation (pages 5-16 to 5-17 in paper Manual, or pages 103-104 in online PDF version)
- BMP T5.21 Better Site Design (pages 5-18 to 5-21 in paper Manual, or pages 105-108 in online PDF version)
- See also Chapters 7 and 9 in on Infiltration and Biofiltration/Bioretention BMPs (Vol. V page 7-1 or 116 in PDF, and page 9-1 or 144 in PDF)
- and see Volume III, Appendix C “Low Impact Design and Flow Modeling Guidance” (Vol. III, pages C-1 to C-22 in paper manual, or pages 158-159 in online PDF)
The following approach to implementation of BMP T5.13 (BMP = Best Management Practice) in the Department of Ecology’s Stormwater Manual has been developed with expert input and review. It is proposed as a practical methodology to implement the State’s BMP guidelines.

### Proposed Soil Specifications
These specifications are designed to achieve an 8 inch depth of soil with 10% “Soil Organic Matter” (SOM) content in planting beds, and 5% organic content in turf areas.

Detailed amendment rates and procedures are described in Section 4 “Amendment Options,” and in the specifications included in Section 7 “Resources”.

Developers may select from the following four options to meet the requirements:

<table>
<thead>
<tr>
<th>Option 1.</th>
<th>Leave undisturbed native vegetation and soil, and protect from compaction during construction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 2.</td>
<td>Amend existing site topsoil or subsoil either at “pre-approved” default rates, or at custom calculated rates based on tests of the soil and amendment.</td>
</tr>
<tr>
<td>Option 3.</td>
<td>Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a “pre-approved” default rate or at a custom calculated rate.</td>
</tr>
<tr>
<td>Option 4.</td>
<td>Import topsoil mix of sufficient organic content and depth to meet the requirements.</td>
</tr>
</tbody>
</table>

### Methods and Amendment Quality
More than one treatment may be used on different areas of the same site. Soil that already meets the depth and organic matter quality standards, and is not compacted, does not need to be amended.

- Compacted subsoils must be scarified at least 4 inches below the 8 inch deep amended layer (for a finished uncompacted depth of 12 inches).
- Planting beds must be mulched with 2 inches of organic material.
- Compost and other materials used to meet organic content must meet these standards:
  - The organic content for “pre-approved” amendment rates can be met only using compost that meets the definition for “composted materials” in WAC 173-350, section 220, available online at [http://www.ecy.wa.gov/programs/swfa/compost/](http://www.ecy.wa.gov/programs/swfa/compost/)
    - The compost must also have an organic matter content of 35% to 65%, and a carbon to nitrogen ratio below 25:1.
    - The carbon to nitrogen ratio may be as high as 35:1 for plantings composed entirely of plants native to the Puget Sound Lowlands region.
  - Calculated amendment rates may be met through use of composted materials as defined above; or other organic materials amended to meet the carbon to nitrogen ratio requirements, and meeting the contaminant standards for “composted materials” in WAC 173-350-section 220.

See Section 4 “Amendment Options,” and Section 7 “Resources” for more on calculated amendment rates.
Planning and Permitting
A site specific Soil Management Plan (SMP – see Section Five “Guide to Developing a Soil Management Plan”) must be approved as part of the clearing and grading or construction permit application.

The Soil Management Plan (SMP) includes:
- A scale-drawing (11” X 17” or larger) identifying area where native soil and vegetation will be retained undisturbed, and which soil treatments will applied in landscape areas.
- A completed SMP form identifying treatments and products to be used to meet the soil depth and organic content requirements for each area.
- Computations of compost or topsoil volumes to be imported (and/or site soil to be stockpiled) to meet “pre-approved” amendment rates; or calculations by a qualified professional to meet organic content requirements if using custom calculated rates. Qualified professionals include certified Agronomists, Soil Scientists or Crop Advisors; and licenced Landscape Architects, Civil Engineers or Geologists.
- Copies of laboratory analyses for compost and topsoil products to be used, documenting organic matter contents and carbon to nitrogen ratios.

Inspection and Verification Procedures
(See also Section Six “Field Guide to Verifying Soil Quality and Depth in New Landscapes.”)

Inspection and verification should be performed by appropriate jurisdiction inspectors.

Some verification may be made by supervising Landscape Architects or Civil Engineers, who submit signed certification that the approved SMP had been implemented.

The following is an outline of a preferred inspection schedule and tasks:
Depending on local resources and procedures, the inspection tasks may be consolidated into fewer visits.

1) Pre-Grading Inspection
- Verify delineation and fencing off of native soils and vegetation to be left undisturbed, per the SMP.
- Review the SMP with the general contractor to ensure that topsoil stockpiling and other specified measures are incorporated into the work plan.

2) Grading Progress Inspection
- Verify that proper erosion control methods are being implemented.
- Verify that excavation and stockpiling of native soils follows the SMP.
- Verify that subgrades are consistent with the SMP.

3) Post-Construction Inspection
Preferably prior to planting, so that omissions can easily be corrected:
- Verify that compost, mulch, topsoil and amendment delivery tickets match volumes, types and sources approved in the SMP. If materials other than those approved in the SMP were delivered, submissions by the supplier should verify that they are equivalent to approved products.
- Check soil for compaction, scarification and amendment incorporation by digging at least one 12 inch deep test hole per acre for turf and at least one per acre for planting beds. Test holes must be excavated using only a garden spade driven solely by inspector’s weight.
- Test 10 locations per landscaped acre (10 locations minimum) for compaction, using a simple “rod penetrometer” (a 4 foot long 3/8th inch diameter stainless steel rod, with and a 30 degree bevel cut into the side that goes in 1/8 inch at the tip). Rod must penetrate to 12” depth driven solely by inspector’s weight (see illustration in Section 6).
- Verify placement of two inches of organic mulch material on all planting beds.

Secondary Verification For Failing Sites
If inspector believes the installation does not meet the approved permit conditions, additional testing may be ordered to determine whether remediation steps are required prior to final occupancy and payment. An independent consultant (Certified Soil Scientist, Crop Advisor or Agronomist; or Licensed Landscape Architect, Civil Engineer or Geologist) should conduct the following additional sampling and analysis:
- Organic matter content should be verified by an independent soil testing service, using the Loss On Ignition method.
- If necessary, the percentage of fine particles (less than #200 mesh) should be confirmed by a certified Soil Laboratory using a wet sieve test.
- At present, an analytical method for verifying scarification has not been identified. Verification may be a matter of professional opinion.
Select the soil preparation options that best suit each area of the project site. Either choose a pre-approved default amendment rate, or have a qualified professional calculate a custom rate based on soil and amendment tests described in Section 5, using the calculation method described in Section 7 “Resources”).

**OPTION 1: Leave native vegetation and soil undisturbed, and protect from compaction during construction.**

Identify areas of the site that will not be stripped, logged, graded or driven on, and fence off those areas to prevent impacts during construction. If neither soils nor vegetation are disturbed, these areas do not require amendment.

**OPTION 2: Amend existing site topsoil or subsoil**

either at default “pre-approved” rates, or at custom calculated rates based on specifier’s tests of the soil and amendment.

**Scarification.** Scarify or till subgrade to 8 inches depth (or to depth needed to achieve a total depth of 12 inches of uncompacted soil after calculated amount of amendment is added). Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained. Amend soil to meet required organic content.

### A. Planting Beds

1. **PRE-APPROVED RATE:** Place 3 inches of composted material and rototill into 5 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).

2. **CALCULATED RATE:** Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 10% organic content.

Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

### B. Turf Areas

1. **PRE-APPROVED RATE:** Place 1.75 inches of composted material and rototill into 6.25 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).

2. **CALCULATED RATE:** Place calculated amount of composted material or approved organic material and rototill into depth of soil needed to achieve 8 inches of settled soil at 5% organic content.

Water or roll to compact to 85% of maximum dry density.

Rake to level, and remove surface woody debris and rocks larger than 1 inch diameter.
**OPTION 3: Stockpile existing topsoil during grading. Replace it before planting.**

Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a pre-approved default rate or at a custom calculated rate.

**Scarification.** If placed topsoil plus compost or other organic material will amount to less than 12 inches: Scarify or till subgrade to depth needed to achieve 12 inches of loosened soil after topsoil and amendment are placed. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

Stockpile and cover soil with weed barrier material that sheds moisture yet allows air transmission, in approved location, prior to grading.

Replace stockpiled topsoil prior to planting. Amend if needed to meet required organic content.

### A. Planting Beds

1. **PRE-APPROVED RATE:** Place 3 inches of composted material and rototill into 5 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).

2. **CALCULATED RATE:** Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 10% organic content.

   Rake beds to smooth and remove surface rocks larger than 2 inches diameter.

   Mulch planting beds with 2 inches of organic mulch or stockpiled duff.

### B. Turf Areas

1. **PRE-APPROVED RATE:** Place 1.75 inches of composted material and rototill into 6.25 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).

2. **CALCULATED RATE:** Place calculated amount of composted material or approved organic material and rototill into depth of replaced soil needed to achieve 8 inches of settled soil at 5% organic content.

   Water or roll to compact soil to 85% of maximum dry density.

   Rake to level, and remove surface rocks larger than 1 inch diameter.

**OPTION 4: Import topsoil mix of sufficient organic content and depth to meet the requirements.**

**Scarification.** Scarify or till subgrade in two directions to 6 inches depth. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

### A. Planting Beds

Use imported topsoil mix containing 10% organic matter (typically around 40% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Rake beds to smooth, and remove surface rocks over 2 inches diameter.

Mulch planting beds with 2 inches of organic mulch.

### B. Turf Areas

Use imported topsoil mix containing 5% organic matter (typically around 25% compost). Soil portion must be sand or sandy loam as defined by the USDA.

Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.

Place second lift of 3 inches topsoil mix on surface.

Water or roll to compact soil to 85% of maximum.

Rake to level, and remove surface rocks larger than 1 inch diameter.
This section outlines steps for professional specifiers to prepare a Soil Management Plan (SMP) to meet the provisions of BMP T5.13 in the Department of Ecology's Stormwater Manual for Western Washington. The main steps to creating the SMP are:

**Step 1: Review Site Landscape Plans and Grading Plans.**
Examine all areas that will not be covered by structures, impervious surfaces, or stormwater detention / infiltration structures, to assess how grading will impact soil conditions and determine areas where different soil treatments may be applied.

Those allowed soil treatment options are:
- **Option 1:** Areas where native soil and/or vegetation will be retained in place;
- **Option 2:** Areas where topsoil or subsoil will be amended in place;
- **Option 3:** Areas where topsoil will be stripped and stockpiled prior to grading for reapplication, and;
- **Option 4:** Areas where imported topsoil will be applied.

**Step 2: Visit Site to Determine Soil Conditions**
Working with plans, check the soil in each area to identify information outlined in the chart below.

<table>
<thead>
<tr>
<th>Areas to be cut during grading</th>
<th>Assess Conditions</th>
<th>Include Information on SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ Quantity of topsoil that can be stockpiled and reapplied.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Depth of any compacted layer less than 12 inches below ultimate finished grade.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Presence of organic matter in subgrade or topsoil that may make amendment unnecessary, or allow calculation of reduced amendment rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will topsoil be stockpiled during grading and reapplied? Will it require supplemental topsoil or compost to achieve 8 inches depth at specified organic content?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will area be amended with compost or topsoil at &quot;pre-approved&quot; rate, or at custom calculated rate?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Areas to be filled during grading</th>
<th>Assess Conditions</th>
<th>Include Information on SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ Estimate what subgrade conditions will be when fill is in place.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Depth of any compacted layer less than 12 inches below ultimate finished grade.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Presence of organic matter in fill soil that may make amendment unnecessary, or allow calculation of reduced amendment rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will area be amended with compost or topsoil at &quot;pre-approved&quot; rate, or at custom calculated rate?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Native vegetation / undisturbed soil to be preserved</th>
<th>Assess Conditions</th>
<th>Include Information on SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ Established native plants.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Undisturbed topsoil and duff layer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Identify those areas to be left undisturbed and fenced during construction.</td>
<td></td>
</tr>
<tr>
<td>Topsoil not requiring grading, but cleared of native vegetation</td>
<td>Assess Conditions</td>
<td>Include Information on SMP</td>
</tr>
<tr>
<td></td>
<td>✓ Depth of compacted layers less than 12 inches deep.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Presence of organic matter that may make amendment unnecessary, or allow calculation of reduced amendment rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ If planning to use calculated amendment rate, sample and test soil as described in Step 4.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will scarification be needed? What depth of scarification is required to allow compost incorporation and achieve 12 inches uncompacted depth?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Will area be amended with compost or topsoil at &quot;pre-approved&quot; rate, or custom calculated rate?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Can areas be protected from compaction during construction?</td>
<td></td>
</tr>
</tbody>
</table>
Step 3: Select Amendment Options.

The most convenient and economic method for achieving the Soil Quality and Depth guidelines depends on: site soil conditions, grading, and resulting subgrade compaction; the practicality of stockpiling topsoil during grading; and site access issues.

“Pre-Approved” or custom calculated rates?

Use of “Pre-Approved” amendment rates may simplify planning, however custom calculated rates can save substantial effort and expense—easily repaying the expense of testing and calculations. (See testing required for custom rates at right and on next page, and calculation method in Section 7 “Resources”.)

Often pasture or woodland soils have adequate organic matter if existing organic layers are preserved. Also, compost products will frequently provide the desired soil organic matter content at lower applications than the Pre-Approved rates (which are based on “average” conditions).

Identifying Options on the Site Plan and SMP form

- Identify the areas where each amendment option will be applied by outlining each area on the site plan with a dark, thick-line pen.
- Assign each area an identifying number or letter (A, B, C…) on the plan, and on the Soil Management Plan form.

Step 4: Identify Compost, Topsoils and Other Organic Materials for Amendment and Mulch.

Amendments for Pre-Approved rates must be compost meeting the definition for “Composted Materials” in WAC 173-350, section 220, (available online at http://www.ecy.wa.gov/programs/swfa/compost/) or topsoil manufactured from these composts plus clean sand or sandy loam soil. Products must be identified on the Soil Management Plan form, and recent product test results must be provided showing that they meet the additional requirements in this Guide for organic matter content and carbon to nitrogen ratio (see specification in Section 3).

For Custom Calculated amendment rates (see right, next page, and formula in Section 7 “Resources”), organic matter may be provided by:

- Compost (as defined above), or
- Other by organic materials with a carbon to nitrogen ratio under 25:1 (35:1 for native plantings), meeting the same contaminant standards as “Composted Materials” in WAC 173-350, section 220.

These products must be identified on the Soil Management Plan form, and recent test results provided showing that they meet these requirements.

Step 5: Calculate Amendment, Topsoil and Mulch Volumes on SMP form

- For Pre-Approved amendment rates, figure the square footage of each area and complete the simple calculation to convert inches of amendment into cubic yards.
- To compute custom calculated amendment rates, use soil and amendment test results and the Model Amendment Rate Calculator Spreadsheet and/or the Equation for Calculating Compost Application Rates (both are in Section 7 “Resources”) to achieve the target Soil Organic Matter content (10% SOM for landscape beds, or 5% SOM for turf areas).

Site Assessment Supplies

- Copy of site grading plan
- Sturdy shovel
- Tape measure

If using custom calculated amendment rates requiring soil tests:
- Clean bucket or stainless steel bowl for mixing soil samples
- Sealable bags for soil samples, and indelible ink pen to label

Sampling and Testing for Custom Calculated Amendment Rates

Soil and amendments submitted for testing should be a composite of samples taken from several spots on a site or in a pile of amendment.

Soil:

Gather samples from soil that will be the subgrade after all grading operations are completed, before placement of imported topsoil or amendments.

- Take samples from 10-12 spots in each area. Imagine a line dividing the area in half lengthwise, then divide each half into five near equal sized widths. Take samples near the middle of each subsection.
- At each sampling spot dig a spades-width hole at least 8 inches deep, then shave a 1 inch slice from the side of the hole to use in the composite sample.
- Thoroughly mix the 10-12 samples from each turf or planting area together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more soil, ask laboratories).
- Label the bag with the site information, area of sample; plus your name, address and phone number.

Amendment:

Producers of composts and manufactured topsoils can usually provide test results for their products. If tests are
nonexistent or incomplete, conduct necessary tests on each proposed amendment.

- Take samples from 10-12 spots in pile of material. Imagine a line dividing the pile in half lengthwise, then gather samples from five spots equally spaced along the length of each side of the pile.
- At each sampling spot, dig a spades-width hole at least 8 inches deep. Use a clean cup or trowel to collect a cup of amendment from the bottom of each hole.
- Thoroughly mix the 10-12 samples from each pile together in a clean plastic bucket or bowl. Place 2 cups of the mix into a sealable plastic bag for testing (some tests may require more compost, ask laboratories).
- Label the bag with the product and supplier information; plus your name, address and phone number.

**Tests to Conduct for Custom Calculated Amendment Rates:**

<table>
<thead>
<tr>
<th>Soil</th>
<th>Compost Amendment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Bulk Density</td>
<td>- Bulk Density</td>
</tr>
<tr>
<td>- Percent Organic Matter</td>
<td>- Percent Organic Matter (by “loss on ignition” method)</td>
</tr>
<tr>
<td>(by “loss on ignition” method)</td>
<td></td>
</tr>
<tr>
<td>- Moisture Content as is</td>
<td></td>
</tr>
<tr>
<td>- Carbon to Nitrogen Ratio (C:N)</td>
<td></td>
</tr>
<tr>
<td>- Heavy Metals Analysis (per WAC 173-350, section 220)</td>
<td></td>
</tr>
</tbody>
</table>
Model SOIL MANAGEMENT PLAN for BMP T5.13

(available as MS Word file at www.SoilsforSalmon.org)

PROJECT INFORMATION
Complete all information on page 1; only site address and permit number on additional pages.

Site Address / Lot No.: ____________________________________________________________
Permit Type: ________________________________________________ Permit Number: ______
Permit Holder: ___________________________________________ Phone: ________________
Mailing Address: ________________________________________________________________
Contact Person: __________________________________________ Phone: ________________
Plan Prepared By: ________________________________________________________________

ATTACHMENTS REQUIRED (Check off required items that are attached to this plan)

- Site Plan showing, to scale: _____________________________
- Areas of undisturbed native vegetation (no amendment required) __________________
- New planting beds and turf areas (amendment required) ___________________________
- Type of soil improvement proposed for each area _________________________________

Soil test results (required if proposing custom amendment rates)
Product test results for proposed amendments

AREA # ________ (should match Area # on Site Plan)
PLANTING TYPE
- __ Turf
- __ Undisturbed native vegetation
- __ Planting Beds
- __ Other: ____________________________

SQUARE FOOTAGE OF THIS AREA: ________ square feet

SCARIFICATION ____________________________________________________________

- Subsoil will be scarified
- ____ inches (depth) of scarification needed to achieve finished total 12” loosened depth.

PRE-APPROVED AMENDMENT METHOD:

- Topsoil import
- Amend with compost
- Stockpile and amend
- ____ cu. yds. stockpiled
- ____ inches of compost or imported topsoil applied

PRODUCT: _________________________________________________________________

QUANTITY: ________ CU. YDS.

X 3.1 (conversion factor, inches to cubic yards)

QUANTITY: ________ CU. YDS.

X ____ cu. yards per 1,000 sq. ft.

QUANTITY: ________ CU. YDS.

X ____ cu. yds. stockpiled

QUANTITY: ________ CU. YDS.

CUSTOM AMENDMENT

- Topsoil import
- Amend
- Stockpile and amend
- ____ cu. yds. stockpiled

PRODUCT: _________________________________________________________________

QUANTITY: ________ CU. YDS.

X 3.1

QUANTITY: ________ CU. YDS.

X ____ cu. yards / 1,000 sq. ft.

QUANTITY: ________ CU. YDS.

X ____ cu. yds. stockpiled

QUANTITY: ________ CU. YDS.

MULCH

- ____ .000 sq. ft.
- ____ inches of mulch

PRODUCT: _________________________________________________________________

QUANTITY: ________ CU. YDS.

X 6.2 (conversion, to give 2 inch mulch depth)

QUANTITY: ________ CU. YDS.

TOTAL AMENDMENT/TOPSOIL/MULCH FOR ALL AREAS (complete on page 1 only, totaling all areas/pages in this Plan)

- Product #1: ________________________________________________________________
  - Quantity: ________ cu. yds.
  - Test Results: % organic matter: C:N ratio <25:1 (except mulch, or <35:1 for native plants) “stable” (yes/no)

- Product #2: ________________________________________________________________
  - Quantity: ________ cu. yds.
  - Test Results: % organic matter: C:N ratio <25:1 (except mulch, or <35:1 for native plants) “stable” (yes/no)

- Product #3: ________________________________________________________________
  - Quantity: ________ cu. yds.
  - Test Results: % organic matter: C:N ratio <25:1 (except mulch, or <35:1 for native plants) “stable” (yes/no)

Date: _______________ Inspector: ______________________ Approved: _______________ Revisions Required: ____________________________

Date: _______________ Inspector: ______________________ Approved: _______________ Revisions Required: ____________________________

COMMENTS: ________________________________________________________________

__________________________________________

13
FIELD GUIDE TO VERIFYING SOIL QUALITY AND DEPTH
IN NEW LANDSCAPES

This guide is provided to help professional inspectors verify implementation of soil improvements to fulfill BMP T5.13 “Post Construction Soil Quality and Depth” in the Washington Department of Ecology’s Stormwater Management Manual Western Washington.

The main conditions to be confirmed are:
1. Provision of eight inches of topsoil containing 10% organic matter in planting beds, or 5% in turf areas.
2. Scarification of compacted subsoil four inches below the topsoil layer (for a total uncompacted depth of 12 inches).
3. Placement of two inches of mulch on all planting beds.

The following steps may be completed at multiple visits as a project progresses or in one final project approval inspection, depending on local practices:

**STEP 1: Compare site conditions with approved Soil Management Plan (SMP).**

The SMP approved with the site permit describes soil treatments approved for each area. Make sure site conditions match these details in the SMP:
- Site location and permit holder.
- Turf and planting areas match approved drawings.
- Areas to remain as undisturbed native soil and vegetation have been fenced off during construction to prevent soil compaction or damage to plants.

**STEP 2: Inspect delivery tickets for compost, topsoil and mulches.**

Permittee must provide original delivery tickets for all soil and mulch products. Compare delivery tickets with the SMP to match the following information:
- Delivery location.
- Total quantities for each soil product and mulch.
- Product descriptions and sources.

If materials other than those listed in the SMP were delivered, laboratory test results must be provided to confirm that they are equivalent to approved products.

**STEP 3: Verify depth of amended soil and scarification.**

Use a shovel to dig at least one test hole per acre for turf and one per acre for planting beds to verify eight inch topsoil depth (below mulch layer), incorporation of amendments, and four inches of uncompacted subsoil.

Site Inspection Supplies
- A copy of the approved Soil Management Plan (SMP) for the site, with site drawing.
- A sturdy shovel
- Tape measure or 12” ruler
- 3/8 inch diameter 3-4 foot stainless steel “rod penetrometer” with a 1/8” bevel cut into the tip at 30 degrees from the side, and a 90 degree bend at top to form a handle (see illustration, next page).
- Field Verification Form to record results

Eight Inch Depth of Amended Soil. The top eight inches of soil should be easy to dig using a garden spade driven solely by your weight. The soil should be darker than the unamended soil below, and particles of added organic
matter are likely to be visible. Clay soil that been saturated and then dried may require jumping on the shovel step to penetrate, but the soil should yield easily when moist. Soil that requires vigorous chipping with the shovel to penetrate probably does not meet the specification.

Four Inch Depth of Scarified Subsoil. The next four-inch depth of soil should be loose enough to penetrate with the shovel. It may be rocky, and the loosened depth may vary due to the pattern of scarifying equipment – but some sections of subsoil in a one foot square hole should be loose four inches deep into the subsoil (that is, to a total 12 inch depth from the soil surface).

STEP 4: Check soil depth in several spots.

Use a simple “rod penetrometer” (illustration below) to confirm that the soil is uncompacted twelve inches deep at ten locations per acre – with a minimum of ten on smaller sites. To locate test spots, imagine a line dividing the site (or each acre) in half lengthwise, then divide each half into five nearly equal sections. Conduct tests near the middle of each section. Additional test locations are encouraged.

The rod penetrometer should enter the soil twelve inches deep, driven solely by the inspector’s weight. Irregular scarification or rocks in the lower layer may require probing a few spots at each location to reach the full depth.

STEP 5: Check mulch depth.

Use a shovel to scrape away and reveal surface mulch thickness. A two inch layer of organic material (mulch) such as composted sawdust, wood chips, or ground bark should be distinguished from the underlying soil on all planting beds.

FINAL STEP: Record results on “Field Verification Form” or similar document (see sample form on next page).

What should be attached to the Soil Management Plan?

- Scale drawings showing layout of turf and planting beds, and identifying where soil treatments described in the SMP will be applied.
- Copies of compost and topsoil test results demonstrating that products contain adequate organic matter, and meet carbon to nitrogen ratio and stability standards.
- Where custom calculated amendment rates are used, include laboratory analyses of the soil and organic matter sources plus calculations by a qualified professional showing that the organic matter requirement will be achieved.

What If A Site Does Not Meet the Soil Management Plan Requirements?

If inspection indicates that an installation does not fulfill the approved SMP, the permit holder or their agent should be notified of what steps are needed to comply. When results are unclear or disputed, an independent consultant should conduct sampling for analytical testing of organic matter as described in the project specifications.

Qualified consultants include: Certified Soil Scientists, Crop Advisors or Agronomists; or Licensed Landscape Architects, Civil Engineers or Geologists.
Model FIELD VERIFICATION FORM for BMP T5.13
(available as MS Word file at www.SoilsforSalmon.org)

## PROJECT INFORMATION

Complete all information on page 1, only site address and permit number on additional pages.

<table>
<thead>
<tr>
<th>Site Address:</th>
<th>Permit Type:</th>
<th>Permit Number:</th>
<th>Permit Holder:</th>
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<th>Mailing Address:</th>
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## VISIT RECORD

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<th>Date</th>
<th>Inspector</th>
<th>Items Approved:</th>
<th>Fencing off undisturbed areas</th>
<th>Soil preparation</th>
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<td>Mulch</td>
<td>Other:</td>
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<table>
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<td></td>
<td></td>
<td>Mulch</td>
<td>Other:</td>
</tr>
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</tr>
</tbody>
</table>

## DELIVERY TICKETS FOR AMENDMENT, TOPSOIL & MULCH.

*(Check if tickets match Soil Management Plan (SMP). Total volumes for all areas should be on page 1 of the SMP)*

- **Product #1:**
  - Test Results: % organic matter
  - Quantity: cu. yds.
  - C:N ratio <25:1
  - “stable” (Y/N)
  - Comments:

- **Product #2:**
  - Test Results: % organic matter
  - Quantity: cu. yds.
  - C:N ratio <25:1
  - “stable” (Y/N)
  - Comments:

- **Product #3:**
  - Test Results: % organic matter
  - Quantity: cu. yds.
  - C:N ratio <25:1
  - “stable” (Y/N)
  - Comments:

## AREA # (refer to Areas mapped on Site Plan and described on Soil Management Plan)

<table>
<thead>
<tr>
<th>PLANTING TYPE</th>
<th>Test Holes</th>
<th>Rod Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undisturbed vegetation</td>
<td>Number Test Holes Required: ___ (minimum 1 hole/acre)</td>
<td>Number Rod Tests Required: ___ (minimum 10 tests/acre)</td>
</tr>
<tr>
<td>Turf</td>
<td>Soil Amended 8 Inches Deep? Y / N</td>
<td>Rod penetrates 12 inches deep in all areas? Y / N</td>
</tr>
<tr>
<td>Planting Beds</td>
<td>Amendment Matches Soilmgt. Plan? Y / N</td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td>Topsoil Product?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amendment Visible?</td>
<td></td>
</tr>
<tr>
<td>Square footage:</td>
<td>Subsoil Loose/Scarified 12 Inches Deep? Y / N</td>
<td>Comments:</td>
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<td>Mulch Product:</td>
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<td></td>
</tr>
<tr>
<td>Mulch two inches deep? Y / N</td>
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## AREA #

<table>
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<tr>
<th>PLANTING TYPE</th>
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<tbody>
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<td>Rod penetrates 12 inches deep in all areas? Y / N</td>
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<tr>
<td>Planting Beds</td>
<td>Amendment Matches Soilmgt. Plan? Y / N</td>
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<tr>
<td>Other:</td>
<td>Topsoil Product?</td>
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<td>Square footage:</td>
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<td>Comments:</td>
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<tr>
<td>Mulch Product:</td>
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<tr>
<td>Mulch two inches deep? Y / N</td>
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</tr>
</tbody>
</table>

Add additional sheets for additional Areas
RESOURCES

- Calculating Custom Amendment Rates: Formula & Spreadsheet
- Permitted Composting Facilities in Washington that Sell Bulk Compost
- Soil and Compost Analytical Labs Serving the Northwest
- Additional Resources on Compost Quality & Use, and the Role of Soil Quality in Stormwater Management

- Model Soil Amendment Specifications, in APWA and CSI Formats, located in back of this Guide, and available as MS WORD files for cut-and-paste at www.SoilsforSalmon.org

See more resources online at:

- [www.SoilsforSalmon.org](http://www.SoilsforSalmon.org) – background science, low impact development and design resources
- [www.BuildingSoil.org](http://www.BuildingSoil.org) – soil BMP information for builders – factsheets, erosion control, marketing benefits
CALCULATING CUSTOM AMENDMENT RATES
TO ACHIEVE A TARGET SOIL ORGANIC MATTER CONTENT

Where soils already have some organic content, it is often cost-effective to calculate the amount of compost amendment needed to achieve the target 10% soil organic matter for landscape beds or 5% for turf areas, rather than using the pre-approved rates (see Section Five).

Custom amendment rates can be calculated using either the Equation below, or the Model Spreadsheet on facing page (also available as an Excel spreadsheet online at www.SoilsforSalmon.org).

EQUATION FOR CALCULATING COMPOST APPLICATION RATES:

Use this equation to calculate compost application rates to achieve a target final soil organic matter content (FOM, which should be 10% for landscape beds or 5% for turf areas) for a soil with a given bulk density (SBD) and initial soil organic matter (SOM). The spreadsheet example on the next page illustrates how the equation is applied on typical soils using common composted materials.

\[ CR = \frac{D \times SBD \times (SOM\% - FOM\%)}{SBD \times (SOM\% - FOM\%) - CBD \times (COM\% - FOM\%)} \]

Where:

- \( CR \) = Compost application rate (inches) calculated to achieve the target final organic matter (FOM)
- \( D \) = Depth of finished incorporation (inches)
- \( SBD \) = Soil bulk density (lb/cubic yard dry weight)*
- \( SOM\% \) = Initial soil organic matter(%)***
- \( FOM\% \) = Final target soil organic matter(%)***
- \( CBD \) = Compost bulk density (lb/cubic yard dry weight)**
- \( COM\% \) = Compost organic matter (%)***

Assumption: This equation calculates compost rate using an additive approach. For example, a 3-inch compost rate incorporated to an 8-inch depth will be a final mix containing 3/8 compost and 5/8 soil by volume.

* \( SBD \) To convert Soil Bulk Density in g/cm³ units to lb/cubic yard, multiply by 1697.

** \( CBD \) To convert Compost Bulk Density from lb/cubic yard “as is” to lb/cubic yard dry weight, multiply by solids content.

*** OM All Organic Matter measurements are based on the commonly used “loss-on-combustion” method.
MODEL AMENDMENT RATE CALCULATOR
SPREADSHEET WITH EXAMPLES

Example from an Excel spreadsheet that uses the equation on previous page. This Excel file can be downloaded at www.SoilsforSalmon.org

This set of examples shows amendment rates in a typical sandy soil using a compost with a bulk density of 660 lb/cubic yard, compared with rates for a typical clay soil using compost with a BD of 550 lb/cubic yard.

It demonstrates that soils with a higher initial organic matter (SOM) require less compost amendment to achieve a desired target final organic matter (FOM – which is set at 10%, appropriate for landscape beds, in these examples).

<table>
<thead>
<tr>
<th>SBD</th>
<th>SOM%</th>
<th>FOM%</th>
<th>CBD</th>
<th>COM%</th>
<th>D</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil 2206 bulk density (lb/cubic yard dry weight)</td>
<td>Soil organic matter (percent)</td>
<td>Final organic matter (percent)</td>
<td>Compost bulk density (lb/cubic yard dry weight)</td>
<td>Compost organic matter (percent)</td>
<td>Depth of incorporation (inches)</td>
<td>Calculated compost application rate (inches)</td>
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<td>Sandy Soil</td>
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<tr>
<td>2206</td>
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<td>660</td>
<td>60%</td>
<td>8 inches</td>
<td>3.0 inches</td>
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<tr>
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<td>10%</td>
<td>660</td>
<td>60%</td>
<td>8 inches</td>
<td>2.8 inches</td>
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<td>550</td>
<td>50%</td>
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<td>1.1 inches</td>
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Soil bulk density = 1.3 g/cm³ or 2206 lb/cu yd

Soil bulk density = 1.0 g/cm³ or 1697 lb/cu yd
Compost from many of these facilities is sold and mixed into topsoil products through numerous retail outlets – check with topsoil and nursery vendors too. Please note that some of these facilities are not open to the general public.


<table>
<thead>
<tr>
<th>County</th>
<th>Facility / Company</th>
<th>City</th>
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<td>or (425) 432-2395</td>
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<td>GroCo/ Steerco/ Sawdust Supply</td>
<td>Kent</td>
<td>(206) 622-5141</td>
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<td>Fort Lewis</td>
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<td>Mount Vernon</td>
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<td>(360) 424-0199</td>
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<tr>
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<td>1-800-884-7645 or (425) 337-2700</td>
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<tr>
<td>Thurston</td>
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<td>Tenino</td>
<td>(360) 446-0197</td>
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<td>Whatcom</td>
<td>Green Earth Technology (Compost)</td>
<td>Lynden</td>
<td>(360) 354-4936</td>
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<td>Yakima</td>
<td>Natural Selection Farms</td>
<td>Sunnyside</td>
<td>(509) 837-3501</td>
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Soil testing and plant analysis aid commercial growers, gardeners, and homeowners in making decisions about fertilizing or applying soil amendments. This fertilizer guide lists a variety of laboratories serving Oregon, and provides specific information about laboratory services.

To compile this list, the OSU Extension Service requested information from labs providing services for Oregon and adjacent areas. OSU Extension Service makes no endorsement by listing a laboratory; conversely, omission of a laboratory does not indicate that it’s unsuitable. Another source for locating commercial laboratories is the yellow pages of your local telephone directory.

Before submitting material to a lab, pay attention to the following guidelines:

- Be sure the test you request is the right one to answer your question. Nutrients aren’t the only factor for successful crop production, so a soil test may not tell you why your plants don’t grow. Ask a county Extension agent or other agriculture professional which tests you may need.

- The goal of a soil or tissue test is a fertilizer recommendation. Fertilizer recommendations are based on soil/tissue tests that follow a set procedure or recipe. For example, OSU fertilizer recommendations are based on procedures used in OSU’s Central Analytical Laboratory. Many labs say they use “comparable” procedures, but they may not. A laboratory that uses a procedure different from OSU’s most likely will give a different fertilizer recommendation.

- Before sending samples, call the lab to inquire about costs and shipping instructions. For example, soil samples to be tested for nitrate-nitrogen should be refrigerated or dried rather than sent moist at room temperature.

- Beware of low prices. Laboratory procedures cost money to perform. A lab quoting a low price usually analyzes a few elements and estimates the others. You do not want estimates—make sure you obtain results from analytical work.

- For information on taking soil samples, see EC 628, Soil Sampling for Home Gardens and Small Acreages.

This list is revised regularly. Laboratories wishing to be added to this list may contact:

John Hart, Extension soil science specialist
Department of Crop and Soil Science
Ag & Life Sciences Building 3017
Oregon State University
Corvallis, OR 97331-7306
541-737-5712

For a list of laboratories approved by the Oregon Health Division for drinking water analysis, contact the Oregon Health Division, Drinking Water Systems, P.O. Box 14450, Portland, OR 97214-0450, or call 503-731-4010 or 503-731-4009.

For additional copies of this publication, visit your local county office of the OSU Extension Service, or contact:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
Fax: 541-737-0817

This publication also is available on the OSU Extension Service website (extension.oregonstate.edu/catalog/). Choose Agriculture, followed by Soil and Water (or search within the catalog by the series number, EM 8677).

John Hart, Extension soil scientist, Oregon State University.
This publication replaces FG 74, A List of Analytical Laboratories Serving Oregon.
## Analytical Laboratories Serving Oregon

**EM 8677 • page 2 • Revised May 2008**

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<td>A &amp; L Western Agricultural Laboratories</td>
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<tr>
<td>1311 Woodland Ave., Suite 1</td>
<td>1311 Woodland Ave., Suite 1</td>
<td>Modesto, CA 95351-4732</td>
<td>209-529-4080 • FAX 209-529-4736</td>
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*SC indicates a service is subcontracted.*
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<tr>
<td>Oregon Office</td>
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<td>FAX 503-557-0713</td>
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<td>509-765-1622</td>
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<tr>
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<td>19761 SW 95th Ave., Tualatin, OR 97062</td>
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<td>208-734-3050, 800-759-3050 FAX 208-734-3919</td>
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<td>e-mail: <a href="mailto:stulab@mindspring.com">stulab@mindspring.com</a></td>
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<tr>
<td>Test America</td>
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<td></td>
<td>503-906-9200</td>
<td>FAX 503-906-9210</td>
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<tr>
<td>Umpqua Research Company</td>
<td>P.O. Box 699, 626 NE Division</td>
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<td></td>
<td>541-863-5201</td>
<td>FAX 541-863-6199</td>
<td>e-mail: <a href="mailto:lab@umperlab.net">lab@umperlab.net</a></td>
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<td>1320 E. Spokane St., Pasco, WA 99301</td>
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<tr>
<td></td>
<td>509-547-3838</td>
<td>FAX 509-547-8645</td>
<td>certified NFTA</td>
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<tr>
<td>Utah State University Analytical Lab</td>
<td>4830 Old Main Hill, 166 Ag Science Bldg.</td>
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<td>Waterlab Corp.</td>
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<td>208-722-6564, 800-658-3858 FAX 208-722-6550</td>
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<td>e-mail: <a href="mailto:john@westernlaboratories.com">john@westernlaboratories.com</a></td>
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<td>Web: westernlaboratories.com</td>
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<tr>
<td>William F. Black Soil Testing</td>
<td>503 Gardiner, P.O. Box 317, Burlington, WA 98233</td>
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<td></td>
<td>360-757-6112</td>
<td>e-mail: <a href="mailto:hjlblack@verizon.net">hjlblack@verizon.net</a></td>
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</table>
Background Science

University of Washington Center for Water and Watershed Studies  http://water.washington.edu/

At their Publications index http://water.washington.edu/Outreach/Publications/articles.html  download:
- Proceedings of 1998 Salmon in the City conference – reports on a number of studies by University of WA and other scientists, includes source references for stormwater & water quality data presented in this Guide
- *Guidelines for Landscaping with Compost-Amended Soils*, a 1998 report prepared for the City of Redmond which details trials, stormwater benefits, and 3-7 paybacks on compost amendment based on landscape water savings

This site also includes research on the effects of urbanization, stream restoration techniques, permeable paving, etc.

Soil Biology and Soil Functions: Why Soil Life Matters, and How it Works

US Dept. of Agriculture, NRCS Soil Quality Institute    http://soils.usda.gov/sqi/

Download the excellent *Soil Biology Primer* at http://soils.usda.gov/sqi/concepts/soil_biology/biology.html and other soil quality and erosion prevention resources, or order print copies from 1-800-THE SOIL

Washington State University’s Soil Management research site http://www.puyallup.wsu.edu/soilmgmt/
Of particular interest are the sections on Compost, Current Research, and Soils and Soil Testing

Soil Restoration, Compost Quality and Compost Use


Background and up to date information on Soils for Salmon initiative, this *Building Soil* guide online including calculations spreadsheet, and useful links on compost use and soil restoration. A new (2008) partner site, www.BuildingSoil.org carries this *Building Soil* guide too, along with fact sheets on construction sequencing, erosion control, and customer information.

includes links to Washington State’s Compost Facility Standards – WAC 173-350 section 220 – referred to in this Guide, as well as a current list of Permitted Composting Facilities, and other useful compost resources

U.S. Composting Council  http://compostingcouncil.org/  The most authoritative source for information on compost specifications. Particularly useful to landscape professionals is the recently updated *Field Guide to Compost Use*.

USCC’s “Seal of Testing Assurance” (STA) program is the state-of-the-art for verifying compost quality and specifications for a variety of uses. See http://tmecc.org/tmecc/ and follow the “STA” link for complete information.

Penn State Turfgrass Extension  http://turfgrassmanagement.psu.edu/pdf/ue123.pdf
Download Dr. Peter Landschoot’s practical guide, *Using Composts to Improve Turfgrass Performance*

*Ecologically Sound Lawn Care for the Pacific Northwest*  Seattle Public Utilities
Stormwater Management with Soil and Low Impact Development BMPs


Master Builders Association’s “Built Green” sustainable building program, developed with King and Snohomish Counties, includes soil strategies for home building. [www.builtgreen.net](http://www.builtgreen.net)


**Soil and Compost Use Specifications and Design Guidelines**

WA Dept. of Transportation soil bio-engineering page [http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm](http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm)


Seattle Public Utilities, SEA Street project soil specifications and other Natural Drainage design information at [http://www.seattle.gov/util/NaturalSystems/default.htm](http://www.seattle.gov/util/NaturalSystems/default.htm)

and best landscape practices (including soil) information at [http://www.seattle.gov/util/services/yard/](http://www.seattle.gov/util/services/yard/)


and see Specifications in APWA and CSI format at end of this Guide

**Compost Berms and Blankets for Erosion Control**

Compost Berm, Blanket and Sock specifications, approved BMPs for erosion control, on US EPA NPDES menu (look down this page) [http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=4](http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=4)

For an introduction, see the “Erosion Control with Compost” factsheet on [www.buildingsoil.org](http://www.buildingsoil.org)

Search the internet for “compost berms” and “compost blankets” for current information. Good online articles include:

- *BioCycle Journal* [www.biocycle.net](http://www.biocycle.net) Search the index for various articles, especially “Compost Filter Berms and Blankets Take on the Silt Fence” by Rod Tyler, Biocycle: Vol. 42; No. 1, January 2001
- “Compost Utilization for Erosion Control” from University of Georgia Cooperative Extension, [http://pubs.caes.uga.edu/caespubs/pubcd/B1200.htm](http://pubs.caes.uga.edu/caespubs/pubcd/B1200.htm)

**For More Information Contact:**

Washington Organic Recycling Council  *info@compostwashington.org*  [www.compostwashington.org](http://www.compostwashington.org/)

and see more resources at [www.soilsforsalmon.org](http://www.soilsforsalmon.org) and [www.buildingsoil.org](http://www.buildingsoil.org)
Model Soil Amendment Specification

to implement Soil Quality and Depth BMP T5.13

APWA FORMAT

available as an MS Word file at www.SoilsforSalmon.org
9.14.1 Soil (New Section)

9.14.1(1) Work in this Section

A. Section includes:
   1. Soil amendments.
   2. Soil preparation.
   3. Preparation and finish grading of planting and lawn areas.
   4. Mulching

9.14.1(2) References


B. WAC Chapter 173-350, Definitions and Section 220

C. United States Department of Agriculture (USDA) Soil Texture System of Classification

9.14.1(3) Submittals

A. Soil Management Plan: Prior to commencement of site work, submit a copy of the project Soil Management Plan and an attached implementation schedule that have been approved by local jurisdiction for permit.

B. Samples: Submit samples of all soil amendments. Include a list of sources and certification as specified. Soil amendments shall be submitted in one-gallon containers.

C. At the time of Post-Construction Inspection, furnish copies of material verifications such as load tickets, invoices, sales slips, test results and similar items as specified.


A. Qualifications of Contractor: The Contractor shall be active and experienced in work of the type specified, and upon request by the Contracting Agency, be able to show evidence of successful completion of projects of similar scope.

B. Regulatory Requirements: Obtain and pay for all permits and testing related to the work of this section.

C. Pre-Grading Inspection: In conjunction with the soil preparation specified herein, meet with the Contracting Agency to discuss and verify requirements, schedule, and proposed soil preparation methods.


A. Guarantee: Guarantee materials and workmanship for a period of one-year following Owner's final acceptance.
9.14.1(6) Sequencing And Scheduling
A. Coordinate work of other trades specified elsewhere.
B. Do not perform soil preparation work in areas subject to the subsequent work of other sections, unless approved otherwise.

A. Maintain the work as specified in this section until final acceptance of the work.

A. Composted material must be in compliance with WAC Chapter 173-350 Section 220; plus the following additional requirements.
B. Additional Requirements
   1. The carbon to nitrogen ratio of the compost shall be below 25:1, or below 35:1 if the proposed plantings are composed entirely of plants native to the Puget Sound Lowlands region.
   2. The compost shall have an organic matter content of 35% to 65% as determined by “loss on ignition” test method.
C. Alternative organic materials may be used in lieu of the specified compost if they meet the criteria for carbon to nitrogen ratio, contaminants (as defined in WAC Chapter 173-350 Section 220), and when mixed with existing native soil can achieve a calculated organic content of 5% for turf areas or 10% for planting beds.
D. Submit one-gallon sample, source, and letter of certification from the supplier to the Contracting Agency for approval prior to installation.

9.14.1(9) Mulch
A. Specified compost, or fine ground freshwater bark, or stockpiled forest duff from the project site.
B. Submit one-gallon sample, source, and letter of certification from the supplier to the Contracting Agency for approval prior to installation.

9.14.1(10) Imported Topsoil
A. A mixture of compost, meeting requirements of Section 2.1 above, and sand or sandy loam per USDA soil texture classification. The mixture shall contain a minimum of approximately 5% organic matter for turf areas or a minimum of approximately 10% organic matter for planting beds. The sand or sandy loam shall be free of weeds, deleterious materials, rocks, and debris. 100% of the imported topsoil shall pass through a 3/4” screen, less than 25% shall pass through a #200 sieve.
B. Submit one-gallon sample, source, and letter of certification from the supplier to the Contracting Agency for approval prior to installation.

A. The Soil management Plan (SMP) will be submitted as part of site development / building permit application, and will include the following:
   1. An 11” X 17” or larger site map indicating:
      Option 1. Areas where native soil and vegetation will be retained in place,
      Option 2. Areas where topsoil or subsoil will be amended in place,
      Option 3. Areas that will be stripped and stockpiled prior to grading for reapplication, and
      Option 4. Areas where imported topsoil will be applied
   2. Calculations for volumes of soil to be stockpiled, and amounts of amendment or topsoil to be imported to achieve specified minimum organic matter content.
   3. Names and sources of specified organic amendments and topsoil products to be used, with copies of laboratory analyses documenting that organic matter content and carbon to nitrogen requirements will be achieved and that compost meets WAC Chapter 173-350 Section 220 definition of “Composted Material”.
   4. IF CALCULATED AMENDMENT RATES ARE TO BE USED, characterize site soils to be amended and compost or alternative organic material for the following properties:
      a. Soil- Bulk density, organic matter content and depth of compacted layers to a depth of 12 inches.
      b. Compost or alternative organic material- Bulk density, organic matter content, carbon to nitrogen ratio, moisture content/percent solids.

Soil samples must be gathered following the distribution plan outlined in the Post-Construction Inspection below, and be composed of material from the entire depth to be amended, excluding any surface mulch layers. Calculations by a Qualified Professional must be provided showing that the organic content requirements will be met based on the organic contents and densities of both the site soil and amendments. Qualified Professionals include Certified Soil Scientists, Crop Advisors or Agronomists; and Licensed Landscape Architects, Civil Engineers or Geologists.


A. Protect surrounding construction from damage caused by the work of this section.

9.14.1(13) Subgrades

A. Prepare subgrades as specified in paragraph 9.14.1(14) Amendment Options

9.14.1(14) Amendment Options

A. Select the soil preparation option which best suits the project site. Different options may be used in different areas of the project. Choose either the ‘default’ pre-approved amendment rate, or a qualified professional may calculate a custom rate based on soil and amendment tests described in Section 9.14.1(11) A.4. The selected soil preparation option(s) shall be shown on the Soil Management Plan approved with site development permit.

| OPTION 1: Leave Native Vegetation and Soil Undisturbed, and protect from compaction during construction |
| Identify areas of the site that will not be stripped, logged, graded or driven on, and fence those areas to prevent impacts during construction. If not impacted, either in soils or vegetation, these areas do not require amendment. |
**OPTION 2: Amend Existing Soil In-Place**

**Scarification:** Scarify or till subgrade to 8 inches depth (or to depth needed to achieve a total depth of 12 inches of uncompacted soil after calculated amount of amendment is added). Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

<table>
<thead>
<tr>
<th>A. Planting Beds</th>
<th>B. Turf Areas</th>
</tr>
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<tbody>
<tr>
<td>i. PRE-APPROVED RATE: Place and rototill 3 inches of composted material into 5 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
<td>i. PRE-APPROVED RATE: Place and rototill 1.75 inches of composted material into 6.25 inches of soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
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<tr>
<td>ii. PRE-APPROVED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of soil needed to achieve 8 inches of settle soil at 10% organic content</td>
<td>ii. PRE-APPROVED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of soil needed to achieve 8 inches of settle soil at 5% organic content</td>
</tr>
<tr>
<td>Rake beds to smooth and remove surface rocks larger than 2 inches diameter.</td>
<td>Water or roll to compact soil to 85% of maximum.</td>
</tr>
<tr>
<td>Mulch planting beds with 2 inches of organic mulch.</td>
<td>Rake to level, and remove surface woody debris and rocks larger than 1 inches diameter.</td>
</tr>
</tbody>
</table>

**OPTION 3: Stockpile site topsoils prior to grading for reapplication.** Amend with organic matter or add topsoil if necessary to achieve required organic content to 8 inches depth.

**Scarification:** If placed topsoil plus compost or other organic material will amount to less than 12 inches: Scarify or till subgrade to depth needed to achieve 12 inches of loosened soil after topsoil and amendment are placed. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

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</tr>
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<td>Replace stockpiled topsoil prior to planting.</td>
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</tr>
<tr>
<td>i. PRE-APPROVED RATE: Place and rototill 3 inches of composted material into 5 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
<td>i. PRE-APPROVED RATE: Place and rototill 1.75 inches of composted material into 6.25 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
</tr>
<tr>
<td>ii. CALCULATED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of replaced soil needed to achieve 8 inches of settled soil at 10% organic content</td>
<td>ii. CALCULATED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of replaced soil needed to achieve 8 inches of settled soil at 5% organic content</td>
</tr>
<tr>
<td>Rake beds to smooth and remove surface rocks larger than 2 inches diameter.</td>
<td>Water or roll to compact soil to 85% of maximum.</td>
</tr>
<tr>
<td>Mulch planting beds with 2 inches of organic mulch or stockpiled duff.</td>
<td>Rake to level, and remove surface rocks larger than 1 inches diameter.</td>
</tr>
</tbody>
</table>
9.14.1(15) Inspection and Verification

A. Pre Grading Inspection: Prior to the commencement of site work, contact the Contracting Agency to provide an inspection to verify the delineation and protection of native soils and vegetation to remain undisturbed, and to verify the proposed location for topsoil and material stockpiling. Make corrections and adjustment as directed by the Inspector.

B. Interim Grading Inspection: Prior to the placement of soil amendments, contact the Contracting Agency to provide an inspection to verify that specified erosion control methods have been implemented, the location of stockpiled soil and materials, and that subgrades are consistent with the Soil Management Plan. Make corrections and adjustment as directed by the Inspector.

C. Post-Installation Inspection: Prior to planting, contact the Contracting Agency to provide an inspection to verify that placement of amendments and soil preparation is consistent with the Soil Management Plan. Provide delivery tickets for soil amendments to verify the quantity of material specified on the Soil Management Plan. Make corrections and adjustment as directed by the Inspector.

D. Mulch Placement Verification: At the completion of planting, contact the Contracting Agency to provide a review to verify that mulch has been installed as specified.

E. Secondary Verification for Failing Sites: If the Contracting Agency determines that the installation does not meet the conditions of the approved Soil Management Plan, additional testing by an independent certified soil consultant will be ordered by the Contracting Agency and paid for by the Contractor. Make corrections and adjustment as directed by the Contracting Agency.


A. Final acceptance by the Contracting Agency for soil preparation will be contingent on the approval of all inspections, and that the soil preparation is consistent with these specifications and with the approved Soil Management Plan.

A. Soil amendments, soil preparation, and mulching will be measured along the ground slope and computed in square yards for the areas completed and accepted by the Contracting Agency.

9.14.1(18) Payment

A. Payment will be made in accordance with Section 1.04.1, for each of the following listed bid items that are included in the proposal:

- Amendment Option One - Planting Beds, per square yard.
- Amendment Option One - Turf Areas, per square yard.

- Amendment Option Two - Planting Beds, per square yard.
- Amendment Option Two - Turf Areas, per square yard.

- Amendment Option Three - Planting Beds, per square yard.
- Amendment Option Three - Turf Areas, per square yard.

9.14.4(3) Bark or Wood Chips (DELETE PARAGRAPH)

9.14.4(4) Sawdust (DELETE PARAGRAPH)

9.14.4(8) Compost (DELETE PARAGRAPH)

END OF SECTION
Model Soil Amendment Specification

to implement Soil Quality and Depth BMP T5.13

CSI FORMAT

available as an MS Word file at www.SoilsforSalmon.org
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings, General Provisions of the Contract and Division-1 Specifications sections, apply to this section.

1.2 WORK IN THIS SECTION
   A. Section includes:
      1. Soil amendments.
      2. Soil preparation.
      3. Preparation and finish grading of planting and lawn areas.
      4. Mulching
   B. Substitutions: Substitute products will be considered only under the terms and conditions of Section 01640.

1.3 RELATED WORK IN OTHER SECTIONS
   A. The following Sections contain requirements that may relate to this Section:
      1. Section 02200 -Earthwork
      2. Section 02810 -Irrigation
      3. Section 02900 -Planting
      4. Section 02920 - Seeding

1.4 REFERENCES
   B. WAC Chapter 173-350, Definitions and Section 220
   C. United States Department of Agriculture (USDA) Soil Texture System of Classification

1.5 SUBMITTALS
   A. Make submittals in accordance with Section ________ as applicable.
   B. Soil Management Plan: Prior to commencement of site work, submit an approved copy of the project Soil Management Plan with an attached implementation schedule.
   C. Samples: Submit samples of all soil amendments. Include a list of sources and certification as specified. Soil amendments shall be submitted in one-gallon containers.
   D. At the time of Post-Construction Inspection, furnish copies of material verifications such as load tickets, invoices, sales slips, test results and similar items as specified.
1.6 QUALITY ASSURANCE

A. Qualifications of Contractor: The Contractor shall be active and experienced in work of the type specified, and upon request by the Owner and/or Owner’s Representative, be able to show evidence of successful completion of projects of similar scope.

B. Regulatory Requirements. Obtain and pay for all permits and testing related to the work of this section.

C. Pre-Grading Inspection: In conjunction with the soil preparation specified herein, meet with the Owner and/or Owner’s Representative to discuss and verify requirements, schedule, and proposed soil preparation methods.

1.7 GUARANTEE

A. Guarantee: Guarantee materials and workmanship for a period of one-year following Owner’s final acceptance.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate work of other trades specified elsewhere.

B. Do not perform soil preparation work in areas subject to the subsequent work of other sections, unless approved otherwise.

C. Perform work in accordance with the approved schedule specified in paragraph 1.5 SUBMITTALS. If a schedule delay greater than three days occurs, immediately revise and resubmit schedule to reflect each schedule delay.

1.10 MAINTENANCE

A. Maintain the work as specified in this section until final acceptance of the work.

PART 2 - PRODUCTS

2.1 COMPOST

A. Composted material must be in compliance with WA Department of Ecology’s specifications, which appear in WAC Chapter 173-350 Section 220; plus the following additional requirements.

B. Additional Requirements

1. The carbon to nitrogen ratio of the compost shall be below 25:1 or below 35:1 if the proposed plantings are composed entirely of plants native to the Puget Sound Lowlands region.

2. The compost shall have an organic matter content of 35% to 65% as determined by “loss on ignition” test method.

C. Alternative organic materials may be used in lieu of the specified compost if they meet the criteria for carbon to nitrogen ratio, contaminants (as defined in WAC Chapter 173-350 Section 220), and when mixed with existing native soil can achieve a calculated organic content of 5% for turf areas or 10% for planting beds.
D. Submit one-gallon sample, source, and letter of certification from the supplier to the Owner and/or Owner's Representative for approval prior to installation.

2.2 MULCH

A. Specified compost, or fine ground freshwater bark, or stockpiled forest duff from the project site.

B. Submit one-gallon sample, source, and letter of certification from the supplier to the Owner and/or Owner’s Representative for approval prior to installation.

2.3 IMPORTED TOPSOIL

A. A mixture of compost, meeting requirements of Section 2.1 above, and sand or sandy loam per USDA soil texture classification. The mixture shall contain a minimum of approximately 5% organic matter for turf areas or a minimum of approximately 10% organic matter for planting beds. The sand or sandy loam shall be free of weeds, deleterious materials, rocks, and debris. 100% of the imported topsoil shall pass through a 3/4" screen, less than 25% shall pass through a #200 sieve.

B. Submit one-gallon sample, source, and letter of certification from the supplier to the Owner and/or Owner’s Representative for approval prior to installation.

PART 3 - EXECUTION

3.1 SOIL MANAGEMENT PLAN

A. The Soil management Plan (SMP) will be submitted as part of site development / building permit application, and will include the following:
   1. An 11” X 17” or larger site map indicating:
      Option 1. Areas where native soil and vegetation will be retained in place,
      Option 2. Areas where topsoil or subsoil will be amended in place,
      Option 3. Areas that will be stripped and stockpiled prior to grading for reapplication, and
      Option 4. Areas where imported topsoil will be applied.
   2. Calculations for volumes of soil to be stockpiled, and amounts of amendment or topsoil to be imported to achieve specified minimum organic matter content.
   3. Specified organic amendments and topsoil products to be used, with organic matter content and carbon to nitrogen documented by producer supplied copies of laboratory analyses to demonstrate that requirements will be achieved and that compost meets WAC Chapter 173-350 Section 220 definition of “Composted Material”.
   4. IF CALCULATED AMENDMENT RATES ARE TO BE USED, site soils to be amended and compost or alternative organic material must be characterized for the following properties: Soil- Bulk density, organic matter content and depth of compacted layers to a depth of 12 inches. Compost or alternative organic material Bulk density, organic matter content, carbon to nitrogen ratio, moisture content. Soil samples must be gathered following the distribution plan outlined in the Post-Construction Inspection below, and be composed of material from the entire depth to be amended, excluding any surface mulch layers. Calculations by a Certified Soil Scientist, Crop Advisor or Agronomist must be provided showing that the organic content requirements will be met based on the organic contents and densities of both the site soil and amendments.
3.2 PREPARATION

A. Protect surrounding construction from damage caused by the work of this section.

3.3 SUBGRADES

A. Prepare subgrades as specified in paragraph 3.4 AMENDMENT OPTIONS.

3.4 AMENDMENT OPTIONS

A. Select the soil preparation option which best suits the project site. Different options may be used in different areas of the project. Choose either the "default" pre-approved amendment rate, or a qualified professional may calculate a custom rate based on soil and amendment tests described in Section 3.1.A.4. The selected soil preparation option(s) shall be shown on the Soil Management Plan approved with site development permit.

| OPTION 1: Leave Native Vegetation and Soil Undisturbed, and protect from compaction during construction |
| Identify areas of the site that will not be stripped, logged, graded or driven on, and fence those areas to prevent impacts during construction. If not impacted, either in soils or vegetation, these areas do not require amendment. |

| OPTION 2: Amend Existing Soil In-Place |
| **Scarification:** Scarify or till subgrade to 8 inches depth (or to depth needed to achieve a total depth of 12 inches of uncompacted soil after calculated amount of amendment is added). Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained. |

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<td><strong>i. PRE-APPROVED RATE:</strong> Place and rototill 1.75 inches of composted material into 6.25 inches of soil (a total amended depth of about 9.6 inches, for a settled depth of 8 inches);</td>
</tr>
<tr>
<td><strong>ii. CALCULATED RATE:</strong> Place and rototill calculated amount of composted material or approved organic material into depth of soil needed to achieve 8 inches of settle soil at 10% organic content.</td>
<td><strong>ii. CALCULATED RATE:</strong> Place and rototill calculated amount of composted material or approved organic material into depth of soil needed to achieve 8 inches of settled soil at 5% organic content.</td>
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<tr>
<td>Rake beds to smooth and remove surface rocks larger than 2 inches diameter.</td>
<td>Water or roll to compact soil to 85% of maximum.</td>
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<td>Mulch planting beds with 2 inches of organic mulch.</td>
<td>Rake to level, and remove surface woody debris and rocks larger than 1 inches diameter.</td>
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OPTION 3: Stockpile site topsoils prior to grading for reapplication. Amend with organic matter or add topsoil if necessary to achieve required organic content to 8 inches depth.

**Scarcification:** If placed topsoil plus compost or other organic material will amount to less than 12 inches: Scarify or till subgrade to depth needed to achieve 12 inches of loosened soil after topsoil and amendment are placed. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

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<td>Replace stockpiled topsoil prior to planting.</td>
</tr>
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</tr>
<tr>
<td>i. PRE-APPROVED RATE: Place and rototill 3 inches of composted material into 5 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
<td>i. PRE-APPROVED RATE: Place and rototill 1.75 inches of composted material or into 6.25 inches of replaced soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches);</td>
</tr>
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<td>ii. CALCULATED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of replaced soil needed to achieve 8 inches of settled soil at 10% organic content</td>
<td>ii. CALCULATED RATE: Place and rototill calculated amount of composted material or approved organic material into depth of replaced soil needed to achieve 8 inches of settled soil at 5% organic content.</td>
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<td>Rake beds to smooth and remove surface rocks larger than 2 inches diameter.</td>
<td>Water or roll to compact soil to 85% of maximum</td>
</tr>
<tr>
<td>Mulch planting beds with 2 inches of organic mulch or stockpiled duff.</td>
<td>Rake to level, and remove surface rocks larger than 1 inches diameter.</td>
</tr>
</tbody>
</table>

OPTION 4: Import topsoil meeting organic matter content standards.

Scarfify or till subgrade in two directions to 6 inches depth. Entire surface should be disturbed by scarification. Do not scarify within drip line of existing trees to be retained.

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<tbody>
<tr>
<td>A. Planting Beds: Use imported topsoil mix containing 10% organic matter (typically around 40% compost).</td>
<td>B. Turf Areas: Use imported topsoil mix containing 5% organic matter (typically around 25% compost).</td>
</tr>
<tr>
<td>Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.</td>
<td>Place 3 inches of imported topsoil mix on surface and till into 2 inches of soil.</td>
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<tr>
<td>Place 3 inches topsoil mix on surface.</td>
<td>Place 3 inches topsoil mix on surface.</td>
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<tr>
<td>Rake beds to smooth, and remove surface rocks over 2 inches diameter.</td>
<td>Water or roll to compact soil to 85% of maximum.</td>
</tr>
<tr>
<td>Mulch planting beds with 2 inches of organic mulch.</td>
<td>Rake to level, and remove surface rocks larger than 1 inches diameter.</td>
</tr>
</tbody>
</table>

3.5 **INSPECTION AND VERIFICATION**

A. Pre-Grading Inspection: Prior to the commencement of site work, contact the Owner and/or Owner’s Representative to provide an inspection to verify the delineation and protection of native soils and vegetation to remain in place, and to verify the proposed location for topsoil and material stockpiling. Make corrections and adjustment as directed by the Inspector.
B. **Interim Grading Inspection:** Prior to the placement of soil amendments, contact the Owner and/or Owner's Representative to provide an inspection to verify that specified erosion control methods have been implemented, the location of stockpiled soil and materials, and that subgrades are consistent with the Soil Management Plan. Make corrections and adjustments as directed by the Inspector.

B. **C. Post-Installation Inspection:** Prior to planting, contact the Owner and/or Owner's Representative to provide an inspection to verify that the placement of amendments and soil preparation is consistent with the Soil Management Plan. Provide delivery tickets for soil amendments to verify the quantity of material specified on the Soil Management Plan. Make corrections and adjustments as directed by the Inspector.

D. **Mulch Placement Verification:** At the completion of planting, contact the Owner and/or Owner's Representative to provide a review to verify that mulch has been installed as specified.

E. **Secondary Verification for Failing Sites:** If the Inspector determines that the installation does not meet the conditions of the approved Soil Management Plan, additional testing by an independent certified soil consultant will be ordered by the Inspector and paid for by the contractor. Make corrections and adjustments as directed by the Inspector.

3.10 **FINAL ACCEPTANCE AND PAYMENT**

A. Final acceptance and payment for soil preparation will be contingent on the approval of all inspections, and that the soil preparation is consistent with these specifications and with the approved Soil Management Plan. 

END OF SECTION
Notes

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Learn more at
www.SoilsforSalmon.org
or www.BuildingSoil.org