Achieving the Post-construction Soil Standard

Preserving And Restoring Healthy Soils On Site Developments In King County

Healthy soil is vital to a clean environment and healthy landscapes. Deep soil that is rich in organic material absorbs rainwater, helps prevent flooding and soil erosion, and filters out water pollutants. Healthy soil also stores water and nutrients for plants to use in dry times, promoting healthy plants that require less irrigation, toxic pesticides, and other resources.

Land development and landscaping practices can damage these valuable soil functions by removing or compacting topsoil. The result is erosion, unhealthy landscapes that are difficult and expensive to maintain, polluted water, destroyed fish habitat, and increased need for costly stormwater management structures.

Amendments to King County's Clearing and Grading regulations KCC 16.82 help prevent costly environmental and landscape problems by requiring permit holders to preserve topsoil, restore soils by adding compost after construction, or implement other measures to maintain the soil's moisture holding capacity for areas that have been cleared and graded. There are economical ways to retain the benefits of healthy soil, and avoid more costly damage to streams, wildlife, and human health.

This booklet explains how to preserve and restore soil quality and to meet these new code requirements.

Effective January 1, 2005

King County
Department of Development
& Environmental Services

Soil Treatment Options

There are four *Soil Treatment Options* that can be used to meet the post-construction soil standard.

These options can be used individually, or in combination (more than one may be used in different areas of a single site), so that they work best for the situation. The most convenient and economical methods for achieving the standards depend on site soil conditions, grading and subgrade compaction, practicality of stockpiling site topsoil during grading, and site access issues.

Choose Option 2, 3, 4a and/or 4b to restore soil quality after construction in areas where grading and soil disturbance are unavoidable, and follow these requirements:

- **When amending soil, do so between May 1 and October 1 only.**
- **Avoid plowing or tilling within drip line of trees to be retained.**
- **Final soil depth should be a minimum of 8 inches.**
- **Test soil pH, and if necessary, adjust to suit proposed plants.**

Option 1:

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

NOTE: *Option 1 is only applicable to sites that have the original, undisturbed soil native to the site. This will most often be forested land that is being left undisturbed in the current project.*

This option is the most economical and best for the environment, but is not always feasible.

- Plan site development to leave areas where native vegetation does not need to be disturbed.
- Fence off areas of native vegetation on the site that will not be stripped, logged, or graded to protect them from disturbance during construction.
- Undisturbed areas do not require soil amendment.

Regulatory Requirements

Except for areas that will be covered by impervious surface or have been incorporated into a stormwater facility, areas that have been cleared and graded must have the soil moisture holding capacity restored to that of the original undisturbed soil native to the site to the maximum extent practicable. Areas that have been compacted or had the topsoil or duff layer removed will be amended by adding compost, importing topsoil, stockpiling site topsoil, or through other techniques that are capable of mitigating for lost moisture holding capacity.

Soil amendment shall take place between May 1 and October 1. Replaced **topsoil shall be a minimum of eight inches thick**, unless the applicant demonstrates that a different thickness will provide conditions equivalent to the soil moisture holding capacity native to the site. Replaced **topsoil shall have an organic matter content of between 8 to 13 percent dry weight and a pH suitable for the proposed landscape plants**. (Note: 8-13% soil organic matter (SOM) content in soil is ***not*** the same as 8-13% by volume of compost in soil , but rather approximately 30-40% compost by volume in soil. This booklet explains how to achieve the required 8-13% soil organic matter content.)

It is also recommended that compacted subsoils be tilled or plowed before placing amendments or topsoil, and that planting beds be mulched with two inches of forest duff, ground bark, wood chips or other organic material after planting.

These standards apply to all site development activities, whether permits are required or not, except for surface mine operations conducted pursuant to permits issued by King County and the Washington Department of Natural Resources.

Option 2:

Amend existing soil in place.

Where the soil has been compacted or the forest duff or topsoil removed, the simplest way to restore soil quality is to rototill compost into the existing soil.

- Apply a layer of compost to existing soil at the **pre-approved amendment rate of 2.5 inches**. Use the Compost and Topsoil Calcualtion Worksheet in this booklet or the online Compost and Topsoil Calculator (see Resources page 6) to calculate the quantity of compost needed.

  NOTE: *If desired, a custom compost amendment rate may be used as an alternative to the pre-approved amendment rate (see Pre-approved versus Custom Amendment Rates page 3).*
- Retain copies of compost test results and receipts for compost delivered to the site, as they will be used during inspection to verify the soil requirements have been met.
- Rototill compost into soil to a depth of at least 8 inches. *Note that tilling to this depth will require repeated passes with a large machine, such as a tractor mounted or heavy rear tine rototiller.*

Option 3:

Import topsoil mix with 8 – 13% soil organic matter content.

Where subsoil is too rocky, compacted or poorly drained to amend effectively, a topsoil mix with 8 – 13% soil organic matter can be imported and placed on the surface. "Manufactured" topsoil mixes should be weed free, making them ideal for seeding new lawns.

- Import and apply a topsoil mix with 8 – 13% soil organic matter, which should contain 30 – 40% compost by volume, and clean sand or sandy soil. The soil depth should be 8 inches and the pH suitable for proposed plants.
- Use the Compost and Topsoil Calculation Worksheet in this booklet or the online Compost and Topsoil Calculator (see Resources page 6) to calculate the quantity of topsoil needed.
- Ask topsoil suppliers for test results of their product to verify the material contains the desired organic matter content and pH. Retain copies of topsoil test results and receipts for topsoil delivered to the site, as they will be used during inspection to verify that the soil requirements have been met.
- For best results, plow or till compacted subsoil at least 2 inches deep before applying topsoil mix, and/or rototill some of the newly applied topsoil into the subsoil.

Option 4a – Native Soil:

Stockpile site duff and topsoil, and reapply after grading and construction.

NOTE: Option 4a is only applicable to sites that have the original, undisturbed soil native to the site. This will most often be forested land that is being converted in the current project. Topsoil and forest duff excavated for structures and paved areas, or removed before site grading, can be stockpiled and reapplied after grading or other construction disturbances are completed. Stockpiling may not be practical on small sites.

- Remove forest duff layer and topsoil and stockpile *separately*, in an approved location prior to grading. Cover soil and duff piles with woven weed barrier (available from nursery supply stores) that sheds moisture yet allows air flow.
- Reapply topsoil to landscape areas to a minimum 8 inch depth after grading and other disturbances are completed.
- For best results, plow or till compacted subsoil at least 2 inches deep before replacing stockpiled topsoil, and/or rototill some of the replaced topsoil into the subsoil.
- Apply a 2-inch layer of stockpiled duff as a mulch after planting.

Pre-Approved versus Custom Amendment Rates

A pre-approved soil amendment rate has been calculated for Soil Treatment Options 2 and 4b presented in this booklet. The pre-approved rate is 2.5 inches of compost, applied to the soil as directed. Use of the pre-approved amendment rate may simplify planning, however a custom calculated rate, based on tests of the site soil and proposed compost, can save on effort and expense. Many pasture or woodland soils have adequate organic matter without amendment. Also, some compost products will provide the required soil organic matter content at lower application rates than the pre-approved rate. See Soil Testing Laboratories under Resources in this booklet for how to find accredited laboratories for soil testing.

To calculate a custom compost amendment rate, identify the values below and use the online Compost and Topsoil Calculator (see Resources page 6).

Values to calculate a custom compost amendment rate to be mixed into an 8 inch depth of soil:

- Target soil organic matter (%) – the desired percentage organic matter (8 – 13%) upon completion
- Soil bulk density (lbs/cubic yard dry weight) – obtained from soil testing
- Soil organic matter (%) – obtained from soil testing
- Compost bulk density (lbs/cubic yard dry weight) – obtained from compost testing
- Compost organic matter (%) – obtained from compost testing

Retain soil and compost test results, as they will be used during inspection to verify the soil standard is being met.

Option 4b – Disturbed Soil:

Stockpile site soil, reapply, and amend in place.

NOTE: Option 4b is only applicable to sites where the soil is not the original, undisturbed soil native to the site. This will most often be unforested areas.

- Remove soil and stockpile in an approved location prior to grading. Cover soil with woven weed barrier (available from nursery supply stores) that sheds moisture yet allows air flow.
- Reapply stockpiled soil to landscape areas to a minimum 6 inch depth after grading and other disturbances are completed. In some cases, purchasing additional topsoil will be needed to achieve the 6 inch depth.
- For best results, plow or till compacted subsoil at least 2 inches deep before replacing stockpiled soil, and/or rototill some of the replaced soil into the subsoil.
- Apply a layer of compost to the reapplied soil at the **pre-approved amendment rate of 2.5 inches**. Use the Compost and Topsoil Calculation Worksheet in this booklet or the online Compost and Topsoil Calculator (see Resources page 6) to calculate the amount of compost needed.

  NOTE: *If desired, a custom compost amendment rate may be used as an alternative to the pre-approved amendment rate (see Pre-approved versus Custom Amendment Rates this page).*

- Retain copies of compost test results and receipts for compost delivered to the site, as they will be used during inspection to verify the soil requirements have been met.
- Rototill compost into soil to a depth of at least 8 inches. *Note that tilling to this depth will require repeated passes with a large machine, such as a tractor or heavy rear tine rototiller.*

Figuring Compost, Stockpiling and/or Imported Topsoil Needs

STEP 1.

Review site conditions, landscape and grading plans.

- ❑ Examine site plans and soils. Use a shovel to dig in several areas that have been or will be graded to determine if the newly exposed grades can be easily amended, or if compaction will require plowing/tilling of the subsoil or topsoil import. Determine if there are areas where soil could be stockpiled on-site.
- ❑ Identify areas where soil can be: left undisturbed (Option 1), amended in place with compost (Option 2), removed and replaced with imported purchased topsoil (Option 3), or stockpiled and later reapplied (Options 4a and/or 4b).

Permit Application Requirements

To ensure that the post-construction soil standard will be met, permit application submittal must include:

- Completed **Soil Management Plan** form, with required attachments, including a site plan marked to outline areas where each soil treatment option will be applied, and any stockpiling or staging areas.
- Either a completed **Compost and Topsoil Calculations Worksheet** (see pages 6-7), or a **print-out of the calculation results from the online Compost and Topsoil Calculator**.

  Note: *The online Compost and Topsoil Calculator can be used for either pre-approved or custom amendment rates. The Compost and Topsoil Calculation Worksheet in this booklet should only be used if the pre-approved amendment rate will be used for Options 2 and 4b.*
- Test result reports for compost and/or topsoil products that will be used for the project. These will be used during inspection to verify that the soil requirement has been met.

Soil pH

Use an accredited soil testing laboratory to test the pH of the soil and ask the laboratory to provide information on how to adjust the soil pH, should that be necessary. To find accredited soil testing laboratories, see *Resources* on page 7.

A nursery can provide specific information about suitable pH for landscape plants. Here are optimal soil pH ranges for various plant types:

Lawns – 5.5 to 7.5 pH

Shrubs (except acid-tolerant plants) – 5.5 to 7.0 pH

Acid-Tolerant Shrubs (Rhododendrons, Azaleas, Mountain Laurels, Camellias, Blueberries, native plants) – 4.5 to 5.5 pH

Annual Flower and Vegetable Gardens – 6.0 to 7.0 pH

STEP 2.

Select soil treatment option and suitable pH for each planting area.

Amending with compost is often the most economical way to bring poor soils up to the required soil organic matter content. On sites with the original, undisturbed, native soil, and where space permits, stockpiling and reapplying topsoil may be less costly. Importing topsoil usually costs more than amending existing soil, though it may be easier where subsoil conditions make cultivation difficult.

- ❑ If interested in using a custom compost amendment rate for Options 2 and/or 4b, use an accredited soil testing laboratory to sample and test the site soil to determine the soil bulk density (lbs/cubic yard dry weight) and soil organic matter percentage. These values will be used to calculate the custom compost amendment rate in inches (see Pre-Approved versus Custom Amendment Rates page 3).
- ❑ Identify the areas where the selected Soil Treatment Option(s) (see pages 2-3) will be applied. Outline those areas on the site plan with a dark, thick-line pen.
- ❑ Assign each area an identifying letter (A, B, C…) on the site drawing.
- ❑ Determine desired pH for each lettered area, based on suitability for proposed plants (see *Soil pH* this page).
- ❑ Include required information with permit application (see *Permit Application Requirements* this page).

STEP 3.

Calculate compost and/or topsoil volumes for each area.

- ❑ Calculate the square footage of each lettered area on site plan.
- ❑ If using the pre-approved amendment rate, complete the Compost and Topsoil Calculation Worksheet or use the online Compost and Topsoil Calculator (see Resources page 6) to calculate the quantities of compost and/or topsoil needed.
- ❑ If using a custom amendment rate, only the online Compost and Topsoil Calculator can be used to calculate compost quantities.

Figuring Compost, Stockpiling and/or Imported Topsoil Needs

STEP 4.

Identify compost and/or topsoils to be applied and retain records.

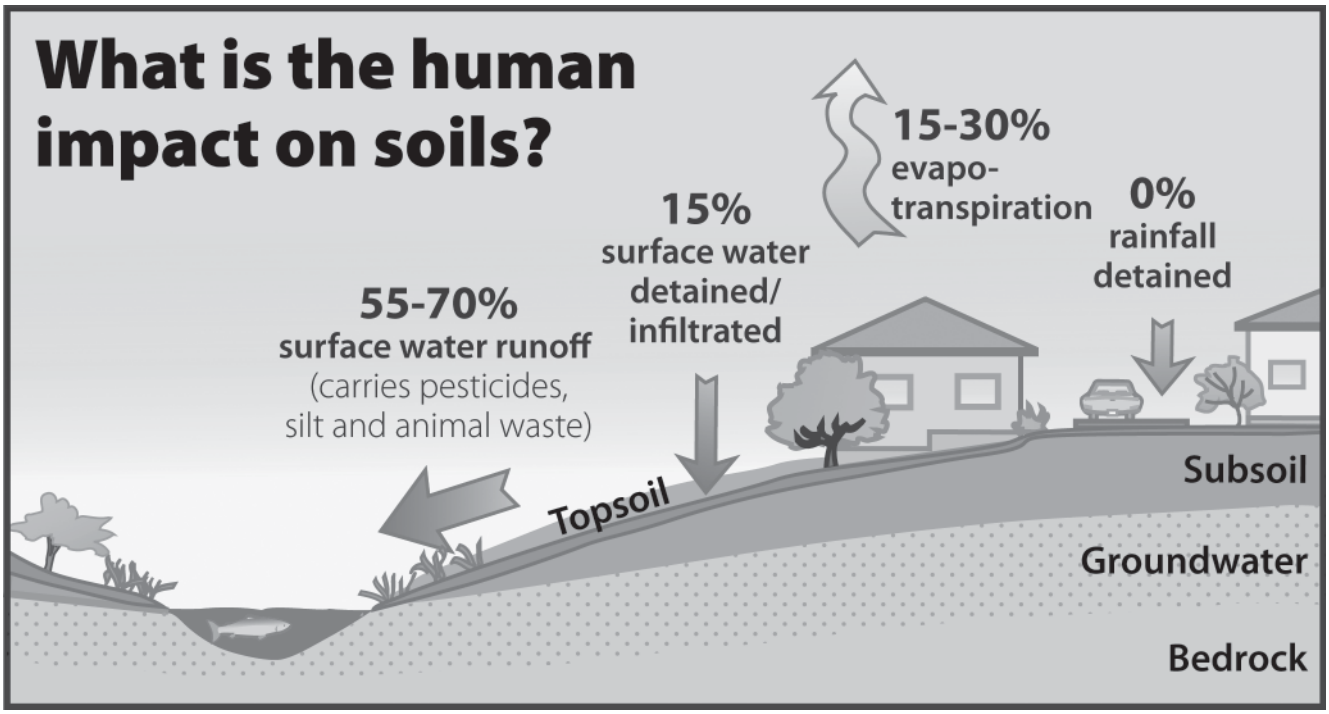
- ❑ Contact compost or topsoil sources and select products that meet the requirements, including 8 – 13% soil organic matter content for topsoil mixes and suitable pH for the proposed plants.
  - Topsoil should contain 30-40% of compost by volume.
  - Compost should contain 40-60% organic matter.

- ❑ If preparing to use a custom compost amendment rate for Options 2 and/or 4b:
  - Determine the target percentage of soil organic matter (8-13%) you wish to achieve

    Note: *8% is better for grassy areas and lawns and 10-13% is better for planting beds.*
  - Request copies of compost test results reports that include the **compost bulk density (lbs/cubic yard dry weight)** and the **percentage compost organic matter**. These values will be used to calculate the custom amendment rate in inches (see Compost and Topsoil Sources and Requirements on page 6 for more information on compost test results requirements).
  - Use the online Compost and Topsoil Calculator to calculate the custom compost amendment rate in inches and the quantities of compost and/or topsoil needed for the project. Print the calculation results.

- ❑ **Complete the Soil Management Plan form in this booklet, with required attachments.** These will become part of your permit documents (see Permit Application Requirements page 4).

- ❑ Retain compost and/or topsoil product delivery tickets and test results, as they will be used as verification records during inspection.



Compost and Topsoil Sources and Requirements

Compost sold in Washington must comply with state standards for compost quality found in the state solid waste rule (WAC 173-350-220). Compost sources include both permitted compost facilities and facilities that don't require permits because they are exempt under the state rule.

Some compost facilities produce compost and topsoil mixes, and topsoil supply companies may use compost produced elsewhere to create topsoil mix products. To achieve the post-construction soil standard, topsoil mixes must contain 8 – 13% soil organic matter content. Ask topsoil suppliers for test results of their product to verify it contains the desired organic matter content and pH; and ask compost suppliers for test results to verify that the compost contains 40-60% organic matter. If using a custom amendment rate, you will also need to know the compost bulk density (lbs/cubic yard dry weight).

Permit applicants that compost their own material at a maximum of 250 cubic yards of compost on site at any one time, may use that material for a project, provided the appropriate tests are conducted and documented. In addition to the annual testing required by WAC 173-350-220, tests must include: 1) organic matter content (range: 40-60%); and, if using a custom compost amendment rate, compost bulk density (lbs./cubic yard dry weight).

Retain test result reports for compost, as well as receipts for compost and/or topsoil delivered to the site by suppliers. These will be used during inspection to verify the soil standard requirements have been met.

See Resources for how to find a list of permitted compost facilities. You may also see your local business directory for producers and suppliers of compost and topsoil products.

Resources

Permitted Compost Facilities

For a list of permitted compost facilities, see the Washington State Department of Ecology Web site at http://www.ecy.wa.gov/programs/swfa/compost/, and click on "Permitted Compost Facilities" in the text, or call the Department's Northwest Regional Office at 425-649-7000.

Compost and Topsoil Calculator

To calculate the amounts of compost and/or topsoil needed for a project, as well as a custom compost amendment rate, use the online Compost and Topsoil Calculator, which can be found on the DDES Web site at www.metrokc.gov/dnrp/swd/compost_calculator.htm.

Soil Testing Laboratories

For a list of accredited soil testing laboratories and guidance on obtaining soil tests, contact the Washington State University King County Extension at 206-205-3100 or 1-800-325-6165 ext. 5-3100.

Learn More

SoilsforSalmon.org – why and how to build healthy soil, case studies, and other resources.

Puget Sound Online – Low Impact Development – information on environmentally sensitive land development techniques (http://www.psat.wa.gov/Programs/LID.htm).

Contacts

For questions related to King County's post-construction soil standards, please contact:

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Ph – 206-296-6608

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TTY Relay: 711

Compost and Topsoil Calculation Worksheet for the Pre-approved Amendment Rate

NOTE: *For Options 2 and 4b, use this worksheet if you plan to use the pre-approved compost amendment rate of 2.5 inches. This worksheet should not be used if a custom compost amendment rate is selected for Options 2 and/or 4b. Instead, use the online Compost and Topsoil Calculator* at www.metrokc.gov/dnrp/swd/compost_calculator.htm.

Option 1

Leave native soil undisturbed, and protect from compaction during construction.
Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

No calculations for compost or topsoil are necessary for this option.

Option 2

Amend existing soil in-place (2.5 inch layer of compost).
Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

Enter ***combined square footage*** of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter .5)

x 8

Multiply ***combined square footage*** by 8 and enter product in box **A** → **A** = **Cubic Yards**

AMOUNT OF COMPOST NEEDED FOR THESE AREAS

Option 3

Import topsoil mix with 8 – 13% soil organic matter (8 inch depth of topsoil).
Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

Enter ***combined square footage*** of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter .5)

x 25

Multiply ***combined square footage*** by 25 and enter in box **B** → **B** = **Cubic Yards**

AMOUNT OF IMPORTED TOPSOIL NEEDED FOR THESE AREAS

Option 4a

Native Soil - stockpile site duff and topsoil and reapply after grading and construction.
Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

Enter ***combined square footage*** of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter .5)

x 25

Multiply **combined square footage** by 25 and enter in box **C** → **C** = **Cubic Yards**

AMOUNT OF SITE TOPSOIL TO BE STOCKPILED AND REAPPLIED IN THESE AREAS

Compost and Topsoil Calculation Worksheet for the Pre-approved Amendment Rate

Option 4b

Disturbed Soil - Stockpile site soil, reapply, and amend in place (2.5 inch pre-approved amendment rate).

CALCULATE STOCKPILED SOIL NEEDED

Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

Enter ***combined square footage*** of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter .5)

x 19

Multiply ***combined square footage*** by 19 and enter in box **D** → **D** = **Cubic Yards**

AMOUNT OF SITE TOPSOIL TO BE STOCKPILED AND REAPPLIED IN THESE AREAS

CALCULATE COMPOST NEEDED

Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

Enter ***combined square footage*** of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter .5)

x 8

Multiply combined square footage by 8 and enter product in box **E** → **E** = **Cubic Yards**

AMOUNT OF COMPOST NEEDED FOR THESE AREAS

Note: *If there is less stockpiled site topsoil than the amount needed to achieve the 8 inch depth once reapplied (amount in box D), additional topsoil should be purchased to make up the difference. Subtract the cubic yards of site topsoil available to be stockpiled from the total amount needed in box D to find the difference—the amount of additional topsoil that will need to be purchased. Add this additional topsoil amount to the amount in box B and enter in box G.*

Order These Amounts

Add amounts in boxes A and E and enter here → **F** **Cubic Yards of Compost**

Enter box B amount here → **G** **Cubic Yards of Topsoil**
(if using Option 4b, see note under Calculate Compost Needed)

Soil Management Plan For Post-construction Soil Standard (KCC 16.82)

12/5/06

King County
Department of Development & Environmental Services

Use ***Achieving the Post-construction Soil Standard*** booklet instructions to carry out this Soil Management Plan.

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

Attach the following to this plan:

- Scale site plan drawings that include areas to be treated with Soil Treatment Options 1, 2, 3, 4a and/or 4b
- Completed Compost and Topsoil Calculation Worksheet or printout of online Compost and Topsoil Calculator results. These calculations will be verified in the DDES permit office.
- Original compost and/or topsoil test results reports demonstrating that products contain adequate organic matter (for soil treatment options 2, 3 and/or 4b)
  - o Topsoil should contain 30-40% of compost by volume, which is equivalent to 8-13% soil organic matter).
  - o Compost should contain 40 – 60% organic matter.

Note: *Retain original delivery tickets for compost and/or topsoil products for verification purposes.*

Soil Treatment Options for Areas Identified on Site Plan

Soil treatment options available:

- **Option 1** – Leave native soil undisturbed, and protect from compaction during construction.
- **Option 2** – Amend existing soil in place.
- **Option 3** – Import topsoil mix with 8-13% soil organic matter content.
- **Option 4a** – For native soil: stockpile site duff and topsoil, and reapply after grading and construction.
- **Option 4b** – For disturbed soil: stockpile site soil, reapply, and amend in place.

Area __________ (refer to lettered areas mapped on site plan)

Square footage: ___________

Selected soil treatment option:

☐ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4a ☐ Option 4b

If using option 2 or 4b, select type of amendment rate:

☐ Pre-approved (2.5”) ☐ Custom (with ____% Target Soil Organic Matter)

Area __________ (refer to lettered areas mapped on site plan)

Square footage: ___________

Selected soil treatment option:

☐ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4a ☐ Option 4b

If using option 2 or 4b, select type of amendment rate:

☐ Pre-approved (2.5”) ☐ Custom (with ____% Target Soil Organic Matter)

Area __________ (refer to lettered areas mapped on site plan)

Square footage: ___________

Selected soil treatment option:

☐ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4a ☐ Option 4b

If using option 2 or 4b, select type of amendment rate:

☐ Pre-approved (2.5”) ☐ Custom (with ____% Target Soil Organic Matter)

Use additional Soil Management Plan forms for additional areas, if necessary.

Record the compost and/or topsoil products to be used

Compost

Product #1: ______________________________

Test Results: ______________% organic matter content

Quantity: ______________ cubic yards

Supplier: ______________________________

Product #2: ______________________________

Test Results: ______________% organic matter content

Quantity: ______________ cubic yards

Supplier: ______________________________

Total cubic yards of compost ______________

Topsoil

Product #3: ______________________________

Test Results: ______________% organic matter content

Quantity: ______________ cubic yards

Supplier: ______________________________

Product #4: ______________________________

Test Results: ______________% organic matter content

Quantity: ______________ cubic yards

Supplier: ______________________________

Total cubic yards of topsoil ______________

FOR DDES USE ONLY

Plan Approval Record

Date: _____ Reviewer: ____________________ Approved: ______

Revisions Required: ______________________________

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Date: _____ Reviewer: ____________________ Approved: ______

Revisions Required: ______________________________

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Achieving the Post-construction Soil Standard

Contacts

For questions related to King County's post-construction soil standards, please contact:

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King County
Department of Development
& Environmental Services

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