



ADVANCED TOPICS IN LID DESIGN:

Soil Protection and Amended Soils

8.2

Learning Objective:

Know the options for meeting **Amended Soils** guidance, strategies for determining site soil conditions, and how to develop a soil management plan.





Introduction

- Guidance
- How soil manages runoff & water quality



Determining Site Soil Conditions



Developing a Soil Management Plan



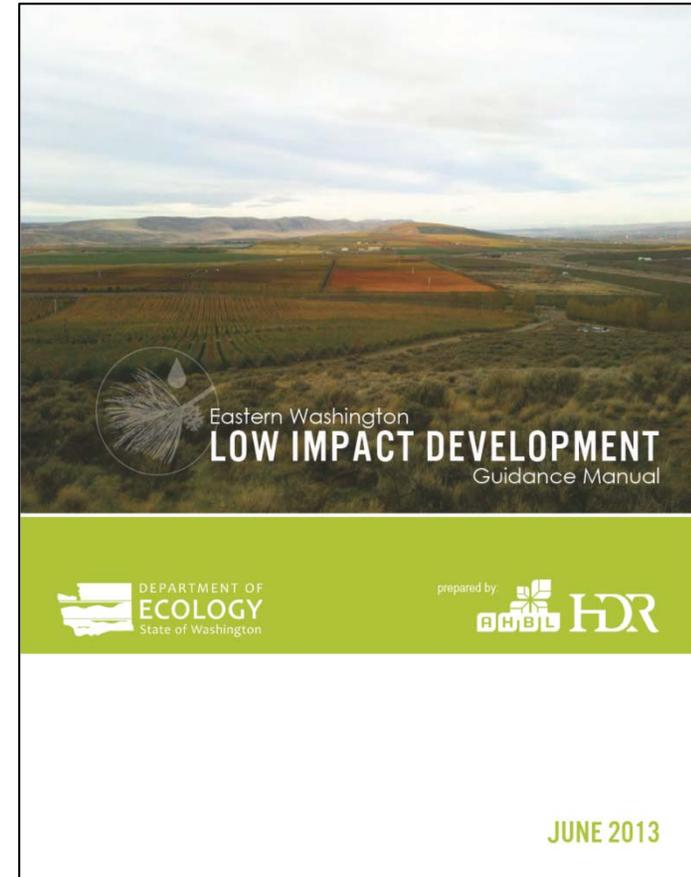
Soil Protection



Soil Amendment

Amended Soils: Guidance

- Applications & Limitations
- Design
- Sizing
- Runoff model representation
- Construction
- Infeasibility criteria
- Maintenance



Amended Soils: Definition

- Soil/landscape system with adequate depth, permeability, and organic matter
- Retains native soil functionality in a post-development landscape



Amended Soils: Applications

- All pervious areas
- Incorporated into designs for dispersion BMPs

Parameter	Design Goal
Organic matter content (non-turf)	6 to 8%
Organic matter content (turf)	3 to 5%
pH	6.0 to 8.0

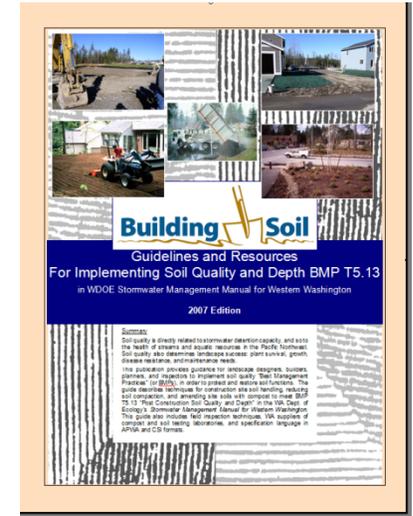


www.specmeters.com

Amended Soils: Runoff Model Representation

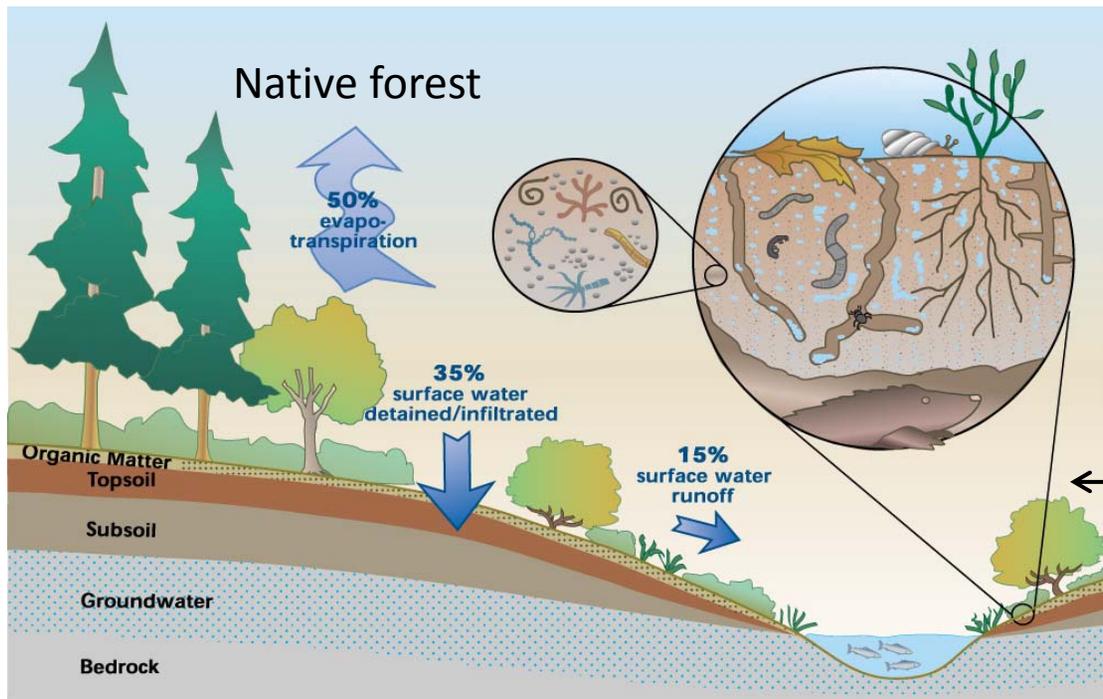
- Areas meeting the design guidelines may be entered into approved runoff models as “Pasture” rather than “Lawn”
- Can be used in designs for dispersion BMPs to improve dispersal and adsorption of stormwater flows and help satisfy Ecology’s Core Element requirements for flow control and runoff treatment

Ecology-approved *Building Soil* manual



- Source of content in Eastern WA LID Manual
- Manual developed regionally with experts
- Develop a “Soil Management Plan” for each site
- Four options for soil management (can use 1 or more per site):
 - 1) Retain undisturbed native soil & vegetation, protect from compaction
 - 2) Amend existing soil in place with compost
 - 3) Stockpile topsoil prior to grading, and reuse on site (amend if needed)
 - 4) Import topsoil meeting organic matter content requirements
- Choose pre-approved or custom calculated amendment rates
- Simple field inspection and verification procedures

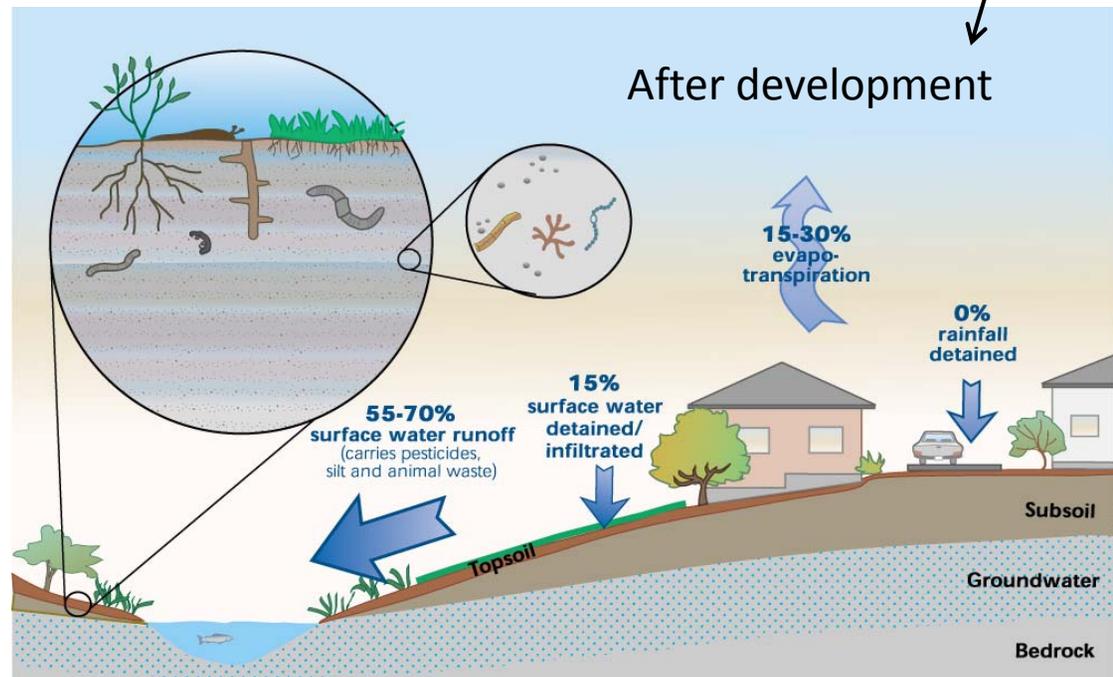
Available www.soilsforsalmon.org or www.buildingsoil.org



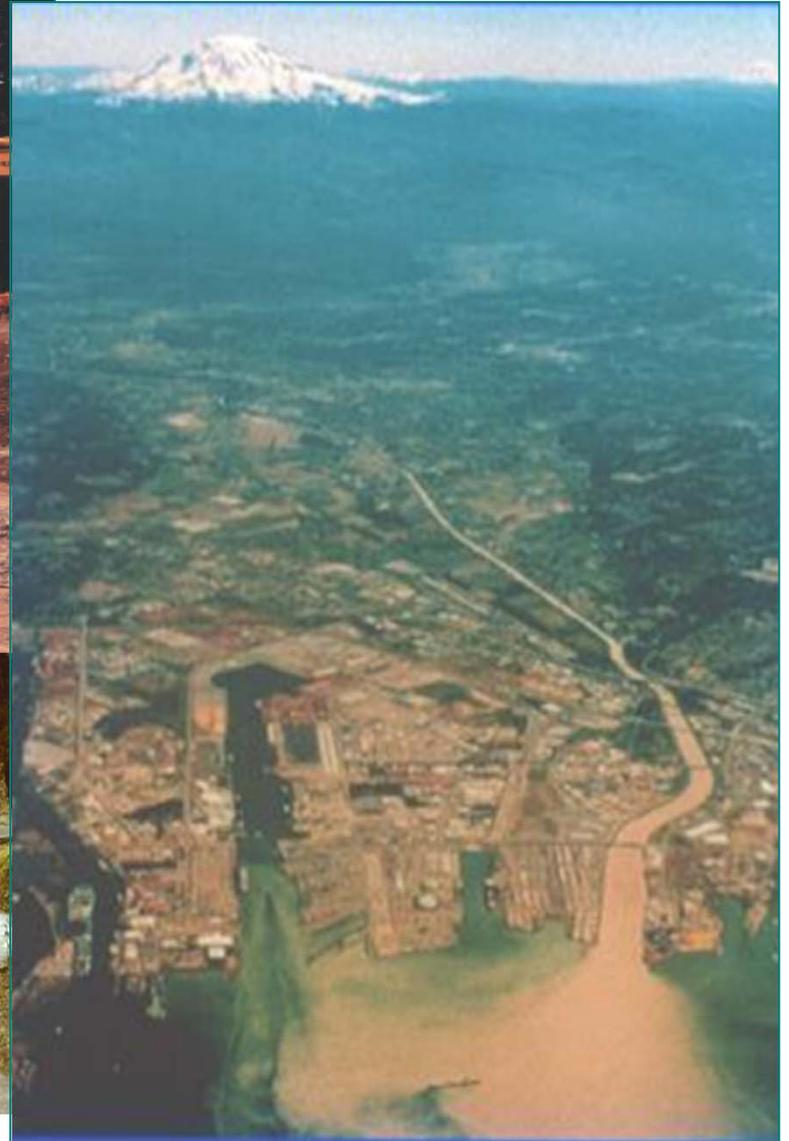
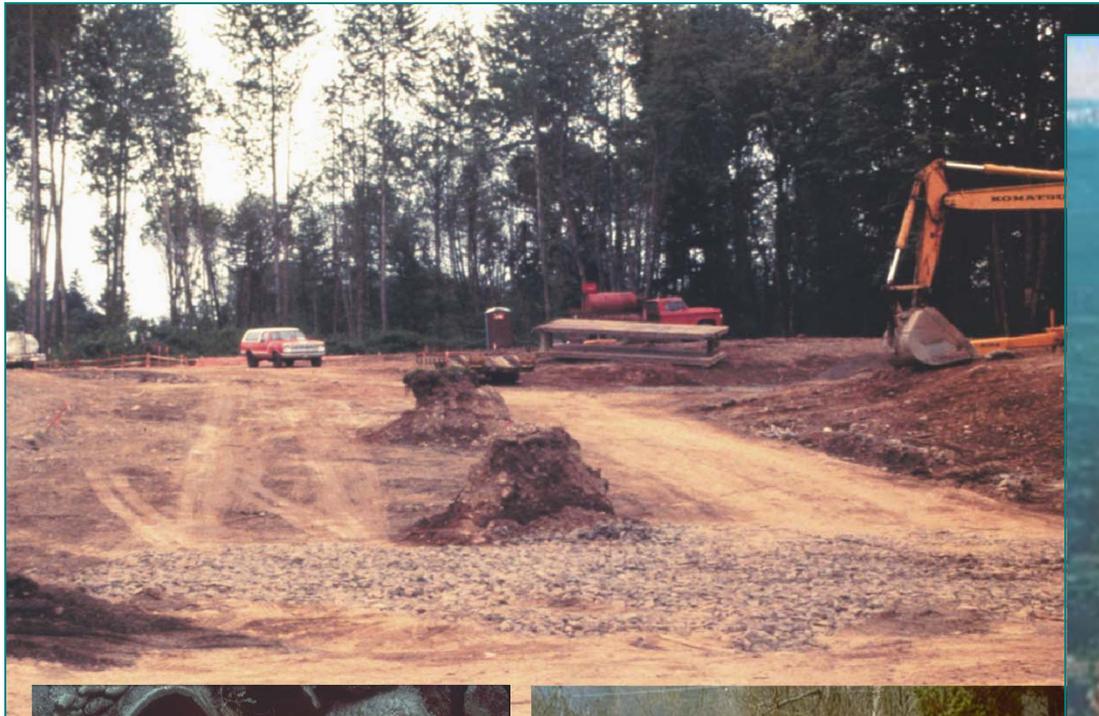
Development typically degrades soil functions.

How can we make this

Function more like this?



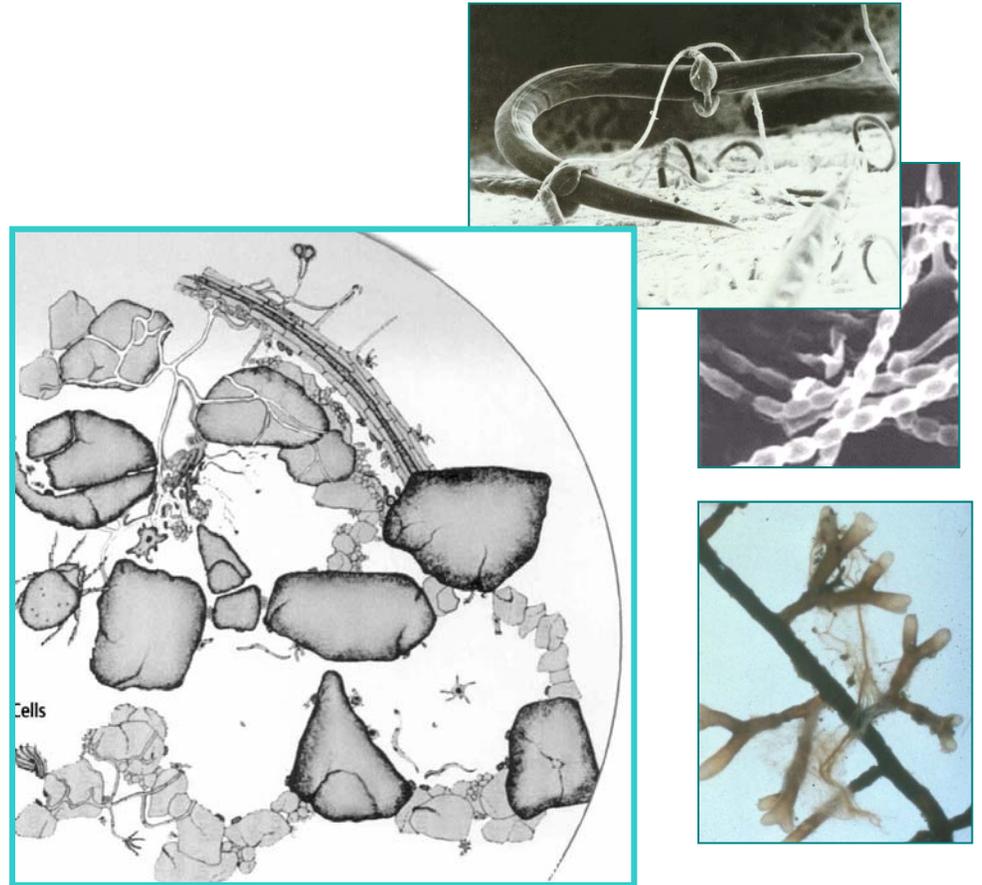
How can we protect or restore soil functions on every site?



Restoring soil life, to restore soil functions

Soil organisms create:

- soil structure
- fertility = nutrient cycling
- plant disease protection
- biofiltration
- erosion control
- stormwater detention



Compost kick-starts the soil ecosystem.
(Provides food and home for organisms)

How does soil life create soil structure?

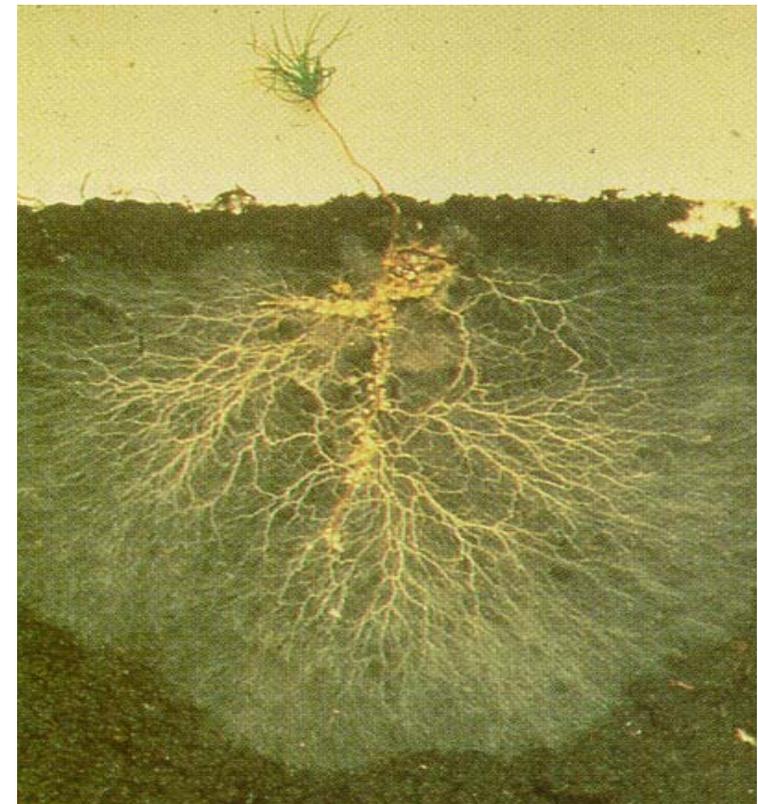
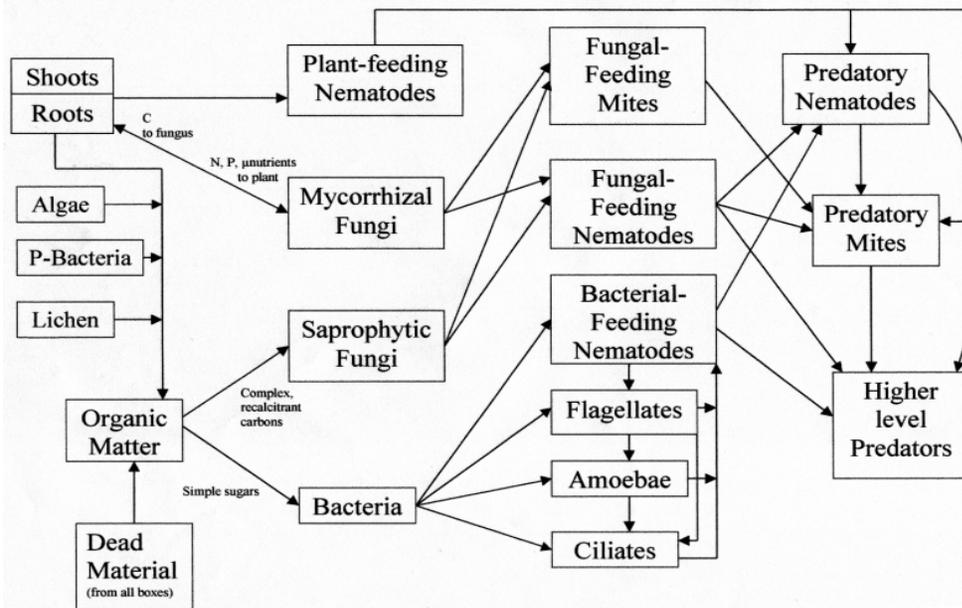
- Bacteria secretions glue clays, silts and sands together into micro-aggregates.
- Micro-aggregates are bound together by fungal hyphae, root hairs and roots.
- Spaces are made by moving arthropods & earthworms, and decaying roots.
- Only when all organisms are present can roots and water move into the soil with ease.



S. Rose & E.T. Elliott

How does soil life provide fertility (nutrient cycling)?

- Soil foodweb stores nutrients in living & dead organic matter
- Nutrients are released in root zone as organisms eat and excrete “waste” (nitrogen, etc.)
- Mycorrhizal fungi bring nutrients and water to roots of plants

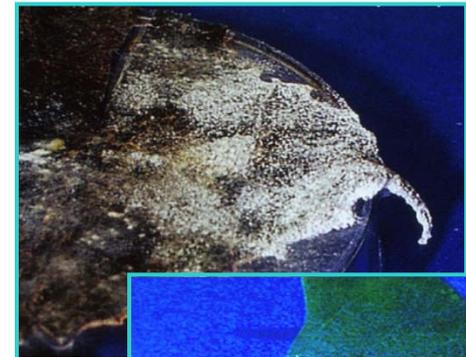


Dr. Michael P. Amaranthus, Mycorrhizal Applications Inc.

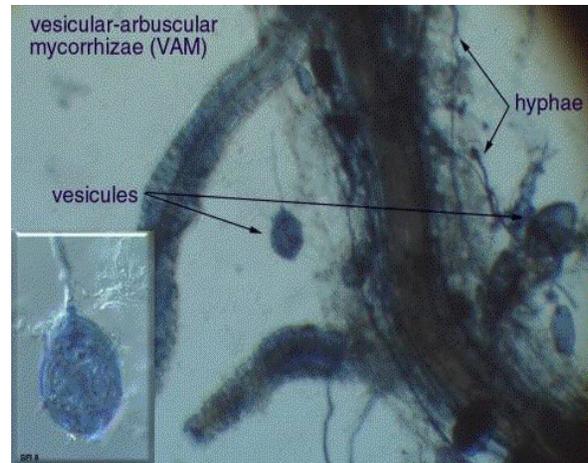
How does soil life provide plant disease protection?

Diversity \Rightarrow predation, parasitization & competition with the few disease-causing organisms

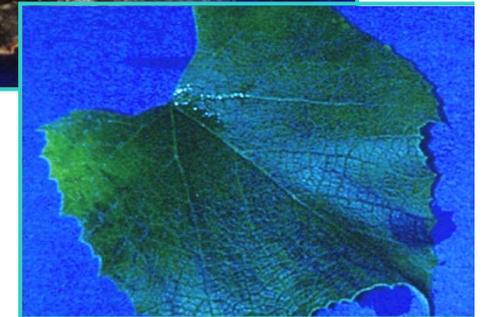
- Bacteria cover leaf surfaces, block infection



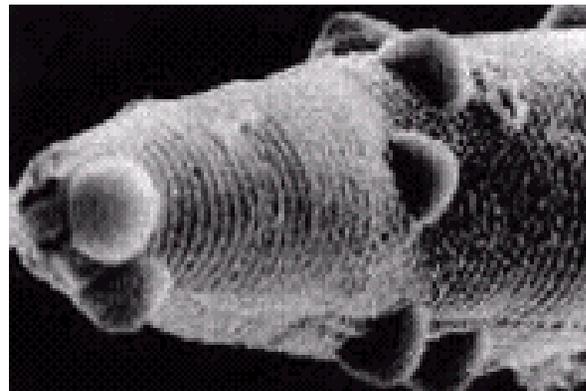
- Ecto- and endo-mycorrhizae prevent root infection



Soil Foodweb Inc.



- Many organisms prey on the few disease-causing organisms



SSSA



How does soil life filter & remove pollutants?

- Creates soil structure
- Breaks down hydrocarbons, pesticides, etc.
- Converts fertilizers/nutrients to stable forms, so they are available to plants but won't wash away
- Increases cation exchange capacity, binding nutrients & other ions
- Binds metals in soil, so they don't wash into streams
- Creates "dissolved organic carbon" (DOC) complexes, which sequester metals & other pollutants in water, reducing toxicity.

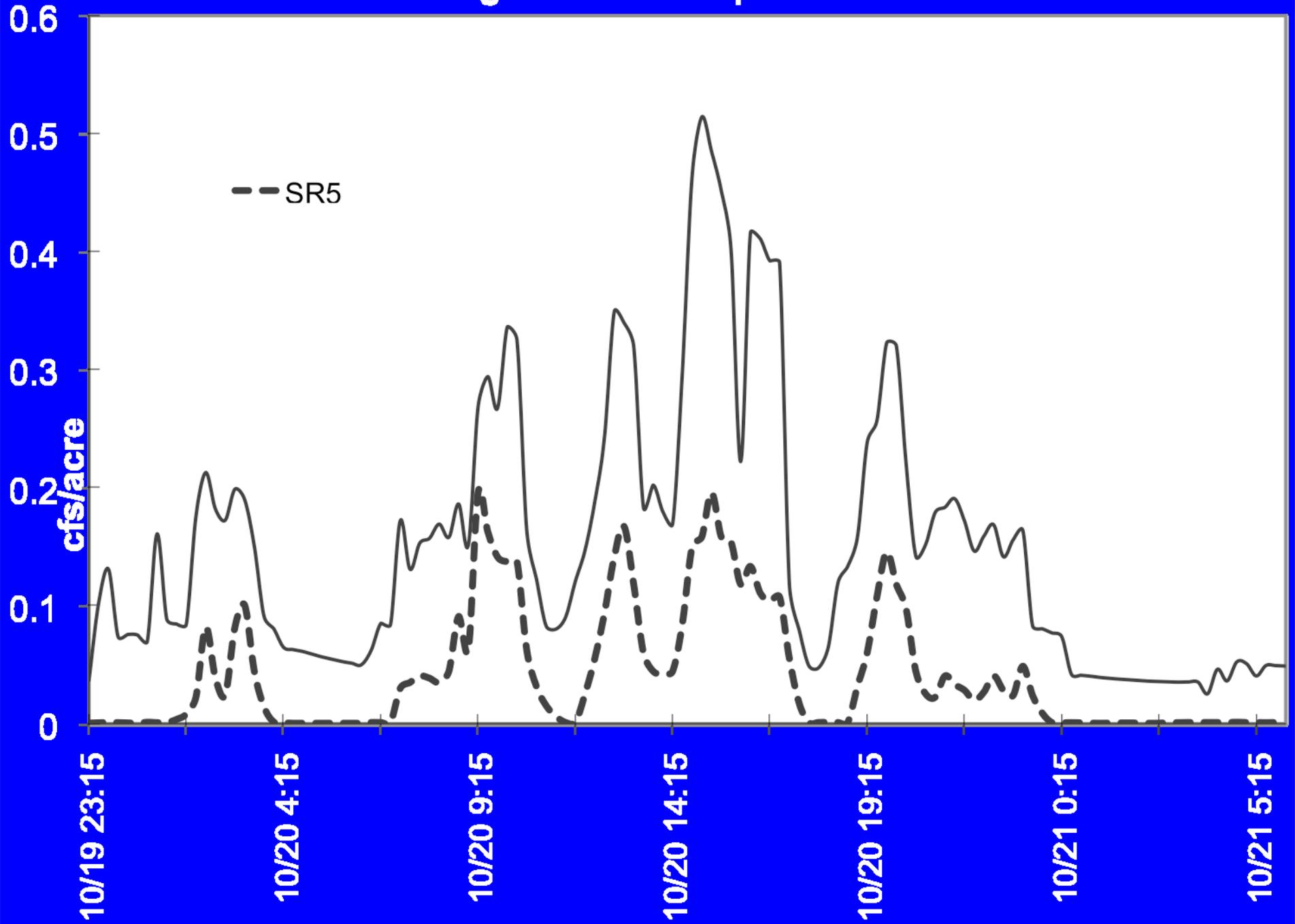


WsDOT: Compost Amended Vegetated Filter Strip - 2004 pollutant & flow reduction trials along I-5



These 3 slides courtesy of:
Mark Maurer, WSDOT
maurerm@wsdot.wa.gov

Flow rates for background vs compost amended shoulder



WsDOT 2004:

10 ft. wide compost-amended strip treats stormwater from 2 lanes

“first flush” – first winter’s rain events



Parameter	Untreated Runoff	Compost filter strip treated	% Concentration Reduction	% Load Reduction
	mg/l			
TDS	52.7	55.5	-5	63
T. Phosphorus	0.089	0.26	-192	-2
COD	73.5	49.6	33	76
TSS	81	23	72	90
	ug/l			
Total Copper	28.18	9.14	68	89
Dissolved Copper	7.85	5.77	26	74
Total Lead	12.62	3.54	72	90
Dissolved Lead	0.5	0.05	90	97
Total Zinc	129.70	31.57	76	91
Dissolved Zinc	64.22	20.71	68	89

TDS=Total Dissolved Solids, COD=Chemical Oxygen Demand, TSS=Total Suspended Solids

Statewide LID Training Program

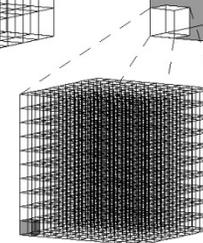
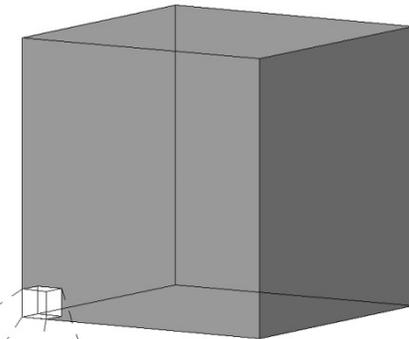
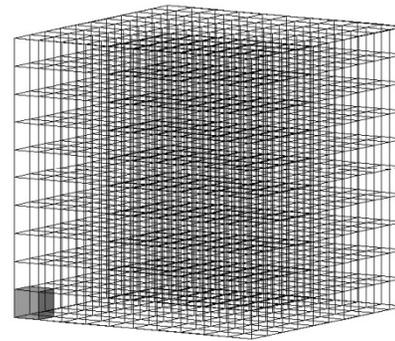
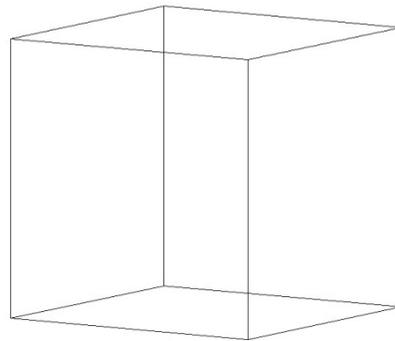


8.2

SOILS

Cation exchange capacity = binding sites

Sand	Silt	Clay
1 Particle Fine Sand .2mm 0.24mm ² Surface Area	1,000 Particles Silt .02mm 2.4 mm ² Surface Area	1,000,000 Particles Clay .002 mm 24 mm ² Surface Area



The smaller the particle the greater the CEC,
but organic complexes multiply binding sites.

Humus/clay colloids have the most!

Cation Exchange Capacity (CEC) for soil mixes

Low fertility soil	Less than 5 meq+/100g
Medium fertility	5-10
High fertility	10-30
Compost/humus	up to 200!

	▪ Fine sand 0.24mm
	▪ Silt 2.4mm
	▪ Clay 24mm
	Relative surface area

Organic-amended soil removes pollutants and binds remainder to Dissolved Organic Carbon (DOC)

Soil removes most toxics, adds dissolved organic complexes that bind remaining metals, nutrients, PAH's and other pollutants.

DOC-bound pollutants are much less toxic to aquatic organisms.

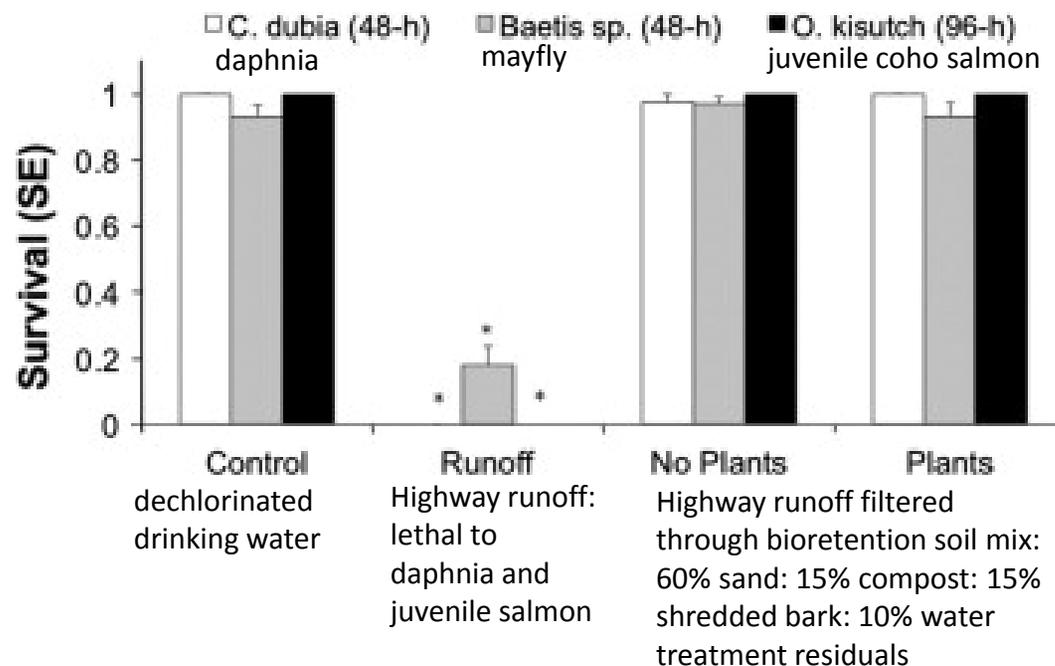


Fig. 4 Survival of three test organisms exposed to control water, untreated September 2012 runoff, runoff treated with bioretention without plants (No Plants), and runoff treated with bioretention with plants (Plants). Asterisks indicate survival significantly lower than control. Error bars are \pm one standard error of the mean.

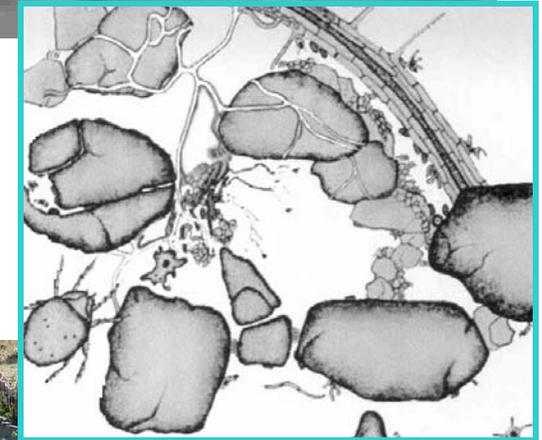
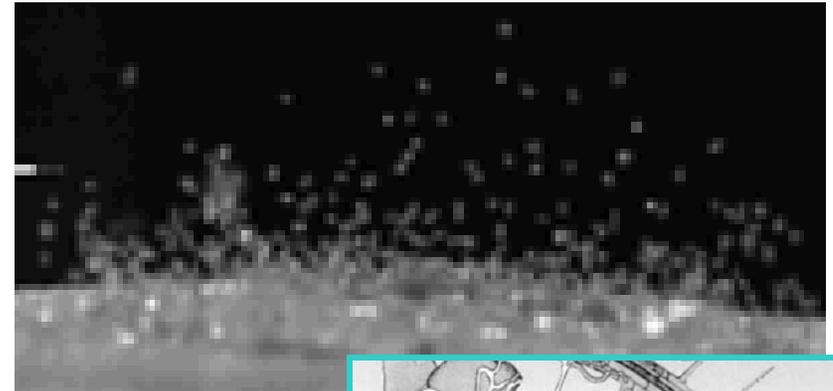
Soil bioretention protects juvenile salmon and their prey from the toxic impacts of urban stormwater runoff

J.K. McIntyre, J.W. Davis, C. Hinman, K.H. Macneale, B.F. Anulacion, N.L. Scholz, J.D. Stark; Chemosphere, 2015 <http://dx.doi.org/10.1016/j.chemosphere.2014.12.052>
<http://www.sciencedirect.com/science/article/pii/S0045653514014805>

“DOC” is the fraction of water-borne organics that pass through a 0.45 μ m filter

How does soil life control erosion?

- Creates pore spaces, increases infiltration
- Sticks soil particles & aggregates together with bacterial slime, fungal hyphae, & root hairs (bigger aggregates are harder to move)
→ “aggregate stability”
- Promotes rapid plant growth & deep root development

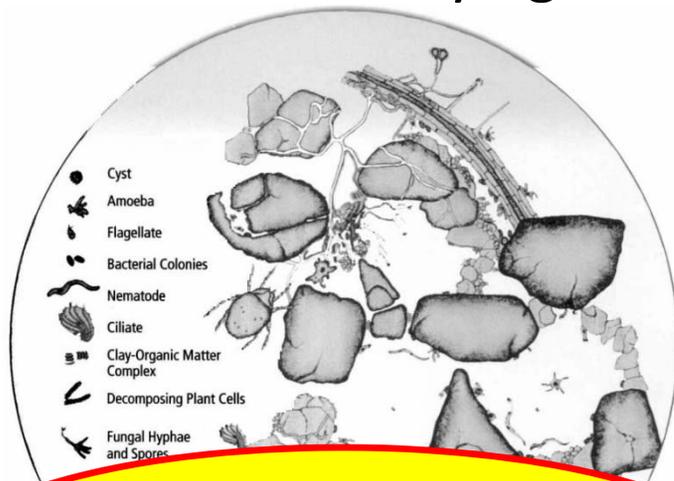


How does soil life provide stormwater detention and infiltration?

- Builds soil structure, pores, & moisture-holding capacity
- Increases surface porosity
- Modifies underlying sub-soils



UW trials, turf on glacial till soil



Learn more:
USDA-NRCS Soil Biology Primer
<http://soils.usda.gov/sqi/>

Compost-amended till soil – over 50% reduction in storm water runoff



How can we enhance & restore soil biodiversity, to improve plant growth, water quality, and reduce runoff?

- Prevent /correct compaction
- Reduce use of pesticides & soluble fertilizers
- **Incorporate compost into soil to feed soil life**



*organic matter + soil organisms + time
creates ⇒
soil structure, biofiltration, fertility, & stormwater detention*

Soil Amendment: A cost-effective solution for new development

- Much better plant survival = fewer callbacks
- Easier planting
- Can cut irrigation needs by 50% = 3-7 year payback on irrigation savings alone



Improving & maintaining soil functions in existing development

- Amend soil when re-landscaping
- Plant native trees & shrubs, especially near waterways
- Mulch beds annually with leaves, chips, compost, etc.
- Mulch-mow (leave clippings) & top-dress turf areas with compost



Determining Site Soil Conditions

USDA Soil Surveys: a good starting point, but use with caution!

⇒ Compare site soil to the existing USDA survey description.

Changes since development:

- Consistency with existing conditions
- Graded and compacted conditions
- Imported soils

The screenshot shows the USDA Web Soil Survey (WSS) homepage. At the top, there's a header with the USDA logo and 'Natural Resources Conservation Service'. Below that, a navigation bar includes 'Home', 'About Soils', 'Help', and 'Contact Us'. A search bar is on the left, and a 'START WSS' button is prominent. The main content area has a 'Welcome to Web Soil Survey (WSS)' section with a description of the service and a 'Four Basic Steps' section. The first step is 'Define' with a sub-step 'Area of Interest (AOI)'. The second step is 'View' with a sub-step 'Soil Map'. On the right, there's a 'I Want To...' sidebar with links to 'Start Web Soil Survey (WSS)', 'Know the requirements for running Web Soil Survey', 'Know the Web Soil Survey hours of operation', 'Find what areas of the U.S. have soil data', 'Find information by topic', 'Know how to hyperlink from other documents to Web Soil Survey', and 'Know the SSURGO data structure'. Below that is an 'Announcements/Events' section with a link to 'Web Soil Survey 3.1 has been released! View description of new features and fixes.' and 'Web Soil Survey Release History'. At the bottom right, there's a 'I Want Help With...' section with links to 'Getting Started With Web Soil Survey', 'How to use Web Soil Survey', 'How to use Web Soil Survey Online Help', and 'Known Problems and Workarounds'.

<http://websoilsurvey.nrcs.usda.gov/app/>

Limitations of traditional soil analysis methods for disturbed urban soils

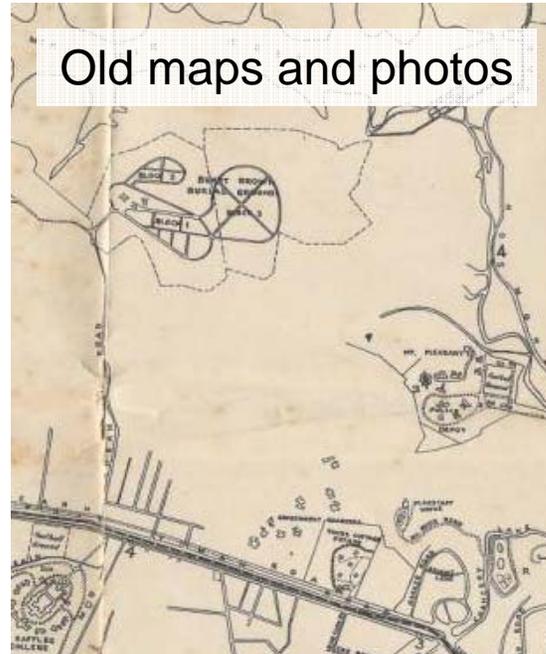
- Soils vary across site:
fill? native? subsoil?
- Mixed or missing horizons –
topsoil layer often removed
- Sharp interface problems
(between native and fill soils)
- Compaction
- Low ph, anaerobic?
- Low organic matter
- Debris, toxins?



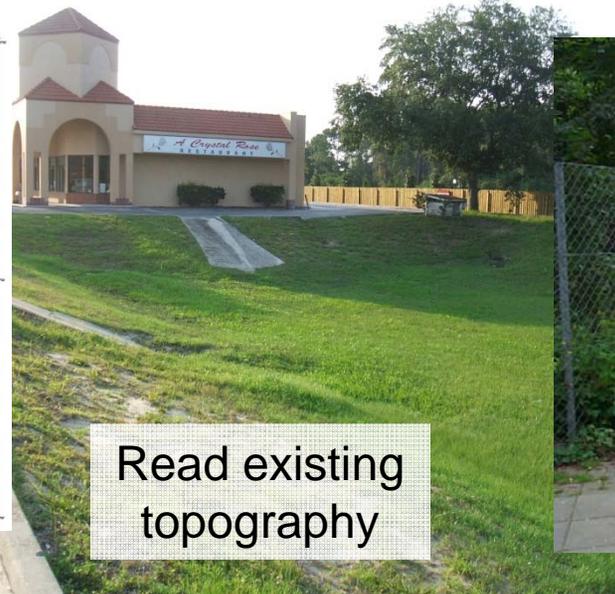
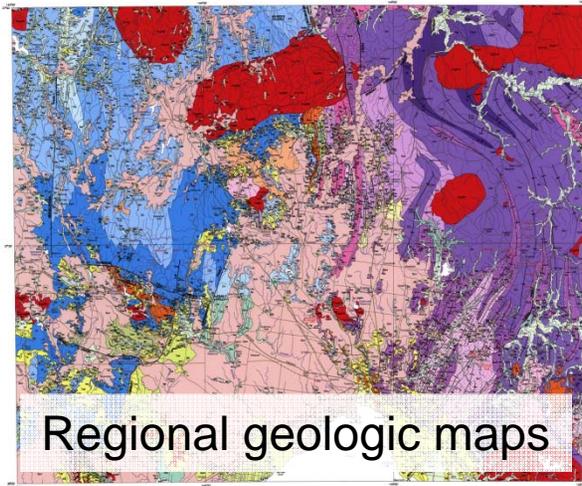
Soil information sources

Soil tests:

- Organic Matter
- Bulk Density
- Nutrients
- Contaminants (if suspected)



B-15		Total Depth	25.0'	Surface Elev.	673 (approx.)	
Boring:	HSA	Equipm't:	Started:	2/23/06	Completed:	2/23/06
Depth**	DESCRIPTION OF MATERIALS (Classification)			Sample Blows*	Sample Depth (Feet)	
0.8	TOPSOIL				1.0	
3.0	RESIDUAL (Possible Alluvial) - Soft, Brown, Sandy Elastic SILT (MH) - moist to wet.			2-2-2	2.5	
				5-7-9	3.5	
6.0	Project soil borings			3-4-6	5.0	
8.0				4-4-5	7.5	
12.0					8.5	
17.0	Very Stiff, Tan and Gray, Sandy SILT (ML) - moist.			7-9-12	18.5	
22.0	Dense, Brown, Silty SAND (SM) - moist to wet.			11-19-22	23.5	
25.0	Boring Terminated at 25 feet				25.0	
Groundwater:						
0 Hour - 14.5 feet						
1 Hour - 4.5 feet						
Stabilized - 2 feet						



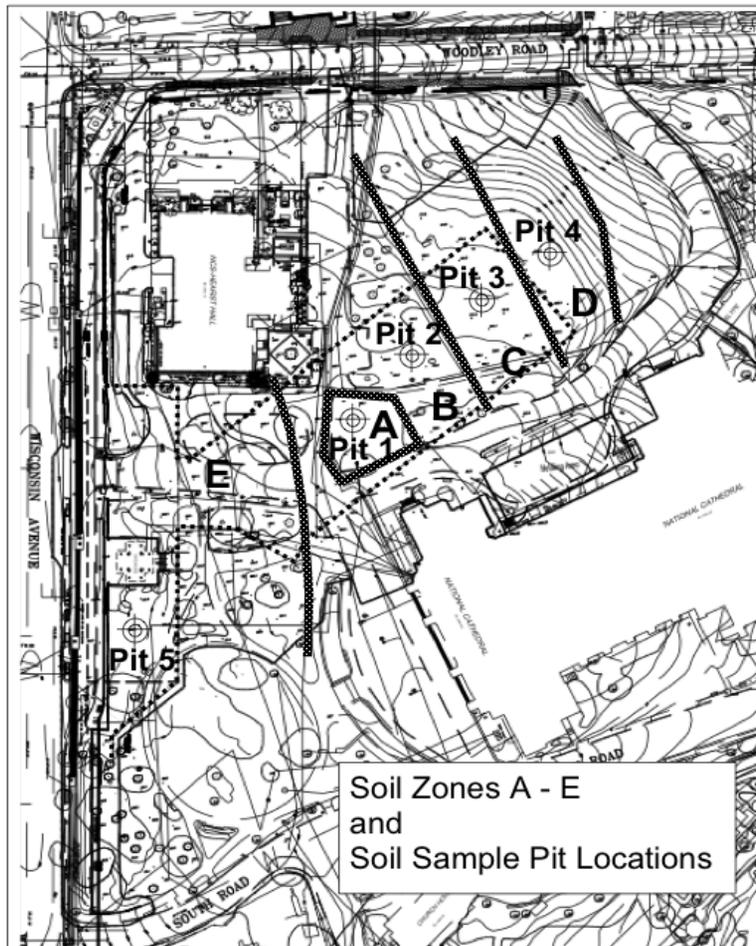


Changes in soil type

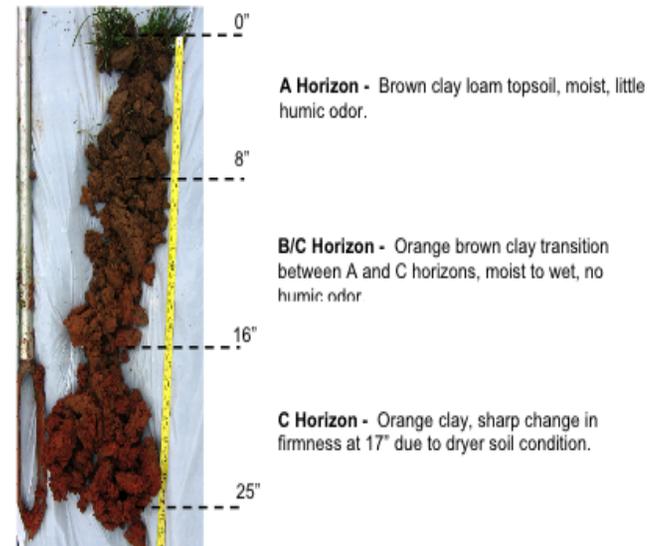
Creating a soil profile with a Dutch auger

Compile information on a site soil survey map

- Record different soil types, test results, and issues
- Identify potential soil & vegetation protection zones



Pit 3 - Soil Zone C: Good quality lawn, no trees. Soil is poorly drained but not anaerobic.



Soil test results and evaluations:

Pit 3 - A horizon: Clay loam soil. low pH (5.8)

This soil is similar to the topsoil found in zone and D. These topsoils are usable as deep soils for trees and for lawns that are not expected to have significant compaction forces or as a base material for and/soil mix for compaction resistant lawn

Pit 3 - B/C horizon: Clay.

This soil could be a useful base to mix with sand and compost in areas of trees, shrubs and or lawns.

Pit 3 - C horizon: Soil determined at field evaluation to have too much clay and too compacted to be useful.

Developing a Soil Management Plan (SMP)

- A scale-drawing identifying areas where each soil treatment option will be applied.
- A completed SMP form identifying treatment options, amendment products and calculated application rates for each area.
- Copies of laboratory analyses for compost and topsoil products to be used, with OM content and C:N

Model SOIL MANAGEMENT PLAN for BMP T5.13
(available as MS Word file at www.SaltsforSalmon.org)

Page # ___ of ___ pages

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)

<input type="checkbox"/> Site Plan showing, to scale:	<input type="checkbox"/> Areas of undisturbed native vegetation (no amendment required)
	<input type="checkbox"/> New planting beds and turf areas (amendment required)
	<input type="checkbox"/> 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	<input type="checkbox"/> Turf	<input type="checkbox"/> Undisturbed native vegetation
	<input type="checkbox"/> Planting Beds	<input type="checkbox"/> Other: _____
SQUARE FOOTAGE OF THIS AREA: _____ square feet		
SCARIFICATION	<input type="checkbox"/> inches (depth) of scarification needed to achieve finished total 12" loosened depth.	
Subsoil will be scarified		
PRE-APPROVED AMENDMENT METHOD:	<input type="checkbox"/> inches of compost or imported topsoil applied	PRODUCT: _____
<input type="checkbox"/> Topsoil import	X <u>3.1</u> (conversion factor, inches to cubic yards)	= cu. yards per 1,000 sq. ft.
<input type="checkbox"/> Amend with compost	X _____,000s sq.ft. in this area	QUANTITY: _____ CU. YDS.
<input type="checkbox"/> Stockpile and amend (_____ cu. yds. stockpiled)	= cubic yards of amendment → → → → →	(needed to cover this area to designated depth)
CUSTOM AMENDMENT	Attach test results and calculations.	
<input type="checkbox"/> Topsoil import	<input type="checkbox"/> inches organic matter or topsoil import	PRODUCT: _____
<input type="checkbox"/> Topsoil & compost lift	X <u>3.1</u>	= cu. yards / 1,000 sq. ft.
<input type="checkbox"/> Amend	X _____,000s sq.ft. in this area	QUANTITY: _____ CU. YDS.
<input type="checkbox"/> Stockpile and amend (_____ cu. yds. stockpiled)	= cubic yards of amendment → → → → →	
MULCH	<input type="checkbox"/> .000 sq. ft.	PRODUCT: _____
	X <u>6.2</u> (conversion, to give 2 inch mulch depth)	QUANTITY: _____ CU. YDS.
	= cubic yards of mulch → → → → →	

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

<input type="checkbox"/> Product #1:	% organic matter	C:N ratio <25:1 (except mulch, or <35:1 for native plants)	<input type="checkbox"/> Quantity: _____ cu. yds.	"stable" (yes/no)
<input type="checkbox"/> Product #2:	% organic matter	C:N ratio <25:1 (except mulch, or <35:1 for native plants)	<input type="checkbox"/> Quantity: _____ cu. yds.	"stable" (yes/no)
<input type="checkbox"/> Product #3:	% organic matter	C:N ratio <25:1 (except mulch, or <35:1 for native plants)	<input type="checkbox"/> Quantity: _____ cu. yds.	"stable" (yes/no)
<input type="checkbox"/> 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: _____

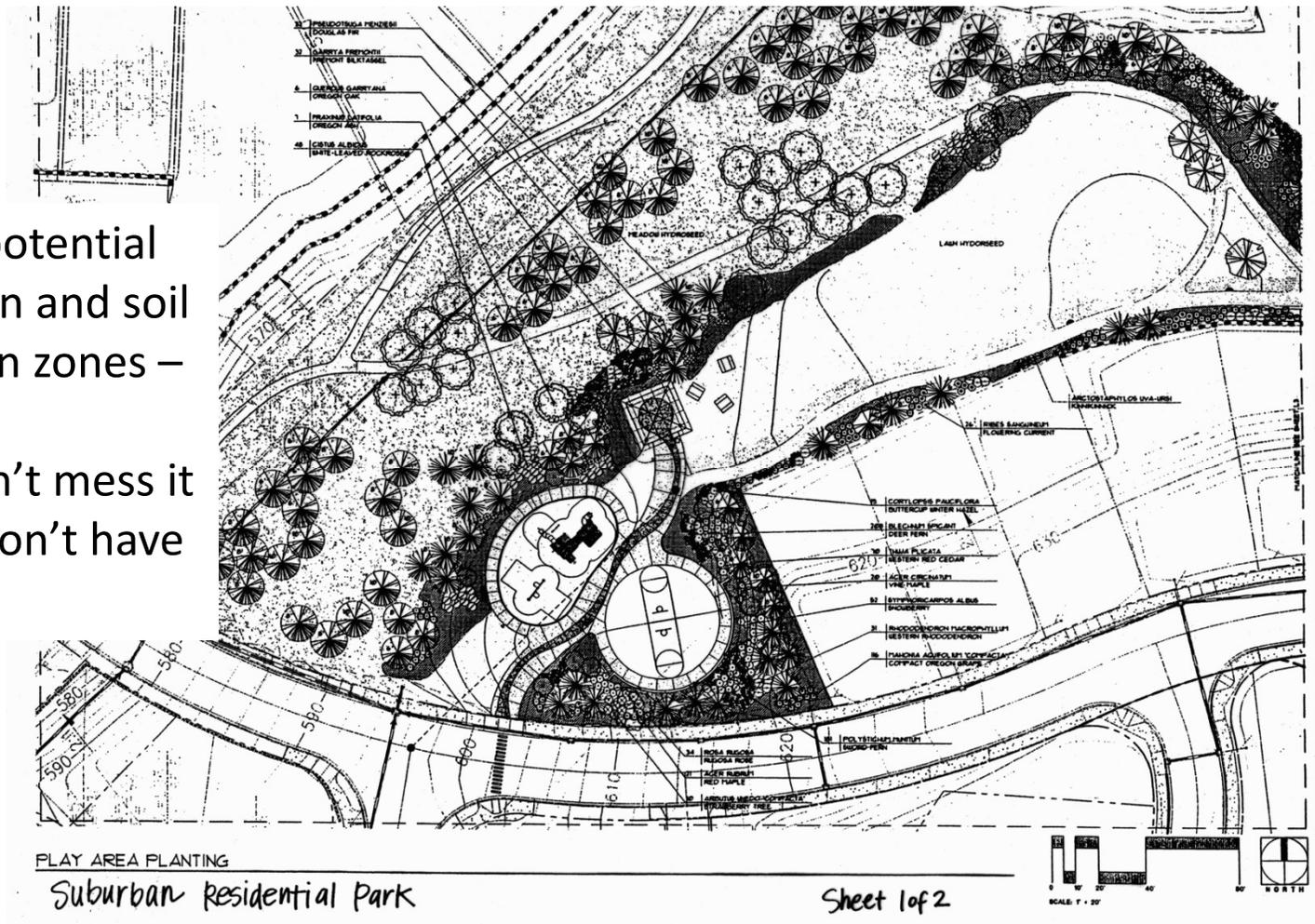
COMMENTS: _____

1: Review Landscape and Grading Plans

Working with plans, check the soil in each area to assess how grading will impact soil conditions and potential for reuse of topsoil excavated from building foundations, stormwater detention facilities, and planned pavement areas.

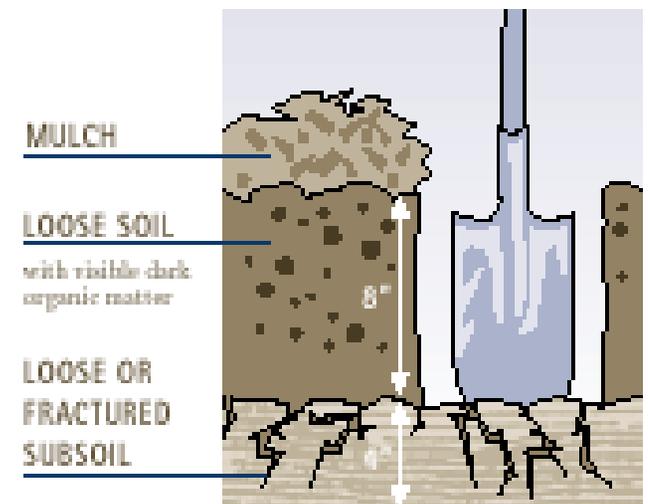
Identify potential vegetation and soil protection zones –

If you don't mess it up, you don't have to fix it!



2. Identify Areas Suitable for Each Option

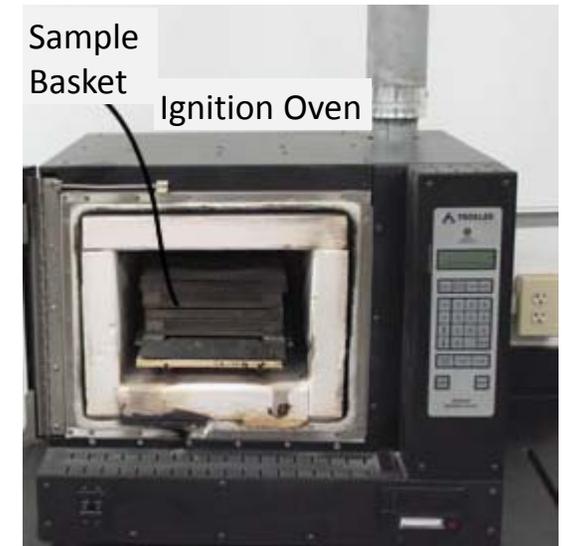
- Established “native” plants and duff– to be left undisturbed.
- Areas to be protected from compaction during construction.
- Areas to be cleared of native vegetation but not graded – may be amended at reduced rate.
- Excavated or graded topsoil suitable for stockpiling and reuse on site.
- Compacted layers less than 12 inches deep (after grading) – require scarification or soil import.
- Existing organic content in soil to be retained or stockpiled and reapplied – reduced amendment rate.



Soil Treatment Options	Amendment Rate Options
<p>Option 1. Retain undisturbed native vegetation and soil, and protect from compaction during construction.</p> <p>Option 2. Amend existing soil at pre-approved or custom calculated rates based on soil and amendment tests.</p> <p>Option 3. Import topsoil mix of sufficient organic content and depth.</p> <p>Option 4. Stockpile native topsoil during grading, and reapply after construction. (import soil if needed to achieve depth). Amend stockpiled soil if needed to meet 5% O.M. (turf) or 10% (planting beds)</p>	<p><u>Pre-approved Amendment Rate</u></p> <p>Turf: Mix 1.75” compost in to 8” depth (≅ 5% OM by loss-on-ignition test)</p> <p>Beds: Mix 3” compost in to 8” depth (≅ 10% OM by loss-on-ignition test)</p> <p><u>Custom-Calculated Rate</u></p> <p>Test soil and amendment for organic content and bulk density, to determine amendment rate needed to achieve 5 or 10% organic content</p>

Clearing up the confusion about “% organic”

- “% **Soil Organic Matter Content**” in lab soil tests is by “loss-on-ignition method” (= amount of combustible carbon by dry weight)
- Most composts are 40-65% organic matter (OM) content by this method



Recommended soil amendment rates

(for low-organic soils or sand-compost mixes):

- 5% Soil Organic Matter Content for Turf
=15-25% compost amendment by volume
- 10% Soil Organic Matter Content for Landscape Beds
=30-40% compost amendment by volume

3. Tests to Conduct for Custom Calculated Amendment Rates

If planning to use calculated amendment rate, sample and test soil. Request compost test results from supplier.

Soil

- Bulk density
- Percent organic matter

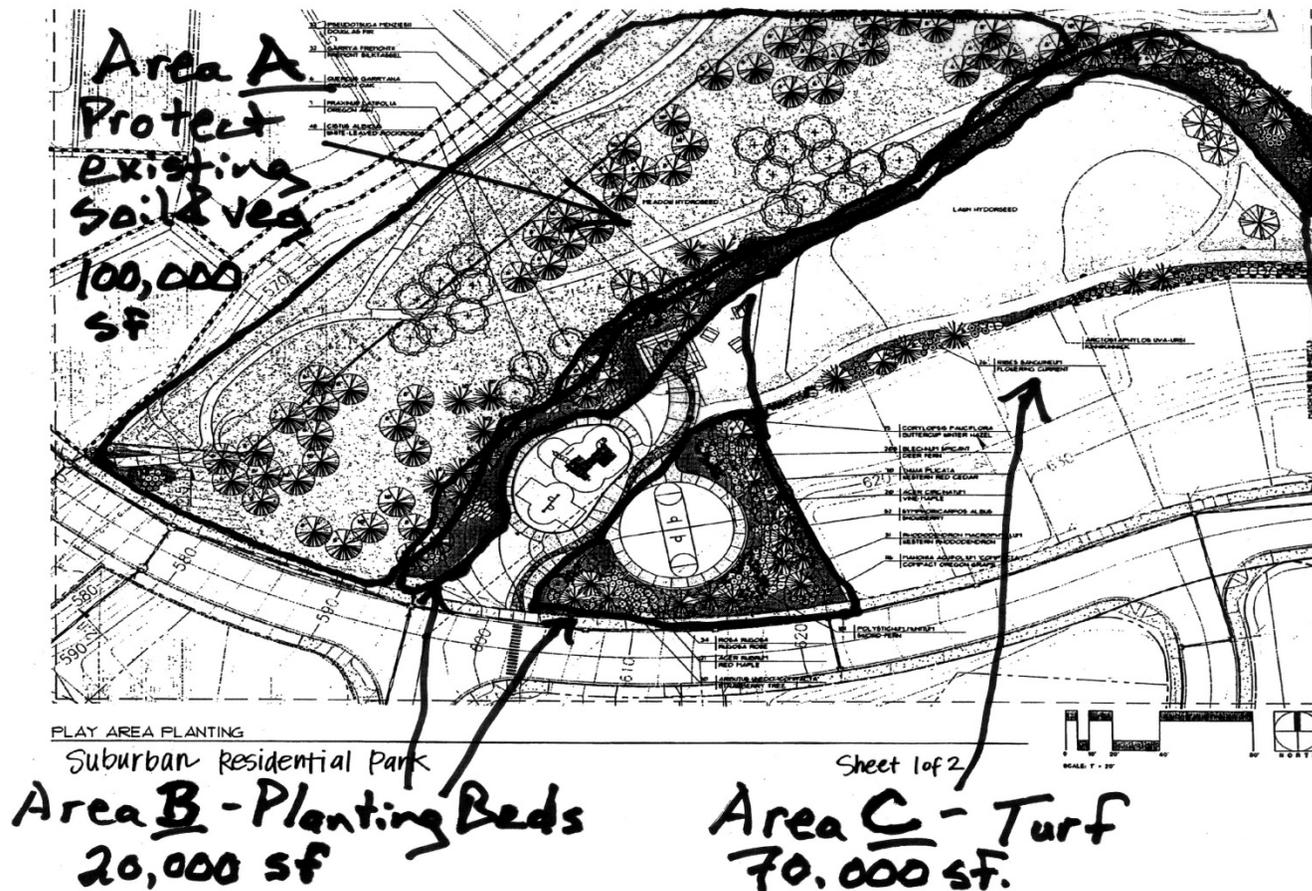
Compost

- Bulk density
- Percent organic matter
- Moisture content
(to determine dry weight, to compute bulk density)
- Carbon to nitrogen ratio

Sampling and calculations should be performed or verified by a licensed Soil Scientist, Geologist, Civil Engineer or Landscape Architect.

4. Select Amendment Options

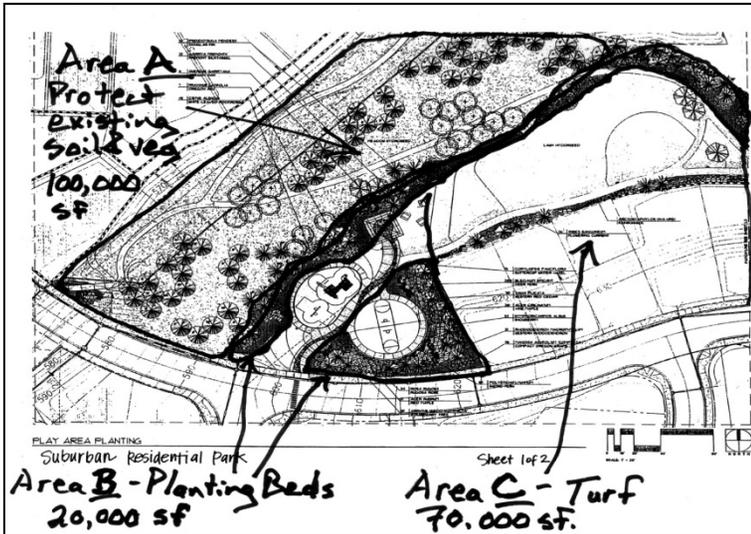
Outline areas where each amendment option will be applied on plan. Assign each area a letter (A, B, C...) on the plan and Soil Management Plan form.



King County's SMP form,
available at

<http://your.kingcounty.gov/solidwaste/compost-calculator.htm>

example site plan for exercise



SOIL MANAGEMENT PLAN FOR KING COUNTY SOIL IMPROVEMENT CODE

(For use with *Achieving the Post-Construction Soil Standard* brochure)

PROJECT INFORMATION

Site Address	
DDES Permit Number:	
Applicant:	Phone:
Mailing Address:	
Plan Prepared By:	

ATTACHMENTS REQUIRED

To-scale site plan showing planting beds and turf areas and which soil management options will be applied, with the square foot area for each. Also show areas where soil will be left undisturbed and protected during construction.
Soil test results (required if proposing custom amendment rates).

AMENDMENT AND TOPSOIL CALCULATIONS

TURF AREAS (As labeled on plan)		TOTAL AREA: ___ ,000 square feet
TREATMENT SELECTED:	<input type="checkbox"/> Pre-approved Amendment 1.75 inches	<input type="checkbox"/> Custom Amendment ___ inches (attach tests and calculations)
AMENDMENT OR TOPSOIL	<input type="checkbox"/> ___ inches compost / topsoil to be applied (from above box) <input checked="" type="checkbox"/> 3.1 = cu. yards / 1,000 sq. ft. <input checked="" type="checkbox"/> ___ ,000s sq. ft. ___ = cubic yards amendment	PRODUCT: _____ QUANTITY: _____ CU. YDS.

PLANTING BEDS (As labeled on plan)		TOTAL AREA: ___ ,000 square feet
TREATMENT SELECTED:	<input type="checkbox"/> Pre-approved Amendment 3.0 inches	<input type="checkbox"/> Custom Amendment Rate ___ inches (attach tests and calculations)
AMENDMENT OR TOPSOIL	<input type="checkbox"/> ___ inches compost / topsoil to be applied (from above box) <input checked="" type="checkbox"/> 3.1 = cubic yards / 1,000 sq. ft. <input checked="" type="checkbox"/> ___ ,000s sq. ft. ___ = cubic yards amendment	PRODUCT: _____ QUANTITY: _____ CU. YDS.
MULCH	<input type="checkbox"/> ___ inches mulch to be applied (minimum 2" recommended) <input checked="" type="checkbox"/> 3.1 = cubic yards / 1,000 sq. ft. <input checked="" type="checkbox"/> ___ ,000s sq. ft. ___ = cubic yards amendment	PRODUCT: _____ QUANTITY: _____ CU. YDS.

TOTAL AMENDMENT / TOPSOIL / MULCH FOR ALL AREAS

Product #1 Name: <input type="checkbox"/> Topsoil <input type="checkbox"/> Compost <input type="checkbox"/> Mulch	Quantity: _____ cu. yds. <input type="checkbox"/> Test Results Supplied
Product #2 Name: <input type="checkbox"/> Topsoil <input type="checkbox"/> Compost <input type="checkbox"/> Mulch	Quantity: _____ cu. yds. <input type="checkbox"/> Test Results Supplied
Product #3 Name: <input type="checkbox"/> Topsoil <input type="checkbox"/> Compost <input type="checkbox"/> Mulch	Quantity: _____ cu. yds. <input type="checkbox"/> Test Results Supplied

Date: _____	Inspector: _____	Approved: _____	Revisions Required: _____
Comments: _____			

King County's Amendment Rate Calculator

<http://your.kingcounty.gov/solidwaste/compost-calculator.htm>

Achieving the Post-construction Soil Standard

Compost and Topsoil Calculator for Pre-approved or Custom Amendment Rates

Soil Management Plan information. **Please note that there are separate calculation sheets for turf and planting beds.**

Are you performing a turf or planting application?

Turf Planting Beds

Pre-approved Compost Amendment rate or Custom Compost Amendment Rate?

Pre-approved Custom

If you have selected Custom Compost Amendment Rate, enter the target percentage of organic matter you'd like to achieve and the following values from soil and compost testing laboratory reports:

Target percentage of soil organic matter: AUTO-CALCULATED.

5% dry weight for turf applications,
10% for planting bed applications.

Bulk Density

SITE SOIL: (lbs/cubic yard dry weight) (1300-2800)

Organic Matter

(%) (0-10)

COMPOST: (lbs/cubic yard dry weight) (500-750)

(%) (35-65)

Enter information from site plans	Enter lettered areas where this option will be used	Enter combined square footage in thousands (Example, for 4,525 sq ft enter 4525 (no commas please))
Option 1: Leave native soil undisturbed	Not Applicable	Not Applicable
Option 2: Amend existing soil in-place	<input type="text" value="A"/> <input type="text" value="B"/> <input type="text" value="C"/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>	<input type="text" value="6500"/>
Option 3: Import topsoil mix	Not Applicable	Not Applicable
Option 4: Disturbed Soil - stockpile, reapply and amend	<input type="text" value=""/>	<input type="text" value=""/>

Need to test organic content and bulk density of compost and native soil for custom amendment rates.

Just enter square footage for default rates.

Results

You have selected the **Custom Compost Amendment Rate**, which is **1.4 inches**.

Site soil bulk density = **1850** lbs/cubic yard dry weight

Site soil organic matter = **1.5%**

Compost bulk density = **625** lbs/cubic yard dry weight

Compost organic matter = **55%**

Depth compost must be incorporated into soil = **8** inches

Stockpile these quantities of site soil:

0.0 cubic yards of stockpiled site soil.

Order these quantities of compost and/or topsoil:

27.7 cubic yards of compost.

0.0 cubic yards of topsoil.

	Amount Stockpiled Soil Needed	Amount Compost Needed	Amount Topsoil Needed
Option 1: Leave native soil undisturbed	N/A	N/A	N/A
Option 2: Amend existing soil in-place Areas: A, B, C Square footage in thousands = 6500	*	27.7 cubic yards	*
Option 3: Import topsoil mix Areas: Square footage in thousands =	*	*	*
Option 4: Disturbed Soil - stockpile, reapply and amend Areas: Square footage in thousands =	*	*	*
Totals	*	27.7 cubic yards	*

Suggested Inspection Procedures

- Pre-Grading Inspection
- Grading Progress Inspection
- Post-Construction Inspection
- Mulch Verification

Exact number of inspections will vary between jurisdictions and project type.

Example form and guide at www.soilsforsalmon.org

Verifying Soil Quality and Depth - SECTION 01A

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. Page # ____ of ____ pages

Site Address: _____

Permit Type: _____ Permit Number: _____
Permit Holder: _____ Phone: _____
Mailing Address: _____

Customer Representative At Inspection: _____ Phone: _____
Plan Prepared By: _____

VISIT RECORD

Date:	Inspector:	Items Approved: <input type="checkbox"/> Fencing off undisturbed areas <input type="checkbox"/> Soil preparation <input type="checkbox"/> Mulch <input type="checkbox"/> Other:	
Date:	Inspector:	Items Approved: <input type="checkbox"/> Fencing off undisturbed areas <input type="checkbox"/> Soil preparation <input type="checkbox"/> Mulch <input type="checkbox"/> Other:	
Date:	Inspector:	Items Approved: <input type="checkbox"/> Fencing off undisturbed areas <input type="checkbox"/> Soil preparation <input type="checkbox"/> Mulch <input type="checkbox"/> Other:	

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).

<input type="checkbox"/> Product #1: <input type="checkbox"/> Test Results: ___ % organic matter ___ C:N ratio <25:1 ___ "stable" (Y/N) <input type="checkbox"/> Quantity: ___ cu. yds. (except mulch, or <35:1 for native plants)	Comments:
<input type="checkbox"/> Product #2: <input type="checkbox"/> Test Results: ___ % organic matter ___ C:N ratio <25:1 ___ "stable" (Y/N) <input type="checkbox"/> Quantity: ___ cu. yds. (except mulch, or <35:1 for native plants)	
<input type="checkbox"/> Product #3: <input type="checkbox"/> Test Results: ___ % organic matter ___ C:N ratio <25:1 ___ "stable" (Y/N) <input type="checkbox"/> Quantity: ___ cu. yds. (except mulch, or <35:1 for native plants)	

AREA # _____ (described on Soil Management Plan)

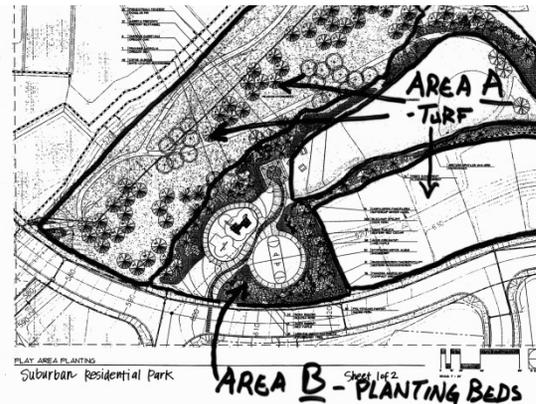
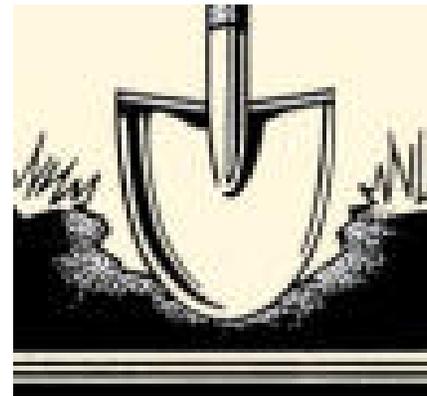
(minimum 1 hole/acre) Y / N	Rod Test Number Rod Tests Required: _____ (minimum 10 tests/acre)
	Rod penetrates 12 inches deep in all areas? Y / N

Additional sheets for additional Areas

model
Field Verification form &
guide is on page 16 in the
"Building Soil" manual,
and on website

Inspection / Verification Supplies

- Field Verification Form
- Soil Management Plan
- Site drawing
- Shovel
- Tape measure



verifying soil usability and depth - dcl.rh@dnr.wa.gov

Model FIELD VERIFICATION FORM for BMP 15.13
(available as MS Word file at www.SoilForSalmon.org)

Page # ____ of ____ pages

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

Site Address: _____

Permit Type: _____ Permit Number: _____

Permit Holder: _____ Phone: _____

Mailing Address: _____

Customer Representative At Inspection: _____ Phone: _____

Plan Prepared By: _____

VISIT RECORD

Date:	Inspector:	Items Approved:	Fencing off undisturbed areas _____	Soil preparation _____
			Match _____	Other: _____
Date:	Inspector:	Items Approved:	Fencing off undisturbed areas _____	Soil preparation _____
			Match _____	Other: _____

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.)

<input type="checkbox"/> Product #1: _____	Comments: _____
<input type="checkbox"/> Test Results: _____ % organic matter _____ C:N ratio >25:1 _____ "stable" (Y/N)	
<input type="checkbox"/> Quantity: _____ cu. yds. (except match, or <3:1 for native plans)	
<input type="checkbox"/> Product #2: _____	
<input type="checkbox"/> Test Results: _____ % organic matter _____ C:N ratio >25:1 _____ "stable" (Y/N)	
<input type="checkbox"/> Quantity: _____ cu. yds. (except match, or <3:1 for native plans)	
<input type="checkbox"/> Product #3: _____	
<input type="checkbox"/> Test Results: _____ % organic matter _____ C:N ratio >25:1 _____ "stable" (Y/N)	
<input type="checkbox"/> Quantity: _____ cu. yds. (except match, or <3:1 for native plans)	

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

PLANTING TYPE	Test Holes	Rod Test
Undisturbed vegetation _____	Number Test Holes Required: _____ (minimum 1 hole/acre)	Number Rod Tests Required: _____ (minimum 10 tests/acre)
Turf _____	Soil Amended 8 inches Deep? _____ Y / N	
Planting Beds _____	Amendment Matches Soil Mgmt. Plan? _____ Y / N	Rod penetrates 12 inches deep in all areas? _____ Y / N
Other: _____	<input type="checkbox"/> Topsoil Product? _____	
	<input type="checkbox"/> Amendment Viable? _____	
Square footage: _____	Subsoil Loose/Scarified 12 inches Deep? _____ Y / N	
(If Planting Bed, Match is Required After Planting)	Comments: _____	
Match Product: _____		
Match two inches deep? _____ Y / N		

PLANTING TYPE	Test Holes	Rod Test
Undisturbed vegetation _____	Number Test Holes Required: _____ (minimum 1 hole/acre)	Number Rod Tests Required: _____ (minimum 10 tests/acre)
Turf _____	Soil Amended 8 inches Deep? _____ Y / N	
Planting Beds _____	Amendment Matches Soil Mgmt. Plan? _____ Y / N	Rod penetrates 12 inches deep in all areas? _____ Y / N
Other: _____	<input type="checkbox"/> Topsoil Product? _____	
	<input type="checkbox"/> Amendment Viable? _____	
Square footage: _____	Subsoil Loose/Scarified 12 inches Deep? _____ Y / N	
(If Planting Bed, Match is Required After Planting)	Comments: _____	
Match Product: _____		
Match two inches deep? _____ Y / N		

Add additional sheets for additional Areas

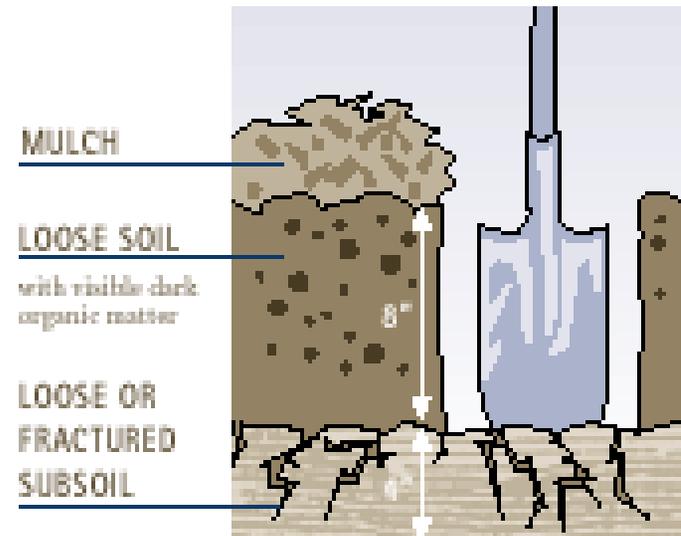


Pre-Grading / Grading Progress Inspection

- Verify native soils & vegetation delineation and protection (fencing or other) per SMP
- Review SMP with general contractor and/or grading equipment operator
- Verify subcontractors informed of SMP
- Verify erosion controls in place
- Verify excavation & stockpiling of native soils consistent with SMP
- Check sub-grades consistent with SMP

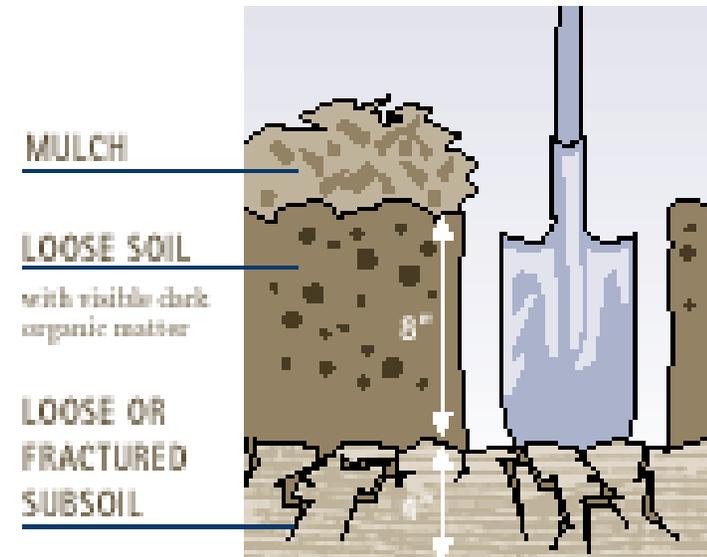
Post Construction (prior to planting)

- Compare conditions to SMP / drawings
- **Confirm volumes on amendment delivery tickets match approved SMP**
- Dig test holes to check depth of amended soil & scarification
- Use shovel test to check un-compacted depth in multiple locations



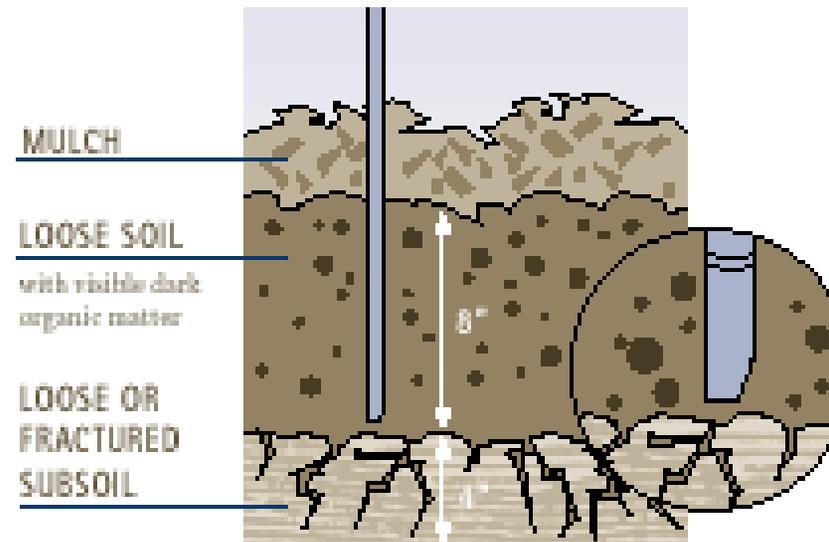
Dig Test Holes to Check Depth of Amended Soil & Scarification

- At least three 12 inch deep test holes per acre (3 minimum) for each treatment
- 8" depth of amended soil (excluding mulch layer)
- Scarified subsoil



Check Soil Depth

- Use shovel or rod “driven only by inspectors weight” to test for compaction
- Test 10 locations per landscaped acre (10 minimum).



In Case Of Dispute



Referred to third party for sampling and testing of organic matter:

- Independent Certified Agronomist, Crop Advisor or Soil Scientist; Licensed Civil Engineer, Landscape Architect or Geologist
- Accredited Soil Testing Lab

Best to avoid this, by having clear SMP and delivery tickets that match volumes/products listed on SMP.

How to Select Compost

Know your supplier!



- Field tests:
 - earthy smell - not sour, stinky, or ammonia
 - brown to black color
 - uniform particle range
 - stable temperature (does not get very hot if re-wetted)
 - not powdery or soaking wet
 - Solvita field maturity test
- Soil/compost lab test info:
 - Nutrients
 - Salinity
 - pH
 - % organic content (OM)
- Mfr.-supplied info:
 - Meets US Compost Council (STA) “Seal of Testing Assurance”, State WAC 173-350, & WsDOT specs
 - C:N ratio
 - Weed-seed trials
 - Nutrients, salinity, contaminants
 - Size: “screen”, % fines
- Specifications:
 - WsDOT
 - Bioretention Soil: Compost spec www.seattle.gov/util/GreenInfrastructure

“Composted Material” per WAC 173-350-220

- Produced at “Permitted Facilities” with environmental safeguards to protect streams and groundwater.
- Process monitored to ensure temperatures that destroy most pathogens.
- Tested at frequencies dictated by feedstock & output, for:
 - Heavy metals
 - Pathogens
 - Physical contaminants
 - Biological stability (affects odors and plant response)



Bioretention spec compost meets WAC and STA



SOIL CONTROL LAB

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95074
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 5010741-1/2-2192
Group: Jan.15 D #33
Reporting Date: February 17, 2015

Cedar Grove Compost
17825 Cedar Grove Rd. SE
Maple Valley, WA 98038
Attn: Howard Stenn

Date Received: 30 Jan. 15
Sample Identification: MV Sales 1-29-15
Sample ID #: 5010741 - 1/2

Metals	Results	Units	MDL	% Recovery	Date Tested
Arsenic (As):	7.5	mg/kg dw	1.0	105.5	05 Feb. 15
Cadmium (Cd):	Less than 1.0	mg/kg dw	1.0	101.4	05 Feb. 15
Chromium (Cr):	36	mg/kg dw	1.0	111.4	05 Feb. 15
Copper (Cu):	120	mg/kg dw	1.0	103.7	05 Feb. 15
Lead (Pb):	40	mg/kg dw	1.0	112.6	05 Feb. 15
Mercury (Hg):	Less than 1.0	mg/kg dw	0.10	95.4	05 Feb. 15
Molybdenum (Mo):	1.6	mg/kg dw	1.0	103.8	05 Feb. 15
Nickel (Ni):	26	mg/kg dw	1.0	106.5	05 Feb. 15
Selenium (Se):	4.3	mg/kg dw	1.0	125.2	05 Feb. 15
Zinc (Zn):	210	mg/kg dw	1.0	104.5	05 Feb. 15
Cobalt (Co)	4.3	mg/kg dw	0.50	110.0	05 Feb. 15
Total Solids (TMECC 03.09)	45	%	0.05	NA	30 Jan. 15
pH	7.34	Std. Units	0.10		
Inerts					
Total Inerts	< 0.1	% dw	0.10		
Plastic	< 0.1	% dw	0.10		
Film Plastic	< 0.1	% dw	0.10		
Metal	< 0.1	% dw	0.10		
Glass	< 0.1	% dw	0.10		
Sharps	None Detected		-		
Total Nitrogen (N)	1.6	% dw	-		
Salmonella	< 3	MPN/4g	3		30 Jan. 15
Stability Indicator					
	9.1	mg CO2-C/g OM/day	-		

Method (metals): EPA 3050B / EPA 6010
Method (metals): TMECC 04.12-B / 04.14-A
Method (Mercury Hg) TMECC 04.06 / EPA 7471
Method (pH): TMECC 04.11A
Method (Inerts): TMECC 02-02-C
Method (Total N): TMECC 4.02-D
Method (Salmonella): TMECC 07.02-A
Method (Stability Indicator): TMECC 05.08-B

Analyst: Assaf Sadeh




US COMPOSTING COUNCIL
Seal of Testing Assurance

Cedar Grove Compost
Howard Stenn
17825 Cedar Grove Rd. SE
Maple Valley WA 98038

Washington State Department of Transportation

Product Identification:
MV Sales 1-29-15
Date Sampled/Received: 29 Jan. 15 / 30 Jan. 15

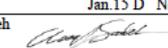
Compost Technical Data Sheet for Washington State DOT Projects

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	Specification Requirements	Test Results
	%, dry weight passing through	%, dry weight passing through
Size Classification	Sieve Size Fine Medium Coarse	Sieve Size
TMECC 02.02-B	2" 100 100 80 - 100	2" 100.0
	3/4" 70 - 100	1" 100.0
	5/8" 90 - 100 85 - 100	3/4" 100.0
	1/4" 75 - 100 70 - 85 40 - 60	5/8" 98.9
		1/4" 86.4
	Maximum Particle Length	Maximum Particle Length
	4" 4" 6"	Less than 4"
pH		
TMECC 04.11-A 1:5 slurry	6.0 min. and 8.5 max.	7.34
Physical Contaminants		
TMECC 03.08-A % dry weight basis	0.5 max.	< 0.5
Organic Matter Content		
TMECC 05.07 A Loss-on-Ignition % dry weight basis	40 min.	51.2
Soluble Salts		
TMECC 04.10-A 1:5 Slurry dS/m (mmols/cm)	4.0* max.	3.8
Maturity Indicator		
TMECC 05.05 A Cucumber Bioassay % average of control	Germination: 80% or greater Vigor: 80% or greater	Germination: 100 Vigor: 100
Stability Indicator		
TMECC 05.08-B Carbon Dioxide Evolution Rate	7 or below mg CO2-C/g OM/day	9.1
C/N Ratio	18:1 - 35:1 25:1 - 35:1	17.5

*Check for special provisions in Columbia River basin

*This compost product has been sampled and tested by the Seal of Testing Assurance Program of the United States Composting Council (USCC), using certain methods from the Test Methods for the Examination of Compost and Composting Manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality, or suitability for any particular use.

Laboratory Group:	Jan.15 D No.33	Laboratory Number:	5010741-1/2-2192
Analyst: Assaf Sadeh		www.compostlab.com	Date Reported: 16-Feb-15

Carbon to Nitrogen ratio of composts

- For turf & most landscapes
C:N ratio of 20:1 to 25:1 - good nutrient availability for first year of growth (no other fertilizer needed)
- For native plants and trees
C:N ratio of 30:1 to 35:1, and coarser (1" minus screen)
 - less nitrogen better for NW natives, discourages weeds
 - for streamside, unlikely to leach nitrogen

Importing “Topsoil”

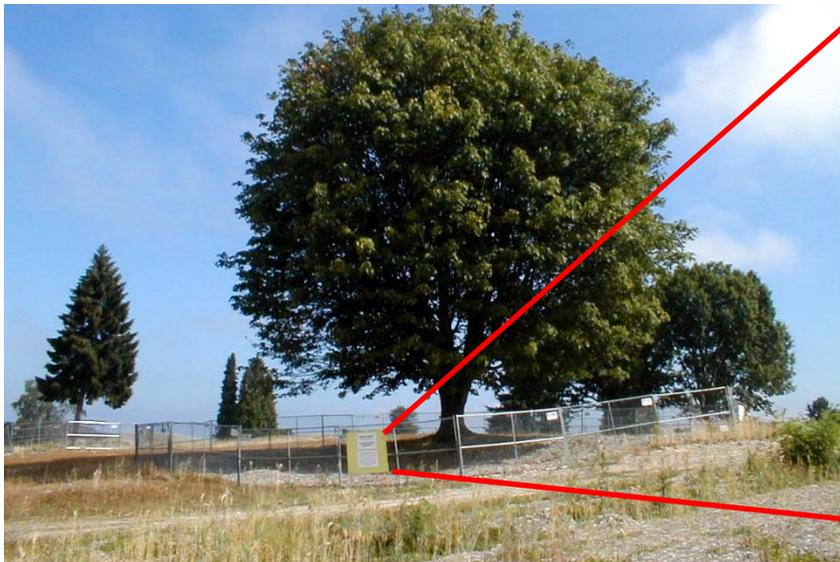
- “Topsoil” is not a defined, regulated product. Topsoil products often include subsoil, uncomposted organic material, land-clearing and construction debris...
- Best to use mixes containing only clean compost and mined sand or “sandy loam” as defined by USDA.
- Important to avoid excess clay that can inhibit drainage – spec <5% passing #200 sieve



- Good soil specs for planting, turf, & other areas available at www.seattle.gov/util/engineering/standardspecsplans Div. 9-14

Protecting soil & vegetation during construction

- Fence *vegetation & soil protection zones*
- Inform all contractors & subs: no stockpiles etc.
- If temporary vehicle access required, place steel plates over 6" coarse wood chip.



Fence to protect from construction impacts



Communicate vegetation & soil protection zones and Soil Management Plans to all contractors and crews

Soil and tree preservation are similar, but trees sometimes need extra effort in tight urban spaces.



Statewide LID Training Program



8.2 SOILS

Compost Application Methods



Compost application & incorporation methods:

- Blowing
- Spreading
- Tilling / ripping
- Blending off-site



Blowing & spreading

- Blower trucks
- Various construction grading equipment
- Other equipment :
golf course & farm spreaders



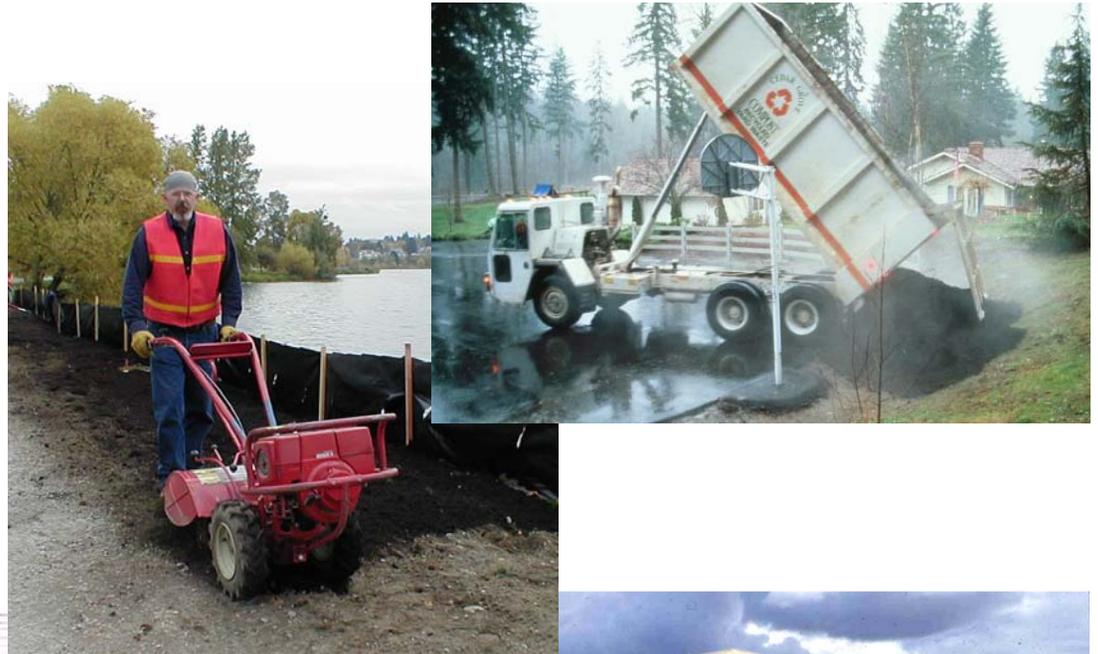
Issaquah Highlands – the big scale

PB
PORT BLAKELY
COMMUNITIES



Incorporating amendments into soil

- Range of equipment for different-sized sites
- Till in to 8" depth
- If compacted, rip (scarify) to 12" depth before/while amending



Stockpile site soils & amend, after road & foundation work

- Allows mass grading
- Can reduce hauling & disposal costs
- Set grade to allow re-application of topsoil & allow for settling
- Amend stockpile to spec offsite, or after reapplication
- Spread after concrete work
- Rip in first lift, to reduce sub-grade compaction, and break up sharp soil horizons that can limit water penetration



Redmond Ridge

- Large, master-planned development
- Forest left undisturbed where possible - no compaction
- Cleared vegetation & duff stockpiled for use as soil amendment
- Removed topsoils stockpiled
- All soils amended to 12" depth with organics
- **Early Problems:** Too much organic esp. for turf areas, organic materials not composted (landclearing & duff) - soft soil, excessive water retention, low N, plant/turf problems as result



Redmond Ridge: improved method

- Grade site 12 in. below finish
- Install foundation, along with driveway & walkway rock pads
- Spread 14 in. amended soil mix, (will settle to 12 inches) rip in first lift to mix with subsoil
- Soils blended offsite from native duff plus compost
- Soil organic matter controlled to ~10%, pH and C:N ratio for optimal plant growth



Putting organics to work - SEA Streets

Street Edge Alternative
onsite detention demo,
Seattle Public Utilities
and SDOT.



- Compost in wet and dry zones
- **98% reduction in runoff.**

www.seattle.gov/util/GreenInfrastructure

Compost Based Erosion Control BMPs



- EPA and Ecology-approved BMPs: **blankets, berms, and socks** see www.buildingsoil.org
- “2 for 1” – use compost for erosion control, then till in at end to meet soil BMP:
 - No disposal costs
 - Faster planting, better growth
- Costs: blankets similar to rolled products, but savings on disposal, plus 2 for 1 benefits
- Learn more at www.buildingsoil.org/tools/Erosion_Control.pdf



“2 for 1”: construction erosion control and soil quality BMPs are met with compost at Issaquah Highlands.



Broadview Green Grid, Seattle

Compost-amended soil in bioretention swales,
compost blankets on slopes



Broadview -

Erosion control with compost blankets, berms, and socks
day after 100-year storm event – no erosion



WsDOT: Erosion control, water quality, successful landscapes with lower mtce. costs

- SR 14, Vancouver
Coarse compost, blown in
Note erosion where not applied



- Compost amendment, ripped in
- Extensive soil bio-engineering info at:
<http://www.wsdot.wa.gov/Design/Roadside/>

WsDOT projects around Washington

Erosion control and plant establishment on steep site using compost blankets

Chelan



Photos courtesy of Sandy Salisbury, WSDOT

Combine methods as needed for best water quality and flow control

WsDOT - Protecting Wetland Area from I-5 Runoff



USING MULCHES

After planting and for annual maintenance

MULCH BENEFITS:

- Limit weed growth, make weeds that sprout easier to pull or cultivate
- Conserve water, moderate soil temperature, and reduce erosion
- Replenish soil organic matter, enhancing soil biodiversity, structure, and nutrient cycling = increased plant vigor



MULCHING BEST PRACTICES

- Annual, spring or fall, until plant canopy closes
- Arborist wood chips best (for woody & perennial plants).

Selling soil BMP's to developers, builders, landscape contractors, & homeowners:

Value to builder/contractor

- Better erosion control
- Less plant loss = fewer callbacks
- Making money on materials and labor
- Quicker planting in prepped soil
- Easier maintenance
- Better appearance sells next job

Sell quality & savings to customer

- Better plant survival/ health/ growth/ appearance
- Lower water bills
- Lower maintenance costs
- Reduced chemical needs
- Better for salmon because:
 - reduced storm runoff
 - improved water quality



← Compost

Which site is selling
the next job?

No Compost →



I-5 Marvin Rd. Interchange

Links to useful soil specifications:

Building Soil: Guidelines for Implementing
WDOE Soil Quality & Depth BMP
(includes APWA & CSI specs)

www.soilsforsalmon.org or www.buildingsoil.org

LID Technical Guidance Manual for Puget Sound

www.psp.wa.gov/stormwater.php

Eastern WA: www.wastormwatercenter.org

WsDOT “Soil Bioengineering” specs

www.wsdot.wa.gov/Design/Roadside/

Seattle Green Stormwater Infrastructure specs

www.seattle.gov/util/GreenInfrastructure

King County soil regs (in Grading code)

<http://your.kingcounty.gov/solidwaste/greenbuilding/soil-standard.asp>

City of Seattle soil regs (in Stormwater code)

<http://www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm>



LID Manual includes
a Soil chapter from the
Building Soil manual

Builders, developers, and landscapers

are adopting practices that preserve and improve the soil on building sites, grow healthier landscapes, and protect waterways. Local governments are beginning to require these practices.



5 Steps to Building Soil

Best management practices (BMPs) during construction:

1. Retain and protect native topsoil & vegetation where practical
2. Restore disturbed soils, to restore healthy soil functions, by:
 - stockpiling & reusing good quality site soil, or
 - tilling 2-3" of compost into poor site soils, or
 - bringing in 8" of compost-amended topsoil
3. Loosen compacted subsoil, if needed, by ripping to 12" depth
4. Mulch landscape beds after planting
5. Protect restored soils from erosion or re-compaction by heavy equipment

Why build healthy soil?

- More marketable buildings and landscapes
- Better site erosion control
- Reduced need for water and chemicals
- Less stormwater runoff, better water quality
- Healthy landscapes = satisfied customers

Washington State's [stormwater permits](#) require these soil BMPs. That requirement is taking effect locally as towns and counties around Western Washington update their stormwater codes (as required by law). Some jurisdictions already require the soil BMPs – all will soon.

The good news is, it's easy, and customers want it. New home buyers say they are happy to pay more for a healthy, easy to care for landscape – and that starts with the soil.

Successful Projects

[Learn more about these projects >](#)



preserving vegetation, stockpiling topsoil



amending existing soil with compost



placing compost amended topsoil

Tools for builders

View [slide show](#) (PDF 5MB) Why, how-to tips, and successful projects, or [brochure](#)

Watch [video](#) (on King County's website)

Building Soil Manual

the builder's guide:

- [summary](#) (PDF) with links to compost calculator, suppliers, specs, and more
- [full Building Soil Manual](#) (PDF, 4MB)

[Soil BMP requirements](#) in state and local codes, or [text of State BMP](#) (PDF)

[Landscaping guide](#) (PDF) Design, building, and maintenance tips for professionals

[When to amend?](#) (PDF) Construction sequencing for soil protection and restoration

[Erosion control with compost](#) (PDF)

Meet your TESC requirements, build healthy soil, work faster, and save money.

[Homebuyer factsheet](#) (PDF) Print and use to promote your healthy soil and landscape practices to your customers. It sells!

Learn More – Background, science, specs and resources for designers, and related information are available on our partner website:

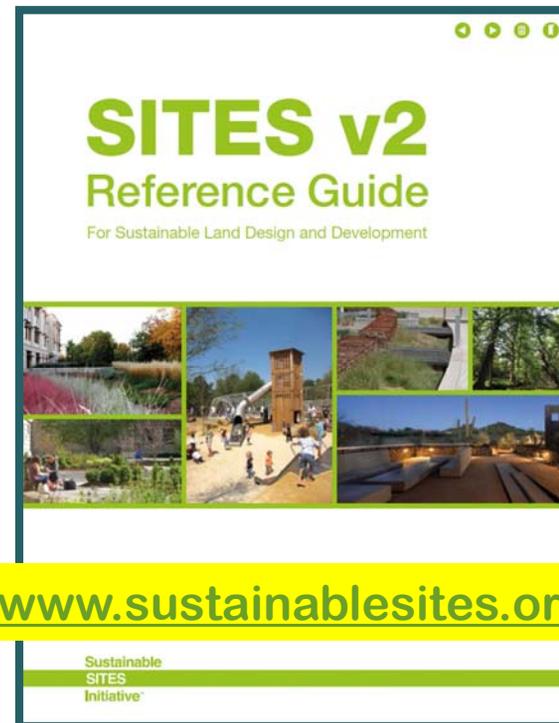
www.soilsforsalmon.org

Science and design: www.SoilsforSalmon.org

Builder's info: www.BuildingSoil.org

Related national standards: 2014 Sustainable Sites (SITES™)

- SITES is the new national site & landscape equivalent to the USGBC's LEED™ green building certification system.
- SITES includes soil protection and restoration requirements modeled on Washington's
- Includes Soil Management Plan requirement
- Similar Green Stormwater BMP requirements to WA LID & DOE stormwater manuals



A natural solution - for healthier streams, and healthier landscapes

Conserve existing soils and vegetation where possible.

Restore natural functions in disturbed soils by correcting compaction and using organic amendments.

Building Soil
Foundation for Success

Builders, developers, and landscapers are adopting practices that preserve and improve the soil on building sites, grow healthier landscapes, and protect waterways. Local governments are beginning to require these

Why build healthy soil?

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5 Steps to Building Soil

Best management practices (BMPs) during construction:

1. Retain and protect native topsoil & vegetation where practical
2. Restore disturbed soils, to restore healthy soil functions, by:
 - stockpiling & reusing good quality site soil, or
 - tilling 2-3" of compost into poor site soils, or
 - bringing in 8" of compost-amended topsoil
3. Loosen compacted subsoil, if needed, by ripping to 12" depth
4. Mulch landscape beds after planting
5. Protect restored soils from erosion or re-compaction by heavy equipment

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Successful Projects
[Learn more about these projects >](#)

www.BuildingSoil.org

SOILS FOR SALMON
Healthy Soils. Healthy Environment

Building the Soil for Cleaner Water, Healthier Streams, Successful Landscapes, and Healthy Communities

Soils for Salmon

Builders, developers, and landscapers are adopting practices that preserve and improve the soil on building sites, and protect waterways, and local governments are beginning to require it.

The simple soil "best management practices" (BMPs) described here include preserving site topsoil and vegetation where possible, reducing compaction, and amending disturbed soils with compost to restore healthy soil functions.

Advantages to builders, consumers, and the environment include:

- More marketable buildings
- Better erosion control
- Easier planting
- Healthy, attractive landscapes
- Easier maintenance with less water and chemical needs
- Reduced stormwater runoff, with better water quality for salmon, wildlife, and people too.

Follow the links at left to learn more...

Questions? Information you'd like to see on this site? Email info@compostwashington.org

Created and maintained by the Washington Organic Recycling Council

www.SoilsforSalmon.org