

WSDOT Experiences Using Compost on Roadside Applications

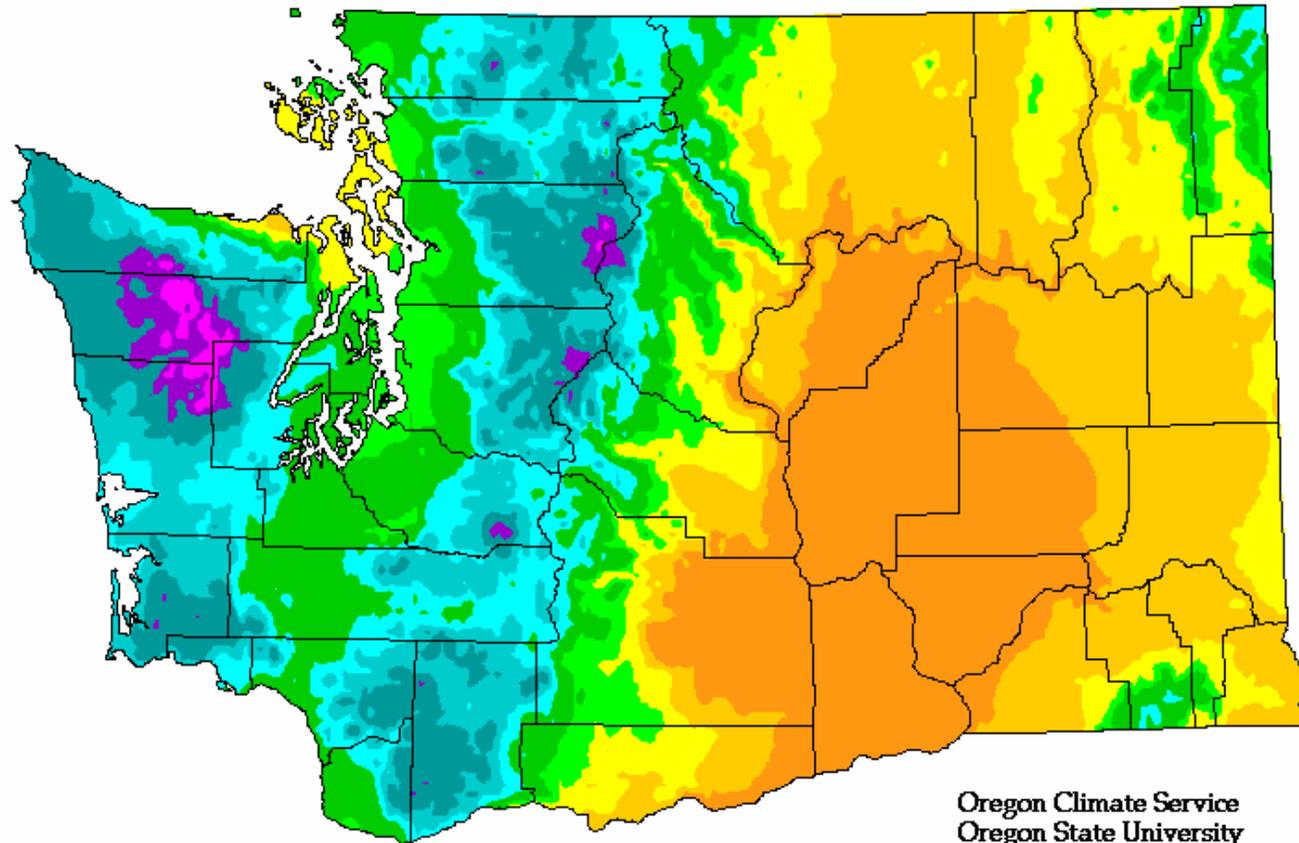
Sandy Salisbury, LA
Region Liaison Landscape Architect

October 11, 2006



Average Annual Precipitation

Washington

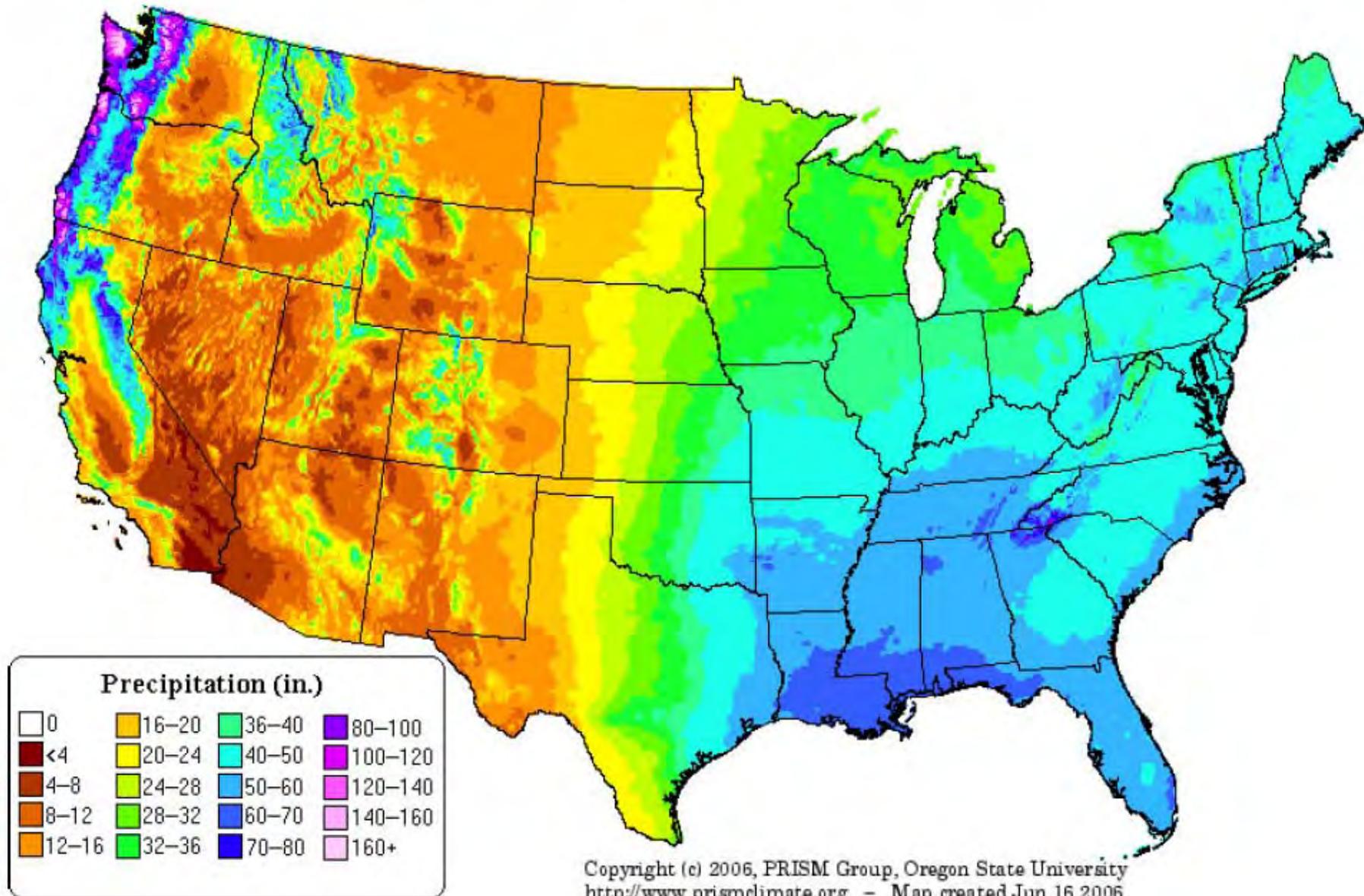


Legend (in inches)	
Under 10	60 to 80
10 to 20	80 to 100
20 to 30	100 to 140
30 to 40	140 to 180
40 to 60	Above 180

Period: 1961-1990

This map is a plot of 1961-1990 annual average precipitation contours from NOAA Cooperative stations and (where appropriate) USDA-NRCS SNOTEL stations. Christopher Daly used the PRISM model to generate the gridded estimates from which this map was derived; the modeled grid was approximately 4x4 km latitude/longitude, and was resampled to 2x2 km using a Gaussian filter. Mapping was performed by Jenny Weisberg and Nathaniel DeYoung. Funding was provided by USDA-NRCS National Water and Climate Center.

Precipitation: Annual Climatology (1971-2000)



Today's Roadmap

- Why I use compost
- “Enabling” Legislation & Partnerships
- WSDOT Compost Specifications
- Waste Reduction & Compost Quality
- Water Quality studies
- Results in the field



2000 7 20



Applied at just over 1 inch depth – we ran out = Control Area





Forks, WA – 140" precip./yr – marine clay



FEB 22 2005



US 395, Spokane, WA
Soil = very fine sand

Compost applied
Dec. 2005

← Compost & seed only

Seed, mulch, fertilizer, tackifier →

Applied April 11, 2006

Heavy Rains early June 2006





“Enabling” Legislation & Cooperation

- Revised Code of Washington (RCW) 43.19A.050 Instructs WSDOT to increase purchases of recycled products. 80% of \$ for all soil amendments used on an annual basis must be compost. “Compost” must be derived from biological conversion of biosolids or cellulose-containing waste materials (RCW 43.19A.010)
- WAC 173-350 Sets Standards for Solid Waste Handling & heavy metals in compost
- WSDOT partners with Ecology – share information & participate in compost operator training to get high quality compost
- WA State Dept of Ecology – initiative to reuse and reduce wastes. 3rd initiative is to increase recycling for organic materials.



WSDOT Compost Specifications

- Stable, mature result of aerobic decomposition of organic matter.
- pH between 6.0 and 8.5
- Soluble Salt content below 4 mmhos/cm (1:5 Slurry Method, Mass Basis)
- Minimum organic matter of 40%
- STA Certification of Lab and compost producer from US Composting Council

Water Quality & Quantity Research

SR 8 Compost Amended Vegetated Filter Strips (CAVFS)

- Two 12' lanes and an 8' shoulder drained onto the plots
- 3 plots approximately 20' long by 10' wide
- The plots were excavated to 18" deep
- One plot received standard roadway ex
- One plot received 12" roadway ex and 6" topsoil
- One plot received 12" roadway ex and 6" compost

Water Quality & Quantity Research

SR 8 Compost Amended Vegetated Filter Strips (CAVFS)

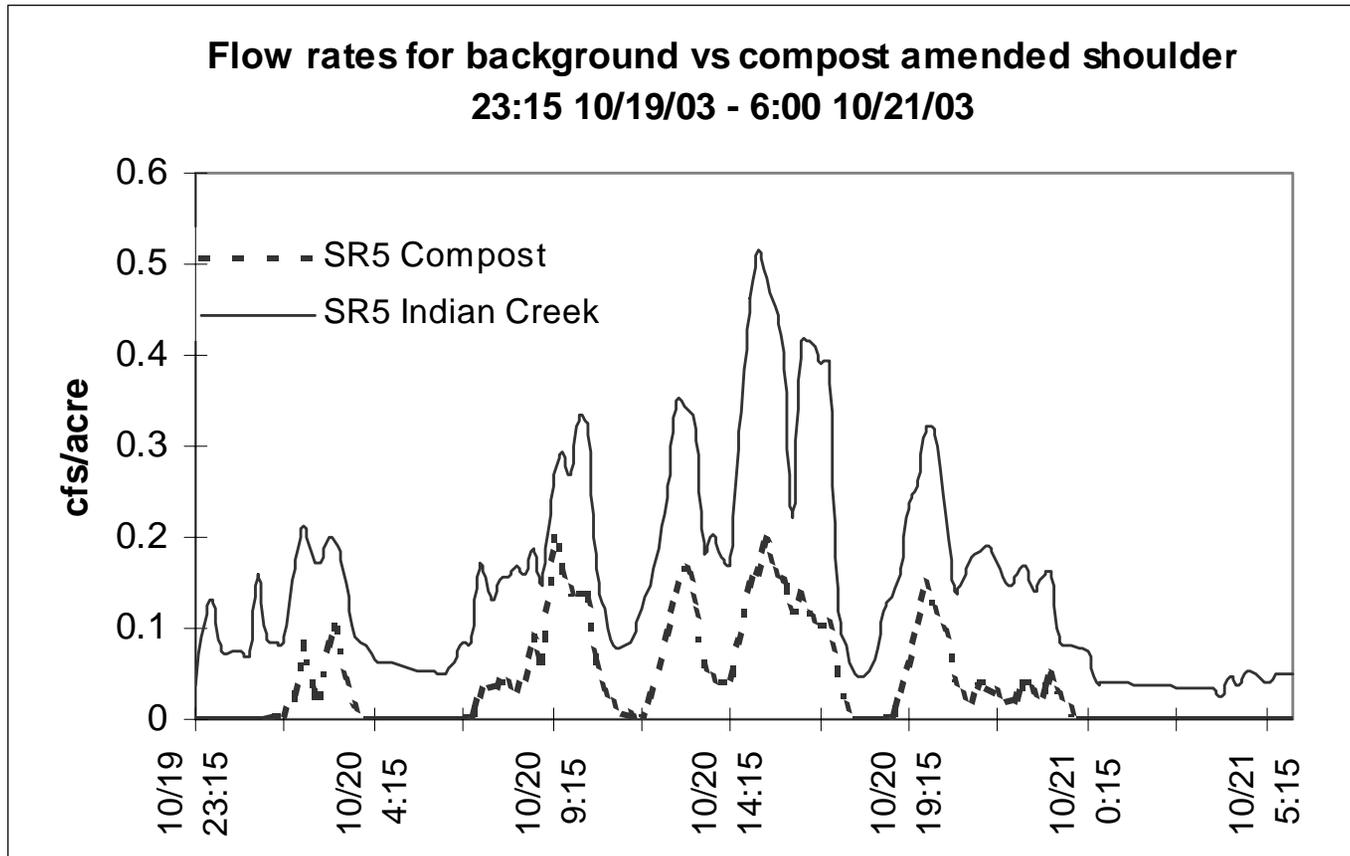
- The tests were to determine the level of contaminants in the runoff
- French drains were installed at the bottom of the plots
- We never got any runoff into the drain in the compost amended plot
- Therefore we couldn't prove it improved water quality (Conclusion - there must be something wrong with the test system)

I-5 Martin Way Compost Amended Vegetated Filter Strip

- 4" compost blanket applied to a 10' wide strip
 - 2 – 12' lanes and an 8' shoulder drain onto strip
 - Water quantities were compared to flows into the Indian Creek stormwater facility
-
- October 16, 2003 – a 2.8 inch precipitation - no measurable runoff from the compost strip. Oct 20, 4" rain



I-5 Martin Way CAVFS



Flow rates for CAVFS vs. Curb and Gutter
CAVFS infiltrated 65% of runoff

I-5 Martin Way CAVFS

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

- Overall reduction in pollutant levels except Total Dissolved Solids and Total Phosphorus
- When the flow reduction is factored in, there is an overall reduction of these two elements as well.

WSDOT Highway Runoff Manual

- CAVFS a BMP for Water Quality Treatment
- Saw flow control benefits but need data to qualify as Flow Control BMP
- Further research needed

I-5 Lynwood CAVFS Research

Site selection criteria

- Rainfall (Puget Sound convergence zone), soil type, and traffic density typical of urban Puget Sound highways
- Selected site: I-5 near Lynwood
- Monitoring extent = 3 years (hydraulics – flow control), 2 years (chemistry)



Completed Filter Strip



Pollutant removal summary

	Removal by Concentration			Removal by Load		
	Control		Compost 2	Control		Compost 2
Total Suspended Solids	-98%	<	-94%	-99%	=	-98%
Total Phosphorus	-82%	=	-84%	-91%	>	-96%
Soluble Phosphorus	950%	>	75%	550%	>	61%
Total Copper	-86%	<	-81%	-94%	=	-96%
Dissolved Copper	-0.4%	=	-8%	-48%	=	-78%
Total Zinc	-94%	=	-86%	-97%	=	-98%
Dissolved Zinc	-71%	=	-73%	-86%	=	-93%
Oil and Grease	-93%	=	-79%	-95%	=	-95%
	< significantly less than					
	> significantly greater than					
	= equal to					
	net pollutant removal					
	better performance by comparison					
	net pollutant increase					
	no performance					

Pollutant removal % values are relative to curb-and-gutter
 significance test $\alpha = 0.05$

Water Quality Monitoring

- Major Conclusions
 - Relative to treatment in filter strips without compost amendment:
 - TSS - compost amendment may decrease performance
 - Phosphorus - compost amendment may improve performance
 - Metals - compost amendment may have no effect on performance
 - Oil & Grease - compost amendment may have no effect on performance

Water Quality Monitoring

- Major Conclusions
 - Filter strips with and without compost amendment both substantially reduce pollutant concentrations and loads in highway runoff for all pollutants except soluble phosphorus and dissolved copper

Hydraulics performance summary

Comparison to non-composted vegetated filter strip

	Compost 1	Compost 2
Flow Volume	-90%	-50%
Peak Discharge Rate	-75%	~(+)
Flow Duration	~(-)	~(-)

significance test $\alpha = 0.05$

~(+/-) indicates some, but not significant change

Hydraulic performance difference between Compost 1 and Compost 2 a result of differences in underlying geology (sand and peat under Compost 1, glacial till under Compost 2)

Hydrologic Monitoring

- Major Conclusions relative to non-compost vegetated filter strips
 - ❑ Volume – Flow volumes decrease with CAVFS
 - ❑ Rate – Flow rates decrease with CAVFS
 - ❑ Duration – CAVFS do not appear to reduce flow durations

Hydrologic Monitoring

- Major Conclusions
 - Benefits of compost amendment generally realized most when storm precipitation depth exceeds 0.2 inches
 - Peak discharge rates increase markedly once storm precipitation depth exceeds 0.6 inches

C:N Ratio



← 30:1 C:N ratio – no weeds
Native grass growth very good



Didn't Spec. C:N ratio →
10:1 - Lots of weeds



Erosion Control Benefits



SR 20, Methow River Bridge, Twisp

Plant Establishment Benefits



Compost – No Compost

Richland, May 2006

SR 12 Phase 2, with compost



SR 182 Queensgate, without compost



Compost – No Compost

Richland, May 2006



SR 12 Phase 2, with compost

SR 182 Queensgate without compost



SR 12 Phase 2, May 2006

Seeded Fall 2005



SR 182 Queensgate, May 2006

Seeded Fall 2005



Questions?

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SEA Streets Project



Retrofitted with LID BMPs

SEA Streets Project

- SEA ~ Street Edge Alternatives
- Two projects that drain 26 and 2.3 acres
- The 2nd Ave. project has prevented all dry season flow and 98% of the wet season runoff (Horner, et al)
- Potential to mitigate impacts on urban highway by retrofitting adjacent neighborhoods with Low Impact Development techniques using compost amended soil

Iowa State University Research

- Plots consisted of 3 types of compost blankets, 2 & 4 inches deep, 6" top soil, and bare soil
- 2 sets of 6 replicates of each plot, one set was bare and the other seeded per IDOT standard erosion control seed mix
- Plots were on a 3H:1V slopes
- Rainfall simulators applied 4 inches per hour

Iowa State University Research

- Runoff from compost-treated areas during a 30-minute high intensity rain storm was less than 0.8% of the runoff from areas treated with topsoil, and 0.5% or less of that from compacted subsoil.
- Compacted subsoil and topsoil typically began producing runoff within 5 to 8 minutes after rainfall began, areas treated with any of the three types of compost took, on average, 30 – 60 minutes to begin producing runoff

Iowa State University Research

- Nutrients & metals originally present in soils and compost
- Inter-rill runoff rates
- Inter-rill erosion rates
- Nutrients & metals in Inter-rill runoff
- Rill erosion rates
- Growth of planted erosion control vegetation
- Weed growth

Iowa State University Research

- There were no significant differences in inter-rill erosion between 2- and 4-inch compost treatments.
- With the exception of phosphorus in runoff from the biosolids compost, the total soluble mass of each of the three pollutants contained in runoff caused by a 30-minute storm was significantly lower in compost runoff than in runoff from conventionally-treated test plots. This is primarily the result of the significantly lower runoff produced by the compost blankets

Iowa State University Research

- Compost-treated areas produced as much planted cover-crop growth as conventionally-prepared roadside areas.
- Compost-treated plots produced significantly less weed growth than conventionally-prepared embankments.
- No significant difference between incorporation and blankets in most applications.