

Beneficial Use of Organics

in

FDOT Road Projects



Provided by

F O R A

A Division of Recycle Florida Today

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For related publications see Florida Department of Environmental Protection
Web Page <http://www.dep.state.fl.us/dwm/bureaus/bpss/documents.htm>

INTRODUCTION

The FORA Division of Recycle Florida Today (RFT) is comprised of public and private sector producers of recycled organic products i.e. mulches, composts and soil amendments with the shared goal of promoting the beneficial reuse of organics. With the cooperation of the University of Florida – Institute of Food and Agricultural Sciences, we are providing the enclosed studies and articles that detail the many benefits of using organics in FDOT road projects. The FORA Division of RFT is committed to working with the FDOT to increase the amount of organics utilized in FDOT projects as required by Florida Statutes.

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Florida Department of Transportation Specifications for Composted Materials¹

Gerald Kidder and Grady L. Miller²

This fact sheet presents the specifications for composted materials to be used in Florida Department of Transportation (FDOT) projects. A summary of these specifications is presented in Table 1. Compost suppliers must furnish data on their material.

A more detailed reference can be found in special provisions M1620000 (topsoil) and M9810200 (mulch), both available from the FDOT Specifications Office in Tallahassee.

General Requirements (for all uses)

All composts used by Florida Department of Transportation projects must:

- ▶ Meet requirements of Florida Department of Environmental Protection (FDEP) for unrestricted distribution. In other words, the compost must be classified as one of the following:
 - Type Y (yard waste compost)
 - Type YM (yard waste and manure compost)
 - Type A (solid waste compost containing less than 2% foreign matter)
 - Type AA (composted biosolids)
- ▶ Pass a weed seed germination test and be weed free
- ▶ Have a moisture content between 30% and 55%
- ▶ Pass through a 25-mm (1-inch) or smaller screen

¹ This document is SL-139, one of a series of fact sheets of the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Date first published: March 1998. Please visit the FAIRS Web site at <http://hammock.ifas.ufl.edu>.

² G. Kidder, professor, Soil and Water Science Department and G.L. Miller, assistant professor, Environmental Horticulture Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0290.

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- ▶ Have been tested for the following:
 - total Kjeldahl nitrogen (reported as a percentage of dry solids)
 - dry solids (reported as a percentage of as-received compost)
 - bulk density (specify whether measured on an as-received or dry-weight basis)
 - organic matter (as shown by a loss-on-ignition test)
 - ▶ Have a pH between 4.0 and 8.5

High EC Compost for Use as a Soil Amendment

In addition to the general requirements listed above, if the electrical conductivity (EC, or soluble salt) value of the compost exceeds 4.0 dS/m (mmhos/cm), based on the saturated paste extract method, the amended soil should be leached with at least 25 mm (1 inch) of either rainwater or irrigation water before planting seeds. (Leaching with 50 mm of water would be safer.)

Compost for Use as Mulch

In addition to the general requirements listed above, compost that will be used as a mulch must meet the following conditions:

- ▶ Foreign matter content must be less than 2% of the dry weight
- ▶ There should be no foreign matter, such as glass or metal shards, of a size and shape that can cause injury
- ▶ Over half of the solids should be from particles 1/2 inch in size or greater (in other words, the material should be slightly coarse to coarse in nature)

Preference will be given to compost:

- ▶ made from uncontaminated woody waste materials
- ▶ with a high water-holding capacity, low electrical conductivity, and very low FDEP-regulated metal content

Compost for Use in Ornamental Horticulture Applications

In addition to the general requirements listed above, compost to be used as potting media (or as a component of potting media) in the establishment and maintenance of landscape ornamental plants must be certified free of parasitic nematodes (as tested by the Florida Department of Agriculture and Consumer Services).

Material which passes through a screen smaller than 1 inch may be required for some specific applications.

Table 1. Summary of Specifications

Required Parameter	Soil Amendment	Mulch	Horticulture Applications
Okay for unlimited distribution	✓	✓	✓
No weeds	✓	✓	✓
Moisture between 30 and 55%	✓	✓	✓
Passes through 25 mm (1 inch) screen	✓	✓	✓
pH between 4.0 and 8.5	✓	✓	✓
Data on N, % solids, bulk density, and organic matter	✓	✓	✓
Electrical conductivity <4.0 dS/m or leach with 25 mm rain before planting	✓		✓
Foreign matter <2% of dry weight and none that can cause injury		✓	
Coarse texture (eg, >50% solids stay on half inch screen)		✓	
Preference given to uncontaminated woody waste		✓	
Preference given to low EC, high water-holding capacity		✓	
Free of plant parasitic nematodes			✓
Material finer than 1 inch (25 mm) for some applications			✓

Application Rates and Techniques for Using Composted Materials in Florida DOT Projects¹

Gerald Kidder and Grady L. Miller²

Application rates of composted materials will differ depending on whether they are being used as soil amendments, mulches, or topdressing fertilizer. This fact sheet is designed to help a user determine the amounts of materials to apply for each use in Florida Department of Transportation (FDOT) Projects.

The following are some of the common ways that rates of application are expressed:

- ▶ weight per unit area (e.g., metric tons per hectare or U.S. tons per acre)
- ▶ dry matter per unit area (e.g., oven dry weight per unit area)
- ▶ volume per unit area (e.g., cubic meters per hectare or cubic yards per acre)
- ▶ thickness of layer (e.g., centimeters or inches)

Composts can contain a large percentage of water, so it is necessary to distinguish if the weight is being expressed on an as-received basis or an oven-dry basis. The oven-dry basis provides a constant reference point and is usually used when expressing the nutrient content of composts.

Soil Amendment

Roadside soil is amended with compost to improve the soil as a medium for plant growth. This is especially important when establishing utility turf on road shoulders and other areas of exposed soil. Soil that is good for building roadbeds is usually not good for growing plants.

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² G. Kidder, professor, Soil and Water Science Department and G.L. Miller, assistant professor, Environmental Horticulture Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0290.

Compost used as a soil amendment is usually mixed in the top 15 to 20 cm (6 to 8 in) of soil. Rototilling generally gives the most complete mixing, but disking is also used for incorporation of compost. The recommended rate of application of compost in FDOT projects is 100 metric tons of dry matter per hectare. Several expressions of this rate, given different known quantities of the compost, are presented in Table 1.

Mulch

Mulch is a layer of material placed on the soil surface. Mulch protects soil from the direct impact of rain and wind. Mulch can be very useful in protecting steep slopes from erosion while vegetation such as shrubs and groundcover are becoming established. It also shades the soil and helps control weeds in plantings of groundcover. Mulch is applied at much higher rates than soil amendments. Coarse mulch such as ground-up urban plant debris (yard waste) should be applied in a layer 5 to 8 cm (2 to 3 in) thick. Fine-textured organic materials are usually not appropriate for use as a mulch in FDOT projects.

Topdressing (fertilizer)

Compost that is rich in plant nutrients can be used as a fertilizer (a topdressing) and spread over the top of grasses growing on the roadside. Such nutrient-rich compost is an excellent substitute for chemical fertilizer. Additionally, its use helps the FDOT meet state guidelines for use of recycled materials.

However, fertilizing roadsides is not appropriate in the following circumstances:

- ▶ the grass is growing very well
- ▶ there is very little grass to start with (i.e., poor stand).

In the first case, fertilizing will only increase the need for mowing and will not increase the soil protecting benefits of good soil cover. In the second case, there is little grass to take up the fertilizer, so the fertilizer is wasted. Poor stands are usually the result of other limiting factors such as droughty soil. Those will not be corrected by fertilizer.

How to use Table 1

Table 1 provides the amount of as-received compost to be applied to achieve the FDOT recommended amendment rate of 100 metric tons of dry matter per hectare (45 US tons per acre). In the table, find the moisture content and bulk density of your material. Read across to the column which has the units you wish to use in applying the compost. Rates will be about three times greater when mulching. Topdressing (fertilizing) rates will depend on the nitrogen (N) content of the compost but will likely be approximately 5% of the amendment rate.

Table 1. Amount of as-received compost to apply to achieve the FDOT recommended amendment rate of 100 metric tons of dry matter per hectare.

Moisture content (% by wt)	Bulk density		Weight per unit area		Volume per unit area		Thickness of layer	
	g/cm ³	lb/cu yd	metric tons per hectare	U.S. tons per acre	cu meters per 10 sq meters	cu yards per 100 sq feet	centimeters	inches
30	0.42	700	143	64	0.34	0.42	3.4	1.4
	0.48	800	143	64	0.30	0.37	3.0	1.2
	0.54	900	143	64	0.27	0.33	2.7	1.1
	0.59	1000	143	64	0.24	0.29	2.4	0.9
35	0.42	700	154	69	0.37	0.45	3.7	1.5
	0.48	800	154	69	0.32	0.39	3.2	1.3
	0.54	900	154	69	0.29	0.35	2.9	1.1
	0.59	1000	154	69	0.26	0.32	2.6	1.0
40	0.42	700	167	74	0.40	0.49	4.0	1.6
	0.48	800	167	74	0.35	0.43	3.5	1.4
	0.54	900	167	74	0.31	0.38	3.1	1.2
	0.59	1000	167	74	0.28	0.34	2.8	1.1
45	0.42	700	182	81	0.44	0.53	4.4	1.7
	0.48	800	182	81	0.38	0.47	3.8	1.5
	0.54	900	182	81	0.34	0.41	3.4	1.3
	0.59	1000	182	81	0.31	0.37	3.1	1.2
50	0.42	700	200	89	0.48	0.59	4.8	1.9
	0.48	800	200	89	0.42	0.51	4.2	1.7
	0.54	900	200	89	0.37	0.46	3.7	1.5
	0.59	1000	200	89	0.34	0.41	3.4	1.3
55	0.42	700	222	99	0.54	0.65	5.4	2.1
	0.48	800	222	99	0.47	0.57	4.7	1.8
	0.54	900	222	99	0.42	0.51	4.2	1.6
	0.59	1000	222	99	0.37	0.46	3.7	1.5

Benefits of Using Compost and Mulch in Florida Roadside Plantings¹

Robert J. Black and Grady L. Miller²

Compost

Issues in roadside landscaping are substantially different from those in conventional landscapes or in agriculture, where more intensive maintenance practices are usually the rule. For most roadside plantings, a fundamental maintenance practice – irrigation – is not available. Budgetary and/or environmental considerations limit or forbid applications of chemical fertilizers or herbicides. Roadside soils are often poor and will have been disturbed, compacted or otherwise compromised by highway construction activity.

The high cost of extensive sodding means that most grasses used in highway landscapes must be planted from seed. Once germinated, the grass must be able to establish itself in the face of erratic precipitation, little or no fertilization, competition from weeds, and the potentially erosive run-off of rainwater from pavement surfaces. Incorporation of compost in roadside soils can aid in the establishment of vegetative cover by improving the physical and chemical properties of these soils.

The benefits and practical consequences of using compost as a soil amendment in roadside plantings of utility turf are presented on the next page.

¹ This document is ENH-126, one of a series of fact sheets of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Date first published: May 1998.

² R.J. Black, associate professor, and G.L. Miller, assistant professor, Environmental Horticulture Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0670.

Benefits	Practical Consequences
Increases water retention in sandy soils	More water available for grass seed germination and seedling establishment
Enables soil to hold more plant nutrients (increased cation exchange capacity) for longer periods of time	Increases growth rate of grass seedlings which results in faster coverage of seeded area
Provides small amounts of plant nutrients to the soil/plant system	More nutrients available for seedling growth
Reduces soil bulk density and increases total pore space	Provides greater aeration for enhanced root growth and microbial activity. Increases water infiltration and movement into soils which reduces runoff and erosion
Helps moderate soil temperatures	Prevents rapid fluctuations in soil temperature hence, a better environment for root growth
In some cases, reduces soil-borne diseases	Healthy stands of grass seedlings
Suppresses the population of certain nematodes	A more extensive grass root system
Positive effect on soil microbial populations	Provides for slow release of plant nutrients

Mulch

Mulch is any material applied to the soil surface for protection or improvement of the area covered. Mulches are used in conventional landscapes to beautify plant beds, to modify the soil environment and to enhance plant growth. They are often used in roadside landscapes to prevent steep slopes from eroding until ground covers can become established.

Mulch, when correctly applied, has the following beneficial effects upon a roadside planting:

- ▶ Prevents loss of water from the soil by evaporation
- ▶ Suppresses weeds when the mulch material itself is weed-free and applied thickly enough to prevent weed seed germination or to smother existing small weeds
- ▶ Acts as an insulator that keeps the soil cool under intense heat and warm under intense cold
- ▶ Prevents crusting of soil surface, thus improving the absorption and movement of water into the soil while at the same time reducing erosion
- ▶ Prevents soil splash, which helps to control erosion and keeps soil-borne disease from splashing up onto a plant
- ▶ Some mulches may add a small amount of nutrients to the soil
- ▶ Adds to the beauty of the landscape by providing a cover of uniform color and interesting texture to the surface

Evaluation of Composted Materials on Florida Roadsides

Gerald Kidder, Robert J. Black, Grady L. Miller, and Donald A. Graetz¹

This fact sheet gives a brief overview of a three year project conducted by researchers of the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS) as part of contract WPI# 0510743 with the Florida Department of Transportation (FDOT).

Project Objectives

- ▶ Provide fundamental information for proper utilization of composted wastes on roadsides
- ▶ Assist FDOT in establishing standards and specifications for using composts
- ▶ Provide FDOT with educational and promotional materials on using composts

Components of the Project

The project had five major components.

- ▶ A literature review and survey of compost use by all DOTs in the U.S.
- ▶ Field studies of compost amendment effects on utility turf on road shoulders
- ▶ Field studies on fertilizing road shoulder grass with compost
- ▶ Laboratory and greenhouse studies of the composted materials used in the field
- ▶ Drafting specifications for compost purchase and use in FDOT projects

¹ G. Kidder and D. A. Graetz, professors, Soil and Water Science Department, and R. J. Black, associate professor, and G. L. Miller, assistant professor, Environmental Horticulture Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0290.

National Survey of Compost Use by DOTs

The results were reported first to FDOT and later published in the July and August 1997 issues of *BioCycle* magazine. The first part was featured as the July cover article. Details are presented in the factsheet, "Compost Utilization by State Departments of Transportation in the United States."

The Field, Greenhouse, and Lab Studies

Highway shoulders were amended with compost, rototilled, and seeded at three locations in Summer 1996. Target rates were 100, 200, and 300 metric tons of dry matter per hectare (45, 90, and 135 US tons per acre). Evaluations ran through Spring 1998.

- ▶ Broward County at Copans Road interchange off I-95; shoulders of on/off ramps; grass cover was poor; had been planted in the limestone road base without topsoil
- ▶ Hernando County on SR 50 a mile or two west of I-75; rolling topography; an area of deep, droughty sand; sparse vegetative cover
- ▶ Taylor County on US 19/98 just north of Salem; level flatwoods topography; area of high water table and fairly good soil cover; vegetation a mixture of planted grasses, volunteered grass, sedges, and broadleaf plants

Highway shoulders were topdressed with biosolids or manure composts at the fertilization rate of 1 pound nitrogen per 1,000 square feet (1 to 5 tons per acre) at two locations.

- ▶ Taylor County on SR 51 about a mile east of Steinhatchee; an area of well-drained, deep sand with very poor vegetative cover
- ▶ Putnam County on SR 26 about two miles east of Melrose; an area of well-drained, deep sand with good vegetative cover

Compost physical and chemical characteristics were measured in the laboratory. The effects of compost additions on grass germination and growth were measured in greenhouse studies. Findings were used to help interpret results from the field studies and set specification standards.

Specifications for Compost Used in FDOT Projects

Draft specifications were presented to FDOT. Final specifications are found in special provisions M1620000 (topsoil) and M9810200 (mulch). More details may be found in the fact sheet, "Florida Department of Transportation Specifications for Composted Materials."

Major Findings of the Project

- ▶ Use of composted materials by DOTs across the U.S. varies considerably. Standards and specifications for their use are in various stages of development as experience increases. Where properly used as soil amendments or mulches, these materials improve road shoulder vegetative cover and decrease erosion.
- ▶ Composts with high soluble salt content can be used in FDOT projects provided seeding is delayed until at least an inch or two of rainfall has leached the amended area.
- ▶ Amending road shoulder soil at a rate of 100 metric tons of dry compost per hectare (45 U.S. tons per acre) significantly improved the establishment of grass from seed. The effect was more pronounced where the soil was droughty (e.g., steep slopes or deep sand) than where the water table was often near the soil surface (e.g., level, flatwoods topography).
- ▶ Fertilization of road shoulders with 1 to 5 tons of compost per acre (supplying 1 pound of nitrogen per 1,000 square feet) had no appreciable effect on stand or appearance of roadside vegetation. Observations suggest that adequacy of water is a greater factor in roadside vegetation growth than adequacy of nutrients.



Innovative Uses of Compost Erosion Control, Turf Remediation, and Landscaping

Compost has been viewed as a valuable soil amendment for centuries. Most people are aware that the use of compost is an effective way to improve plant growth. Compost-enriched soil can also reduce erosion, alleviate soil compaction, and help control disease and pest infestation in plants. These beneficial uses of compost can increase healthy plant production, help save money, reduce the use of chemical fertilizers, and conserve natural resources.

Compost used for a specific purpose or with a particular soil type works best when it is tailor-made or specially designed. For example, compost that is intended to prevent erosion might not provide the best results when used to alleviate soil compaction, and vice versa. Technical parameters to consider when customizing a compost mixture include maturity, stability, pH level, density, particle size, moisture, salinity, and organic content, all of which can be adjusted to fit a specific application and soil type.

Compost Technology to Control Erosion

According to the U.S. Department of Agriculture, the United States loses more than 2 billion tons of topsoil through erosion each year. Erosion occurs when wind and rain dislodge topsoil from fields and hillsides. Stripped of its valuable top layer, which contains many essential nutrients, the soil left behind is often too poor to sustain good plant growth. Eroded topsoil can also be carried into rivers, streams, and lakes. This excess sediment, sometimes containing fertilizers or toxic materials, threatens the health of aquatic organisms. It can also compromise the commercial, recreational, and aesthetic value of water resources. As a result, preventing erosion is essential for protecting waterways and maintaining the quality and productivity of soil.

Controlling Erosion in Construction and Road Building

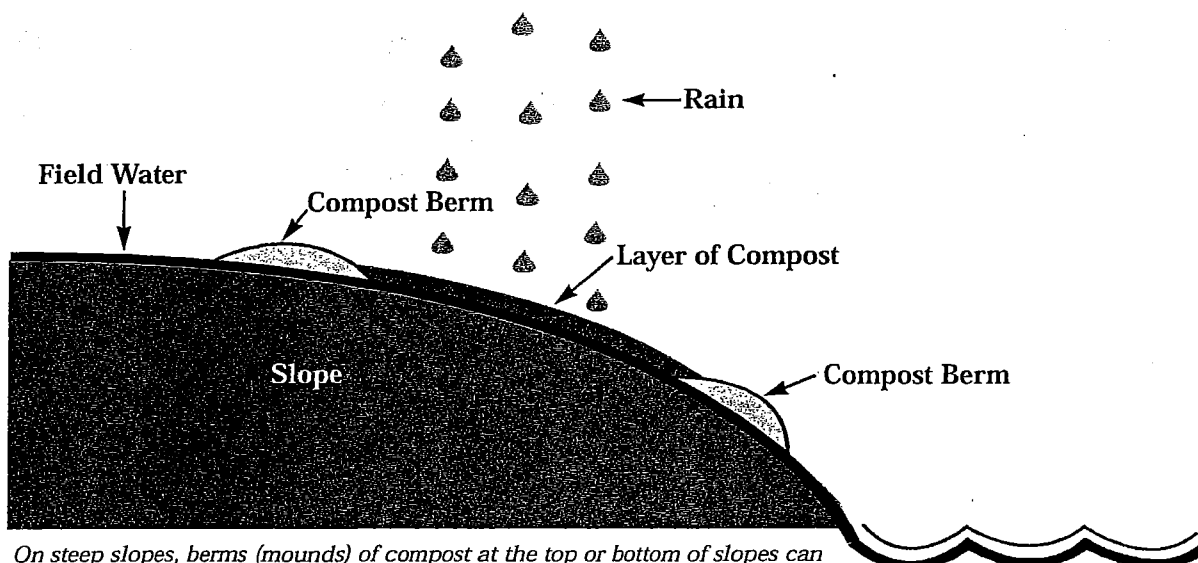
Erosion is a naturally occurring process; however, it is often aggravated by activities such as road building and new construction. At the beginning of some construction projects, all vegetation and topsoil is removed, leaving the subsoil vulnerable to the forces of erosion. On steep embankments along roads and highways, compost can be more effective than traditional hydromulch at reducing erosion and establishing turf because compost forms a thicker, more permanent growth due to its ability to improve the infrastructure of the soil.

Depending on the length and height of a particular slope, a 2- to 3-inch layer of mature compost, screened to 1/2 to 3/4 of an inch and placed directly on top of the soil, has been shown to control erosion by enhancing planted or volunteer vegetation growth. On steep slopes, berms (mounds) of compost at the top or bottom of slopes can be used to slow the velocity of water and provide additional protection for receiving waters. Because of its ability to retain moisture, compost also helps protect soil from wind erosion and during droughts.

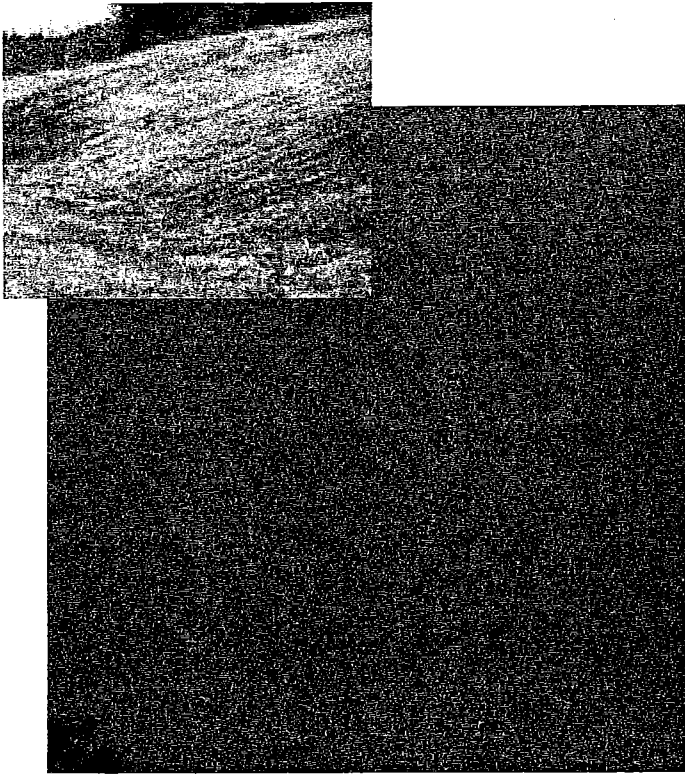
Controlling Erosion in Road Construction

The Federal Highway Administration (FHWA), of the U.S. Department of Transportation and the U.S. Environmental Protection Agency, recently conducted an erosion control demonstration project that compared mature yard trimmings compost that met FHWA specifications with hydromulch, a substance traditionally used for controlling erosion on roadside embankments. The purpose of the study was to determine the effectiveness of mature yard trimmings compost compared with hydromulch in establishing Fescue grass.

The project site was at a newly constructed intersection in suburban Washington, DC. Two embankments with steep slopes were selected. The first embankment had a 2 to 1 slope; the second had a 3 to 1 slope. A hydromulch/fertilizer treatment also was applied to a section of each of the slopes. Adjacent to these sections, 2-1/2 inches of mature yard trimmings compost was spread. On the 2 to 1 slope, a small amount of fertilizer was also applied, while the 3 to 1 slope was left unfertilized. Fescue grass seed was added and covered with a thin layer of compost to conceal the seed from birds.



On steep slopes, berms (mounds) of compost at the top or bottom of slopes can be used to slow the velocity of water and provide additional protection for receiving waters.



Photos courtesy of The Federal Highway Administration, Office of Environment & Planning, and Federal Lands Highway Program

Embankment adjacent to new intersection. Top left photo shows hillside before seeding. Photo at right shows grass cover. Compost-treated plot displays darker green color and thicker growth.

Results of the project revealed that compost used alone produced better results than either of the areas treated with hydromulch or the area treated with compost and fertilizer. While the areas with the hydromulch/fertilizer combination showed quick initial vegetative growth, the areas treated with only compost persevered within 6 months, out-performing the traditional method by establishing a thick, healthy vegetative cover. The growth in the compost/fertilizer plot was superior to that found in the hydromulch/fertilizer plots. A possible explanation for compost alone out-performing the area treated with compost and fertilizer is that chemical fertilizers often increase soil salinity, which in turn could negatively affect the beneficial micro-organisms in compost and inhibit the establishment of healthy grasses.

Using Compost to Remediate Turf Grasses

Providing safe, uniform playing surfaces for recreational activities, such as golf, football, soccer, and other field sports, requires intensive turf management. Recreational turf grasses are subjected to extensive wear and tear, making them difficult to manage and highly susceptible to turf diseases, pests, and soil compaction. To address these problems, turf managers traditionally use a combination of fertilizers, pesticides, fungicides, and aeration techniques that usually result in high costs and potential for negative environmental impacts.

Some turf managers are now using compost to replace peat moss in their topdressing applications based on its proven success in suppressing plant disease. Compost, when properly formulated, unlike peat moss, is teeming with nutrients and micro-organisms that stimulate turf establishment and increase its resistance to common turf diseases, such as snow mold, brown patch, and dollar spot. For example, after 3 years of using compost as a topdressing, the Country Club of Rochester, New York, has nearly eliminated the need for fungicide applications for such diseases.

Alleviating Soil Compaction

Soil compaction is another persistent landscape management problem, particularly in areas of heavy traffic, such as parks, zoos, golf courses, and athletic playing fields. Compacted soil impedes healthy turf establishment by inhibiting the movement of air, water, and nutrients within the soil. Bare soil, weeds, increased runoff, and puddling after heavy rains are the most obvious signs of a soil compaction problem.

Traditional methods for alleviating soil compaction—aeration, reseeding, or complete resodding—are labor-intensive and expensive, and

◆ What Are the Benefits of Using Compost?

Soil Enrichment:

- Adds organic bulk and humus to regenerate poor soils.
- Helps suppress plant diseases and pests.
- Increases soil nutrient content and water retention in both clay and sandy soils.
- Restores soil structure after reduction of natural soil microbes by chemical fertilizer.
- Reduces or eliminates the need for fertilizer.
- Combats specific soil, water, and air problems.

Pollution Remediation:

- Absorbs odors and degrades volatile organic compounds.
- Binds heavy metals and prevents them from migrating to water resources or being absorbed by plants.
- Degrades, and in some cases, completely eliminates wood preservatives, petroleum products, pesticides, and both chlorinated and nonchlorinated hydrocarbons in contaminated soils.

Pollution Prevention:

- Avoids methane production and leachate formation in landfills by diverting organics for composting.
- Prevents pollutants in stormwater runoff from reaching water resources.
- Prevents erosion and silting on embankments parallel to creeks, lakes, and rivers.
- Prevents erosion and turf loss on roadsides, hillsides, playing fields, and golf courses.

Economic Benefits:

- Results in significant cost savings by reducing the need for water, fertilizers, and pesticides.
- Produces a marketable commodity and a low-cost alternative to standard landfill cover and artificial soil amendments.
- Extends municipal landfill life by diverting organic materials from the waste stream.
- Provides a less costly alternative to conventional bioremediation techniques.

provide only short-term solutions. Some turf managers are starting to use compost and compost amended with bulking agents, such as aged crumb rubber from used tires or wood chips, as cost-effective alternatives. Incorporating tailor-made composts into compacted soils improves root penetration and turf establishment, increases water absorption and drainage, and enhances resistance to pests and disease. Using tailored compost can also significantly reduce the costs associated with turf management. Research conducted at a U.S. Air Force golf course in Colorado Springs, Colorado, for example, indicated that turf grown in areas improved with tailored compost required up to 30 percent less water, fertilizer, and pesticides than turf treated conventionally.

◆ Greening the Links

The U.S. Army Golf Course Operations Division at Fort George Meade, Maryland, and the U.S. Environmental Protection Agency began a 3-year pilot demonstration in 1995 to determine the effectiveness of compost amended with crumb rubber in alleviating soil compaction, erosion, and turf disease problems. The golf course superintendent estimates that using compost technology would save nearly \$50,000 a year in maintenance costs.



Photo courtesy of U.S. Army, Fort George Meade, Maryland

At the U.S. Army Golf Course at Fort George Meade, Maryland, erosion can clearly be seen on the untreated right side of the path, while rubber amended compost is helping keep erosion in check on the left.

Mature yard trimmings compost amended with crumb rubber was incorporated into compacted soils at 13 different locations around the two golf courses. Many of the selected sites included areas adjacent to, or at the end of golf cart paths, on slopes surrounding greens, or in tee boxes. These sites were selected because of their susceptibility to compaction and erosion caused by heavy traffic and water runoff. The compost mixture was tilled into the soil to a depth of about 3 to 5 inches and then uniformly seeded. To act as a control, one of the plots was amended only with crumb rubber.

In the first year of the pilot, course operators reported that healthy, green turf grass took hold at most of the sites, with no signs of compaction or erosion. Results were particularly impressive in eroded ditches along cart paths. The areas treated with the compost mixture showed full growth of turf grasses and total abatement of erosion, whereas the plot amended only with crumb rubber showed few signs of improvement.

***Using amended compost
can significantly reduce
the costs associated with
turf management.***

Using Compost in Landscaping Activities

Supplies of high-quality, low-cost topsoil are declining, particularly in urban areas where the demand is greatest. Compost is, therefore, becoming particularly important in applications requiring large amounts of topsoil. Increasingly, compost is being used as an alternative to natural topsoil in new construction, landscape renovations, and container gardens. Using compost in these types of applications is not only less expensive than purchasing topsoil, but it can often produce better results when trying to establish a healthy vegetative cover.

After a lawn or garden has been established, maintaining it can be a challenge for both home gardeners and commercial landscape contractors. While aeration, topdressing, and chemical fertilizer applications are some of the techniques commonly employed in landscaping applications, compost can be a successful alternative. When used as a topdressing, or periodically tilled into the soil, compost can stimulate plant growth, reduce pests and plant infestation, and improve soil structure.

Compost is also an effective landscaping mulch. Placed over the roots of plants, compost mulch conserves water and stabilizes soil temperatures. In addition, compost mulch keeps plants healthy by controlling weeds, providing a slow release of nutrients, and preventing soil loss through erosion. Landscapers and gardeners also use compost as mulch because its dark, rich color accents the vibrant colors of flowering plants.

Landscaping Constitution Gardens

In 1973, the U.S. National Park Service used a compost mixture made of digested sewage sludge, wood chips, leaf mold, and a small amount of topsoil to transform a badly compacted 40-acre tract of land located in Washington, DC, into a landscaped park. This project is one of the earliest successful large-scale landscaping applications using compost.

The original plans for the park renovations included planting azalea beds and thousands of annuals around a 6-acre lake. However, the site assessment revealed that the soil was almost as hard as concrete, with little pore space for plant roots and for water infiltration. The soil was too low in nutrients for healthy plant growth. In addition, the water table was high, causing flooding and root rot in existing plants.

Park Service staff spread over 9,400 cubic yards of the compost mixture over the site. Fertilizer, woodchips, and seed were added, and the soil was tilled to a depth of 2 feet. Impressed by the hardiness and beauty of a stand of hardwood trees along the area's western edge, Park Service staff decided to plant several varieties of native trees rather than the planned azalea beds. Data taken 3 years after the project ended indicated that most of the nearly 2,000 trees initially planted had flourished in the park.



Photo courtesy of U.S. National Park Service

More than 9,400 cubic yards of compost was used to remediate heavily compacted soil at Constitution Gardens in Washington, DC.

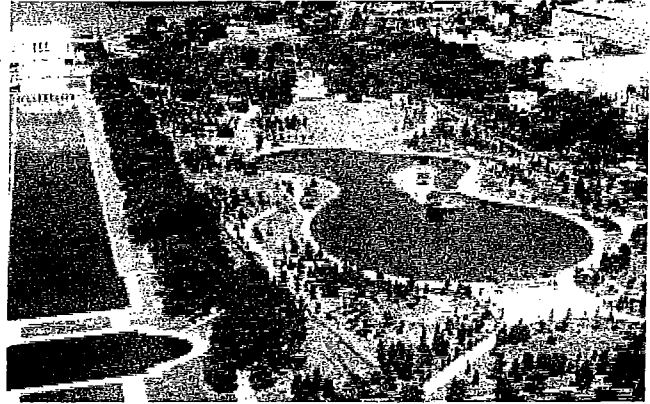


Photo courtesy of U.S. National Park Service

Three years after compost was applied, the vegetation at Constitution Gardens flourishes.

The compost use in this project not only improved the quality of the existing soil, but also saved taxpayers over \$200,000. Park Service staff also reviewed other options for remediating the soil at the park, including the purchase of topsoil to spread over the existing poor soil. If the Park Service staff had chosen to use topsoil, the cost of the project would have doubled.

Using Compost for Rooftop Gardens

Several years ago, officials at Pace School in Pittsburgh, Pennsylvania, proposed building a playground and garden for their students. They soon discovered, however, that the only space available was on the school's roof, so they designed a unique rooftop garden.

Plans for the garden included building large, 6-foot deep planters. Before the planters were constructed, several important factors had to be taken into consideration. The planter mix used had to be light enough for the roof to withstand the weight, yet dense enough to prevent rapid evaporation caused by the wind and summer heat. In addition, the planter mix had to be able to endure freezing temperatures in winter, and provide adequate drainage to prevent the planters from overflowing during rainstorms.

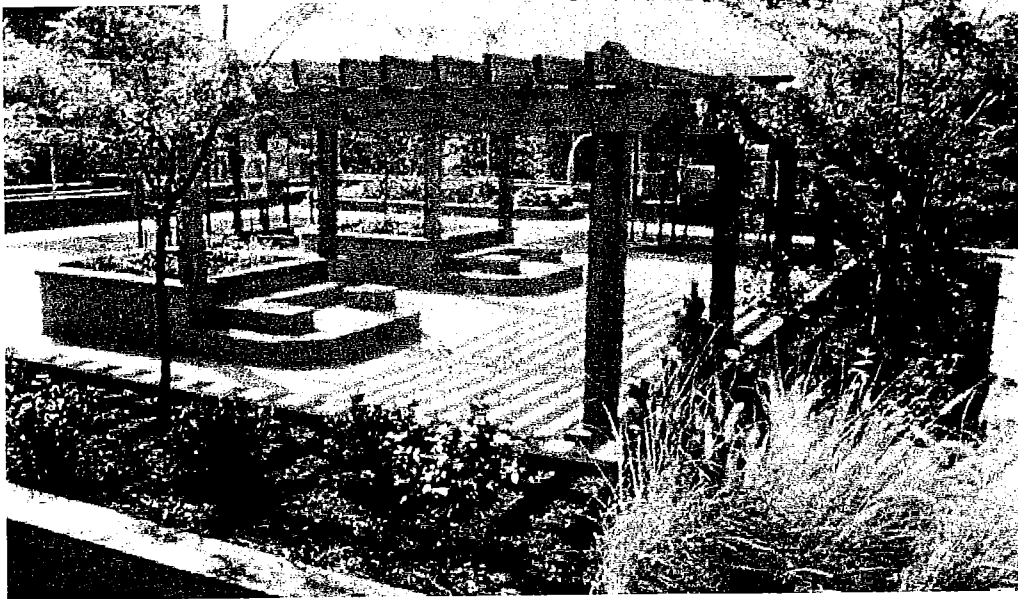


Photo courtesy of AgRecycle Inc.

Tailor-made compost was the key to success for the rooftop garden at Pace School in Pittsburgh, Pennsylvania.

To meet these special needs, the school decided to use a tailor-made mature compost blend, chosen because its bulk density is much lighter than soil-based mixes. The compost mix is also extremely absorbent, maintains good drainage, and protects plant roots from climatic fluctuations.

A local compost producer tailor-made a mature yard trimmings compost mixture to meet the project's specifications. A layer of polystyrene packaging peanuts was placed in the bottom of each planter box to enhance drainage, and a 5-foot layer of the compost mixture was placed on top.

Four years after the project began, the school continues to use its rooftop garden for a number of activities, including teaching science classes and gardening methods. The compost has performed very well as a growing medium and continues to produce beautiful, healthy plants that both the students and teachers can enjoy.

◆ Using Compost in Landscape Maintenance

Each year, millions of people visit Point State Park in Pittsburgh, Pennsylvania. Heavy traffic and 12 continuous years of chemical fertilizer applications caused the park's grassy areas to become increasingly compacted, eroded, and depleted of vital nutrients.

After considering several options, park officials decided to aerate the grassy areas and apply a special blend of mature yard trimmings compost and fire calcined clay. This compost mixture was designed to alleviate compaction, add nutrients to the soil, and to improve water-holding capacity. Workers spread a 1/4-inch topdressing of the compost mixture and then uniformly applied grass seed. Soon after the compost was applied, park officials noted that the turf was healthier and that the soil no longer exhibited signs of compaction.

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TRENDS IN UTILIZATION

STATE TRANSPORTATION DEPARTMENTS EXPAND COMPOST USE

Photo courtesy of NC DOT

CURRENTLY, 19 state Departments of Transportation (DOTs) have specifications for compost and 34 DOTs report experimental or routine use of compost on road-sides in one or more applications. These include such uses as a soil amendment or a component in manufactured topsoil, as a mulch or topdressing, for erosion control, in hydroseeding, for wetlands mitigation, on filtration berms and in bioremediation. In a recent study for the Florida Department of Transportation, telephone interviews were conducted with landscape architects, engineers, maintenance staff and environmental planning officials in the 50 states regarding compost utilization by their agencies. The interviews revealed that each state has unique attributes and requirements that determine how its road-sides are developed and maintained.

Compost markets, likewise, vary from state to state. While DOT compost utilization projects (or lack thereof) reflect these differences, several notable trends and issues recurred in the discussions with DOT personnel. In general, where compost is being considered or already is being used by a DOT or its contractors, the demand is for a product that is reliably mature, and available in the quantities and to the specifications required. Other repeated requirements are that the compost be economically and qualitatively competitive with the alternatives, and in keeping with state environmental standards.

PRODUCT EFFECTIVENESS

Among state DOTs with organized or ongoing efforts to investigate the usefulness of commercially produced compost in one or more of the applications listed above, satisfactory or better results have generally been obtained from composts that meet specification standards. Performance is sometimes measured against results obtained from comparable usage of peat, hu-

Nationwide survey of state transportation agencies provides important data on specifications, application results, cost savings as well as challenges to compost producers.

Part I

Donna Mitchell

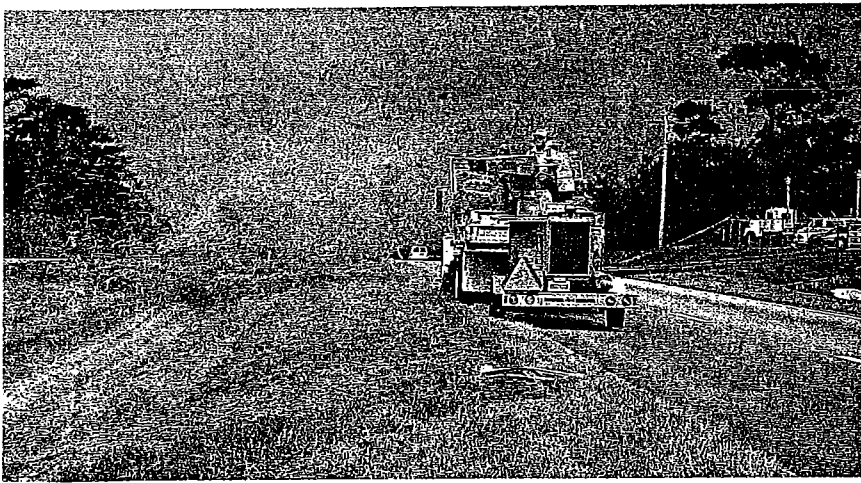
When growing wildflowers (above) or grass (below) in compost amended soils, Departments of Transportation in many states report results ranging from adequate to outstanding.

mus, bark, topsoil or fertilizer and sometimes from plantings to unamended roadside soils.

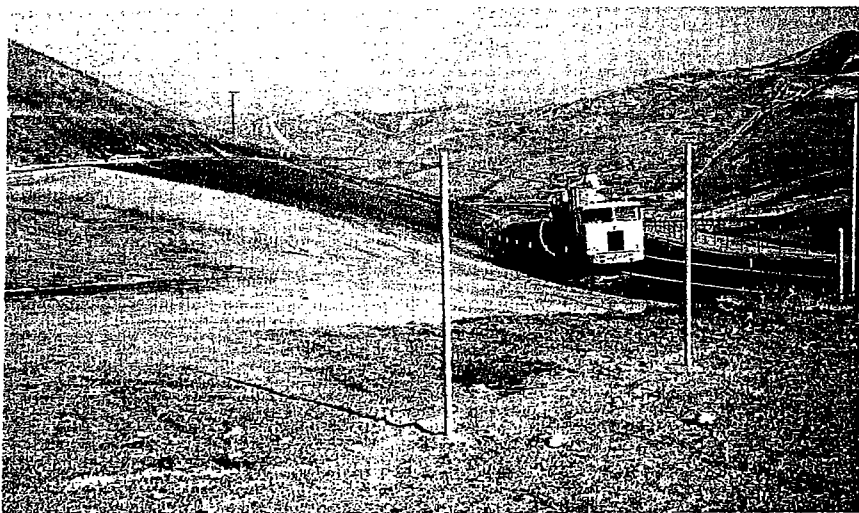
Frequently noted benefits to roadsides from compost utilization include improvement of soils and consequent plant growth attributed to the addition of organic matter, nutrients and microbial populations to poor soils; effective erosion control and slope stabilization; and reduction in use of chemical fertilizers and herbicides through substitution of compost as, respectively, a topdressing or mulch.



Photo courtesy of CA DOT



Mulch is applied to roadside after seeding (above), while grass seed is hand applied to strip supplied with compost (right). Seeding with compost and hydroseed fiber (below) has been effective for sediment control.



Photos courtesy of FL DOT

Minnesota DOT (MnDOT) has had compost as a standard specification item for the past nine years and has completely gotten away from bringing in topsoil and peat moss. Compost is used as a soil amendment and conditioner, more for the organic matter than fertilizer content. MnDOT has found such use results in improved structure for clay soils, better water retention in sand, and improved soil biology. Currently 20,000 cubic yards of compost are used annually on roadsides, largely on nonturf landscapes (i.e. in plantings of trees and shrubs), although in the future compost may be used

more often for turf. According to Scott Bradley, Landscape Programs Coordinator, MnDOT most often uses a Grade 1 compost (yard trimmings); Grade 2 contains poultry and/or other animal manures and is sometimes used in turf projects. The agency has had some burning and other short-term problems on shrub material with manure based composts that weren't completely cured. Experiments were successful with a screened MSW compost containing disposable diapers. However, MnDOT is cautious about MSW due to the potential for contaminants, e.g. about glass shards in projects where workers are handling the soil (i.e. in some kinds of plantings). Currently, composts containing MSW or biosolids are used only in pilot projects.

The Massachusetts Highway Department has recently completed the first phase of a two-part research project to develop specifications for compost as a roadside soil amendment. According to Hadrian D. Millon, formerly with the Landscape Design Section, Massachusetts Highway Department, researchers from Harvard and the University of Massachusetts were asked to develop ways of amending on-site soils that would be more economically viable than importing the components for a good quality soil to the site, then blending and placing it (i.e. manufacturing topsoil on-site). The research looked at soil types and gradients of slopes to develop different appropriate mixes of compost and soil. Most New England soil is glacial till — a cobbly, sandy, rocky soil with a shallow soil mantle that usually is lost during construction, leaving behind sterile subsoils. By amending with composts (that are chiefly biosolids), a growing medium can be created. Millon notes that biosolids are composted with wood to create an acceptable C:N ratio. The finished compost is screened to remove any remaining chips or chunks of wood. A typical mix used in their research has been one-third compost to two-thirds existing soil. Seeding has been successful onto the compost-amended soils, and results are being compared to seeding on standard loam. So far, the compost has outperformed the loam.

Departments of Transportation in California, Florida District II, Illinois, Maine, North Carolina and Washington State also report substantial and successful compost utilization in one or more applications. Formal and informal field trials utilizing compost in roadside plantings have been or are being conducted on a first hand basis by DOTs, including those in Arkansas, California, Connecticut, Florida, Georgia, Idaho, Maine, Maryland, Michigan, Missouri, New Hampshire, New Jersey and Oregon.

GRASSES AND WILDFLOWERS

When growing grasses in compost amended soils, results ranging from adequate to outstanding have been obtained by Departments of Transportation in Delaware, Florida District II, Illinois,

Table 1. State DOT and selected compost specifications in effect in 1996, Part I

State, Compost Type, Date Spec'd (When Noted)	Particle Size/ Texture	Color/Odor Organic Content	pH C:N C:P	E.C./ Soluble Salts	Moisture (M) Bulk Density (BD) Water Holding Capacity (WC)	Stability	Inerts/ Nonbiodegradable
Arizona DOT Composted wood or bark for use as soil conditioner	Min 85% must pass through a 6.3 mm sieve	Not less than 85% organic matter	7.5 or less (pH) Min 0.5% N				
Composted steer manure for use as mulch	Must pass through a 12.5 mm screen (6.3 mm if used for lawns)				Must contain wetting agent or be hygroscopic	Well composted and unbleached; no visible amounts of undercomposted straw or bedding	No stones
California DOT Soil amendment ¹	Shall be friable and pass a 25 mm sieve				Relatively dry	Shall comply with the requirements of the California Food and Agricultural Code	
Composted mulch of recycled urban green material ²	At least 85% of particles must be between 1/2" and 3" long, no less than 3/8" in width and 1/16" in thickness						Plastic, glass, metal or rocks shall not exceed 0.1% (sic) by volume
(District 7) Mulch of composted urban green waste ³	Between 1/2" and 1-1/2" in thickness and 1" to 8" in length					Grinding within 1 mo. of cutting Composting in windrows for min. 120 days; min. internal temp between 140-160° for at least 7 days	
Florida Dept. of Agriculture & Consumer Services	<i>At press time, specifications for compost procured by state agencies were in the process of being finalized</i>						
Georgia Dept. of Agriculture Composted organic materials 12/29/93	100% < 1" 90% < 1/2"	Brown to black/ earthy	4.5-8.5 (pH) labeled and suitable to end use	Max 10mmhos/cm labeled and suitable to end use	30 to 50%	May not reheat to 20°C above ambient temp.	Plastic: max 1% All other: max 2%
Georgia DOT Organic materials that have undergone decomposition		Dark brown or black/ minimal odor	5 to 8 (pH)			Stabilized to degree beneficial to plant growth	
Illinois DOT	Thoroughly decomposed					Capable of germinating and supporting vegetation. Thoroughly decomposed	No glass or metal shards. No plastic or man-made material larger than 4mm and sieved out to be less than 1% of total dry weight.
Maine DOT	See CONEG specs	See CONEG specs	See CONEG specs	See CONEG specs	See CONEG specs	See CONEG specs	See CONEG specs
Massachusetts Highway Dept. Compost procurement for amending soils ⁴ 10/96	1/2" or smaller/ humus like	Dark brown to black Min. 40% organic matter (dry weight)	5.5 to 8.0 (pH) 10:1 to 25:1 (C:N) ⁵	<4.0 mmhos/cm (dS/M) or 2560 ppm salt	No visible free water or dust produced when handling	Stability must be assessed by either CO ₂ evolution test or reheating test ⁶	Shall not be visible and should not exceed 1% dry weight
CONEG⁷ Source Reduction Task Force Source-separated compost for general use ⁸ 2/96	<0.5 inch and should meet state particle size standards for topsoil Loose & friable	Min. organic matter 30% (dry weight basis) ⁹	6.0 to 8.0 (pH)	<4.0 mmhos/cm (dS/m)	M generally between 35% to 60%	Stable according to specified testing methods ¹⁰	

Part II of this table will appear in August, 1997 BioCycle

¹In addition to other products, may also include "a relatively dry organic compost derived from sewage sludge, plant material or rice hulls"

²Pending development of final specifications. Interim specifications are for compost used in erosion control and other applications

³See preceding footnote

⁴Proposed standard specifications. May include composted biosolids, yard waste, agricultural wastes, and source separated municipal waste. Not applicable for other processed organic residues (e.g. lime stabilized wastewater sludge)

⁵The reported C:N ratios before and after processing are to be preferred, together with total carbon

⁶For the CO₂ test, the compost respiration shall be no more than 5 mg CO₂-C/gBVS day. For reheating using the Dewar Self-Heating Test, the maximum heat rise should be no greater than 20°C above room temperature (20 to 25°C)

⁷Coalition of Northeastern Governors

⁸As a topdressing to established areas of turf, grass, or other ground cover growth for the purposes of improving soil fertility, aeration, and moisture-holding capacity...

⁹As determined by loss on ignition

¹⁰Dewar Self-Heating Test or Carbon Dioxide Generation Rate as described in the CONEG Model Procurement Specifications Appendix B

Maine, Montana and New Jersey. In a trial conducted by the New Jersey DOT, grass was seeded to plots of sandy soil amended with a compost of biosolids and wood chips. "The composted sludge added to sandy soil does seem to help with moisture retention, and possibly protects the grass apical meristem during extremely dry weather conditions," writes NJDOT Landscape Designer George C. Caruso, Jr., in his report. "Composted sludge immediately helps to form an organic mat in the root zone when incorporated into the sandy soil."

According to Aileen Waech, Broward County (Florida) Streets and Highways Division, the county seeds or sods directly onto a one-half-inch layer of composted yard trimmings applied to roadsides. Larry Hill, Design Division, Michigan DOT, notes that they have started a project using yard trimmings compost as an amendment on slopes that will be seeded for turf. In Florida DOT District II, sprigging shoulders on a site where soil was amended with yard residuals proved a success, and grass has moved in and become established in areas mulched with compost in a tree mitigation project, says Dick Bush, Landscape Development Specialist.

A number of types of compost are being used routinely or experimentally in DOT wildflower projects in Arkansas, Georgia, Maryland, Michigan, New Hampshire, North Carolina, Ohio, Pennsylvania, Virginia and West Virginia. To boost nutrient levels, the Ohio DOT has incorporated mushroom compost into beds where wildflowers for seed production are being grown. Compost is added to planting backfill mixes by DOTs in Georgia, Hawaii, Maine, Maryland, Missouri, New Hampshire, Ohio, South Carolina, Virginia, Wisconsin and Wyoming.

EROSION CONTROL

Applications of compost for erosion control are also reported. Clyde Walton of Maine DOT reports that roadside turf grown in a 50-50 mix of compost and subsoil resists erosion better than grass grown in straight loam. Soil stabilization was immediately achieved by heavy mulching with a coarse textured compost that was also overseeded for future vegetative cover. California DOT (Caltrans) encourages mulching with composted urban green waste (yard trimmings) for erosion control. In conjunction with the California Integrated Waste Management Board, is launching an investigation and demonstration project on the use of compost and cocompost (biosolids) as a primary erosion control material, according to John Haynes, Transportation Erosion Specialist. To date, Caltrans has experimented with compost as an erosion control medium in a variety of applications and site types.

Preliminary findings from the Washington State DOT, as noted by Hans Littooy, Principal Design Landscape Architect, indicate that yard trimmings and yard trim-

In Massachusetts, seeding has been successful onto the compost-amended soils, and results are being compared to seeding on standard loam. So far, the compost has outperformed the loam.

mings/biosolids composts used as part of erosion control in the seeding process have a positive effect on water quality. Broward County Streets and Highways Division uses a final dressing of rock (for stabilization) and composted yard trimmings (for organic content) when working on swale areas and changing water retention areas, says Waech. In an erosion control project on a stream bank, Oregon DOT successfully used a commercially produced medium grind yard trimmings compost on slope inclines that ranged from 1:1 to 3:1. Compost texture is apparently relevant to the effectiveness of compost as a medium for erosion control. Arizona DOT reports that for erosion control, most of their available compost is too fine and would wash off slopes, so they use rock mulch for erosion control instead.

MULCH AND TOPDRESSING

Compost is used as a mulching material for various purposes by DOTs in California,



A Maine stormwater ditch protection project uses stone check dams and wood residuals compost along road shoulder (above). Lakeside buffer areas are planted with 12 inch layer of compost that filters stormwater and restores organic protection over soil (right).



Photos courtesy of ME DOT

Florida, Hawaii, Maine, North Carolina and Texas. Mulching with compost has been tested as a method of reducing herbicide use by the California DOT and is used extensively by Texas DOT in six to 12 inch layers for moisture retention. Composted yard trimmings have been used successfully as mulch in tree planting projects by Florida DOT District II and Broward County Streets and Highways Division. Based on recommendations from arboriculturist Alex L. Shigo, Hawaii DOT is considering switching from turf or other plantings under trees to compost, which because of its biological activity is regarded as "living mulch."

Washington State DOT has engaged the University of Washington Center for Urban Horticulture to conduct research on roadside plantings of young trees and other plants to compare the effects of above ground application (mulching) of compost with those of compost that has been incorporated. Hans Littooy says that in earlier research, the Center for Urban Horticulture found that compost used as a mulch is of greater benefit to trees than when compost is used as an amendment. This, according to Littooy, seems to be the case because incorporation affects soil to a limited soil depth and consequently tree roots are concentrated near the surface of the soil. When compost is applied as mulch, all soil layers receive the benefits of its mycorrhiza, nutrients and promotion of moisture retention. Littooy also notes that these benefits are still a subject of research.

Walt Disney World, Florida reports successful topdressing with composted biosolids in lieu of fertilizing roadside stands of turf; they are more interested in the greening effect than in growth as they prefer to minimize frequency of mowing. Tests on leachates in the substrate, as reported by Roy Mecklenburg, showed that N disappeared within a few months, but the greening effect lasted significantly longer due to a two percent iron content. Idaho DOT has just embarked on a five-year trial where four different types of compost will be applied as topdressing after seeding for native and non-native drought resistant grasses. Ohio DOT has used composted 100 percent poultry manure (3-5-3 fertilizer equivalent) as a turf topdressing with satisfactory results.

Occasional or experimental use of compost in hydroseeding operations by DOTs or their contractors is reported by California, Georgia and Montana. Maine DOT is using compost for sediment control filter berms. Compost also has been used in DOT wetlands creation and mitigation projects in Connecticut, Illinois, Utah and Washington.

Factors such as particle size and moisture content are reported to determine the effectiveness of a compost in a given application. As noted above, compost texture is consequential in erosion control applications. In the Oregon DOT erosion control project, the requisite texture was obtained from a compost of woody yard debris; the same project

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Compost applications have reduced the need for hauling topsoil and peat moss, while achieving erosion control benefits.

Ohio DOT has used composted 100 percent poultry manure (3-5-3 fertilizer equivalent) as a turf topdressing with satisfactory results.



Photos courtesy of CA DOT

made evident that levels of both soil moisture and compost moisture at the time of application affects how well the compost layer "sticks" on slopes. The wetter the ground, the worse the "stick," also, if the compost is too wet, it tends to slide down the slope.

Research funded by the California Integrated Waste Management Board found that mulches of coarser materials (i.e. larger particle sizes) will help deter weed growth and last longer. On occasion, California DOT also has been using finely screened compost in lieu of hydroseeding fibers in the belief that using the compost will eliminate the need for commercial fertilizer in plantings of native grasses. Their experience is that commercial fertilizers favor annuals which then outcompete the perennial natives they are trying to establish.

The effectiveness of a compost in a given application is sometimes linked to the particular type of compost used. The North Carolina DOT reports exceptional results from its applications of composted poultry litter to wildflower beds, whereas results were mixed when other composts were used. Arkansas DOT had good results from composted poultry litter disked into wildflower beds; they assume that its humic acids and micronutrients, along with the slow release of N, were responsible. (According to Donna Gardner of the Arkansas State Highway and Transportation Department, the poultry litter compost — approximately 3-3-3 fertilizer equivalent — was used as a substitute for a 10-20-10 fertilizer; nutritionally comparable applications of this fertilizer were resulting in runoff into ditches, subsequent algae growth and further pollution of creeks.)

The composting process itself has proven useful to the Minnesota DOT. Through a federally funded research project, they have developed a method of using a compost of manure and wood chips in the bioremediation of soil contaminated by petroleum compounds and certain solvents. Since 1991, MnDOT has used this method in 17 separate projects and cleaned over 8,000 cubic meters of various soil types. The cleaned

soil is applied as surface dressing in layers up to four inches in construction areas near clean-up sites. Sodding or seeding follows, and results have been good.

PROBLEMATICALLY EFFECTIVE

Compost is occasionally reported to be effective in a problematic way. The Virginia DOT rarely uses biosolids compost because they found it to be as nutritious for the weeds as for the desired wildflower plantings and, in the case of daylily plantings, the plants grew extremely well but failed to bloom. A trial conducted by the New Jersey DOT found that incorporation of three inch and six inch layers of composted biosolids to soils seeded with grass tended to stimulate too much vegetative growth in wet spring weather and concluded that a two inch layer would be workable and sufficient. Although Arizona DOT has used composted wood as a soil amendment for 20 years and had satisfactory results from turf and shrub plantings in compost amended soil in a half mile long freeway overpass park, Leroy Brady of Arizona DOT Roadside Development reports they are phasing out the use of organic soil amendments as the native plants they currently select do best in low organic soils.

Failures in compost effectiveness on specific projects are generally assigned to the possibility of compost being insufficiently mature or otherwise of compromised quality, to low rates or otherwise incorrect methods of application and/or to environmental conditions that similarly affected the larger landscape. ■

Donna Mitchell is a writer and photographer living in Gainesville, Florida. This article is excerpted from a March, 1997 report researched and written for the Florida Department of Transportation under a grant to the Department of Environmental Horticulture and the Soil and Water Science Department at the University of Florida. For more information contact Robert Black, University of Florida Cooperative Extension, Gainesville, Florida. E-mail: rjb@gnv.ifas.ufl.edu.

STATE HIGHWAY DEPARTMENTS FIND IT PAYS TO USE COMPOST

THE MAJORITY of state Departments of Transportation (DOTs) involved with compost utilization have either recently completed or are in the process of developing or revising their specifications for one or more types of compost. These findings are based on a nationwide study conducted for the Florida DOT that involved telephone interviews with landscape architects, engineers, and maintenance and environmental planning officials regarding compost utilization by their agencies. Several DOTs made reference to one or both of two recent publications: the Model Procurement Specifications for Source-Separated Compost published in February, 1996 by the Coalition of Northeastern Governors (CONEG) Source Reduction Task Force and the 1995 Suggested Compost Parameters and Compost Use Guidelines developed by the Composting Council, the Florida Department of Agriculture and Consumer Services, and the Clean Washington Center.

While a range of characteristics pertaining to compost quality and safety are addressed in specifications (Table 1), the most commonly cited product quality and safety issues arising during actual field use concern compost maturity and observable contaminants in the compost.

Some states reported receiving occasional shipments of immature compost and, in others, concern was expressed that unstable compost would cause soil nitrogen depletion. Washington State DOT (WSDOT) has closed loopholes that allowed composters to avoid maturity testing and has now built in a maturity requirement; producers must provide maturity testing kits with compost deliveries so that DOT personnel can perform the test in the field if they suspect that a batch of compost is not mature. WSDOT also now requires that as part of the permitting process, compost manufacturers submit lab test results indicating that compost meets the specifications (other than maturity) established by the WSDOT. In the experience of the Massachusetts Highway

Nationwide survey of state transportation agencies answers key questions about cost savings, application results and compost specifications.

Part II

Donna Mitchell

Department, commercial compost producers — when compared with local municipal yard trimmings compost producers — make a cleaner, more quality controlled but less stable product which continues to decompose after delivery.

HANDLING CONTAMINANTS

While levels for contaminants such as pathogens, weed seeds, heavy metals, salts and inerts can be and are limited by specifications and, in the first two instances, by the composting process itself, some DOTs report receiving shipments of compost with objectionable odors or pieces of plastic and glass large or ubiquitous enough to be easily noticeable or to raise concerns about injuries to workers or damage to equipment. In Delaware, for instance, there were problems with a cocompost made with MSW that contained obvious bits of glass, plastic and fabric. The contaminants in the MSW created concerns about damage to equipment (e.g. tires). In Georgia, MSW compost was used as mulch once on a maintenance project in an interchange area and workers reported seeing and hearing fragments of metal and glass in the compost during application with a slinger.

The presence of plastic and glass is not a concern across the board. The new specification developed by the Massachusetts Highway Department tries to be broad enough and performance oriented enough to allow for a range of organic and inorganic constituents, so long as particles are clean and small. Hadrian Millon, formerly with the Massachusetts Highway Department, says that they would even happily accept ground up glass, which acts as a coarse sand and bulking agent, if it were not so expensive. They also would be interested in plastic that is shaped in a way to alleviate compaction around the root zone.

Bill Sherman, Ohio DOT District 6 Landscape Architect, recalls highly visible inerts on a slope they amended with an MSW compost but noted that they were completely obscured by the vegetative cover within a year. He adds peat is used for an amendment in areas where pedestrian traffic is anticipat-

Compost and seed are sprayed over steeply sloped disturbed areas along California highways.



Photo by J&M Land Restoration

The New York State DOT has specified peat, humus and compost for use as amendments, if needed, to meet their requirement for a two percent organic content in topsoil; by specifying several materials as amendments, they intend to encourage an atmosphere of economic competitiveness.

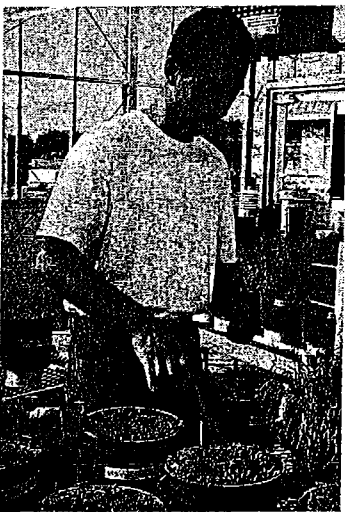


Photo by R.J. Black

The University of Florida conducted a study with the state DOT that included greenhouse tests of grasses grown in different compost mixtures. Out in the field, test plots along a highway are seeded with grass.

ed. The Ohio EPA has been in the process of reviewing the permitting application for an MSW composting facility. Of concern, according to Jan Voelker, Composting Specialist with Ohio EPA, is the potential for inclusion of solvents, industrial solid waste, plastics and home care medical wastes that are currently landfilled.

Pennsylvania DOT discovered that a biosolids compost they applied to wildflower beds had been stored in the open and contaminated with weed seed, which then germinated and grew as well as the wildflowers.

COST AND AVAILABILITY

Consistent availability of a certain or sometimes any type of compost in the large quantities required for roadside projects is problematic in Colorado, Massachusetts, Nebraska, South Dakota, Texas and Wyoming. In Texas, rates of application are sometimes affected by availability. When Maine DOT has a project near a local composting facility, they make an effort to use their compost; New Hampshire DOT, which has an informal policy of using compost as available from municipalities near their projects, has found that product quality varies greatly from town to town. Availability of composts that meet the requirements of specific applications can be an issue in some states.

Cost of compost utilization includes hauling charges which, due to the volume of material required, can be substantial, particularly when long distances are involved. The cost of the compost itself is increased if feedstocks must also be transported long distances to the producers. Hauling expenses were a particular consideration in large and sparsely populated states such as Colorado, Nebraska, Texas and Wyoming.

Recently published research funded by the Massachusetts Highway Department demonstrated that it was more economically viable to amend on-site soils with compost than to import the components required for a good soil to the site for blending and placement. It is estimated that by amending on-site soils with compost as specified by the research results, the in-place cost will be about half the cost of using loam. In New Hampshire, however, a contractor might

still be able to get a better price on loam than on compost.

ACCEPTANCE ISSUES

Composted organics that are commercially produced for large scale consumption are relative newcomers to many regional marketplaces and as such have encountered obstacles to acceptance commonplace for "new" products, chief among them a lack of familiarity with the existence or nature of the product. In some states, large scale compost production is not enough of a market force to have made itself known to the state's DOT. In other instances, though DOT landscape architects may themselves be aware of the availability and potential benefits of a compost, their contractors do not know about or do not understand compost and do not want to use it. In Montana, finding a niche for compost and getting engineers to agree to use it are major requisites for implementing utilization. The Vermont Agency for Transportation is willing to use compost but needs the tools to convince the contractors. In Minnesota, where composted yard trimmings have been used on roadsides routinely for a number of years, both the DOT and the contractors are satisfied with the results. Following specification of compost in 1994 in Illinois, the DOT met with some resistance from workers and contractors largely because it was a new item. However, according to Richard Nowack, Chief of Biological Resources Unit, the biggest issues to confront were how to physically handle compost and how to assess the quality of a given batch. Now composted yard trimmings are used routinely, particularly to improve soil structure and add nutrients.

Direct and indirect resistance to compost utilization on roadsides has arisen for various economic reasons. In one state, an attempt to legislate roadside use of composted biosolids was "shot down by chemical industry lobbyists" and further opposed by the Association of General Contractors on the grounds that mandating compost use would set an undesirable precedent by opening up the possibility that other construction materials would be mandated. Producers of wood mulch and fertilizers see compost as cutting into their markets.

The cost of compost (which ultimately also includes cost of transportation and application) must be competitive with alternatives if contractors are to select it. In Delaware a number of years ago, MSW and biosolids composts were initially being promoted as available for free but, in a move that was felt to be calculated, once they were specified, the compost producers wanted to charge the contractors. Joseph Lesley of the Delaware DOT thinks if the producers had waited until the compost was an accepted product before instigating charges, they might have fared better. A compost of chicken manure and fly ash that the Delaware DOT is now considering for specification is currently being promoted as free but, if it is specified, Lesley anticipates



Table 1. State DOT and selected compost specifications in effect in 1996, Part II

State, Compost Type, Date Spec'd (When Noted)	Particle Size/ Texture	Color/Odor Organic Content	pH C:N C:P	E.C./ Soluble Salts	Moisture (M) Bulk Density (BD) Water Holding Capacity (WC)	Stability	Inerts/ Nonbiodegradable
Michigan DOT Special provision 2/96	Max 1" diameter with less than 10% retained on a 3/4" screen	Dark brown or black. Shall not have an objectionable odor 10 to 50% organic content	6.0 to 8.5 (pH) 10:1 to 20:1 (C:N)	1-7.5 mmho (sic) ¹	No visible free water or dust produced when handling	Demonstrably mature/stable ²	Less than 1% by weight No visible plastic, glass or metal
Minnesota DOT Grade 1 compost for use in turf establishment Nutrient rich, derived from poultry or animal manure; no biosolids unless specified	Total breakdown of raw ingredients Texture similar to highly organic soil	Lack of odor	15:1 (C:N) ³ Max 40% C Min 2.5% total N Min 2.5% total P Min 1.5% total K ⁴		In an air-dried condition at the time of delivery	Decomposition complete as evidenced by total breakdown of raw ingredients and lack of odor or heat generation	No plastic debris, stones, sand, glass, other extraneous matter. Materials shall meet MN Pollution Control Agency. Requirements for allowable levels of any inherent contaminants
Grade 2 compost for use as a landscape planting medium. Derived from de- composed leaves and yard waste; no poultry or animal manure acceptable	Texture similar to shredded peat	As for Minnesota DOT Grade 1 compost, above	5.5 to 7.5 (pH) Between 12:1 and 25:1 (C:N) Max 10% ammonium N of total N	Max 15 mmhos/cm	Moisture between 2% and 40% ⁵	As for Minnesota DOT Grade 1 compost, above	As for Minnesota DOT Grade 1 compost, above
New Jersey Composted sewerage (sic) sludge and wood chips	Per NJDEP interim guidelines	Min organic content 50% by weight	No less than 6.0 pH		Average not more than 55%	Stabilized	
New York State DOT Draft revision to the Standard Specifications for Source-Separated Compost ⁶	<12.5 mm Loose & friable	Min 30% organic matter (dry weight) ⁷	6.0 to 8.0 (pH)	<4.0 mmhos/cm (dS/m)	35 to 60% (M)	Stable to very stable according to test method current on the date of advertisement for bids	Reasonably free of stones, refuse, materials deleter- ious to soil structure or toxic or detrimental to plant germination and growth
North Carolina DOT Composted poultry litter as specified in Request for Contract Quotations 1996	Pass through 5/8" screen	Slight to no odor	5.7 to 7.5 (pH) Nutrients may not be less than 90% of the values in the contractor's quote	<4.0 mmhos/cm (dS/m) ⁸	<40% (M) and no more than 15% over contractor's quote	Meets specified production criteria Also may not exceed 110°F after 5 days stockpiling or increase more than 20°F in 24 hrs	Fillers added to poultry litter must be approved in writing by NCDOT
Oregon DOT Compost for soil conditioning ⁹	Fine texture (for composted ground bark)						Free of substances detrimental to plant life
Pennsylvania DOT Sewage sludge/wood- chips compost as mulch ¹⁰	3/8" to 3"	50% organic matter ¹¹	6.0 min pH		Min 100% WC	Nonburning, free of substances toxic to plant growth	Free of foreign material
Texas DOT	Compost material approved by the Engineer may be used as mulch or as 30% of backfill mix						Free of stones or other foreign mat- ter
US DOT/Fed Highway Admin Organic materials such as leaves, grass, shrubs and yard trimmings 1996	12mm max (sodding & seeding) 25mm max (erosion control); friable	Dark brown/ soil like odor 50% min organic	6.0 to 7.8 (pH) 25:1 to 35:1 (C:N) 120:1 to 240:1 (CP)		40% max (M)	Cured for 4 to 8 weeks Maturity is indicated by temperature stability and soil like odor	2% max
Virginia DOT Composted leaf matter and yard waste 8/95	No recognizable woody fibers, seeds or leaf structures	Average 40% organic matter	6.0 to 8.0 (pH)		Average BD< 1250 lb/cu yd		Free of stones and nonorganic matter
Washington State DOT Composted organic solid waste 10/96	100% must pass through 1" sieve ¹²	Uniform dark, soil- like appearance Min organic matter 30% dry weight ¹³	5.5 to 8.5 pH ¹⁴	<4.0 mmhos/cm		Score a number 5 or above on the Solvita™ Compost Maturity Test	<1% manuf. inert material (plastic, concrete, ceramics, metal, etc.) ¹⁵
Wisconsin DOT	Compost shall be a standard commercial compost of cattle, sheep, or poultry manure or other organic material acceptable to the Engineer						

that charges will accrue. The New York State DOT has specified peat, humus and compost for use as amendments, if needed, to meet their requirement for a two percent organic content in topsoil; by specifying several materials as amendments, they intend to encourage an atmosphere of economic competitiveness.

Composts containing certain feedstocks may not be accepted. Although limits on heavy metals in land application of biosolids are established by the United States EPA 40 CFR Part 503 rule or by a state's internal environmental regulations (which are the same as or more stringent than the EPA's), roadside use of composts containing biosolids is viewed with reserve by at least half a dozen state DOTs, their state environmental offices, and/or among their constituents. Illinois DOT uses mainly yard trimmings compost as there is concern over the heavy metals content of locally available biosolids. The Kentucky DOT is apprehensive about potential damage to the water supply and other points of safety in the use of biosolids compost. Minnesota DOT currently uses composts containing

In some states, even though DOT landscape architects may themselves be aware of the availability and potential benefits of a compost, their contractors do not know about or do not understand compost and do not want to use it.

municipal solid waste or biosolids in pilot projects only.

When the Wyoming DOT tried to use biosolids on a large roadside reconstruction project, they encountered a strong political backlash that ended the use. People perceived that the biosolids contained too many toxins (pathogens and metals) even though the levels in the biosolids tested were well below EPA standards. By comparison, Nebraska Department of Roads reports that biosolids compost would not be available to them as it is being used by farmers as fast as it is made.

In Massachusetts, the Highway Department has taken the position that as long as a compost passes required tests for safety and efficacy, feedstocks are not an issue. In their investigation for the Massachusetts Highway Department into "the feasibility and cost of using a sludge product with other native products to manufacture topsoil for the erosion control and future park plantings on Spectacle Island [in Boston Harbor]," Phillip Craul and James Patterson ultimately recommended a sludge composted with wood chips over use of native topsoil, sludge cake

Table 1. State DOT and selected compost specifications in effect in 1996, Part II (cont'd)

State, Compost Type, Date Spec'd (When Noted)	Particle Size/ Texture	Color/Odor Organic Content	pH C:N C:P	E.C./ Soluble Salts	Moisture (M) Bulk Density (BD) Water Holding Capacity (WC)	Stability	Inerts/ Nonbiodegradable
Wyoming DOT Sample special provisions for landscaping with organic amdt. of 25% composted sheep or cow manure and 75% mountain peat	Amendment to be coarsely ground and thoroughly mixed to ensure an even composition	Min 50% ¹ organic matter	5.5 to 8.0 (pH)	Free from high salt content			Free from stones and materials harmful to plant life
Composting Council Preferred parameters for compost used as soil amendment for turf establishment 6/95	Pass through 1" screen or smaller (preferred) Acceptable size dependent on turf, compost & soil variables	Organic content may vary but must be reported; higher rates preferred and have some use as measure of value	5.5 to 8.0 (pH)	Depends on tolerance of turf species, Max 4.0 dS/m for amended soil	35 to 55% (M) BD must be reported WC must be reported	Stable to highly stable; must pass growth screening test	Avoid glass; minimize man-made inerts
CONEG¹⁶ Source Reduction Task Force Source-separated compost for general use ¹⁷ 2/96	<0.5 inch and should meet state particle size standards for topsoil Loose & friable	Min. organic matter 30% (dry weight basis) ¹⁸	6.0 to 8.0 (pH)	<4.0 mmhos/cm (dS/m)	M generally between 35% to 60%	Stable according to specified testing methods ¹⁹	

¹EPA 120.1=Specified Conductance. EPA, ASTM or Equivalent Method

²Using an acceptable test, e.g. CO₂ respiration or temperature self-heating tests

³Determined by the Kjeldahl method. All other testing will be according to current standard testing procedures of the Univ. of MN Soil Sci. Dept. Soils Testing Lab.

⁴To obtain the N-P-K levels specified, the compost may be fortified with commercial fertilizer.

⁵In accordance with ASTM D 2016, Oven Drying Method. All other testing according to current standard procedures at the Univ. of MN Soils Testing Laboratory.

⁶Composted Sewage sludge must meet the applicable regulatory requirements of the NYS Dept. of Environmental Conservation (DEC) and requires an approved laboratory's certificate of acceptability provided by the producer of the compost. Composted sewer sludge used to amend or manufacture topsoil shall require a certificate from a laboratory approved by the DEC, verifying compliance with all applicable laws, rules and regulations and shall be supplied by the Contractor at the Contractor's sole expense.

⁷As determined by loss on ignition.

⁸Using a water to soil testing method of 2:1.

⁹Includes spent mushroom compost, composted mint plant residue, approved commercially manufactured conditions made from composted sewage sludge amended with organic and inorganic materials or composted yard debris amended with inorganic materials, and fully composted, fine textured ground bark.

¹⁰Specification will probably be modified to include composts from other feedstocks as well as other applications (i.e. as topsoil and soil supplement).

¹¹Oven Dry Basis.

¹²When tested in accordance with AASHTO Test Method T67 and T88.

¹³As determined by loss on ignition (LOI test).

¹⁴When tested in accordance with WSDOT Test Method 417.

¹⁵On a dry weight or volume basis, whichever provides for the least amount of foreign material.

¹⁶Coalition of Northeastern Governors

¹⁷"As a topdressing to established areas of turf, grass, or other ground cover growth for the purposes of improving soil fertility, aeration, and moisture-holding capacity..."

¹⁸As determined by loss on ignition

¹⁹Dewar Self-Heating Test or Carbon Dioxide Generation Rate as described in the CONEG Model Procurement Specifications Appendix B

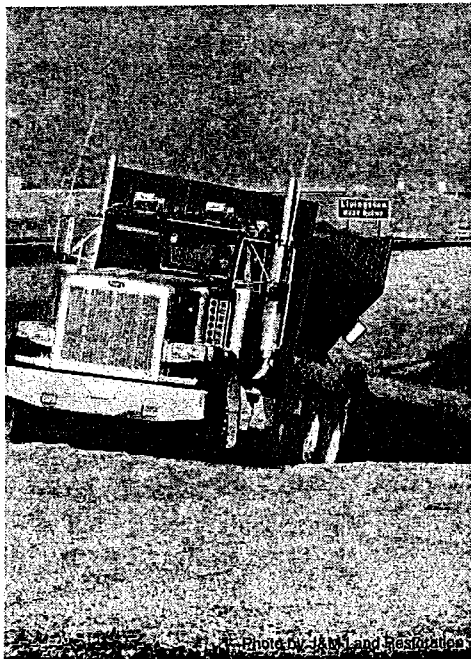
or sludge pellets. The Spectacle Island project involves closing and capping the existing former landfill, using the Island as a disposal site for excavation material from a tunnel project, and covering the tunnel material with a substratum loam and then a topsoil in preparation for landscaping and planting as a future recreational park.

According to the final report: "The composted sludge, mixed with sand ... would give the most suitable planting environment of all four alternatives. The soil structure would be what is necessary, the organic content would be long lasting and more readily available than that yielded by the pellets, and the heavy metal concentrations would not be problematic based on quality data review.

Even if there were significant quantities of heavy metals, some of the biological processes that occur during composting capture the metals in an insoluble compound. ...The two major disadvantages, storage and transportation, are secondary compared to the benefits of using composted sludge."

PROMOTING UTILIZATION

In some states, compost utilization is being actively promoted as a recycling activity by state agencies or legislative mandates. States are increasingly banning yard trimmings



Manure spreaders are being used to apply compost on some relatively flat California terrain.

from landfills and experiencing difficulty in siting landfills for other waste materials; to help develop markets, states have begun establishing quotas for their agencies' use of recycled materials. The King County (Washington) Commission for Marketing Recyclable Materials has commissioned extensive research into product testing and market development for the yard trimmings composts being produced at a number of facilities in the area. King County Department of Public Works Solid Waste Division and Seattle Solid Waste Utility have commissioned trials in collecting and composting commercial food residuals. California Integrated Waste Management Board has funded a project with the University of California that investigates compost for agricultural as well as horticultural use, as well as numerous other compost related projects in communities throughout the state.

Hawaii DOT sees its specification and use of island produced compost as vital to recycling the waste plant materials that result from the island's vegetative growth cycles. The Missouri Department of Natural Resources engaged the Missouri DOT in studies on compost use in tree plantings in an effort to develop potential end users of yard trimmings compost. The Texas DOT is working with their Department of Commerce and the Texas Natural Resources Conservation Commission in recycling efforts.

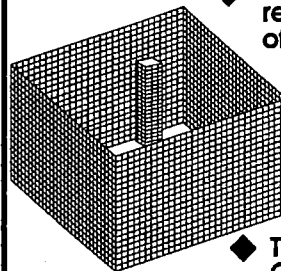
Compost is not being considered for DOT specification or use in some states because amendments to roadside soils aren't considered necessary. Alabama soils aren't as poor in organics as Florida's, for instance, and Alaska's topsoil mantle is thin

King County Department of Public Works Solid Waste Division and Seattle Solid Waste Utility have commissioned trials in collecting and composting commercial food residuals. California Integrated Waste Management Board has funded a project with the University of California that investigates compost for agricultural as well as horticultural use, as well as numerous other compost related projects in communities throughout the state.

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COMPOSTING GONE CAJUN!

The Composting Council's 8th Annual Conference Is "Head'n South!"

- WHAT:** "The Business of Composting"
- WHEN:** January 6-9, 1998
- WHERE:** Heart of the French Quarter, New Orleans
- FEATURING:** A unique opportunity to see composting equipment in operation

"The Business of Composting" will be an informative three-day gathering of compost producers, marketers and every kind of compost equipment vendor imaginable. Every step of the composting process will be demonstrated.

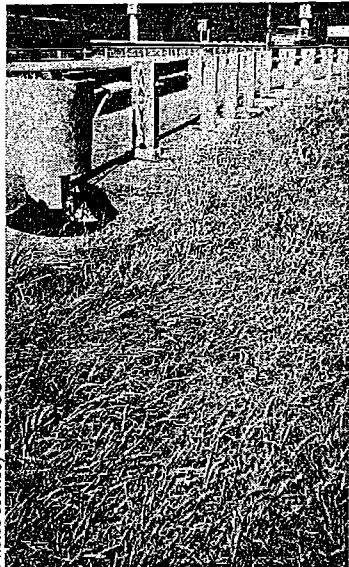
To get more information about the Composting Council's upcoming conference, call, write, fax or e-mail us at:



The Composting Council
114 South Pitt Street
Alexandria, VA 22314

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comcouncil@aol.com

STATE DOT COMPOST SPECS FOR CONTAMINANTS AND HEAVY METALS



Photos courtesy of ME DOT

In Maine, roadside turf is successfully being grown with manufactured loam that utilizes compost combined with subsoils, winter sand sweepings and ditch cleanout soils.

Arizona DOT (composted steer manure): Free of sticks, stones, earth, weed seed, substances injurious or toxic to plant growth.

California DOT (soil amendment): No living vegetation, dirt, objectionable material, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides nor poisonous chemicals that would inhibit plant growth.

California DOT interim specifications: Composted to reduce weed seeds and deleterious material; shall not contain paint, petroleum products, herbicides, fungicides or other chemical residues harmful to plant or animal life.

Georgia Dept. of Agriculture: Must comply with state Environmental Protection Dept. requirements.

Georgia DOT: No human pathogens; does not contain levels of chemicals harmful to plants or humans.

Maine DOT: See CONEG specs (below).

Massachusetts Highway Dept. proposed specifications: Per EPA 40CFR 503 and Massachusetts 310 CMR 32.00 (for application to soils with human activity).

Michigan DOT Special Provision: Meet EPA 40 CFR 503. Be free of viable weed seeds and other plant parts capable of reproducing (except airborne weed species).

Minnesota DOT (grades 1 and 2): No pathogenic material or weed seed. Material shall meet the Minn. Pollution Control Agency requirements for allowable levels of any inherent contaminants.

New York State DOT: Free of sticks, refuse and materials deleterious to soil structure or toxic or detrimental to plant germination

and growth.

North Carolina DOT: Zn & Cu < 2 lb/ton dry wt; Na < 30 lb/ton dry wt. No hazardous materials. Free of specified noxious weeds & protected from non-noxious weeds. No poultry parts, mortalities, litter from houses contaminated with chlamydia.

Oregon DOT: Free of noxious weeds, living plants and rhizomes, and substances detrimental to plant life.

Pennsylvania DOT: Maximum ppm: Cd-25; Cr-1000; Cu-1000; Pb-1000; Hg-10; Ni-200; Zn-2500; PCBs-3.

Texas DOT: Free of sticks or clay.

U.S. DOT/Fed. Highway Admin.: Weed-free, pathogen-free.

Virginia DOT: Free of sticks, heavy metals, toxic matter.

Washington State DOT: Shall comply with the state Dept. of Ecology Interim Guidelines for Compost Quality. Maximum ppm for Grades AA & A compost (respectively): As-20/20; Cd-10/39; Cr-600/1200; Cu-750/1500; Pb-150/300; Hg-8/17; Mo-9/18; Ni-210/420; Se-18/36; Zn-1400/2800.

Wyoming DOT: Free from clay subsoil, lumps, plants or their roots, sticks, weed stolons and seeds, debris, chemicals, or other materials harmful to plant life.

Composting Council: Meets CC Model Regs based on EPA 40CFR 503; should be free of weeds; rates not to surpass turf's annual N requirement.

CONEG Source Reduction Task Force: Delimited by source-separation requirement. Source-separated compost has been proven to be far below EPA heavy metals standards.

but heals fairly rapidly with the long days of sunlight in summer. Iowa's soil is so good it doesn't need amendment, and Arizona is moving toward selecting plants adapted to unamended, low organic or poor soils.

PLANT SELECTION

The selection of grasses, shrubs and trees that are natives, low maintenance and/or otherwise adapted to roadside sites and soils is a direction in which a number of states are moving, either in conjunction with or as an alternative to compost utilization. California is hydroseeding native grasses with a fine yard trimmings compost, partly for fertilization, which they have found to be more beneficial for native perennials than commercial fertilizer. Arizona DOT has found that the native plants they select do better on low organic (unamended) soils; water conservation legislation now prohibits turf plantings in Arizona rights-of-way. Colorado seeds for native grasses and, unless the soil is poor or extremely sandy, uses only fertilizer and

mulch at the time of seeding.

Minnesota DOT grass seed mixes are weighted toward native species. Delaware DOT frequently selects plants suited to the soil at a given site and has switched to grass types that require less maintenance. Because almost everything Hawaii DOT plants now has to be drought tolerant and close to being capable of surviving with the natural rainfall, the plants in their turf areas are often weeds or natives. ■

Donna Mitchell is a writer and photographer living in Gainesville, Florida. This article (Part 1 appeared in the July, 1997 issue), is excerpted from a March, 1997 report researched and written for the Florida Department of Transportation under a grant to the Department of Environmental Horticulture and the Soil and Water Science Department at the University of Florida. For more information contact Robert Black, University of Florida Cooperative Extension, Gainesville, Florida. E-mail: rjb@gnv.ifas.ufl.edu.

TEXAS MAKES INROADS WITH HIGHWAY USE OF COMPOST

LOCATED 60 miles southwest of the Dallas-Ft. Worth metroplex is the bustling town of Stephenville, Texas, population 14,600 and 67,622 dairy cows. Every dairy cow in Stephenville produces approximately 100 pounds/day of manure, 365 days/year — or 18.25 tons/year/ cow. Multiply that by the total number of dairy cows in the area and you get 1,234,101 tons/year of manure — way more than what the land in the Stephenville area can ever handle in the way of direct land application.

Faced with this manure management challenge, the Texas Natural Resource Conservation Commission (TNRCC) began exploring cost-effective options for handling manure outside of the area where it is generated. One promising solution was to compost the manure and then tap end uses in a broader geographic area. And a promising end use selected is application of the compost to Texas roadways to establish vegetation. The TNRCC approached the Texas Department of Transportation (TxDOT) with a proposal to work jointly to demonstrate the application of compost along roadsides to the public, potential contractors, and other interested parties.

TxDOT responded positively to the idea, especially as the agency was becoming increasingly concerned about depleted soils that had little or no organic material to sustain plant growth, leading to severe erosion on many projects. If erosion occurs while the project is still under contract, the contractor must reapply topsoil, seed, fertilizer, and mulch/and or erosion control blankets and cannot leave the project until sufficient grass growth occurs. If erosion results on existing highway sections, TxDOT maintenance is left to deal with the resulting problem, which is an added expense.

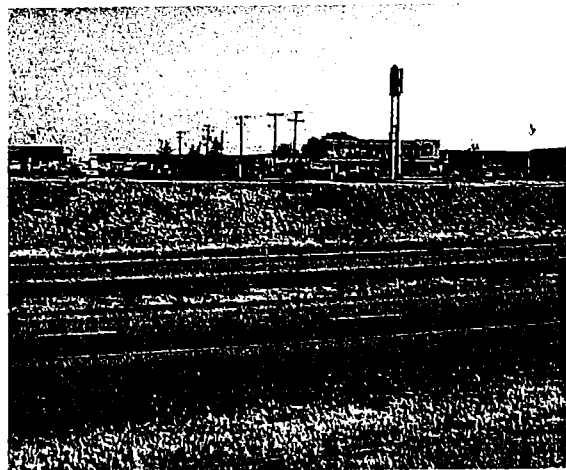
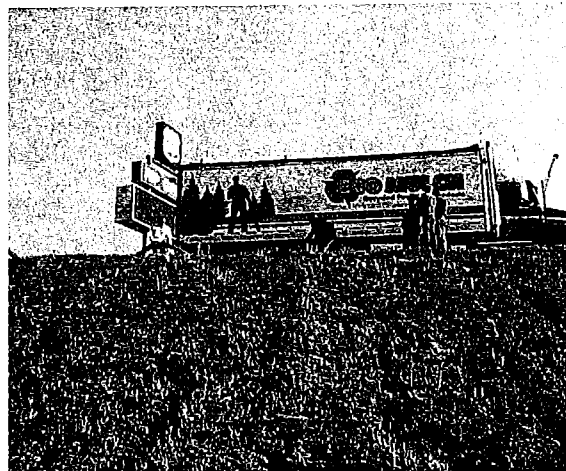
VEGETATING THE FIRST SLOPE

In May, 1999, the two agencies held a demonstration in the West Texas town of Big Spring. TxDOT had tried five times — unsuccessfully — to establish vegetation on a steep, severely eroded overpass. The site was constructed in 1968 in a low rainfall area and had been barren except for the occasional tumbleweed for nearly 30 years. There were six-inch gullies running the entire length of the slope. Compost made from

Success vegetating a slope that hadn't seen green since the highway was built in 1968 has led to broader use of compost by TxDOT — and a potential solution to how to handle the millions of tons of manure generated annually in the state.

*Scott McCoy
and Barrie Cogburn*

The Big Spring site had been unsuccessfully revegetated with conventional treatment, and had six-inch gullies running the entire length of the slope (top). A blend of compost and wood chips was applied at a depth of three inches (middle). Within a month, thick grass was growing in the treated area (left side of bottom photo) versus the untreated area (right side of bottom photo).



The use of compost along roadways in Texas has been demonstrated in 14 of the 25 TxDOT districts, often with remarkable results.

feedlot manure, cotton burrs and yard trimming wood chips was applied with a Rexius blower truck at a depth of three inches, and was used to fill the gullies. Grass seed was mixed in with the compost prior to application. Because wind erosion was considered a problem at this site, wood chips — generally less than three inches in size — were blended with the compost (at a 3:1 ratio of compost to chips) to keep the lighter compost from blowing away. The wood chip blend held the compost in place.

By mid-June, thick grass was growing on soil that had laid barren since the highway was constructed over 30 years before. Compost was the only application that provided a successful growing media over that time. A filter strip made out of the compost mix was built at the top of the slope for demonstration purposes only. It was about 100 feet in length (it would have been longer, but the supply of compost ran out). The filter berm worked well as it rained within a week of the compost blend application and the water was diverted as designed.

WIDESPREAD DEMONSTRATIONS

After the successful Big Spring project, the TNRCC and TxDOT initiated two more demonstrations using a topsoil manufactured from manure compost. The manure was generated by dairy operations located within the North Bosque watershed around Stephenville and Dublin.

Overall, the use of compost along roadways in Texas has been demonstrated in 14 of the 25 TxDOT districts, often with remarkable results. The latest one is in the Brownwood District, where one side of the highway was done without compost and the other had compost applied. The demonstration led this district office to specify compost for ten miles of roadway.

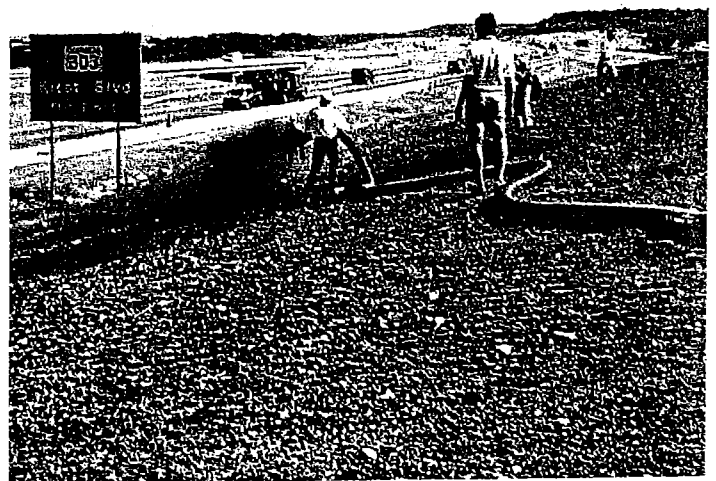
In another demonstration near Dallas, compost was used side by side with conventional vegetative establishment techniques (application of soil to the slope and a synthetic fiber blanket for erosion control). The application was done during a period of drought in north Texas. The areas established using compost had maintained over 90 percent cover while the areas treated with conventional methods had 25 to 30 percent cover. In addition, the compost areas were green and thriving while in the non-treated areas, the grass had withered and died. TxDOT requires 70 percent coverage of vegetation before a job is considered complete (five percent of the payment for highway projects is withheld until 70 percent is achieved); the composted areas far exceeded these requirements.

The demonstrations also have provided an opportunity to test the three different compost classifications developed for TxDOT's specifications (see below). In addition

to manure compost, biosolids and yard trimmings composts have been used. All the applications include a blend of compost and wood chips. Filter berms were used in most of the demonstrations, and with the newly approved filter berm specification, they will be demonstrated in all future programs. Several types of equipment have been used for these applications, including blowers, manure spreaders, side slingers, front-end loaders and graders.

Compost has been applied to the soil surface as a top dressing as well as applied and tilled into the soil. Applications range from one-half inch to two inches deep. We have found that the maximum benefit of compost is limited to one inch in depth, with additional depth adding cost without increasing benefits. Tilling in the compost increases the soil microbe activity with positive benefits to soil tilth.

The demonstration projects also have helped to stimulate an increase in compost production. For example, while composting



had been discussed as an alternative to land application of manure in the North Bosque watershed, potential composters who had the capability to build processing capacity were reluctant due to their apprehension about the compost markets. Several compost operations had come and gone in the area, failing because of the lack of reasonably close markets. The large volume markets were 60 miles away in the Dallas/Ft. Worth Metroplex. Dairy men also were reluctant to sign up with a composter because of this market situation. TxDOT's intentions to use compost (and then actual purchases) helped to address the situation, providing a sustainable market for large volumes of compost. The TNRCC has now assisted in the development of seven composting operations within the Bosque/Leon watersheds.

COST COMPARISONS

The demonstration projects have proven that, in addition to conserving water, using

composted topsoil alongside highways has an economic benefit. "The Big Spring project showed us that using compost for normal roadside maintenance, erosion control, or repairs saves about 20 percent of the cost of a traditional seed-soil-erosion blanket," says TNRCC Commissioner John Baker. "For new construction, the savings jump to about 60 percent." The amount of savings depends on the location of the project, the costs of transporting compost to that site and the type of application.

While no actual cost comparisons have been done at this time, some general cost discussions between TxDOT and TNRCC, contractors and applicators provide some insights, as follows: Application of erosion control compost — \$.75 to \$2/sq.yd. (depending on depth); Application of erosion control blanket — \$1.25 to \$3.50/sq. yd. (depending on slope). Furthermore, in the case of our demonstrations, there has been no additional cost due to the need for maintenance follow-up.



In a demonstration near Dallas, the part of the site treated with compost maintained over 90 percent of its cover (left and above), while an adjacent site treated conventionally had 25 to 30 percent cover.

At the demonstration in the Brownwood District in January, the maintenance engineer expressed a willingness to pay more for the application of compost if it would increase germination rates and reduce the need for revegetation. This would reduce the number of failures that his maintenance staff has to contend with after construction is complete.

Application of mulch/compost material as a filter berm costs in the range of \$.80 to \$2/linear foot. There are no additional costs for removal and disposal and the compost berm provides more organics to the soil. Application of standard silt fence is \$1 to \$3.50/linear foot, which does not include the additional cost of maintenance and the removal and disposal of used materials

(roughly \$1 to \$2/linear foot). In the Brownwood District, the same maintenance engineer indicated that he might be interested in using the compost/mulch filter berm to reduce maintenance and removal costs, even if the initial cost is higher.

COMPOST SPECIFICATIONS

Before any demonstration projects were conducted, TxDOT asked TNRCC if it could assist in developing a specification for compost use. The project took almost a year to complete. Information was gathered from all states that had a specification available. A committee was formed with TxDOT and TNRCC staff, and composters from various communities. TxDOT Special Specification Item 1027, "Furnishing and Placing Compost," was developed and submitted to TxDOT's specification committee for approval, which was given in January, 1998. It identifies three grades or classes — compost for manufactured topsoil, erosion control compost, and general use compost. Erosion control compost and general use compost are required to have 40 to 60 percent organic matter; compost for manufactured topsoil has 30 percent organic matter. Particle sizes for the erosion control compost are two to three times that of the other two compost classes. The TxDOT specifications also require that the compost be tested for maturity using the Solvita test. This provides an added layer of product quality control and confirms the results of laboratory analyses that have to be submitted to TxDOT within six months of compost use.

The success of the Texas demonstration projects led to the development of an additional statewide TxDOT specification. The "Mulch/Compost Filter Berm for Erosion and Sedimentation Control" (Item 1034) was approved for statewide use in September, 2000. Item 1034 increases the particle size of the material to allow for water to filtrate through the berm structure. It allows for the use of a variety of materials to be composted and sets minimum requirements for the quality of material and construction methods.

The mulch filter berm is used when an area is not to be reseeded, so shredded brush meeting the specification would be used. When the filter berm is to be reseeded, the compost filter berm would be used. An example would be if a contractor wanted to put a temporary filter berm around a stockpile of topsoil at the site. A mulch filter berm would be utilized because the berm is temporary and seeding is not necessary. If a berm were being used along the top of a slope to reduce erosion, than a compost filter berm would be put in place that could be seeded and left on site after construction.

TxDOT Special Specification Item 1027, "Furnishing and Placing Compost," identifies three grades or classes — compost for manufactured topsoil, erosion control compost and general use compost.

Over the next three years, districts included in a U.S. EPA-funded watershed protection project have committed to utilize 200,000 cubic yards of compost.

COMPOST USE AND WATERSHED PROTECTION

A UNIQUE partnership between the Texas Department of Transportation (TxDOT), Texas Natural Resources Conservation Commission (TNRCC), and the Texas State Soil and Water Conservation Board (TSSWCB) will result in more compost being used on roadsides and in other applications across Texas. The U.S. Environmental Protection Agency's Region 6 office, along with the TNRCC and TSSWCB, have completed a grant in the amount of \$5.1 million to assist in further encouraging the use of composted dairy manure through funding of a Clean Water Act Section 319 grant. These are incremental funds to be used by states in areas with threatened waterways.

TxDOT projects using compost made from dairy manure from the Bosque and Leon watersheds will receive \$5/cubic yard of compost, which will be applied to

the transportation of finished compost for TxDOT construction and maintenance projects within a 150-mile radius of the watersheds. Because transportation is a large factor in the price of compost, eligibility in this program was limited to those districts within a 150 mile radius of the watersheds. Of the 25 TxDOT districts, seven fall within this region and are eligible for this incentive. The grant also will provide an incentive for the transportation of manure from the dairy operations to area composters.

Cities, counties and universities, also can receive the \$5/cubic yard transportation refund if they want to utilize compost for construction, grounds work or revegetation projects. A series of workshops have begun to assist these other potential markets/users in the utilization of compost for their particular needs.

Using materials that once were considered a waste also supports TxDOT's emphasis on the use of recycled products. All compost feedstocks used on TxDOT projects must meet the same strict EPA standards for Class A biosolids.

REALIZING THE POTENTIAL

The successes with the use of compost in vegetation establishment along Texas roadways have shown the utility of the product for erosion control and moisture retention as expected. The Texas demonstrations have also shown the benefit of compost for vegetation establishment in the harshest of climatic and soil conditions. Probably it is the latter benefit of compost that makes it most attractive to Texas contractors who need to comply with the requirement of achieving 70 percent revegetation of the disturbed area in order to receive full payment.

The economic impact of using compost-enhanced topsoil becomes clearer when considering that Texas has an estimated 1.3 million acres of highway right-of-way. TxDOT's use of the highway soil enrichment process is a huge market for compost, which in turn has the potential to ignite the composting industry and its ability to remove large volumes of organic material from high-impact watersheds. The TNRCC, working closely with many of TxDOT's district offices as well as public and private stakeholders around the state, has moved beyond the demonstration stage to promoting widespread use of compost in highway revegetation.

While it is difficult to calculate the actual amount of compost being used in TxDOT projects, these examples give some sense of the volume. Over the next three years, TxDOT districts included in a U.S. EPA-fund-

ed project (seven districts out of the 25 TxDOT districts) have committed to utilize 200,000 cubic yards of compost (see sidebar). However, one engineer in another district not involved in the EPA project has told us she will utilize 300,000 cubic yards on just one of her projects. The San Antonio district just released its bid for three jobs, which included 10,000 cubic yards in this one letting. At TNRCC, we can only give an educated guess that we will need to find other sources of compost in the state to fill just the needs of TxDOT.

Still, compost use for DOT projects is a very new concept in Texas. Lots of education needs to be done. Contractors who work on DOT projects have been invited to attend workshops with TxDOT staff, which has proved very helpful in lessening apprehension about trying something new. TNRCC and TxDOT staffed a booth at the recent Texas Associated General Contractors annual conference in Austin. Attendees included highway contractors and TxDOT engineers from all over the state. Another booth was staffed by compost suppliers and applicators so that contractors could ask questions about compost. We also electronically distribute a "Navigating the TxDOT Website" fact sheet, which tells composters how to learn more about the TxDOT compost specification, find out what upcoming projects specify compost, and make contact with the low bidder. ■

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Erosion Control and Environmental Uses For Compost

Rod Tyler, Bill Stinson, and Wayne King
Matrixx Organics Company, Richmond, VA

INTRODUCTION

For the last ten years, the use of compost in environmental applications and markets has been increasing at a steady rate. Although environmental uses for compost appear to be an absolutely huge market, there are limited numbers of successful programs that have tapped this great market potential. Still, it is clear that with the invention of pneumatic application equipment, i.e., 'blower trucks', the future use of compost in some of these environmental applications will only increase.

Environmental applications include slope stabilization and erosion control, stormwater filtration, vegetation establishment, and replacement of silt fence with compost filter berms. Filter berms will be the focus of this paper, however we want to briefly point out the advantages of using compost in these other applications.

SLOPE STABILIZATION

In many slope situations, there is no real need to establish vegetation if a layer of mulch is effective in preventing erosion. But how long will the compost or composted mulch last? Will annual applications be required? The norm is to try and establish vegetation, regardless of the severity of the slope. As a result, using compost for slope stabilization and erosion control has met some barriers in the field in that it may not be readily accepted unless seeding is performed on top of the compost layer.

Using both seed and compost applications may or may not be more cost effective than current practices. Certainly, in severe cases where vegetation has not been able to established, compost may be the ONLY option left to try. In these cases, the state, county or local governing body will gladly try anything to keep from repairing the drastically eroding slope every single year. Our experience has shown the local officials will be glad to try any newfangled erosion control materials on their worst possible sites. This truly offers the composting industry a unique chance to quickly show how effective erosion control is with compost. In fact, our marketing motto for erosion control products has now become... "Give us your worst nightmare".

STORMWATER FILTRATION

Stormwater filtration is a relatively new use for compost. Although only a few commercial systems exist, the promise of using compost in filter systems lies in the effectiveness of capture rates compost offers compared to other filter systems. The added benefit is that compost can normally be purchased locally, is annually renewable, and there are good long term odds that this use will also become more mainstream in the next

10 years. This will be further enhanced by recent focuses on water quality and quantity issues in most of our growing communities.

VEGETATION ESTABLISHMENT

For vegetation establishment, compost is perhaps the number one soil amendment when used for turf. For other vegetation establishment, hydroseeding is still king. However, recent comparisons of costs for hydroseeding vs. vegetation establishment with compost and seed applied via a blower truck have proven favorable. In fact, if this combination proves to be as successful in the field as on paper, it will eventually replace part of the hydroseeding market. After all, what would you rather have – a hydroseeded lawn or a lawn seeded with ¼” of compost? For other environmental applications, like the slopes mentioned earlier, seeding is even more tedious than turf, so the likelihood of compost use increasing in these applications is nearly 100%.

FILTER BERMS REPLACE SILT FENCES

Silt fence has been used for erosion control on slopes and around the edges of construction sites for years. It is obviously the accepted standard. (By the way, who invented this stuff and is she now retired in a warm ocean climate somewhere?) Silt fence is used on nearly 100% of construction projects in the US, but there are some inherent problems with it's use. First, it just does not work as well as we originally thought it did. In fact, most officials at the state level will agree that it really does not work at all. Yet it continues to be used and is considered the standard for our environmental containment of silt and sediment.

Silt fence, by the way, is also a product made from petroleum resources, is hard to install properly, and is quite often left abandoned on job sites. Further, it prevents natural migration of aquatic animals like turtles and salamanders from area to area as they are disturbed during the construction process. In developing communities that are sensitive to endangered species or aquatic life, this has recently become a bigger issue of concern. Last but not least, silt fence, if it is picked up after construction is completed, needs to be properly disposed of in a landfill. What a waste.

HISTORICAL PERSPECTIVE

Compost, when properly installed in long filter berms, actually works better than silt fence in the function both were intended to perform: Keep both suspended and settleable solids out of our water sources when moving on the surface. Perhaps a historical review may help at this point.

In 1993, Bill Stewart conducted research which showed surprising results in a number of erosion applications on a local roadway that had extremely steep slopes. The research (regarded as one of the first major sources of info on this topic) also showed how ineffective silt fence was. In 1994, the Maine Waste Management Agency tested

compost in Kennebec County to determine if the results were predictable. This followed with Clyde Walton from Maine DOT to be one of the first to specify compost filter berms on DOT projects in 1996. In 1997, USEPA recognized the use of compost for erosion control and specifically the use of filter berms as important methods to reduce environmental problems associated with erosion. CalTrans has been working on many projects for the last ten years and now has a very progressive program.

So why are we still using silt fence? Until the advent of the blower trucks, accessibility and efficient application of compost or composted mulch was hard to achieve. Manual application on 2:1 slopes would be nearly impossible. Application of filter berms around construction sites would require a bobcat, loader or other equipment and would simply be less efficient. However, the blower trucks are now becoming popular in nearly every major city in the US and with them comes the possible services relating to efficient applications of organic materials.

Reasons to use filter berms:

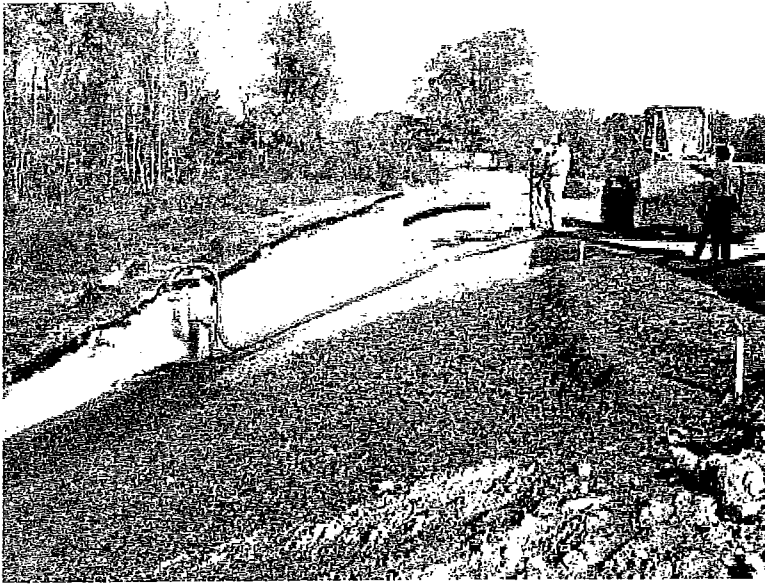
The compost amends native soil, assisting in vegetation establishment
The berms can be easily be incorporated into native soil when the job is completed, which means less hassles at the end of long projects
Incorporated material left on site provides better organic matter levels for seeding/planting
Filter berms are less expensive than silt fence
Filter berms are more effective in removing sediment and clearing up our waterways
Filter berms are more effective at removing chemical compounds from runoff
Compost is an annually renewable resource, all organic, and 100% natural

Reasons NOT to use silt fence:

Silt fence is ineffective in removing sediment and chemicals from runoff
Silt fence is hard to keep up during construction projects
Silt fence is often left on site after construction and is unsightly
Silt fence is a non-recycled material and needs to be landfilled
Silt fence allows a certain level of environmental damage on every project it is used on

How Organic Materials prevent erosion

What is so special about compost or composted mulch that allows it to perform the filtering function? Most experts in the field have noted they are surprised that filter berms hold up under heavy rains. When filter berms are used in combination with slope protection via a layer of compost or composted mulch, you can expect minimal erosion.



Filter berm at the top of a slope with compost

There are two main reasons these two applications assist in reducing erosion. First, filter berms reduce the speed of water flowing on a given slope. By preventing speed of water, which reduces also the speed of soil particles tumbling down the slope, overall displacement of other soil particles is reduced. Many applications have tried a series of filter berms down the slope which has worked well to slow the water down long enough to reduce erosion of the slope.

A layer of compost or composted mulch applied to the slope acts like a 'wet blanket' or a 'wet deck of cards' scattered randomly over the surface. Remember, soil particles are normally round and roll easily once displaced by water. As they gain speed and momentum, they displace other soil particles which channel together in faster moving water and this creates small rills. Rills lead to channels and channels lead to gullies. The rounder the soil, steeper the slope and greater quantity of water, the more erosion.

Compost and composted mulch prevents the soil from rolling or gaining this momentum and therefore covers it like a blanket. A secret of success in the field is making sure that water is not able to 'get under the blanket' at the top of the slope. If water is allowed to get under the layer of compost, and if the slope is steep, you can expect erosion and the compost or composted mulch will float away. However, if you have a filter berm at the

top of the slope and keep the compost layer continuous over the 'shoulder' of the slope, the water will hit the slope and ride all the way to the bottom on top of the blanket of organic materials.

Organic materials are more flexible, lighter, and absorb more water than soils in general, so they also aid in helping water infiltrate into the soil underneath. For vegetation establishment, this is crucial to new seedling germination.

ECONOMICS

All the experts reviewing Bill Stewart's research have had the same comments. What about the cost? Until a mechanism of delivery was possible and predictably available via blower trucks, the use of compost and composted mulch for filter berms has been limited. Depending on the charge for installation and the cost of local compost or composted mulch products, filter berms can be significantly less expensive than silt fence. In other words, cost is not a real barrier to the use of filter berms.

In a study conducted in South Carolina with one of the very largest builders, we determined that silt fence would cost about \$1.50 per linear foot of installed silt fence. This cost did not include the cost to remove the silt fence and disposal costs. However, it appears that many people in the field ignore these costs or simply consider the costs of retrieving silt fence as zero. When comparing the installation of a 1 foot high by 2 foot wide filter berm of compost, we found we could be very cost competitive (see cost spreadsheet at the end of this paper).

It is important to note that the costs we experienced in the project in South Carolina were perhaps the lowest we have found in the country. In general, the larger the contractor, the better price they have for silt fence installation. In other meetings with smaller contractors, we discovered that they were paying up to \$4.50 per linear foot of silt fence, with an earmarked \$2.00 per linear foot included for the removal and disposal of used silt fence.

In many markets, the cost of application matches the cost of the product. For instance, a \$16 per cubic yard compost would cost \$16 per yard for application. Many blower truck operators simply double costs of materials to arrive at an installed cost for organic materials. This is a good rule of thumb to use and when calculating the amount of compost or composted mulch required, we determined that one cubic yard will provide 20 linear feet of filter berm 1 foot high and 2 feet wide. This sized berm is adequate for the majority of silt fence replacements, which are actually demarcations of the work zone itself. Much of the silt fence installation, when performed on flat ground, is simply to show the perimeter of the active work zone.

Remember that on state jobs, where silt fences are used, that the monies to pay for installation and removal has to come from some tax base or government fund. It stands to reason for all of these agencies to band together and support compost use for filter berms because it can save the state money and it will most likely be a locally produced product. In every single case study we have done, the officials at the state level agreed that silt fence did not work to achieve the runoff and erosion reduction goals. Also, they pointed out that silt fence is not actually specified in many projects. Rather, the contractor

has to submit an erosion control plan or water discharge plan that calls for some recognized method to reduce erosion.

Silt fence, because it is so common, is the leading tool used to respond. In other words, if local contractors put compost filter berms into their plan, the local officials would have to determine if this tool would be acceptable. Several agents confessed they could not shut a project down if we submitted filter berms as the chosen method, but if it failed, we would be forced to utilize another method.

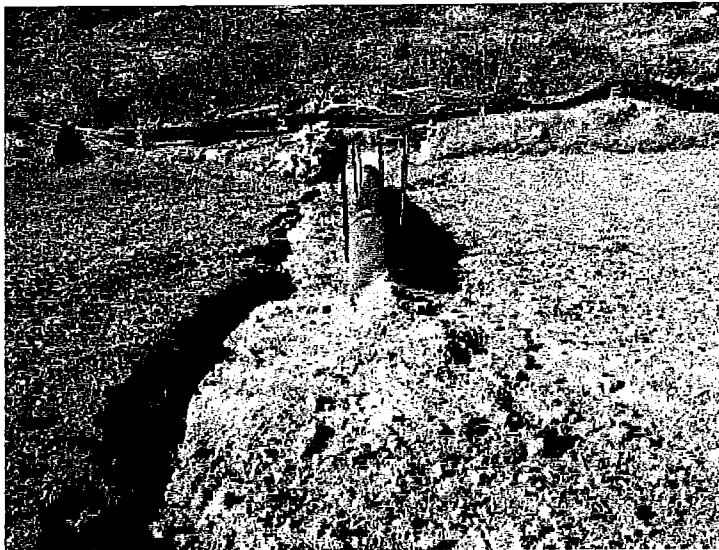
Real world benefits of using filter berms are during projects that are very dynamic. A day in the life of field construction is unpredictable and often times weather plays a spoiling role in the best laid plans of good contractors. When berms are disturbed at the top of slopes, as is shown in the photo below, we violate the cardinal rule not to let water under the berm or compost blanket. Without repair, erosion will set in and gullies will form. However, the new option with compost filter berms and blower trucks is to provide a 'Band-Aid' to these real world un-preventable construction scars. Trucks can quickly and efficiently return to sites and cover initial erosion that starts as a result of late completion of guard rail installation or other surface disturbances. This makes local officials very comfortable with the use of compost because it allows a faster remedy than waiting until the slope is eroded, getting a dozer to level it back out and reseeded. Remember, those are your tax dollars on state projects!

FIELD REPORTS

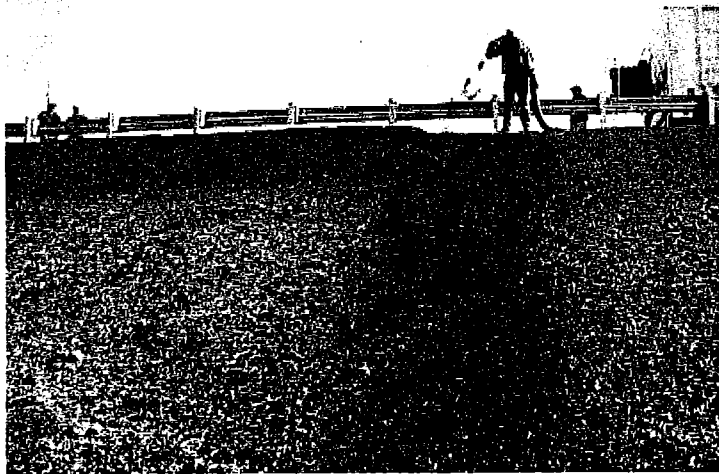
Two field projects have been completed recently which focus on the principle objectives outlined earlier: reducing erosion on slopes using compost blankets and replacement of filter berms using filter berms.

Richmond, Virginia

A project was coordinated in Richmond with the Virginia Department of Transportation to determine the effectiveness of compost for mulch and as filter berms. Due to the nature of the slopes, we did not gather much data on filter berms. The berms installed at the top of the slope were eliminated during the final phase of the project, which allowed us to examine the use of compost for repair in these types of situations. The 'construction scar' shown below is indicative of real life projects that have soil disturbances during their final phase and this can cause significant disturbance to the berm or allow water to get under the compost blanket. The photo on the right shows the 'Band-Aid' we used to fix the problem. This is clearly a low cost method compared to other options.



Construction Scar

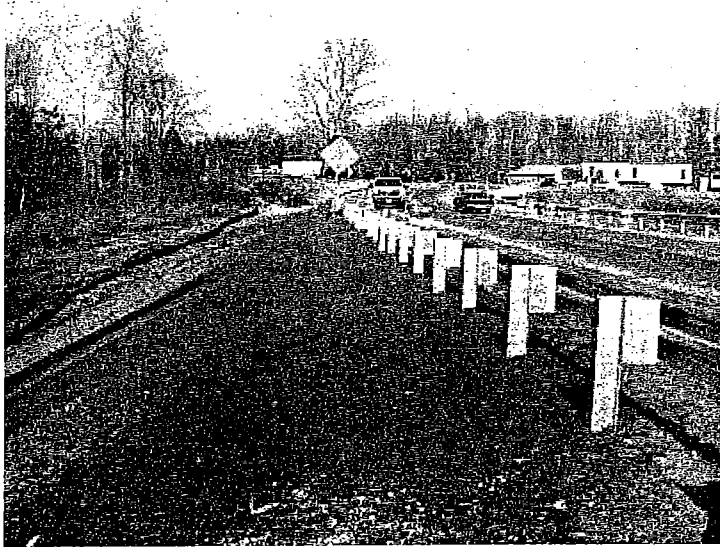


Band-Aid for construction scar

Four other compost materials were used in two different applications (2" and 4" application depths). The slope was covered with these composts and eight treatment areas resulted. All of the composts were applied with a blower truck which allowed even, efficient application. One of the benefits we discovered by using a blower truck was that there is ample hose (500 ft) to reach most areas needing application. The materials used were a 2" minus compost, a 1/2" minus product, leaf compost 1/2" minus and recycled 'overs', a product common after screening 1/2" minus products. The overs

were rather punky and a little on the larger side, but seemed to work adequately in the blower trucks.

The treatment areas ran the entire length of the slope for all eight treatments. We used the other side of the road, which had matching slope and soil type, as the control. The photos below show the erosion associated with the control area. This area had been a problem in the past for VDOT, so the project served a good purpose in showing how compost can impact even the worst erosion situations.



Treated slopes with compost



Untreated controls

The results of the project were similar for all four treatment areas – there was minimal erosion on all of the slopes except where the berms had been disturbed late into the process, allowing water to get under the mulch layer. Besides these areas, there was no noticeable erosion of soil from anywhere on any of the applications. Since we repaired the damaged areas with our 'Band-Aid' application, erosion has been minimal or non-existent.

The VDOT offices were tremendously cooperative in this effort and it is important for readers to understand that these projects take a lot of time and energy and a commitment from both parties to see it through to the final phase. VDOT has since hydroseeded the areas in an effort to understand how the treatment areas would respond. VDOT has concluded that there may be combinations of compost, filter berms and hydroseeding for the toughest erosion projects.

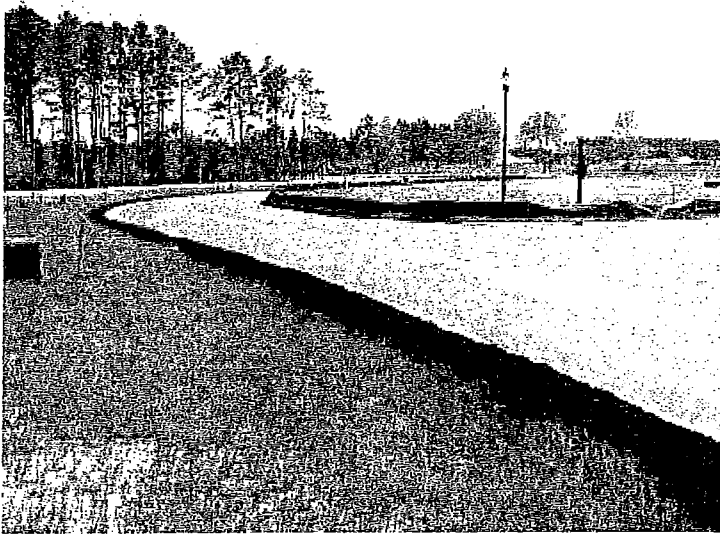
The final determination for the four materials used on the slopes was that the 2" application rates provided enough protection for the slopes to reduce erosion to acceptable levels. Obviously, a 4" application offers for protection, but there is concern that the costs for these materials and their application would be too high. The 2" application rates, however, are cost competitive with the repair costs experienced on these severe slopes and problem areas.

Sun City, South Carolina

DelWebb, a large developer in Sun City, South Carolina, ran several tests using compost for erosion control and filter berm replacement. This project provided much of the data and field results that we missed in the VDOT trial - mainly information about filter berms and the replacement of silt fences.

As a large developer, DelWebb is faced with constant environmental concerns. In the current project, they build up to 500 houses per year, with a total of 6,000 houses targeted in the local area. This requires a large disturbance on local soils, like any construction project. The state requires silt fence be properly installed around each new construction phase. DelWebb became interested in compost because of their environmental concern and their desire to use recycled products, where possible. DelWebb also has a strong commitment to local environmental issues, as well as being good stewards of the land as they develop large areas.

The photos below show the application of filter berms to replace silt fence on DelWebb property. We used the one foot high by two foot wide berm and they seemed to hold up well in most areas. In a few cases, where the berm became damaged from traffic or equipment, we simply asked DelWebb to fix the berm by adding a small amount of compost with a bobcat. This allows minimal maintenance to be performed with equipment normally already on most construction sites.



The final analysis of the filter berms at DelWebb is that they work well enough to consider using in all future construction. The company is currently analyzing costs and has asked to move to the next stage, which will be to use filter berms for an entire new development phase, or neighborhood. As these filter berms are placed, it will be an excellent test to determine how the berms hold up through an entire project rather than just for a couple of months. It is obvious that if the filter berms are more cost effective and perform better than silt fence that they will eventually be adopted as the norm for all construction projects with large developers like DelWebb.

ISSUES FOR THE FUTURE

We need to be conscious of the possible damage to the environment that our accepted practices are now causing. Is the use of silt fence causing more harm than good? Since we never have calculated the amount of materials which escape silt fence, there is a good chance that the amount of environmental damages are larger than we originally thought. We should be conscious of this as we support the new uses of compost and composted mulch in the applications outlined above.

Training and education is certainly a huge need in every state. Even though many states have reportedly worked with some type of compost, all of the state agents we worked with were hungry for information and eager to learn. All of them agreed to field trials during the first meeting, mostly out of frustrations with silt fence failures. As an industry, we need to develop easy to access data, project reviews, specifications, and architect drawings of filter berms and compost applications which satisfy our environmental goals.

In states which have annual printing of spec books for DOT or other agencies, compost use needs to be automatically included with the appropriate drawings. The US

Composting Council already has a good set of specifications to use for erosion control and due to the amount of requests, our offices recently developed CAD drawings to accompany a modified set of specs we make available to all interested parties. This information needs to be at every state office which can use these products.

Finally, nothing substitutes for field projects demonstrating the value of what has been discussed above. The three projects we coordinated helped us learn first hand about the issues, roadblocks and politics that are present in every single project you encounter. We would like to thank those involved for accepting our challenges to use compost and allowing us to demonstrate what others have found to be true. Compost is a versatile, useful product which reduces erosion when used as a filter berm or erosion control blanket.

There are several case studies that have been conducted including Texas, California, Ohio, and other states which have shown that compost has outperformed hydromulch and has reduced erosion by other standard methods used. It is clear we are just at the tip of the iceberg for market development in this area.

Tyler, King and Stinson are founders of Matrixx Organics Company, based in Richmond, VA. Specifications and drawings for filter berms can be obtained via email at rodndon@gte.net.

EPI - Grind-All SE		Del Webb Project		4/5/2000			
Cost comparisons of various soil and mulch applications in the Landscape							
Application	Product cost/ft	Product cost/A	Installation cost/ft	Installation cost/A	Total cost/ft	Total cost/A	Comments
Sodding (per square foot)	\$ 0.16	\$ 6,970	\$ 0.10	\$ 4,356	\$ 0.26	\$ 11,326	Sod may not take first time
Compost & Seed Application		\$ 3,200		\$ 4,000		\$ 7,600	\$400 per acre for good seed
Features	One inch application with seed will smooth over rough spots, reduce final grading required.						
Benefits	Less prep costs, more control over window of time needed to complete job, lower costs						
1.5 inches compost applied is \$16.00/c.y. for material and \$20.00/c.y. for installation = \$36/c.y total seed cost figured at \$400/acre)							
Total Savings per Acre:						\$ 3,726	
Installation of Silt Fence (per linear foot of installation)	\$ 0.60	n/a	\$ 0.90	n/a	\$ 1.50	n/a	Does not work - ineffective
Filter Berm Application (flats) (\$16/yd product + \$20/yd install at 20 linear ft. per cubic yard)	\$ 0.80		\$ 1.00		\$ 1.80		
Filter Berm Application (slopes) (\$16/yd product + \$20/yd install at 6.75 linear ft. per cubic yard)	\$ 2.37		\$ 2.96		\$ 5.33		
Features	Aquatic animals able to effectively navigate over berms, no cleanup needed, recycled product, living filter						
Benefits	Preservation of local environment, less cost, more aesthetically appealing, more effective at removing sediment						
Total Savings per Year:							(need total ft. of silt fence)
Slope Stabilization/Naturalization (\$16 per yard for product and \$20 for installation)							
Mulch applications - seed extra (2" application)	\$ 0.10	\$ 4,320	\$ 0.12	\$ 5,400	\$ 0.22	\$ 9,720	
Features	Not necessary to seed slopes, soil stays in place, less repair required, aesthetically appealing						
Benefits	Lower overall land mgt. Cost, more environmentally appealing, less erosion of valuable soil						
Installation of Landscape mulch (per cubic yard - manual application)	\$ 15.00		\$ 25.00		\$ 40.00		(all mulch costs per cubic yard)
Custom Mulch Application	\$ 15.00		\$ 20.00		\$ 35.00		
Features	More even application, use 25% less materials, utilize less labor during peak times						
Benefits	More aesthetically appealing, employees do other tasks, less expensive overall						