Using Compost to Improve Erosion Control and Highway Planting

Caltrans Office of Roadside Management & Landscape Architecture Standards
Why Highway Planting & EC?

- Safety
  - Headlight Glare Screen
  - Roadway Delineation
  - Fire Suppression
  - Wind Breaks
Why Highway Planting & EC?

- Environmental Compliance
  - Re-Vegetation
  - Required Mitigation Planting
  - Erosion Control
What’s the Common Thread?

- **Safety**
  - Headlight Glare Screen
  - Roadway Delineation
  - Fire Suppression
  - Wind Breaks

- **Environmental Compliance**
  - Re-Vegetation
  - Required Mitigation Planting
  - Erosion Control
What’s the Common Thread?

Plants
Soils Resource Eval. System

- Factors Limit Plant Growth?
- Treatments That Address Limits?
Key Problem

- Key Factors That Limit Plant Growth
  - Slope Stability
  - Protection From Erosion
  - Available Water/Infiltration
  - Nutrient Availability
  - Biological Activity
How Do We Fix These Problems?

- Key Factors That Limit Plant Growth
  - Slope Stability
  - Protection From Erosion
  - Available Water/Infiltration
  - Nutrient Availability
  - Biological Activity
Compost
Compost and Soil Structure

- Soil Soaked in Bleach
  - No Organics
  - Collapsed Structure
  - Rainfall = Erosion
  - Limited Infiltration
  - Little Retained Moisture

- Class I Ag Topsoil
  - Plenty of Organics
  - Strong Structure
  - Limited Erosion
  - Significant Infiltration
  - Moisture Retention

Topsoil With Organics Removed

Class I Ag Topsoil

Photo - Vic Claassen, UC Davis
Compost and Soil Structure

- Reduced Splash/Rill Erosion
- Reduced Runoff Volume & Rate
- Increased Infiltration
- Increased Water Holding Capacity
Compost and Soil Structure

- Reduced Splash
- Erosion
Compost and Soil Structure

- Reduced Runoff Volume

Source: Britt Faucette, University of Georgia
Compost and Soil Structure

Reduced Runoff Rate

Source: Britt Faucette, University of Georgia
Compost and Soil Structure

- Increased Infiltration Volume

Source: Britt Faucette, University of Georgia
Compost and Soil Structure

- Doubled Water Holding Capacity

Other Compost Benefits

- Improved Biological Activity
  - Food & Air
    - Soil Bacteria
    - Actinomycetes
    - Fungi
  - Plant Nutrients

Source: Natural Resources Conservation Service
Carbon & Nitrogen

High C/ Low N
- Long Material Life
- Better for Natives
- Plants N Deprived?

High N/ Low C
- Short Material Life
- Better for Grasses?
- Better for Weeds?
- Water Quality?
Recap

- Healthy Plants
- Healthy Soil
- Compost
What Is Compost?
What Is Compost?

Time + Temperature = Compost
What Is Compost?

Is This Compost?
What Is Compost?

Or This?
What Is Compost?

Or This?
What Is Compost?

Time + Temperature = Compost
New/Revised Specifications

Specs
Why Revise The Spec?

Why Revise the Compost Material Specification?

CALTRANS DRAFT COMPOST SPEC. (1/2/97)

“COMPOST: - Compost shall be derived from green material consisting of chipped, shredded, or ground vegetation or clean processed recycled wood products, or a Class A, exceptional quality biosolids compost, as required by U.S. EPA, 40 CFR, part 503c regulations, and any other mixtures of materials which shall be processed or treated to meet standards established by the Director, and shall not contain paint, petroleum products, herbicides, fungicides, or other chemical residues that would be harmful to plant or animal life. Other deleterious material such as plastic, glass, metal or rocks, shall not exceed 0.1 percent by weight or volume. A minimum internal temperature of 131 degrees Fahrenheit shall be maintained for 72 hours. In addition, during the composting process, a compost shall remain at a minimum of 55 degrees Fahrenheit for a period of 30 days. During the composting process, the compost shall be thoroughly mixed, and a minimum of 15 day thermophilic compost process has been completed. Compost shall be screened through a minimum of 3/8 inch screen.

The moisture content of the compost shall not exceed 27%. Moisture content shall be defined by taking a representative sample of the compost and allowing it to dry in an oven at 105 degrees Fahrenheit for 16 hours. The dried sample shall be weighed and the weight shall be used to calculate the moisture content. The moisture content of the compost shall be determined as follows:

1. Compost shall be tested for maturity/stability with a Solvita Test Kit supplied by the compost producer. The compost shall measure a minimum of 7 on the maturity/stability scale.”
Why Revise The Spec?

- Lower Cost
- Improve Quality Control
- New Ideas
Why Revise The Spec?

Cost
Compost Use Increasing

2003  2004  2005  Jun-06

Cubic Yards

- 2003: 0
- 2004: 4,000
- 2005: 20,000
- Jun-06: 20,000

September 2006
California Department of Transportation
Costs Remain High

![Bar chart showing installed price/acre for different materials.]

- **2" Compost (Now)**: $100,000
- **EC Blanket**: $80,000
- **EC Netting**: $60,000
- **2" Mulch**: $40,000
- **2" Compost (Prop)**: $20,000
- **BFM**: $0
- **Hydroseed**: $0

*Source: September 2006, California Department of Transportation*
Why Revise?  Lower Cost

- Current Weighted Avg >$300/CY
- High Price Due To:
  - Bagged (vs Bulk) Materials
  - Application Method (Hydroseeding)
Revisions Promote:

- Use Bulk (vs. Bagged) Materials
- Alternative Application Methods
  - Bulldozer
  - Slinger Spreader
  - Snow-Blower

Goal: Reduce Cost to $40/ CY
Cost Recap

Application Flexibility = Lower Costs

September 2006  California Department of Transportation
Why Revise The Spec?
Tighter Spec = QC

CALTRANS DRAFT COMPOST SPEC. (1/2/97)

"COMPOST: - Compost shall be derived from green material consisting of chipped, shredded, or ground vegetation or clean processed recycled wood products, or a Class A, exceptional quality biosolids compost, as required by US EPA, 40 CFR, part 503c regulations, or a combination of green waste and biosolids compost. The compost shall be processed or completed to reduce weed seeds, pathogens, and deleterious material and shall not contain paint, petroleum products, herbicides, fungicides, or other chemical residues that would be harmful to plant or animal life. Other deleterious material such as plastic, glass, metal or rocks, shall not exceed 0.1 percent by weight or volume. A minimum internal temperature of 135 degrees shall be maintained for at least 15 continuous days during the composting process. The compost shall be thoroughly turned a minimum of five times during the composting process, and shall go through a minimum 90 days curing period after the 15 day thermophilic compost process has been completed. Compost shall be screened through a minimum of 3/8 inch screen.

The moisture content of the compost shall not exceed 25%. Moisture content shall be defined by California Test 226. Compost Products with a higher moisture content may be used provided the weight of the compost is increased to equal compost with a maximum moisture content of 25%.

Compost shall be tested for maturity/stability with a Solvita Test Kit supplied by the compost producer. The compost shall measure a minimum of 7 on the maturity/stability scale."
Why Revise?  Quality Control

Old Spec Tests For:

- Maturity
Why Revise?  Quality Control

New Spec Tests For:

- Maturity
- pH
- Soluble Salts
- Stability
- Pathogens
- Stability
- Phytotoxicity
- Particle Size
- Physical Contaminants
- Heavy Metals
Old QC/QA Submittals

- Contractor Performs Solvita Test (For Maturity) in the Field
- Contractor Submits Results to the Engineer
New QC/QA Submittals

- Producer Submits Samples to STA Lab
- Samples Tested via STA Methodologies
- Results Returned to Compost Facility
- Paperwork Submitted by Contractor:
  - Compost Lab Test Results
  - Certificate of Compliance
  - Compost Technical Data Sheet (CTDS)
QC Recap

- Improved (Standardized) Testing
- Improved Submittals
- Greater Quality Assurance
New/Revised Specifications

New Ideas
New Ideas

Cost Effective Bulk Application Methods
Which Is The More Permanent Solution?
Rotary Spading Machines

- 22” Depth - Single Pass
- 8’ Wide
- 3800 LBS
- 1-3 MPH
- 90 HP Tractor
Rotary Spading Machines

- Incorporate Large Quantities of Compost Into Subsoil
- Produce Loose Topsoil Well Mixed With Organics
 Rotary Spading Machines

- Large Spaders Open Subsoils
  - Admit Air and Moisture
  - Increase Water Holding Capacity
  - Improve Soil Fertility
  - Enable Extensive Root System Development

- Penetrate Hard Soils
  - Work Well in Dry, Compacted Soils
  - Work Where Rototillers, Plows & Discs Ineffective
Other Incorporation Options

- Spider Excavator
- An Option for Steep Slopes?
Ideas Recap

- New Ideas
- New Specs
- Sustainable Roadsides
New/Revised Specifications

The Specs
Spec Overview

- **Planting Specifications**
  - Mulch
  - Soil Amendment
  - Planting

- **Erosion Control Specifications**
  - Erosion Control (Type C & Type D)
  - Erosion Control (Drill Seed)
  - Erosion Control (Compost Blanket)
  - Erosion Control (Cultivate)
New/Revised Specifications

Planting Specs
Planting Specifications

- **Mulch**
  - Revised Compost Definition

- **Soil Amendment**
  - Replaces “Std Spec” Compost Definition

- **Planting**
  - Removed Std Spec Soil Amend Reference
Planting Specifications

- Mulch
- Soil Amendment
EC Specifications

- EC (Type C & Type D)
  - Updated Compost Definition
  - Removed Seed Inoculant Reqt.
  - Pay by Area
- EC Drill Seed
  - Added Compost Definition
- EC (Compost Blanket)
- EC (Cultivate)
Erosion Control (Type C/D)

- Erosion Control (Type C)
- Erosion Control (Type D)
Erosion Control (Drill Seed)
EC (Compost Blanket & Cultivate)

- Erosion Control (Compost Blanket)
- Erosion Control (Cultivate)
New/Revised Specifications

All
Specs
Compost - “Materials” Spec

Compost Shall Comply With the Following…
Producer Requirements

Compost Producer Shall be Fully Permitted Per:

- California Integrated Waste Management Board
- Local Enforcement Agencies
- Any Other State and Local Agencies That Regulate Solid Waste Facilities
Feedstock Options

- Green Material
  - Chipped, Shredded, or Ground Vegetation
  - Clean, Processed, Recycled Wood Products

- Biosolids

- Manure

- Mixed Food Waste
All Materials

- Shall be Composted to Reduce Weed Seed and Pathogens in Conformance with CA. Title 14, CCR, Div. 7, Ch. 3.1, Art. 7, Sec. 17868.3
  - Similar To US EPA Regulation 40 CFR, Part 503b
Compost Shall NOT

- Be Derived from Mixed Municipal Solid Waste.
- Contain Paint, Petroleum Products, Herbicides, Fungicides.
- Contain Chemicals Harmful to Animal or Plant Life.
Compost Shall NOT

- Possess Objectionable Odors
- Possess Metal Concentrations Exceeding Title 14, CCR, Div. 7, Ch. 3.1, Sect. 17868.2
# Physical/Chemical Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Backfill</th>
<th>Soil Prep (Cultivate)</th>
<th>Mulch</th>
<th>Drill Seed EC (Type C/D)</th>
<th>Hydriased Seed WT</th>
<th>Blanket (Vegetated Noon Inc)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soluble Salts (Electrical Conductivity)</strong></td>
<td>TMECC 04.10-A Electrical Conductivity Measurement, Mass Basis</td>
<td>0.100 dS/m</td>
<td>0.100 dS/m</td>
<td>0.100 dS/m</td>
<td>0.100 dS/m</td>
<td>0.100 dS/m</td>
<td>0.100 dS/m</td>
</tr>
<tr>
<td><strong>Moisture Content</strong></td>
<td>TMECC 03.09-A Total Solids and Moisture at 70°-75° C, % Wet Weight Basis</td>
<td>30-60%</td>
<td>30-60%</td>
<td>N/A</td>
<td>30-60%</td>
<td>30-60%</td>
<td>30-60%</td>
</tr>
<tr>
<td><strong>Organic Matter Content</strong></td>
<td>TMECC 05.07-A Loss-on-Ignition Organic Matter Method (LOI), % Dry weight basis</td>
<td>30-65%</td>
<td>30-65%</td>
<td>30-100%</td>
<td>30-65%</td>
<td>30-65%</td>
<td>30-65%</td>
</tr>
<tr>
<td><strong>Maturity (Bioassay)</strong></td>
<td>TMECC 05.05-A Germination and Vigor Seed Emergence, % Relative to positive control</td>
<td>80% or above</td>
<td>80% or above</td>
<td>80% or above</td>
<td>80% or above</td>
<td>80% or above</td>
<td>80% or above</td>
</tr>
<tr>
<td><strong>Stability (Respirometry)</strong></td>
<td>TMECC 05.06-B Carbon Dioxide Evolution Rate, mg CO₂ per g OM per day</td>
<td>8 or below</td>
<td>8 or below</td>
<td>N/A</td>
<td>8 or below</td>
<td>8 or below</td>
<td>8 or below</td>
</tr>
<tr>
<td><strong>Particle Size</strong></td>
<td>TMECC 02.02-B Sample Sieving for Aggregate Size, % Dry Weight Basis</td>
<td>Inches 5/8</td>
<td>% Pass 95%</td>
<td>Inches 5/8</td>
<td>% Pass 96%</td>
<td>Inches 5/8</td>
<td>% Pass 95%</td>
</tr>
<tr>
<td><strong>Pathogen (Fecal Coliform)</strong></td>
<td>TMECC 07.01-B Fecal Coliforms, &lt;1000 MPN/gram</td>
<td>Pass</td>
<td>&lt;1000 MPN/gram</td>
<td>Pass</td>
<td>&lt;1000 MPN/gram</td>
<td>Pass</td>
<td>&lt;1000 MPN/gram</td>
</tr>
<tr>
<td><strong>Pathogen (Salmonella)</strong></td>
<td>TMECC 07.02 Salmonella, &lt;3 MPN/4 grams of TS</td>
<td>Pass</td>
<td>&lt;3 MPN/4 grams of TS</td>
<td>Pass</td>
<td>&lt;3 MPN/4 grams of TS</td>
<td>Pass</td>
<td>&lt;3 MPN/4 grams of TS</td>
</tr>
<tr>
<td><strong>Physical Contaminants (Man-made inerts)</strong></td>
<td>TMECC 02.02-C Man Made Inert Removal and Classification, Plastic, Glass &amp; Metal Sharp &gt; 4 mm fraction</td>
<td>&lt;1% None Detected</td>
<td>&lt;1% None Detected</td>
<td>&lt;1% None Detected</td>
<td>&lt;1% None Detected</td>
<td>&lt;1% None Detected</td>
<td>&lt;1% None Detected</td>
</tr>
</tbody>
</table>
Submittal Requirements

- Compost Technical Data Sheet
- Copy of the Compost Producer’s STA certification
- Certificate of Compliance (Per Caltrans Std Specs).
**Compost Technical Data Sheet**

<table>
<thead>
<tr>
<th>Compost Parameters</th>
<th>Test Results</th>
<th>Reported as (mass fraction)</th>
<th>TMECC Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size</td>
<td>%, dry weight passing through</td>
<td>02 US 30, Sample Screen for Analysis Size Classification</td>
<td></td>
</tr>
<tr>
<td>Heavy Metal Content</td>
<td>10%&lt;br&gt;100 ppm&lt;br&gt;PASS&lt;br&gt;ULF (US EPA Class A)</td>
<td>40 CFR 201.12, items 2 and 3&lt;br&gt;04 00 Heavy Metals standard,&lt;br&gt;and Standard Elements</td>
<td>04 00 Heavy Metals standard,&lt;br&gt;and Standard Elements</td>
</tr>
<tr>
<td>Soluble Salt (Ammonium ion)</td>
<td>0.00%&lt;br&gt;50 ppm&lt;br&gt;NS2&lt;br&gt;ULF</td>
<td>04 00 Heavy Metals standard,&lt;br&gt;and Standard Elements</td>
<td>04 00 Heavy Metals standard,&lt;br&gt;and Standard Elements</td>
</tr>
<tr>
<td>pH</td>
<td>6.0&lt;br&gt;6.2&lt;br&gt;NS2&lt;br&gt;ULF</td>
<td>04 11 pH by Test pH</td>
<td>04 11 pH by Test pH</td>
</tr>
<tr>
<td>Salmonella (Dissociation)</td>
<td>0.0%&lt;br&gt;50 PPM&lt;br&gt;NS2&lt;br&gt;ULF</td>
<td>05 05 A Salmonella&lt;br&gt;and Vibrio cholerae</td>
<td>05 05 A Salmonella&lt;br&gt;and Vibrio cholerae</td>
</tr>
<tr>
<td>Organic Matter Content</td>
<td>0.4%&lt;br&gt;3.5%&lt;br&gt;NS2&lt;br&gt;ULF</td>
<td>05 01 A, B, C, D, E&lt;br&gt;Organic Matter Balance (LOD)</td>
<td>05 01 A, B, C, D, E&lt;br&gt;Organic Matter Balance (LOD)</td>
</tr>
<tr>
<td>Indoxyl Sulfate (Indoxyl)</td>
<td>N.A.</td>
<td>ELISA</td>
<td>ELISA</td>
</tr>
<tr>
<td>Pathogens</td>
<td>10%&lt;br&gt;100 ppm&lt;br&gt;PASS&lt;br&gt;ULF (US EPA Class A)</td>
<td>07 01 B, C, D, E&lt;br&gt;Pathogens</td>
<td>07 01 B, C, D, E&lt;br&gt;Pathogens</td>
</tr>
<tr>
<td>Moisture content</td>
<td>1%&lt;br&gt;20%&lt;br&gt;NS2&lt;br&gt;ULF</td>
<td>03 19 A, B&lt;br&gt;Pathogens</td>
<td>03 19 A, B&lt;br&gt;Pathogens</td>
</tr>
<tr>
<td>Physical Contaminants</td>
<td>0.0%&lt;br&gt;100 ppm&lt;br&gt;PASS&lt;br&gt;ULF (US EPA Class A)</td>
<td>02 04 C, D&lt;br&gt;Surface Contaminants</td>
<td>02 04 C, D&lt;br&gt;Surface Contaminants</td>
</tr>
</tbody>
</table>
# Planting NSSPs

These nonstandard special provisions are in "Final Draft" form and may be used in current projects provided only minor edits are made. Significant edits will trigger the nonstandard special provision review process - requiring submittal, review and concurrence by the Specification Owner. When in doubt - discuss the proposed edits with your HQ LAP Landscape Coordinator.

For more information regarding the use of these nonstandard specifications, please visit our FAQ page.

<table>
<thead>
<tr>
<th>New?</th>
<th>Description</th>
<th>Blanket Concurrency</th>
<th>CAD Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised</td>
<td><strong>Planting</strong> (English)</td>
<td>Not Available Contact Your District Landscape Coordinator</td>
<td>No Detail</td>
</tr>
<tr>
<td></td>
<td><strong>Planting</strong> (Metric)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Revised to reference the new Draft NSSP for Soil Amendment, rather than the Standard Specifications Section 20-2.03 Soil amendment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New</td>
<td><strong>Soil Amendment</strong> (English)</td>
<td>Not Available Contact Your District Landscape Coordinator</td>
<td>No Detail</td>
</tr>
<tr>
<td></td>
<td><strong>Soil Amendment</strong> (Metric)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replaces the Standard Specification Section 20-2.03 &quot;Soil Amendment.&quot; Includes updated Department definition of compost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revised</td>
<td><strong>Mulch</strong> (English)</td>
<td>Not Available Contact Your District Landscape Coordinator</td>
<td>No Detail</td>
</tr>
<tr>
<td></td>
<td><strong>Mulch</strong> (Metric)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Revised to use updated Department definition of compost. Use the Standard BEEs item for Mulch.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Erosion Control NSSPs

These nonstandard special provisions are in "Draft" form and maybe used in current projects provided only minor edits are made. Significant edits will trigger the nonstandard special provision review process - requiring summation, review and concurrence by the Specification Owner. When in doubt - discuss the proposed edits with your LAP Landscape Coordinator.

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<th>New?</th>
<th>Description</th>
<th>Blanket Concurrence</th>
<th>CAD Detail</th>
</tr>
</thead>
</table>
| New  | Erosion Control (Type C) English  
Erosion Control (Type C) Metric  
Supersedes the Erosion Control (Type C) SSP currently on the DEC/OC Server. |  | No Detail |
| New  | Erosion Control (Type D) English  
Erosion Control (Type D) Metric  
Supersedes the Erosion Control (Type D) SSP currently on the DEC/OC Server. |  | No Detail |
| New  | Erosion Control (Type M) English  
Erosion Control (Type M) Metric  
Compost Blanket SSP. Covers installation of compost and seed, to form a fibrous blanket to help establish permanent roadside vegetation. minimize weed competition, minimize loss soil loss, retain soil moisture, improve soil structure and fertility. |  | No Detail |
| New  | Erosion Control (Brill Seed) English  
Erosion Control (Brill Seed) Metric  
Covers drill seeding of areas to provide permanent erosion control. Use drill seeding to establish vegetation on slopes no greater than 4:1 (h:v) that are accessible from the roadway. Add a nonstandard item (measured by the square meter for Erosion Control (Brill Seed) to the BEEs/Engineer’s Estimate. Use this specification together with other appropriate storm water BMPs. |  | No Detail |
Recap

- Planting Specifications
  - Mulch
  - Soil Amendment
  - Planting

- Erosion Control Specifications
  - Erosion Control (Type C & Type D)
  - Erosion Control (Drill Seed)
  - Erosion Control (Compost Blanket)
  - Erosion Control (Cultivate)
Remember

Use the Specs
Using Compost to Improve Erosion Control and Highway Planting

Thank-You
The Laboratory

- Compost Filter Socks
  - Currently Under New Products Review Process