Compost: Benefits, Selection and Application

Presented by:

Ron Alexander, President

R. Alexander Associates, Inc.

11/4/19

Topics

- Product Usage Trends
- Composting and Product Specs
- Soil Testing
- How to Select / Spec Compost
- Compost and Mulch Benefits to Plants and Soil
- Compost and Mulch Applications

ACWD
ALAMEDA COUNTY WATER DISTRICT

BAWSCA
Bay Area Water Supply & Conservation Agency

Various community-based water conservation efforts…

Save water and protect the environment! **BAWSCA** offers a variety of rebates and programs to help Bay Area water users become more water efficient inside the home and outdoors. For water-wise gardening, visit Bay Area Water Wise Gardening.

Alameda County Water District offers a wide variety of rebates, incentives and technical assistance to our residential, commercial, industrial, institutional and large landscape customers.

Compost and mulch use is a great tool !

Various Initiatives

Landscaping Toolbox

WaterSmart Gardener

Find rebates, tips and services to help create and maintain a water-efficient landscape for residential properties

Commercial and Large Landscapes

Rebates, services and resources for commercial landscapes. Includes success stories, water budget program, and audit services

Conservation Links

Organizations and resources promoting water conservation and sustainable landscaping

Landscapers, LA's Homeowners (etc.) are forced to establish vegetation, landscapes and crops on problematic sites

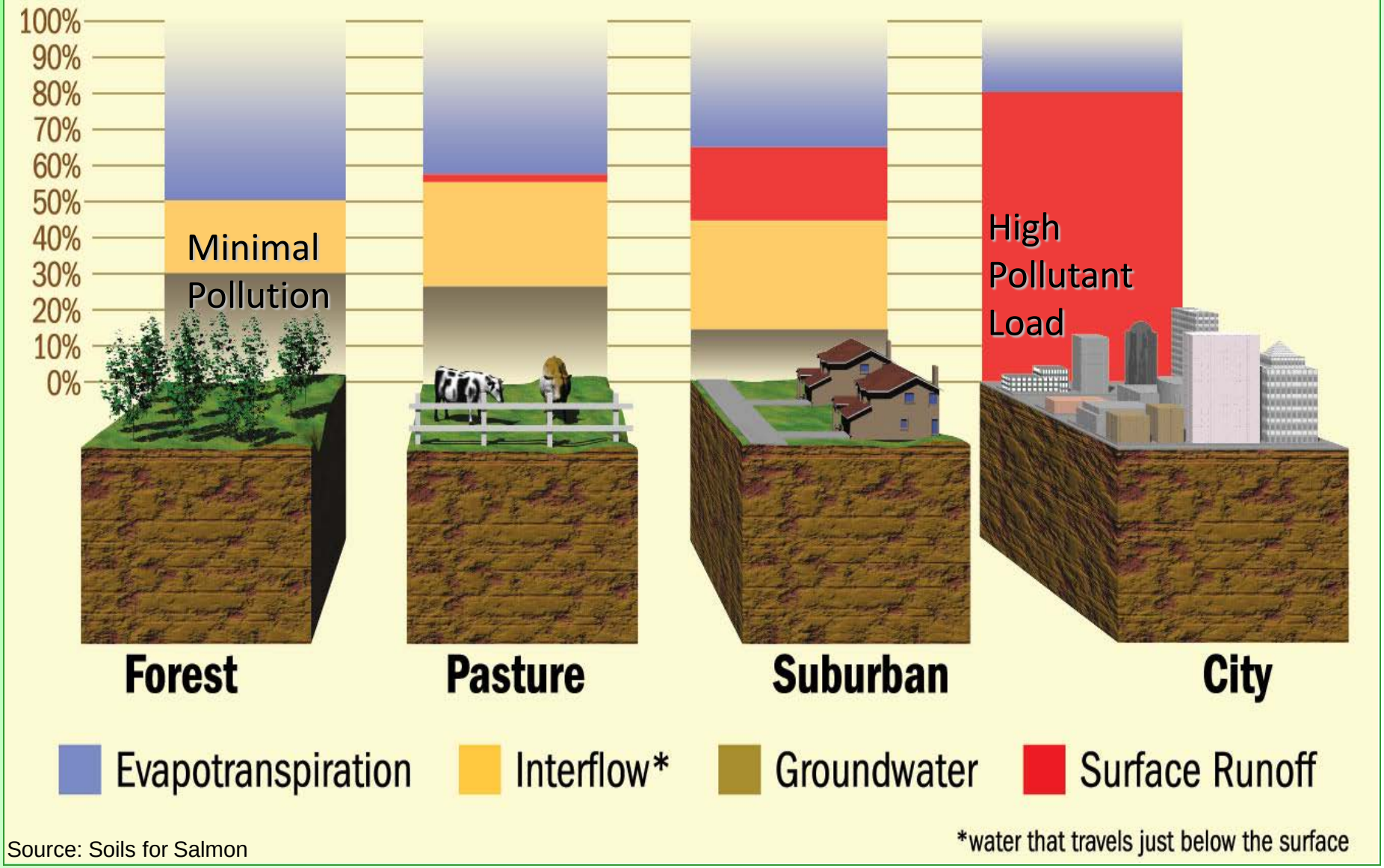
Soil management is even more important with climate change (e.g., drought, flood, temp. extremes)

Need to use more sustainable soil management practices - *for plants, economics, and environment*

Often Planting in Damaged and Depleted Soils

- Most soils have poor structure (fine texture)
  - Drainage, compacted, slow water percolation
  - Less water accepted (storm water management issue)
  - Significant erosion
- Some low in moisture-holding capacity (droughty)
  - Inefficient nutrient uptake, nutrient loss

Land Use Affects Hydrology



Source: Soils for Salmon

Greater storm water mgt. concerns. Research proves sediment load in water directly corresponds to pollutant load in surface water

***Problem*: not often creating landscapes in 'true' or higher quality topsoil, and trying to vegetate stressed (and sometimes) over-used land**

- Poor structure
- Lacking macro pores (50% concept) and organic matter
- Reduced soil life

COMPOST CAN BE USED TO CREATE ACCEPTABLE LANDSCAPE GRADE SOILS AND IMPROVE OVERALL VEGETATION

Sustainable Landscaping Trends, Green Building and Infrastructure

Low Impact Development Center

THE Sustainable SITES Initiative®

- Promotes Healthy Soils
- Recreate/mimic ‘natural’ systems
- Provide ‘Water Efficiency Landscapes’ (WELO), gain LEED/SSI credits

RESCAPE CALIFORNIA

NATIONAL & STATE INITIATIVES

U.S. GREEN BUILDING COUNCIL LEED™ LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Model Water Efficient Landscape Ordinance (WELO) is in Effect

- Applies to all **permitted** landscape projects with landscape area of:
  - 2,500 sf for landscape renovation
  - 500 sf for new construction
  - “Landscape area” includes pools, but not hardscape
- Projects must meet water budget, based on weather in project location
  - Water budget allows ~25% of area for high water use plants (lawn) or pool
  - Vegetable gardens get higher water budget
- Products
  - Requires 4 CY compost / 1,000 SF
    - Unless already have 6% OM already
  - Requires 3” (9 CY/1,000 SF) of mulch
  - Establishment of native plants ►►

Similar Trends in Agriculture

To enhance food production and improve agricultural sustainability

More agricultural initiatives now, but information based or poorly funded

Compost / Composting

Various types of composts in California

- Approximately 120 Commercial / Permitted sites, some unlicensed sites because of size / feedstock

- 6 M tons managed, 20 M CY compost

Definition

Compost is the product manufactured through the controlled aerobic, biological decomposition of biodegradable materials. The product has undergone mesophilic and thermophilic temperatures, which significantly reduces the viability of pathogens and weed seeds, and stabilizes the carbon, such that it is beneficial to plant growth. Compost is typically used as a soil amendment, but may also contribute plant nutrients.

Current AAPFCO definition

Can test to prove the product is a 'real' compost, and will work for your application

Use the Right Compost !

Use and Specify

U.S. Composting Council Seal of Testing Assurance Program Participating Products

US COMPOSTING COUNCIL
Seal of Testing Assurance

Barnes – Regional Composting
3511 West Cleveland Ave.
Huron, OH 44839
Telephone: 800-421-8722
Fax: 419-433-3555

Sample Date: 8/14/20

COMPOST TECHNICAL DATA SHEET

Compost Parameters	*Reported as (units of measure)*	*Test Results*	*Test Results*
Plant Nutrients:	%, weight basis	*%, wet weight basis*	*%, dry weight basis*
Nitrogen	Total N (TN or TKN+NO_3-N)	.72	1.12
Phosphorus	P_2O_5	.13	.21
Potassium	K_2O	.32	.50
Calcium	Ca	2.34	3.64
Magnesium	Mg	.57	.89
Moisture Content	%, wet weight basis	42	
Organic Matter Content	%, dry weight basis	31.31	
pH	unitless	7.4	
Soluble Salts *(electrical conductivity)*	dS/m (mmhos/cm)	3.49	
Particle Size	screen size passing through	½'	
Stability Indicator *(respirometry)* CO_2 Evolution	mg CO_2-C/g TS/day, AND	.14	
	mg CO_2-C/g OM/day	.5	
Maturity Indicator *(bioassay)* Percent Emergence, AND Relative Seedling Vigor	average % of control, AND	92	
	average % of control	86	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Certified Compost™
STA | Seal of Testing Assurance
US Composting Council®

Participating Composters:

- Complete on-going product testing

  -Operate on-going sampling/testing regime, larger facilities test more often

  -Using uniform sampling and analytical testing methods (from national testing manual - TMECC)

  -Using only STA Program certified labs

- Disclose test data results (lab analyses) on uniform label
- Provide appropriate end use instructions to end users

Many DOTs and other Specifiers (LAs) Require STA compost

Caltrans

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Important Parameters

Compost Parameters	Reported as
pH	N/A
Soluble salts	dS/m (mmhos/cm)
Primary plant nutrients	%, as-is (wet) & dry weight basis
Nitrogen	Total N
Phosphorus	P_2O_5
Potassium	K_2O
Calcium	Ca
Magnesium	Mg
Moisture content	%, wet weight basis
Organic matter content	%, dry weight basis
Particle size	Screen size passing through
Stability (respirometry)	mg CO_2-C/g OM per day
Maturity (Bioassay) -Percent emergence -Relative seedling vigor	 % (average) % (average)
Select Pathogens	PASS/FAIL (Per US EPA Class A standards, 40 CFR § 503.32(a)
Trace metals	PASS/FAIL (Per US EPA standards, 40 CFR § 503.13, Table 3)

US COMPOSTING COUNCIL
Seal of Testing Assurance

Z-Best Products
Kellie Lopez
980 State Highway 25
Gilroy
CA 95020

Date Sampled/Received: 26 Feb. 15 / 26 Feb. 15

Product Identification	Compost
2.2015 Zbest Organic Compost	

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	*Reported as (units of measure)*	*Test Results*	*Test Results*
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	59.7	
Organic Matter Content	%, dry weight basis	59.9	
pH	units	7.72	
Soluble Salts *(electrical conductivity EC_1)*	dS/m (mmhos/cm)	2.3	
Particle Size or Sieve Size	maxium aggregate size, inches	0.38	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	2.8	Stable
	mg CO_2-C/g TS/day	1.7	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	90.0	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Feb.15 D Laboratory Number: 5020776-1/2

Analyst: Assaf Sadeh www.compostlab.com

ANALYTICAL CHEMISTS and BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

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

Account #: 2030369-1/1-5038
Group: Mar.12 C #1
Reporting Date: March 28, 2012

Purple Cow Organics
P.O. Box 620856
Middleton, WI 53562
Attn: Sandy Syburg

Date Received: 13 Mar. 12
Sample Identification: Soilife Compost
Sample ID #: 2030369 - 1/1

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.2	0.69	%
Ammonia (NH_4-N):	130	74	mg/kg
Nitrate (NO_3-N):	160	93	mg/kg
Org. Nitrogen (Org.-N):	1.2	0.70	%
Phosphorus (as P_2O_5):	0.48	0.28	%
Phosphorus (P):	2100	1200	mg/kg
Potassium (as K_2O):	0.96	0.56	%
Potassium (K):	8000	4700	mg/kg
Calcium (Ca):	8.3	4.8	%
Magnesium (Mg):	3.6	2.1	%
Sulfate (SO_4-S):	210	120	mg/kg
Boron (Total B):	28	16	mg/kg
Moisture:	0	41.4	%
Sodium (Na):	0.053	0.031	%
Chloride (Cl):	0.11	0.063	%
pH Value:	NA	8.20	unit
Bulk Density :	27	47	lb/cu ft
Carbonates ($CaCO_3$):	330	190	lb/ton
Conductivity (EC5):	2.2	NA	mmhos/cm
Organic Matter:	32.6	19.1	%
Organic Carbon:	19.0	11.0	%
Ash:	67.4	39.5	%
C/N Ratio	17	17	ratio
AgIndex	> 10	> 10	ratio

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	5400	-	mg/kg
Arsenic (As):	4.1	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	39	1200	mg/kg
Cobalt (Co)	3.6	-	mg/kg
Copper (Cu):	39	1500	mg/kg
Iron (Fe):	9400	-	mg/kg
Lead (Pb):	44	300	mg/kg
Manganese (Mn):	320	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	2.2	75	mg/kg
Nickel (Ni):	11	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	110	2800	mg/kg

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	0.96	1.5
mg CO_2-C/g TS/day	0.31	0.49
Stability Rating	*very stable*	*very stable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	100	100
Description of Plants	*healthy*	*healthy*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 13 Mar. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	0.0	0.0	0.00
6.3 to 9.5	0.2	0.1	1.30
4.0 to 6.3	1.0	0.7	0.97
2.0 to 4.0	21.0	21.2	0.61
< 2.0	77.7	78.1	0.61

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Can often get more detailed (and historical) data from these composters

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ReScape Compost Spec

Property	Test Method	Unit of Measurement	Requirement
pH	TMECC 04.11-A Elastomeric pH 1:5 slurry method pH	units	6–8.5
Soluble salts	TMECC 04.10-A Electrical conductivity 1:5 slurry method	dS/m (mmhos/cm)	0– 5 or 0-10
Moisture content	TMECC 03.09-A Total solids & moisture at 70 ± 5 °C	% wet weight basis	30–60
Organic matter Content	TMECC 05.07-A Loss-on-ignition organic matter method (LOI)	% dry weight basis	30–60
Maturity	TMECC 05.05-A Germination and vigor	% relative to positive control	Seed emergence 80 or above Seedling vigor 80 or above
Stability	TMECC 05.08-B Carbon dioxide evolution rate	mg CO_2-C/g OM per day	5 or below
Pathogen	TMECC 07.01-B Salmonella < 3 MPN per 4 grams, dry weight basis	Pass/ Fail	Pass
Pathogen	TMECC 07.01-B Fecal coliform bacteria < 1,000 MPN per gram, dry weight basis	Pass/ Fail	Pass
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Plastic, glass, and metal % > 4 mm fraction	% dry weight basis	combined total: < 0.5%, < 0.1% film plastic
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Sharps (sewing needles, straight pins and hypodermic needles) % > 4mm fraction	% dry weight basis	none detected
Particle size - fine for soil amendment compost	TMECC 02.02-B Sample sieving for aggregate Size classification	% dry weight basis	Pass 2”-inch sieve 98% min Pass 3/8-inch sieve 95% min

EXAMPLE

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ReScape Compost Spec

Arsenic	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass < 10 OMRI**
Cadmium	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass < 20 OMRI**
Chromium	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass < 100**
Copper	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass <400**
Lead	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass < 90 OMRI**
Mercury	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass <4**
Nickel	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass <80**
Selenium	**US EPA**	**mg/kg (ppm)**	**EPA 503 pass <5**
Zinc		**mg/kg (ppm)**	**EPA 503 pass <2800**
Ammonium (N or NH4-N)		**ppm or mg/kg dry weight**	**<450**
Sodium (Na)		**% dry weight**	**<0.5**
Carbon : Nitrogen Ratio		**Carbon : Nitrogen**	**≤20:1**
Bulk Density		**lbs/CY dry weight** **lbs/CF dry weight**	**>19 and <41** **>500 and <1100**

Note: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC). (Table modified from the US Composting Council Landscape Architectural Specifications 2009.)

- **Heavy metal content spelled out**
- **Additional parameters (?), participation req's.**

US Composting Council
Seal of Testing Assurance®

REGISTERED cdfa ORGANIC INPUT MATERIAL

OMRI

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Caltrans Compost Specifications

Property	Test method [a]	Requirement
pH	TMECC 04.11-A Elastomeric pH 1:5 slurry method pH	6–8.5
Soluble salts	TMECC 04.10-A Electrical conductivity 1:5 slurry method dS/m (mmhos/cm)	0–10
Moisture content	TMECC 03.09-A Total solids & moisture at 70 ± 5 °C % wet weight basis	30–60 *(40-60)*
Organic matter Content	TMECC 05.07-A Loss-on-ignition organic matter method (LOI) % dry weight basis	30–70 *(40-60)*
Maturity	TMECC 05.05-A Germination and vigor % relative to positive control	--
	Seed emergence	80 or above
	Seedling vigor	80 or above
Stability	TMECC 05.08-B Carbon dioxide evolution rate mg CO_2-C/g OM per day	8 or below
Pathogen	TMECC 07.01-B Salmonella < 3 MPN per 4 grams, dry weight basis	Pass, <3
Pathogen	TMECC 07.01-B Fecal coliform bacteria < 1,000 MPN per gram, dry weight basis	Pass, < 1,000
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Plastic, glass, and metal % > 4 mm fraction	Combined total: < 0.5% (0.25% film plastic)
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Sharps (sewing needles, hypodermic needles, etc.) % > 4mm fraction	None detected

EXAMPLE

Replace extra text with numbers / table
May modify some of the numbers

Caltrans Compost Specifications

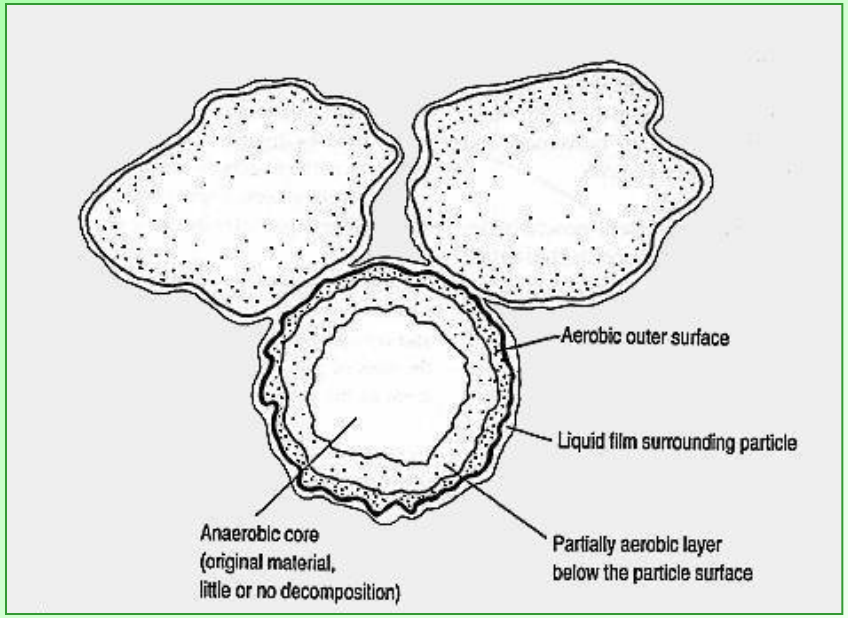
	PARTICLE SIZING FOR	PARTICULAR PRODUCTS	
Fine compost **(for soil incorporation)**	**TMECC 02.02-B Sample sieving for aggregate Size classification % dry weight basis**	**Min**	Max
	Pass 2-inch sieve	**98%**	**--**
	Pass 3/8-inch sieve	**95%**	**--**
Medium compost* **(for erosion control blankets, native plant establishment, landscape mulching)**	**TMECC 02.02-B sample sieving for aggregate Size classification % dry weight basis**	**Min**	**Max**
	Pass 2-inch sieve	**90%**	**--**
	Pass 3/8-inch sieve (minimum 25% retained)	**40%**	**75%**
	Maximum particle length: 6 inches		
Coarse compost* **(for compost filter socks)**	**TMECC 02.02-B sample sieving for aggregate Size classification % dry weight basis**	**Min**	**Max**
	Pass 2-inch sieve	**95%**	**--**
	Pass 3/8-inch sieve (minimum 60% retained)	**0%**	**40%**
	Maximum particle length: 6 inches		

[a] TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Particle size based on end use

Are good compost specs that exist!

Commercial Composting Facility ‘Walk Through’



Surface area phenomenon

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Various Methods
(Technology levels, Sizes)

Microbes:

- Oxygen
- Food (C/N)
- Water

Feedstock Reception

Size Reduction

Feedstock preparation: grinding (and mixing if food waste, etc.)

Site Layout

Organized, materials flow in one direction

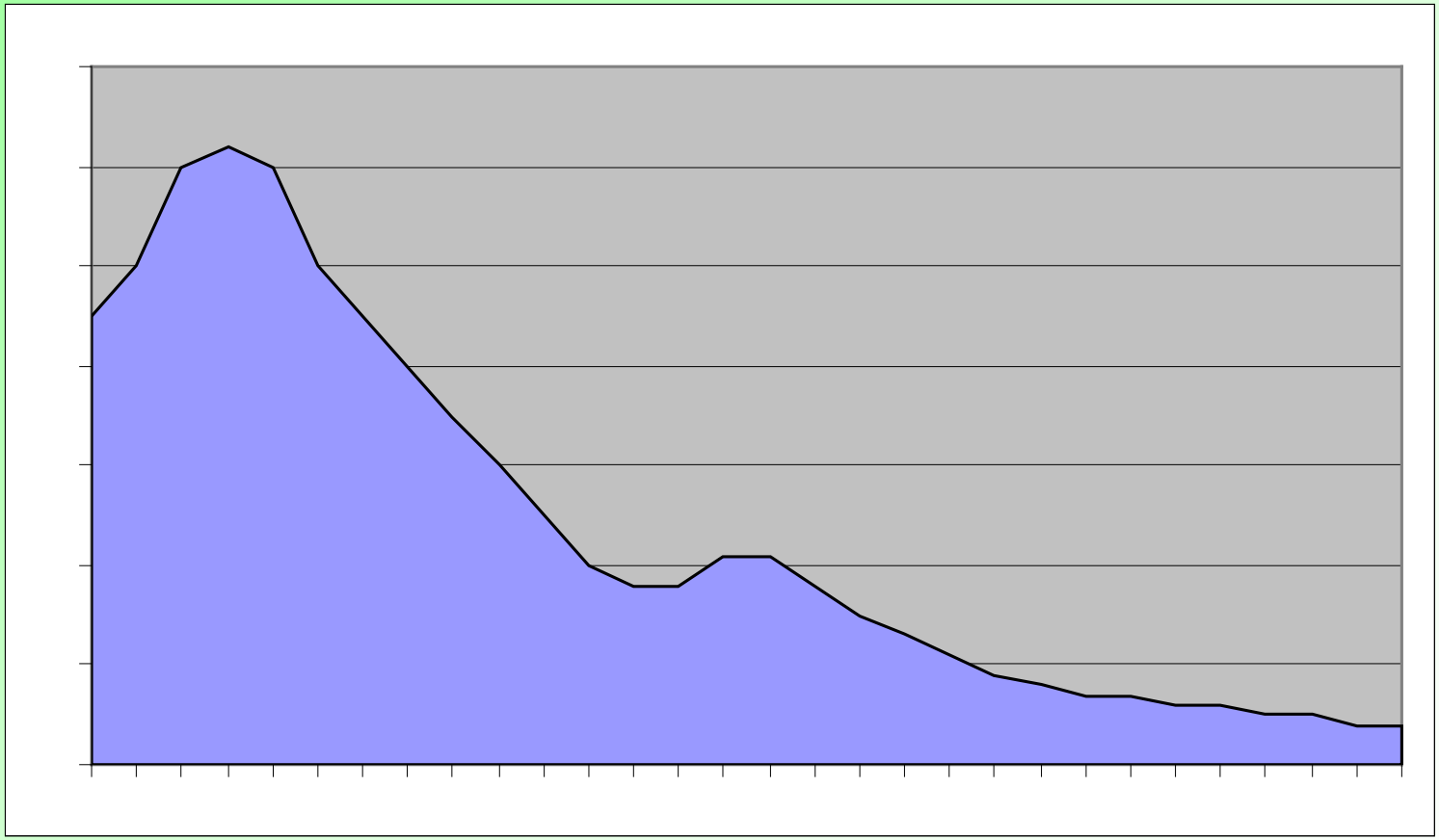
Turning Windrows

Oxygenating vs. ‘fluffing’ (convection)

Forced air instead of turning

Aerobic Process

Oxygen Demand



Composting high rate and stabilization

Curing

Screening

Storing

Monitoring Temperature

High-temperature composting phase

Lower-temperature
curing phase

Screening

Screening (sizing for specific applications)

Typical Compost Feedstocks

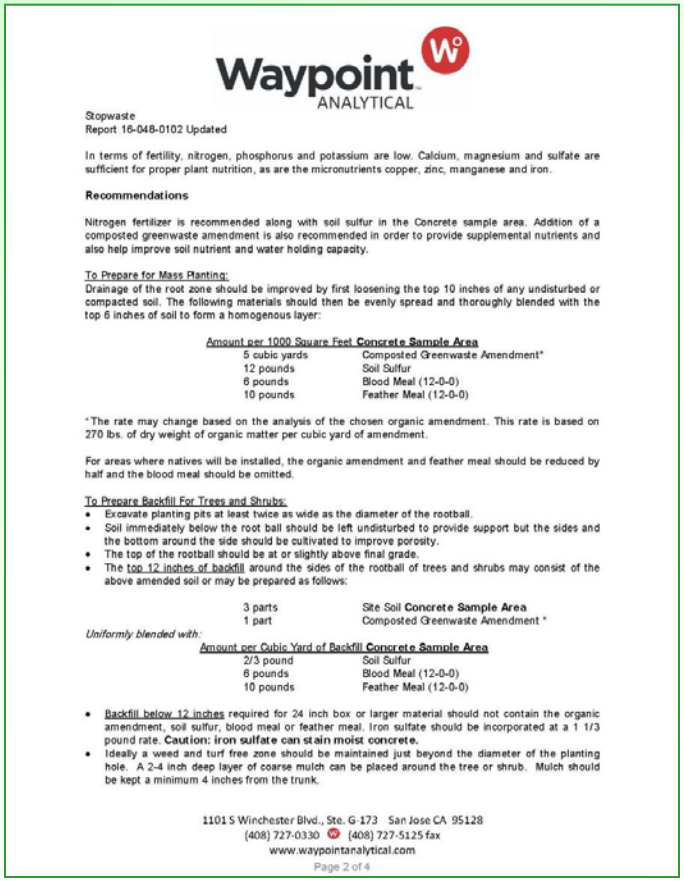
- **Yard trimmings**
- **Food residuals**
- Manure
- Biosolids*
- Industrial by-products*
- MSW* *(no SSO)*

Feedstock influences product characteristics, pro and cons?

**Not OMRI Listable*

Understand Your Soil

- Soil testing is very important and often forgotten
- Soil analysis shall include:
  - Soil texture, infiltration rate, pH, EC, Na, OM *(basics)*
  - Often provide recommendations (compost application rates)
- Testing done by universities and private labs *(WELO requires)*



Waypoint ANALYTICAL

Stopwaste
Report 16-048-0102 Updated

In terms of fertility, nitrogen, phosphorus and potassium are low. Calcium, magnesium and sulfate are sufficient for proper plant nutrition, as are the micronutrients copper, zinc, manganese and iron.

Recommendations

Nitrogen fertilizer is recommended along with soil sulfur in the Concrete sample area. Addition of a composted greenwaste amendment is also recommended in order to provide supplemental nutrients and also help improve soil nutrient and water holding capacity.

To Prepare for Mass Planting:
Drainage of the root zone should be improved by first loosening the top 10 inches of any undisturbed or compacted soil. The following materials should then be evenly spread and thoroughly blended with the top 6 inches of soil to form a homogenous layer:

Amount per 1000 Square Feet **Concrete Sample Area**	
5 cubic yards	Composted Greenwaste Amendment*
12 pounds	Soil Sulfur
6 pounds	Blood Meal (12-0-0)
10 pounds	Feather Meal (12-0-0)

*The rate may change based on the analysis of the chosen organic amendment. This rate is based on 270 lbs. of dry weight of organic matter per cubic yard of amendment.

For areas where natives will be installed, the organic amendment and feather meal should be reduced by half and the blood meal should be omitted.

To Prepare Backfill For Trees and Shrubs:

- Excavate planting pits at least twice as wide as the diameter of the rootball.
- Soil immediately below the root ball should be left undisturbed to provide support but the sides and the bottom around the side should be cultivated to improve porosity.
- The top of the rootball should be at or slightly above final grade.
- The top 12 inches of backfill around the sides of the rootball of trees and shrubs may consist of the above amended soil or may be prepared as follows:

3 parts	Site Soil **Concrete Sample Area**
1 part	Composted Greenwaste Amendment.*

Uniformly blended with:

Amount per Cubic Yard of Backfill **Concrete Sample Area**	
2/3 pound	Soil Sulfur
6 pounds	Blood Meal (12-0-0)
10 pounds	Feather Meal (12-0-0)

- Backfill below 12 inches required for 24 inch box or larger material should not contain the organic amendment, soil sulfur, blood meal or feather meal. Iron sulfate should be incorporated at a 1 1/3 pound rate. **Caution: iron sulfate can stain moist concrete.**
- Ideally a weed and turf free zone should be maintained just beyond the diameter of the planting hole. A 2-4 inch deep layer of coarse mulch can be placed around the tree or shrub. Mulch should be kept a minimum 4 inches from the trunk.

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(408) 727-0330 (408) 727-5125 fax
www.waypointanalytical.com
Page 2 of 4

Soil Functions

Soil provides

- A physically stable medium for plant growth
- Acts as a repository for plant nutrients and water
- Medium for microbial (and other) life

Plus environmental benefits …

- Acts as a biofilter – binding and degrading pollutants
- Absorbs runoff (and reduces erosion)
- Sequesters carbon

We can help soil to properly function if we re-establish the carbon cycle

Compost and Mulch as a Drought Management Tool

- Amending soil and/or mulching can help reduce the dependency on irrigation (reduce water usage volumes)
- Assist plant survival…. AND

Captures the <u>FREE WATER</u> that falls from the sky as precipitation

Rainwater

Why its included in the WELO ordinance, is key to field success

Choosing the Proper Product

- Understand the application (specific end use, details of application)
- Obtain product test results (get help with interpretation)
- Buy certified / Listed products
- Know the Supplier *(are they educated?)*
- Get samples, test data and end use information from supplier – *up-front*
- If purchased in bulk, inspect the product before it is dumped

List of composters can be found on USCC website
https://compostingcouncil.org/participants/

A Comparison Between Mulch and Soil Amendment Properties

Property	Mulch	Amendment
Moisture conservation	Moderate to high	Low to moderate
Moisture retention	Low (in the mulch) High (in the soil under mulch)	High
Soil temperature	Immediate changes	Slight or unchanged
Soil structure	Changes with time	Changes immediately
Phytotoxicity potential	Low to medium	Low to high
Root contact	Low initially	High
Fertility	None to low	Low to moderate
Pathogens	Low to none	None to high
Nitrogen tie up	Low to none	None to high
Weed control	Moderate to high	Low to none

Source: Creating a Healthy Root Zone, James Downer and Ben Faber, University of California

N and O depletion when many mulches are mixed in soil

Not interchangeable products !!

Soil Amending Compost
(often 3/8” screened)

Lots of carbon-based mulches are used…

Bark and recycled wood is common

↑ not considered a
'recycled product'

Coarser Compost for Mulching

(and Erosion Control / Storm Water Management)

Benefits of Compost Use to the Landscape World

Physical:

- Improves soil structure
- Moisture management

Chemical:

- Modifies and stabilizes pH
- Increases cation exchange capacity
- Supplies nutrients

Biological:

- Supplies soil biota
- Suppresses plant diseases

Other:

- Binds/degrades contaminants
- Binds nutrients

Soil Structure: Physical Modification

Improves

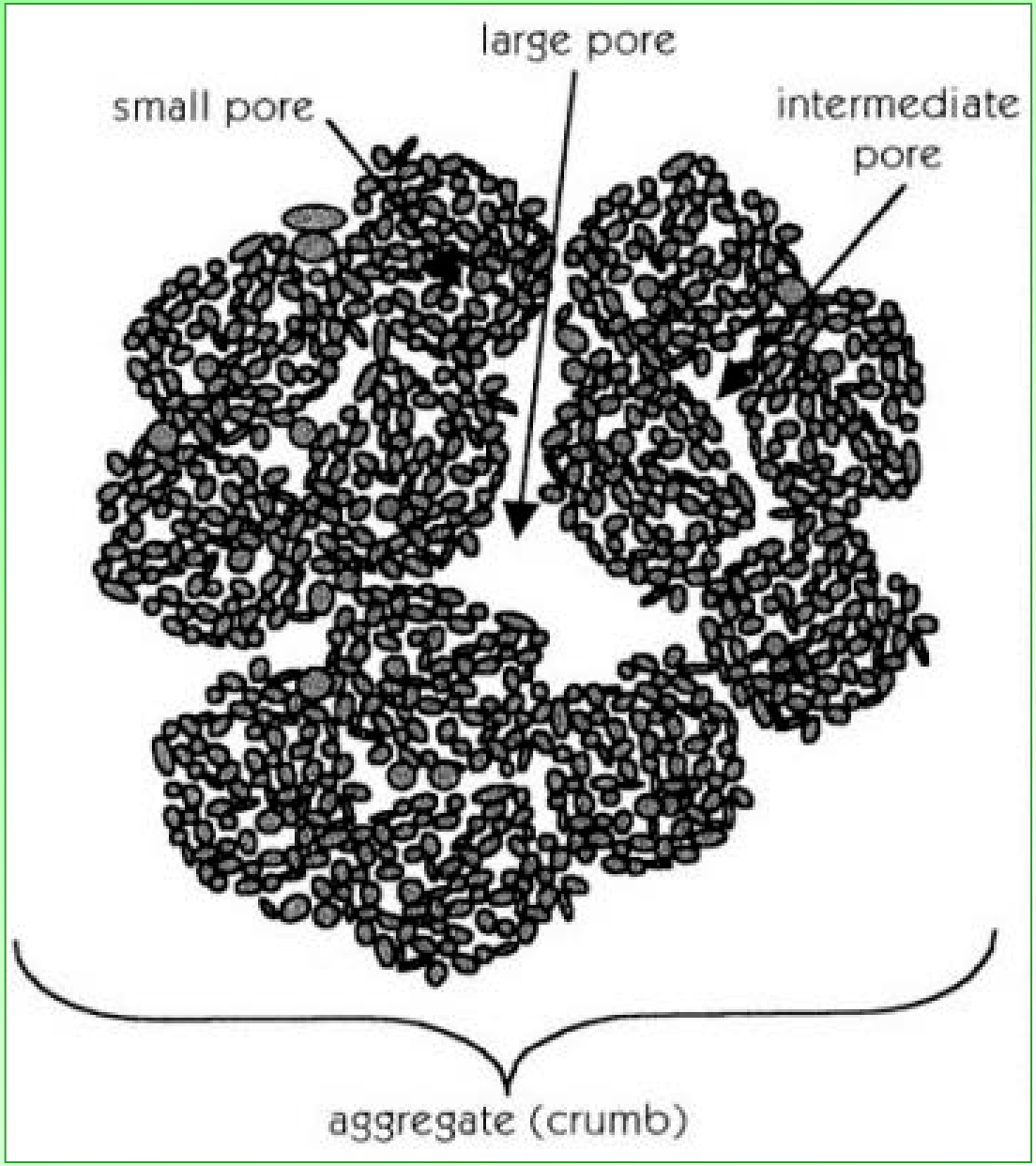
-Water (oxygen, other) movement

-Rooting – more extensive, faster

-Pore spacing, soil aggregation

-Biological and physical mechanisms
-Less wind and water erosion, better salt movement

Soil Aggregation



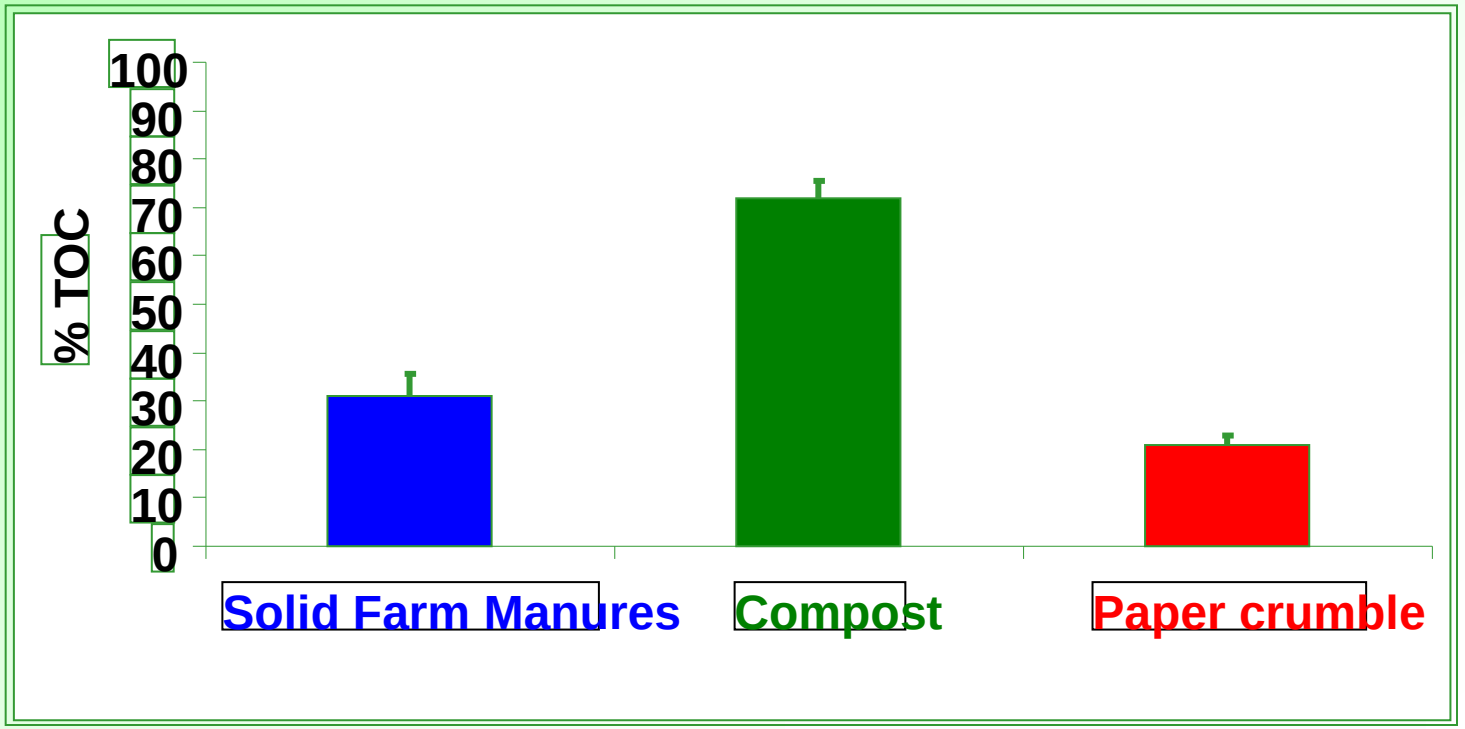
A well aggregated soil has a range of pore sizes. This medium size soil crumb is made up of many smaller ones. Very large pores occur between the medium size aggregates. Occurs physically and biologically.

Improved

- **Tilth (Workability)**
- **Reduced bulk density**
- **Improved rooting**

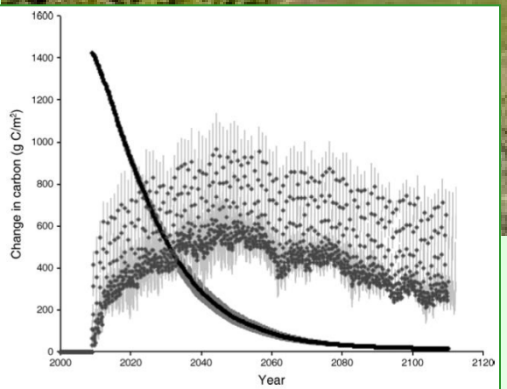
Long Lasting Organic Matter –

Lignin as % of Total Organic Carbon



Carbon Farming

Marin Carbon Project



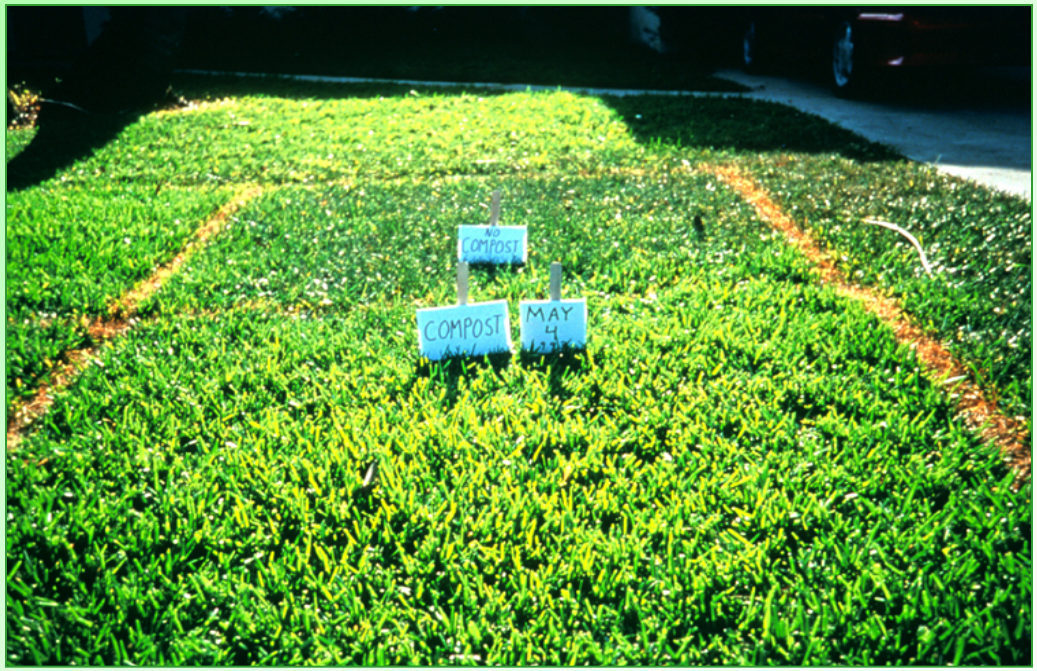
- Research identified 30-year affect (100 yr?), and no significant effect on native plant diversity

R. Alexander Associates, Inc. ©

Carbon Sequestration

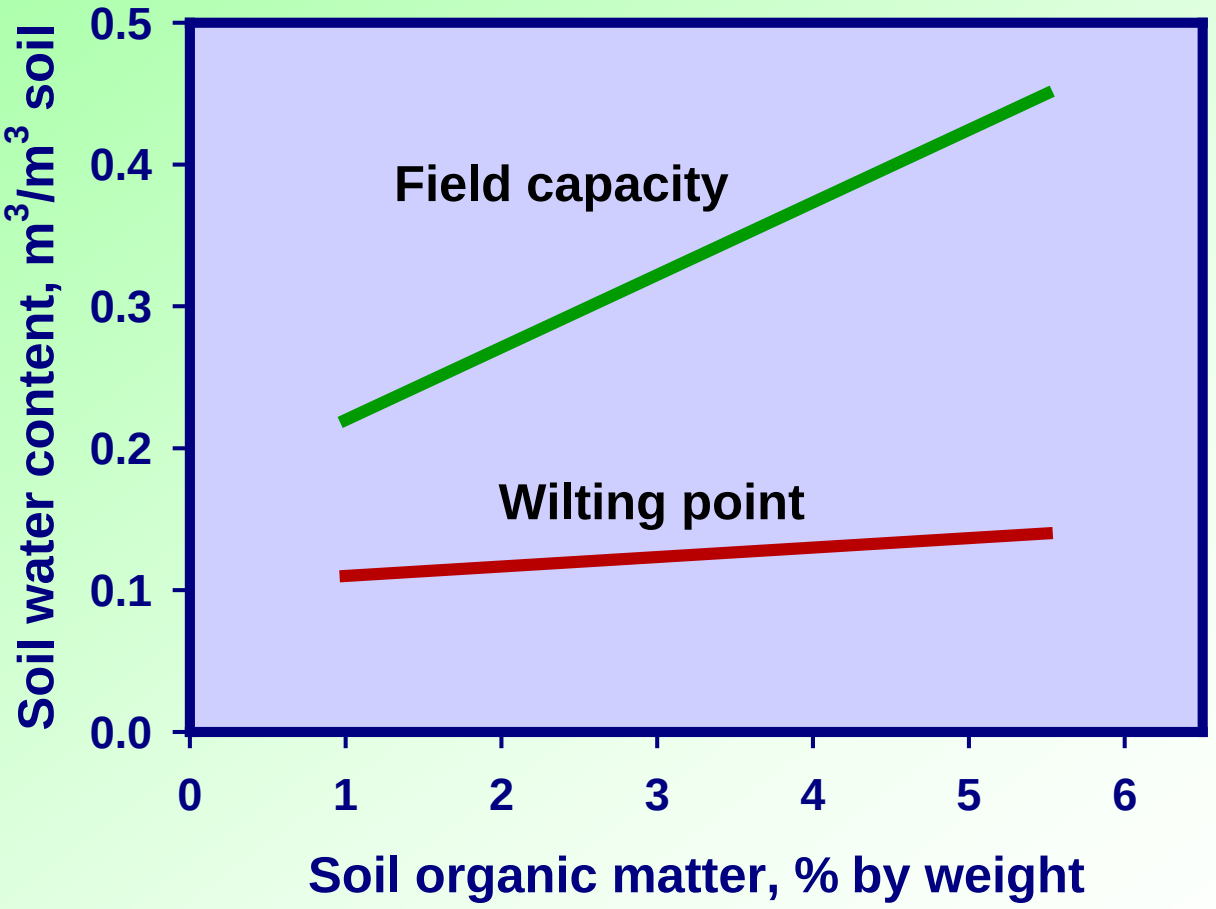
- Soil contains 75% of the carbon pool on land (25% stored in living plants and animals)
- Benefits of soil carbon sequestration
  - Removing CO_2 from the atmosphere
  - Improved soil and water quality
  - Decreased nutrient loss
  - Reduced soil erosion
  - Increased water conservation
  - Greater crop production

Increased Soil Water Holding Capacity



and Moisture Absorption

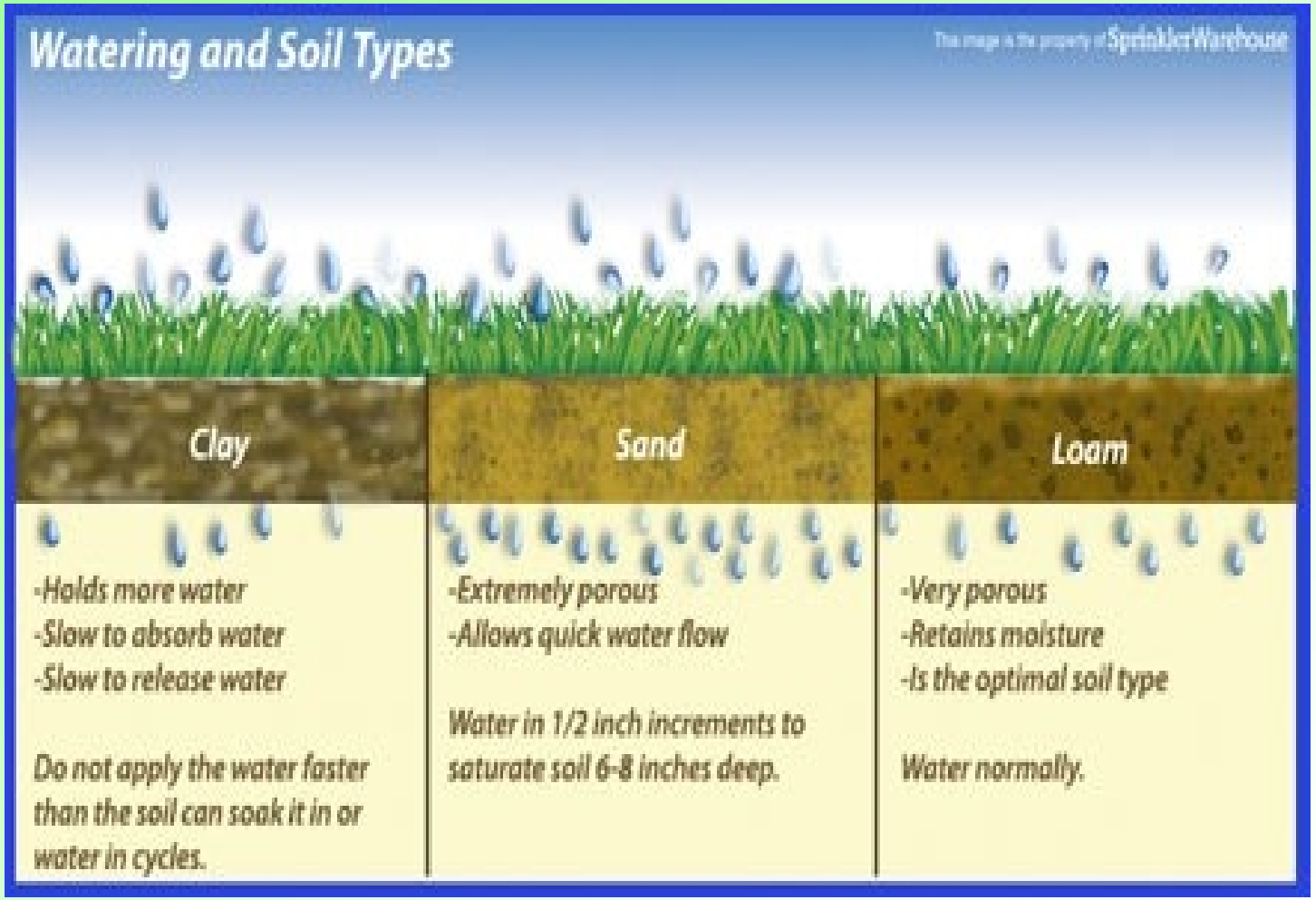
Effect of Organic Matter on Available Soil Water



ATTRA – each increase of 1% OM can increase soil WHC by 16,500 gallons H_2O/A

Reduce irrigation 30-50% by 'fixing' soil first

Soil Type Affects Irrigation Strategies



Organic matter benefits in several ways

Compost Restores Storm Water Infiltration Capacity

So, helps to recharge aquifers…

Source: University of Washington trials on glacial till soil. Reduce runoff by up to 50%

Influence of Compost on Soil Water Management

Western Washington Loamy Sand (% dairy solids compost added)	**OM (%)**	**Saturated Hydraulic Conductivity (in/hr)**	**Moisture at Field Capacity (weight %)**	**Moisture at Field Capacity (in/ft)**	**Bulk Density (g/cm^3)**
0	2.0	4.3	21.5	2.2	1.20
10	2.0	4.3	26.8	2.7	1.28
20	2.4	5.4	37.0	3.7	1.09
30	4.4	7.5	50.9	5.1	0.99

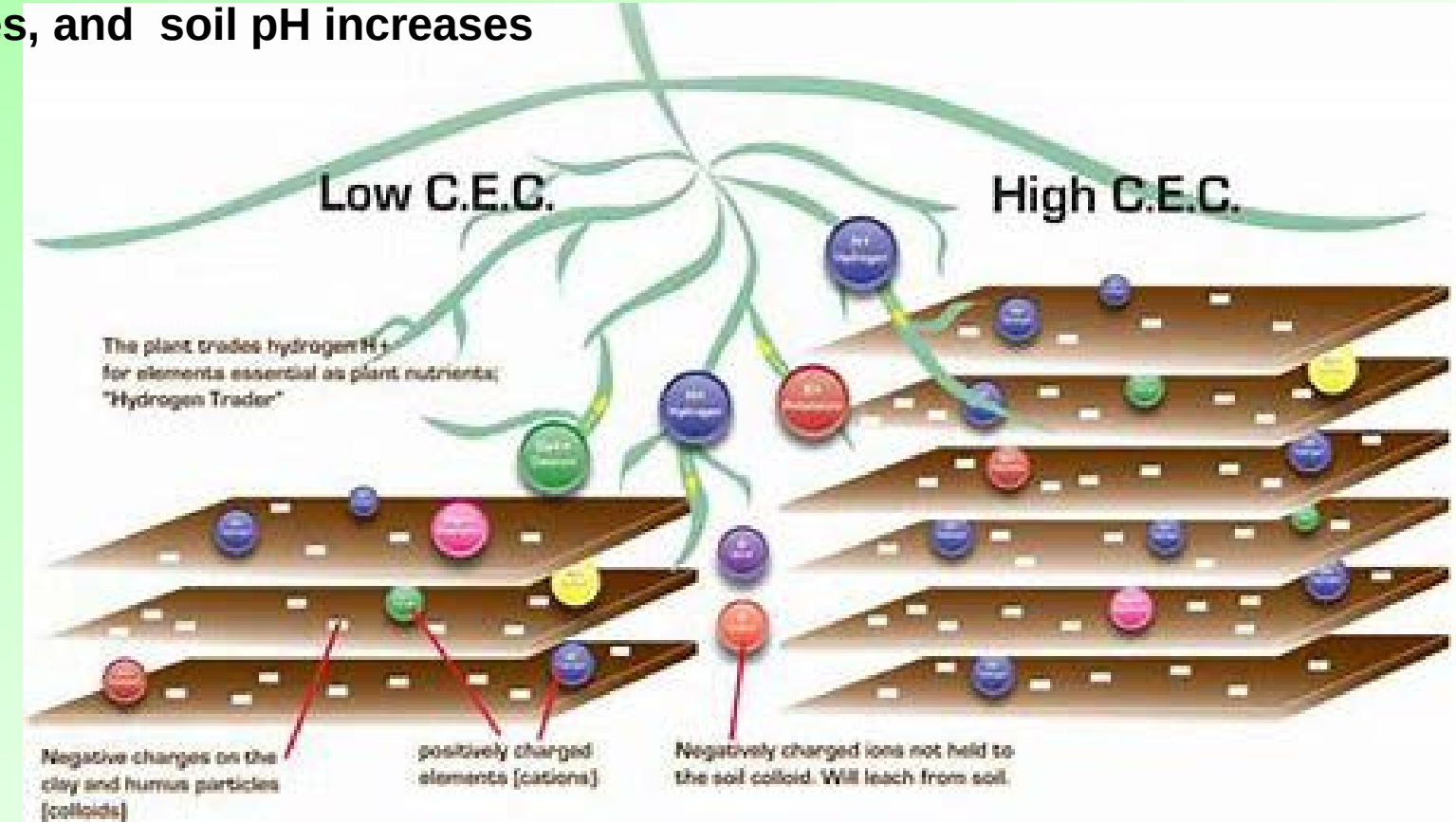
WORC/ECY 2008

Great tool for water management – too much, too little

Compost Supplies Macro and Micro Nutrients

SOM is a Nutrient Reservoir

- **Cation exchange capacity (CEC) is the total amount of cations that a soil can retain**
- **The higher the soil CEC the greater ability it has to store plant nutrients**
- **Soil CEC increases as the amount of clay and organic matter increases, and soil pH increases**



Key ingredient in bioretention soil mixes

Composting Creates High Temperatures:

(Naturally)

- Weed free
- Human/animal pathogen, and
- Plant disease destruction

Supplies and Feeds
Soil Biology

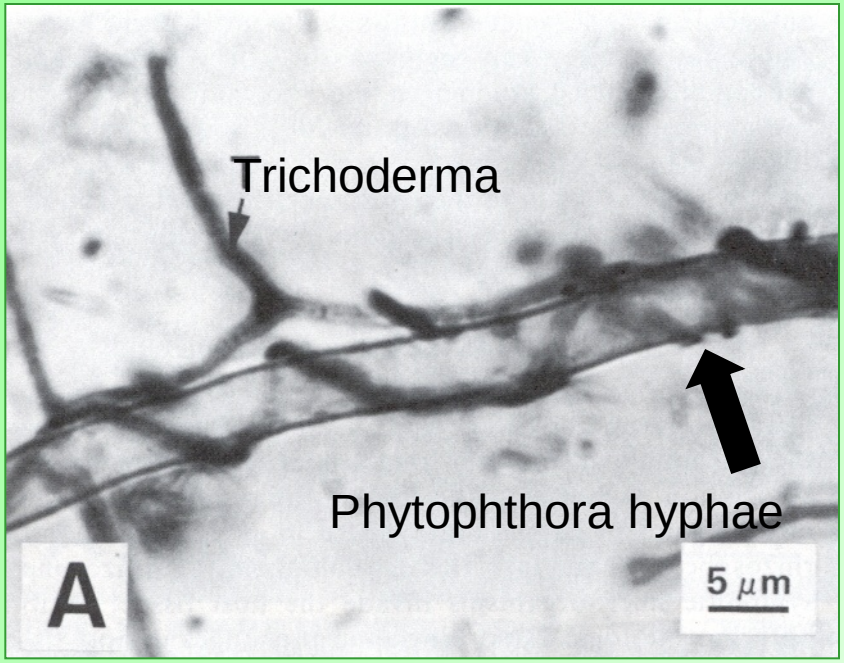
Responsible for

- Organic matter decomposition and nutrient cycling
- Increased nutrient supply to plant roots
- Formation and stabilization of soil structure
- Breakdown of organic contaminants
- Control of pests and pathogens

Microbial population and diversity are measures of soil quality

Microbes work in symbiosis with plants

Suppresses Soil-Borne Diseases



4 Mechanisms of Disease Suppression, via beneficial organisms:

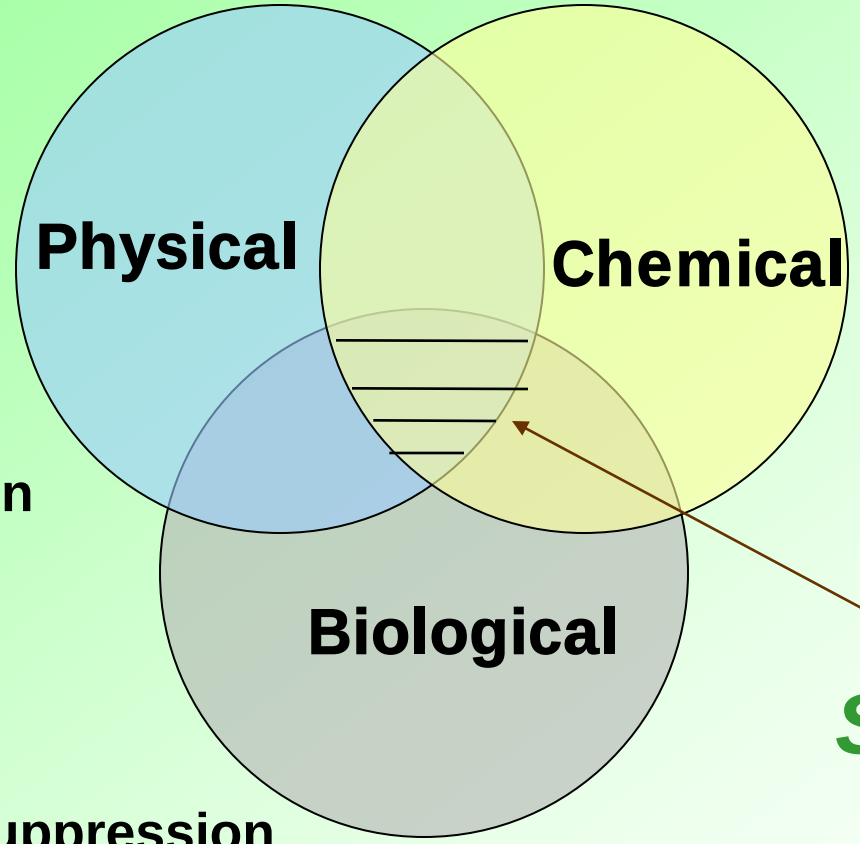
1. Induced systemic resistance (ISR) or systemic acquired resistance (SAR) – turns on plant's natural disease-fighting mechanisms
2. Antagonism (kills/harms disease organisms)
3. Competition for nutrients (and energy)
4. Competition for root colonization

Preventative, not curative

(Malajczuk, 1983)

Healthy Soils Improve Water Efficiency

- Root proliferation
- Aeration
- Water retention
- Water infiltration and transmission
- Erosion prevention



- Nutrient retention and release
- pH
- Energy (C) storage
- Toxicity prevention

Soil Health

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection

Compost Application

Soil Incorporant

- Ag crop establishment
- Turf establishment
- Garden bed preparation
- Reclamation/remediation
- Nursery production
- Roadside Vegetation

Surface Applied

- Fruit trees
- Garden bed mulch
- Erosion control media
- Turf topdressing

Growing Media Component

- Container/potting substrates
- Landscape (e.g. rooftop, raised planters)
- Backfill mixes (tree and shrub plantings)
- Golf course (e.g. tee, green, divot mixes)
- Manufactured topsoil

Lots of applications,
Staple of landscape industry…
(future land mgt tool)

General Landscape Applications

- Planting Beds
- Tree/Shrub Planting
- Topsoil manufacturing
- Turf Establishment and Maintenance

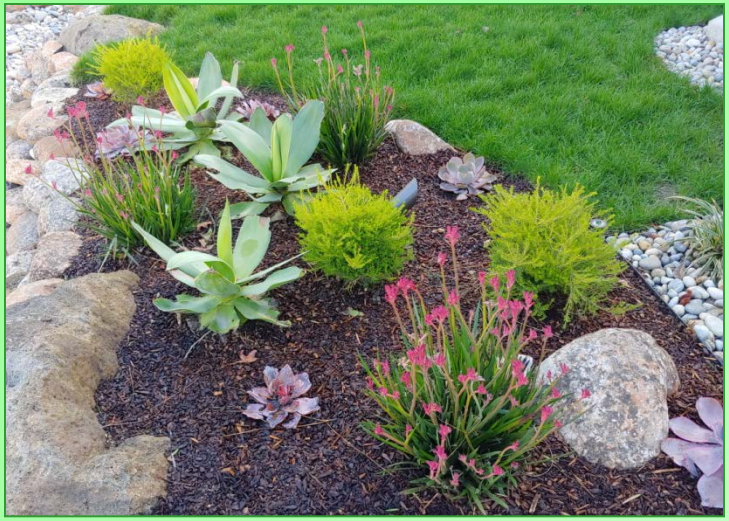
-Apply 1-2” layer and incorporate to a 6-8” depth (3-6 CY / 1,000 SF)

-Do not over incorporate

-Water plants in well

(can reduce fertilizer, gypsum application)

Homes, Parks, Public & Private Land



Urban Food Production

Interior Landscapes and Potting Media Amendment

TREE/SHRUB PLANTING

- **Excavate Planting Hole 2-3 Width of Rootball**
- **Blend 1 Part Compost to 2-3 Parts Soil**

- Place plant
- Backfill hole with soil blend
- Firm occasionally
- Water

Home Lawn Conversion with Sheet Mulching

Photo: Apri

Done to reduce water consumption

Photos: Stop waste

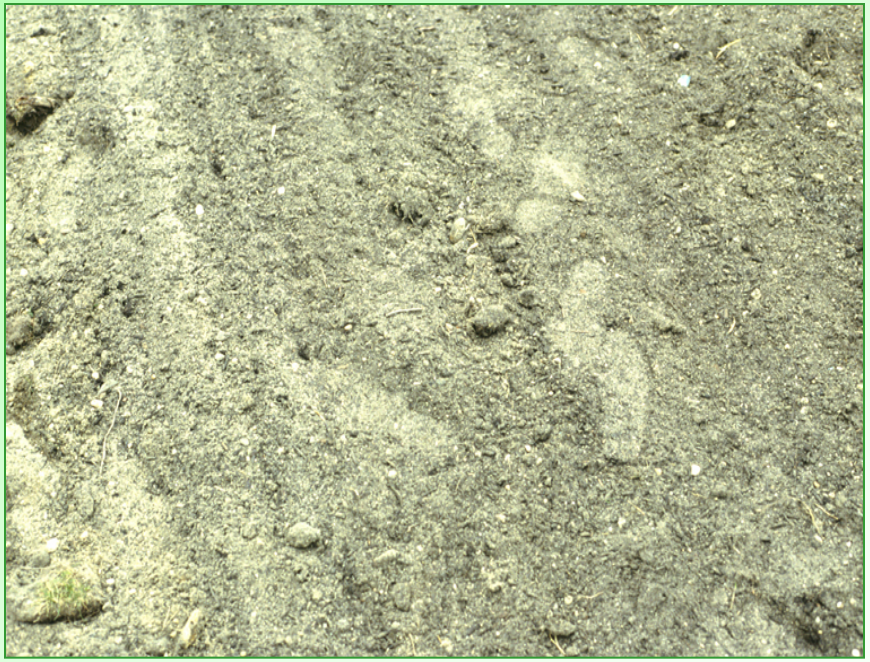
Lawns / Turf

Can create and renovate existing lawns with compost (less popular today)

To avoid long-term irrigation, manage storm water

Roadside and large land projects

-Apply 1-2” layer - sometimes more, depends on soil quality and incorporation depth *(specify within spec)*



-Remove clods, stones, etc. over 2”

-Incorporate to 6-8” depth (e.g., rototill, disc)

-Smooth prior to seeding or laying sod

-Water and fertilize

Great storm water management benefits

Compost Filter Strip (10’ wide) Treats Stormwater From 2 Lanes of Roadway

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

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

Source: Washington State DOT (Cedar Grove yard trimmings compost)

Site Restoration / Establishment of Natives

-Apply 4” coarse, compost
(Lifetime application)

-Vic Claassen, UC Davis research – low nutrient needs, Med climate
-Faster, denser vegetation establishment

Caltrans research found….

Deep incorporation of compost improves soil characteristics including:

- **Infiltration and permeability**
- **Water holding capacity**
- **Texture**
- **Nutrient levels and cycling**
- **Micro-organism populations**
- **Rooting depth**
- **Oxygen exchange and air space**
- **Vegetation Coverage**

Restoration - Compost Incorporation

Before

After Compost Incorporation

Two Years Later

Invasive weed suppression

Turf Topdressing

- **Turf Maintenance**
- **Partial Renovation**

If keeping lawn, and are trying to reduce water usage

Athletic fields

(aeration and topdressing is an important practice)

TOPSOIL MANUFACTURING

On-site soil blending / improvement

Use in landscaping, (subsoils/sand) reclamation, brownfields, contaminated sites, etc.

Great technique when have adequate volumes of 'soil' (mineral substrate) on-site

Financial savings, plus superior soil

Transport 270 CY, instead of 540-810 CY

Can be ½ the cost…

...but must make sure that the process is done properly, may need broadleaf weed control

Off-site soil blending

Blend ratio depends on initial soil quality and goals

- Typically 20-30% inclusion rate (compost/soil mix by volume)

Many soil blends available to homeowners at garden centers / ldsp. yards

R. Alexander Associates, Inc.©

Commercial scale

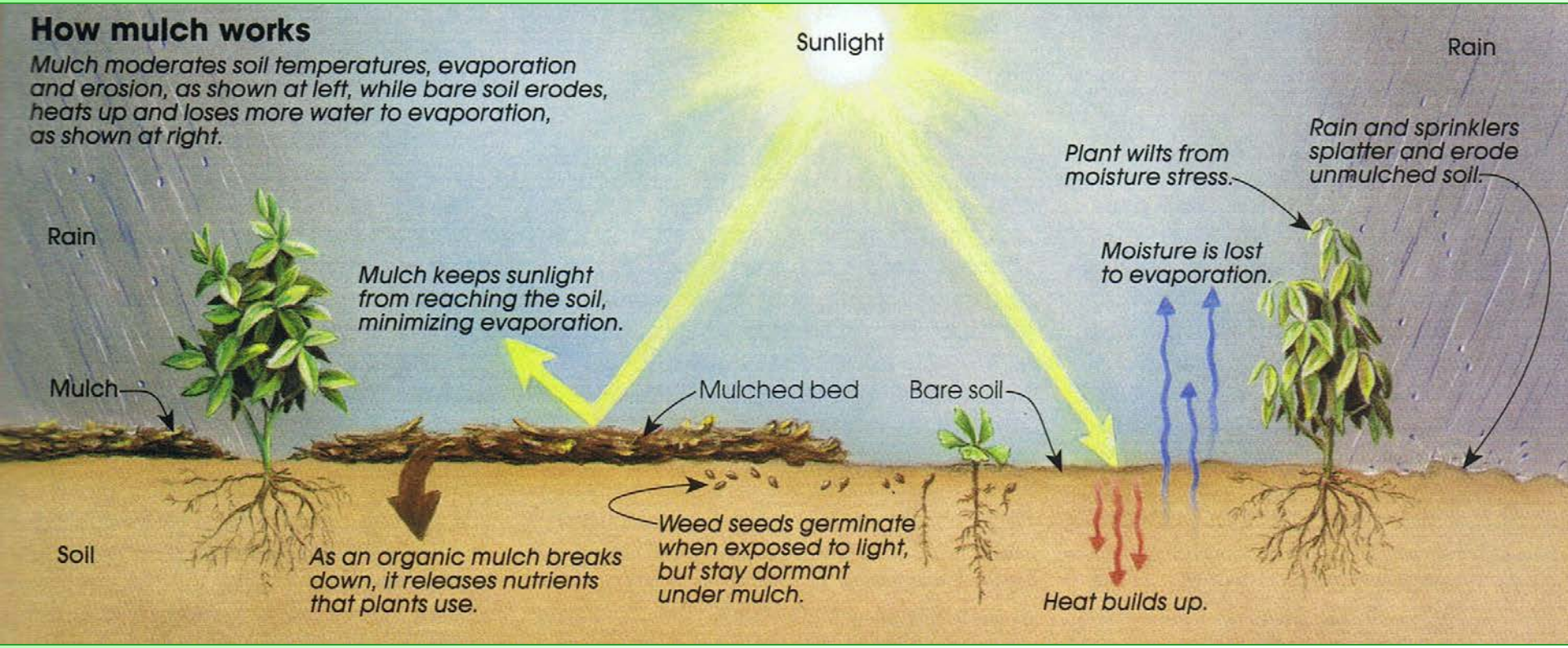
R. Alexander Associates, Inc.©

Mulching

- Mulch applied to the soil surface
- Around planted materials and on slopes to both increase water holding capacity and reduce moisture evaporation, and for aesthetic purposes (and much more…)
- Reduces herbicide usage *(Round-Up?)*

(What's wrong with this picture)

How Mulch Works



- Absorbs radiant heat – *reduces soil temperature*
- Reduces water evaporation from soil
- Helps water absorption
- Reduces weed growth – *they use water too*
- Breaks down and adds OM to soil

Mulching Provides Many Benefits…*Well Documented*

- **Conserves moisture**
  - **Reduces irrigation by up to 70%**
- **Reduces soil temperature (8-10°F) and temperature fluctuations**
- **Suppresses weed establishment**
- **Improve soil structure and increase soil fertility over time**
- **Improves erosion control**

Preferences…

Often more related to 'look' (and cost) than efficacy

(Bark mulch is not considered to be a recycled product)

R. Alexander Associates, Inc.©

Recycled mulch is required where available

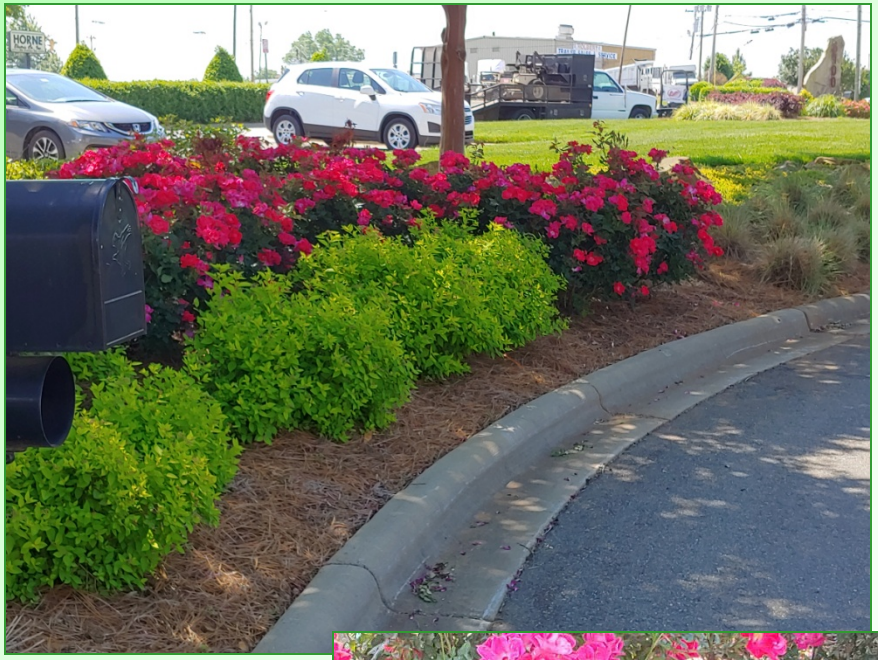
Woody materials

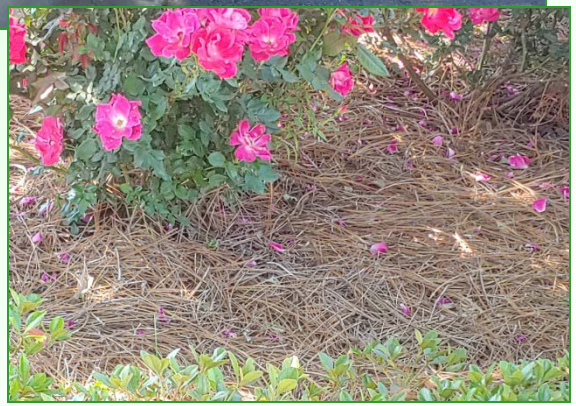
Coarser Composts
(and sometimes finer)

Apply 3” layer

(9 CY / 1,000 SF)

Lots of options….
good and bad





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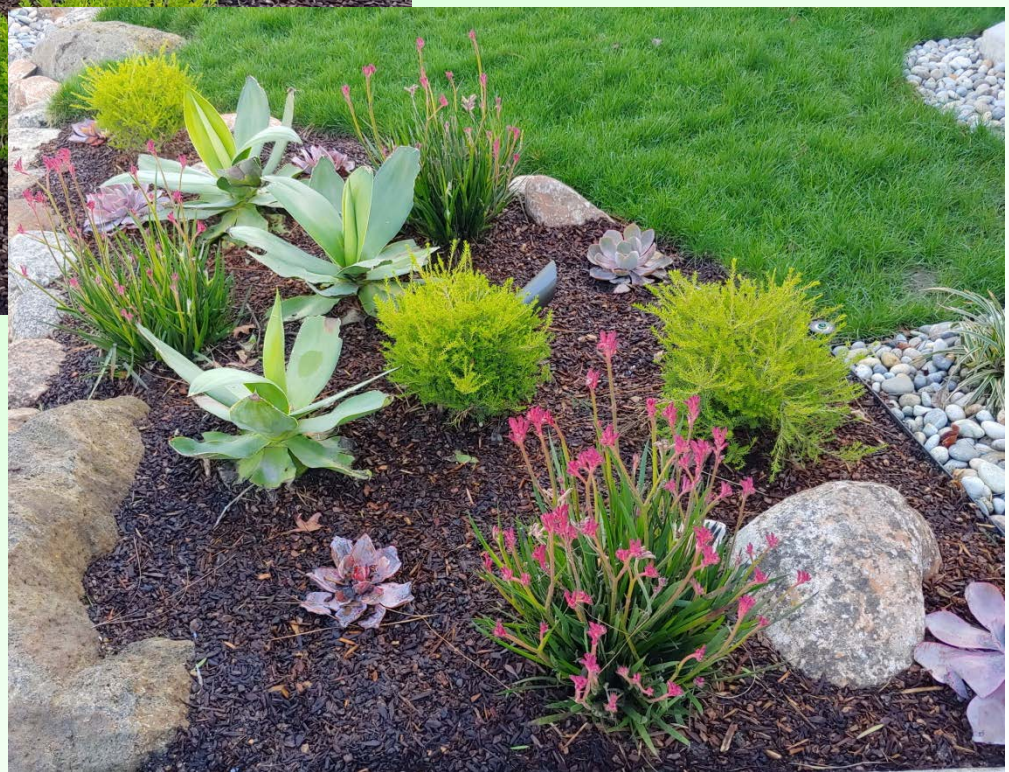
Mulching Volcanos

Can be consequences of improper mulching

Why are Stones being used?



Not All Mulches are the Same..

Material	Uses	Application Depth
Bark	Contains waxes that shed water moving it into the soil. Great to use in ornamental beds	2” Small chips/nuggets 3” Large chips/nuggets
Wood Chips	Compost fresh chips for a couple of months before use. Use in ornamental beds.	2” Small chips/nuggets 3” Large chips/nuggets
Leaves	Use dry, aged and shredded leaves. Use either in vegetable garden or ornamental bed.	4” loose 1”-2” settled
Grass Clippings	Only use grass from an herbicide free lawn. It is best when dried for a few days. A good source of nitrogen. Use in vegetable garden.	4” loose 1”-2” compressed
Compost	Inhibits plant disease, builds the soil, and provides plants with nutrients. Use in vegetable or ornamental beds.	1”-2”
Straw	Inhibits plant disease and is a good insulator. Use in vegetable gardens.	4” loose

- Type of mulch not specified in ordinance, so you may have to

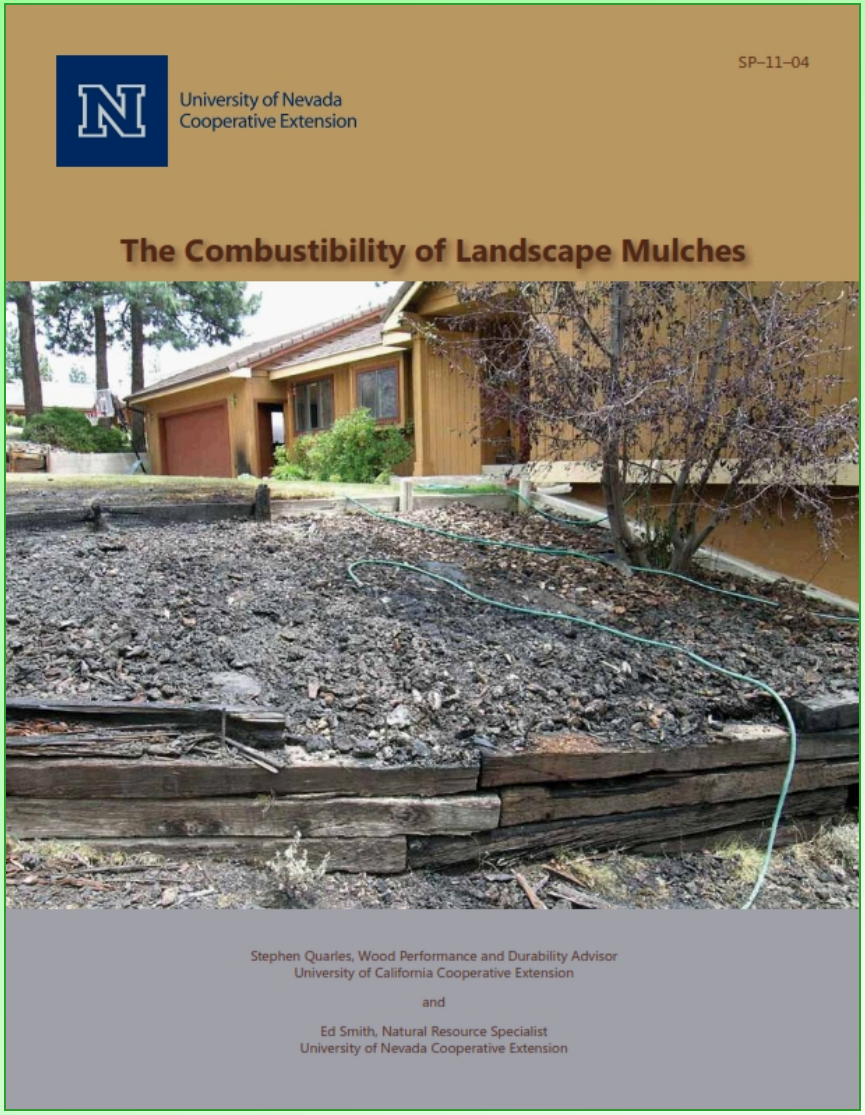
The Holden Arboretum, 2003

Research Shows Some Mulches Better than Others for WHC

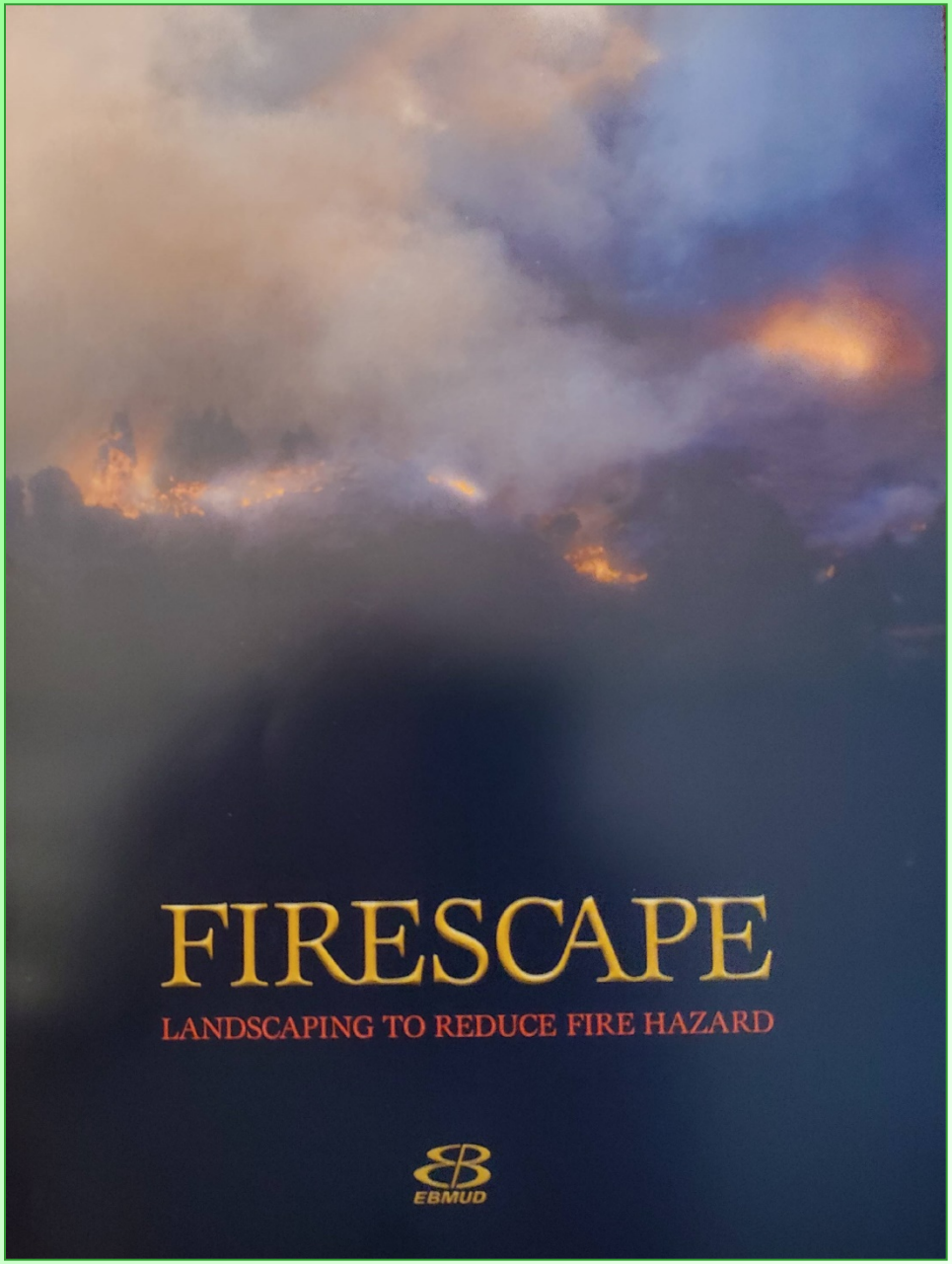
Treatment and Depth	WHC *(inches water)*	WHC *(inches water / foot appl. depth)*	Std. Dev.
Gro-Mulch – 3”	0.91	3.64	0.11
Yard waste – 5”	1.13	2.72	0.17
Yard waste – 3”	0.63	2.51	0.11
Yard waste – 1”	0.20	2.34	0.04
Composted yard waste – 3”	0.40	1.59	0.15
Fabric + OGC – 3”	0.35	1.42	0.04
OGC – 3”	0.31	1.25	0.01
Bark – 3”	0.28	1.11	0.03
Xerimulch – 3”	0.02	0.81	0.01
1” Rock – 3”	0.02	0.09	0.01
Fabric	-	-	-
Control	-	-	-

Ref: Water retention & evaporative properties of landscape mulches. Univ. of CA (Shaw, Pittenger, McMaster)

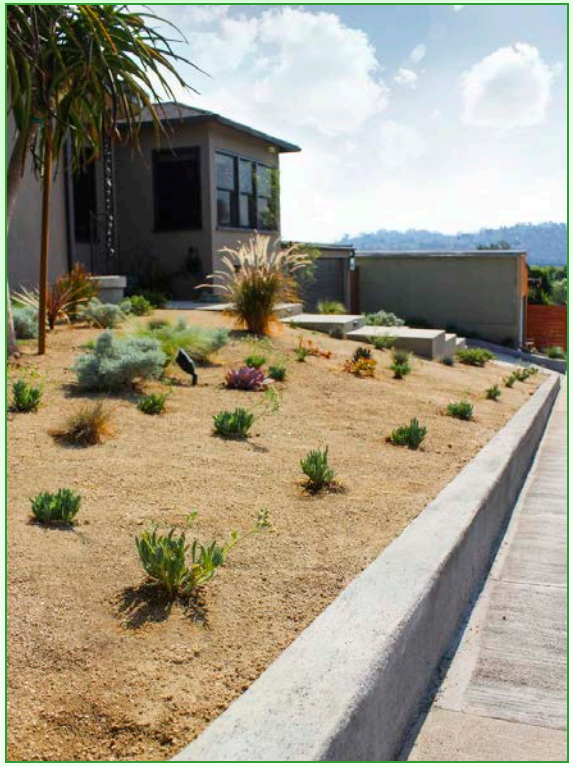
Combustibility of Landscape Mulch



-Most customers will likely want to use it, but be smart with it
-Composted mulches, least combustible



Suggests decomposed granite or gravel mulches in high risk areas



Erosion Control and Storm Water Management Applications for Compost

Soil and Water Protection

Erosion Control, Storm Water Mgt, Mulching Applications

Coarser, mulchy composts

Erosion/Sediment Control

- National specs exist
  - US EPA supports

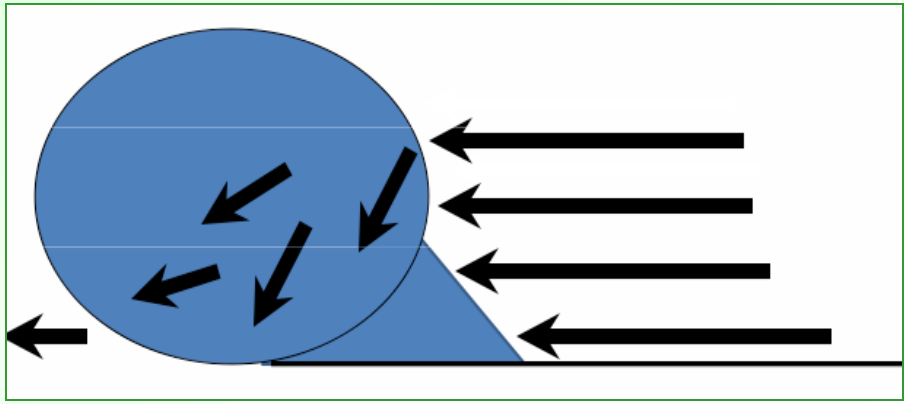
Compost blankets
(berms and socks)

Coarse compost particles absorb rain energy, fine particles absorb water

Total / 100% contact with soil.
Extensive rooting

Can be staked into place, so work on concentrated flows

Act as a 3-dimensional filters, so large sediment capacity

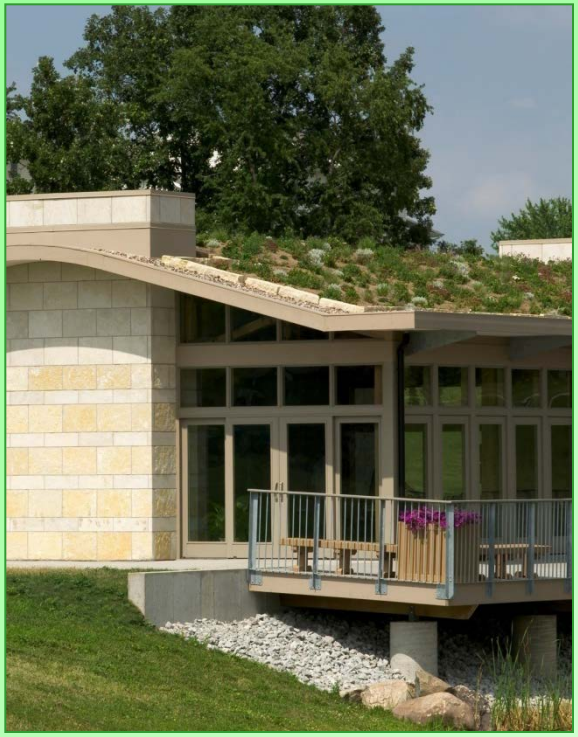


Caltrans uses…

Compost applications, over time, blend in with the natural landscape

Compost berms – sediment control

Green Infrastructure Applications



Source: IDNR, Erth Products, LLC, Filtrexx

Storm water mgt.

Roof top gardens and bioretention features

Rain Gardens

Stormwater media

Compost / sand mixes similar to bioretention features

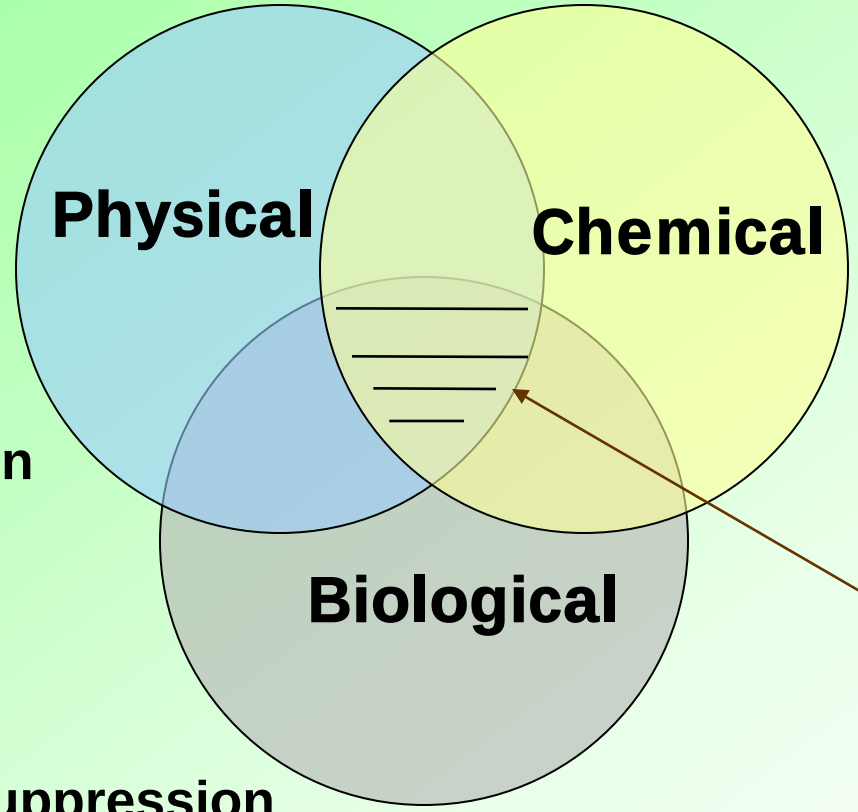
Source: SOCCRA, RAA

Bioretention Mulches

Composted, stringy (heavier) mulches are more non-floating

Teach Customers to Invest in Water Efficiency and…

- Root proliferation
- Aeration
- Water retention
- Water infiltration and transmission
- Erosion prevention



- Nutrient retention and release
- pH
- Energy (C) storage
- Toxicity prevention

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection

Healthy Soil

Healthy Soils Improves…

- Plant growth and survival rates
  - Ability for ‘plants’ to better handle environmental stresses
  - Microbial life, many live symbiotically with plant life
- Sustainability of landscape / turf / slope
  - **Less water**, other inputs
  - Lower maintenance costs
- Erosion / sediment control and
- Storm water management

Compost and mulch usage assist in creating healthy and water efficient soils !

QUESTIONS

More information:
- www.compostingcouncil.org
- www.lawntogarden.org/marketplace

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