The National Academies of
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TRANSPORTATION RESEARCH BOARD

TRB Webinar: Compost It! Environmental Benefits of Compost in Highway Roadsides

June 23, 2021

2:00- 3:30 PM Eastern

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hours (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Beth Ewoldsen at Bewoldsen@nas.edu

#TRBwebinar

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

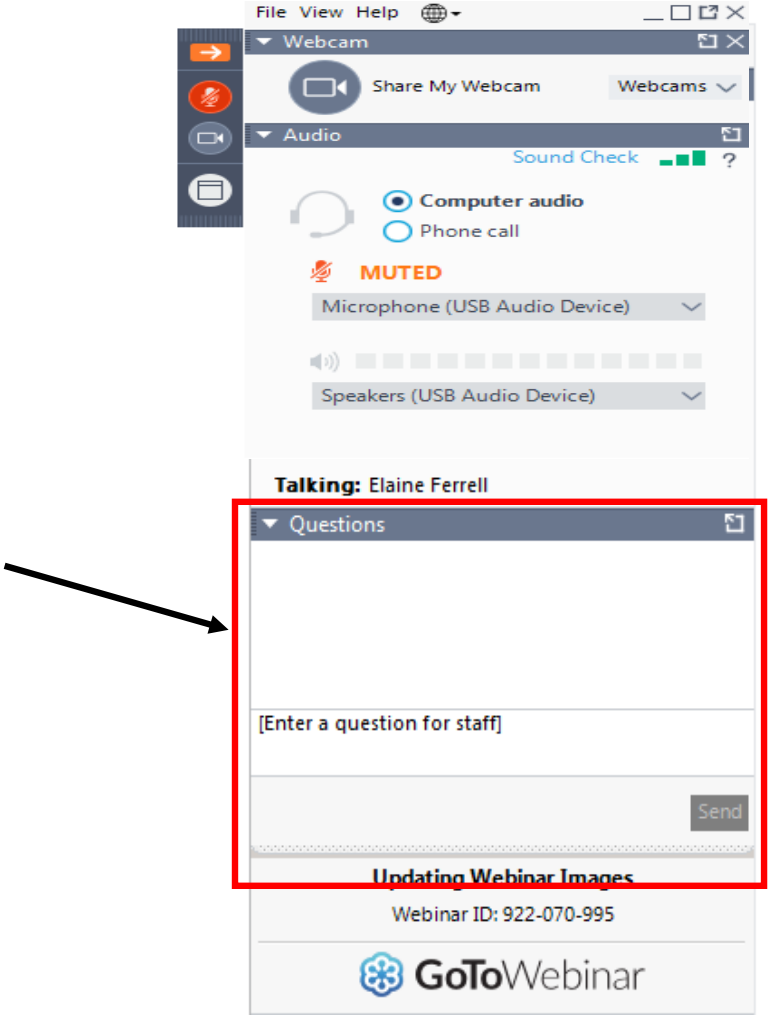
REGISTERED CONTINUING EDUCATION PROGRAM

Learning Objectives

- Use compost-based best management practices in highway roadsides

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



#TRBwebinar

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Compost Production and Use

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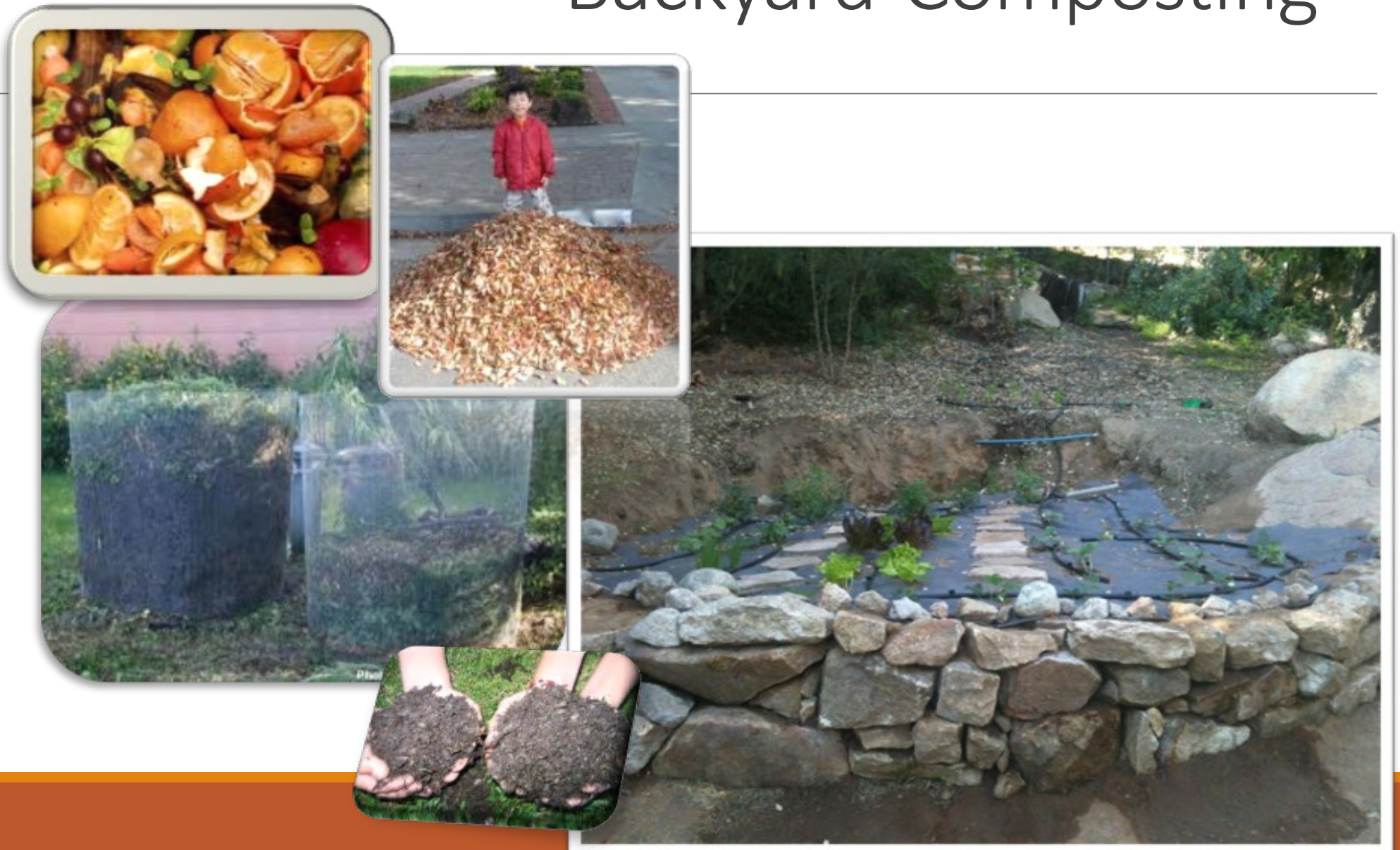
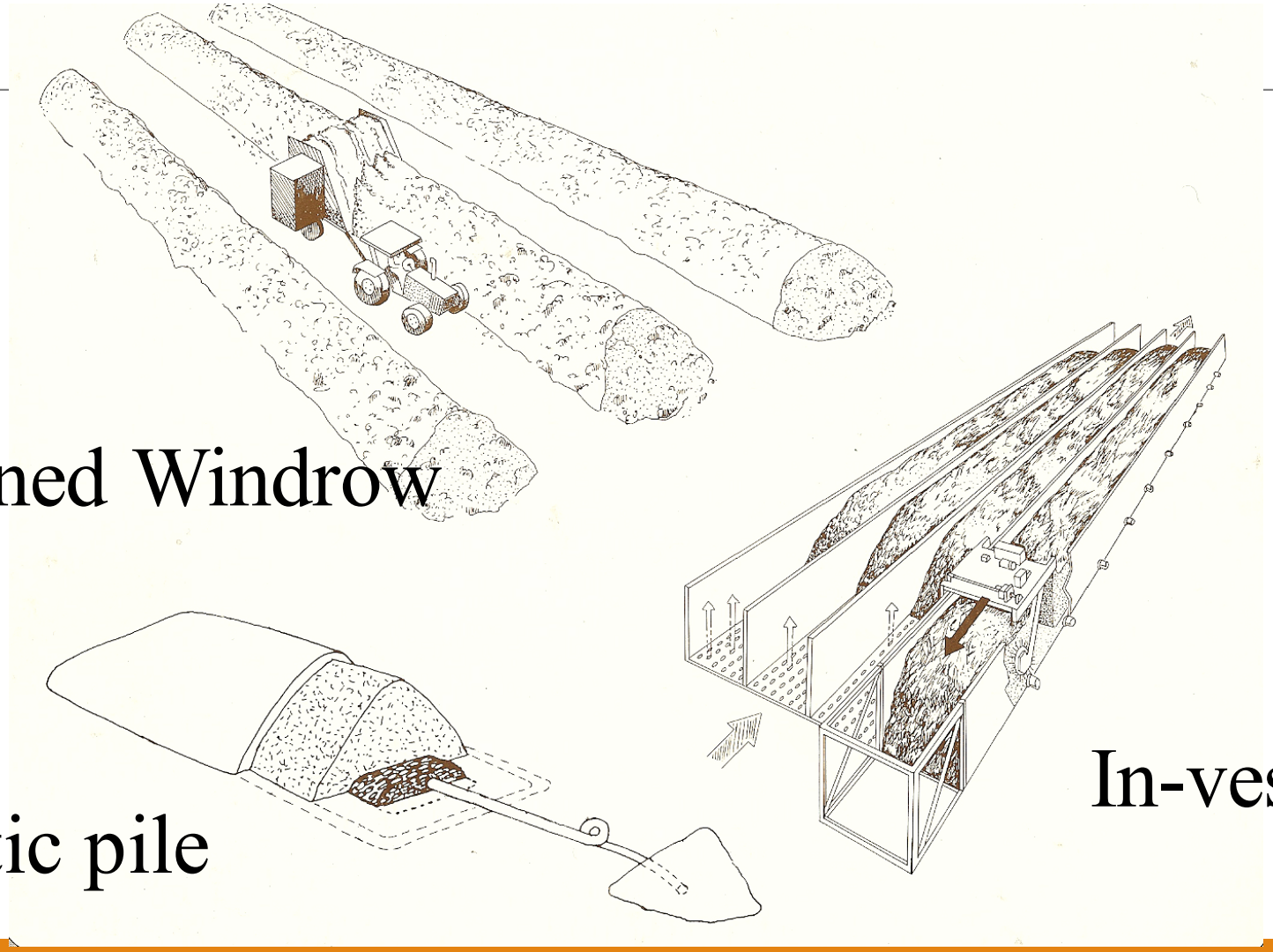
UNIVERSITY OF CALIFORNIA, RIVERSIDE

Backyard Composting

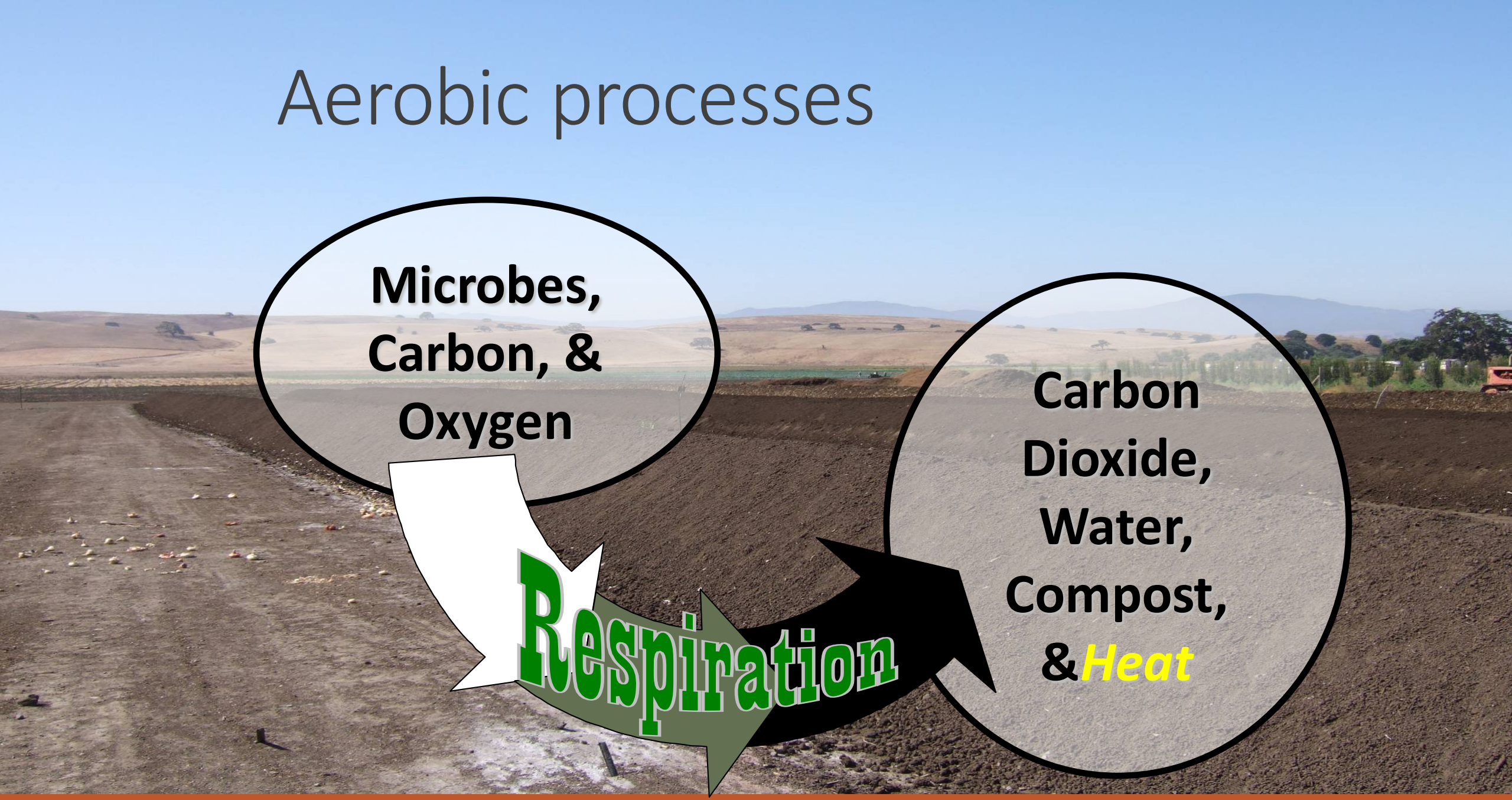


Thermophilic composting

Composting alternatives



Aerobic processes



Why compost?

- **To eliminate disease organisms**
  - ***Animal • Plant • Human***
- **To produce a stable and safe soil amendment**
  - ***Nutrients • Odors • Phytotoxins***

Thermophilic composting

Microbes tend to specialize in the temperatures they prefer.

In California soils and in our bodies mesophiles are most abundant. Pathogens are mesophiles.

Between 110°F and 155°F, thermophiles dominate.

Above about 160°F dieoff begins.

Reliable pathogen kill occurs above 131°F.

Heat greatly accelerates microbial efficiency.


25x
HOT!!

Composting is a biosecurity measure for

- ✪ plants
- ✪ animals &
- ✪ humans


Carbon is the energy source for microbes
C

Nitrogen is the critical nutrient for microbes

N


Water is the habitat where microbes live and grow.
H_2O

Oxygen

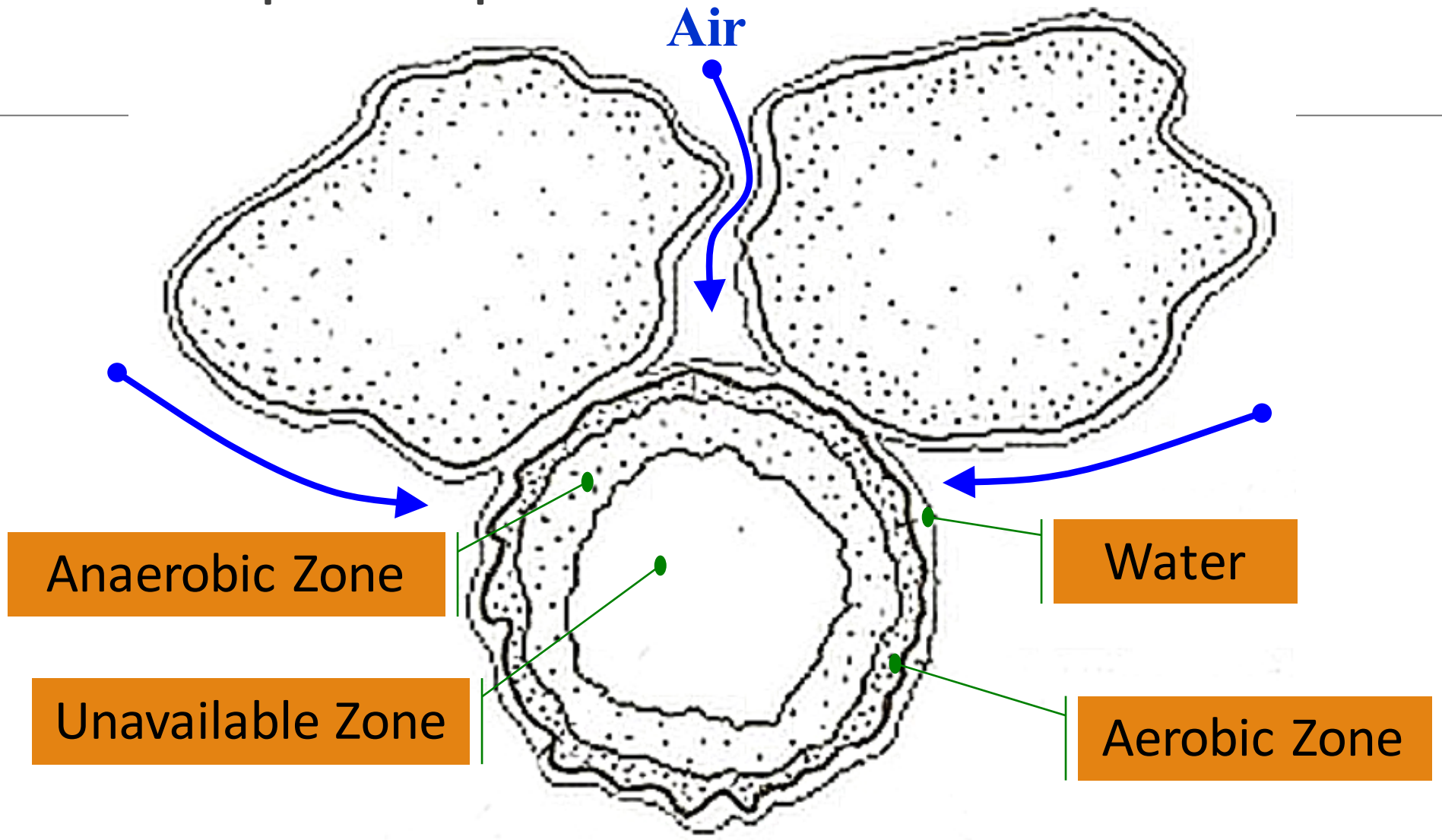
O_2

Acts as an electron acceptor

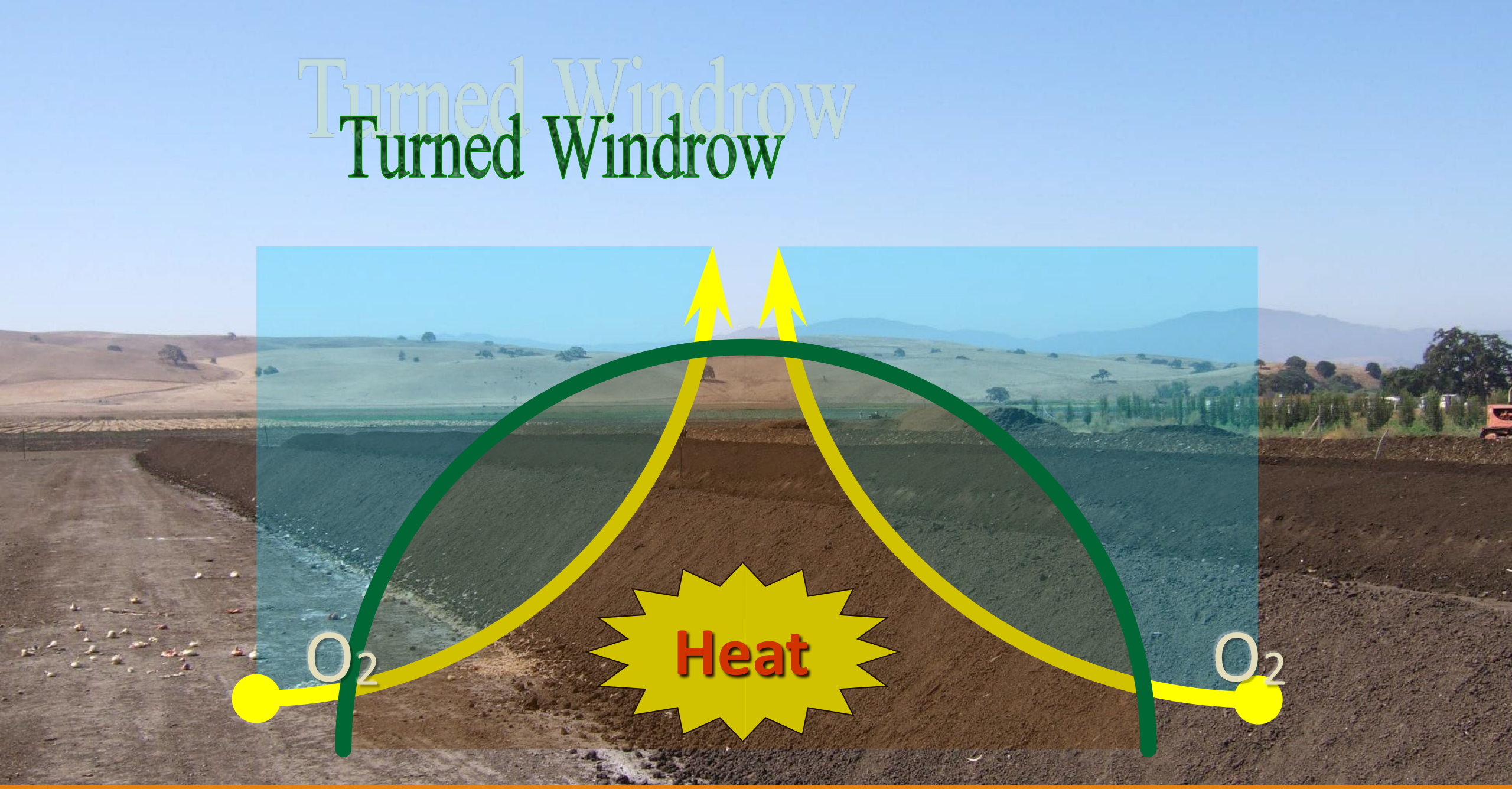
Permits efficient liberation of *energy* from carbon

Energy is used by microbes to grow and reproduce

Compost particle environment



Turned Windrow



Two Phases of Composting

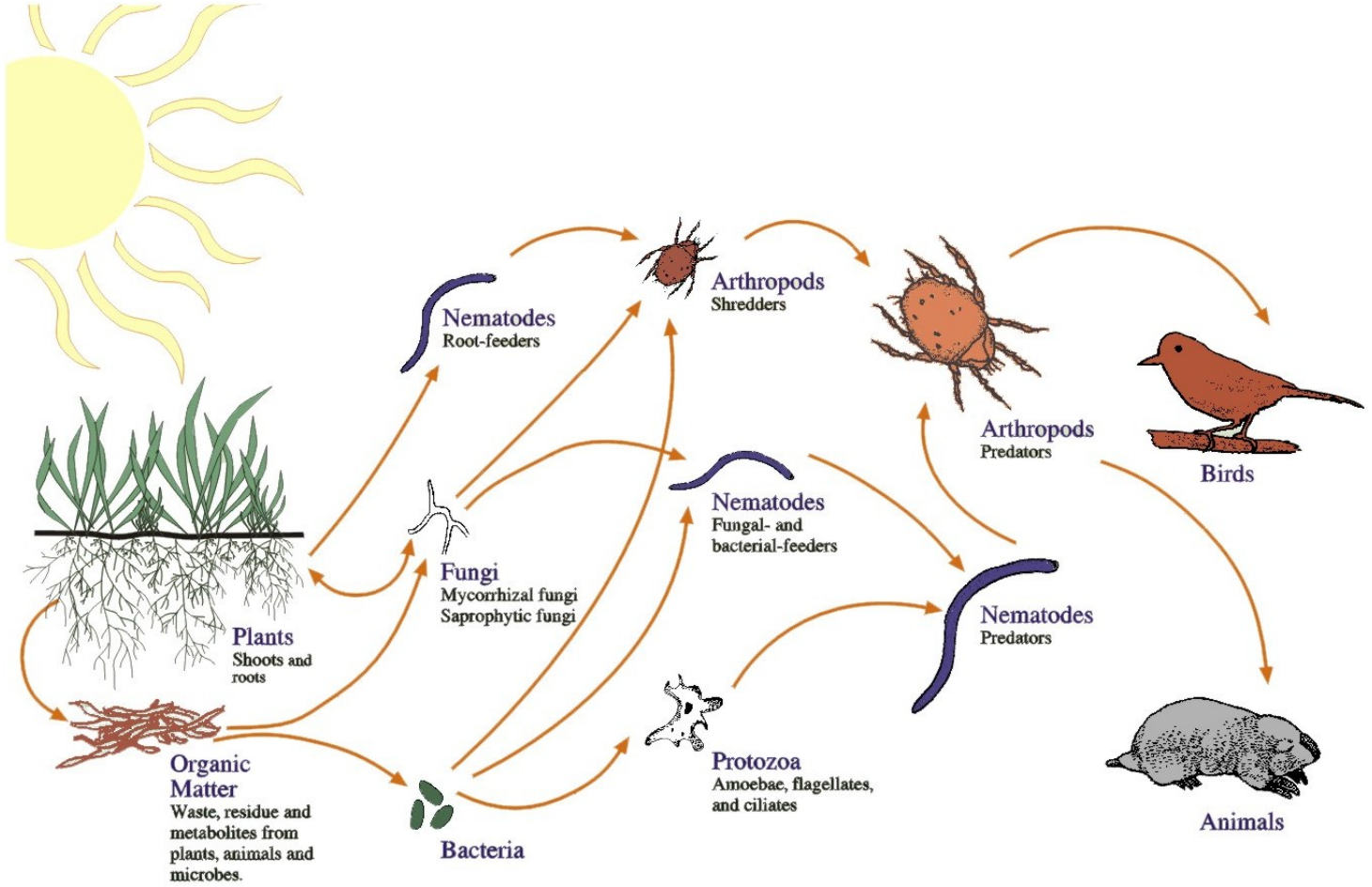
Active phases (Oxygen is typically supplied)

- Mesophilic phase (10°C - 40°C)
  - Biological activity begins
  - Hours to days
- Thermophilic phase (40°C - 65°C)
  - Decay really takes off
  - Weeds and pathogens are destroyed
  - Byproducts of incomplete decay remain which are
    - Phytotoxic (*i.e.*, organic acids)
    - Odiferous (*i.e.*, amines)
  - Takes days to weeks

Curing phase

- Oxygen is not supplied
- Byproducts of the active phase are decayed, reducing odors and phytotoxins
- Takes weeks to months
- After curing it is ready to USE!

Soil Improvement Using Compost


Nematodes
Root-feeders
Arthropods
Shredders
Arthropods
Predators
Birds
Fungi
Mycorrhizal fungi
Saprophytic fungi
Nematodes
Fungal- and
bacterial-feeders
Plants
Shoots and
roots
Nematodes
Predators
Organic
Matter
Waste, residue and
metabolites from
plants, animals and
microbes.
Protozoa
Amoebae, flagellates,
and ciliates
Bacteria
Animals

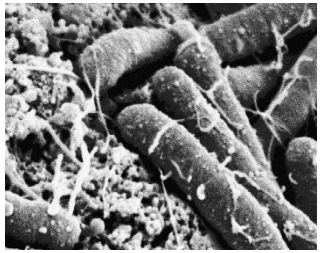
Soil fauna

Compost in soil

Encourages the formation of soil aggregates

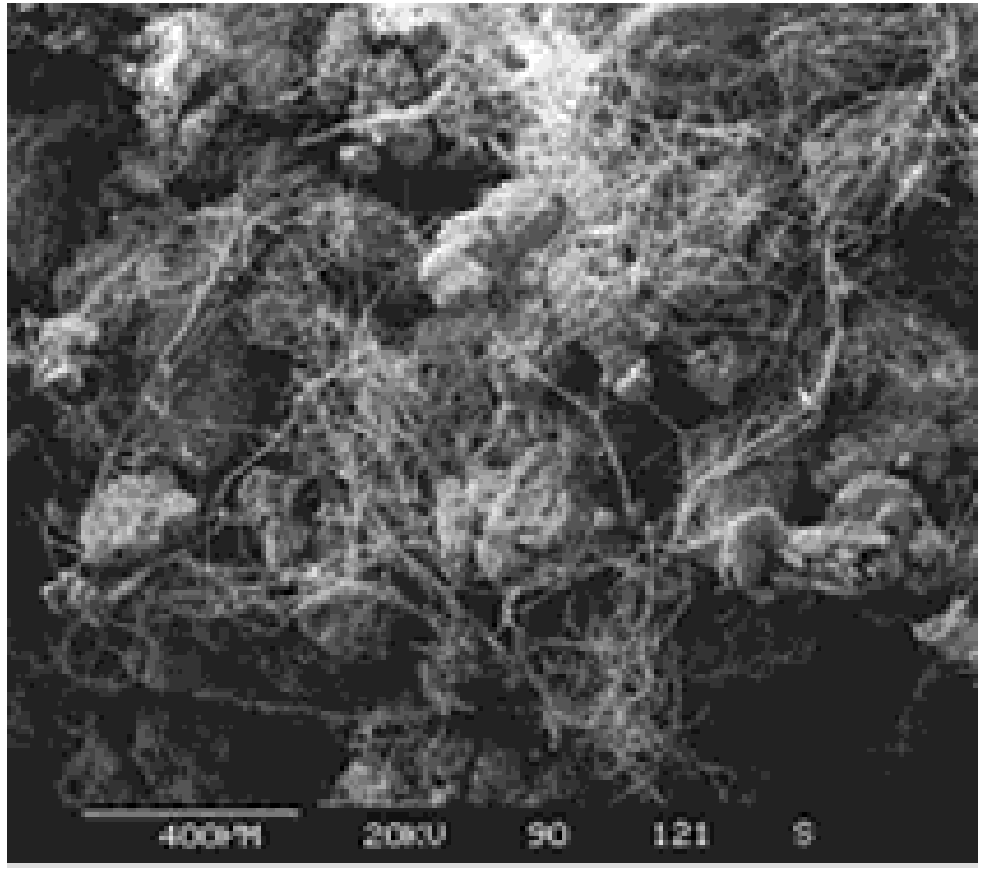
Aggregates are soil clusters held together as a result of compost decomposition

- Fungal hyphae bind particles together
- Bacterial polysaccharides serve as glue



fungi

bacteria



Aggregates

Soils formed from aggregates are said to have “good structure”

Aggregated soils

- Hold water while allowing air to penetrate
- Facilitate drainage and salt removal
- Allow roots to penetrate
- Are more stable, resisting erosion

Soil amendments: modify soil properties

Improve	Improve tilth
Improve	Improve water holding capacity
Improve	Improve aeration
Improve	Improve infiltration capacity
Adjust	Adjust pH
Promote	Promote microbial activity and diversity

Mulches

- *Anything* that covers the soil to conserve water and control weeds is a mulch.
- *Compost* used as a mulch is therefore a mulch.
- *Uncomposted mulches* are more likely to contain weed seeds and plant or other pathogens and are less stable.

Mulches: Compost Particle Sizes Matter

Large Particles

- Allows water to reach the root zone
- Suppress weeds
- Decompose slowly for long life

Small Particles

- Holds water that then evaporates
- Can grow weeds
- Decompose more quickly

"Overs" great for mulches

"Fines" best for soil amendments

Uncomposted mulches are more likely to contain weed seeds and pathogens

Mulches: cover the soil

Protect	Protect soils against erosion
Conserve	Conserve water by slowing evaporation
Control	Control weeds
Control	Control certain plant diseases
Decorate	Decorate landscapes

Mulches: cover the soil

HIGHER C:N RATIOS

LARGER PARTICLES SIZES

LOW TRASH LEVELS

MATURITY LESS IMPORTANT

Fertilizer value: slow release

Compost nutrient content is usually not available immediately

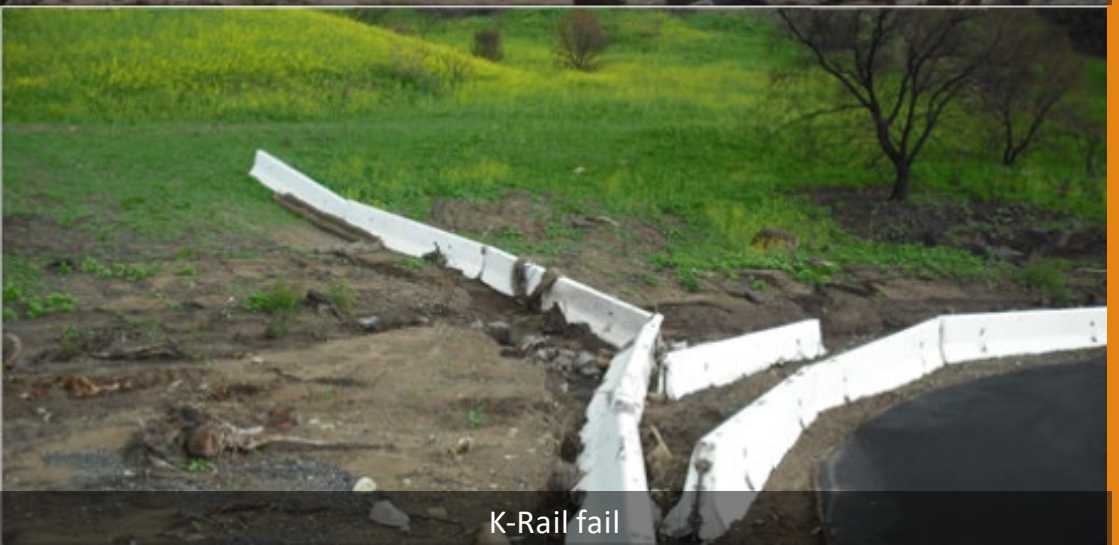
Important in long-term nutrient budgeting

Low C:N ratios are better fertilizers

Using Compost to Improve Post-fire Water Quality

DAVID CROHN
UNIVERSITY OF CALIFORNIA, RIVERSIDE

Adjacent slopes in Temecula, CA



K-Rail fail

Compost controls erosion better than structures

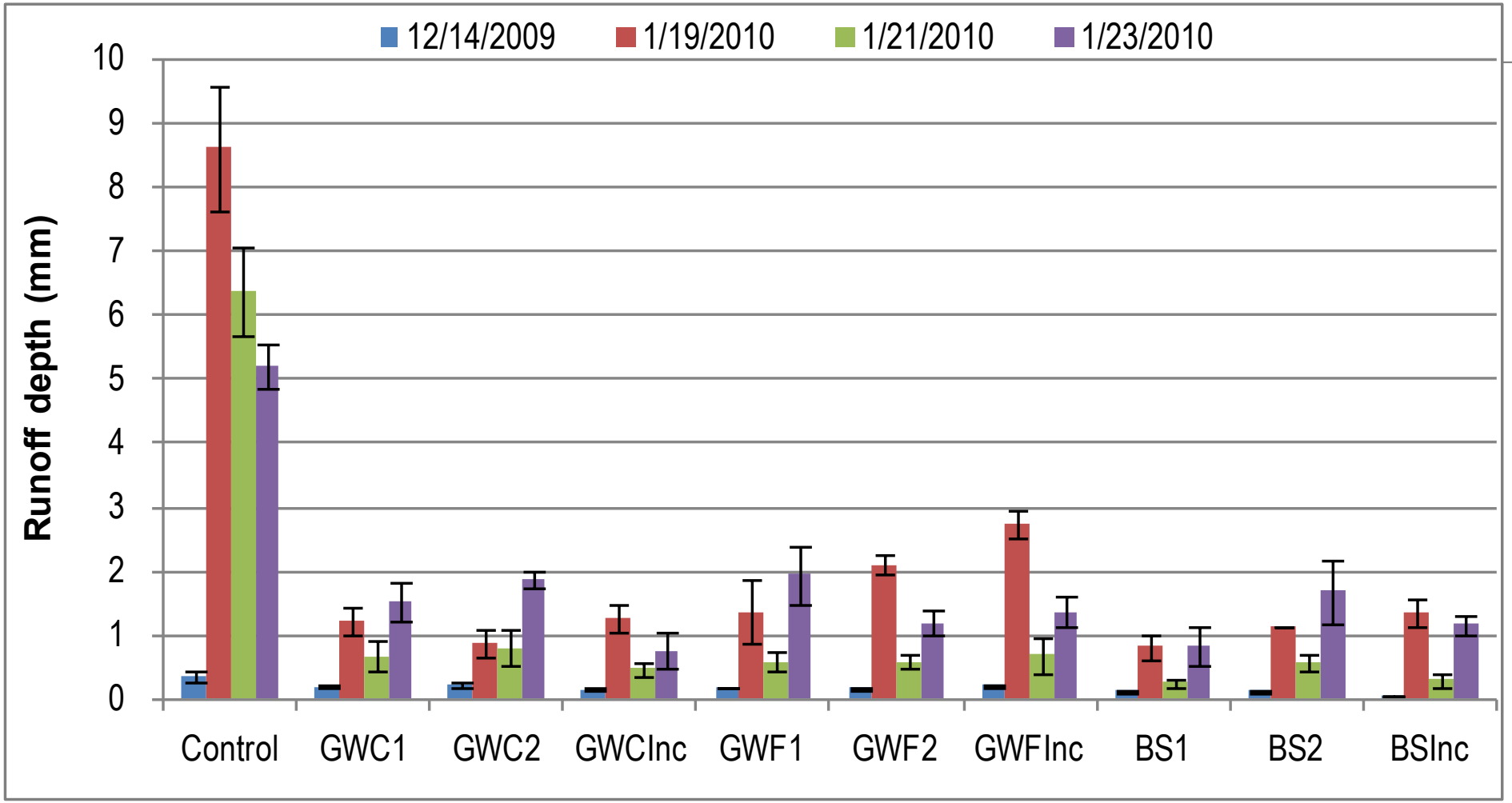
Controlled burn Nov. 2009

Installed Slope followed by Winter Rains

TREATMENTS: *Biosolids Compost fines, Greenwaste Compost (fines & overs)*

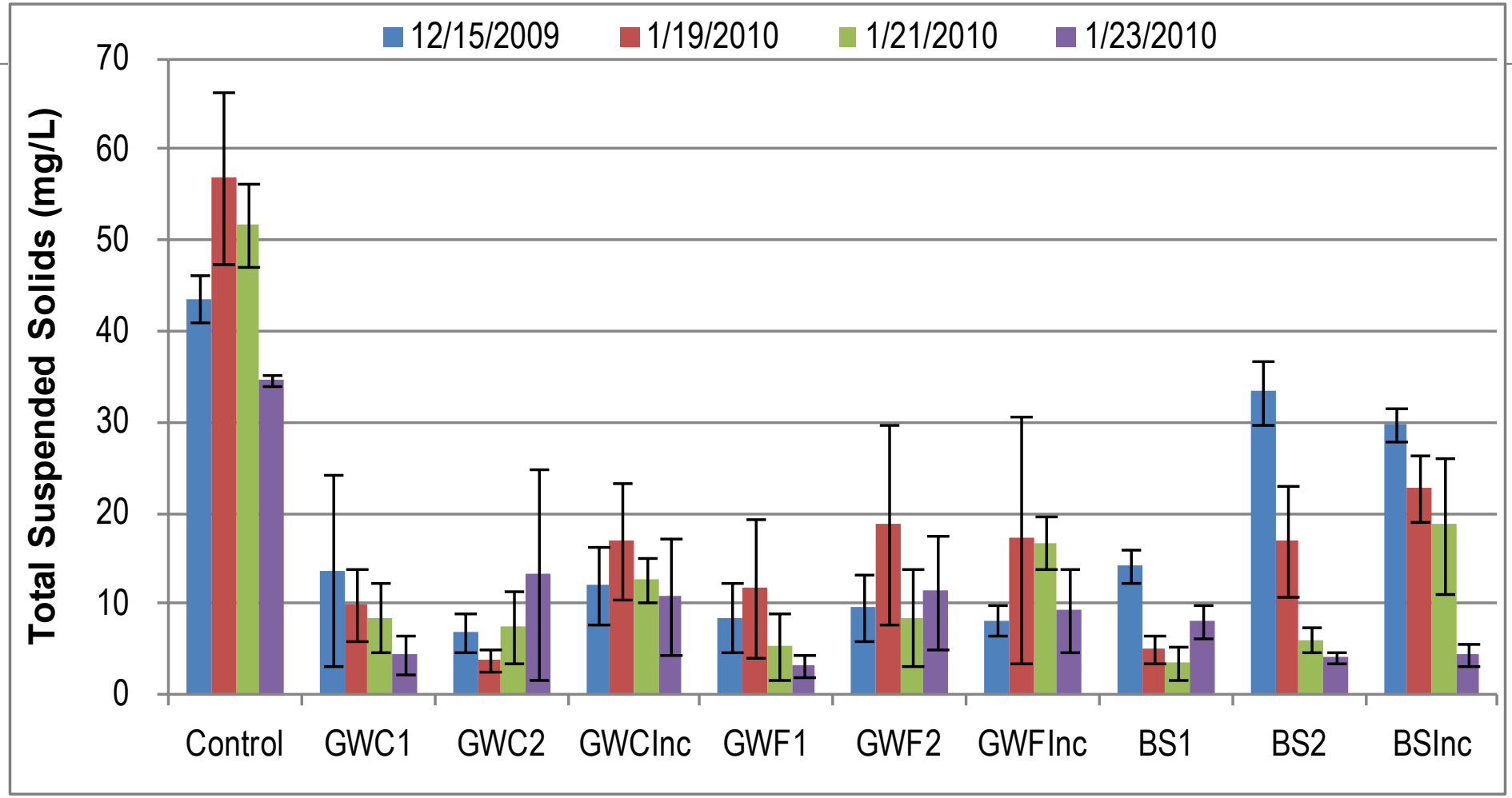
APPLIED: *1” deep, 2” deep, 2” deep incorporated, Control*

Total Runoff Depths (mm)



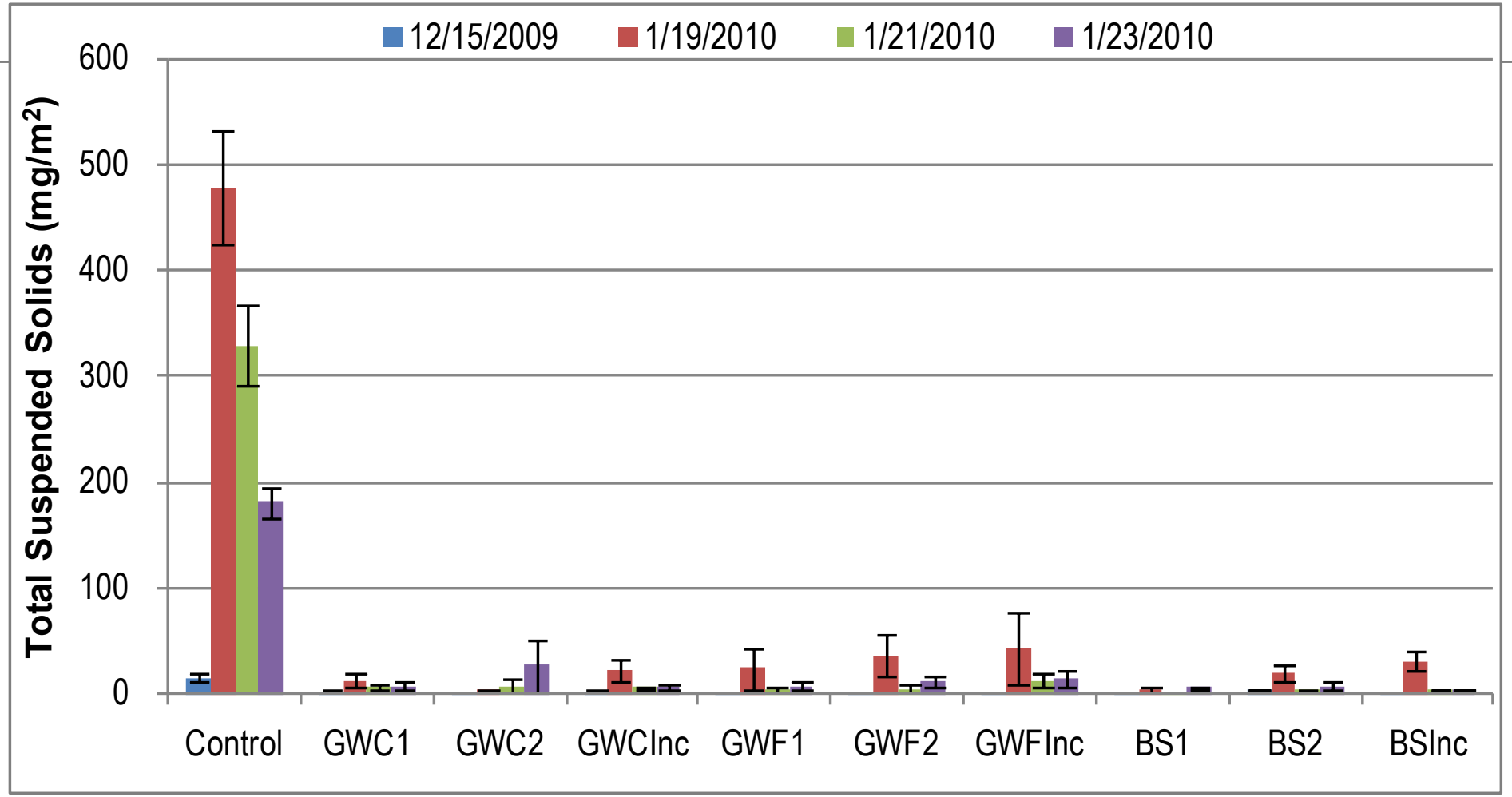
Total Suspended Solids

Concentration



Total Suspended Solids

Exported Mass



Post-Fire Conclusions

Compost blankets reduced

- Runoff by 86%
- Total dissolved solids (TDS) by 88%
- Total suspended solids (TSS) by 96%
- Total solids (TS) by 97%
- Total dissolve phosphorus (TDP) by 72%
- Orthophosphate (OP) 77%
- Suspended phosphorus (SP) 98%
- Nitrate (73%)

Surface mulching and incorporation performed similarly

Applying 2" offered no benefits over 1", and increased some pollutant losses

Results similar for greenwaste compost “overs” (>3/8") and “fines” (<3/8")

Summary

Composting stabilizes organics so that

- Plant and human diseases are eliminated
- Weeds are reduced

Composts inspire microbes to improve soil structures so that

- Soils both hold and transmit water
- Nutrients are retained
- Plants do better

Compost mulches can control the erosion that follows fires or road construction/maintence

Environmental Benefits of Compost for Erosion Control

Caltrans Landscape Architecture Department

Environmental Benefits of Compost

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1. Build healthy soils

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2. Establishes vegetation

Environmental Benefits of Compost

1. Build healthy soils
2. Establishes vegetation
3. Protects water quality

Characteristics of Compost

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4. High-water holding capacity slows down and disperses the energy of sheet flow.

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2. Provides optimum vegetation growth.

3. Protects the soil surface from splash erosion.

4. High-water holding capacity slows down and disperses the energy of sheet flow.

5. Natural bio-filtration characteristics.

Erosion Control Applications

Existing Site Condition

Compost Blanket

(Slope Stabilization & Vegetation Establishment)

Compost Blanket

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Compost Blanket
(Slope Stabilization & Vegetation Establishment)

Compost Berms
(Linear Sediment Barriers)

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(Linear Sediment Barriers)

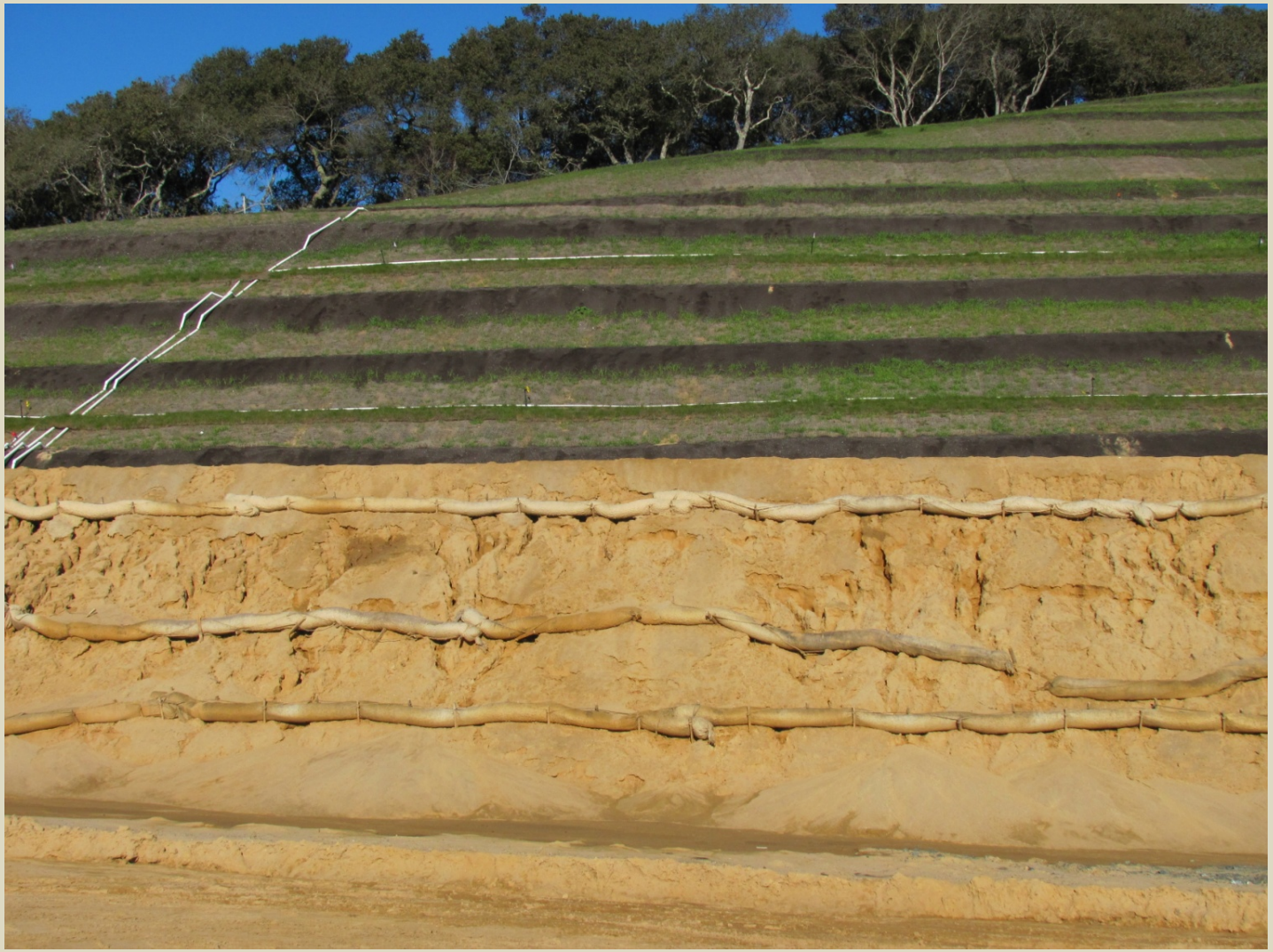
Compost Socks
(Linear Sediment Barriers)

Erosion Control Performance Comparisons

(Bonded Fiber Matrix and Fiber Rolls)

Erosion Control Performance Comparisons

(Compost Blanket vs. BFM and Fiber Rolls)



Erosion Control Performance Comparisons

(BFM with and without Compost)

Compost Blanket
(Concentrated Flows)

Compost Blanket
(Steep Slope and Windy Applications)

Compost Blanket
(Steep Slope and Windy Applications)

Site Restoration
(Coastal Prairie Grassland)

Before

Site Restoration
(Coastal Prairie Grassland)

After Compost Incorporation

Site Restoration

(Coastal Prairie Grassland)

Two Years Later

Site Restoration

(Coastal Prairie Grassland)

Before

After

Invasive Weed Suppression

(Compost vs. Herbicide)

Compost

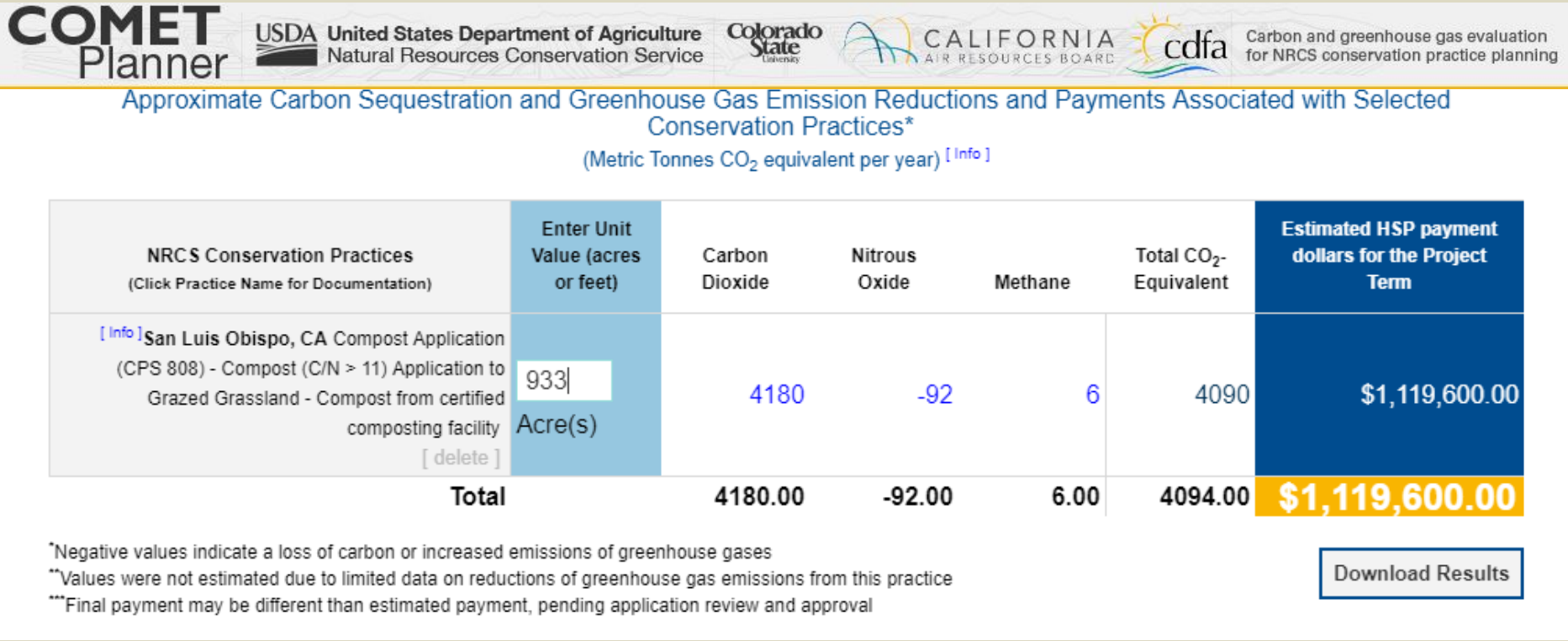
Herbicide

Invasive Weed Suppression

(Compost vs. Herbicide)

Biofiltration
(Compost Incorporation)

Carbon Sequestration



http://comet-planner-cdfahsp.com/

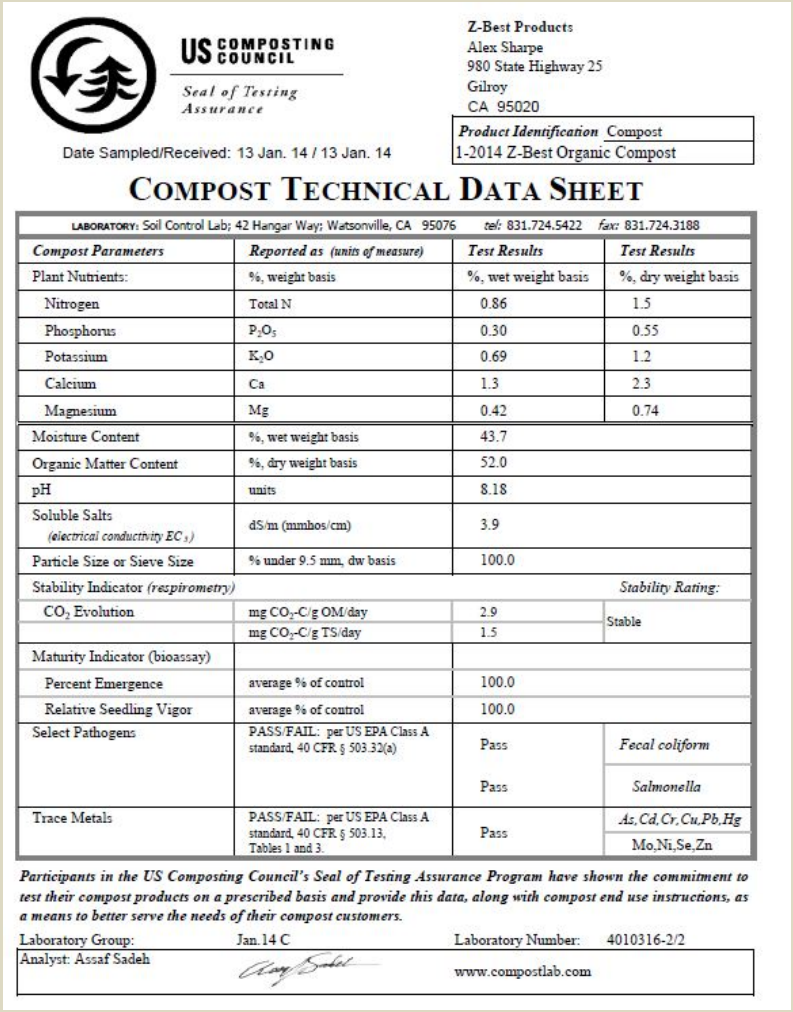
Particle Size Specification

Property	Test method [a]	Requirement	
Particle size: **Fine Compost** For soil amendment and 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%	--
	Maximum particle length: 3 inches		
Particle size: **Medium Compost** For soil protection and native plant establishment.	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 50% retained)	50%	75%
	Maximum particle length: 6 inches		
Particle size: **Coarse Compost** For filter sock and berm applications.	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 70% retained)	--	30%
	Maximum particle length: 6 inches		

Physical Contaminants

Property	Test method [a]	Requirement
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Plastic, glass, and metal % > 4 mm fraction	combined total: < 0.5%
Physical contaminants	TMECC 02.02-C Man-made inert removal and classification: Sharps (sewing needles, straight pins and hypodermic needles) % > 4mm fraction	none detected

STA Certification



US COMPOSTING COUNCIL
Seal of Testing Assurance

Z-Best Products
Alex Sharpe
980 State Highway 25
Gilroy
CA 95020

Product Identification Compost
1-2014 Z-Best Organic Compost

Date Sampled/Received: 13 Jan. 14 / 13 Jan. 14

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	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.86	1.5
Phosphorus	P_2O_5	0.30	0.55
Potassium	K_2O	0.69	1.2
Calcium	Ca	1.3	2.3
Magnesium	Mg	0.42	0.74
Moisture Content	%, wet weight basis	43.7	
Organic Matter Content	%, dry weight basis	52.0	
pH	units	8.18	
Soluble Salts *(electrical conductivity EC_s)*	dS/m (mmhos/cm)	3.9	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	100.0	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	2.9	Stable
	mg CO_2-C/g TS/day	1.5	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	100.0	
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: Jan.14 C Laboratory Number: 4010316-2/2

Analyst: Assaf Sadeh www.compostlab.com

US Composting Council's Seal of Testing Assurance Program

Environmental Benefits of Compost on Highway Roadsides

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- Networking opportunities
- May provide a path to Standing Committee membership

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Other TRB events for you

- *July workshops:* **How We Move Matters: Exploring the Connections between New Transportation and Mobility Options and Environmental Health**

- *July 20:* **TRB Webinar: Are We All in the Same Boat? Involving Communities in Coastal Resilience**

- *July 27-28:* **Geospatial Data Acquisition Technologies in Design and Construction Summer Committee Meeting 2021**

https://www.nationalacademies.org/trb/events