Aerated Static Pile Composting
Applications and Opportunities

INTRODUCTION AND OVERVIEW

MARYLAND DEPARTMENT OF AGRICULTURE

JANUARY 26, 2019

PETER MOON, P.E. - O2COMPOST

Objective: To Convert Raw Feedstocks

Into High Quality Soil Amendments

Using the Aerated Static Pile Method

Sonoma Valley Stables, Petaluma, CA

What is Composting?

This is Not Composting

This is Composting

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This is Composting

One Definition of Composting

WA Solid Waste Handling Standards: WAC 173-350-100

"Composting" means the biological degradation and transformation of organic solid waste under controlled conditions designed to promote aerobic decomposition."

One Definition of Composting

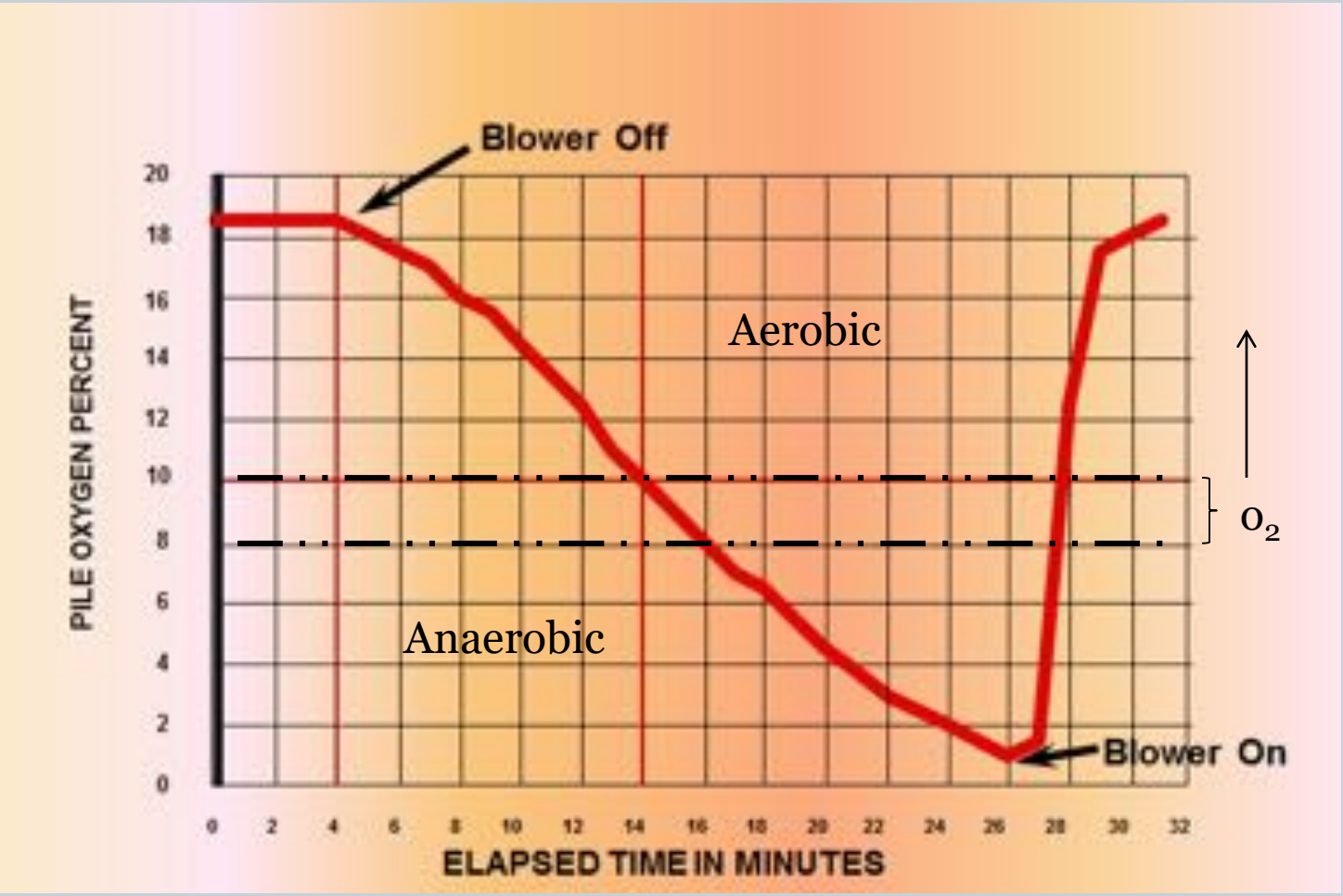
WA Solid Waste Handling Standards: WAC 173-350-100

"Natural decay of organic solid waste under uncontrolled conditions is not composting."

Front End Loader Turned Windrows

Tow Behind Windrow Turner

Oxygen Consumption with Time



Aerated Static Pile (ASP) Composting

Horse Manure w/ Shavings

ASP Composting

- First Developed in the Early 1970's – Beltsville Method
- Maintains Aerobic Conditions Throughout the Pile
- Controls Pile Temperatures by Adjusting Airflow
- Eliminates the Need to Turn the Compost Pile
- Saves Time and Reduces the Cost of Labor and Fuel

Advantages of ASP Composting?

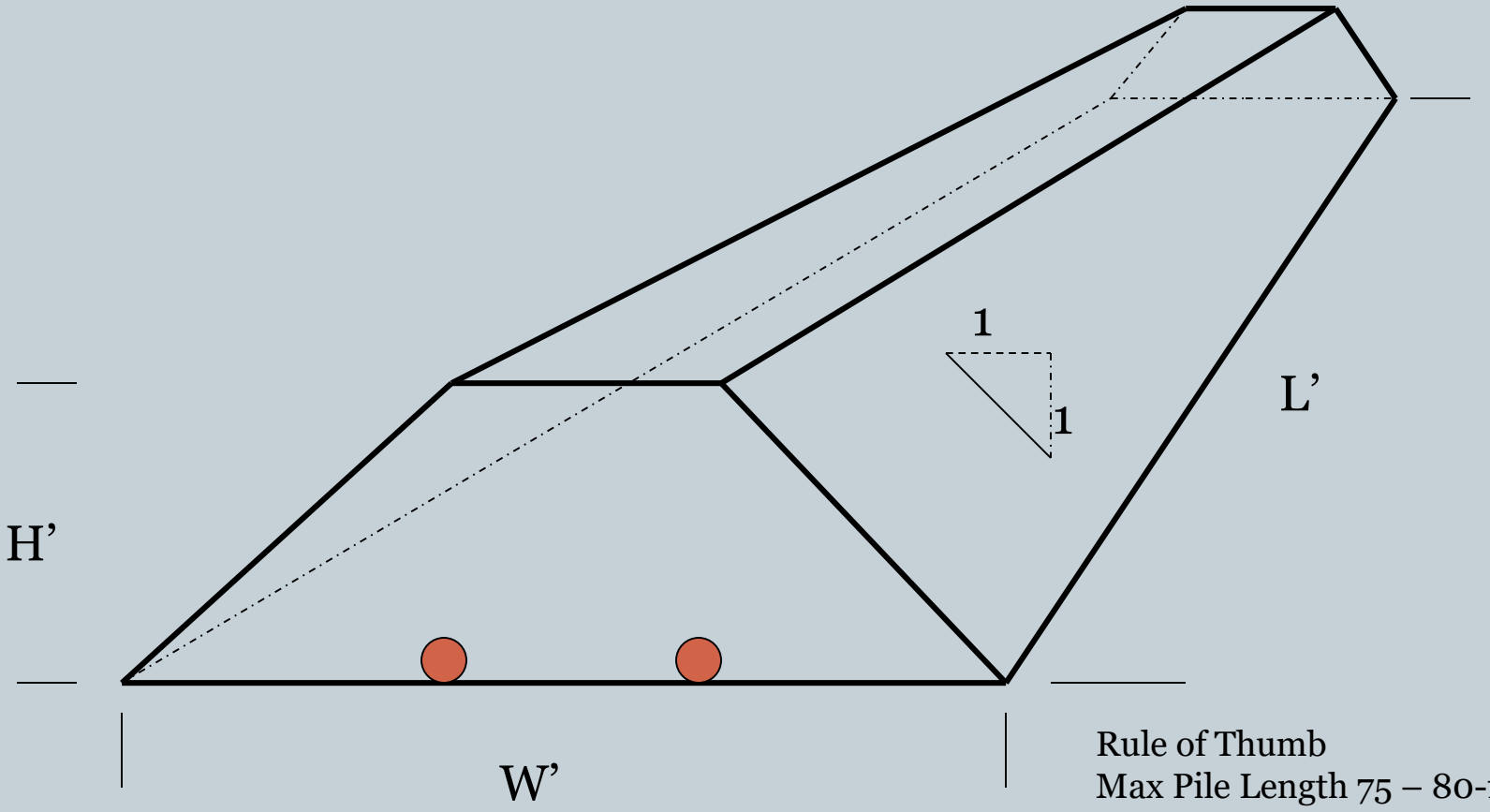
WITH ASP COMPOSTING, WE:

- Construct the compost pile over a network of aeration pipes and
- Induce airflow into the pile using an electric blower / timer
- Do not turn the pile during the first 21 – 30 days (Active Phase)
- Adjust the airflow to manage pile temperatures and optimize the biology of the composting process; and
- Operate the blower using either grid power or solar power

The Anatomy of an Aerated Static Pile

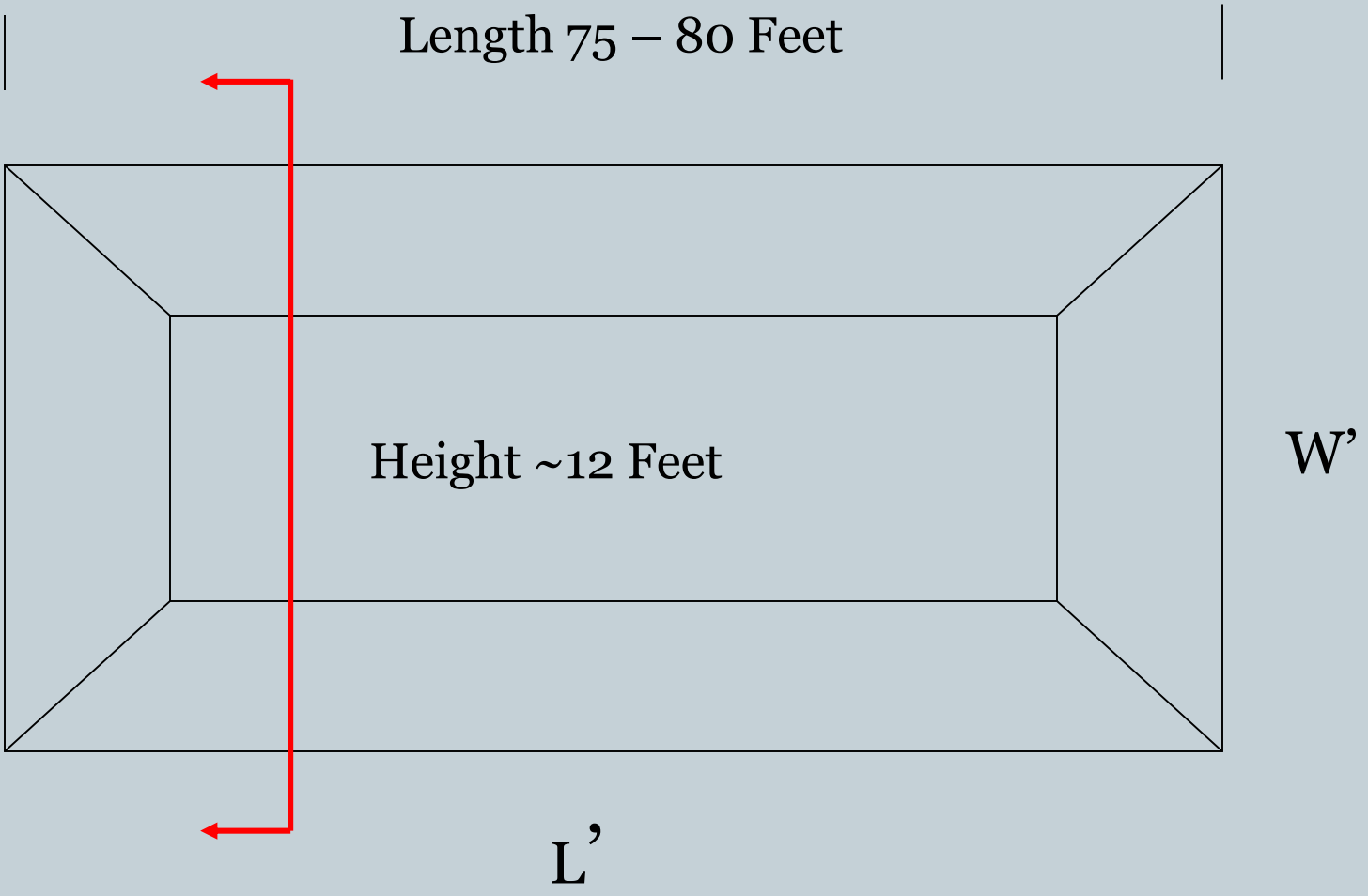
Horse Manure w/ Shavings

Isometric View - Aerated Static Pile

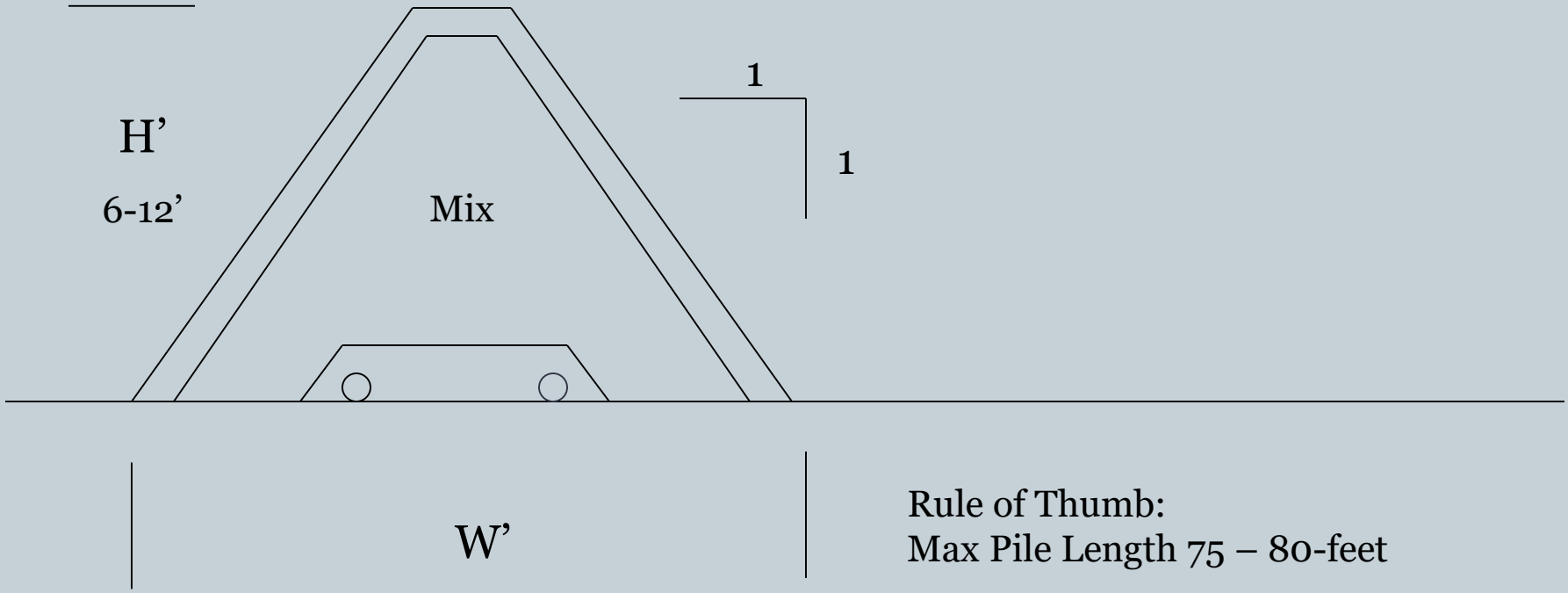


Rule of Thumb
Max Pile Length 75 – 80-feet

Plan View

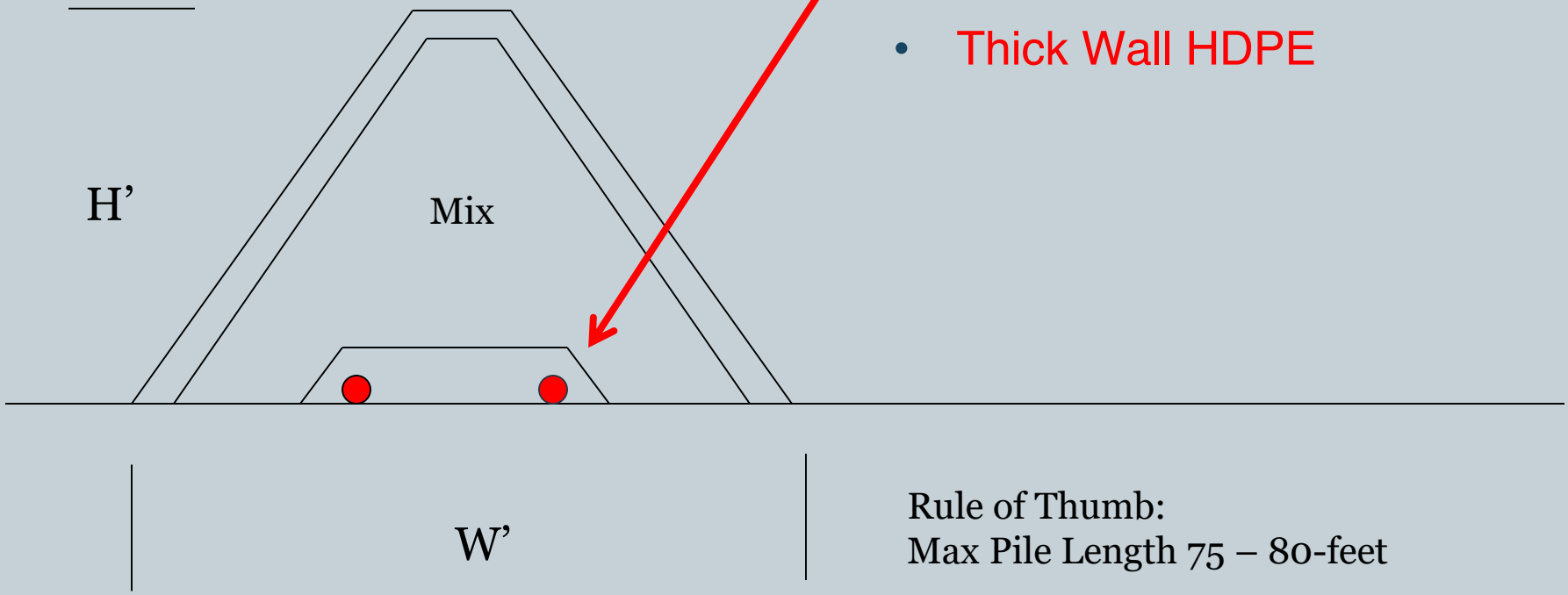


Cross Section View of an ASP



Rule of Thumb:
Max Pile Length 75 – 80-feet

Section View of an ASP



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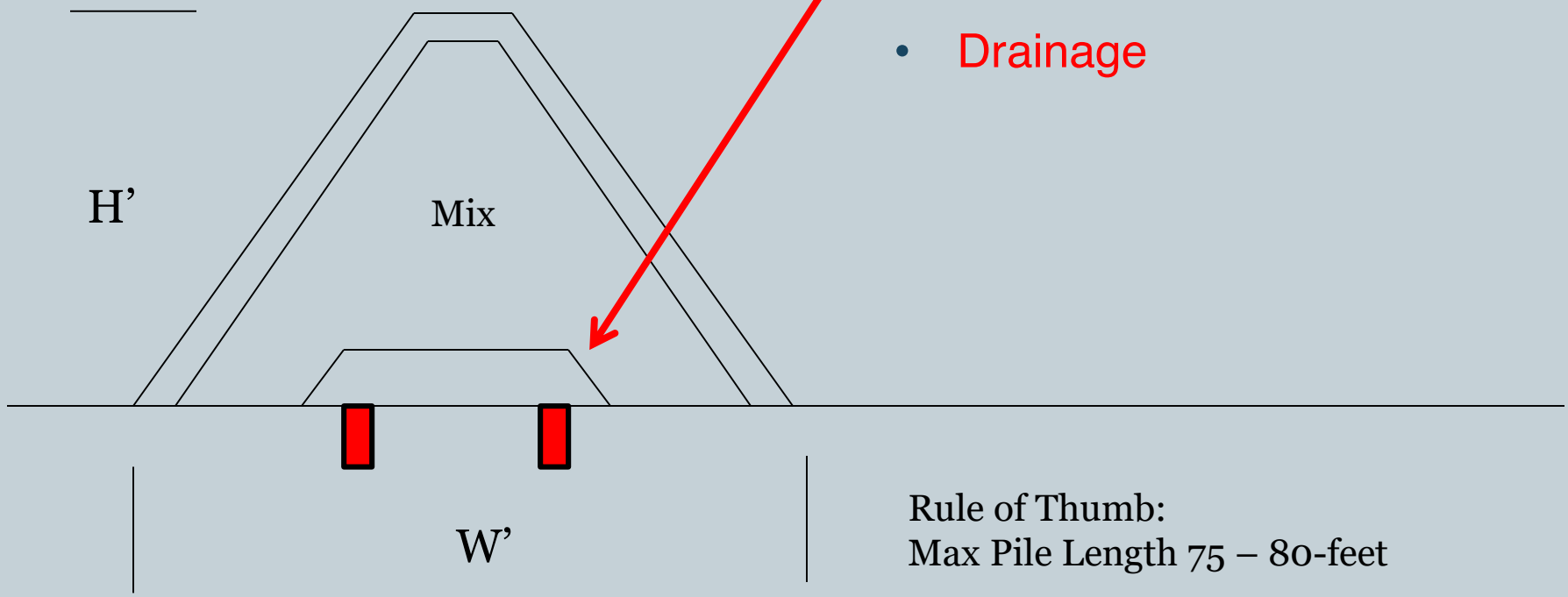
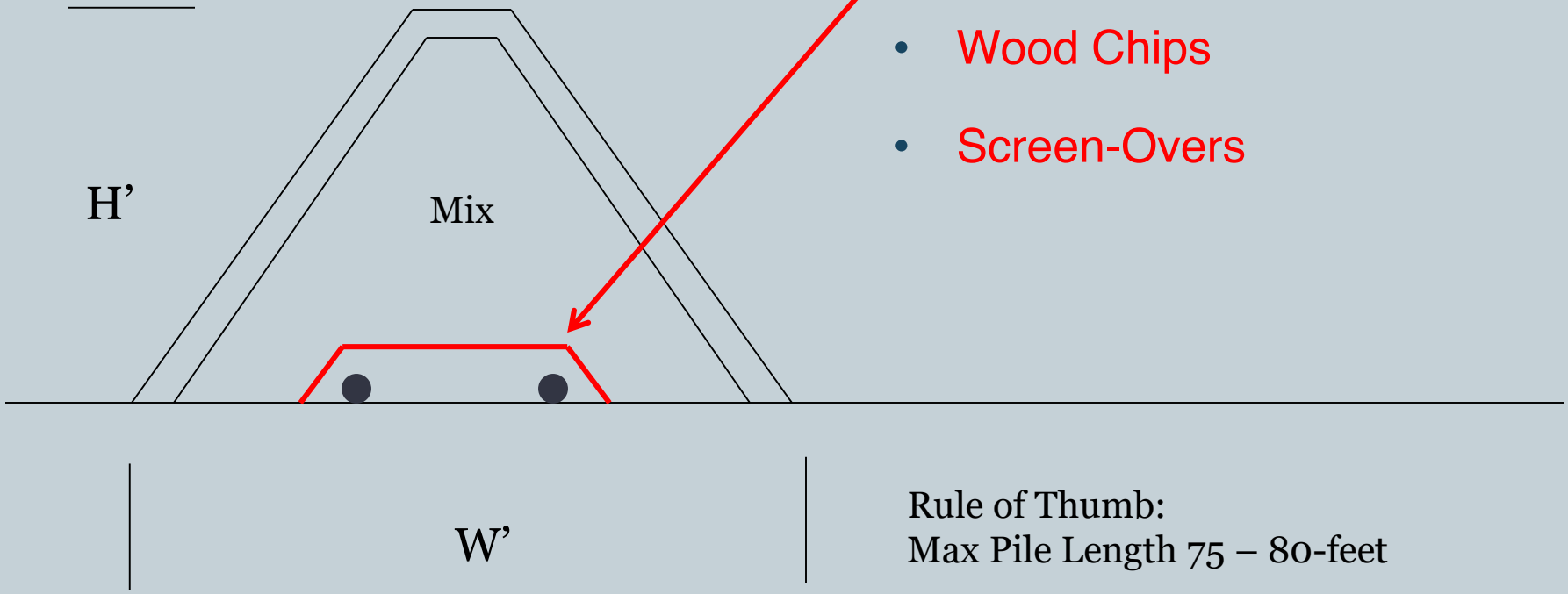


Section View of an ASP



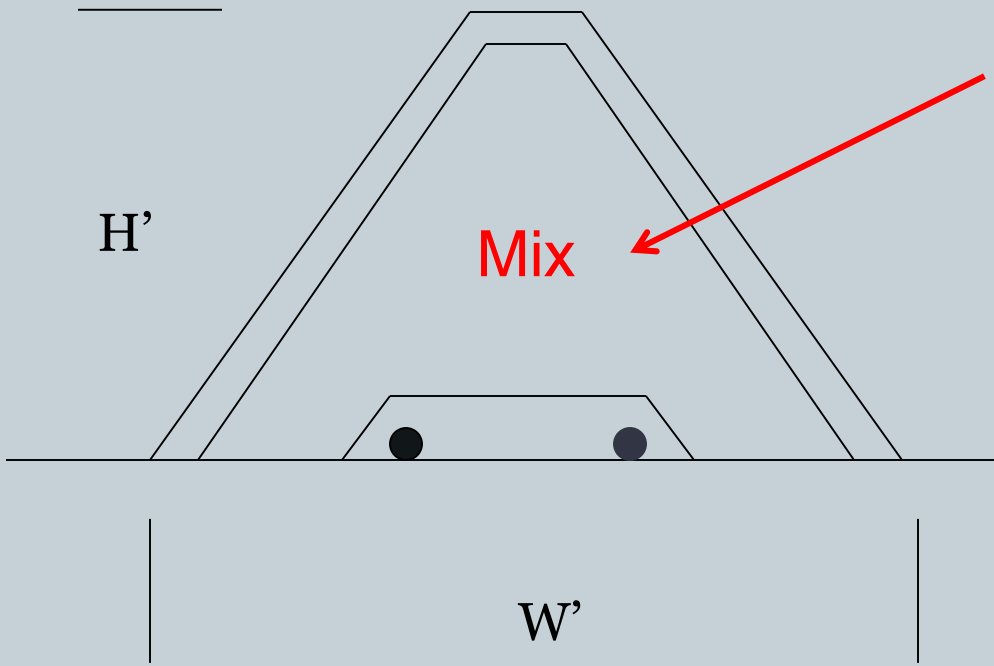
Pipes on Grade

Aeration Plenum Layer

- Wood Chips
- Screen-Overs

Rule of Thumb:
Max Pile Length 75 – 80-feet

Section View of an ASP



Pipes on Grade

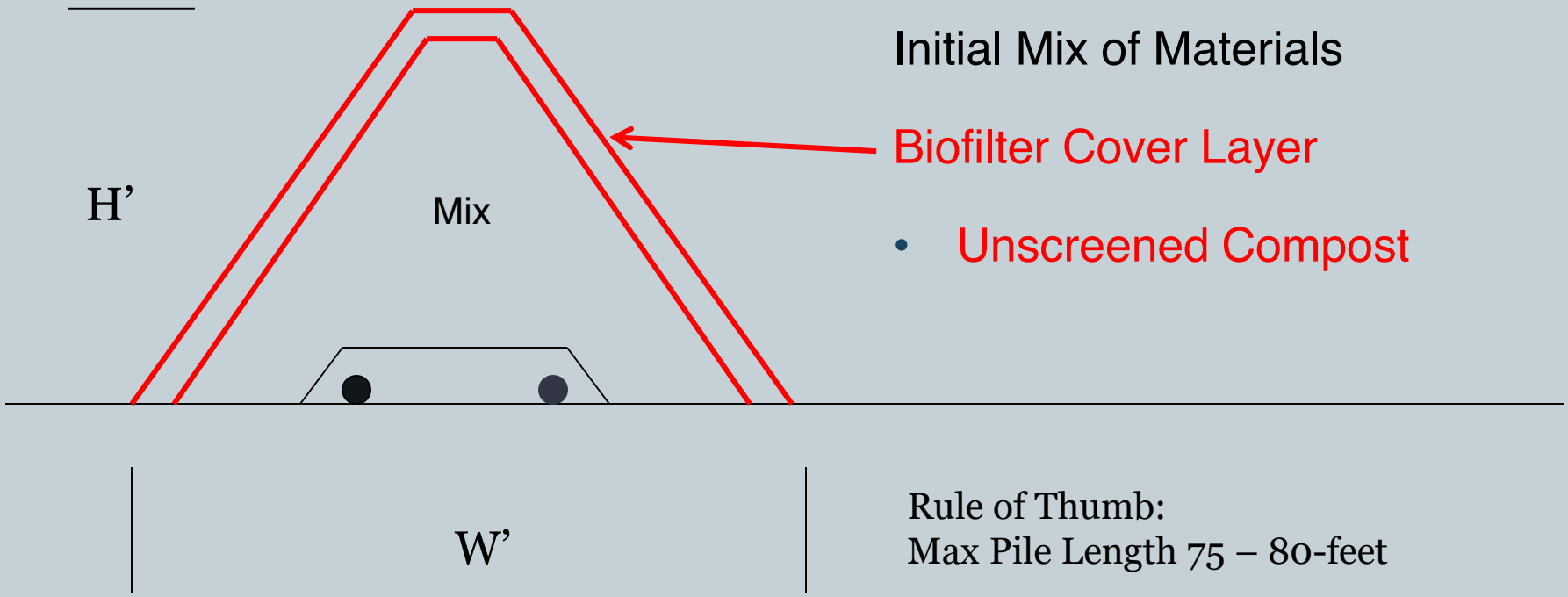
Aeration Plenum Layer

Initial Mix of Materials

- C:N Ratio
- Bulk Density
- Moisture Content

Rule of Thumb:
Max Pile Length 75 – 80-feet

Section View of an ASP



Pipes on Grade

Aeration Plenum Layer

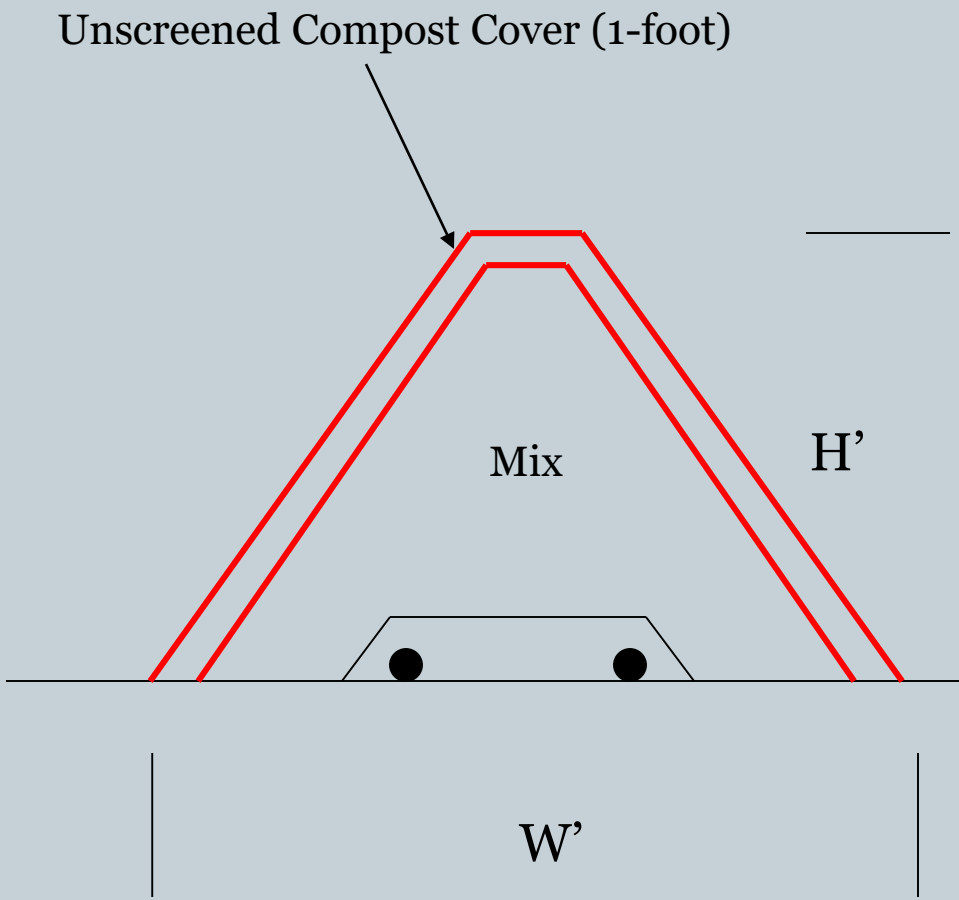
Initial Mix of Materials

Biofilter Cover Layer

- Unscreened Compost

Rule of Thumb:
Max Pile Length 75 – 80-feet

Biofilter Cover Layer



- Insulating Layer (PFRP)
- Biofiltration Layer
- Nutrient Retention
- Vector Barrier
- Moisture Retention
- Improve Aesthetics

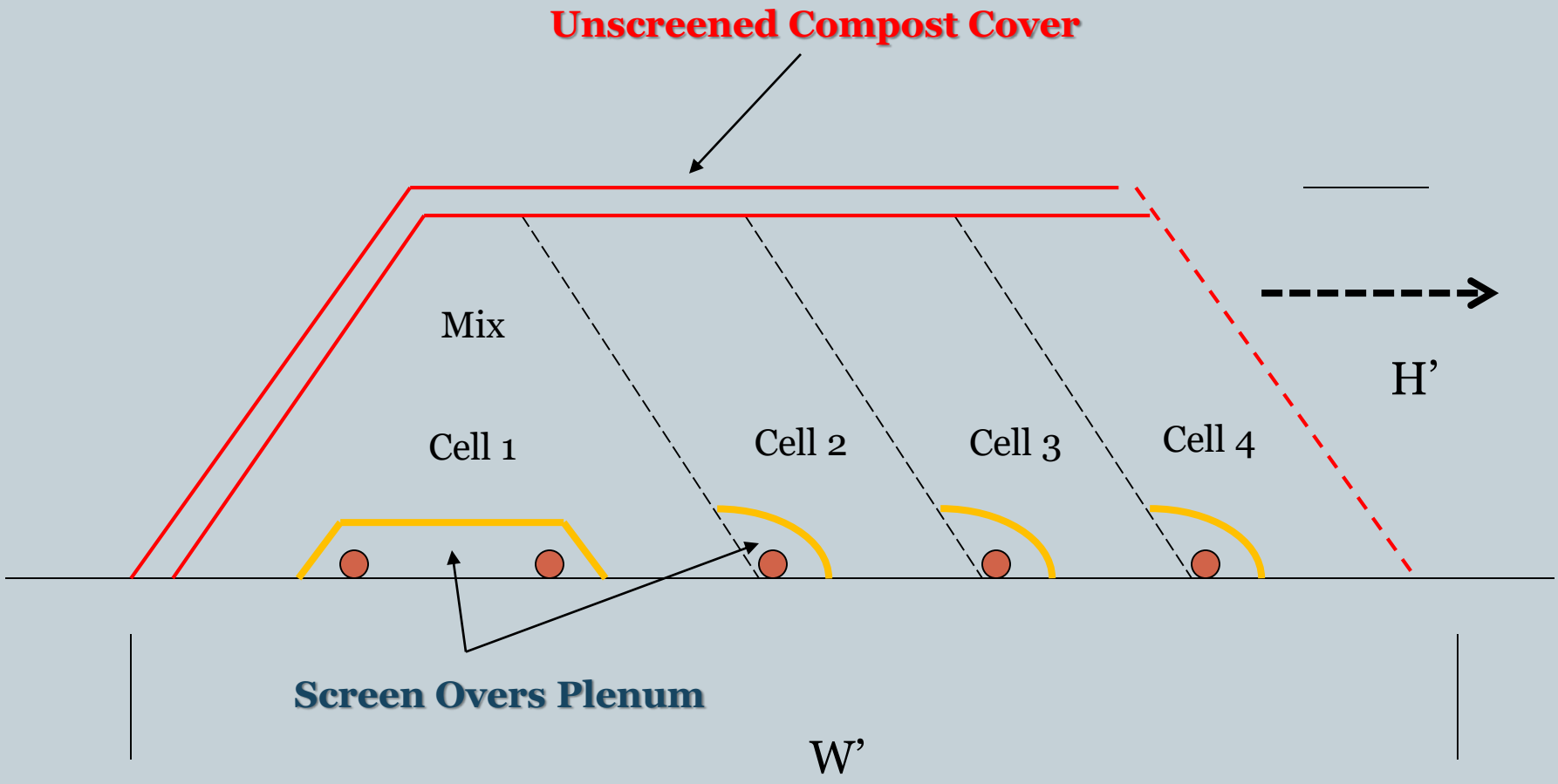
Rule of Thumb:
Max Pile Length 75 – 80-feet

Partially Constructed ASP

ASP Hands-on Workshop

Constructing an ASP in 2 Minutes or Less

Section View of an Extended ASP



Extended ASP Composting

Upper Valley Disposal Service, Rutherford, CA

The Importance of Aeration

BY INDUCING AIRFLOW INTO THE COMPOST PILE WE ARE ABLE TO:

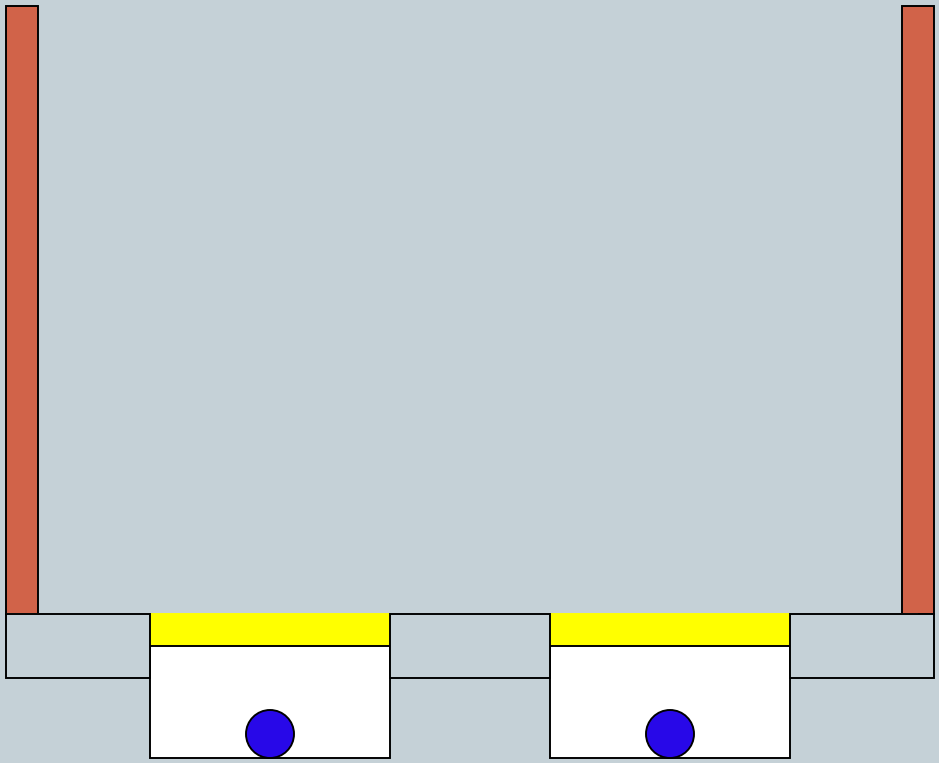
- Maintain aerobic conditions without turning the pile
- Optimize the biology of the composting process
- Manage pile temperatures
- Reduce offensive odors and neighbor complaints
- Expedite the rate of composting
- Produce a high quality compost product in less time

Top-Down Aerated Bay System

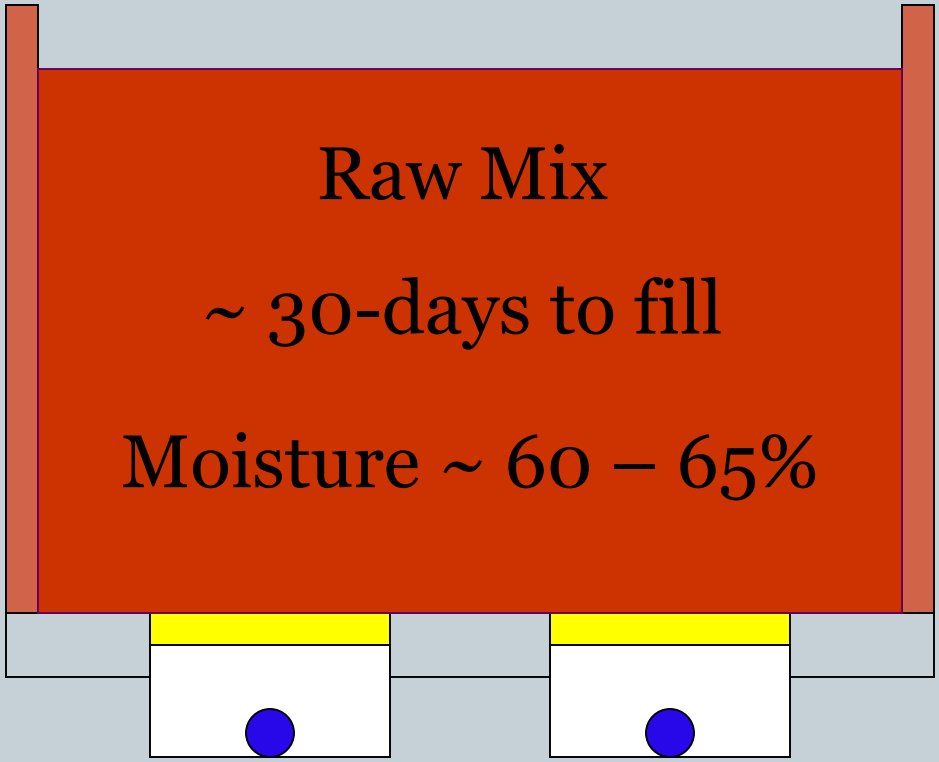
Liberty Bell Farm, Snohomish

Completed Aeration System

Cross Section of an Aerated Bin

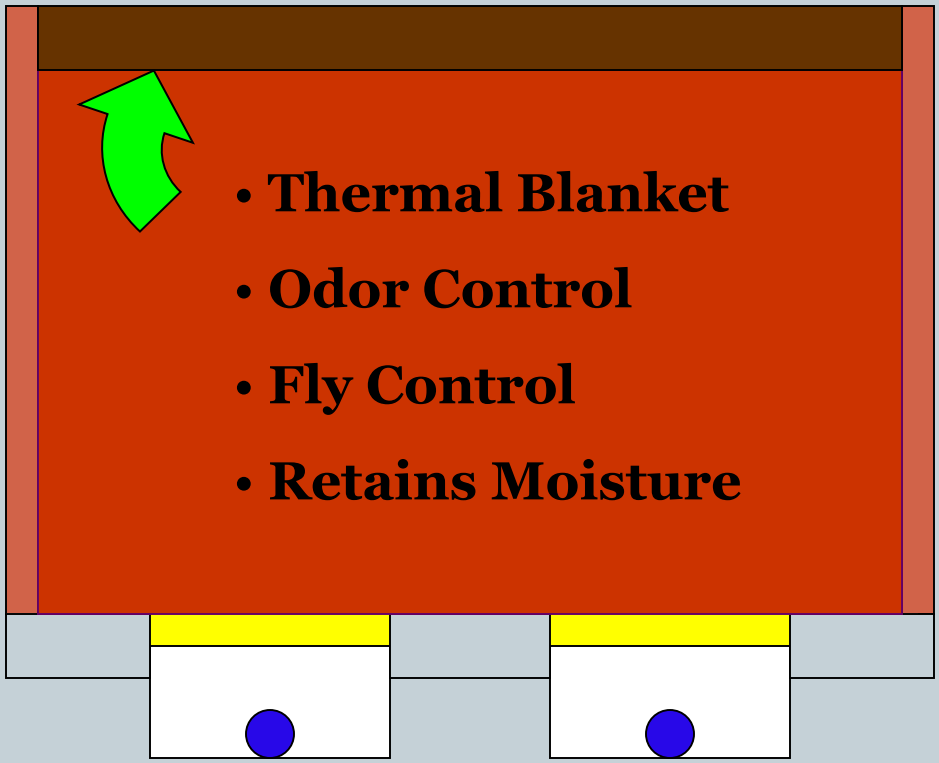


Cross Section of an Aerated Bin



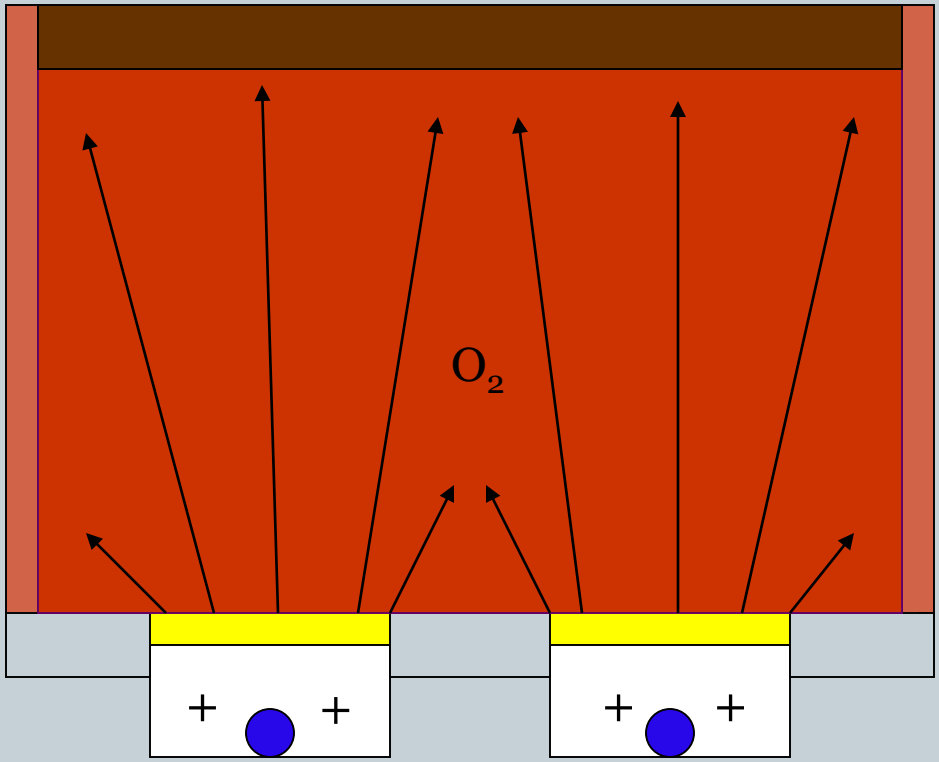
Cross Section of an Aerated Bin

Compost Cover



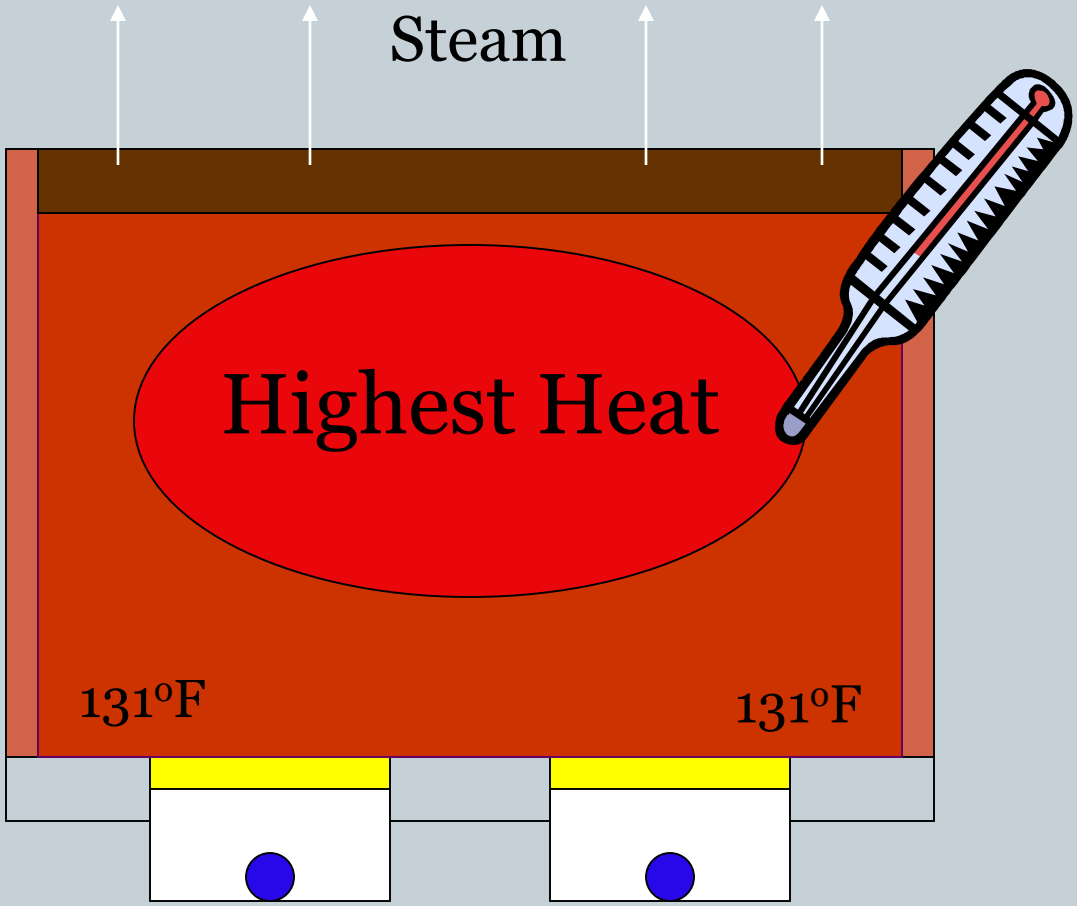
Cross Section of an Aerated Bin

Typical Aeration Cycle: 2-min ON & 30-min OFF



No Turning!

Cross Section of an Aerated Bay



Cleaning Out Wet Bedding

Removing Solid Manure

Moisture Conditioning the Mix

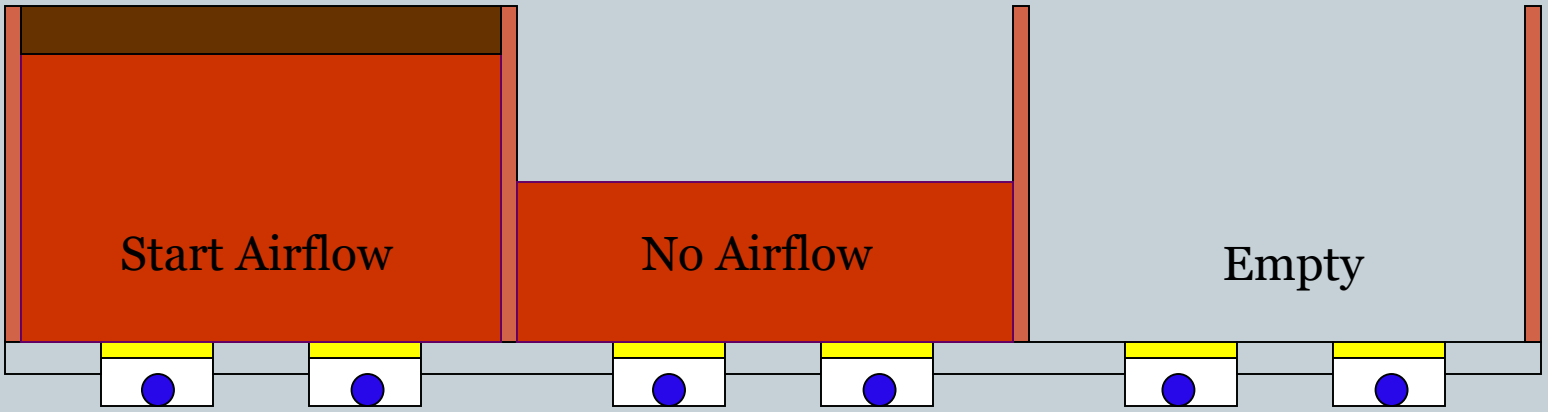
Dumping Cart into Compost System

Adding Final Cover Layer

Adding the Final Touch

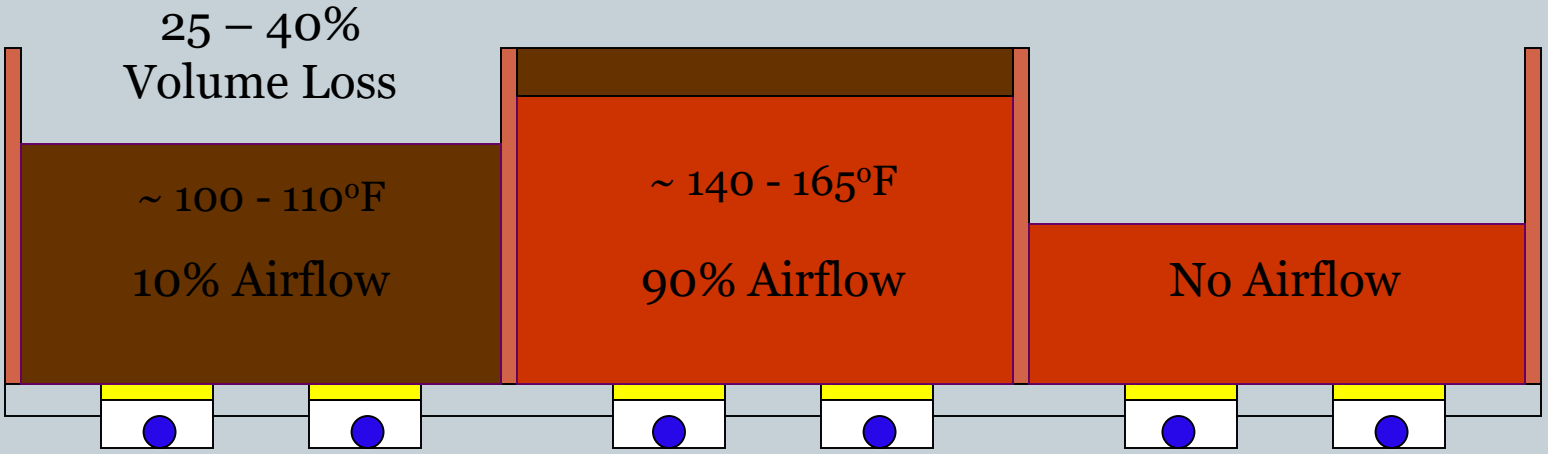
Monitoring Compost Temperatures

Cross Section of a 3-Bay System - Stage 1



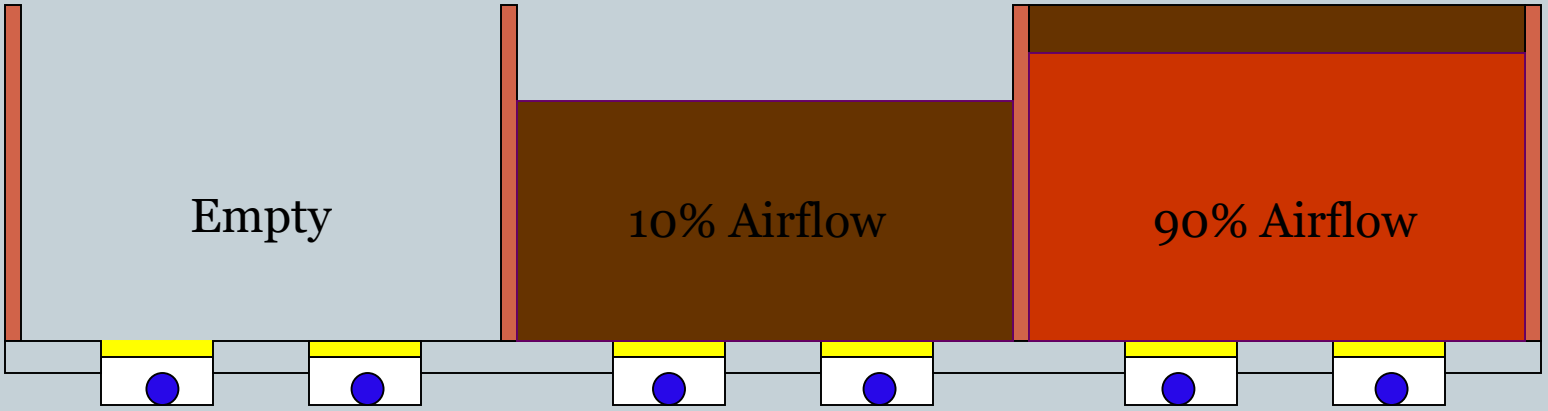
Bin #1	Bin #2	Bin #3
Active Phase	Filling	Empty

Cross Section of a 3-Bay System - Stage 2



Bin #1	Bin #2	Bin #3
Curing Phase	Active Phase	Filling

Cross Section of a 3-Bay System - Stage 3



Bin #1

Ready for Batch #4

Bin #2

Curing Phase

Bin #3

Active Phase

The Evolution of O_2Compost Systems Since 1998

O_2Compost
Compost Systems & Training

Chicken Mortality Composting

Draper Valley Farms, Mt. Vernon, WA

Chicken Mortality Composting

Draper Valley Farms, Mt. Vernon, WA

Chicken Mortality Composting

Draper Valley Farms, Mt. Vernon, WA

Prototype Compost System

O_2Compost “Research Laboratory”

On-Grade Aerated Compost Systems

Sonoma Valley Worm Farm, CA

On-Grade Aerated Compost Systems

Greenville, NC

On-Grade Aerated Compost Systems

Camden, NC

Top-Down Compost Systems

Adding Raw Manure from Above

Removing Compost from Below

Top Down 3-Bin Compost Structure

Nickerson Farm – Sterling, MA

Aerated Static Pile Composting

PART 2

VIRTUAL TOUR OF ASP COMPOST FACILITIES

O2Compost Micro-Bin System

Plywood & 2 x 6 Tongue & Groove Bins

Top Down, Sliding Lid Compost System

Low Profile, Aesthetically Pleasing

Aerated Static Bin Composting

Edwards Equestrian Center, MT

Aerated Static Bin Composting

Mohican Farm, Cooperstown, NY

Quaker Smith Point, VT

Aerated Bay Composting

Silver Oaks Stable, Long Island, NY

Aerated Block Bay System

Thacher School – Ojai, CA

Free-Standing Aerated Static Pile

Detweiler Homestead Farm, PA

Aerated Static Pile Composting

Micro-Green Farm, NJ

Extended Aerated Static Pile

Two Particular Acres – Royersford, PA

Simple On-Grade Pipe System

Bailey Compost, WA

Large Aerated Bay Composting

Lenz Enterprises – Stanwood, WA

The Benefits of ASP Composting

WITH ASP COMPOSTING, WE:

- Reduce the footprint of the Active compost pad
- Increase site capacity as well as the throughput of a given facility
- Reduce the cost of processing (less equipment, labor and fuel)
- Resolve off-site odor impacts and neighbor complaints
- Process more challenging feedstocks
- Improve product quality and increase the selling price

Pop Quiz

The three layers within an Aerated Static Pile Include:

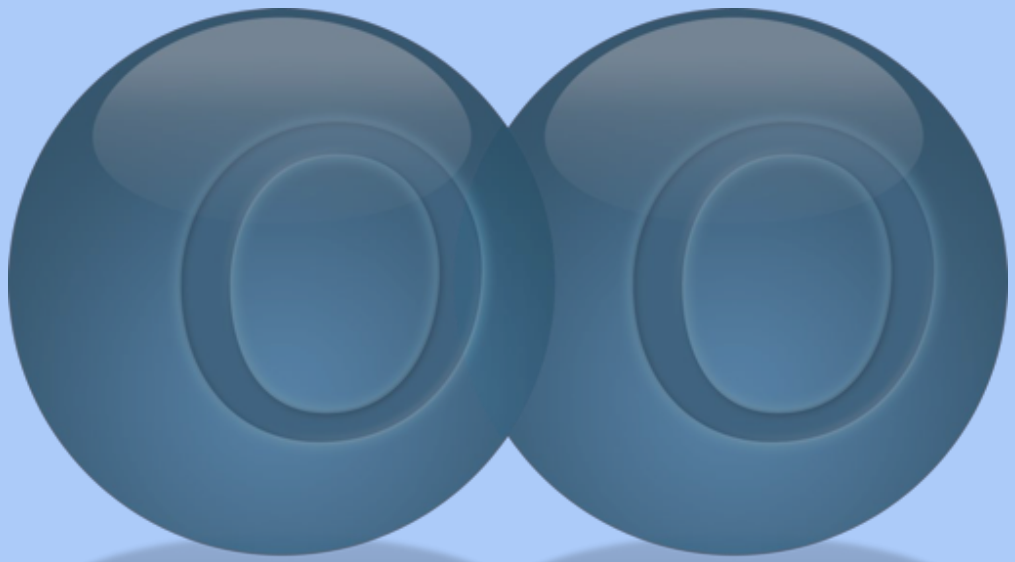
- The Plenum Layer – Why is this important?
  - To help distribute airflow uniformly across the base of the pile
- The Mix Layer – What are the Key Parameters
  - Nutrient Balance (Carbon to Nitrogen Ratio)
  - Bulk Density as an indirect measure of Porosity
  - Moisture Content
- The Biofilter Layer – What are the two key reasons
  - Insulate the mix layer > pile temperatures over 131°F for 3 days
  - Manage odors and off-site impacts to neighbors

Aerated Static Pile Composting

PART 3

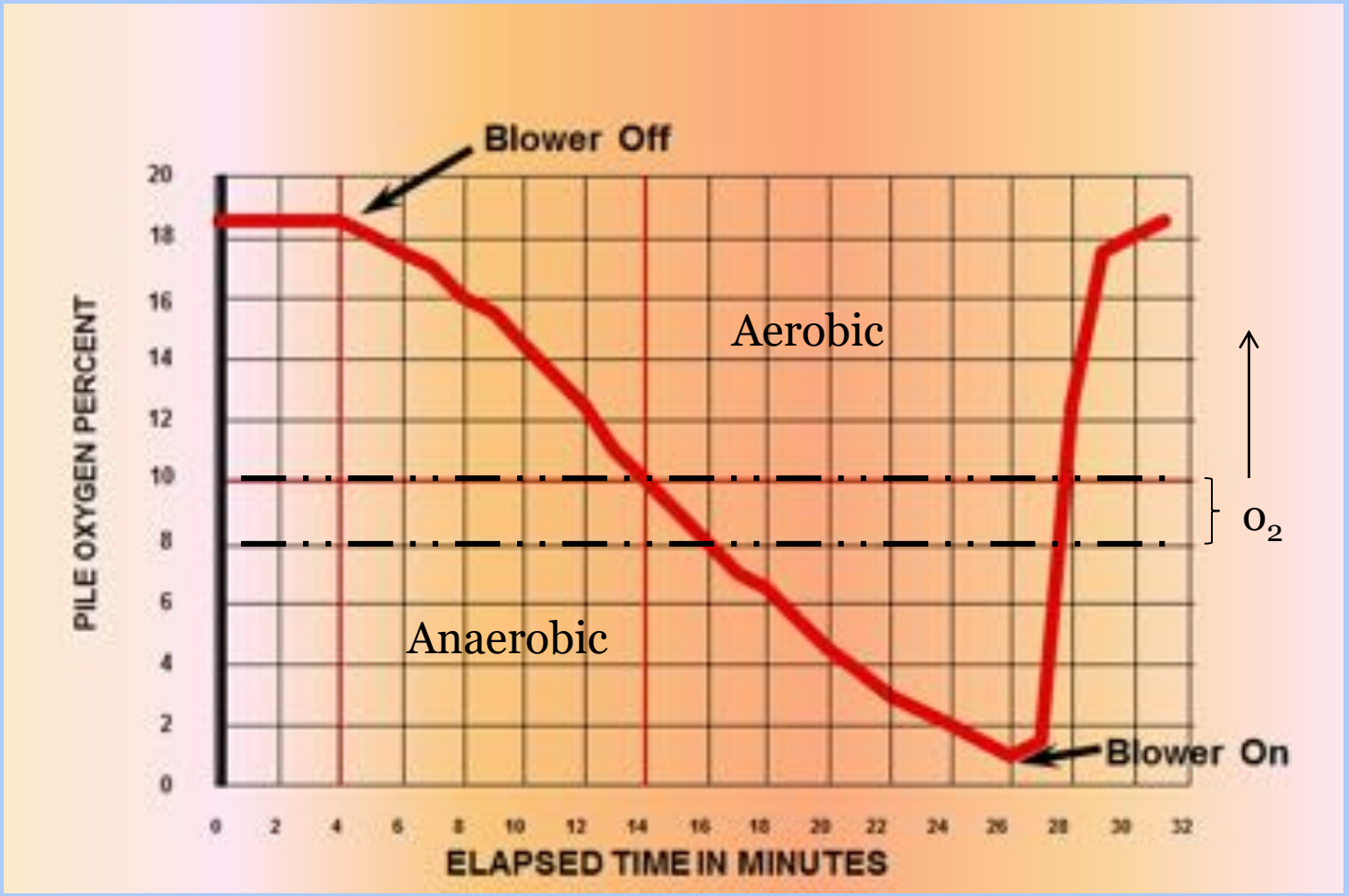
COMPOSTING IS A BIOLOGIC PROCESS

The Secret to Composting is…

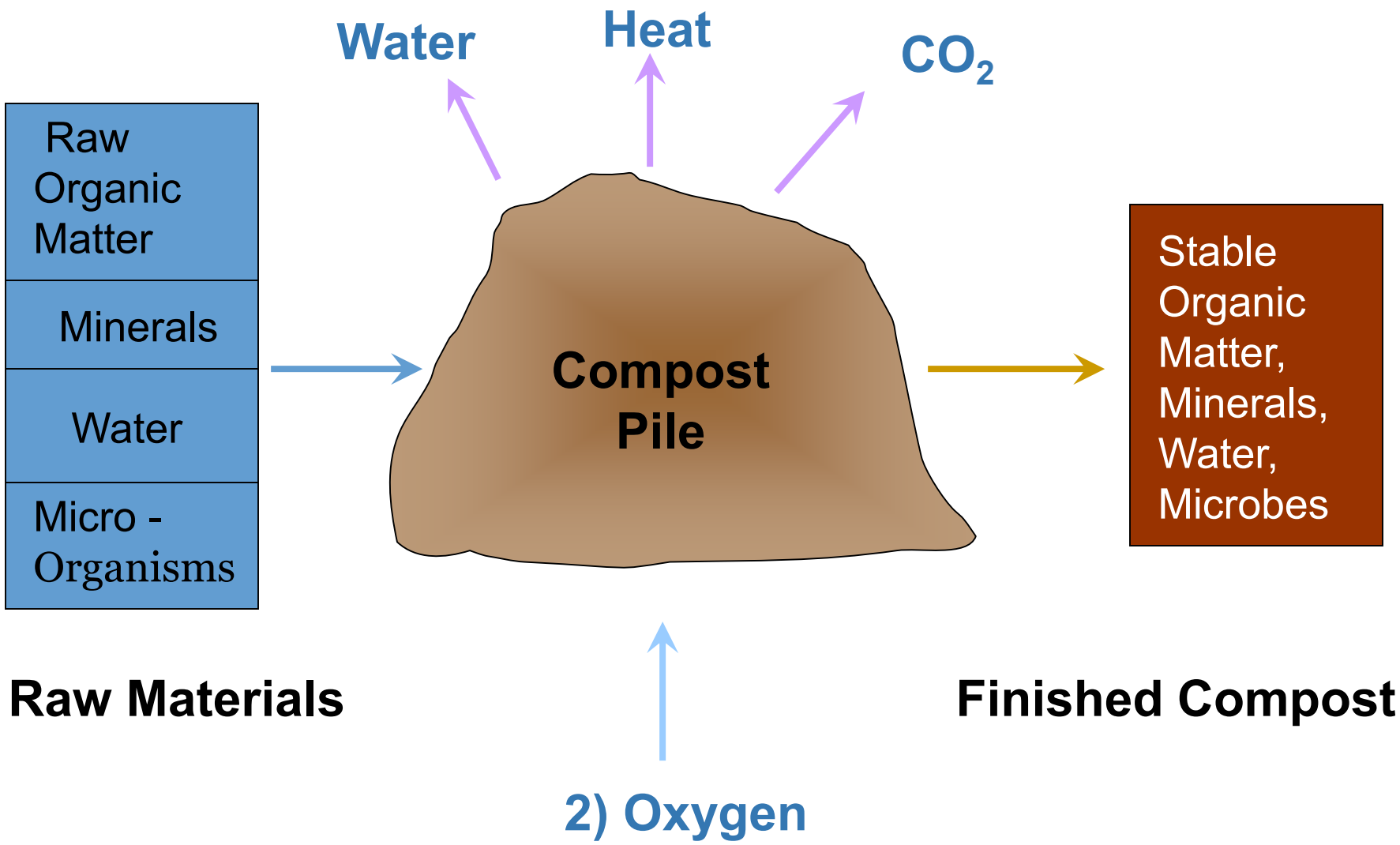


Oxygen!

Oxygen Consumption with Time



The Composting Process



Aeration

Allows the Operator to:

- Maintain Aerobic Conditions
- Mitigate Impacts from Objectionable Odors
- Manage Pile Temperatures
- Reduce the Loss of Nutrients
- Facilitate the Rate of Composting & Curing
- Produce Superior Compost Products

Compost Mix – The Key to Success

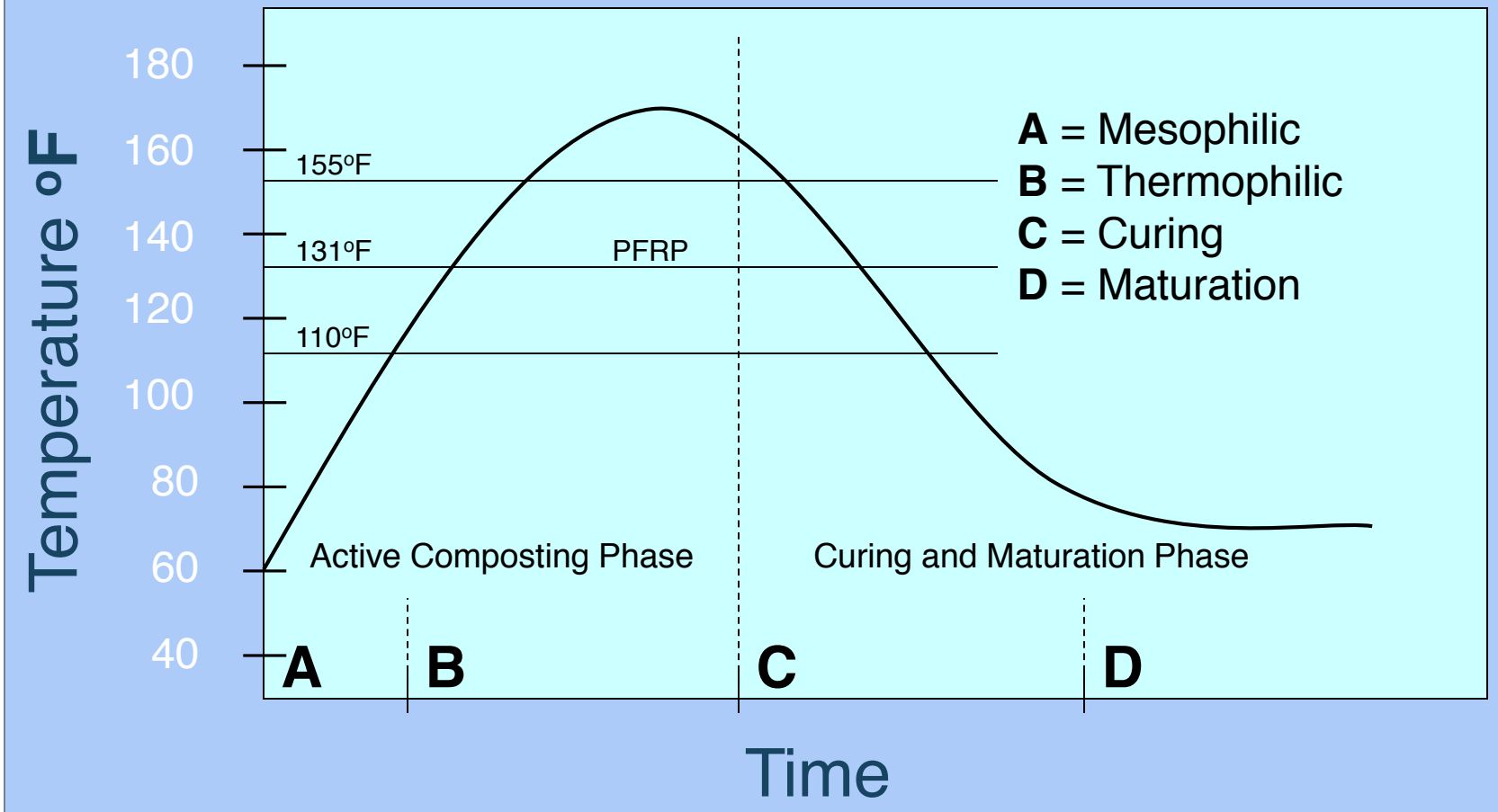
4 Critical Parameters

1. Carbon to Nitrogen Ratio (C:N ~ 30:1)
2. Porosity: Volume of Void Space
   - Bulk Density: 550 – 950 pounds per cubic yard
   - Free Airspace: 35 to 60%
3. Moisture Content (60 – 65%)
4. pH
   - Bacterial decomposers prefer pH 6.0 to 7.5.
   - Fungal decomposers prefer pH 5.5 to 8.0.
   - Ideal range is 5.8 to 7.2

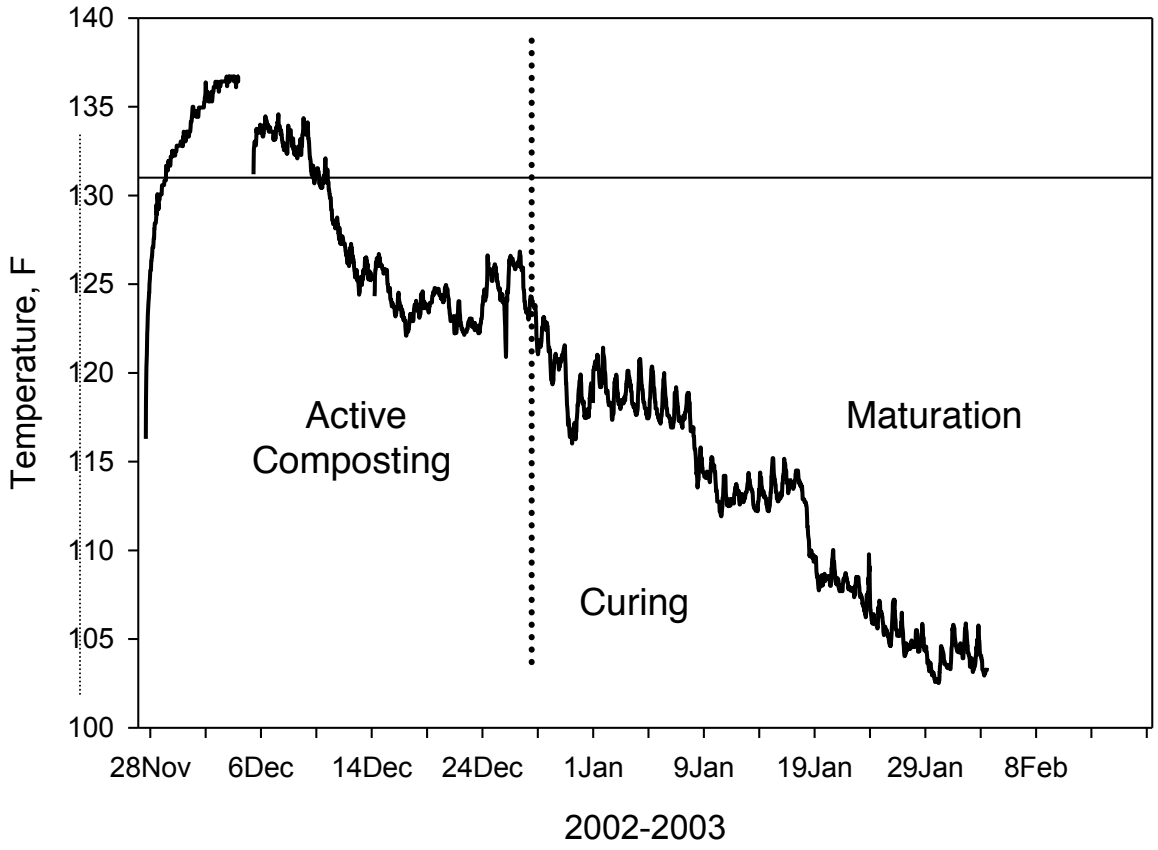
Requirements for Aerobic Composting

Parameter	Reasonable Range	ASP Preferred Range
C:N Ratio	20:1 to 40:1	25:1 to 30:1
Moisture	40% to 65%	60% to 65%
Bulk Density	650 to 1,250 pcy	950 pcy (max)
Free Air Space	35% to 60%	35% to 50%
pH	5.5 to 8.5	6.5 to 8.0
Particle Size	1/16" to 3"	>50% 1/8" to 2" (max)
O_2 Concentration	>5%	>10%
Temperature	131° to 170°F	131° to 150°F

The Compost Life-Cycle



Actual Temperature Data Curve



Mid-Term Exam

- After turning a compost pile, or when the blower for an Aerated Static Pile turns off, how quickly does the oxygen deplete in the core of the pile?
- What percentage of O2 do we want to maintain in an aerobic system?
- Active Composting is primarily a _____ driven process whereas Curing is primarily a _____ driven process.

Mid-Term Exam

- True or False: Curing starts at an exact point in time
- PFRP means a Process to _____.
- What are the criteria for PFRP with ASP Composting?
- Our objective in meeting PFRP conditions are to "destroy" _____. At these temperatures we also effectively eliminate _____ and _____.

Bonus Points

What is the one correct answer to all composting questions?

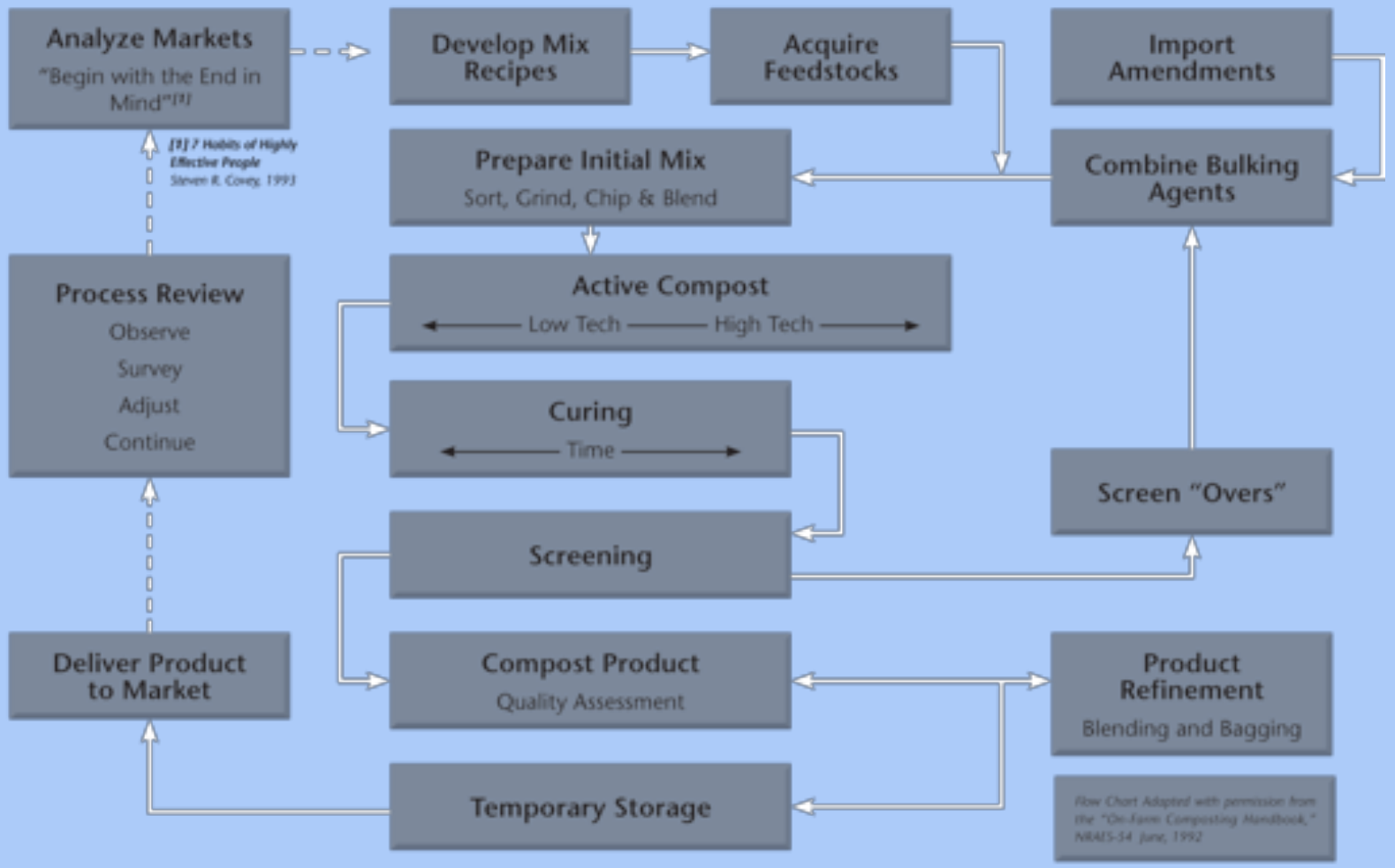
It Depends!

Aerated Static Pile Composting

PART 4

COMPOSTING AS A MANUFACTURING PROCESS

Composting Process Flow Chart



Mass Balance Analysis

Tilz Soil & Compost				
In-Bound Green Waste per Year	7,000	tons / yr	125%	Peaking Value
Process Mass Balance	**Average Condition**		**Peak Condition**	
Monthly Tonnage	583	tons / mo.	729	tons / mo.
Shredded Bulk Density	650	pounds / cubic yard	650	pounds / cubic yard
Monthly Volume	1,795	cy / avg. mo.	2,244	cy / peak mo.
Volume Loss w/ Active Composting	25%		25%	
Volume After Active Composting	1,346	cy / avg. mo.	1,683	cy / avg. mo.
Volume Loss w/ Curing	10%		10%	
Volume After Curing	1,212	cy / avg. mo.	1,514	cy / peak mo.
Screened Fines Proportion	60%		60%	
Screened Product Volume	727	cy / avg. mo.	909	cy / peak mo.
Screen "Overs" Proportion	45%		45%	
Screened "Overs" Volume	545	cy / avg. mo.	681	cy / peak mo.
Curing Time	1.5	months	1.5	months
Curing Storage Volume	2,019	cy	2,524	cy
Screened Product Storage Time	3	months	4	months
Screened Product Storage Volume	2,181	cy	2,726	cy
Screen Overs Storage Time	3	months	4	months
Screen Overs Storage Volume	1,636	cy	2,044	cy

Continuous Flow

Materials Handling

When the method of mixing and processing is successful at meeting the biological requirements for composting:

- The primary focus of composting then becomes materials handling.
- Composting is a manufacturing process, and
- The objective should be to produce a high quality product.

Adaptability

Your Method of Operating Will Evolve Over Time

Recommendations:

- Start small and grow in planned increments.
- Define your key objectives & set goals.
- Always strive to improve product quality.

Adaptability

Your Method of Operating Will Evolve Over Time

- Always work to reduce materials handling;
- Identify and manage constraints in your system;
- Respond to regulatory changes;
- Be a good neighbor; and
- Keep it Simple Stupid (KISS).

Summary – Keys to Success

- Manage the compost facility based on a continuous yet variable flow of materials (i.e., Flow Diagram);
- Handle raw feedstocks promptly;
- Pay particular attention to: 1) aeration; and 2) the amount of moisture in the system;
- Do not lose sight of the big picture; manage the site by practicing good housekeeping techniques; and
- **Always strive to improve product quality**!

Aerated Static Pile Composting

PART 5

CONDUCTING AN ASP PILOT PROJECT

The Four Stages of Learning

- Unconscious Incompetence
- Conscious Competence
- Conscious Incompetence
- Unconscious Competence

- Don’t know what you don’t know
- Know what you know
- Know what you don’t know
- Don’t know what you know

Learning by Doing

Bridging the Gap Between Knowledge and Understanding

Small Volume Pilot Projects

- Quick and Inexpensive to Construct & Start-up
- Prototype Compost Mix
  - C:N Ratio
  - Bulk Density
  - Moisture Content
- Confirm Suitability Before Setting up a Larger Pile
- Get Stakeholder Buy-In

O2Compost Micro-Bin System

Large Volume Pilot Projects

O2Compost Aerated Bay System

- Provide Operator Training
- Resolve Logistical Constraints
- Test a Variety of Mixes
- Establish Standard Operating Procedures
- Reveal Permit Requirements
- Establish Regulatory Confidence.

Logistical Constraints

- Feedstock Sources
- Transportation
- Aeration System
- Equipment
- Operators
- Power/Water
- Permits

Salt Lake City Pilot Project

Stakeholder Buy-In

- Partners
- Investors
- Employees
- Regulators
- Neighbors
- Customers
- End-Users

Fish Waste Compost Demonstration Project

Aerated Static Pile Composting

PART 6

INCREASING SITE CAPACITY BY REDUCING OPERATING FOOTPRINT

Windrow Turners

Self Propelled Straddle Type
~16-feet wide by 7-feet high

Windrow Turners

PTO Powered - Tow Beside
~16-feet wide by 7-feet high

Example Turned Windrow Compost Facilities

Compost Facility in New York
Yard Waste & Leaves

Compost Facility in California
Yard Waste & Food Waste

Turned Windrow Compost Facility

Compost Facility in Texas
Biosolids with Shredded Wood

15 Windrows ~ 7,500 cy
Problem: No Room to Expand

Turned Windrows

Site Dimensions and Turned Windrow Capacity

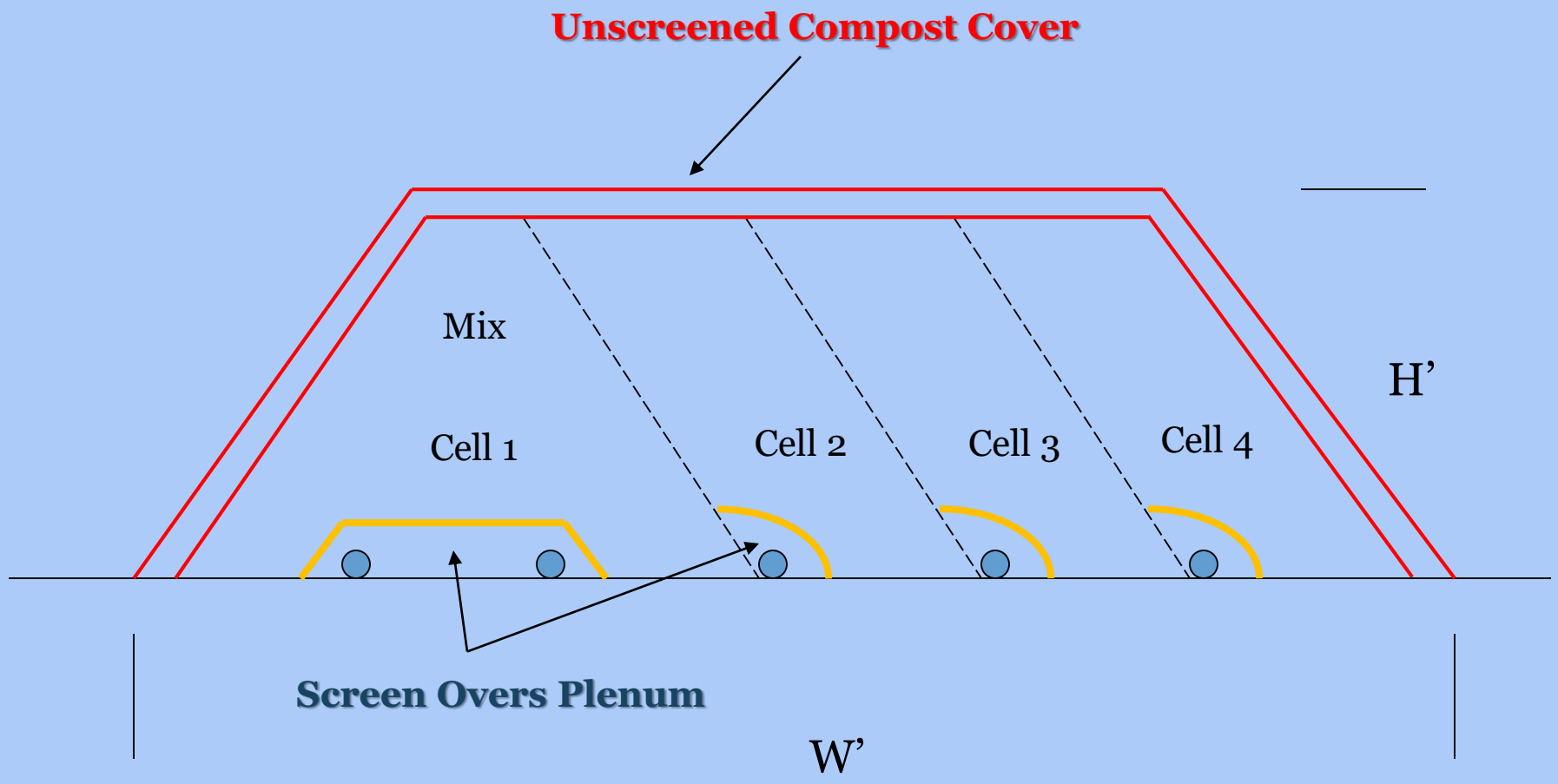
- Site Dimensions: 350-feet x 300-feet: ~2.4 Acres
- Windrows: 16-feet wide, 6-feet high, 300-feet long
- Windrow Volume: ~ 500 cubic yards / windrow
- 15 Windrows: Total Volume ~7,500 cubic yard

Turned Windrows

EASP Batch Flow-Through Composting

Bailey Compost, Snohomish, Washington

Section View of an Extended ASP



Extended Aerated Static Piles

Site Dimensions and EASP Capacity

- Site Dimensions: 350-feet x 300-feet: ~2.4 Acres
- EASP: 80-feet wide, 135-feet long, 10-feet high
- EASP Volume: ~ 3,250 cubic yards / EASP
- 7 EASP's: Total Volume ~22,750 cubic yards
- Increased Capacity: 22,750 cy / 7,500 cy = 3x
- Tow Beside Windrow Turners: 6x – 8x

Extended Aerated Static Piles

Extended ASP Composting

Bailey Compost, Snohomish, Washington

Continuous Flow “Wedge” Method

Envirofert Compost, Auckland, New Zealand

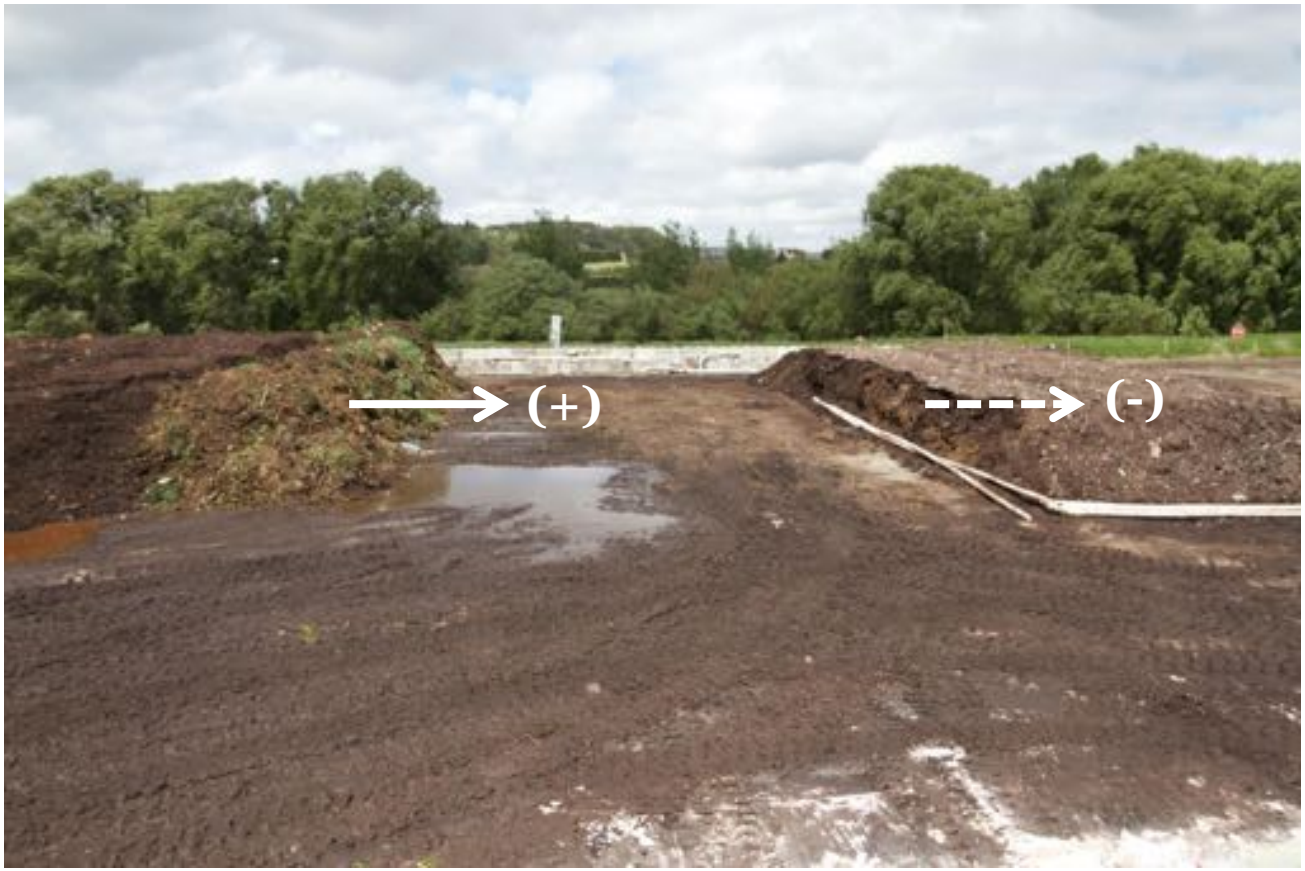
Blowers & Manifold System

Auckland, New Zealand

Advancing / Receding Faces

Auckland, New Zealand

Advancing / Receding Faces



Auckland, New Zealand

Aerated Static Pile Composting

PART 7

RESOLVING ODOR IMPACTS & NEIGHBOR COMPLAINTS

The Challenge

Offensive Odors are the single most common reason for compost facility closure.

Impacted neighbors become upset, organized and relentless in their goal to shut down offending compost facilities.

Despite this, they are not the enemy!

Turning Windrows

Core Gases Released from an anaerobic compost windrow in an effort to reestablish aerobic conditions within the pile.

Odors can be particularly strong and offensive when the feedstocks consist of high nitrogen manure, grass clippings and food waste.

Photo: BioCycle Magazine

Extended Aerated Static Pile

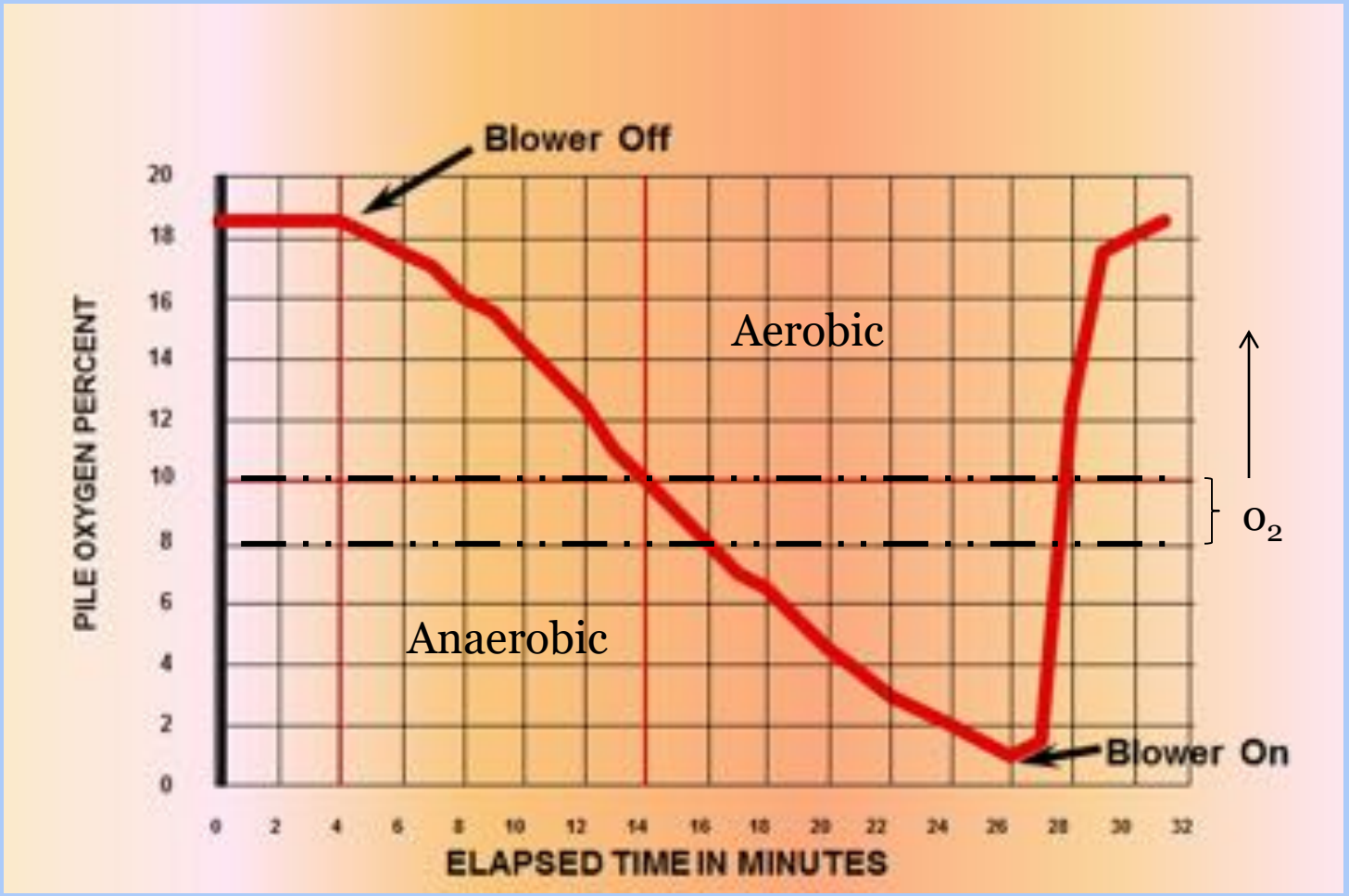
No Pile Turning during the first 30-days of Active Composting

Blowers Operated by On/Off Cycle Timers

Easy to Maintain Aerobic Conditions Throughout the Pile

Photo: Ned Foley Two Particular Acres Compost, Royersford, PA

Oxygen Consumption with Time



Most Odors are By-Products of Anaerobic Respiration

- Rotten Eggs - dimethyl sulfide, hydrogen sulfide.
- Rancid Fats, Oils & Grease - butyric acid.
- Dead Animals - putrescine, cadaverine
- Fishy – trimethyl amine
- Pine - terpene.
- Ammonia – not O_2

conditions > function (pH)

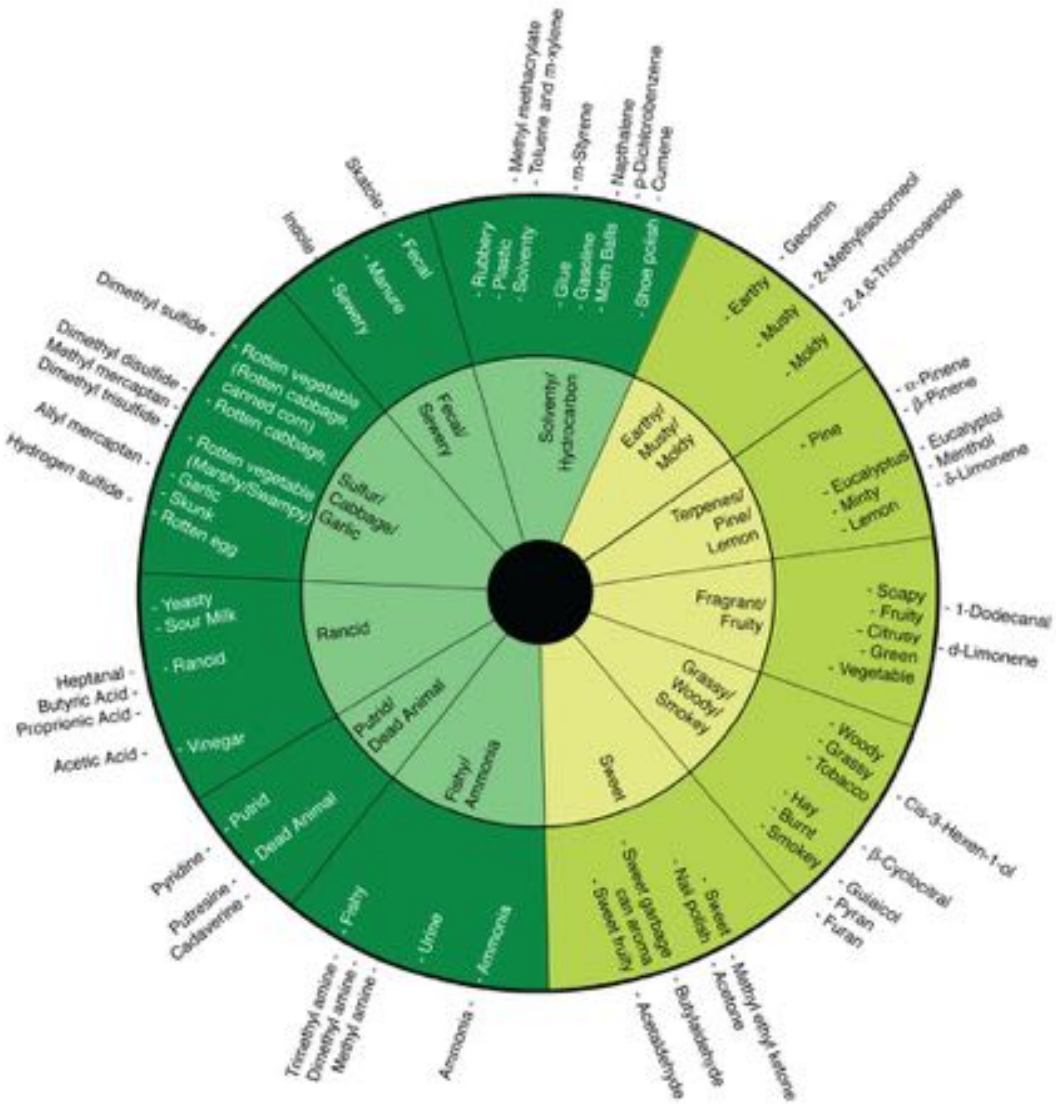


Figure 1. Composting odor wheel

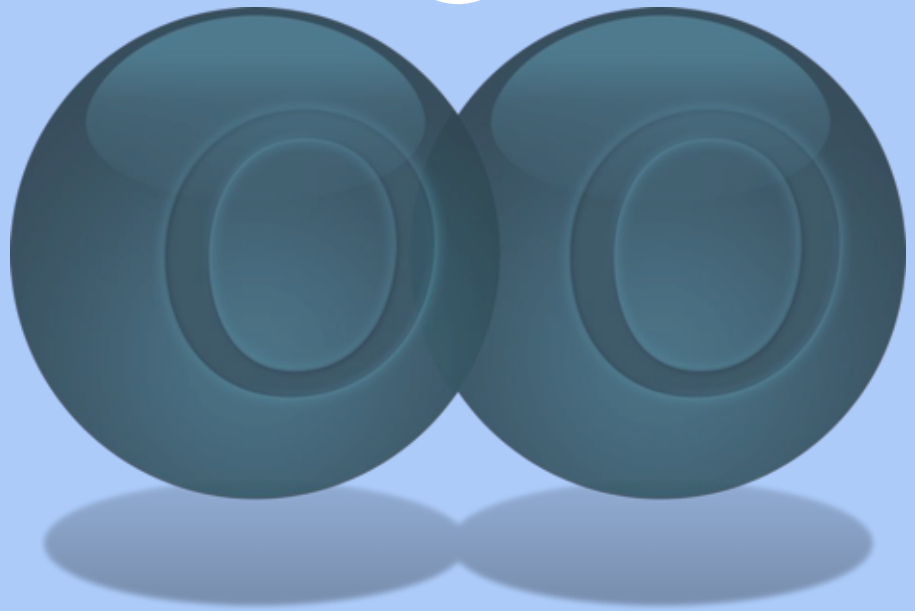
Source: "Sensory Assessment and Characterization of Odor Nuisance Emissions during the Composting of Wastewater Biosolids," *Water Environment Research*, Volume 81, Number 7

How Do Anaerobic Compounds Form?

Under conditions that restrict the entry of oxygen into feedstocks or compost piles.

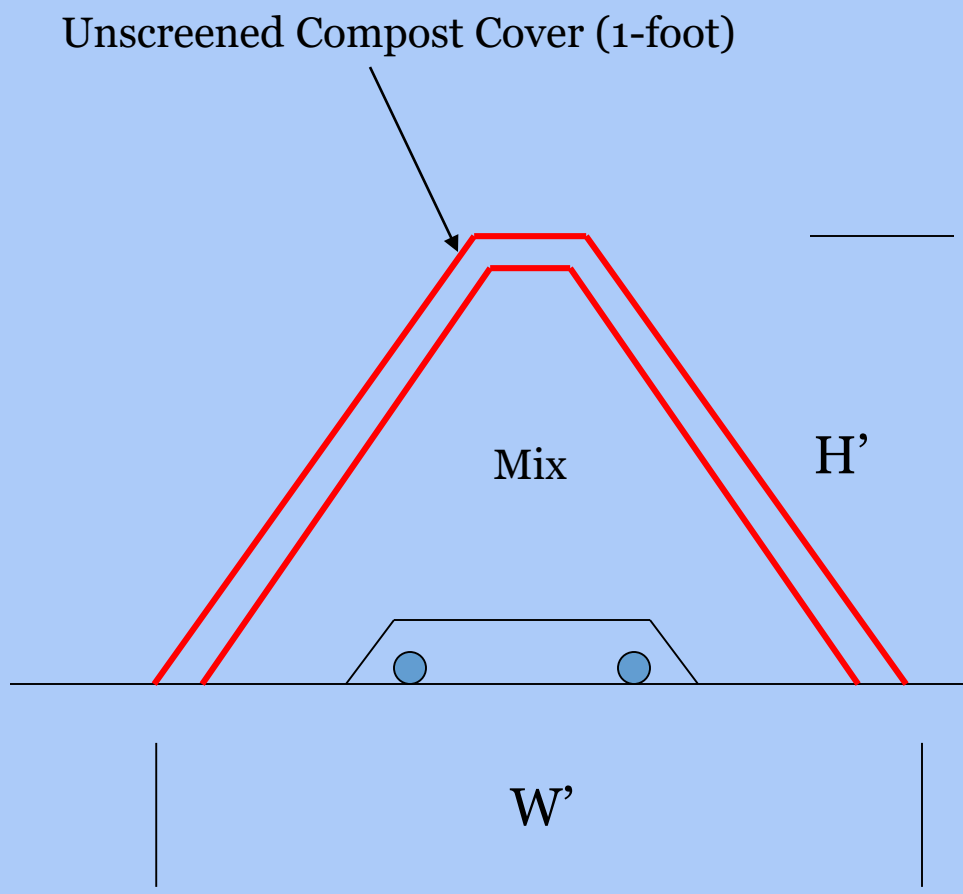
- High moisture content
- Inadequate porosity (high bulk density)
- Rapidly degrading substrates
- Excessive pile size

How do you remediate anaerobic metabolism?



ADD *OXYGEN*
AND MAKE SURE THE MIX WILL SUPPORT AEROBIC MICROBES!

Section View of an ASP



- Insulating Layer (PFRP)
- **Biofiltration Layer**
- Nutrient Retention
- Vector Barrier
- Moisture Retention
- Improve Aesthetics

Rule of Thumb:
Max Pile Length 75 – 80-feet

VOC Emission Reduction Study

Tulare, CA 2012

Odor Evaluation

Gathered Representative Samples from the Surface of Compost Piles

Evaluated Odor Character and Strength by Off-Site Odor Panel

Evaluated Constituent Gases

Measured VOC and GHG Emissions.

C.E. Schmidt Environmental Consultants

The Benefits of ASP Composting with a Biofilter Cover Layer

Pollutant	Reduction
Volatile Organic Compounds – VOC's	98.8 %
Ammonia – NH_3	83.2 %
Carbon Dioxide - CO_2	71.9 %
Methane - CH_4	13.0 %
Nitrous Oxide - N_2O	88.8%

Table ES-1: Results in emissions testing in pounds of pollutant per ton of feedstock over the 22-day active composting period

Steps to Minimize Offensive Odors

1. Receive and Process Odorous Wastes Promptly
2. Provide Adequate Carbon-Rich Bulking Material
3. Establish a Bulk Density of 650 – 950 pcy
4. Place on an Aeration System ASAP
5. Cover with a Biofilter Layer (unscreened compost)
6. Maintain Aerobic Conditions for the first 30-days

People “Smell with Their Eyes”

- Good Housekeeping
- Clean-up Receiving Areas
- Temporary Covers on top of Raw Feedstocks Overnight
- Clean Ditches and Puddles
- Aerate Stormwater & Leachate Ponds
- Correlate Meteorological Conditions and On-Site Activities with Complaints

Lenz Enterprises - Stanwood, WA

Aerated Static Pile Composting

PART 8

REDUCING OPERATING COSTS

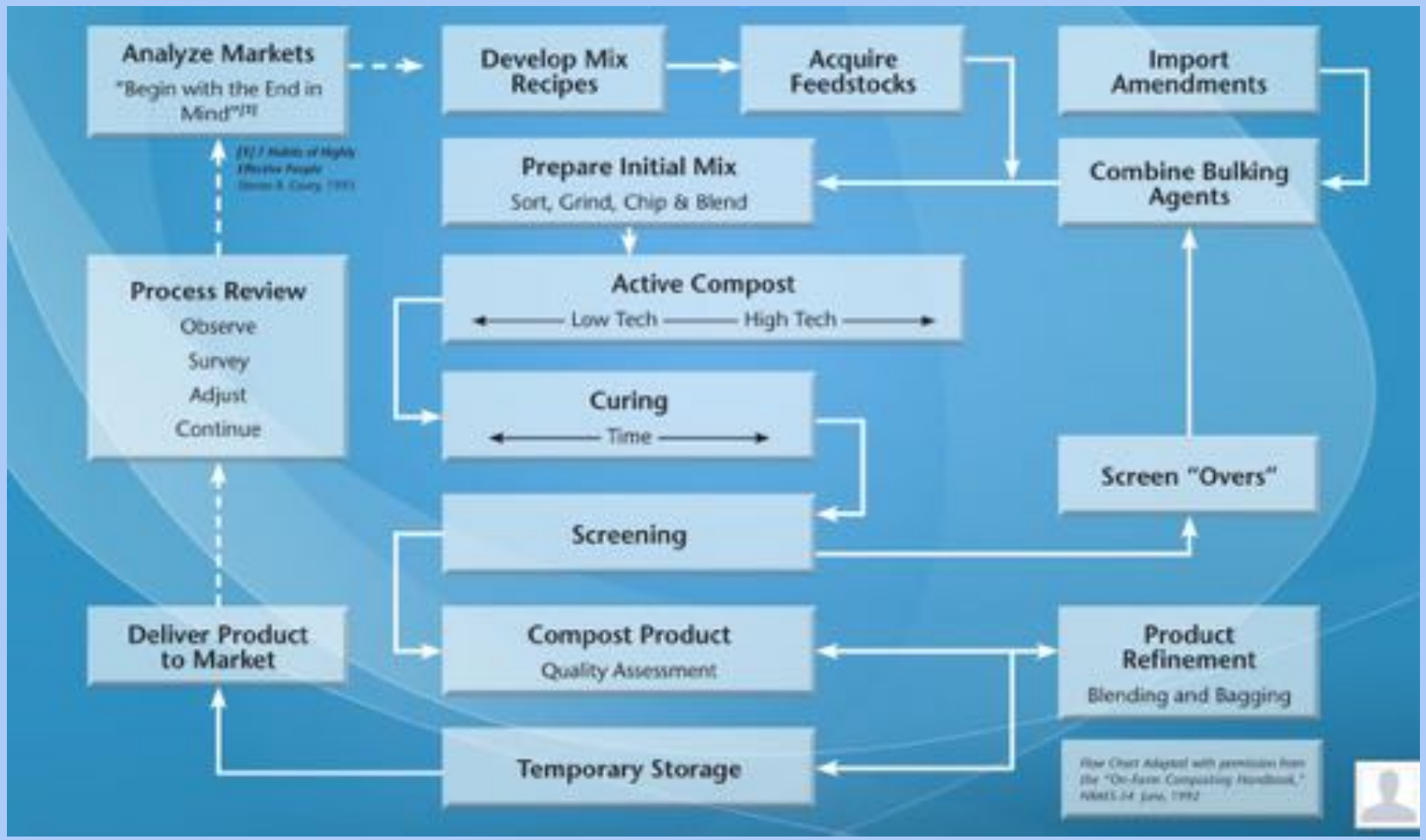
Extended Aerated Static Piles

Turned Windrows

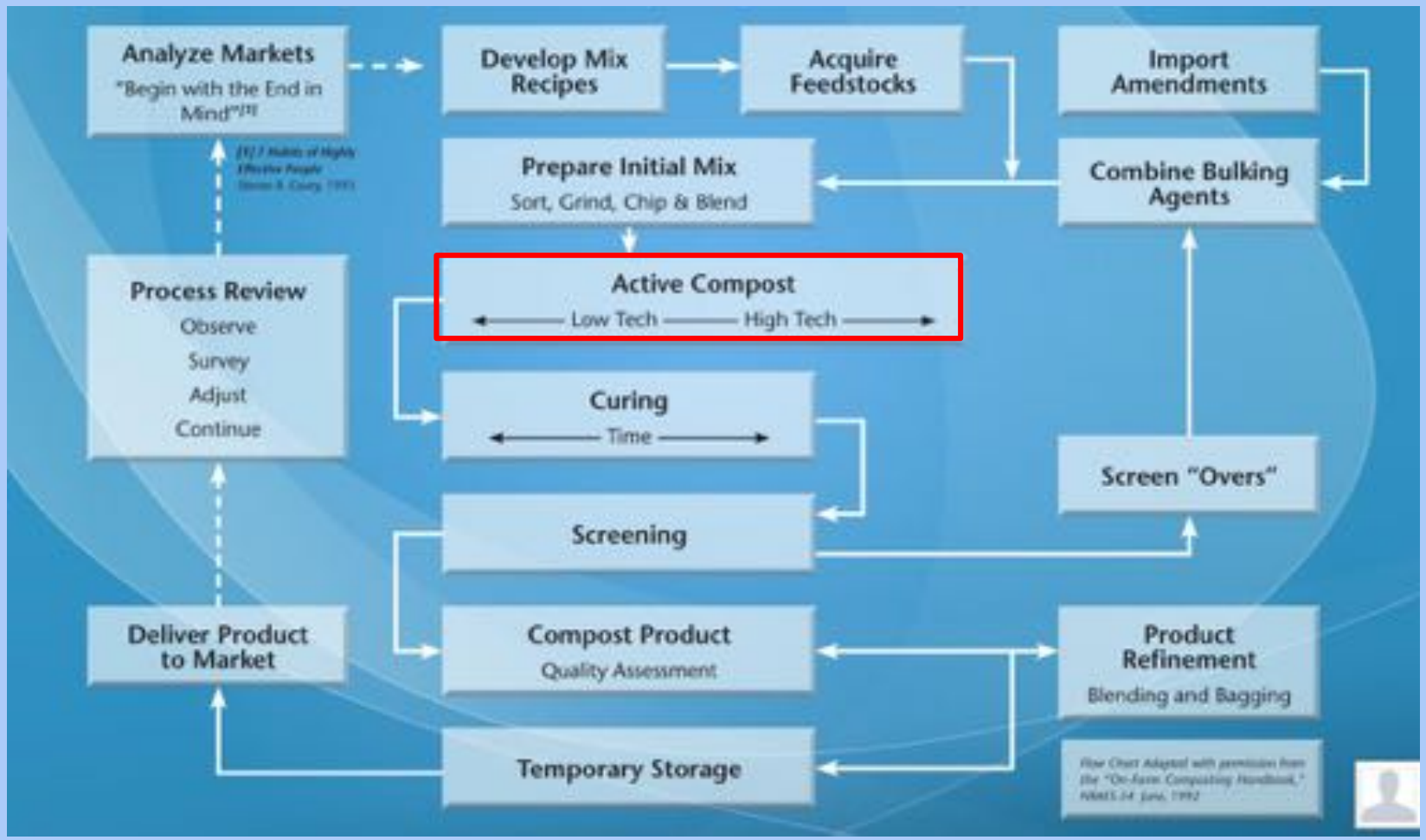
Site Dimensions and EASP Capacity

- Site Dimensions: 350-feet x 300-feet: ~2.4 Acres
- Windrow Volume: ~ 7,500 cubic yards
- 7 EASP's: Total Volume ~22,750 cubic yards
- Increased Capacity: 22,750 cy / 7,500 cy = 3x
- Tow Beside Windrow Turners: 6x – 8x
- Increased Cycle Time: 1 ½ - 2x cubic yards / year

Composting Flow Chart



Composting Flow Chart



Process Comparison

Turned Windrows	Aerated Static Piles
• Windrow Construction • Windrow Turning 8-16x • Time on Pad: 6 – 8 wks • Pile Deconstruction • Move to Curing	• Pile Construction • No Pile Turning • Time on Pad: 4 – 6 wks • Pile Deconstruction • Move to Curing

Process Comparison

Turned Windrows	Aerated Static Piles
• Windrow Construction	• Pile Construction
• Windrow Turning 8-16x	• No Pile Turning
• Time on Pad: 6 – 8 wks	• Time on Pad: 4 – 6 wks
• Pile Deconstruction	• Pile Deconstruction
• Move to Curing	• Move to Curing

Windrow Turners

Self Propelled Straddle Type Windrow Turner
16-feet wide by 7-feet high

Turned Windrows – 22,750 Cubic Yards

Investment:	$600,000 - $850,000
Life Expectancy	4 – 6 years
Labor:	80 hrs/mo.
Fuel Cost:	$YY / mo.
Routine Maintenance:	$ZZ / mo.
Major Repairs:	$10,000 - $20,000/yr
Insurance:	Strongly Recommended

Aerated Static Piles – 22,750 Cubic Yards

Investment:	$25,000 - $50,000
Life Expectancy	20 years (plus)
Labor / Site Inspections:	2 hrs/wk or 8 hrs/mo.
Power Installation Cost:	$15,000 - $30,000
Power Operating Cost:	$100 - $250 / month
Maintenance & Repairs	Incidental
Insurance:	None Recommended

How Much Will My Compost System Cost to Build?

There are Three Cost Components:

- O2Compost Training Program
- Construction Materials
- Construction Equipment and Labor

Average System Costs

O2Compost System	Style	O2C Training	Materials	Construction	Total Cost
Micro-Bin	Portable	$675	$325	0	$1,000
Macro-Bin	Fixed	$1,675	$500	$250	$2,425
Cornerstone ASP	Portable	$2,475	$250	0	$2,725
Cornerstone 3-Bay	On-Grade	$2,475	$2,525	0	$5,000
Cornerstone 3-Bay	Top-Down	$2,475	$2,500	0	$4,950
Sterling 3-Bay	On-Grade	$3,975	$3,525	$2,500	$10,000
Sterling 3-Bay	Top-Down	$3,975	$3,525	$4,000	11,500
Paragon	On-Grade	$3,000	$5,250	$2,500	$10,750

How Much Will My Compost System Cost to Operate?

There are Four Cost Components:

- Time to Prepare the Mix and Fill the Bin
- Time to Monitor the Composting Process
- Time and Equipment to Remove the Compost
- Electrical Power

What About Getting a Grant to Help Pay for My Compost System?

- Paper Work, Paper Work, Paper Work
- This Process Can Take 12 to 18 months
- More Stringent Construction Standards
- Cost Share of $1 : $1 After Construction
- Often it's "Hurry-up and Wait"
- Open Invitation to Visitors

Return on Your Investment

Reduce Expenses

- Hard Costs
- Soft Costs
- Environmental Costs
- Intangible Costs

Create Benefits

- Product Sales & Profits
- Improve Horses' Health
- Improved Aesthetics
- Sustainable Agriculture

Hard Costs

Eliminate Disposal Expense

Soft Costs

- Owner's Time and Effort
- Inefficient Use of Labor
- Excessive Bedding
- Fuel Costs
- Equipment Maintenance & Repairs
- Veterinarian Bills

Improving Horses' Health

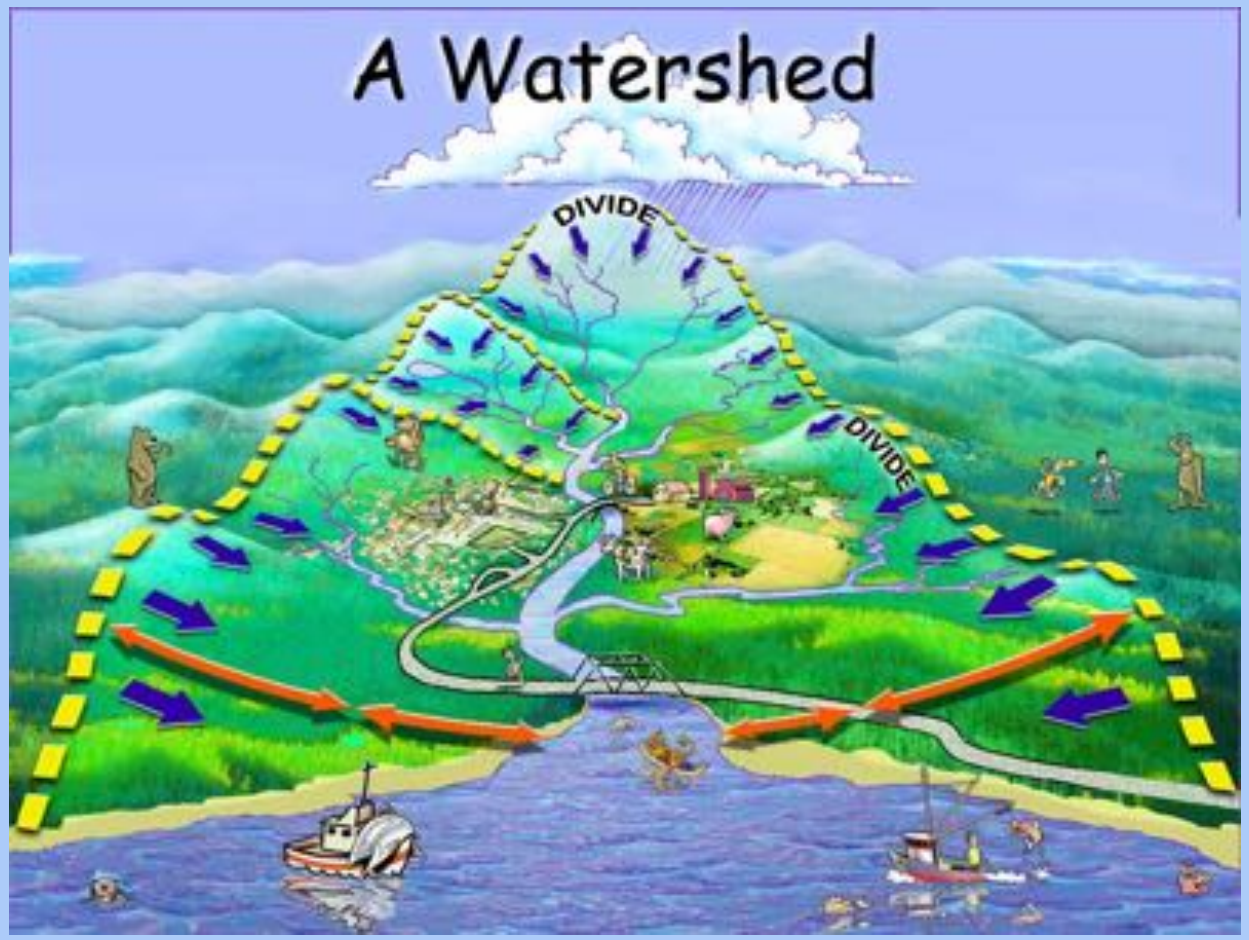
Lush Pasture Grass - Parasites and Weeds?

When to Call Your Vet?

- Soft Costs
  - owners' time,
  - fuel and equipment,
  - horses' health,

Ascarid Impaction of SI

Environmental Costs



Protecting Aquatic Life

The Chesapeake Bay watershed is 64,000 square miles.

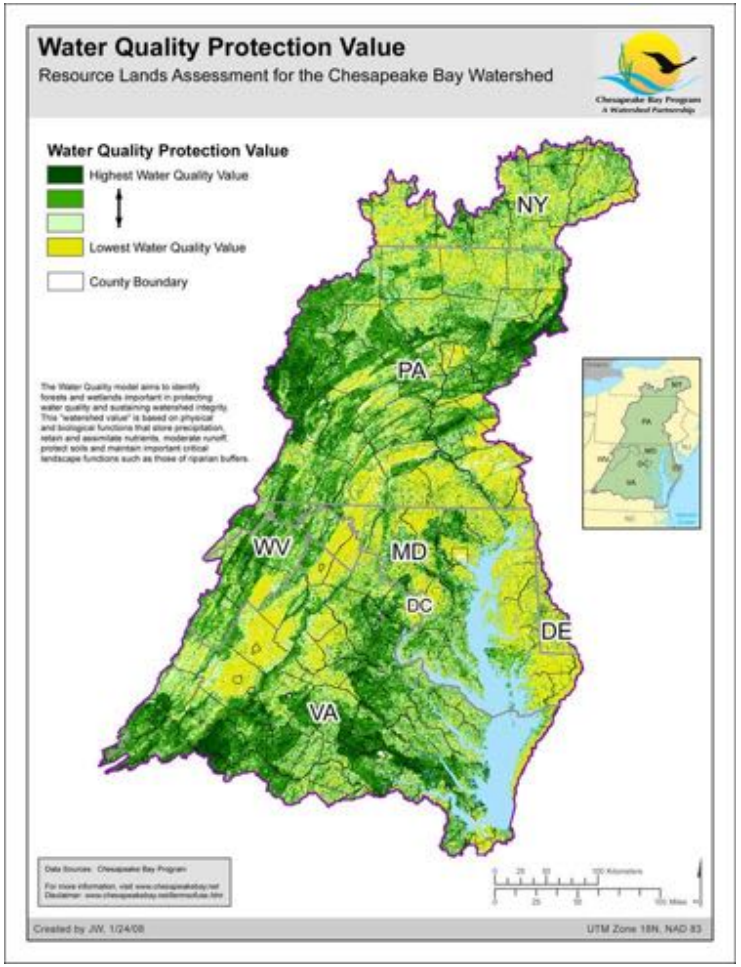
It has 11,600 miles of tidal shoreline, including tidal wetlands and islands.

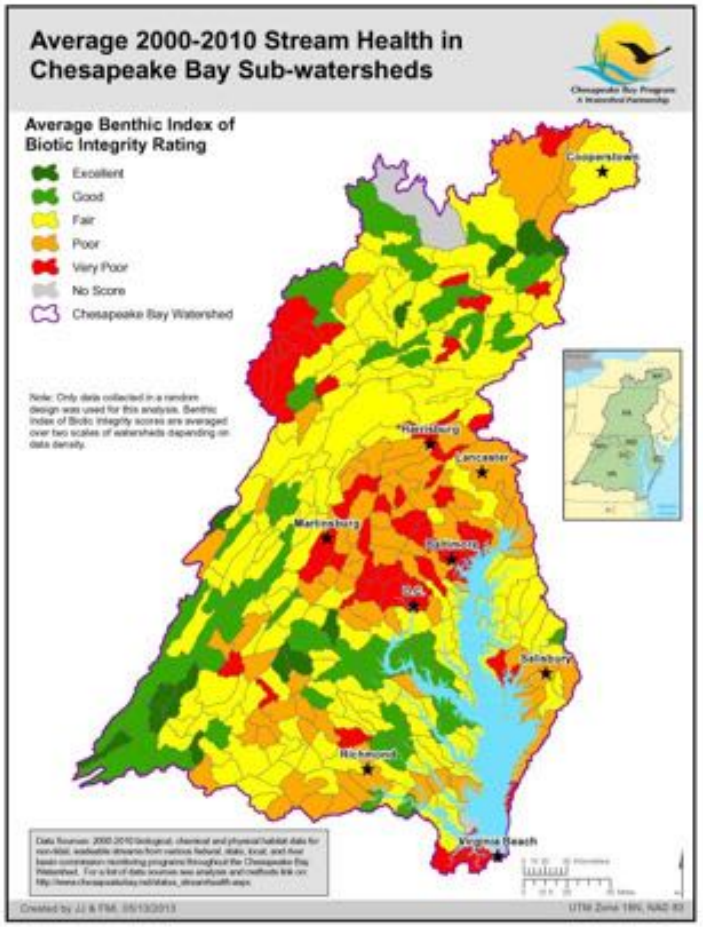
The watershed encompasses parts of six states.

Approximately 17 million people live in the watershed.

About 10 million people live along its shores or near them.

Chesapeake Bay Watershed





Protecting Aquatic Life

Ammonia in Small Concentrations is Toxic to Salmonoids

Protecting Aquatic Life

High BOD and Nutrients in Runoff

Intangible Costs

- Human Health
- Neighbor Complaints
- Regulatory Compliance
- Poor Aesthetics & Lost Business
- Deferred Maintenance
- Frustration and Sleepless Nights

Protecting Human Health

Nitrates in the Ground Water

Benefits of Using Compost

- Convert Nutrients to plant available forms
- Increase soil organic content
- Decrease soil compaction
- Improve pasture grass, reduce weeds
- Increase infiltration and moisture retention in soil
- Decrease soil erosion

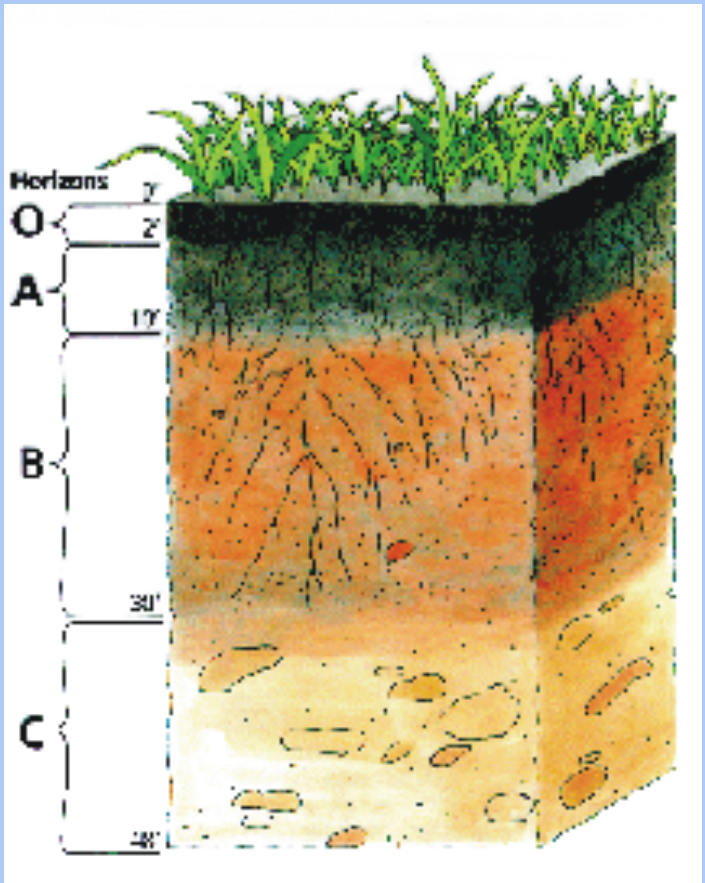
Soil Horizons

Topsoil is

a Complex

Living

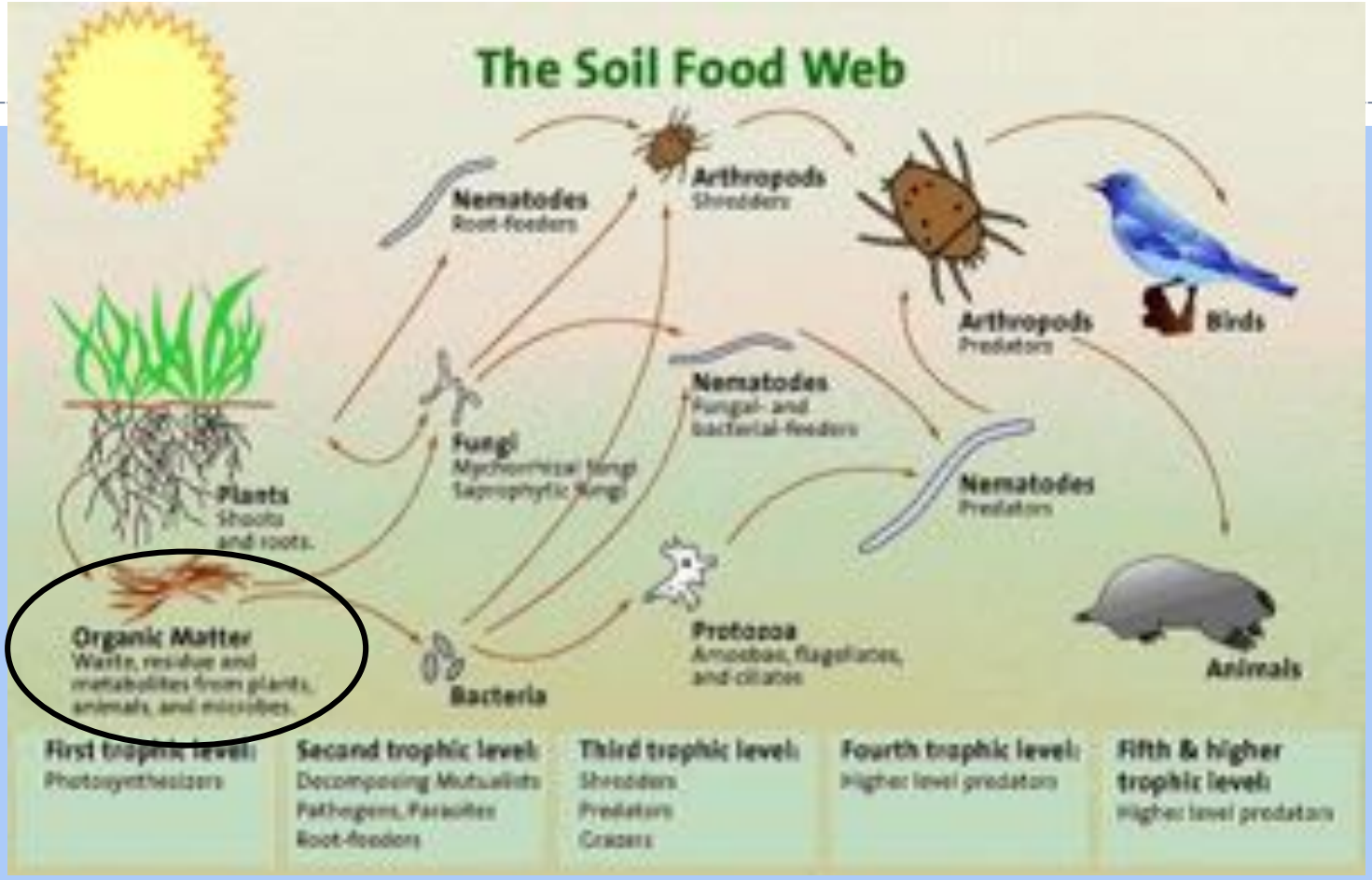
Organism



Organic Soil

Mineral Soil

Parent Material



Soil is a Complex Living Organism

Q&A

Oklahoma

Massachusetts

New Jersey

Washington

Maryland

O2Compost
Compost Systems & Training

Aerated Static Pile Composting
Applications and Opportunities

THANK YOU

PETER MOON - O2COMPOST