

Solid Waste Landfills as a Repository for ABR

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Disposal of Arsenic-Bearing Water Treatment Residuals:
Assessing the Potential for Environmental Contamination

Topics

- Types of landfills
 - Regulations
 - Engineering Controls
 - Chemical environments
- Fate of metals/metalloids in landfills
 - Concerns
 - Factors affecting risk to environment
 - Leachability

Types of Landfills

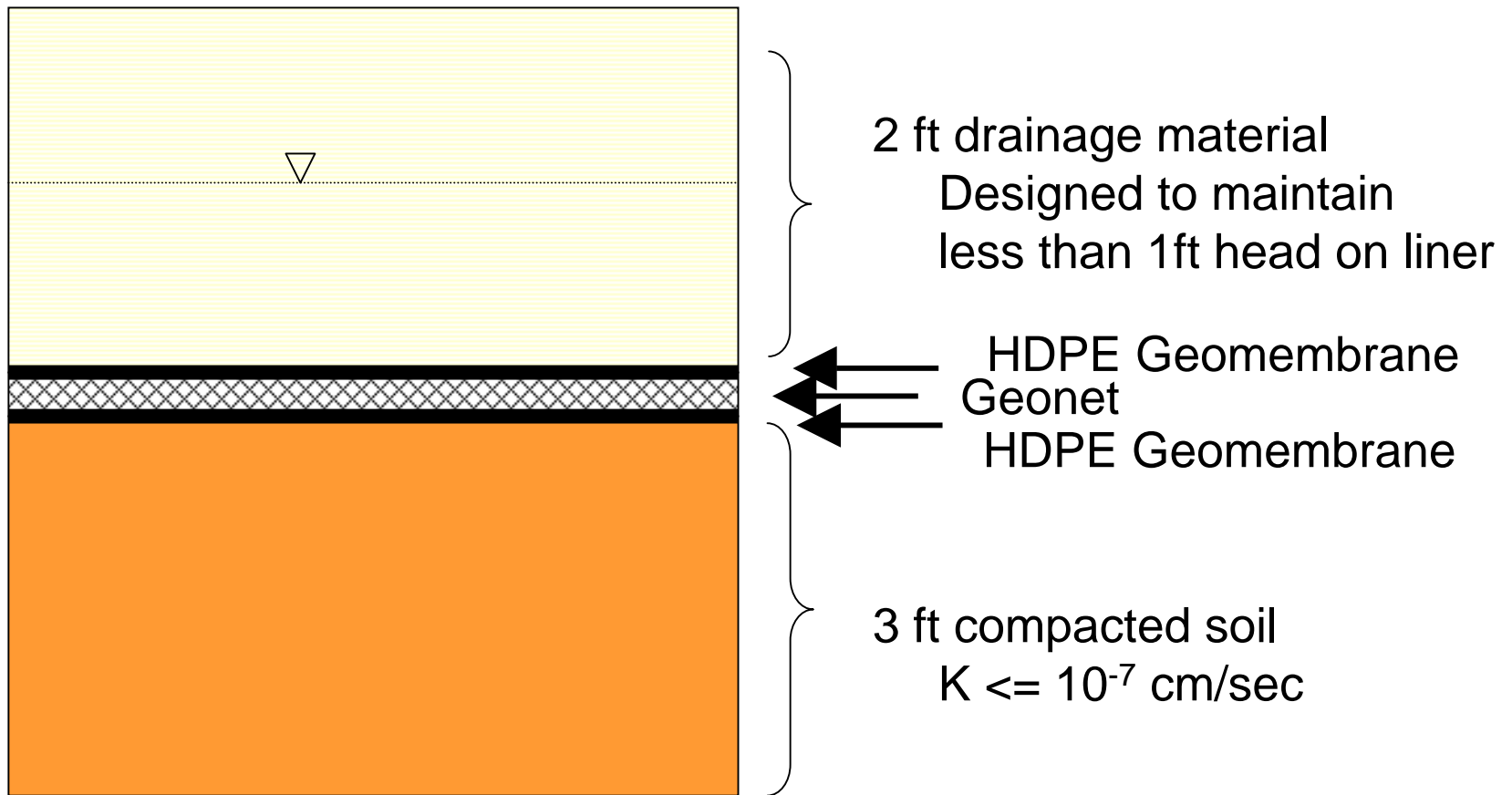
- Hazardous waste landfills
- Municipal solid waste landfills
- Other types
 - Construction and demolition debris
 - Industrial waste landfills

Hazardous Waste Landfills: RCRA Subtitle C Landfill (40 CFR 264)



Typical Subtitle C Liner

Double Liner

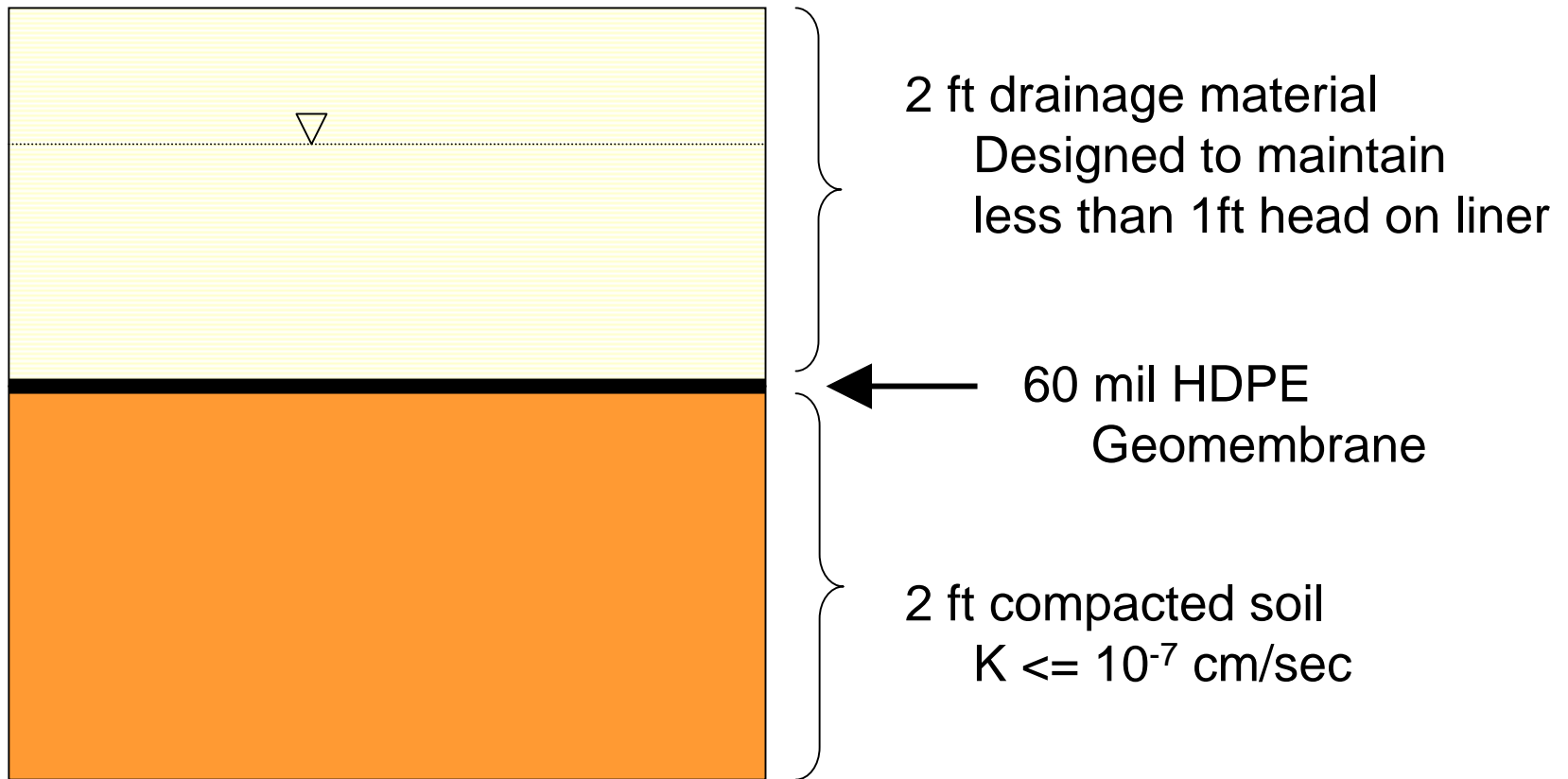


MSW Landfills: RCRA Subtitle D Landfill (40 CFR 258)



Typical Subtitle D Liner

Single Composite Liner







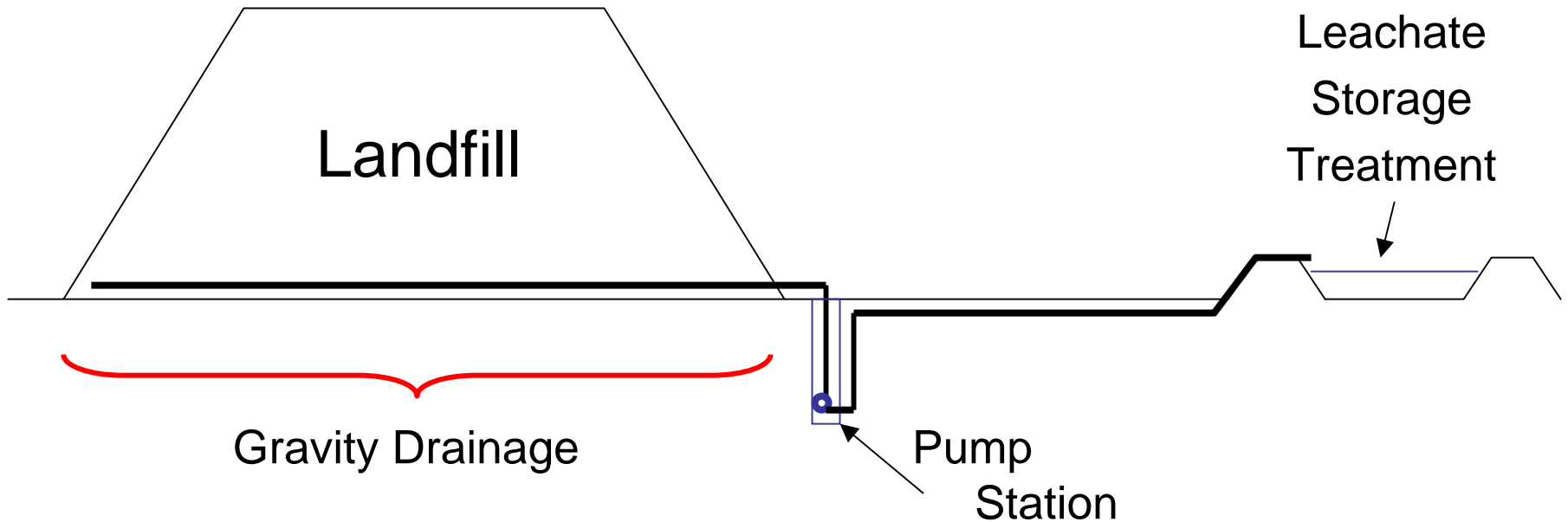








Leachate is then sent to Treatment and/or Storage Facility













Lined Leachate Lagoon



Lined Leachate Lagoon

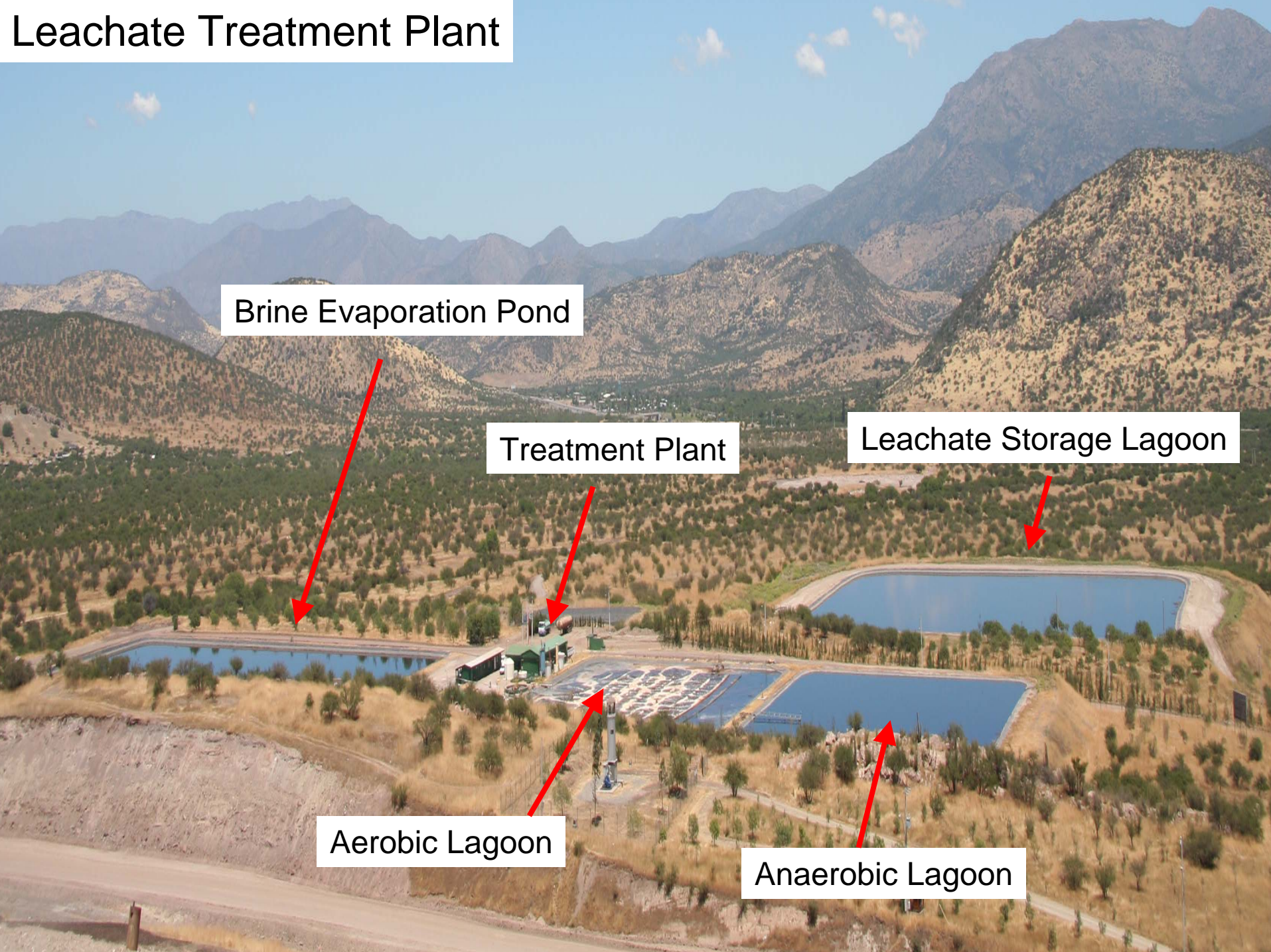
Leachate Storage Tank



Leachate Storage/Treatment Tanks



Leachate Treatment Plant



Brine Evaporation Pond

Treatment Plant

Leachate Storage Lagoon

Aerobic Lagoon

Anaerobic Lagoon

Aerobic Treatment Lagoon



Reverse Osmosis Treatment



Leachate Treatment Using Wetlands



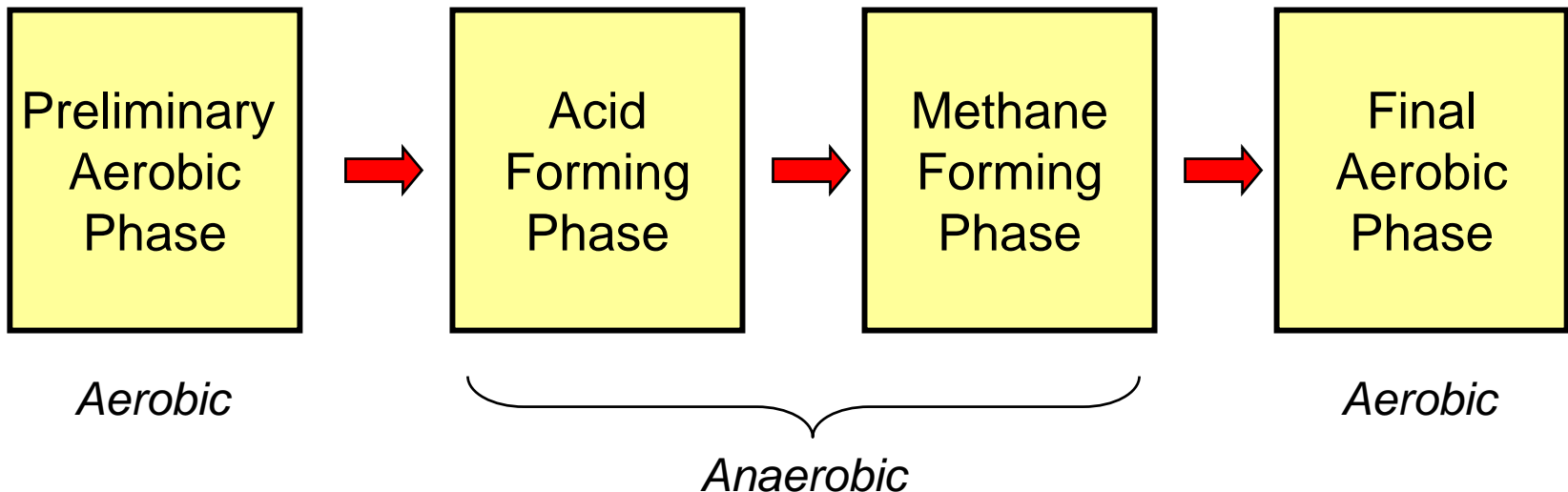
Leachate Recirculation to Landfill using Spray Irrigation



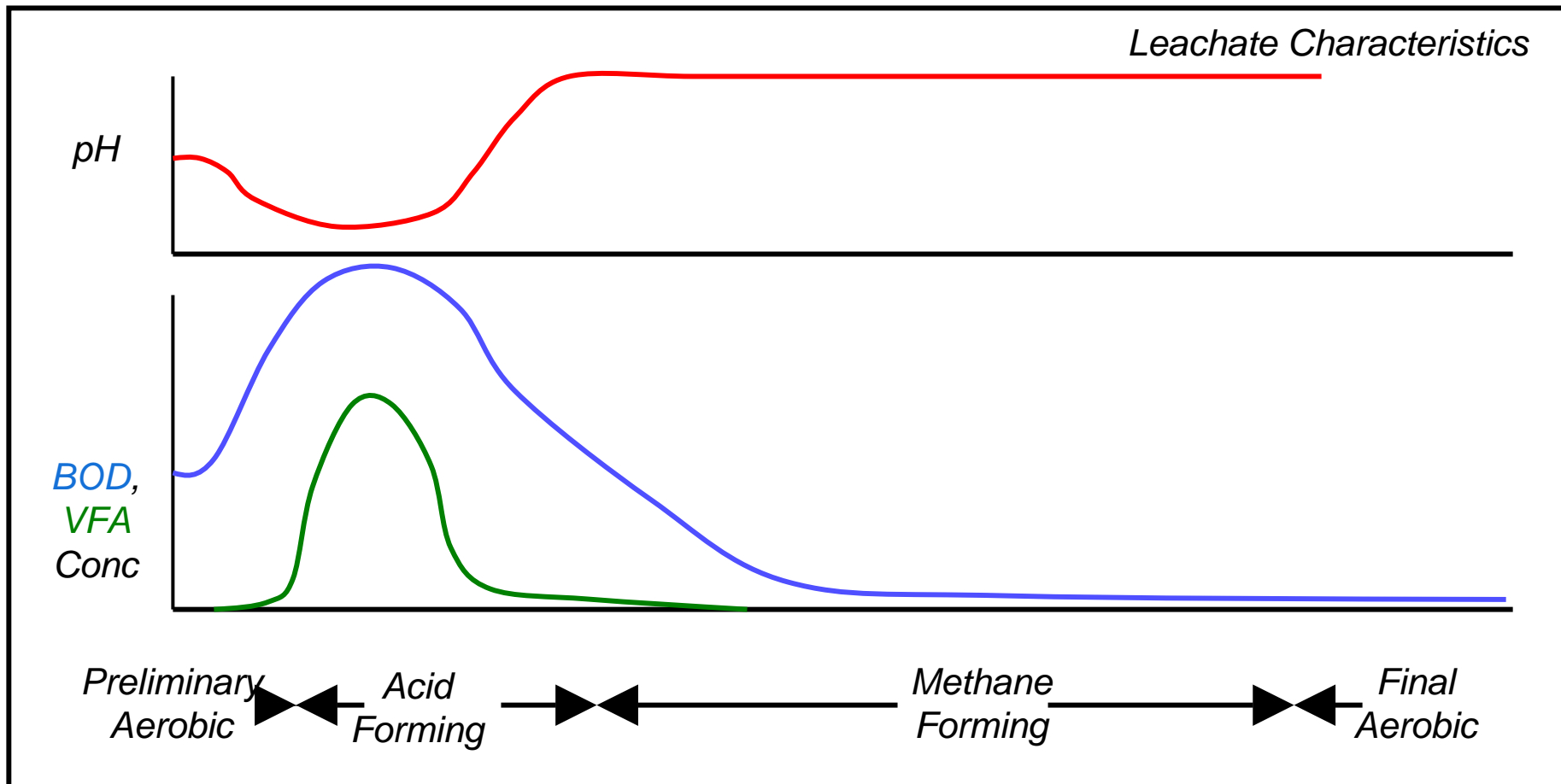
Leachate Recirculation to Landfill using Horizontal Trenches



Waste Stabilization in MSW Landfills



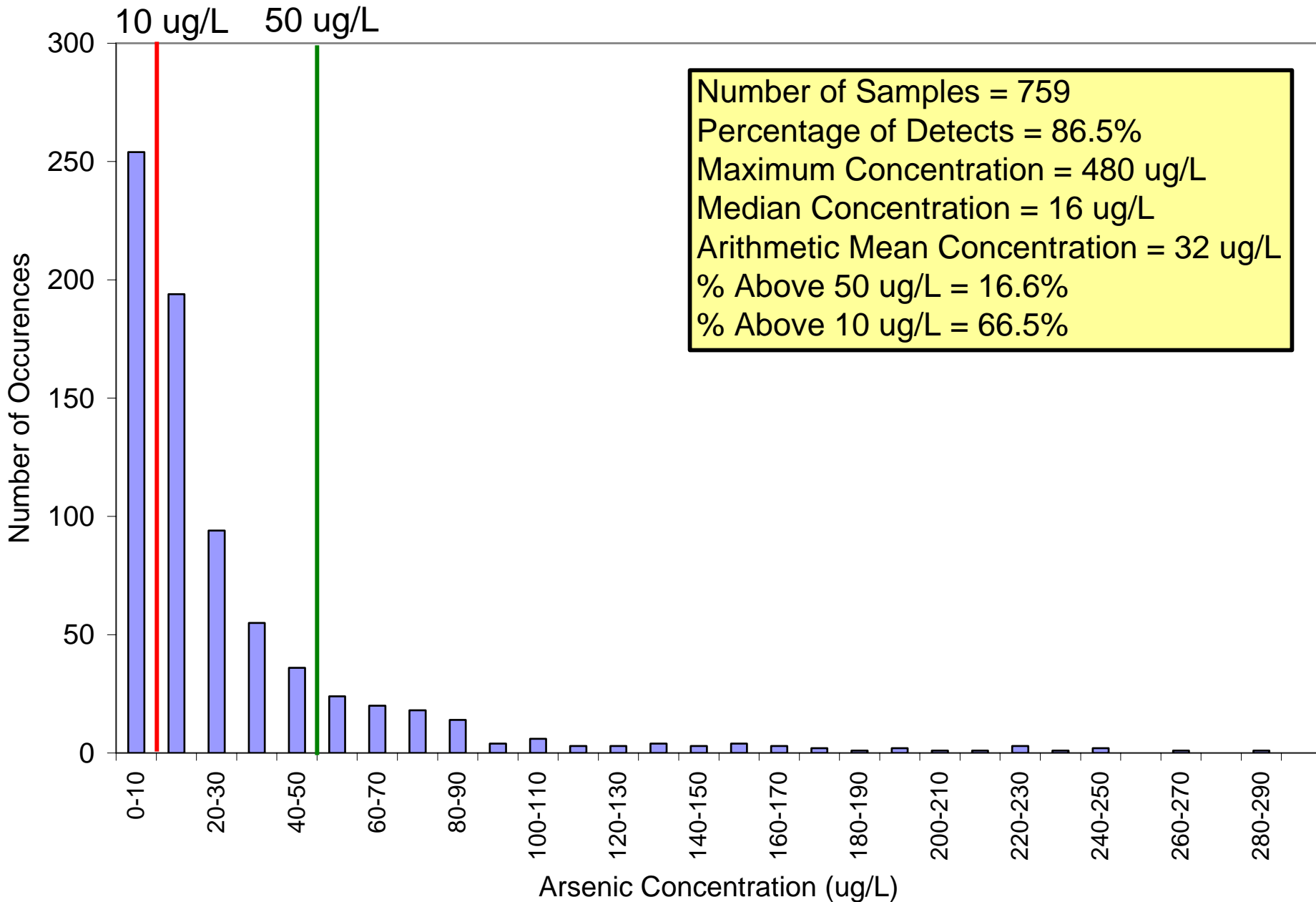
Waste Stabilization in MSW Landfills



Concentrations in MSW Landfill Leachates

Statistic	Arsenic	Lead
Number Samples	2,444	2,539
% Detected	71.1	50.2
5 th Percentile	4	2
10 th Percentile	6	4
Median	20	21
Mean	441	133
90 th Percentile	100	250
95 th Percentile	260	500
GWCTL	50 (10)	15

Arsenic in Florida Landfill Leachate



Other Landfill Types

- Construction and demolition (C&D) debris landfills
- Industrial waste landfills

C&D Debris Landfill



Approximately ½ of states have liner requirements

Unlined Landfill for Hurricane Katrina Debris







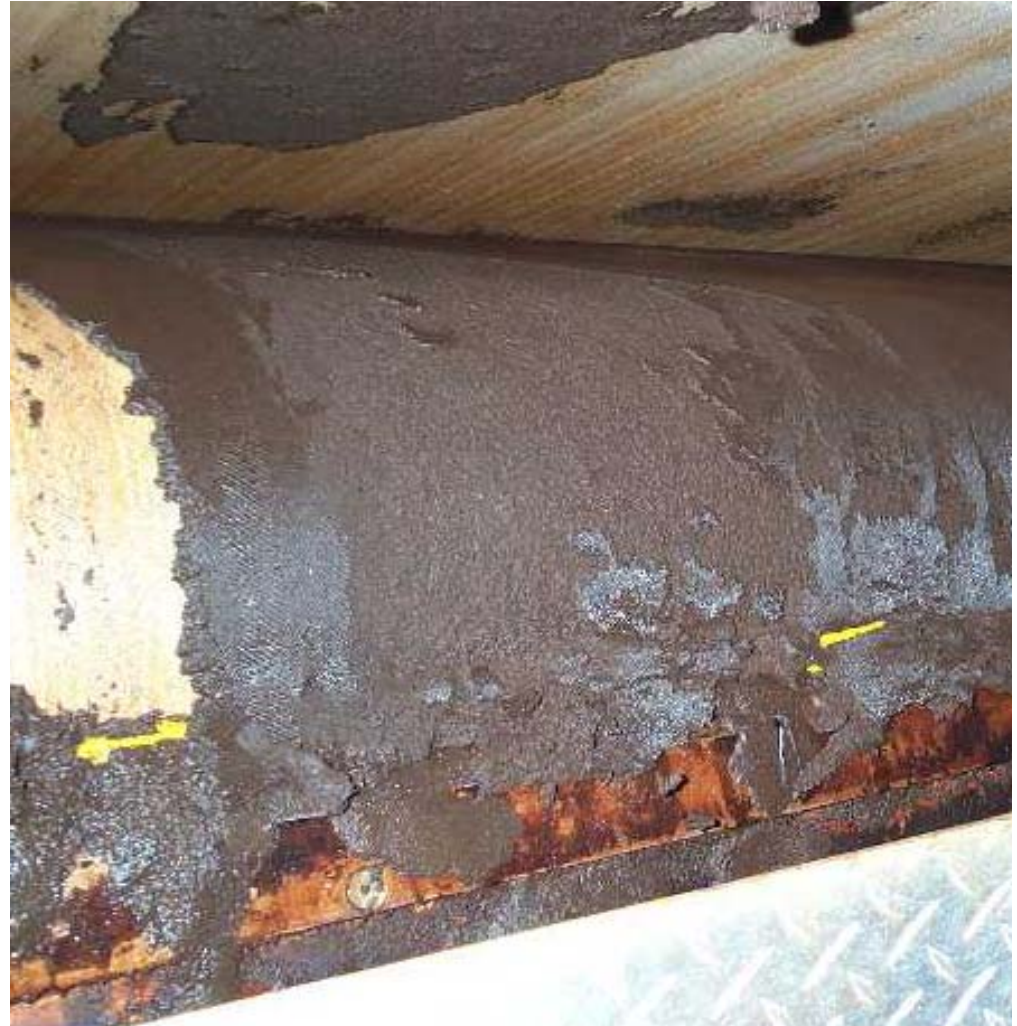


Concentrations in C&D Debris Landfill Leachates

Statistic	Arsenic	Lead
Number Samples	48	68
% Detected	54.2	60.3
5 th Percentile	5	2.9
10 th Percentile	8	4
Median	32.5	40
Mean	34.9	122
90 th Percentile	75	220
95 th Percentile	77.3	360
GWCTL	50 (10)	15

ABR Disposal?

- Hazardous waste disposal unlikely
- MSW landfill (would probably accept if ABR meets liquids restrictions)
- Other (depends on state regulations)



Ferric coagulant drinking water
sludge in Florida →







**Metal-bearing wastes are
disposed in landfills**

Lead-Based Paint



Mercury Lamps



Treated Wood



Wood Ash





Discarded Electronic Devices



Potential Problems Posed

- Groundwater contamination (primarily an unlined landfill issue)
- Impact on leachate quality
- Impact on gas quality (e.g., Hg)
- Long-term operation issues

Factors to be Considered

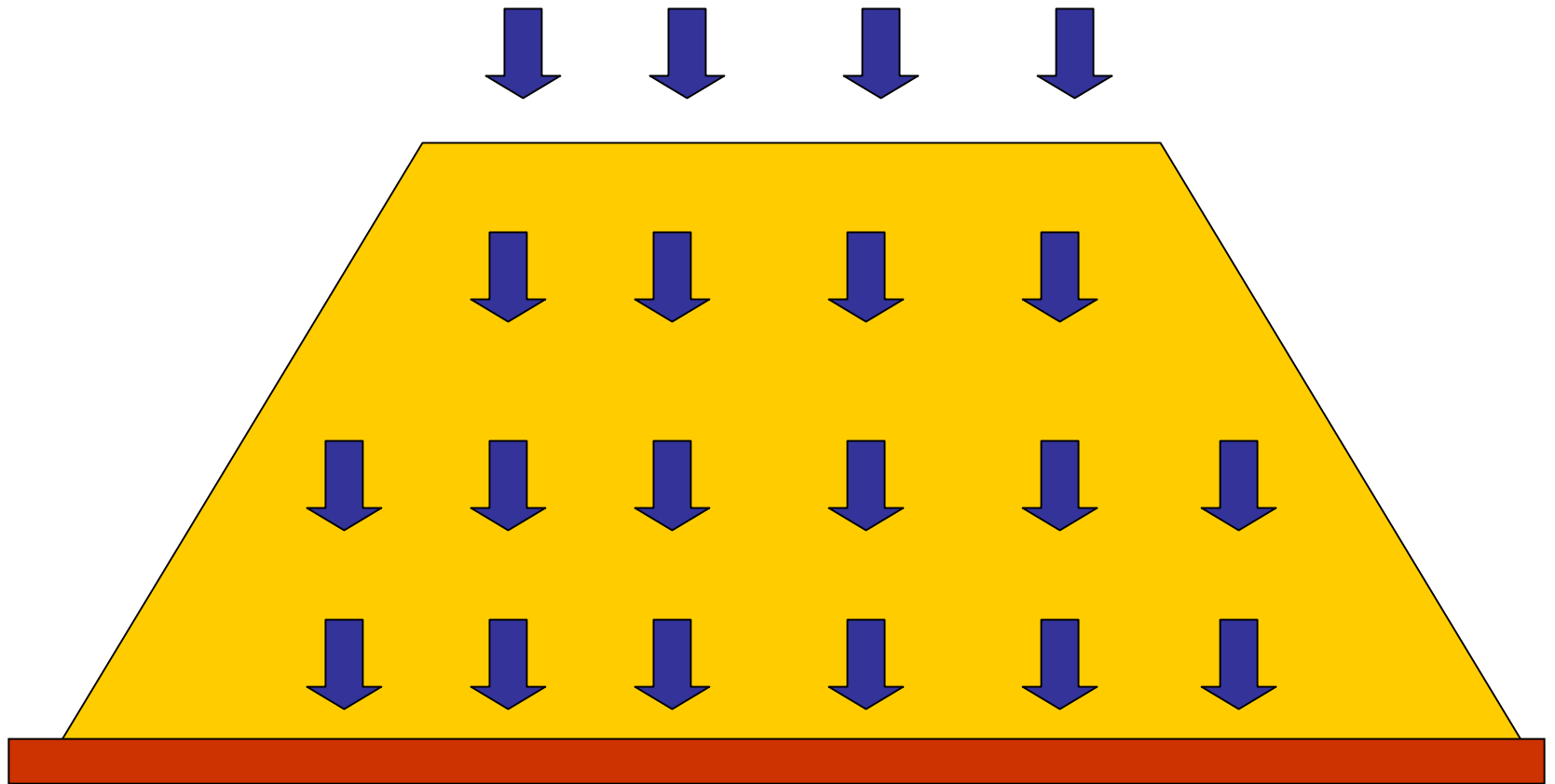
- Leachability
- Rainfall and amount of leachate
- Fraction in the landfill

Important Point

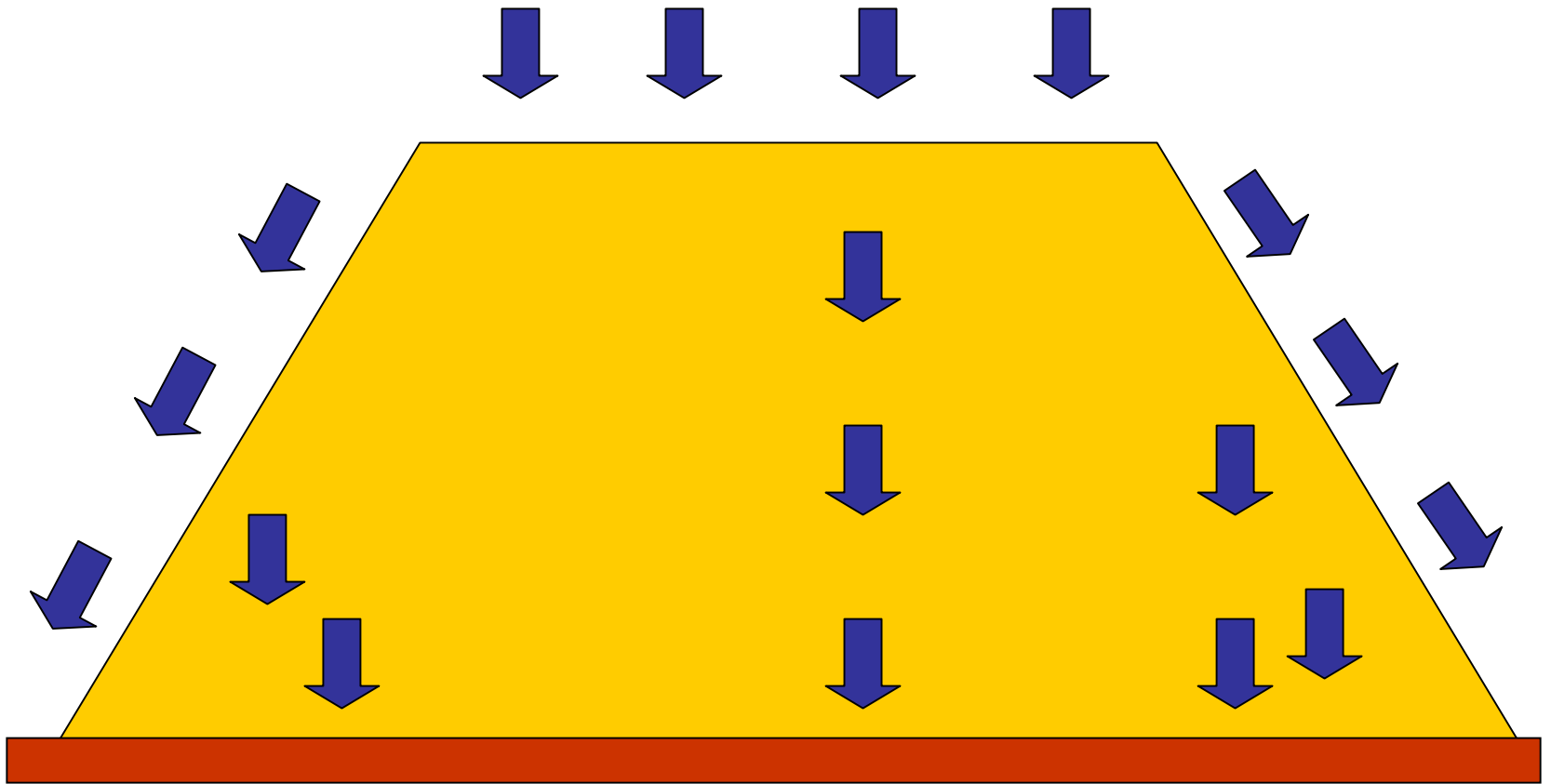
- A majority of the waste in modern landfills stays dry



Incorrect Perception



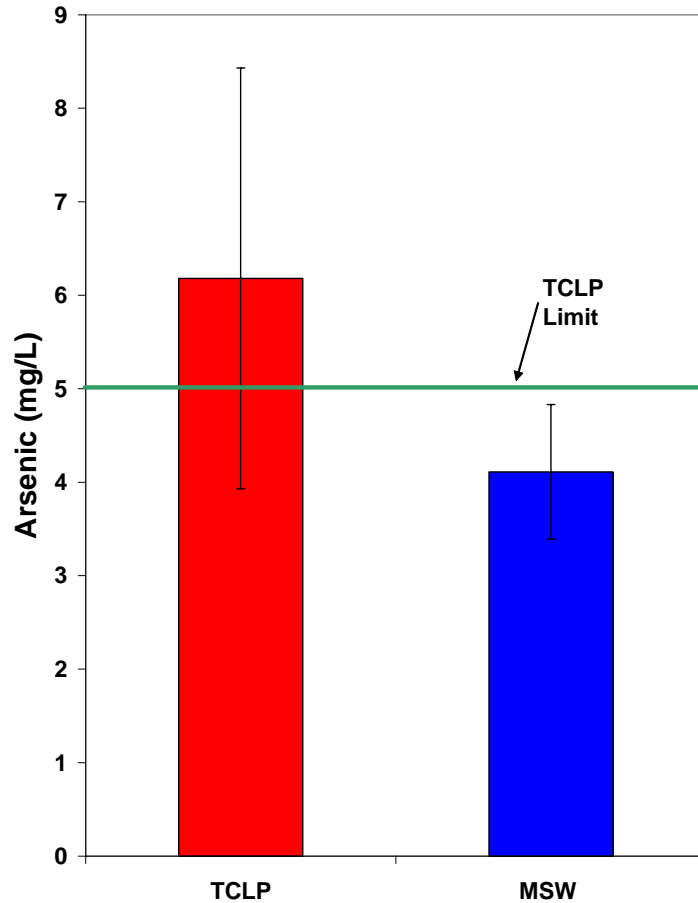
More Accurate Perception



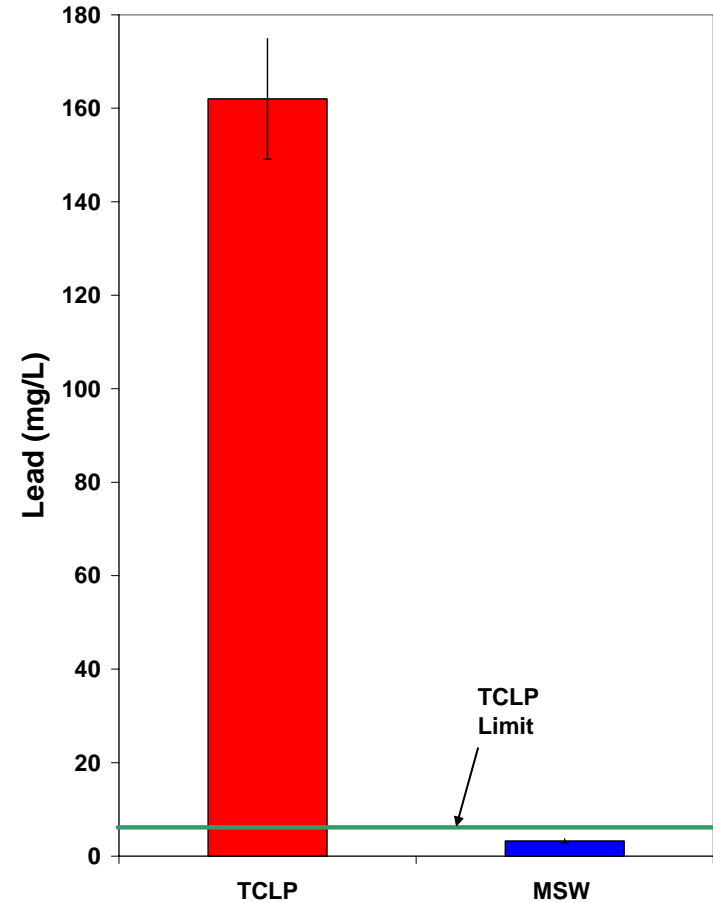
A Few Comments on Leaching

- Several studies show that TCLP may not be reflective of leaching that will occur in a landfill for some wastes.
- TCLP does not always under predict leaching.

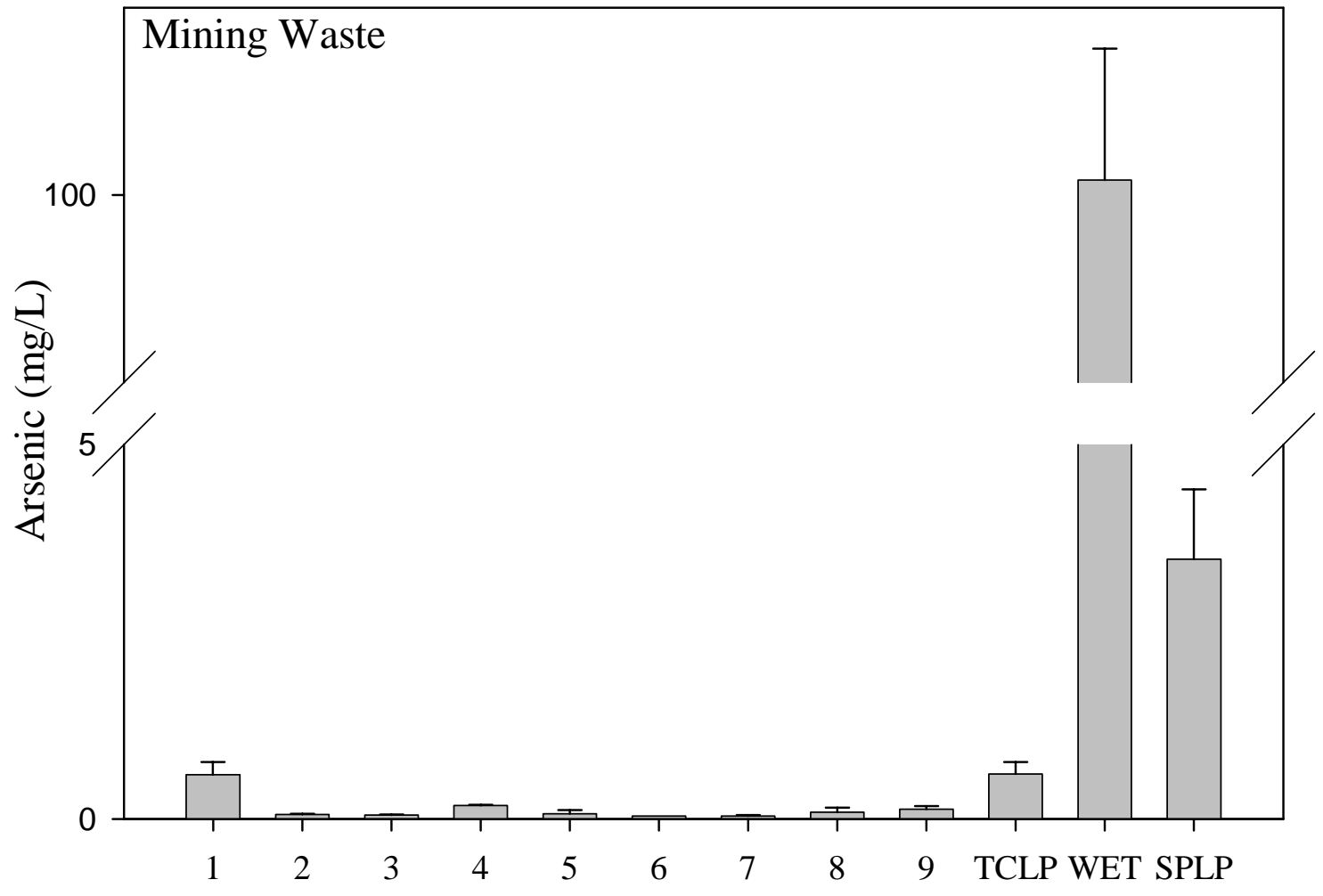
Leaching in MSW LF Leachate

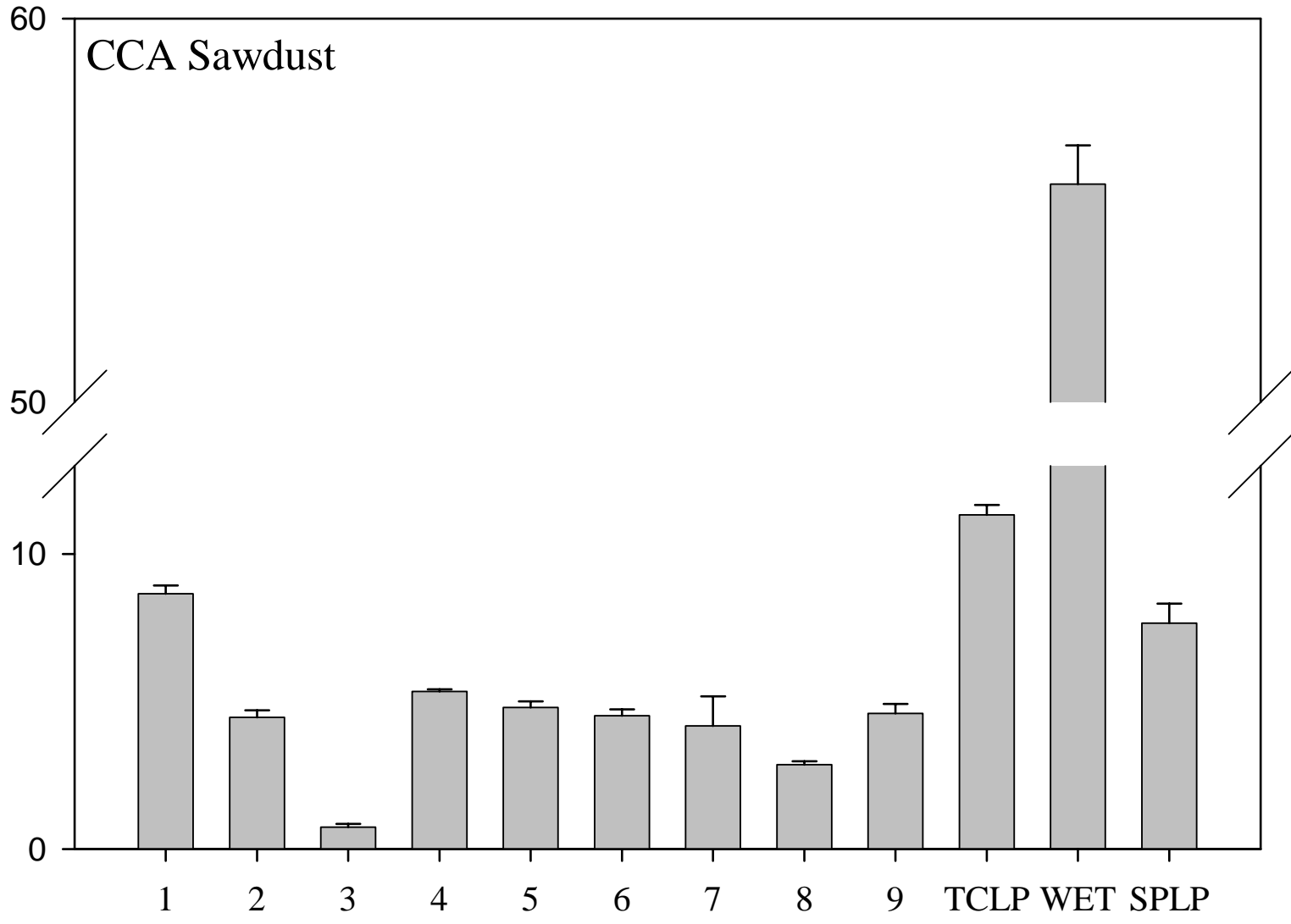


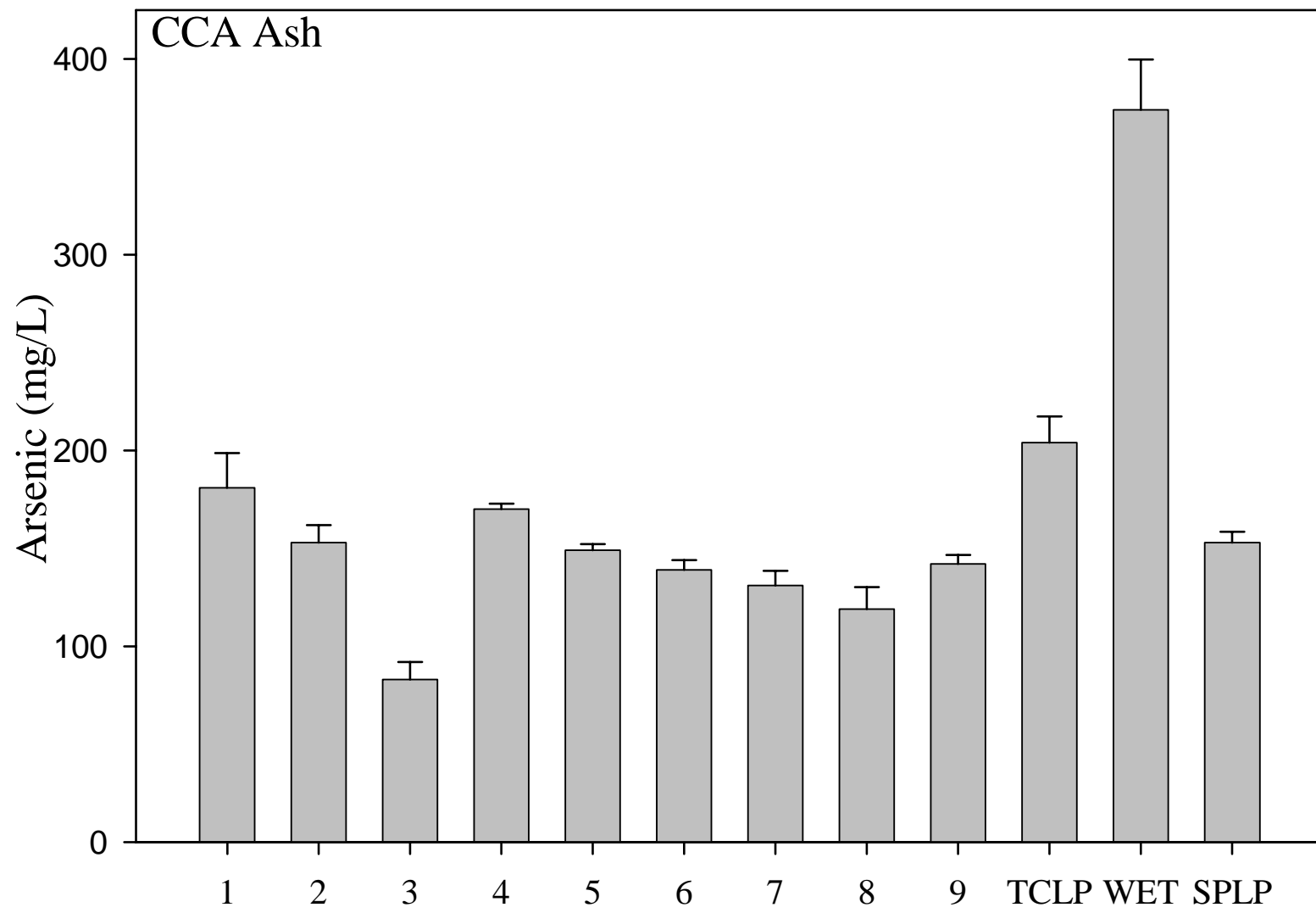
CCA-Treated Wood

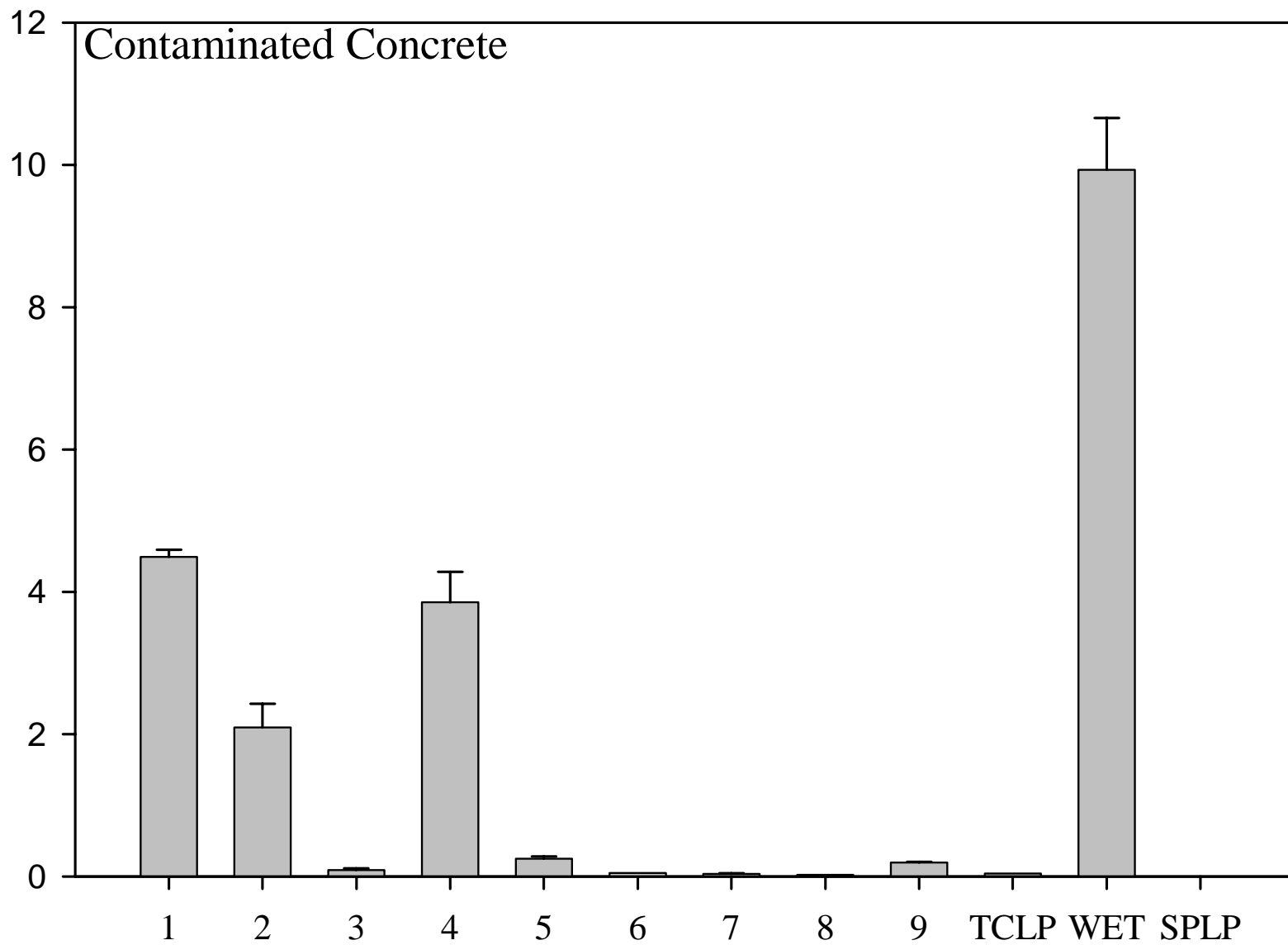


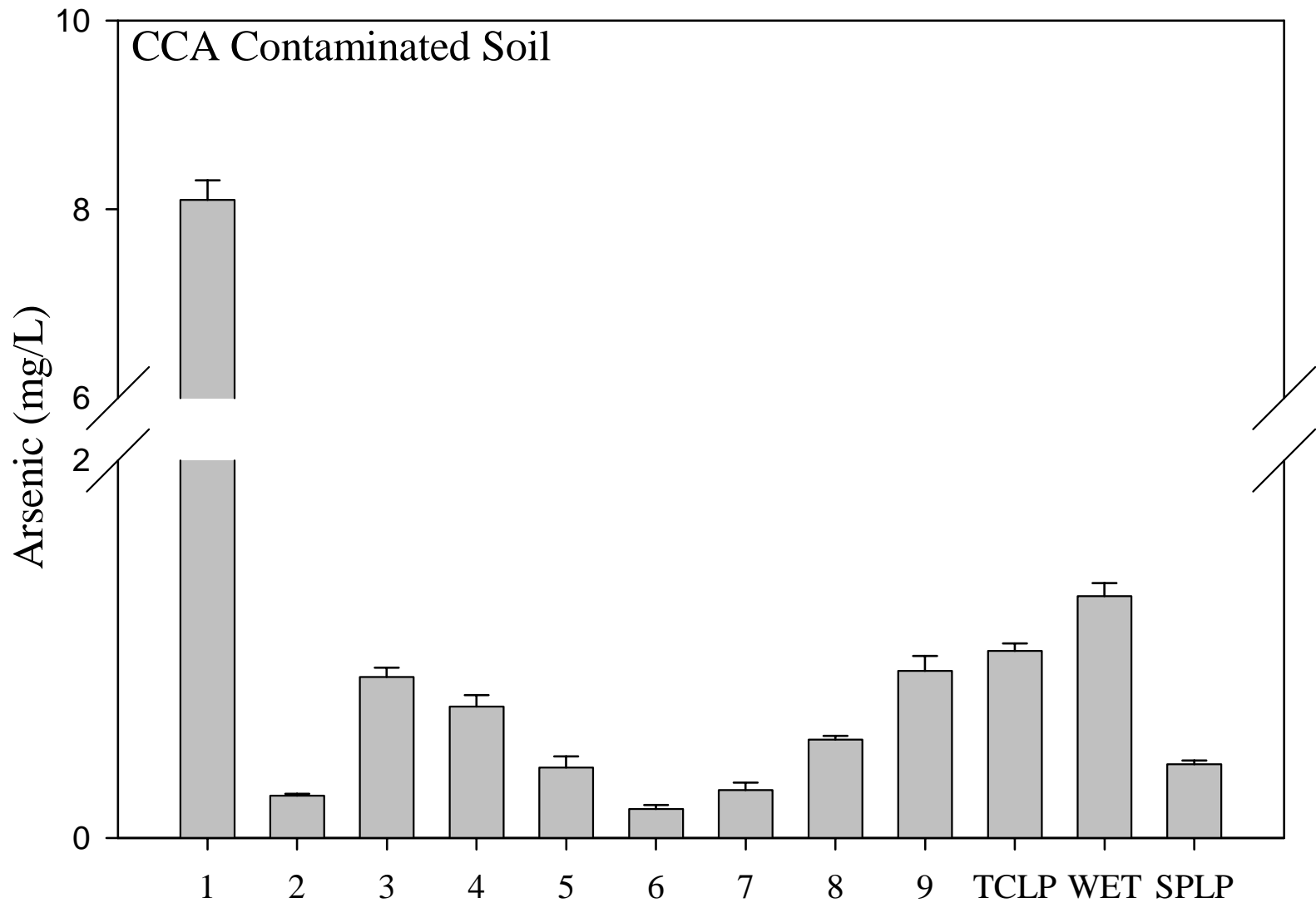
Printed Wire Boards







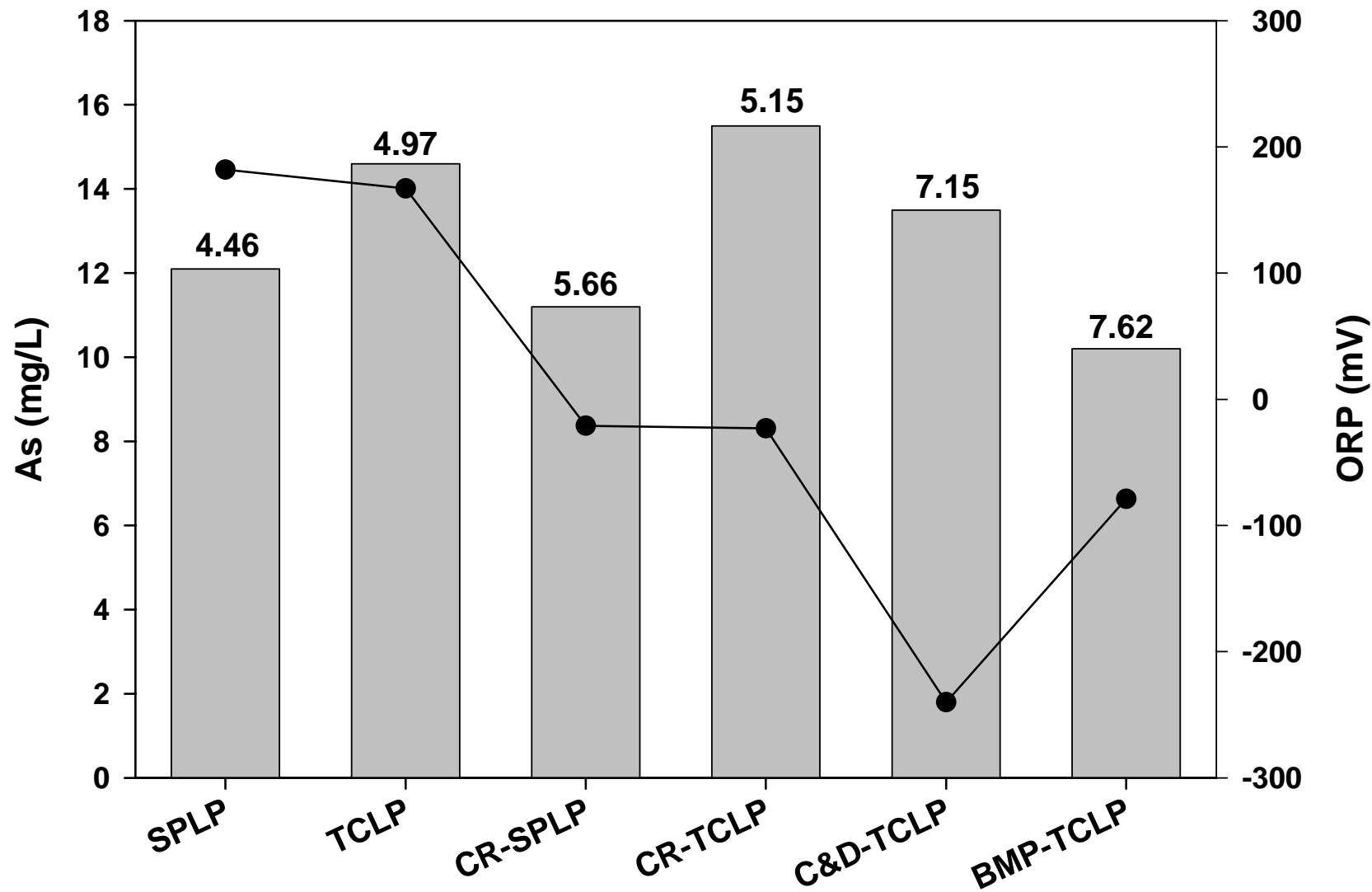




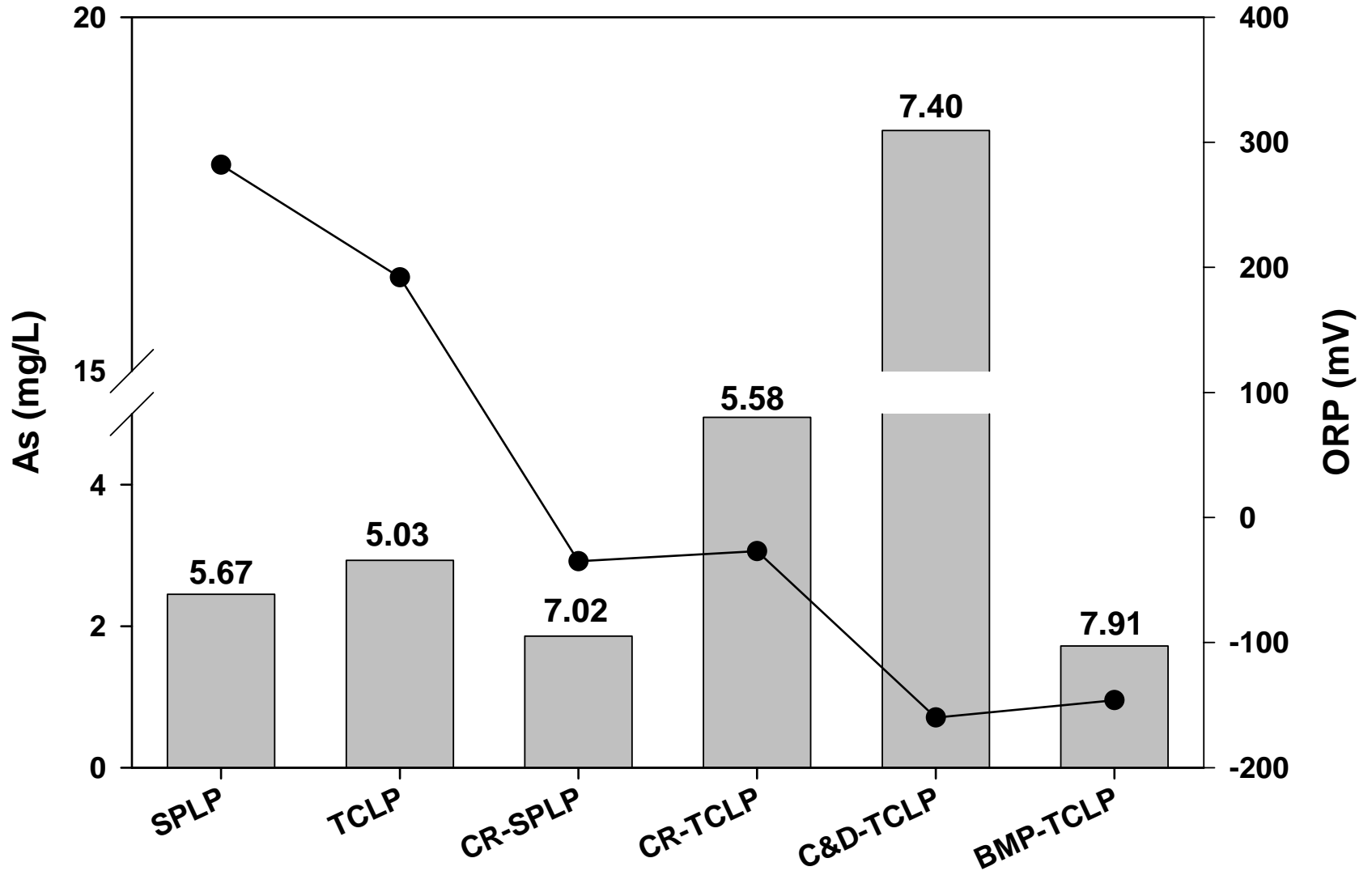
Many Reasons for the Difference

- pH
- Leachate chemistry
- Redox conditions
- Interactions with waste and other chemicals in leachate
 - Precipitation
 - Sorption

Leaching from CCA Sawdust Sample



Arsenic Leaching from GFH Sludge



Simulated Landfills











SPEED
LIMIT
5

ALL WORKERS
MUST WEAR
HARD HATS
WHILE IN
THE WORK AREA



Plastic



Food waste from Publix



A scale was used to weigh components.





Paper and
Cardboard

Non-putrescible wastes

- Plastic
- Glass
- Steel
- Wood
- Yard Waste
- Aluminum

Putrescible wastes

- Vegetable and
Fruit Waste
- Cat Food





RECYCLING

000071

Computer Monitor



Cell Phones

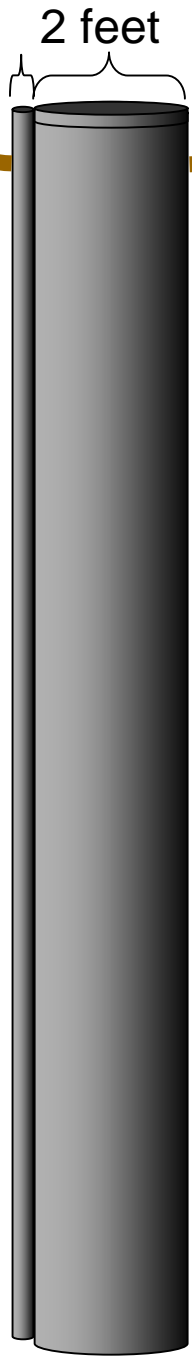
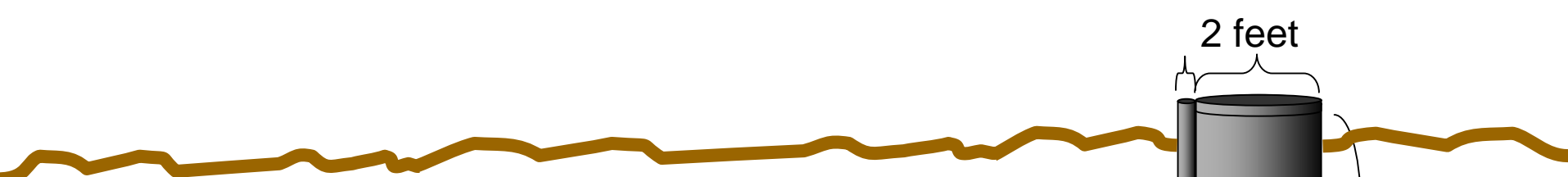


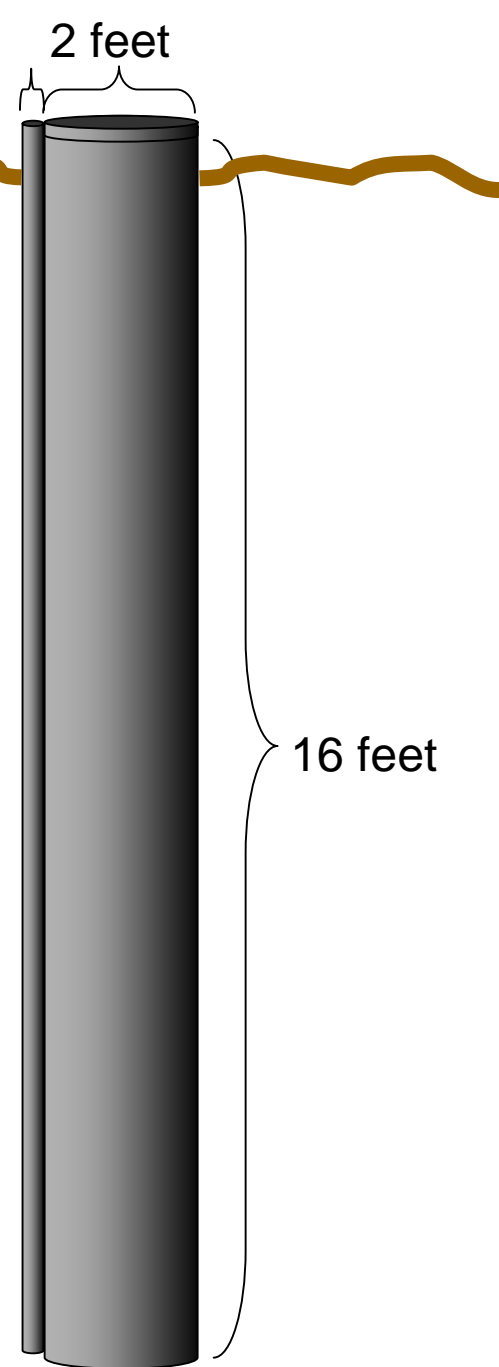
Desktop Computer



Smoke Detector

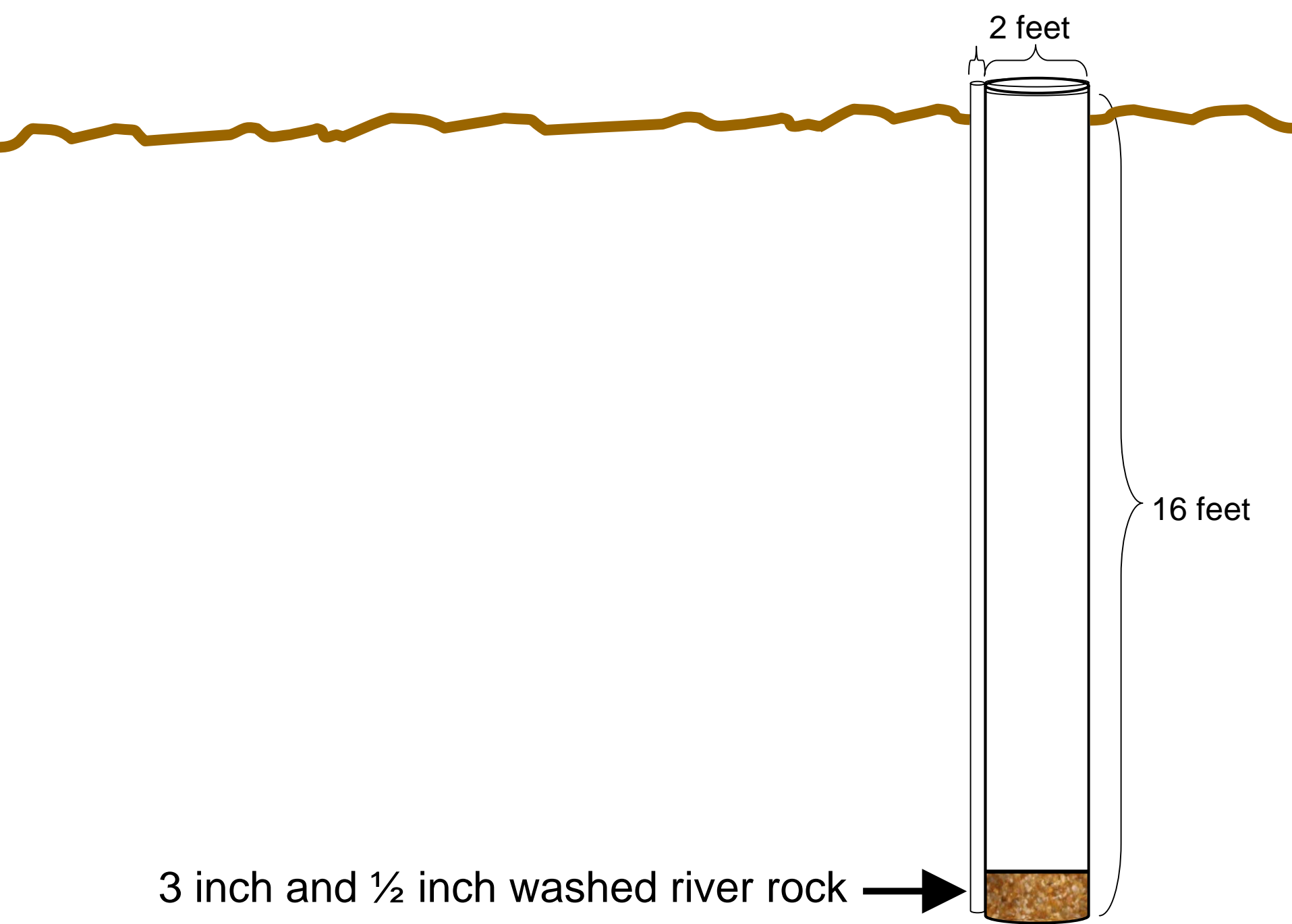






2 feet

16 feet

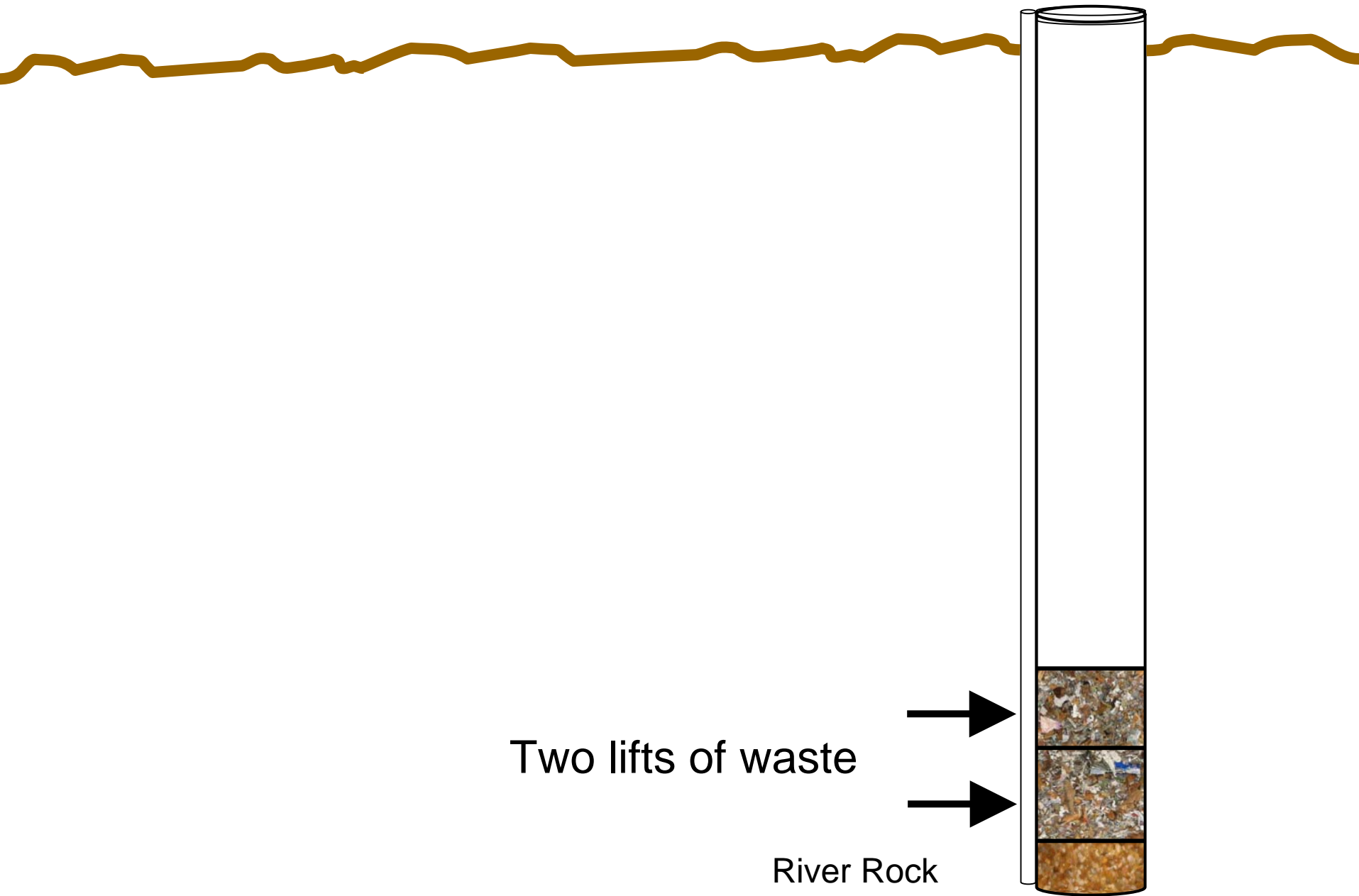


2 feet

16 feet

3 inch and 1/2 inch washed river rock





Two lifts of waste

River Rock

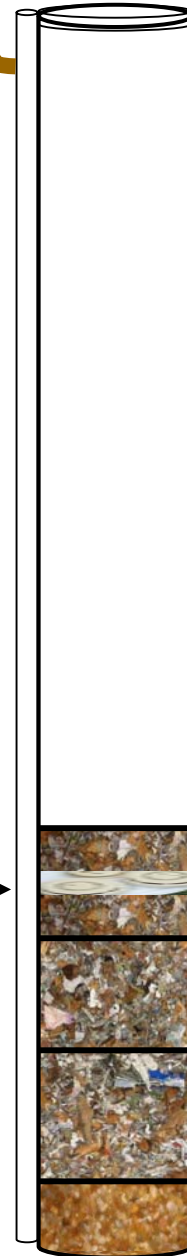


3 Smoke detectors mixed into middle of lift



Two Lifts of Waste

River Rock





1 CPU mixed into middle of lift →

Smoke Detectors

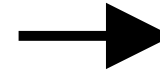
Two Lifts of Waste

River Rock





1 monitor mixed into middle of lift



CPU

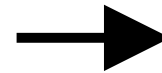
Smoke Detectors

Two Lifts of Waste

River Rock



1 keyboard and 1 mouse



Monitor

CPU

Smoke Detectors

Two Lifts of Waste

River Rock



4 Cell Phones and 8 Ni-Cd Batteries



Keyboard and Mouse

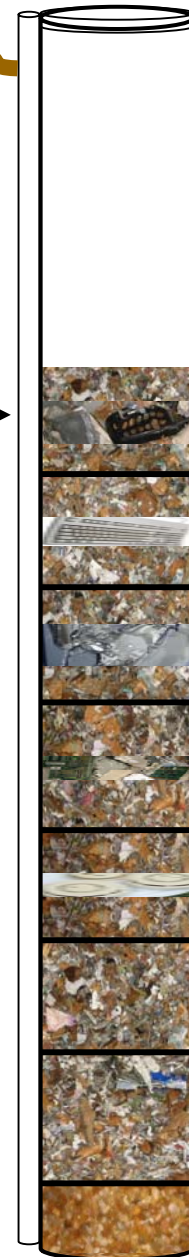
Monitor

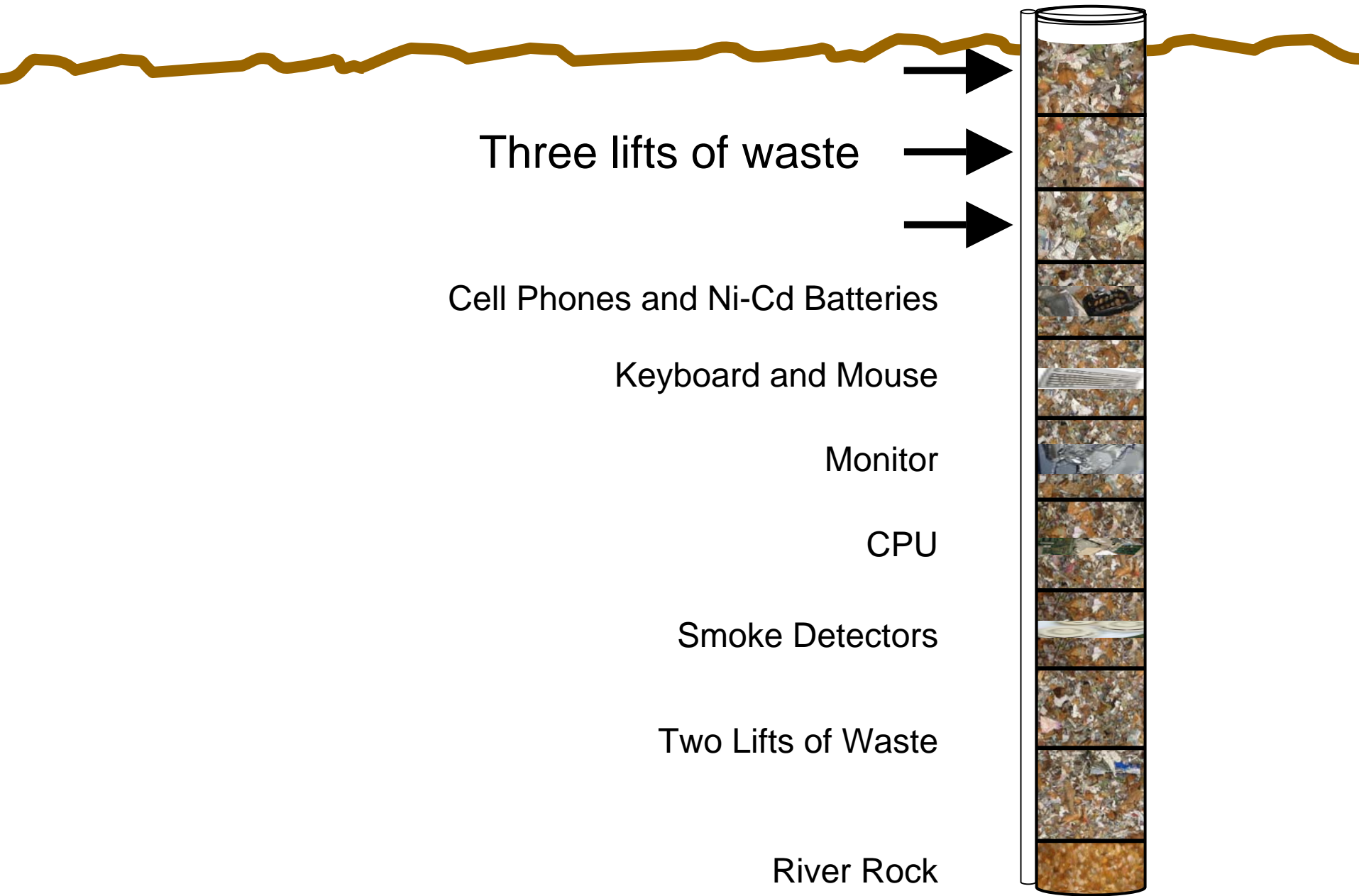
CPU

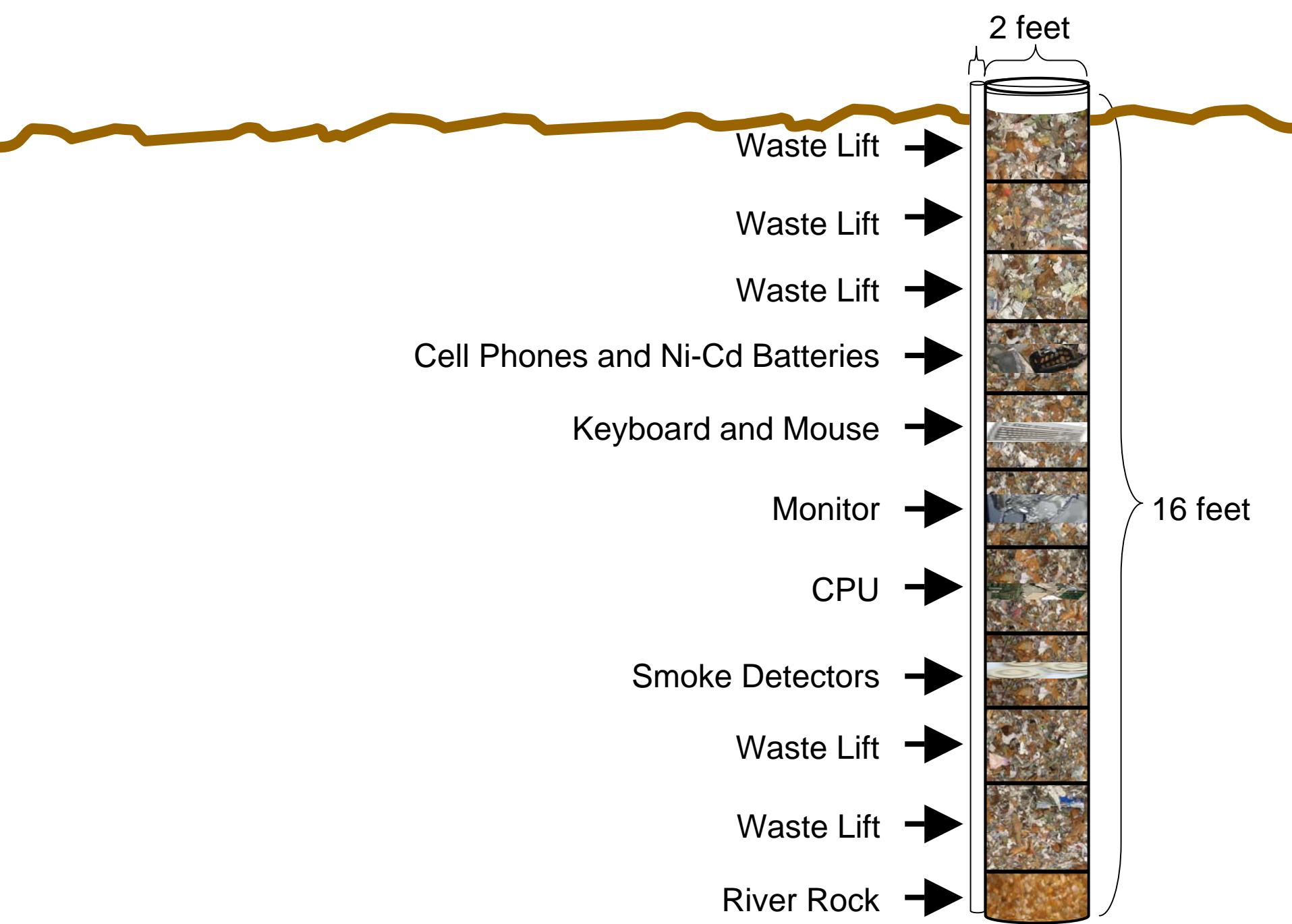
Smoke Detectors

Two Lifts of Waste

River Rock









Water distribution system



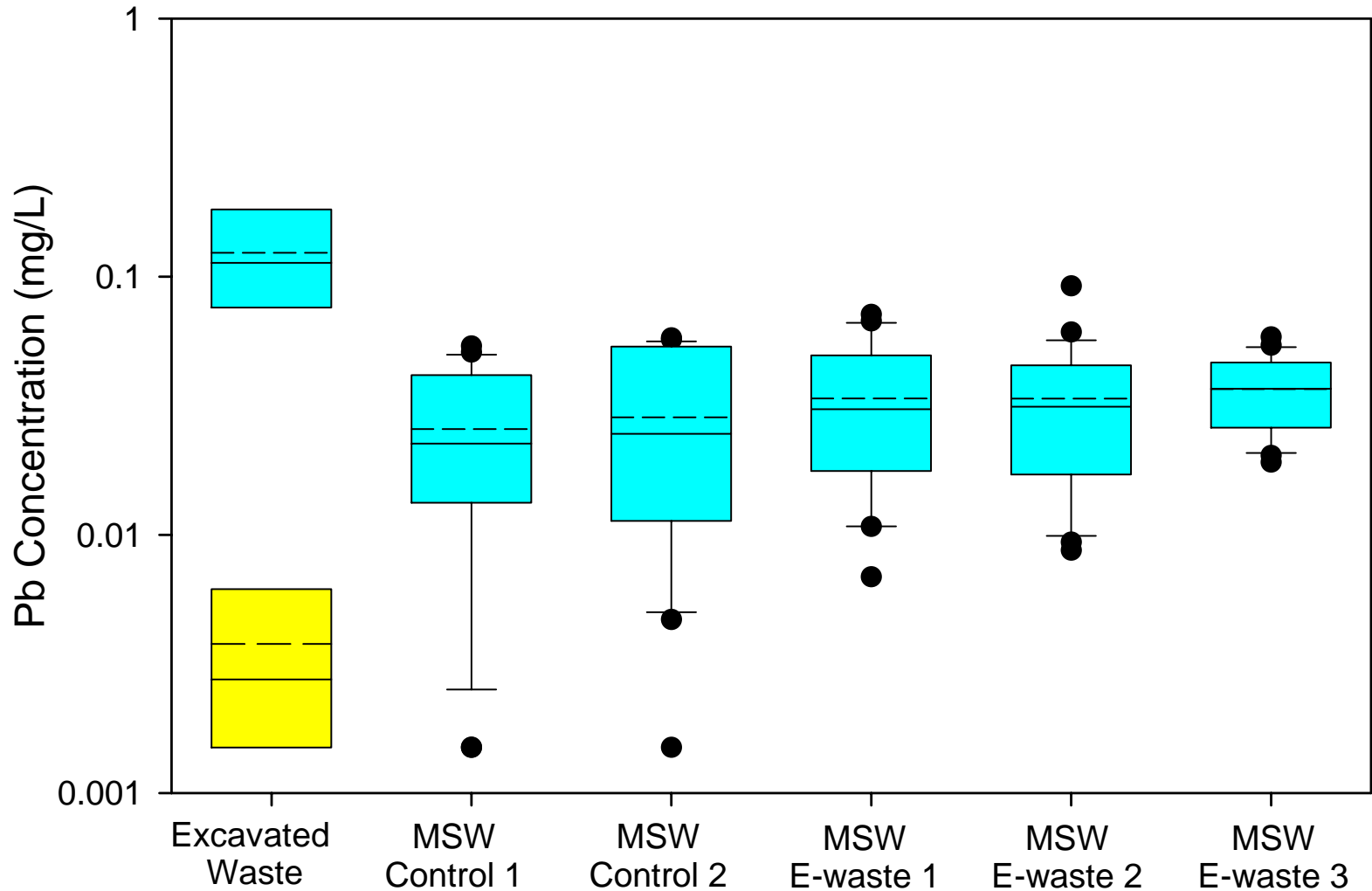


Water addition

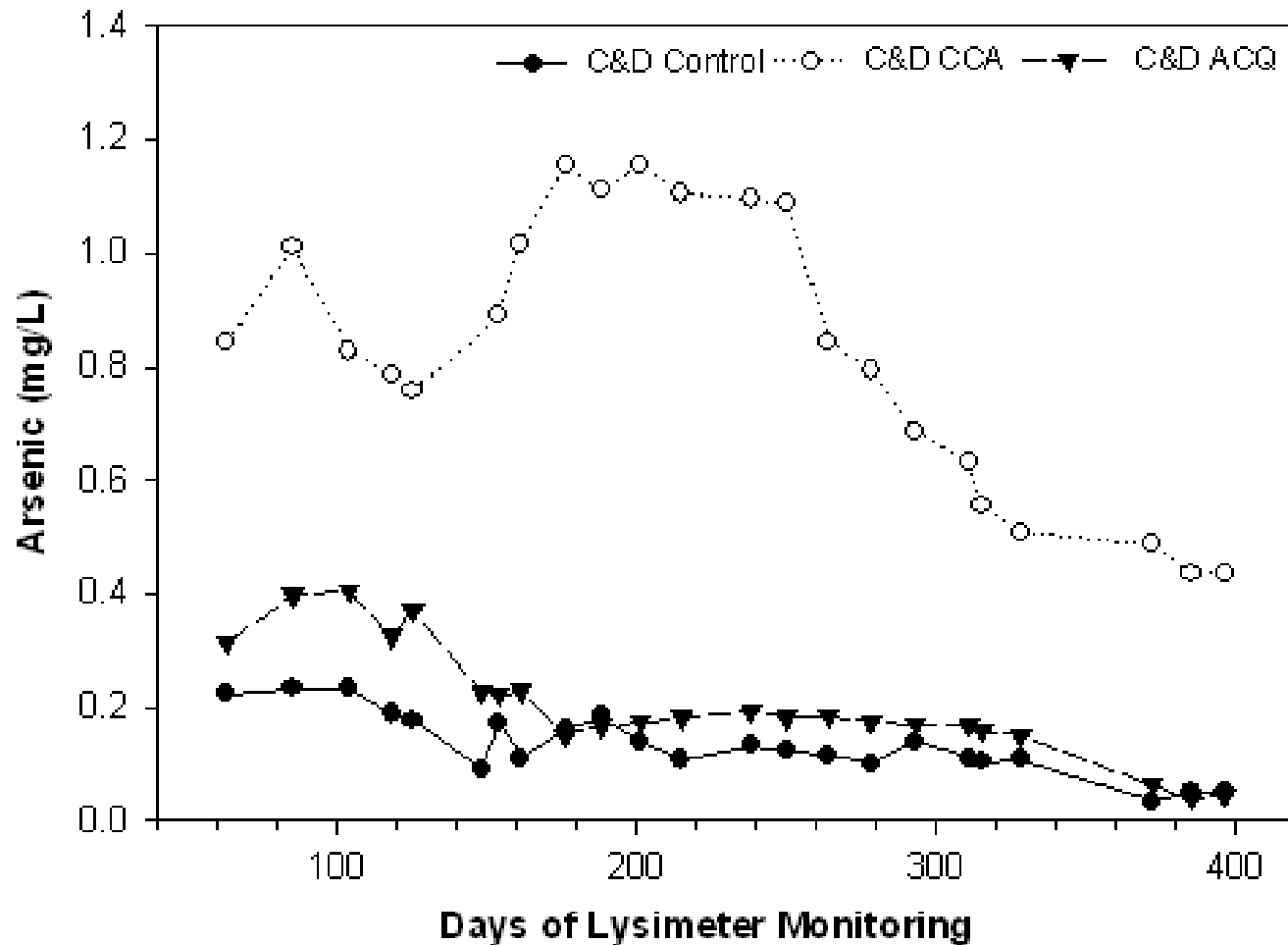


Box Plot of Leachate Lead Concentrations

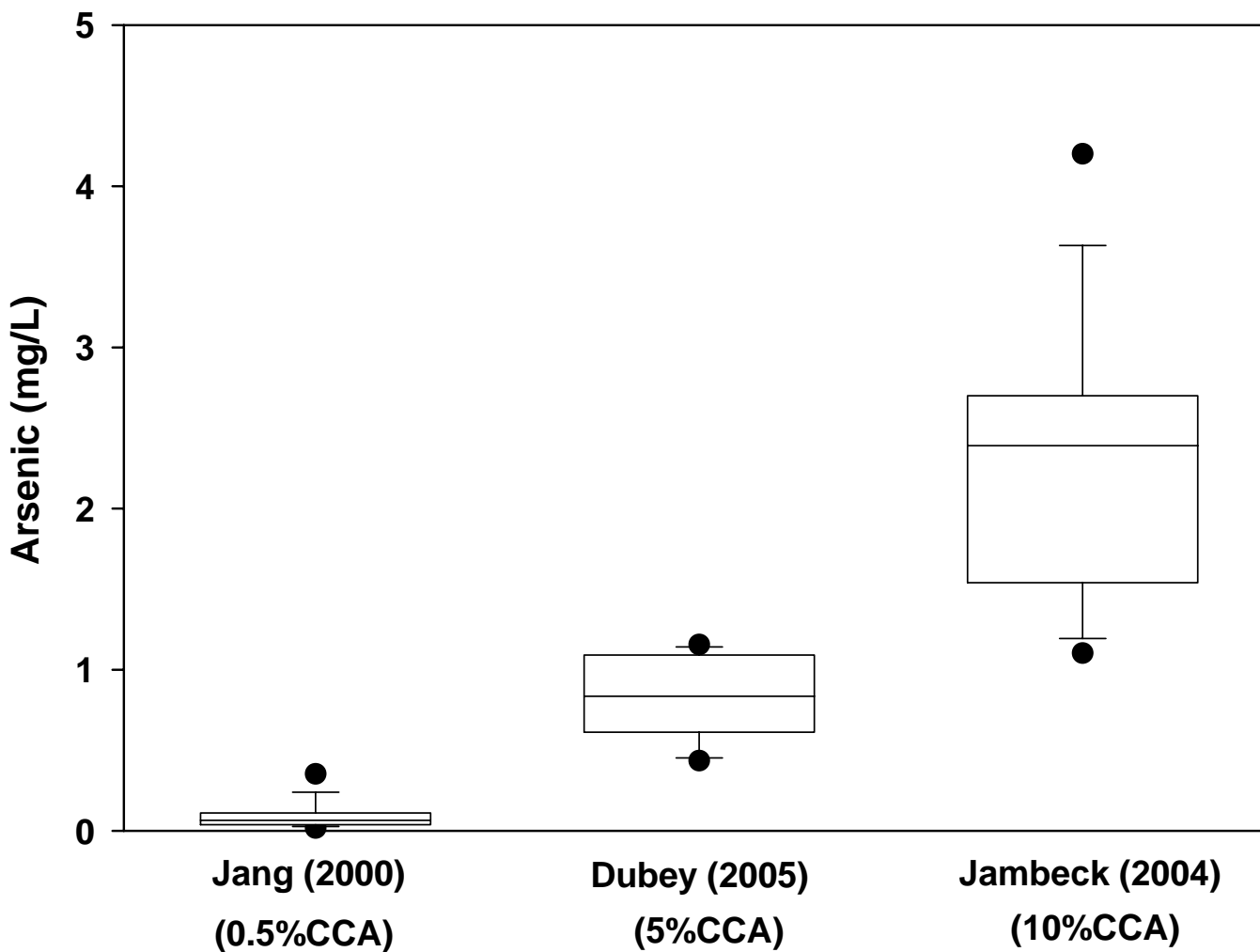
(Leachates with pH less than 7 in cyan, pH greater than 7 in yellow)



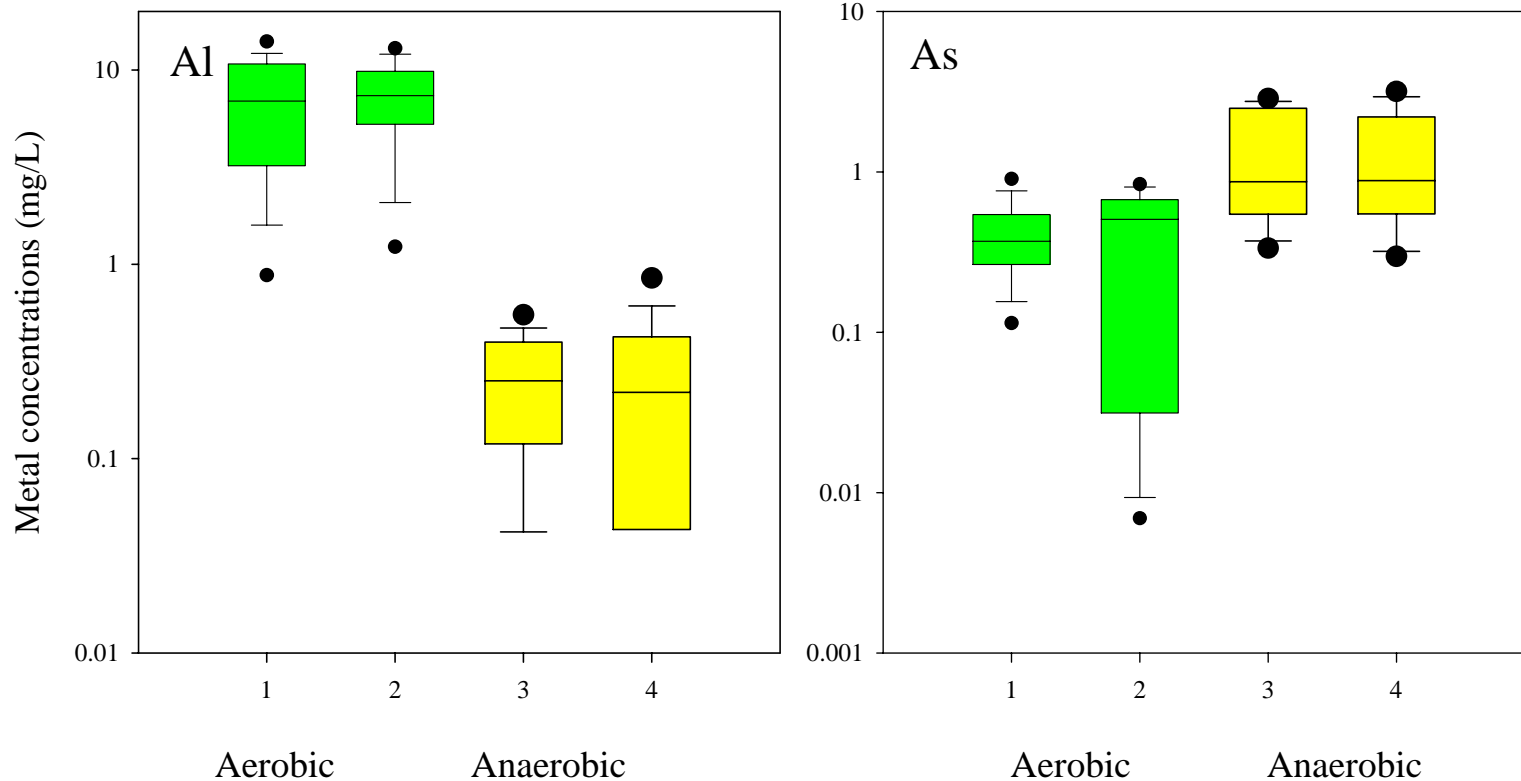
Arsenic vs. Time in C&D Lysimeter Leachate



Arsenic Concentration in CCA Lysimeter Leachates from Three C&D Lysimeter Projects



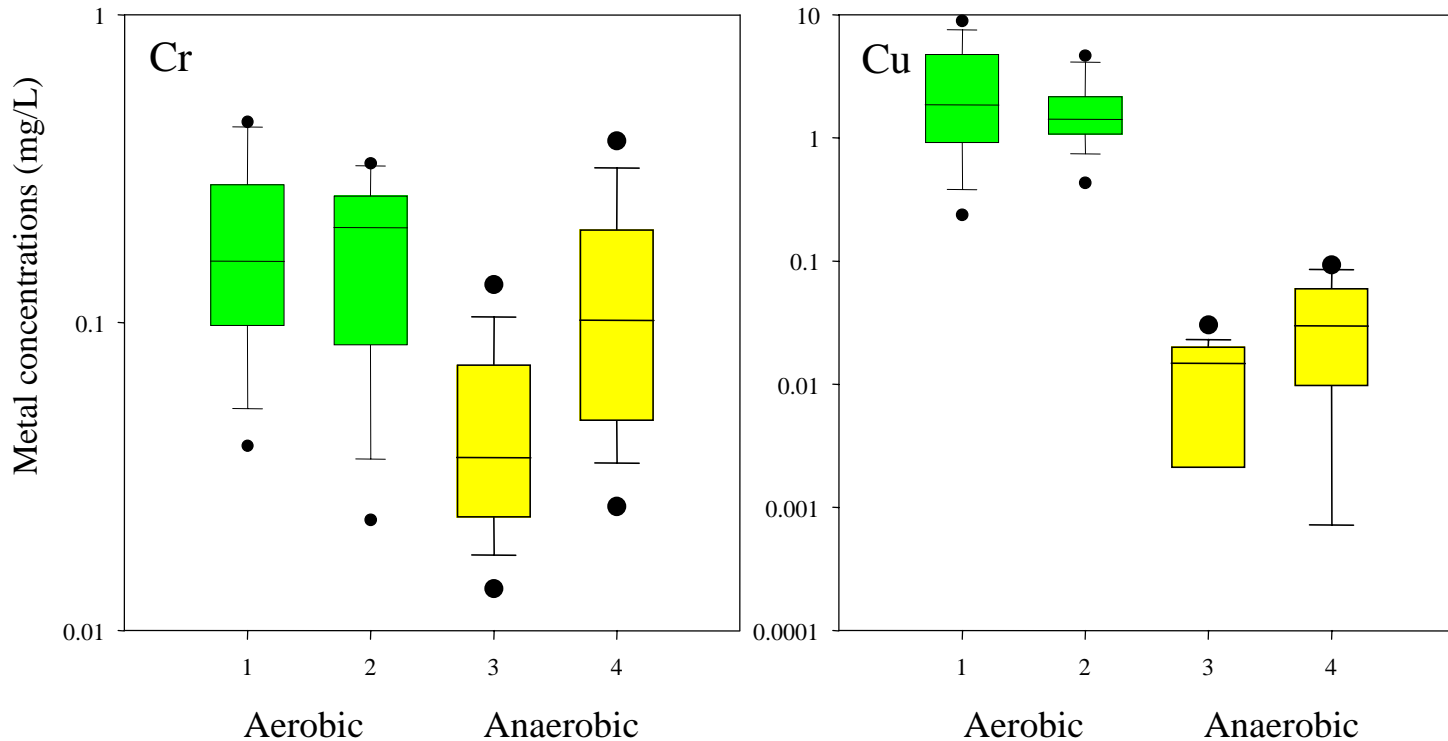
Comparison of concentrations of metal leached between aerobic and anaerobic lysimeters



Al: aerobic > anaerobic

As: aerobic < anaerobic

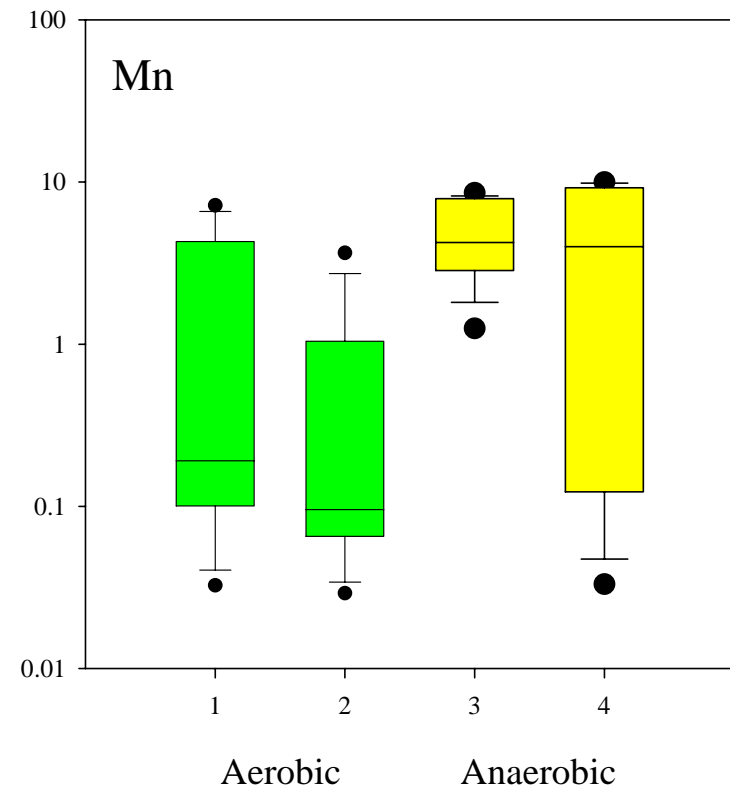
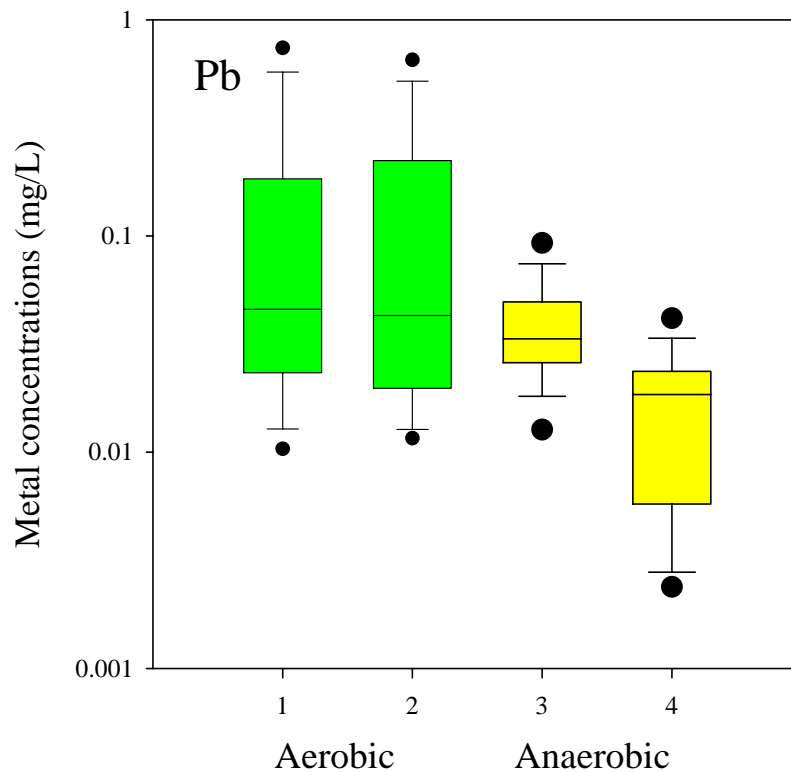
Comparison of concentrations of metal leached between aerobic and anaerobic lysimeters



Cr: aerobic > anaerobic

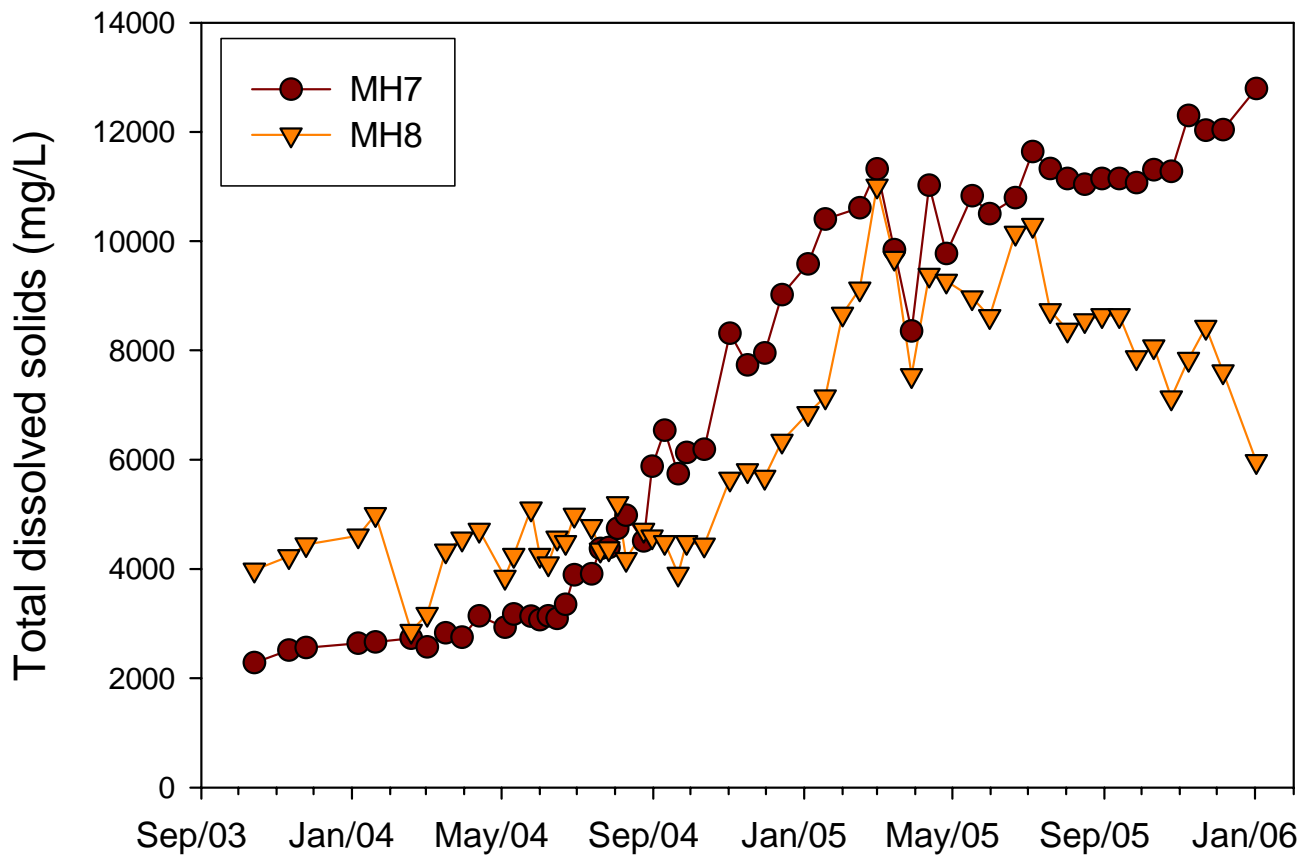
Cu: aerobic > anaerobic

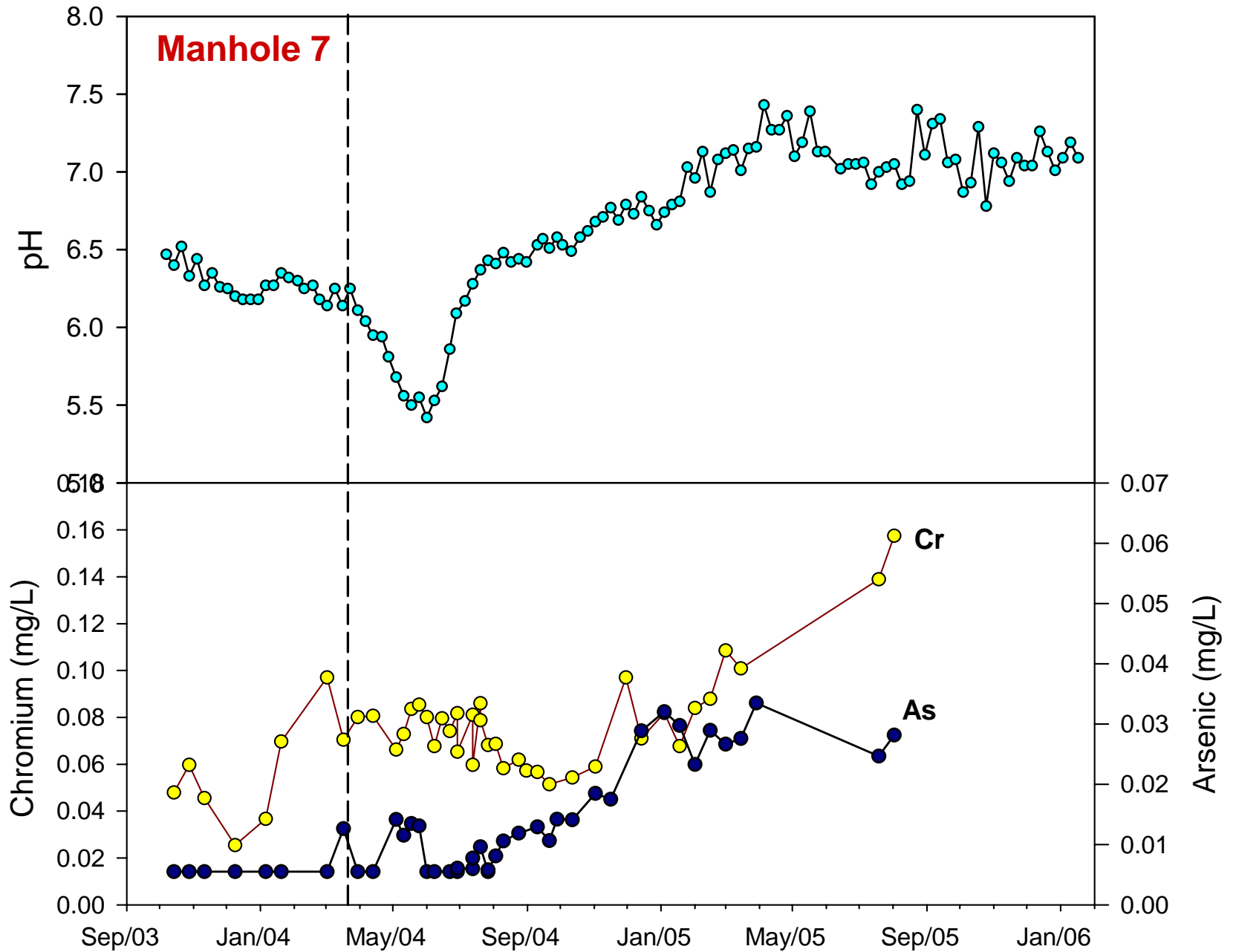
Comparison of concentrations of metal leached between aerobic and anaerobic lysimeters



Pb: aerobic > anaerobic

Mn: aerobic < anaerobic





Lead Leaching from CRT Glass: Impact of pH

