



U.S. ARMY

# SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR

28-30 NOVEMBER 2018

GALVESTON, TX

Engineering and Operational Controls

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US Army Corps  
of Engineers®

28-30 Nov 2018

Galveston, TX

# Overview

- **Approach and Concepts**
- **Aquatic Placement Controls**
- **Upland/Nearshore Placement Controls**

# **Risk**

**If it is determined that unacceptable risk(s) exist,**

**Engineering and/or operational controls  
must be evaluated for effectiveness for the  
site and sediment conditions.**

# Concepts

- Risk is managed by controlling the exposure -- concentration and duration.
- Exposure can be reduced by reducing the source concentration, the total mass released, or the rate of release and by altering the release locations.

# Engineering Control

**Definition:** Requires a physical technology or modification of the placement site or design to cause the desired change in conditions.



Source: Geotechnical  
Supply Inc

# Operational Control

**Definition:** Action that can be undertaken by dredge operator to reduce unacceptable risks of the dredging operations using existing equipment.





# Control Applications

**Changes in dredging equipment and/or operations can modify:**

the total mass released, the rate of release  
and the release locations

**But changes in dredging equipment and/or operations involves tradeoffs:**

- dredge production rates,
- project duration,
- costs,
- etc.

# Engineering Controls -- Size Matters

- **As size increases:**

- Production rate increases,
- Concentration of resuspended sediment increases, and
- Availability dilution decreases.



# Aquatic Placement Controls

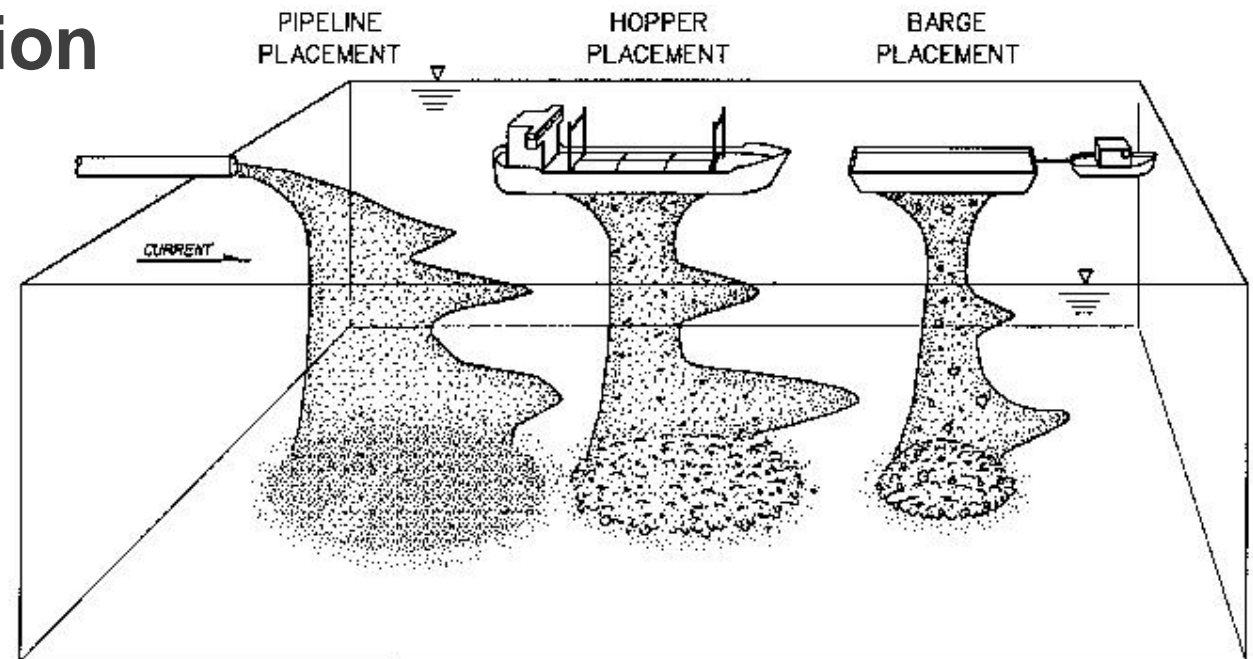
# Aquatic Control Measures

- **Water Column Management**
  - Submerged discharge
  - Silt curtains
  - Geocontainers
  - Treatment (polymer addition, sequestration)
  - Reduce discharge rate
  - Promote mixing (discharge while under tow)
- **Benthic Management**
  - Treatment
  - Lateral confinement or CAD
  - Capping with cleaner dredged material or armor
  - Geocontainers



# Engineering Modifications

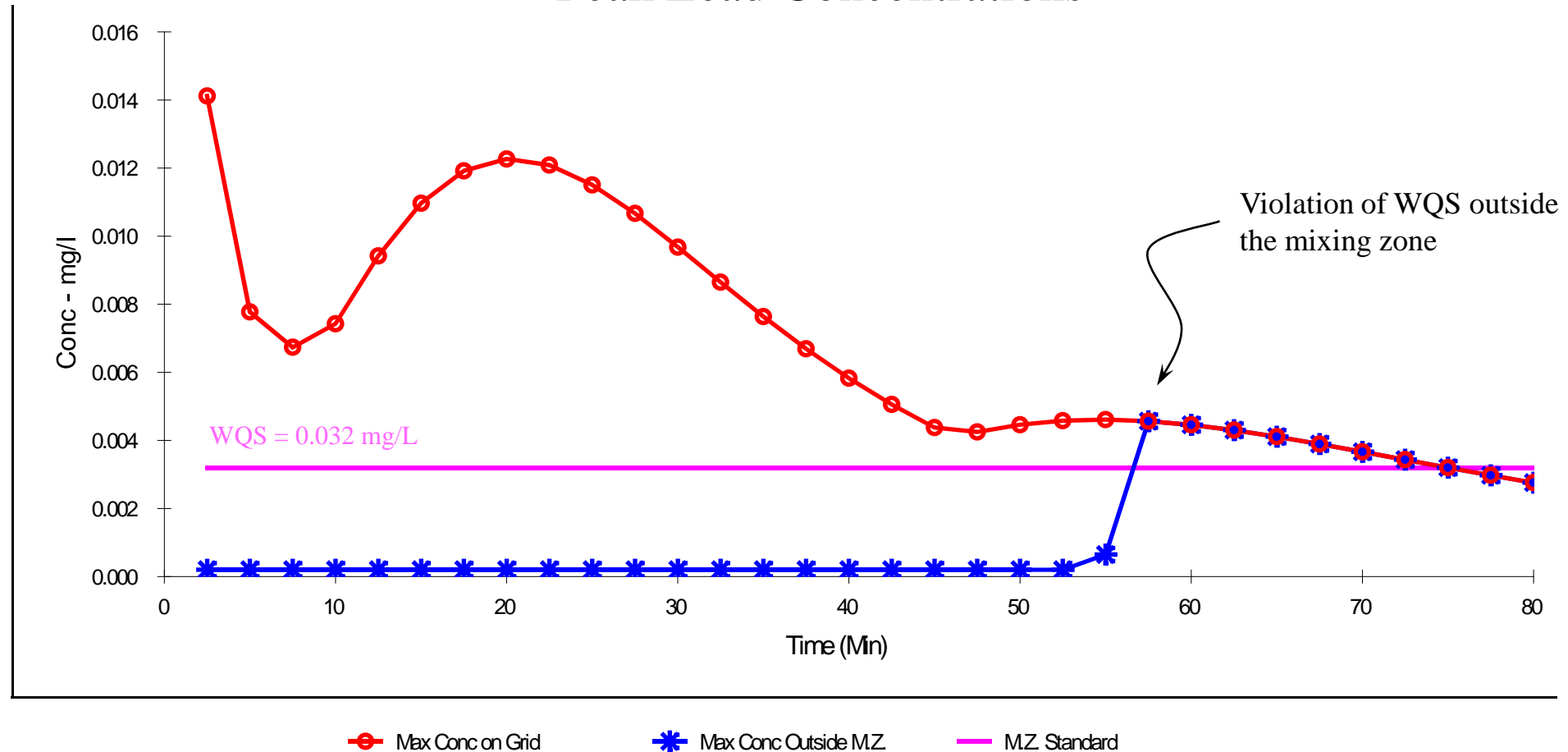
- Select different equipment type
- Select different equipment size
- Control placement operation
  - Location
  - Rate
  - Method



# STFATE Evaluation of Alternatives

## 3000 CY Barge – Single Dump

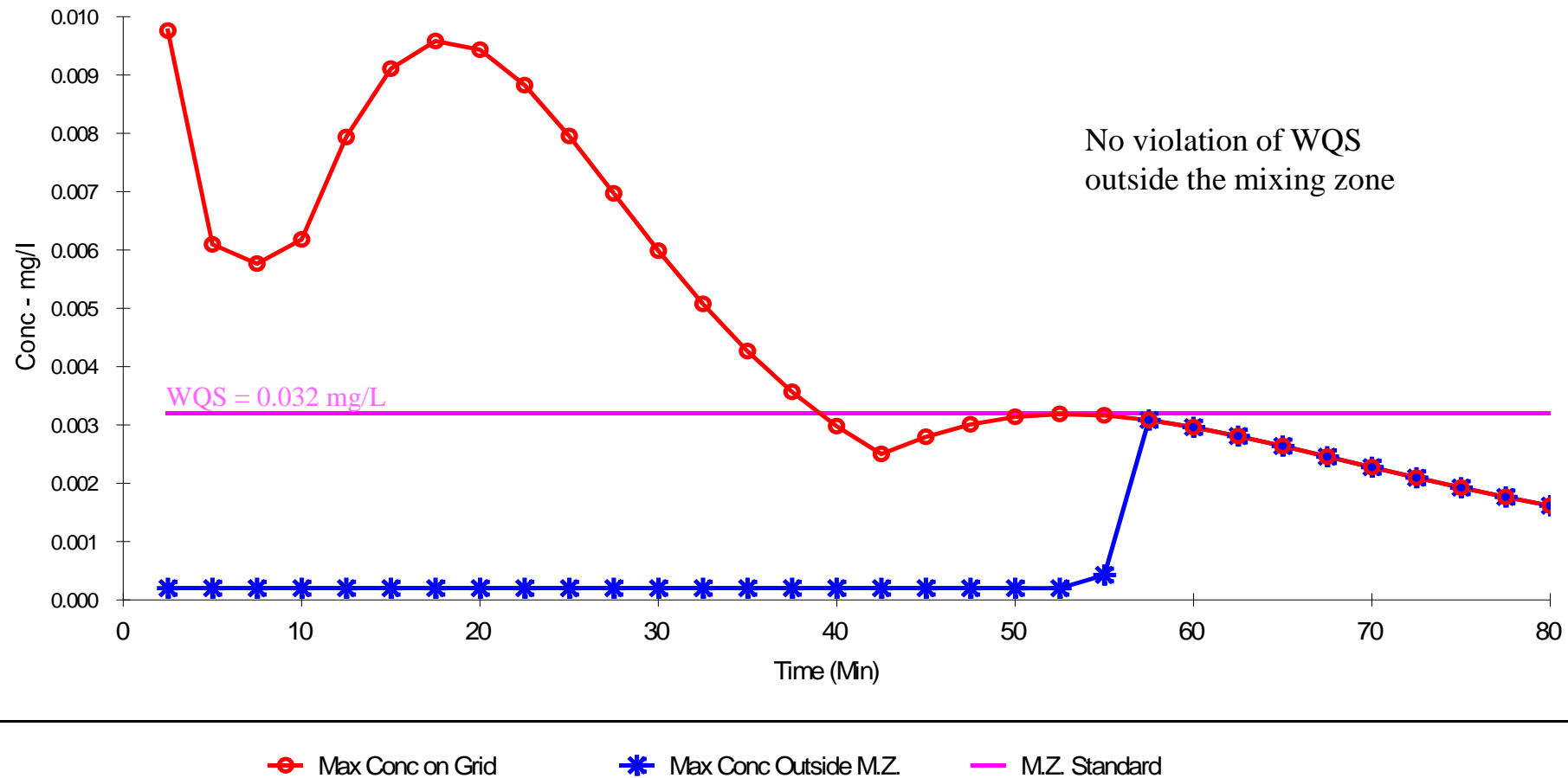
### Peak Lead Concentrations



# STFATE Evaluation of Alternatives

## 1500 CY Barge – Single Dump

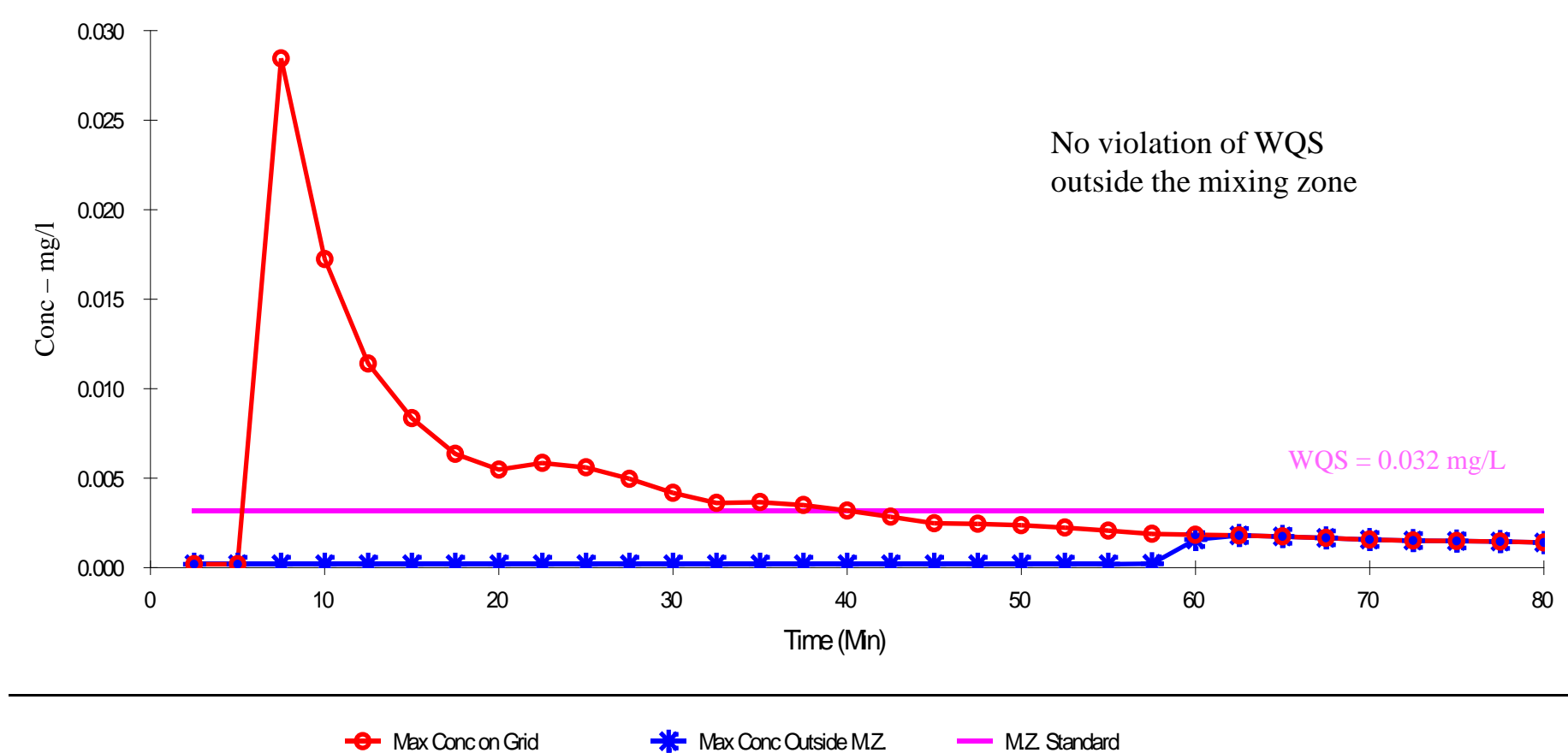
### Peak Lead Concentrations



# STFATE Evaluation of Alternatives

## 3000 CY Barge – Spreading Discharge

### Peak Lead Concentrations

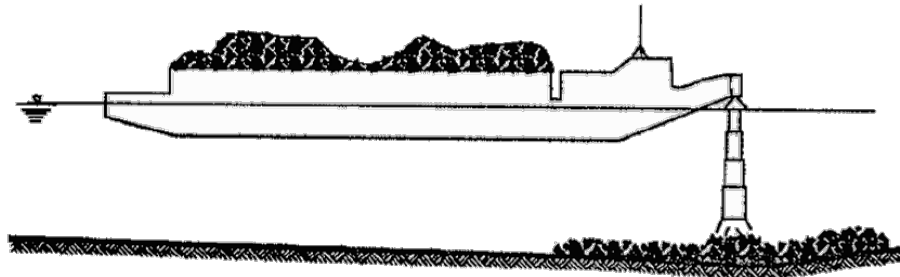


# Submerged Discharge

- Can reduce water column dispersion
- Can improve accuracy of placement
- Pipeline configurations
- Diffuser design available
- Tremie technology



Submerged Diffuser



Barge with Tremie





# Silt Curtains

## ■ Purpose

- To control SS/turbidity in the water column (mainly at dredging site)

## ■ Advantages

- Can be used to protect sensitive environments
- Can allow particles to settle out of the upper water column
- Commercially available

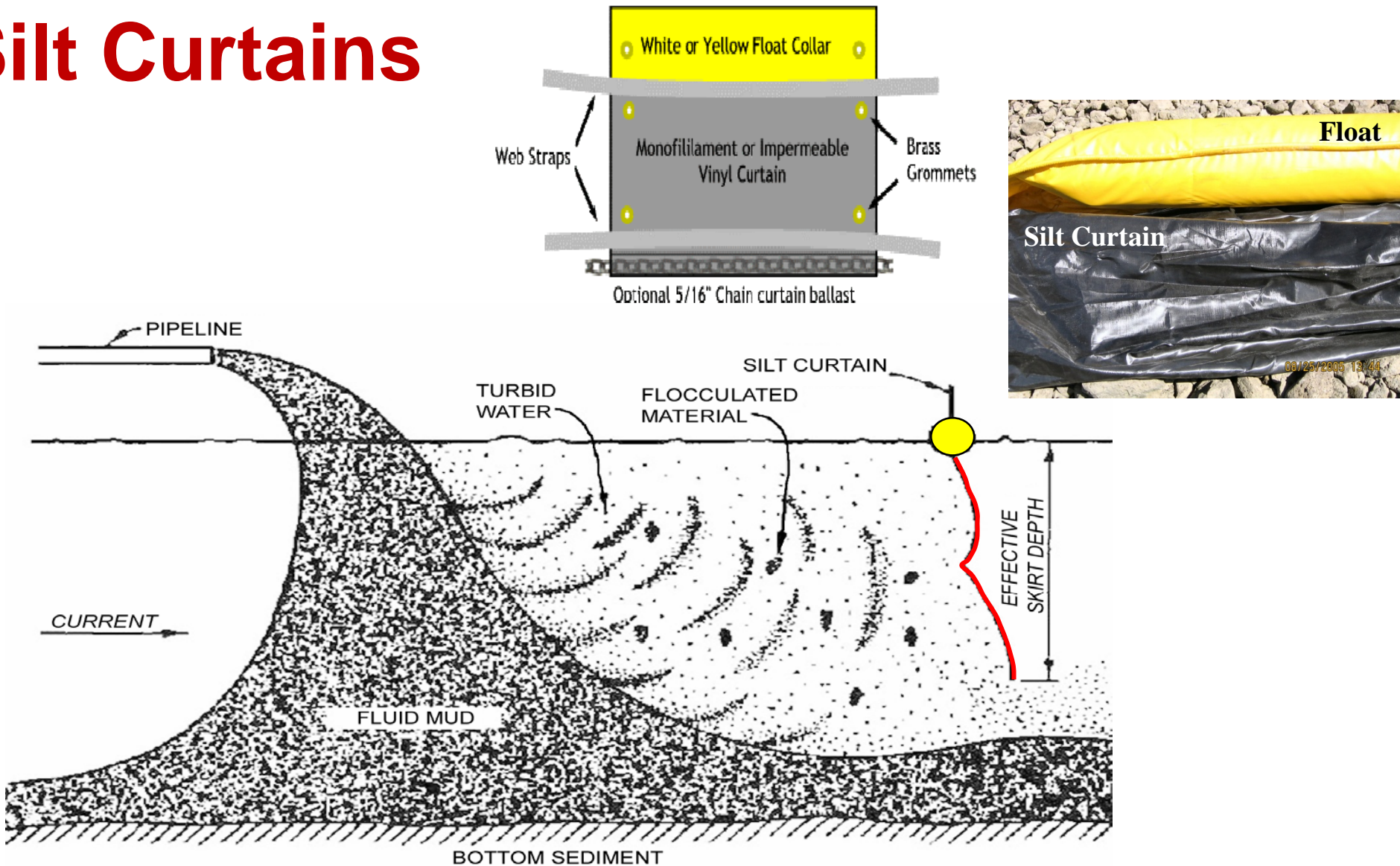
## ■ Limitations

- Strong currents ( $> 1$  knot/1.5 fps)
- High winds
- Debris/ice
- Excessive wave heights
- Fluctuating water levels
- Must allow traffic in/out (such as bubble curtains)



- <http://el.erdcl.usace.army.mil/elpubs/pdf/doere21.pdf>

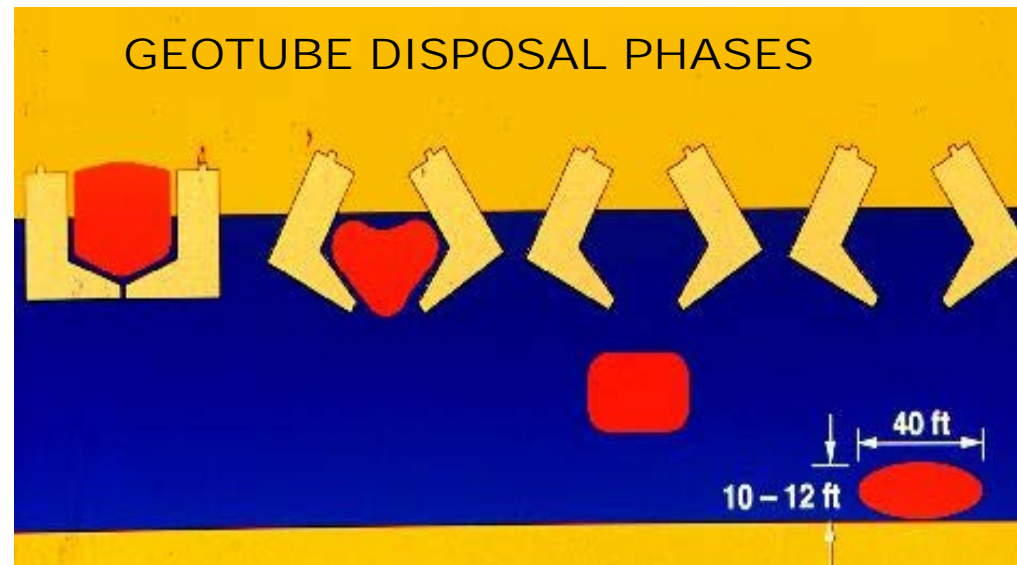
# Silt Curtains



# Geo-containers

- Geotextiles used for solids containment
- Reduce water column entrainment
- Reduce water release rate
- Reduce water column dispersion
- Reduce capping requirements
- Engineering design approaches available

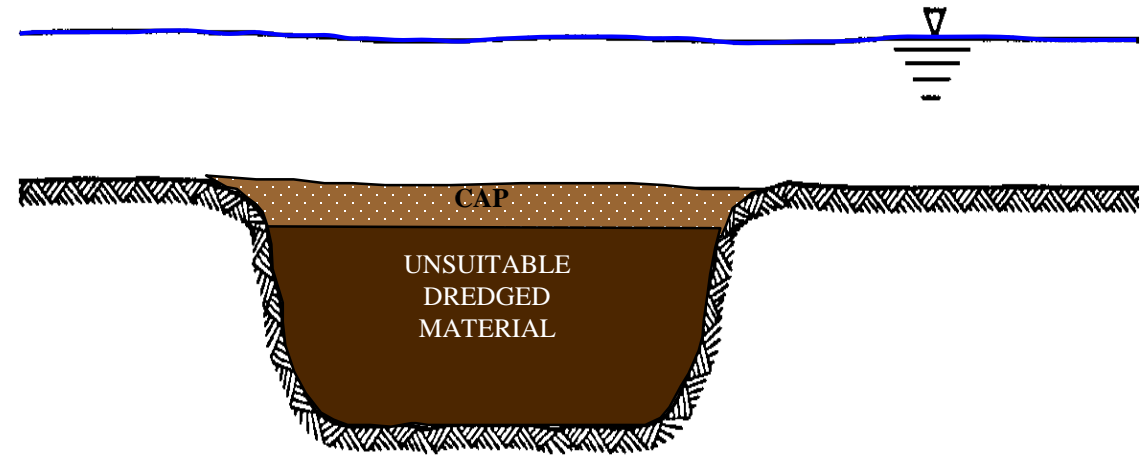




# CAD/Capping/Treatment

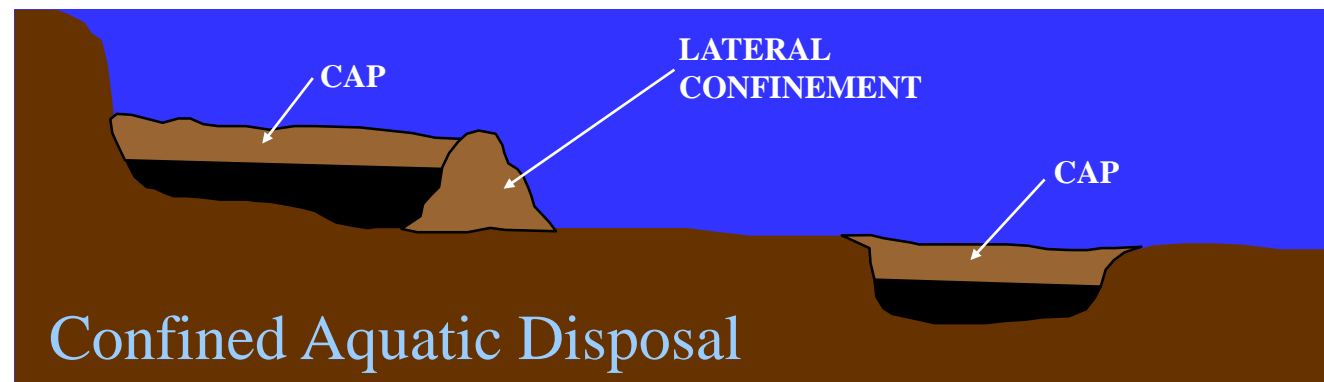
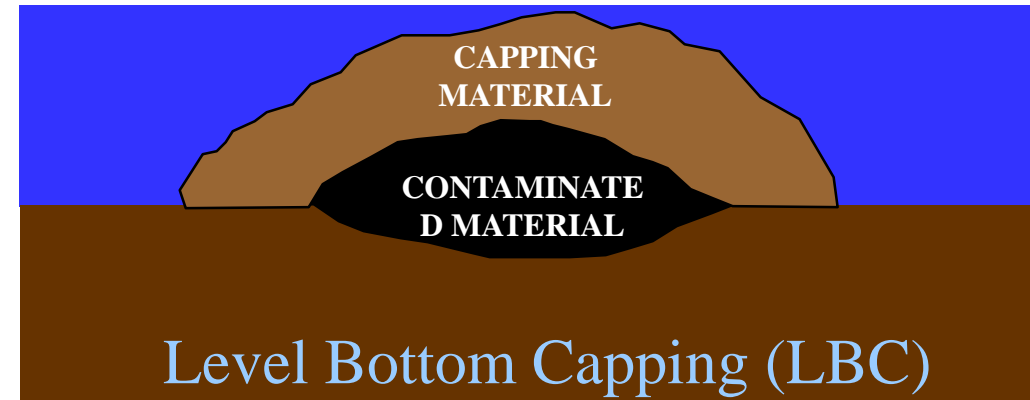
Purpose - Manage contaminant risks by:

- Physical isolation of contaminants
- Reduction of contaminant flux
- Physical stabilization
  - Limiting losses during placement
  - Reducing mobilization and erosion
- Reduction of bioavailability/bioaccumulation



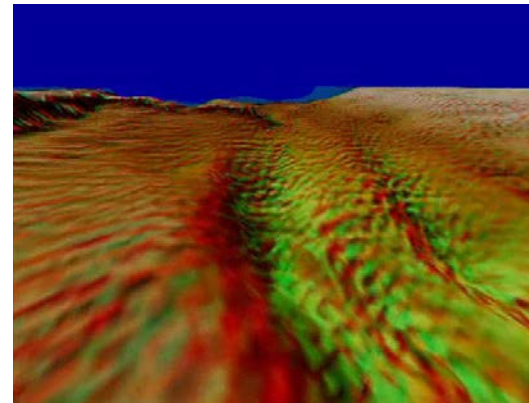
# CAD Approaches

- Existing Pits/Fills or Excavated Pits – (most stable)
- Lateral Confinement
- Mounds
- In Situ Capping



# Capping/Treatment Considerations

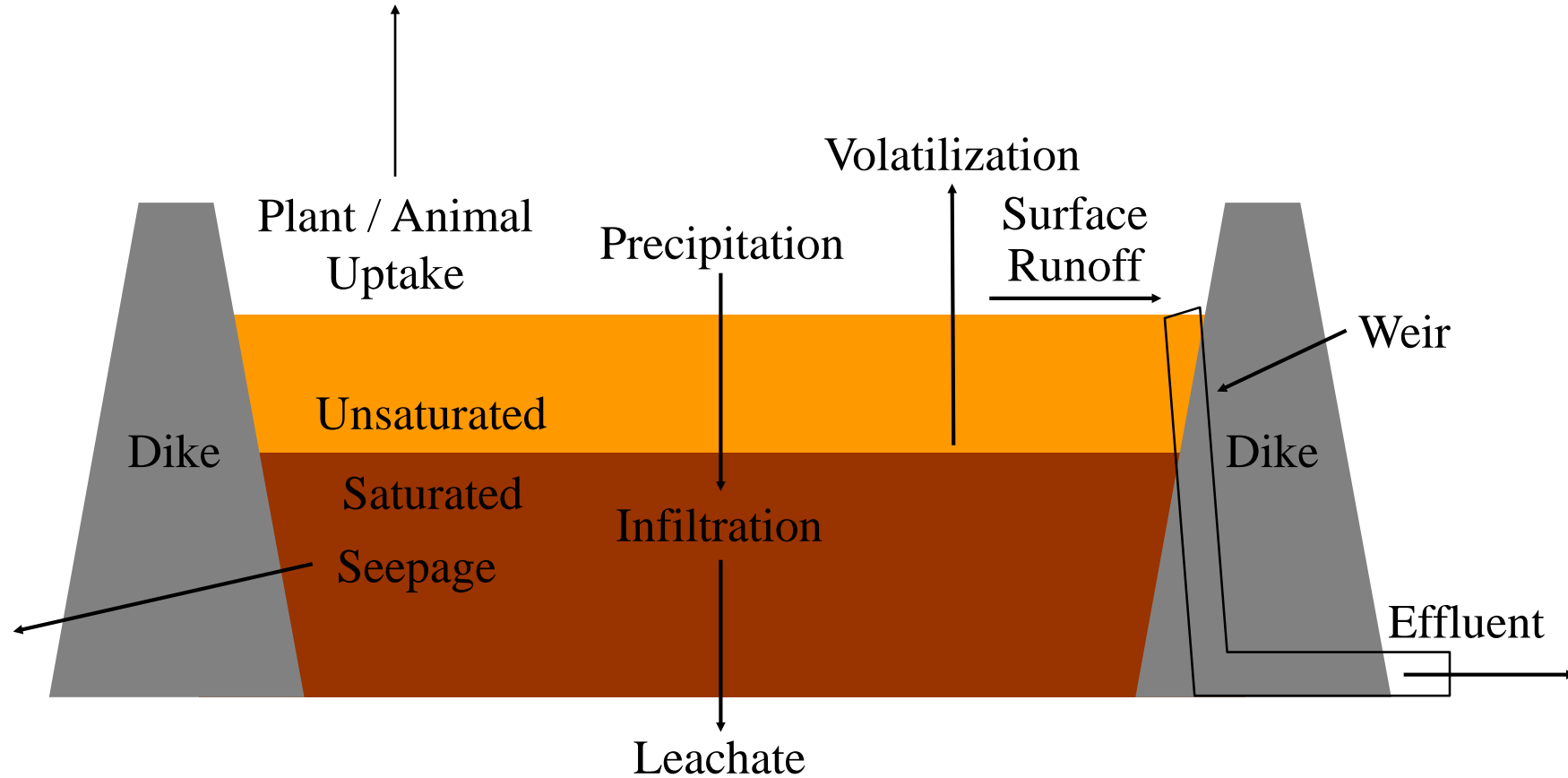
- Placement and design of constructed cells
- Placement techniques for unsuitable material
  - Controlled, accurate
- Placement techniques for cap/treatment material
  - Even coverage or incorporation of adsorbents or reactants
  - Avoid displacing unsuitable material
- Cap/Treatment design – account for:
  - Bioturbation
  - Bioaccumulation
  - Recolonization
  - Consolidation
  - Contaminant transport
  - Erosion



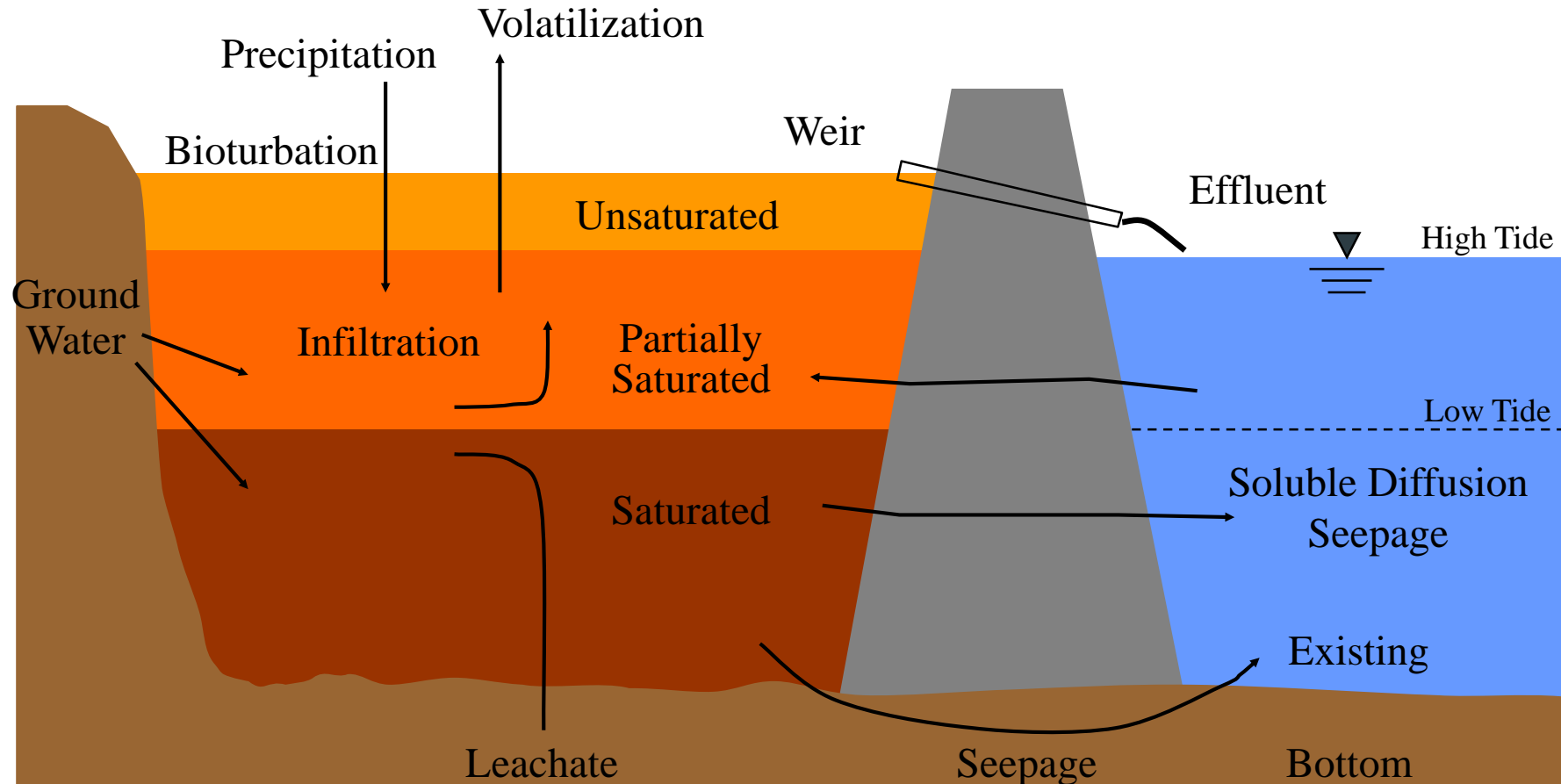


# Upland/Nearshore Placement Controls

# Contaminant Pathways - Upland CDF



# Contaminant Pathways - Nearshore CDF



# Upland/Nearshore Pathways Controls

- **Operational (During filling)**
  - Surface water management, production rates, sequencing placement, self-sealing
- **Treatment of Discharges**
  - Filtration, flocculation, treatment of dissolved constituents
- **Engineered Controls (Containment)**
  - Surface covers, liners, lateral containment
- **Site Management (After Filling)**
  - Surface water management, vegetation, dewatering, surface treatments

# Effluent and Runoff Controls

- **TSS & Particulate Associated Contaminants**
  - **Design & Operational modifications** – increase retention time
    - ▶ Increase ponding
    - ▶ Reduce short-circuiting – baffles, spur dikes, inlets
    - ▶ Improve weir operation, locations and design
    - ▶ Limit fetch to reduce wind induced resuspension
  - **Filtration** – cells, permeable dikes and barriers
  - **Chemical flocculants**
  - **Engineered controls** – vegetation, capping

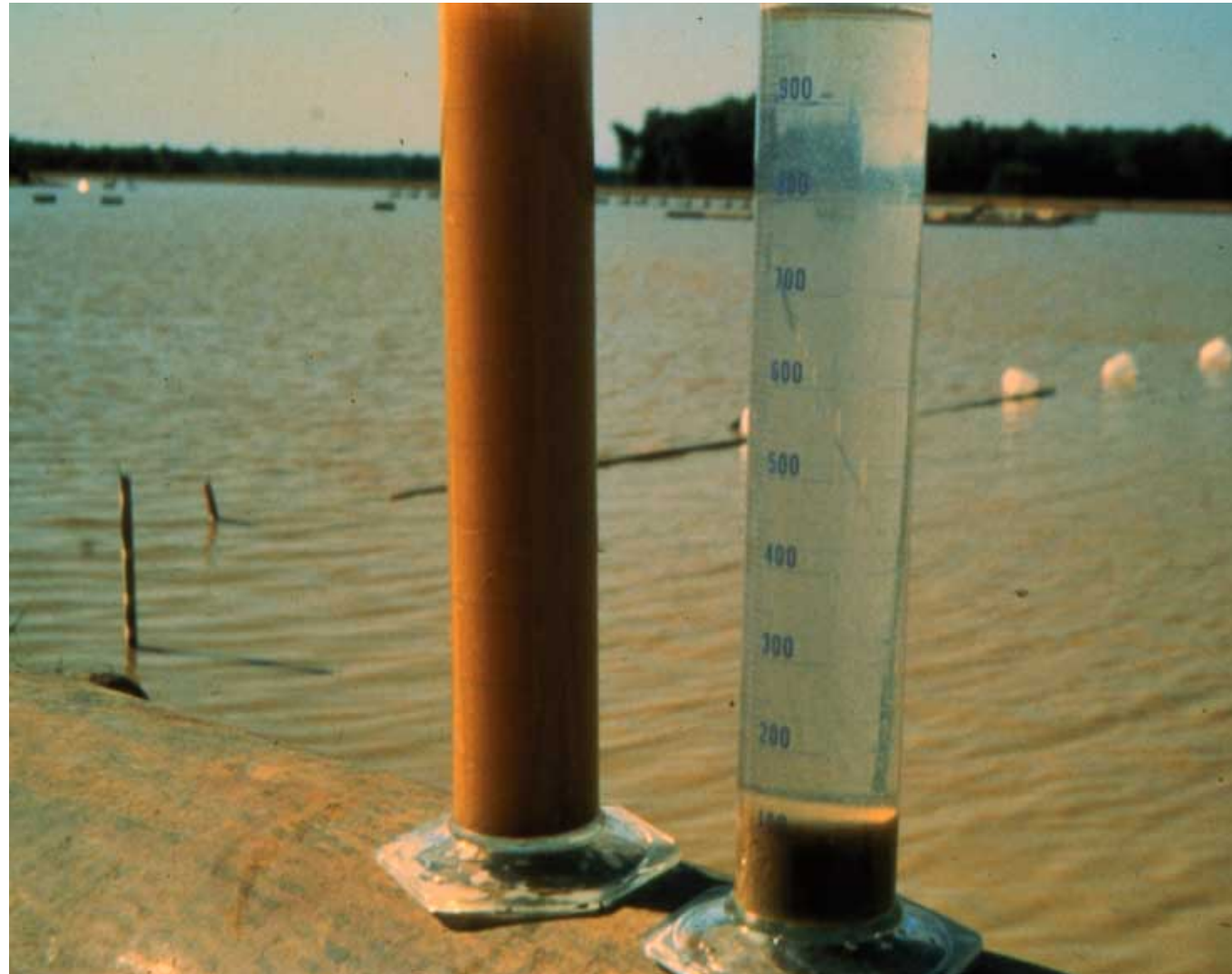
# Filter Cell



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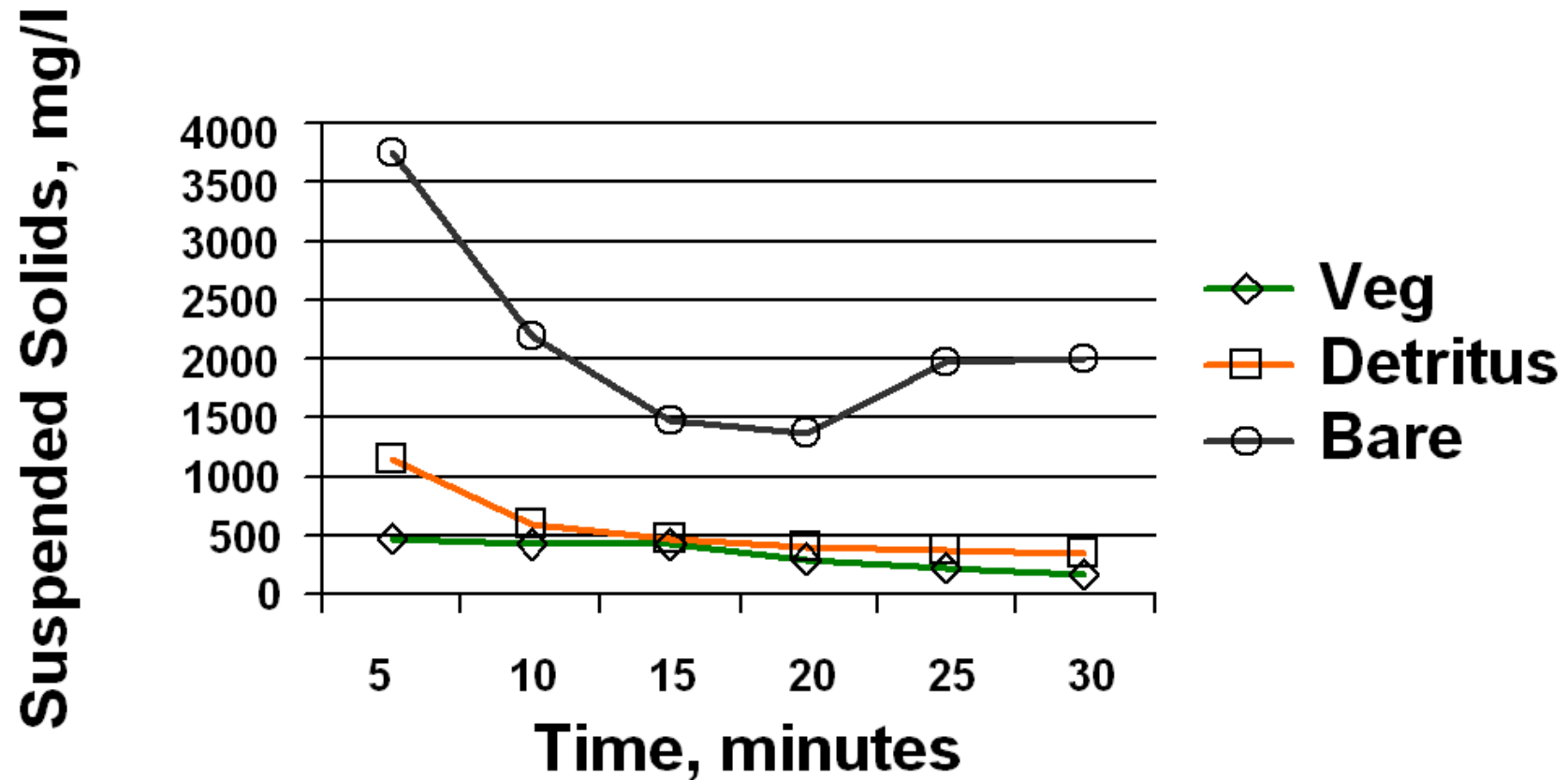
# Flocculant Addition

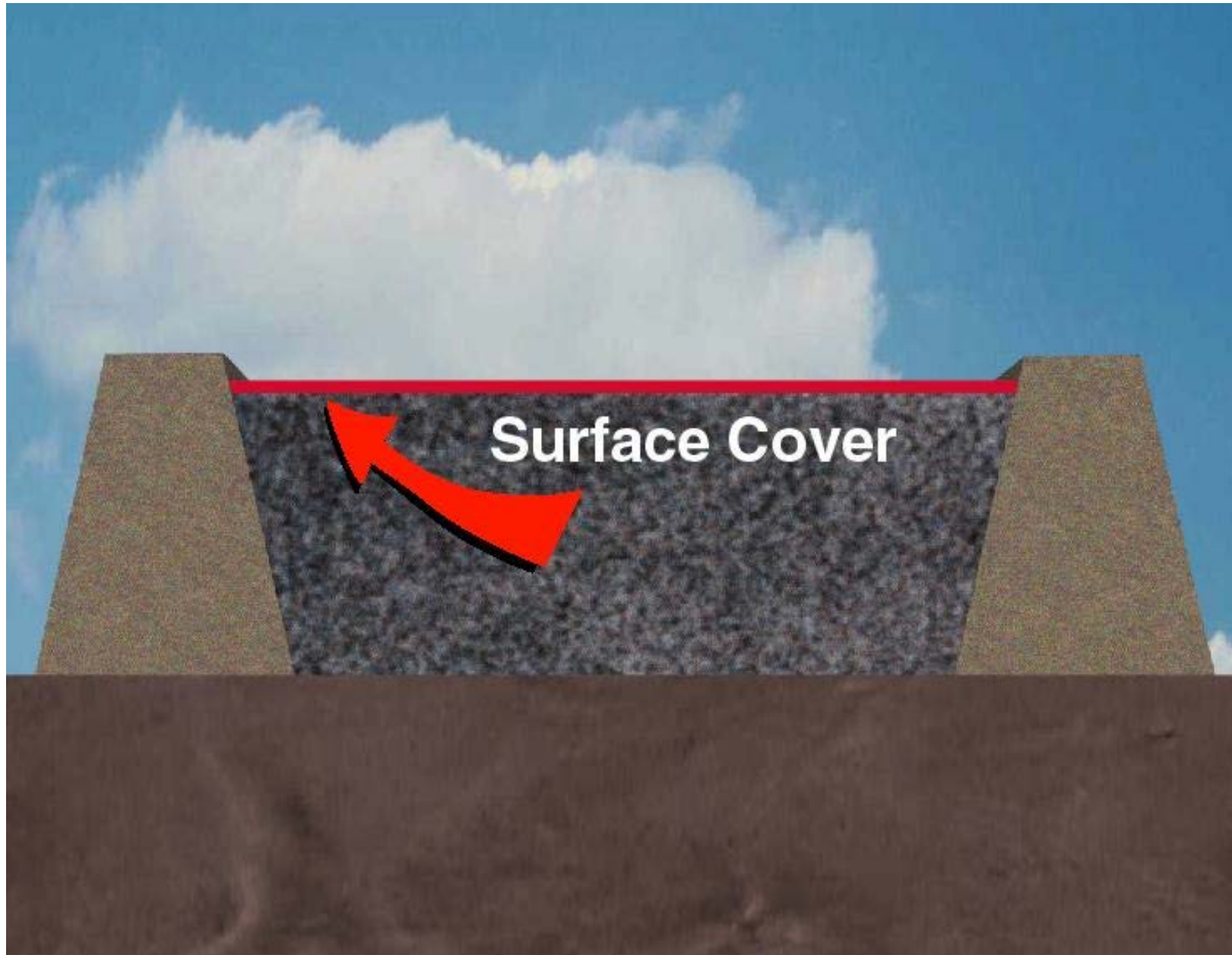


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# Runoff SS Controls





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# Michigan City, MI



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# Effluent and Runoff Controls

## ■ Dissolved Contaminants

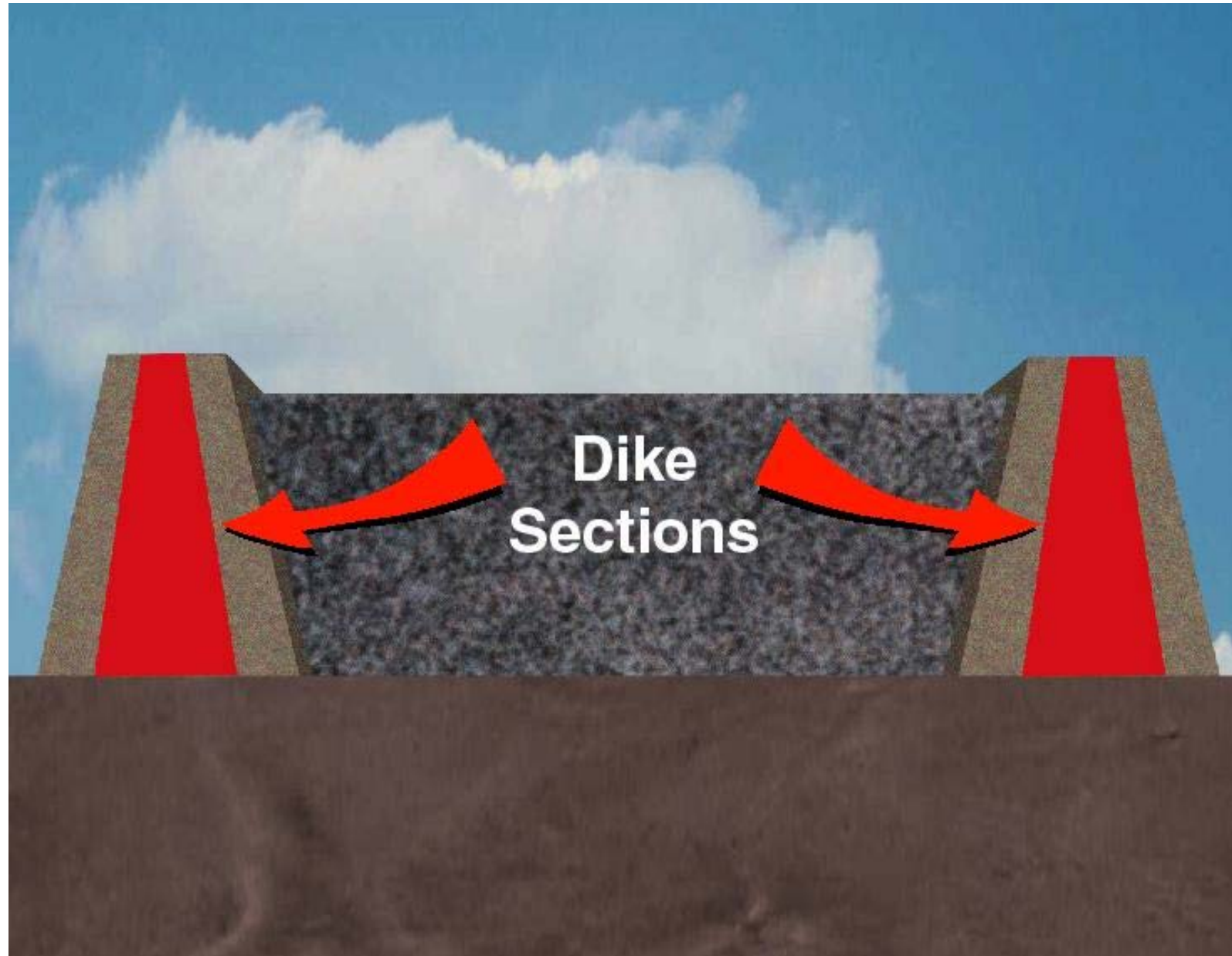
### • Treatment

- ▶ Carbon adsorption
- ▶ Ion exchange
- ▶ Chemical or UV oxidation
- ▶ Biological – wetlands

### • Dispersion

- ▶ Reduced discharge rate and controlled release
- ▶ Dispersed discharge and extension into flow field





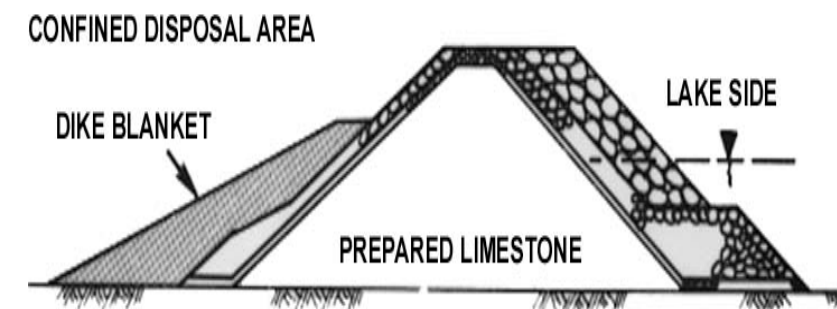
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# Calumet Harbor, Chicago, Illinois



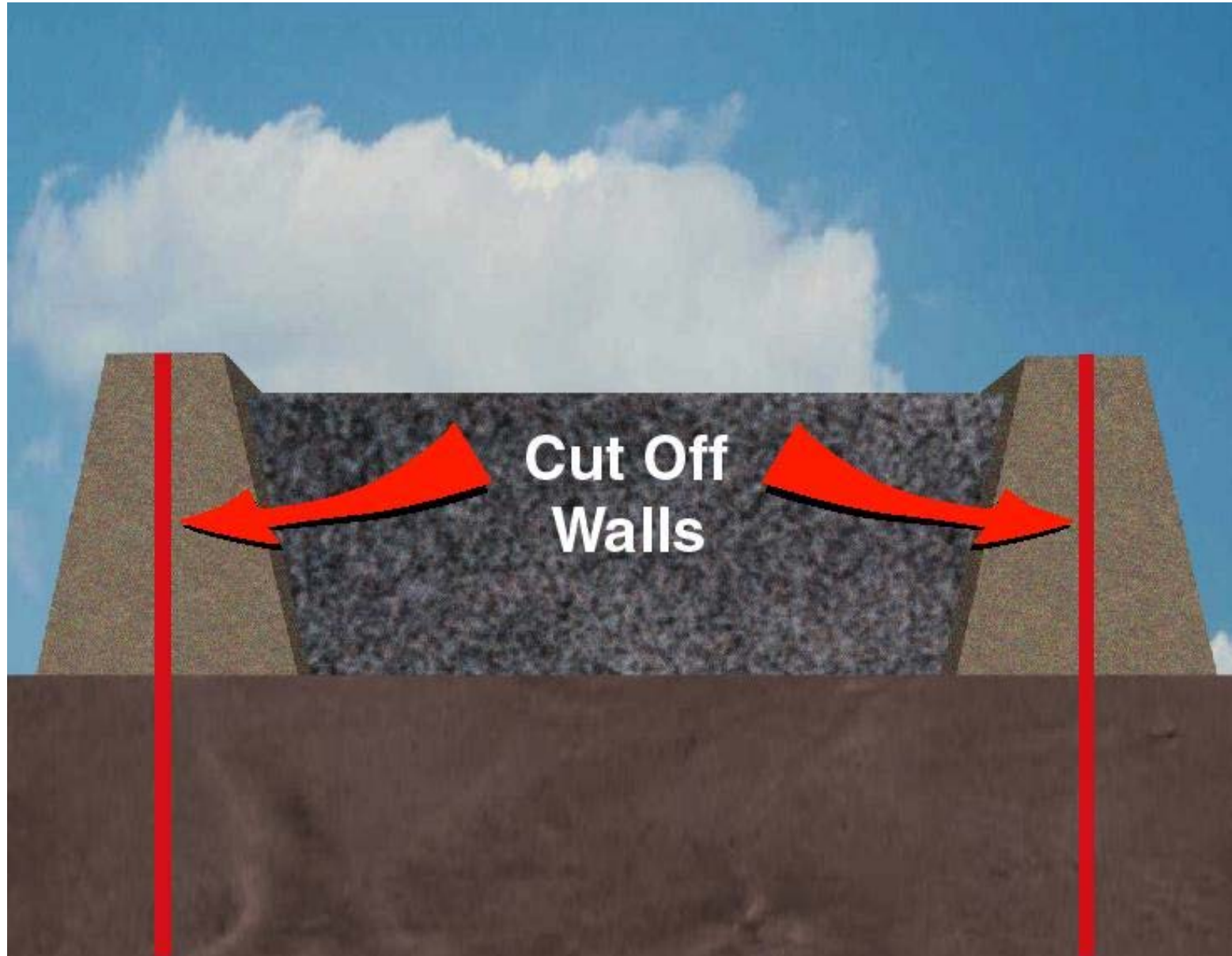
CLAUMET HARBOR CDF, 1984



# Leachate Controls

- **Liners and Drains**
  - Geomembranes
  - Clay for coarse-grained materials
  - Collection and dispersion
- **Amendments**
  - Stabilizing agents
  - Adsorbing or precipitating agents such as activated carbon to control organics or apatite to control certain metals





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## Waukegan Harbor, Illinois

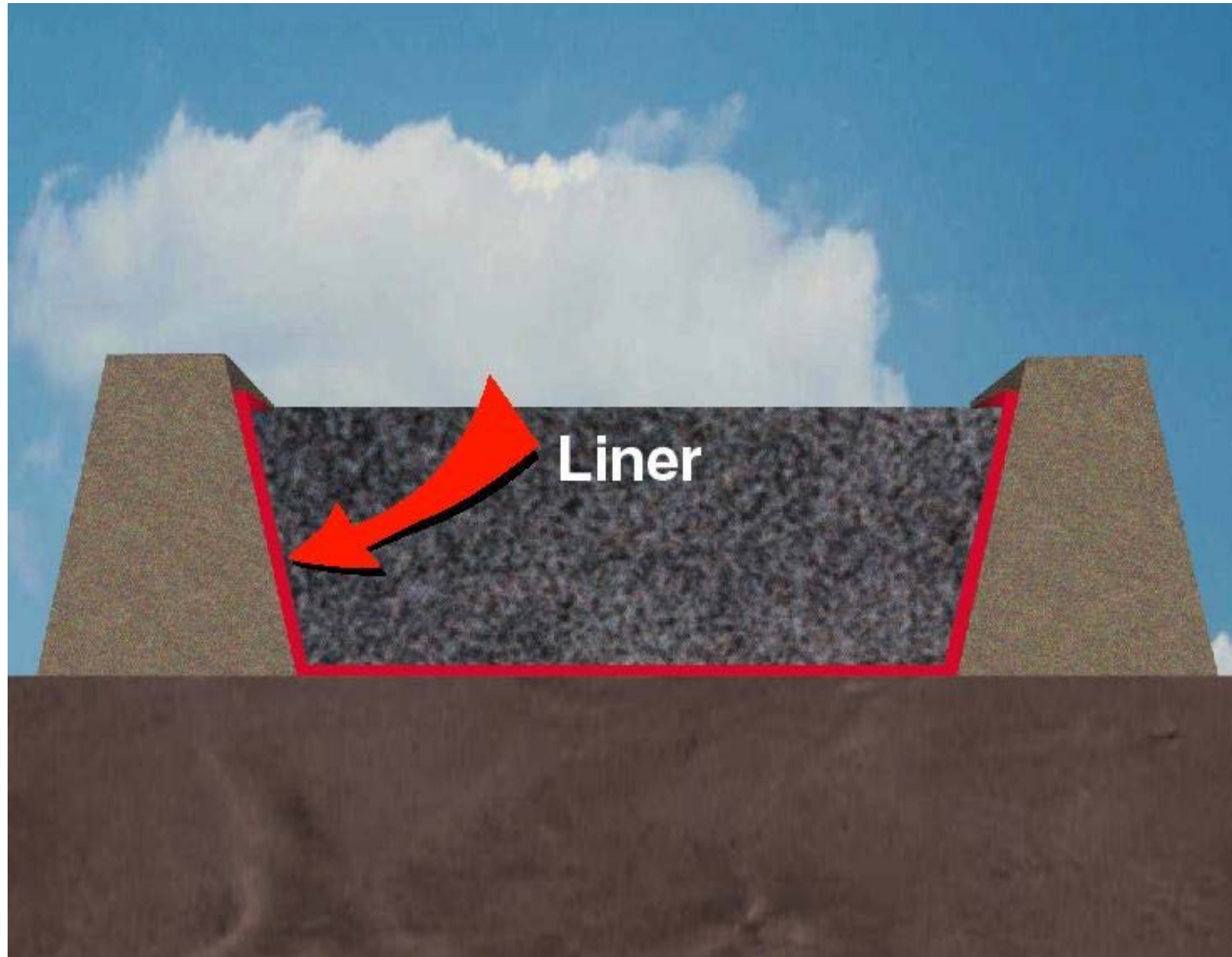


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# Parrot Beak, Rotterdam, The Netherlands



# Volatilization Controls

- **Activated Carbon Applications**

- CDF pond
- Slurry
- Provides control during active placement

- **Capping** (long-term control)

- Prevent exposed condition by maintaining pond
- Cover dredged material with clean material
- Provides post-placement control



# Contaminant Uptake Management & Controls

- Manage vegetative cover
- Amendments/treatments to reduce bioavailability
- Cap to reduce exposure
- Others more site specific depending on target species



# Questions?