SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR
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Engineering and Operational Controls and Adaptive Management

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Overview

- Approach and Concepts
- Dredging Controls
- Aquatic Placement Controls
- Upland/Nearshore Placement Controls
- Adaptive Management and Monitoring

Risk

If it is determined that unacceptable risks exist,

- Effectiveness of engineering and/or operational controls must be evaluated for the site and sediment conditions.
- Risk is managed by controlling the exposure -- concentration, duration and receptors.
- Exposure can be reduced by reducing the source concentration, the total mass released, or the rate of release and by altering the release locations.
- Applies to dredging, beneficial use and placement in aquatic, nearshore or upland environments

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 or site manager to reduce unacceptable risks of the dredging operations using existing equipment or site.

Control Applications

Changes in dredging equipment and/or operations can modify:

total mass released,
timing of releases,
rate of release,
release locations

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

dredge production rates,
costs,
others
project duration,
capacity,

Engineering Controls -- Size Matters

- **As size increases:**
  - Production rate increases,
  - Concentration of resuspended sediment increases,
  - Availability dilution decreases.

Dredging Controls

Dredging Controls (Turbidity/Burial/Take)

- **Engineering Controls**
  - Silt curtains
  - Anti-turbidity valves
  - Dredge type and size
  - Turtle deflectors
  - Chains

- **Operational Controls**
  - Production rate
  - Overflow controls
  - Decanting controls
  - Dredgehead operations (swing speed, depth of cut, bucket speed, etc.)
  - Dredge windows

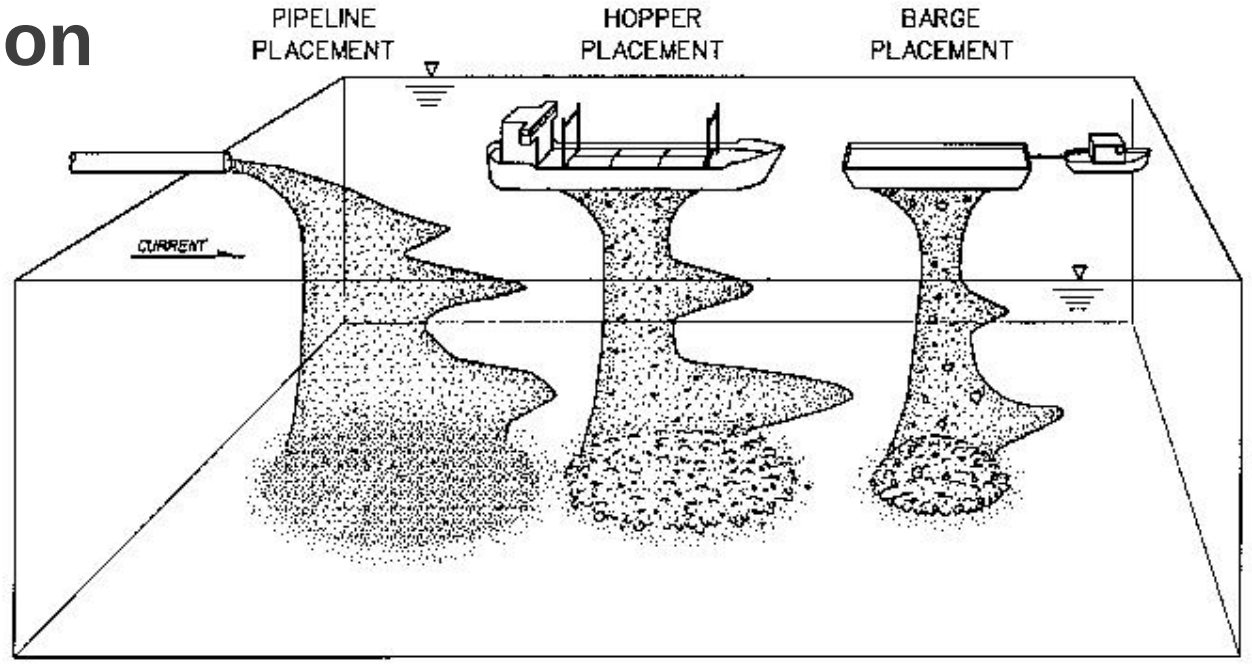
Aquatic Placement Controls

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

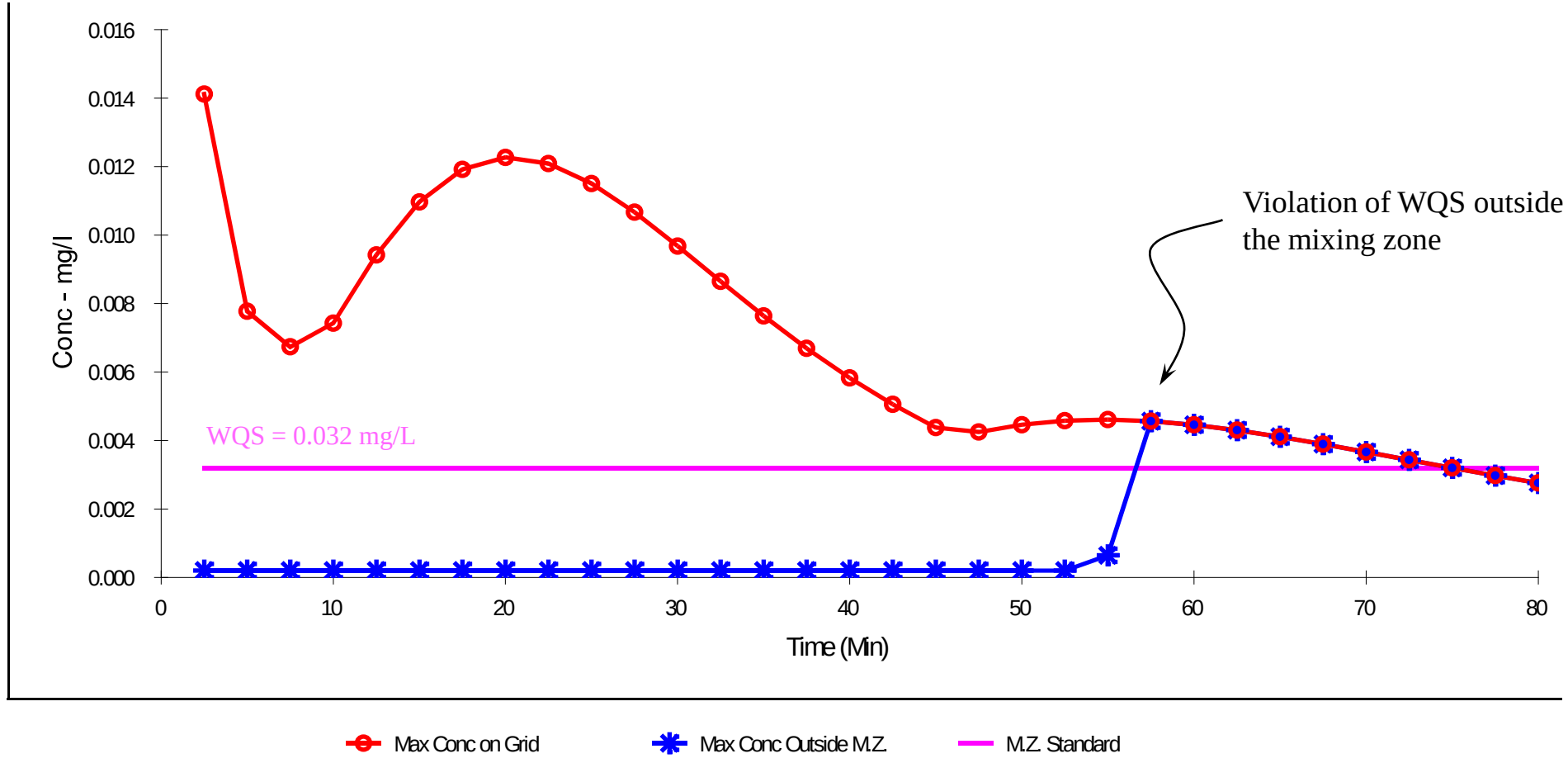
Engineering Modifications

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



STFATE Evaluation of Alternatives

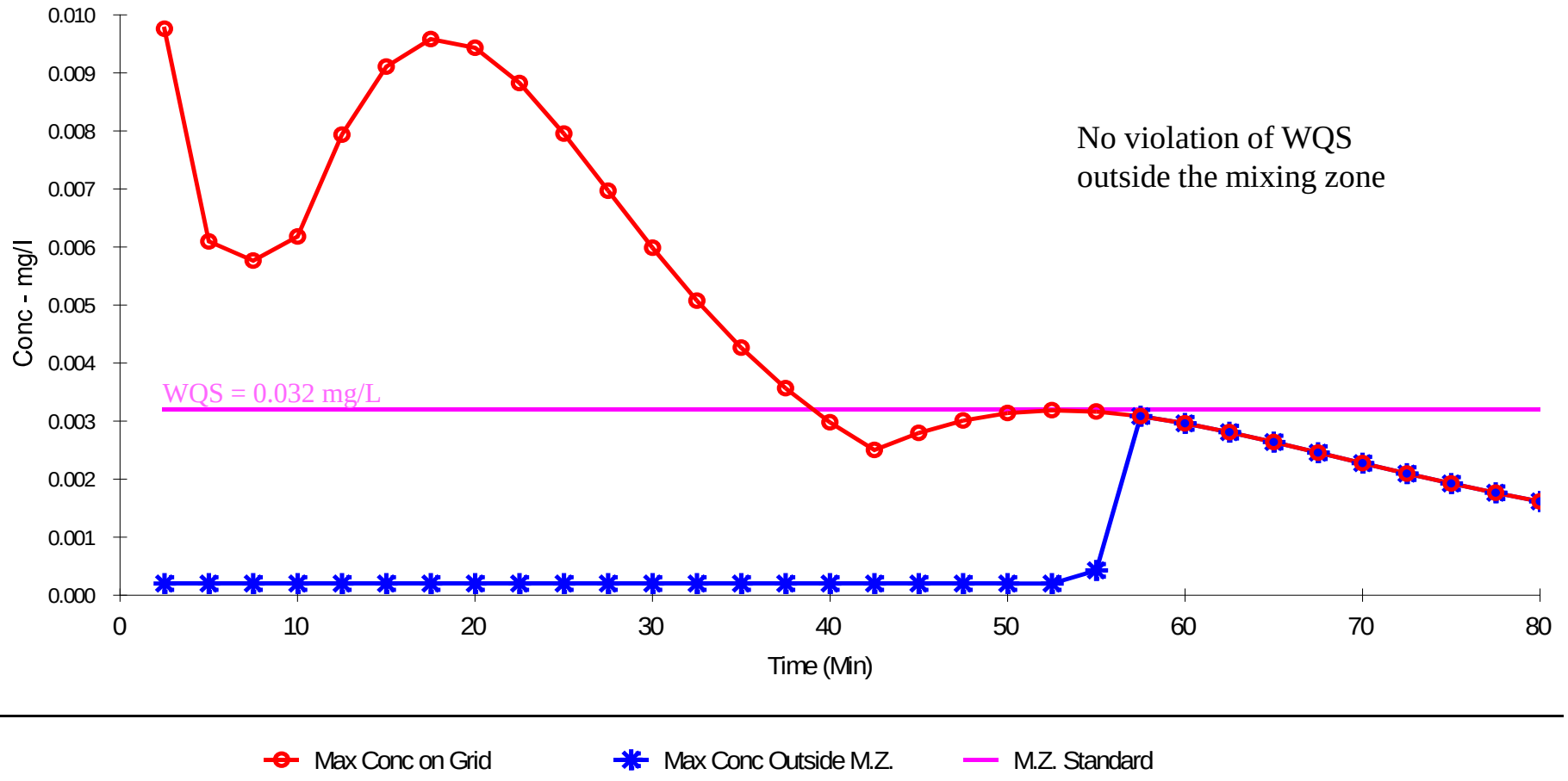
3000 CY Barge – Single Dump



STFATE Evaluation of Alternatives

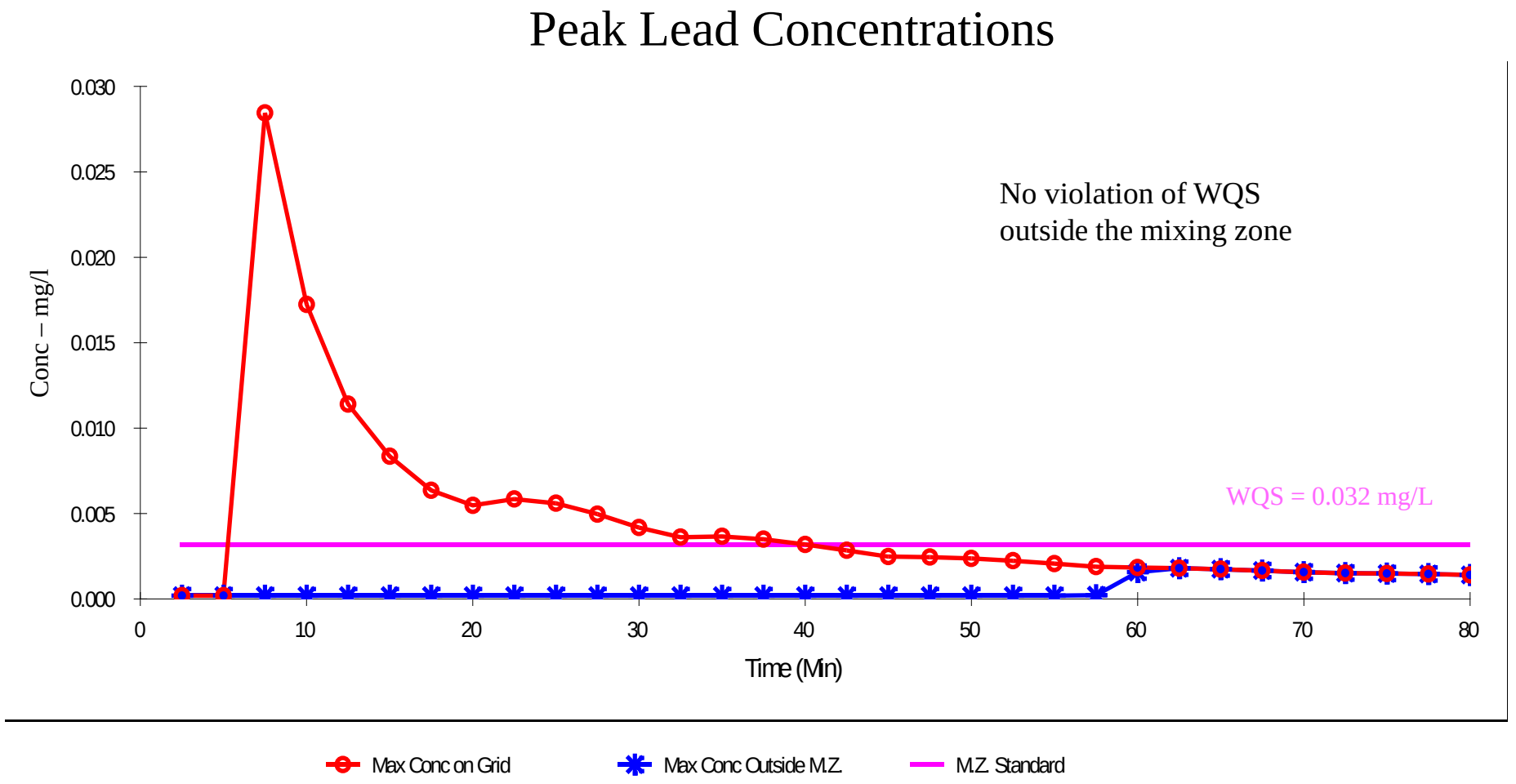
1500 CY Barge – Single Dump

Peak Lead Concentrations



STFATE Evaluation of Alternatives

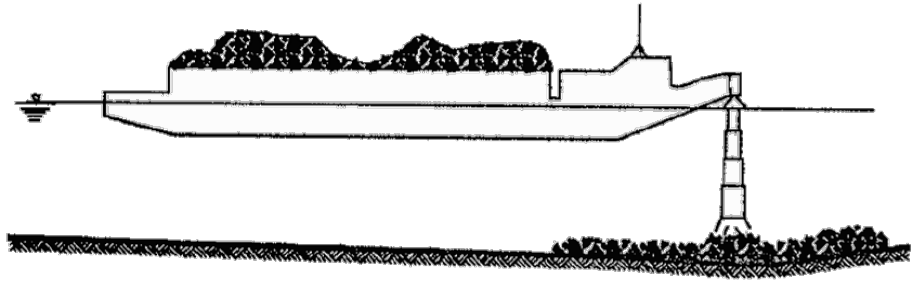
3000 CY Barge – Spreading Discharge



Submerged Discharge

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

Submerged Diffuser



Barge with Tremie

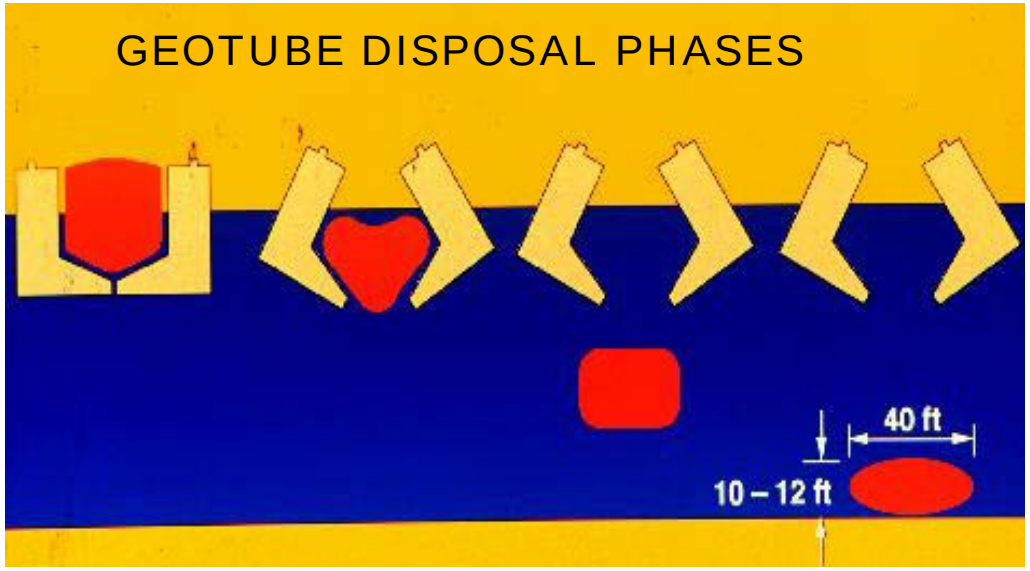
Silt Curtains

- **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.erdc.usace.army.mil/elpubs/pdf/doere21.pdf**

Geo-containers

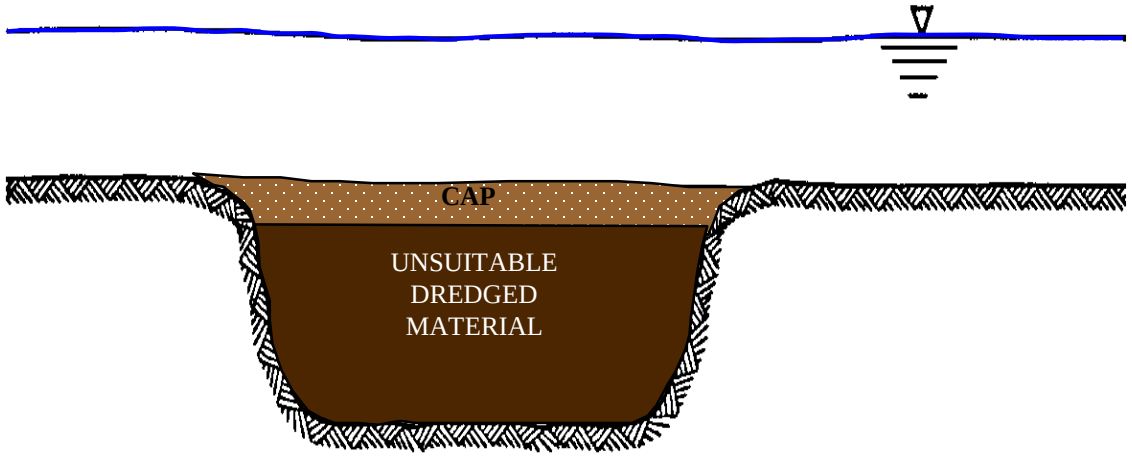
- Geotextiles used for solids containment
- Reduce water column entrainment
- Reduce water release rate
- Reduce water column dispersion
- Reduce capping requirements
- Engineering design approaches available


GEOTUBE DISPOSAL PHASES
40 ft
10 – 12 ft

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

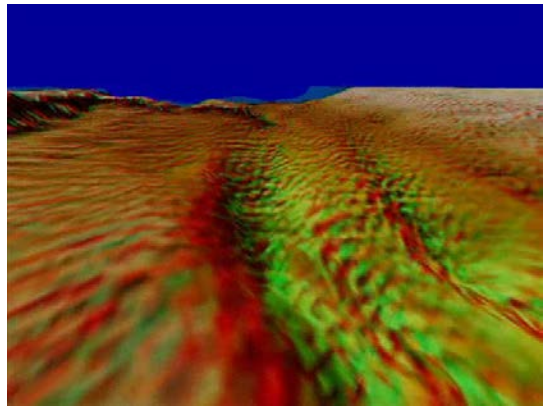


Ashtabula Field Demonstration

- Mix both PAC and GAC in two layers of dredged material in the dump scow using a small conventional dredge bucket and placed conventionally to cover a dredged material mound
- >80% reduction in PCB bioaccumulation at low PAC concentrations (0.2% w/dw)

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

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

Adaptive Management and Monitoring

- **Operational (During filling)**
  - Surface water management, production rates, sequencing placement, self-sealing
- **Treatment of Discharges**
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Monitoring and Adaptive Management

- **Traditionally**
  - To assure compliance with regulatory requirements
  - Water and air sampling at points of compliance for comparison with water and air quality standards

Monitoring and Adaptive Management

- **Adaptively**
  - To support the risk paradigm
  - To address uncertainties in exposure data and source strength
  - To address uncertainties in effects data
  - To learn from the project and provide data for future assessments
  - To support adaptive risk management alternatives
  - To assure effectiveness of control measures
  - To assure compliance with risk goals and regulatory requirements

Key Points

- Engineering and operational controls are available to address most dredging and placement concerns
- Controls often represents a trade-off among risk, production, duration, capacity and costs that need to be evaluated to find the best balance
- Adaptive management approaches can inform the effectiveness of and need for control methodologies
- Treatment can be a cost effective technology to expand placement alternatives including beneficial use
- Dredge windows are often a precautionary method of control which could be achieved by other controls informed by adaptive management and monitoring

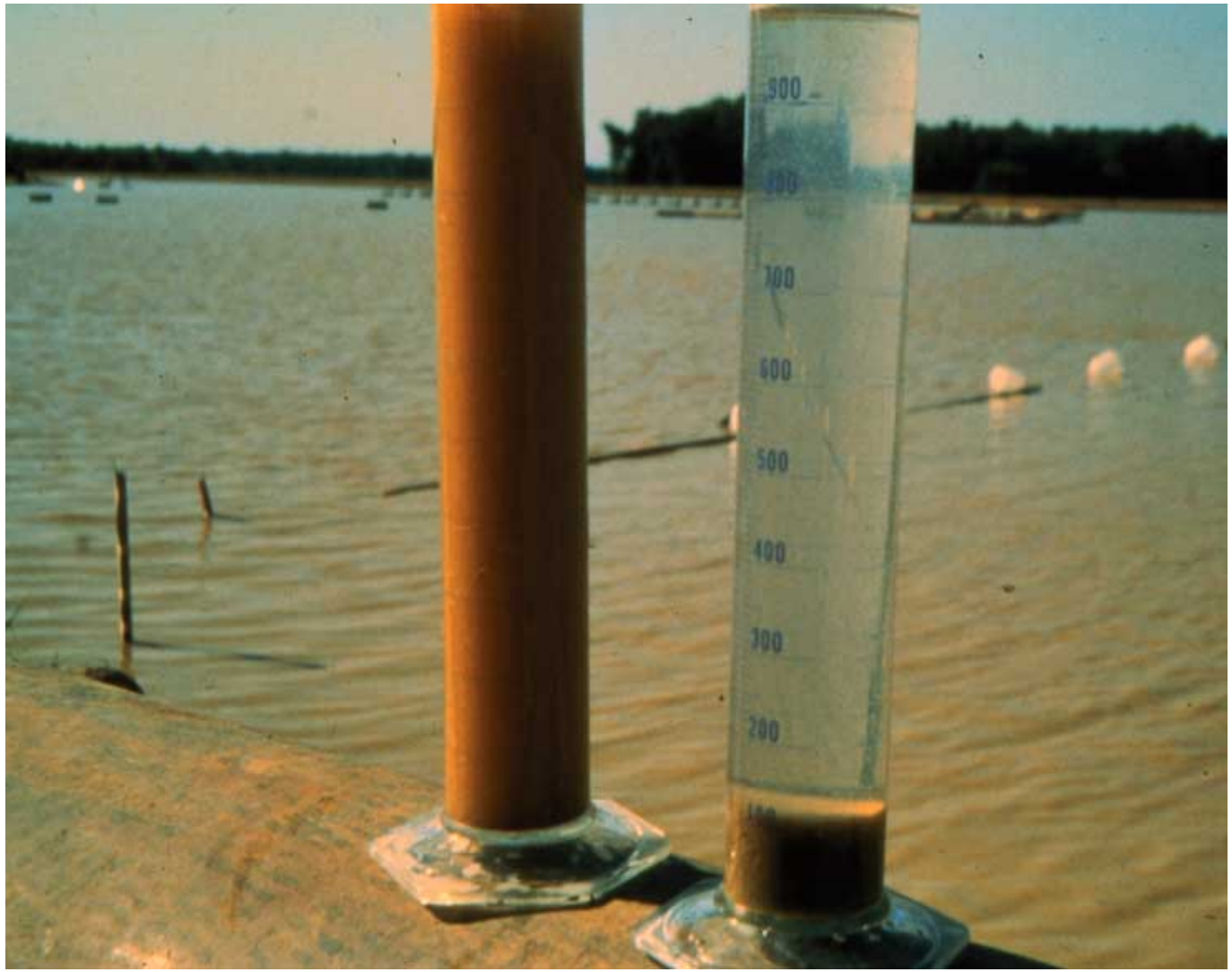
Questions?

Effluent and Runoff Controls

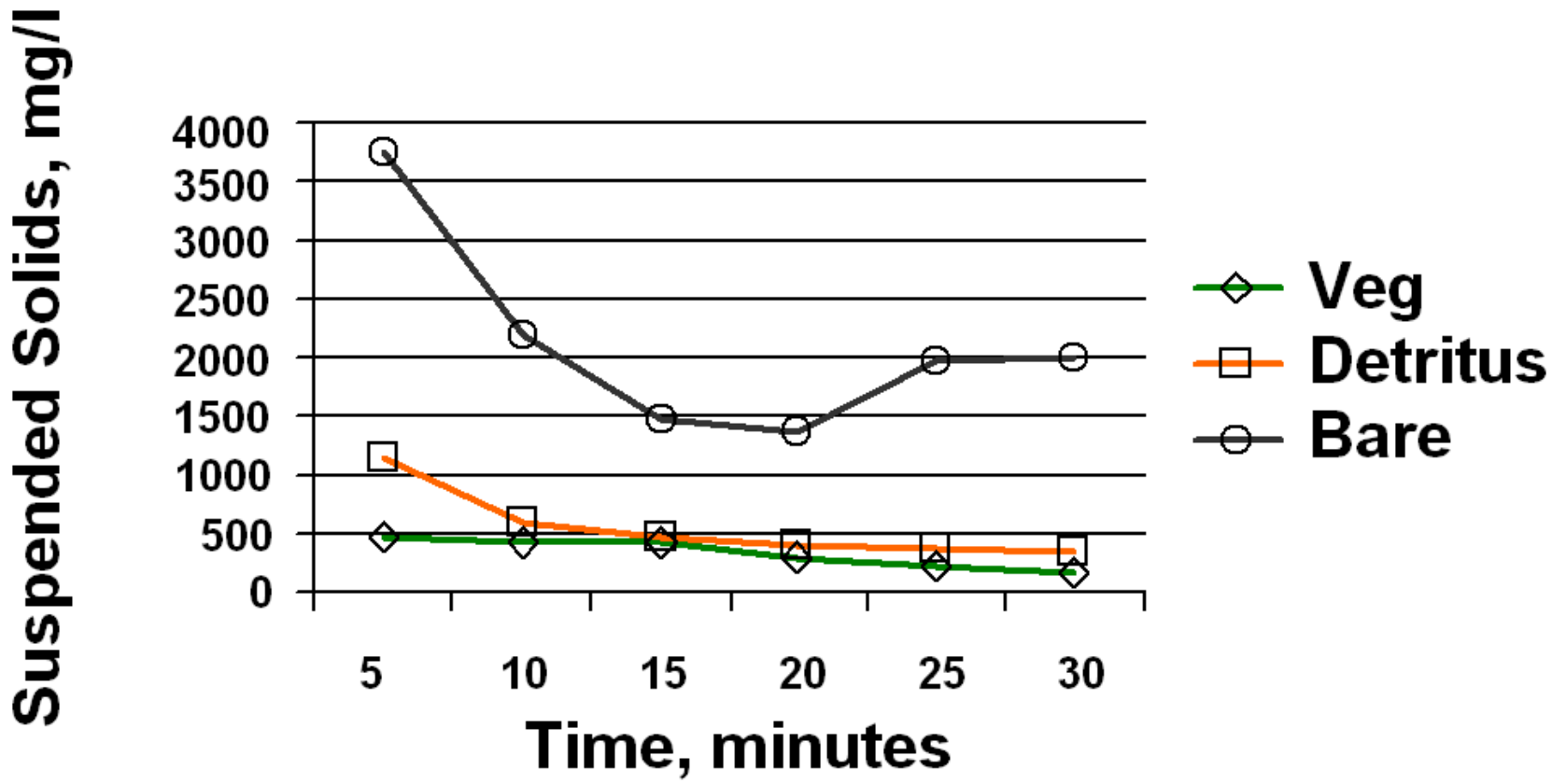
- **TSS & Particulate Associated Contaminants**
  - **Design & Operational modifications –** increase retention time
    - Increase ponding
    - Reduce short-circuiting – baffles, spur dikes, inlets
    - Improve weir operation, locations and design
    - Limit fetch to reduce wind induced resuspension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

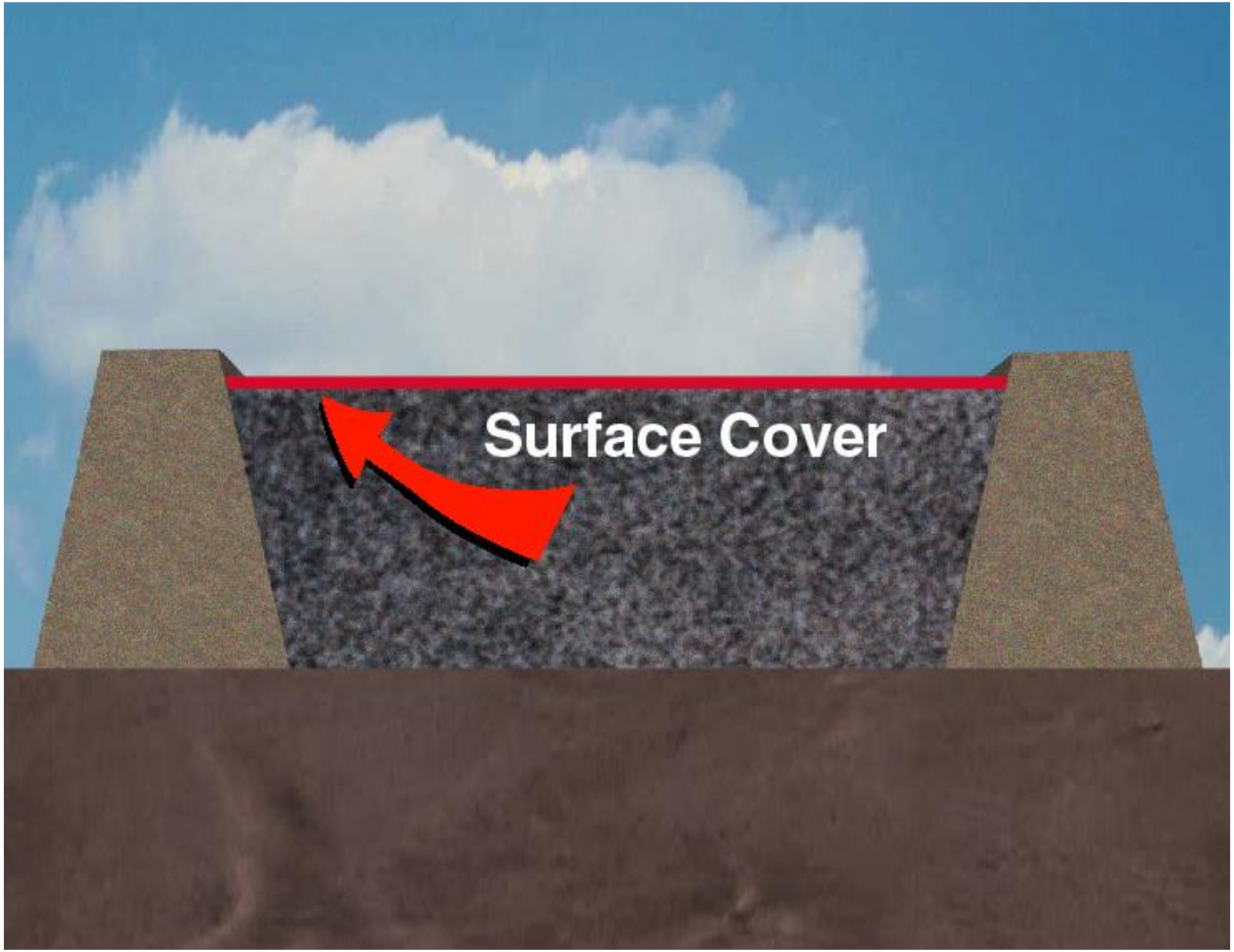
Filter Cell

Flocculant Addition



Runoff SS Controls

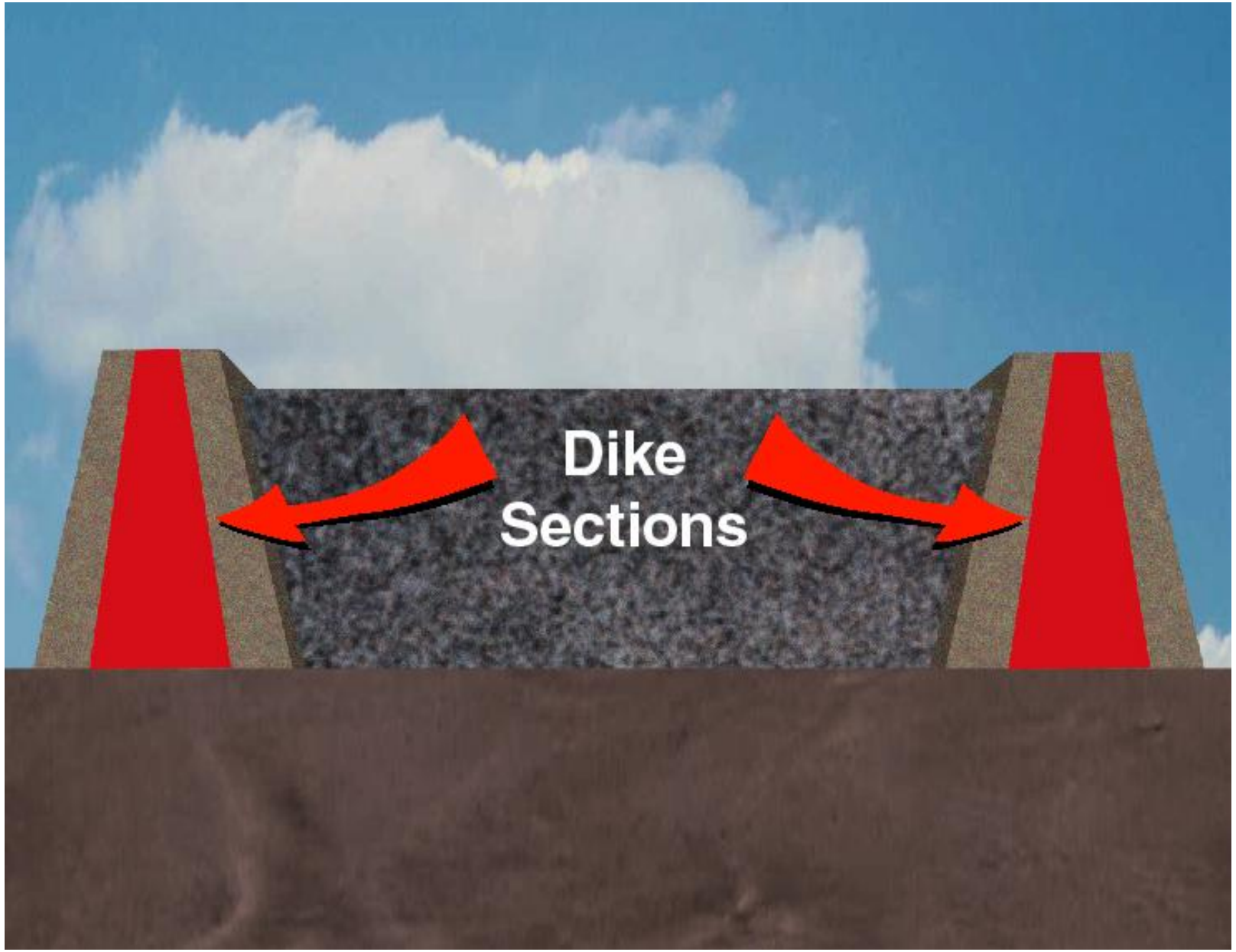



Surface Cover

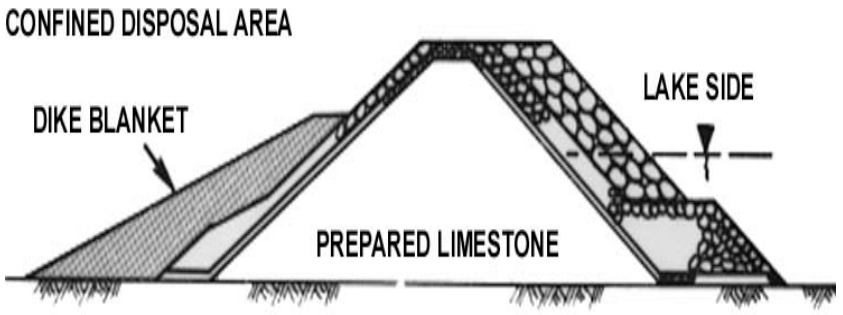
Michigan City, MI

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



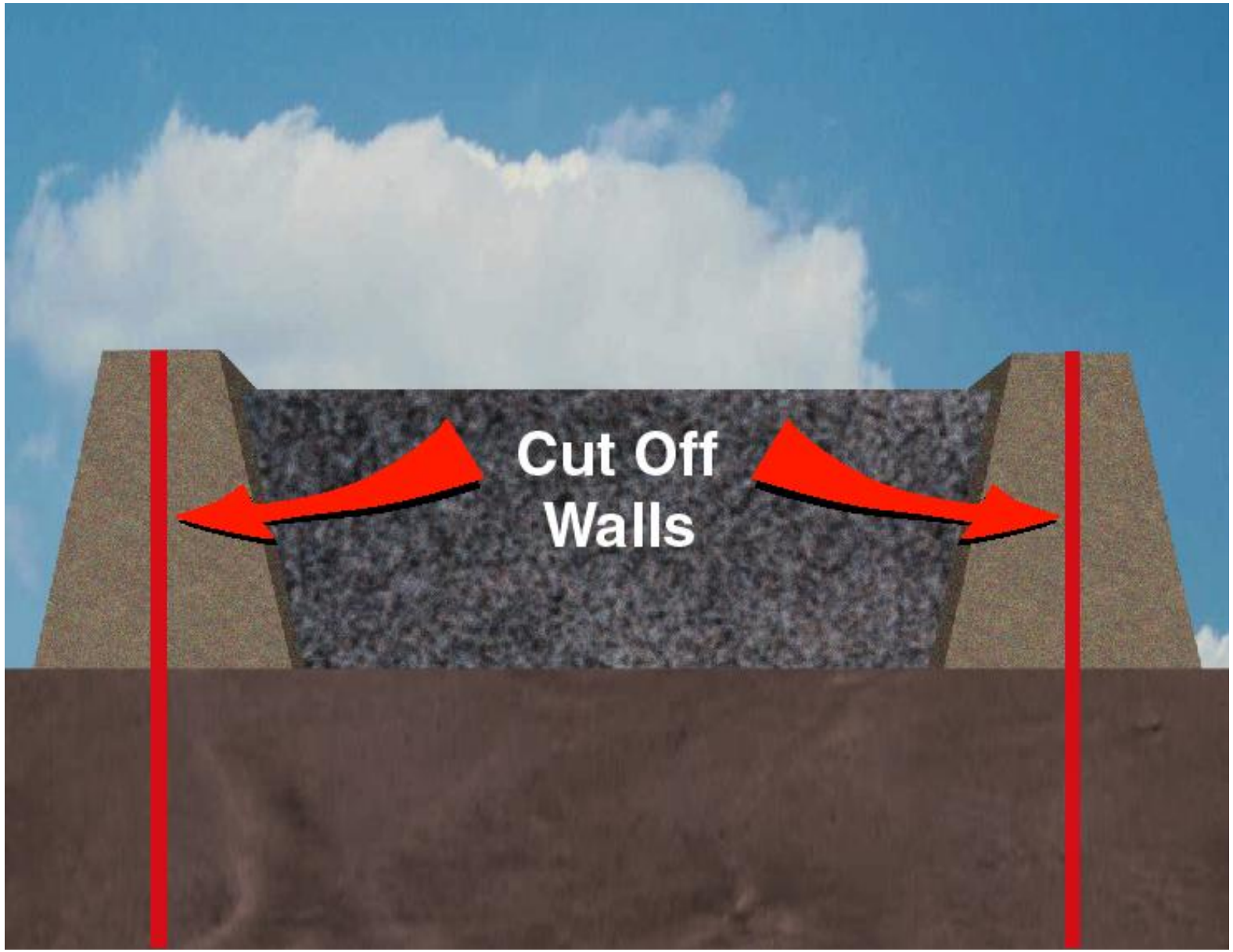
Calumet Harbor, Chicago, Illinois



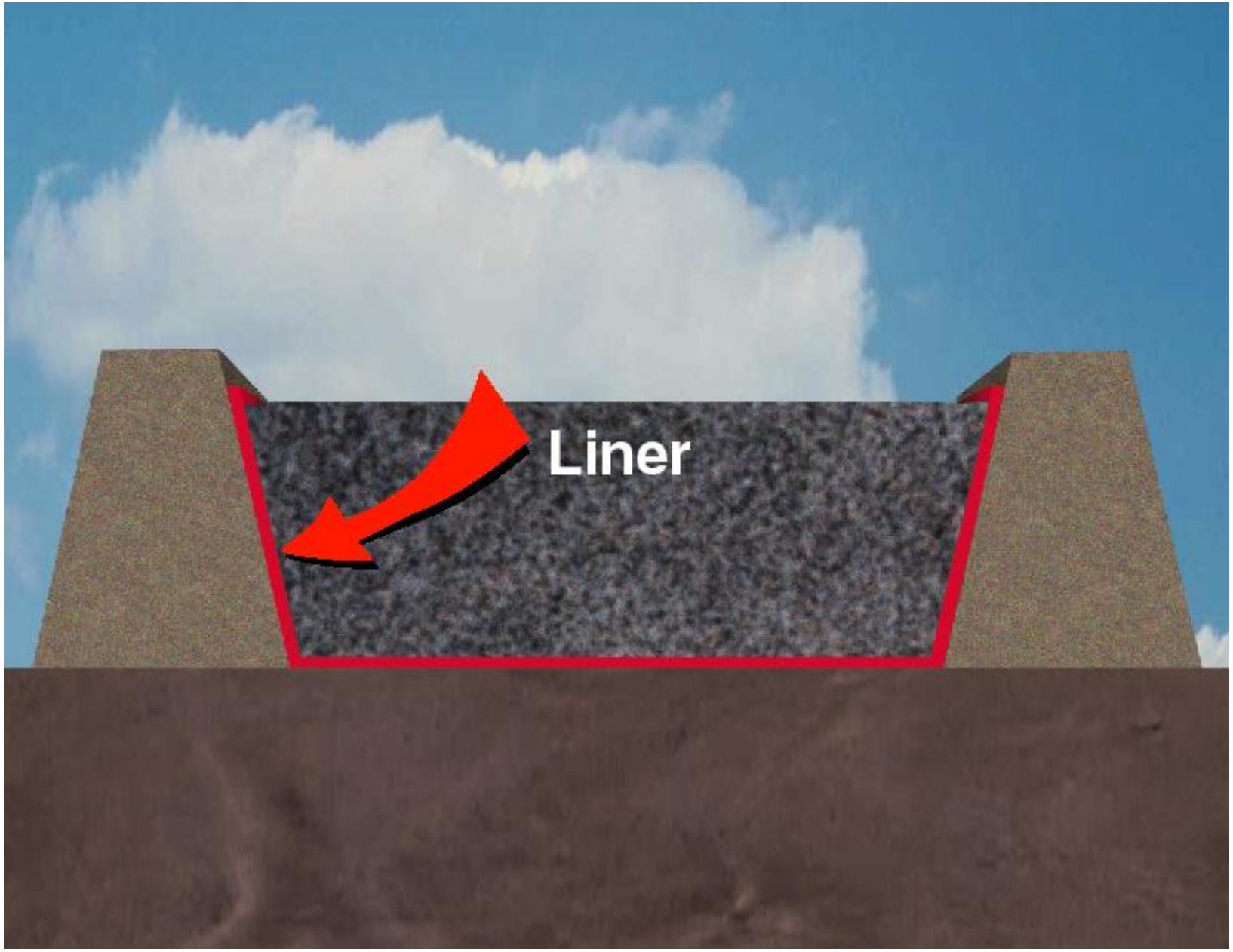
CLAUMET HARBOR CDF, 1984

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

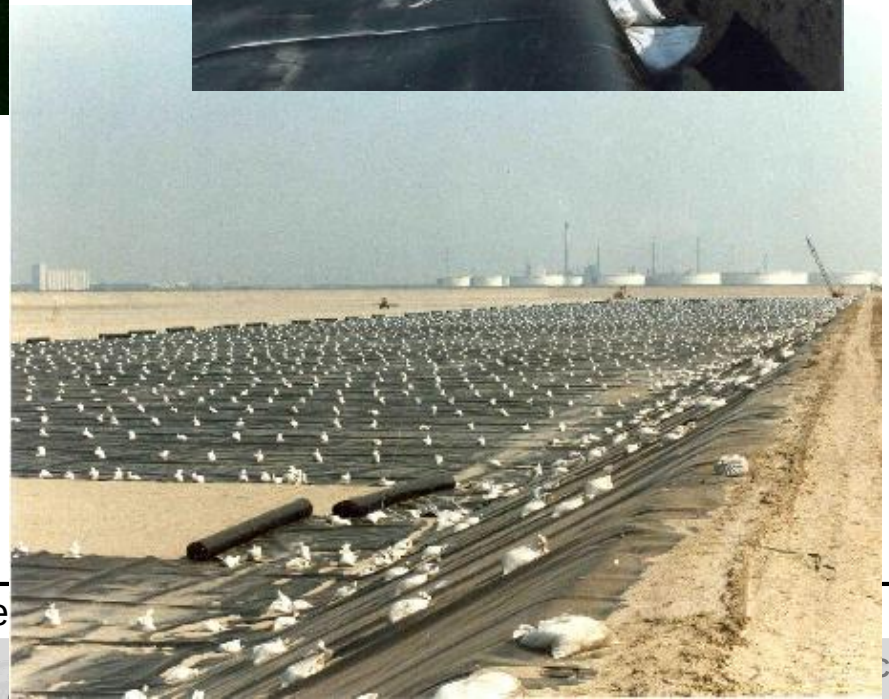


Waukegan Harbor, Illinois



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?