Subaqueous Capping

By Dr. Michael R. Palermo
Mike Palermo Consulting, Inc.

Mike Palermo
Consulting

Outline

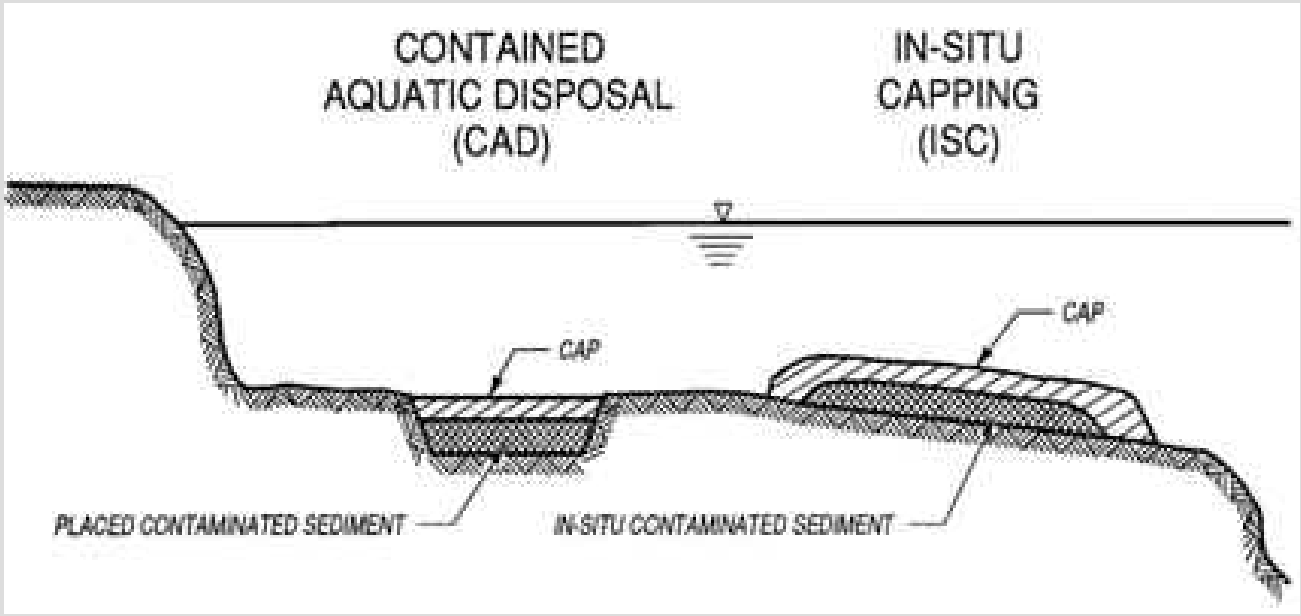
- Definitions and Historical Use of Capping
- Cap Design
- Cap Placement Methods
- Monitoring

In-Situ Capping

- ISC – placement of a subaqueous covering or cap of clean isolating material over an in-situ deposit of contaminated sediment.
- Potentially economical and effective remedy approach.
- Should be considered equally with other remedy options such as MNR or Environmental Dredging.
- Successfully implemented at a number of sites.

Dredged Material Capping vs. In-Situ Capping

- DM Capping – material is initially dredged and placed
- ISC – capping of material in place
- Dredging/ISC combinations



Where has DM capping been applied?

- New York
- Long Island Sound
- New England sites
- Puget Sound
- Boston
- Providence
- Los Angeles
- Portland
- Netherlands
- Belgium
- Hong Kong
- New Bedford, MA

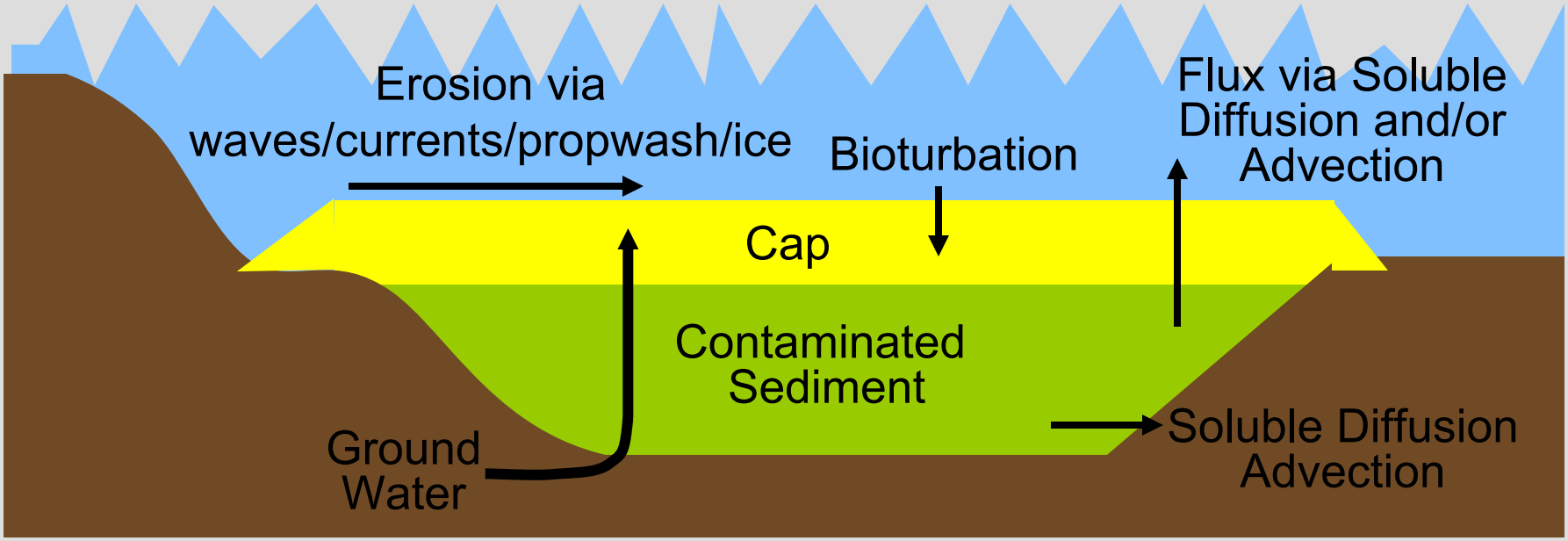
In-Situ Capping

- Advantages
  - Quick risk reduction
  - Easy to implement
  - Cost Effective
  - Potential for Enhancement
- Disadvantages
  - Sediments remain in the aquatic environment
  - Water depths reduced
  - Habitat changes
  - Subject to episodic storms, floods, etc.
  - Long term monitoring/ maintenance required
  - Institutional controls required

Where has ISC been applied?

- Sheboygan WI Demo
- Convair Lagoon
- Japan
- Sweden
- Norway
- Hamilton Harbor, Ontario
- Palos Verdes Shelf Pilot
- Housatonic River
- Puget Sound
  - Simpson Kraft Tacoma
  - Denny Way CSO
  - Pier 51
  - Pier 54
  - Eagle Harbor
- Pine Street Superfund
- Future sites:
  - Onondaga Lake
  - Fox River
  - Silver Lake

Conceptual Illustration – In-Situ Subaqueous Capping



Primary Functions of a Cap

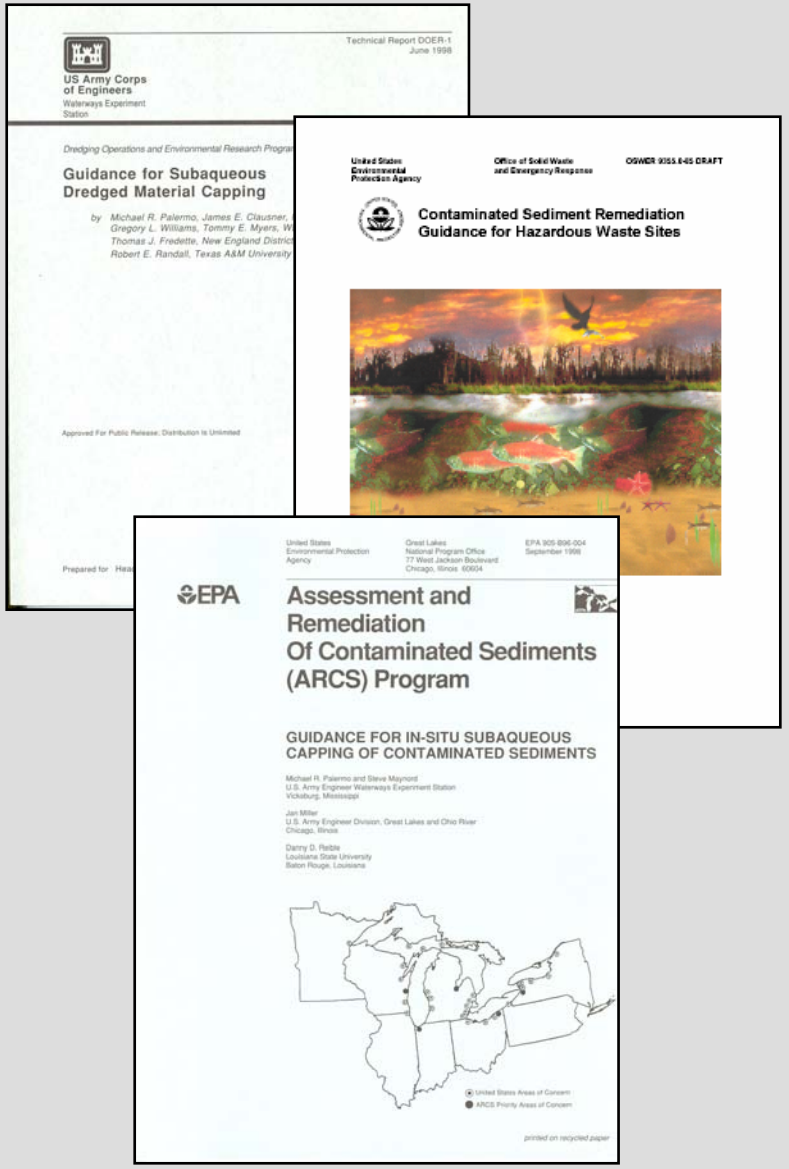
- Physical isolation of CS from the aquatic environment
- Stabilization/ erosion protection of CS, preventing resuspension and transport
- Chemical isolation/ reduction of movement (flux) of dissolved and collodially transported contaminants to the water body

To achieve these results, capping projects must be ENGINEERED.

Success requires that the cap be properly designed, constructed, and maintained.

Technical Guidance for ISC

- USACE guidance for DM capping (USACE 1998)
  - http://www.wes.army.mil/el/dots/doer/pdf/trdoer1.pdf
- EPA (ARCS) guidance for ISC (EPA 1998)
  - http://www.epa.gov/glnpo/sediment/iscmain/index.html
- EPA Superfund Sediment Guidance (EPA 2005)
  - http://www.epa.gov/superfund/resources/sediment/guidance.html



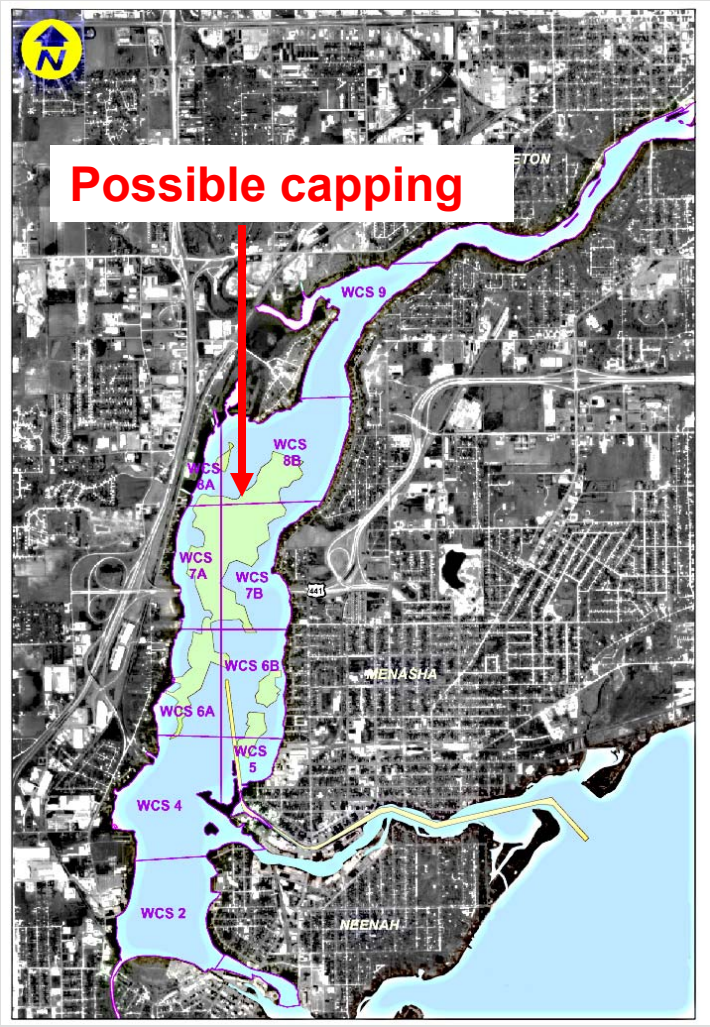
ISC Design Sequence

1. Define objectives and standards.
2. Characterize the contaminated sediments.
3. Characterize the site.
4. Determination feasibility of in-situ capping (where caps can be placed).
5. Design the cap (composition and thickness).
6. Select equipment and placement techniques.
7. Evaluate if objectives are met.
8. Develop monitoring/ management program.

Cap Siting – Fox River Example (OU1)

Cap area exclusions:

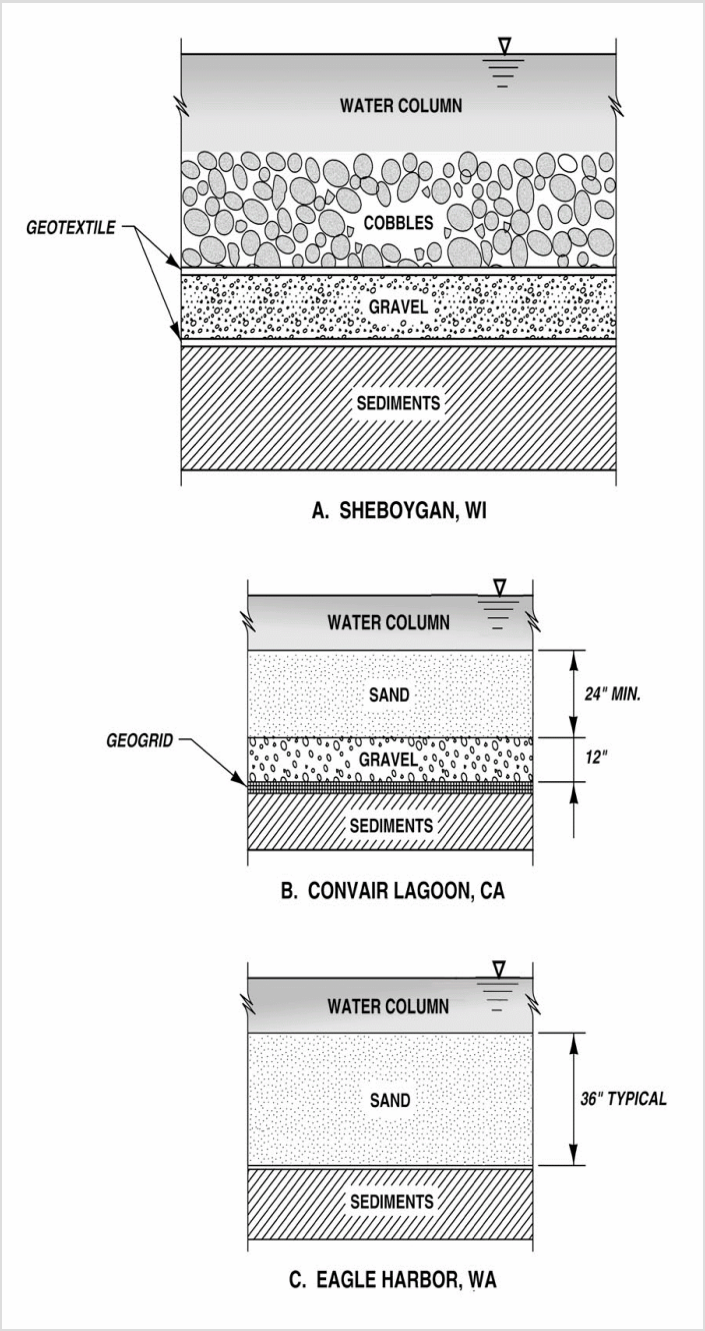
- Navigation channels
- Over infrastructure
- PCB > 50 ppm
- Shallow water resulting in post cap elevations
  - > -3 ft chart datum, OU 1, 3
  - > -4 ft chart datum OU4



Feasibility Determination for ISC

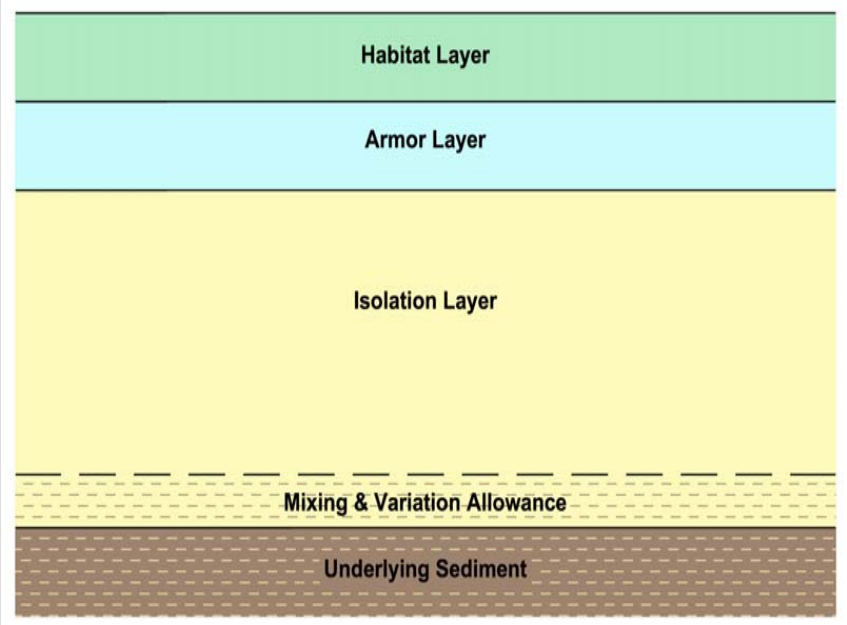
Easier to evaluate factors which may eliminate capping:

- Compatibility with waterway uses
- Flow modification
- Depth limitations
- GW flow conditions
- Erosion potential



Design Components

- Bioturbation
- Consolidation
- Erosion
- Operational
- Chemical Isolation



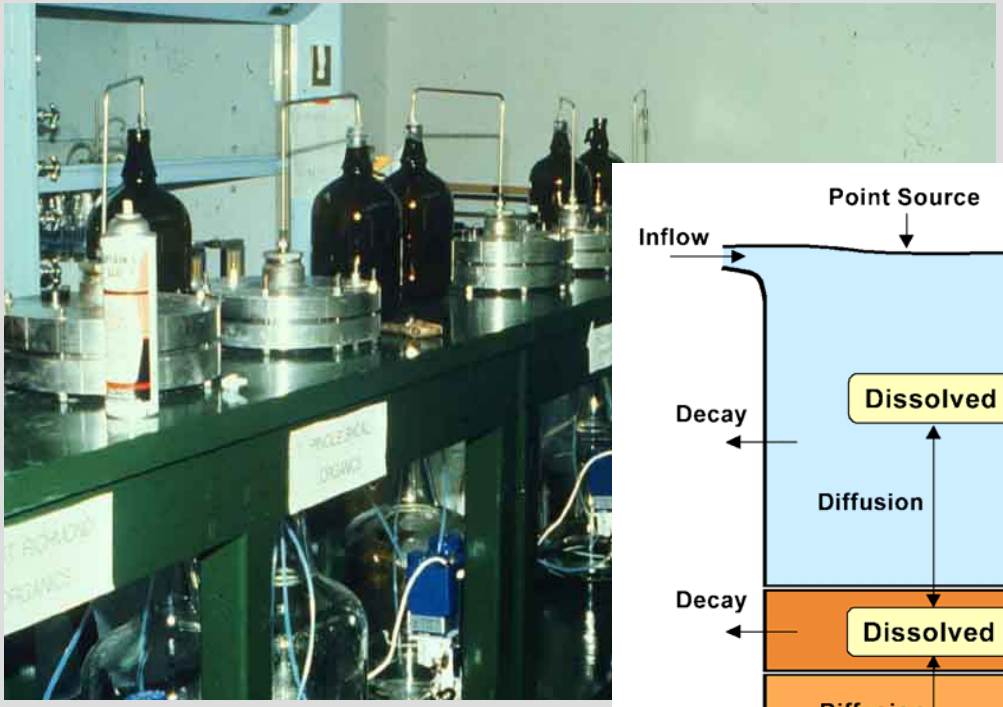
Anacostia Capping Demo

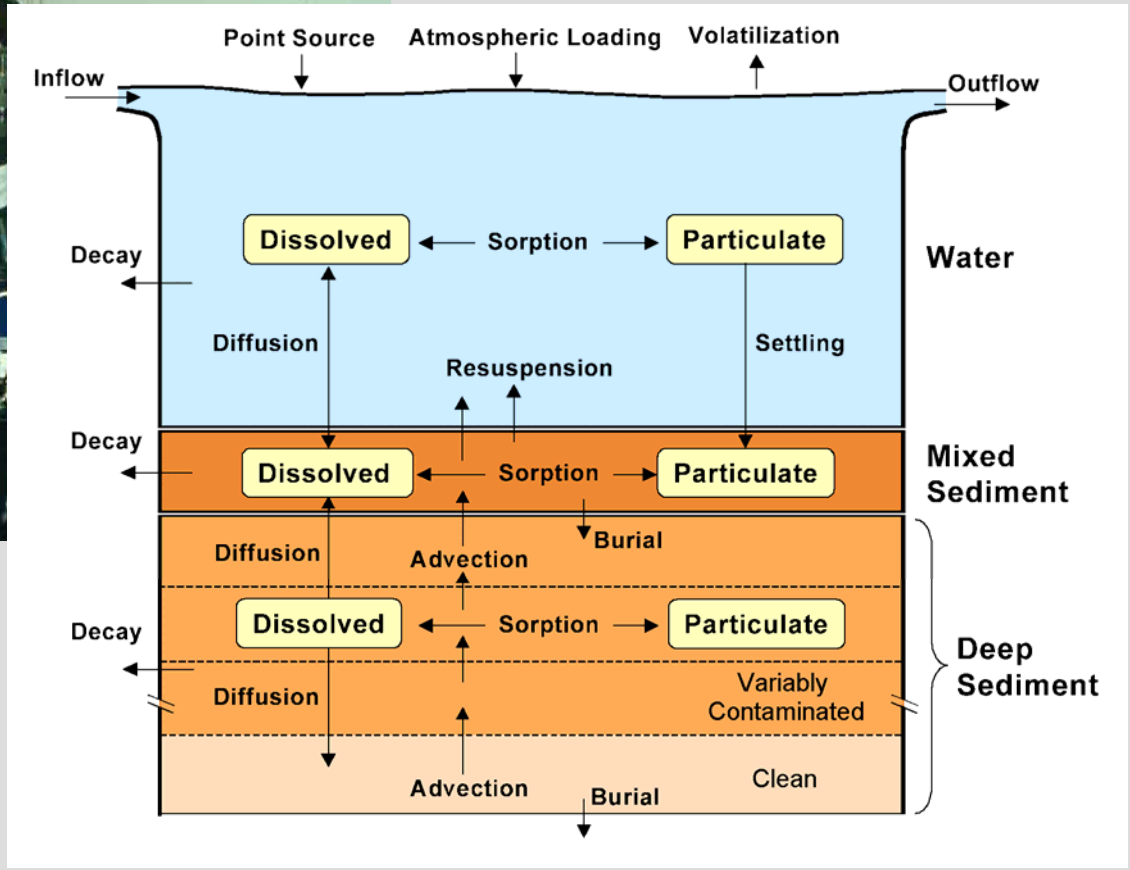
Sand/Apatite

AquaBlok

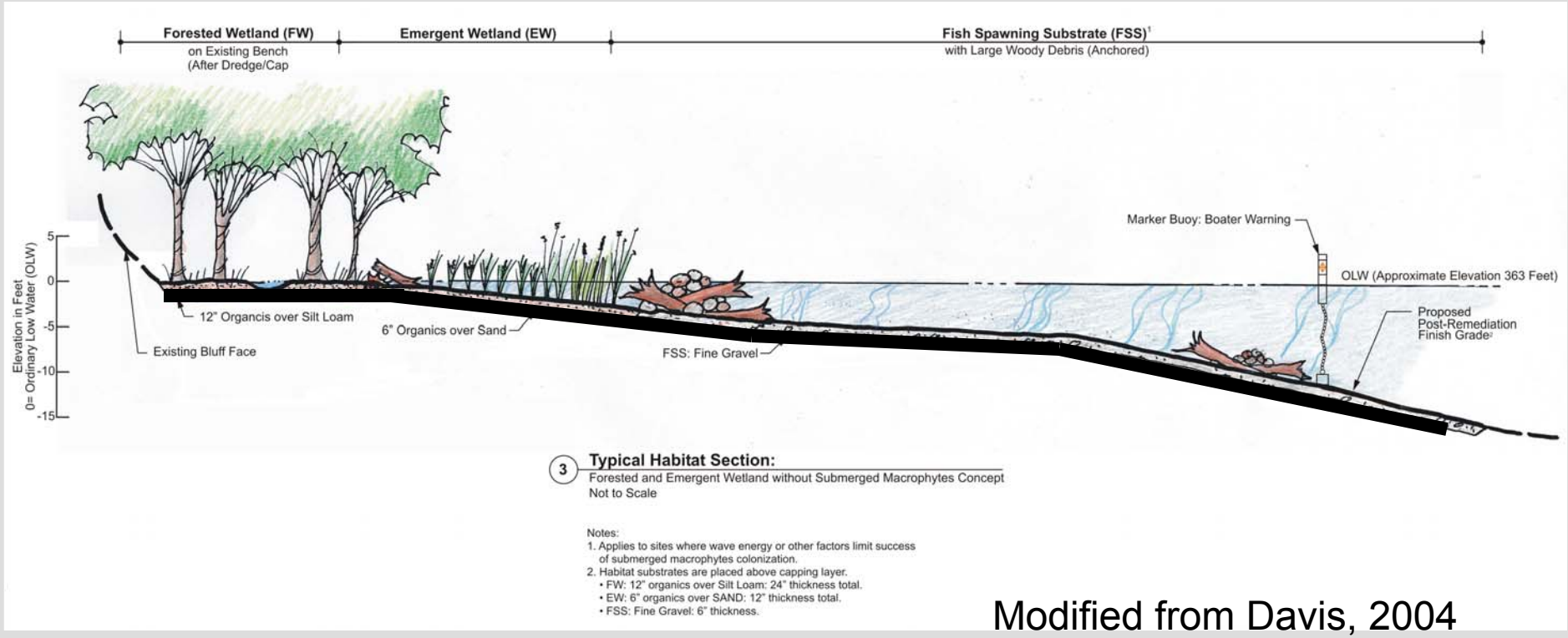
Coke Breeze

Chemical Isolation Testing and Modeling





Potential Habitat with Cap

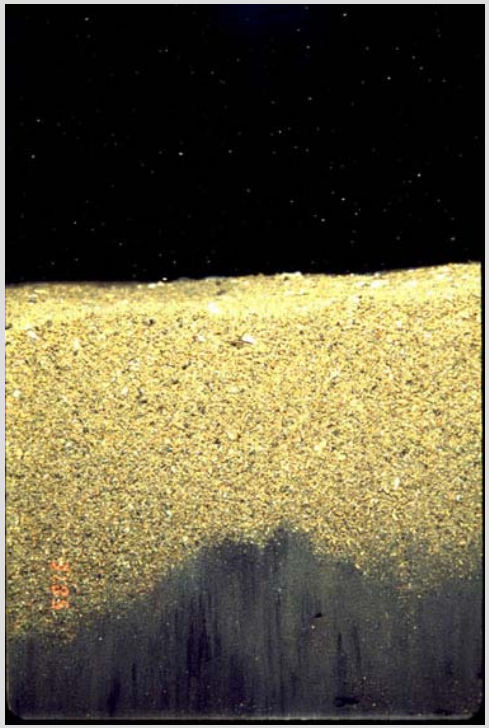


Modified from Davis, 2004

M

Processes Critical to Successful Cap Implementation

- Source Control
- Resuspension During Placement
- Slope Stability
- Bearing Capacity/ Displacement
- Mixing
- Consolidation
- Equipment Selection/ Operational Capabilities



Operational Capabilities

- Ability to place thin lifts
- Ability to place uniform thicknesses
- Ability to monitor placement

Denny Way

CSO

Sheboygan

Demo

Eagle Harbor

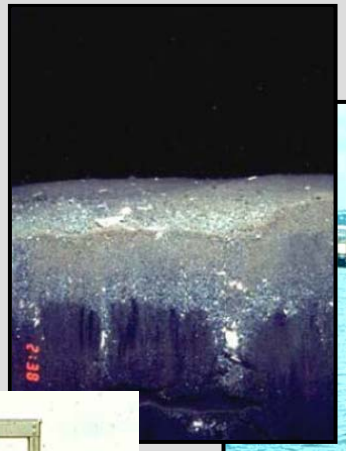
Pine Street

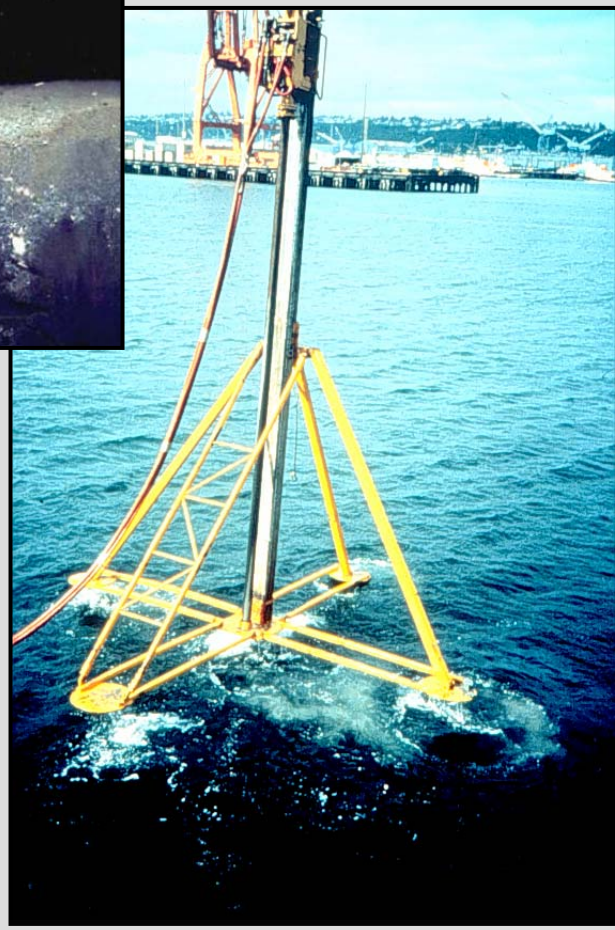
Lake Ketelmeer (Netherlands)

Housatonic – ½ Mile

Cap Monitoring

- Clear objectives and hypotheses
- Tiered approach
- Equipment and methods
  - Bathymetry
  - Cores
  - SPI Camera





Cap Monitoring – Severe Event Response

- Storm, flood, ice jam, etc.
- Return period trigger – 100 year event?
- Likely use of all the tools

Cap Management Actions

- Management Actions integrated with monitoring
- Tiered Management
  - Increased monitoring
  - Add more cap thickness
  - Add a cap component
  - Removal

Take Home Message

- All decisions should be risk-based
- Evaluate all options on a comparable basis
- Balance costs and effectiveness for risk reduction
- Combinations of options often most efficient
- Solutions are
  - Project specific
  - Site specific
  - Sediment specific

Questions?

mike@mikepalermo.com

Mike Palermo
Consulting