

2025 SAME Savannah Post Annual Program Review

Successful Remediation and Restoration Case Studies for Stream Channels with Impacted Sediment

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Objective: Discuss cleanup and restoration methods for stream channels with sediment impacts and passive treatment of metals impacted surface water.



Sediment Removal



Surface Water Passive Treatment

<https://cheat.org/acid-mine-drainage-remediation/>

Overview

**1 Challenges & Approaches
of Managing Sediments in
Stream Channels**

**2 Sediment Removal
Methods**

3 Dredging Solutions

4 Restoration Considerations

**5 Surface Water Passive
Treatment**

6 Q&A and Contact

Challenges & Approaches of Managing Sediments in Stream Channels

Overview of Contaminated Sediments

- What is Contaminated Sediment?
 - “Soil, sand, organic matter, or other minerals that accumulate on the bottom of a water body and contain toxic or hazardous materials at levels that may adversely affect human health or the environment” (USEPA, 2005)
- Sources of contamination include both anthropogenic and natural sources.
- Where are contaminated sediments found?
- What are the risks of contaminated sediment?
- Who regulates cleanup of contaminated Sediment sites?
- What are the options for cleanup?



Sediment Removal Approaches

- **Dry-condition sediment removal** with pump around or bypassing stream flow for efficient removal of contaminated sediments under dry conditions
- **Wet-condition sediment removal** (dredging) to address contamination and improve habitat quality
- **Capping** – potentially with pre-dredging
 - Capping – difficult without dredging due to increase in flooding potential
 - Pre-dredging with capping – remove the “worst” material to make room for cap material



Removal With Pump Around Stream Flow



Removal with River Bypass

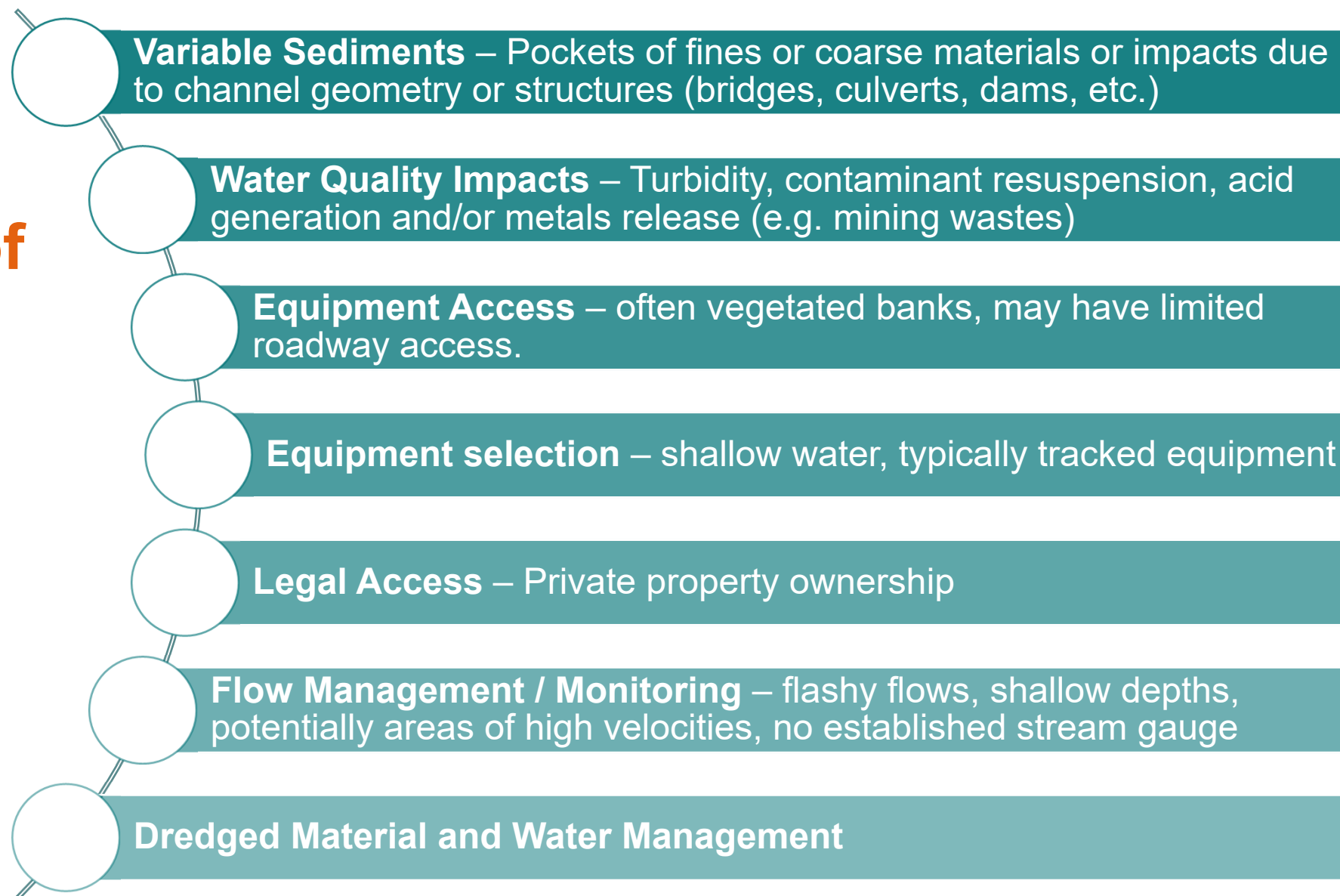


Mechanical Dredging



Reactive Cap in a Marsh

Challenges of Managing Sediment Removal in Stream Channels



Sediment Removal Methods

Sediment Removal With Pump Around Stream Flow

- Plastic-lined berm placed to create a dam pool
- Pumps used to pump water from dam pool into pipes to bypass remediation reach of the stream channel
- Allowed removal “in the dry”
- Berm designed to allow overtopping and resumption of flow through the channel if pumps failed or flows increase to exceed pump capacity



**Remediated stream impacted
with PCBs from industrial
facility.**



Sediment Removal With Bypassing Stream Flow



**Remediated river impacted
with NAPL discharge from
former manufactured gas
plant lagoon.**

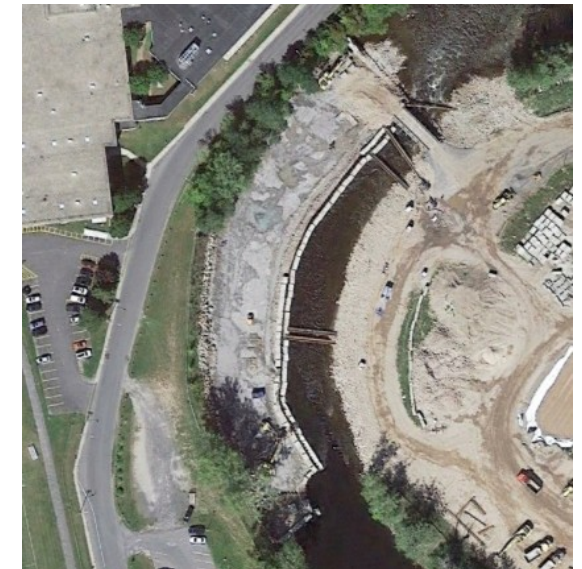
- Design and remediation of sediment and riverbank soil removal on 2,000-foot stretch of river
- Stream flow diverted to one side of channel using temporary sheet piling
- Flow can be “flipped” to remediated side and opposite side dewatered for removal
- Impacted sediments were stabilized, dewatered, and loaded for off-site thermal treatment and disposal
- Large river cobbles were screened/segregated and reused



Phase 4



Phase 7



Phase 5

Unnamed Tributary, Ohio



Remediated tributary with PCB impacted sediments

- Construction of large earthen berms around excavation areas to prevent flooding and provide access
- Tributary divided into cells using sheetpile to support dewatering/dry excavation
- Sediment removed to pre-defined depths using long-stick excavators
- Removed more than 9,300 cy of PCB-impacted sediment and soil
- Pugmill used to stabilize sediments prior to off-site disposal

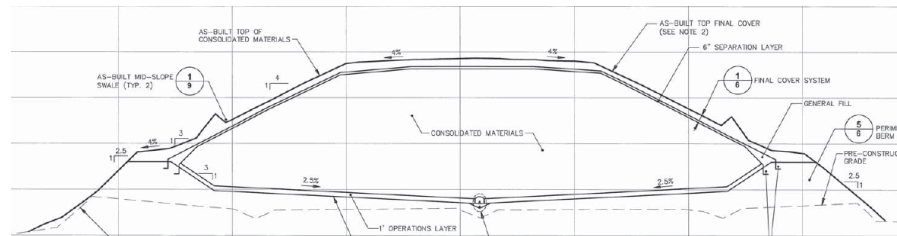


Glade Creek Remediation and Restoration, Illinois



**Remediate creek impacted
with creosote at the largest
former wood-treating facility
in the world.**

- Relocation of ~ 1,500 feet of creek to circumvent non-aqueous phase liquid (NAPL) discharge
- Construction NAPL barrier and recovery trench
- Sediment removal at original stream location
- Consolidation of ~ 31,000 cy of waste materials in an onsite containment cell
- Restoration included creation of compensatory wetlands and phytoremediation to maintain GW levels to promote DNAPL collection.



Dredging Solutions

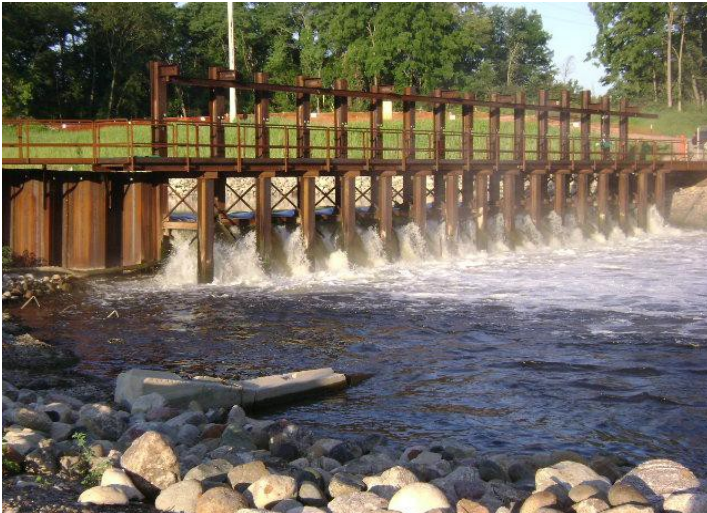
Dredging Technologies

- Mechanical
- Hydraulic



Dredging with Water Control

- Water control structure was used for five months to maintain stable water levels in the upstream removal areas
- Sediment removal and restoration



Water Control Structure



Physical Barriers to Control and Contain Disturbed Soils and Sediments



Sediment Removal

Dredging – River and Small Boat Harbor by Barge

- Mechanical dredging and cover material placement
- Removal of ~ 49,000 cy of sediment
- Placement of ~11,800 cy of amended cover material over 5.5 acres
- Cover material amended with granular activated carbon (GAC)
- Amended cover placement allowed for a significant cost savings by reducing dredge, backfill, and disposal volumes



Dredging and Enhanced Natural Recovery

- GLLA project where Arcadis, under contract with USACE, supported USEPA GLNPO and State Agency
- Combination of dredging, beneficial use, residuals cover, and ENR provided for a cost-effective and sustainable remedy
- Beneficial use material was reused as landfill cover, reducing disposal costs
- Shallow areas received sand cover for ENR, reducing dredge volumes



Marsh Restoration with Capping, Arkansas

- Sediment restoration from shallow marsh and wetland areas impacted by crude oil release tailored to three different site areas and levels of contamination
 - Limited sediment removal
 - Amended capping using low ground pressure vehicle operations
 - Enhanced natural recovery with in-situ amendment material broadcasted



Reactive Cap Placement in Open Water Area



Amendment Placement over Heavily Vegetated Area

Restoration Considerations

Sediment and Stream Restoration

- Some considerations for stream, streambank, and floodplain restoration include:
 - Flood control
 - Create habitat
 - Prevent erosion
 - Improve water quality
 - Protect infrastructure



Town Branch Creek, Kentucky

- The restoration project is one of the largest of its kind in the state of Kentucky with 3.5 miles of creek and floodplains restored
- Stream channel was restored primarily with rip rap for conveyance and protection of existing stream structures
- Habitat and aesthetic restoration was critical and included various in-stream habitat enhancement structures, bank cover vegetation and riparian zone plantings



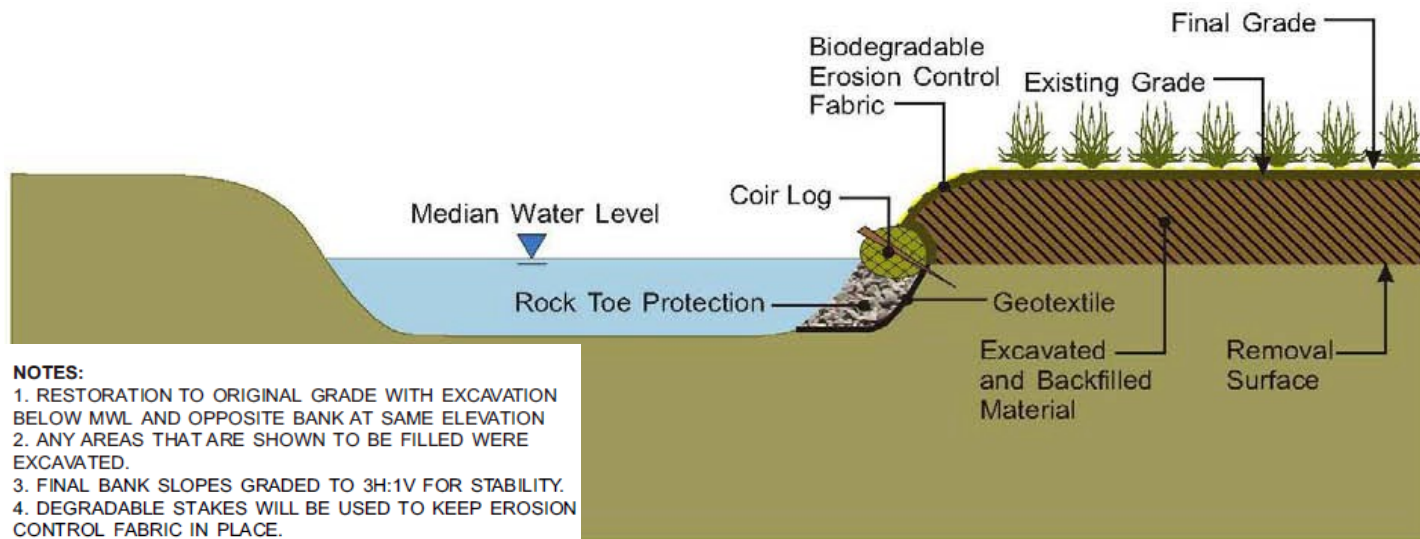
Riverbank Restoration, New York

- Sediment and riverbank removal to remove impacts migrating from previously remediated upland source area
 - Sediment and riverbank removal
 - Restoration considered high flows and ice scour and installed soft armoring and native tree, shrub, and herbaceous species to restore the riparian habitat.
 - Successful restoration after three years.



Dredging with Enhanced Natural Recovery

- 30-foot-wide buffer zone established/restored in floodplain
- Habitat restoration included use of native wetland species
- Use of hard armor minimized where possible
- Monitoring/maintenance plan based on adaptive management approach
- All disturbed areas restored with trees, shrubs, native grasses, or stone



NOT-TO-SCALE

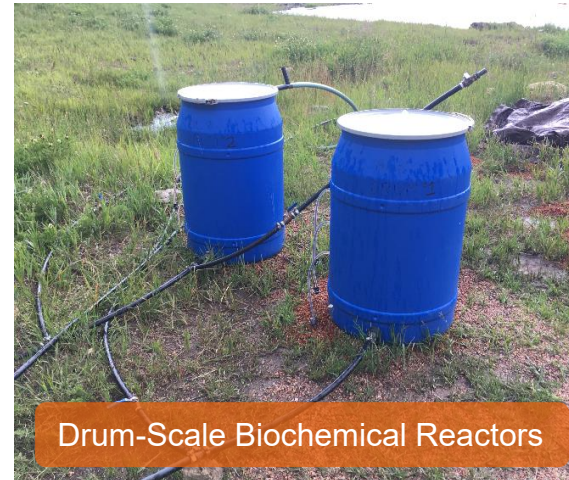
EXAGGERATED VERTICAL SCALE



Surface Water and Shallow Groundwater Passive Treatment

Passive Treatment Technologies

- Biochemical Reactors
- Constructed Wetlands and Phytoremediation
- Limestone channels / ponds / Beds



<https://cheat.org/acid-mine-drainage-remediation/>

Biochemical Reactor – Metals Treatment

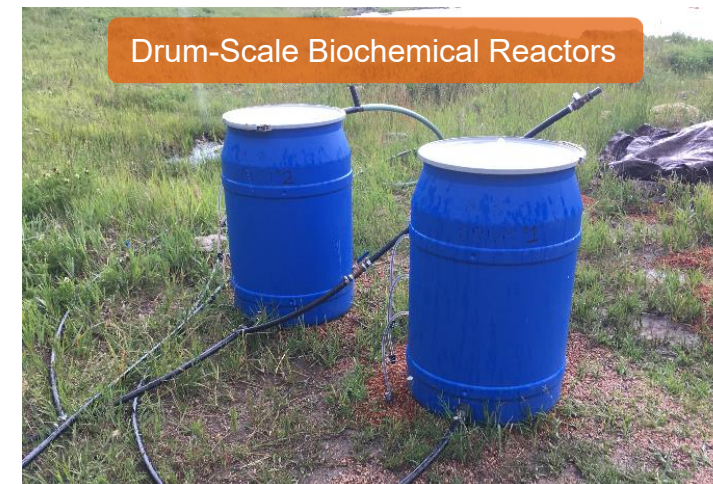
Former Uranium Mine, Western US

- Pilot testing of potential full-scale remedies (variable flow rates)
- Dissolved uranium = 7 mg/L (Exceeds EPA MCL)



Passive Treatment of Uranium

- Multiple strategies tested at the pilot-scale
- Ultimately, biochemical reactor strategy most effective



Passive Treatment of Uranium

- Biochemical reactors tested at larger scale
- Multiple configurations tested



Biochemical Reactor Media Beneath Gravel Layer



Biochemical Reactor Cell

Jersey Barrier Design:

- ~2.5-ft deep cell, HDPE lined
- Low surface disturbance, but short flow path (potential for short circuiting)



Mixing of Biochemical Reactor Media for Placement into Cells



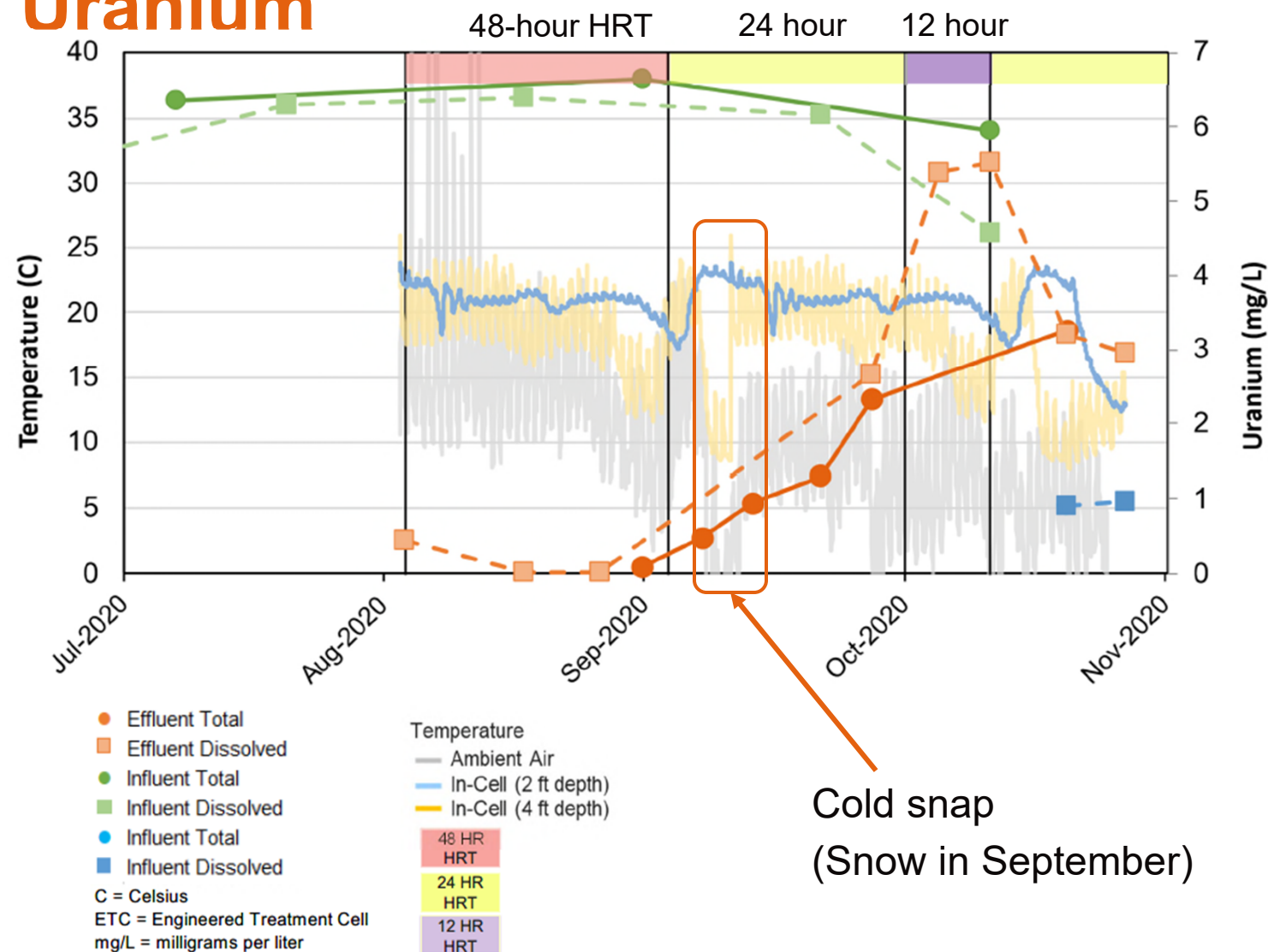
Small Conex Box Reactor Cell

“Modular” Design:

- Conex boxes for longer vertical flow path
- Easier disposal and replacement of spent media

Passive Treatment of Uranium

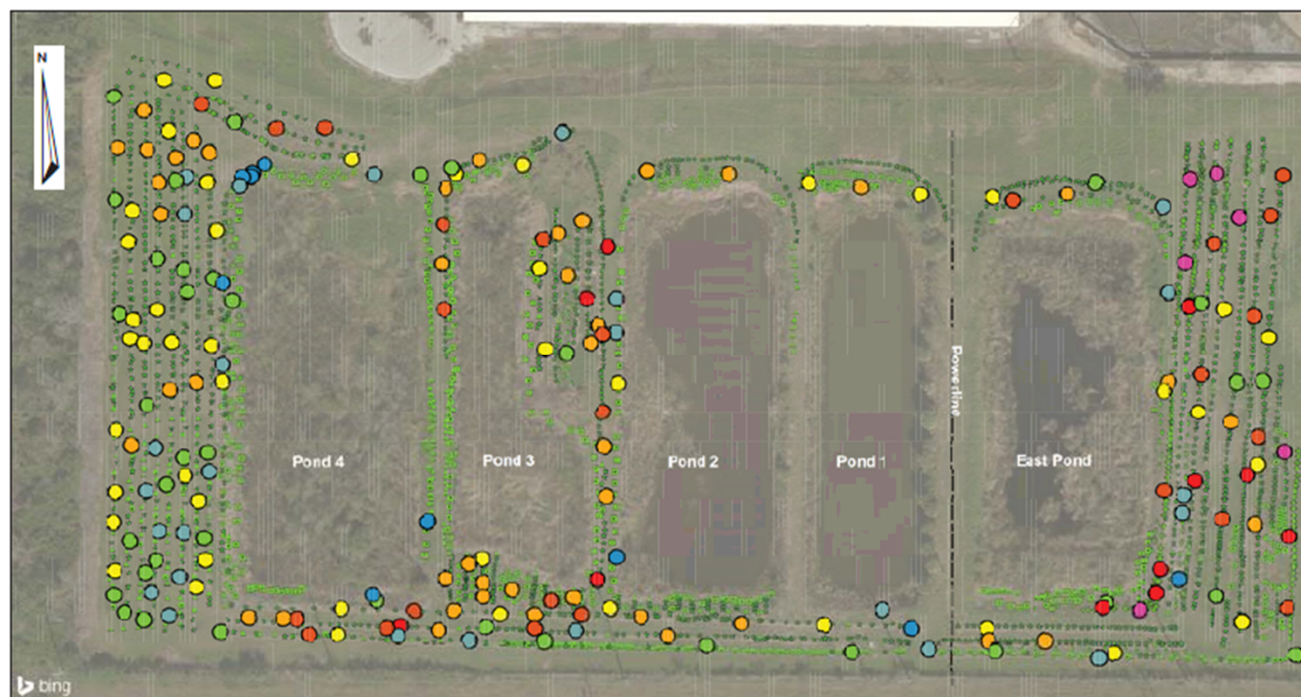
- Conex box treatment most effective at 24 to 36-hour hydraulic residence time
- Biological treatment extremely temperature sensitive
- Longevity enhanced with periodic injections of emulsified vegetable oil



Phytoremediation – Ammonia and Nitrate

Kinder Morgan Site, Florida

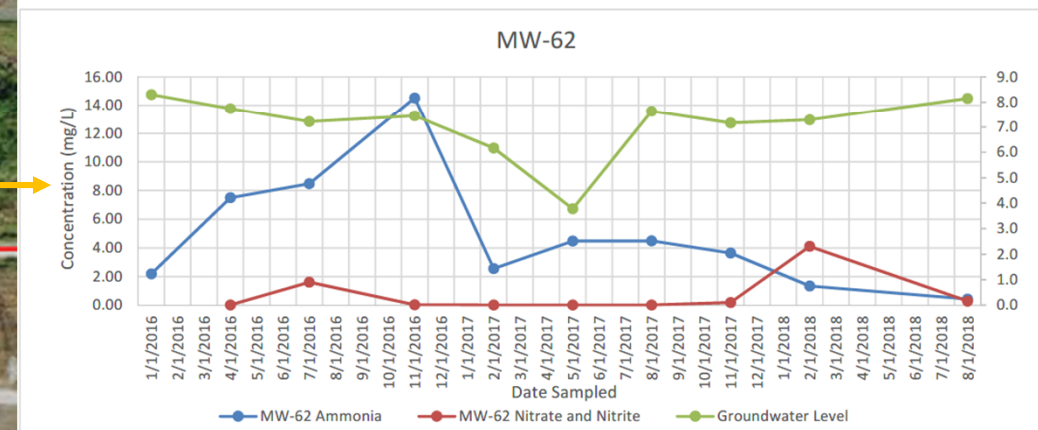
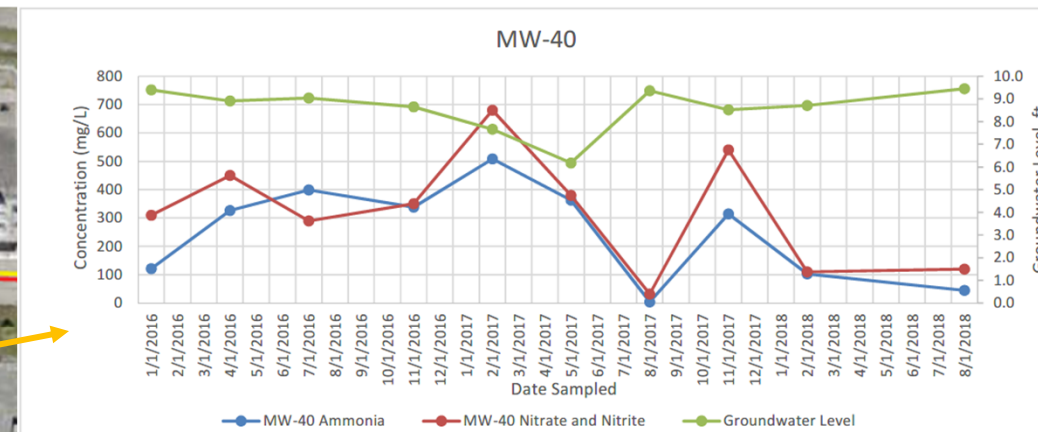
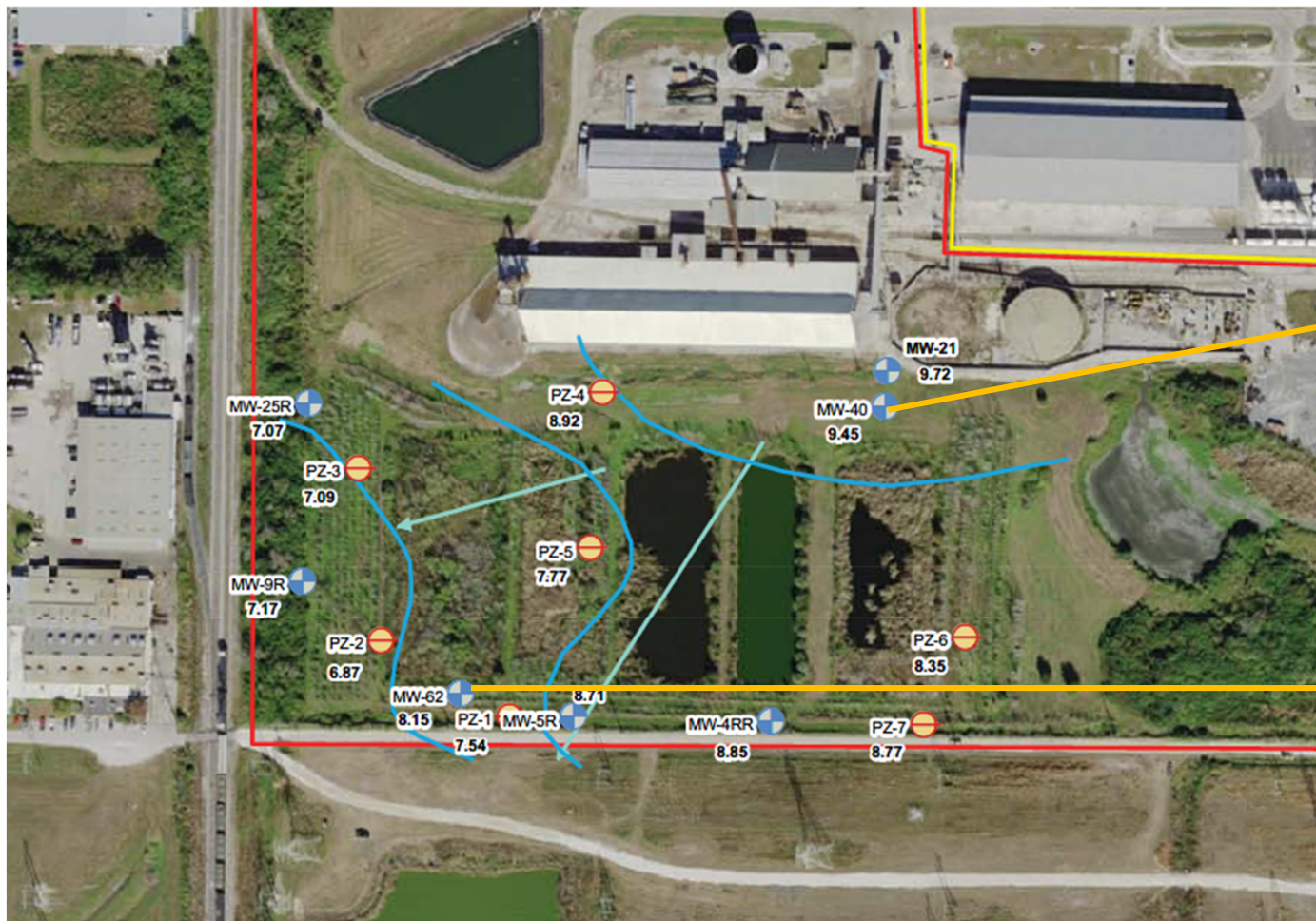
- Deep-rooted trees planted for uptake of water (hydraulic control) and nutrients (phytoremediation)
- System includes ~3,000 trees
- Decreases in ammonia and nitrate observed



Common Name	Scientific Name
Pop Ash	<i>Fraxinus caroliniana</i>
Hybrid Poplars	<i>Populus deltoides x Populus nigra</i>
Tulip Poplars	<i>Liriodendron tulipifera</i>
Red Maple	<i>Acer Rubrum</i>
Swamp Cottonwood	<i>Populus heterophylla</i>
Swamp Tupelo	<i>Nyssa biflora</i>
Coastal Willow	<i>Salix hookeriana</i>
Hybrid Willow	<i>Salix alba</i>

Phytoremediation – Ammonia and Nitrate

Kinder Morgan Site, Florida



Phytoremediation – Arsenic and PAHs

Eppinger & Russel Wood Treatment Site, Virginia

- Plants used for arsenic/PAH uptake as well as “phytohydraulics”
- Deep rooted grasses and shrubs/trees grown in over time
- Demonstrated arsenic uptake in plants

Pre-Remedial Measures



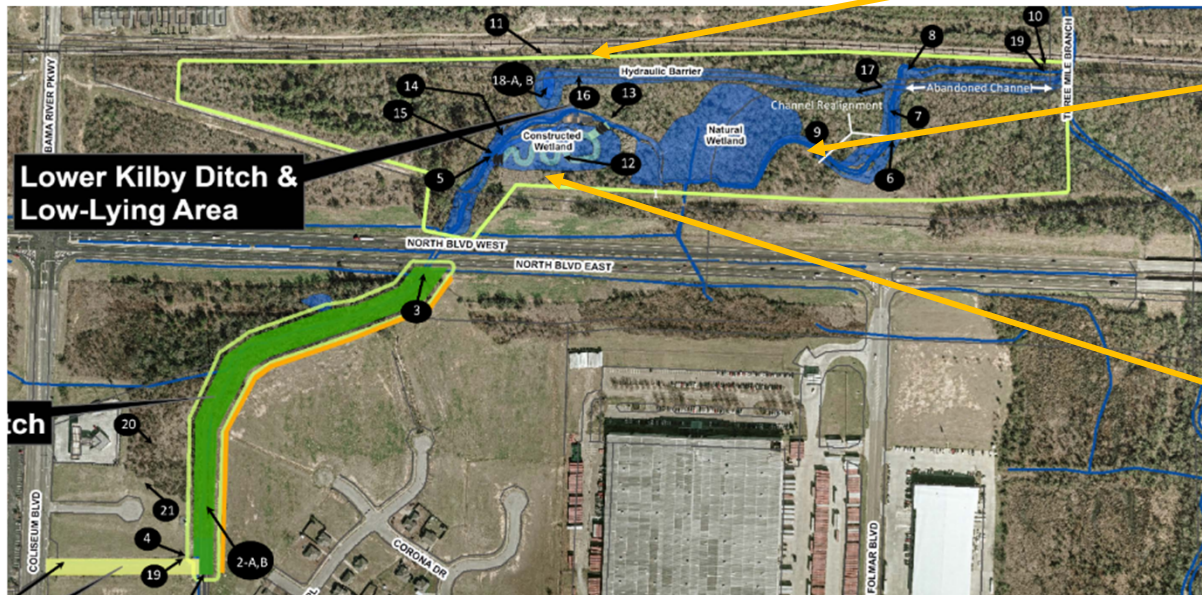
Post-Cutoff Wall July 2013



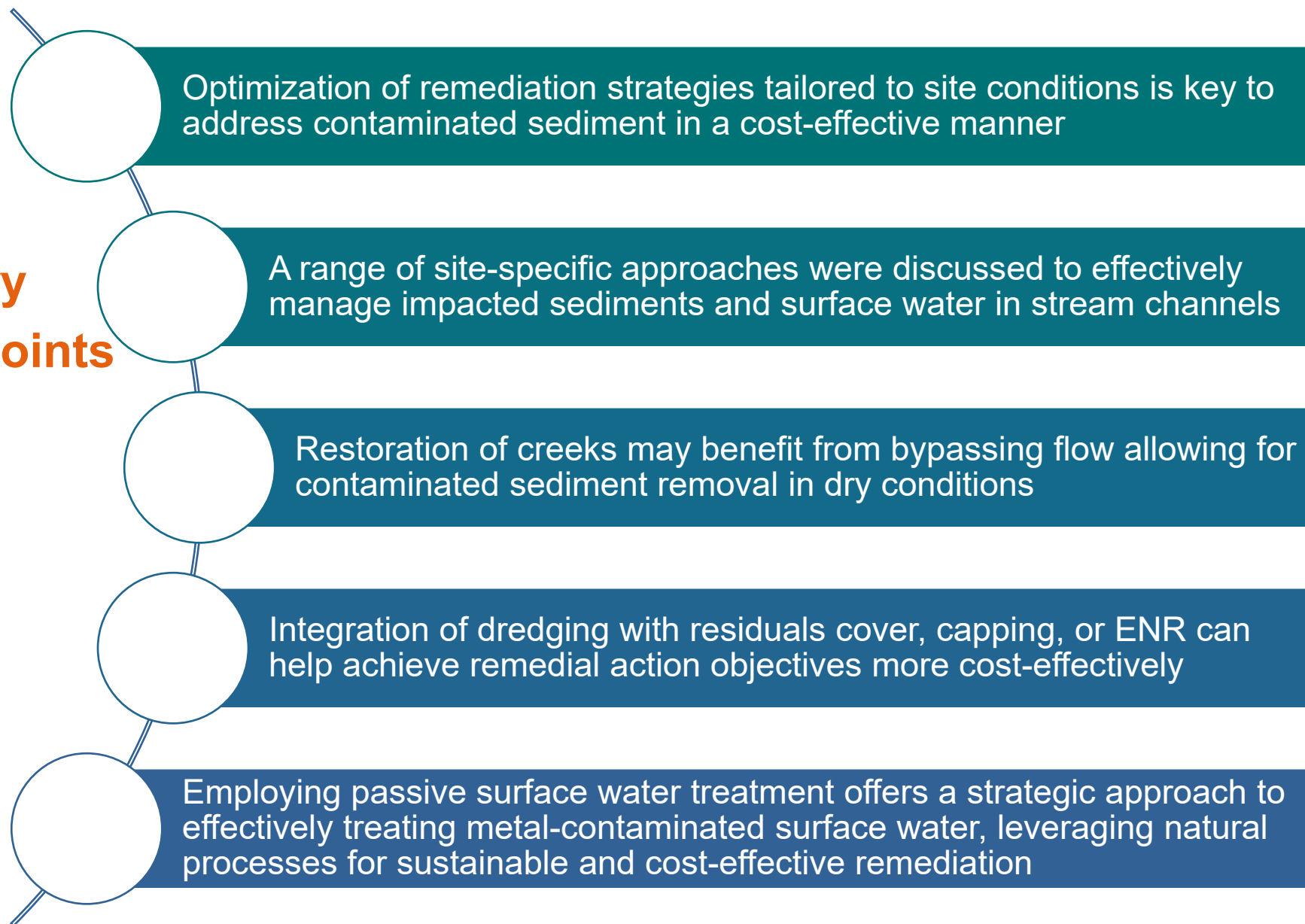
Constructed Wetland – Trichloroethylene Plume Treatment

Alabama Dept of Transportation (ALDOT)

- Institutional control (IC) boundary
- Constructed wetland used for retaining water and aerobic treatment of trichloroethylene (TCE) and byproducts
- TCE is < 5 ppb leaving the site on the northeast corner



Summary of Key Points Covered



Goal

Offer practical strategies to optimize remediation design, manage contamination, and leverage natural recovery processes to address sediment contamination.

Thank you for joining!

Questions? Please reach out to:

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