ASHTABULA RIVER, OH

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U.S. ENVIRONMENTAL PROTECTION AGENCY, GLNPO AND ORD

GLLA Project Coordination Team

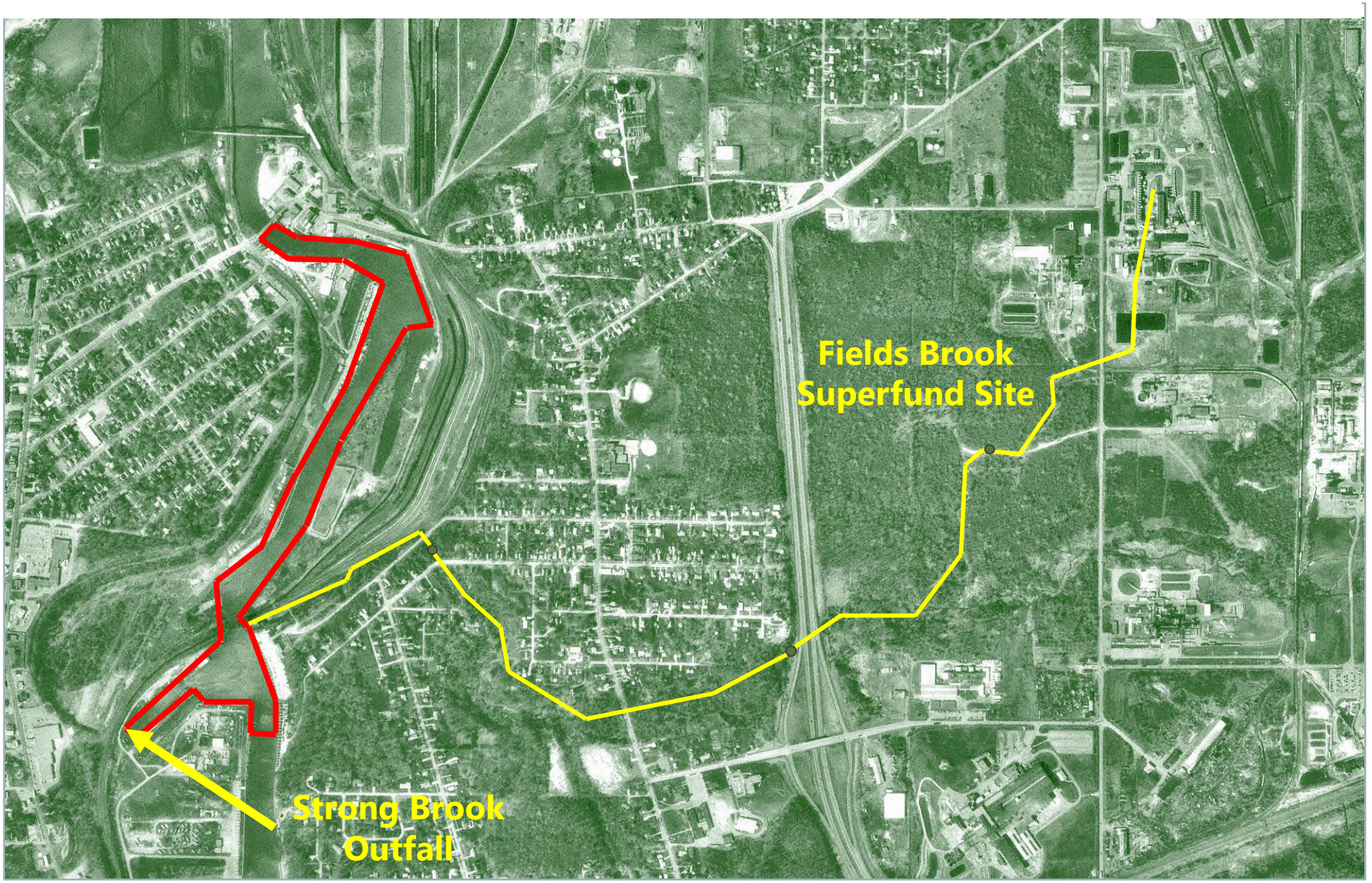
Great Lakes Legacy Act Project Partners

- Federal: USEPA GLNPO
- Non-Federal: Ashtabula City Port Authority
- Non-Federal: Ashtabula River Cooperation Group II
- Non-Federal: Ohio EPA

Project Coordination Team Members

- USEPA Region 5
- USACE Buffalo District
- US Fish & Wildlife
- NOAA

Site Overview

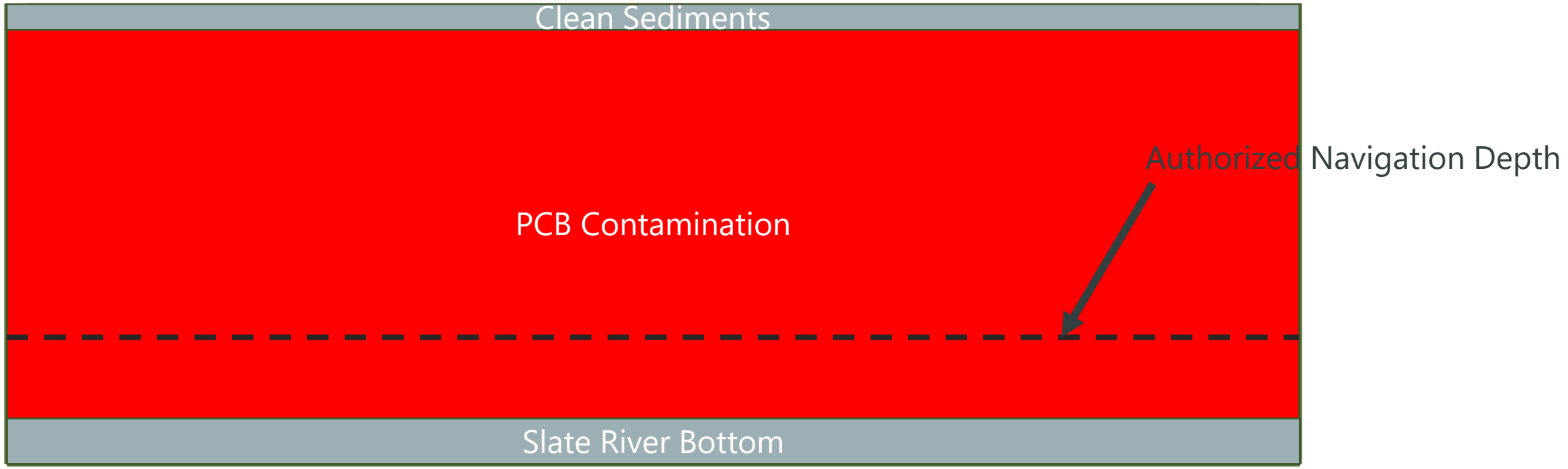


Site Overview

- Upstream
  - Natural, “wild”, river
  - 1 to 3 foot water depth
  - Riffles
  - Fast flowing, flashy
- Remediation site
  - Man-made, deepened river
  - 16 to 22 foot water depth
  - Maintained Federal Navigation Channel
  - 20 years without dredging due to high contaminant levels

Upstream of Cleanup Site

Simplified Cross Section



Objectives of Remediation

- Drivers of remediation
  - Restrictions on fish and wildlife consumption
  - Degradation of benthos
  - Restrictions on dredging activities
  - Fish tumors or other deformities
- Short-term goals
  - Restore navigational depth
  - Provide potential for natural Sedimentation
  - Achieve contaminant cleanup goals
    - PCB SWAC = 7.5 ppm (vs. pre-remediation SWAC of <1 ppm)
    - PAH point concentrations = 22 ppm

Objectives of Remediation

- Long-term goals
  - PCB SWAC = 0.25 ppm
  - PAH point concentrations = 22 ppm
  - Meet unrestricted disposal requirements for future navigation dredging
- Active remedy + MNR expected to be final remedy for site
  - Estimated 10 years of MNR

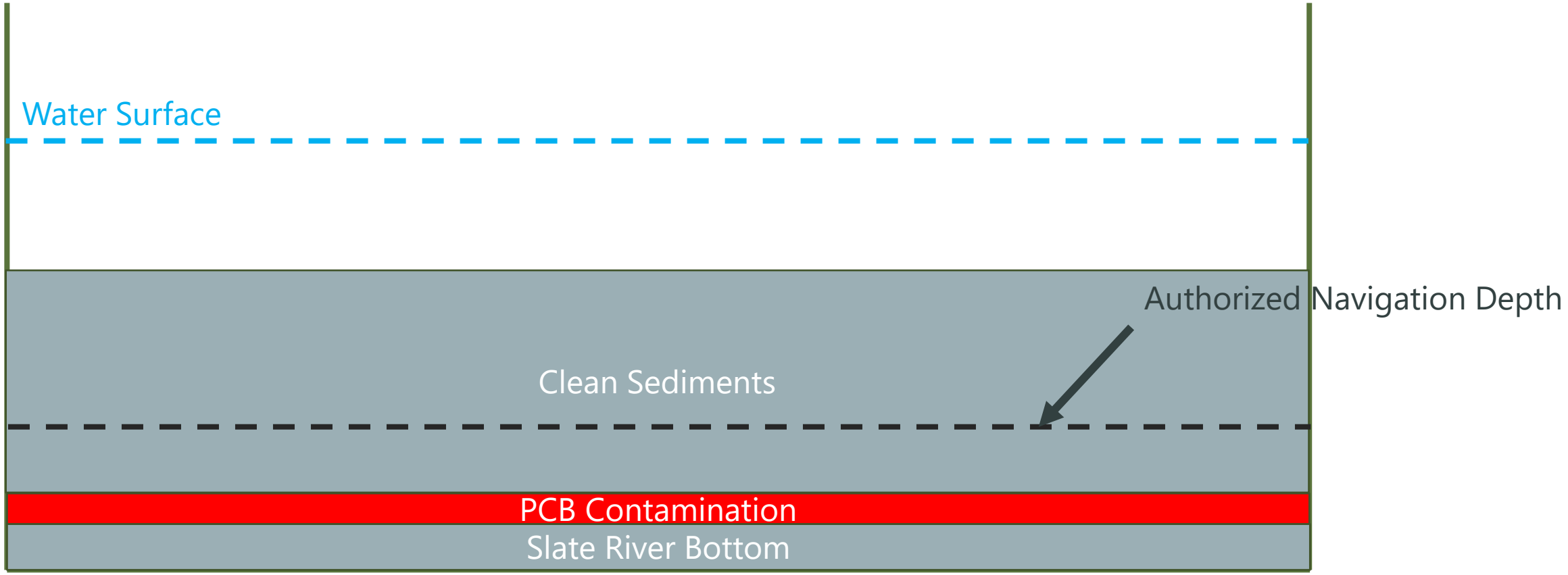
Summary of Completed Early or Final Remedy

- Early actions
  - Fields Brook cleanup (completed in 2005)
- Final remedy
  - Deep dredge with disposal
    - 500,000 cubic yards removed
    - Dredge to 20 feet below low water datum, or to bedrock
    - Depth of cuts: 2 to 18 feet
    - Average dredge cut: 11 feet

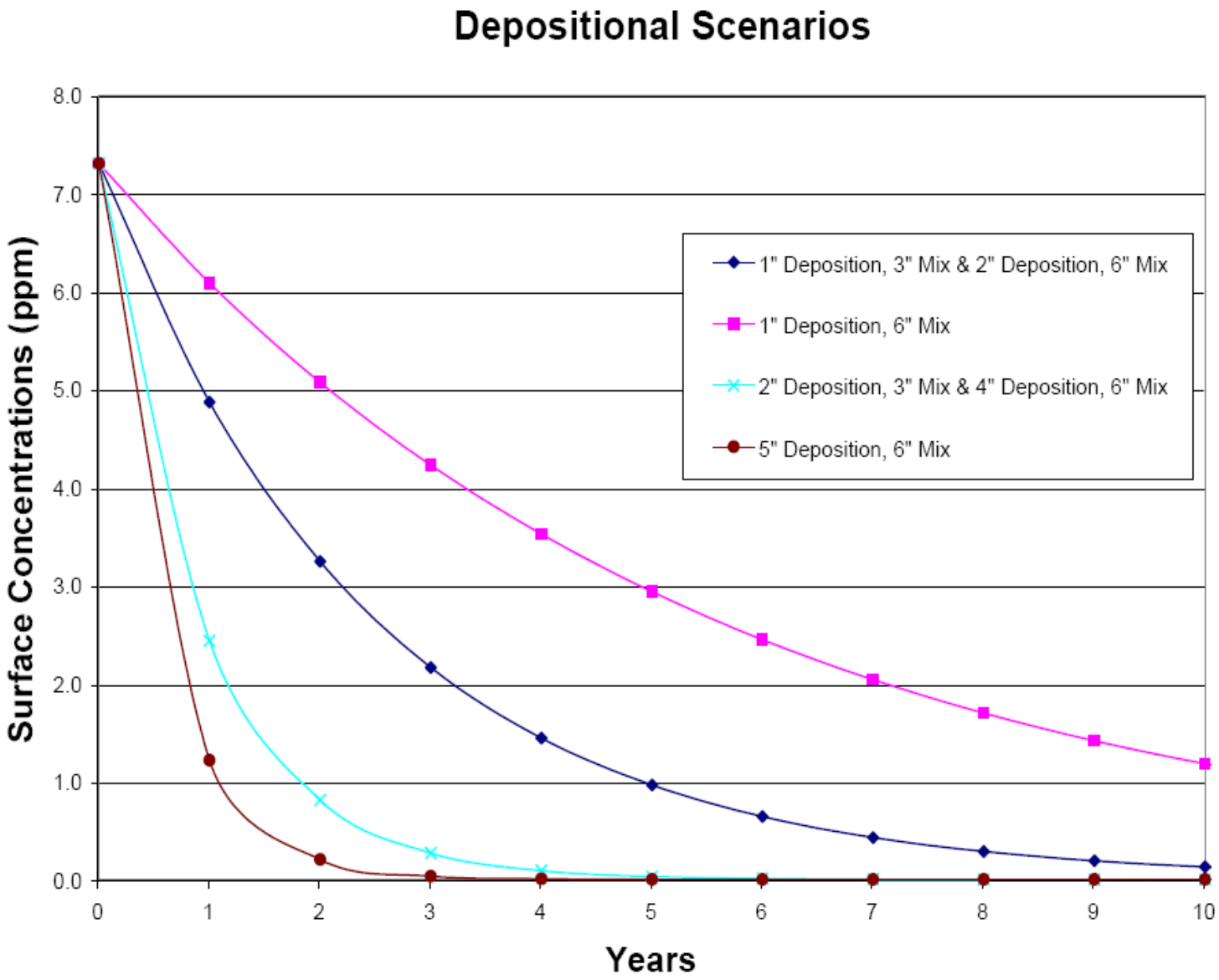
Operations Overview

Cleanup Dredging

Simplified Cross Section



Re-Sedimentation and Recovery



Additional Source ID'd

Remedy Effectiveness Assessment (REA) Used a Weight of Evidence Approach

- Utilized multiple lines of evidence (LOE) to assess the remedy effectiveness
- Engaged multiple agencies and stakeholders to collect and synthesize data from the project and the AOC

Data Type		Ohio EPA	NOAA	USGS	GLNPO	ORD	Reference(s)
Physical Line of Evidence							
Bathymetry	Pre-				√		[23]
	Post-				√		[27]
Qualitative Habitat Evaluation Index (QHEI)	Pre-	√					[4]
	Post-	√					[20]
Biological Line of Evidence							
Invertebrate Community Index (ICI)	Pre-	√					[20]
	Post-	√					
Macroinvertebrate Tissue Analysis	Pre-				√		[28]
	Post-					√	[19, 26]
Amphipod Survival	Pre-			√	√		[25, 28]
	Post-		√				[29]
Riparian Spiders	Post-			√		√	[30]
Index of Biotic Integrity (IBI)	Pre-	√					[20]
	Post-	√					
Modified Index of Well-being (MIwb)	Pre-	√					[20]
	Post-	√					
Sport Fish Fillet Total PCBs	Pre-	√					[8, 20]
	Post-	√					
Brown Bullhead Whole Fish Total PCBs	Pre-				√	√	[19, 23]
	Post-					√	[31, 32]
Caged Channel Catfish Total PCBs	Pre-				√		[28]
Brown Bullhead Internal/External Fish Histopathology	Pre-			√			[17]
	Post-			√		√	[19, 33]
Brown Bullhead Blood and Liver DNA Damage	Pre-					√	[19]
	Post-					√	
Chemical Line of Evidence							
PCB Surface Weighted Average Concentrations (SWAC)	Pre-				√		[3, 28]
	Post-				√	√	[11, 27, 34]
Sediment PCB Mass	Pre-					√	[24, 26]
	Post-					√	
Radionuclides (Radium, Thorium, Uranium)	Pre-				√		[28]
	Post-				√	√	[34, 35]

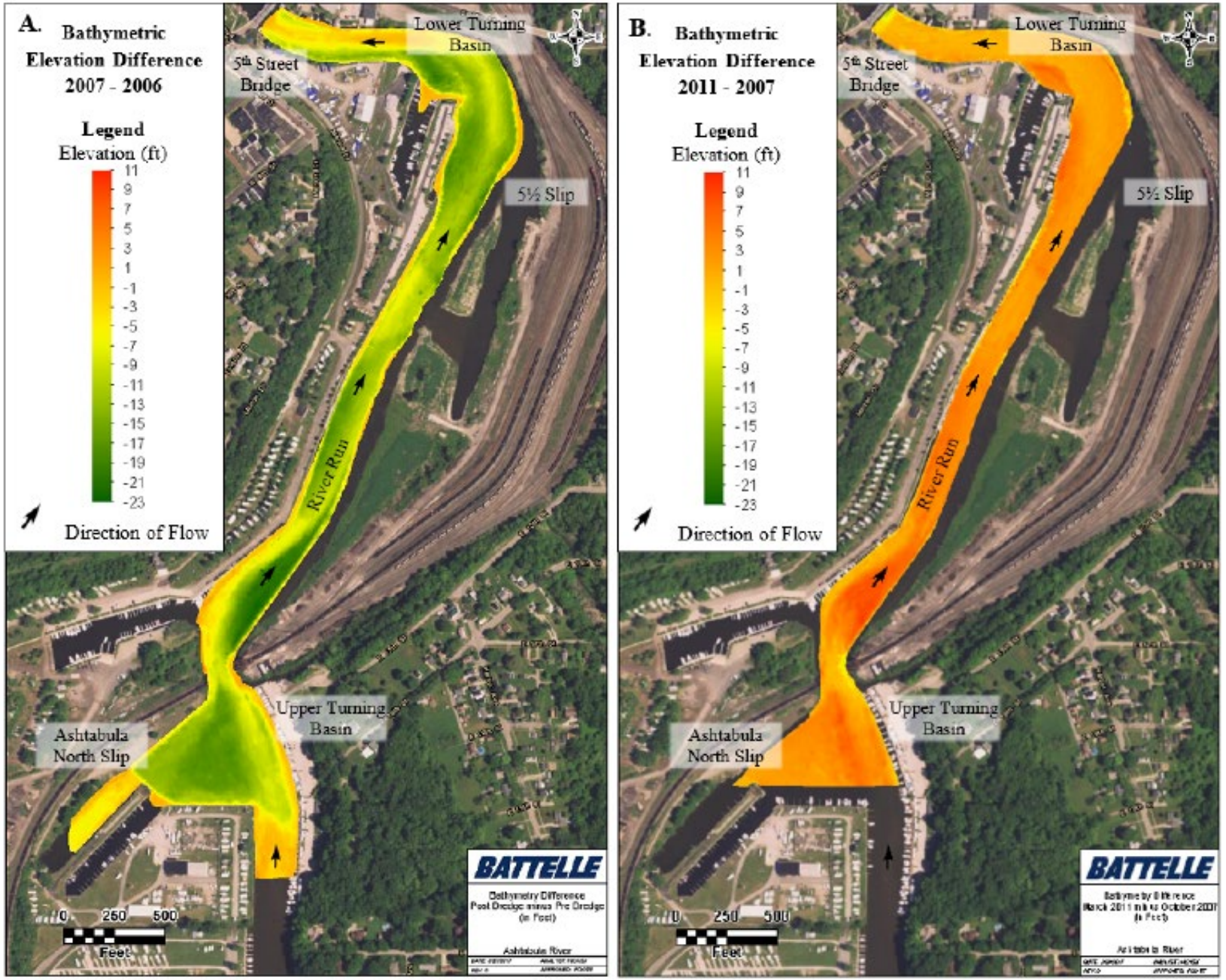


Figure 3-3. Post-Dredge Bathymetric Difference Maps Comparing A. 2007 to 2006 and B. 2011 to 2007. Sources: U.S. EPA [23], U.S. EPA [27]

Physical LOE

- An example of a physical LOE
- High resolution multi-beam bathymetric surveys conducted pre-, post- and long term
- Comparison of bathymetric surveys shows changes due to construction and over time

Biological LOE

- Some examples of a biological LOE for Ashtabula River
- IBI and Miwb demonstrated improvements post remedy and over time

Table 4-1. Pre- and Post-Remediation IBI Values (1989-2011)

Approximate River Mile	*River Segment*	*Pre-Remediation*					*Post-Remediation*	
		1989	*1998*	*2003*	*2004*	*2005*	*2009*	*2011*
0.6	5th Street Bridge	27						42
0.9	Lower Turning Basin							40
1.1	5½ Slip		32.5	44	40	37.5	44	37
1.2	River Run							46
1.25	River Run	31.4	33.5	34.5	44	36	46	45.8
1.6	Upper Turning Basin							45.5
1.8	Upper Turning Basin	36.4						
2.3	*Upstream* [a]		44					44
GLLA Project Area Average		31.6	33.0	39.3	42.0	36.8	45.0	42.7
Ohio EPA Lacustuary Target					38			

Table 4-2. Pre- and Post- Remediation MIwb Values (1989-2011)

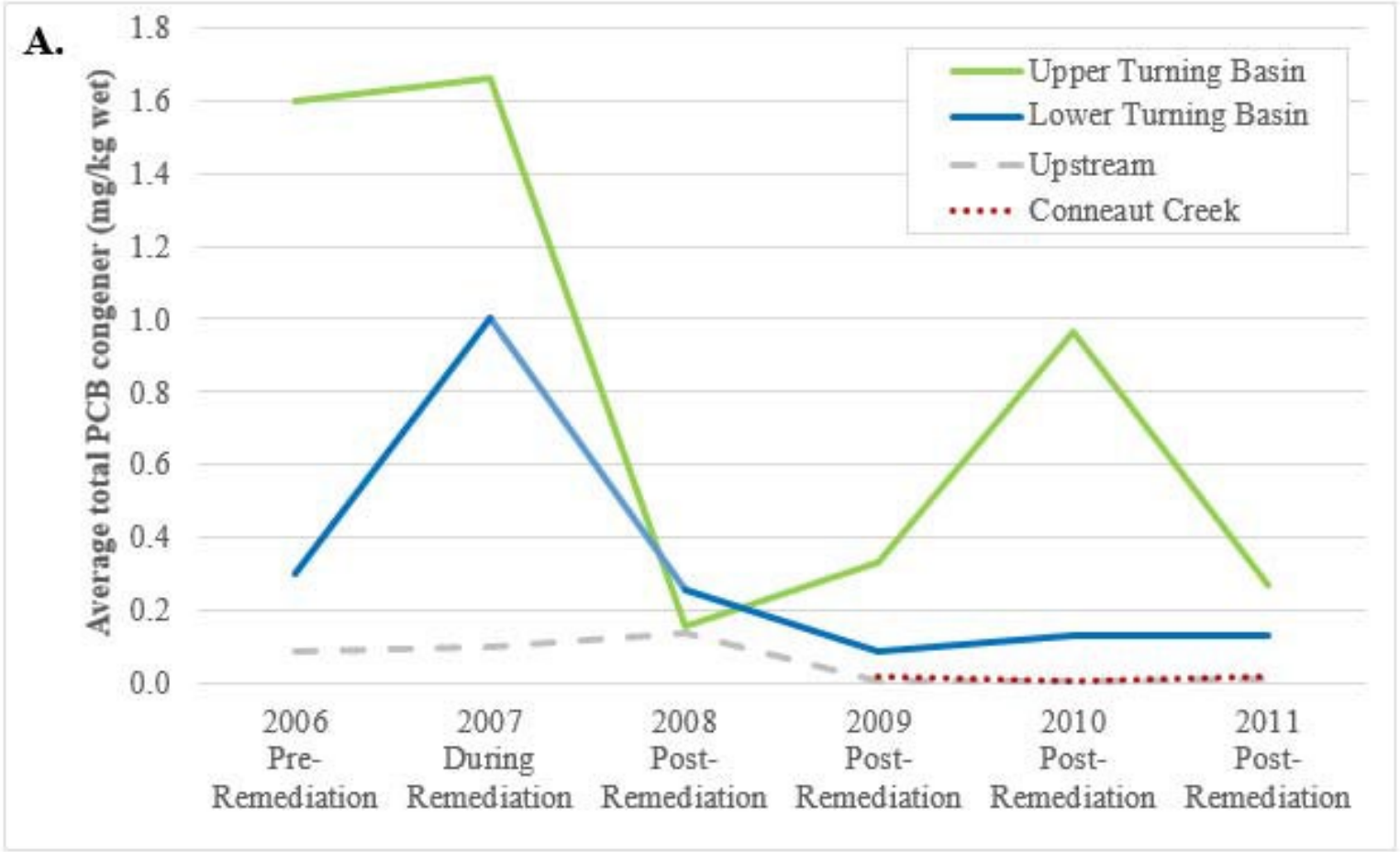
Pre-Remediation					*Post-Remediation*	
1989	*1998*	*2003*	*2004*	*2005*	*2009*	*2011*
2.59						9.3
						9.35
	8.19	8.49	7.85	8.86	8.72	8.71
						9.92
6.02	7.47	8.16	7.59	8.65	8.37	8.96
						9.01
7.97						
	9.27					9.01
5.53	7.83	8.33	7.72	8.76	8.55	9.21
			8.2			

[a] The Upstream sampled location was not part of the GLLA project, but is shown as a reference value for comparison purposes. Values given in red do not meet the Ohio EPA Lacustuary Target, values in green meet or exceed the target. Source: Ohio EPA [20].

BIOLOGICAL LOE

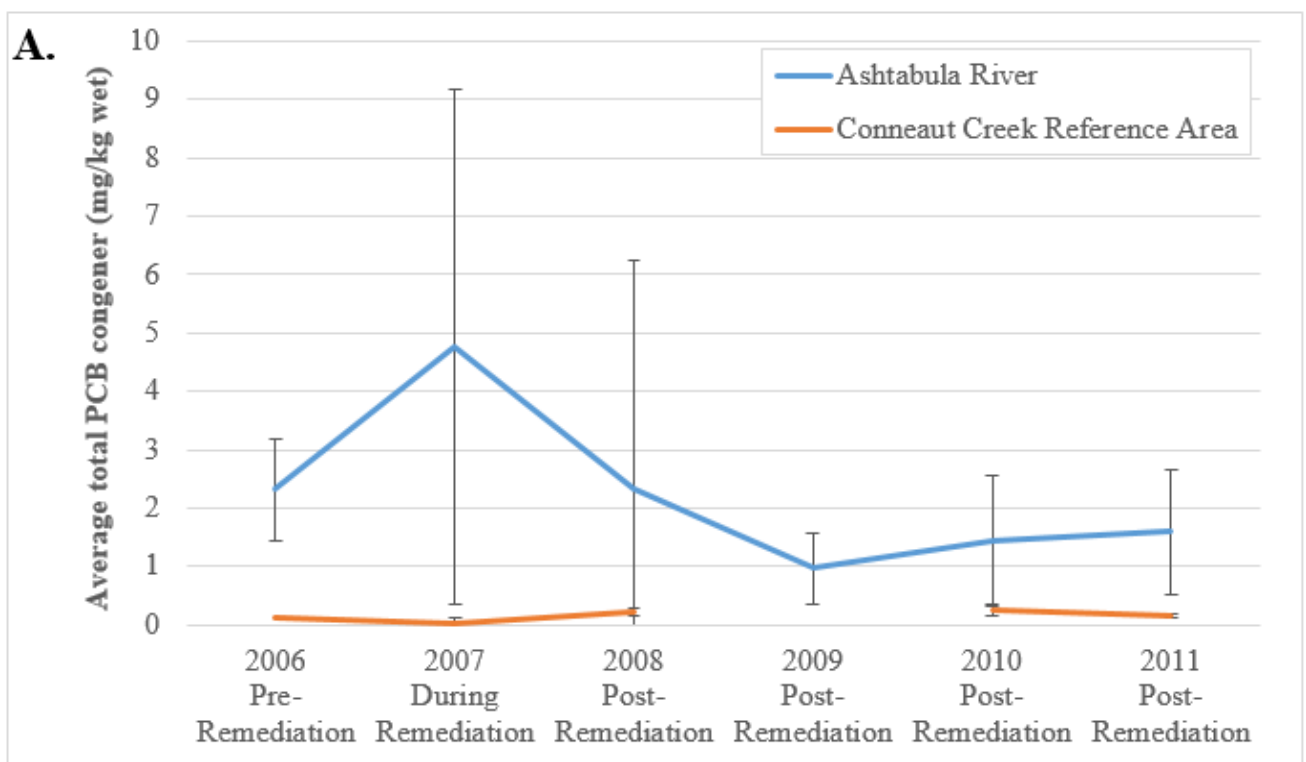
Macroinvertebrate PCB concentrations over time

Reduction over time at Ashtabula and relative to reference site (Conneaut)



BIOLOGICAL LOE

- Brown bullhead – CoC concentrations
- Reductions after remedy
- And relative to the reference (Conneaut)

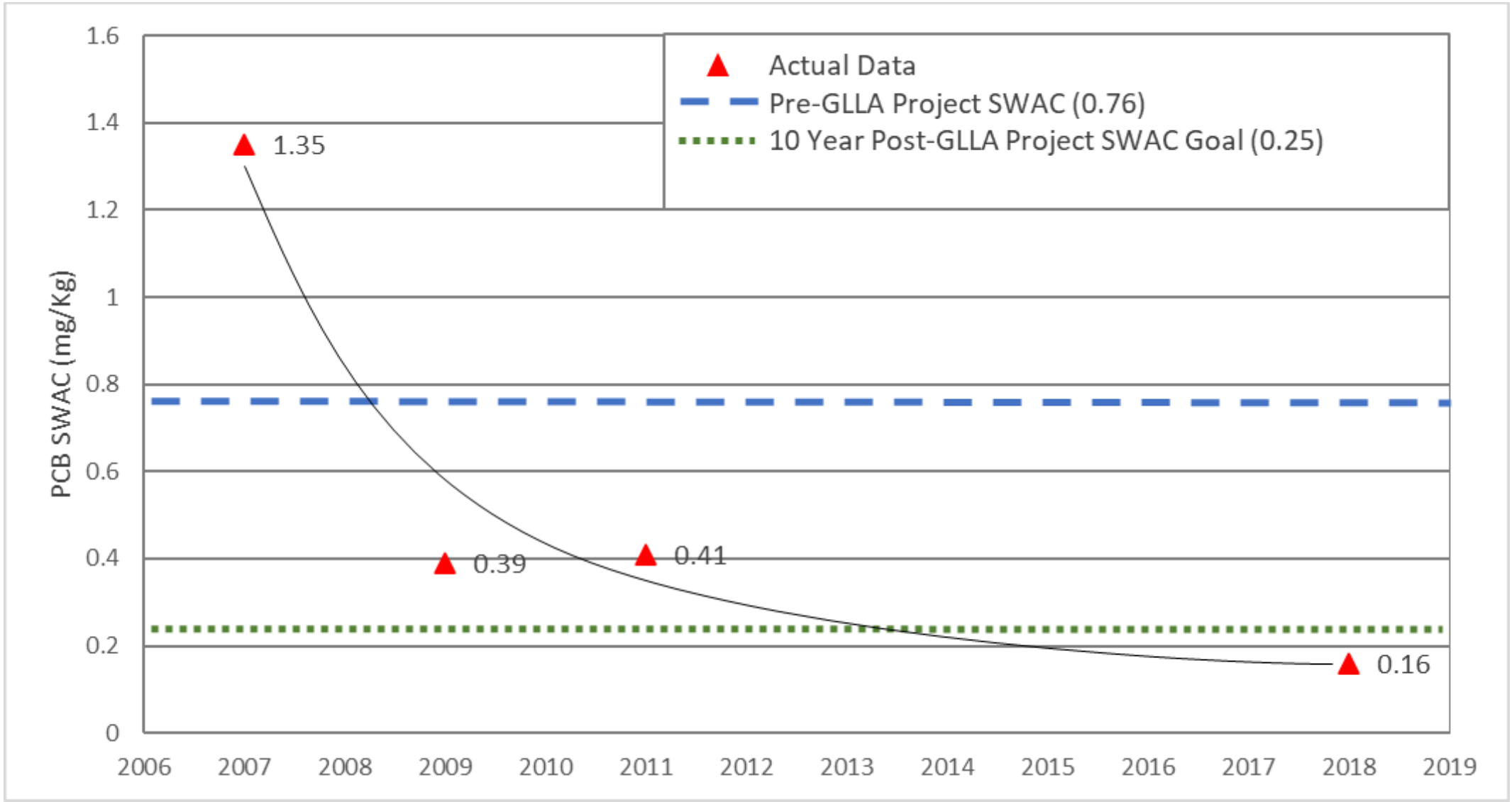


Chemical LOE

Did the remedy achieve short- and/or long-term remediation objectives for surface sediment?

- Short-term goal
  - 7.5 ppm PCB SWAC
  - 40 ppm PCB maximum
- Short-term achieved
  - 2.5 ppm PCB SWAC
  - 33 ppm PCB maximum
- Long-term goal
  - 0.25 ppm PCB SWAC
- Long-term achieved
  - 0.16 ppm PCB SWAC

Chemical LOE - SWAC



Chemical LOE - SWAC

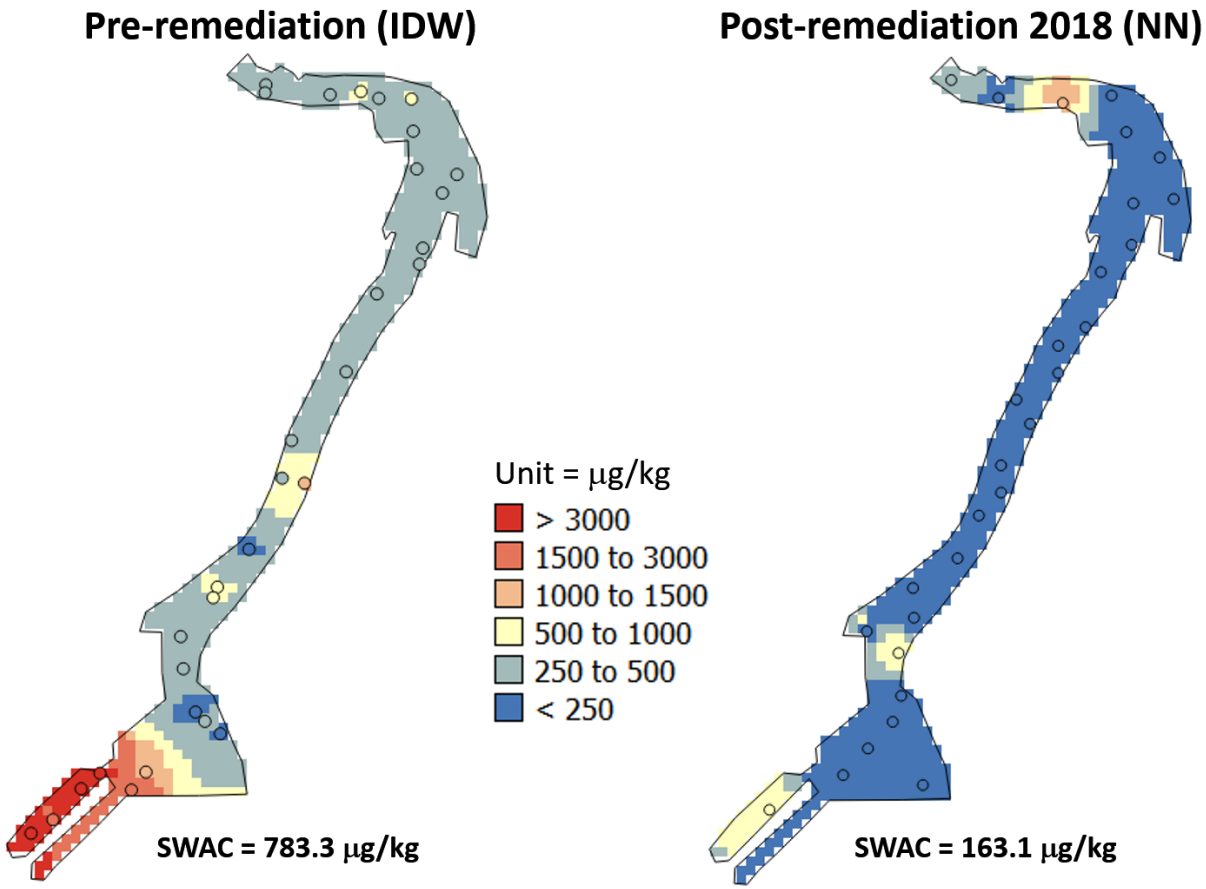
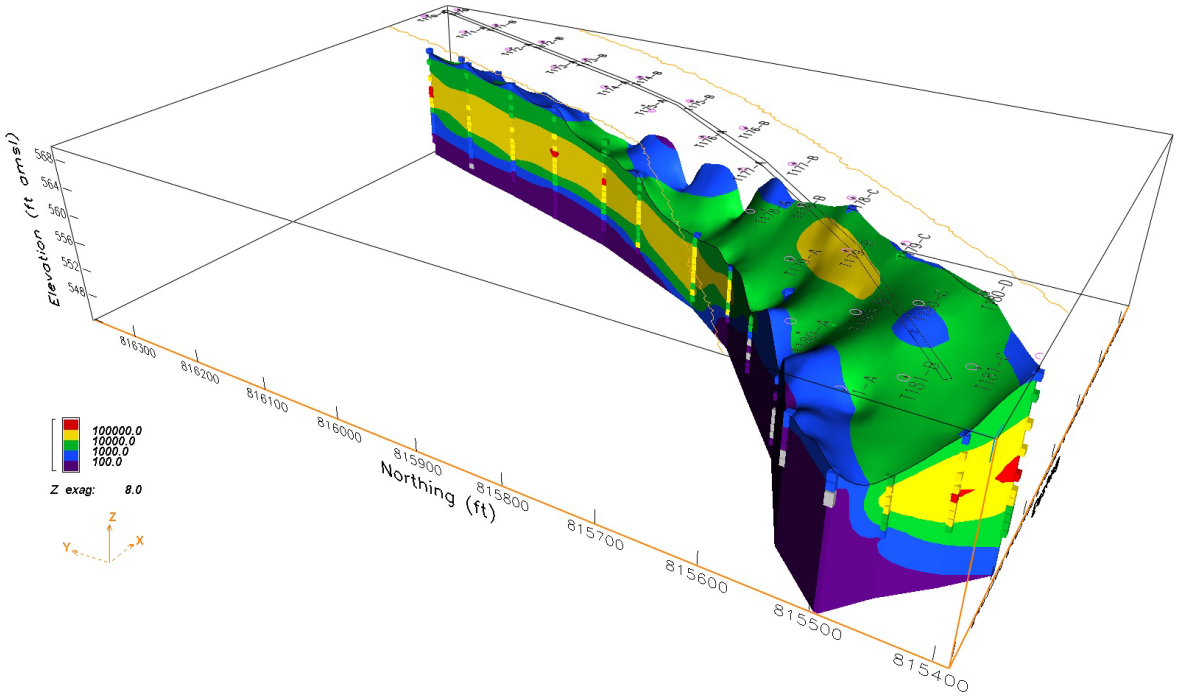
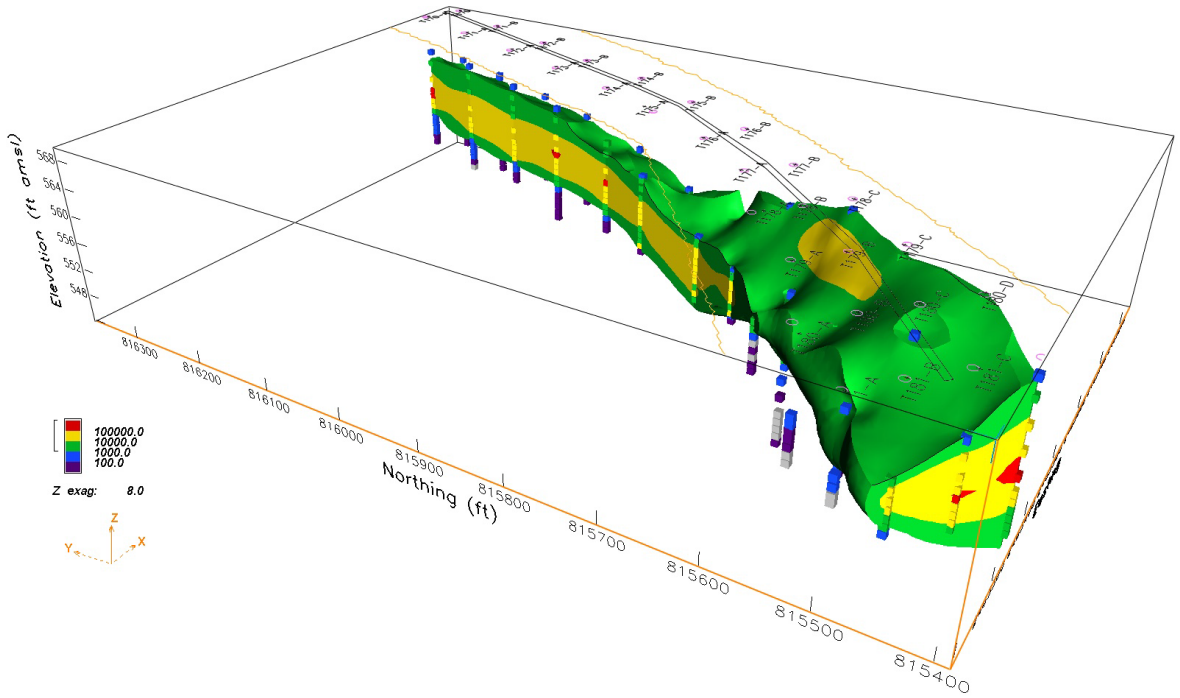


Figure 10. Maps of total PCBs as congeners estimated across the Ashtabula River Remediation Area by Inverse Distance Weighting (IDW) for the 2006 pre-remediation sampling event and by Nearest Neighbor (NN) for the 2018 post-remediation sampling event (10-year target, total PCBs < 250 µg/kg). These interpolations have the best performance compared to other interpolations for the respective sampling event due to a lower Mean Absolute Error (MAE) compared to the other interpolations.

Chemical LOE- PCB Mass Removal





- Over 14,000 lbs of PCBs removed by the remedy.

FINAL REMEDY EFFECTIVENESS ASSESSMENT

Assessing the multiple LOEs, metrics showed an improvement when compared to baseline

Line of Evidence	Relative Change*	Remarks
Physical		
Bathymetry	++	497,383 yd^3 (91%) of the estimated contaminated sediment volume was removed within the project area [11].
Qualitative Habitat Evaluation Index (QHEI)	++	Increasing QHEI values indicate that the physical habitat within the project area is able to support a diverse biological community [20]. BUI# 14 Loss of Fish and Wildlife Habitat removed in 2014.
Biological		
Invertebrate Community Index (ICI)	-	ICI indicates an overall decline in macroinvertebrate diversity and population [43]. BUI #6: Degradation of Benthos remains impaired.
Macroinvertebrate Tissue PCBs	++	Significantly lower concentrations of total PCB congeners were seen within the project area after remediation [32].
Index of Biotic Integrity (IBI); Modified Index of Well-Being (MIwb)	++	Increasing IBI and MIwb values indicate fish mass, density, diversity, and populations have recovered [20]. Note: This trend was also seen prior to the GLLA project. BUI# 3 Degradation of Fish and Wildlife Populations removed in 2014.
Sport Fish Fillet PCBs	++	PCB concentrations in smallmouth bass, common carp, and freshwater drum fillets collected in the Ashtabula River post-remediation were not different from the background Lake Erie fish of similar size and species [20]. BUI# 1 Restrictions on Fish and Wildlife Consumption removed in 2014.
Whole Brown Bullhead PCBs	++	The total PCB congener concentrations in brown bullhead significantly decreased after remediation [19].
Brown Bullhead Tumors/ Anomalies	+	Rate of skin and liver tumor incidence decreased, however rates remain above the minimum removal criteria for BUI #4: Fish Tumors or Other Deformities [33].
Brown Bullhead DNA Damage	++	DNA damage in blood and liver samples decreased [19].
Other		Caged Channel Catfish: Pre- remediation PCB concentrations increased, but not repeated post-remediation [14]. Amphipod Survival: Limited studies suggest presence of toxic sediments pre- and post-remediation [28, 29]. Riparian Spiders: Post-remediation samples suggest ongoing PCB bioavailability [30].
Chemical		
PCB SWAC	++	PCB SWAC concentrations obtained post-remediation met project goals, and are projected to meet the 10-year post-remediation goal (2007- 1.35 mg/kg; 2009- 0.39 mg/kg; 2011- 0.41 mg/kg) [11, 34].
Subsurface PCB Mass	++	14,324 lb (74%) of the original estimated PCB mass was removed from the project area [11]. Core samples collected post-remediation in the ORD Study Area had lower concentrations of PCBs [32].
Surface Sediment Radionuclides	0	The activities of total radium and total uranium slightly increased; total thorium slightly decreased. Post-remediation average activities were consistent with average background concentrations [35].

*Relative change when comparing pre-remediation to post-remediation data discussed in this report.

- ++ Indicates an overall improvement with statistical confidence.
- + Indicates a general improvement that was not statistically significant or statistics were unavailable.
- 0 Measures were unable to differentiate a change.
- - Indicates a general decline that was not statistically significant or statistics were unavailable.
- -- Indicates an overall decline with statistical confidence.

Long-Term Objectives Achieved

- *Restrictions on Fish and Wildlife Consumption* - ***Removed 2014***
- *Degradation of Fish and Wildlife Populations* - ***Removed 2014***
- *Degradation of Benthos* - ***Removed 2018***
- *Restrictions on Dredging Activities* - ***Removed 2020***
- *Fish Tumors or Other Deformities* - ***Removed 2019***

Key Take-Home Messages

- Set reasonable expectations
- Consider role of MNR to augment active remediation
- Evaluate broad spectrum of remedial goals