Hudson River PCBs Superfund Site Case Study

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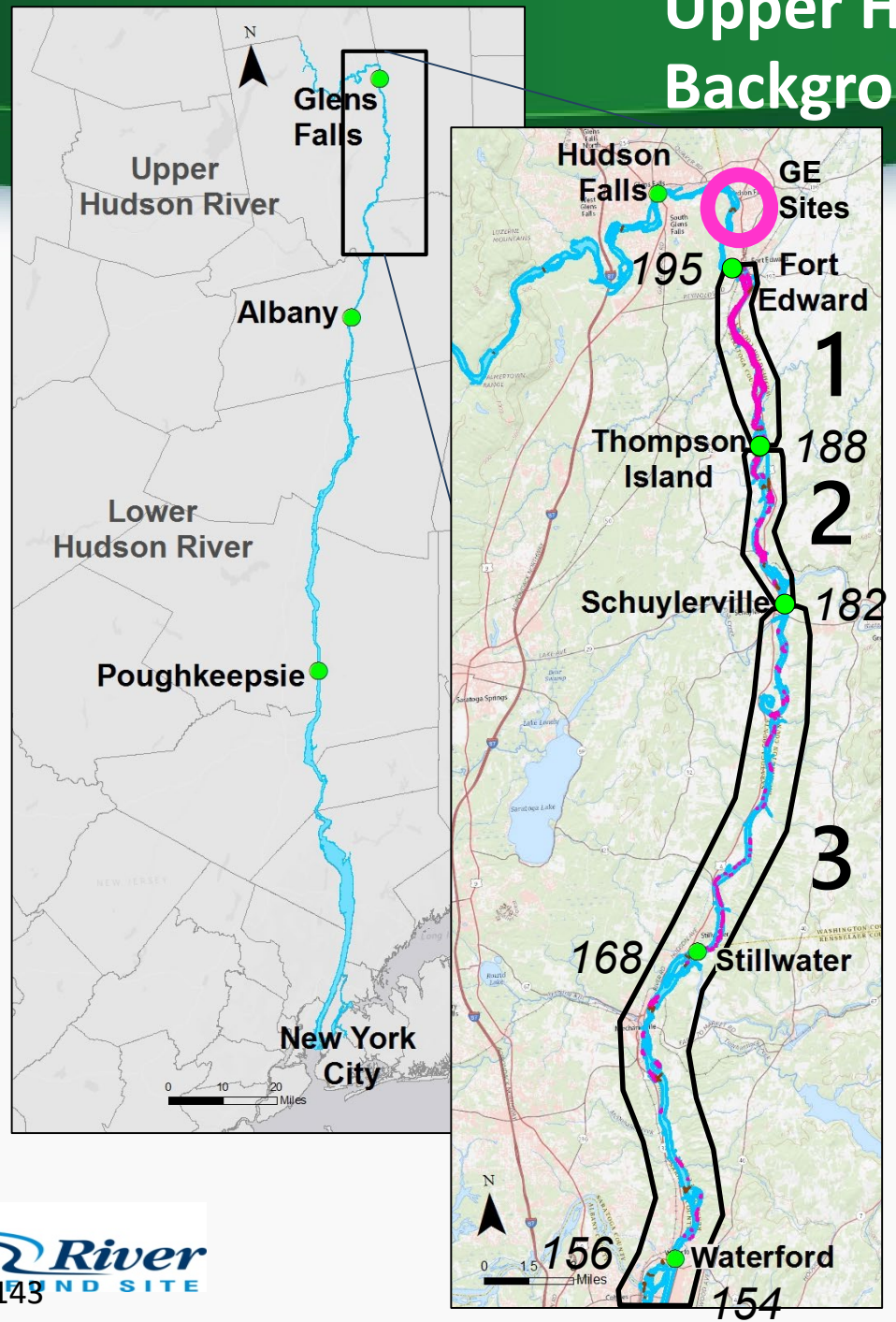
Outline

1. Objectives of the Hudson River Remediation
2. Remedy Overview
3. History of External Source Control
4. Deviations from What was Planned
5. Hudson River Monitoring Elements
6. Sediment Improvements
7. Water Column Improvements
8. Fish Monitoring Observations and Initial Improvements
9. Summary and Conclusions

Upper Hudson Site Background



- GE discharges of PCBs at begin in the late 1940s and end in 1977.
- Multiple GE-related PCB sources & discharges were discovered and controlled: 1974 to 2009.
- 2002 Record of Decision to dredge the river bottom.
- Dredging of the river bottom.
  - 2009 to 2015 (no dredging in 2010)
- Post-remediation long term monitoring started in 2016 and will continue into the future.

Legend

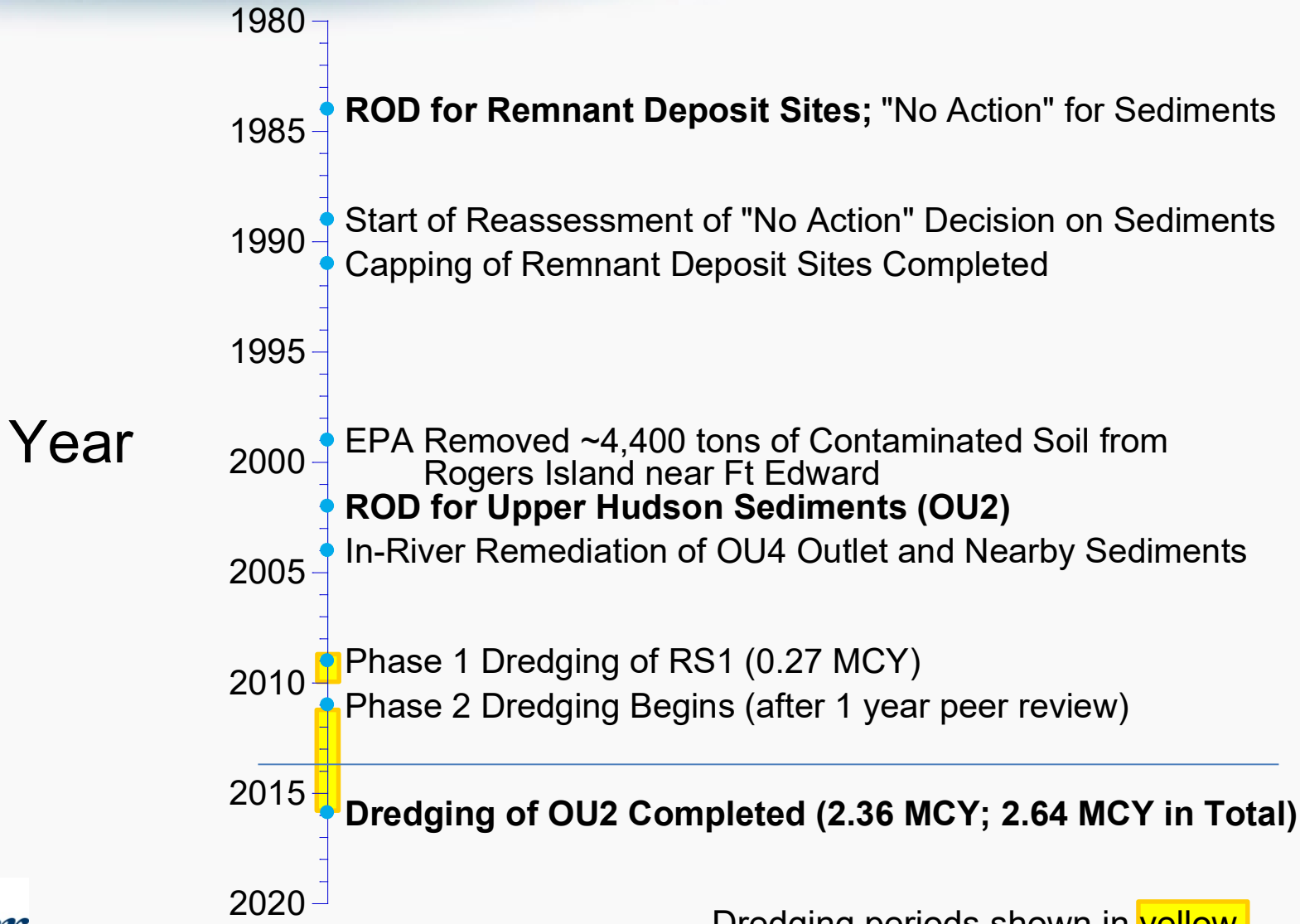
!	Water Monitoring Location
	Dredging Area
	River Bottom
3	River Section Number
156	River Mile

Objectives of the Remediation

2002 ROD (OU2):

1. Reduce the cancer risks and non-cancer health hazards for people eating fish from the Hudson River by reducing the concentration of PCBs in fish
2. Reduce the risks to ecological receptors by reducing the concentration of PCBs in fish
3. Reduce PCB levels in sediments in order to reduce PCB concentrations in river (surface) water that are above applicable or relevant and appropriate requirements (ARARs)
4. Minimize the long-term downstream transport of PCBs in the river
5. Reduce the inventory (mass) of PCBs in sediments that are or may be bioavailable

Remedy History



Dredging periods shown in yellow.

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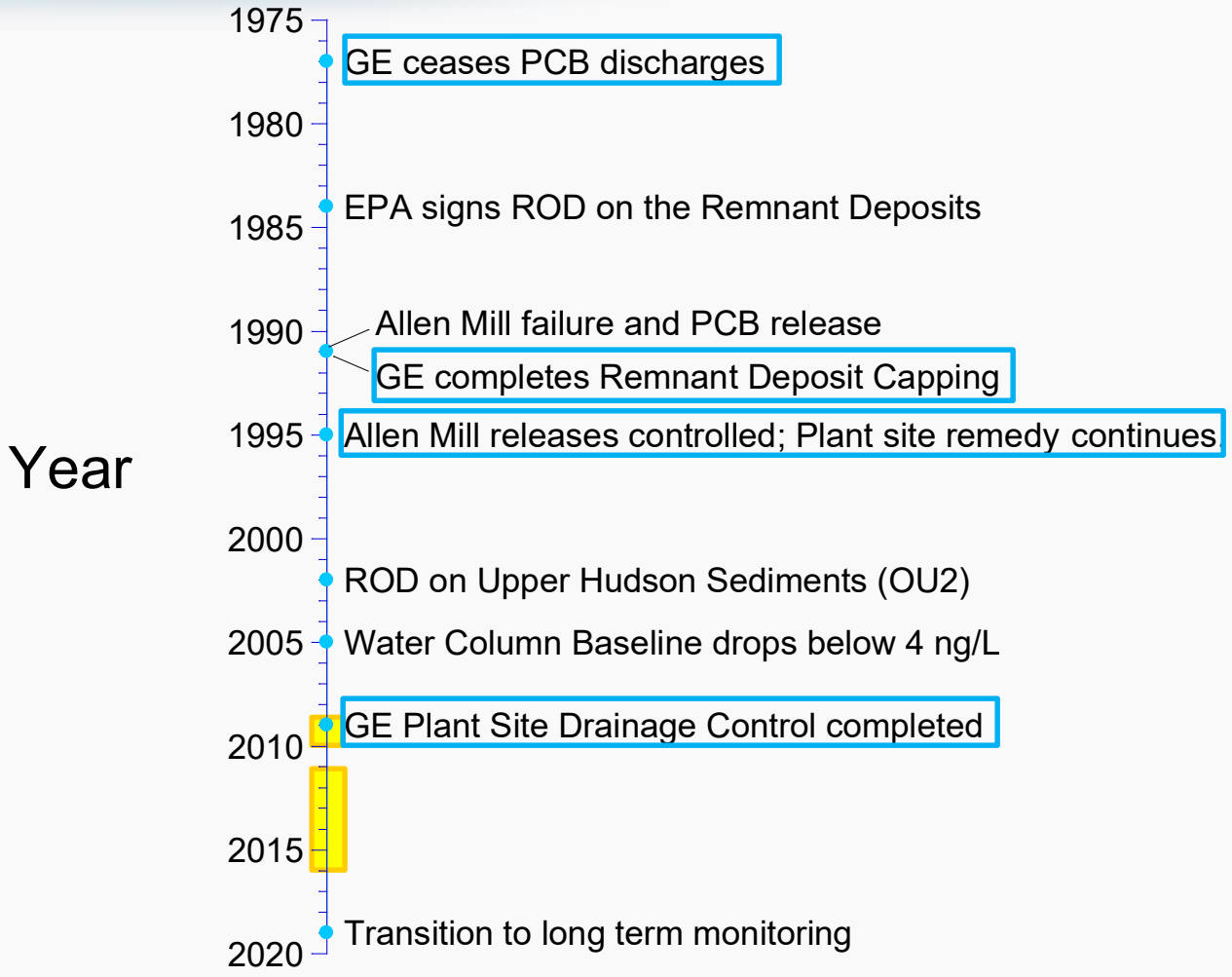
History of External Source Control



Major control events in blue frame.
Dredging periods shown in yellow.

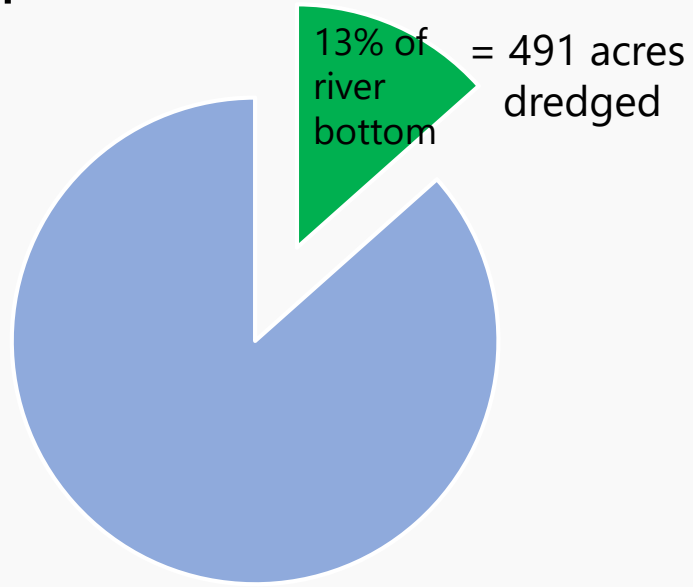
Scope and Schedule Deviations

Component	Feasibility Study (FS) and 2002 ROD Design Assumptions	Selected Remedy Implementation
Dredging Start and Duration	• 2004 or 2005 start date • 5 or 6 years with 1 or 2-phase implementation • One year of equilibration	• Dredging 2009-2015 with 2010 Peer Review. • 7 years to implement dredging, • 8 years with habitat reconstruction (2016) • one year of equilibration (2017)
Mass Removed	• 21,700 kg Tri+ PCB (69,800 kg Total PCB)	• 48,600 kg Tri+ PCB (156,000 kg Total PCB)
Dredging Sequence	• Upstream to downstream • Some simultaneous dredging as operations moved down stream	• 2009, 2011-2012: Generally upstream to downstream • 2013-2015: Simultaneous dredging along project alignment
Dredging Infrastructure	• One facility (upstream) or 2 facilities (one northern/upstream and one southern/ downstream) • In-river transport of dredged sediments and backfill materials	• Single upstream processing facility • In-river transport of dredged sediments • Multiple backfill loading facilities.

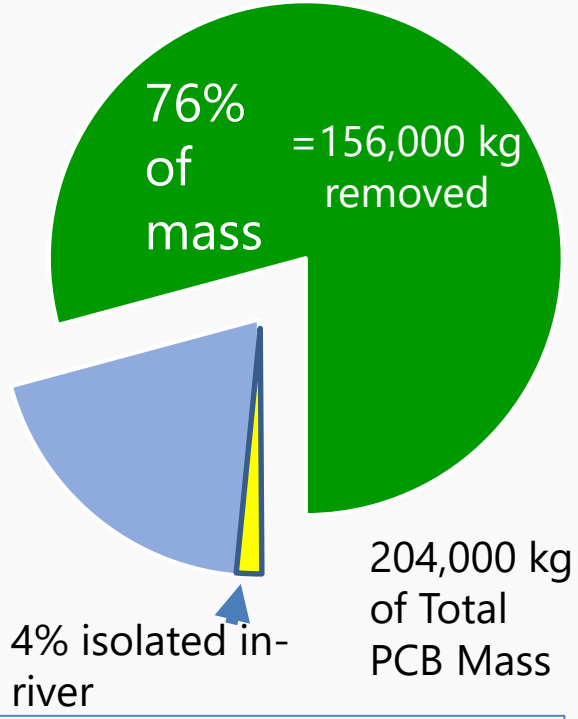
What Was Done?

Approximately 500 acres were dredged over a 40 mile stretch of the Upper Hudson between 2009 and 2015.

Spatial Extent of Remediation



PCB Mass Removed



Relative to requirements of the 2002 ROD, the remedy:

- Achieved a greater overall percent reduction in PCB mass
- Removed more than twice as much PCB mass on an absolute basis
- Left behind essentially the same mass as anticipated (<10% more)

Hudson River PCB Monitoring Timeline:

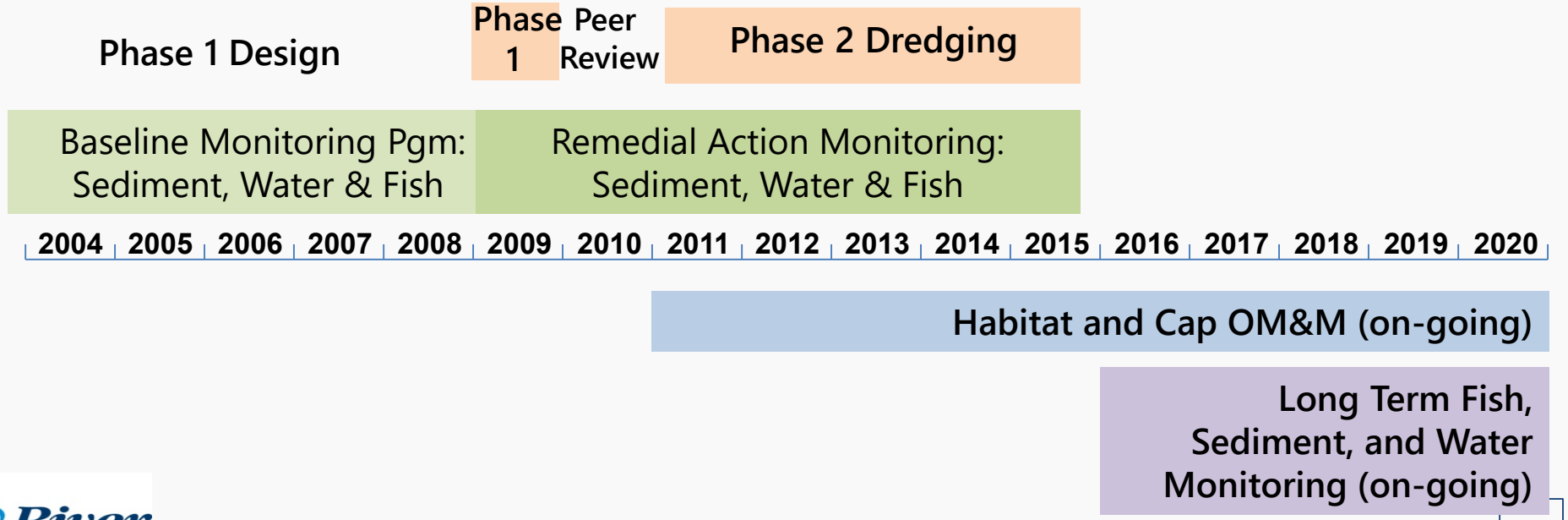
- **Historical Monitoring**

  Sediment: Sampling Events: 1976-1977, 1984, 1991, 1992, 1994, & 1998

  Water: Annual Collection from1976-2002, multiple stations

  Fish: Spring and Fall Events, 1976-2004

- **Design, Dredging and OM&M**



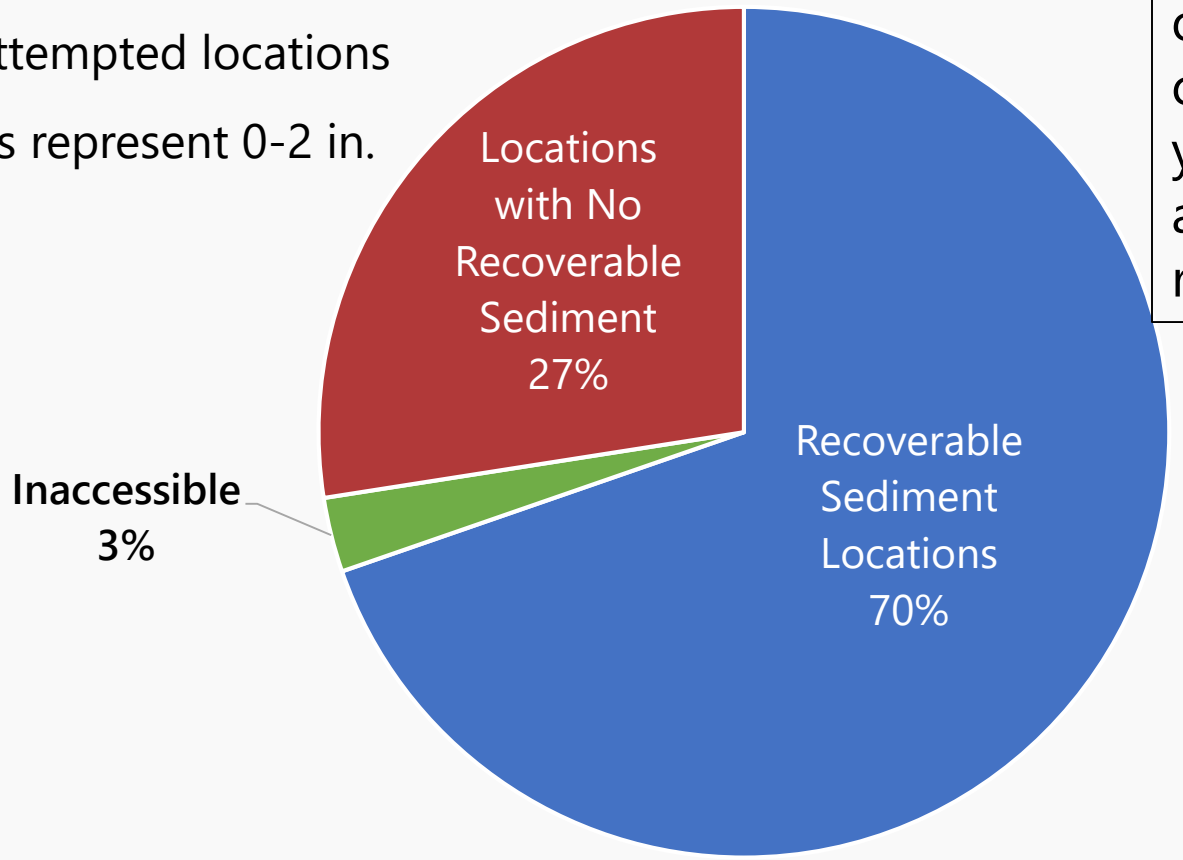
Post-Remedy Sediment Studies 2016 & 2017

Combined EPA/GE and NYSDEC Sampling Locations

1,871 locations in total

1,818 attempted locations

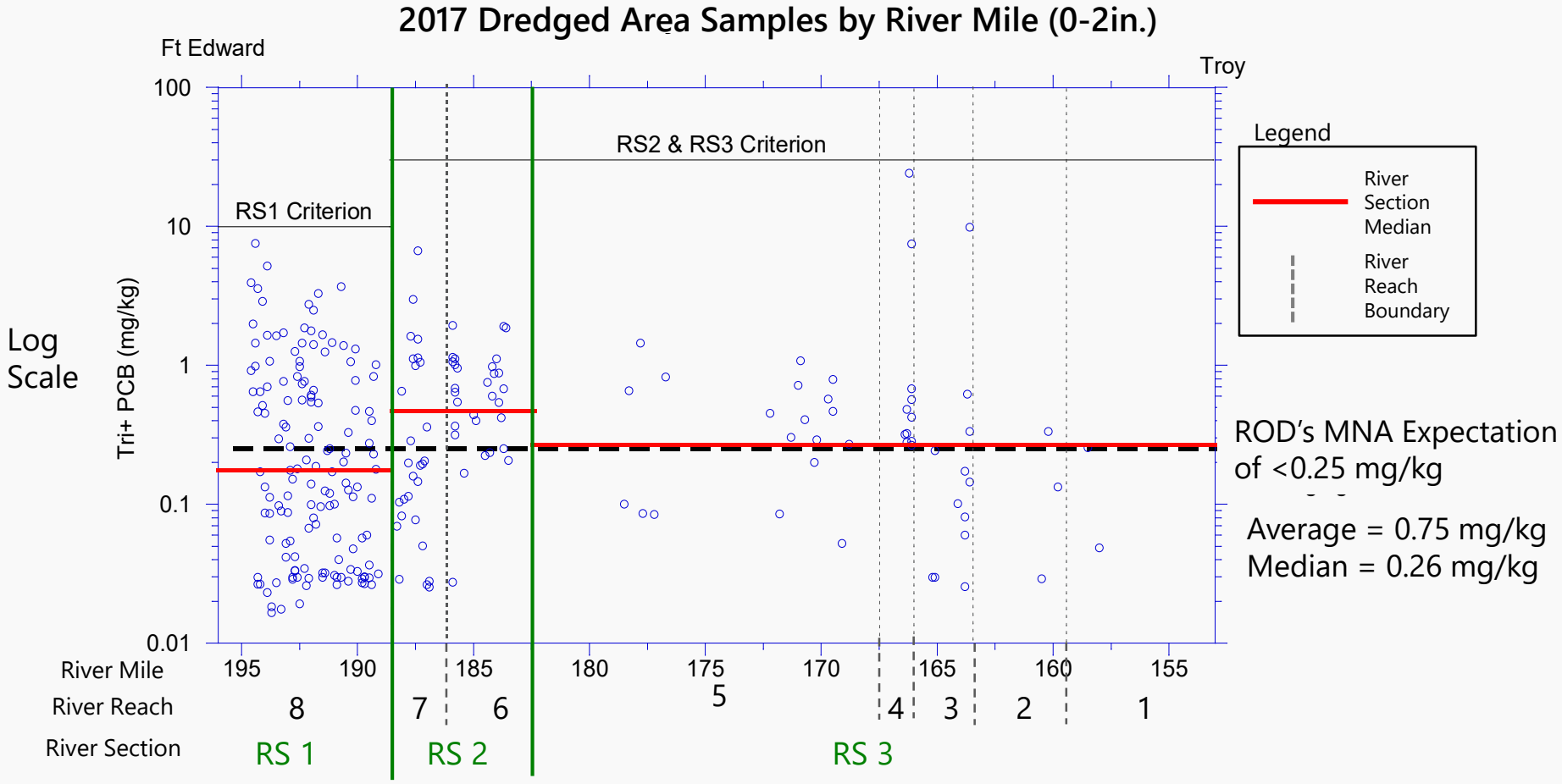
Samples represent 0-2 in.



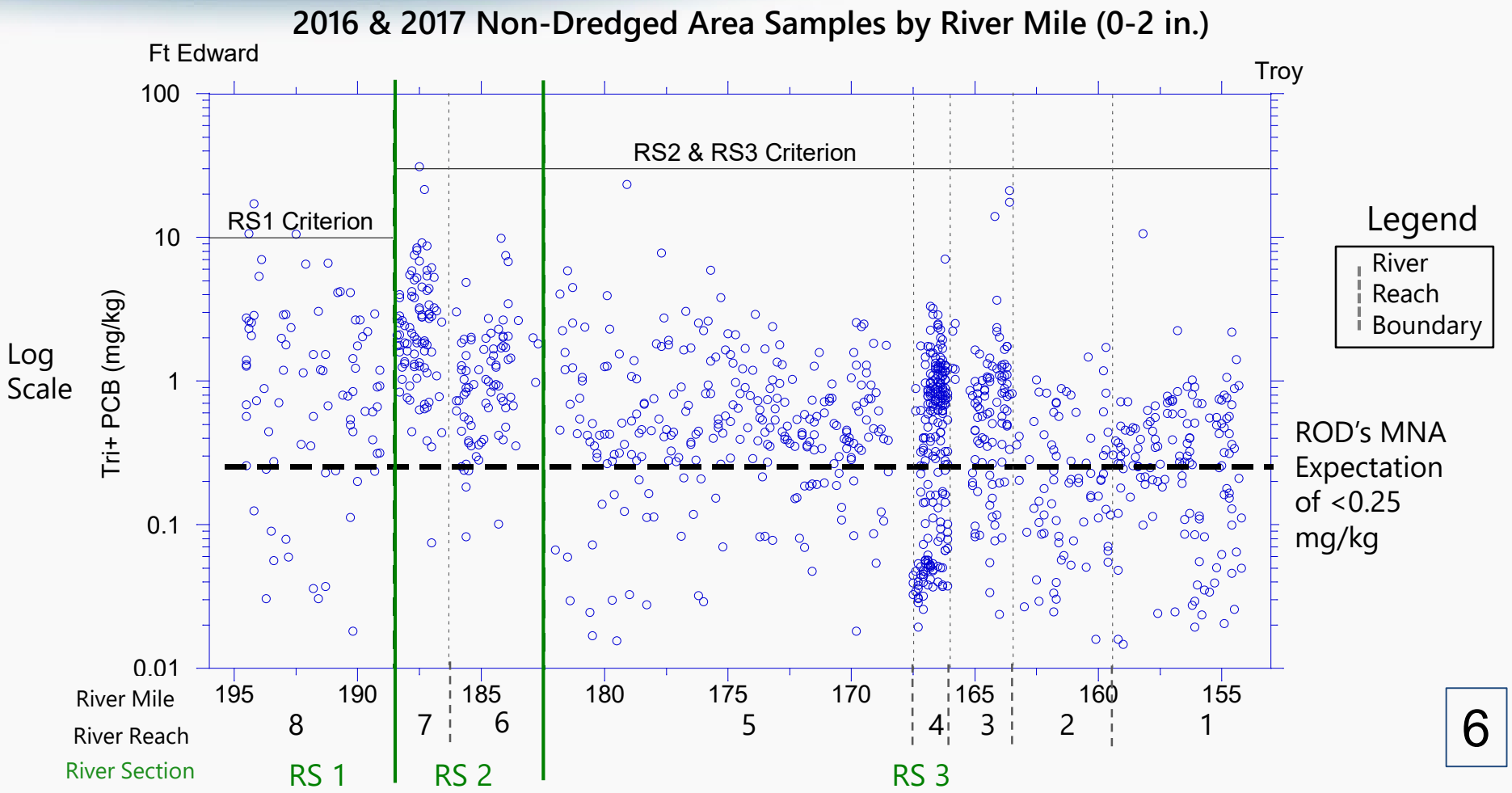
Unprecedented study of post-dredging conditions 2 to 8 years after various areas were remediated.

Backfilled Areas Remain at Low Levels:

No evidence for substantive recontamination



Non-Dredged Areas Remain Low and Decline Downstream



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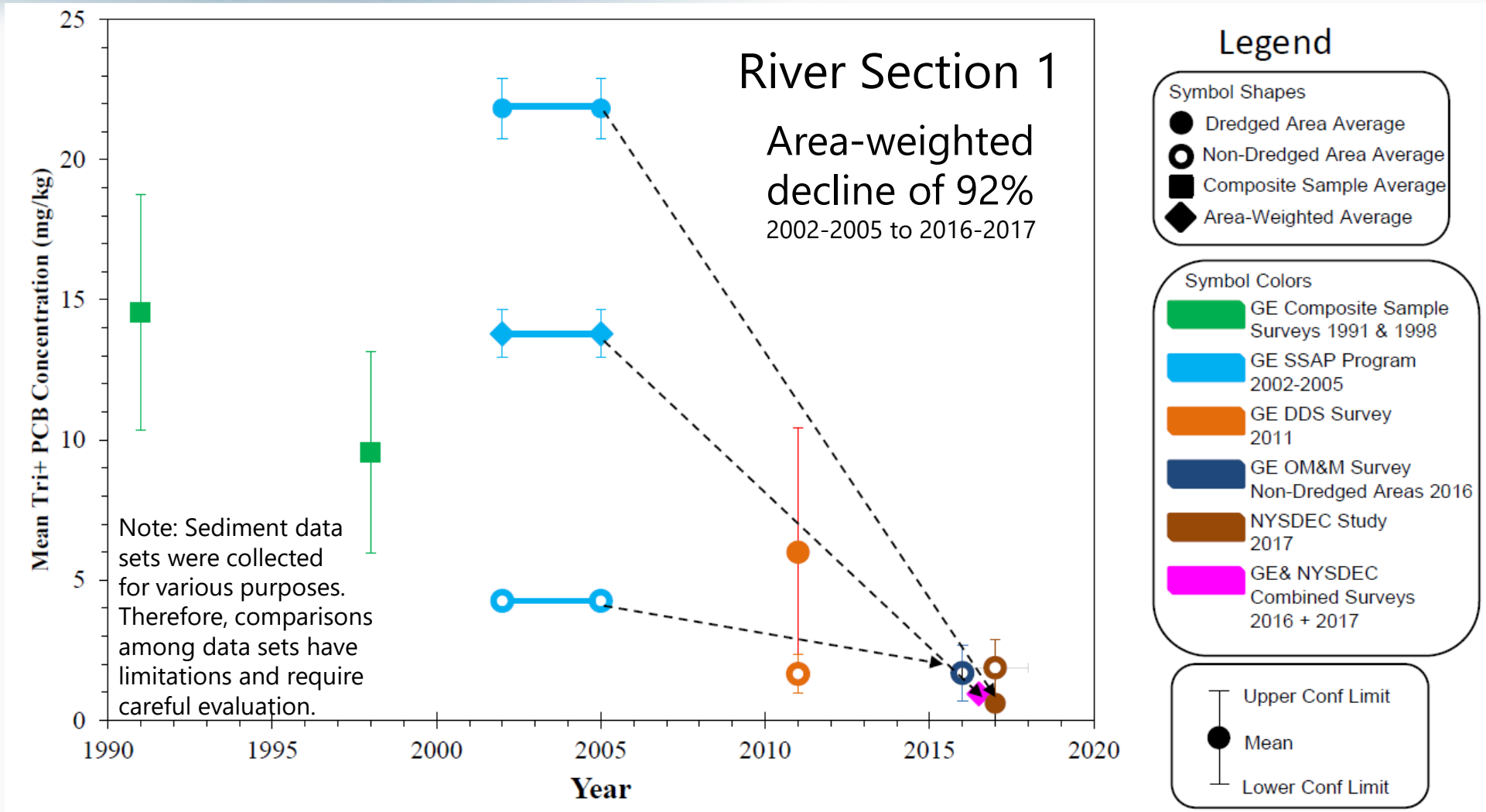
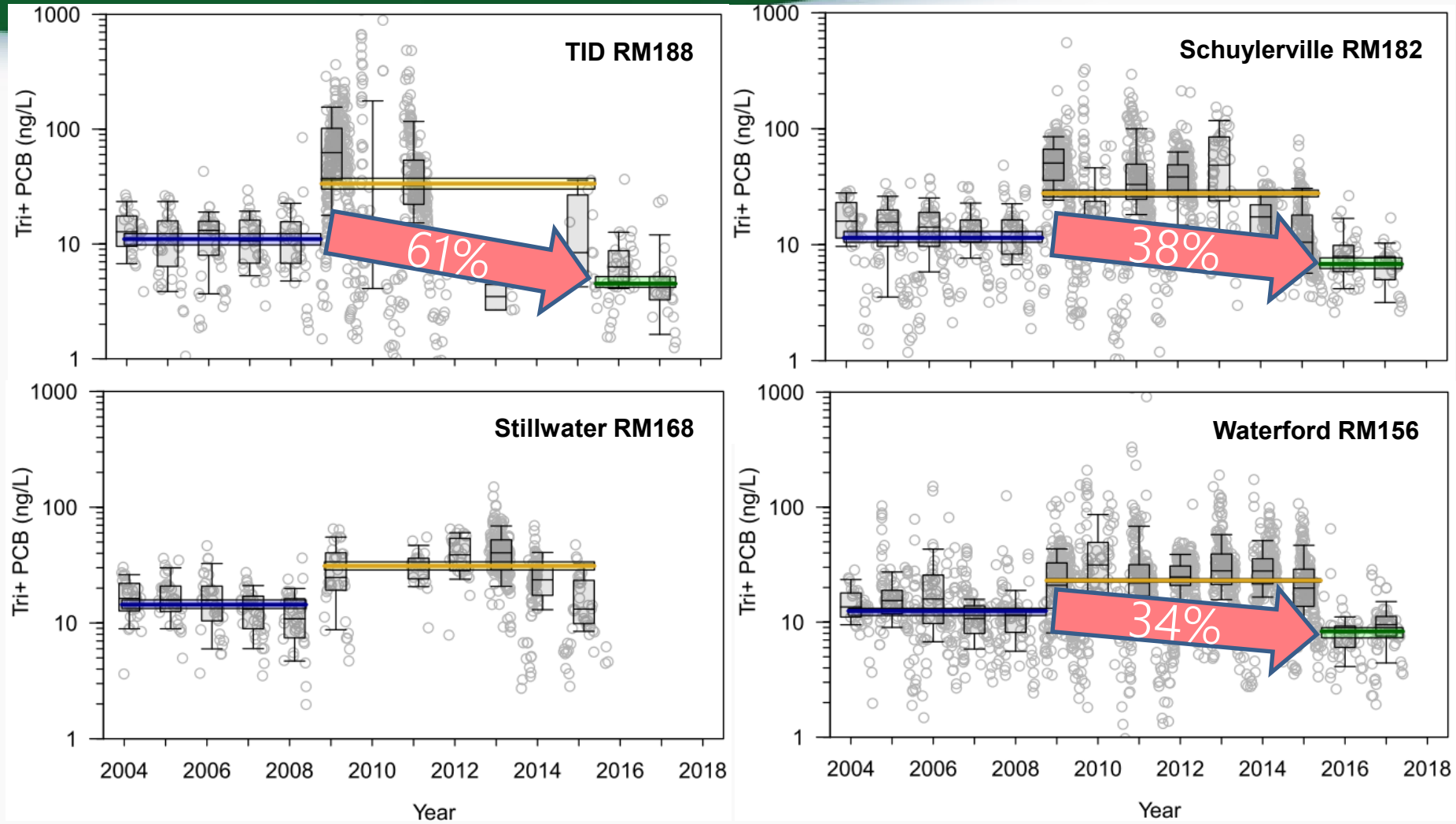
Remedy + Attenuation eliminated surface sediment (0-2in.) contamination in excess of ROD criteria.
-Only 4 locations in the 1,818 attempted exceeded the ROD thresholds.

Data Document a Substantial Reduction in Surface PCB Concentration



Smaller but still substantive declines were observed in RS2 and RS3.

Water Column Concentrations have Declined between 30 and 60%

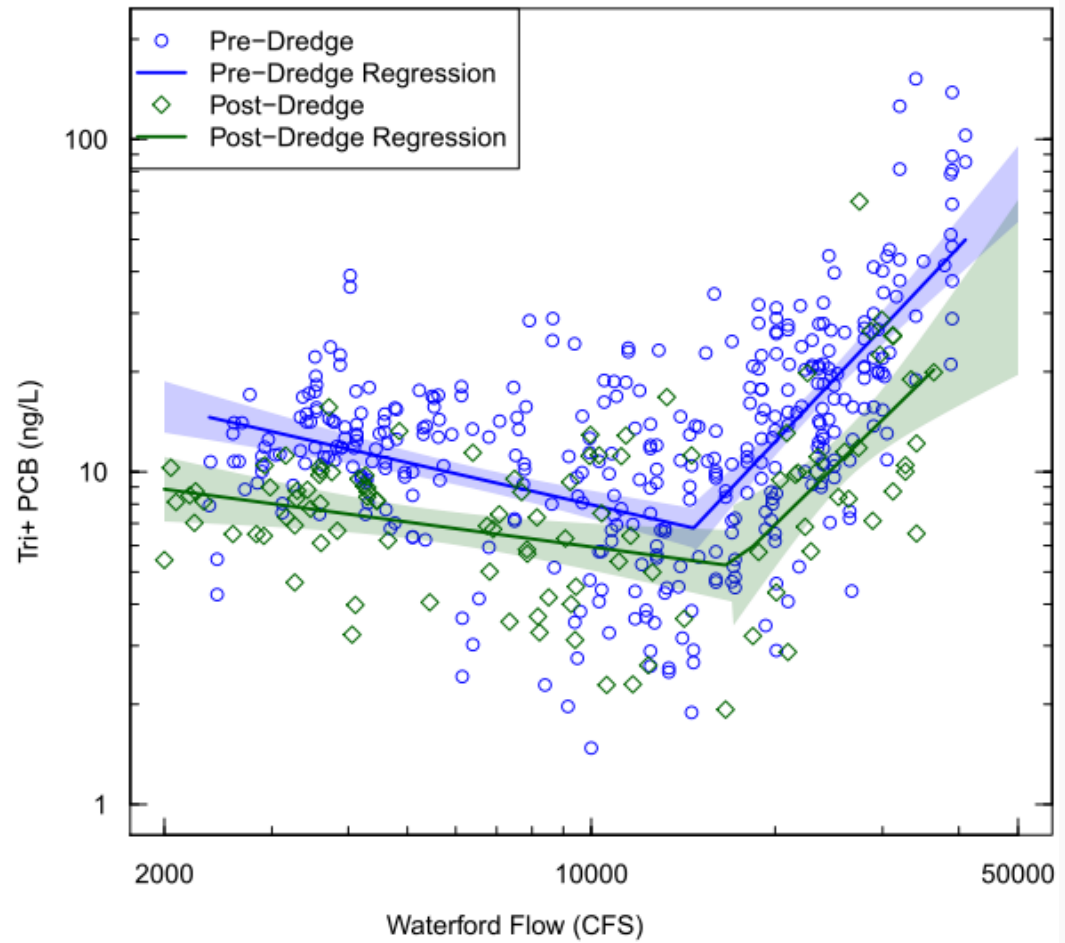


Water Column PCB Concentrations

Baseline (2004-2008)
Dredging (2009-2015)
Post-Dredging Period (2016-2017)

Decline in Water Column PCB Loads to Lower Hudson

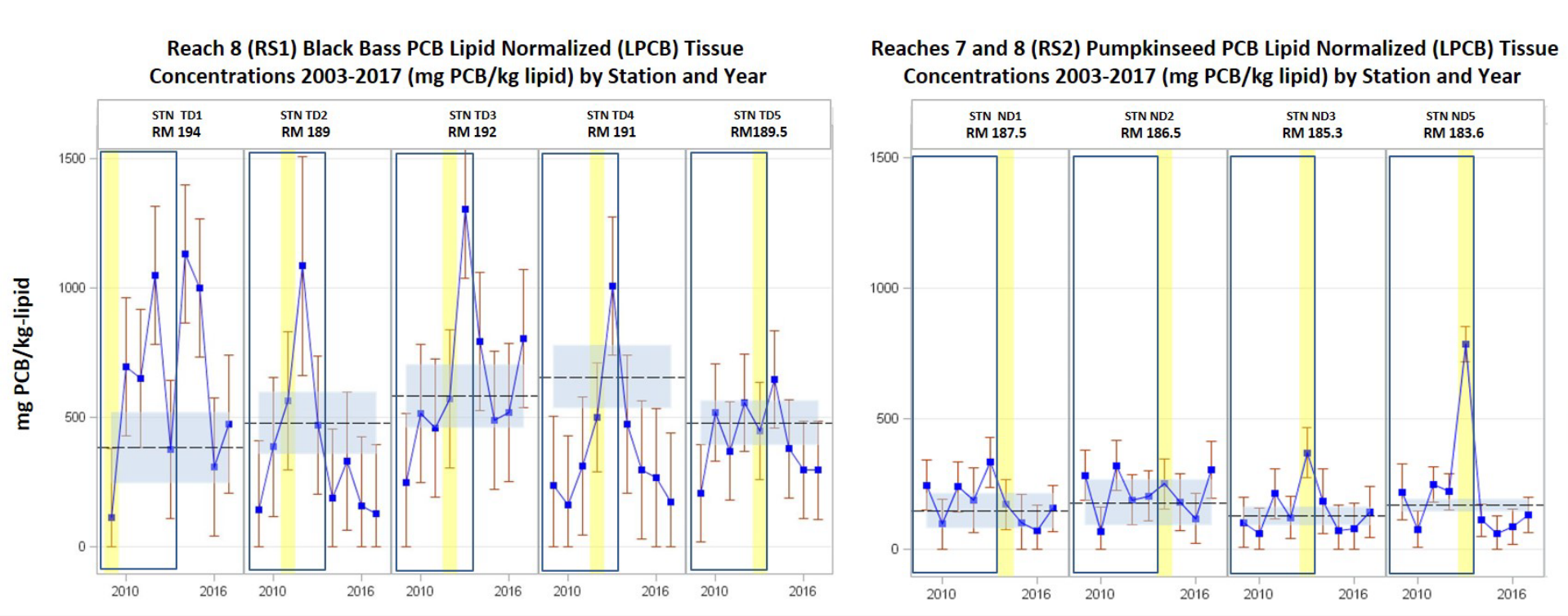
Within 2 years of completion of dredging, PCB loads to the Lower Hudson have decreased between 30 and 50% relative to baseline.



Shaded regions represent 95%CI band on regression line.

Post-dredging PCB concentrations at Waterford have declined across all flow conditions

PCB Concentrations in Fish



LEGEND

Station arithmetic mean with 95%CI

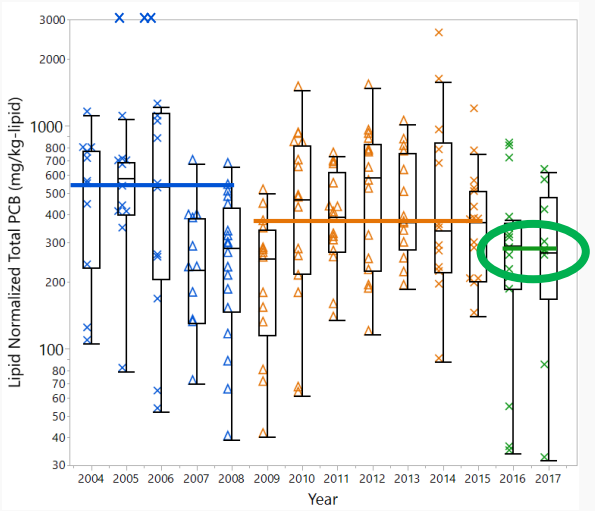
Dredging Year

Mean station pre-dredging baseline (2004-2008) with 95% CI

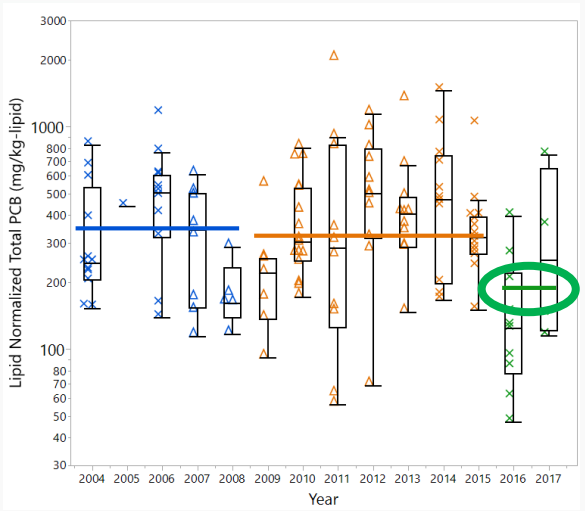
NYSDEC standard fillet approach not used 2007-2013

Fish - Upper Hudson Large Mouth Bass – Lipid Normalized

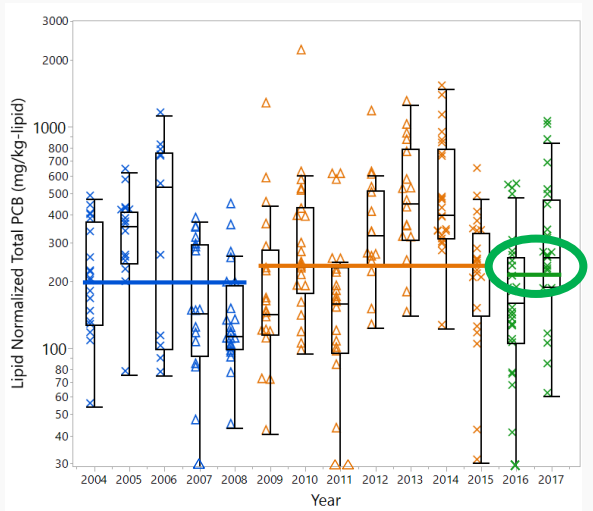
River Section 1



River Section 2



River Section 3



- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2017)

PCB concentrations in fish have largely recovered from dredging impacts and are now at or below baseline conditions

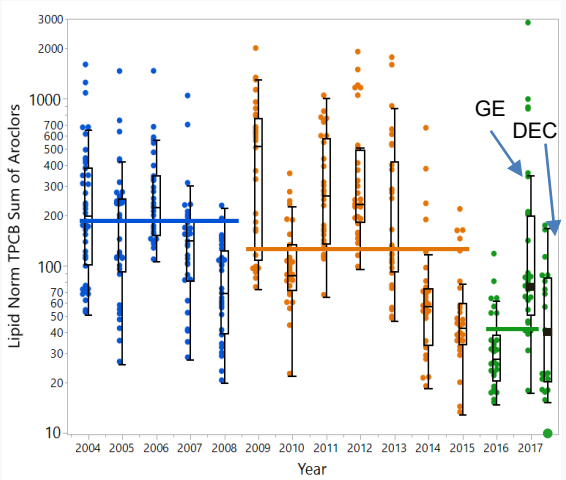
Hudson River PCBs SUPERFUND SITE

157

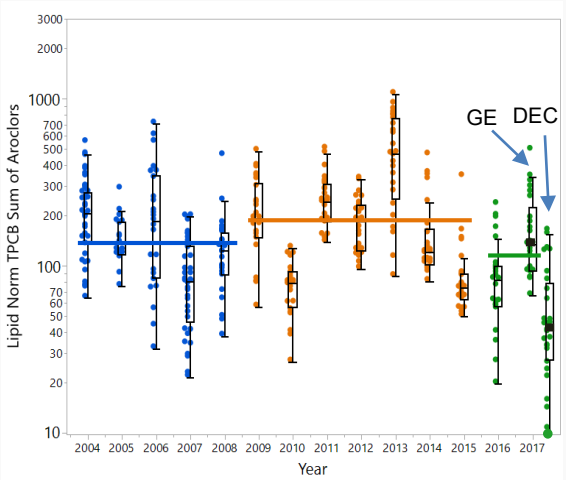
× Standard Fillet △ Rib-out Fillet

Fish - Upper Hudson Pumpkinseed – Lipid Normalized

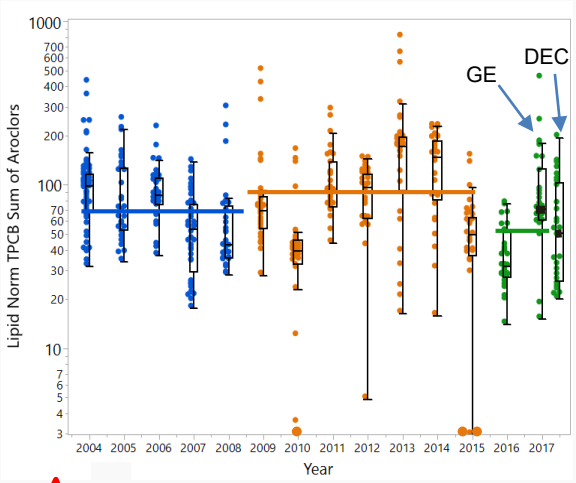
River Section 1



River Section 2



River Section 3



Before Dredging (2004-2008)

During Dredging (2009-2015)

?

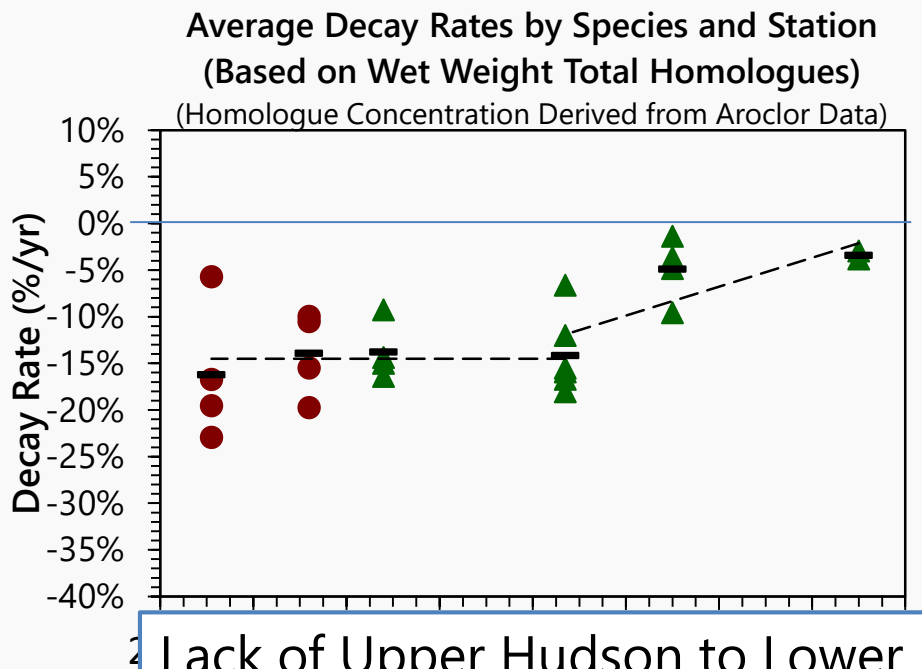
After Dredging (2016-2017)

*All Pumpkinseed samples are whole body individuals

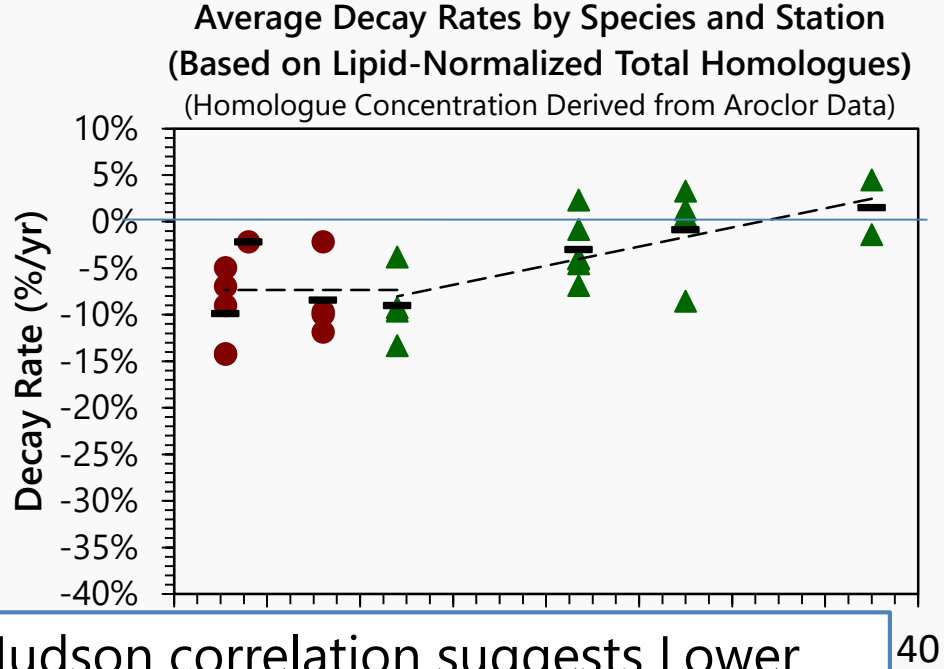
EPA estimates that as many as 8 years or more of post-dredging fish data will be needed to discern the new rate of recovery.

Fish PCB Recovery Rates (Pre-remediation data)

Wet Weight Basis



Lipid-Normalized Basis



Lack of Upper Hudson to Lower Hudson correlation suggests Lower Hudson fish burdens are controlled by local conditions.

The impact of further Upper Hudson improvements on downstream conditions is unclear, particularly below RM 110 (Catskill)

Pre-remediation fish tissue recovery rates decline with distance downstream in the Lower Hudson

Summary and Conclusions

1. Data show that the dredging effort met the ROD criteria.
   - Minimal elevated surface concentrations in the dredged areas.
     - Unlike other dredging projects where backfill was not deployed.
2. Remedial action removed more PCB mass than expected.
   - Total mass remaining is comparable to ROD expectations but in some limited areas more remains than expected, *e.g.*, RS 2.
3. Surface sediment conc. have substantially declined, exceeding ROD expectations in all river sections.
4. Water column concentrations are well below baseline conditions and do not appear to show any lingering impacts due to the dredging.

Summary and Conclusions

5. PCB loads to Lower Hudson have decreased from 30 to 50%, depending on flow.

6. Fish body burdens have declined from the dredging period maxima and are now at or below baseline conditions.

7. Year-to-year variations in fish body burdens indicate it is likely to require 8 or more years of monitoring to assess the actual post-dredging rate of recovery.

8. The impact of further Upper Hudson improvements on downstream conditions is unclear.

Questions?

For additional information on the Hudson River Dredging Project contact:

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