Lessons Learned from the Hudson River Superfund Site

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Disclaimer

- The views expressed are my own and do not necessarily represent those of NOAA, the Hudson River Natural Resource Trustees, or U.S. EPA.
- The Hudson River Superfund Site is a very different situation than the Anacostia and any comparisons between them must recognize this.

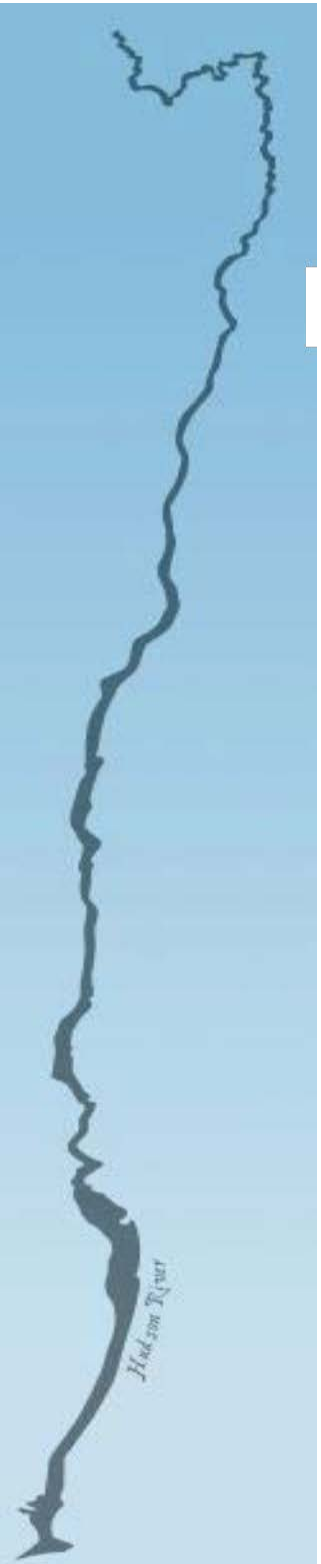
Overview

- Background on the Hudson
- Hudson vs. Anacostia
- EPA Remedial and NOAA Trustee Roles
- Hudson River Remedy
- Trustee Concerns
- Recommendations and Lessons Learned
- Additional Information

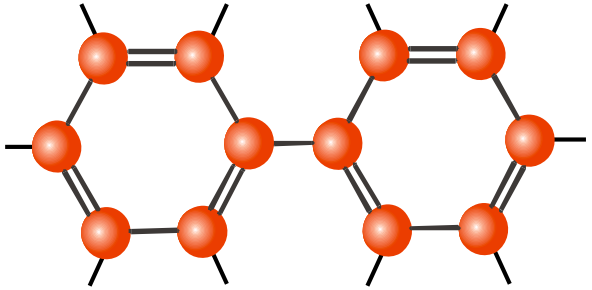
Some Differences Between the Hudson and Anacostia

- Hudson is a 200 mile NPL site, single contaminant, single responsible party focus
- Anacostia =has one NPL site (WNY) with small defined formal area and several other sites including federal sites; multiple sites, sources, contaminants (PCBs, PAH's, metals)
- Hudson mix of urban-rural / Anacostia is urban
- PCB contamination levels much higher in Hudson
  - e.g., cleanup targets in Hudson are > Anacostia sediment concentrations

Hudson River Background



The Problem



- At least 200 miles of the Hudson River are contaminated with PCBs from GE's releases since 1940's.
- Very high levels of PCBs are pervasive in Hudson River resources, including in ground water, surface water. sediments, floodplain soils, fish, birds, mammals and other wildlife of the River and adjacent areas.
- Adverse impacts include: bans and/or advisories on consumption of fish and waterfowl; environmental and human health risks; restrictions on navigational dredging and use of resources
- River sediments continue to be a source of PCBs to water and biota.
- Elevated levels of PCBs remain after dredging

Ranges of PCBs in Hudson River

Sediments, Upper Hudson: ND - 4,747 ppm, 1976-2001 (Max of 18,100 ppm in 2005)

Sediments, Lower Hudson: ND -40 ppm, 1976-2001

Water, Upper Hudson: 0.006 - 5.1 ppb, 1975-2001

Water, Lower Hudson: 0.006 - 0.46 ppb, 1975-2001

Fish fillets, Upper Hudson: <0.02 -1,836 ppm, 1977-98

Fish fillets, Lower Hudson: <0.02 - 686 ppm, 1977-98

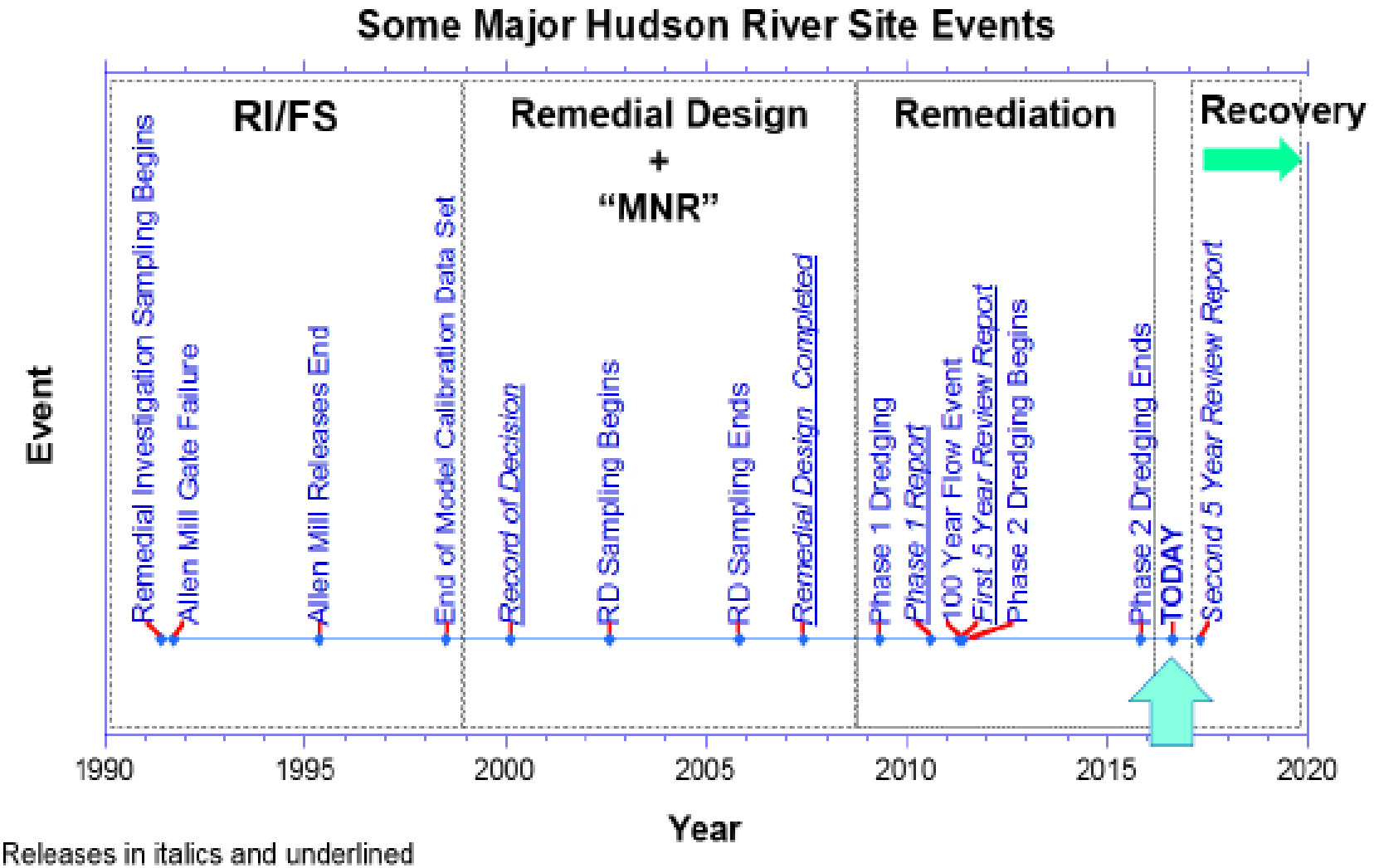
Data above from NRDA plan of 2002. Note current concentrations are lower.

Cleanup and Restoration Roles

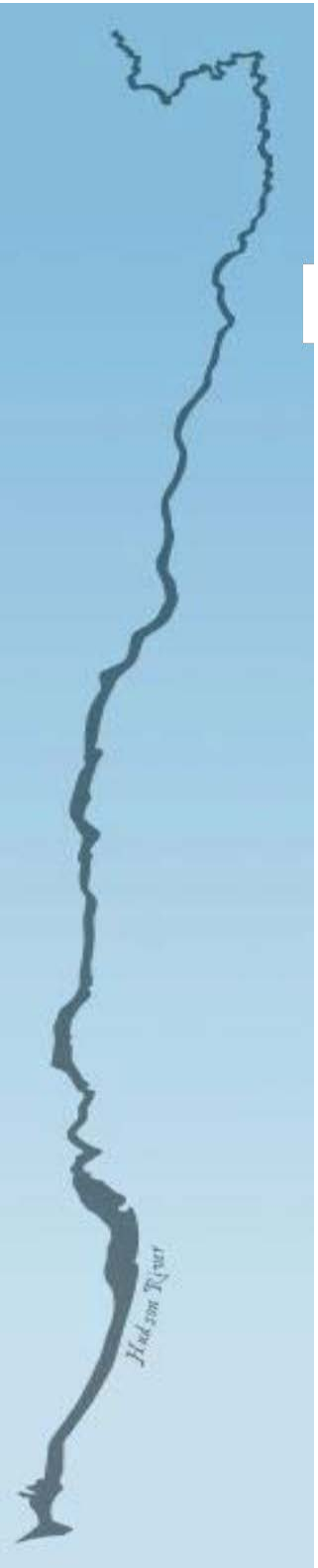
- **EPA: Superfund –** *clean up hazardous substances to protect the environment and public health.*
- **Trustees: Natural Resource Damage Assessment –** *assess and restore or replace natural resources injured by hazardous substances to provide for the public's use.*

See factsheet:
https://casedocuments.darrp.noaa.gov/northeast/hudson/pdf/FactSheet_EPATrustees_041715_final.pdf

Where we are now:

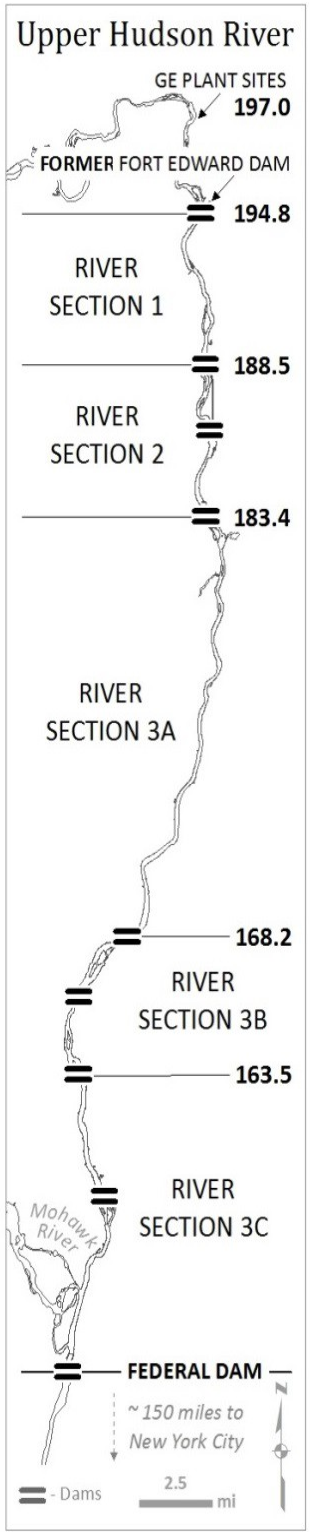


Report Releases in italics and underlined



The OU-2 Remedy

- 2002 ROD:
  - Dredging
  - Monitored Natural Attenuation



Cleanup Targets in the Upper Hudson River (UHR):

Dredging (3/10/Select) and Monitored Natural Recovery (2002 ROD)

River Section 1 Remedy (~6 miles, 1 river pool):

3 g/m² Tri+ PCBs mass per unit area (MPA) or
10 mg/kg Tri+ PCBs in surface sediment
(=~ 25-30 mg/kg total PCBs in top 12 inches).

River Sections 2 & 3 Remedy:

(~ 35 miles, 7 reaches/pools)

10 g/m² Tri+ PCBs MPA or
30 mg/kg Tri+ PCBs in surface sediment
(=~ 60-90 mg/kg total PCBs in top 12 inches).

Tri+ PCBs =Trichloro-biphenyl and higher chlorinated PCBs

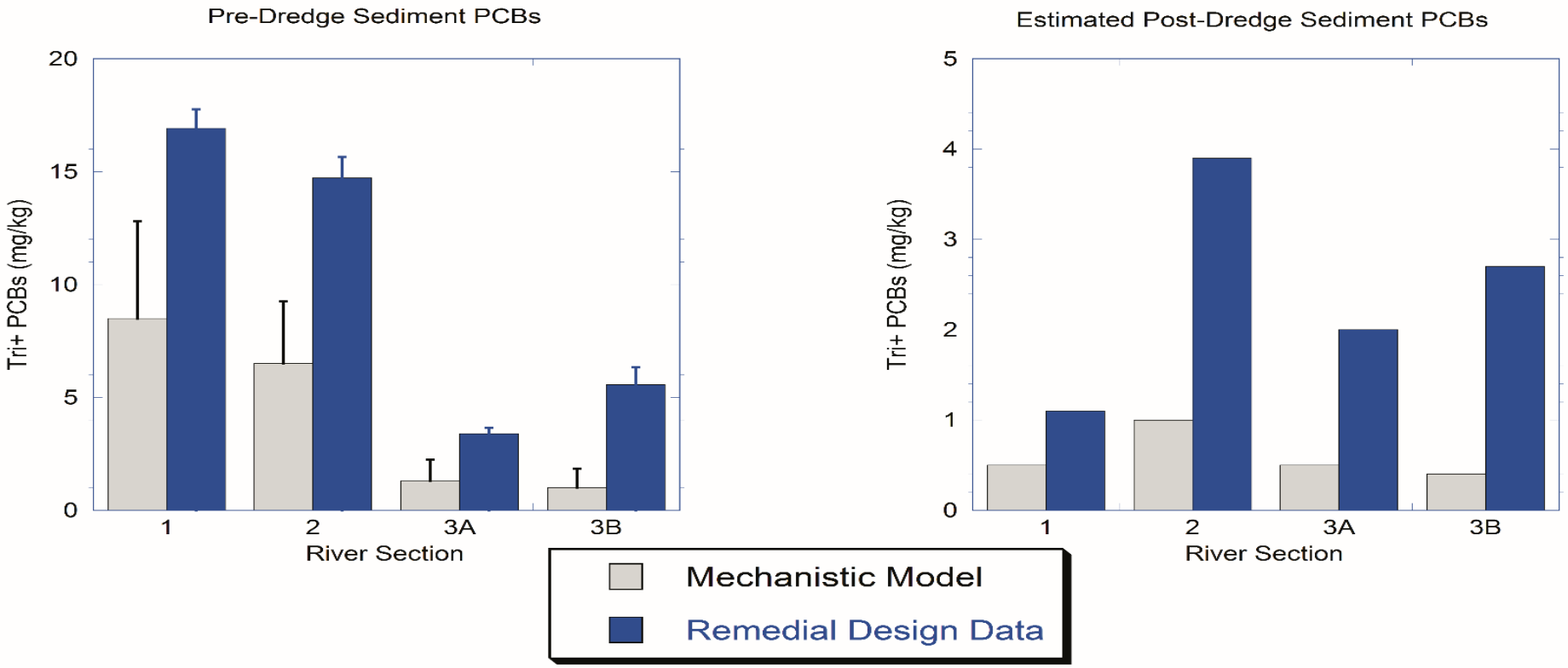
- *Consistent with historical analytical data*
- *PCBs in HR fish 98-100% Tri+ (USEPA 2002)*

Post 2002 ROD Findings

Remedial Design Sediment Data Collected After the Remedy Was Selected (i.e., Post-2002 ROD)

- Sediment sampling in 2002-05 in the Upper Hudson River to design the remedy (e.g., delineate dredge cut lines)
- Systematic (unbiased) sampling
- >8000 cores collected with PCBs measured in the top 2 inches (5 cm)

Surface Sediment PCBs: Mechanistic Model Predicted vs Measured Post-ROD



Measured Tri+ PCBs in surface sediments exceeded the model mean by a factor of 2-3 and the upper bound of model predictions

Estimated post-remediation PCBs for the selected remedy were 3-5X higher than model predictions

Summary of Post-ROD Findings

- Measured pre-dredge surface sediment PCBs were 2-3 higher than predicted by the mechanistic model throughout the Upper Hudson
- Estimated post-remediation PCBs for the selected remedy will be 3-5X higher than model predictions
- Rate of sediment natural attenuation slower than models predicted (8% vs. ~3%; EPA disagrees)
- PCB loads from the UHR to the LHR in 2008 3X greater than predicted by the models and showed little evidence of decline[1]
- Fish PCBs ~2X greater than predicted
- Despite these findings, there was no change to the 2002 remedy.

[1] USEPA 2010. Hudson River PCBs Site EPA Phase 1 Evaluation Report

NOAA's Efforts to Provide Updated Lower Hudson River Fish Projections

- As trustees, knowing when fish are no longer contaminated above health thresholds is crucial to our understanding of how long injury to fish will last into the future (e.g., via consumption advisories).
- NOAA used a model emulation approach to apply updated surface sediment PCB data and decay rates to assess the impact of the post-2002 ROD findings on predictions of Lower Hudson River fish PCBs.
- NOAA's analysis shows that, absent further removal of PCBs, achievement of Lower Hudson fish PCB threshold concentrations protective of human health may be delayed for up to several decades.

Re-visiting Projections of PCBs in Lower Hudson River Fish Using Model Emulation was recently published in the peer-reviewed journal, Science of The Total Environment (Vol 557-558, pp 489-501).

NOAA Concerns Re: Unremediated PCBs: Potential Impact on Recovery and Restoration

- The magnitude of contamination remaining post - dredging may delay recovery of natural resources
- Residual contamination may also limit the type and amount of restoration options in the Upper Hudson, where it would be most valuable.
  - Trustees would need to consider harm from creating an "attractive nuisance" in PCB-contaminated areas.
  - Restoration projects may need to be located further from the site of greatest contamination.

NOAA Recommendations on the In-River Remedy

- To achieve the original goals and timeline of the ROD, consider additional dredging.
- Conduct a robust post-dredging monitoring program for water, fish & sediment to determine the protectiveness and effectiveness of the remedy.
- Post-remedial sediment monitoring should include a probability-based statistical design for selection of sample locations within dredged and undredged areas for each individual reach, adequately sample cohesive sediments, and measure PCBs in the top 0-2, 2-6 and 6-12 inches.
- Fish QA/QC: evaluate change in fish processing protocol and develop correction factors for 2007-2013 fillet fish data, which are biased low.

Lessons Learned

- Prior to remedy selection, ensure that sampling of sediment (surface and depth), water, fish, etc. is adequate to correctly characterize baseline conditions and remedial impacts
- Ensure that data are collected consistently over time to allow the system rate of recovery to be correctly measured, especially if Monitored Natural Attenuation is part of the remedy.
- Ensure that modeling is well supported by and updated with new data
- Ensure all stakeholders agree on QA/QC and approach implemented
- Ensure adequate post-remedy sampling and adaptive management exists and is followed
- Integrate more robust habitat restoration into the remedy
- Use an independent peer review panel of outside experts on remediation, modeling, sampling, habitat reconstruction, etc.

For Additional Information

- **NOAA Hudson River NRDA Website:**
  www.darrp.noaa.gov/northeast/hudson/index.html
- **NOAA Factsheet:**
  https://casedocuments.darrp.noaa.gov/northeast/hudson/pdf/Predicting%20Future%20Levels%20of%20PCBs%20in%20Lower%20Hudson%20River%20Fish%202016.pdf
- **EPA Hudson River Website:**
  https://www.epa.gov/hudson/
- **EPA Factsheet:**
  https://www3.epa.gov/hudson/pdf/EPA%20Response%20to%20NOAA%20-%20Factsheet.pdf
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