Third Five-Year Review Report for the Hudson River PCBs Superfund Site

APPENDIX 7

FIVE-YEAR REVIEW TEAM AND

PUBLIC NOTICE OF THE FIVE-YEAR REVIEW

Prepared by:

WSP USA Solutions Inc.

July 2024

THIRD FIVE-YEAR REVIEW REPORT FOR THE HUDSON RIVER PCBs SUPERFUND SITE

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LIST OF ATTACHMENTS

1.1 Five-Year Review Team and Meetings

The U.S. Environmental Protection Agency (EPA) Comprehensive Five-Year Review (FYR) Guidance (EPA, 2001) states that, for complex projects, a multidisciplinary FYR team of experts may be needed to adequately review the protectiveness of the remedy. Because of the complexity of the Hudson River PCBs Superfund Site (Site) cleanup for Operable Unit 2 (two-part remedy – dredging followed by monitored natural recovery), EPA assembled a FYR team of experts and agency representatives from a diverse group of disciplines and perspectives. This appendix describes the FYR Team formation, and the communication associated with the meetings.

Upon initiation of the Third FYR, EPA established a team that included representatives of the state agencies, federal agencies, natural resource trustees, Community Advisory Group members, and EPA subject matter experts (Table 7-1). Prior to the first meeting, team members provided their availability and preferred days and meeting times. The EPA team scheduled meetings to achieve the maximum feasible representation of invited participants (Table 7-2).

During each meeting, the FYR team provided input on the materials presented by EPA. The presentations focused on EPA's analysis of site data and the FYR process as defined in EPA's guidance documents. The presentation and follow-up questions provided by Scenic Hudson on behalf of certain team menbers are included in Attachment A. Team members actively participated in the meetings. The meetings were well attended with extensive discussion of the topics presented.

EPA intends to provide an opportunity for the public to comment on the FYR Report. The comments received will be carefully considered by EPA prior to finalizing the FYR Report.

1.2 Third Five-Year Review Public Notices

On April 19, 2022, EPA issued a news release announcing that the agency had begun its Third FYR of the cleanup of the Hudson River PCBs Superfund Site. The news release was distributed to media outlets in the upper and lower Hudson River, elected officials in the project area, the Site's Community Advisory Group, and the Hudson River PCBs Site email Listserv. EPA also published a public notice in the Post Star and Times Union newspapers on April 24, 2022 (Attachment B).

Although EPA does not typically seek public comment on FYR reports, EPA intends to provide an opportunity for the public to comment on the Third FYR Report for the Hudson River PCBs Superfund site.

References:

EPA. 2001. Comprehensive Five-Year Review Guidance. June 2001.

Table A7-1 Third Five-Year Review Team Members

	Organization	Name	Title
1	USEPA	Gary Klawinski	Albany Office/Hudson Project Director
2	USEPA	Mike Cheplowitz	Albany Office/Hudson Project Manager (FYR Lead Manager)
3	USEPA	Joe Battipaglia	Albany Office Project Manager
4	USEPA	Larisa Romanowski	Community Involvement Coordinator (FYR CIC)
5	USEPA	Daniel (Matt) Wiener	Albany Office/Hudson Project Manager
6	USEPA	Jennifer Edwards	EPA Superfund HQ – Five-Year Review
7	USEPA	Chloe Metz	EPA Region 2 – Five-Year Review Coordinator
8	USEPA	Marian Olsen	EPA Region 2 – Human Health Risk
9	USEPA	Charles Nace	EPA Region 2 – Ecological Risk
10	USEPA	Marc Greenberg	EPA Emergency Response Team – FYR support
11	USEPA	Elizabeth Leilani Davis	Site Attorney
12	USACE	As needed	Technical Support Team (multiple people)
13	NYSDEC	David Tromp	NYSDEC Hudson River Team
14	NYSDOH	Angela Martin	Hudson River Team – Public Health Specialist
15	NOAA	Lisa Rosman	Regional Resource Coordinator
16	NOAA	Tom Brosnan	Deputy, Assessment and Restoration Division
17	US Fish and Wildlife	Kathryn Jahn	DOI Manager
18	NYS Attorney General's Office	John Davis	Technical Support – Geologist
19	Community Advisory Group	Mike Dulong	Riverkeeper (Environmental and User Group)
20	Community Advisory Group	Drew Gamils	Scenic Hudson (Environmental and User Group)
21	Community Advisory Group	Althea Mullarkey	Consultant
22	Community Advisory Group	Terry Middleton	Resident
23	Community Advisory Group	Andrew Squire	Resident
24	Community Advisory Group	Manna Jo Greene	Hudson Clearwater Sloop (Environmental and User Group)

Table A7-2 Five-Year Review Team Meetings and Topics

Date	Meeting Type	Topics Discussed
December 14, 2022 1-2 pm	Virtual – MS Teams Meeting	• Introduction – discuss overall Five-Year Review (FYR) process and approach for the meetings • What is a FYR and what is being reviewed? • What was determined during the last FYR
January 18, 2023 1-3 pm	Virtual – MS Teams Meeting	• Presentation and discussion regarding the Remnant Deposits (Operable Unit [OU] 1) • Presentation and discussion regarding water data – Upper Hudson River Remedy (OU2) • Presentation and discussion regarding caps – Upper Hudson River Remedy (OU2)
February 1, 2023 1-3 pm	Virtual – MS Teams Meeting	• Presentation and discussion regarding fish data – Upper Hudson River Remedy (OU2)
March 1, 2023 1-3	Virtual – MS Teams Meeting	• Presentation and discussion regarding sediment data – Upper Hudson River Remedy (OU2)
March 15, 2023 1-3	Virtual – MS Teams Meeting	• Overview presentation; other discussions as raised by FYR Team (OU1 and OU2)
August 8, 2023 4-5 pm	Virtual – MS Teams Meeting	• Follow-up discussion regarding 10 questions provided by Scenic Hudson
September 20, 2023 2-3 pm	Virtual – MS Teams Meeting	• Continue follow-up discussion regarding 10 questions provided by Scenic Hudson

Attachment A

Third Five-Year Review Team Meeting Presentations and Follow-Up Questions

HUDSON RIVER PCBS SUPERFUND SITE
FIVE-YEAR REVIEW TEAM MEETING
THE MEETING WILL BEGIN AT 1PM

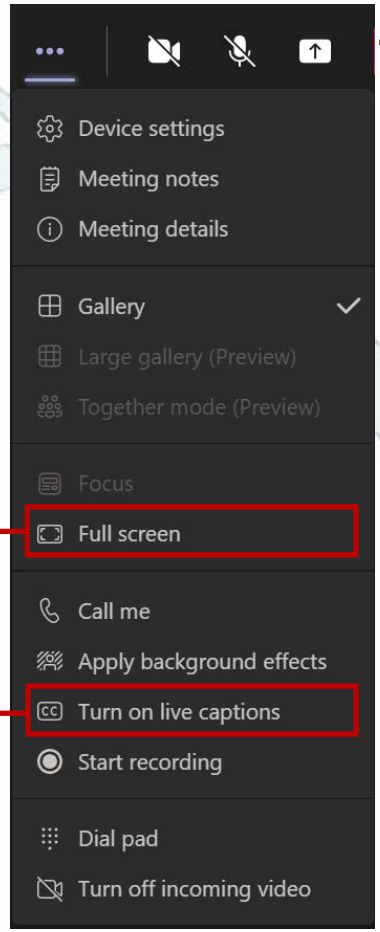
to ask question and share comments

to raise hand

to turn on/off video

to un/mute mic

to leave the call



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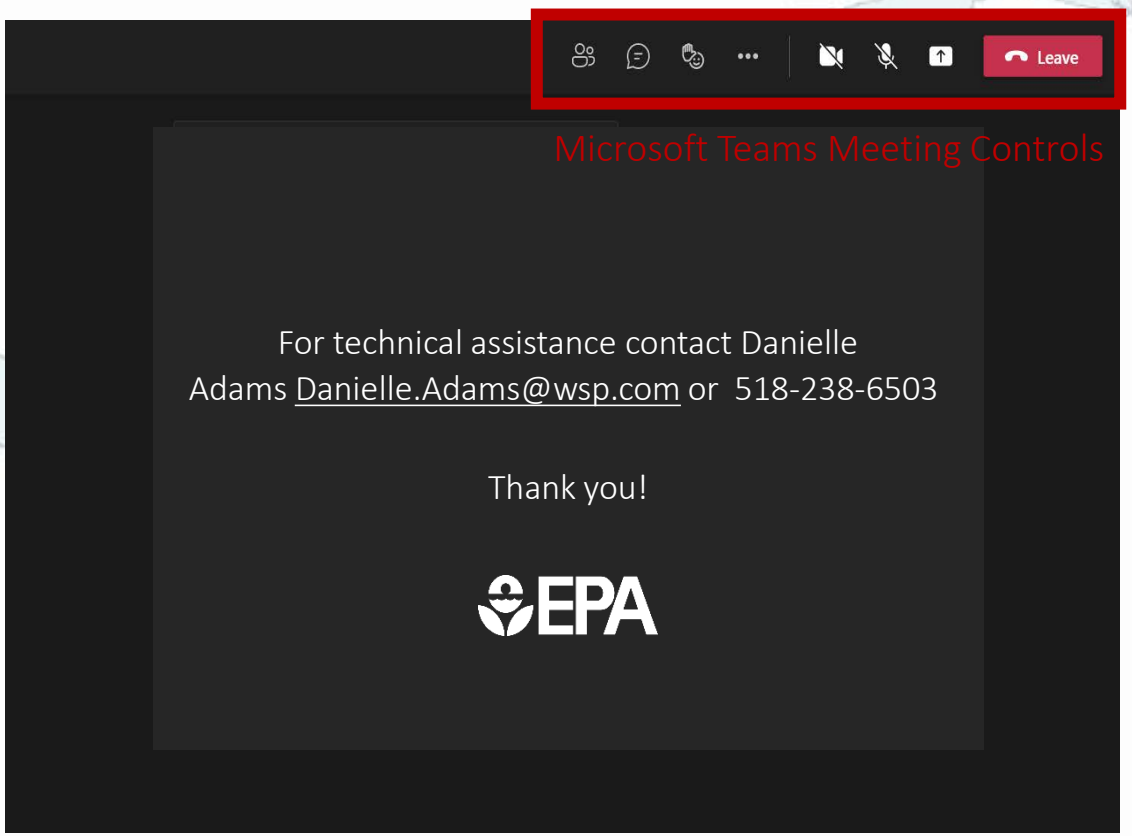

Hudson River
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Third Five-Year Review
Team Meeting #1

December 14, 2022

Virtual Meeting

Topics for today's meeting

- Introduction – Team Meetings
  - Meeting Approach/Logistics
  - Roles and Responsibilities
  - Anticipated Schedule
  - Background/History
- Five-Year Review (FYR) Purpose, Process and Considerations
- Summary of Past FYR's with focus on last review

Meeting Approach/Logistics

- EPA plans to keep the meetings to key participants and alternates
  - Please try to avoid surprises on who is attending (check in with EPA if you want others to join)
  - The smaller the group the easier it will be to have productive discussions
- Unfortunately, given the nature of the FYR, EPA will not be able to distribute materials/analysis in advance or after meetings
  - Presentations will likely be included in the report
  - There will be a formal opportunity to review and comment on the report
  - EPA is available to answer questions outside of the Team meetings
- Meeting format will be open-dialogue
  - We anticipate receiving feedback and answering questions during the presentations
  - EPA hopes to have an ongoing discussions throughout the meeting
  - The meeting is scheduled for 1 ½ hours but our goal is to get through the materials in 1 hour (given the technical nature of the materials - going longer would be challenging)

Meeting Approach/Logistics (Cont'd)

- About 35 slides to cover today
- Please remain on mute when others are speaking
- Please turn your camera on if you are speaking (at your discretion)
- Please use the "raise hand" feature under the Reactions button to get the moderator's attention
- EPA will monitor the Chat, but our preference is to have discussions (raising hand and dialog is our preference)
- Please be respectful of others positions and comments
- Let's try to have one ongoing dialog and avoid side conversations (including in the chat)

Roles and Responsibilities

Five-Year Review (FYR) Team is formed

FYR guidance Section 3.3 – "You should determine the appropriate level of assistance and team structure. For some reviews, the project manager may be the only member of the team, consulting with technical experts as necessary. For other reviews, a multi-disciplinary team may be needed to adequately review the protectiveness of the remedy."

Take away – EPA is not required to form a FYR Team but given the level of involvement and interest in this project EPA's view is that input from the Team is very important and valued

Roles and Responsibilities (Cont'd)

Team Members

	Organization	Name	Title
1	USEPA	Gary Klawinski	Albany Office/Hudson Project Director
2	"	Mike Cheplowitz	Albany Office/Hudson Project Manager (FYR Lead Manager)
3	"	Joe Battipaglia	Albany Office Project Manager
4	"	Larisa Romanowski	Community Involvement Coordinator (FYR CIC)
5	"	Daniel (Matt) Wiener	Albany Office/Hudson Project Manager
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7	"	Chloe Metz	EPA Region 2 – Five Year Review Coordinator
8	"	Marian Olsen	EPA Region 2 - Human Health Risk
9	"	Charles Nace	EPA Region 2 - Ecological Risk
10	"	Marc Greenberg	EPA Emergency Response Team – FYR support
11	"	Leilani Davis	Site Attorney
12	US Army Corps of Engineers/WSP	As needed	Technical Support Team (multiple people)
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22	"	Terry Middleton	Resident
23	"	Andrew Squire	Resident
24	"	Manna Jo Greene (as available)	Hudson Clearwater Sloop (Environmental and User Group)

Roles and Responsibilities (Cont'd)

- Roles
  - EPA Project Management – responsible for the completion of the FYR
  - EPA Community Involvement Coordinator – responsible for ensuring the required and appropriate elements of community involvement are completed
  - State Agencies – support agencies (NY State is also a natural resource trustee)
  - Federal Agencies – support agencies (which are also natural resource trustees)
  - CAG Representatives – provide community perspective, insight and input
  - EPA Support includes USACE contractors – provide technical expertise (including national experts), conduct the majority of the analysis, assist with responding to technical questions and compile the report

Roles and Responsibilities (Cont'd)

- Five-Year Review team – overall role - reminder
  - Assists in accomplishing the FYR
  - Participates in the process and contributes to the review
  - Shares the understanding that EPA has a deadline for the FYR
  - Commits to working closely together through the FYR process

FYR Team Meetings - Anticipated Schedule

All meetings are on the following Wednesday from 1:00 to 2:30

- December 14, 2022 - Kickoff (this meeting)
- January 18, 2023 – Remnant Deposits, Water Column, Caps
- February 1, 2023 – Fish
- February 15, 2023 - Sediment
- March 1, 2023 – Other discussions as needed

Meeting series needs to end no later than about 3 to 4 weeks before the report is issued to the public to allow EPA time to wrap up the report

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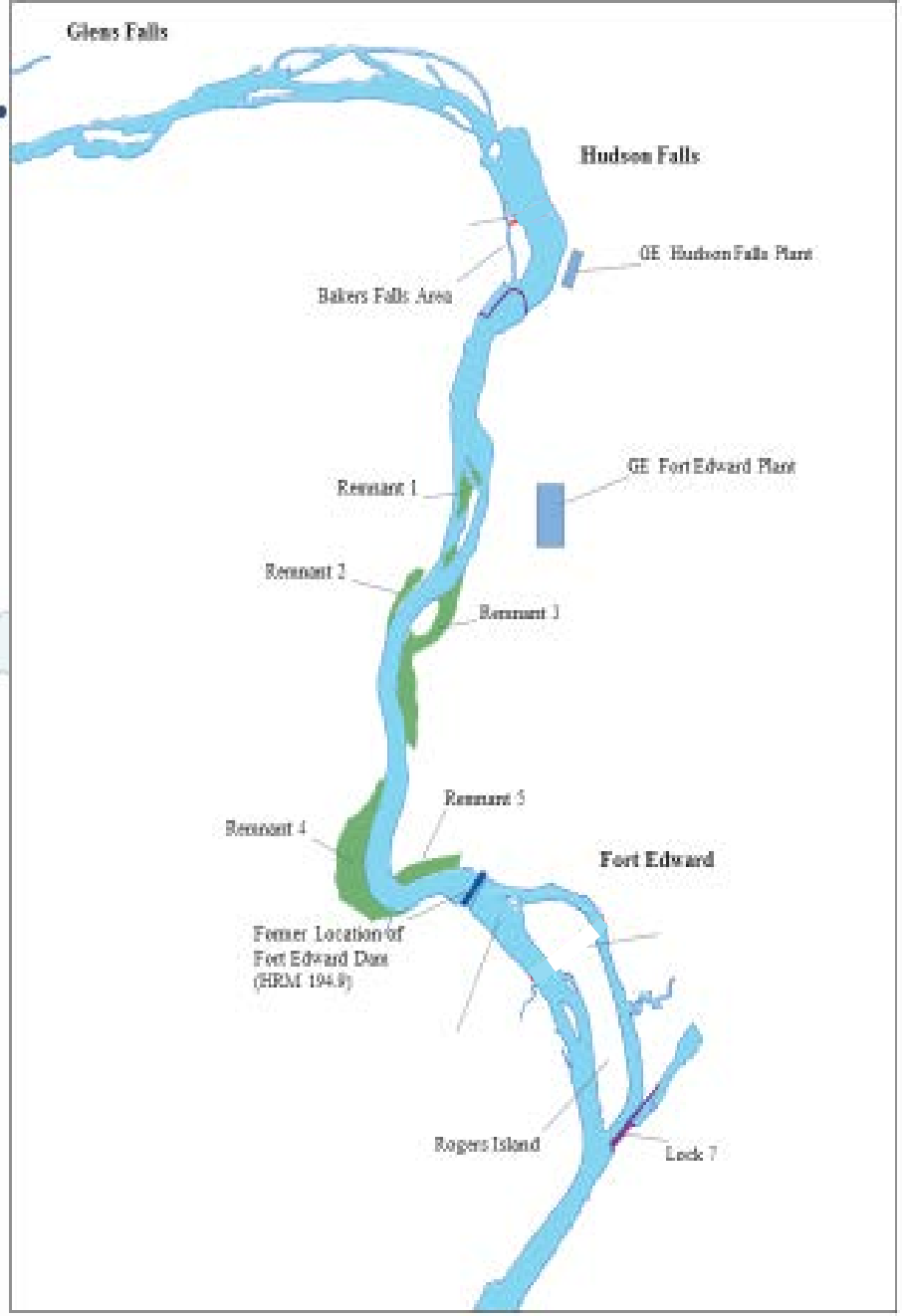
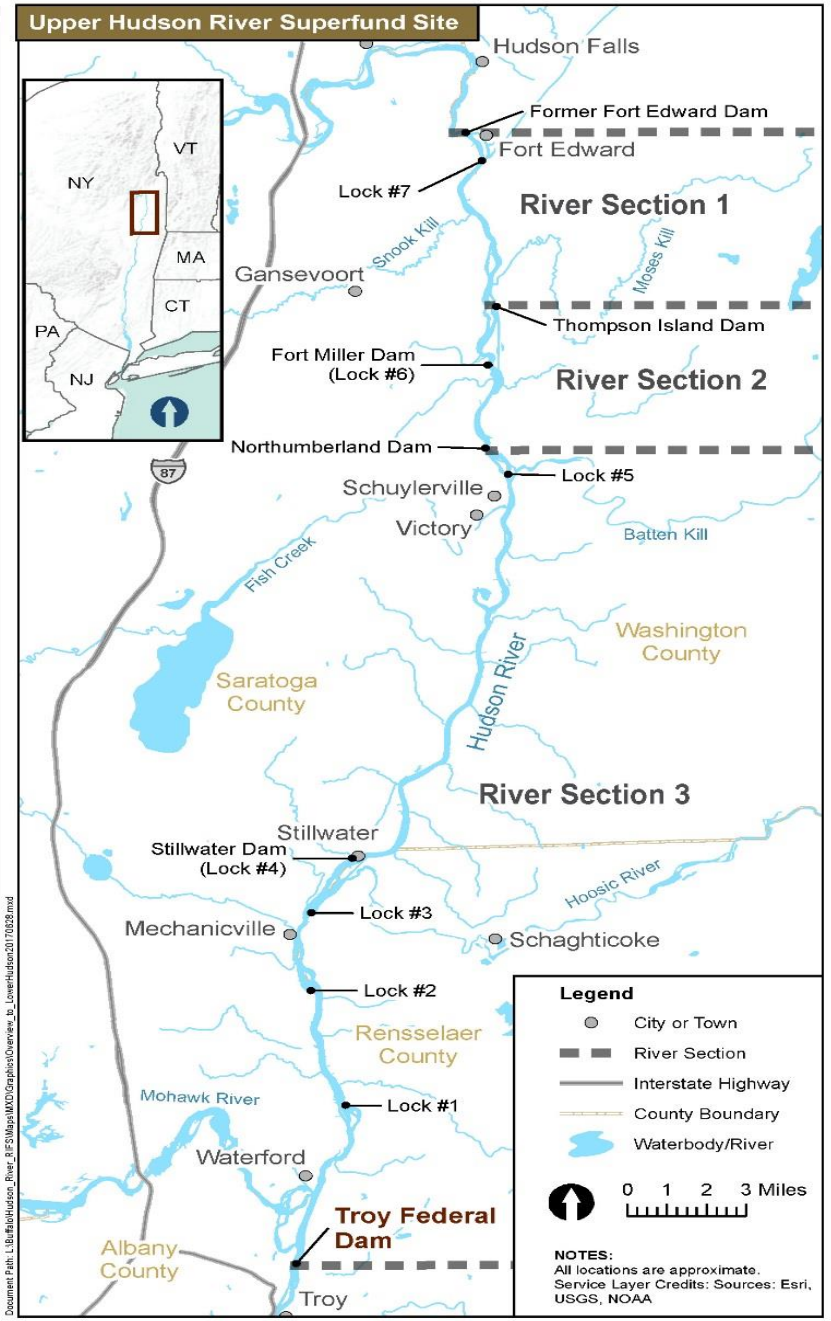




OU1 | OU2

Background: Remnant Deposits (OU1)

- Remnant Deposits are areas of PCB-contaminated sediment that became exposed after the river water level dropped following the removal of the Fort Edward Dam in 1973
- EPA selected a cleanup plan (Record of Decision) to address the Remnant Deposits in 1984
- Cleanup of the Remnant Deposits included an in-place containment and cap system, shoreline protection (rip-rap) perimeter fencing and signage which was completed in 1991
- Inspections are conducted semi-annually in accordance with the EPA-approved Post-Closure Maintenance Plan – repairs are made as necessary

Background: In-River Sediments (OU2)

- Upper river (40 miles) is series of pools (dams and locks)
- In-river sediments between Fort Edward and the Federal Dam at Troy were extensively contaminated with PCBs from releases from the GE Plants in Hudson Falls and Fort Edward - the removal of the Fort Edward Dam in 1973 caused further downstream transport of PCBs in river water and PCB-contaminated sediment and debris
- Following an interim no-action decision in 1984, EPA selected a remedy consisting of targeted dredging (Phases 1 and 2) followed by MNR through its 2002 ROD
- Notable statement from the ROD (Page 98)

  "EPA's selected remedy for the Site includes a combination of remedial activities that were tailored to the conditions at the Site, including removal of contaminated sediment using **environmental dredging** techniques, **institutional controls**, and **monitored natural attenuation** of residual PCB contamination **until acceptable PCB concentrations in fish are attained**."

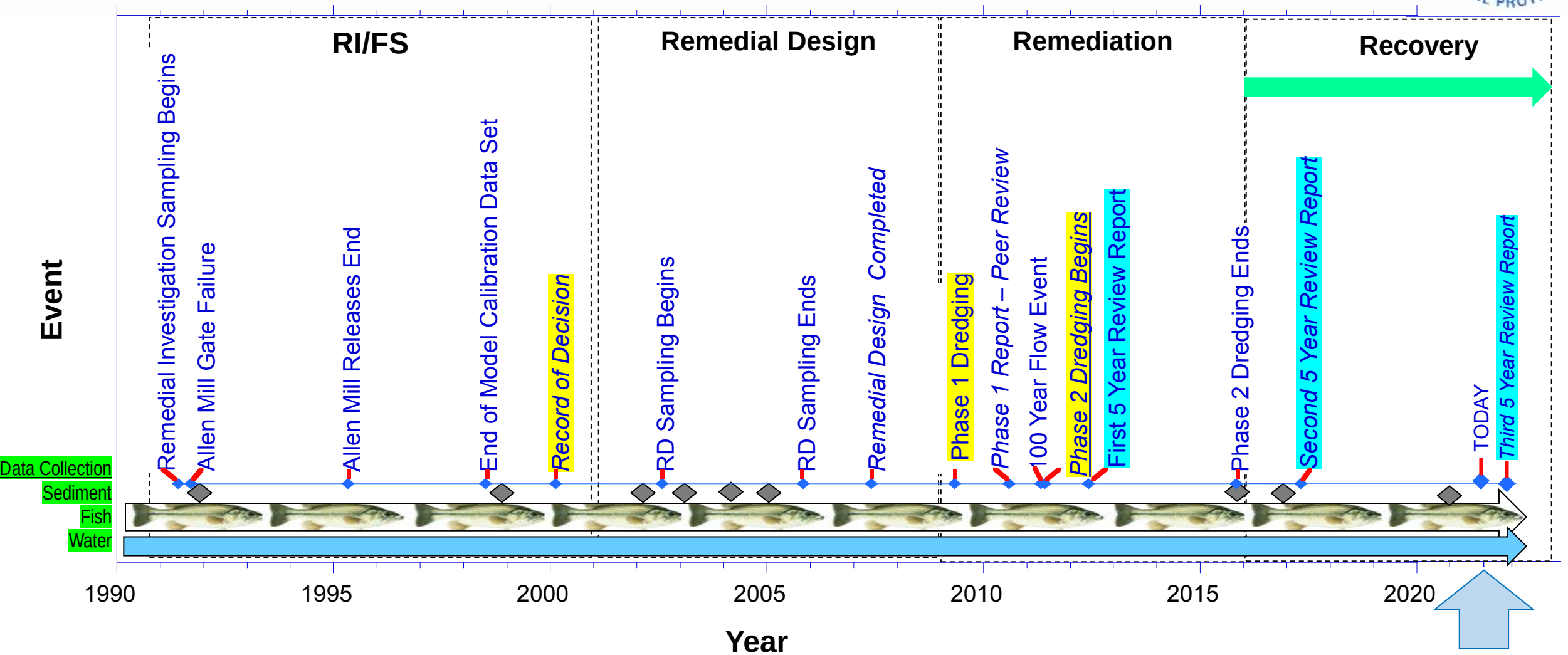
  - Reminder – the remedy included an extended period of natural recovery (decades of recovery)

Background: In-River Sediments (OU2) (Cont'd)

- Following remedial design, construction was undertaken in two phases starting in 2009:
  - Phase 1 dredging 2009
  - Peer Review 2010
  - Phase 2 dredging 2011-2015
  - Habitat reconstruction completed in 2016
  - 2.75M CY of sediment removed from river (≈310,000 lbs of PCBs)
  - Monitoring of sediment, water and fish ongoing
- Long term monitoring of sediment, water and fish, and cap monitoring and maintenance (OM&M) associated with MNR began in 2016 and is ongoing

Background: In-River Sediments (OU2) (Cont'd)

Major Site Events for OU2



Report Releases in italics and underlined

Five-Year Review

Purpose, Process and Considerations

Five-Year Review - Purpose

- Required for remedial actions that leave contamination in place above levels that allow for unrestricted land/resource use
- Uses current information and data to evaluate the implementation and performance of the selected remedy
- Assesses protectiveness of the selected remedy
  - Reminder - not a review associated with exploring alternative remediation options or strategies
- Follows EPA guidance and memoranda on the FYR process, including report organization and protectiveness statement determinations
  - https://www.epa.gov/superfund/superfund-five-year-reviews

Five-Year Review - Process

- Once EPA received all data it initiated the FYR data review
- EPA invites agency and community representatives to join Five-Year Review Team
  - EPA technical experts
  - Support agencies
  - Representative CAG members
- FYR Team conducts meetings throughout the data review process
- Team members provide input to EPA through regular meetings
- Report is drafted by the Region; HQ provides review/input
- Public comment period (unique to the Hudson River Project)
- Final report to be issued – with follow up on comments

Considerations

- The five-year review is focused on answering the required technical questions (following EPA guidance – there is some flexibility in the guidance)
- EPA follows a science-based approach
- Remedy is ongoing – monitored natural recovery phase continues - remaining residual PCBs
- Previous FYRs and associated evaluation will be taken into account in the current review

Five-Year Review - Components

- Required technical questions
  A. Is the remedy functioning as intended by the decision documents?
  B. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?
  C. Has any other information come to light that could call into question the protectiveness of the remedy?
- Protectiveness determination
- Other FYR issues/recommendations

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Five-Year Review Reports Timeline and Protectiveness Determinations

	Timeline				Protectiveness Statement	
	Data Period	**Date of issue**	**Public Comment Period**	**Report Signed**	**OU1 Remnant Deposits**	**OU2 In-River Sediments**
First Five-Year Review	All available data up to 2011	June 1, 2012	N/A	June 1, 2012	Short-term Protective	Will be Protective
Second Five-Year Review	2011 - 2016	June 1, 2017	June 1, 2017 to September 1, 2017	April 1, 2019	Short-term Protective	Protectiveness Deferred
Third Five-Year Review	2017 - 2021	To be covered in later slide				

Second Five-Year Review Overview (as reminder)

Remnant Deposits (OU-1)

Protectiveness Determination Summary

- Short-term protective
- In-place capping is effective
- Inspections and monitoring conducted regularly
- Institutional controls related to long-term protectiveness (some follow up needed)

Remnant Deposits (OU-1)

Technical Assessment

A. *Is the remedy functioning as intended?*
   - The caps on the Remnant Deposits are intact and functioning as intended to prevent potential contact with and volatilization of the PCB waste (contaminated sediment)

B. *Are the risk assumptions still valid?*
   - Risks were evaluated and it was determined that the capping of PCBs greater than 5 mg/kg would be consistent with current risk practices

C. *Has new information come to light that would call into question the protectiveness?*
   - No other information has come to light that could call into question the protectiveness of the OU1 remedies

- Note: areas of floodplain in the area of the remnant sites are being evaluated as part of the Floodplain RI/FS – which is not part of this FYR

In-River Sediments (OU-2)

Protectiveness Determination Summary

- EPA deferred its determination of protectiveness
- Not enough data available to determine if the remedy will be protective within the time frame anticipated by the 2002 ROD
- Insufficient data available to assess whether interim targets will be reached in the time frames estimated at the time of the 2002 ROD - eight or more years of post-dredging fish tissue data are needed
- In the interim, the State of New York has fishing restrictions and advisories in place to minimize human consumption of contaminated fish

In-River Sediments (OU-2)

Technical Assessment – Question A

Is the remedy functioning as intended?

- Source control in place (GE plant sites)
  - Important to reach long-term remedial goal
  - Rogers Island water column data has generally achieved goal of less than 2 ng/L Tri+ PCBs since 2004
- Advisories in place
  - State of New York fishing restrictions and consumption advisories to address human exposure pathways
  - NYSDOH outreach – minimize human consumption of fish
- Project implemented within expectations
  - Reduction in overall surface sediment PCB concentrations consistent with the 2002 ROD
    - 76% of PCB mass was removed (ROD predicted 65% reduction)
  - Construction complied with Engineering Performance Standards and Quality of Life Performance Standards

In-River Sediments (OU-2)

Technical Assessment– Question A (Cont'd)

Is the remedy functioning as intended?

- Differences between anticipated and implemented dredging operations
  - Potential reasons for lag in recovery
    - Delayed start
    - Sequence of the dredging work
    - Operational adjustments
    - Reduction in surface concentrations in RS 2 less than expected
  - Increased mass removal

In-River Sediments (OU-2)

Technical Assessment– Question A (cont'd)

Is the remedy functioning as intended?

- Post-dredging data were within expectations
  - 2016-2017 sediment data deemed encouraging, but additional monitoring needed
  - Water column PCB data generally consistent with 2002 ROD expectations
  - Fish data suggested that fish had begun to recover from dredging impacts and were generally back to pre-dredging levels
  - Sediment data outside dredge areas suggested recovery occurring
- Monitoring to continue
  - Fish, water, and sediment data to be collected into the future
  - Future data will help estimate recovery with increasing confidence and will guide EPA's decision-making

In-River Sediments (OU-2)

Technical Assessment– Question B

Are the risk assumptions still valid?

- Human Health Risks
  - Risks calculated for the ROD were re-assessed using then-current exposure assumptions, toxicity values and standards to determine if the conclusions of the risk assessment or the protectiveness of the remedy had changed
    - Toxicity values for human health were taken from the Integrated Risk Information System for both cancer and non-cancer health effects, consistent with EPA guidance
- EPA determined that the human health Remedial Action Objectives for Human Health in the 2002 ROD were still valid and appropriate

In-River Sediments (OU-2)

Technical Assessment– Question B (cont'd)

Are the risk assumptions still valid?

- Ecological Risks
  - Exposure parameters used in risk assessment were evaluated: body weight; food, water and sediment ingestion rates; home range
  - Literature search for updated values
  - River otter and mink were the most sensitive species identified in ROD
  - Risk ranges recalculated based on updated values, resulting in narrower risk ranges than presented in the ROD, with a slight reduction in the upper bounds
    - River Otter: 0.2 to 0.07 mg/kg PCB in largemouth bass vs. ROD value of 0.3 to 0.03 mg/kg PCB
    - Mink: 0.34 to 0.11 mg/kg PCB in spottail shiner vs. ROD value of 0.7 to 0.07 mg/kg PCB
- EPA determined that ecological Remedial Action Objective developed in the 2002 ROD was still valid and appropriate

In-River Sediments (OU-2)

Technical Assessment – Question C

Has new information come to light that would call into question the protectiveness?

- No such information had come to light
- EPA anticipates that eight or more years of data are needed to draw statistically reliable estimates of fish recovery
- 2002 ROD model forecasts were considered adequate for comparison of alternatives

In-River Sediments (OU-2)

Protectiveness Statement

Protectiveness Determination: **Protectiveness Deferred**

(as a reminder - pause for team to read – follow up discussion)

A protectiveness determination of the remedy at OU2 cannot be made until further information is obtained. There is not enough data available since the completion of dredging and related project activities in 2015 to determine if the remedy will be protective within the time frame anticipated by the Record of Decision (ROD). There is also not sufficient data available to assess whether the interim targets identified in the ROD will be reached in the time frames estimated at the time the ROD was issued in 2002. A critical factor needed for the protectiveness determination is a reliable calculation of the rate of decline in post-dredging fish tissue PCB levels. It is necessary to examine the annual record over a longer period of time in order to calculate this rate with statistical certainty. EPA estimates that as many as eight or more years of post-dredging fish tissue data are needed. This information will be obtained through the collection and evaluation of fish tissue data along with the water and sediment data collected as part of the long-term monitoring program. Once statistically relevant rates of decline in post-dredging fish tissue PCB levels can be established, EPA will estimate the rates of recovery and determine if they are reasonably consistent with those predicted in the ROD. It is anticipated that this additional information will be obtained with the results of the 2024 fish data. EPA expects to complete its evaluation of that data in 2025, after which time a protectiveness determination could be made. Remedial activities completed to date have substantially reduced PCB source materials in the Upper Hudson River. Natural attenuation is ongoing within the Upper Hudson River, and these processes are expected to result in the River eventually reaching the long-term remediation goal for the protection of human health with regard to fish consumption (0.05 mg/kg PCBs in species-weighted fish fillet). As EPA indicated in the ROD, EPA believes it likely that improvement will occur gradually over more than five decades. In the interim, the State of New York has in place fishing restrictions and advisories against consumption of fish to control human exposure pathways that could result in unacceptable risks. EPA acknowledged in the ROD that the consumption advisories are not fully effective in that they rely on voluntary compliance in order to prevent or limit fish consumption. EPA will continue to work with New York State to ensure the ongoing maximum effectiveness of the advisories.

Remnant Deposit Sites (OU-1)

Other Issues/Recommendations

- Institutional controls needed to prevent long-term exposure
- Property ownership to be determined
  - EPA continues to work to identify property owner
  - Continue to coordinate with NYS
- Passive recreation request from Town
  - This community request is on hold

In-River Sediments (OU-2)

Other Issues/Recommendations

- Additional information needed
  - Fish collection every year
  - Water column collection bi-weekly / monthly
  - Sediment collection every 5 years
- IRIS database updates
- Fish Advisory Outreach program follow-up
- Institutional Control(s) for caps
- Fish recovery
- OM&M program is important to remedy effectiveness
  - Adjustments have been made to the water, fish and sediment programs based on the post-dredging data
  - Have the flexibility to be adjusted as necessary during the ongoing MNR
  - Work plans are under review/discussion
  - Extensive long-term monitoring continues

Anticipated FYR Schedule

- April 2022: Third FYR announced
- Majority of data received spring/summer 2022
  - Delays due to lab challenges (COVID/supply chain issues)
  - Last data set - sediment received in August
  - Additional information and QA/QC data being provided to EPA as requested
- January - March 2023: EPA internal review by Region 2 senior staff and Headquarters FYR staff
- Mid-March 2023: FYR Team meetings conclude
- Mid-April to May 2023: FYR Release for public comment (30 days)
  - Follow up on comments – approach TBD based on what is received
- Late July 2023: FYR report complete

Next Steps

- Meeting #2 January 18, 2023, 1:00-2:30pm
  - Topics to be covered: Remnant Deposits, Water Column, Caps
  - Technical presentations of data and information
  - Environmental media - statistical evaluations of recovery
  - Identify challenges and present ongoing analyses
- Fish and sediment to be covered in future meetings
- Suggestions for future meetings?
- Other thoughts from Team?

HUDSON RIVER PCBS SUPERFUND SITE
FIVE-YEAR REVIEW TEAM MEETING
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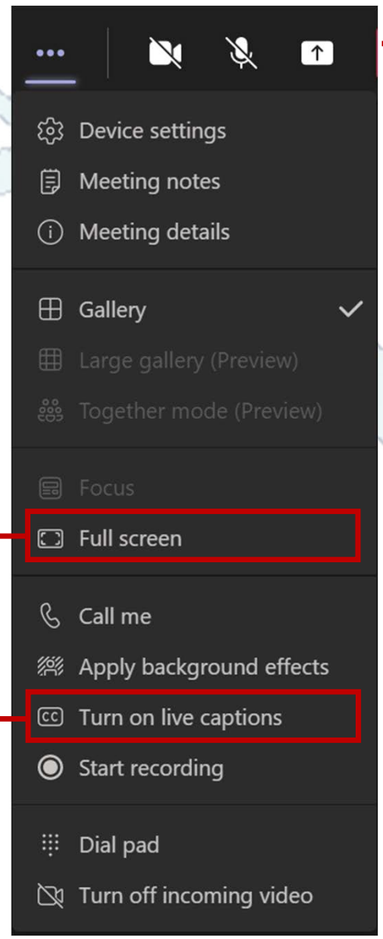

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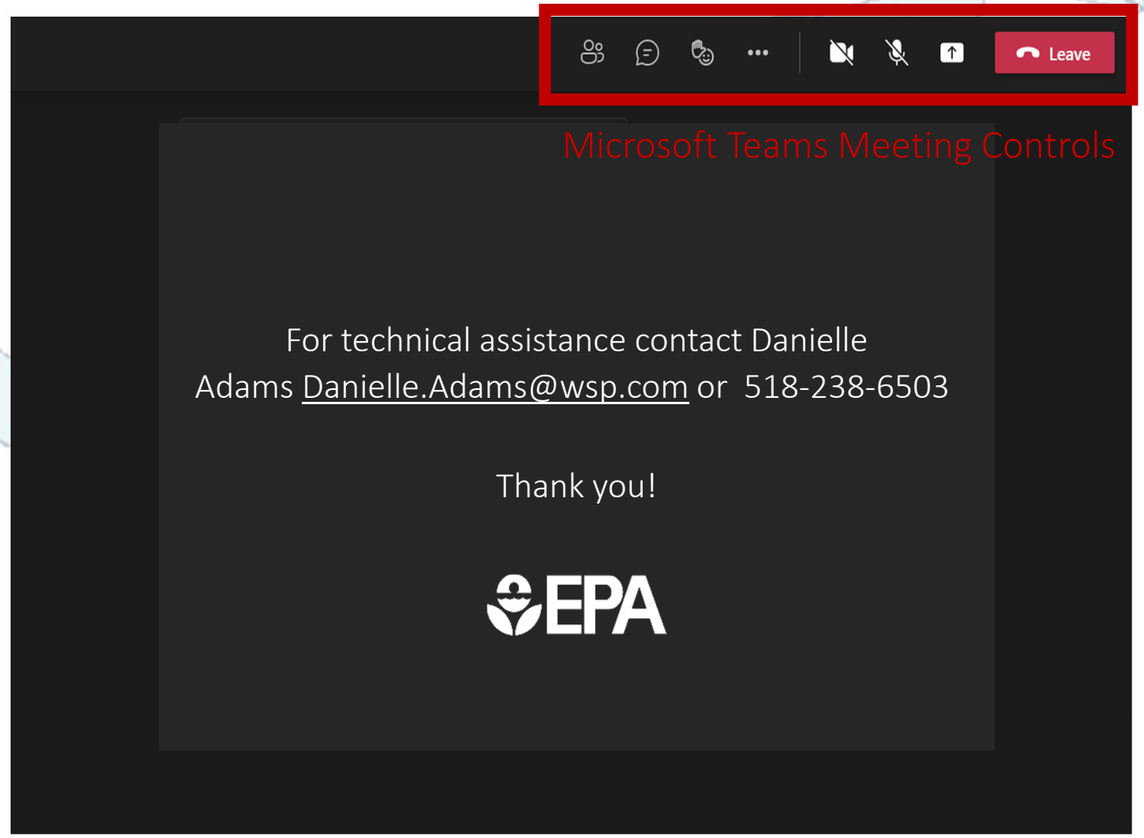

Third Five-Year Review Team Meeting #2

January 18, 2023

Virtual Meeting

Topics for Today's Meeting:

- Remnant Deposits (OU1)
- Upper Hudson River (OU2):
  - Water Column Data
  - Caps

Note: Follow-up slides regarding volume/mass removed during dredging available for discussion, if time allows.

Reminder: Meeting Approach/Logistics

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  - Check in with EPA if you want others to join

- EPA will not be able to distribute materials/analysis in advance or after meetings
  - Presentations will likely be included in the report
  - Formal opportunity to review and comment on the report
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- Meeting format will be open-dialogue
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  - Be respectful of others
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Remnant Deposits (OU1)

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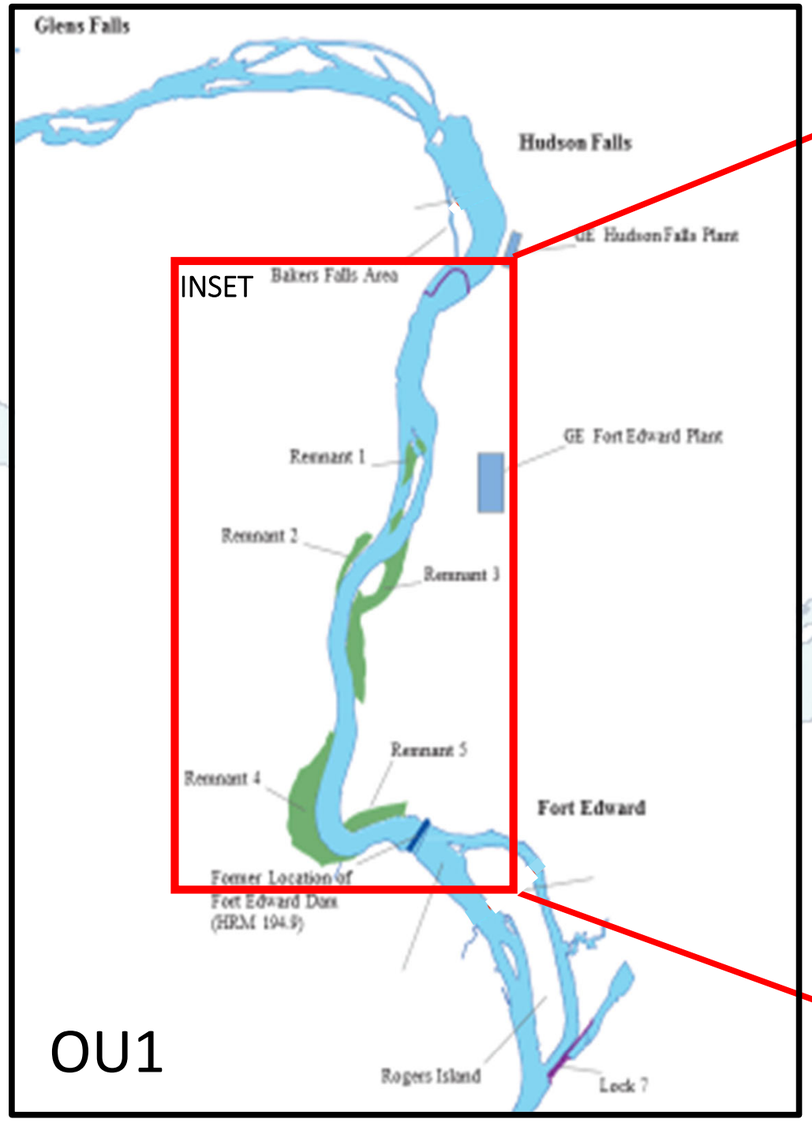
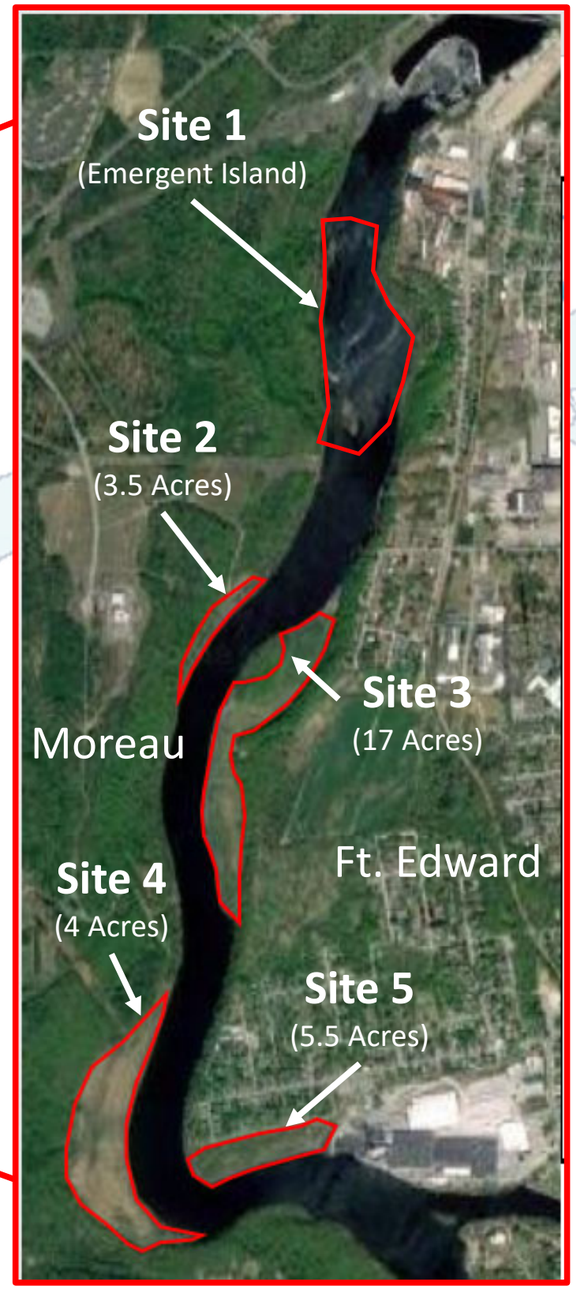
PCBs SUPERFUND SITE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

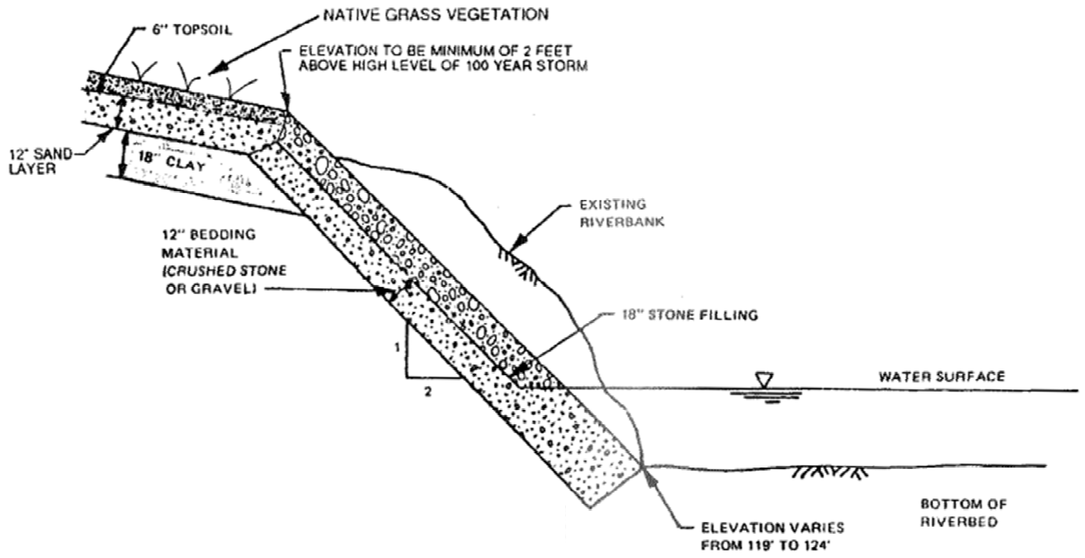


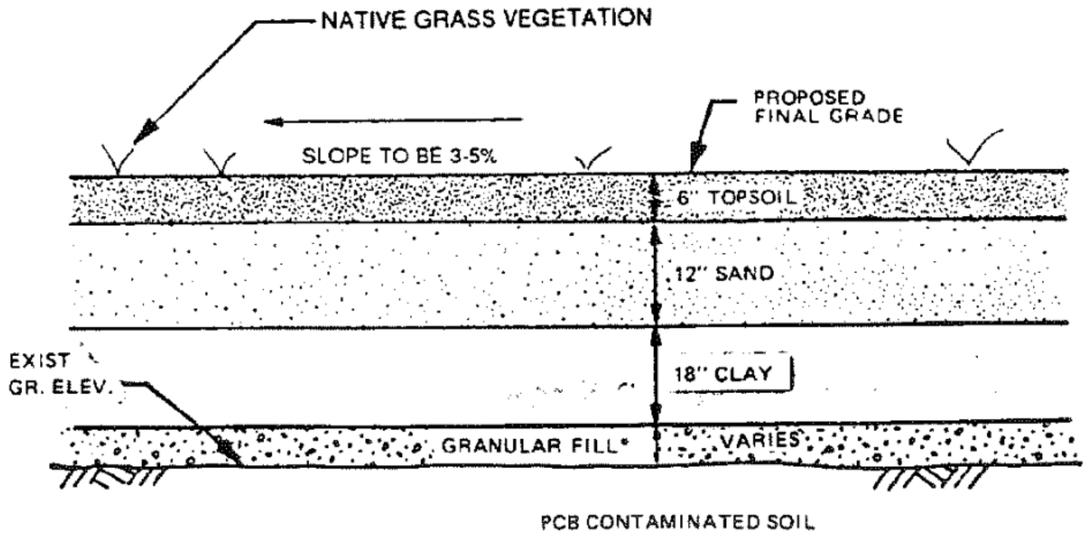


Background

- Remnant Deposits are areas of PCB-contaminated sediment that became exposed after the river water level dropped following the removal of the Fort Edward Dam in 1973
- EPA selected a cleanup plan (Record of Decision) to address the Remnant Deposits in 1984
- Cleanup of Remnant Deposits 2-4 included an in-place containment and cap system, shoreline protection (rip-rap), perimeter fencing, and signage.
  - Construction/installation was completed in 1991.
  - Remnant Deposit 1 was historically located in the middle of the river but because it had significantly eroded away, it was not designated for cleanup.

In-Placement Containment and Cap System





Source: Metcalf and Eddy (1989)

Current Status

- Inspections are conducted semi-annually in accordance with the EPA-approved Post-Closure Maintenance Plan
  - Repairs are made (as necessary) based on inspections
- Monitoring of the Remnant Deposits includes water sampling at:
  - Bakers Falls (upstream)
  - Rogers Island (downstream)
  - Additional monitoring is also performed to support the OU2 Remedy (next meeting topic)
- The next inspection is expected to occur in **May 2023**

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB Concentrations at Bakers Falls and Rogers Island

Hudson River PCBs SUPERFUND SITE

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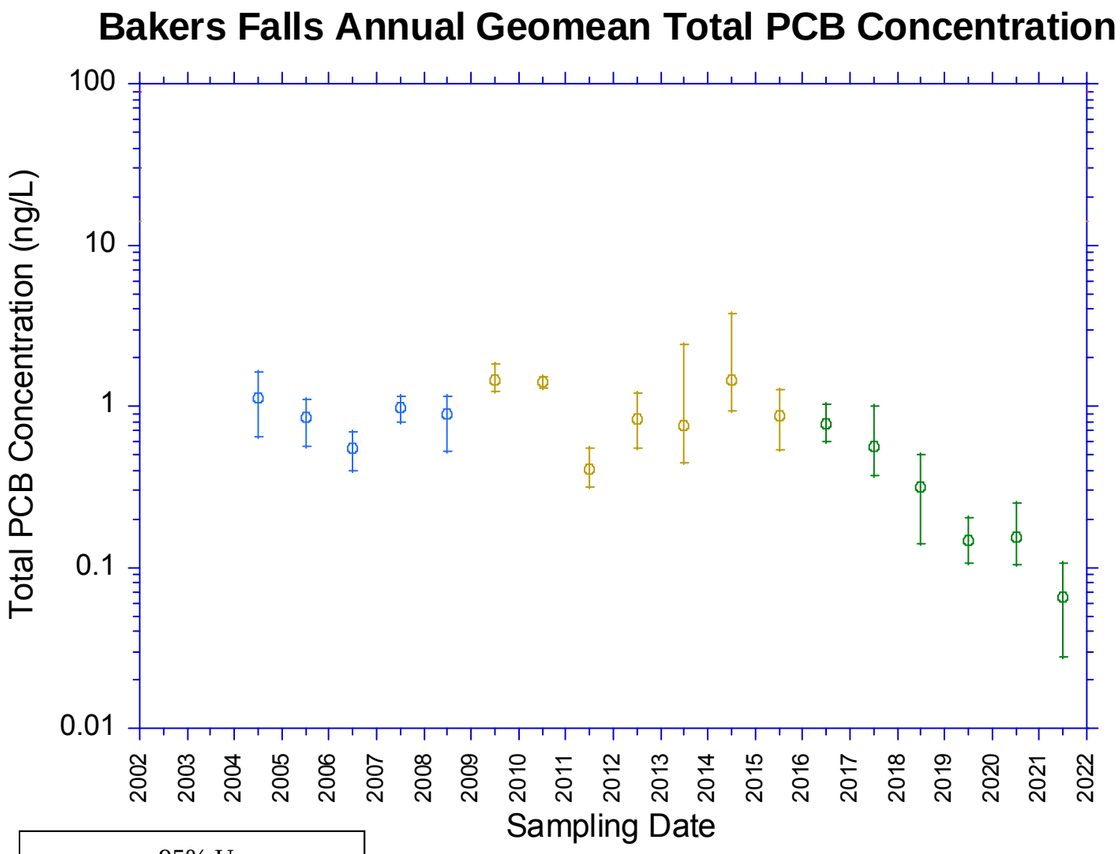
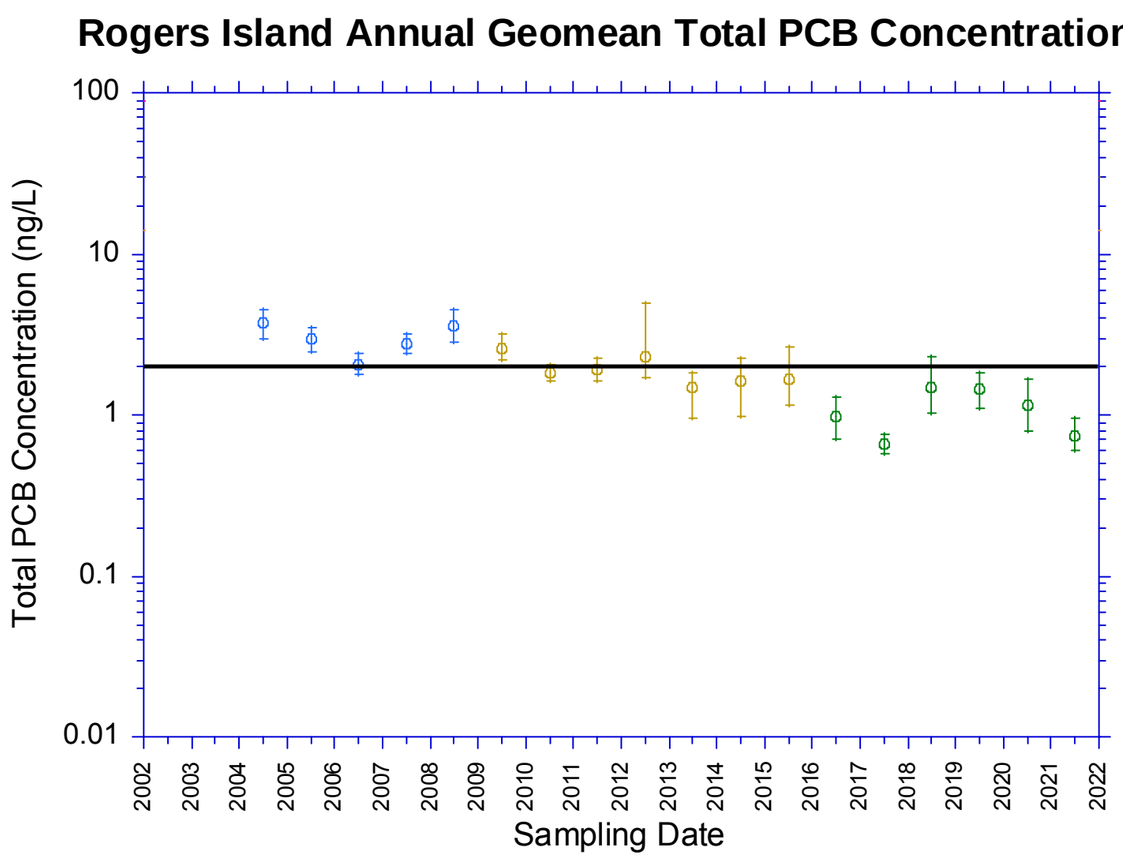




Recent samples collected at Rogers Island (downstream of Remnant Sites) are typically <2 ng/L (ppt)

Future Considerations

- Institutional control needs to be implemented to ensure that potential future use of the Remnant Deposits does not compromise the integrity of the cap system or result in unsafe exposures
- EPA understands that there has been interest in passive recreational use of the Remnant Deposits (i.e., Remnant Deposits 2 and 4) and has been cooperating with local municipalities to explore potential future-use options
- EPA is working with New York State to determine the ownership of the properties in order to implement the appropriate institutional controls

Upper Hudson River (OU2)

Water Column

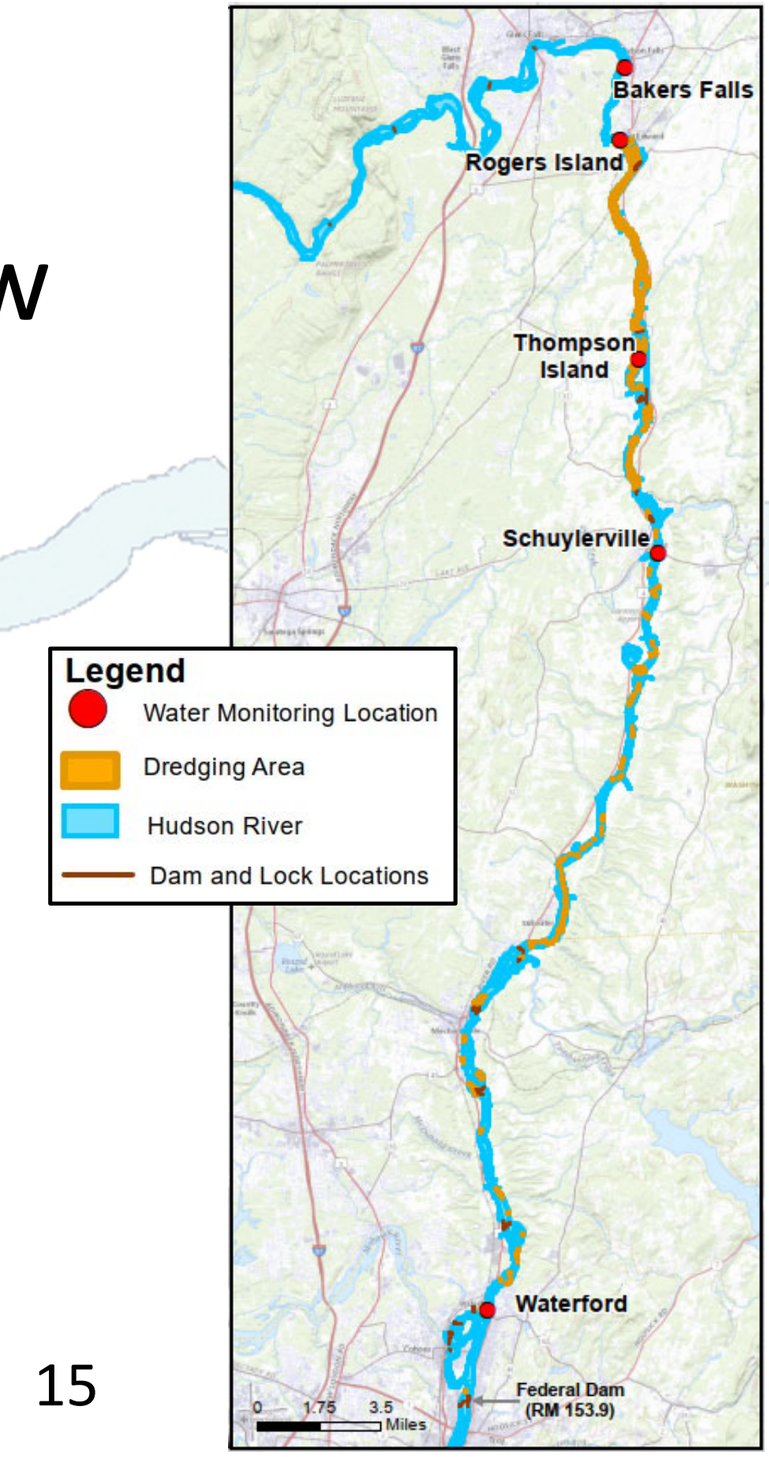
Background

- Design of the current water column sampling program is focused on tracking the recovery of the river during the post-dredge period
  - Water concentrations are linked to fish and sediment concentrations
- Remedial Action Objectives (RAOs) relevant to the water column sampling program are:
  - RAO #3: Reduce PCB levels in the sediment in order to reduce PCB concentrations in river (surface) water that are above surface water Applicable or Relevant and Appropriate Requirement (ARARs)
  - RAO #5: Minimize the long-term downstream transport of PCBs in the river

Hudson River
PCBs SUPERFUND SITE

Water Column Monitoring Overview

- Five monitoring locations are sampled regularly:
  - Two locations upstream of dredging (Bakers Falls and Rogers Island)
  - Three locations amongst dredging areas
    - RS1: Thompson Island Dam (TID)
    - RS2: Schuylerville
    - RS3: Waterford
- Data is collected to assess different flow conditions:
  - Routine Sampling (All Stations)
    - Bakers Falls and Rogers Island: Monthly
    - TID, Schuylerville, and Waterford: Weekly (weather permitting)
  - High-flow Sampling (Only Schuylerville and Waterford)
    - Samples collected to capture rising and falling limb of storm event
  - Samples analyzed for PCBs by congener-specific method (EPA M1668C)



Summary of FYR Data Evaluations

- Data used in current FYR evaluation:
  - Pre-dredging (BMP) – 2004 to 2008
  - Dredging (RAMP) – 2009 to 2015
  - Post-dredging (OM&M) – 2016 to 2021
    - Focus of Current FYR

- Analyses being performed in FYR include:
  - Changes in PCB concentrations through time and progress towards compliance with ROD Criteria (ARARs)
  - Factors impacting PCB concentrations/loads
  - Evaluation of PCB load to Lower Hudson River

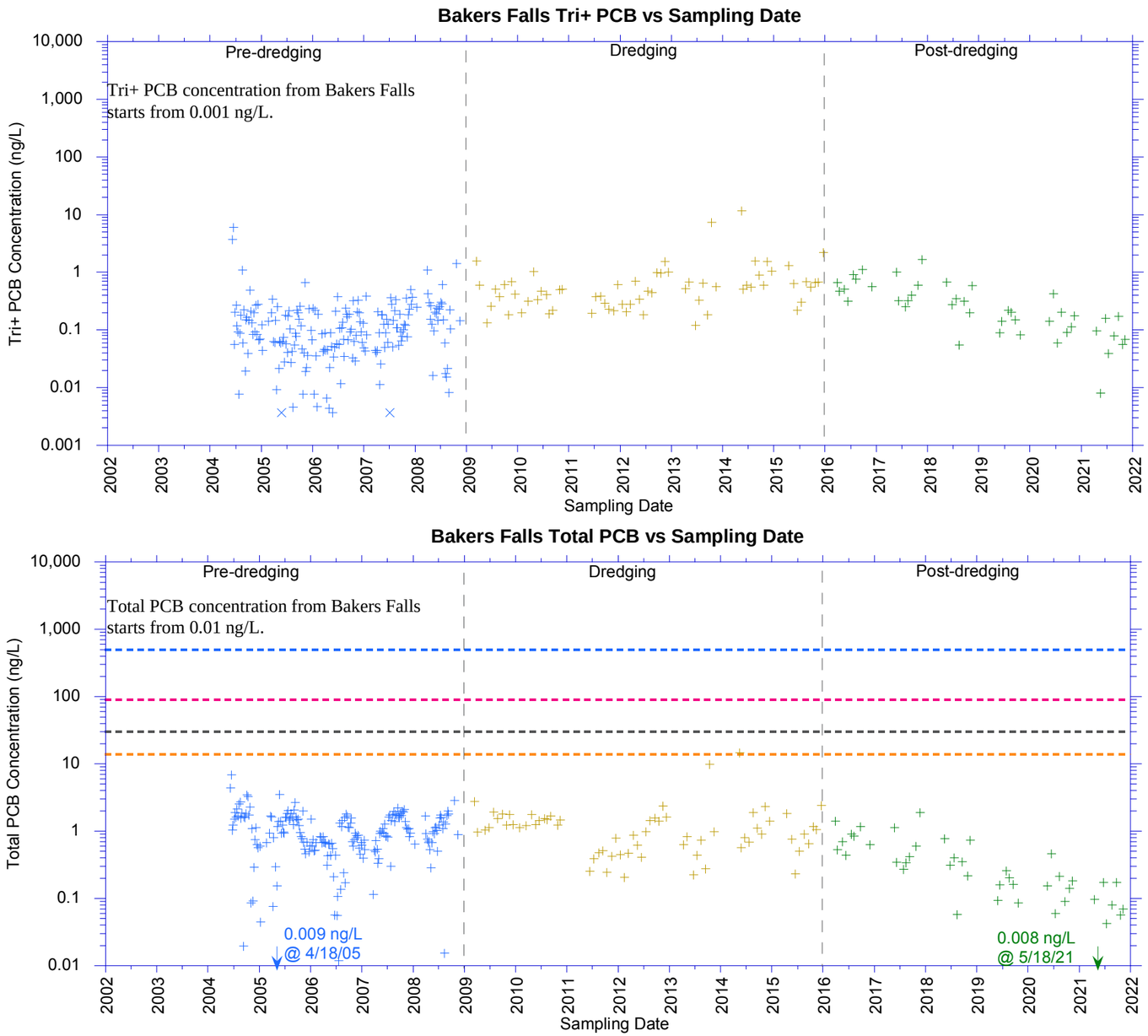
Changes in PCB Concentrations Through Time

- Individual water column datapoints plotted (2004 – 2021)
  - TPCBs: Used to evaluate compliance with ROD Criteria
  - Tri+ PCBs: More reflective of potential impacts to fish
- Progress towards ROD Criteria
  - Percentage of samples below most stringent ROD Criteria (14 ng/L)
  - Considers both “routine only” samples and “all” samples
  - Relevant to monitoring locations within dredging areas (TIP, Schuylerville, and Waterford)

2004 to 2021 Total PCB & Tri+ PCB Concentrations Bakers Falls

Hudson River PCBs SUPERFUND SITE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



Legend:

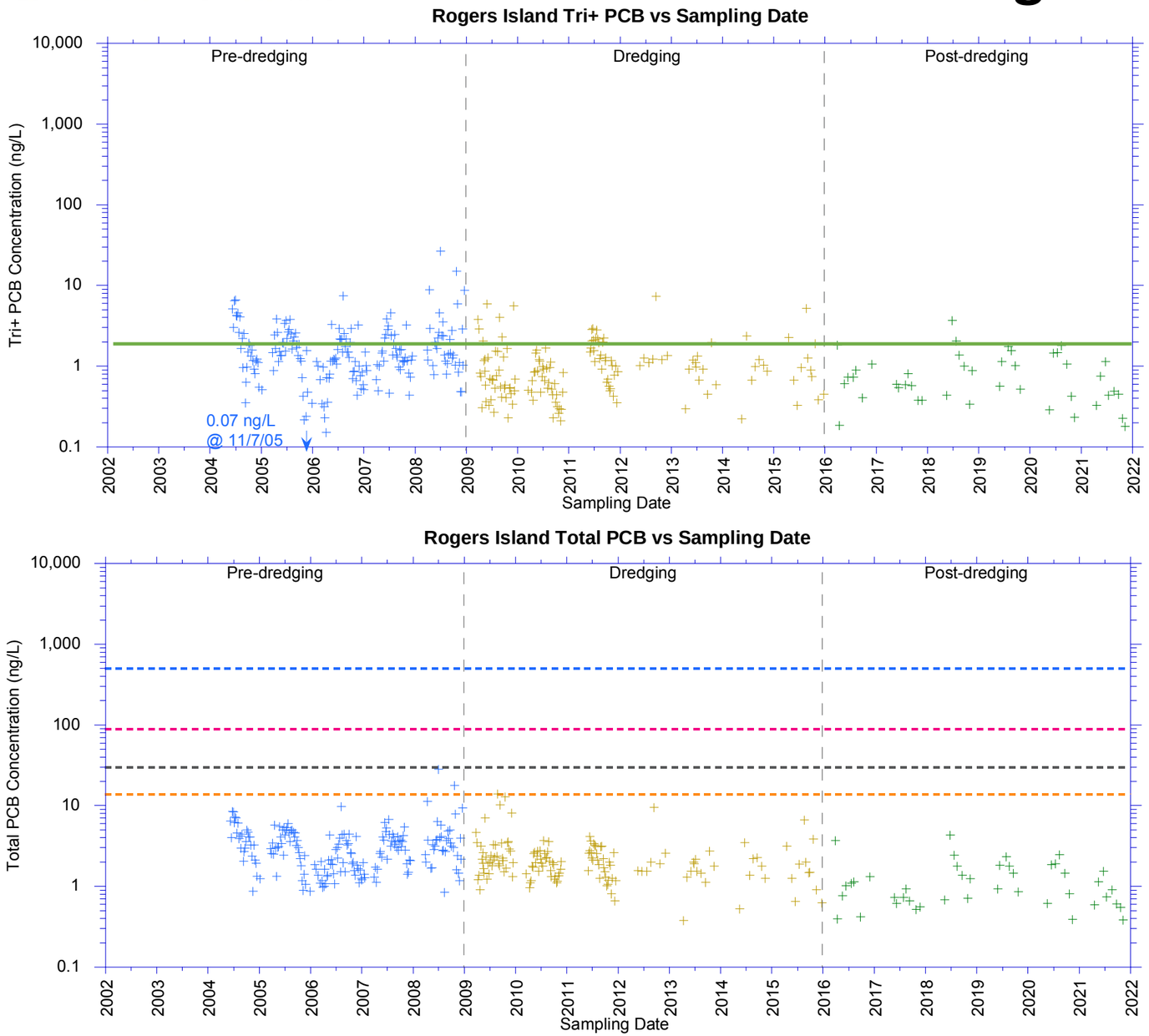
- Routine Samples
- High Flow Samples
- Non-Detect Samples

- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period

- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Located upstream of known GE-related PCB releases
- 2-to-3 orders of magnitude lower than those observed in the downstream areas

2004 to 2021 Total PCB & Tri+ PCB Concentrations
Rogers Island



Legend:

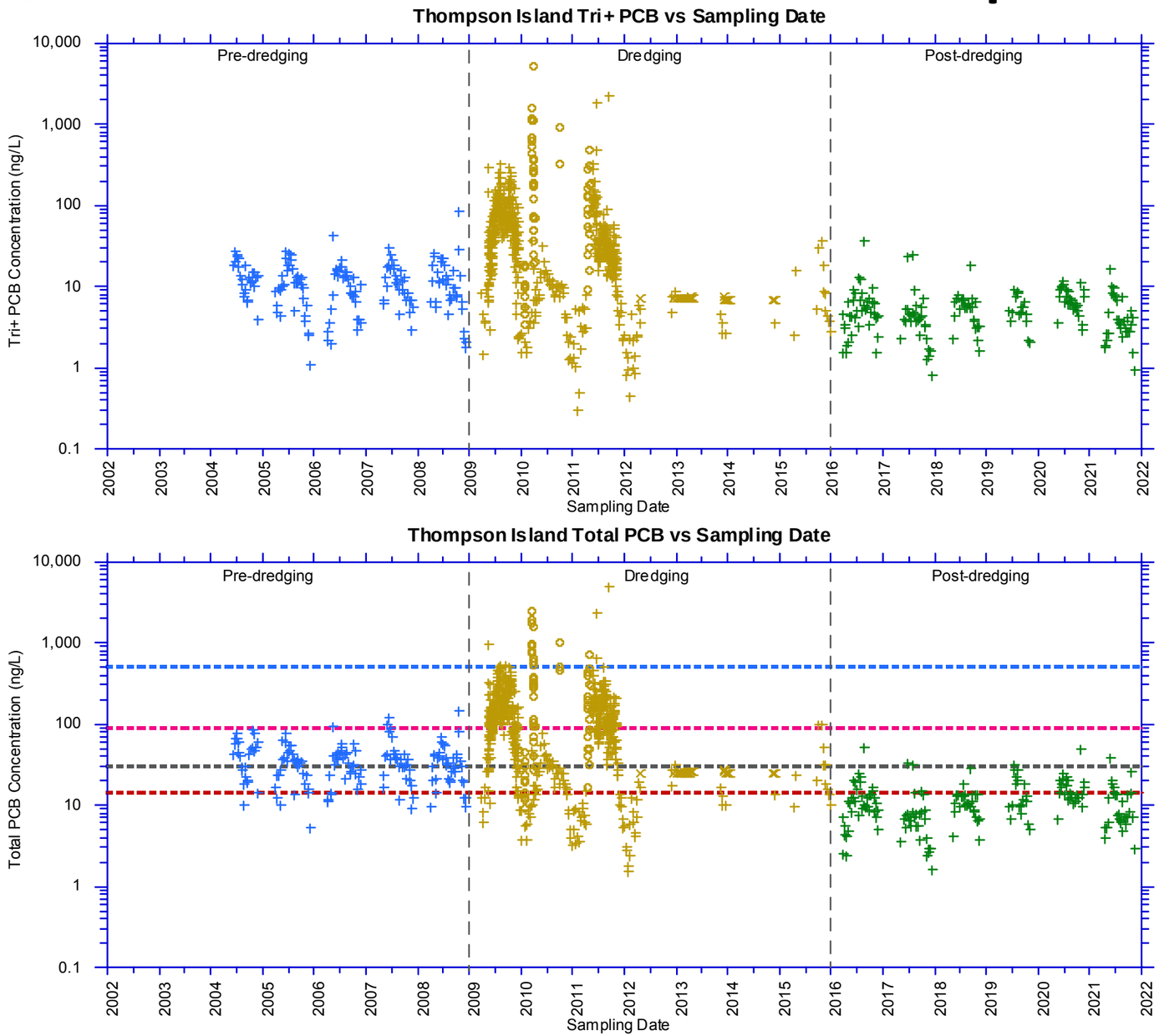
- Routine Samples
- High Flow Samples
- Non-Detect Samples

- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period

- Assumed Ft. Edward Tri+ PCB concentration following source control at GE Hudson Falls plant (2002 ROD) (2 ng/L Tri+ PCB)
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- >95% of the samples collected at Rogers Island during the post-dredging period are <2 ng/L (ROD assumption for OU2 background concentration following upstream source control)

2004 to 2021 Total PCB & Tri+ PCB Concentrations Thompson Island Dam



Legend:

- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

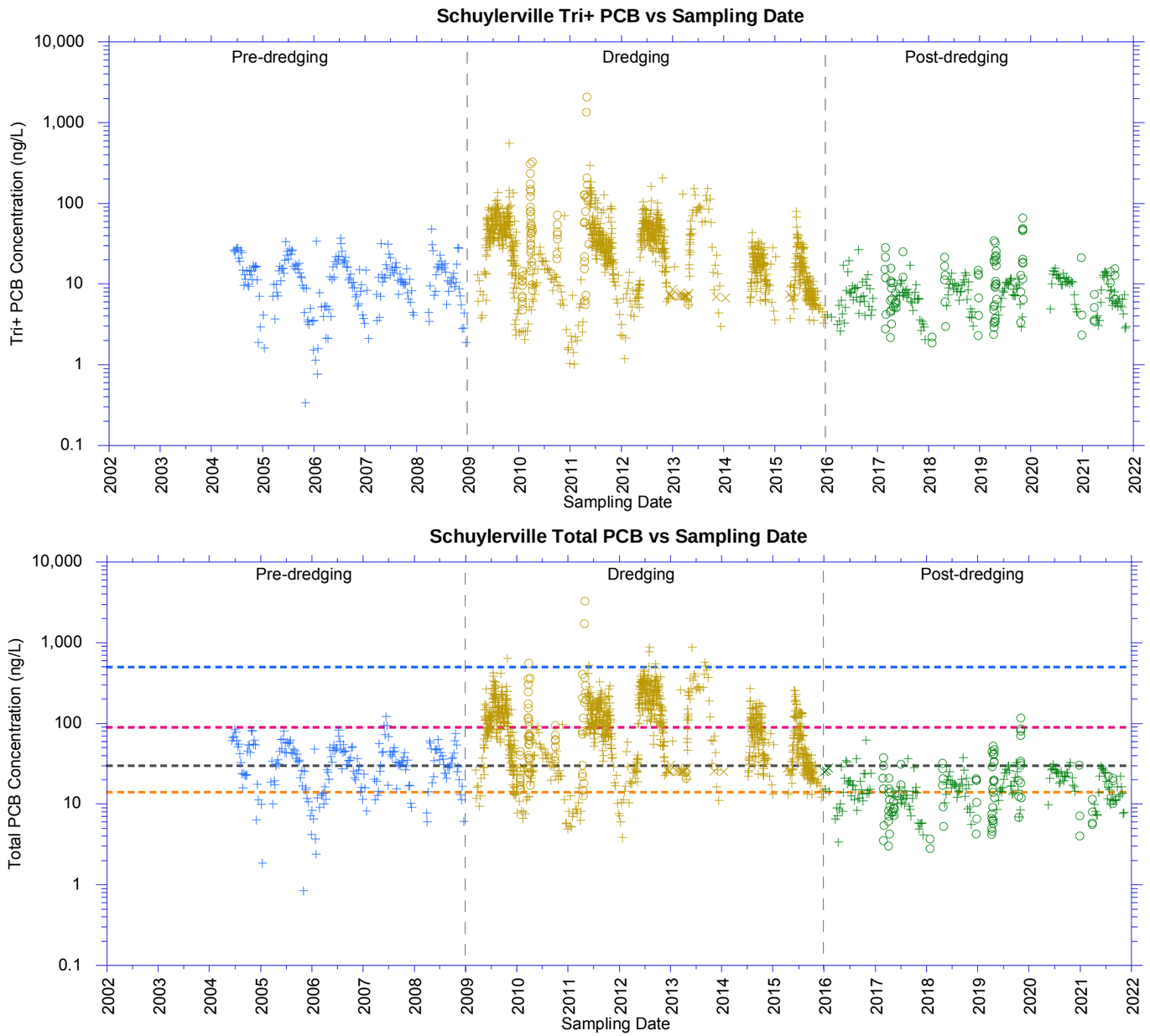
During the post-dredging period:

- Water column PCB concentrations decreased relative to both the pre-dredging and dredging periods

% Sample Below ROD Criteria (14 ng/L)		
	Pre-dredge	Post-dredge
All Samples	10%	76%

2004 to 2021 Total PCB & Tri+ PCB Concentrations Schuylerville

Hudson River PCBs SUPERFUND SITE



Legend:

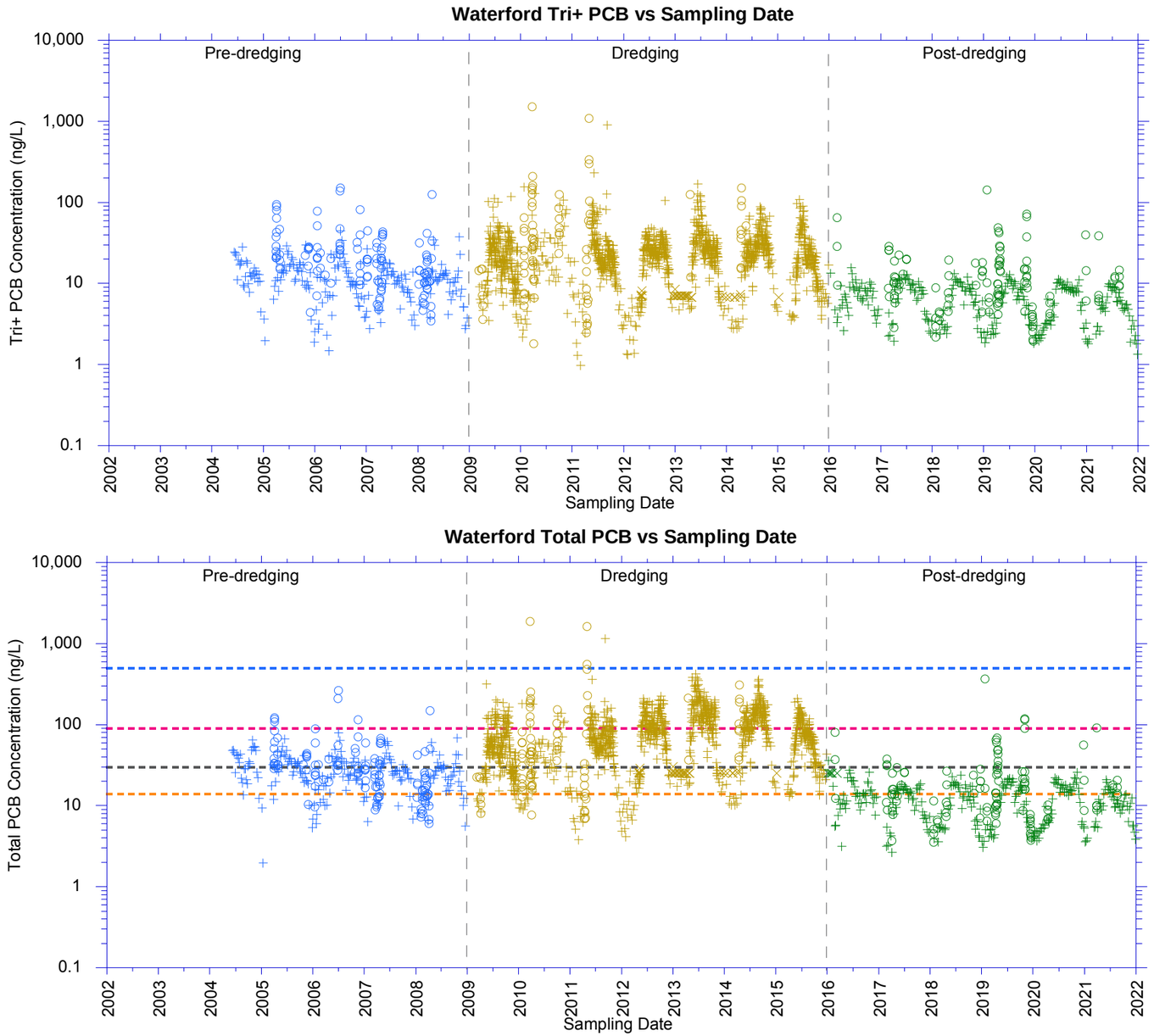
- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

During the post-dredging period:

- Water column PCB concentrations decreased relative to both the pre-dredging and dredging periods

% Sample Below ROD Criteria (14 ng/L)		
	Pre-dredge	Post-dredge
All Samples	16%	44%
Routine	16%	40%

2004 to 2021 Total PCB & Tri+ PCB Concentrations Waterford



Legend:

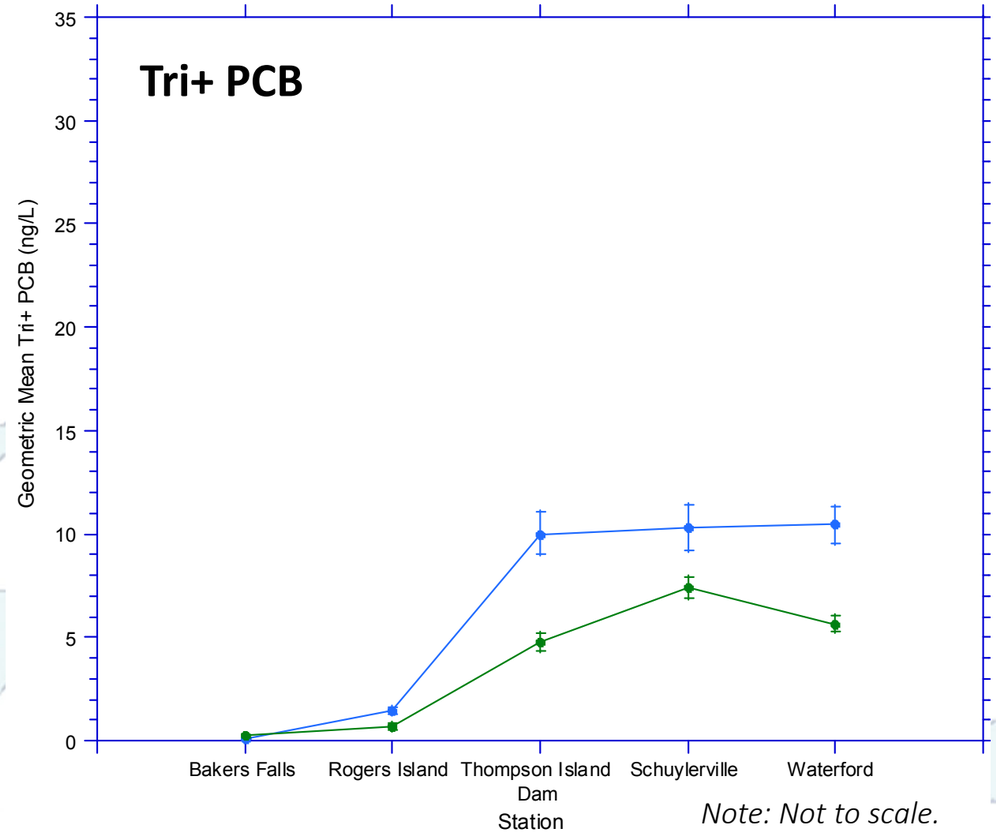
- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

During the post-dredging period:

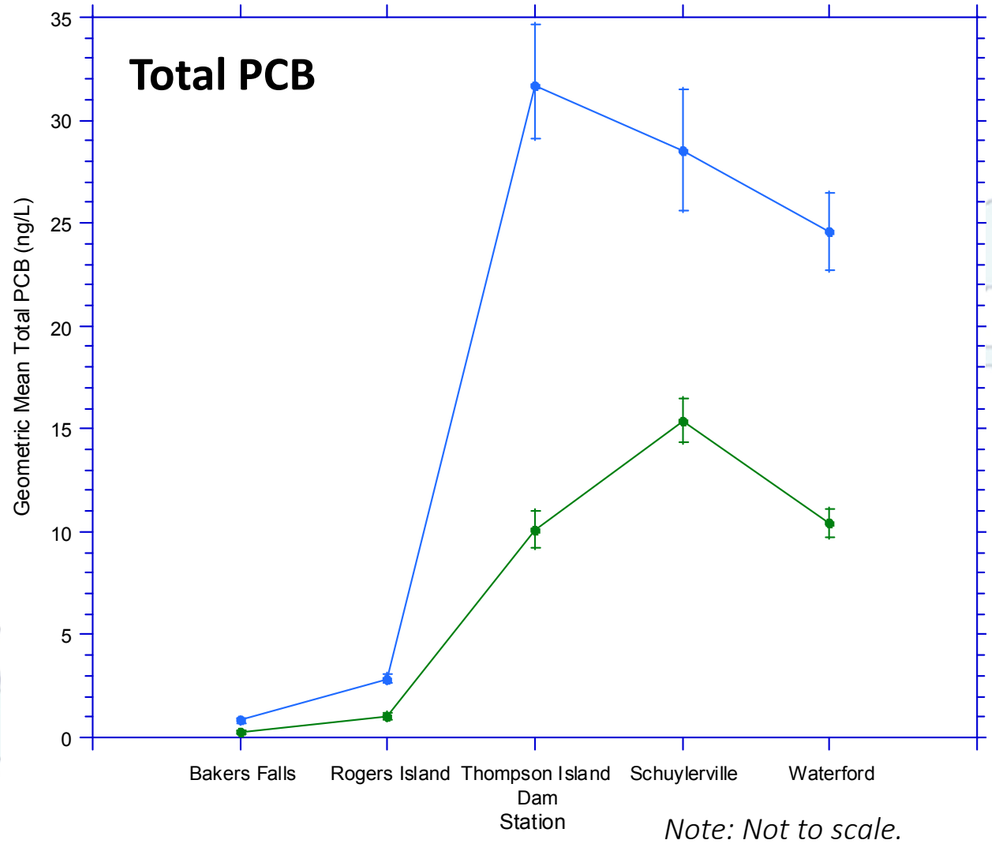
- Water column PCB concentrations decreased relative to both the pre-dredging and dredging periods

% Sample Below ROD Criteria (14 ng/L)		
	Pre-dredge	Post-dredge
All Samples	18%	57%
Routine	16%	61%

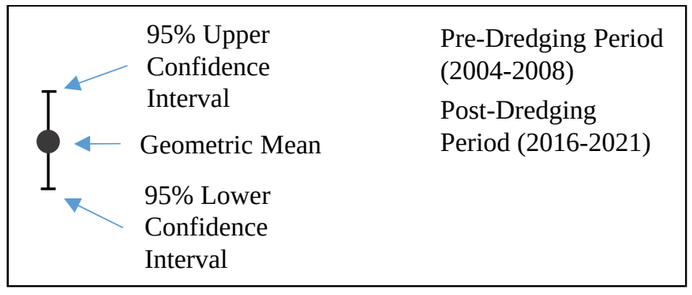
Pre-Dredging (2004-2008) and Post-Dredging (2016-2021) Routine Samples Geometric Mean PCB Concentrations by Station



Note: Not to scale.



Note: Not to scale.

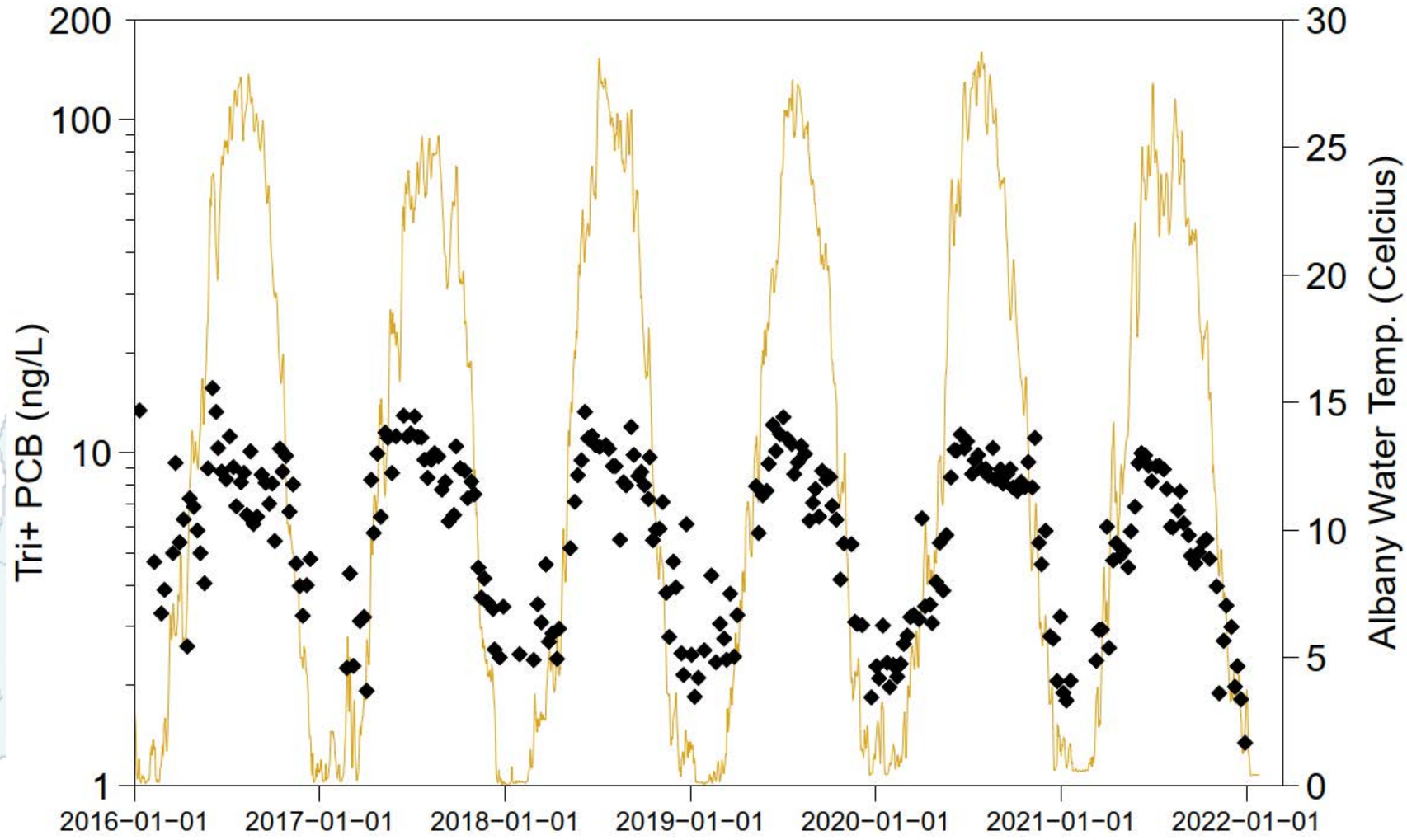


- During the post-dredging period:
  - Concentrations are notably lower than pre-dredging period
  - PCB concentrations **increase** as water moves from RI → TID → Schuylerville
  - PCB concentrations **decrease** as the water continues from Schuylerville → Waterford
  - Special study to be conducted to help explain these trends

Factors Impacting PCB Concentrations

- Seasonality and associated changes in water temperature
  - PCB concentrations tend to be **higher** in the summer months (higher water temperatures) and **lower** in the winter months (lower water temperatures)
- River flows (velocity)
  - PCB concentrations typically **higher** during high flow events than routine sampling due to impacts of storm event-specific phenomena

Impacts of Season on Tri+ PCB Concentration



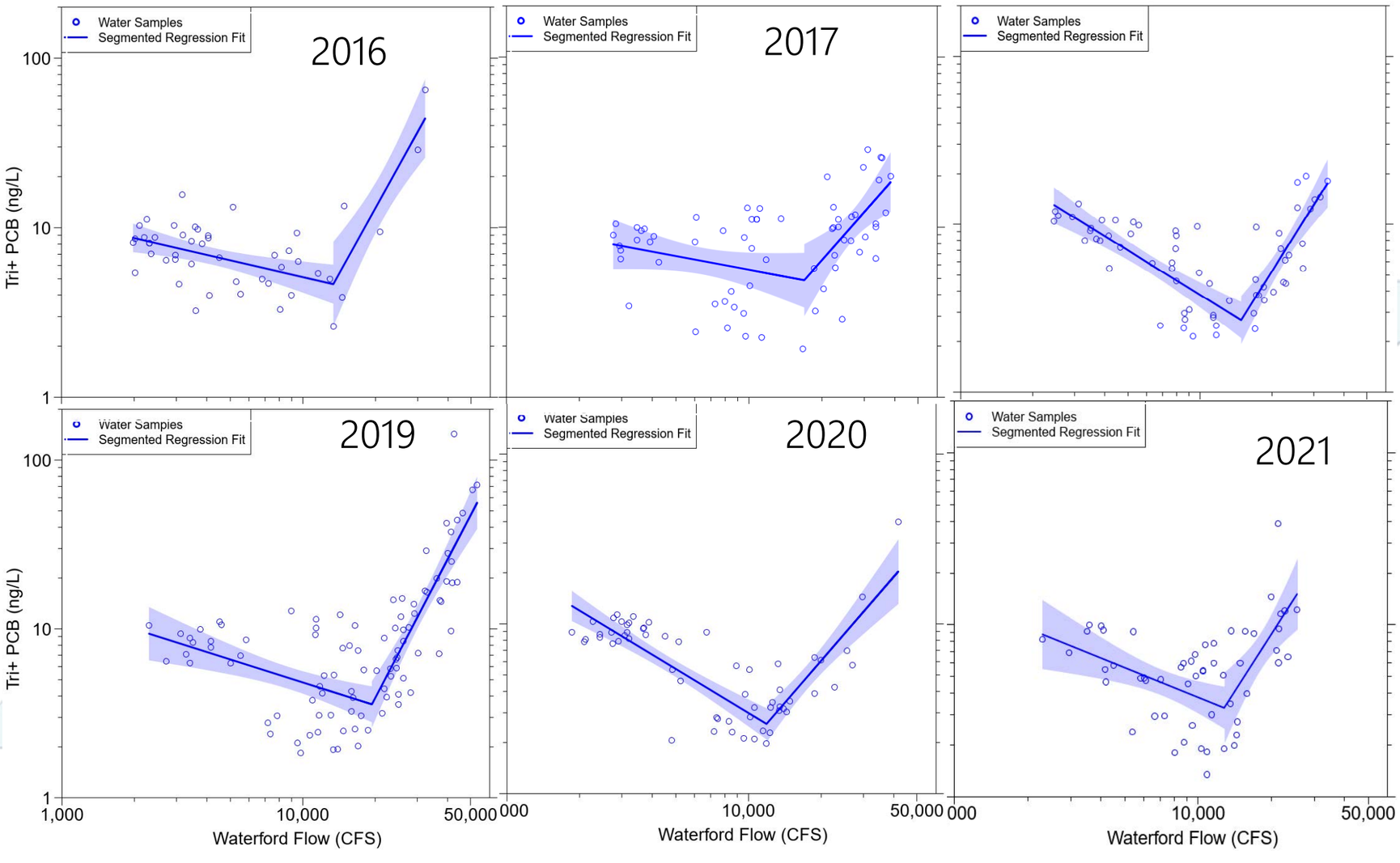
Legend:

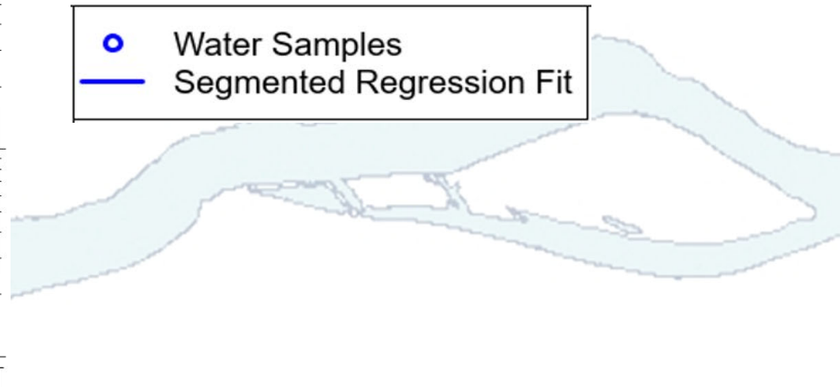
- ◆ Waterford Station water column samples collected under Routine Sampling Program
- Albany USGS Station Water Temperature

PCB concentrations tend to be **higher** in the summer months (higher water temperatures) and **lower** in the winter months (lower water temperatures) under non-high flow conditions

Note: Water temperature data recorded at Albany USGS Station (#01359139).

Impacts of Flow on Tri+ PCB Concentration





Piecewise or "segmented" relationship between Tri+ PCB concentration and flow is indicative of the two distinct concentration-flow regimes:

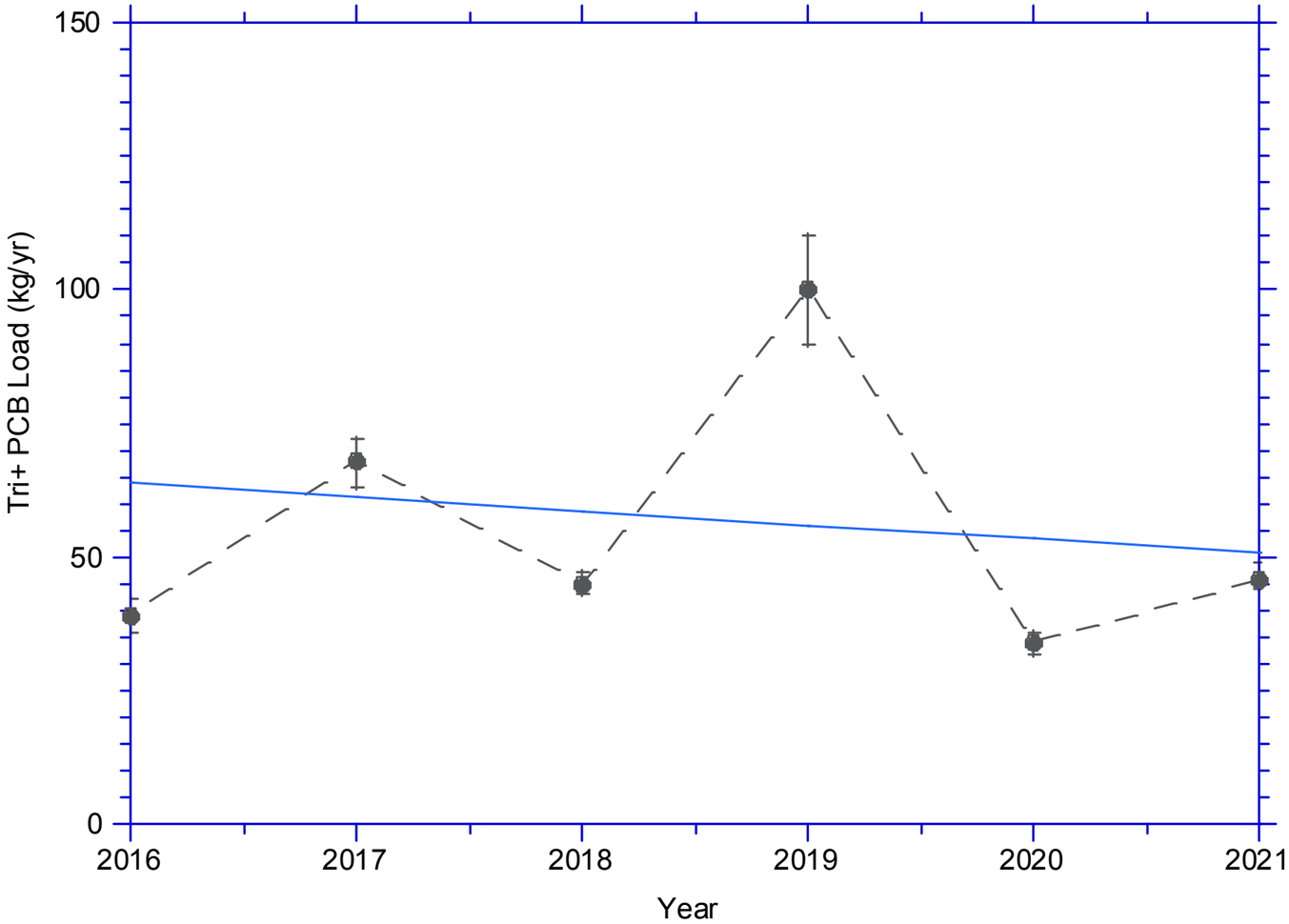
- **Low flow**: Dilution dominates
- **High flow**: Resuspension dominates

Note: Blue line represents best-fit of the segmented regression model between concentration and flow. Blue shaded area represents the 95% confidence band about the fit.

Evaluation of PCBs Load to Lower Hudson River

- Annual PCB load is calculated to incorporate the concentration-flow relationship and seasonality
- Annual PCB load is also normalized to account for variations in the year-to-year PCB load introduced by flow and temperature (referred to as a flow- and temperature normalization or “FTN”)
  - Performed to help identify changes overtime in the Tri+ PCB load by accounting for covariates that are known to impact annual PCB load
  - Enables a better evaluation of whether there is a decline in the calculated PCB load over time

2016 to 2021 Annual Tri+ PCB Loads at the Waterford Monitoring Station



Legend:

Annual PCB Load (with 95% Confidence Intervals)

Time Trend in Flow- and Temperature-Normalized Annual PCB Load

- Annual Tri+ PCB loads ranged from 36 kg in 2020 to 101 kg in 2019.
- Annual Tri+ PCB loads are higher in years with higher flows
- FTN Tri+ PCB loads decreased by ~22% between 2016 and 2021

Note: Annual PCB loads are estimated using the USGS LOADEST load estimation program. Flow and temperature normalized (FTN) PCB loads adjust annual loads to remove the influence of year-to-year variability in flow and seasonality such that the FTN PCB loads reflect changes in PCB concentration only.

Factors Impacting PCB Loads

- As with PCB concentrations, year-to-year variations in PCB load due to seasonality (water temperature) and river flows (velocity) are evident

Year	Number of High Flow Days	Annual Load (kg)	Annual Load for Low Flow Days (kg)	Annual Load for High Flow Days (kg)	Percentage of High Flow Days (%)	Percentage of Load on High Flow Days (%)
2016	2	40	34	6	0.5	14
2017	22	67	46	21	6	31
2018	11	46	38	8	3	18
2019	37	112	47	65	10	58
2020	3	35	30	5	0.8	13
2021	1	47	46	1	0.3	2
Combined	76	347	242	105	3	30

Observations Regarding Water Column Data

- <u>Relative to the pre-dredging period</u>:
  - Post-dredging water column PCB concentrations have **decreased**
  - The percentage of samples meeting the most stringent ROD Criteria (14 ng/L) has **increased**
  - The annual PCB loads at Waterford have **decreased**
  - Flow- and temperature-normalized (FTN) Tri+ PCB loads decreased by approximately 22% between 2016 and 2021

- There are environmental factors that impact water column PCB concentrations and PCB loads, which impact the ability to see trends through time

Upper Hudson River (OU2)

Caps

Background

- Multi-component subaqueous caps were installed in certain locations to isolate residual sediment PCB contamination

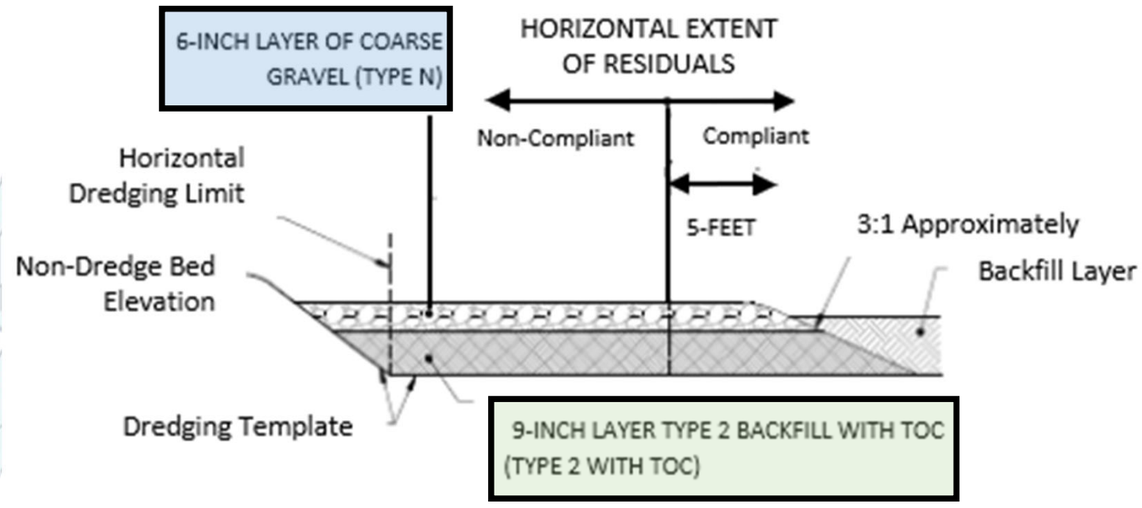
- The cap monitoring program consists of a series of:
  - Hydrographic and topographic surveys (latter limited to shallow-water areas)
  - Visual inspections
  - Physical investigations (when needed)

Cap Monitoring Overview

- Tier 1 Survey: Results of periodic monitoring are used to evaluate "Measurable Loss":
  - Measurable Loss is defined as the loss of >3 inches of cap thickness over a contiguous 4,000 ft^2 area or a contiguous area representing over 20 percent of the capped area, whichever is less

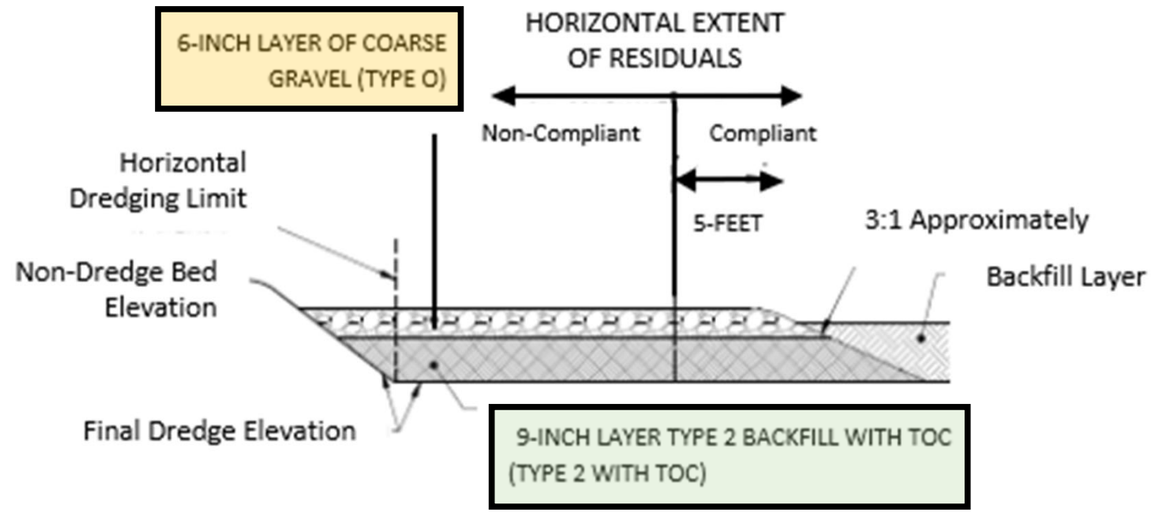
- Tier 2: If Measurable Loss is identified, additional investigations are performed (including the use of direct observation techniques) to confirm loss, which may lead to additional protective measures/mitigation

Example of Phase 2 Cap Layers



MEDIUM VELOCITY ISOLATION CAP TYPE C (1)

NOT DRAWN TO SCALE



HIGH VELOCITY ISOLATION CAP TYPE C (2)

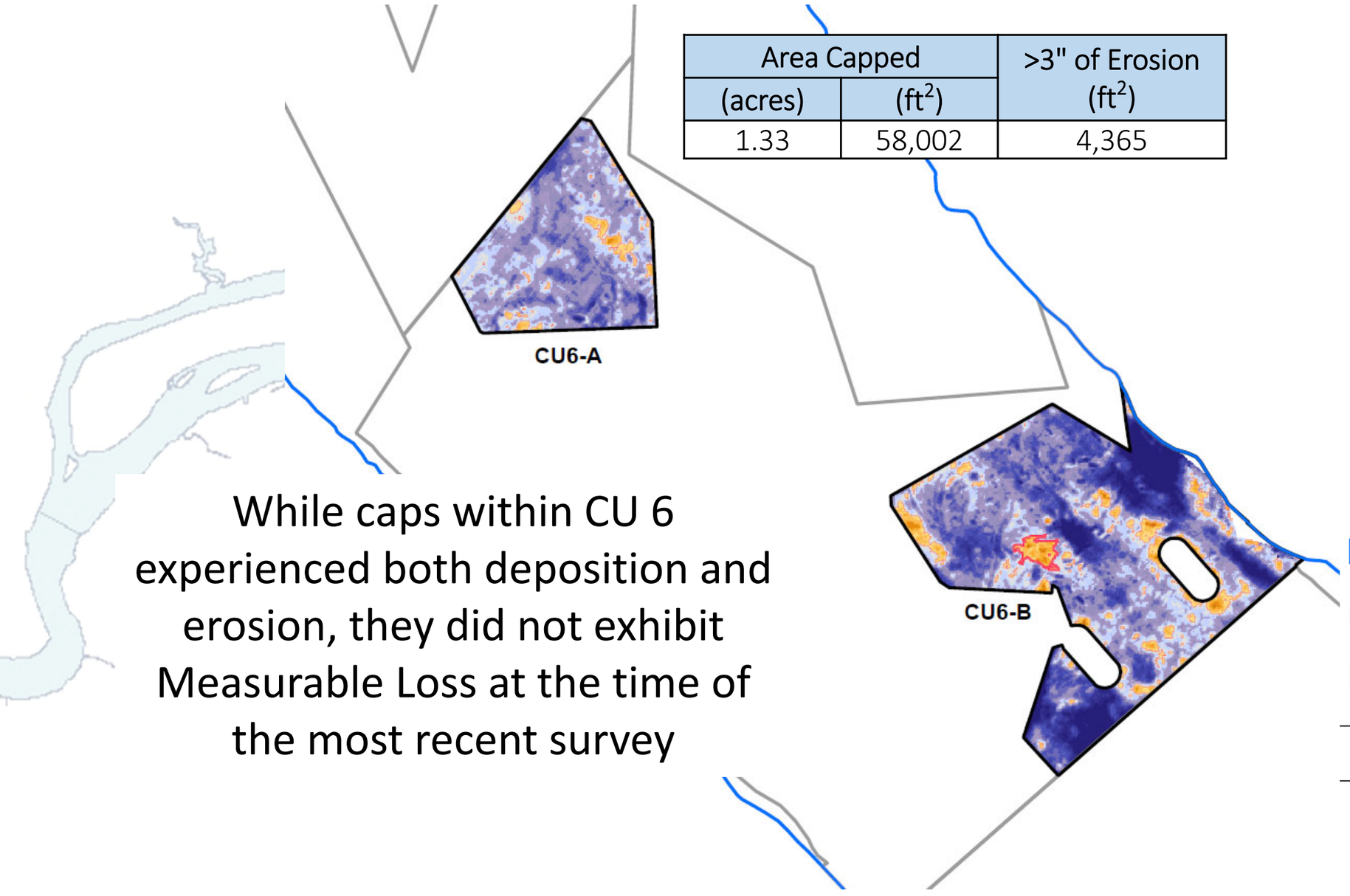
NOT DRAWN TO SCALE

Summary of FYR Data Evaluations

- This FYR will present the findings of cap monitoring events performed in 2016 and 2018 (not included in Second FYR)
- Analyses performed in FYR encompass:
  - Total capped area with >3 inches of erosion for each CU
  - Largest contiguous capped area with >3 inches of erosion for select CUs (those where total capped areas with >3 inches of erosion was >75% of Measurable Loss Criteria)

Bathymetric Comparison of Tier 1 and Reference Surveys at CU 6-A and CU 6-B

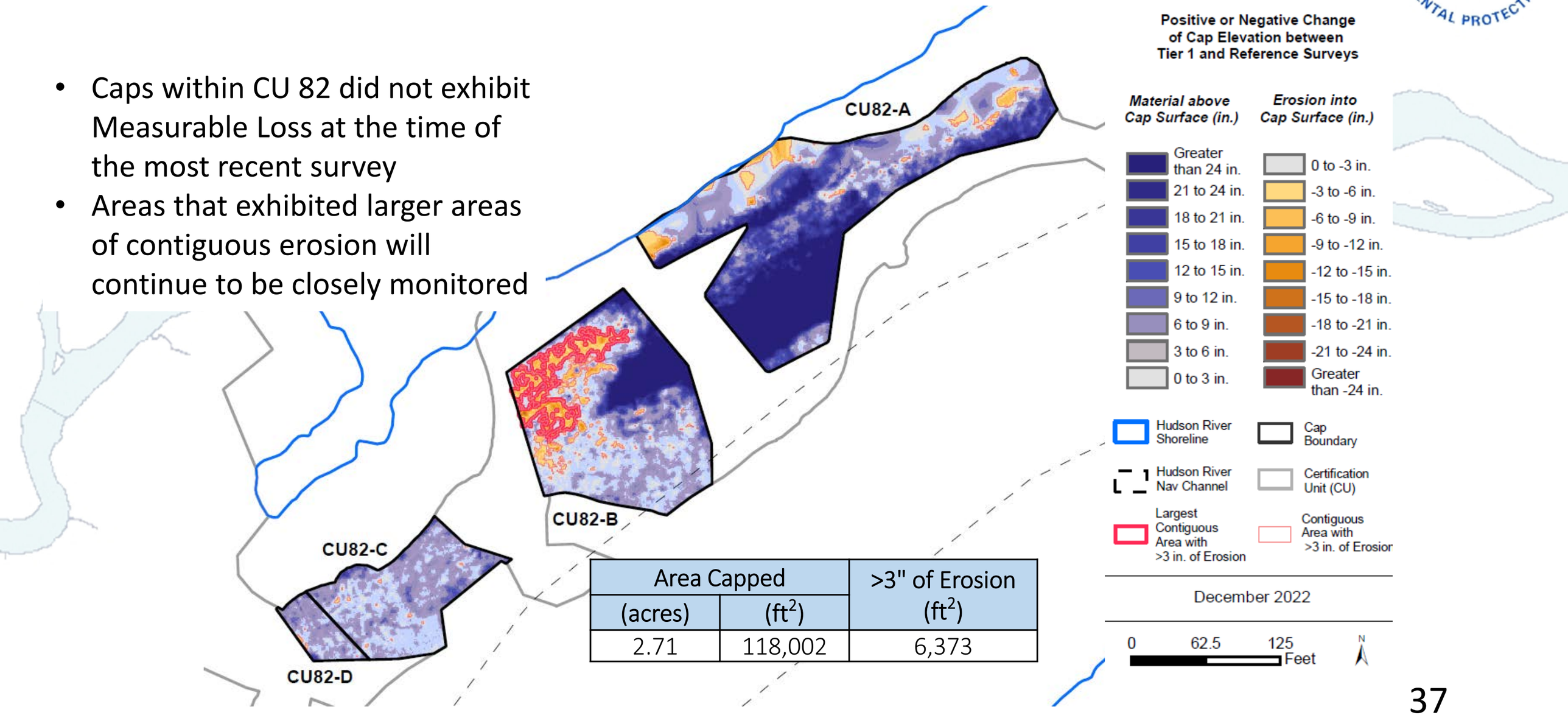
Area Capped		>3" of Erosion
(acres)	(ft^2)	(ft^2)
1.33	58,002	4,365



While caps within CU 6 experienced both deposition and erosion, they did not exhibit Measurable Loss at the time of the most recent survey

Bathymetric Comparison of Tier 1 and Reference Surveys at CU 82-A to 82-D

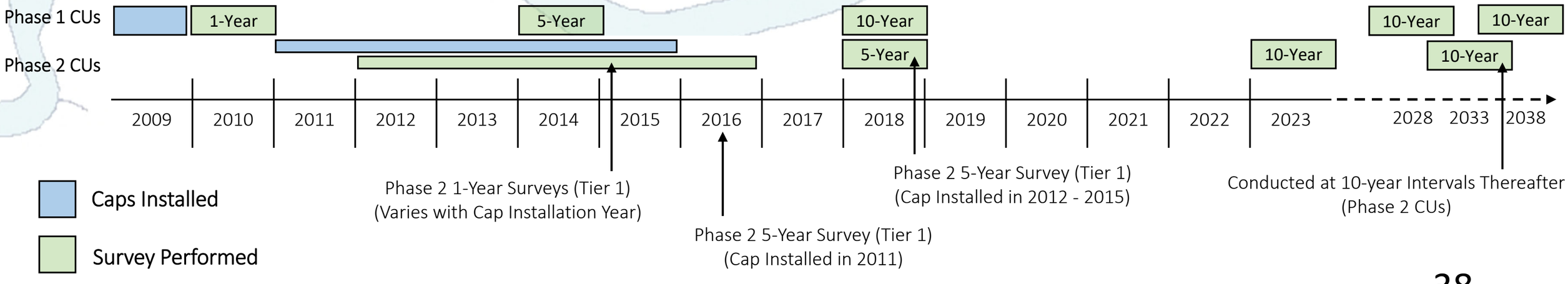
- Caps within CU 82 did not exhibit Measurable Loss at the time of the most recent survey
- Areas that exhibited larger areas of contiguous erosion will continue to be closely monitored



Area Capped		>3" of Erosion
(acres)	(ft^2)	(ft^2)
2.71	118,002	6,373

Observations Regarding Cap Surveys

- No Measurable Loss observed in the most recent surveys (2016 to 2018)
  - No mitigation measures required at this time
  - Deposition of material on top of some caps observed (expected to continue due to changes in hydrodynamic conditions from dredging)
- EPA will continue to closely monitor caps to evaluate possible erosion and identify cap areas approaching Measurable Loss thresholds



Next Steps

- Meeting #3 scheduled for **February 1, 2023, 1:00-2:30pm**
  - Topic: fish data
  - Technical presentations of data and information
  - Evaluation of recovery
  - Identify challenges and present on-going analyses
- Sediment data to be covered in Meeting #4 (2/15)
- Suggestions or other thoughts?
- Review of follow-up action items

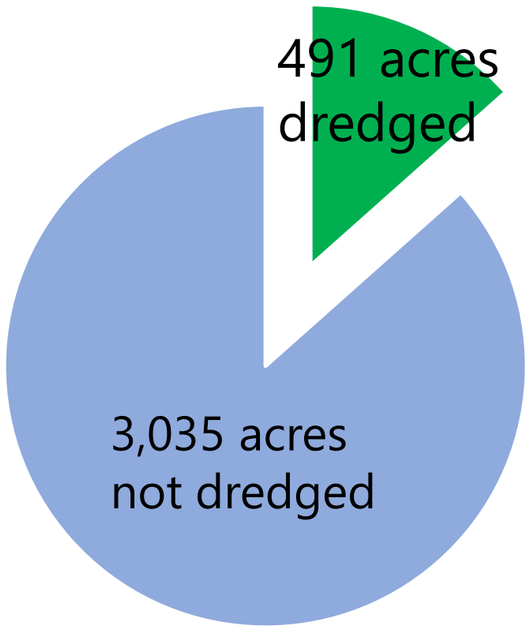
Follow-up Item: Mass Removed

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

Relative to requirements of the 2002 ROD, the remedy:

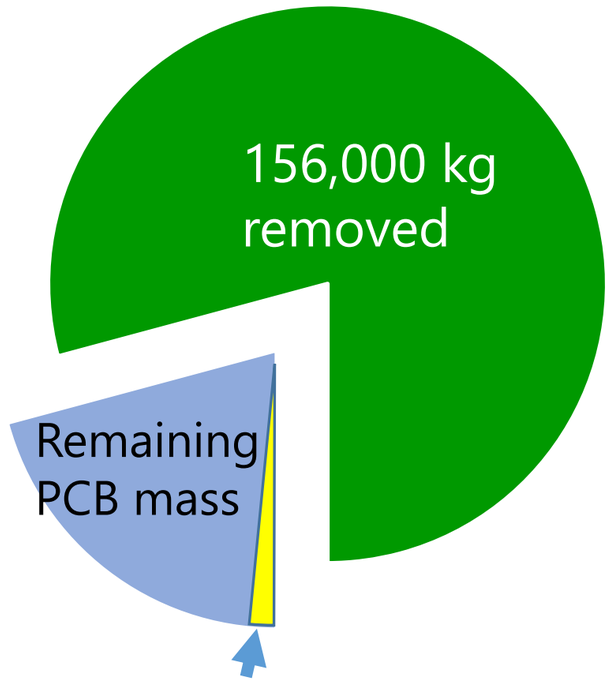
- Achieved a greater overall percent reduction in PCB mass
- Removed more than twice as much PCB mass on an absolute basis
- Left behind essentially the same mass as originally anticipated (within 10% of original estimate)

Spatial Extent of Remediation



3,656 acres of river bottom

PCB Mass Removed



204,000 kg of Total PCB mass

Follow-up Item: Reduction in Surface Sediment

Surface Sediment Tri+ PCB Decline in River Section 1

Hudson River PCBs SUPERFUND SITE

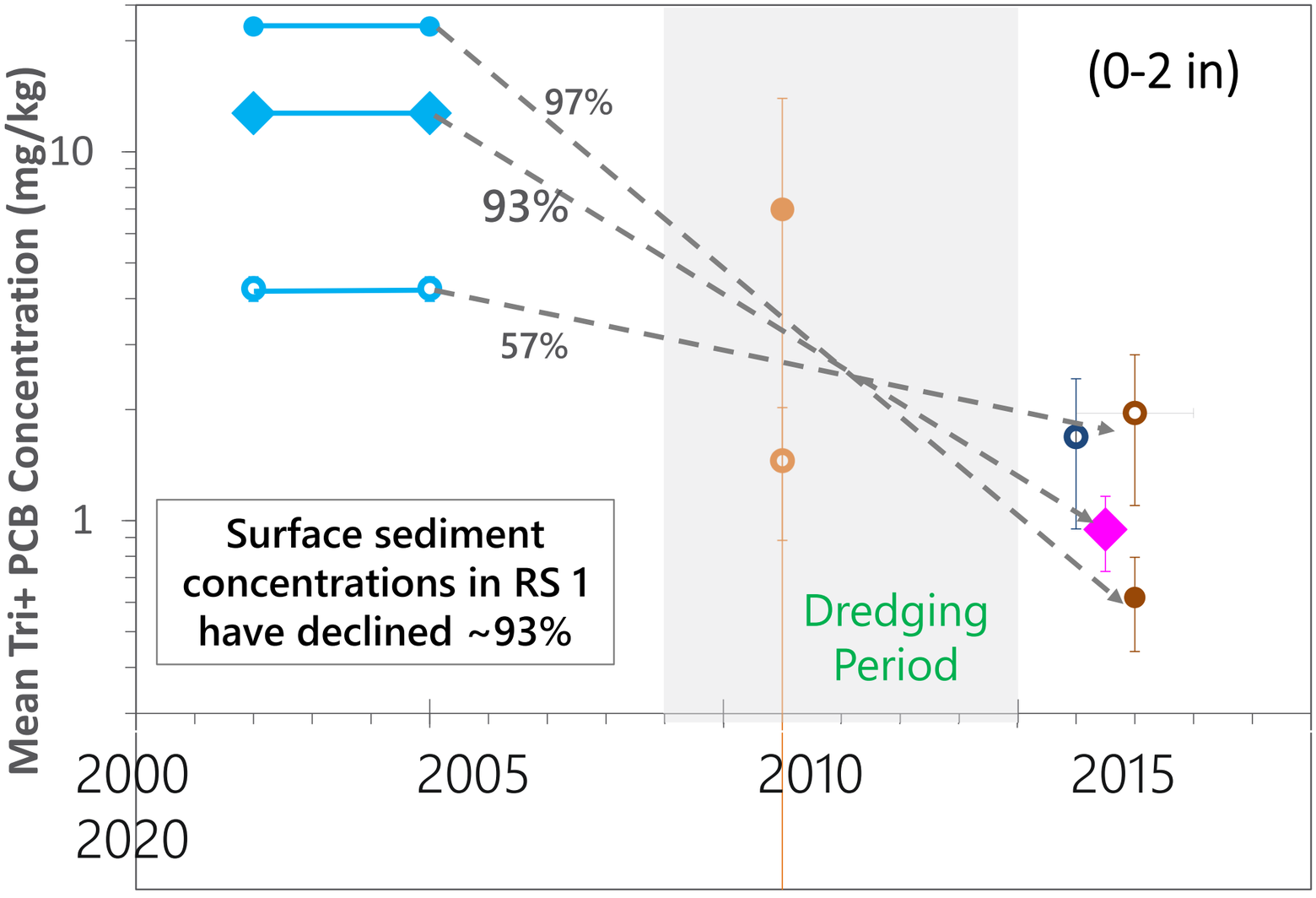
Legend

Arithmetic Means

- Dredged Area Average
- Non-Dredged Area Average
- Area-Weighted Mean

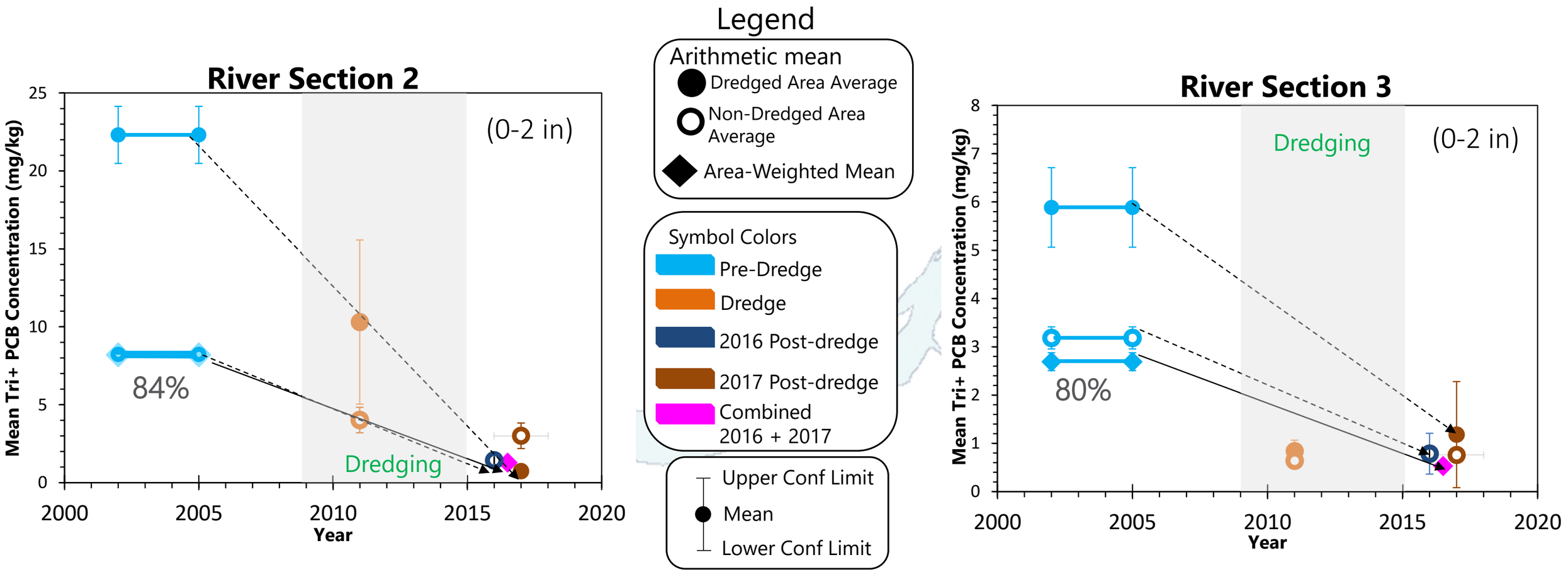
- Pre-Dredge
- Dredge
- 2016 Post-dredge
- 2017 Post-dredge
- Combined 2016 + 2017

- Upper Conf Limit
- Mean
- Lower Conf Limit



Follow-up Item: Reduction in Surface Sediment

Surface Sediment Tri+ PCB Decline in River Sections 2 and 3



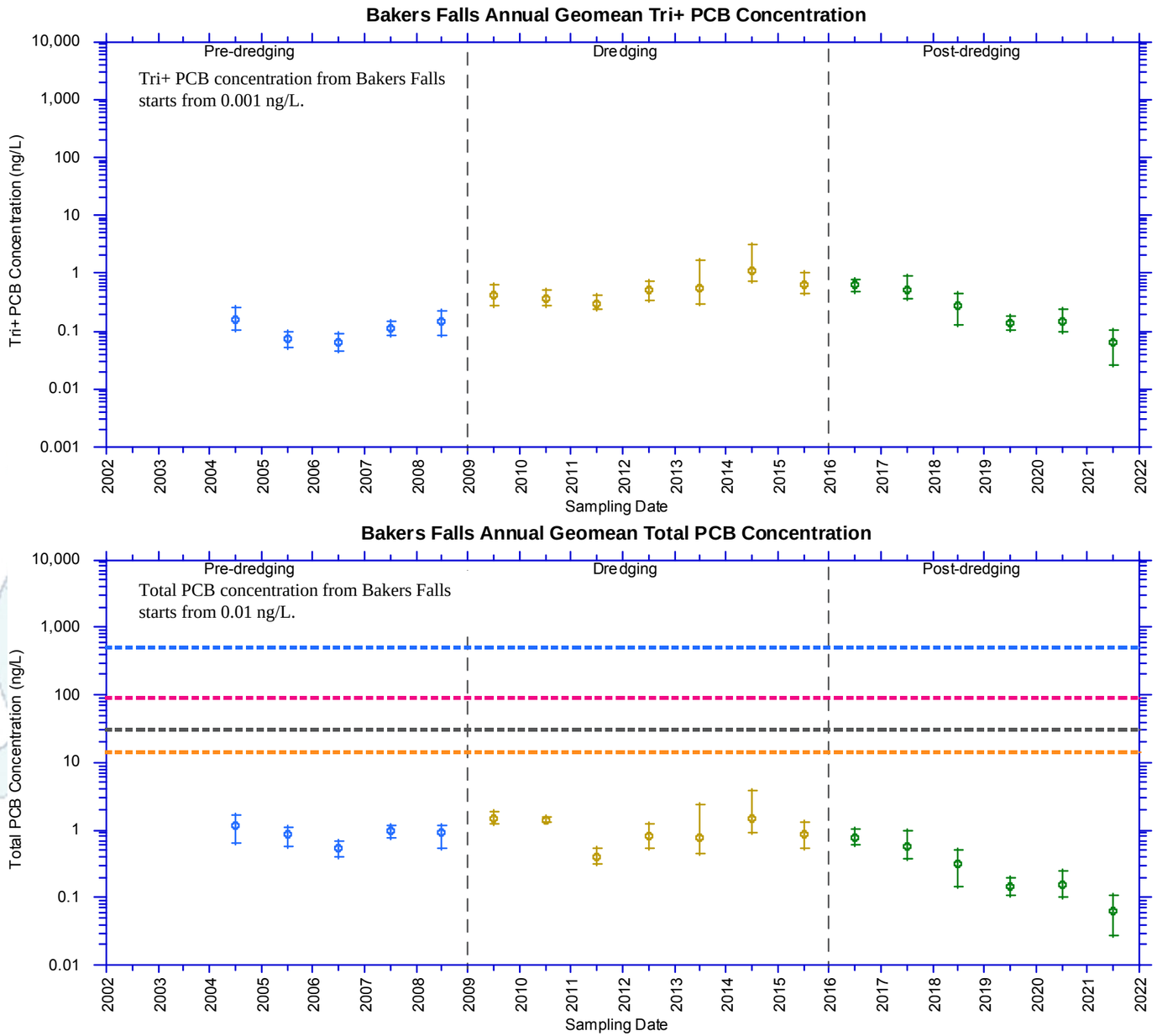
- Declines in average Tri+ PCB concentrations in surface sediments:
  - 93, 84 and 80 percent in RS 1, 2, and 3, respectively
- Reductions are greater than anticipated in the ROD.

Supporting Information

Changes in PCB Concentrations Through Time

- Geometric means plotted per year (2004-2021)
  - Easier to visualize year-to-year changes
  - Routine samples used in calculation
    - Less influenced by year-to-year variation in storm events
    - High flow data would bias the mean towards high flow data
    - High flow data only available at Waterford and Schuylerville
- Uncertainty calculated using bootstrap methods

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB and Tri+ PCB Concentrations at the Bakers Falls Monitoring Station

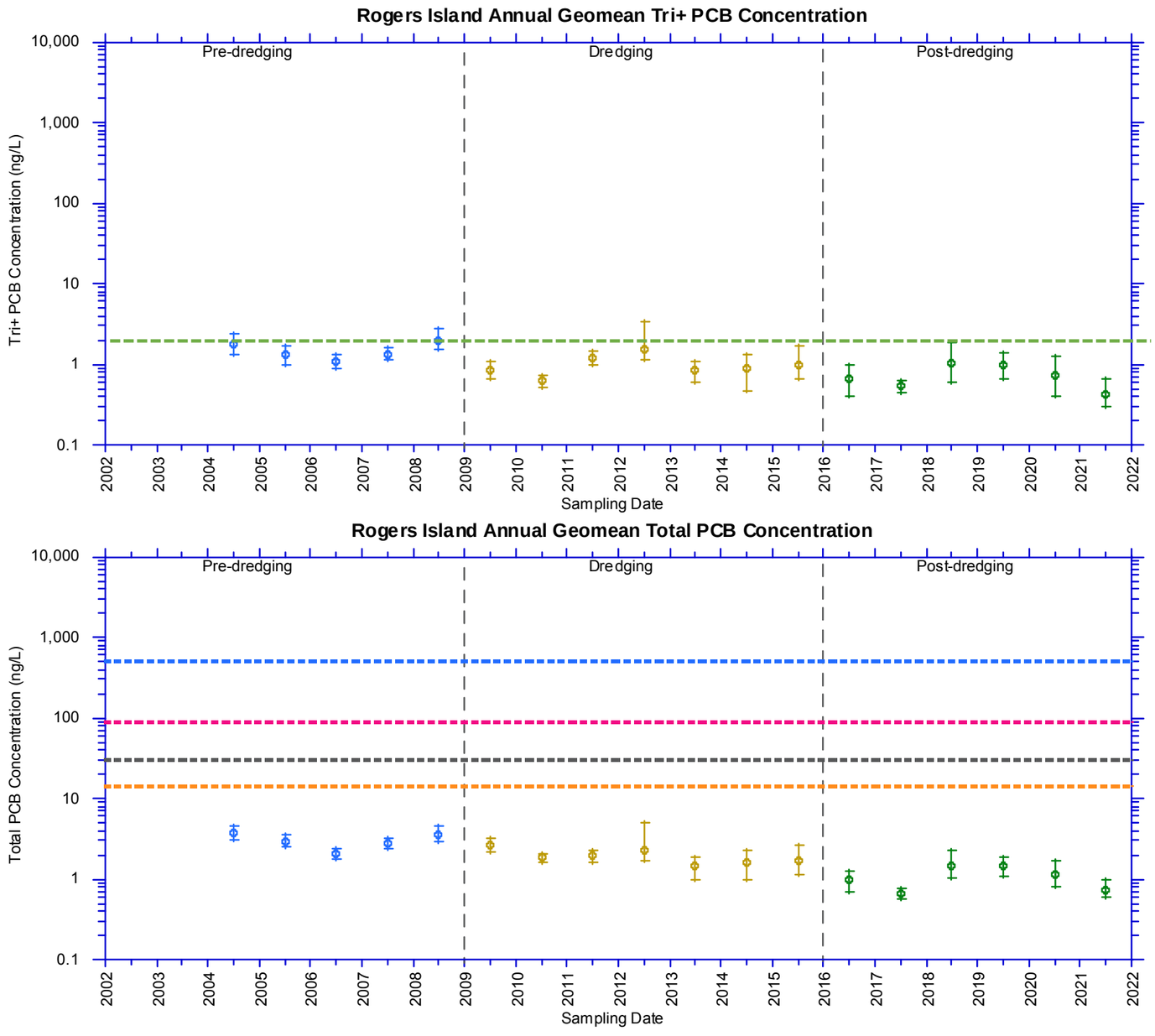


Legend:

- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Located upstream of known GE-related PCB releases
- 2-to-3 orders of magnitude lower than those observed in the downstream areas

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB and Tri+ PCB Concentrations at the Rogers Island Monitoring Station

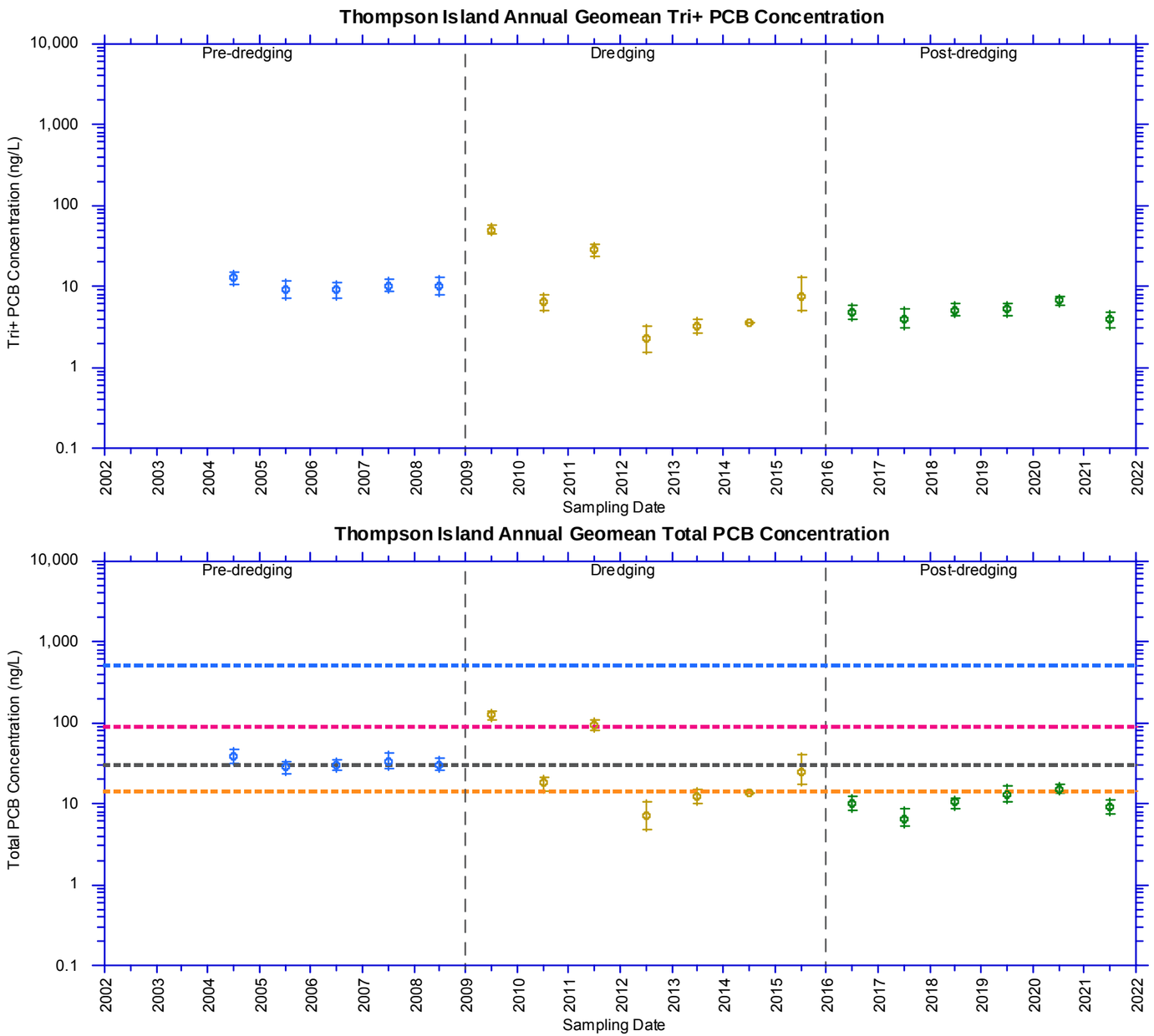


Legend:

- Upper 95% Confidence Interval
- Annual Geomean Concentration
- Lower 95% Confidence Interval
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Assumed Ft. Edward Tri+ PCB concentration following source control at GE Hudson Falls plant (2002 ROD) (2 ng/L Tri+ PCB)
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Geometric mean of Tri+ PCB concentrations in routine post-dredging samples is <2 ng/L (ROD assumption for OU2 background concentration following source control at GE Hudson Falls Plant)

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB and Tri+ PCB Concentrations at the Thompson Island Monitoring Station



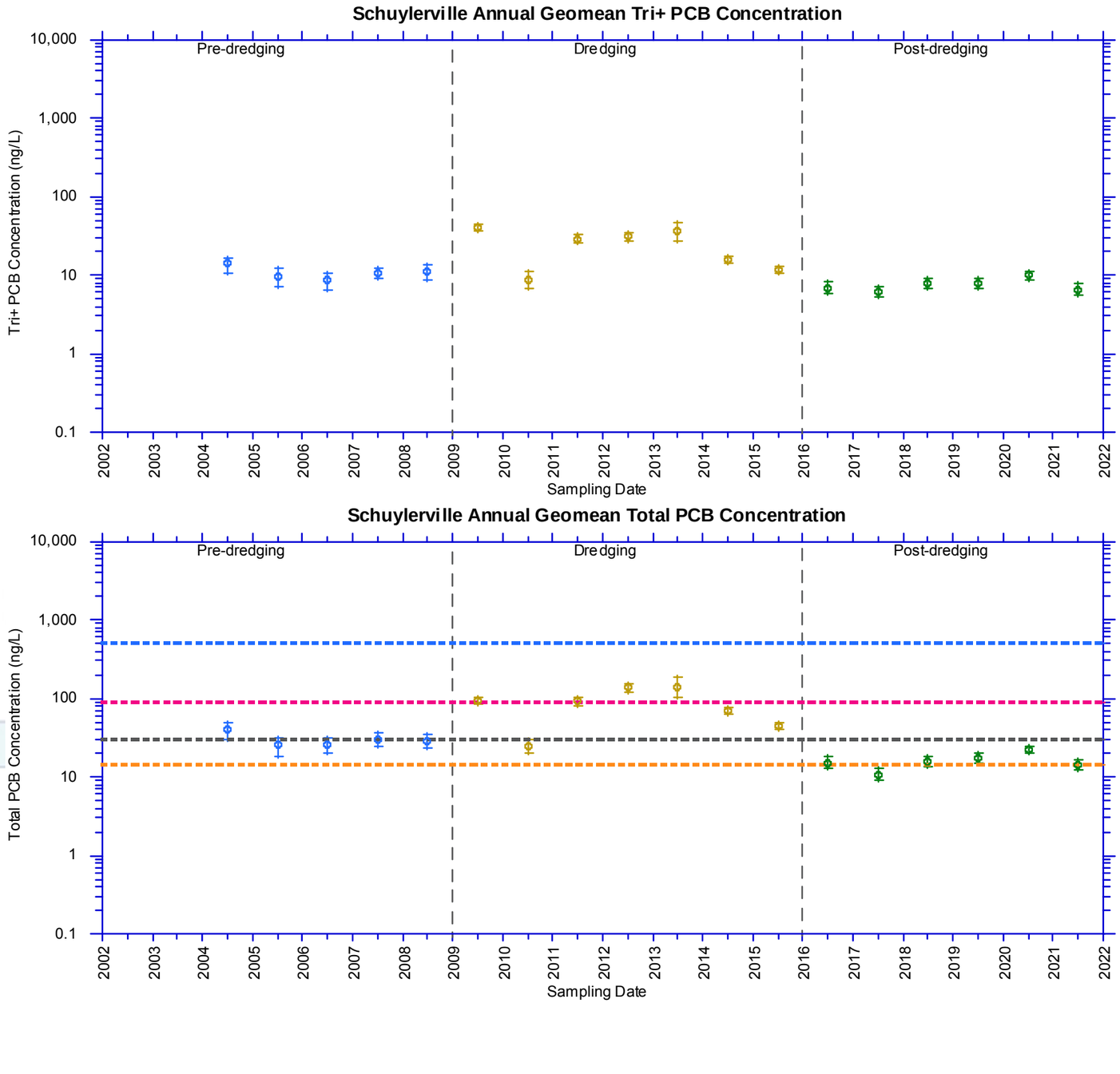
Legend:

- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Geometric mean of Tri+ PCB concentrations in routine annual post-dredging samples ranges from 3 to 10 ng/L

% Sample Below 14 ng/L ARAR		
	Pre-dredge	Post-dredge
All Samples	10%	76%

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB and Tri+ PCB Concentrations at the Schuylerville Monitoring Station



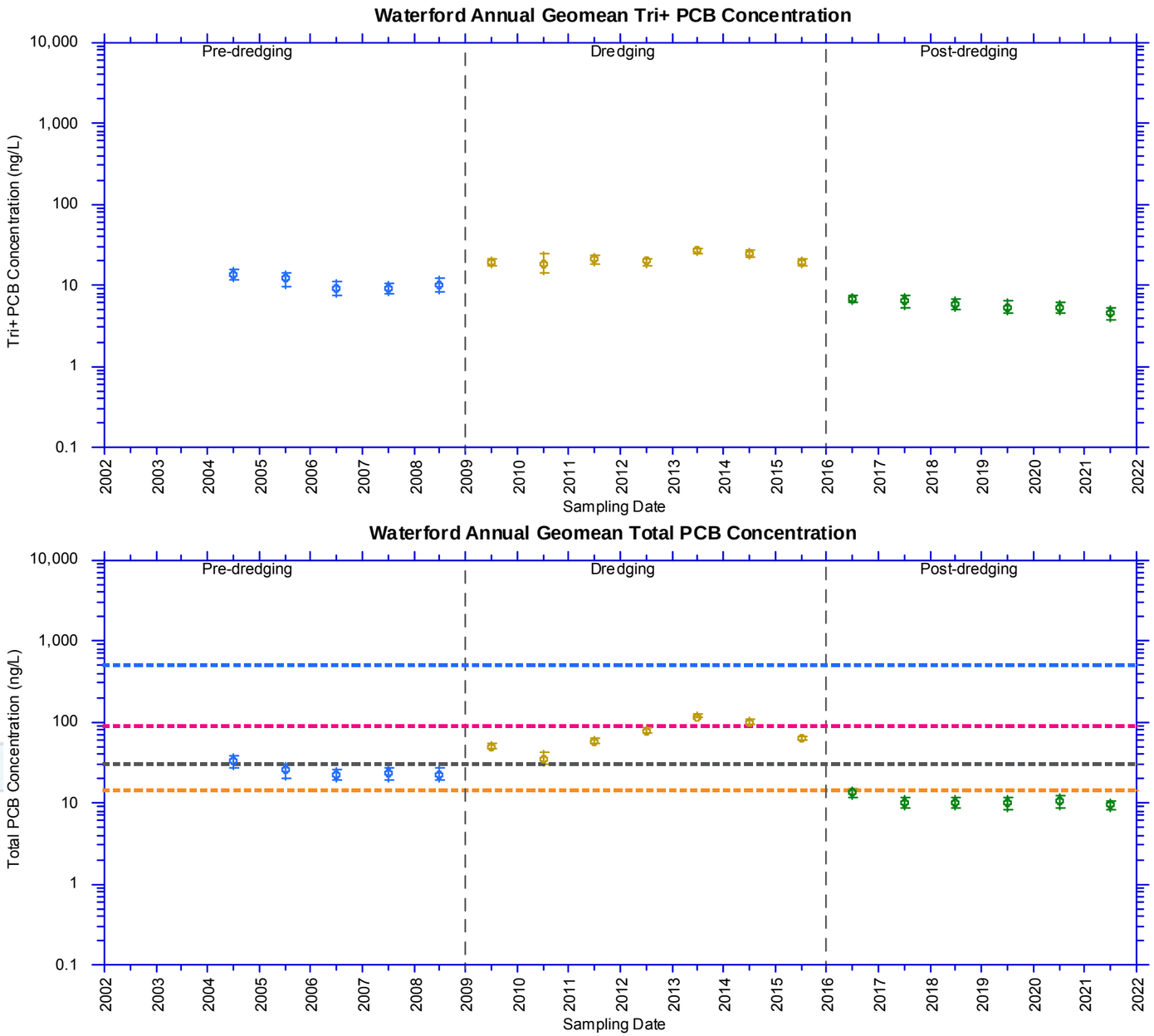
Legend:

- Routine Samples
- High Flow Samples
- Non-Detect Samples
- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period
- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Geometric mean of Tri+ PCB concentrations in routine annual post-dredging samples ranges from 3 to 10 ng/L

% Sample Below 14 ng/L ARAR		
	Pre-dredge	Post-dredge
All Samples	16%	44%
Routine Samples	16%	40%

2004 to 2021 Routine Samples Annual Geometric Mean Total PCB and Tri+ PCB Concentrations at the Waterford Monitoring Station



Legend:

- Routine Samples
- High Flow Samples
- Non-Detect Samples

- Pre-Dredging Period
- Dredging Period
- Post-Dredging Period

- Federal Maximum Contaminant Level for Drinking Water (500 ng/L TPCB)
- NYS Standard for Protection of Human Health and Drinking Water Sources (90 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Saltwater PCBs (30 ng/L TPCB)
- Criteria Continuous Concentration Federal Water Quality Criterion for Freshwater PCBs (14 ng/L TPCB)

- Geometric mean of Tri+ PCB concentrations in routine annual post-dredging samples ranges from 3 to 10 ng/L

% Sample Below 14ng/L ARAR		
	Pre-dredge	Post-dredge
All Samples	18%	57%
Routine Samples	16%	61%

HUDSON RIVER PCBS SUPERFUND SITE
FIVE-YEAR REVIEW TEAM MEETING
THE MEETING WILL BEGIN AT 1PM

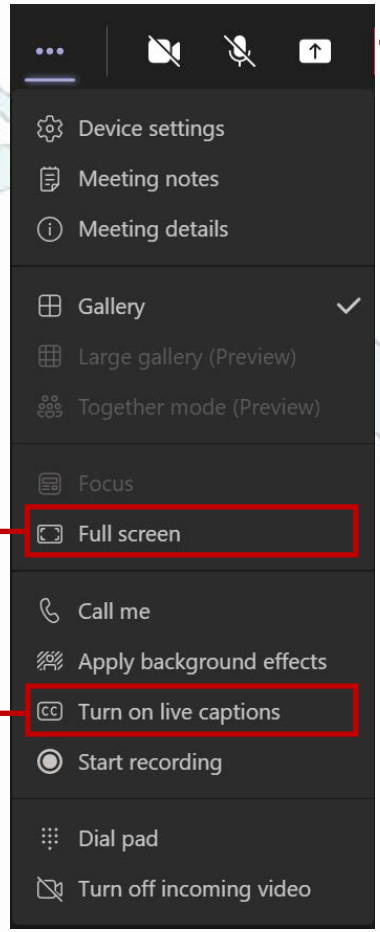
to ask question and share comments

to raise hand

to turn on/off video

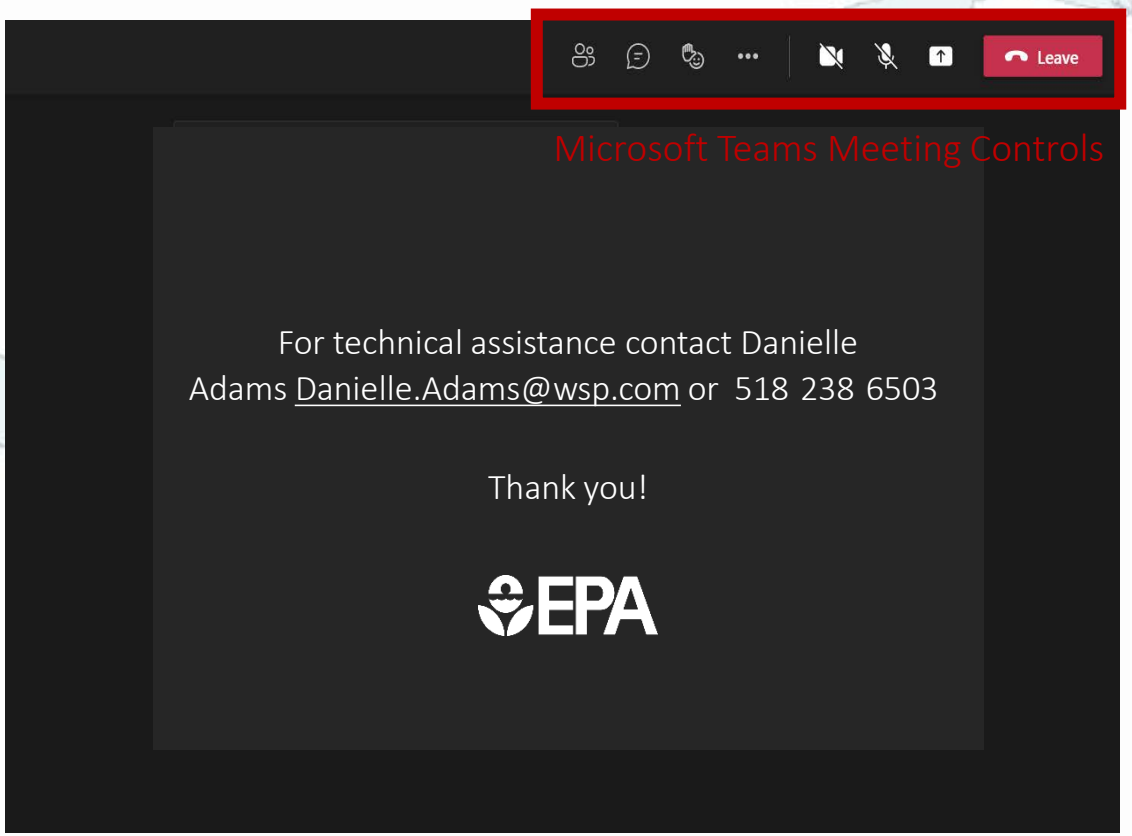
to un/mute mic

to leave the call



to view full screen

to view live caption



Hudson River
PCBs SUPERFUND SITE

Third Five-Year Review
Team Meeting #3

February 01, 2023

Virtual Meeting

Topics for Today's Meeting:

- Upper Hudson River (OU2):
  - Fish
    - Pre-dredging, during dredging and post-dredging
    - Focus for this FYR will be on post-dredging data (2016 – 2021)
      - *Note: EPA has some data from 2022 and EPA's review is under way*

Reminder: Meeting Approach/Logistics

- EPA plans to keep the meetings to key participants and alternates
  - Check in with EPA if you want others to join

- EPA will not be able to distribute materials/analysis in advance or after meetings
  - Presentations will likely be included in the report – any errors will be corrected before inclusion in the FYR report
  - Formal opportunity for public review and comment on the report
  - EPA is available to answer questions outside of the FYR Team meetings

- Meeting format will be open-dialogue
  - We anticipate receiving feedback and answering questions during the presentations
  - The meeting is scheduled for 1 ½ hours but our goal is to get through the materials in 1 hour

Reminder: Meeting Approach/Logistics (Cont'd)

- About 30 slides to cover today
- Meeting etiquette:
  - Remain on mute unless speaking (*6 for phone participants)
  - Use camera if you are speaking (at your discretion)
  - Use "raise hand" feature to get the moderator's attention
  - Be respectful of others
  - EPA will monitor the Chat, but our preference is to have one on-going dialog (please avoid side conversations)

Upper Hudson River (OU2)
Fish Tissue

Hudson River PCBs SUPERFUND SITE

Background

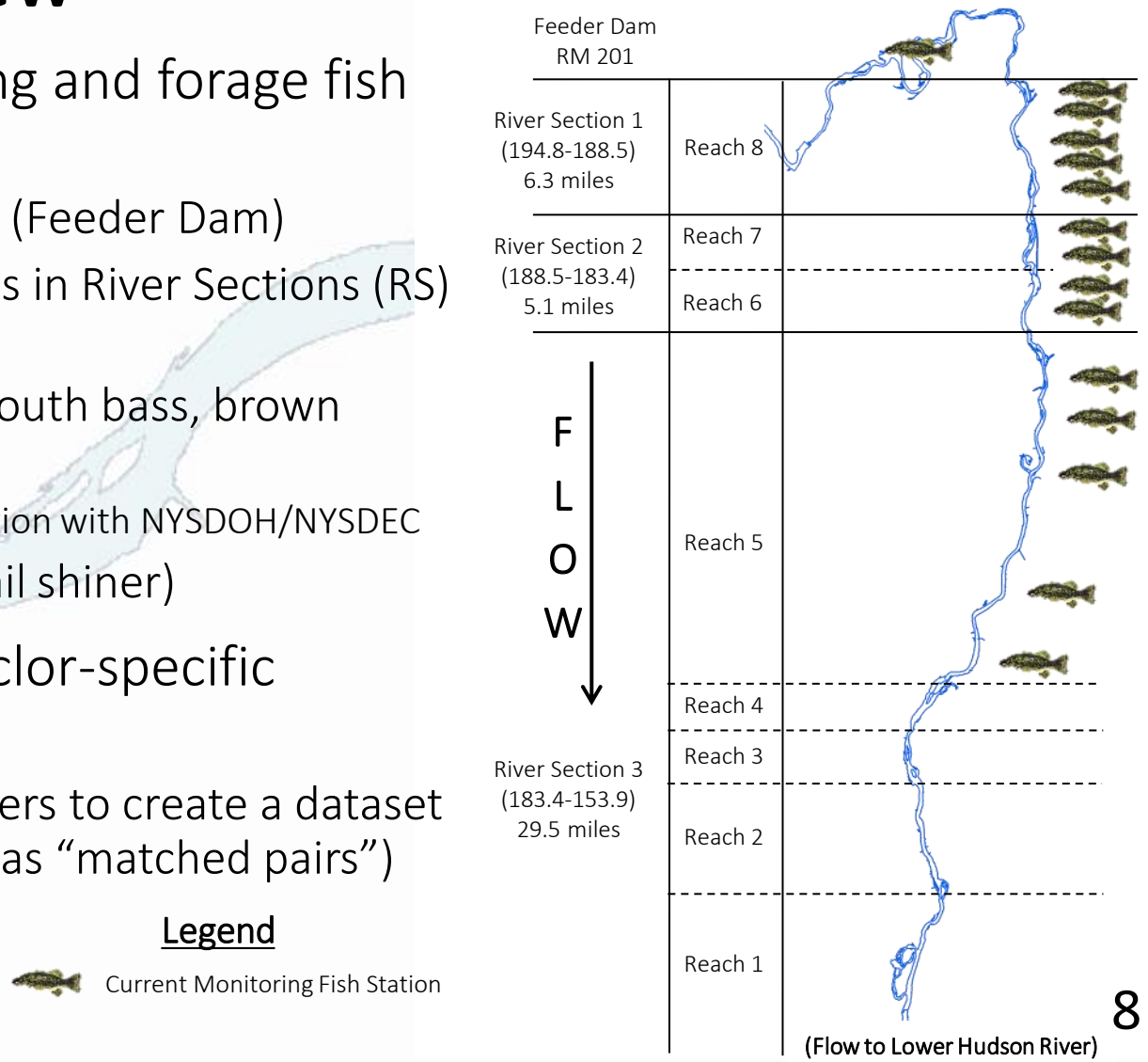
- Design of the current fish tissue sampling program is focused on tracking the recovery of the river during the post-dredging period
  - Fish tissue concentrations are linked to water column and sediment concentrations
  - Scope of the fish sampling program was refined in 2021 (consistent with the Draft WFS OM&M Workplan)
- Remedial Action Objectives (RAOs) relevant to the fish tissue sampling program are:
  - RAO #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
    - The risk-based remediation goal (RG) for the protection of human health is 0.05 mg/kg PCBs - ½ lb. meal per week
    - Other targets (milestones) include:
      - 0.4 mg/kg PCBs- ½ lb. meal every two months
      - 0.2 mg/kg PCBs - ½ lb. meal per month
  - RAO #2: Reduce the risks to ecological receptors by reducing the concentration of PCBs in fish
    - The risk-based RGs for the protection of ecological receptors were revised during the Second FYR to:
      - 0.2 mg/kg LOAEL to 0.07 mg/kg NOAEL in largemouth bass
      - 0.34 mg/kg LOAEL to 0.11 mg/kg NOAEL in spottail shiner

LOAEL - Lowest Observed Adverse Effect Level
("lowest" value at which adverse effects have been observed)

NOAEL - No Observed Adverse Effects Levels
(highest dose or body burden at which an adverse effect was not observed)

Fish Tissue Monitoring Overview

- Fish are collected annually (sport fish in spring and forage fish in fall)
  - One sample area upstream of the dredging areas (Feeder Dam)
  - Multiple sampling areas across the dredging areas in River Sections (RS) 1, 2, and 3
  - Four sport fish species (largemouth bass, smallmouth bass, brown bullhead, and yellow perch)
    - Other species will be sampled in the future in coordination with NYSDOH/NYSDEC
  - Two forage fish species (pumpkinseed and spottail shiner)
- Tissue samples are analyzed for PCBs by Aroclor-specific method (SW8082A)
  - A subset of samples are also analyzed for congeners to create a dataset of "paired" congener-Aroclor results (referred to as "matched pairs")



Legend

Current Monitoring Fish Station

Summary of FYR Data Evaluations

- Data used in current FYR evaluation:
  - Pre-dredging (BMP) – 2004 to 2008
  - Dredging (RAMP) – 2009 to 2015
  - Post-dredging (OM&M) – 2016 to 2021
    - Focus of current FYR

- Analyses being performed in FYR include:
  - Evaluation of fish tissue PCB concentrations by species over time
  - Evaluation of fish tissue PCB concentrations over time (species-weighted average) and progress towards human health RAO targets and goals
  - Evaluation of progress towards ecological risk RAO goals

Fish Analysis Considerations

- Lipid content (lipid-normalized)
- Species
  - Individual
  - Species-weighted average
- Locations
  - Upper Hudson
  - River Section
  - River Reach
  - Station
- Fish size
  - Length and weight
  - Age
- Tissue type
  - Fillet type
  - Whole-body
- Aroclor and congener composition in fish
- Aroclor and congener matched pair samples
- $TPCB_{HE}$ conversion factor – data treatment
- QA/QC Results
  - Reference material samples (NIST)
  - Lab replicate samples
  - MS/MSD
- Relationship of forage fish to sport fish
- Relationship of Reaches 1 to 4 with Reach 5
- Impacts of annual variations in river flows
- Relationship of water column and sediment to fish
- Number of years of data needed to detect a trend
- Background concentrations at the Feeder Dam
- Other species to be considered in consultation with NYSDOH/NYSDEC

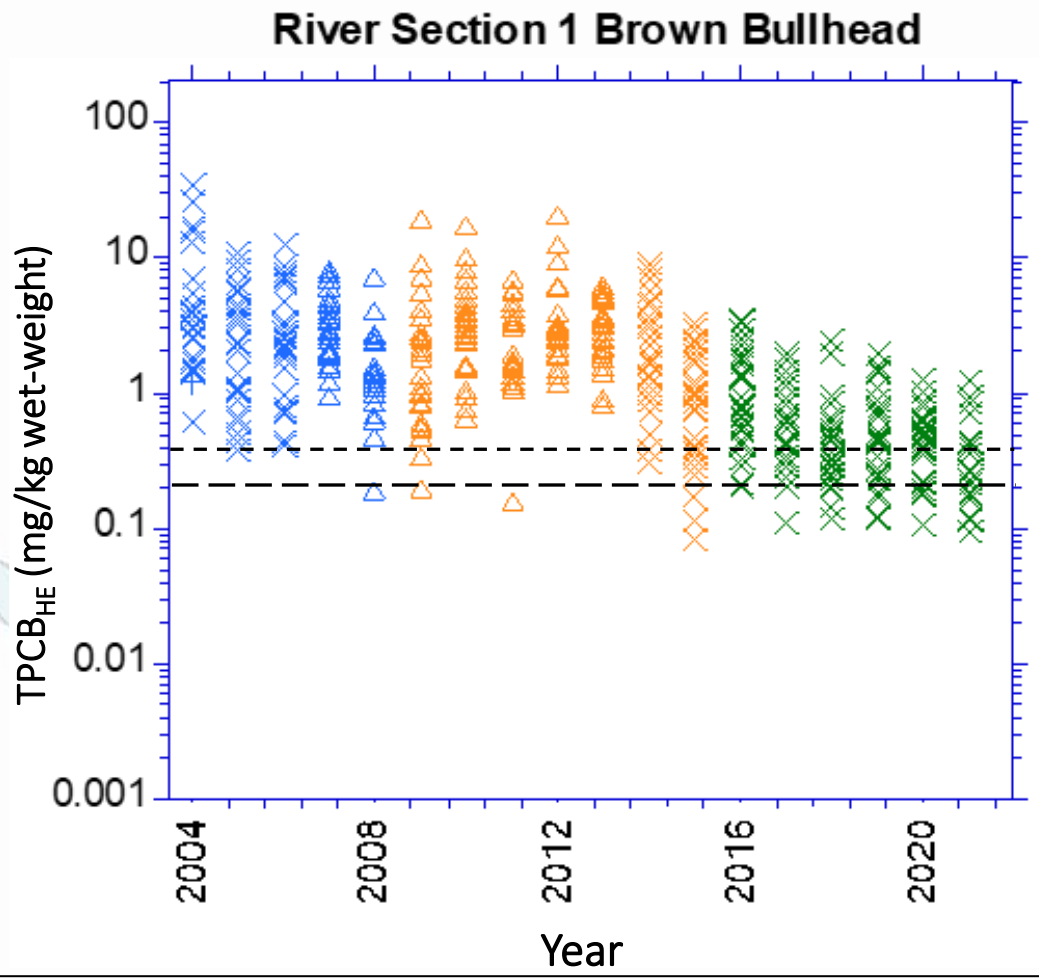
Evaluation of Fish Tissue PCB Concentrations by Species Over Time

Individual species plotted for each RS (2004 – 2021)

- Total PCB homologue equivalent ($TPCB_{HE}$)
  - Calculated on both a **wet-weight basis** and a **lipid-normalized basis** (adjusted for fat content in fish)
- Percentage of samples below the first intermediate human health target (0.4 mg/kg-ww)

Hudson River PCBs SUPERFUND SITE

Example



Legend

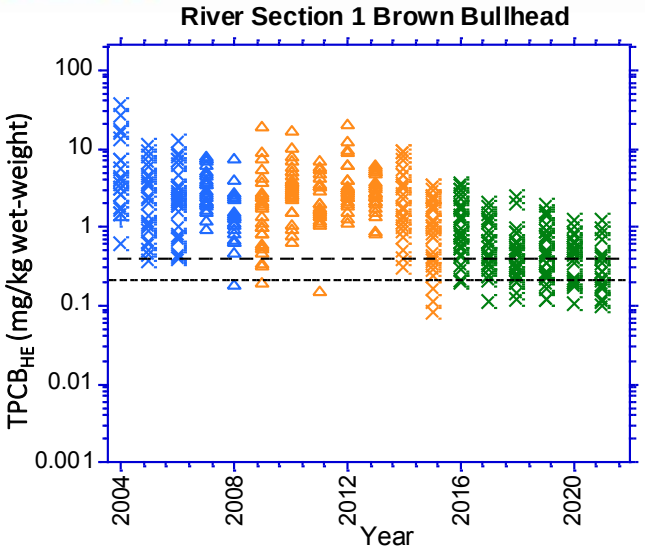
Sample Source
- × NYSDEC Standard Fillet*
- \+ GE Standard Fillet*
- △ GE Rib-out Fillet

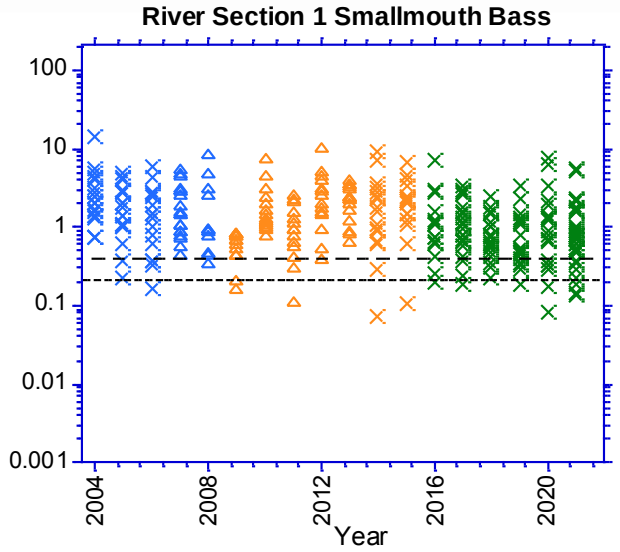
Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

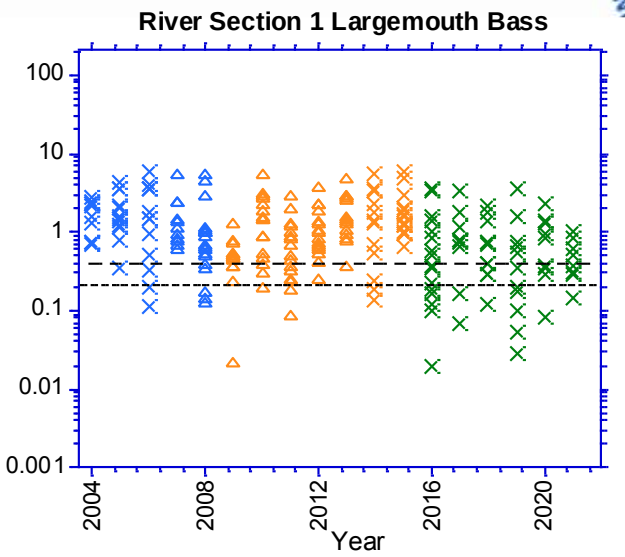
Target (Milestone) PCB Concentration
- - - 0.4 mg/kg-ww
- — - 0.2 mg/kg-ww

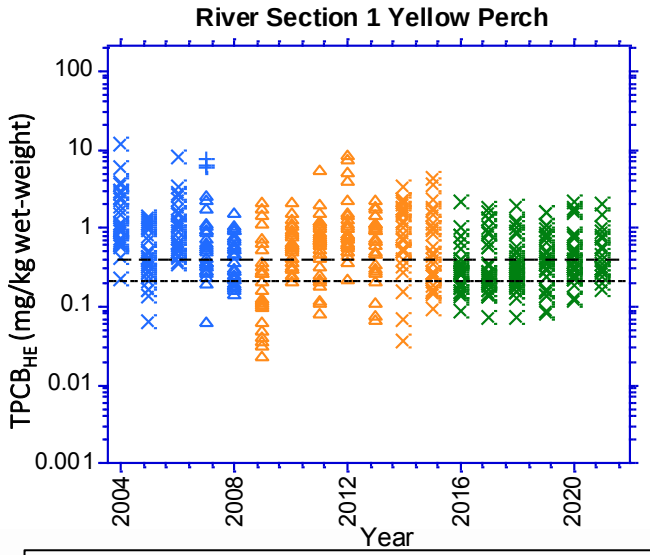
2004 to 2021 Wet-Weight $TPCB_{HE}$ Concentrations

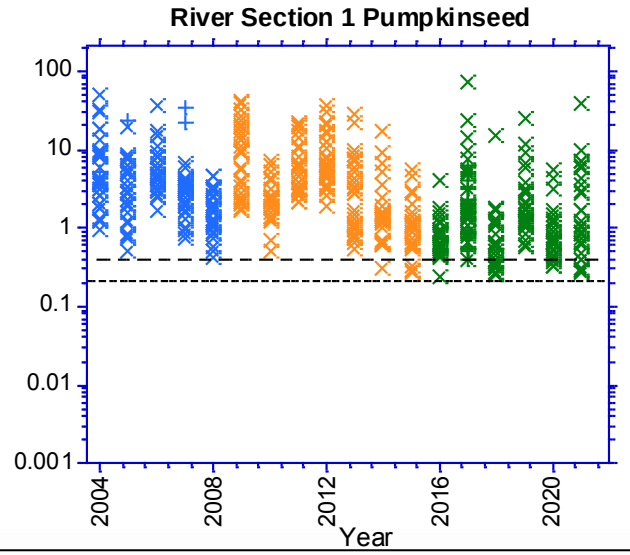
River Section 1











Post-dredging fish PCB concentrations are generally lower than the pre-dredging period

% of Samples Below 0.4 mg/kg –ww		
	Pre-dredge	Post-dredge
Brown Bullhead	2%	40%
Largemouth Bass	14%	42%
Smallmouth Bass	8%	21%
Yellow Perch	29%	64%
All Sport Fish	**15%**	**44%**

Notes:

*Sport fish samples are fillets and pumpkinseed samples are whole-body composites

1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

Legend

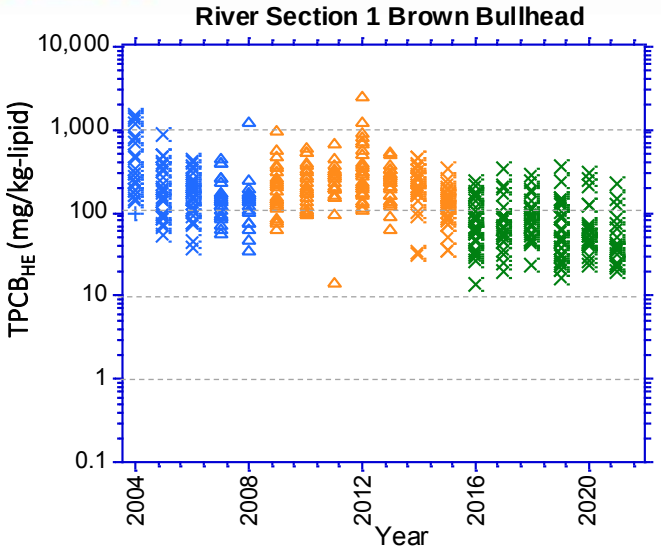
Sample Source: + NYSDEC Standard Fillet*; × GE Standard Fillet*; △ GE Rib-out Fillet

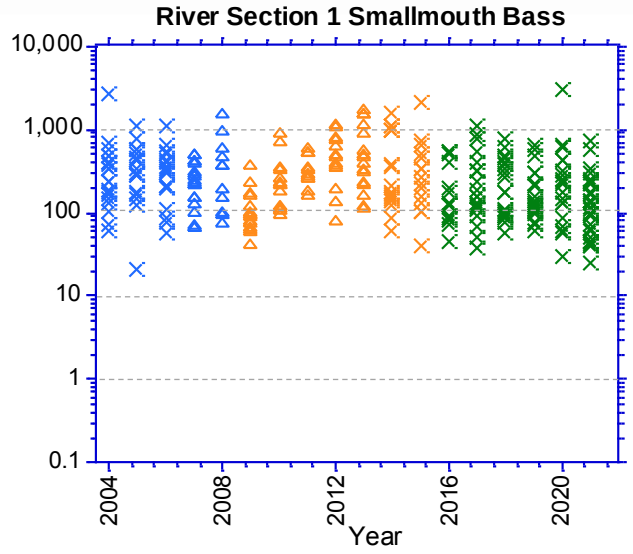
Sampling Period: Pre-Dredging Period (2004-2008); Dredging Period (2009-2015); Post-Dredging Period (2016-2021)

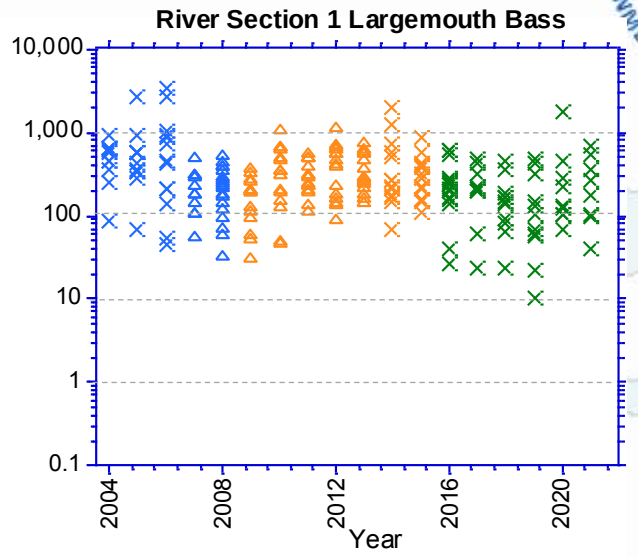
Target (Milestone) PCB Concentration: ---- 0.4 mg/kg-ww; – – – 0.2 mg/kg-ww

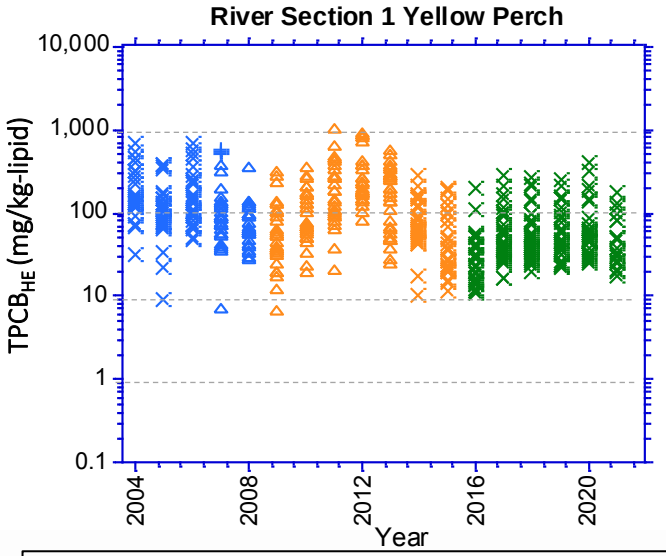
2004 to 2021 Lipid-Normalized $TPCB_{HE}$ Concentrations

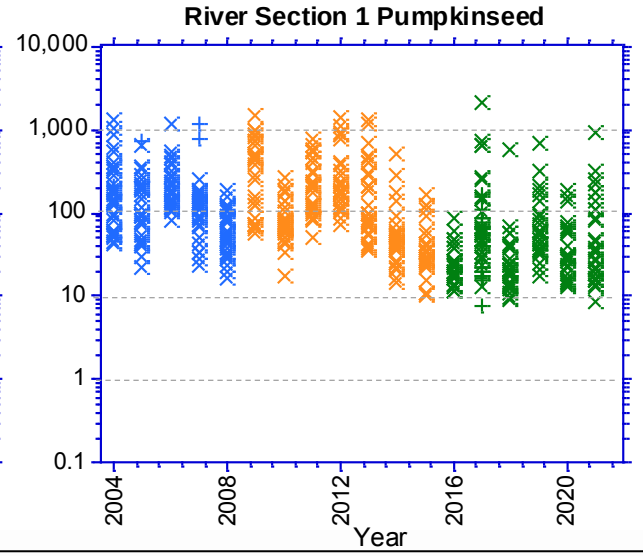
River Section 1











Notes:

*Sport fish samples are fillets and pumpkinseed samples are whole-body composites

1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

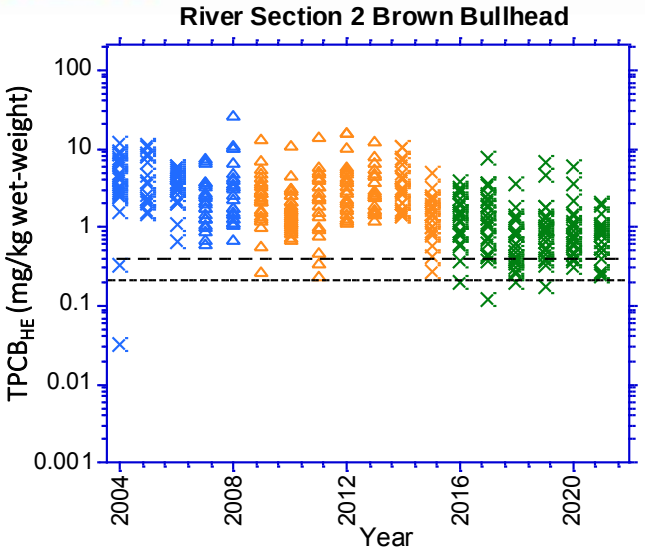
Legend

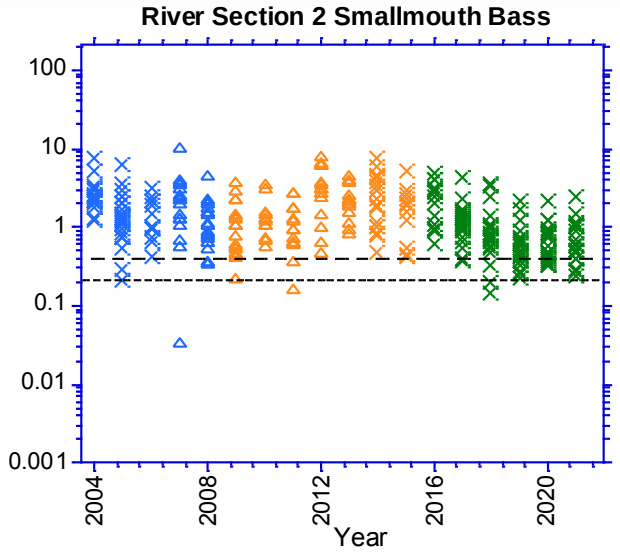
Sample Source
- NYSDEC Standard Fillet*
- GE Standard Fillet*
- GE Rib-out Fillet

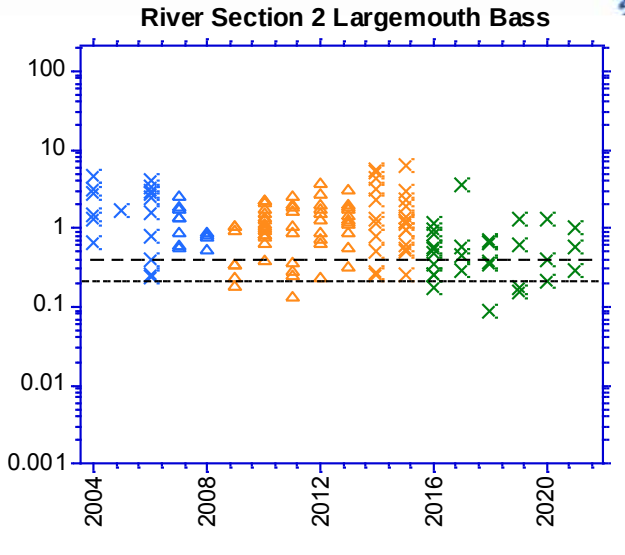
Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

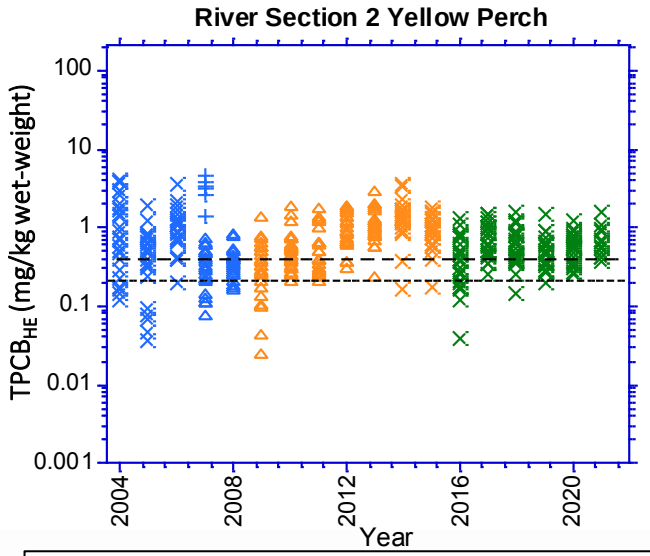
2004 to 2021 Wet-Weight $TPCB_{HE}$ Concentrations

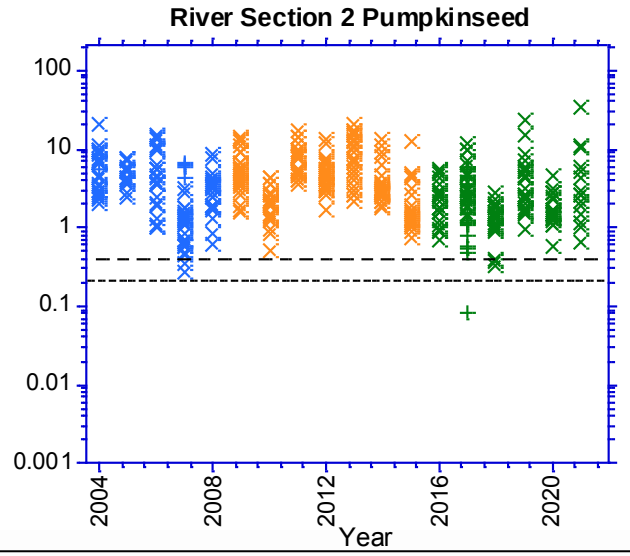
River Section 2











Post-dredging fish PCB concentrations are generally lower than the pre-dredging period

% of Samples Below 0.4 mg/kg –ww		
	Pre-dredge	Post-dredge
Brown Bullhead	2%	16%
Largemouth Bass	8%	39%
Smallmouth Bass	6%	16%
Yellow Perch	33%	30%
All Sport Fish	**16%**	**22%**

Notes:

*Sport fish samples are fillets and pumpkinseed samples are whole-body composites

1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

Legend

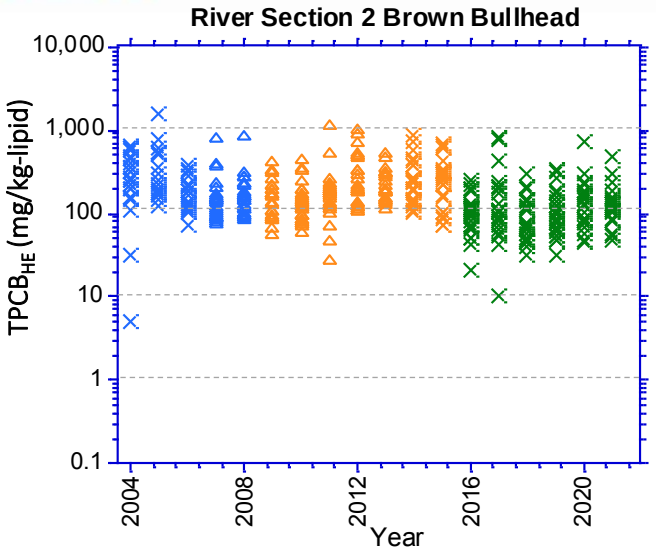
Sample Source: + NYSDEC Standard Fillet*; × GE Standard Fillet*; △ GE Rib-out Fillet

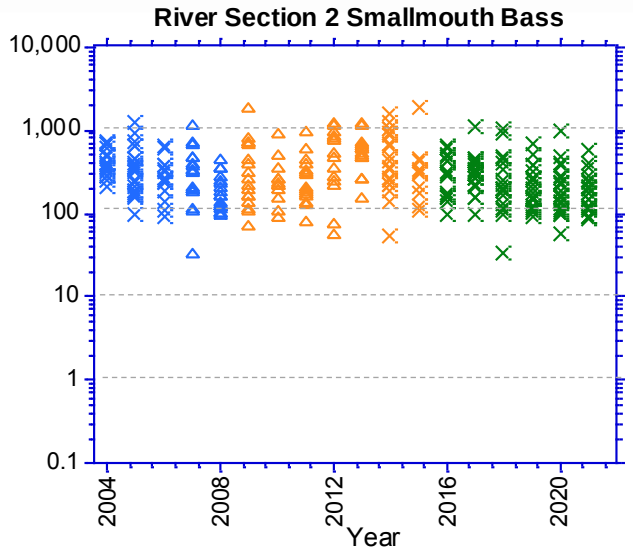
Sampling Period: Pre-Dredging Period (2004-2008); Dredging Period (2009-2015); Post-Dredging Period (2016-2021)

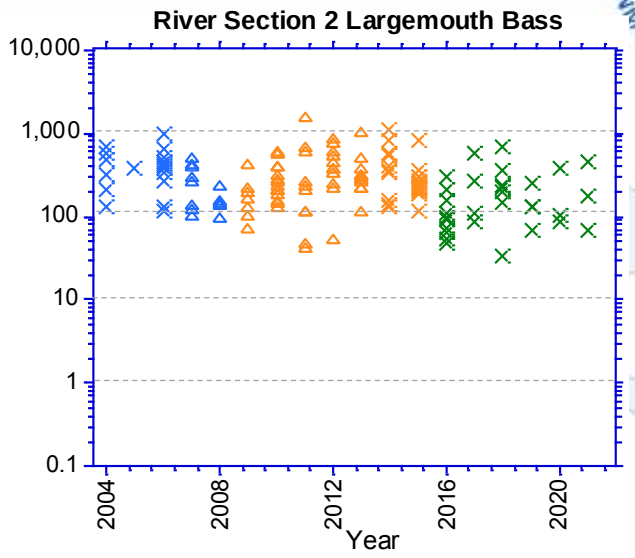
Target (Milestone) PCB Concentration: ---- 0.4 mg/kg-ww; – – – 0.2 mg/kg-ww

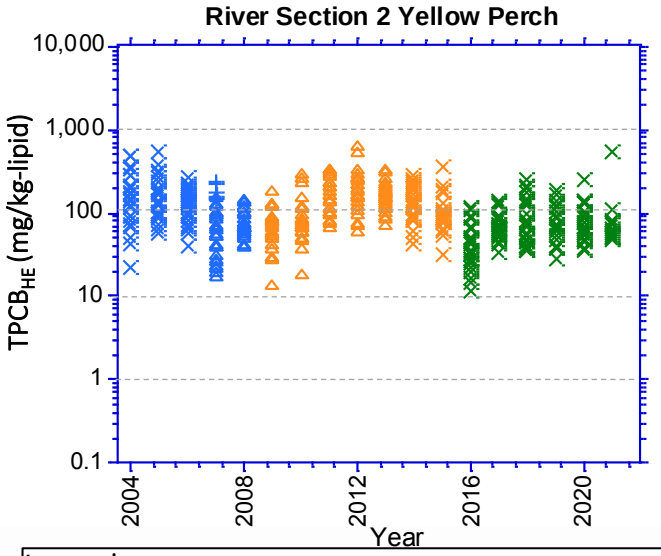
2004 to 2021 Lipid-Normalized $TPCB_{HE}$ Concentrations

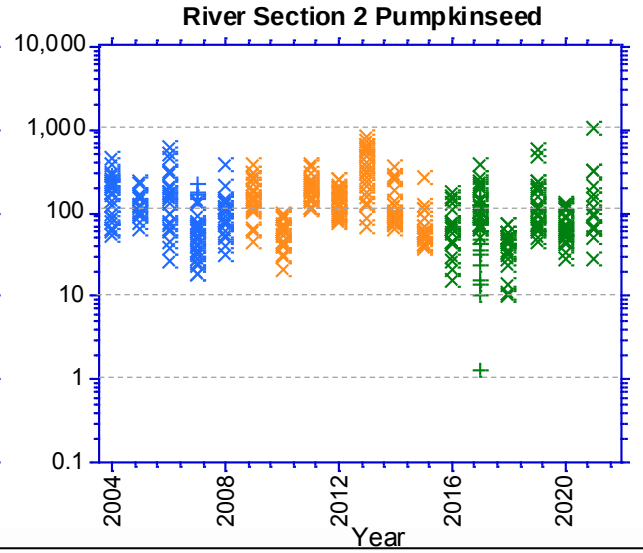
River Section 2











Notes:

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1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

Legend

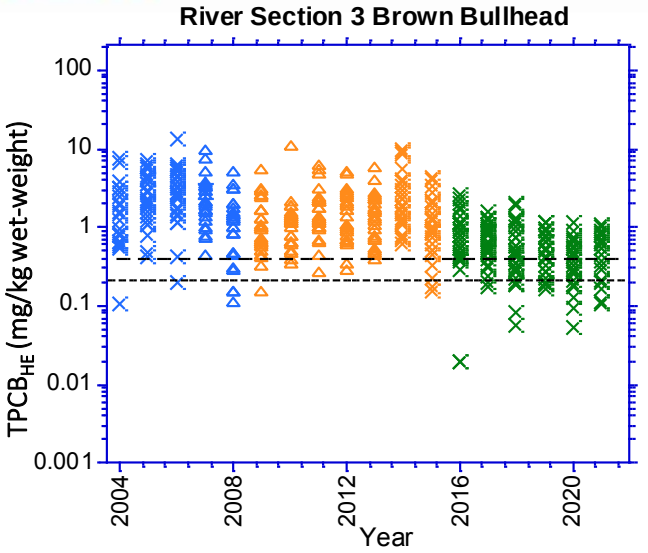
Sample Source
- NYSDEC Standard Fillet*
- GE Standard Fillet*
- GE Rib-out Fillet

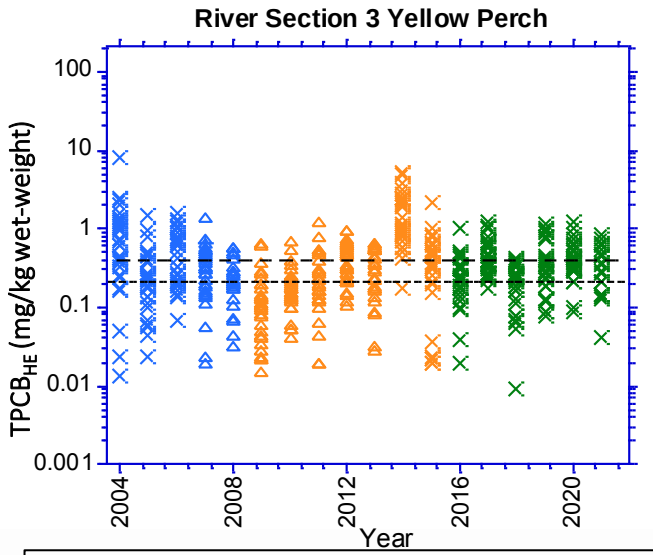
Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

2004 to 2021 Wet-Weight $TPCB_{HE}$ Concentrations

River Section 3

RS 3





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Yellow Perch	55%	68%
All Sport Fish	**30%**	**42%**

Notes:

*Sport fish samples are fillets and pumpkinseed samples are whole-body composites

1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

Legend

Sample Source
- + NYSDEC Standard Fillet*
- × GE Standard Fillet*
- △ GE Rib-out Fillet

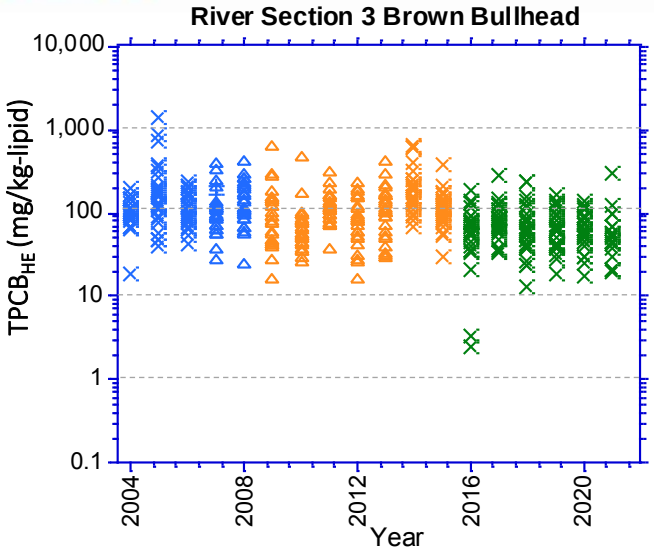
Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

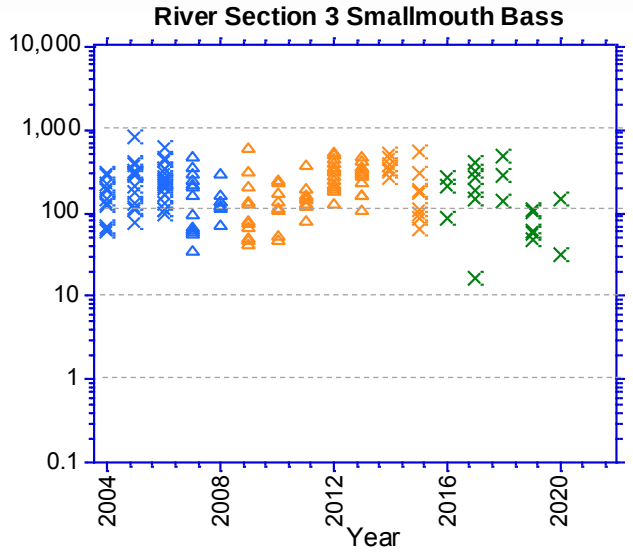
Target (Milestone) PCB Concentration
- ---- 0.4 mg/kg-ww
- – – – 0.2 mg/kg-ww

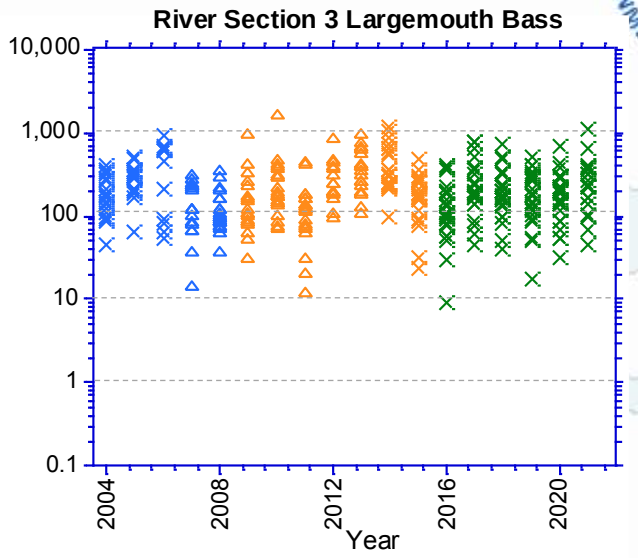
2004 to 2021 Lipid-Normalized $TPCB_{HE}$ Concentrations

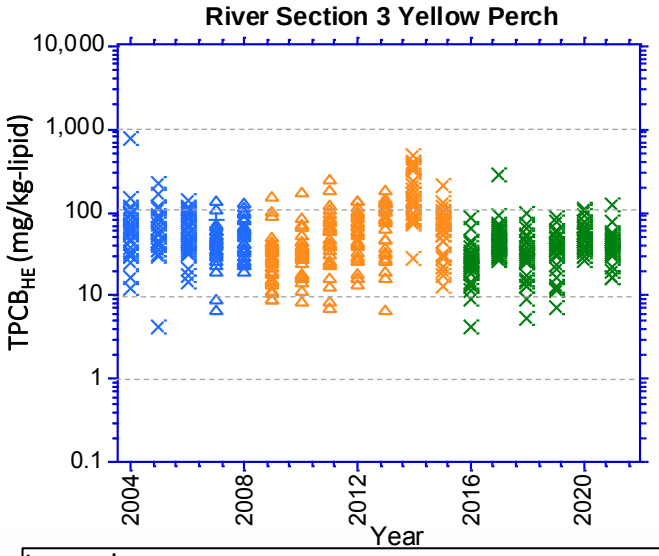
River Section 3

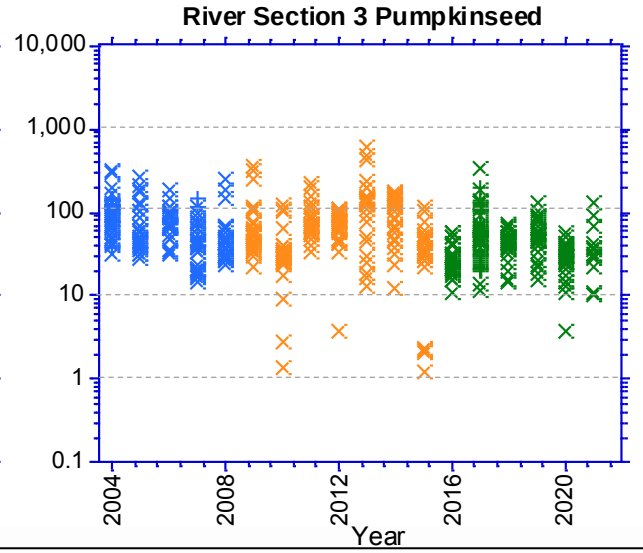
RS 3











Notes:

*Sport fish samples are fillets and pumpkinseed samples are whole-body composites

1. PCB concentrations are expressed as Total PCB homologue equivalent values ($TPCB_{HE}$), based on conversion from reported Aroclor results

Legend

Sample Source
- NYSDEC Standard Fillet*
- GE Standard Fillet*
- GE Rib-out Fillet

Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

Percentage of Samples <0.4 mg/kg-ww Target

Species	River Section 1		River Section 2		River Section 3		UHR RS 1 to RS 3	
	Pre-Dredging	Post-Dredging	Pre-Dredging	Post-Dredging	Pre-Dredging	Post-Dredging	Pre-Dredging	Post-Dredging
Brown Bullhead	2%	40%	2%	16%	6%	34%	3%	31%
Largemouth Bass	14%	42%	8%	39%	33%	25%	21%	31%
Smallmouth Bass	8%	21%	6%	16%	18%	30%	10%	20%
Yellow Perch	29%	64%	33%	30%	55%	68%	39%	56%
All Sport Fish	**15%**	**44%**	**16%**	**22%**	**30%**	**42%**	**20%**	**37%**

Evaluation of Fish Tissue PCB Concentrations Over Time (Species-Weighted Average) and Progress Towards Human Health RAO Targets and Goals

- Species-weighted average plotted for each RS (2004 – 2021) and for UHR as a whole
  - Total PCB_{HE} wet-weight basis
  - Integrates temporal, spatial, and species data to generate a single estimate of fish tissue PCB concentration across one or more river sections
  - Brown bullhead, black bass (largemouth bass and smallmouth bass), and yellow perch
- Progress towards human health RAO targets and goals

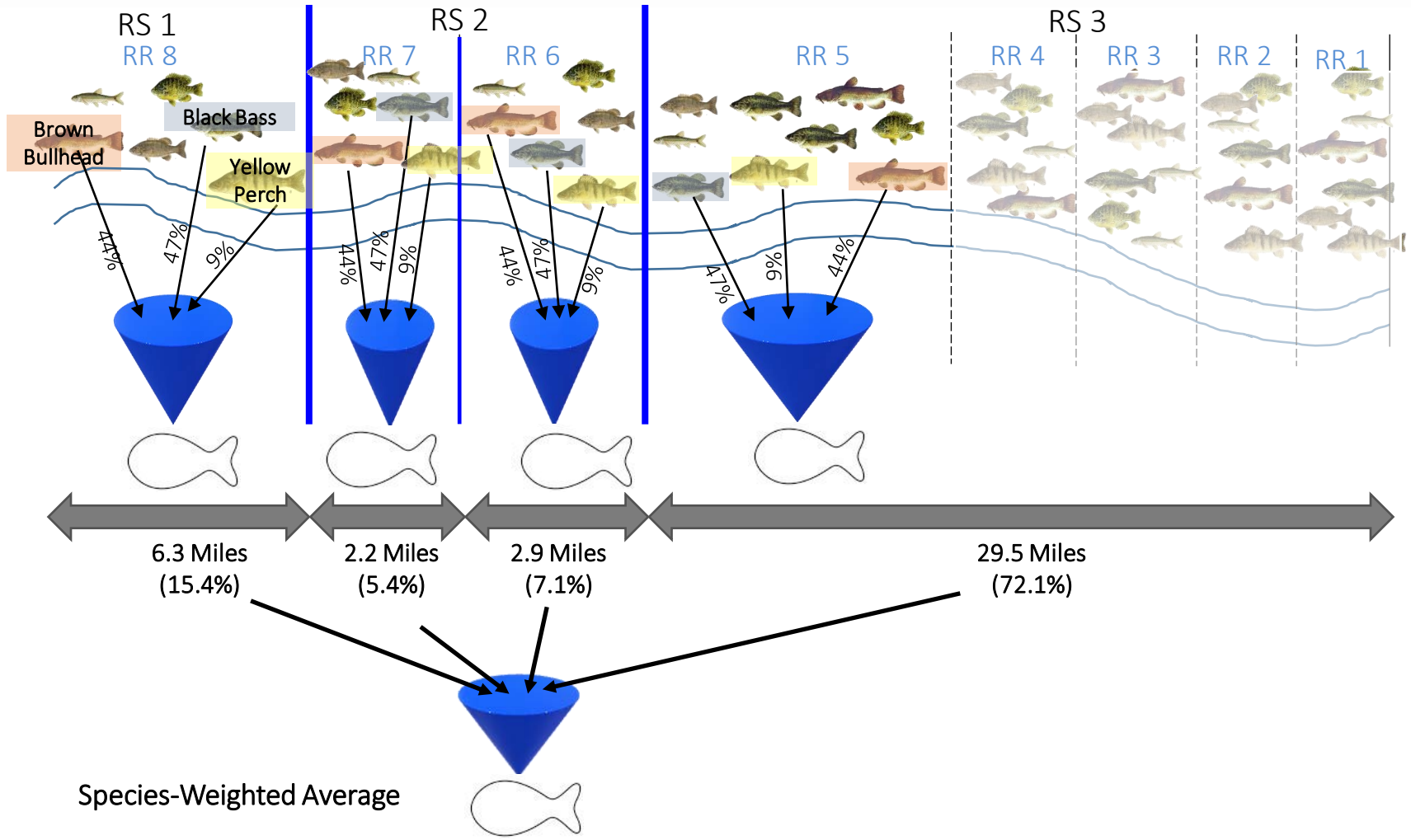
Species-Weighted Average Methodology

Average PCB concentration by species

Species weight based on likelihood of collection

Species-Weighted Average by River Section or River Reach

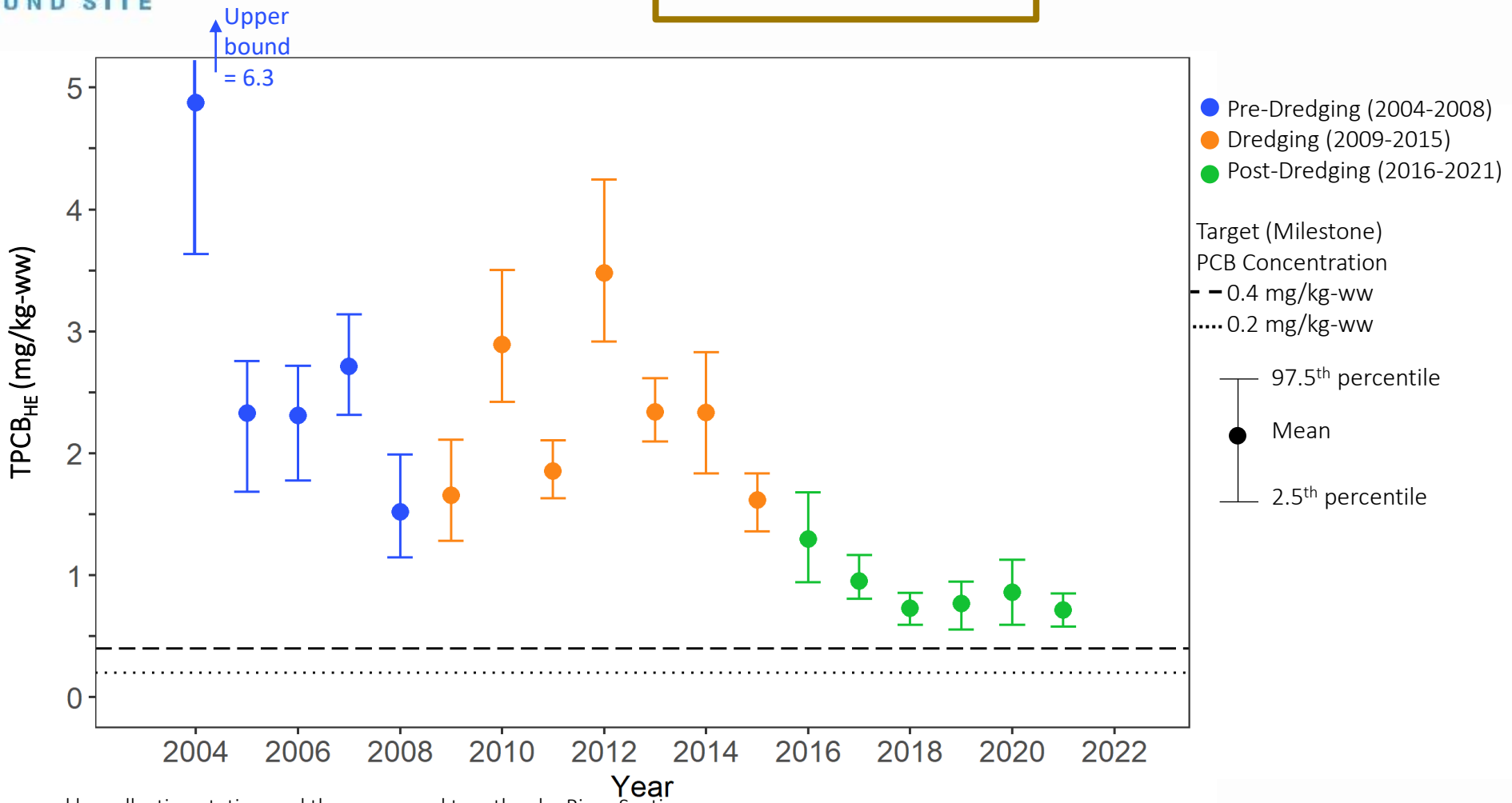
River Section or River Reach weight based on length



Notes:
1. Only spring sport fish are used in the calculation
2. Fish collected outside of the fish monitoring areas and in Reaches 4 through 1 were not included in the calculation

Species-Weighted Average Wet-Weight $TPCB_{HE}$

River Section 1

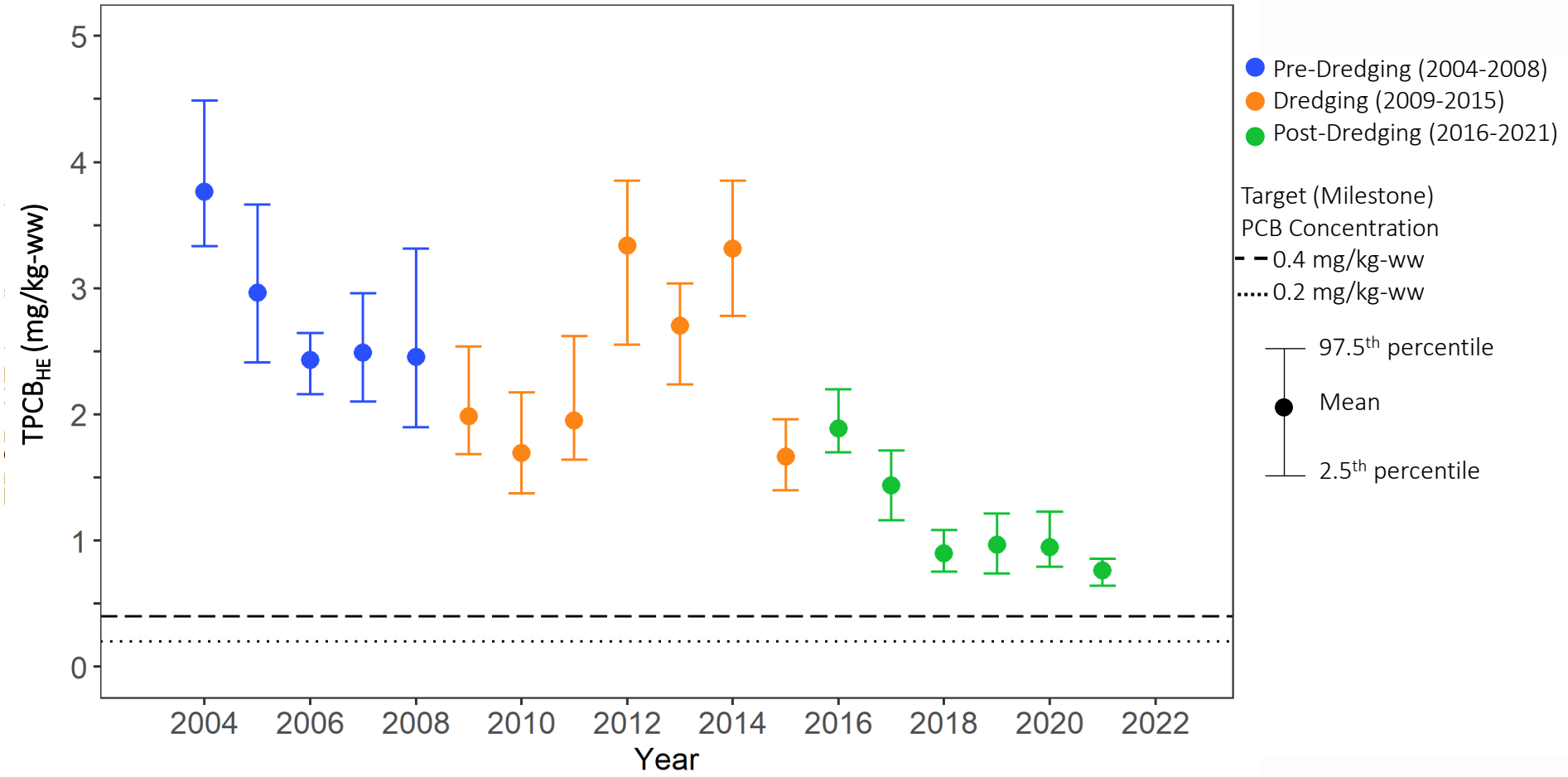


Notes

1. Individual species are averaged by collection station and then averaged together by River Section
2. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
3. Upper Hudson River average is weighted by both species and river section length. River Section 1 = 6.3 miles (15.4%); River Section 2= 5.1 miles (12.5%); and River Section 3= 29.5 miles (72.1%). Data from river Reaches 4 through 1 are not included in this calculation since they were not collected regularly. Reach 5/River Section 3 is weighted to reflect all 29.5 miles of River Section 3, while the fish monitoring stations representing River Section 3 are all located in Reach 5, which is 14 miles long
4. 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method
5. The samples from 2007-2013 are rib-out fillets, all other data is NYSDEC standard fillet samples
6. The confidence interval for 2004 ranges from 3.6 to 6.3

Species-Weighted Average Wet-Weight $TPCB_{HE}$

River Section 2



Notes

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2. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
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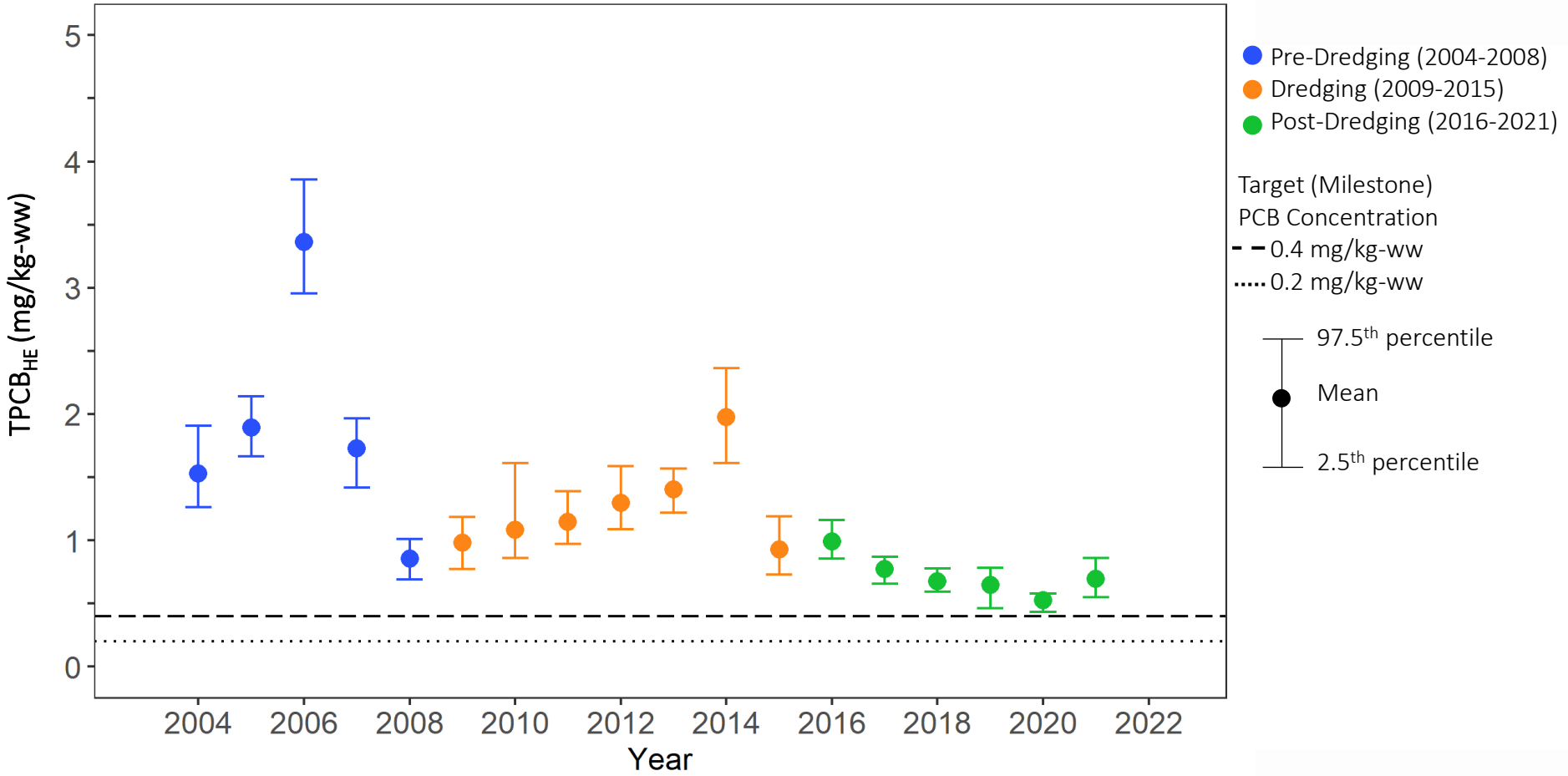
5. The samples from 2007-2013 are rib-out fillets, all other data is NYSDEC standard fillet samples

Species-Weighted Average Wet-Weight $TPCB_{HE}$

River Section 3



Notes

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2. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
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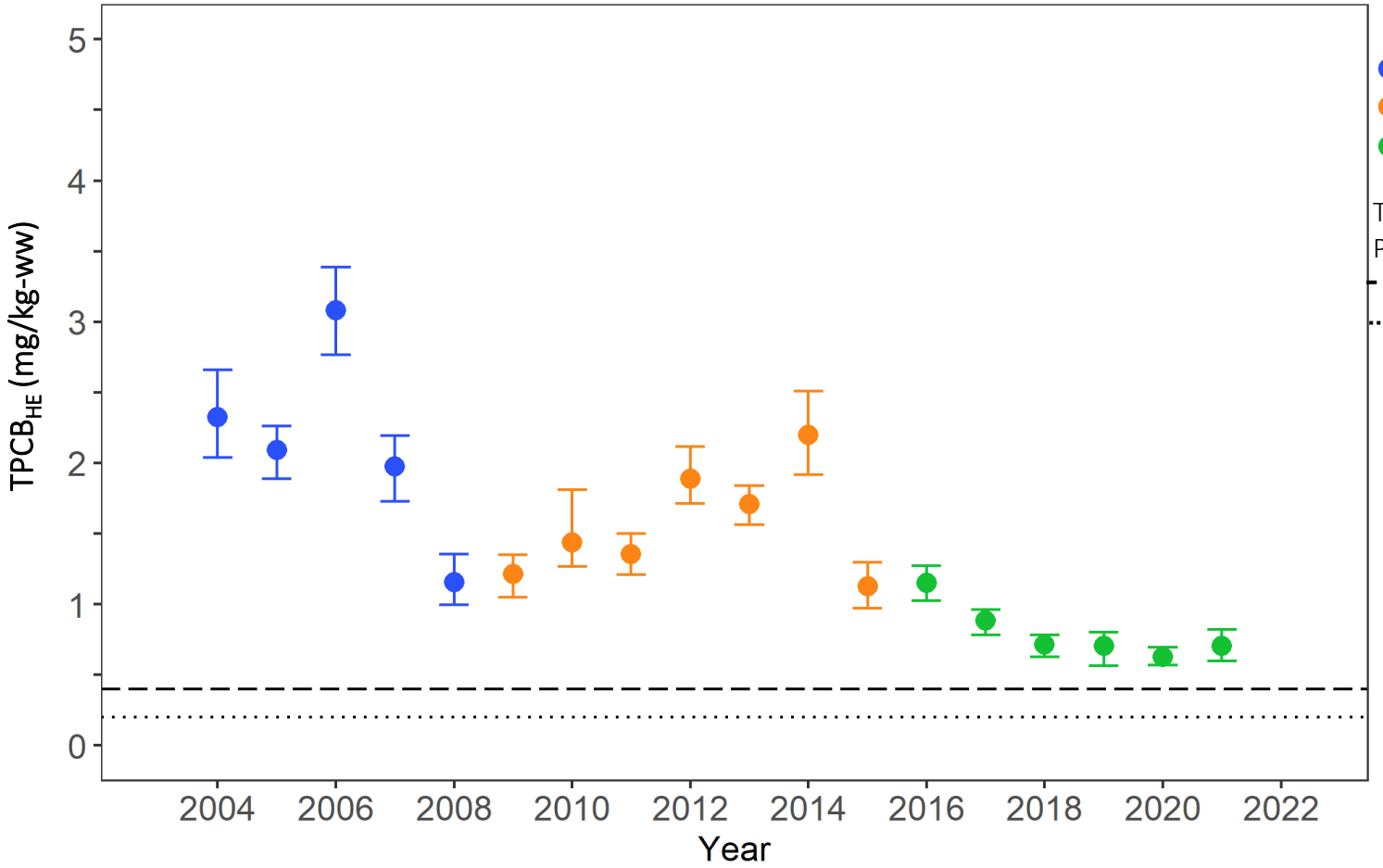
5. The samples from 2007-2013 are rib-out fillets, all other data is NYSDEC standard fillet samples

Species-Weighted Average Wet-Weight $TPCB_{HE}$

Upper Hudson River (RS 1 to RS 3)



Species-weighted average concentrations have **decreased** since the pre-dredging period

Notes

1. Individual species are averaged by collection station and then averaged together by River Section
2. River Section fish tissue PCB concentrations are weighted by species. Largemouth and smallmouth bass = 47%, brown bullhead = 44%, yellow perch = 9%
3. Upper Hudson River average is weighted by both species and river section length. River Section 1 = 6.3 miles (15.4%); River Section 2= 5.1 miles (12.5%); and River Section 3= 29.5 miles (72.1%). Data from river Reaches 4 through 1 are not included in this calculation since they were not collected regularly. Reach 5/River Section 3 is weighted to reflect all 29.5 miles of River Section 3, while the fish monitoring stations representing River Section 3 are all located in Reach 5, which is 14 miles long
4. 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method
5. The samples from 2007-2013 are rib-out fillets, all other data is NYSDEC standard fillet samples

2004-2021 Total PCB_{HE} Species-Weighted Averages by River Section (wet-weight, mg/kg)

Monitoring Period	Year	Upper River Average		River Section 1		River Section 2		River Section 3	
		River Section 1-3 Mean	Confidence Limit	River Section 1 Mean	**Confidence Limit**	River Section 2 Mean	**Confidence Limit**	River Section 3 Mean	**Confidence Limit**
Baseline (Pre-Dredge) Monitoring Period (BMP)	2004	2.3	2.0 - 2.7	4.9	3.5 - 6.4	3.8	3.2 - 4.4	1.5	1.2 - 1.9
	2005	2.1	1.9 - 2.3	2.3	1.8 - 2.9	3.0	2.3 - 3.7	1.9	1.7 - 2.1
	2006	3.1	2.8 - 3.4	2.3	1.9 - 2.8	2.4	2.2 - 2.7	3.4	3.0 - 3.8
	2007	2.0	1.8 - 2.2	2.7	2.3 - 3.2	2.5	2.1 - 3.0	1.7	1.5 - 2.0
	2008	1.2	0.98 - 1.3	1.5	1.2 - 1.9	2.5	1.8 - 3.5	0.85	0.68 - 1.0
Dredging (2009, 2011-2015) Remedial Action Monitoring Program (RAMP)	2009	1.2	1.0 - 1.4	1.7	1.3 - 2.2	2.0	1.6 - 2.6	0.98	0.77 - 1.2
	2010	1.4	1.2 - 1.7	2.9	2.4 - 3.5	1.7	1.3 - 2.2	1.1	0.83 - 1.5
	2011	1.4	1.2 - 1.6	1.9	1.6 - 2.1	1.9	1.6 - 2.5	1.1	0.93 - 1.4
	2012	1.9	1.7 - 2.2	3.5	2.8 - 4.2	3.3	2.8 - 4.0	1.3	1.0 - 1.6
	2013	1.7	1.6 - 1.9	2.3	2.1 - 2.6	2.7	2.3 - 3.1	1.4	1.2 - 1.6
	2014	2.2	1.9 - 2.5	2.3	1.9 - 2.9	3.3	2.8 - 3.9	2.0	1.6 - 2.4
	2015	1.1	0.97 - 1.3	1.6	1.3 - 1.9	1.7	1.4 - 2.0	0.93	0.73 - 1.2
OM&M Monitoring (on-going)	2016	1.1	1.0 - 1.3	1.3	0.98 - 1.7	1.9	1.6 - 2.2	0.99	0.84 - 1.1
	2017	0.88	0.79 - 0.97	0.95	0.79 - 1.1	1.4	1.2 - 1.8	0.77	0.67 - 0.88
	2018	0.71	0.64 - 0.79	0.73	0.61 - 0.87	0.90	0.72 - 1.1	0.68	0.59 - 0.78
	2019	0.70	0.59 - 0.82	0.77	0.60 - 0.96	0.97	0.75 - 1.3	0.65	0.50 - 0.80
	2020	0.63	0.56 - 0.71	0.86	0.63 - 1.2	0.95	0.74 - 1.2	0.52	0.45 - 0.60
	2021	0.71	0.59 - 0.86	0.71	0.58 - 0.9	0.76	0.66 - 0.89	0.69	0.54 - 0.90

Notes:

1. Individual species are averaged by collection station and then averaged together by River Section.
2. Reach and River Section fish tissue PCB concentrations are weighted by species. Black bass = 47%, bullhead = 44%, yellow perch = 9%.
3. Upper Hudson River average is weighted by both species and river reach length. Reach 8: = 6.3 miles (15.4%); Reach 7 = 2.2 miles (5.4%); Reach 6 = 2.9 miles (7.1%); and Reach 5 = 29.5 miles (72.1%). Fish sampling stations in Reaches 4-1 are not currently included in the calculation set. Fish samples from monitoring stations in Reach 5, which is 14 miles long, are used to represent all 29.5 miles of River Section 3. Fish data were not available for Reach 7 in 2008.
4. Dredging was not performed in 2010 so that a planned peer-review of the project could be convened for the purpose of refining the selected remedy.
5. The samples from 2007-2013 are rib-out fillets, all other data are from NYSDEC standard fillet samples.
6. 95% confidence limits on the mean are calculated using a bias-corrected and accelerated (BCA) bootstrap method.

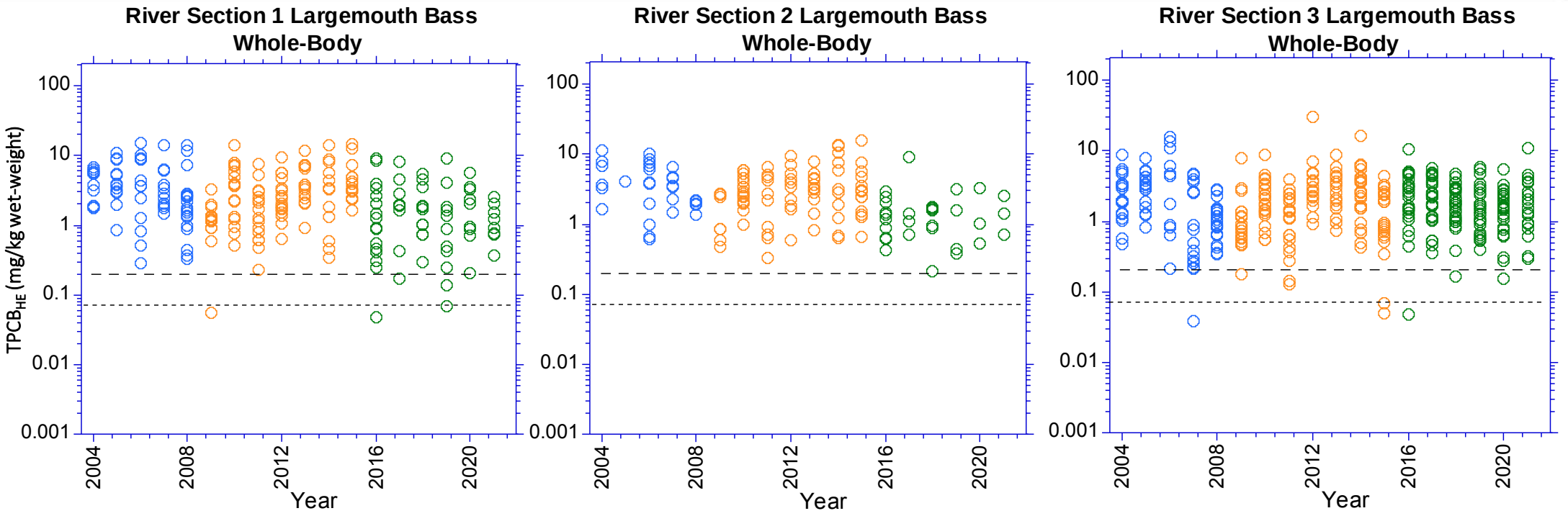
Evaluation of Progress Towards Ecological Risk RAO Goals

Background

- During the Second FYR, EPA's review of recent toxicity data resulted in a revision to the risk-based concentration ranges for PCBs in largemouth bass and spottail shiner
  - **Largemouth bass** (consumed by the river otter): 0.2 to 0.07 mg/kg PCBs (LOAEL and NOAEL, respectively)
    - Whole body bass concentrations are currently estimated using a multiplier of 2.5 on the fillet concentrations (EPA BERA 1997)
    - Future sampling to include smaller whole-body bass will be conducted at the appropriate time
  - **Spottail shiner** (consumed by the mink): 0.34 to 0.11 mg/kg PCBs (LOAEL and NOAEL, respectively)

Ecological Risk- Largemouth Bass (Whole-Body Equivalent)

Risk-based concentration range: 0.2 to 0.07 mg/kg PCBs in fish



Largemouth bass are analyzed as fillet samples, the results of which are then multiped by 2.5 to estimate whole-body concentration from a fillet result (EPA BERA 1997)

Notes:

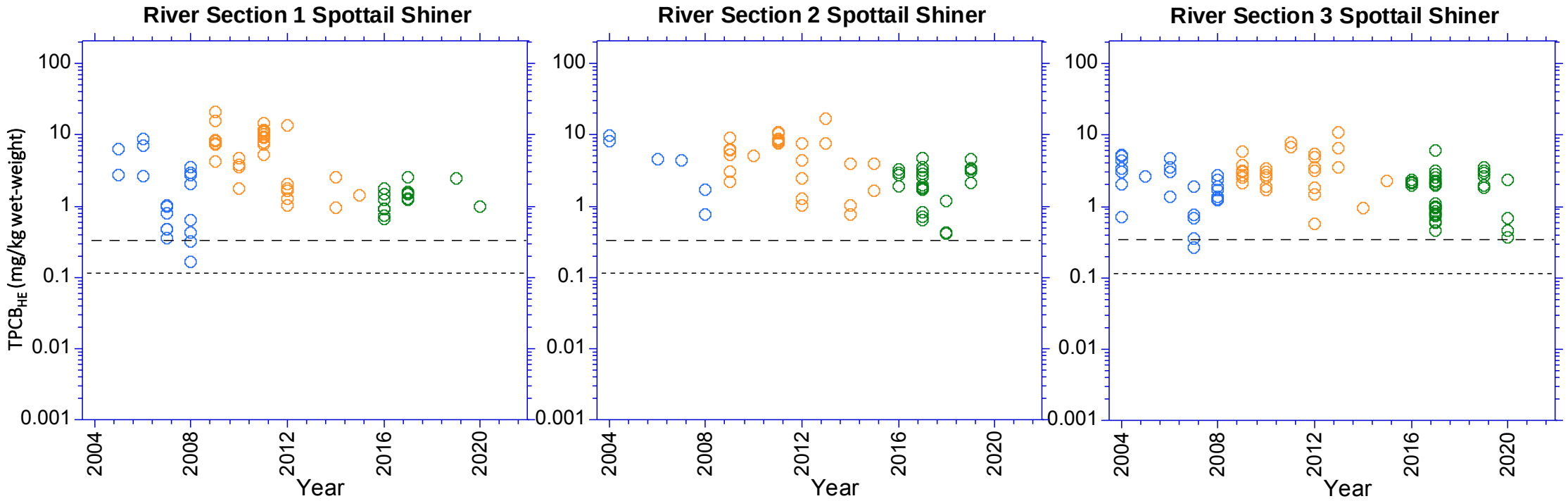
1. PCB concentrations are expressed as Total PCB homologue equivalent values (TPCB$_{HE}$), based on conversion from reported Aroclor results

Legend

- Whole-body equivalent
- Sampling Period
  - Pre-Dredging Period (2004-2008)
  - Dredging Period (2009-2015)
  - Post-Dredging Period (2016-2021)
- Eco Risk Target PCB Concentration
  - 0.2 mg/kg-ww
  - 0.07 mg/kg-ww

Ecological Risk – Spottail Shiner

Risk-based concentration range: 0.34 to 0.11 mg/kg PCBs in fish



Notes:

1. PCB concentrations are expressed as Total PCB homologue equivalent values (TPCB$_{HE}$), based on conversion from reported Aroclor results

Legend

○ Whole-body

Sampling Period
- Pre-Dredging Period (2004-2008)
- Dredging Period (2009-2015)
- Post-Dredging Period (2016-2021)

Eco Risk Target PCB Concentration
- 0.34 mg/kg-ww
- 0.11 mg/kg-ww

Observations Regarding Fish Tissue Data

- Relative to the pre-dredging period:
  - Overall, post-dredging fish PCB concentrations are **lower** than the pre-dredging period
  - The percentage of samples below the first human health target (0.4 mg/kg-ww) has **increased**
  - Species-weighted average concentrations have **decreased** in all river sections

Next Steps

- Meeting #4 scheduled for **February 15, 2023, 1:00-2:30pm**
  - Topic: sediment data
  - Technical presentations of data and information
  - Evaluation of recovery
  - Identify challenges and present on-going analyses
- Suggestions or other thoughts?
- Review of follow-up action items

Follow-up Items from Prior Meetings

OU1 Estimate of PCB Mass Remaining

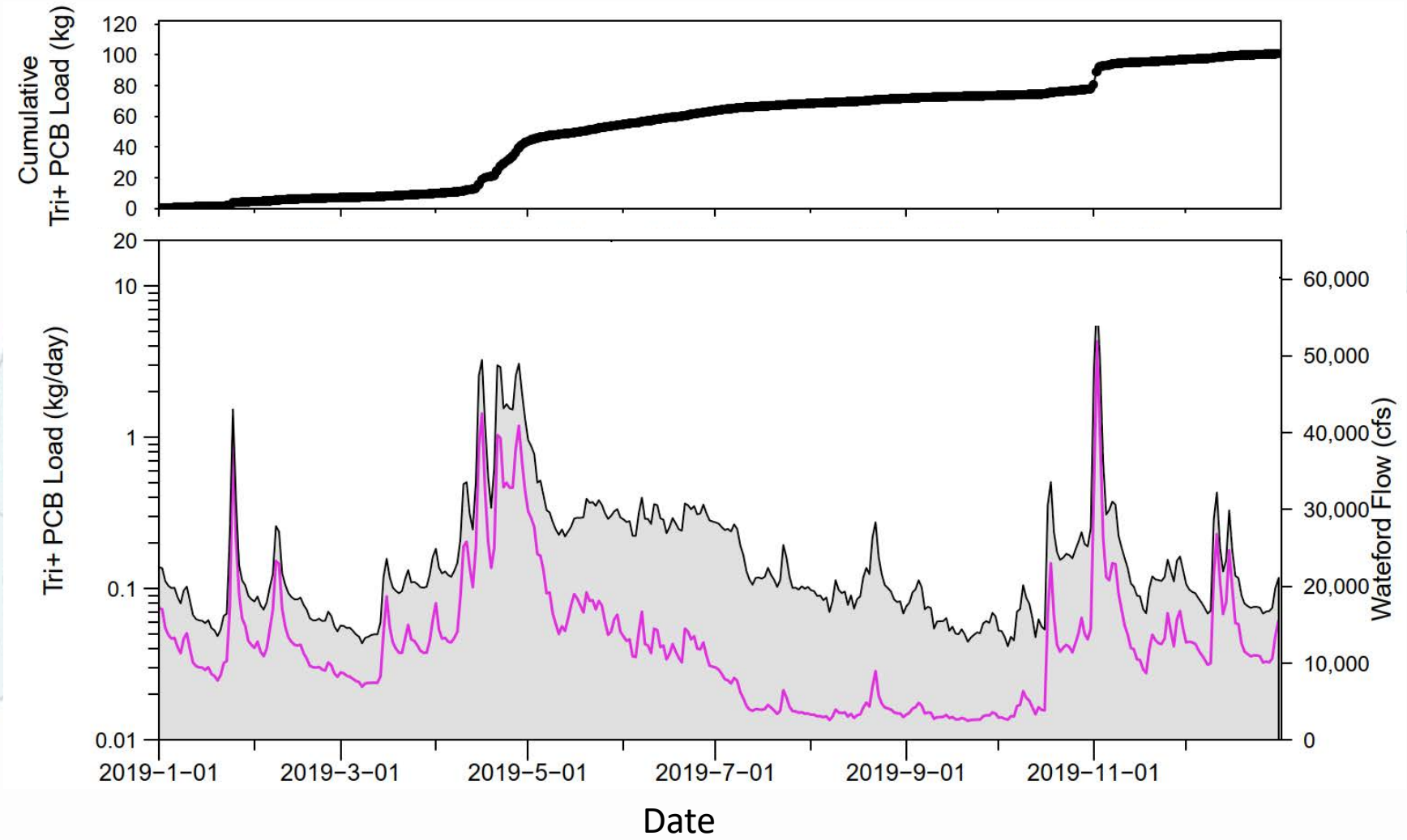
PCB Contamination in Remnant Deposits

Remanent Area	Area[1] (acres)	Contaminated Depth[2] (ft)	Contaminated Volume[2] (yd^3)	PCB Mass[2] (lb)
2	3.5	5	64,530	570
3	17	8	160,925	18,550
4	24	3	80,130	4,600
5	3.5	8	31,630	22,650
Total	**48**		**337,215**	**46,370**

Notes:

1. Area (acres) listed is from 2nd FYR (EPA 2019)
2. Source of contamination depth, volume and PCB mass is 1984 ROD
3. Remnant Deposit 1 originally appeared as an island, but due to flooding in 1976 and 1983 most of the exposed sediment associated with this deposit was scoured
4. Contamination from Remnant Deposit 3A (approximately 14,000 yd^3) was removed by NYSDEC in 1978 and was placed in a secure encapsulated site in Moreau, NY
5. Remnant Deposit 4 and 4A contaminated volume and PCB mass were combined; deeper contaminated depth is shown on the table

PCB Load at Waterford in 2019 (Example)



HUDSON RIVER PCBS SUPERFUND SITE
FIVE-YEAR REVIEW TEAM MEETING
THE MEETING WILL BEGIN AT 1PM

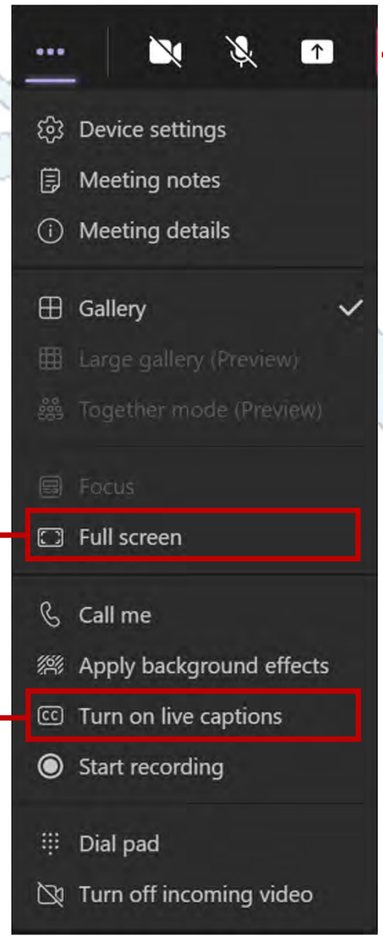
to ask question and share comments

to raise hand

to turn on/off video

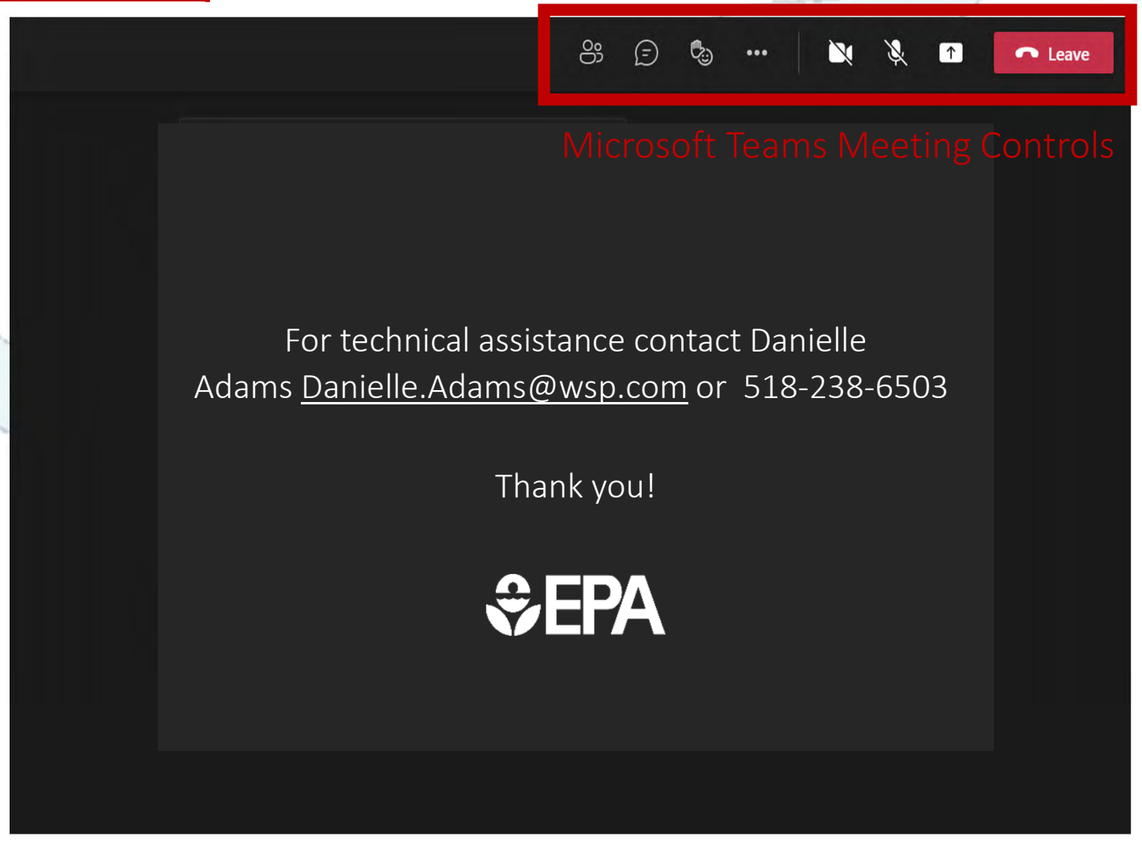
to un/mute mic

to leave the call



to view full screen

to view live caption



Microsoft Teams Meeting Controls

Third Five-Year Review Team Meeting #4

March 01, 2023

Virtual Meeting

Topics for Today's Meeting:

- Upper Hudson River (OU2):
  - Surface sediment (0-2 inch)
    - Focus for this FYR will be on post-dredging data (2016/2017 and 2021)
- Follow-up items from prior meetings
  - PCB mass remaining in OU1
  - Volume/mass removed in OU2
  - Reduction in surface sediment in OU2
  - Daily PCB load example

Reminder: Meeting Approach/Logistics

- EPA plans to keep the meetings to key participants and alternates
  - Check in with EPA if you want others to join

- EPA will not be able to distribute materials/analysis in advance or after meetings
  - Presentations will likely be included in the report
  - Formal opportunity to review and comment on the report
  - EPA is available to answer questions outside of the FYR Team meetings

- Meeting format will be open-dialogue
  - We anticipate receiving feedback and answering questions during the presentations
  - The meeting is scheduled for 1 ½ hours but our goal is to get through the materials in 1 hour

Reminder: Meeting Approach/Logistics (Cont'd)

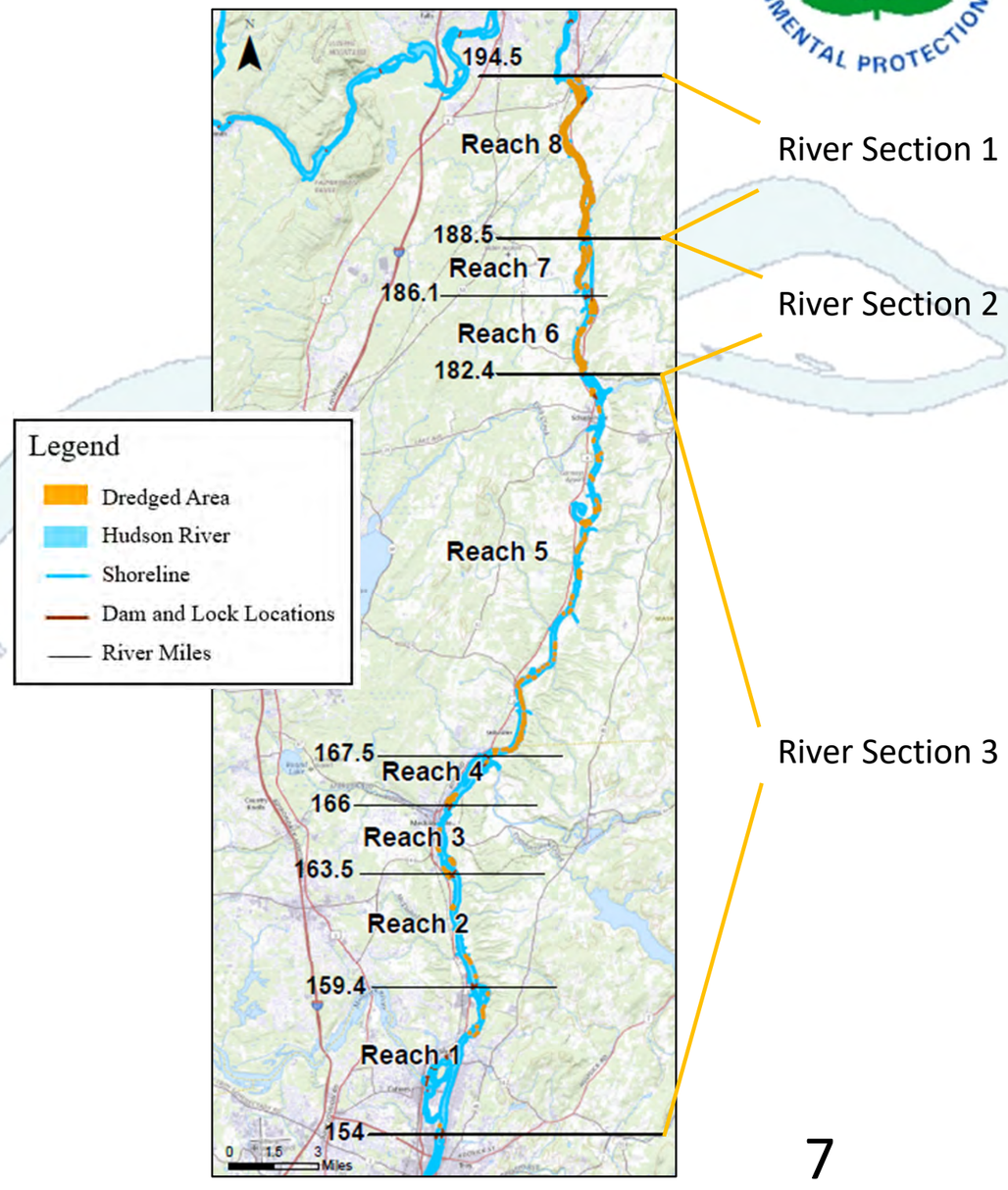
- About 40 slides to cover today

- Meeting etiquette:
  - Remain on mute unless speaking
  - Use camera if you are speaking (at your discretion)
  - Use "raise hand" feature to get the moderator's attention
  - Be respectful of others
  - EPA will monitor the Chat, but our preference is to have one on-going dialog (avoid side conversations)

Upper Hudson River (OU2)
Surface Sediments (0-2 inch)

Outline

- Program Background
- Recalculation of Aroclor 1221 in NYSDEC 2017 Samples
- Summary of FYR Data Evaluations
  - Spatial variation
  - Temporal variation between 2016/2017 and 2021
  - Areas of interest review
- Follow-up Items



Background

- Surface sediment sampling program objectives
  - Track recovery of the mainstem of the river during the post-dredging period
    - Reminder: landcut, backwater, tributaries, unsafe and rock areas were not sampled
    - Unsafe and rock areas are included in area-weighted averages
    - Sampling every five years (initial sampling in 2016)
    - Designed to detect a 5% rate of decline over 10 years (by 2026)
      - River Section-based design, but allows for reach-based evaluation
- Sediment concentrations are linked to water and fish concentrations
- Data up to December 2021 are included in this FYR
- Note: Beryllium-7 (Be-7) bearing samples were collected in May/June 2022
  - Not included in this FYR

Data used in current FYR evaluation

Year	Sampled by	Sample Type	Design Basis	Sample Size		
				Dredged Area	Non-Dredged Area	Total
2016	EPA / GE	0-2 inch Surface Sediment	Simple Random Sampling (SRS)	0	215	215
2017	NYSDEC	0-2 inch Surface Sediment	Systematic Triangular Grid	249	840	1,089
2021	EPA / GE	0-2 inch Surface Sediment	Generalized Random Tessellation Sampling (GRTS) Algorithm	153	589	742

Notes:

- GRTS provides flexibility to adjust the number of samples over time while maintaining spatially representativeness
- EPA refined the 2021 program to reduce the error in estimating the mean
- Additional sampling was conducted under the 2016 program, but samples were not analyzed due to the availability of 2017 data

Recalculation of Aroclor 1221 in NYSDEC 2017 Samples

- EPA identified a mistake in the quantitation of Aroclor 1221 by the Pace Minneapolis lab
- The mistake is associated with TCMX co-eluting with the Aroclor 1221 peak 2 in the chromatogram
- Peak 2 identified by Pace Minneapolis lab is less intense than the correct peak 2, which is co-eluted with TCMX
- The mistake leads to an underestimate of Aroclor 1221
- EPA recalculated the Aroclor 1221 concentrations in all 2017 samples

Aroclor 1221 Chromatogram from GEHR SOP

Wrong peak 2 (mis-identified by Pace Minneapolis)

Correct peak 2 from SOP immediately before TCMX

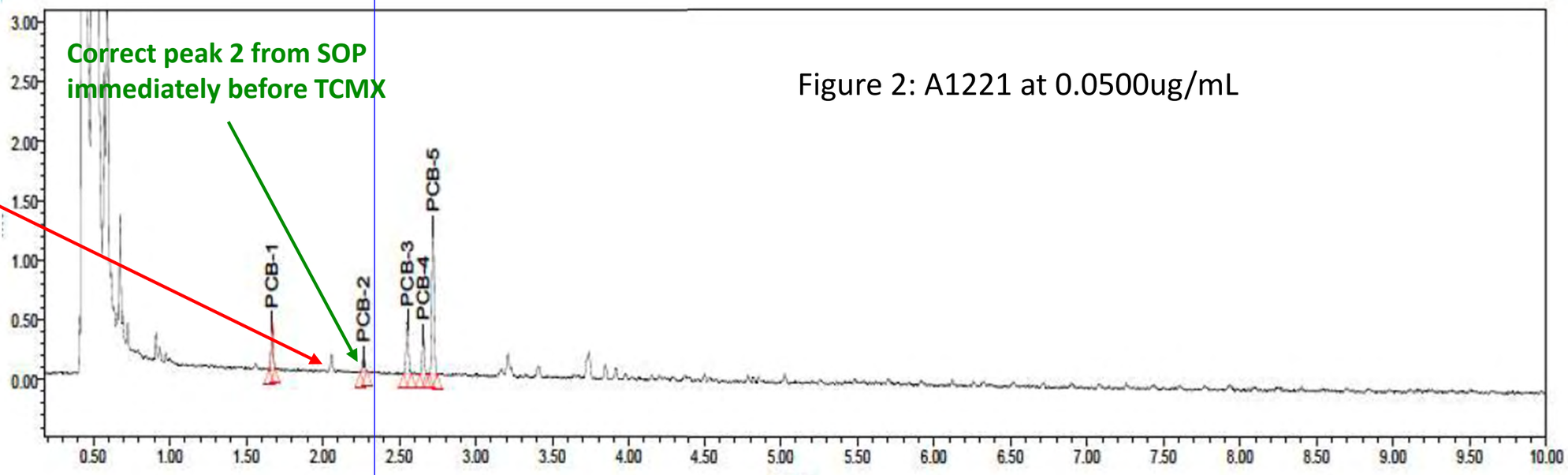


Figure 2: A1221 at 0.0500ug/mL

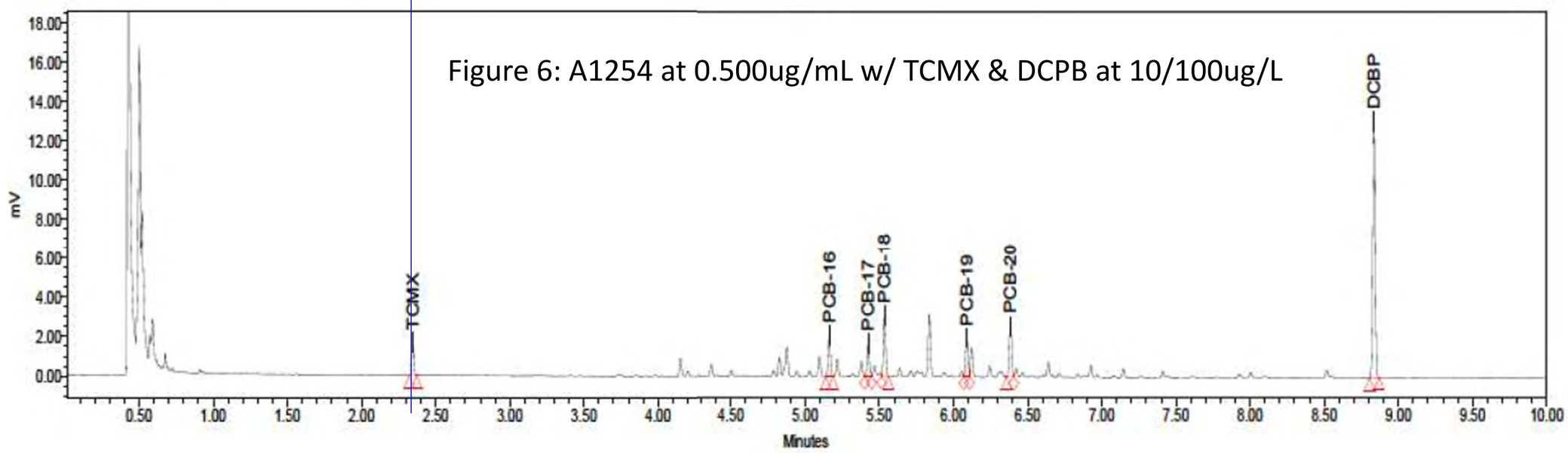


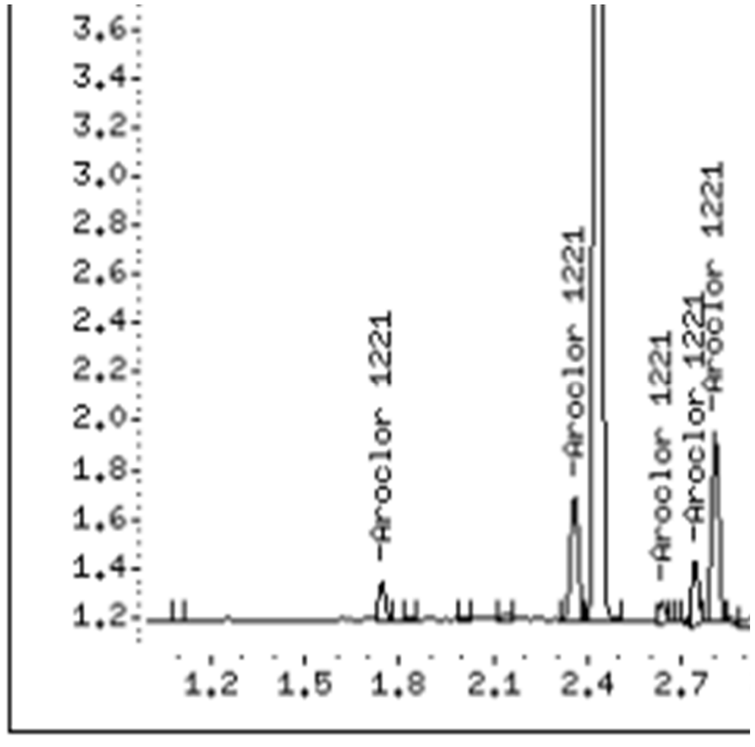
Figure 6: A1254 at 0.500ug/mL w/ TCMX & DCPB at 10/100ug/L

Example Aroclor 1221 Chromatograms in Samples

Fully resolved peak 2
2021

ICU-RCH6-8685-P007

Wrong peak 2 (mis-identified by Pace Minneapolis)

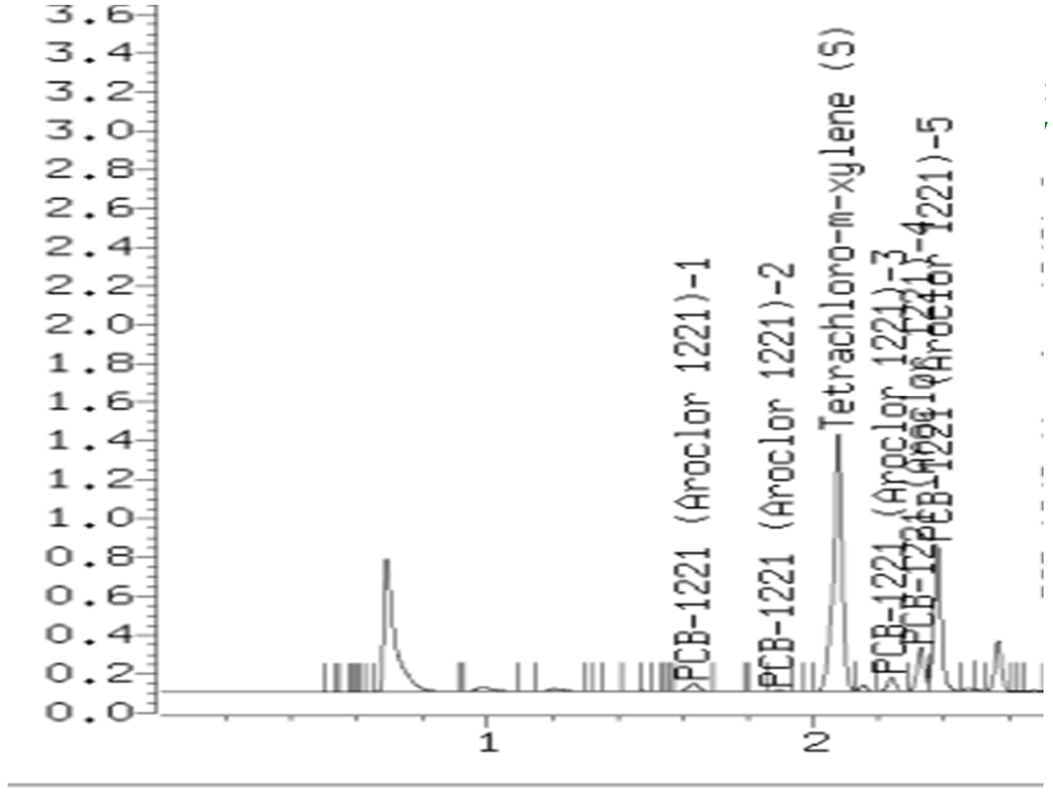


Correct peak 2 has a higher response than the wrong peak 2 in sample

Unresolved peak 2 (co-elute with TCMX)
2017

HR17-OU2-R7-034

Peak 2



Comparison of Original and Recalculated 2017 Results

Dredged Areas: Geometric Mean

River Section	N	Aroclor 1221			Tri+ PCB			TPCB (Sum of Aroclors)		
		Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)	Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)	Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)
RS1	143	0.12	0.17	41%	0.19	0.20	4%	0.29	0.33	16%
RS2	58	0.30	0.52	72%	0.45	0.48	7%	0.74	0.97	30%
RS3	48	0.17	0.32	85%	0.29	0.31	8%	0.47	0.63	34%

Non-Dredged Areas: Geometric Mean

River Section	N	Aroclor 1221			Tri+ PCB			TPCB (Sum of Aroclors)		
		Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)	Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)	Original Conc (mg/kg)	Recalculated Conc (mg/kg)	Increase (%)
RS1	50	0.40	0.54	35%	0.77	0.80	4%	1.22	1.42	16%
RS2	99	1.00	1.50	50%	1.64	1.73	6%	2.72	3.31	21%
RS3	691	0.22	0.31	39%	0.44	0.46	4%	0.67	0.78	15%

- Field duplicate samples averaged
- Excludes Champlain Canal and Landcut samples

ND = Half RL

- Tri+ PCB = 0.13 × Aroclor 1221 + 0.89 × (Aroclor 1242 + Aroclor 1254)

Summary of FYR Data Evaluations

- Analyses being performed in this FYR include:
  - Spatial variation
  - Temporal variation between 2016/2017 and 2021
  - Areas of interest review
- FYR considerations
  - River section and reach
  - Dredged and non-dredged areas
  - Tri+ PCB and TPCB
  - Area-weighted average

Spatial Variation of Tri+ PCB & TPCB Concentrations

- PCB concentration *vs.* river mile
- River-Wide-Area (RWA)-weighted average by river section and reach

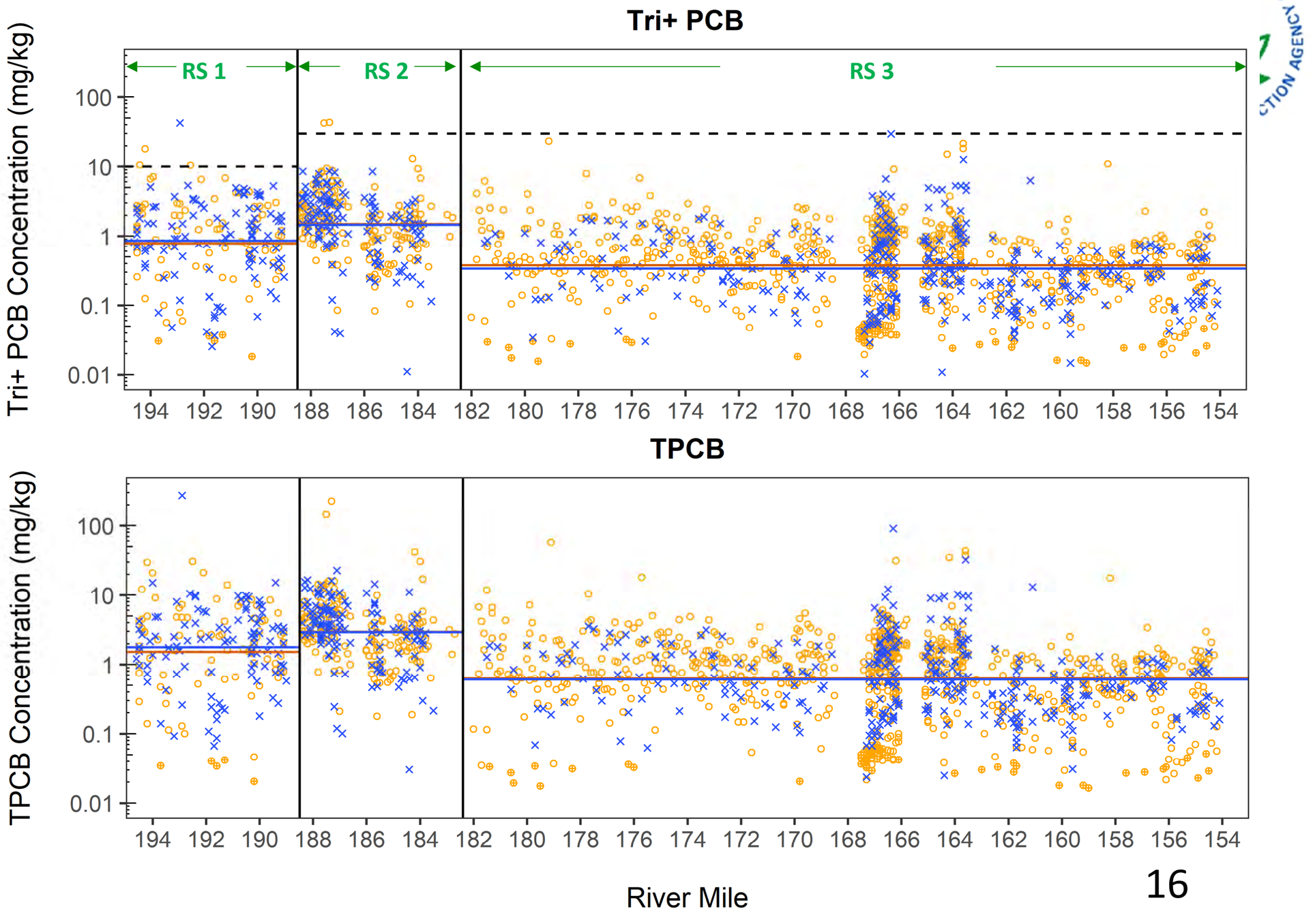
Hudson River
PCBs SUPERFUND SITE

Spatial Variation

Non-Dredged Area by River Section

Legend

- 2016/2017 Detect
- 2016/2017 Non-Detect
- 2021 Detect
- 2016/2017 Geometric Mean
- 2021 Geometric Mean
- Tri+ PCB Dredging Criteria
- River Section Bound



Hudson River
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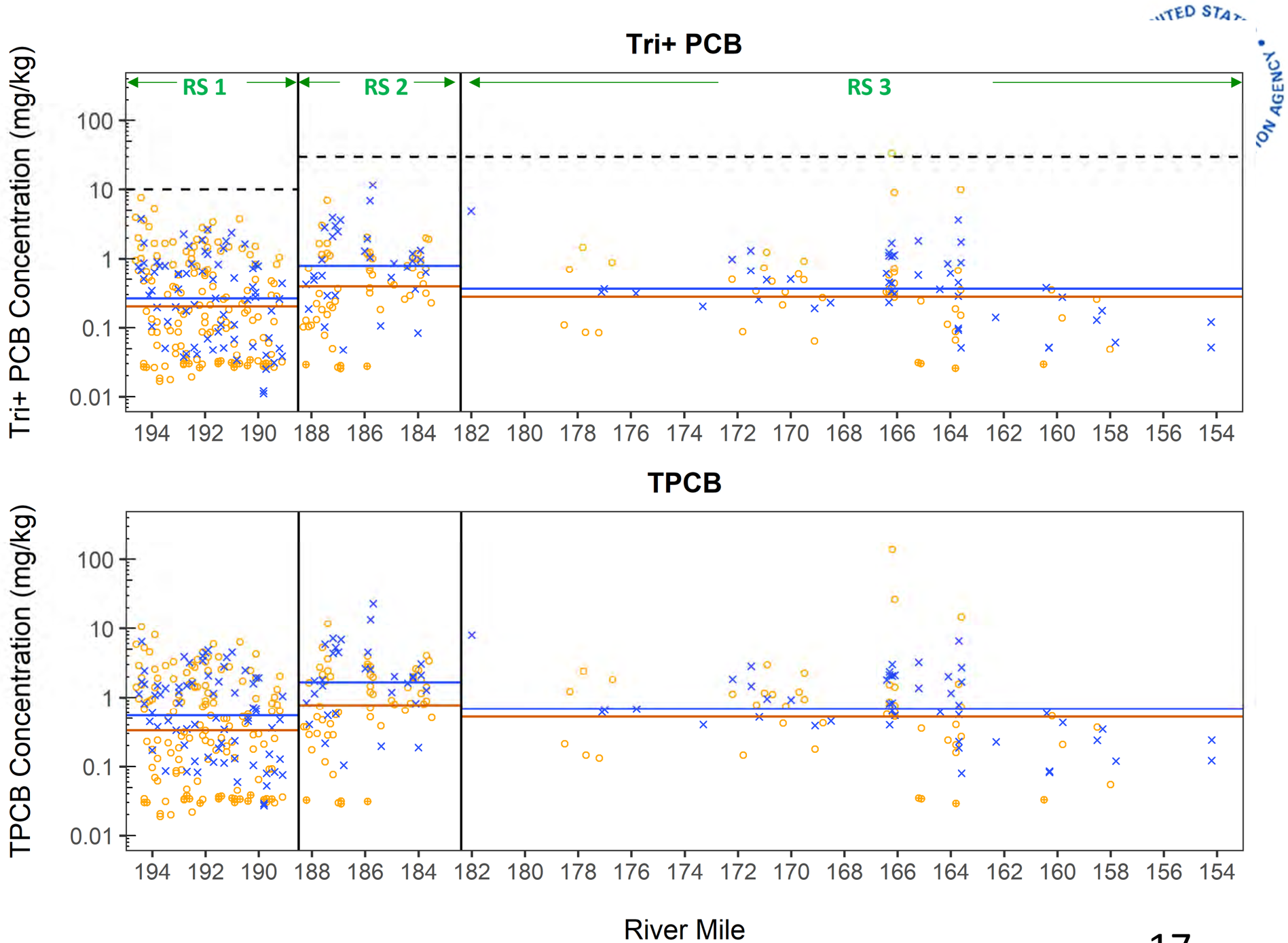
Spatial Variation

Dredged Area by River Section

Legend

- 2016/2017 Detect
- 2016/2017 Non-Detect
- 2021 Detect
- Tri+ PCB Dredging Criteria
- 2016/2017 Geometric Mean
- 2021 Geometric Mean
- River Section Bound



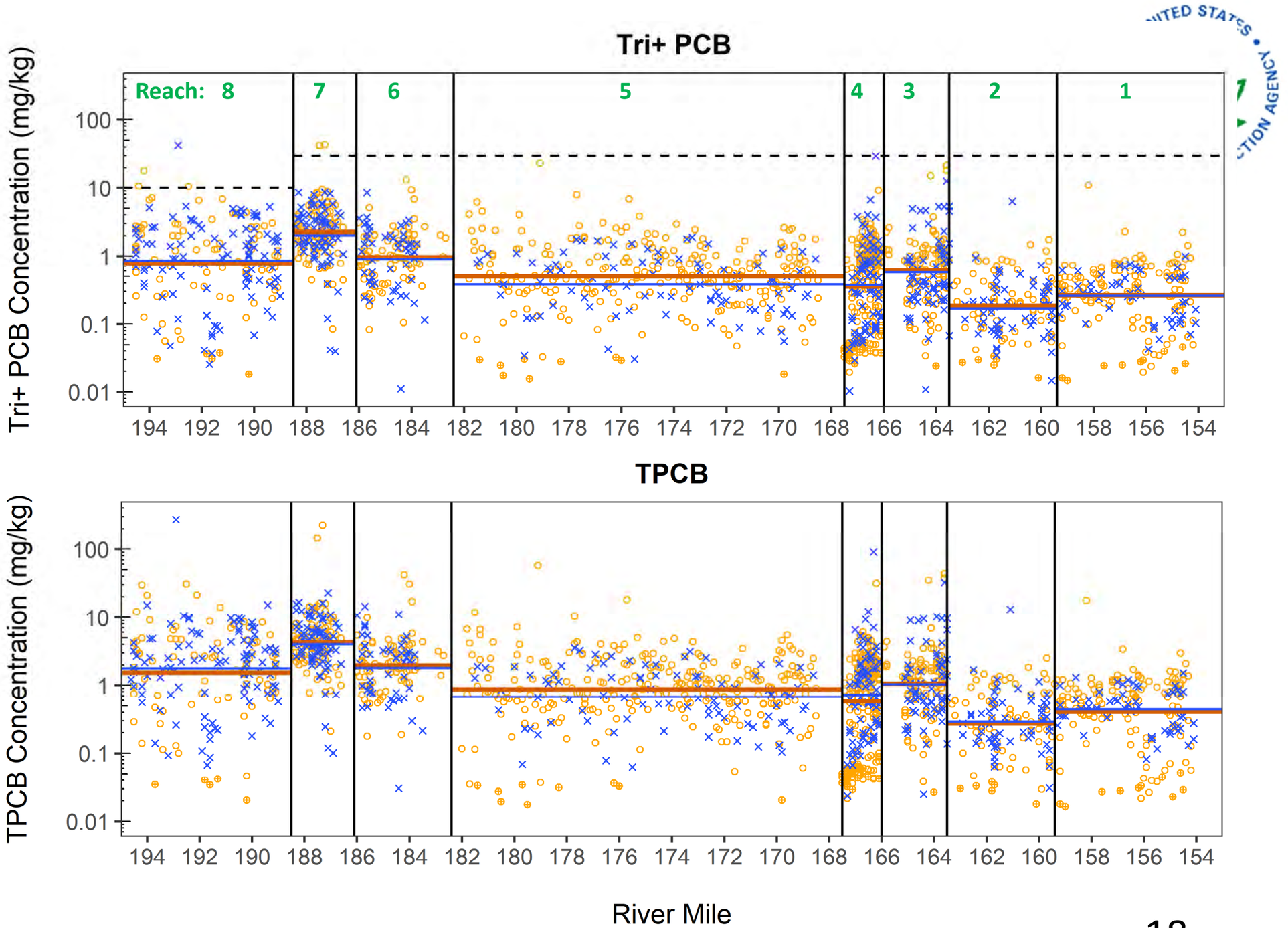
Hudson River
PCBs SUPERFUND SITE

Spatial Variation

Non-Dredged Area by Reach

Legend

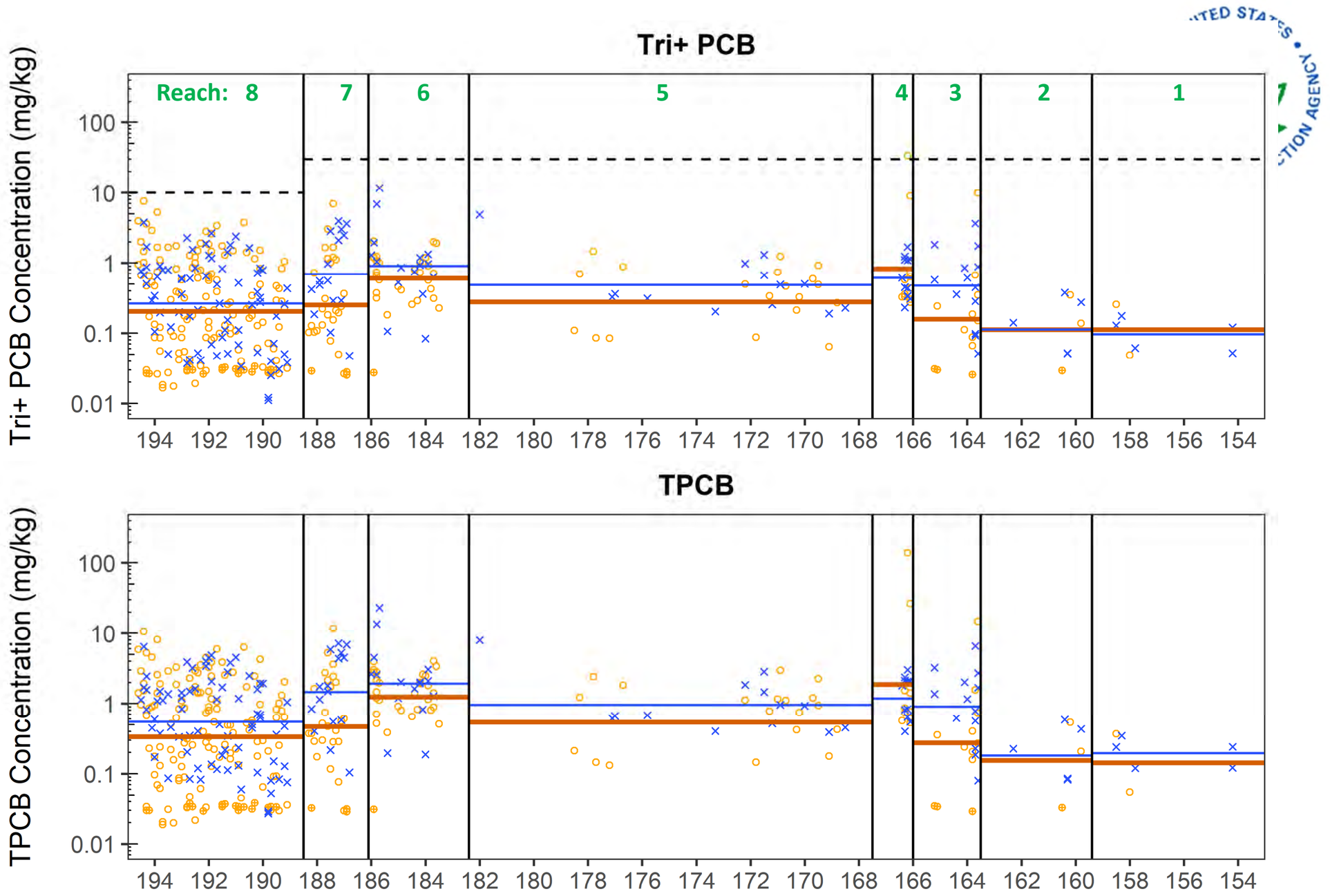
- 2016/2017 Detect
- 2016/2017 Non-Detect
- 2021 Detect
- Tri+ PCB Dredging Criteria
- 2016/2017 Geometric Mean
- 2021 Geometric Mean
- Reach Bound



Hudson River PCBs SUPERFUND SITE

Spatial Variation

Dredged Area by Reach

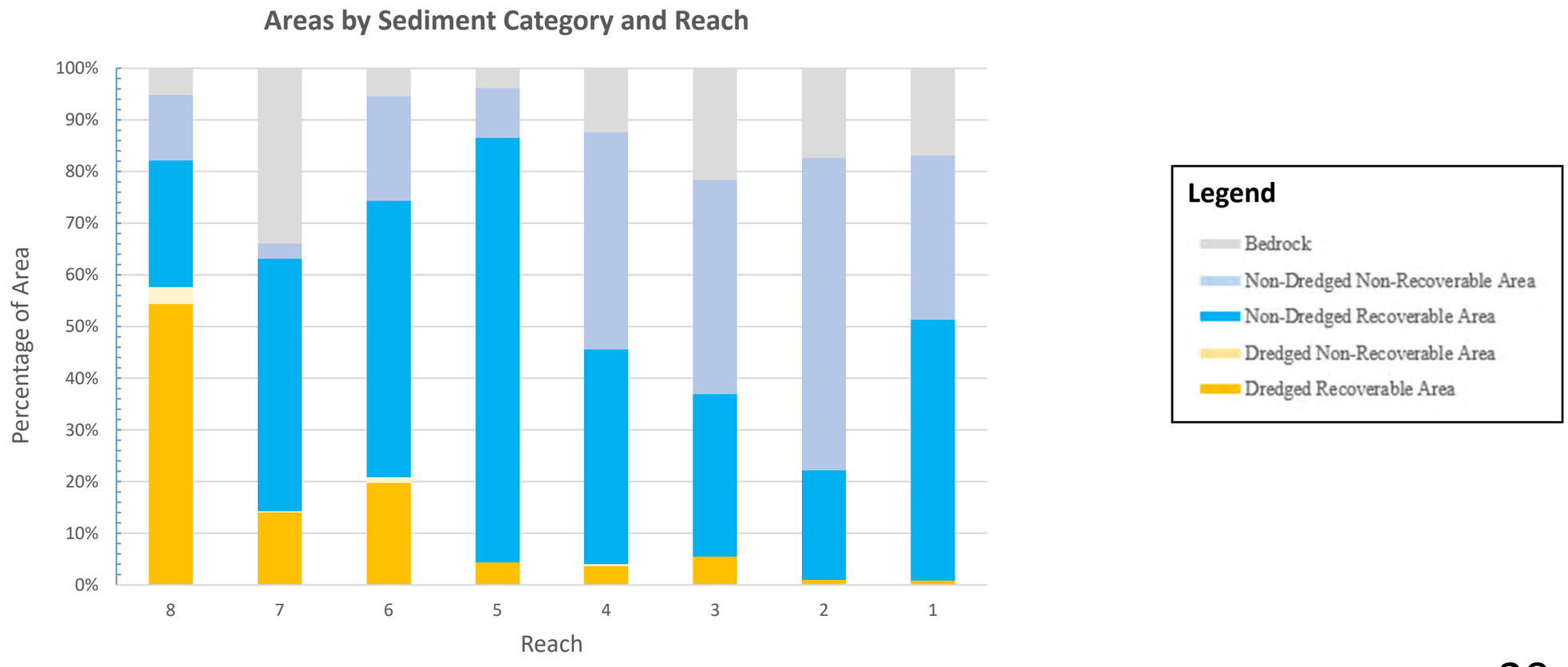


Legend

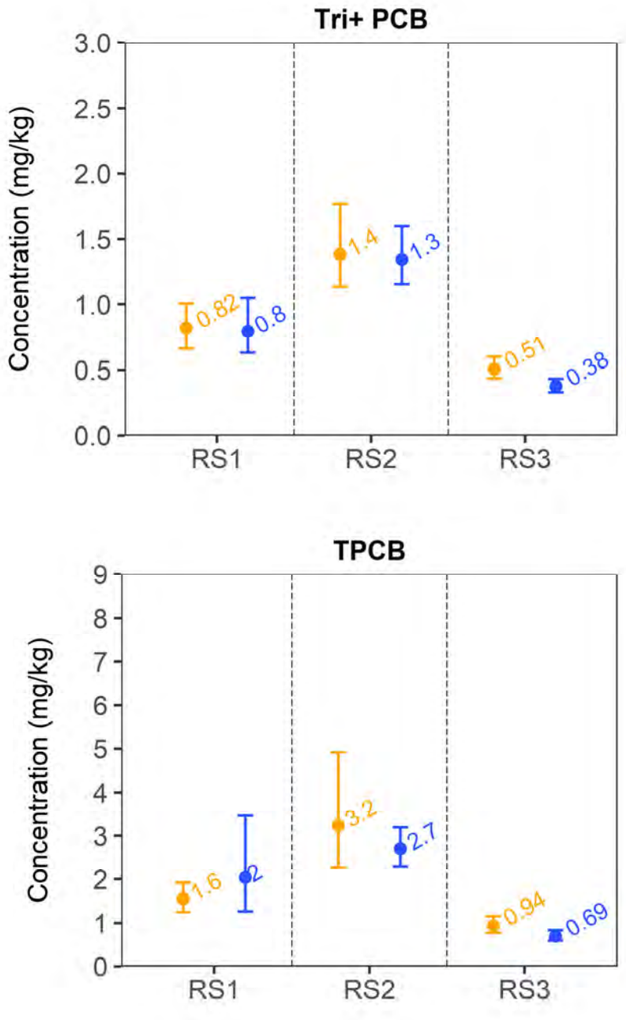
- 2016/2017 Detect
- 2016/2017 Non-Detect
- 2021 Detect
- Tri+ PCB Dredging Criteria
- 2016/2017 Geometric Mean
- 2021 Geometric Mean
- Reach Bound

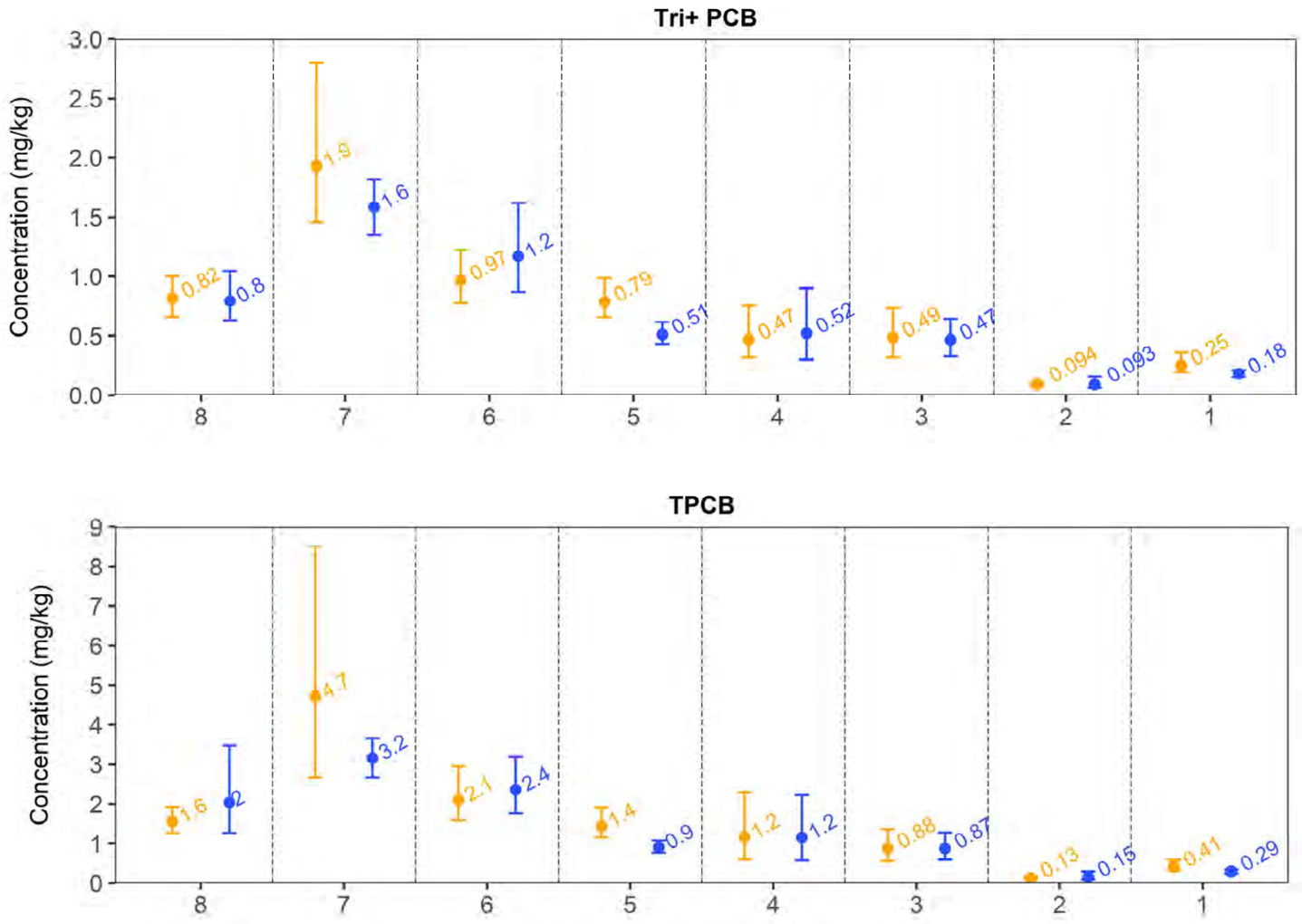
River-Wide-Area (RWA)-Weighted Average

- More representative of fish exposure conditions
- Accounting for bedrock and non-recoverable areas



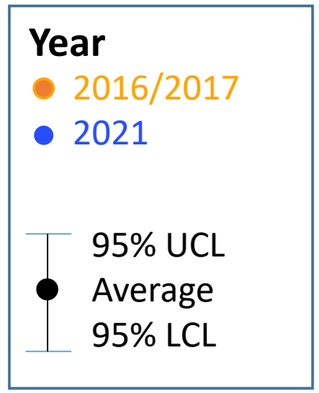
Spatial Variation River-Wide-Area (RWA)-Weighted Average PCB Concentrations





River Section

Reach



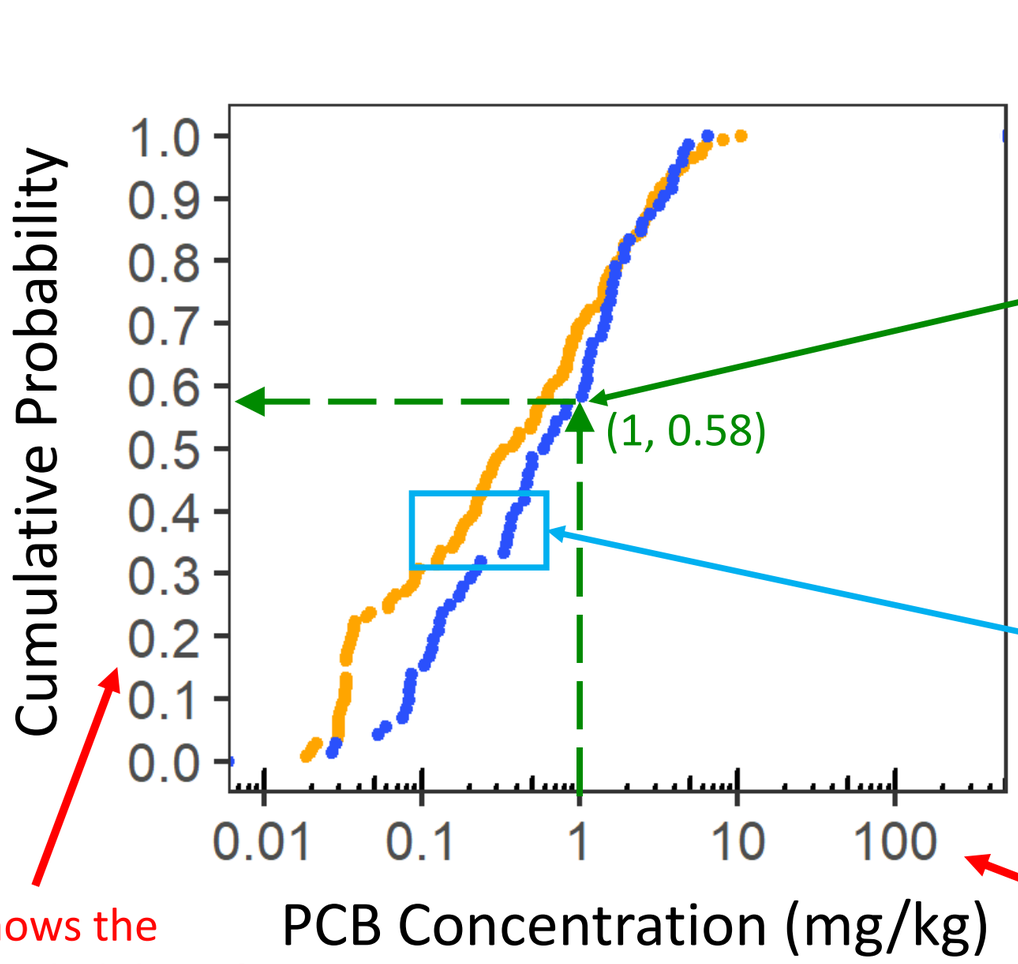
Notes:

- UCL: Upper Confidence Limit
- LCL: Lower Confidence Limit

Temporal variation between 2016/2017 and 2021

- Cumulative probability distribution plot
  - Has the population of dataset as a whole shifted?
  - How low and high concentrations have changed?
- Ratio of geometric mean from 2021 to 2016/2017
  - Has the average concentration in recoverable areas changed?
- River-Wide-Area (RWA)-weighted average
  - Accounts for low concentration areas (rocks and unrecoverable)

Temporal Variation: How to Read Cumulative Probability Distribution Plot - Example



1. Visualize the distribution of measured concentrations

Proportion of samples with concentration below 1 mg/kg is 58%

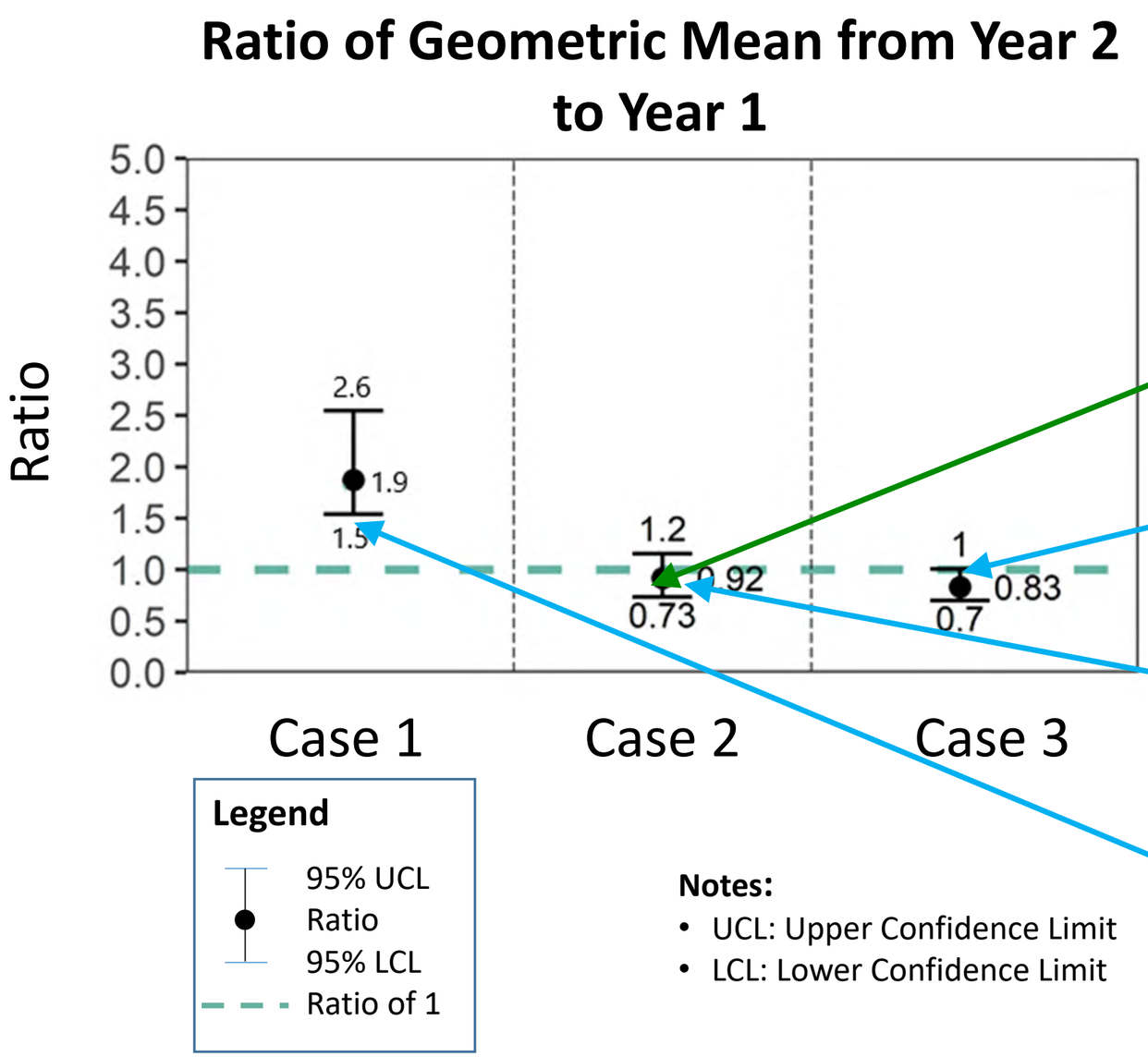
2. Compare two groups:

Moving along the x-axis, Group 2 has higher concentrations than Group 1

The y-axis shows the cumulative probability of observing a concentration at or below a specific value

The x-axis shows the range of concentration

Temporal Variation: How to Read Ratio of Geometric Mean Concentrations - Example



$$Ratio = \frac{Geometric\ Mean\ of\ Year\ 2\ Samples}{Geometric\ Mean\ of\ Year\ 1\ Samples}$$

Geometric mean concentration of Year 2 is 92% of the geometric mean concentration of Year 1

95% UCL at or below 1 =>
Change is statistically significant

Confidence interval includes 1 =>
Change is not statistically significant

Confidence interval above 1 =>
Change is statistically significant

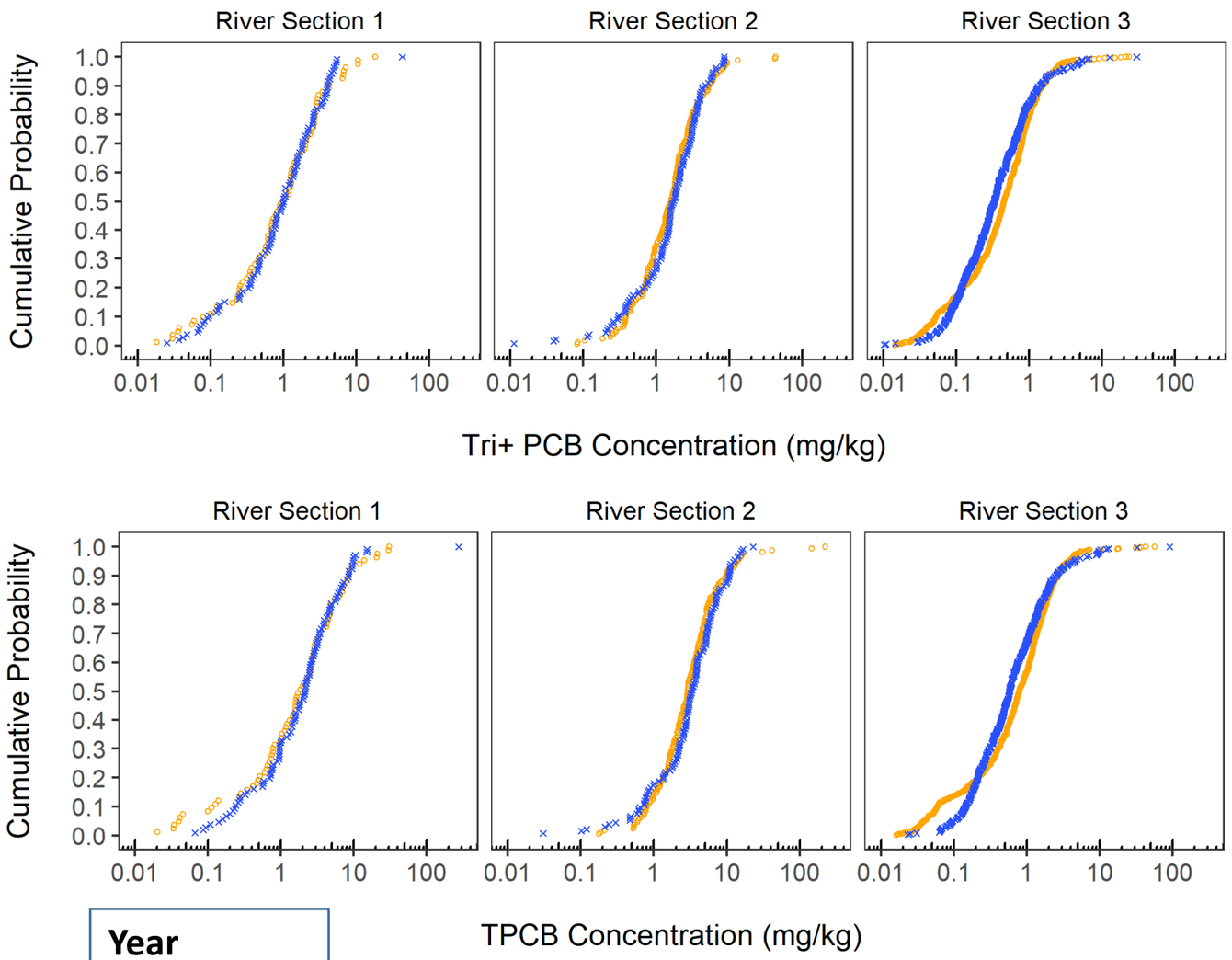
Notes:

- UCL: Upper Confidence Limit
- LCL: Lower Confidence Limit

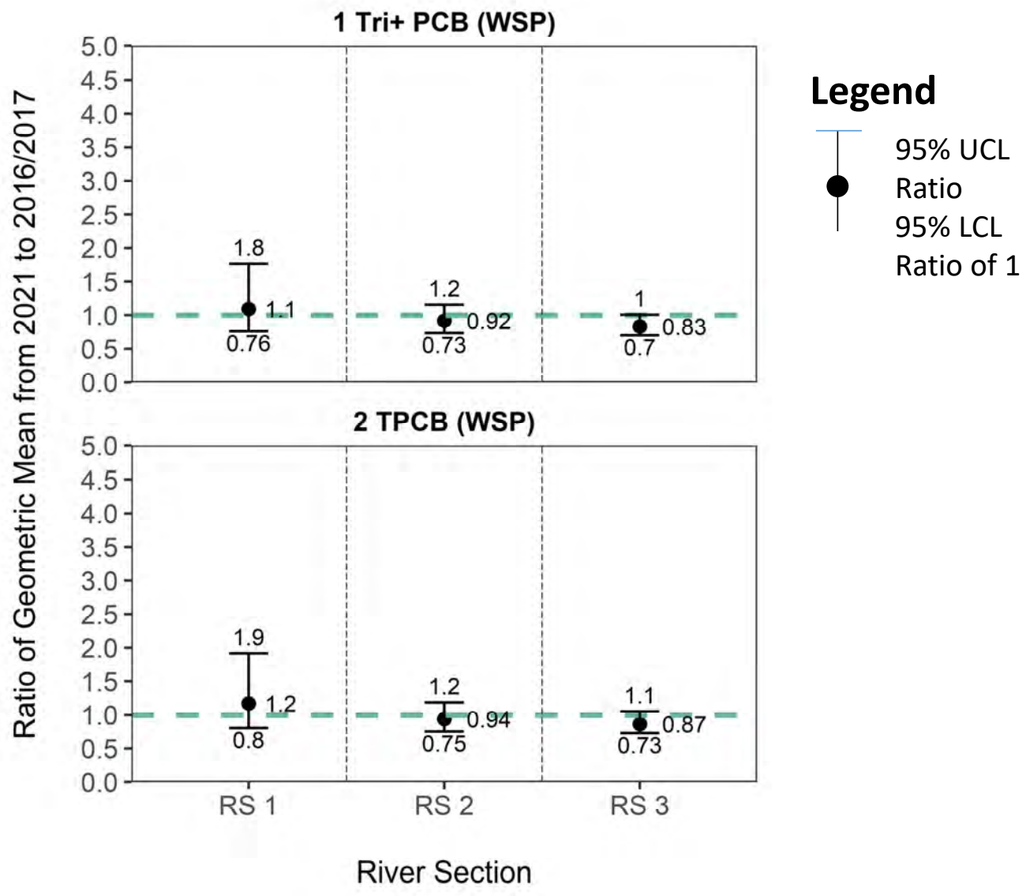
Temporal Variation - River Section Scale

PCB Concentrations – 2016/2017 and 2021 Data
River Section Scale

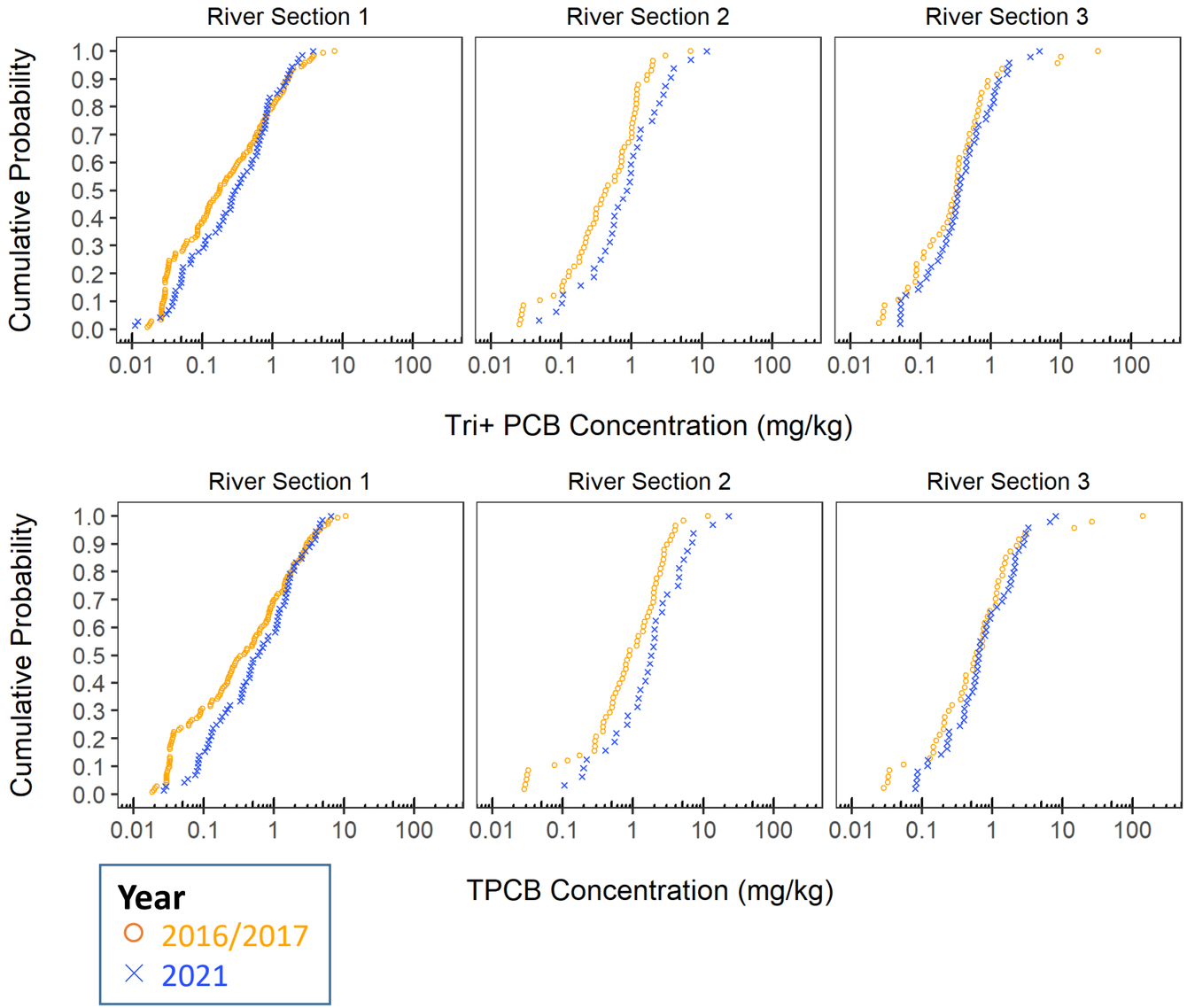
Non-Dredged Area

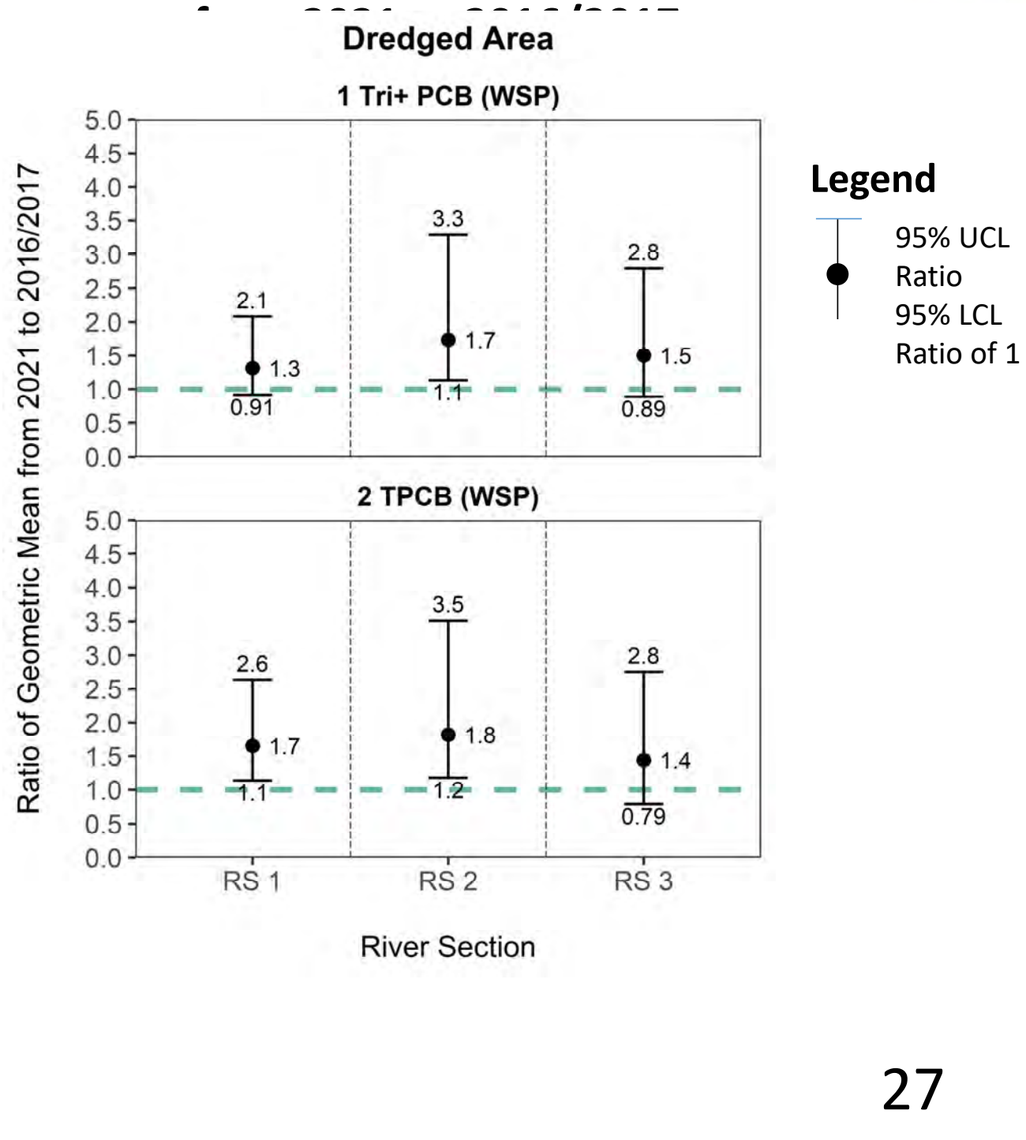


Ratio of Geometric Mean from 2021 to 2016/2017



PCB Concentrations – 2016/2017 and 2021 Data
River Section Scale

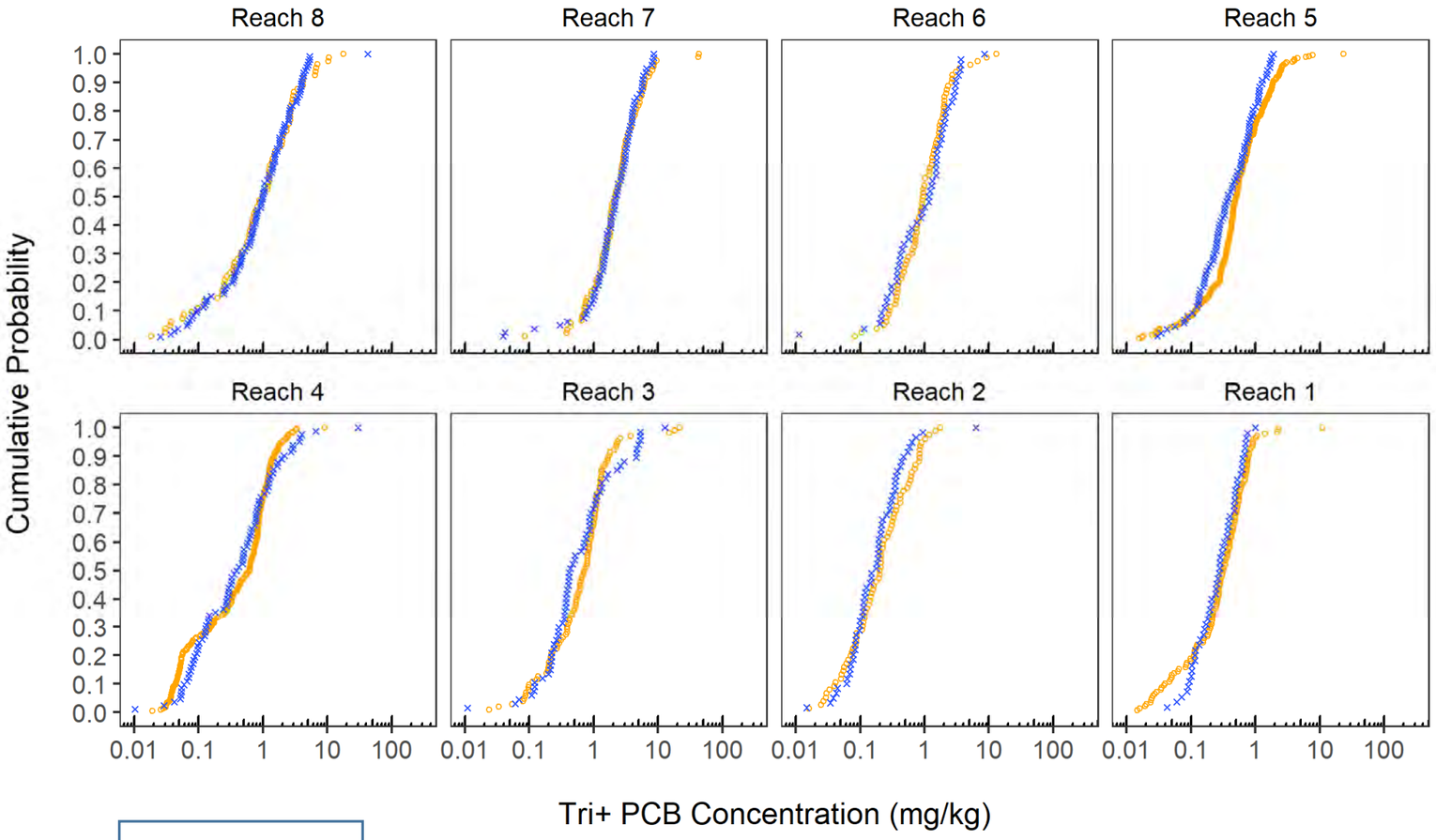




Temporal Variation - River Reach Scale

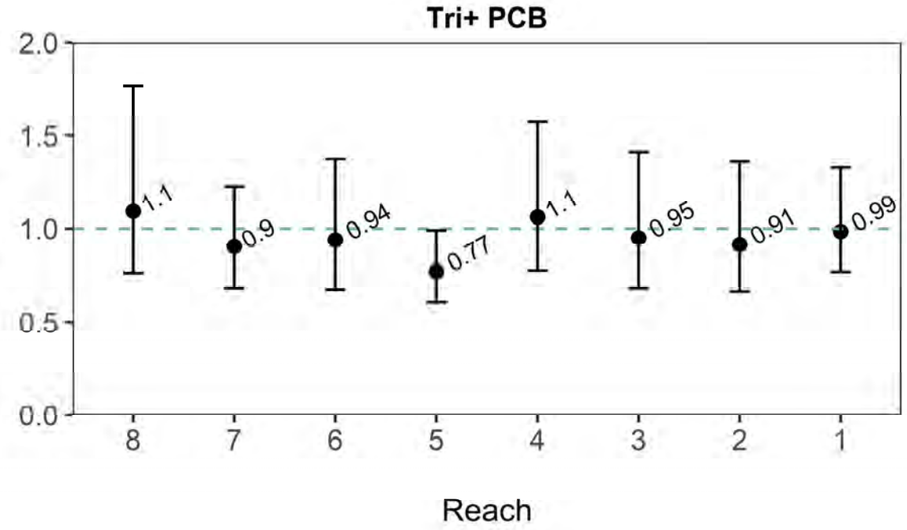
PCB Concentrations – 2016/2017 and 2021 Data
River Reach Scale

Tri+ PCB in Non-Dredged Areas



Year
- 2016/2017
- 2021

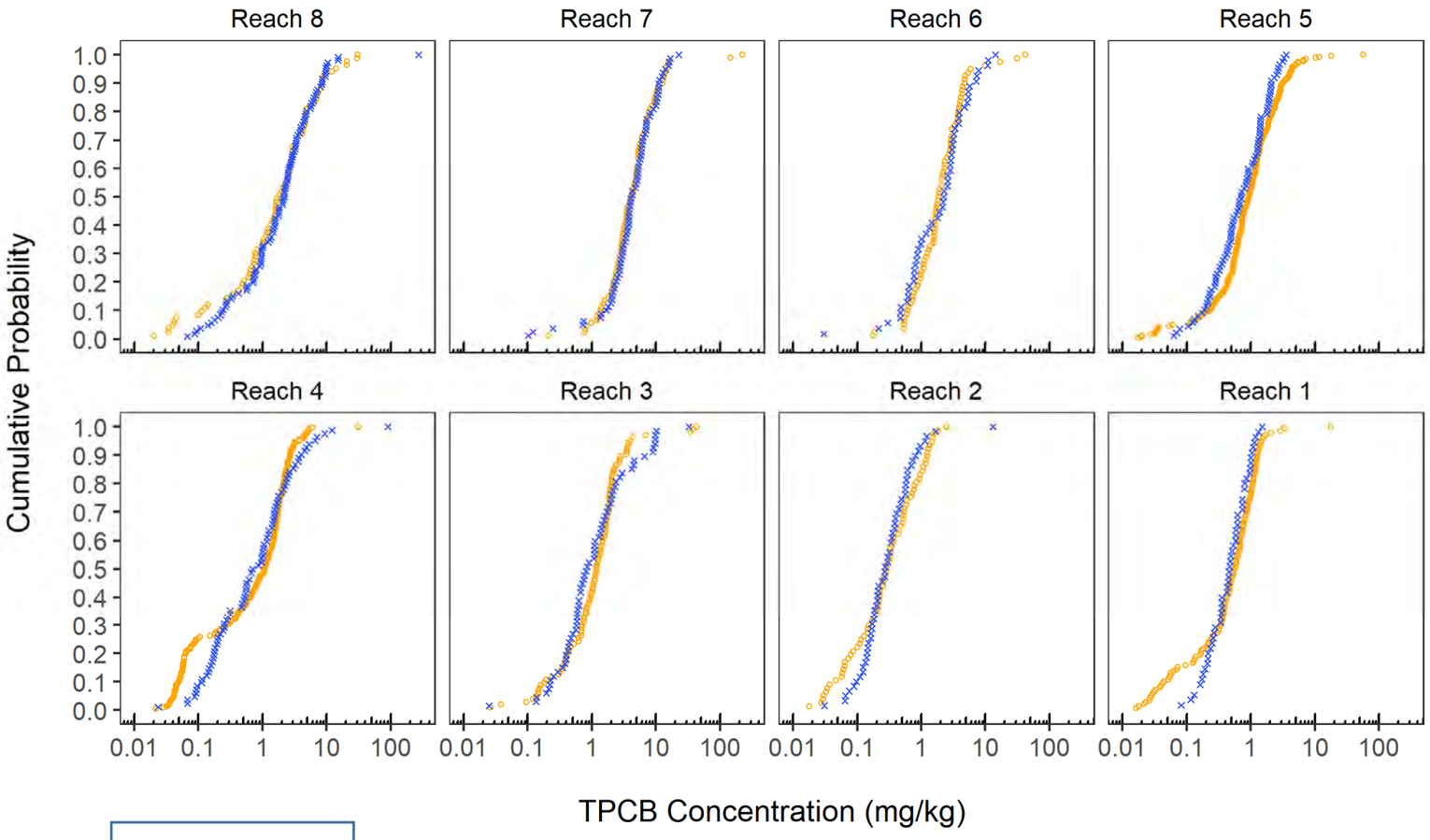
Ratio of Geometric Mean from 2021 to 2016/2017



Legend
- 95% UCL
- Ratio
- 95% LCL
- Ratio of 1

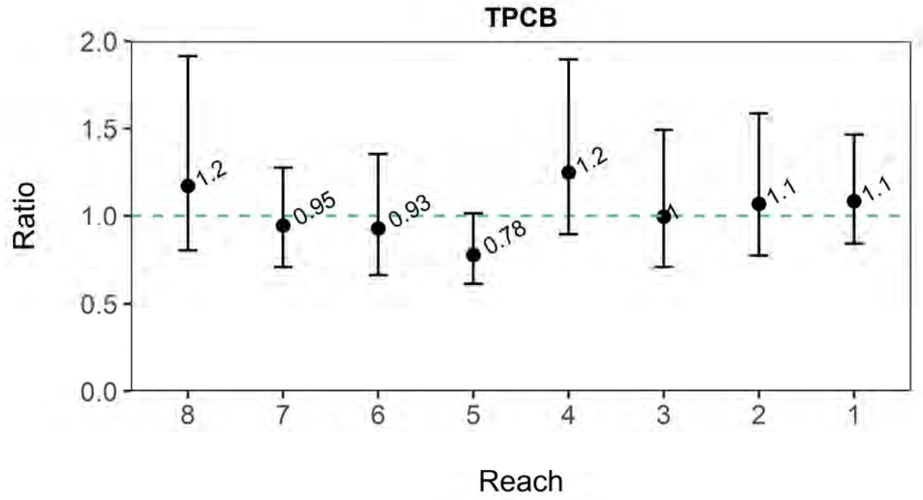
PCB Concentrations – 2016/2017 and 2021 Data
River Reach Scale

TPCB in Non-Dredged Areas



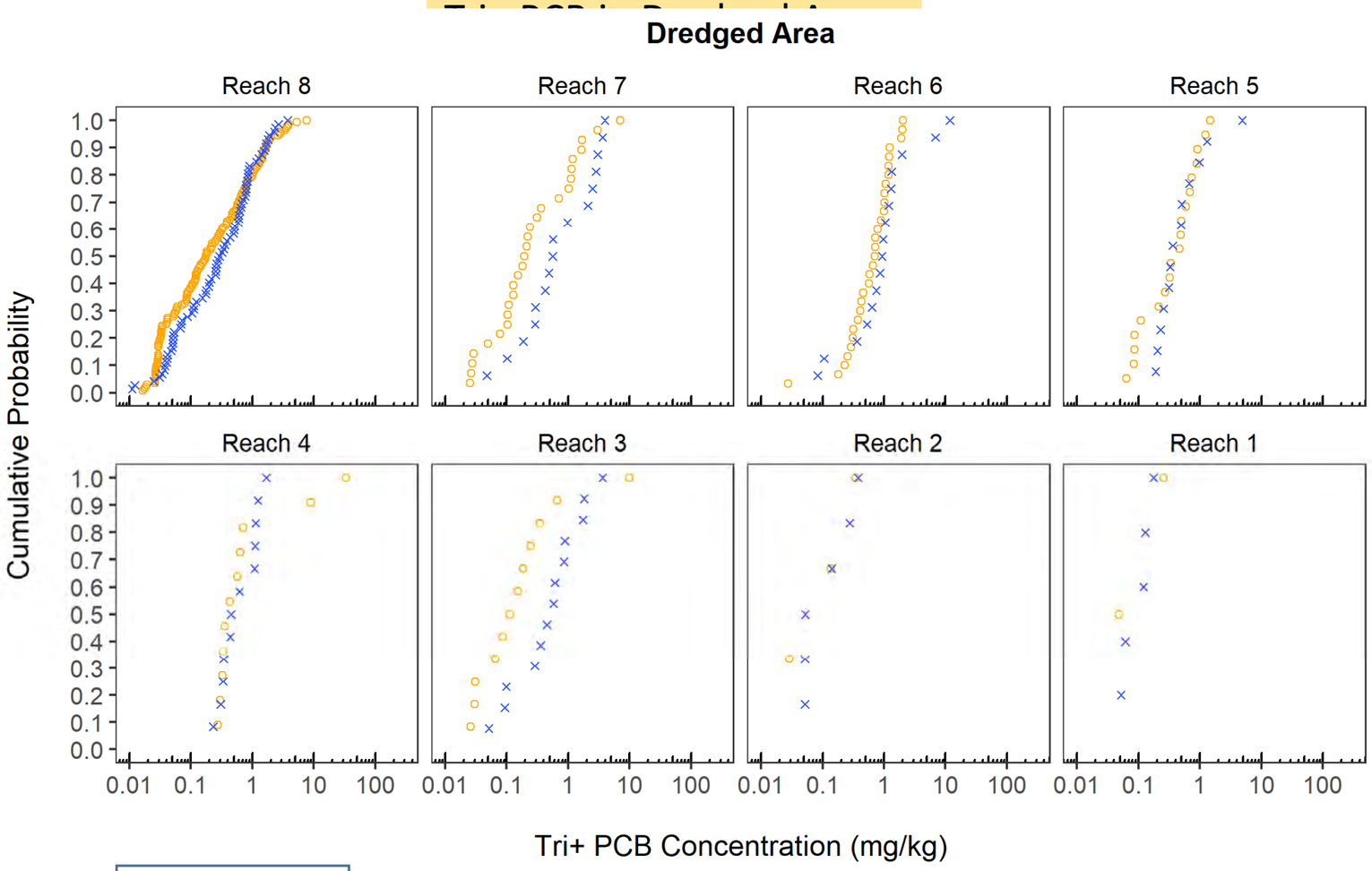
Year
- 2016/2017
- 2021

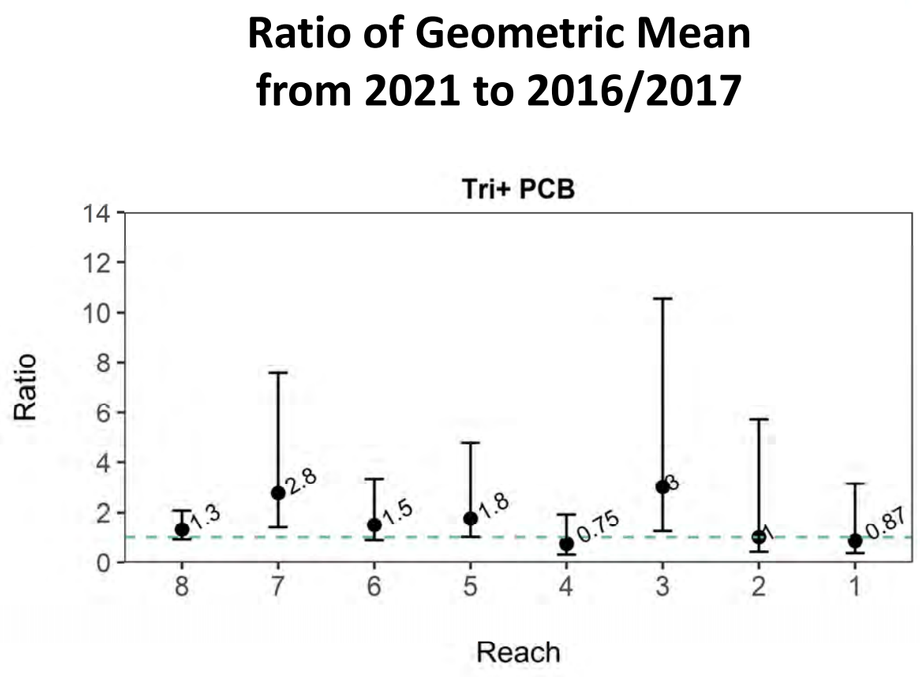
Ratio of Geometric Mean from 2021 to 2016/2017



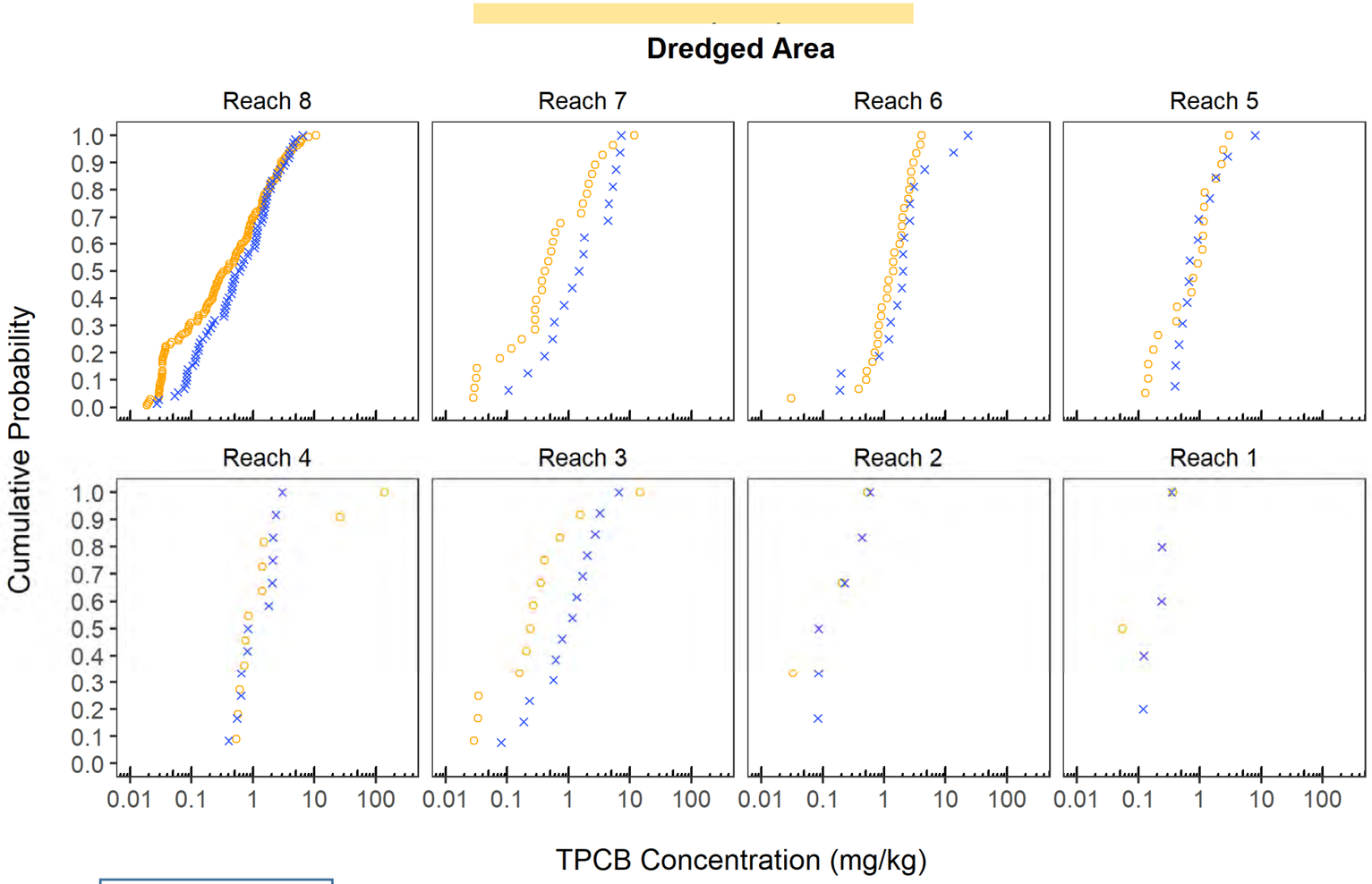
Legend
- 95% UCL
- Ratio
- 95% LCL
- Ratio of 1

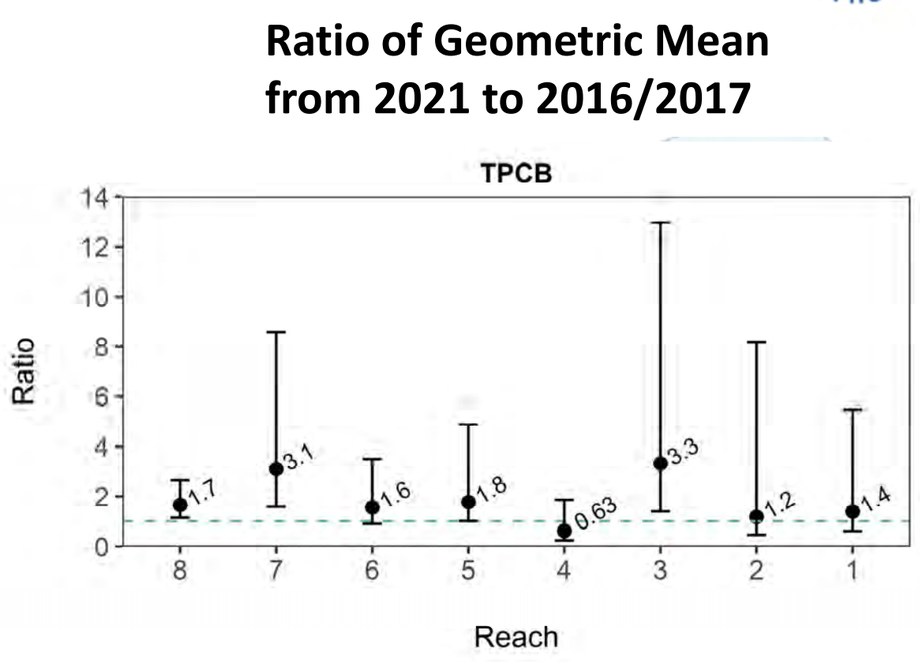
PCB Concentrations – 2016/2017 and 2021 Data
River Reach Scale





PCB Concentrations – 2016/2017 and 2021 Data
River Reach Scale





River-Wide-Area (RWA)-Weighted Average PCB Concentrations – 2016/2017 and 2021 Data

Hudson River PCBs SUPERFUND SITE

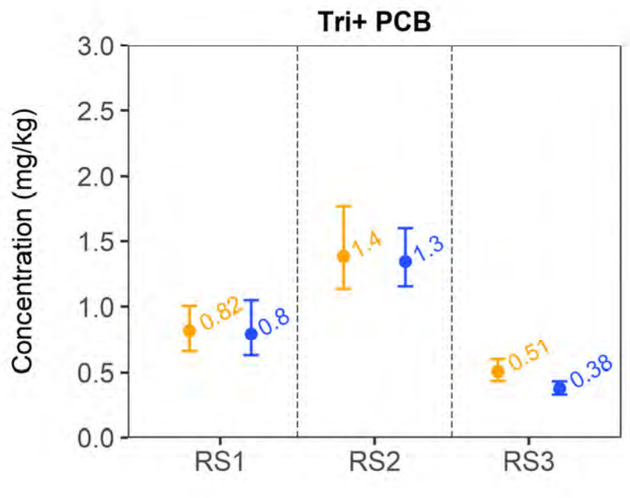
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

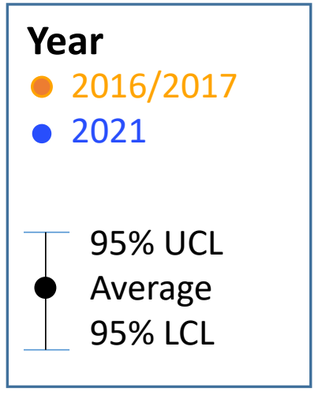
Tri+ PCB (mg/kg)

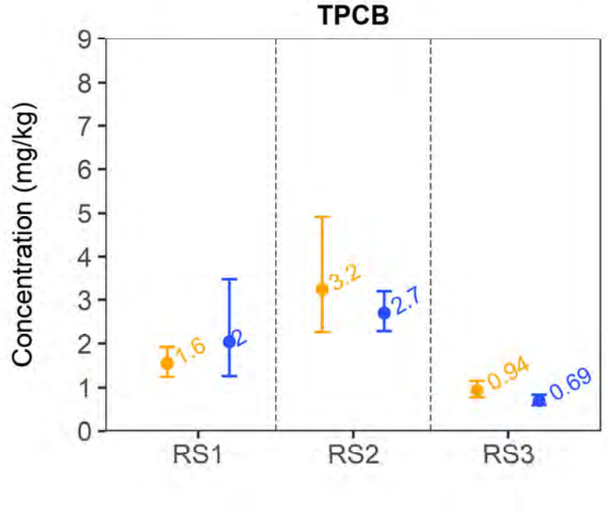
River Section	2016/2017		2021	
	RWA-Weighted Average	95% Confidence Limits	RWA-Weighted Average	95% Confidence Limits
1	0.82	0.66 - 1	0.8	0.63 - 1
2	1.4	1.1 - 1.8	1.3	1.2 - 1.6
3	0.51	0.43 - 0.6	0.38	0.33 - 0.43

TPCB (mg/kg)

River Section	2016/2017		2021	
	RWA-Weighted Average	95% Confidence Limits	RWA-Weighted Average	95% Confidence Limits
1	1.6	1.3 - 1.9	2	1.3 - 3.5
2	3.2	2.3 - 4.9	2.7	2.3 - 3.2
3	0.94	0.77 - 1.2	0.69	0.59 - 0.83







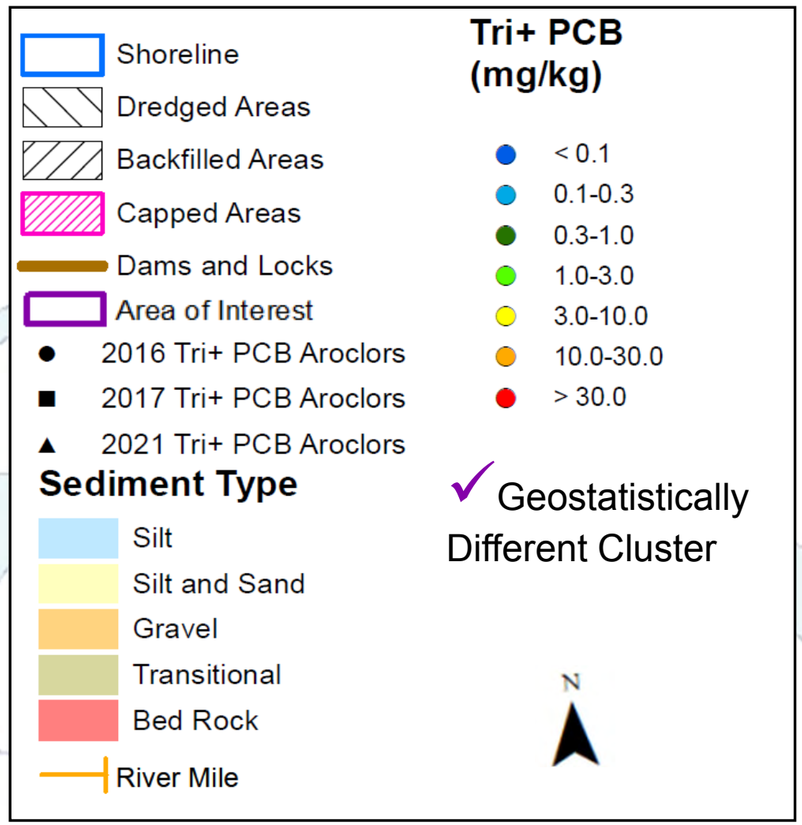
Areas of Interest Identified in 2019

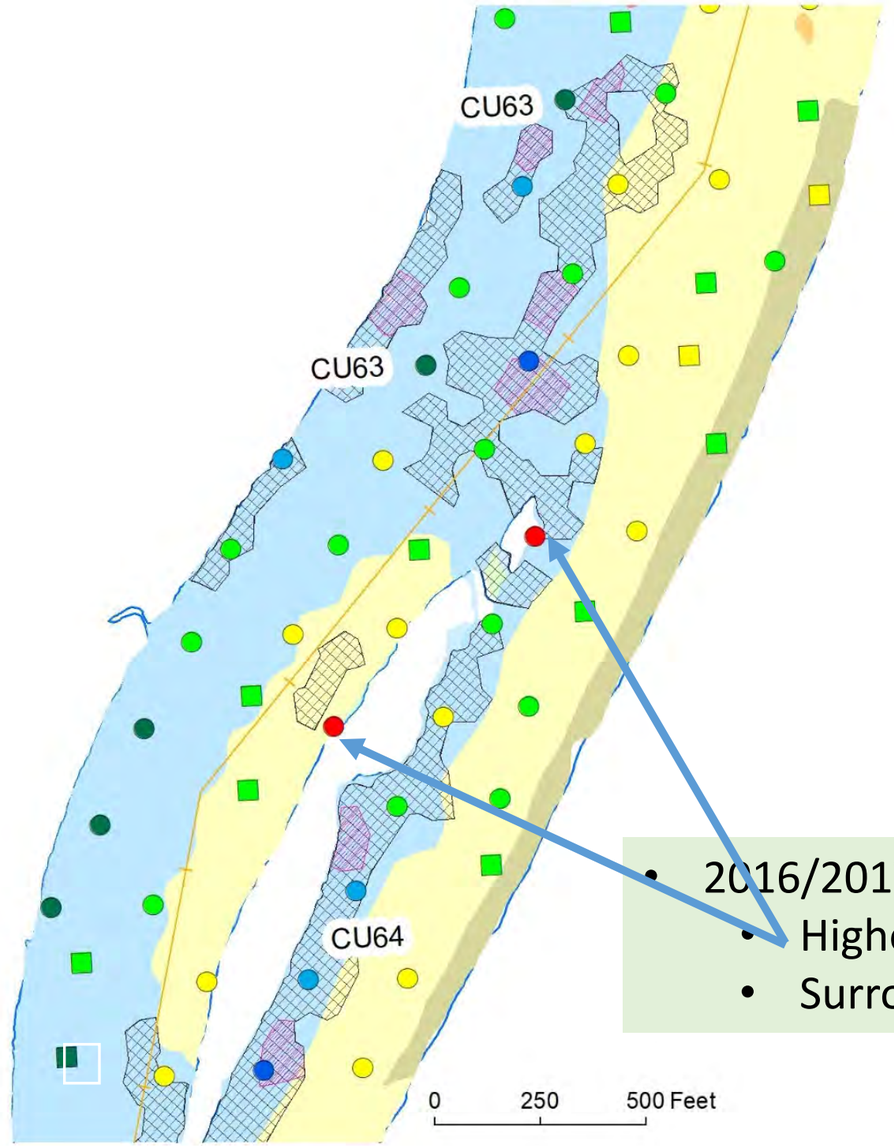
- Comprises a cluster of locations where the average Tri+ PCB concentration within a 250-foot radius of those locations is statistically significantly greater than the average Tri+ PCB concentration across the entire UHR at a 95% confidence level.
- Contains sediments with Tri+ PCB concentrations greater than the ROD-specified surface sediment dredging criterion for each river section, *i.e.*, 10 mg/kg in RS 1 and 30 mg/kg in RS 2 and RS 3.
- Three areas of interest were identified, based on Tri+ PCB data collected during 2016/2017:
    1) near Galusha Island between RM 188 and 187 in RS 2/Reach 7
    2) near the Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4
    3) near the Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3

Evaluation of Areas of Interest

- 2021 Tri+ PCB data near the areas of interest were compared to the 2016/2017 results
  - Tri+ PCB concentrations near the three areas of interest
  - Changes in the spatial extent of each of the areas of interest

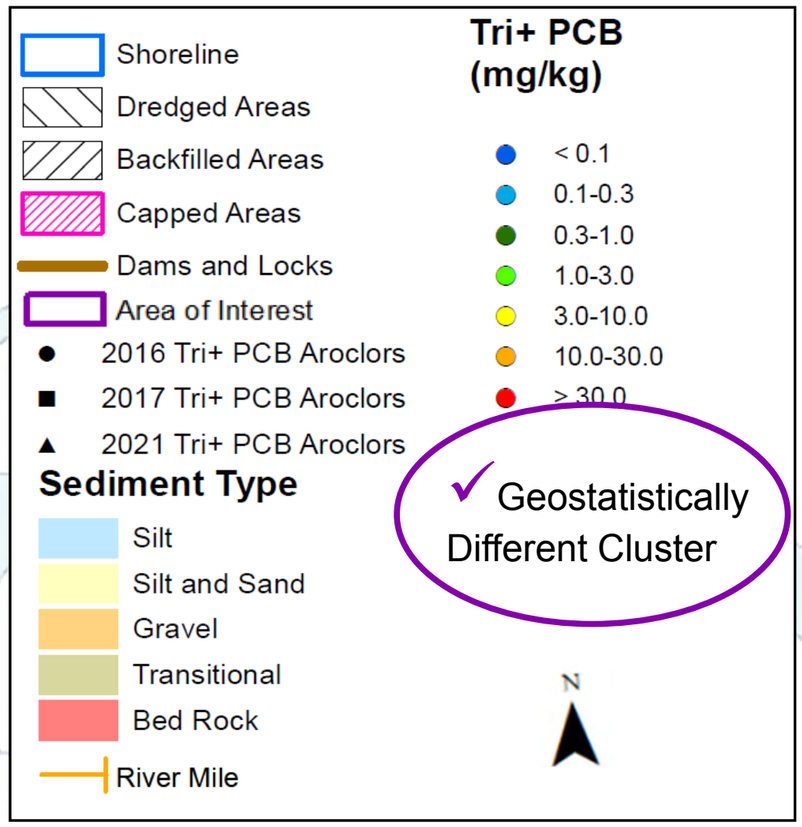
#1: near Galusha Island between RM 188 and 187 in RS 2/Reach 7

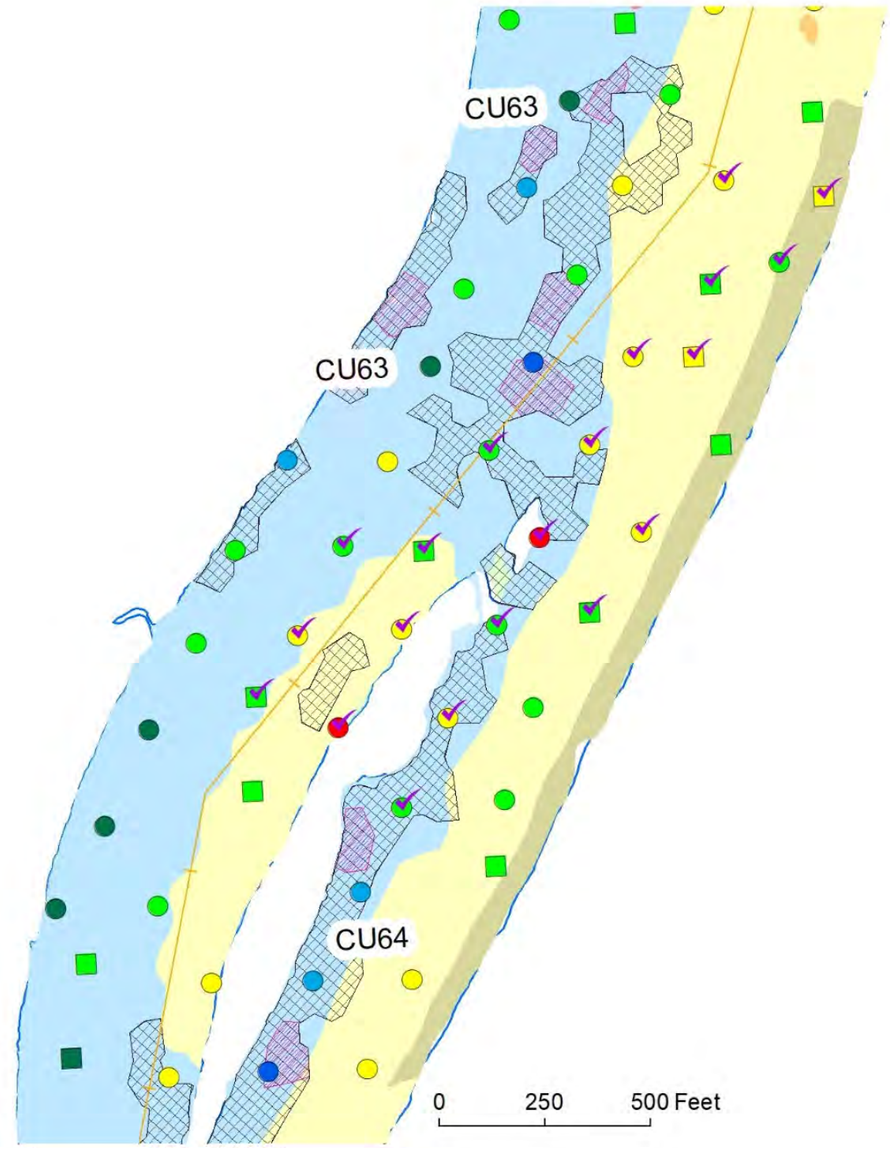




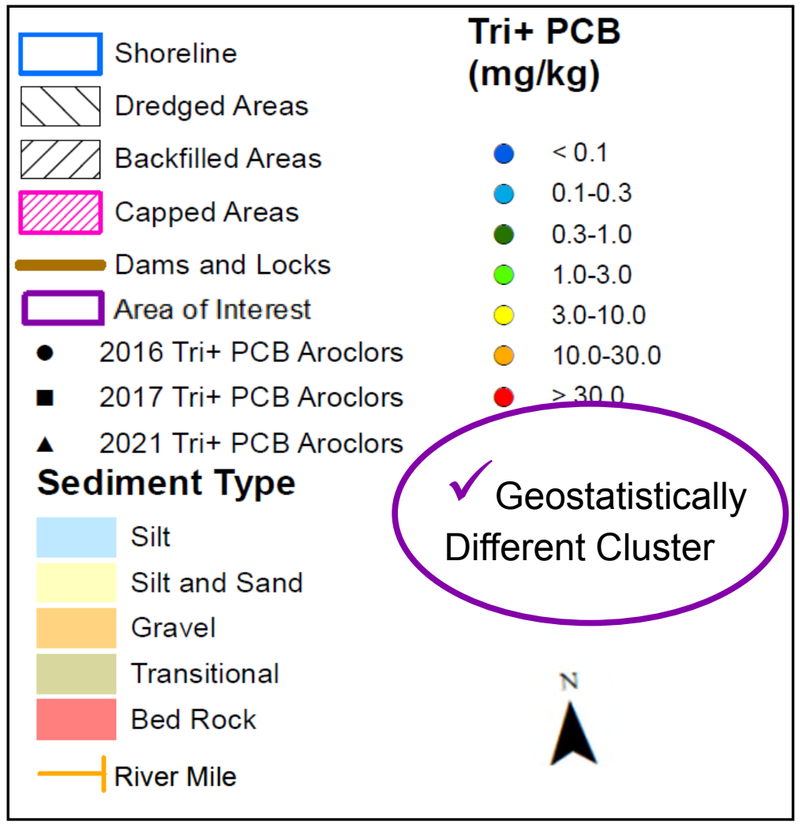
- 2016/2017 data:
  - Highest two: 42 and 43 mg/kg
  - Surrounded by < 10 mg/kg

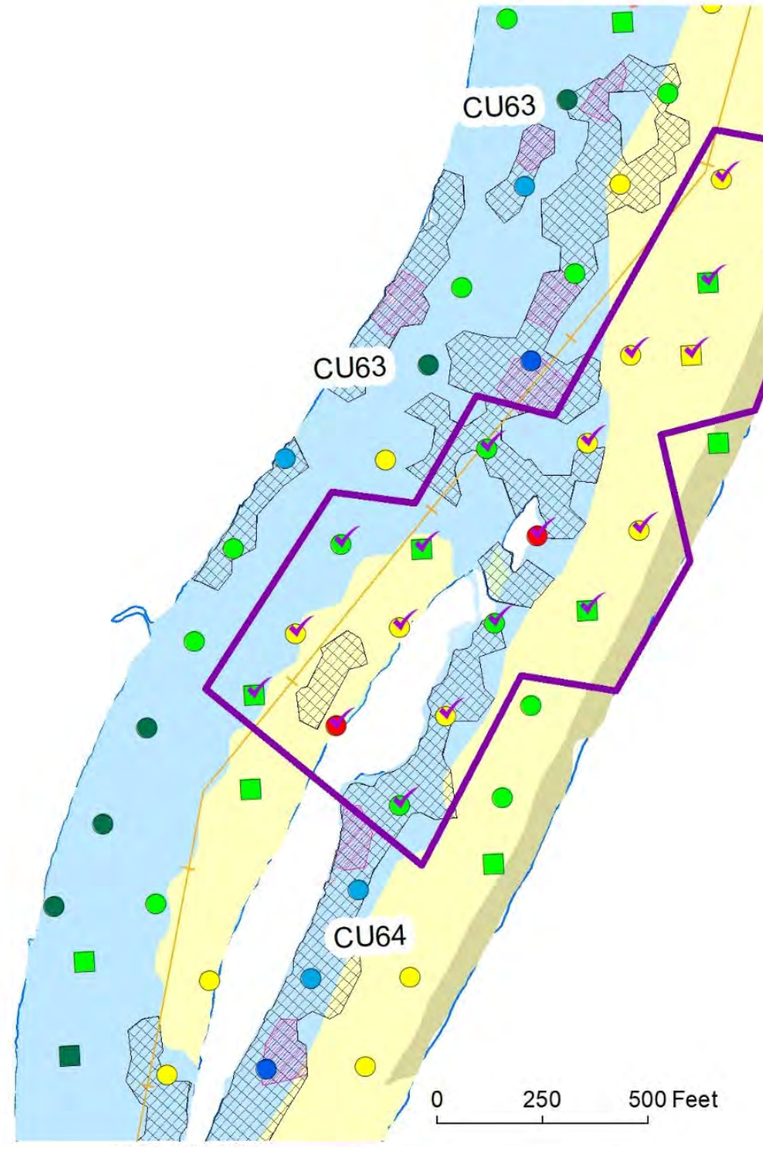
#1: near Galusha Island between RM 188 and 187 in RS 2/Reach 7





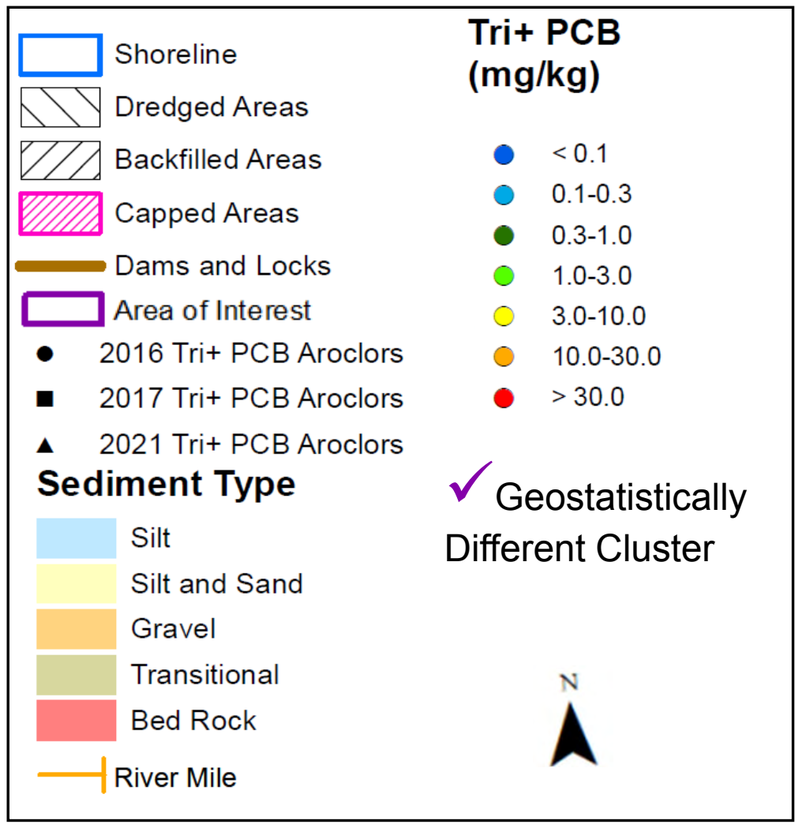
#1: near Galusha Island between RM 188 and 187 in RS 2/Reach 7

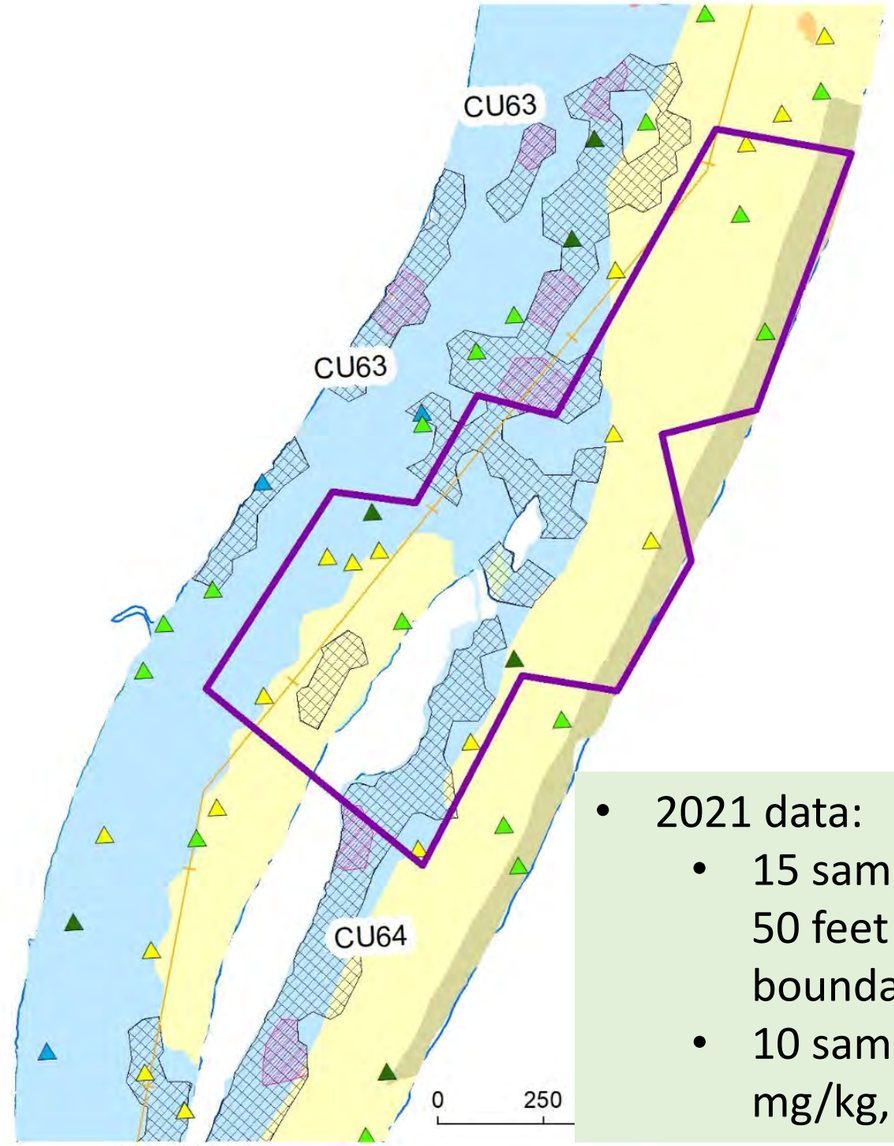




- 2016/2017 data:
  - 20 locations were identified as comparatively elevated concentrations
  - Average: 8.1 mg/kg

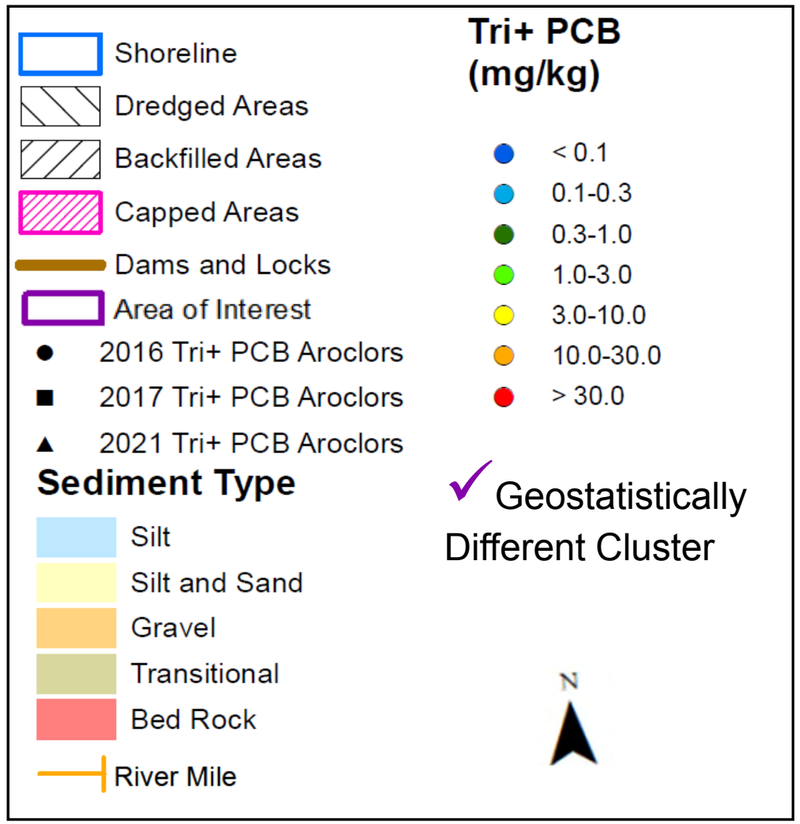
#1: near Galusha Island between RM 188 and 187 in RS 2/Reach 7

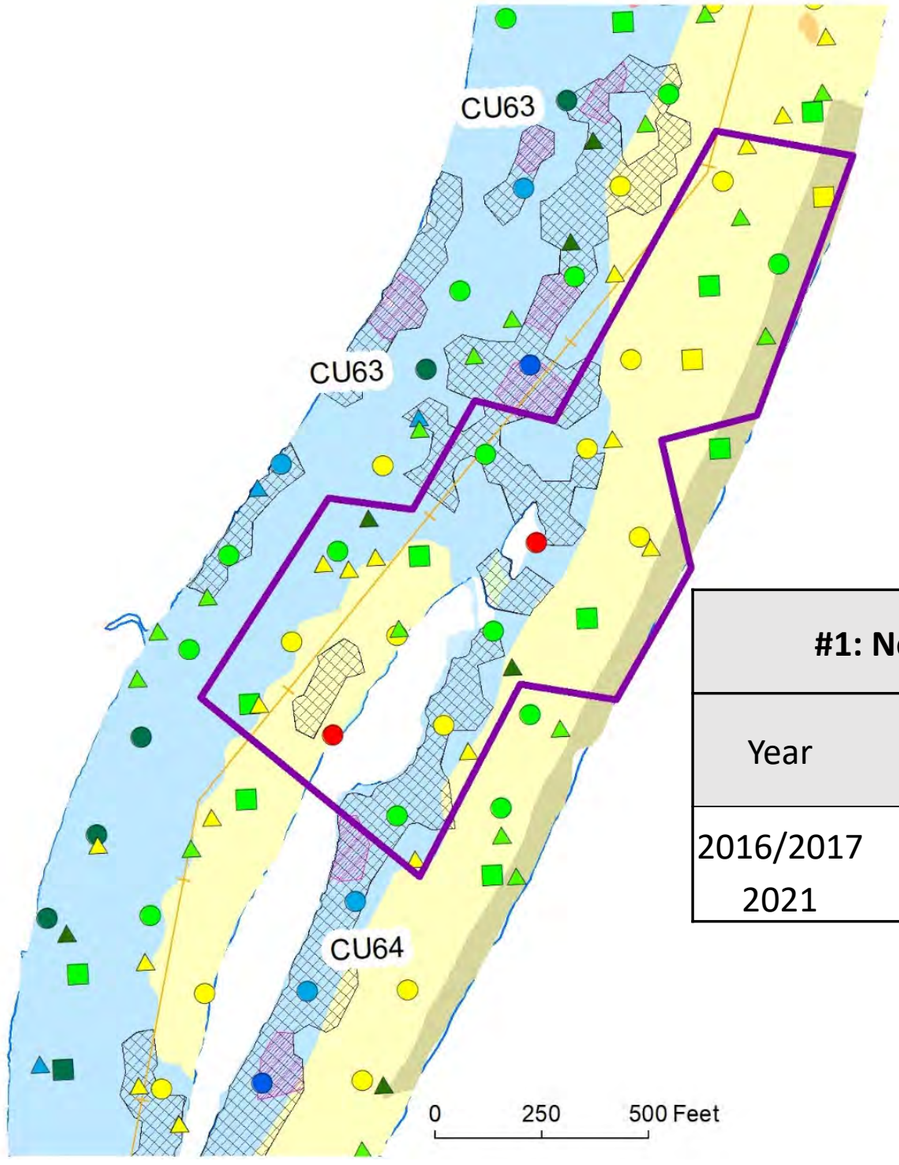




- 2021 data:
  - 15 samples were collected within 50 feet of the areas of interest boundary (ave = 3.5 mg/kg)
  - 10 samples > 3 mg/kg, max = 8 mg/kg, ave = 4.5 mg/kg

#1: near Galusha Island between RM 188 and 187 in RS 2/Reach 7

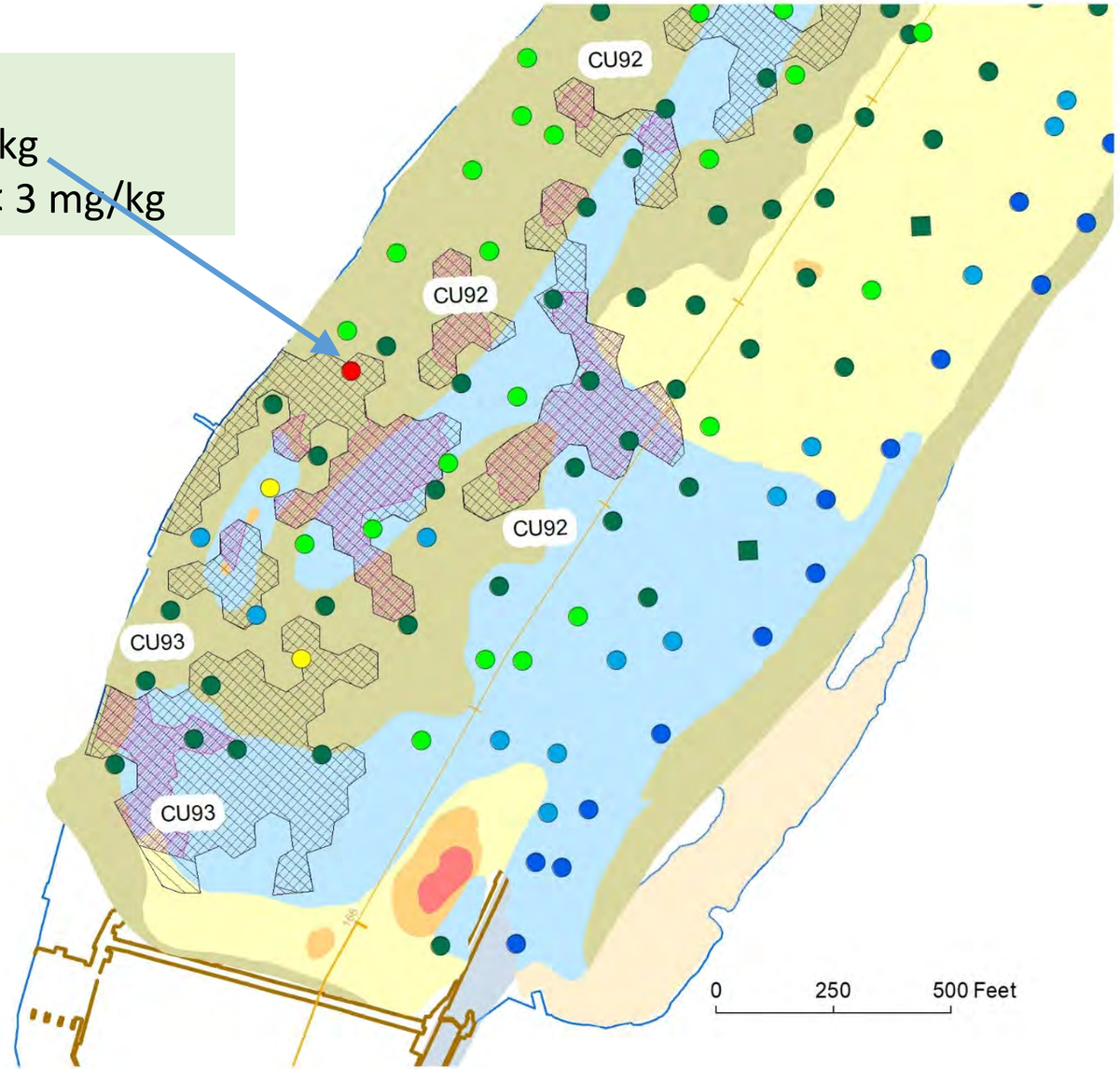




#1: Near Galusha Island (~21 acres)				
Year	Count	Tri+ PCB (mg/kg)		
		Max	Min	Average
2016/2017	20	43	1.0	8
2021	15	8	0.7	3.5

#2: near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4

- 2016/2017 data:
  - Max: 33 mg/kg
  - The others: < 3 mg/kg



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

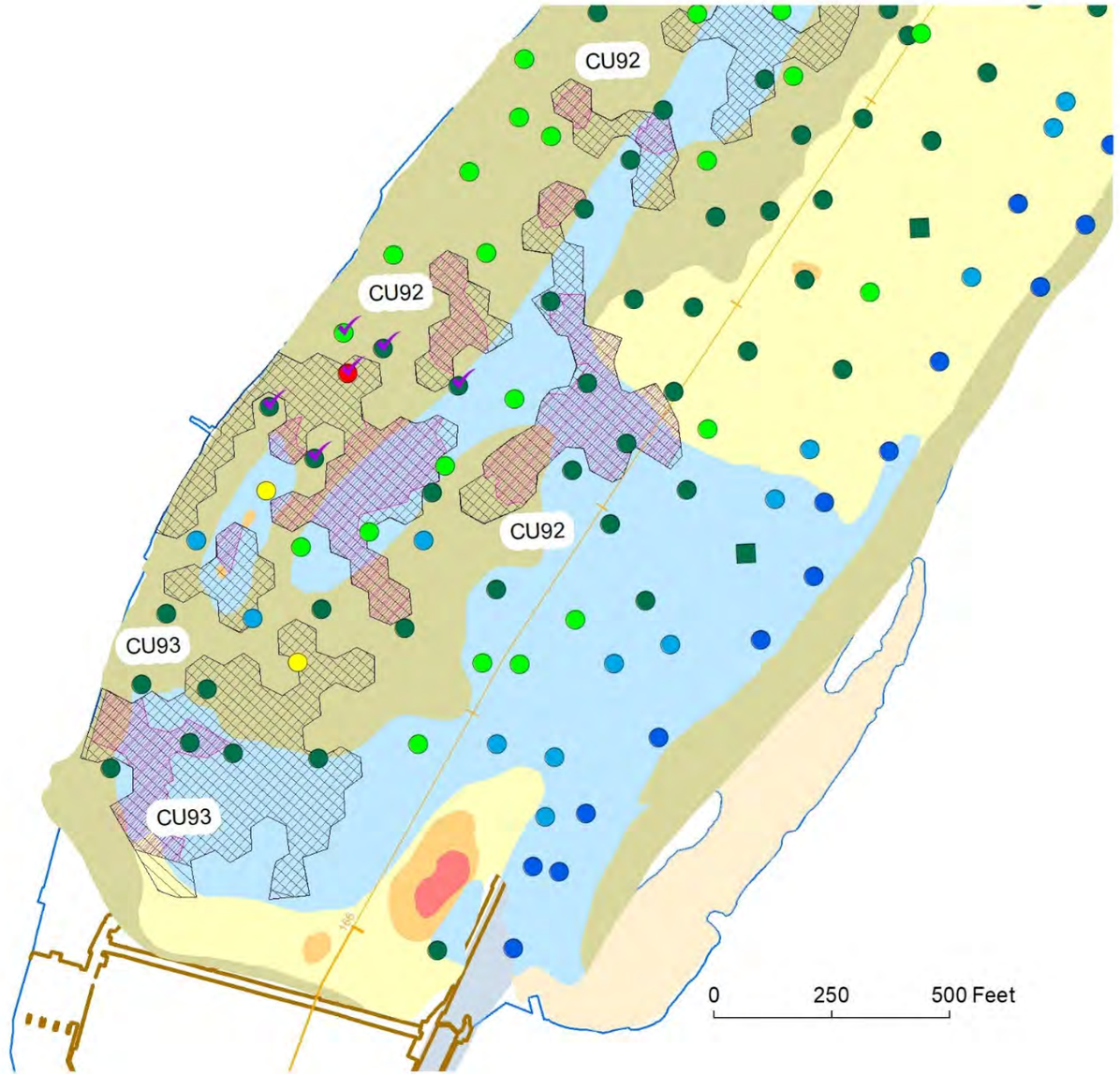
- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

River Mile

✓ Geostatistically Different Cluster

N

#2: near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

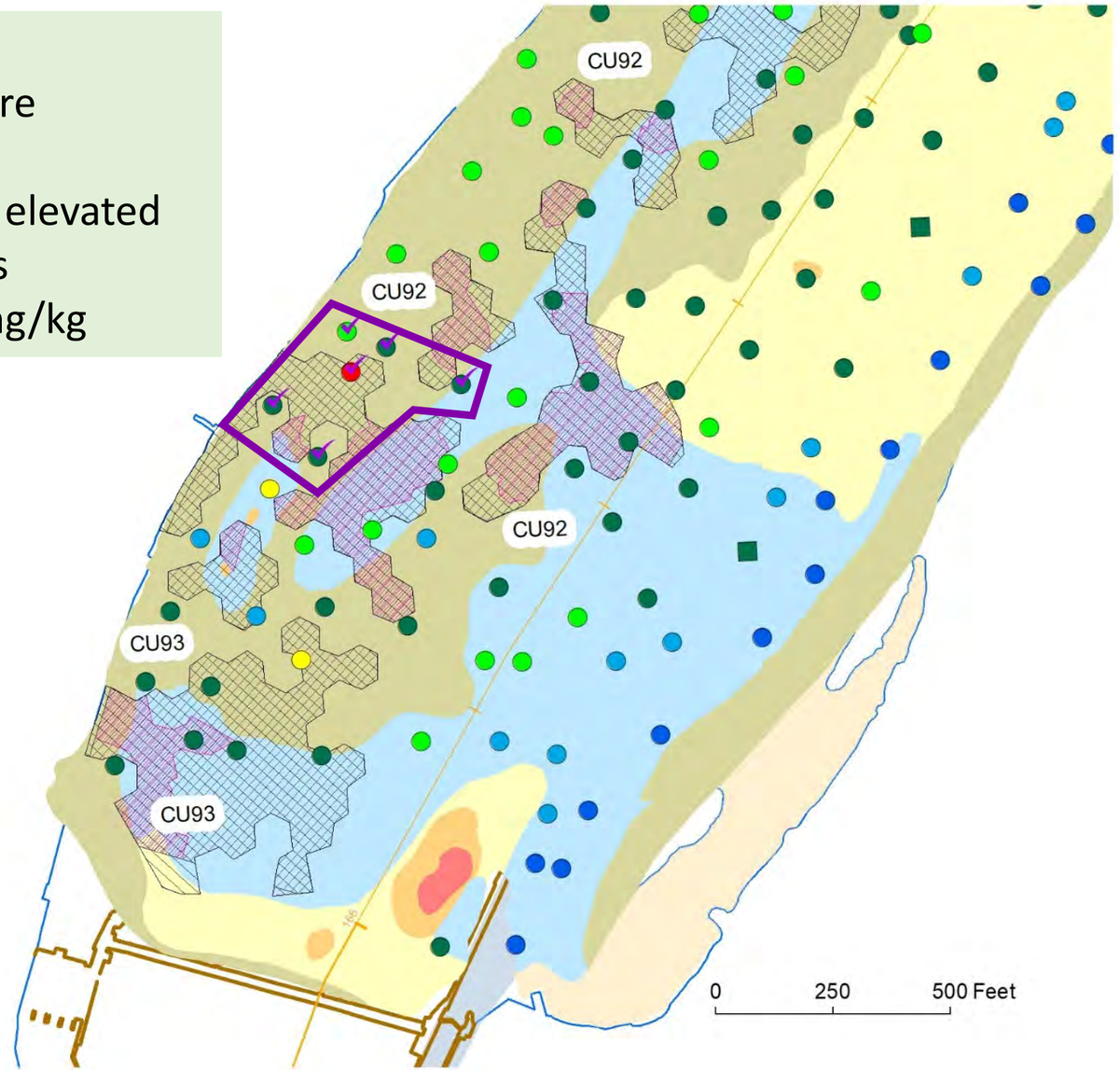
- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock
- River Mile

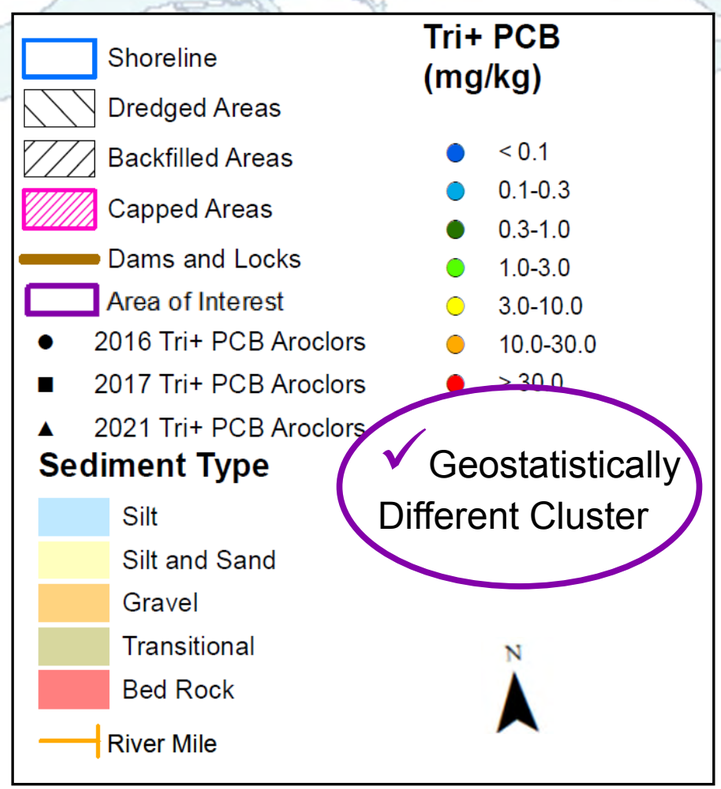
✓ Geostatistically Different Cluster

N

#2: near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4

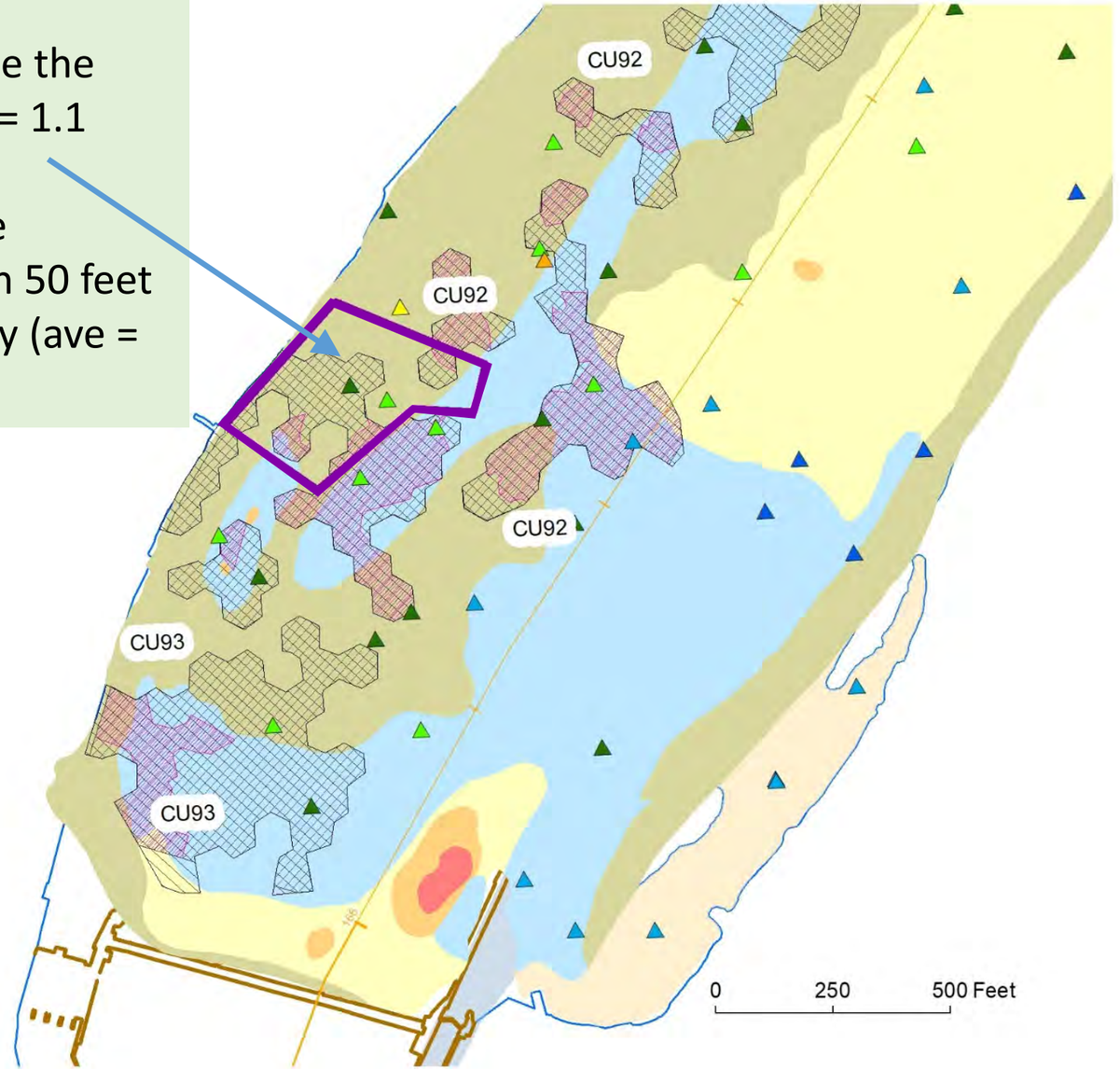
- 2016/2017 data:
  - 6 locations were identified as comparatively elevated concentrations
  - average: 6.4 mg/kg





#2: near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4

- 2021 data:
  - 2 samples inside the boundary (ave = 1.1 mg/kg)
  - 5 samples were collected within 50 feet of the boundary (ave = 1.7 mg/kg)



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

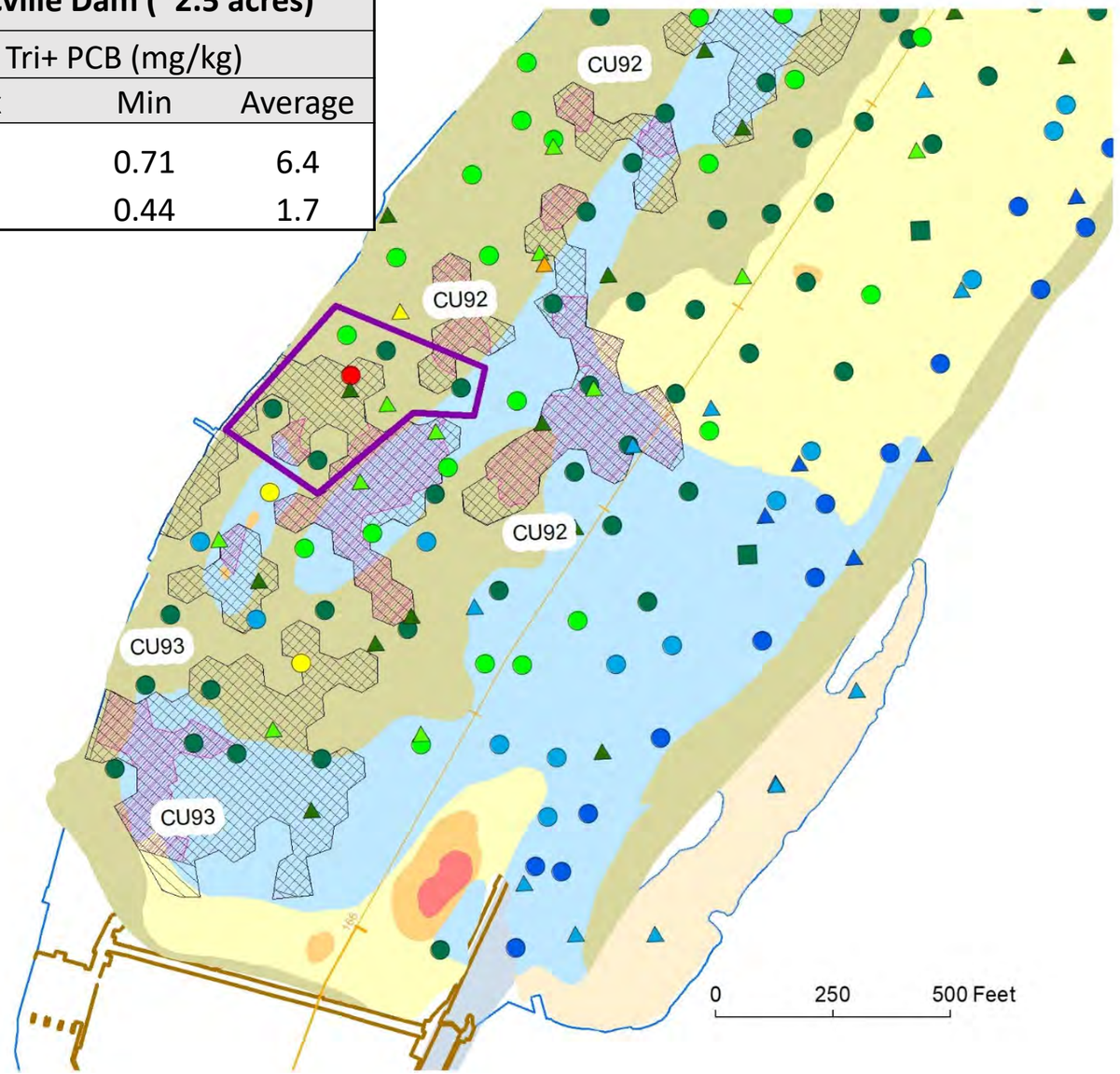
River Mile

✓ Geostatistically Different Cluster

N

#2: near Upper Mechanicville Dam, north of RM 166 near CU-92 in RS 3/Reach 4

#2: Near Upper Mechanicville Dam (~2.5 acres)				
Year	Count	Tri+ PCB (mg/kg)		
		Max	Min	Average
2016/2017	6	33	0.71	6.4
2021	5	3.7	0.44	1.7



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

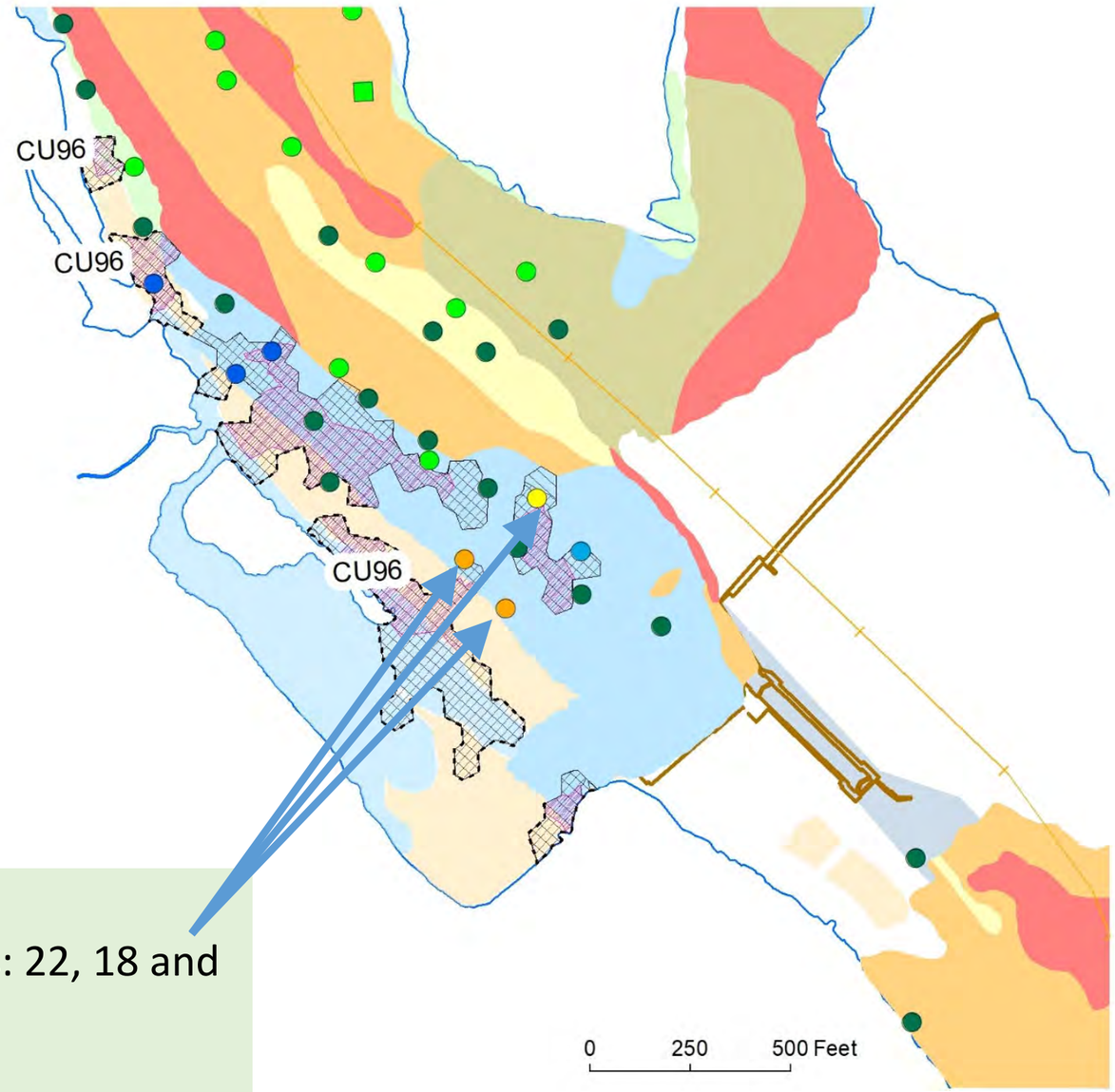
Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock
- River Mile

✓ Geostatistically Different Cluster

N

#3: near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

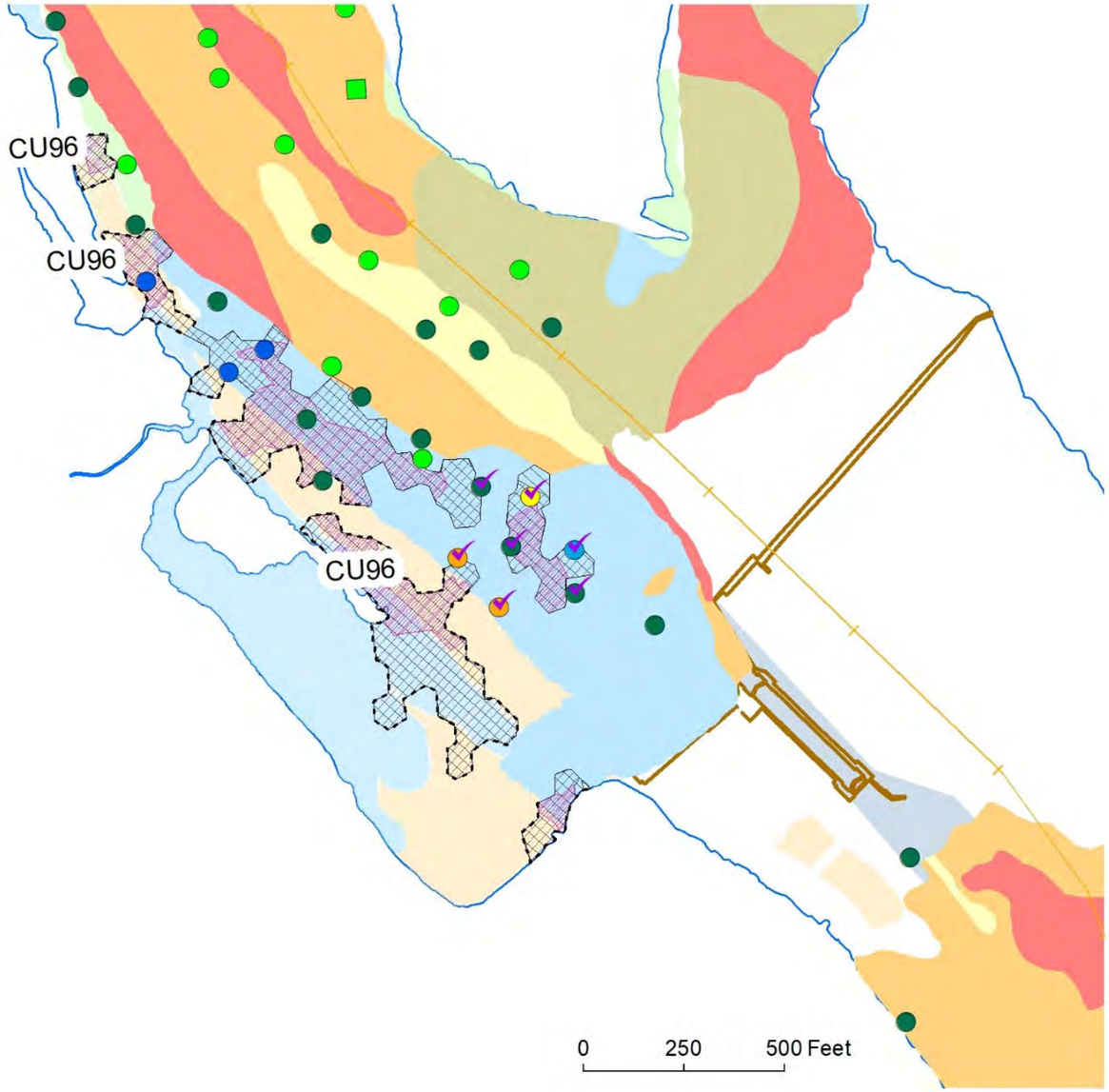
River Mile

✓ Geostatistically Different Cluster

N

- 2016/2017 data:
  - High conc samples: 22, 18 and 9.9 mg/kg
  - others: < 1 mg/kg

#3: near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
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- Silt and Sand
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River Mile

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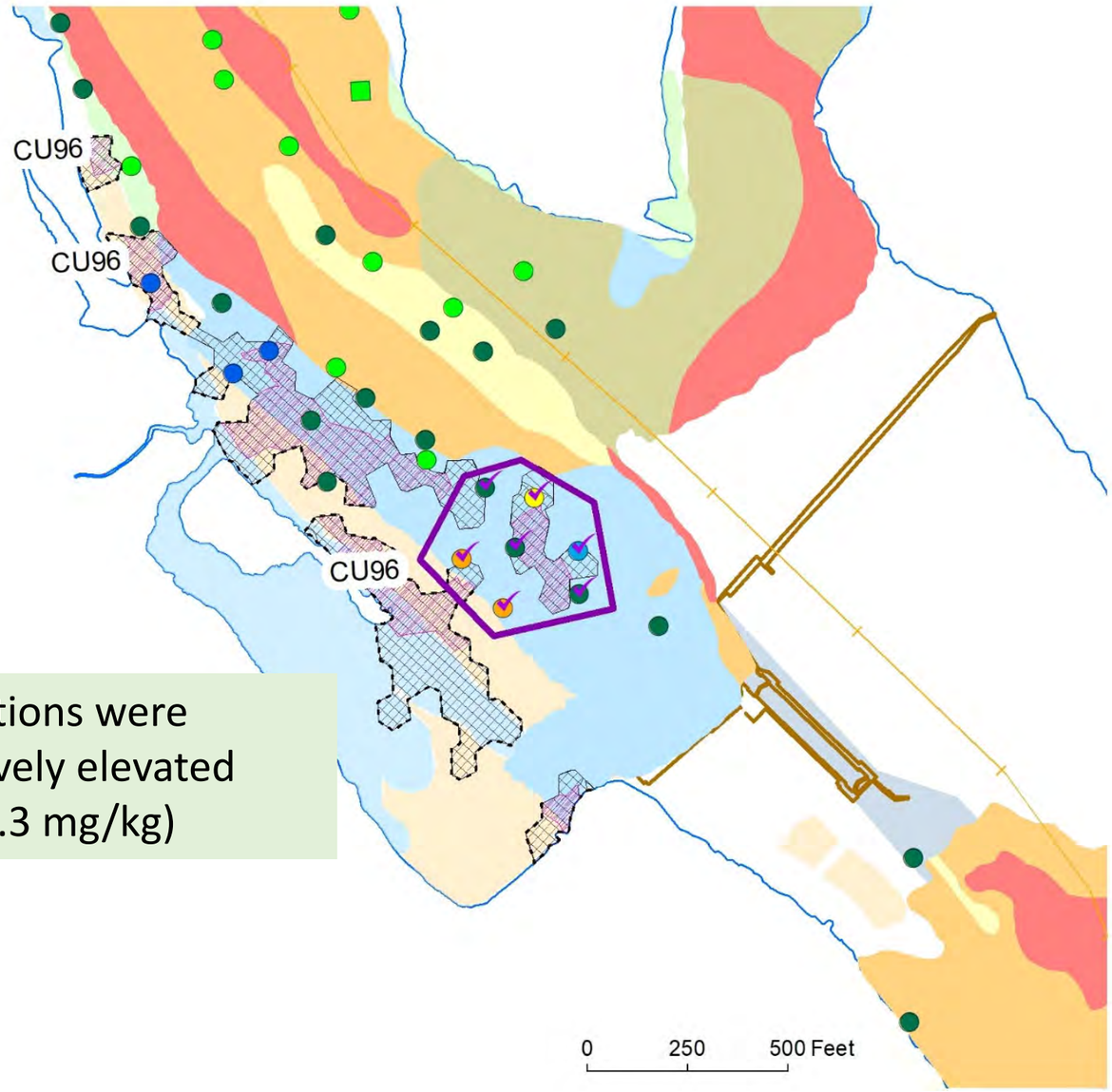
#3: near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3



Shoreline
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2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

- < 0.1
- 0.1-0.3
- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

River Mile

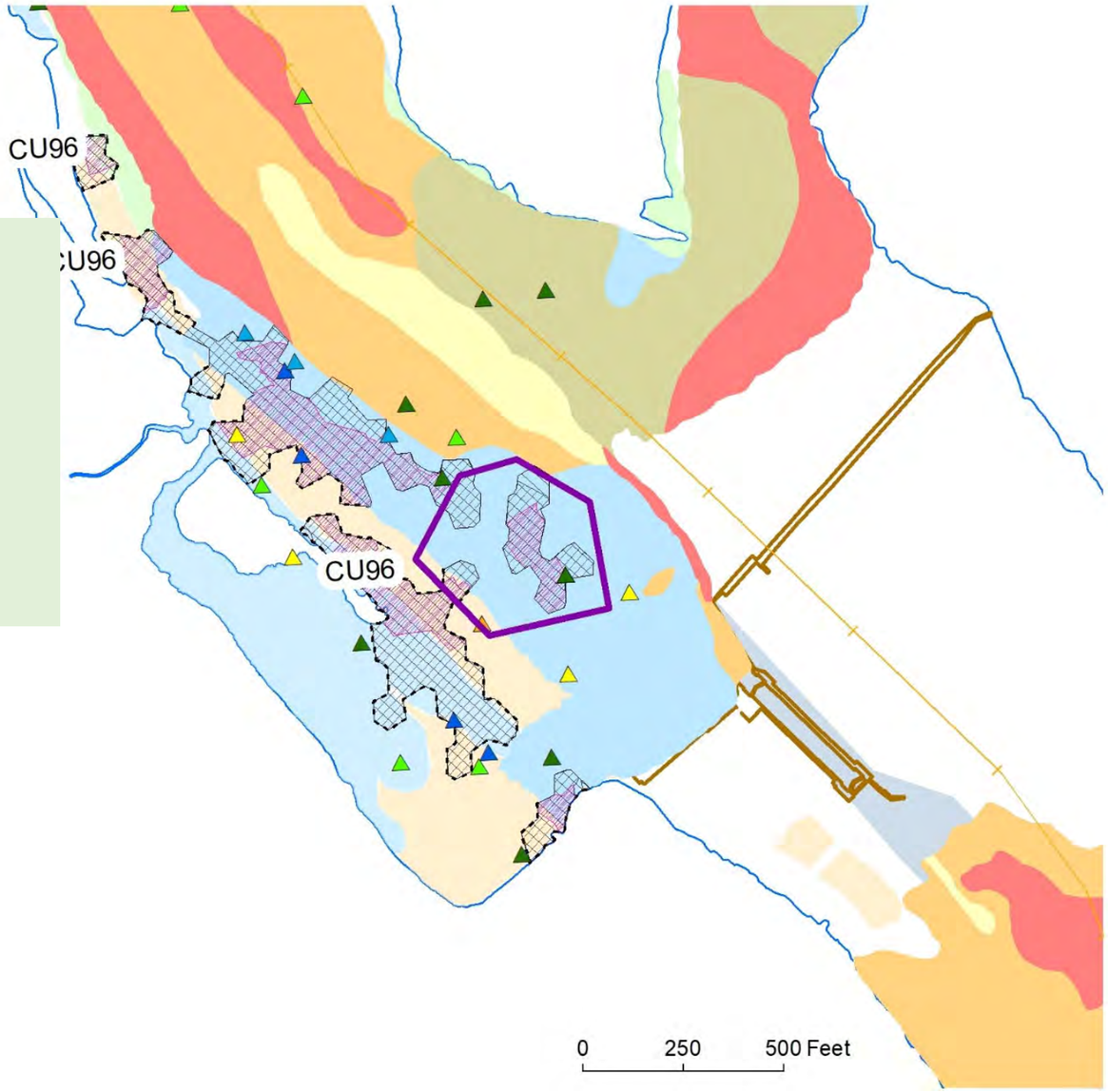
✓ Geostatistically Different Cluster

N

- 2016/2017 data: 7 locations were identified as comparatively elevated concentrations (ave = 7.3 mg/kg)

#3: near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3

- 2021 data:
  - 4 samples were collected within 50 feet of the areas of interest boundary
  - max: 13 mg/kg
  - average: 4.0 mg/kg



Shoreline
Dredged Areas
Backfilled Areas
Capped Areas
Dams and Locks
Area of Interest
2016 Tri+ PCB Aroclors
2017 Tri+ PCB Aroclors
2021 Tri+ PCB Aroclors

Tri+ PCB (mg/kg)

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- 0.3-1.0
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- 3.0-10.0
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- > 30.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
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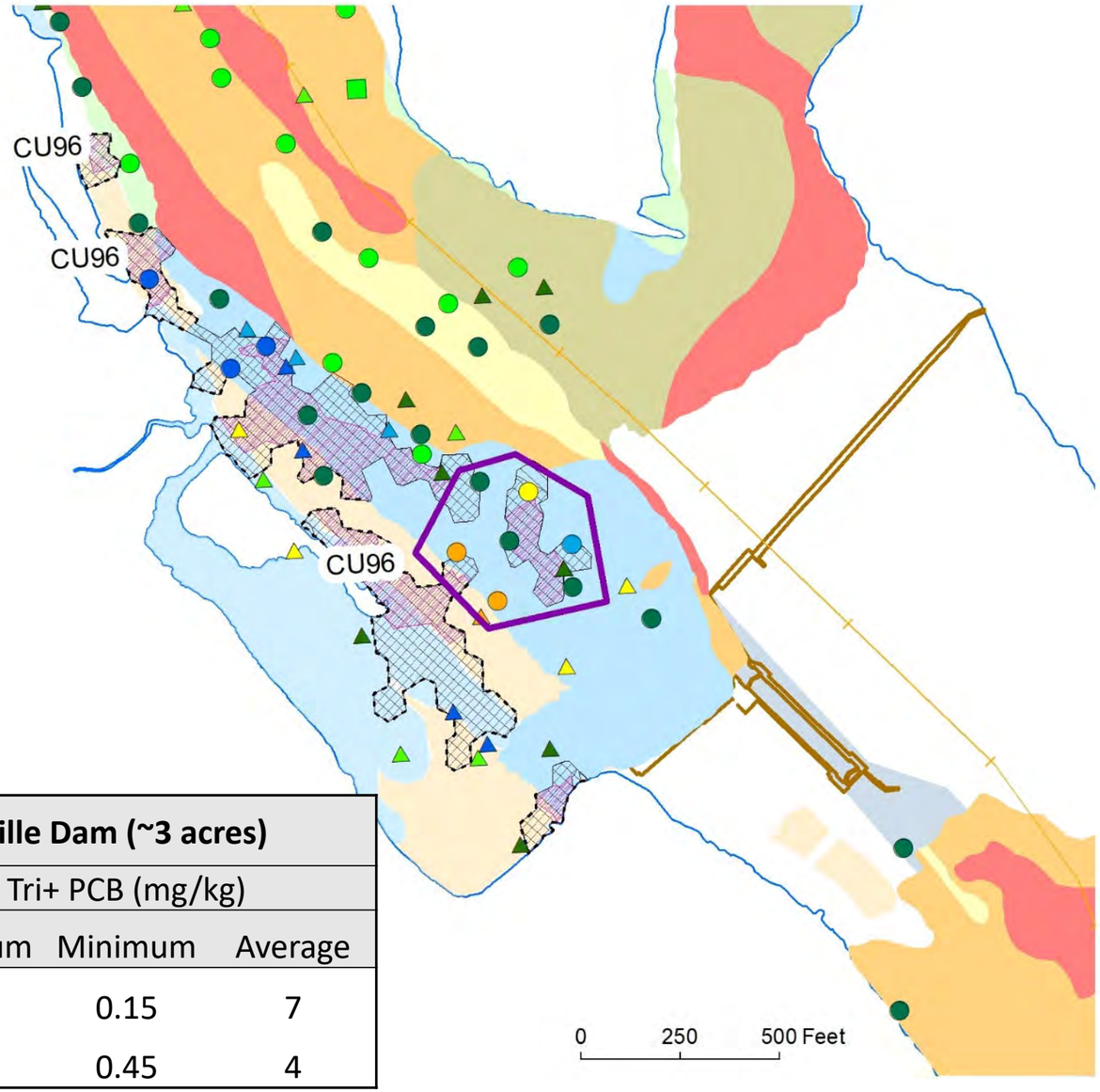
- Bed Rock

River Mile

✓ Geostatistically Different Cluster

N

#3: near Lower Mechanicville Dam, between RM 164 and 163, near CU-96 in RS 3/Reach 3



Shoreline
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- 0.3-1.0
- 1.0-3.0
- 3.0-10.0
- 10.0-30.0
- > 30.0

Sediment Type

- Silt
- Silt and Sand
- Gravel
- Transitional
- Bed Rock

River Mile

✓ Geostatistically Different Cluster

N

#3: near Lower Mechanicville Dam (~3 acres)				
Year	Count	Tri+ PCB (mg/kg)		
		Maximum	Minimum	Average
2016/2017	7	22	0.15	7
2021	4	13	0.45	4

Follow-up Items from Prior Meetings

OU1 Estimate of PCB Mass Remaining

PCB Contamination in Remnant Deposits

Remanent Area	Area[1] (acres)	Contaminated Depth[2] (ft)	Contaminated Volume[2] (yd^3)	PCB Mass[2] (lb)
2	3.5	5	64,530	570
3	17	8	160,925	18,550
4	24	3	80,130	4,600
5	3.5	8	31,630	22,650
Total	**48**		**337,215**	**46,370**

Notes:

1. Area (acres) listed is from 2nd FYR (EPA 2019)
2. Source of contamination depth, volume and PCB mass is 1984 ROD
3. Remnant Deposit 1 originally appeared as an island, but due to flooding in 1976 and 1983 most of the exposed sediment associated with this deposit was scoured
4. Contamination from Remnant Deposit 3A (approximately 14,000 yd^3) was removed by NYSDEC in 1978 and was placed in a secure encapsulated site in Moreau, NY
5. Remnant Deposit 4 and 4A contaminated volume and PCB mass were combined; deeper contaminated depth is shown on the table

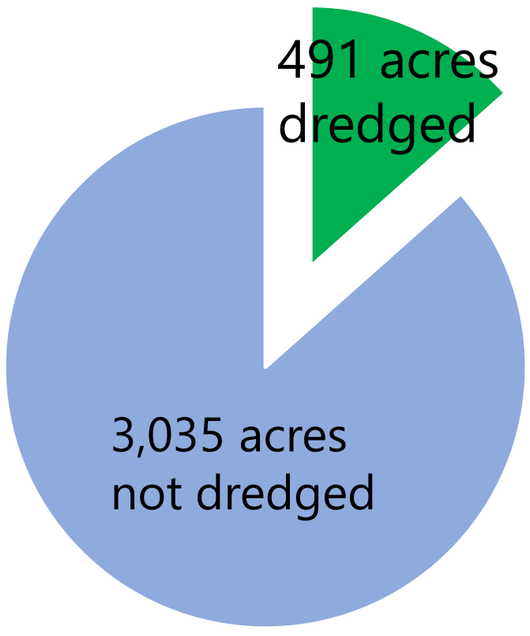
Follow-up Item: Mass Removed in OU2

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

Relative to requirements of the 2002 ROD, the remedy:

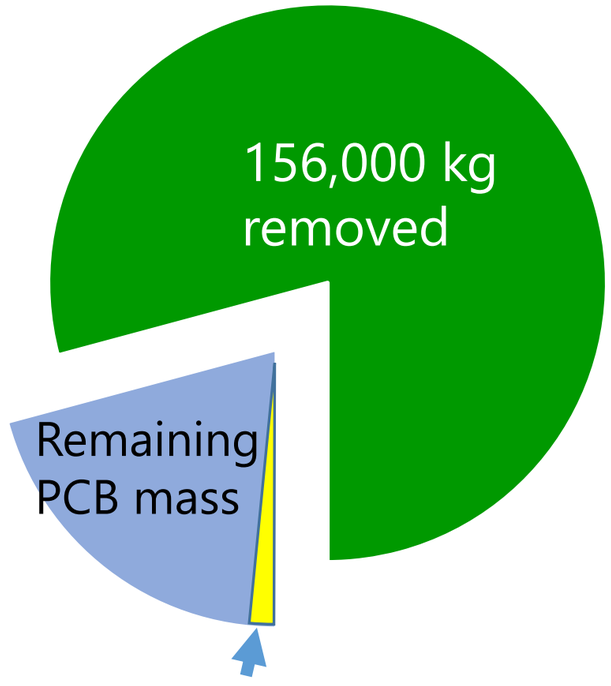
- Achieved a greater overall percent reduction in PCB mass
- Removed more than twice as much PCB mass on an absolute basis
- Left behind essentially the same mass as originally anticipated (within 10% of original estimate)

Spatial Extent of Remediation



3,656 acres of river bottom

PCB Mass Removed



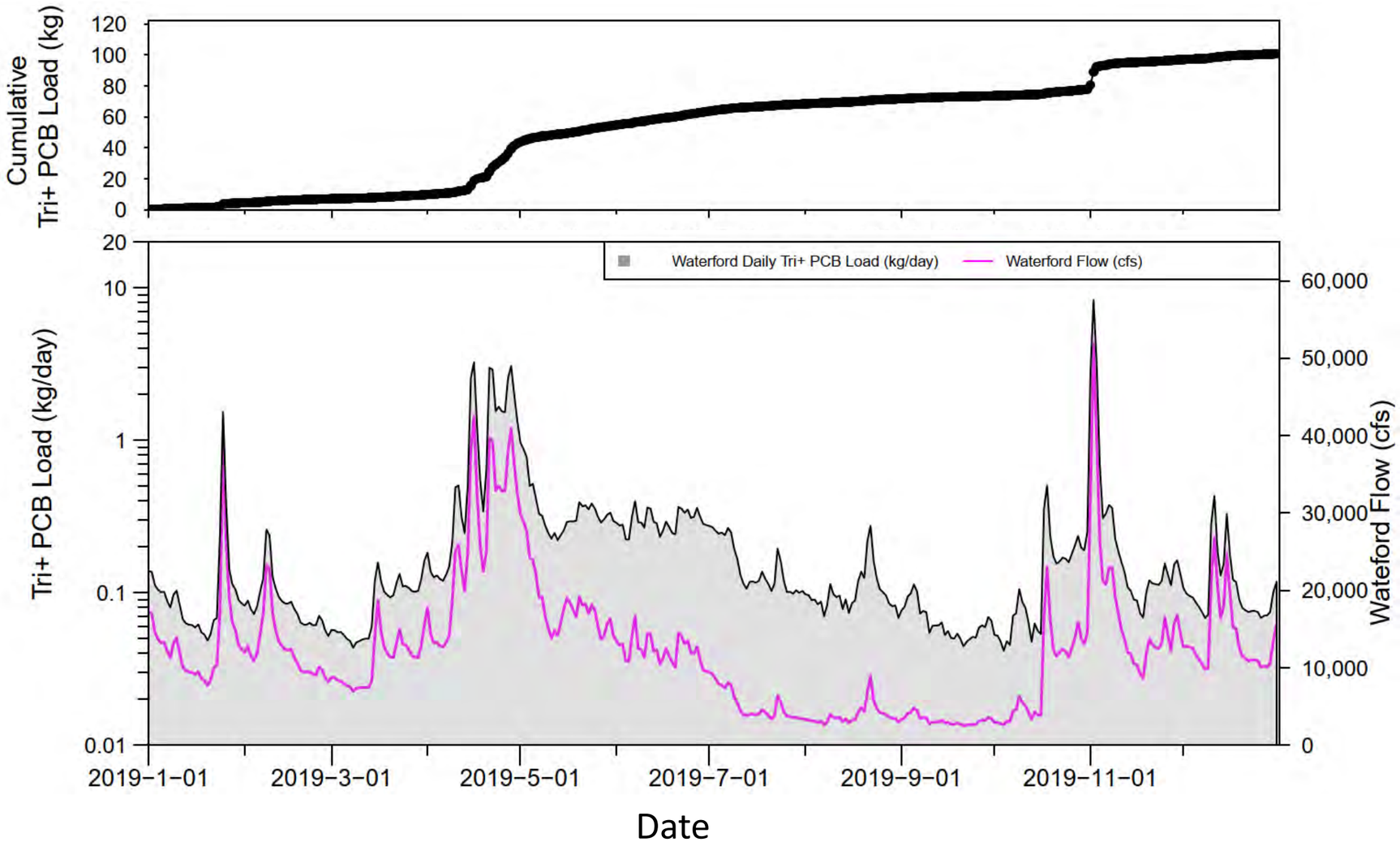
204,000 kg of Total PCB mass

Follow-up Item: Reduction in Surface Sediment

Surface Sediment Tri+ PCB Decline from Pre-Dredging to Post-Dredging

River Section	Percent Decline	
	Reported in 2019	Recalculated Aroclor 1221 for 2017 Data
1	93%	92%
2	84%	83%
3	80%	80%

PCB Load at Waterford in 2019 (Example)



Waterford Flow (cfs)

Waterford Tri+ PCB Load (kg/day)

Next Steps

- Meeting #5 scheduled for **March 15, 2023, 1:00-2:30pm**
  - Topic: overview presentation; other discussions as needed (OU1 and OU2)
- Suggestions or other thoughts?
- Review of follow-up action items

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FIVE-YEAR REVIEW TEAM MEETING
THE MEETING WILL BEGIN AT 1PM

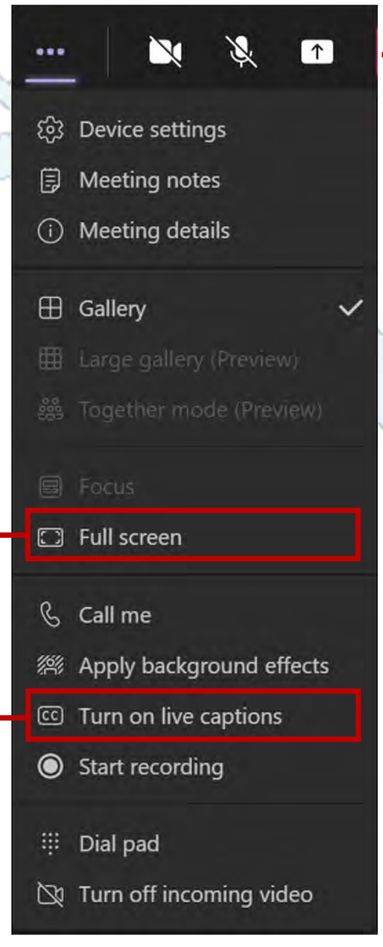
to ask question and share comments

to raise hand

to turn on/off video

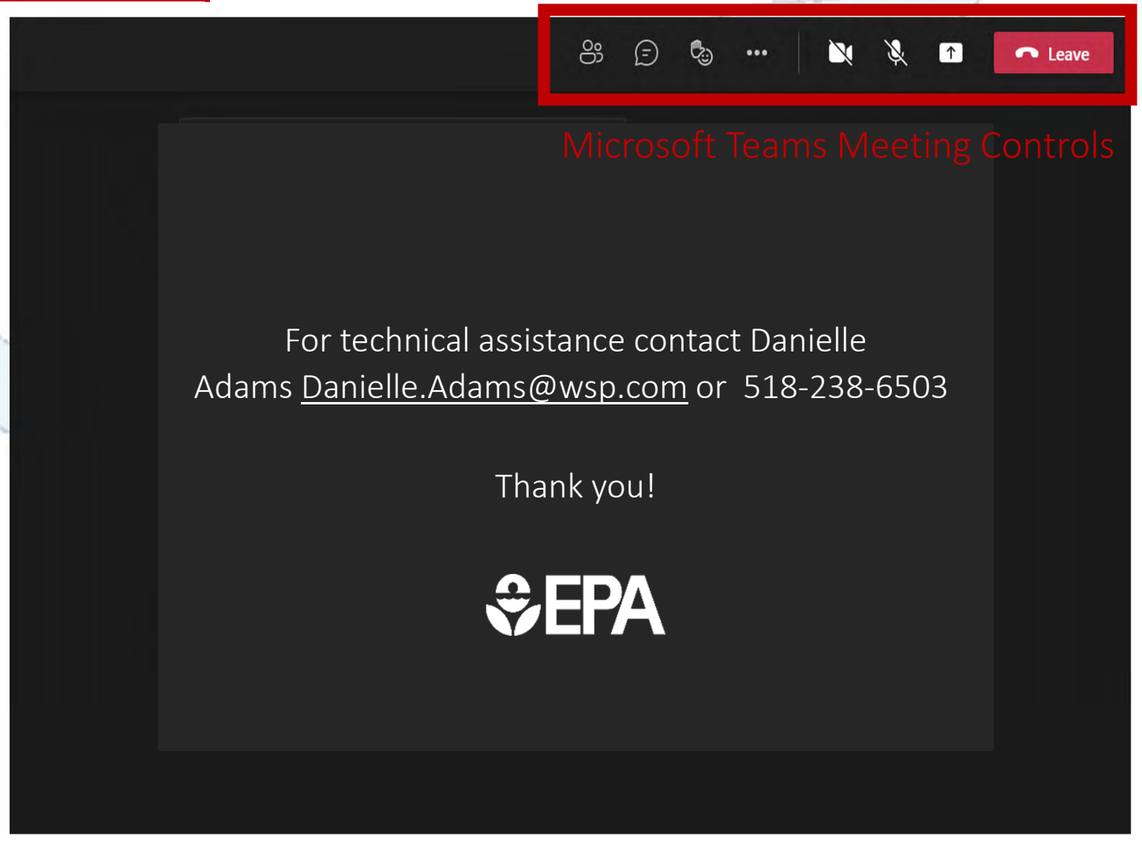
to un/mute mic

to leave the call



to view full screen

to view live caption



Microsoft Teams Meeting Controls

Third Five-Year Review
Team Meeting #5

March 15, 2023

Virtual Meeting

Topics for Today's Meeting:

- Considerations for the Three FYR Questions
- Follow-up items from prior meetings
  - Arithmetic vs. Geometric Mean
  - Cohesive vs. Non-Cohesive PCB Concentrations in Sediments
  - Response to recent questions

Reminder: Meeting Approach/Logistics

- EPA plans to keep the meetings to key participants and alternates

- EPA will not be able to distribute materials/analysis in advance or after meetings
  - Presentations will likely be included in the report
  - Formal opportunity to review and comment on the report
  - EPA is available to answer questions outside of the FYR Team meetings

- Meeting format will be open-dialogue
  - We anticipate receiving feedback and answering questions during the presentations
  - The meeting is scheduled for 1 ½ hours but our goal is to get through the materials in 1 hour

Reminder: Meeting Approach/Logistics (Cont'd)

- About 30 slides to cover today

- Meeting etiquette:
  - Remain on mute unless speaking
  - Use camera if you are speaking (at your discretion)
  - Use "raise hand" feature to get the moderator's attention
  - Be respectful of others
  - EPA will monitor the Chat, but our preference is to have one on-going dialog (avoid side conversations)

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Brief Summary of Material Covered in Previous Meetings

Summary of Water Data Evaluations
(January 18, 2023/Meeting #2)

- **Changes in PCB concentrations through time and progress towards compliance with ROD Criteria (ARARs)**
  - Individual water column datapoints plotted (2004 – 2021)
  - Percentage of samples below most stringent ROD Criteria (14 ng/L TPCB)

- **Factors impacting PCB concentrations/loads**
  - Seasonality and associated changes in water temperature
  - River flows (velocity)

- **Evaluation of PCB load to Lower Hudson River**
  - Annual PCB load is calculated to incorporate the concentration-flow relationship and seasonality

Summary of Cap Data Evaluations
(January 18, 2023/Meeting #2)

- Presentation of the findings of cap monitoring events performed in 2016 and 2018 (not included in Second FYR)

- Evaluation of integrity of the caps
  - Total capped area with >3 inches of erosion for each CU
  - Largest contiguous capped area with >3 inches of erosion for select CUs (those where total capped areas with >3 inches of erosion was >75% of Measurable Loss Criteria)

Summary of Fish Data Evaluations
(February 1, 2023/Meeting #3)

- **Evaluation of Fish Tissue PCB Concentrations by Species Over Time**
  - Individual species plotted for each RS (2004 – 2021)
  - Percentage of samples below the first intermediate human health target (0.4 mg/kg-ww)

- **Evaluation of Fish Tissue PCB Concentrations Over Time (Species-Weighted Average) and Progress Towards Human Health RAO Targets and Goals**
  - Species-weighted average plotted for each RS (2004 – 2021) and for UHR as a whole
  - Progress towards human health RAO targets and goals

- **Evaluation of Progress Towards Ecological Risk RAO Goals**

Summary of Sediment Data Evaluations
(March 1, 2023/Meeting #4)

- **Evaluation of spatial variation**
  - PCB concentration vs. river mile
  - River-Wide-Area (RWA)-weighted average by river section and area

- **Evaluation of temporal variation between 2016/2017 and 2021**
  - Cumulative probability distribution plot
  - Ratio of geometric mean from 2021 to 2016/2017
  - River-Wide-Area (RWA)-weighted average

- **Review areas of interest**
  - 2021 Tri+ PCB data near the areas of interest were compared to the 2016/2017 results

Considerations for the Three FYR Questions

Protectiveness Statements

- Statement is required for all OUs where Remedial Action is underway or complete and when hazardous substances are remaining at the site.
  - EPA may also issue a site-wide statement (if applicable)
- Protectiveness generally defined by risk and answers to Questions A, B, and C
- Guidance gives examples for statements
  - Considers example scenarios to advise on which protectiveness statements apply
- Status of Remedial Action (construction complete, ongoing, etc.) should be included in protectiveness determination

Protectiveness Statements

- Five general categories for statements:
  - **Protective** – Construction complete, functioning as intended and exposures are under control
  - **Will be Protective** – Construction ongoing, no performance issues identified, and exposures are under control
  - **Short-term Protective** – Construction complete, functioning as intended and exposures are under control BUT issues may affect future performance
  - **Deferred** – Not enough data to determine if risks are under control (new analyses need to be completed)
  - **Not Protective** – Exposures are not under control

FYR Questions per EPA's 2001 *Comprehensive Five-Year Review Guidance* (EPA 540-R-01-007)

Question A: Is the remedy functioning as intended by the decision documents?

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question A: Is the remedy functioning as intended by the decision documents?

Considerations include:	OU 1	OU 2
Assess attainment of Remedial Action Objectives (RAOs)	Routine inspections of remnant deposit caps	Fish (species weighted average) and water PCB data (concentrations and loads at Waterford)
Assess data to identify items that may impact remedy performance	Bakers Falls and Rogers Island water data	Post-dredging fish, water, sediment and cap data
Review implementation of institutional controls	Routine inspections of remnant deposit access control and signage	Various activities focused around outreach by New York State DOH
Assess exposure pathways that could result in unacceptable risks	Routine inspections of remnant deposit caps	Fish PCB data
Assess whether maintenance related activities, as implemented, will maintain the effectiveness of remedy	Routine inspections of remnant deposit caps	OM&M Program

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Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Considerations include:	OU 1	OU 2
Review if changes in ARARs or promulgation of new standards effect the protectiveness of the remedy	Monitor statutory regulations at the local, state and federal level	
Evaluate changes in land use or the anticipated land use on or near the site	Routine inspections and oversight	
Evaluate whether new human health or ecological exposure pathways or receptors have been identified	Assess if conceptual site model has changed	
Evaluate whether new contaminants or contaminant sources have been identified	Ongoing assessment and review of new information	
Determine if there are changes in the physical site conditions	Routine inspections and long-term oversight	
Determine if there are changes in the toxicity factors for contaminants of concern	Ongoing assessment including any updates to IRIS database	

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Considerations include:	OU 1	OU 2
Determine whether ecological risks have been adequately addressed	Review Risk Assessment assumptions and approach	
Consider potential site impacts from climate change and other related impacts such as flooding	Consider effects in the region and near the Site due to increasing frequency of heavy precipitation events and/or increasing intensity of storms (winds, precipitation). These impacts could cause increased erosion of the caps and cleaner sediment covering more highly contaminated sediment. Continue to monitor USGS flow data and flow projections	

Note: Issues/Recommendations will be identified in the FYR. There were findings in the Second FYR that are also being considered by EPA.

Follow-up Items from Prior Meetings

Questions Recently Received

- **Were sediment total PCB concentrations used as reported or was some adjustment made to calculate "homologue equivalents"? If adjusted, what algorithm was used?**

  Yes, sediment TPCB concentrations are used "as reported". Homolog Equivalent PCB concentrations are not calculated for sediment samples.

- **Were TRI+ PCB concentrations calculated according to the same formula reported in the previous FYR? Will the formula be updated due to the re-calculation of A1221 values? [Tri+ PCB = 0.03*A1221 + 1.16*(A1242+A1254) Eqn. 2-3 (EPA FYR2,Appendix 5, p.2-13)]**

  Yes, the formula is the same as the previous FYR, which was first presented in Corrective Action Memo (CAM) 3 (GE, 2011) and has not been updated.

- **Were samples from the canal excluded from the analyses presented?**

  Yes, the samples from the canal were excluded.

- **Were field duplicate samples included in the analyses?**

  Yes, field duplicate samples were included (the parent and duplicate samples were averaged).

- **EPA presented several figures showing the ratio of the geometric means from 2021 to 2016/2017 by river section and reach for the non-dredged areas. Because the arithmetic mean is more relevant for assessing exposure to the food web, could EPA present the same figures using the arithmetic mean?**

  Geometric mean is the appropriate statistic for comparison of concentration ratios between the two sampling events (will be presented later in this meeting).

Questions Recently Received

- **In the previous FYR, EPA postulated a 5% recovery rate in sediment. It would be useful to compare the arithmetic mean concentrations in 2021 to the expected 5% decay concentration from the 2016/17, which would correspond to about 20-25% decline in concentration in 2021. Do the confidence limits for the 2021 sediment PCBs include the expected concentration assuming a 5% decay?**

  This analysis is problematic due to limited data (only two data points is not sufficient given year-to-year variability).

- **Has EPA evaluated the number of samples by sediment type for each reach in 2016/17 and 2021?**

  EPA has focused on evaluating data on the basis of dredge and non-dredge areas. However, an evaluation by sediment type has been performed in response to a question from the FYR Team (will be presented later in this meeting).

- **Has EPA evaluated the potential effect of backfill broadcast over the dredged areas on the surrounding areas? In 2017, NYSDEC analyzed sediment grain size, which indicated that non-dredged areas near the dredged areas had a high percentage of sand in the samples that was similar to the samples from the dredged areas.**

  No, this analysis is challenging and has no clear objective. We recognize that backfill is present in the non-dredged areas, and likely reduced the surface concentrations slightly. However, EPA is not evaluating the mechanism that is reducing sediment concentrations, only whether the concentrations are decreasing.

Questions Recently Received

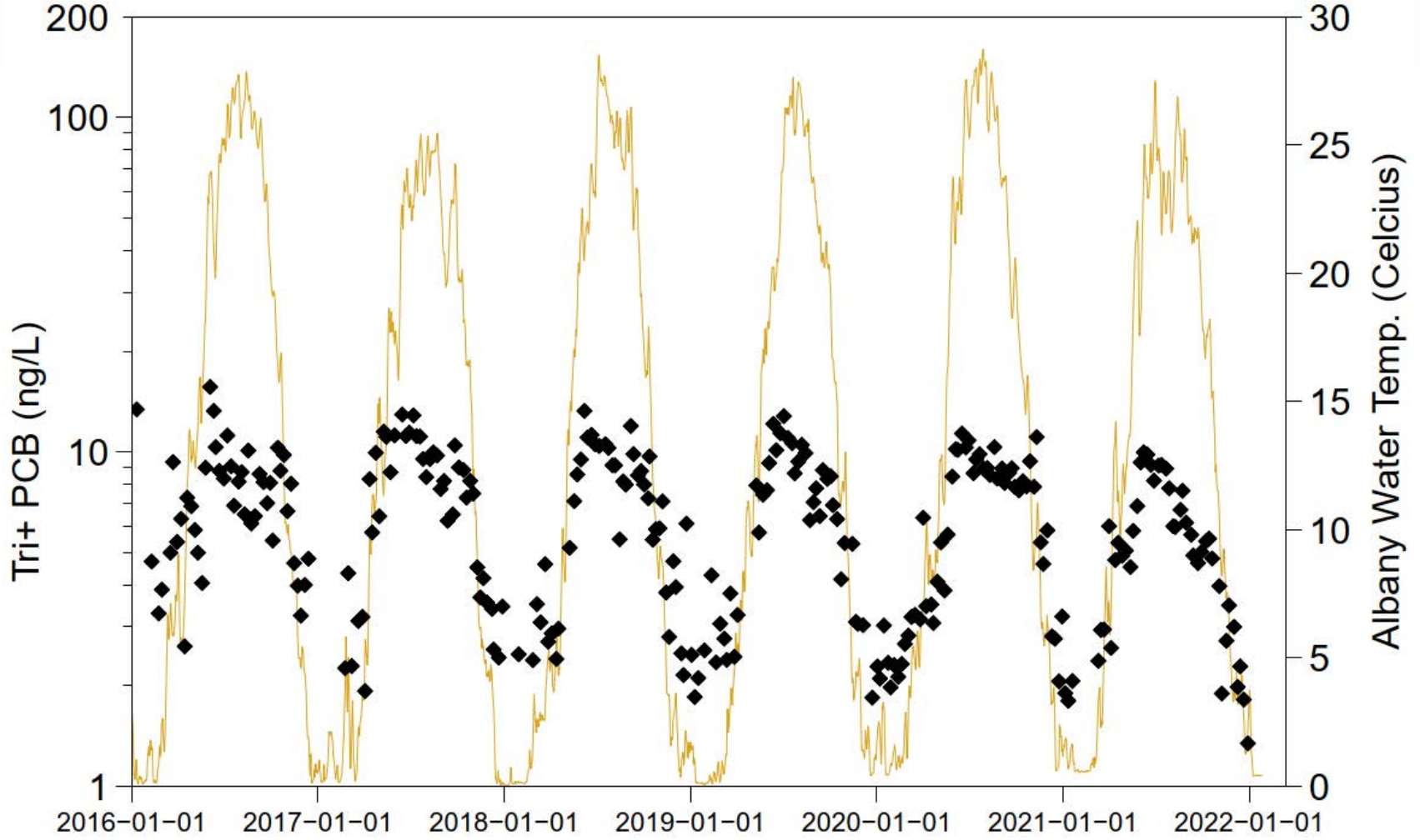
- **In the 3/1 meeting, EPA postulated that the inconsistency between the estimated 80-90% reduction in sediment PCBs and the approximately 50% reduction in water and fish post-dredging might be due to a "lack of equilibrium". Does EPA have any data to support this hypothesis? Has EPA considered alternative hypotheses?**

  Multiple lines of evidence must be considered when evaluating the relationship between the three media. Various special studies and additional analysis are planned to continue to gather important data for EPA to evaluate the relationship between the media. To understand whether equilibrium in a dynamic system such as the Hudson River has been met, multiple factors must be considered (e.g., trends in PCB sediment concentrations in dredge areas vs. non-dredge areas; water column data over time; PCB concentrations in yearling fish and fish age).

- **A review and discussion of the "new" water analysis formula EPA shared with the Team at the meeting that discussed loads.**

  See next slides, which were included in the FYR Team Meeting #2 (Water Column).

Impacts of Season on Tri+ PCB Concentration

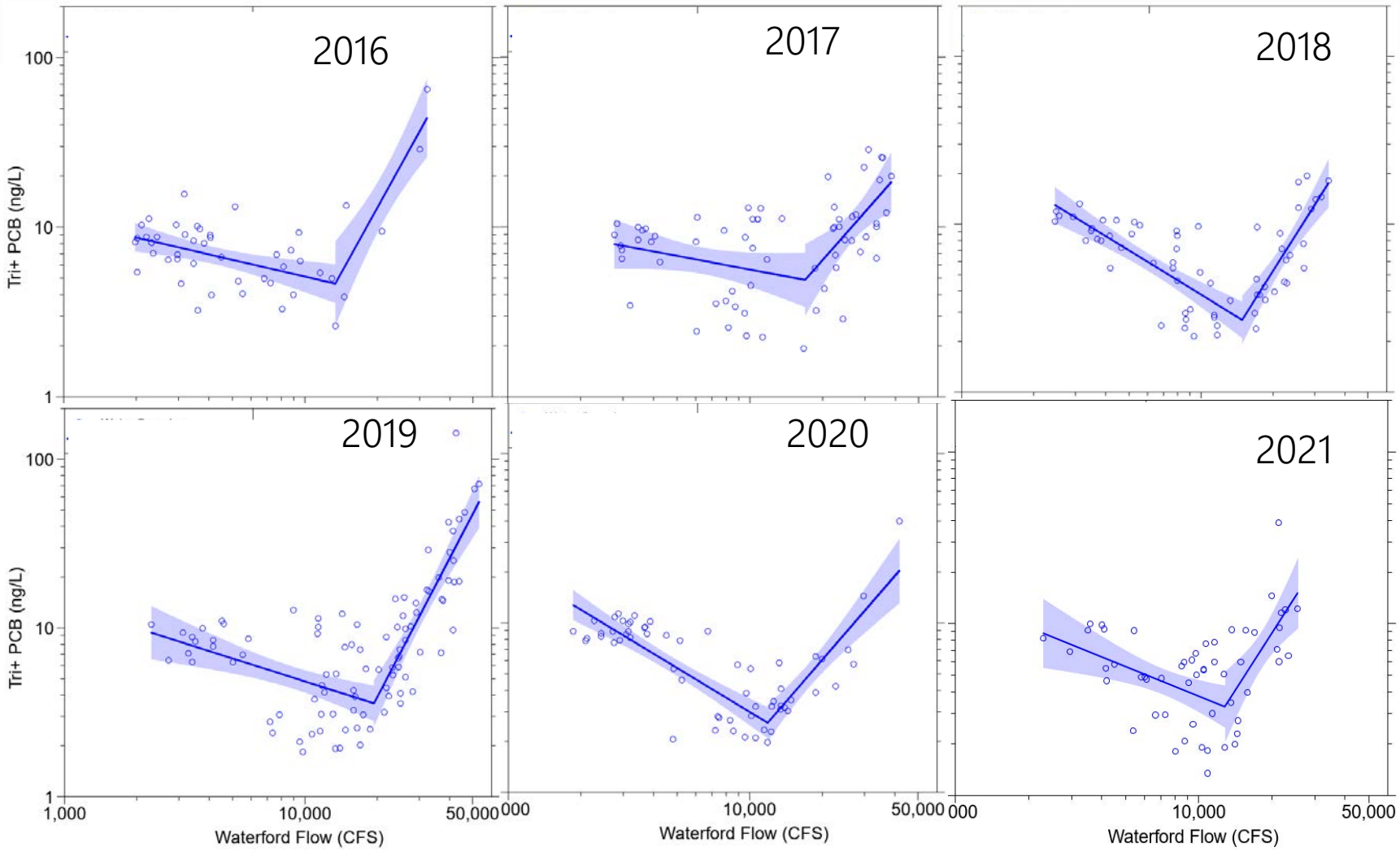


Legend:
- Waterford Station water column samples collected under Routine Sampling Program
- Albany USGS Station Water Temperature

PCB concentrations tend to be **higher** in the summer months (higher water temperatures) and **lower** in the winter months (lower water temperatures) under non-high flow conditions

Note: Water temperature data recorded at Albany USGS Station (#01359139).

Impacts of Flow on Tri+ PCB Concentration



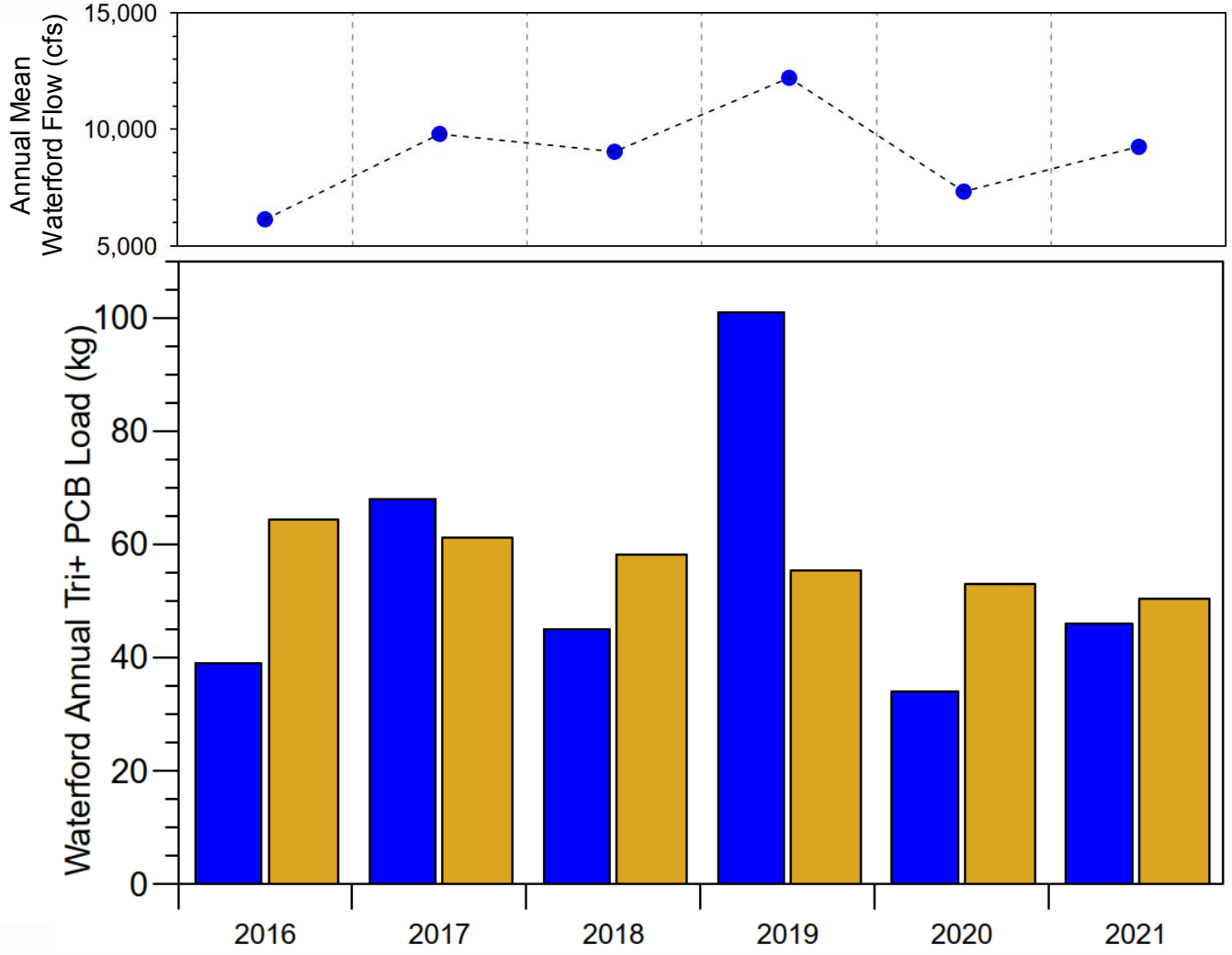
Water Samples
Segmented Regression Fit

Piecewise or "segmented" relationship between Tri+ PCB concentration and flow is indicative of the two distinct concentration-flow regimes:

- **Low flow**: Dilution dominates
- **High flow**: Resuspension dominates

Note: Blue line represents best-fit of the segmented regression model between concentration and flow. Blue shaded area represents the 95% confidence band about the fit.

2016 to 2021 Annual Tri+ PCB Loads at the Waterford Monitoring Station



Legend:

- Mean of Annual Waterford Flow
- Annual Tri+ PCB Load
- Flow-Temperature-Normalized Annual Tri+ PCB Load

- Annual Tri+ PCB loads ranged from 34 kg in 2020 to 101 kg in 2019.
- Annual Tri+ PCB loads are higher in years with higher flows

Notes:

1. *Annual PCB loads are estimated using the USGS LOADEST load estimation program. Flow-temperature-normalized (FTN) PCB loads adjust annual loads to remove the influence of year-to-year variability in flow and seasonality such that the FTN PCB loads reflect changes in PCB concentration only.*
2. *Mean annual flows based on daily mean flow measured at the USGS Waterford Station (#01335754).*

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Arithmetic Mean vs. Geometric Mean

Note: EPA often considers both

The Use of Geometric Mean and Arithmetic Mean in 3rd FYR

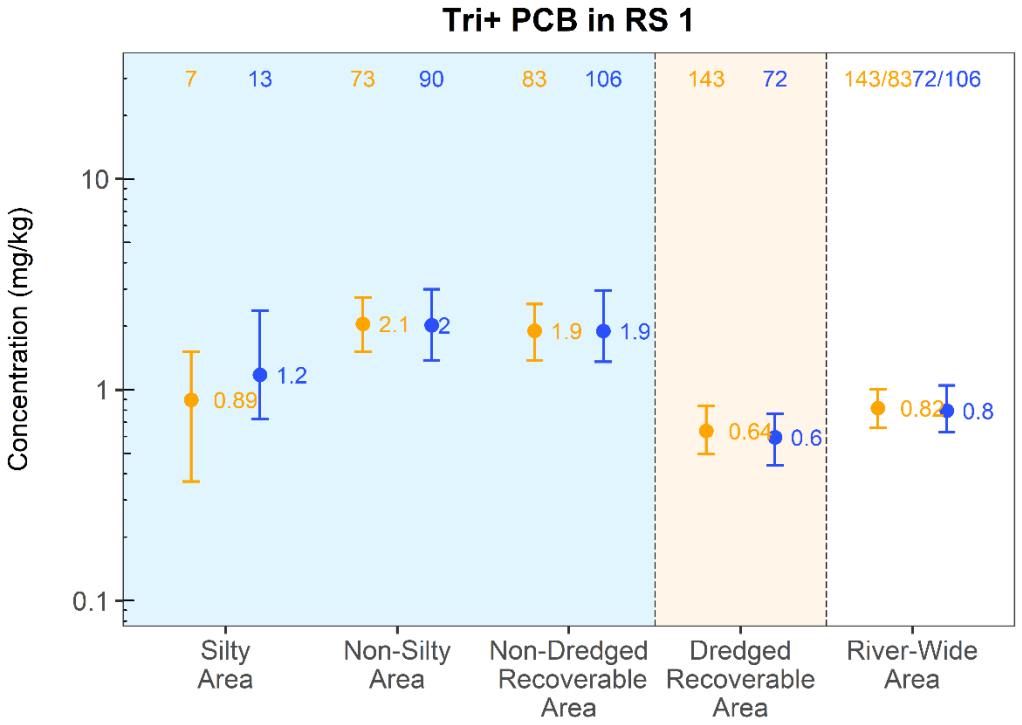
Arithmetic Mean	Geometric Mean

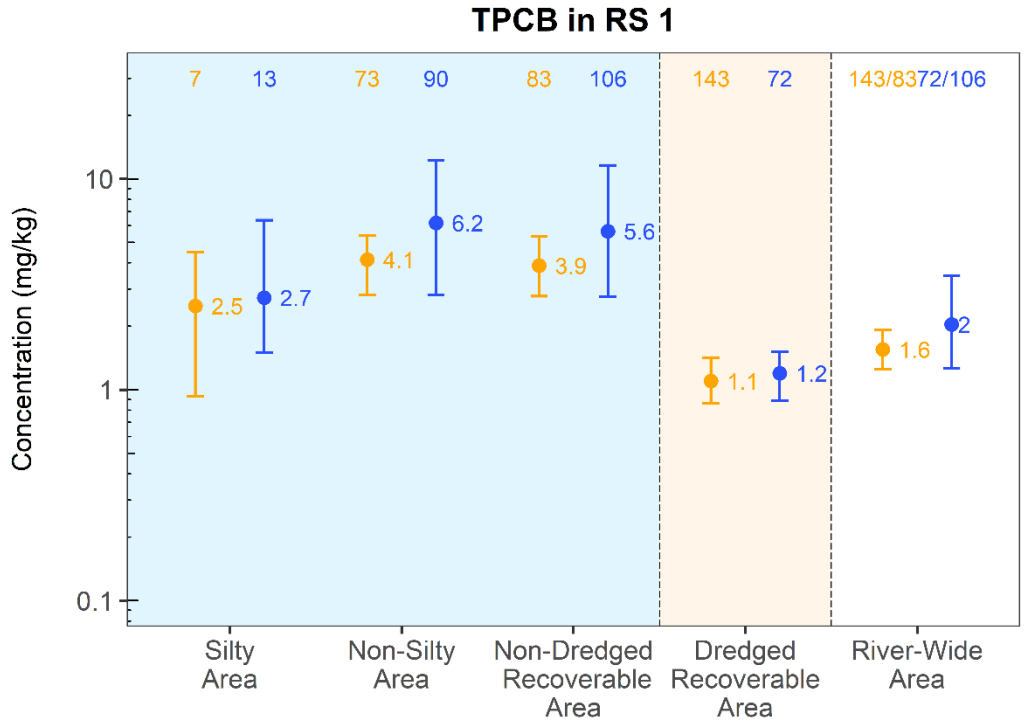
• **Fish**:
  • Species-weighted average
• **Sediment:**
  • Recoverable sediment average
  • River-wide sediment average
	• **All Media:**
	  • Temporal evaluations (e.g., year-to-year, dredging periods)
	• **Fish**:
	  • PCB conversion factors (geomean of the ratios)

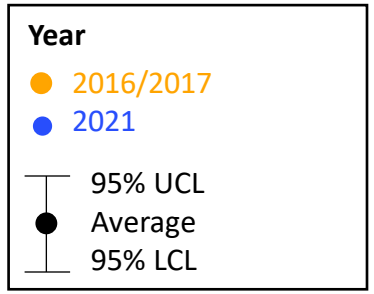
- Hudson River datasets are generally lognormally distributed.
  - The geometric mean is a better estimate of the central tendency and is less influenced by outlier results.
  - The geometric mean serves as a better basis for temporal evaluation of Hudson River data. Since a first-order log regression is used to represent change over time, we expect some level of noise/variability in that dataset over time.
  - The geometric mean is appropriate for determining ratios for data comparison.

Silt (Cohesive) vs. Non-Silt (Non-Cohesive) Comparison in Non-Dredged Areas

Surface Sediment PCB Concentrations
River Section 1







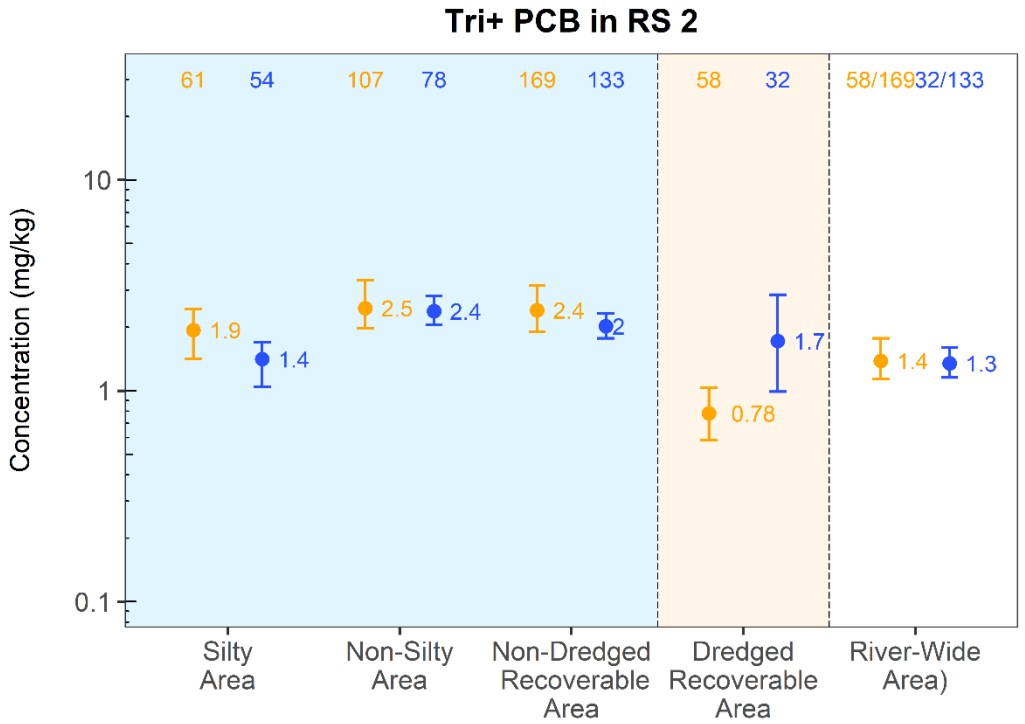
Non-Dredged Area

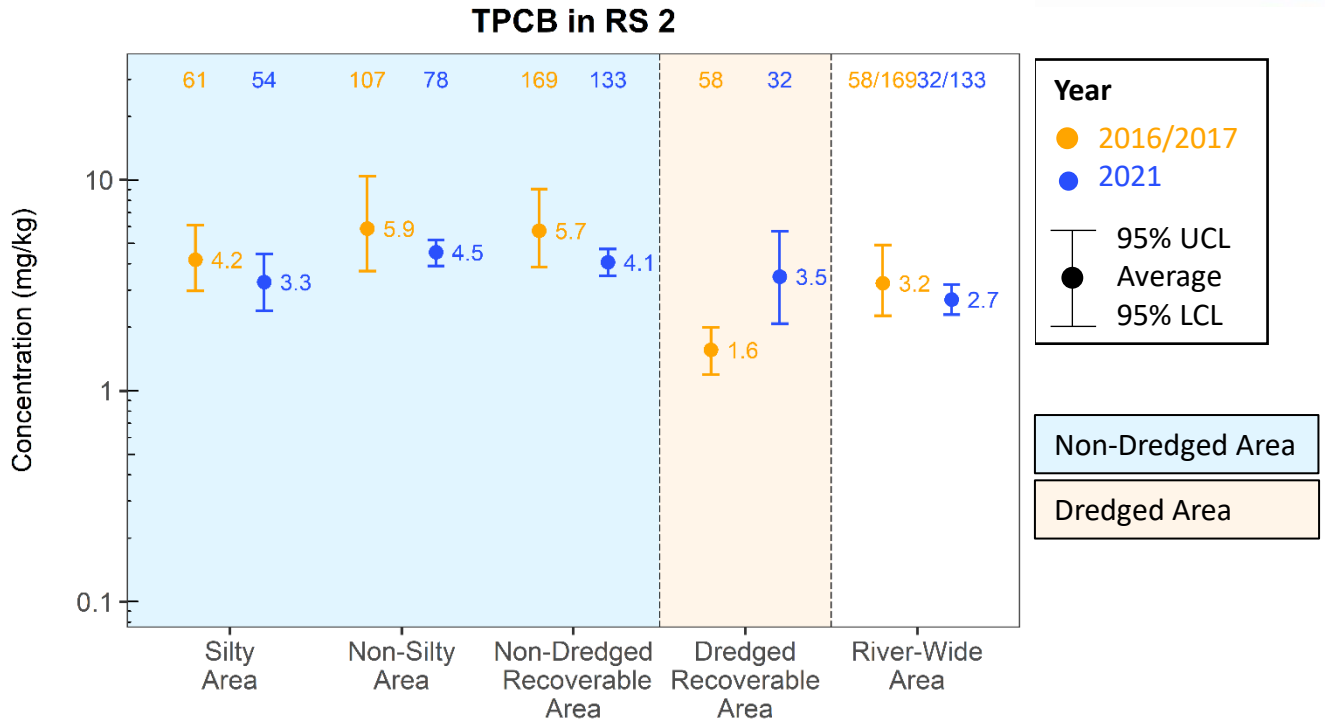
Dredged Area

River Section 1	Area (acres)	Percentage
Non-Dredged Silty Area	17	8%
Non-Dredged Non-Silty Area	187	92%
Non-Dredged Recoverable Area	130	24%
Dredged Recoverable Area	290	54%
Non-Recoverable and Bedrock Area	112	21%
River Wide Area	532	

- Silty and Non-Silty areas are from GE's 2002-2003 Side-Scan Sonar Survey
- Non-Silty area includes "Silt and Sand", "Gravel", "Transitional" and "Bedrock" areas
- GE 2002-2003 SSS did not cover the entire river bottom bank to bank
- River-Wide area includes recoverable dredge, recoverable non-dredge, non-recoverable and bedrock areas
- xx/xx represents number of samples from dredged and non-dredged areas

Surface Sediment PCB Concentrations
River Section 2

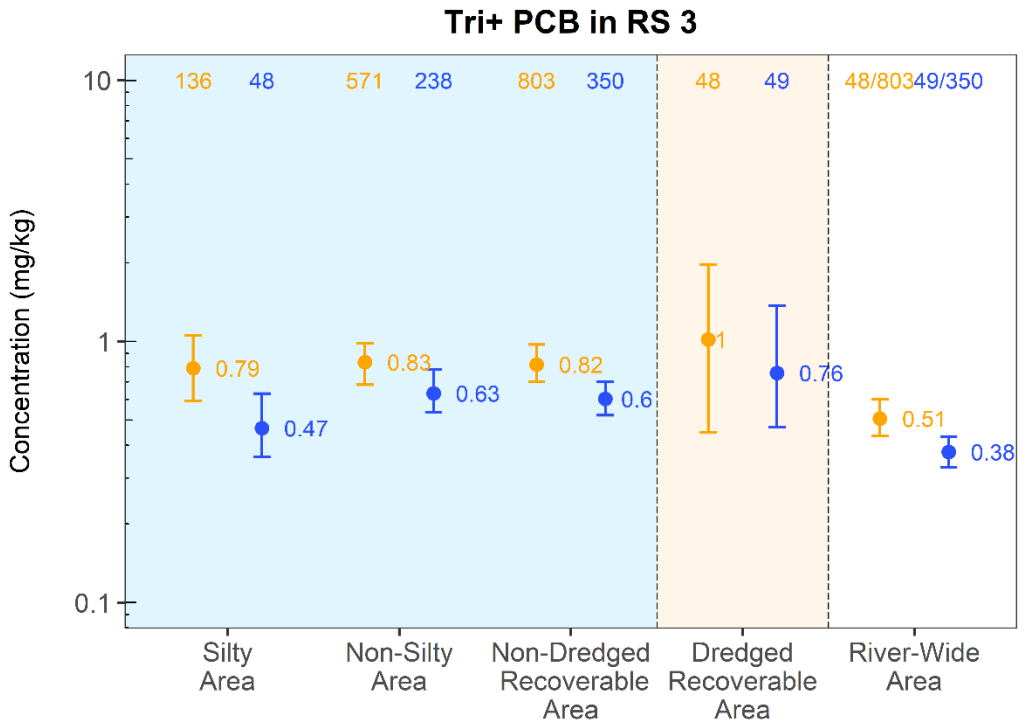


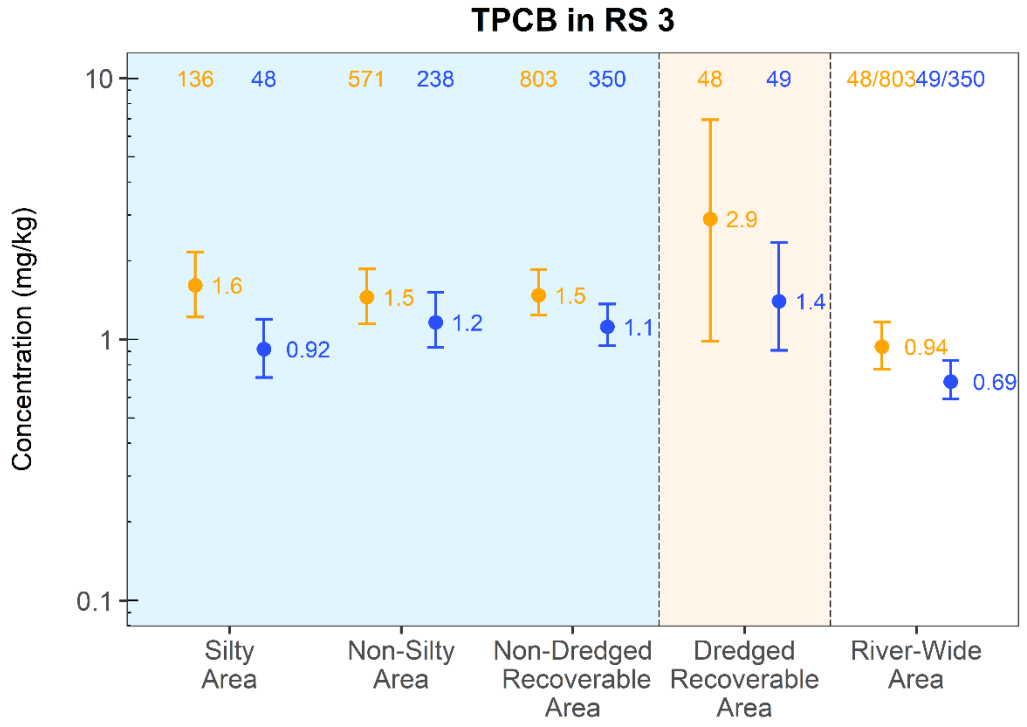


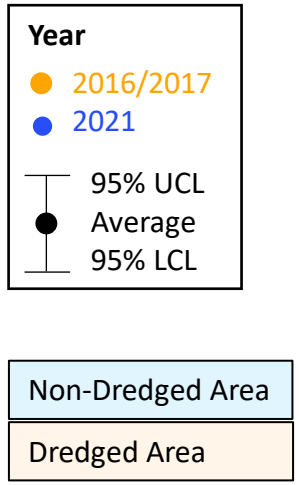
River Section 2	Area (acres)	Percentage
Non-Dredged Silty Area	93	26%
Non-Dredged Non-Silty Area	267	74%
Non-Dredged Recoverable Area	244	52%
Dredged Recoverable Area	82	17%
Non-Recoverable and Bedrock Area	148	31%
River Wide Area	474	

- Silty and Non-Silty areas are from GE's 2002-2003 Side-Scan Sonar Survey
- Non-Silty area includes "Silt and Sand", "Gravel", "Transitional" and "Bedrock" areas
- GE 2002-2003 SSS did not cover the entire river bottom bank to bank
- River-Wide area includes recoverable dredge, recoverable non-dredge, non-recoverable and bedrock areas
- xx/xx represents number of samples from dredged and non-dredged areas

Surface Sediment PCB Concentrations
River Section 3







River Section 3	Area (acres)	Percentage
Non-Dredged Silty Area	329	14%
Non-Dredged Non-Silty Area	2,023	86%
Non-Dredged Recoverable Area	1,603	57%
Dredged Recoverable Area	91	3%
Non-Recoverable and Bedrock Area	1,141	40%
River Wide Area	2,835	

- Silty and Non-Silty areas are from GE's 2002-2003 Side-Scan Sonar Survey
- Non-Silty area includes "Silt and Sand", "Gravel", "Transitional" and "Bedrock" areas
- GE 2002-2003 SSS did not cover the entire river bottom bank to bank
- River-Wide area includes recoverable dredge, recoverable non-dredge, non-recoverable and bedrock areas
- xx/xx represents number of samples from dredged and non-dredged areas

Next Steps

- Status of 3rd Five-Year Review
  - EPA is continuing to evaluate data and draft the FYR Report
  - In support of preparing the FYR Report, EPA is also considering the input received from the FYR Team members
  - EPA anticipates releasing the 3rd FYR Report in May – June timeframe
  - Public comment period following release
  - EPA will keep FYR Team updated if schedule changes

Attachment B

Third Five-Year Review Public Notice and News Release

EPA PUBLIC NOTICE

U.S. Environmental Protection Agency Reviews Cleanup at Hudson River PCBs Superfund Site

The U.S. Environmental Protection Agency (EPA) has begun its third five-year review of the **Hudson River PCBs Superfund site**. The purpose of this review is to ensure that the cleanup is working as intended and protective of public health and the environment.

Dredging to remove polychlorinated biphenyls (PCBs) from a 40-mile stretch of the upper Hudson River between Troy and Fort Edward, New York was completed in the fall of 2015. The current five-year review will include an assessment of the last five years of fish, water, and sediment data (2017-2021). This data will assist EPA in further understanding the rate of recovery in the river. It is anticipated that additional years of data may be needed to determine the rate of recovery with statistical confidence.

The five-year review will also include a review of the areas of PCB-contaminated sediment located upstream of the areas that have been dredged. These areas, known as the remnant deposits, became exposed after the river level dropped after the Fort Edward Dam was removed in 1973. These areas are now capped, maintained, and monitored.

A summary of cleanup activities and an evaluation of the protectiveness of the implemented cleanup plan will be included in the five-year review report.

What is an EPA Five-Year Review?

The five-year review is legally required under the Superfund law every five years after the start of on-site construction when contaminants remain at a site. These regular reviews include:

- Inspecting the site and cleanup technologies;
- Reviewing monitoring data, operating data, and maintenance records;
- Determining if any new regulatory requirements have been established since EPA's original cleanup decision was finalized; and,
- Specifically for the Hudson River PCBs site, assessing current river conditions, including post-dredging sediment, water, and fish data.

How can the public provide input in the review?

EPA expects to issue the third five-year review report in fall 2022 and will make it available for public input. Prior to issuing the report, EPA will also present on the progress of the review to the site's Community Advisory Group (CAG). CAG meetings are open to the public and information about the meetings will be announced in advance. EPA anticipates that the third five-year review will be completed by spring 2023. The five-year review report will be available on EPA's Hudson River project webpage: **www.epa.gov/hudsonriverpcbs**.

For further information or questions about the five-year review of the Hudson River PCBs Superfund site:

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For more information: www.epa.gov/hudsonriverpcbs

U.S. ENVIRONMENTAL PROTECTION AGENCY
NEWS RELEASE
EPA.GOV/NEWSROOM

EPA Begins Third Five-Year Review of Upper Hudson River PCB Cleanup

Contact: Larisa Romanowski, (518) 407-0400, romanowski.larisa@epa.gov

ALBANY, NY (April 19, 2022) – The U.S. Environmental Protection Agency has initiated its third five-year review of the cleanup of the Hudson River PCBs Superfund site, which extends from Hudson Falls, New York, to New York City. Dredging to remove polychlorinated biphenyls (PCBs) from a 40-mile stretch of the upper Hudson River between Fort Edward and Troy, New York was completed in 2015. The cleanup was conducted by General Electric (GE) Company under the oversight of and a legal agreement with EPA.

The purpose of this five-year review, which is legally required under the Superfund law every five years after the start of on-site construction at a site, is to ensure that the cleanup is working as intended and protective of people's health and the environment.

"As we continue our work to monitor and assess the upper Hudson, move forward with the Hudson River floodplain investigation and evaluate how best to assess the lower Hudson, EPA is committed to continuing to fully engage our state and federal partners and the site's Community Advisory Group during the five-year review process," **said EPA Regional Administrator, Lisa F. Garcia**. "It has been EPA's long-standing experience on this iconic site that engagement from the public has strengthened our work and served well communities up and down the Hudson."

EPA will in part be evaluating new data collected since the second five-year review was conducted in 2017. As part of the upcoming five-year review, EPA will review the fish, water and sediment data collected between 2017 and 2021. This five-year review will be one of many future reviews and will not serve as the final assessment of the cleanup, rather, it will evaluate whether the stated goals of the cleanup are being met, or are expected to be met, based on the available data.

In the second five-year review report, issued in 2019, EPA deferred a determination about the protectiveness of the cleanup remedy in the Upper Hudson River until additional Hudson River fish tissue data could be gathered. As described in the second five-year review, it is anticipated that additional years of data may be needed to determine the rate of fish recovery with

statistical confidence. Lowering PCB levels in fish tissue is the key objective of the cleanup remedy selected in 2002 by EPA.

The Operation, Maintenance & Monitoring phase of the upper Hudson cleanup will continue. During this phase, there is ongoing monitoring to track the ongoing recovery of the river. EPA will also continue to conduct periodic five-year reviews.

The upcoming five-year review will also include a review of actions taken as a result of a 1984 cleanup plan for the areas of PCB-contaminated sediment upstream of the areas targeted for dredging. These areas, known as the remnant deposits, became exposed after the river water level dropped following removal of the Fort Edward Dam in 1973. These areas are now capped, maintained, and monitored.

EPA's other activities to address contamination in the Upper Hudson include an ongoing comprehensive floodplain investigation to evaluate and address PCB contamination that may be present in sediment carried onto low-lying shoreline areas in the Upper Hudson River. EPA is also continuing its plans for supplemental studies in the Lower Hudson River.

EPA expects to release the third five-year review report in fall 2022 and will make it available for public input. Prior to issuing the report, EPA also will present on the progress of the review to the site's Community Advisory Group (CAG). CAG meetings are open to the public and information about the meetings will be announced in advance. EPA anticipates the third five-year review report will be completed by spring 2023. The five-year review report will be available on EPA's Hudson River webpage.

Between the 1940's and 1970's, GE discharged PCBs into the Hudson River from its two former capacitor manufacturing plants in Fort Edward and Hudson Falls, New York. In 2002, EPA issued a Record of Decision calling for the targeted environmental dredging of approximately 2.65 million cubic yards of PCB-contaminated sediment from a 40-mile stretch of the Upper Hudson River between Fort Edward and Troy, NY, followed by a period of monitored natural recovery predicted to extend more than five decades. The dredging and capping work in the Upper Hudson River was conducted between 2009 and 2015.

For more information about the Hudson River PCBs Superfund site, visit the EPA Hudson River webpage.

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22-027 ####