



Hudson River PCBs Superfund Site

Upper River (OU2) Long-term Monitoring Update

Community Advisory Group Meeting

Thursday, March 31, 2022

Virtual Meeting

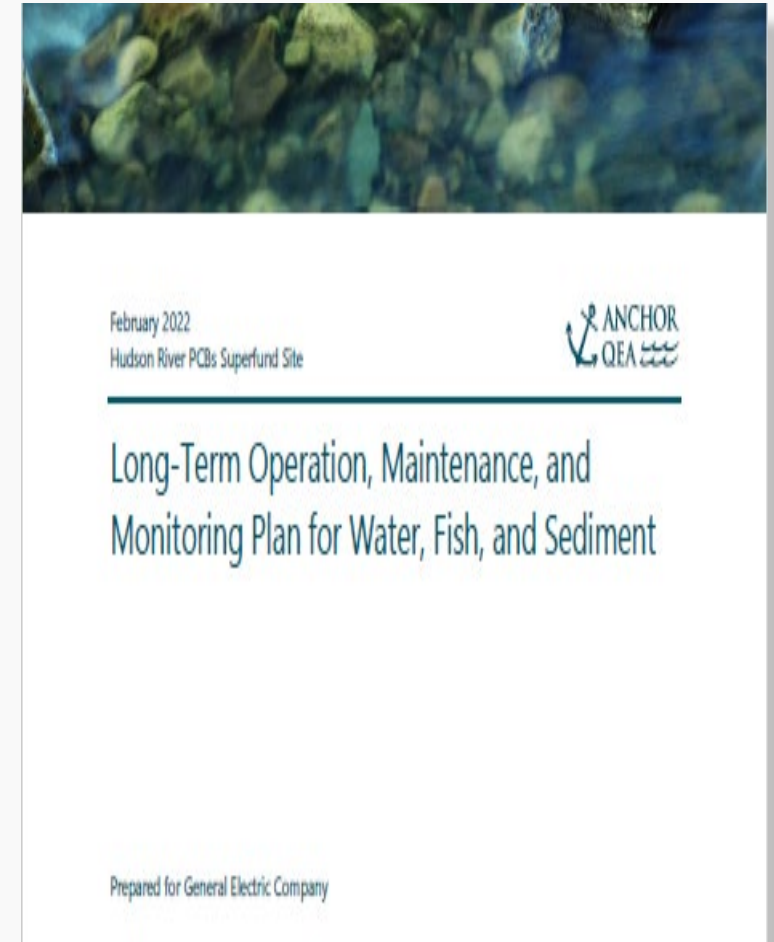


- **Upper River – Long-Term Monitoring Program**
 - Monitoring Work Plan
 - Fish Program
 - Water Program
 - Sediment Program
 - Capping Program

Long-Term Operation, Maintenance, and Monitoring (OM&M) Plan for Water, Fish and Sediment (2022)



- GE submitted the OM&M plan for water, fish, and sediment to EPA for review on February 28, 2022
 - Required as part of the 2010 scope of work for Phase 2
 - EPA anticipates other agency comments in early/mid April
- The document outlines each program (water, fish, sediment, and caps) in detail
 - Includes sampling procedures and laboratory requirements
 - Habitat monitoring and maintenance is documented in separate reports
- EPA conducted extensive review of existing data over the last 2 years in close coordination with NYSDEC and GE to develop appropriate scopes of work
 - Scopes of work generally consistent with existing monitoring program
 - Monitoring of the river will continue with modifications as necessary going forward



Long-Term Monitoring Activities



- Purpose: Collect data necessary to continue to monitor the recovery of water, fish and sediment
- General overview of the long-term monitoring program
 - Fish – annual (spring and fall collection) - additional fish every 5 years
 - Water Column – 1-3 times monthly
 - Sediment – every 5 years (sampled 2021)
 - Caps – generally every 10 years going forward - next survey 2023
- The number of samples and sample frequency for each program were derived from an evaluation of post-dredging data

FISH PROGRAM



Program overview

- Existing program adjusted based on post-dredging data
 - Same stations, same species
- Annual monitoring :
 - Spring – sportfish (black bass, perch, bullhead etc.)
 - Fall collection - pumpkinseed
 - RS1, RS2, RS3(Reach 5), Albany/Troy, Catskill, and Tappan Zee
- Periodic monitoring :
 - Feeder Dam for upstream reference conditions
 - Reaches 4 through 1
 - Forage fish
 - Supplemental monitoring program (NY State fish consumption evaluations)
- Key analytical program components
 - National Institute of Standards and Technology (NIST) standard reference materials
 - Periodic analysis of 5% of samples by congener



EPA considerations in development of program

- Ability to detect 5% rate of decline in PCBS over 10 years
 - Reach, river section, species
- How to reduce uncertainty/variability in program
- How the data will be used during OM&M



Fish Program - Routine Monitoring



Location	Black Bass		Brown Bullhead	Yellow Perch	Pumpkinseed	Spottail Shiner	Striped Bass	White Perch	Channel Catfish
	Largemouth Bass	Smallmouth Bass							
Feeder Dam	10	10	20	20	20	10			
RS 1 Reach 8	8	32	20	20	30	15			
RS 2 Reaches 7 and 6	3	21	20	12	16	28			
RS 3 Reach 5	20		20	20	15	15			
RS 3 Reaches 4-1					80				
Albany/ Troy		20		15	10	12	30	If insufficient yellow perch	10
Catskill		20	20	20			20	If insufficient yellow perch	
Tappan Zee (Nyack)							20		

Sampling Frequency:

- Annual
- Every 3 Years
- Every 5 Years

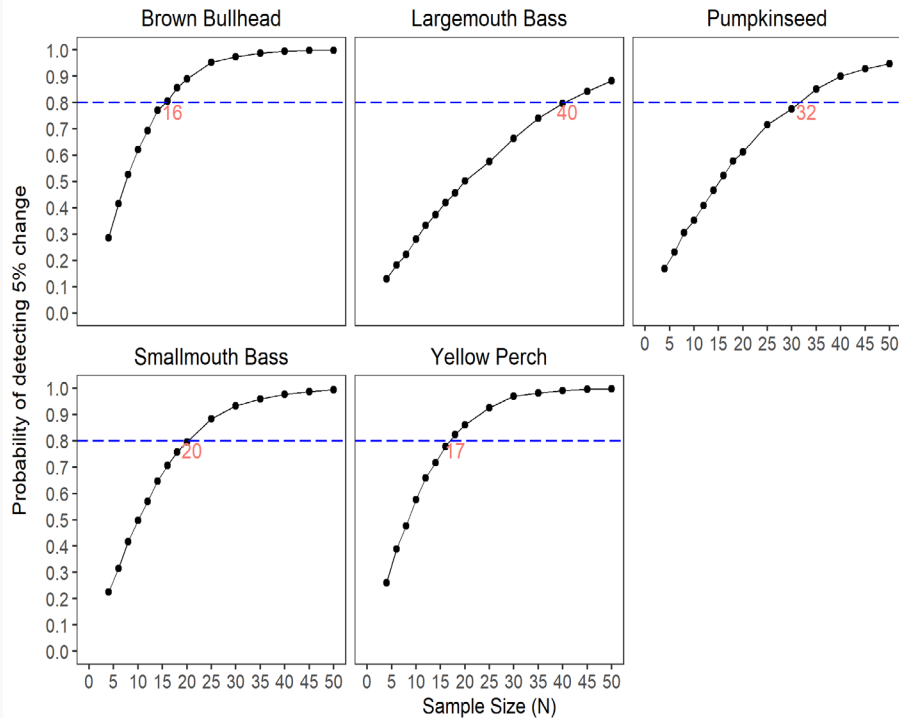
EPA Considerations:

- Sample size adjusted to observe 5% annual rate of decline over 10 years
- Fish-tissue PCB levels at Feeder Dam do not show trends over time and consistently low PCB concentrations compared to downstream stations.
- PCB data from pumpkinseed and spottail shiner are correlated.

Fish Program - Routine Monitoring

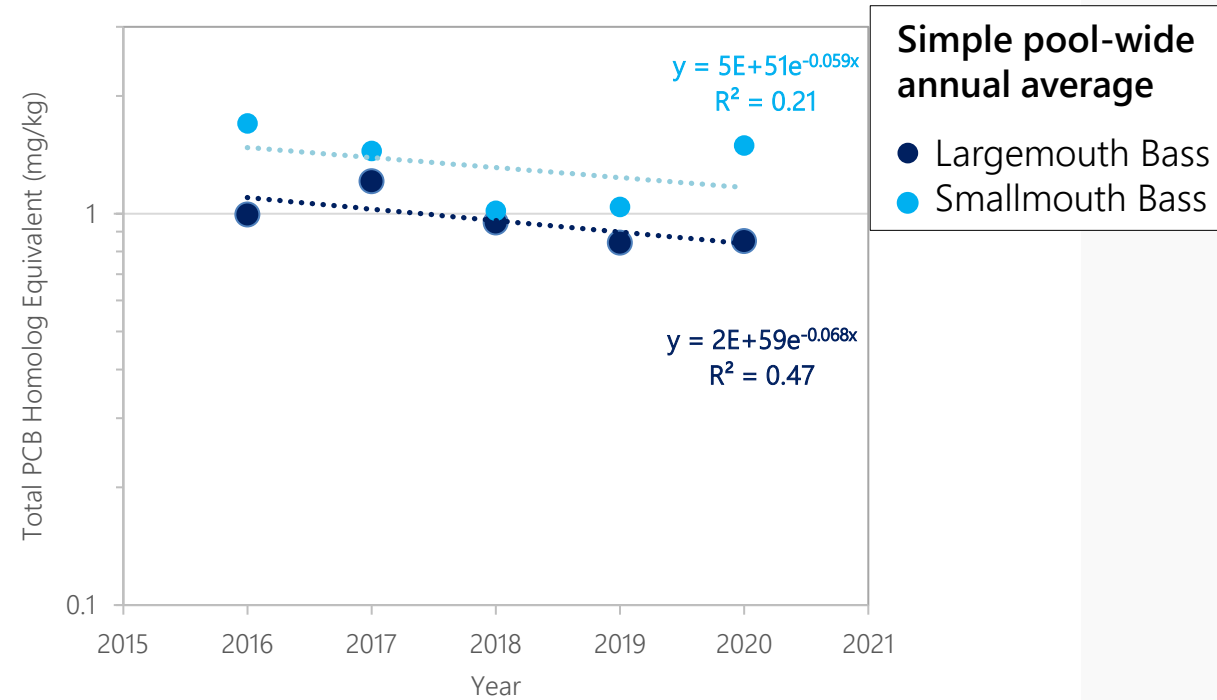


Power analysis results for RS 1: TPCB_{HE} Wet



- Sample counts based on statistical evaluation
- Goal to observe a 5% rate of decline over 10 years

Largemouth Bass and Smallmouth Bass Trends in RS 1

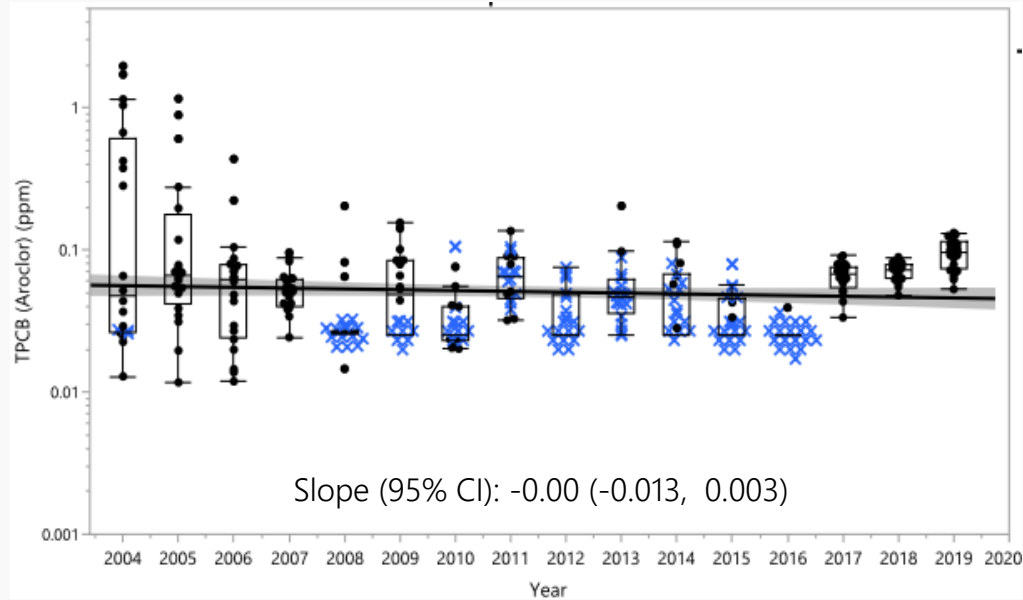


- Species substitution can create additional uncertainty in program
- Largemouth bass and smallmouth bass not always have similar PCB levels

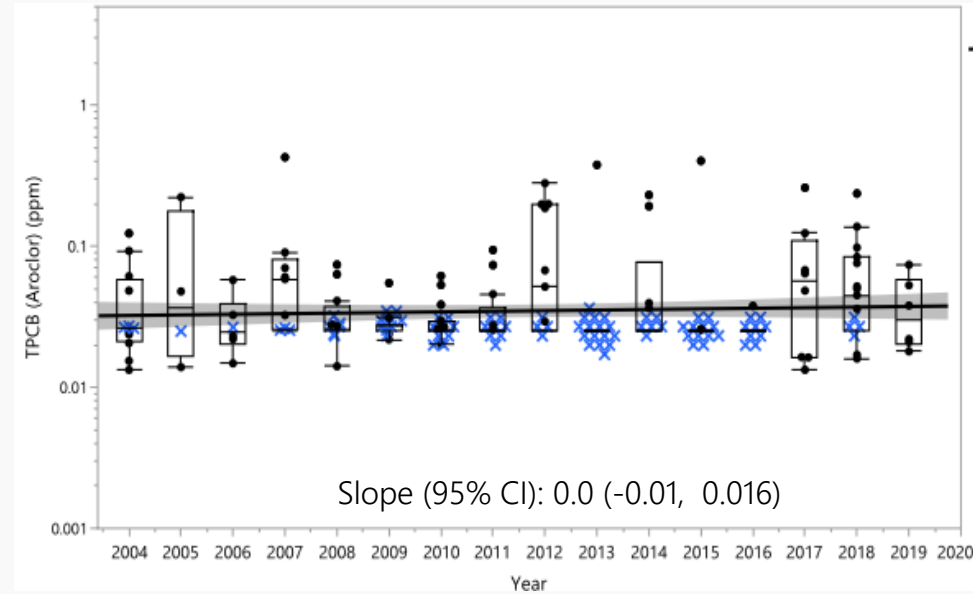
Fish Program - Feeder Dam



Pumpkinseed

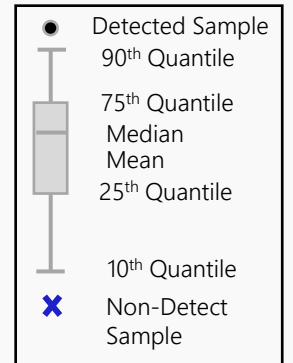


Smallmouth Bass



Legend

Linear Regression



NDs are plotted (1/2 RL)

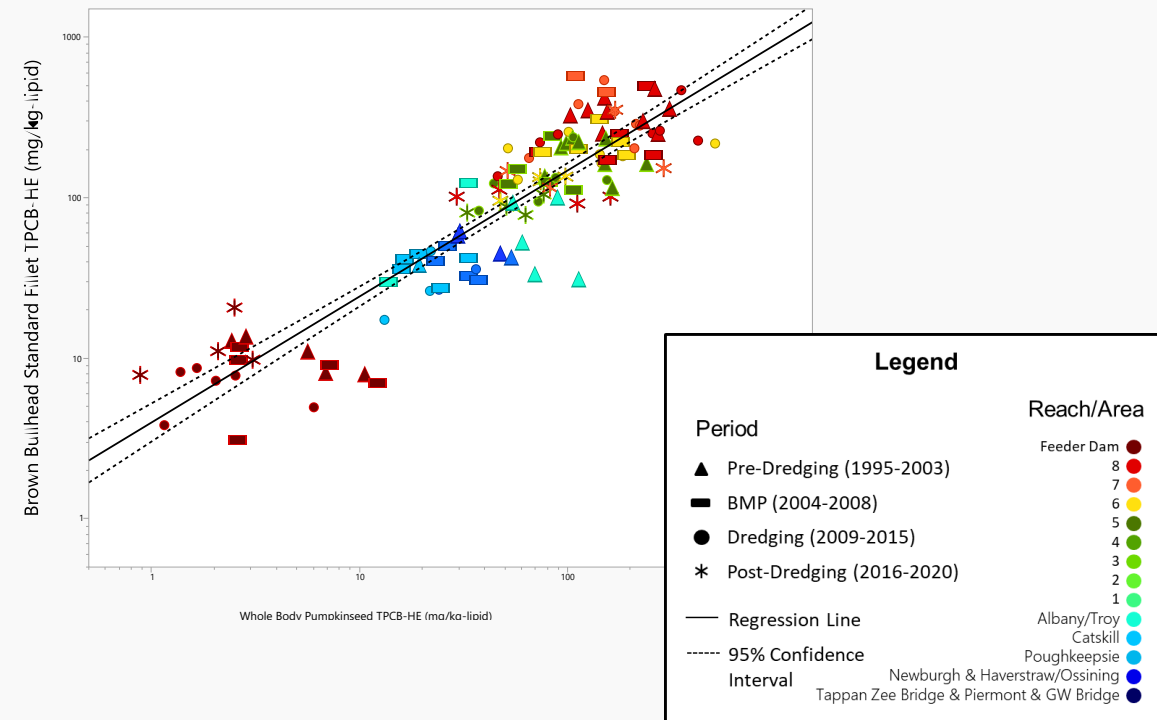
- Fish-tissue PCB levels at Feeder Dam did not show trends over time
- Concentrations are generally an order of magnitude lower than Upper Hudson River fish

Fish Program - Reaches 4 through 1



Location	Target Species	Target Sample Size per Reach	Frequency
RS 3 (Reaches 4 to 1)	Pumpkinseed	20 (80 total)	<ul style="list-style-type: none"> • Every <u>five (5) years</u> starting in 2021 • Monitoring of other species when levels in pumpkinseed have declined enough to indicate that a “check” of other species is warranted

- Data indicates reach 1-4 fish are consistent with EPAs understating that Reach 5 fish are an appropriate representation of RS3
 - Fish tissue PCB concentrations in Reaches 4 to 1 are appropriately bound by reach 5 and Albany Troy (Reach 5 and Albany/Troy)
- Pumpkinseed can be used as a surrogate to track forage fish and sport fish and determine when additional sampling may be necessary
- Goal is to measure a 5% annual rate of decline over 10 years in pumpkinseed



Upper Hudson River Species-Weighted Average Over Time

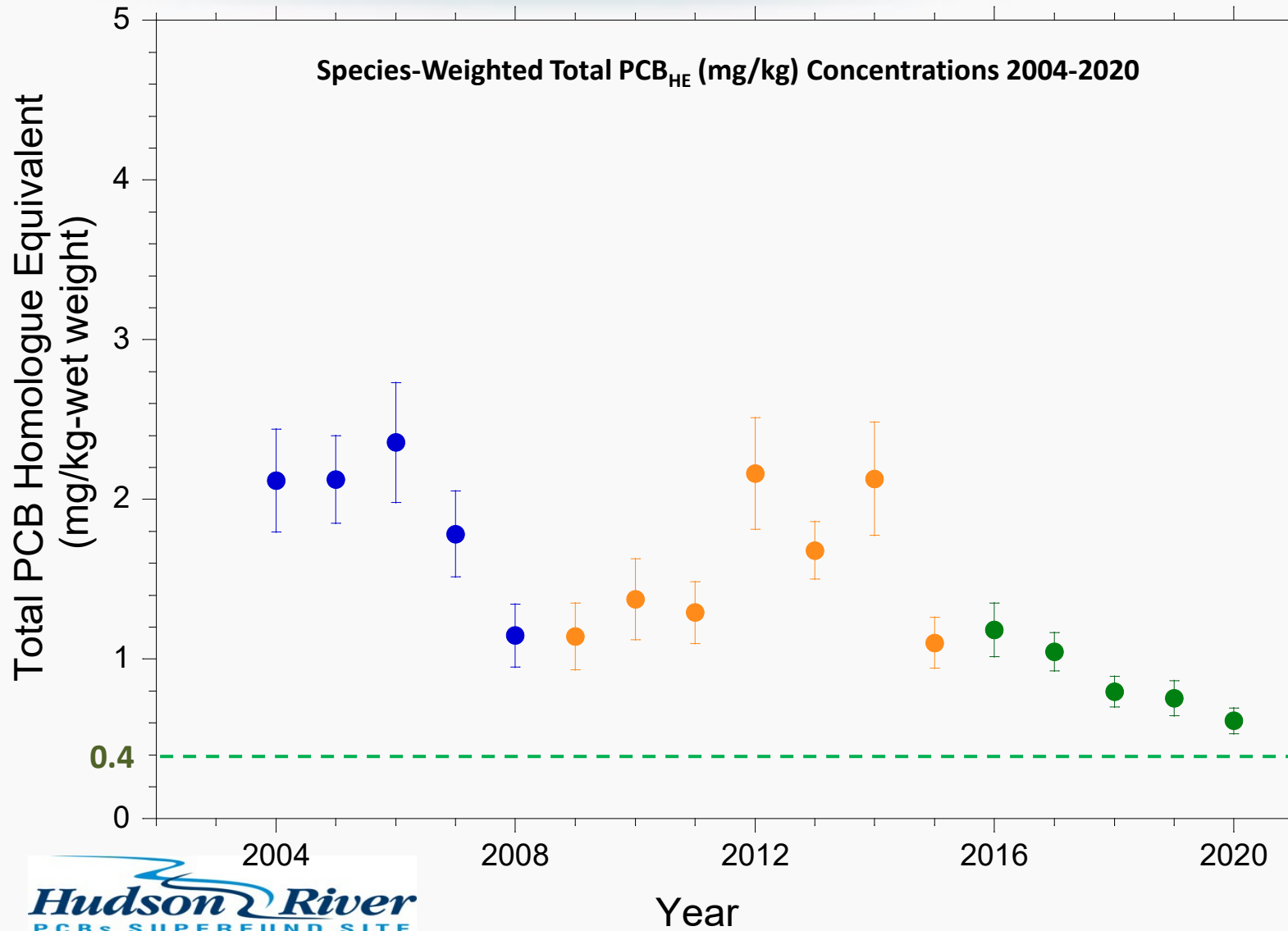
– Combined River Sections 1, 2 and 3



Legend

- Before Dredging (2004-2008)
- During Dredging (2009-2015)
- After Dredging (2016-2020)

- Upper Conf Limit
- Mean
- Lower Conf Limit



Notes

1. River Section fish tissue PCB concentrations are weighted by species. Black bass = 47%, Ictalurid = 44%, yellow perch = 9%.
2. 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%). There is no regular fish sampling in river reaches 4-1 (of River Section 3). Reach 5 in River Section 3 is taken to represent all 29.5 miles of River Section 3. Reach 5 is 14 miles in length.
3. Fish data were not available for Reach 7 of River Section 2 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 confidence Interval is equal to the mean plus or minus 2 standard errors on the mean

Hudson River Species-Weighted Average over Time



**2004-2020 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 Interval	River Section 1 Mean	Confidence Interval	River Section 2 Mean	Confidence Interval	River Section 3 Mean	Confidence Interval
Baseline (Pre-Dredge) Monitoring Period (BMP)	2004	2.1	1.8 - 2.4	4.3	2.9 - 5.7	3.4	2.8 - 4.0	1.4	1.1 - 1.7
	2005	2.1	1.8 - 2.4	2.3	1.8 - 2.8	2.9	2.2 - 3.5	2.0	1.6 - 2.3
	2006	2.4	2.0 - 2.7	2.5	2.0 - 3.1	2.4	2.1 - 2.8	2.3	1.8 - 2.8
	2007*	1.8	1.5 - 2.1	2.5	2.0 - 2.9	2.2	1.7 - 2.7	1.6	1.2 - 1.9
	2008*	1.1	0.95 - 1.3	1.5	1.1 - 1.9	2.5	1.6 - 3.5	0.83	0.63 - 1.0
Dredging (2009, 2011-2015) Remedial Action Monitoring Program (RAMP)	2009*	1.1	0.93 - 1.4	1.5	0.89 - 2.1	1.9	1.4 - 2.4	0.93	0.68 - 1.2
	2010*	1.4	1.1 - 1.6	2.6	2.0 - 3.3	1.6	1.3 - 1.9	1.1	0.74 - 1.4
	2011*	1.3	1.1 - 1.5	1.5	1.2 - 1.9	2.0	1.4 - 2.5	1.1	0.88 - 1.4
	2012*	2.2	1.8 - 2.5	3.0	2.2 - 3.7	3.3	2.5 - 4.1	1.8	1.4 - 2.2
	2013*	1.7	1.5 - 1.9	2.4	2.1 - 2.7	2.6	2.1 - 3.1	1.4	1.1 - 1.6
	2014	2.1	1.8 - 2.5	2.3	1.7 - 2.8	3.0	2.5 - 3.6	1.9	1.5 - 2.4
OM&M Monitoring (on-going)	2015	1.1	0.94 - 1.3	1.7	1.3 - 2.0	1.6	1.2 - 1.9	0.90	0.70 - 1.1
	2016	1.2	1.0 - 1.3	1.3	0.95 - 1.6	1.6	1.3 - 1.9	1.1	0.88 - 1.3
	2017	1.0	0.92 - 1.2	1.0	0.84 - 1.3	1.6	1.2 - 2.0	0.95	0.80 - 1.1
	2018	0.80	0.70 - 0.89	0.81	0.65 - 0.97	0.94	0.71 - 1.2	0.77	0.64 - 0.89
	2019	0.75	0.65 - 0.86	0.82	0.62 - 1.0	1.0	0.73 - 1.4	0.69	0.56 - 0.82
	2020	0.61	0.53 - 0.69	0.87	0.58 - 1.2	0.84	0.61 - 1.1	0.52	0.43 - 0.60

* Rib-out fillet

Notes:

1. Reach and River Section fish tissue PCB concentrations are weighted by species. Black bass = 47%, bullhead = 44%, yellow perch = 9%.
2. 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%). There are not currently fish sampling locations in river reaches 4-1. 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.
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 Confidence Interval is equal to plus or minus 2 Standard Errors on the mean.

WATER PROGRAM



Program overview

- Existing program adjusted based on post-dredging data
 - Same stations
- Routine:
 - 1-3 samples per month April-November
 - Frequency based on time of year
- High flow:
 - Collect representative samples across all flows
 - Support calculation of PCB loads to the lower river

EPA considerations in development of program

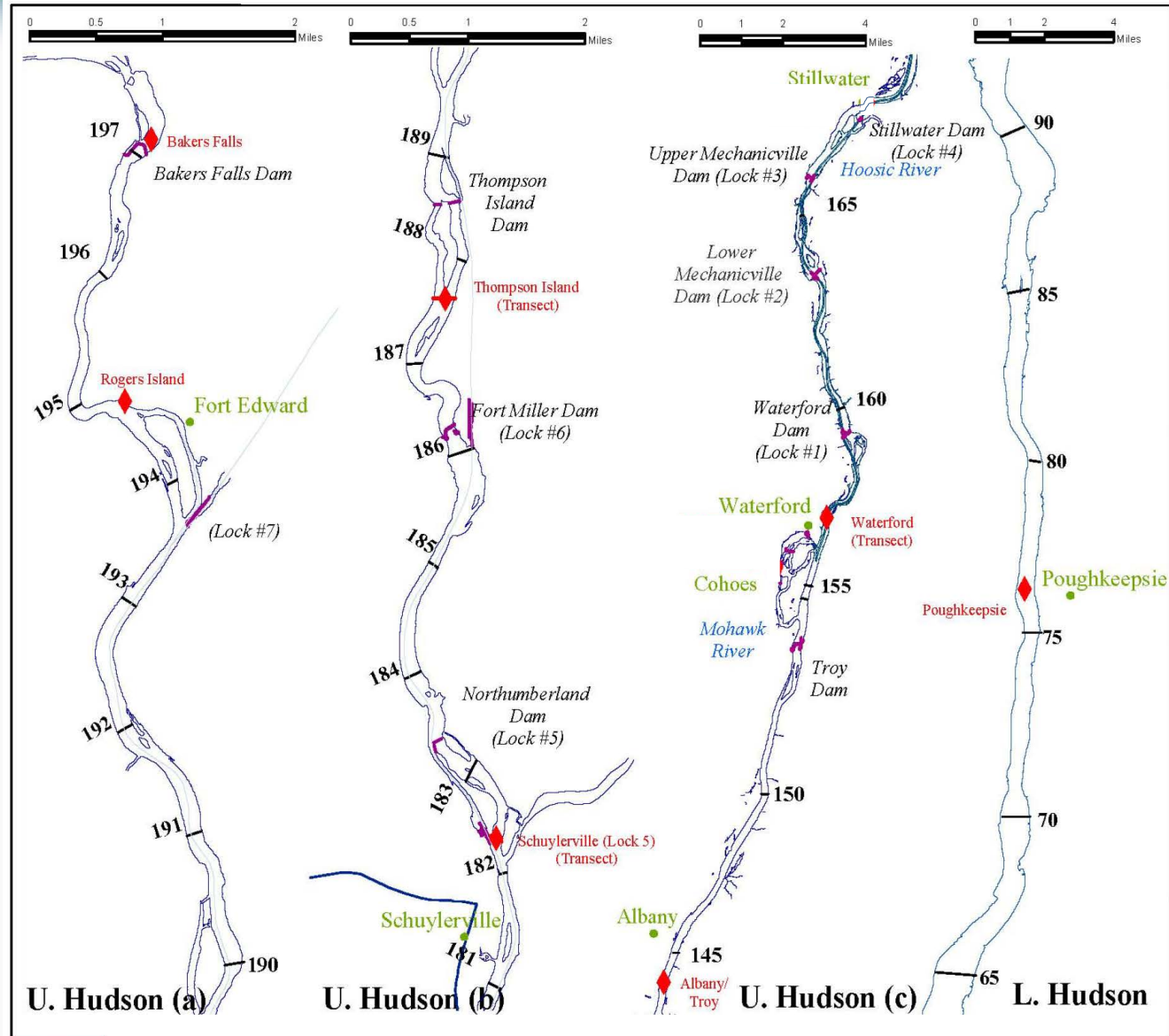
- Ability to detect 5% rate of decline in PCBS over 10 years
 - Ability to quantify load
 - Seasonality of PCB concentrations
- Program will be adjusted in future as necessary based on data collection and ongoing analyses



Water Program - Monitoring Stations



Station	Sample Collection Frequency	Samples per Year
Bakers Falls	Monthly April to November	8
Rogers Island	Monthly April to November	8
Thompson Island Dam	Once in November, twice a month in April and October, three times a month in May to September	20
Schuylerville (Rt. 29 Bridge)	Once in November, twice a month in April and October, three times a month in May to September	20
Waterford	Monthly November to March, twice a month in April and October, three times a month in May to September	24



LOCATOR MAP OF THE HUDSON RIVER

U. Hudson (a)
U. Hudson (b)
U. Hudson (c)
L. Hudson

Monitoring Stations

- Champlain Canal
- Dams and Locks
- Shoreline
- River Miles

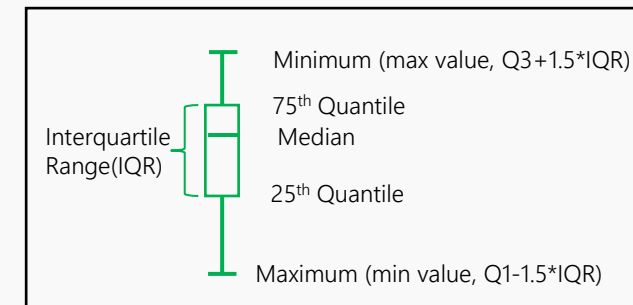
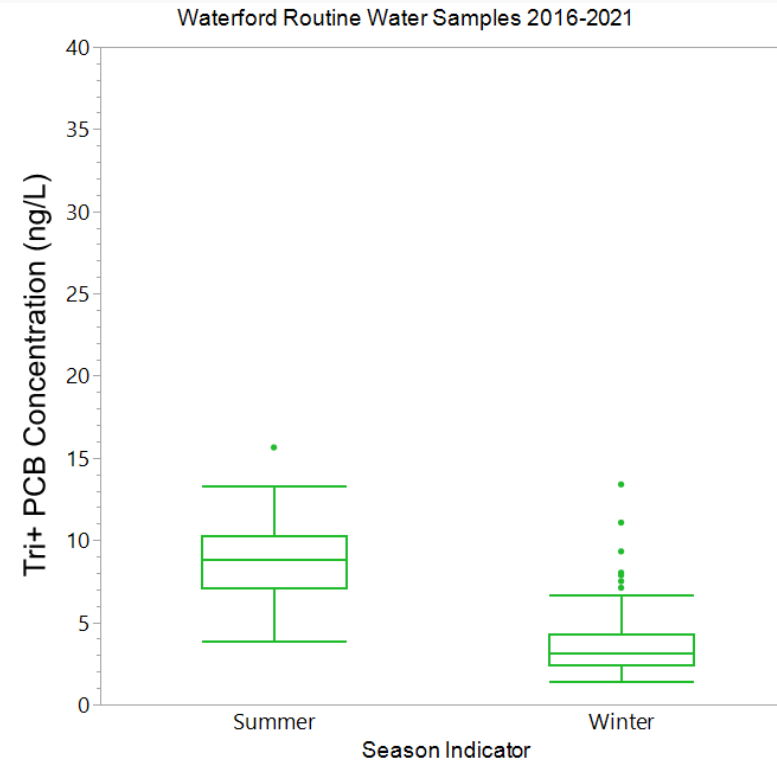
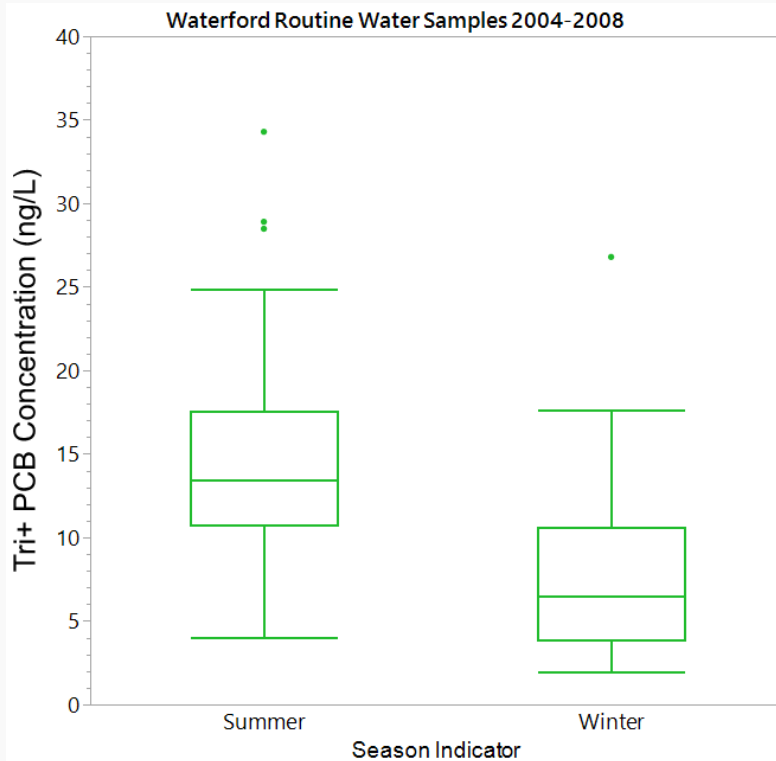
Source: Anchor QEA, 2009. Phase 1 Remedial Action Monitoring Program Quality Assurance Project Plan. Hudson River PCBs Site. Figure 2-13. May 2009.

Note: River miles measured from the Battery (0.0).

Water Program - Routine Sampling



- During summer months Tri+ PCB concentrations are higher and more variable compared with winter months.
- Higher frequency of sampling during summer months to capture this variability

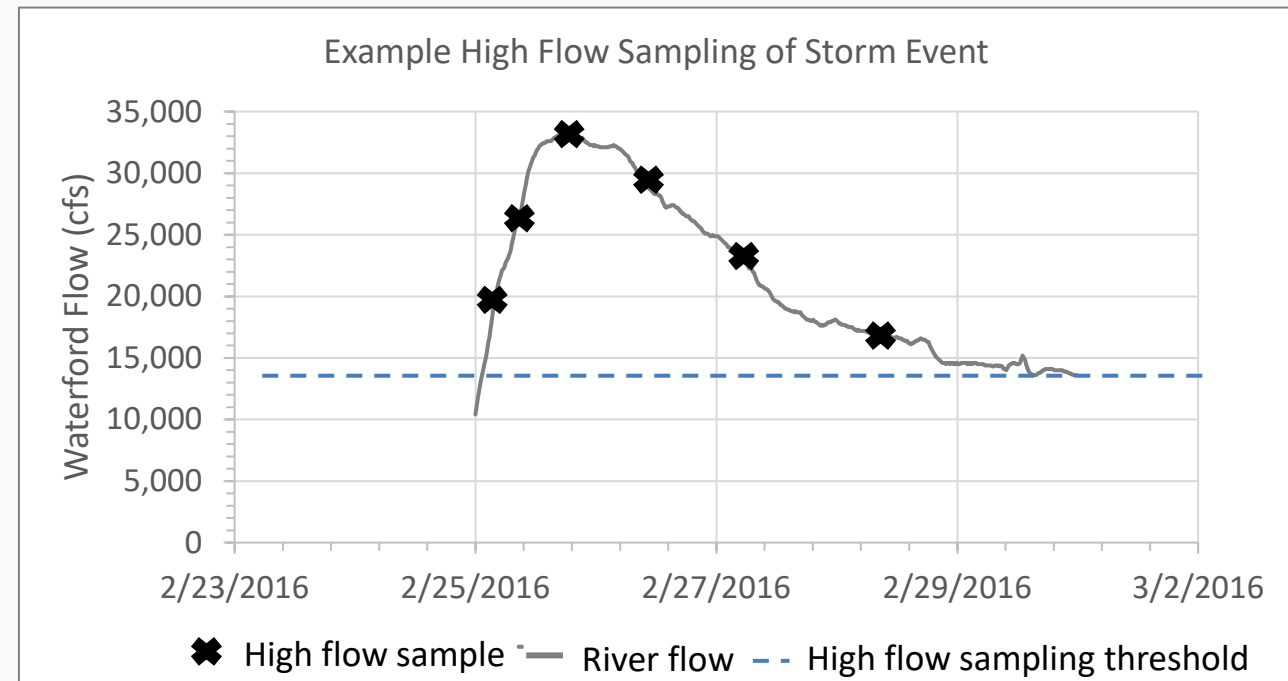


Note: Summer months are defined as May to September. Winter months are defined as November to March.

Water Program - High Flow Water Sampling



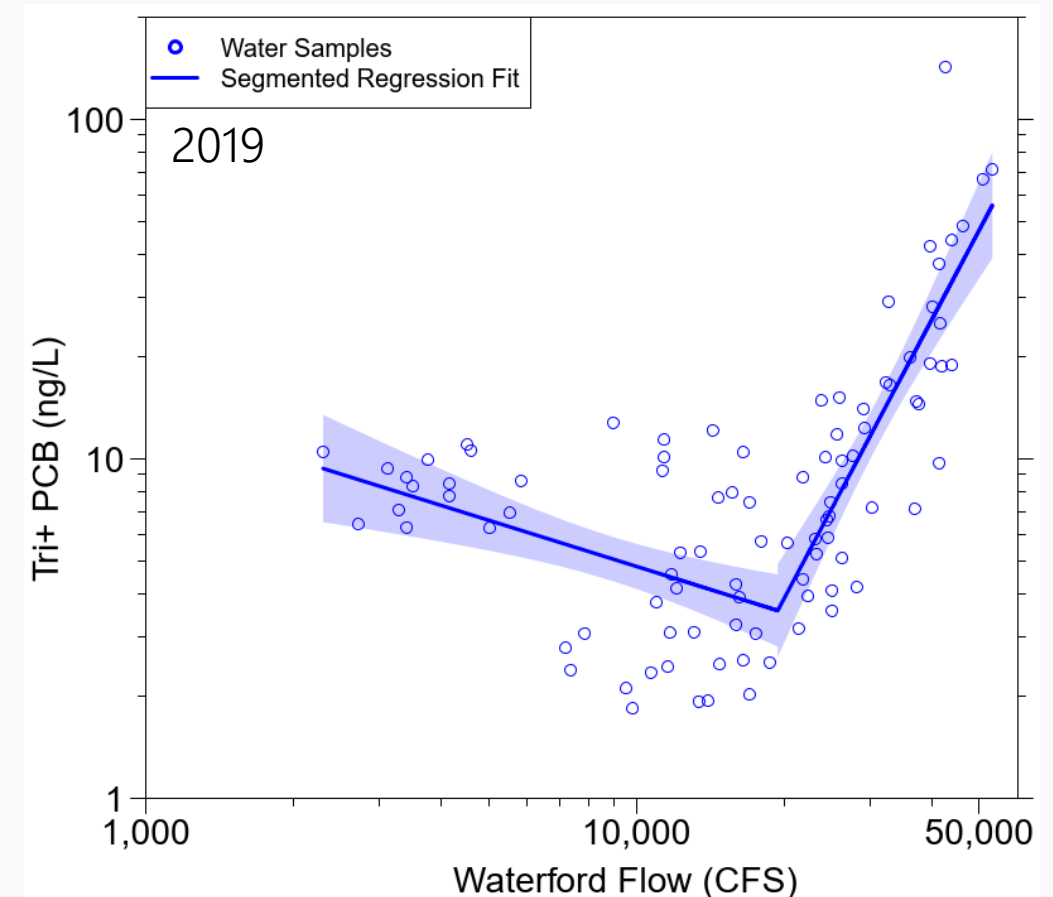
Station	High Flow Sampling Threshold	Sampling Coverage	Sampling Approach
Schuylerville (Dix Bridge)	11,000 cfs at Ft. Edward gaging station	<ul style="list-style-type: none"> Sample across range of observed flows within year Sample the rising, peak and falling limb of storm event hydrograph Sample storm events across seasons (spring and fall) 	Bridge-based
Waterford	15,000 cfs at Waterford gaging station		Bridge-based



Water Program - High Flow Water Sampling



- Relationship between PCB and flow is non-linear:
 - Sampling across range of observed flows is necessary to develop relationship between PCB and flow
 - Flow threshold at Waterford above 15,000 cfs (11,000 cfs at Ft. Edward)
 - PCB concentrations increase with increasing flows above the high flow threshold



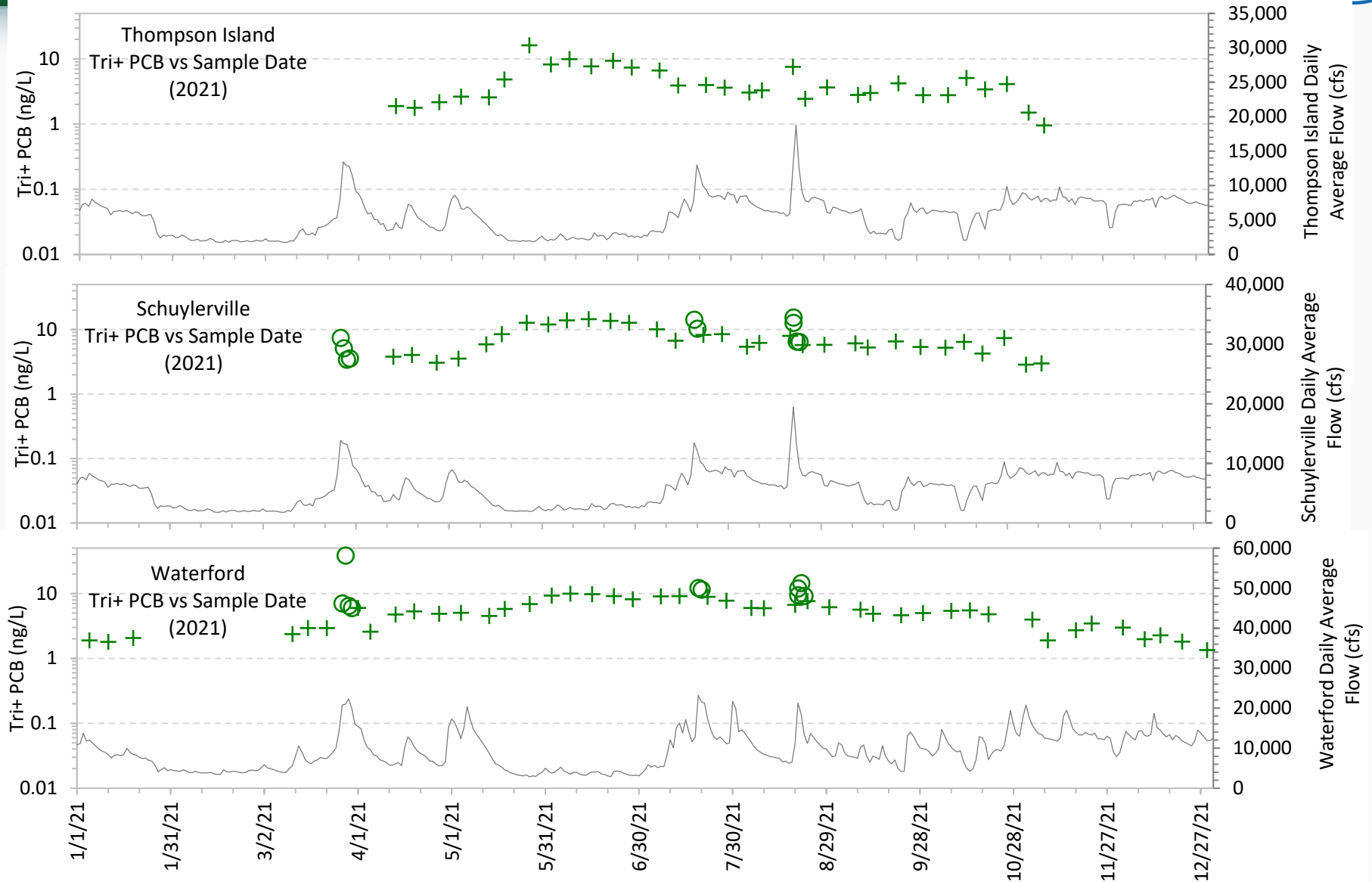
Water Program - 2021 Results



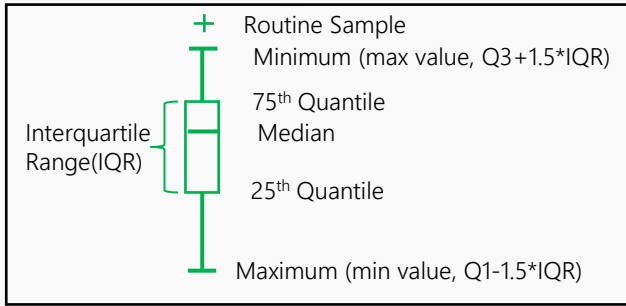
Legend

- High Flow Samples
- + Routine Samples
- × Non-detects
- Daily Flow

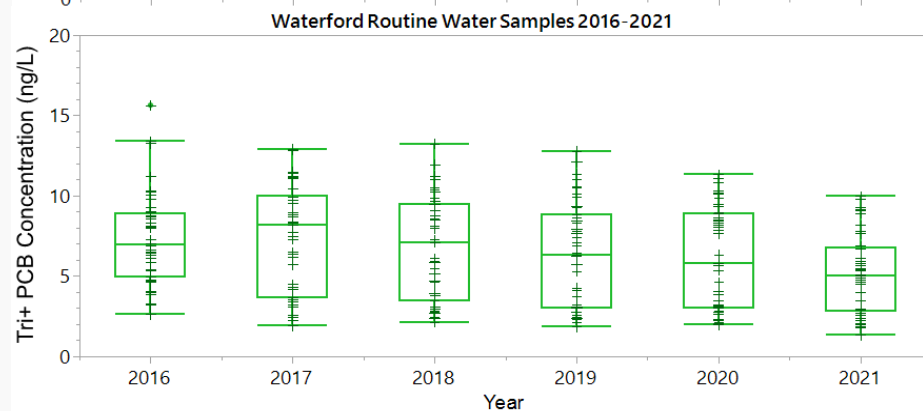
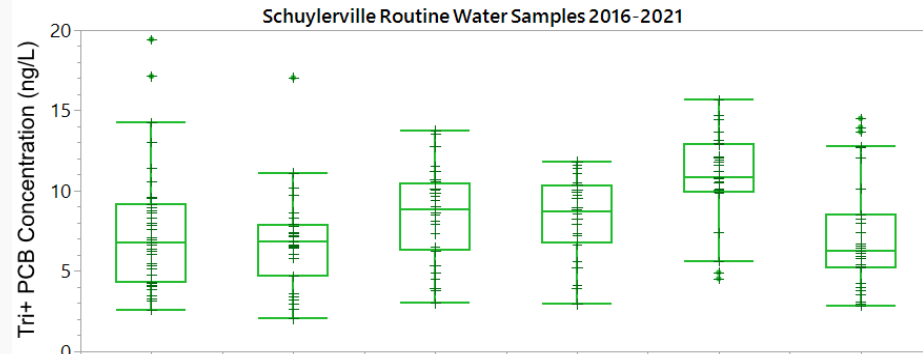
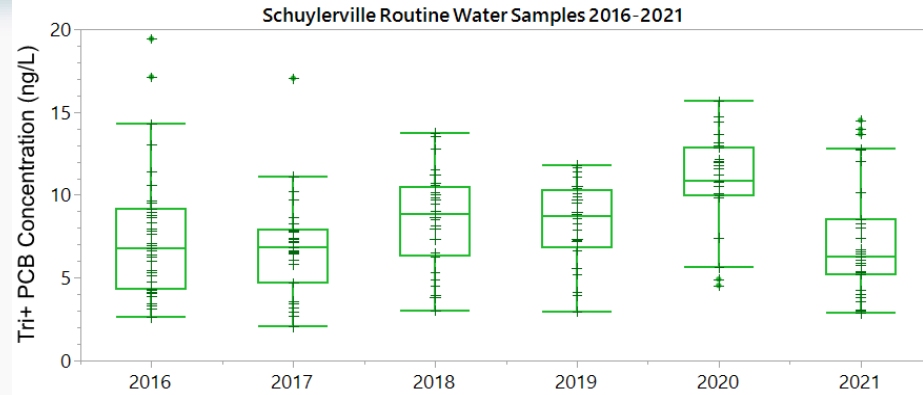
Note: Thompson Island and Schuylerville flow based on Ft. Edward flow, adjusted for increased drainage area.



Water Program - 2021 Results



- Recently received data from 2021 under review



SEDIMENT PROGRAM



Sediment Program - Overview



Program Overview

- Surface sediment program
 - Initially developed by EPA in 2016; adjustments made for 2021
 - Same areas sampled
 - EPA to receive 2021 data soon
 - Every 5 years – next round 2026
- Recently-deposited sediment program
 - First round anticipated 2022 – 45 samples

EPA considerations in development of program

- Ability to detect 5% rate of decline over 10 years
 - Reach, River Section
- Consistency across river sections



Sediment Program - Surface Sediment (0-2 inch)



- Collect 745 samples every 5 years
 - Dredge and non-dredge areas
- Key analytical program components
 - NIST standard reference material
 - Analyze 8% of samples by congener

**River Section-based
Number of Samples**

River Section	Dredge	Non-Dredge	Total
1	70	110	180
2	30	135	165
3	46	354	400
Total	146	599	745

**River Reach-based
Number of Samples**

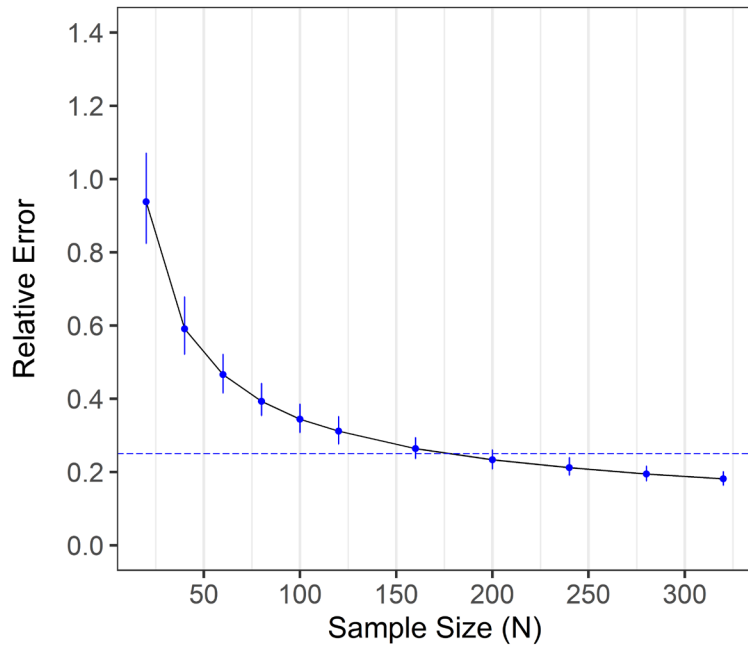
Reach	Dredge	Non-Dredge	Total	
8	70	110	180	River Section 1
7	15	80	95	River Section 2
6	15	55	70	
5	12	88	100	River Section 3
4	12	83	95	
3	12	68	80	
2	5	60	65	
1	5	55	60	
Total	146	599	745	

Sediment Program - 2021 Surface Sediment (0-2 inch)

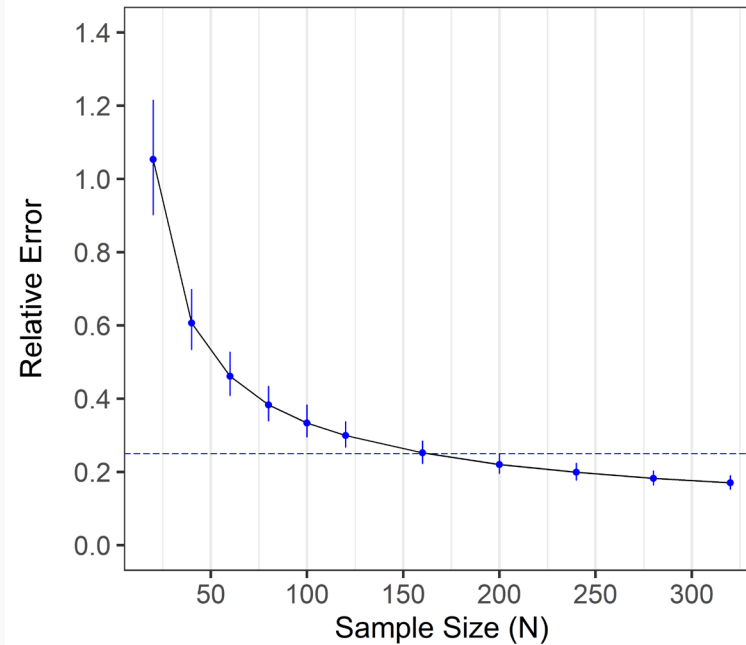


Calculated Relative Error on Area-Weighted Arithmetic Mean Tri+ PCB

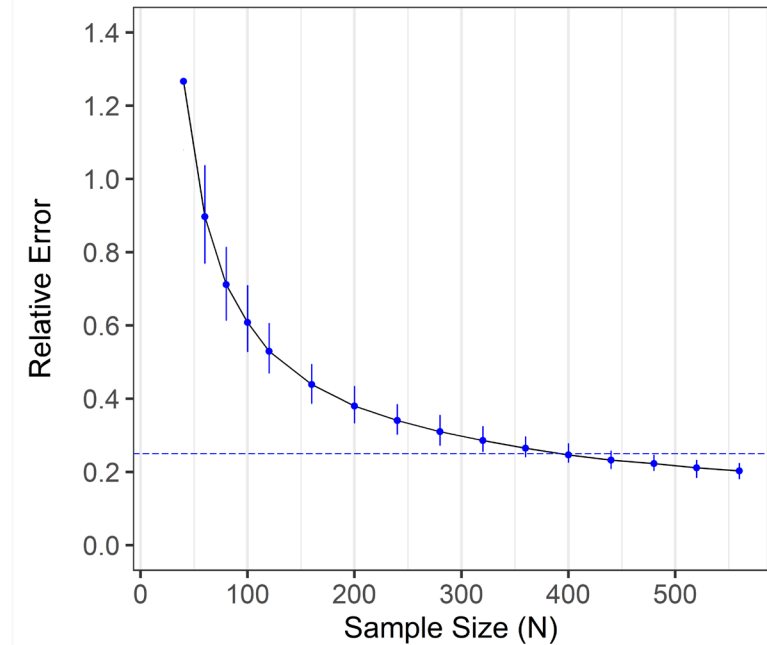
River Section 1



River Section 2



River Section 3



Number of Samples by River Section to meet Target for Relative Error on Mean:

	RS1	RS2	RS3	Total
2021 25% error	180	165	400	<u>745</u>

- Sample size is optimized to estimate mean within 25% error for each river section

Sediment Program - 2021 Surface Sediment Collection



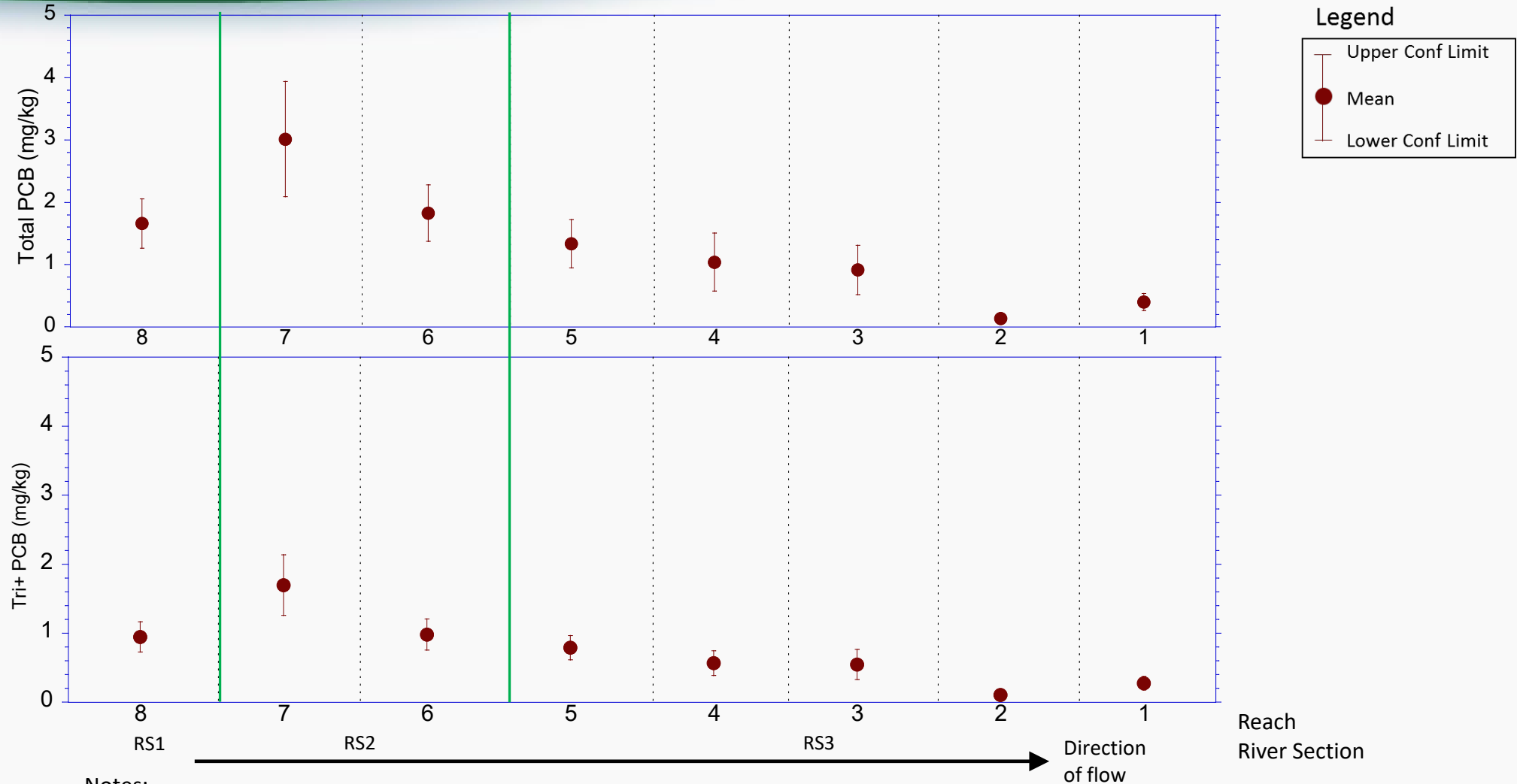
2021 Surface Sediment Sampling Location Counts by River Reach

River Reach (Section)	Dredged Area Locations	Non-Dredged Area Locations	Total Locations
8 (RS 1)	70	110	180
7 (RS 2)	15	80	95
6 (RS 2)	15	55	70
5 (RS 3)	12	88	100
4 (RS 3)	12	83	95
3 (RS 3)	12	68	80
2 (RS 3)	5	60	65
1 (RS 3)	5	55	60
Total	146	599	745

- Collected September 16th to November 4th, 2021
- Program implemented as designed with primary and secondary locations
- Collection method – van veen and ponar
- Data and report expected spring 2022



Sediment Program - Area-Weighted Mean Sediment Concentrations 2016 and 2017



Notes:

1. Error bars represent plus or minus 2 times the standard error on the mean of the reported result
2. When calculating the area-weighted mean, the Abandoned locations were set equal to one half of the median reporting limit from all non-detect samples (0.03 mg/kg)



ENGINEERED CAPS AND SELECT AREAS BATHYMETRY PROGRAM

Caps and Bathymetry Program - Engineered Cap Monitoring Approach



Bathymetric surveys of engineered caps

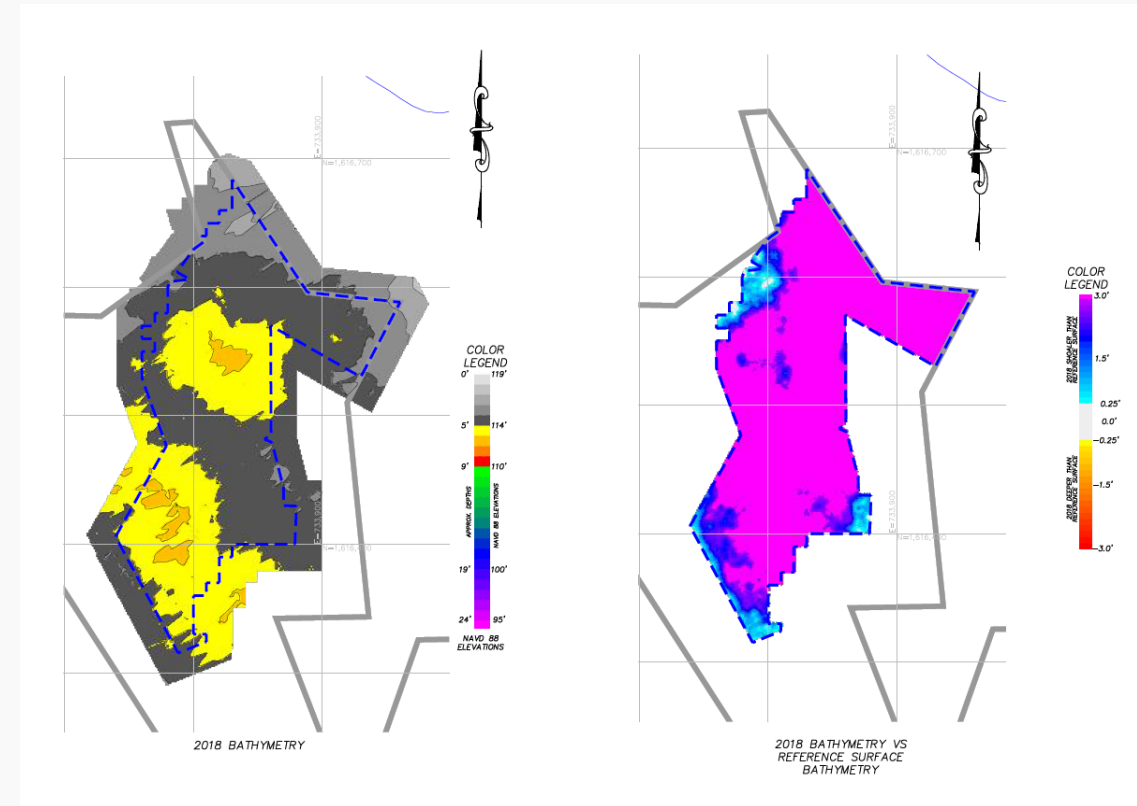
- Survey every 10-years and after 100-year storm events
- Last survey 2018 - next survey 2023
- Measurable loss: over 3 inches of sediment lost over 4,000 ft² contiguous area or 20% cap (whichever is less)
- If measurable loss observed from bathymetry, visual or physical inspections will be conducted

Chemical isolation cap effectiveness

- Six sentinel areas (20 cores each) will be monitored starting in 2026

Bathymetric surveys of “select areas”

- Surveys conducted to confirm areas are continuing to be stable





- Document under review
 - EPA to provide comments to GE
 - EPA to receive agency comments by early/mid April
 - Anticipate finalizing plan later this spring
- GE to phase in implementation of the program
- Adjustments to program as data indicates
- Continue to coordinate closely with NYS
- Continue to update CAG
 - Changes to program
 - Ongoing data evaluations

Questions

