Hudson River PCBs Site
Phase 2 Dredge Area Delineation Report

A Summary for the Hudson River CAG

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TASC Background

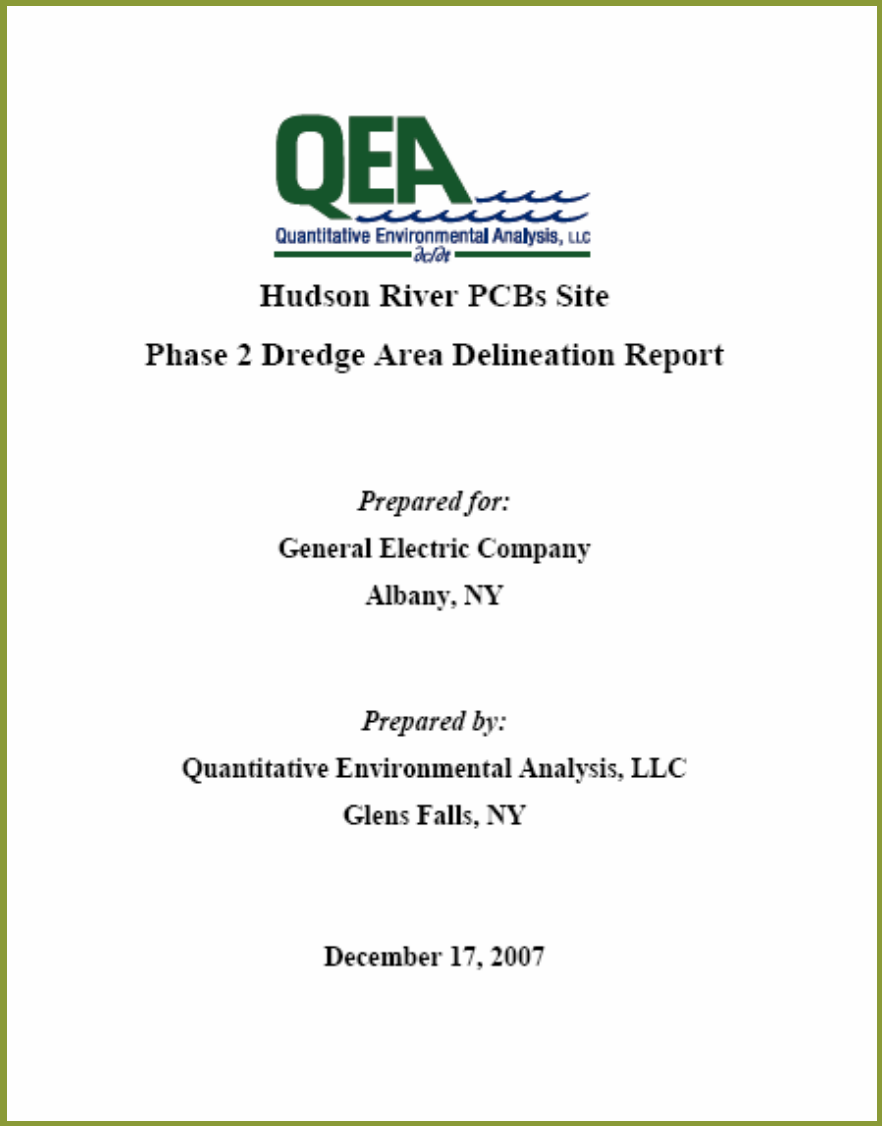
- Technical Assistance Services for Communities
- EPA sponsored program
- Services provided by E² Inc.
  - Information assistance
  - Community education
  - Technical expertise
  - Technical assistance plans
  - Superfund Jobs Training Initiative

Services to Hudson River CAG

- Explain the Phase 2 Dredge Area Delineation Report in an understandable way
- Focus on amount of sediment removed vs. amount of PCBs removed

Phase 2 Report

- Third draft released December 2007
- Organized into seven sections



QEA
Quantitative Environmental Analysis, LLC

Hudson River PCBs Site

Phase 2 Dredge Area Delineation Report

Prepared for:

General Electric Company

Albany, NY

Prepared by:

Quantitative Environmental Analysis, LLC

Glens Falls, NY

December 17, 2007

Report Sections

1. Introduction
2. Data Analysis
3. Delineation General Methodology
4. Interpolation Methods
5. Delineation Results
6. Conclusions and Summary
7. References

Background and Objectives

Methods

Results

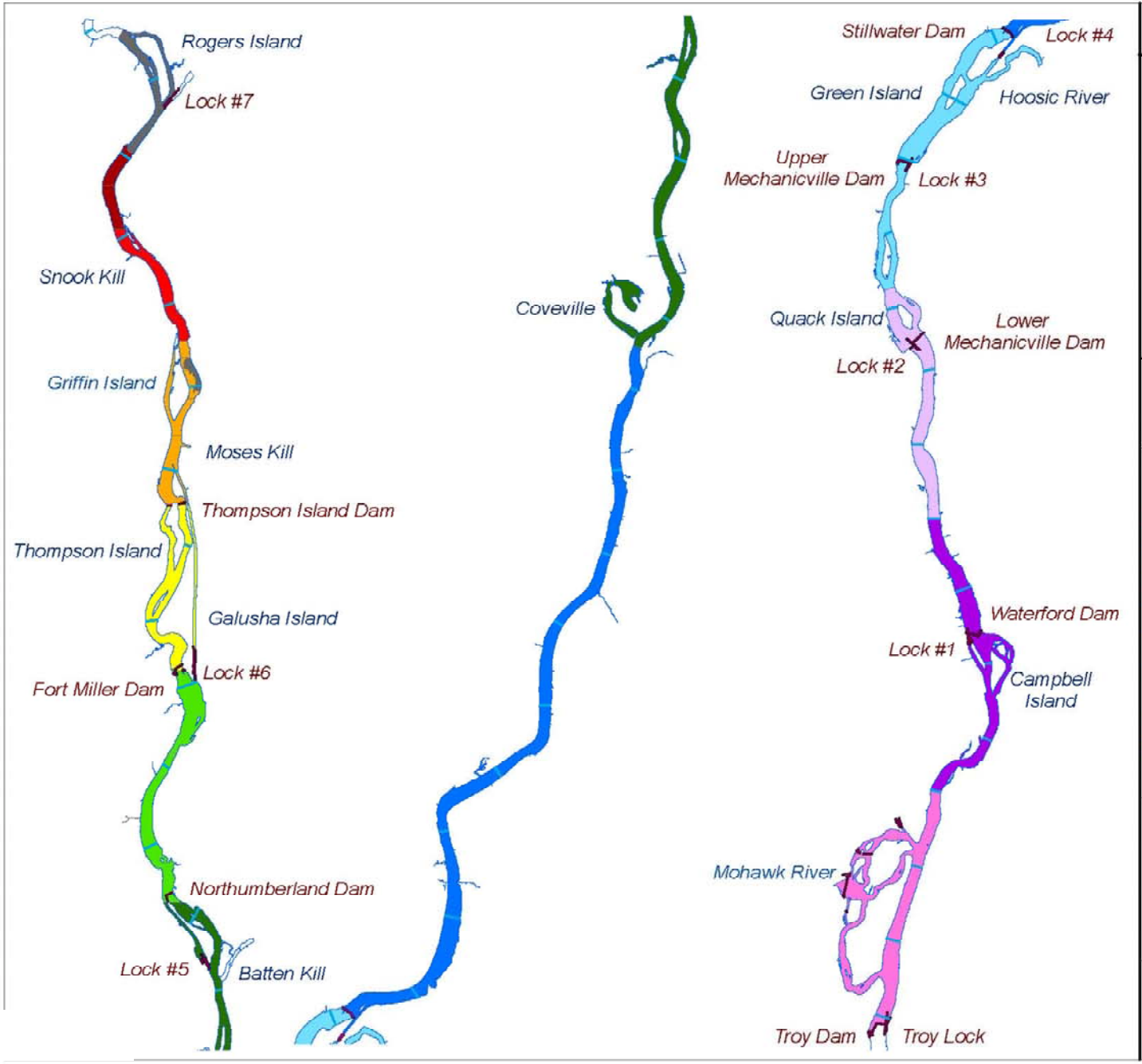
Conclusions

Document History

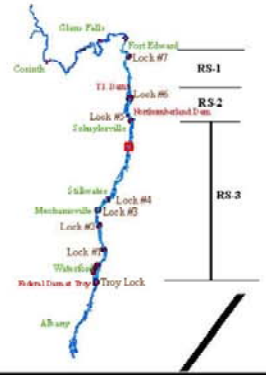
- ROD: February 2002
- AOC between GE and EPA: August 2003
  - GE agreed to conduct Remedial Design for the ROD selected remedy
  - Remedial Design in two phases:
    - Phase 1—1st year of dredging
    - Phase 2—remainder of project
- Phase 1 Dredge Area Delineation Report: March 2005
- Phase 2 Dredge Area Delineation Report: December 2007

Area Covered by Phase 2 Report

- Areas covered by ROD minus Phase 1 dredging areas
- 37+ miles of Upper Hudson River



LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 5,000 10,000 Feet

LEGEND

- Phase 1 Area
- Northern TIP (NTIP)
- Snook Kill Area (SK)
- Griffin Island Area (GI)
- Landlocked Area (LL)
- Fort Miller Dam Area (FMD)
- Northumberland Dam-Coveville Area (NDCA)
- Coveville-Stillwater Dam Area (CSD)
- Upper Mechanicville Dam Area (UPM)
- Lower Mechanicville Dam Area (LMD)
- Waterford Dam Area (WD)
- Troy Dam Area (TD)
- Shoreline
- River Miles
- Dams and Locks

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Figure 1-1.

Summary of Phase 2 Areas

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Project Objectives

- Identify Phase 2 areas to be dredged
- Identify depths of removal for those areas
- Identify PCB concentrations within the delineated sediments

Methods Overview

- Collect sediment data
- Use data to determine areas to dredge

ROD Selected Remedy

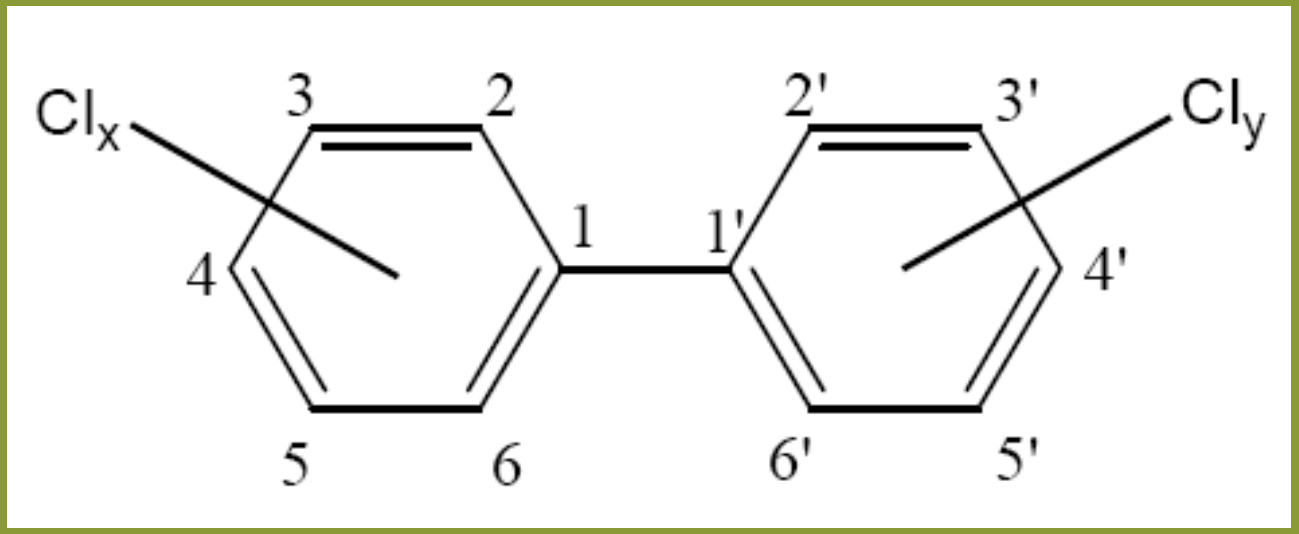
River Section	Criteria for Removal		
	MPA PCB_{3+} (g/m^2)	Top 12" PCB_{3+} Concentration (mg/kg)	Other
1	3	10	
2	10	30	
3		30	"Hotspots"

All sediments removed to the 1 mg/kg PCB_{3+} concentration depth.

Sediment Sampling Program

- Sampling took place from 2002-2005
- Collected a variety of sediment data including:
  - Mass per unit area of PCBs with 3+ chlorine atoms in sediment cores (PCB_{3+})
  - Surface PCB concentrations
  - Depth of PCB-containing sediments
  - Other physical characteristics
- Sampling primarily done at spaced intervals

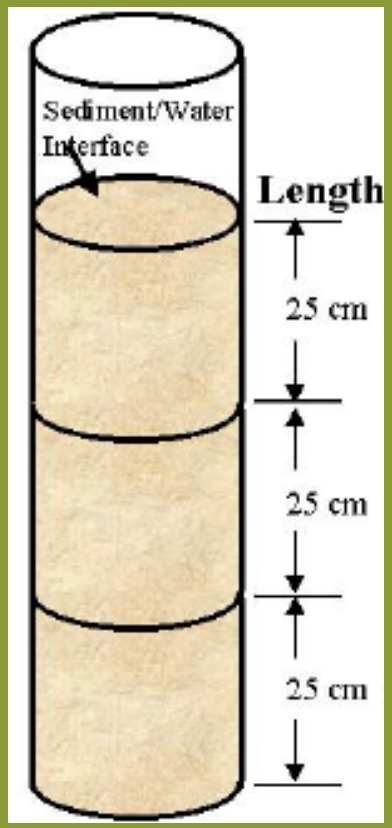
PCB_{3+} Structure



Sediment Cores

- Column of sediment extracted from river bottom
- Collected in aluminum or plastic tubes
- Several feet in length
- Sliced into smaller columns and analyzed for PCBs
- GPS coordinates collected for each core
- Over 8,500 cores taken

MPA: Mass Per Unit Area



MPA =

Length Core Slice

x

Concentration PCBs

x

Sediment Density

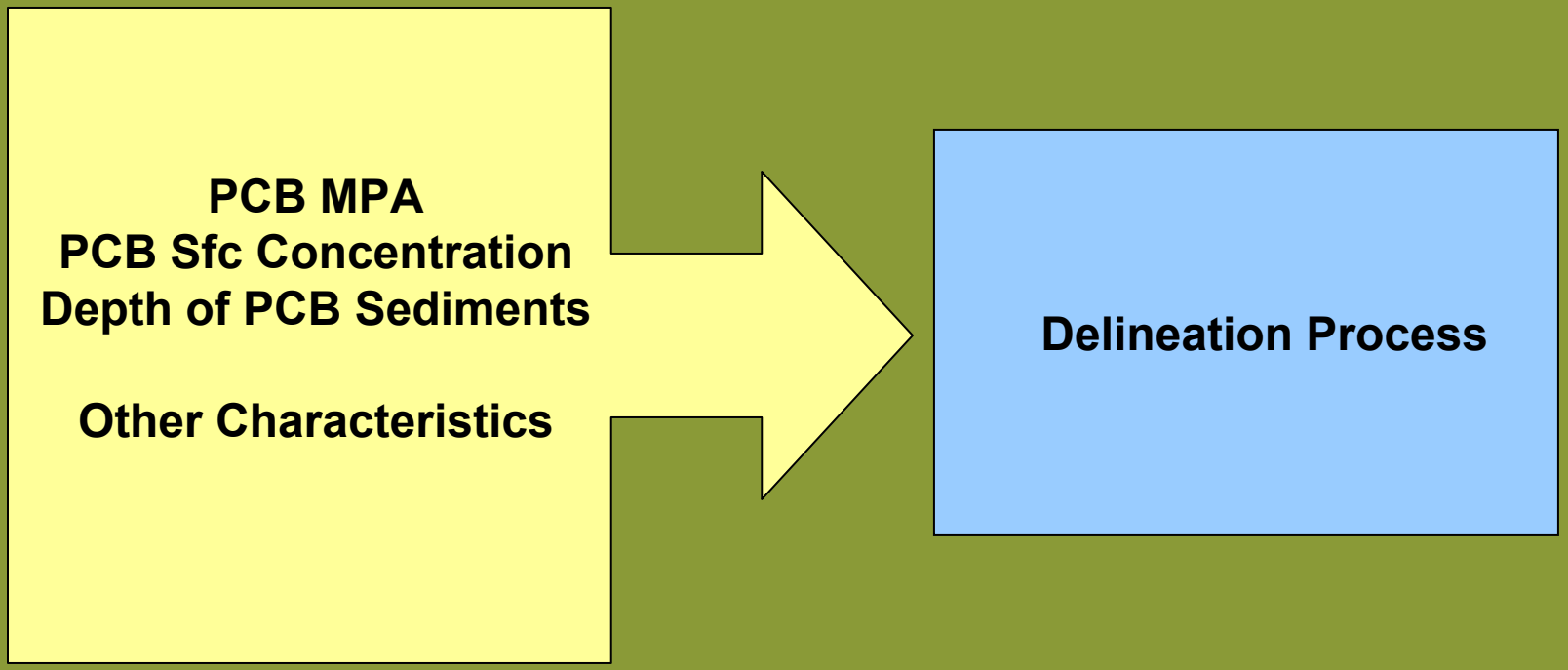
How New Samples Are Different

- Over time PCB concentrations in sediment can change
  - Buried
  - Redistributed
- Older GPS data not as accurate (±1 m vs. ±1 cm)
- Older PCB analysis methods may have been different

Additional Sampling Considerations

- Sample contamination
- Outliers
- Incomplete Cores
- Nondetects

How Was All This Data Used?



What is Delineation?

- To indicate or represent by drawn or painted lines

Delineated Parameters

- Horizontal
  - MPA
  - Maximum surface PCB concentrations
- Vertical
  - Total PCB concentrations

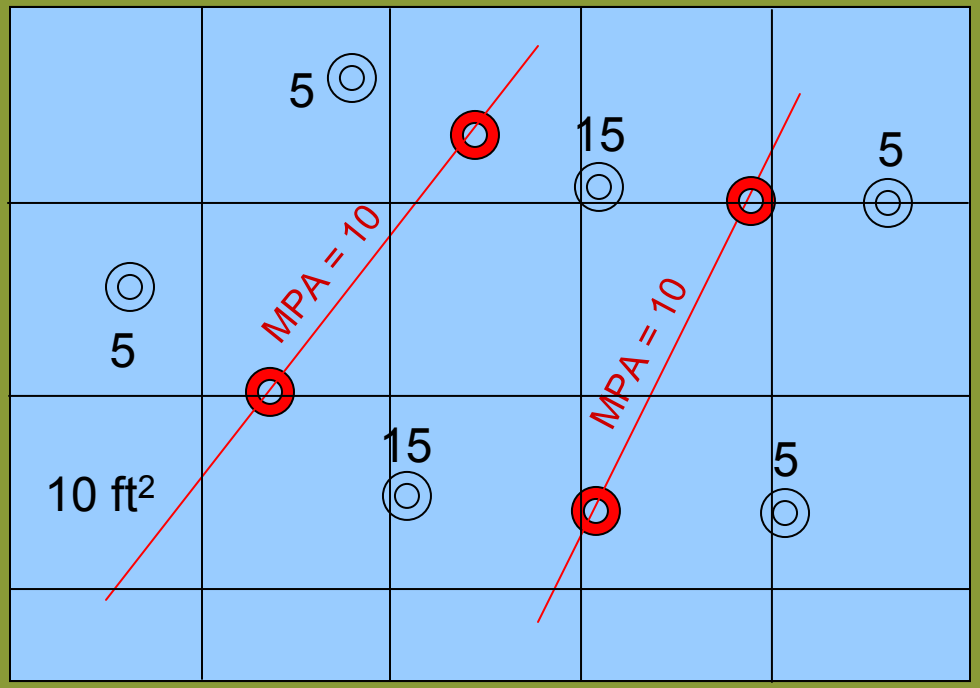
Phase 2 General Delineation Process

- Based solely on the physical and chemical characteristics of the river and sediment bed
- Used interpolation to predict horizontal (Kriging) and vertical (Inverse Distance Weighting) dredge area boundaries

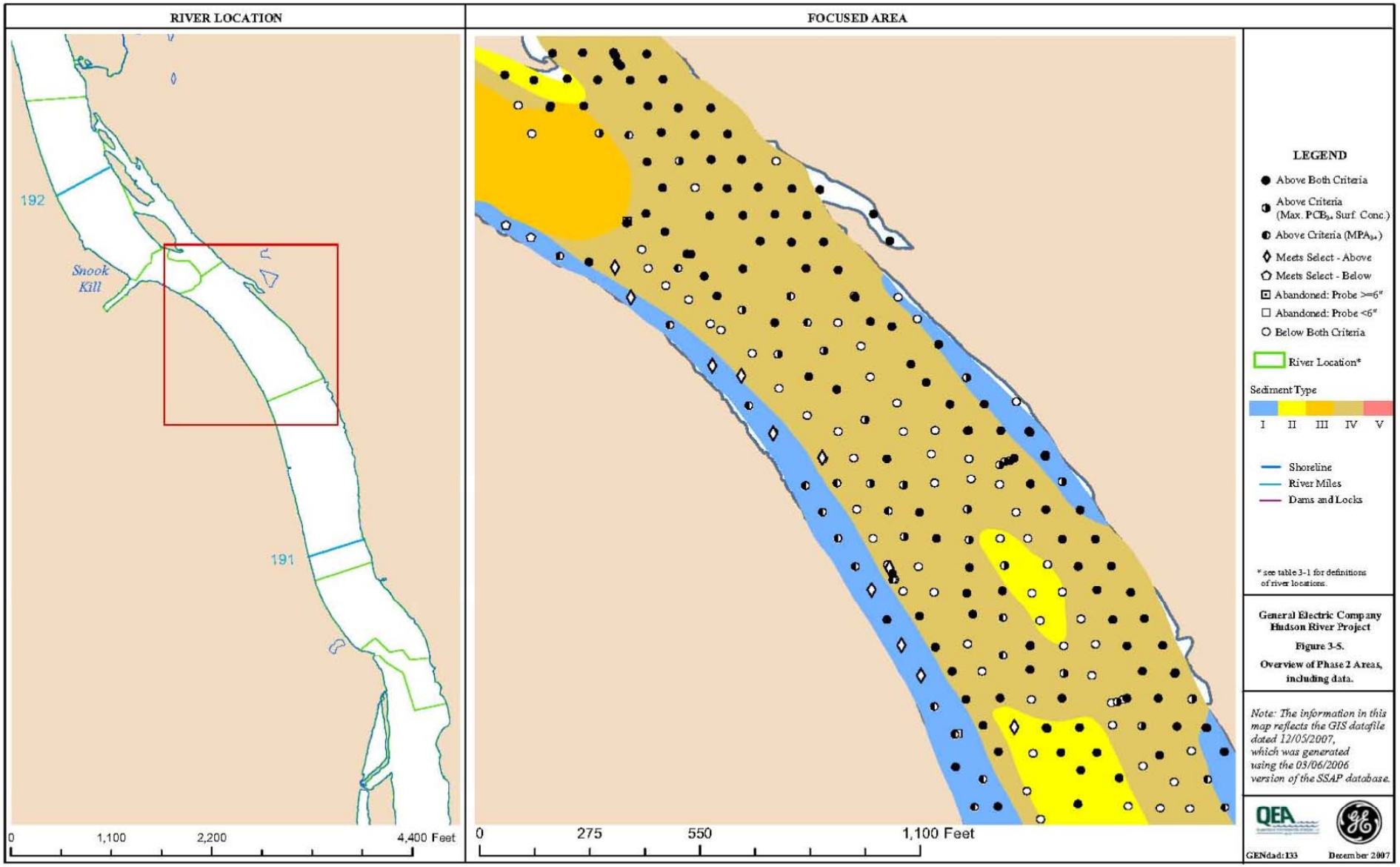
What is Interpolation?

- Determining the value of an unknown quantity at an unobserved location from observations of its value at nearby locations

River Section 2



Criteria for Removal: MPA = 10 g/m²



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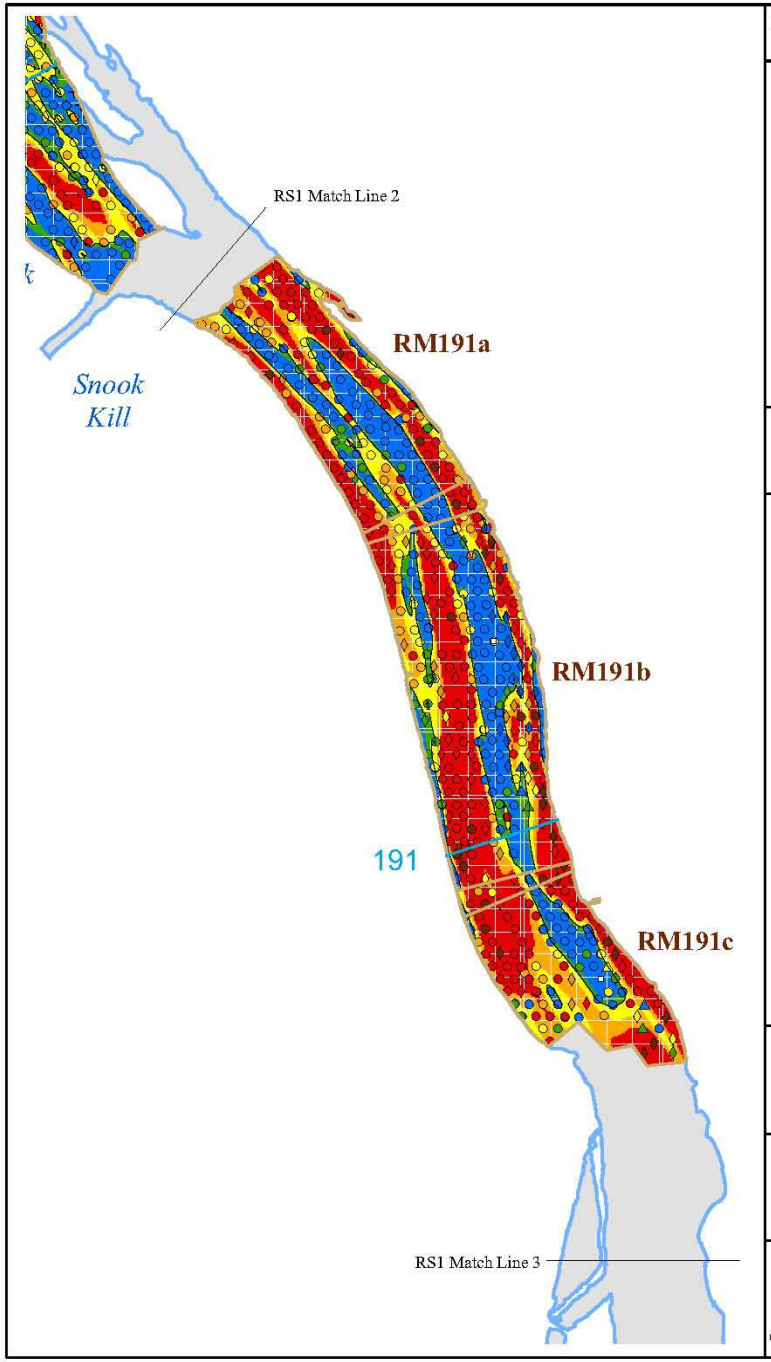
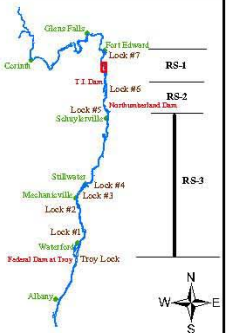


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 350 700 Feet

LEGEND

MPA_{3+} (g/m^2)
- 0 - 2
- 2 - <3
- 3 - 6
- 6 - <10
- 10 - 50
- > 50

MPA_{3+} Data
- Conf. Level 1 Core
- Conf. Level 2 Core
- Grab Sample
- Abandoned: Probe <6"
- Inaccessible Location

- Kriging MPA_{3+} Dredge Contour
- Variogram Area
- Not Subject to Kriging
- River Miles
- Dams and Locks
- Shoreline

Background colors represent kriging results interpolated on a 10 ft grid. Based on the 03/08/06 GIS database file.

Figure 5-2.

Kriging results for MPA_{3+}.

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Horizontal Delineation

- Create contour lines on maps based on interpolation for both MPA and Maximum Surface PCB Concentration
- Overlay the maps
- Locate outermost criteria values and recommend as dredging boundaries

Vertical Delineation

- First found horizontal dredge areas
- Cores within those areas subdivided into 18 depth intervals
- Average total PCB concentrations calculated for each interval
- Interpolations performed to find more detailed depth profile
- Deepest interval equal to or above 1 mg/kg assigned for each core
- Each 10 ft^2 grid cell assigned the lowest depth value of all cores
- That depth was the depth of recommended sediment removal

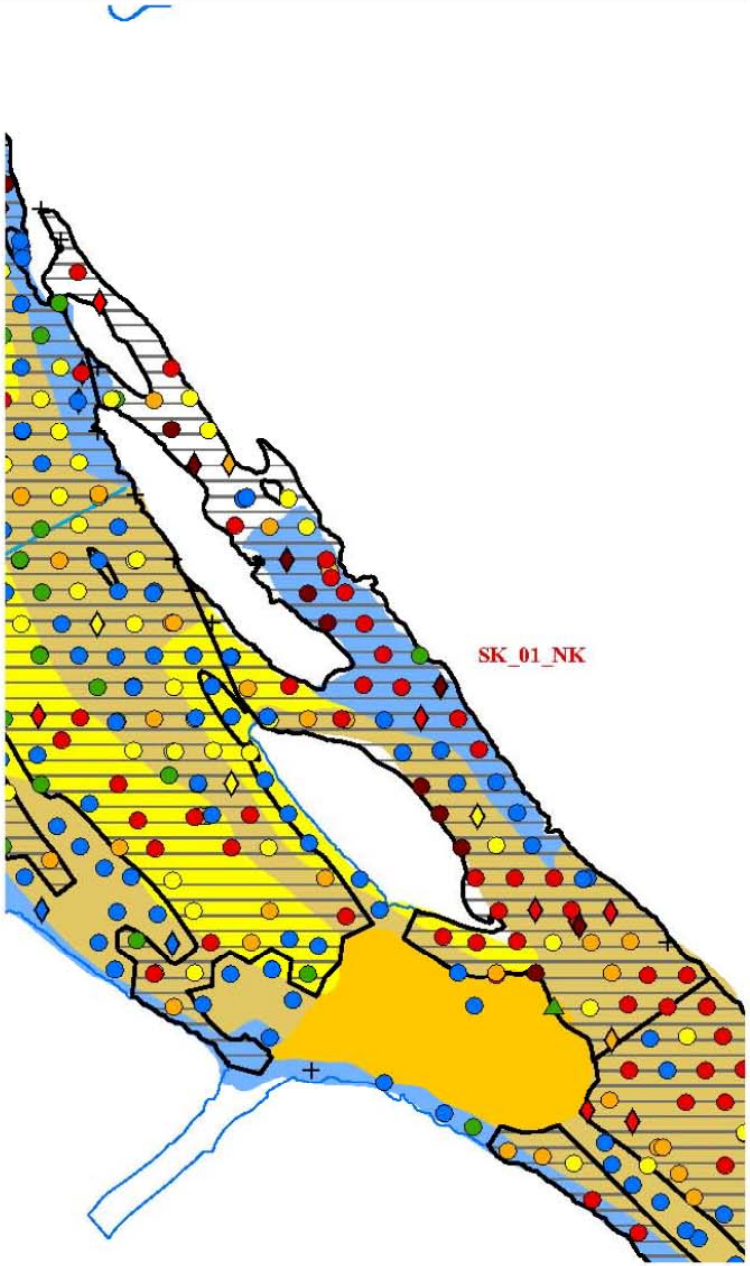
Additional Interpolation Considerations

- Outlier points
- Single, isolated points
- Data gaps

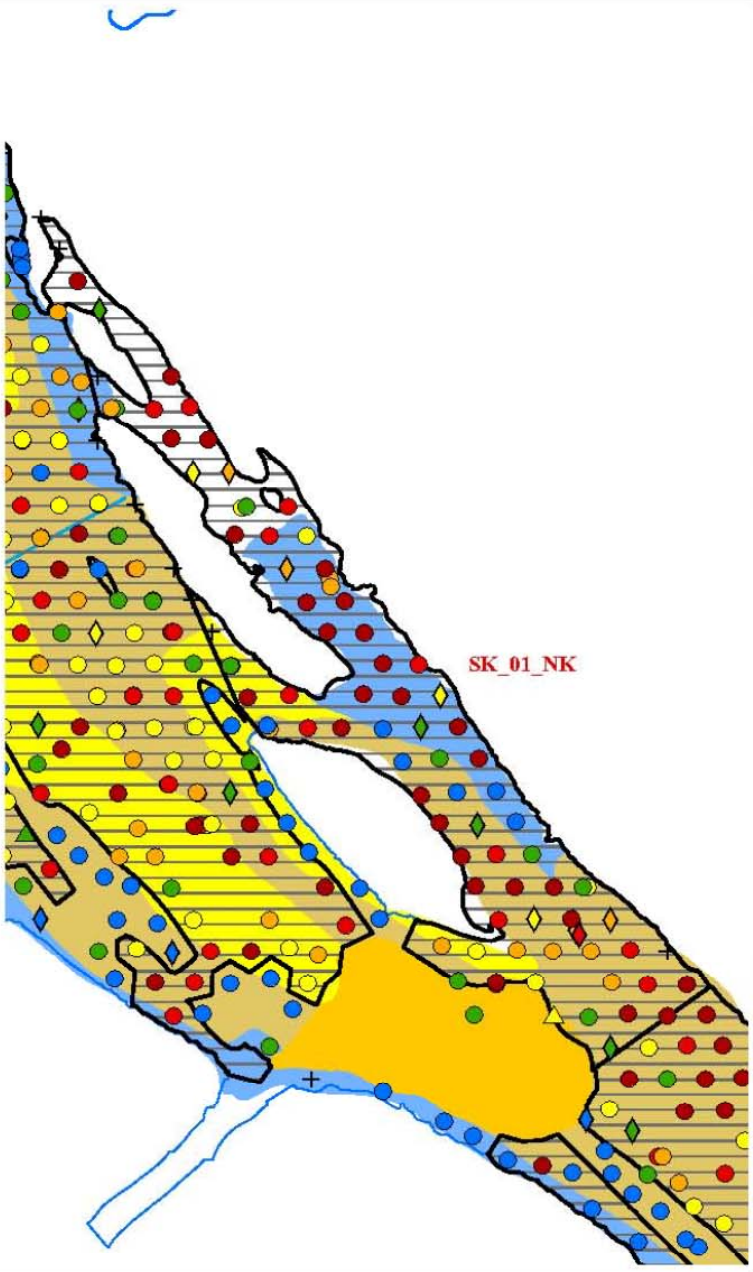
Results

- Areas to dredge
- Depth of each area to dredge
- Presented on a series of maps

Non-Kriged Dredge Area Boundaries and MPA_{3+} Data



Non-Kriged Dredge Area Boundaries and Max. PCB_{3+} Surf. Conc. Data



LOCATOR MAP OF THE UPPER HUDSON RIVER

GRAPHIC SCALE

0 100 200 Feet

LEGEND

MPA$_{3+}$ (g/m^2)
- 0 - 2
- 2 - <3
- 3 - 6
- 6 - >10
- 10 - 50
- > 50

Max PCB$_{3+}$ Surf. Conc. (mg/kg)
- 0 - 5
- 5 - <10
- 10 - 20
- 20 - <30
- 30 - 50
- > 50
- Phase 2 Dredge Area
- Isolated Dredge Area

Type of Sample
- Conf. Level 1 Core
- Conf. Level 2 Core
- Grab Sample
- Abandoned: Probe < 6"
- Historical Core
- Inaccessible Location

SSS Sediment Data
- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- Shoreline
- River Miles
- Dams and Locks

Based on the 11/28/07 GIS database file

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Figure 5-65.

Areal delineation showing MPA_{3+} and PCB_{3+} concentrations.

Snook Kill

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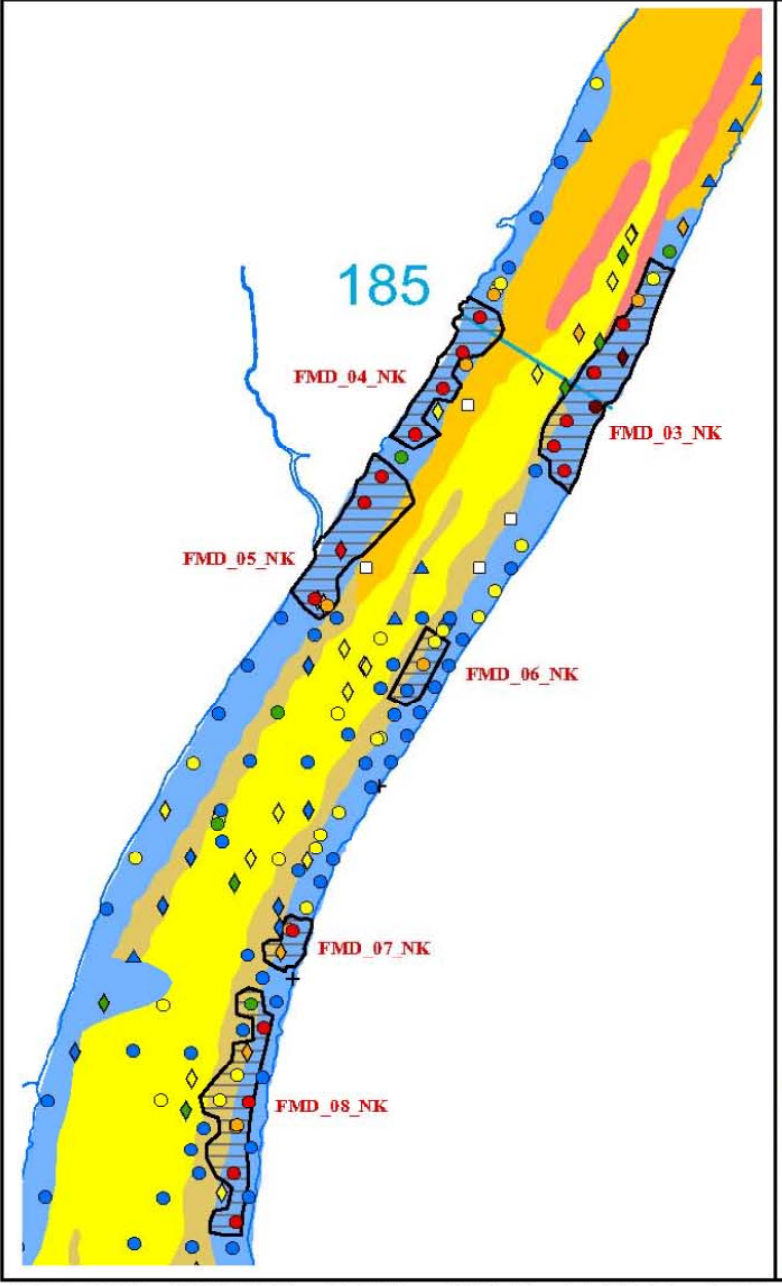
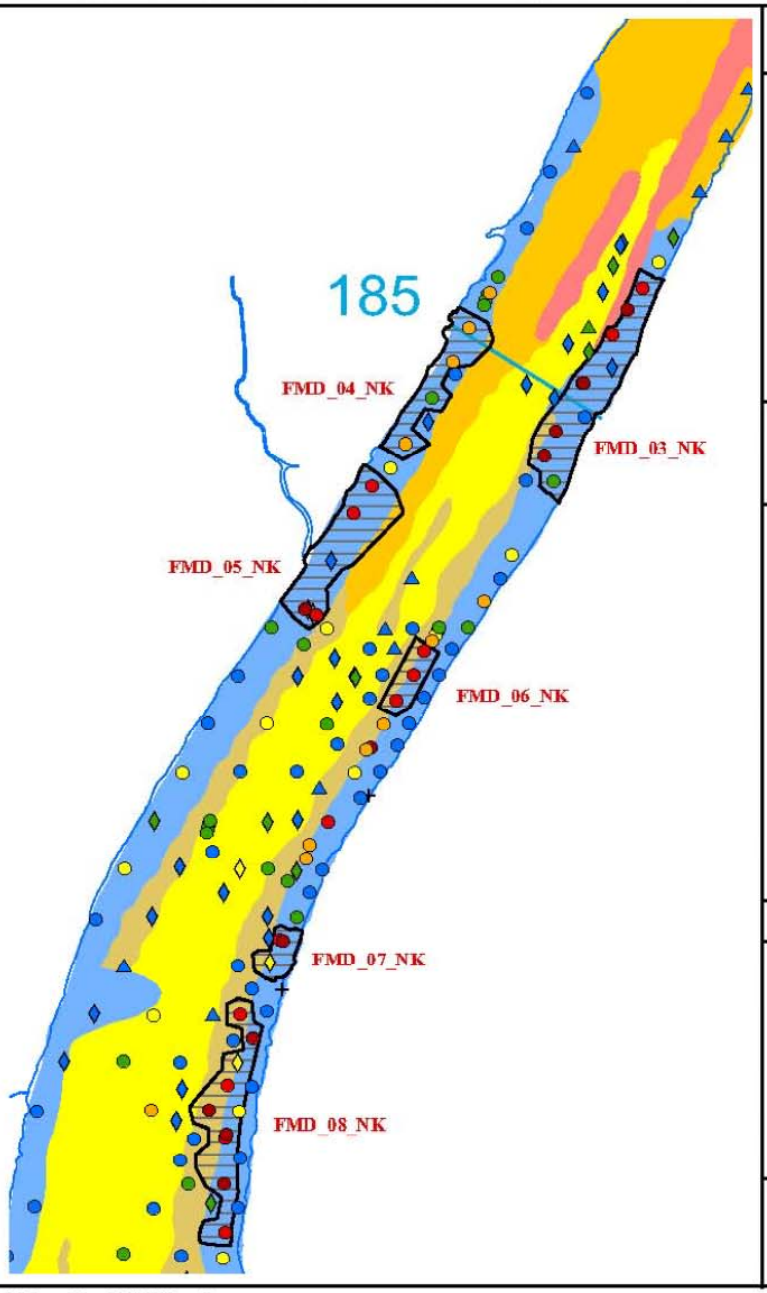
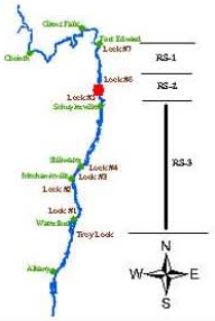
Non-Kriged Dredge Area Boundaries and MPA_{3+} Data



Non-Kriged Dredge Area Boundaries and Max. PCB_{3+} Surf. Conc. Data



LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 210 420 Feet

LEGEND

MPA_{3+} (g/m^2)
- 0 - 2
- 2 - <3
- 3 - 6
- 6 - >10
- 10 - 50
- > 50

Max PCB_{3+} Surf. Conc. (mg/kg)
- 0 - 5
- 5 - <10
- 10 - 20
- 20 - <30
- 30 - 50
- > 50
- Phase 2 Dredge Area
- Isolated Dredge Area

Type of Sample
- Conf. Level 1 Core
- Conf. Level 2 Core
- Grab Sample
- Abandoned: Probe < 6"
- Historical Core
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SSS Sediment Data
- Type I Sediment
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- Type III Sediment
- Type IV Sediment
- Type V Sediment
- Shoreline
- River Miles
- Dams and Locks

Based on the 11/28/07 GIS database file

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Figure 5-79.

Areal delineation showing MPA_{3+} and PCB_{3+} concentrations.

Fort Miller Dam
Area 2

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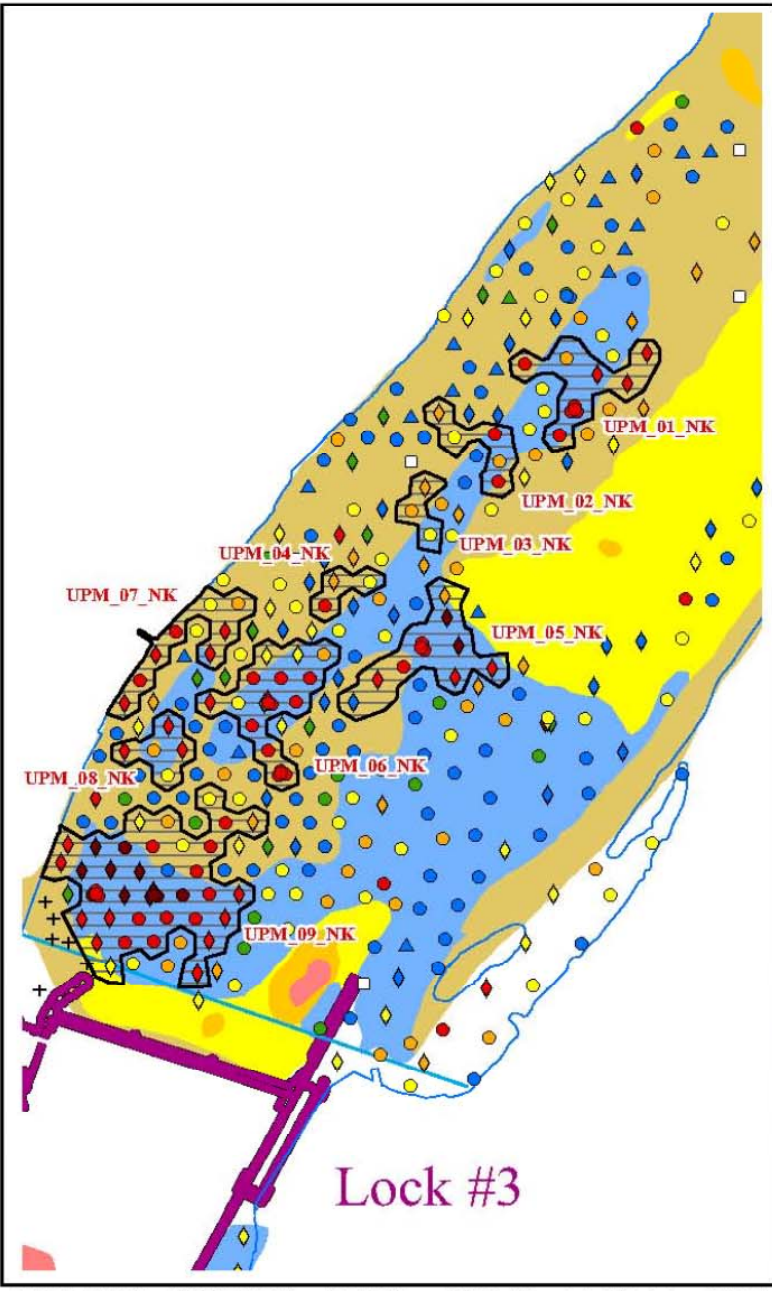
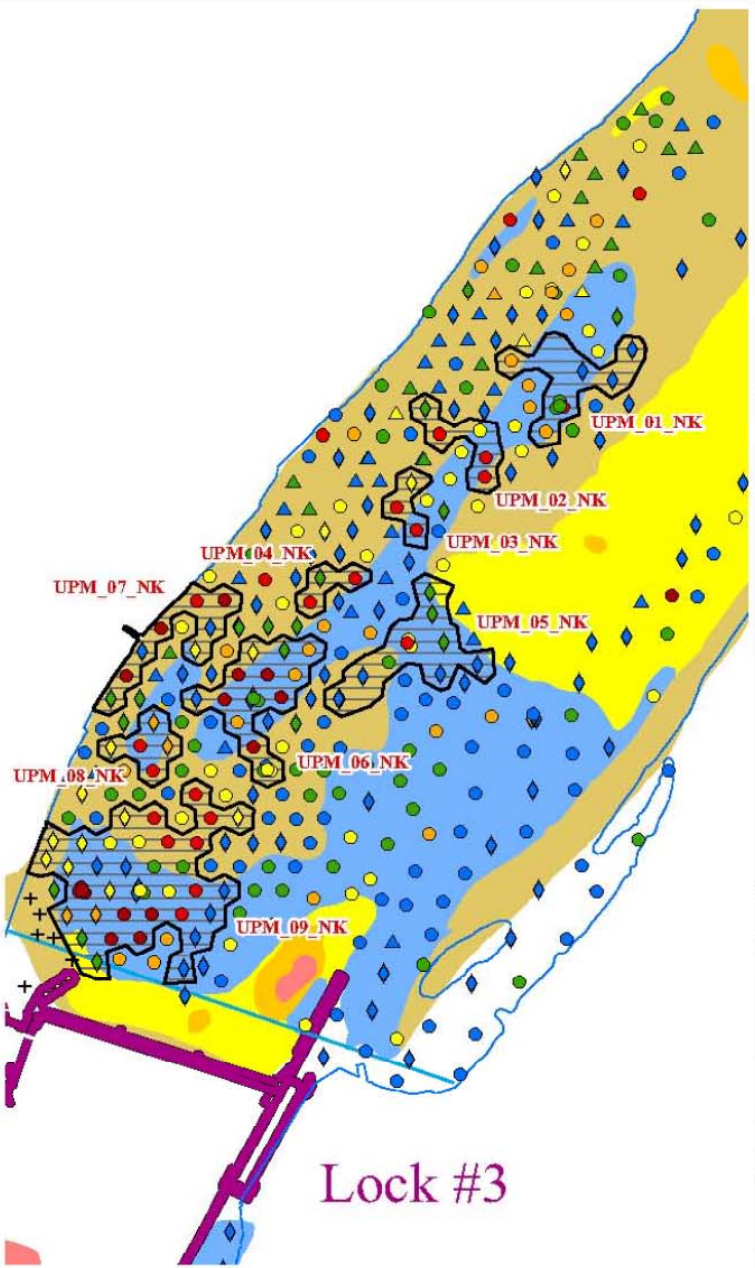
Non-Kriged Dredge Area Boundaries and MPA_{3+} Data



Non-Kriged Dredge Area Boundaries and Max. PCB_{3+} Surf. Conc. Data



LOCATOR MAP OF THE UPPER HUDSON RIVER

GRAPHIC SCALE

0 200 400 Feet

LEGEND

MPA$_{3+}$ (g/m^2)
- 0 - 2
- 2 - <3
- 3 - 6
- 6 - >10
- 10 - 50
- > 50

Max PCB_{3+} Surf. Conc. (mg/kg)
- 0 - 5
- 5 - <10
- 10 - 20
- 20 - <30
- 30 - 50
- > 50
- Phase 2 Dredge Area
- Isolated Dredge Area

Type of Sample
- Conf. Level 1 Core
- Conf. Level 2 Core
- Grab Sample
- Abandoned: Probe < 6"
- Historical Core
- Inaccessible Location

SSS Sediment Data
- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- Shoreline
- River Miles
- Dams and Locks

Based on the 11/28/07 GIS database file

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Figure 5-101.

Areal delineation showing MPA_{3+} and PCB_{3+} concentrations.

Upper Mechanicville Dam Area 1

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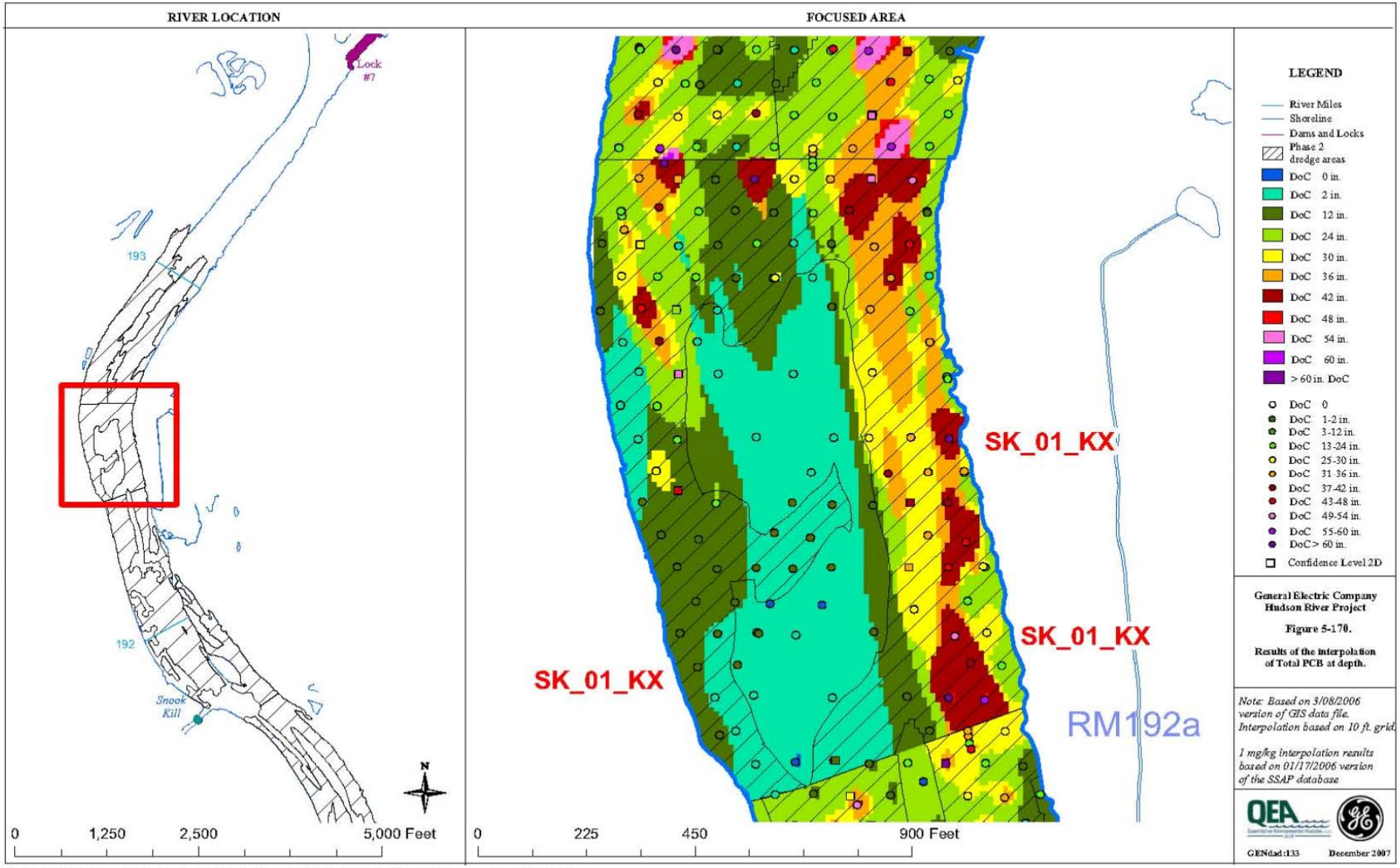

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Conclusions

- 168 separate dredge areas delineated in Phase 2
- 400 acres
- 1,531,400 yd^3 sediment targeted for removal
- Average depth of contamination is less than 3 ft in most dredge areas
- Seven areas have contamination to depths of 5 ft or more

Phase 1 and Phase 2 Totals

River Section	Targeted Acres	kg of PCBs Removed
1	310	60,600
2	86	28,500
3	95	24,000

ROD Estimate Comparison

River Section	ROD Estimates		Phase 1 & 2 Targets	
	yd^3 Sediment	kg of PCBs	yd^3 Sediment	kg of PCBs
1	1,492,000	36,000	939,800	60,600
2	565,000	23,600	364,000	28,500
3	393,000	6,700	491,000	24,000
Total	**2,450,000**	**66,300**	**1,794,800**	**113,100**

How Can More PCBs Be Removed if Less Sediment is Dredged?

- Comprehensive sampling program undertaken after ROD was issued showed that PCB concentrations greater than 1 mg/kg are not as deep in the sediments as previously estimated

What Does This Mean?

ROD MPA		DAD MPA	
30	Total MPA 83	30	Total MPA 91
20		25	
15		20	
10		15	
5		1	
2		0	
1		0	

Questions?

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