

Gowanus Canal Superfund Site Brooklyn, NY



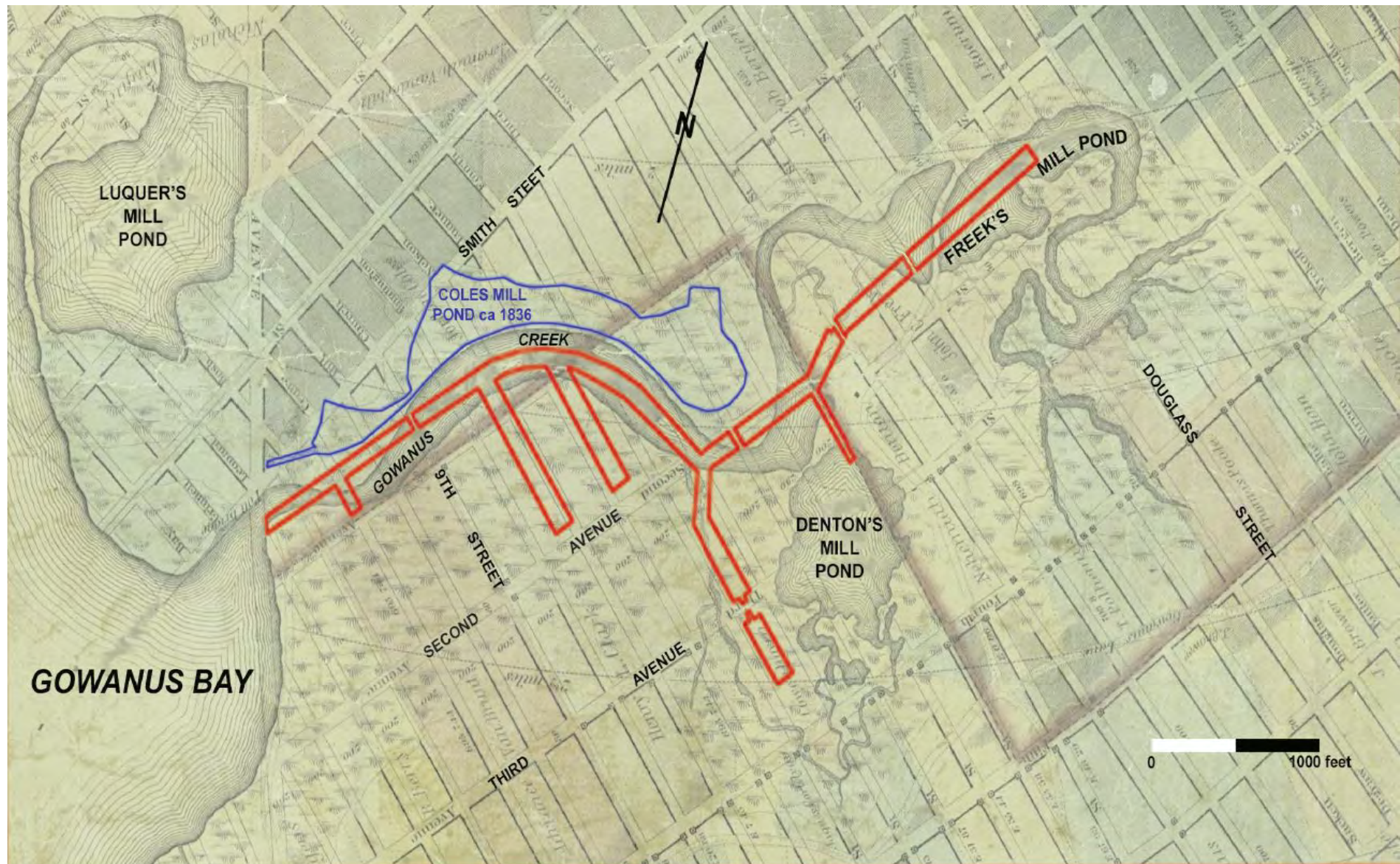
**U.S. Environmental Protection Agency
Region 2
April 2011**



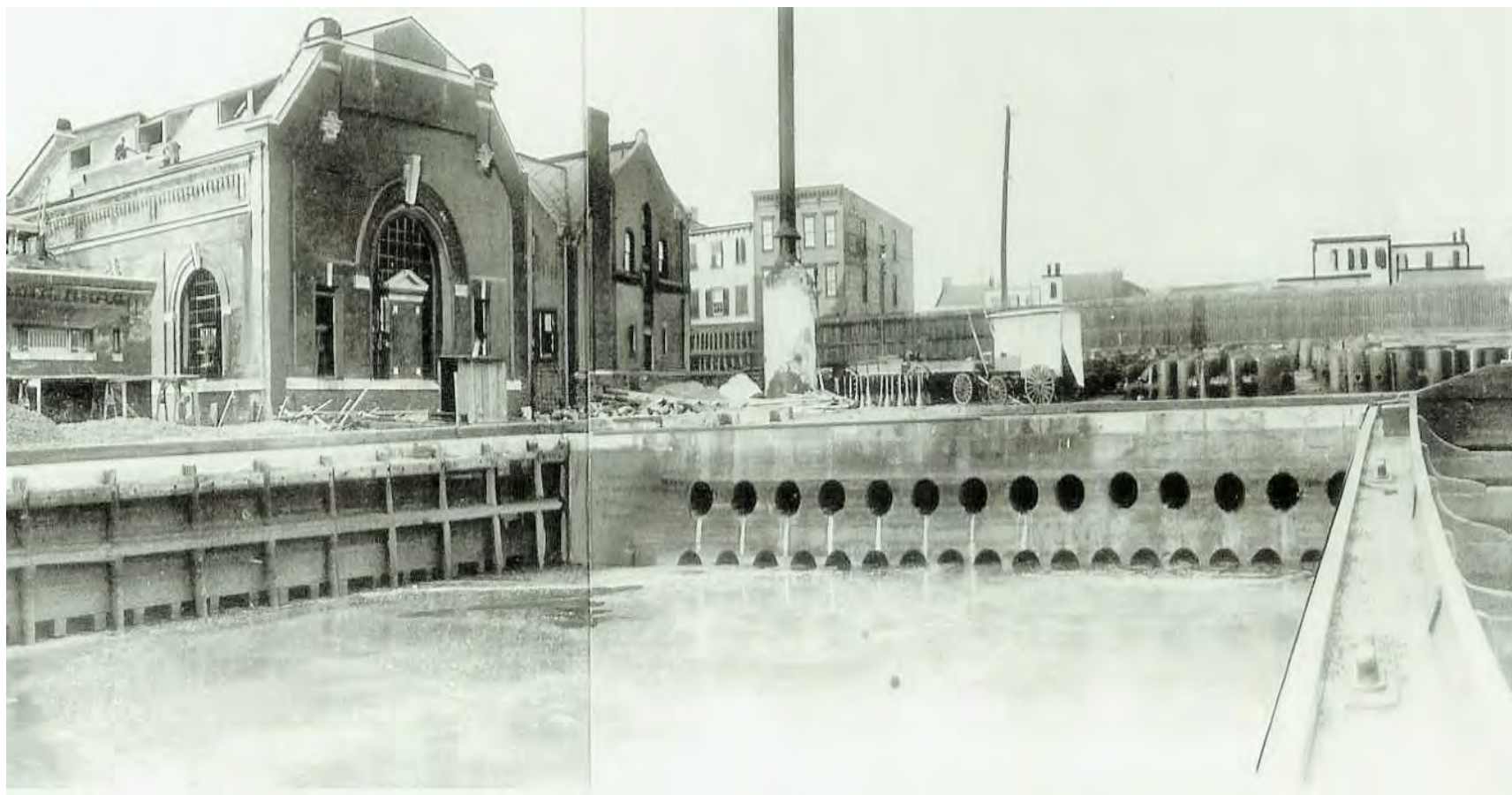
A Perspective

- ◆ From the New York Daily News:









Gowanus Canal CSO Discharge Characteristics

Discharge Location and Source		Annual-Average Discharge Characteristics		
Outfall #	Regulator	Overflow Volume (MG)	Percent of Total Discharge	Frequency of Overflows
RH-034	Gowanus PS	188.4	64%	53
OH-007	Second Ave PS	75.8	26%	47
OH-006	19 St-3 Ave	14.6	5%	30
RH-031	Outfall RH-031	7.7	3%	11
RH-035	Outfall RH-035	2.1	1%	8
RH-036	R-22	1.6	1%	19
OH-005	Carroll St-3 Ave	1.0	< 1%	5
RH-038	R-24	0.9	< 1%	13
RH-037	R-23	0.5	< 1%	13
RH-033	R-25	0.2	< 1%	8
OH-008	Storm			
OH-009	Closed			
RH-032	Storm			
RH-039	Closed			
Total Discharge:		292.8		



Manufactured Gas Plants





Aerials of sheens



Remedial Investigation Objectives

- ◆ **Characterize the nature and extent of contamination for evaluating risk**
- ◆ **Identify the sources of contamination**
- ◆ **Evaluate human health and ecological risks**
- ◆ **Investigate canal characteristics that will influence the cleanup approach**

RI Sampling Activities

- ◆ **Surface sediment sampling (top 6 inches)**
- ◆ **Surface water sampling**
- ◆ **Deep sediment sampling**
- ◆ **Fish and crab tissue sampling**
- ◆ **Air sampling**
- ◆ **Sampling at CSOs and other outfalls**
- ◆ **Soil and groundwater sampling on properties adjacent to canal**

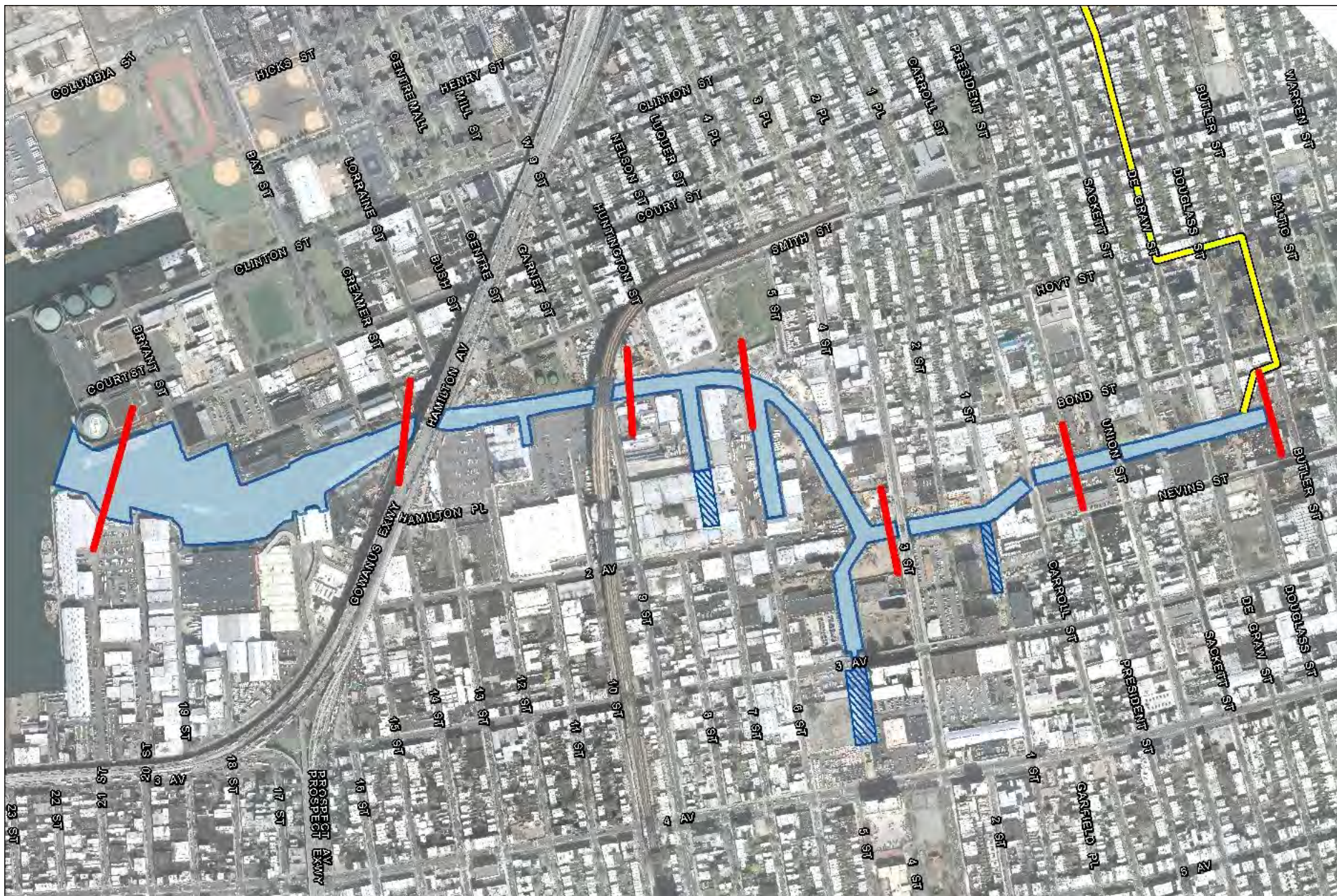
Surface Water and Sediment Sampling Locations



Air Sampling Locations



Fish and Crab Tissue Sampling Locations



Fish and Crab Samples Collected

Type	Species
Small prey fish	Atlantic Tomcod Hake Mummichog
Blue Crab	Blue Crab
Larger Fish	American Eel Striped Bass White Perch

CSO and Other Outfall Sampling Locations

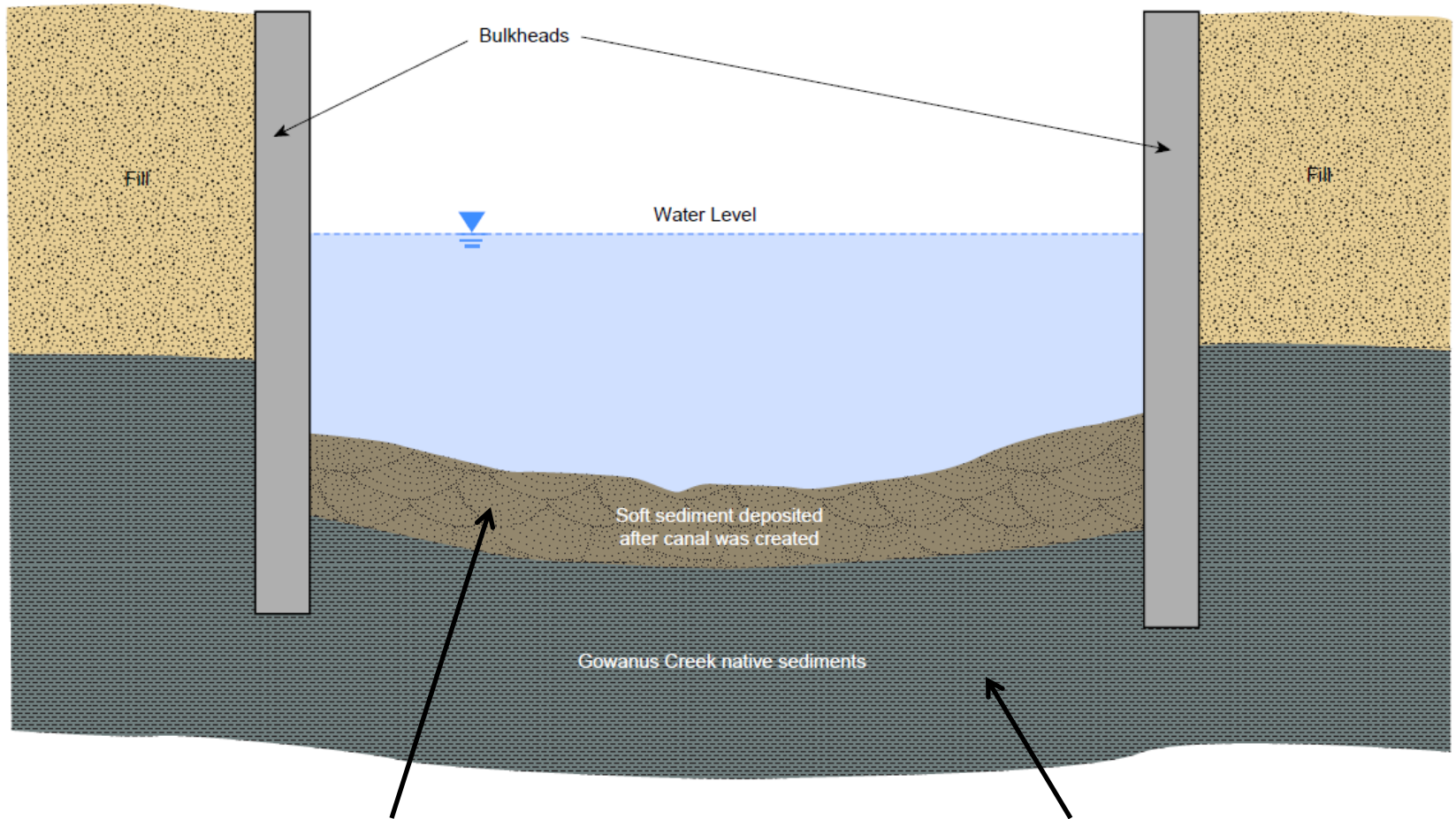


Remedial Investigation Results

Gowanus Canal Bathymetry



Gowanus Canal Sediment Layers



Soft Sediment

Native Sediment

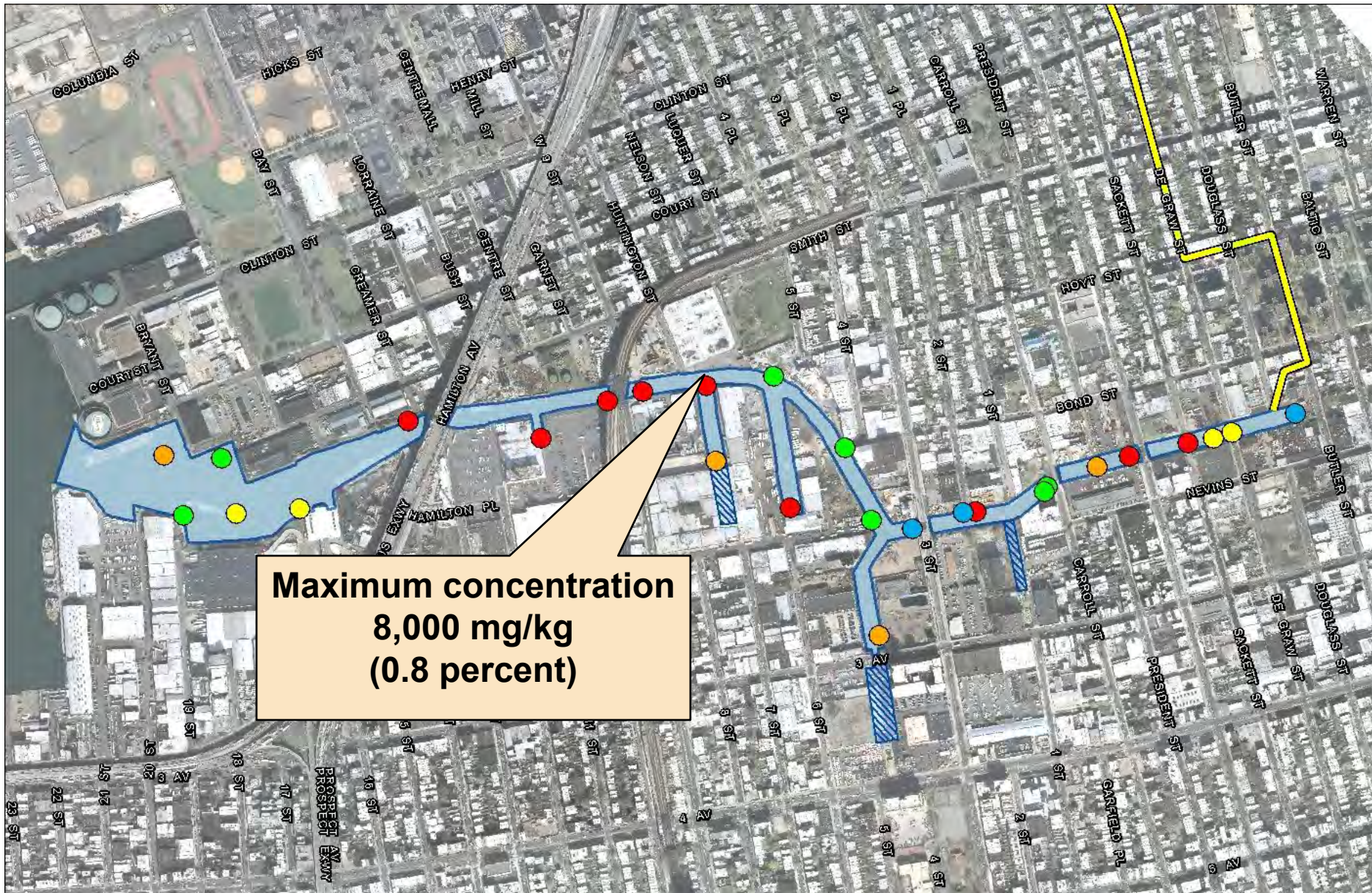
Primary Contaminants

- ◆ **Polycyclic Aromatic Hydrocarbons (PAHs)**
- ◆ **Polychlorinated biphenyls (PCBs)**
- ◆ **Metals (barium, cadmium, copper, lead, mercury, nickel, silver)**
- ◆ **Benzene, toluene, ethylbenzene, xylenes (BTEX)**
- ◆ **Non-aqueous phase liquid (NAPL)**

Surface Sediment Sampling Results

- ◆ **Surface sediment (top 6 inches) is the “biologically active” zone where humans and wildlife are most likely to be exposed to contaminants**
- ◆ **Concentrations of PAHs, PCBs, and eight metals are significantly higher in the Canal sediment than in Gowanus Bay / Upper NY Harbor reference area sediment**

PAH Concentrations in Surface Sediment



Surface Water Sampling Results

Constituents Exceeding Screening Values

	Dry Weather		Wet Weather	
Type	Ecological	Human Health	Ecological	Human Health
VOCs	None	Benzene	None	Ethylbenzene PCE
SVOCs	None	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Indeno(1,2,3-cd)pyrene Bis(2-ethylhexyl)phthalate	None	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(,h)anthracene Indeno(1,2,3-cd)pyrene Naphthalene
Metals	Cobalt Copper Nickel	Arsenic Chromium Cobalt Copper Mercury Thallium	Cobalt Iron Lead Nickel	Arsenic Chromium Cobalt Lead Mercury

Air Sampling Results

	Canoe Level		Street Level		Background	
Compound (µg/m³)	Round 1 without aeration	Round 2 with aeration	Round 1 without aeration	Round 2 with aeration	1000 ft from canal	RIOPA Study
Benzene	1.1	3.8	2.3	1.4	0.91	2.15
Chloroform	0.28	0.24	0.39	0.45	0.29	0.32
Ethylbenzene	5.1	4.4	1.7	1.8	1.2	1.29
Methylene chloride	4.5	2	5.1	2	5.4	0.95
Xylenes (total)	16	28	6.8	7.6	4.6	1.49
Naphthalene	3.4	2.6	1.3	4.4	0.17	Not available

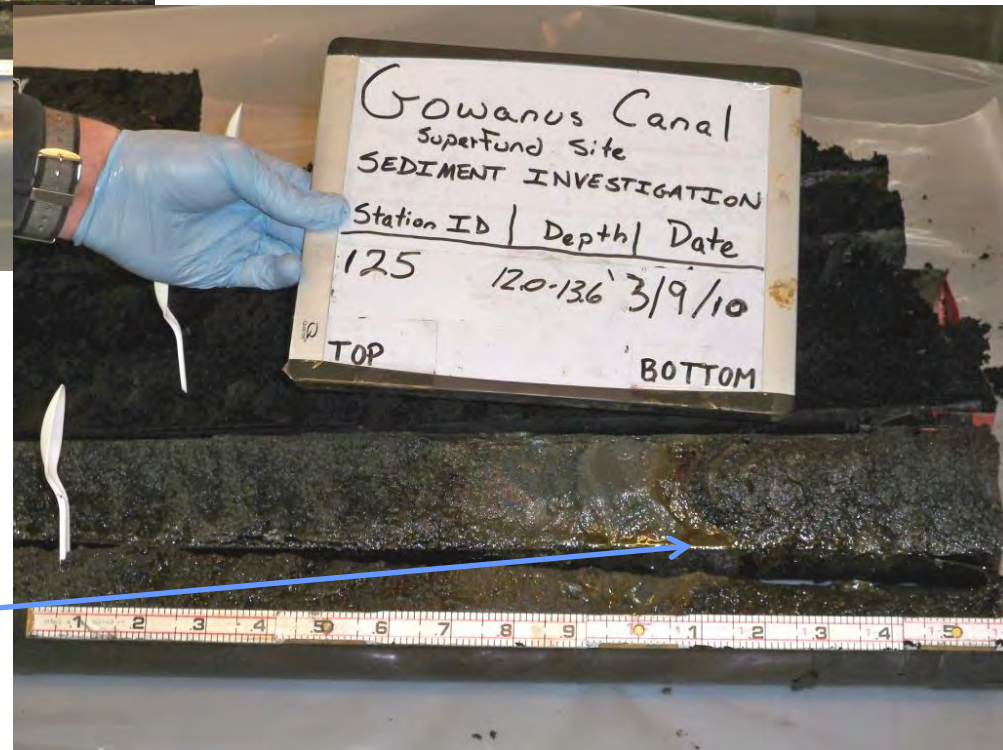
Deep Sediment Characterization



Soft Sediment

Native Sediment

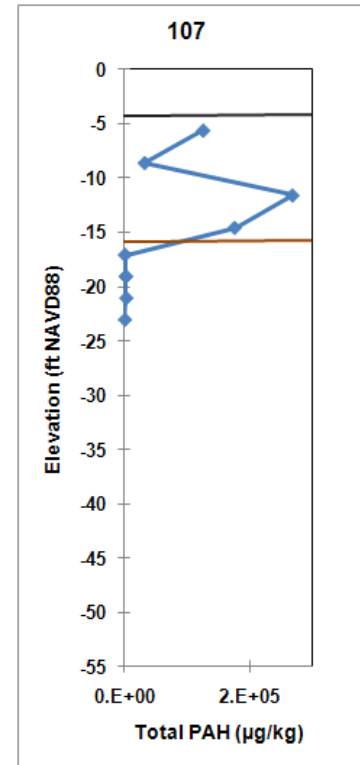
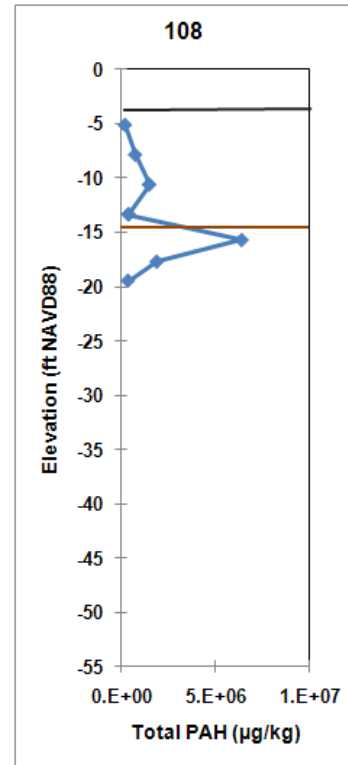
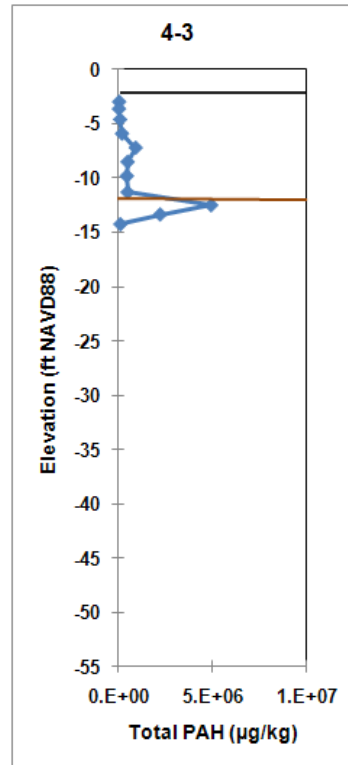
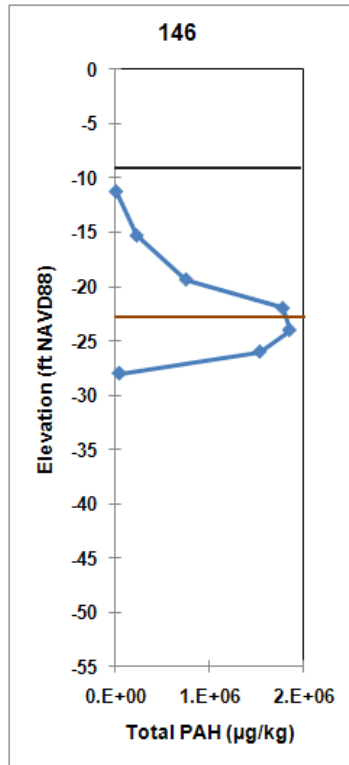
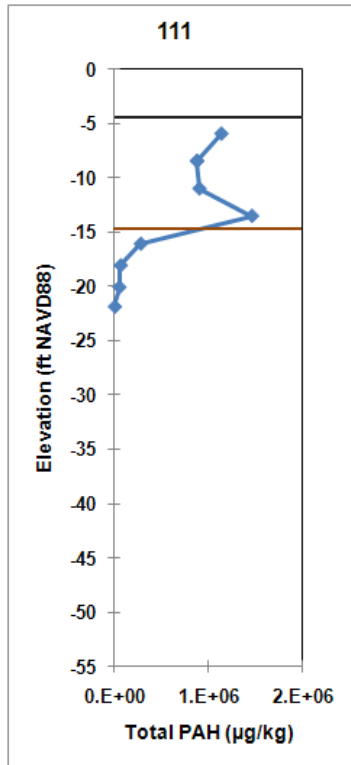
NAPL



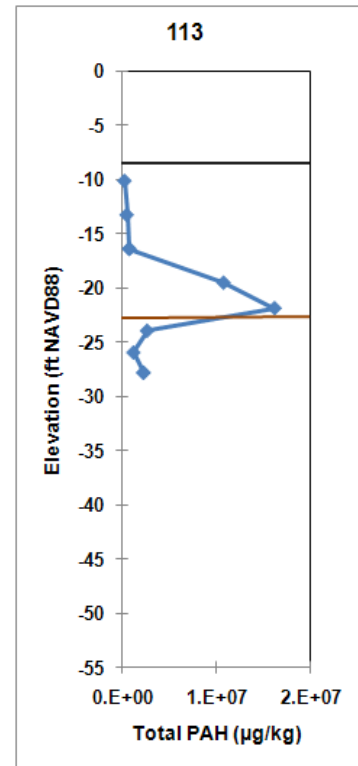
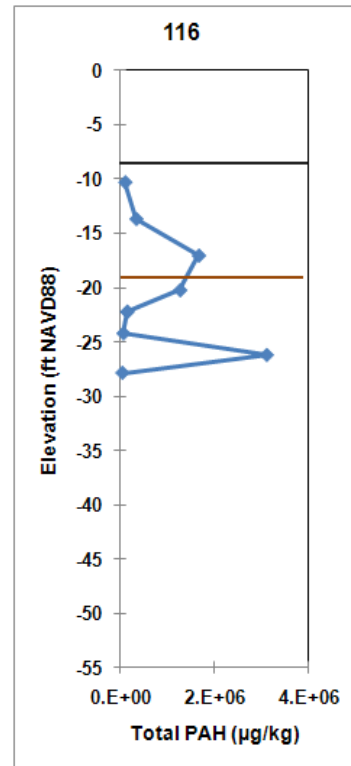
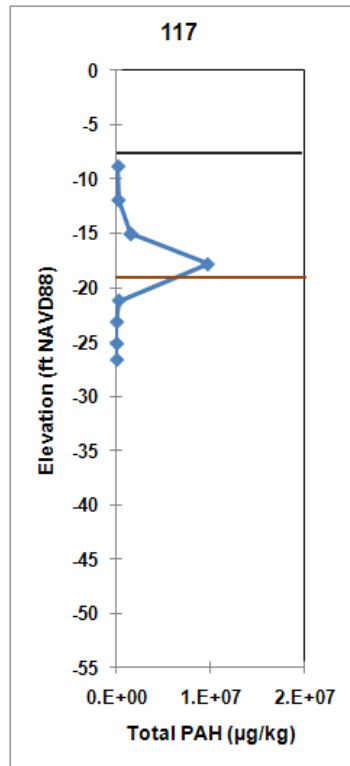
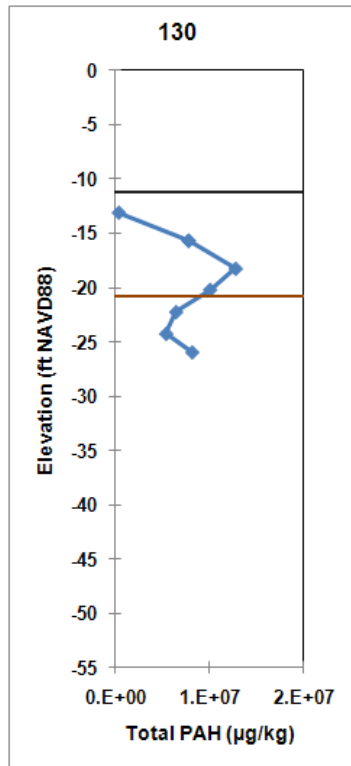
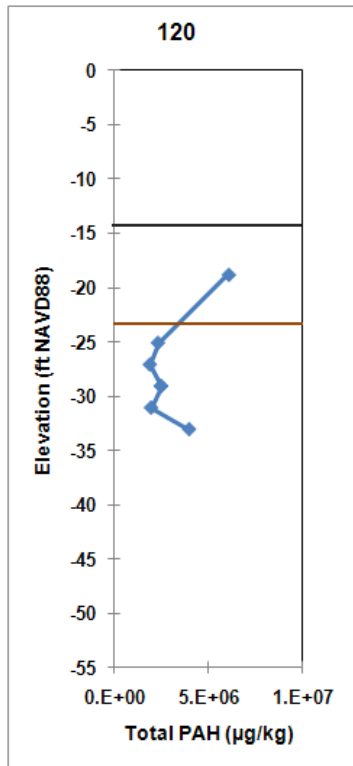
Comparison of Different Deep Sediment Layers

Sediment Layer	BTEX (mg/kg)	PAHs (mg/kg)	PCBs (mg/kg)	Lead (mg/kg)
Surface soft	0.36	527	0.43	533
Deeper soft	188	3,490	3.5	770
Native	233	2,920	0.026	14

Vertical PAH Deep Sediment Profiles Upper Canal



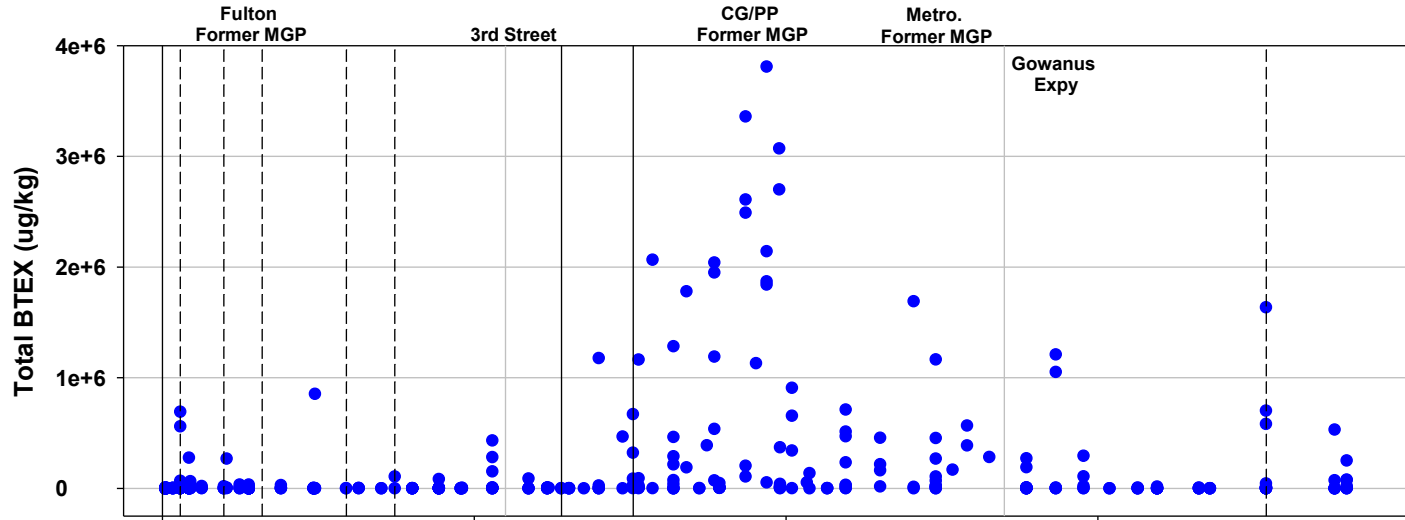
Vertical PAH Deep Sediment Profiles Middle Canal



Longitudinal BTEX Profiles

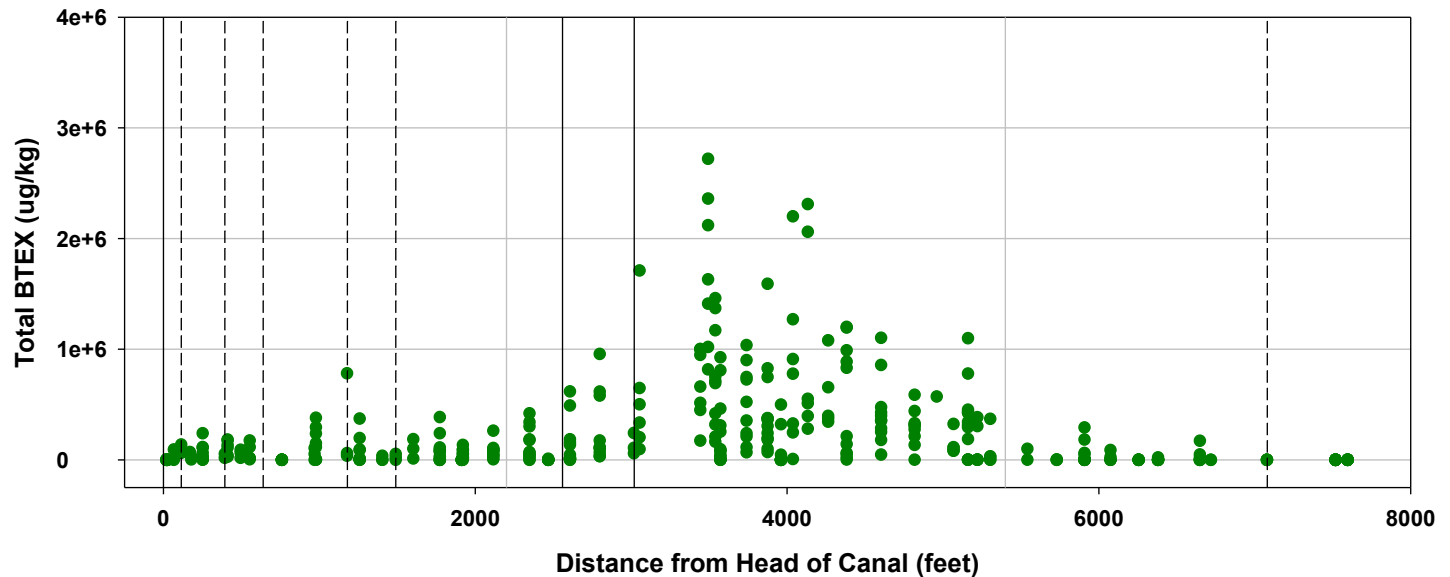
Total BTEX in Soft Sediment

Soft



Total BTEX in Native Sediment

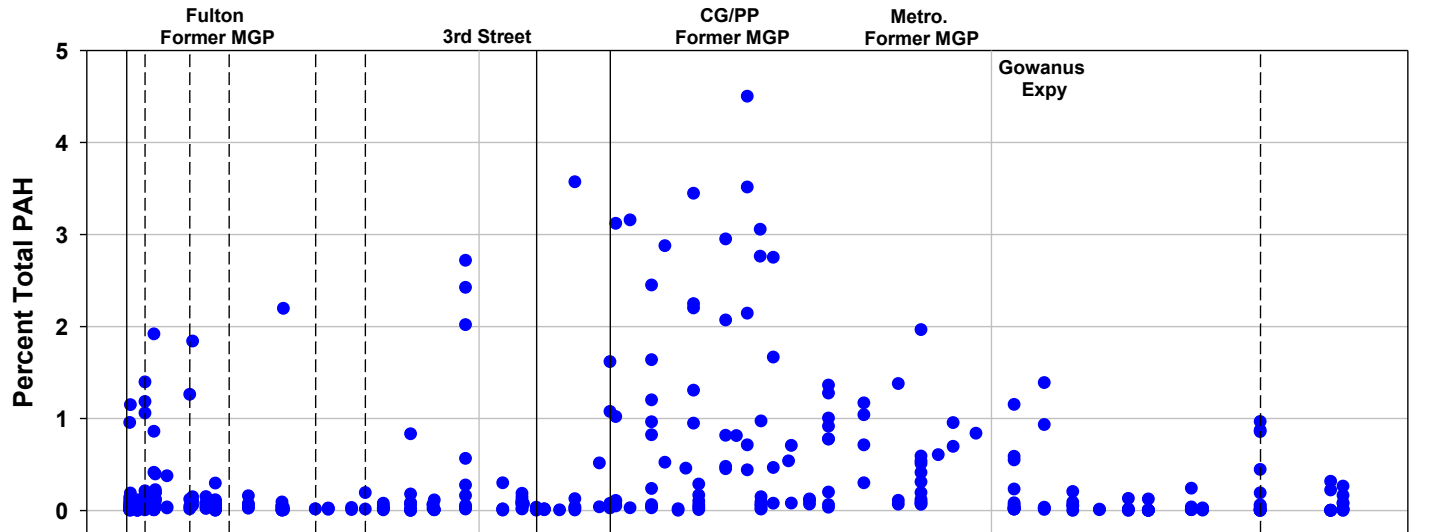
Native



Longitudinal PAH Profiles

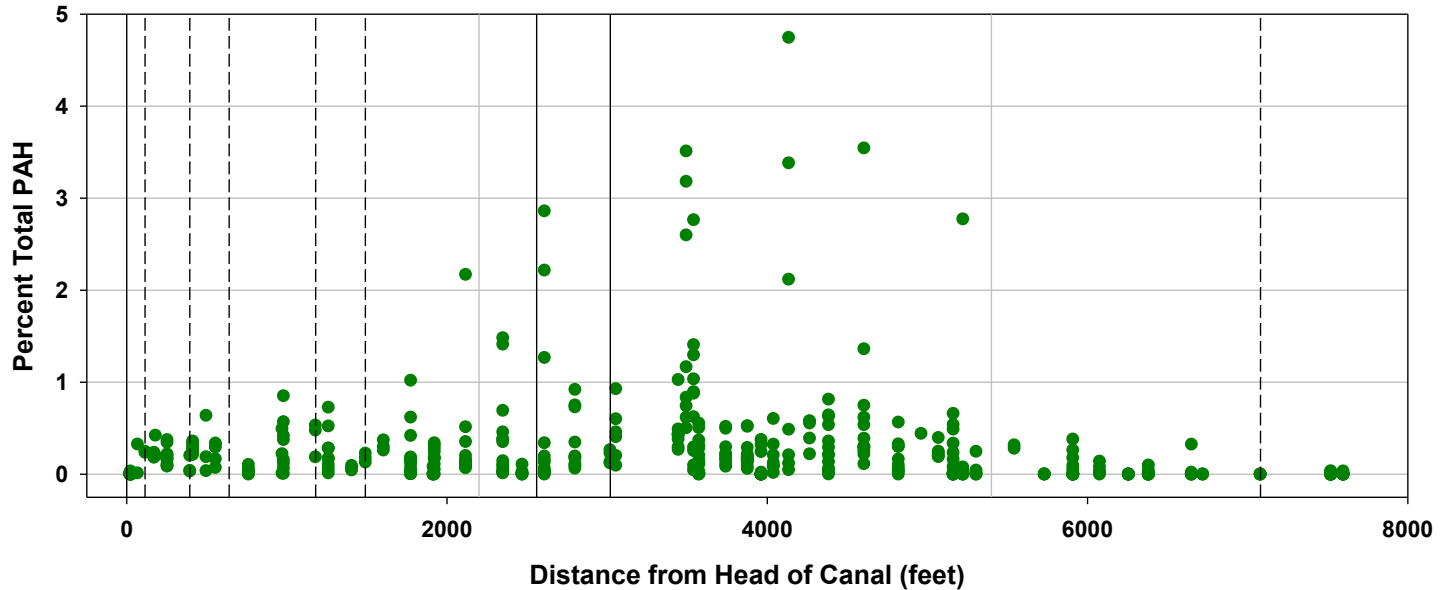
Percent Total PAH in Soft Sediment

Soft



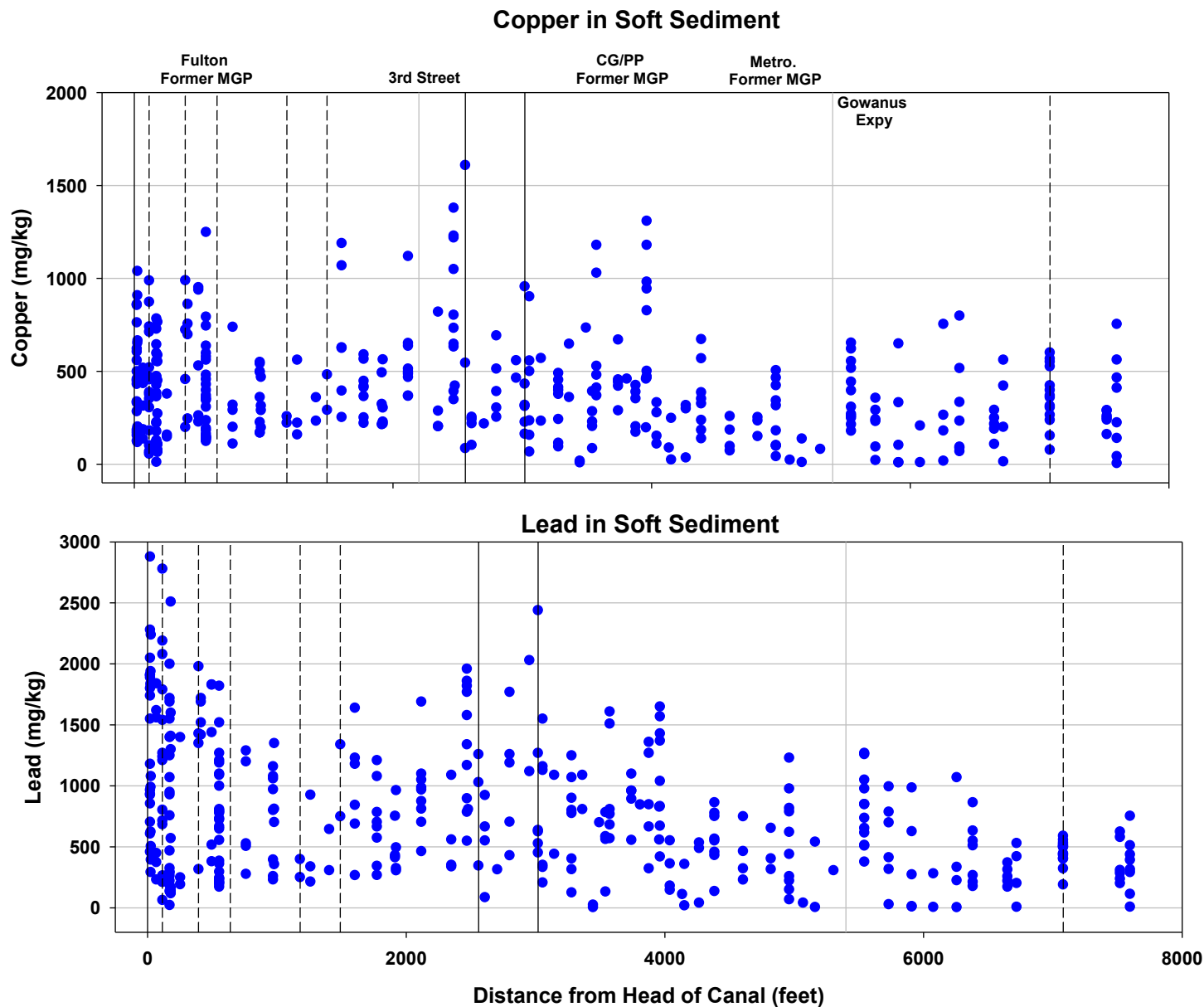
Percent Total PAH in Native Sediment

Native



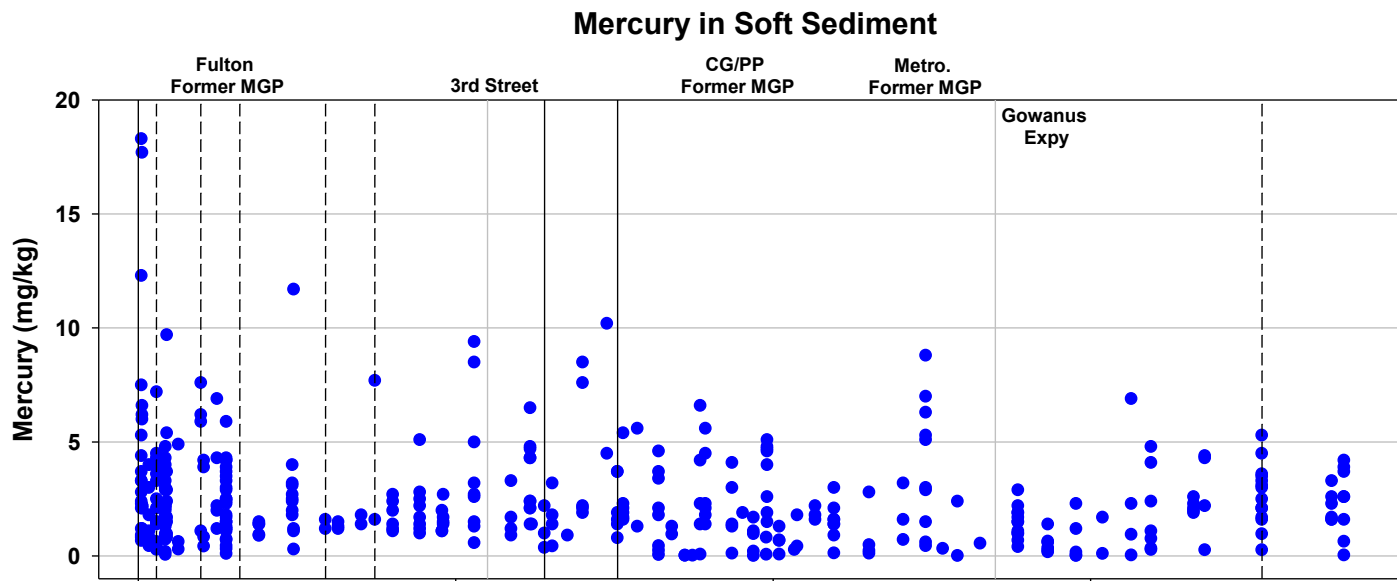
Longitudinal Copper and Lead Profiles

Soft

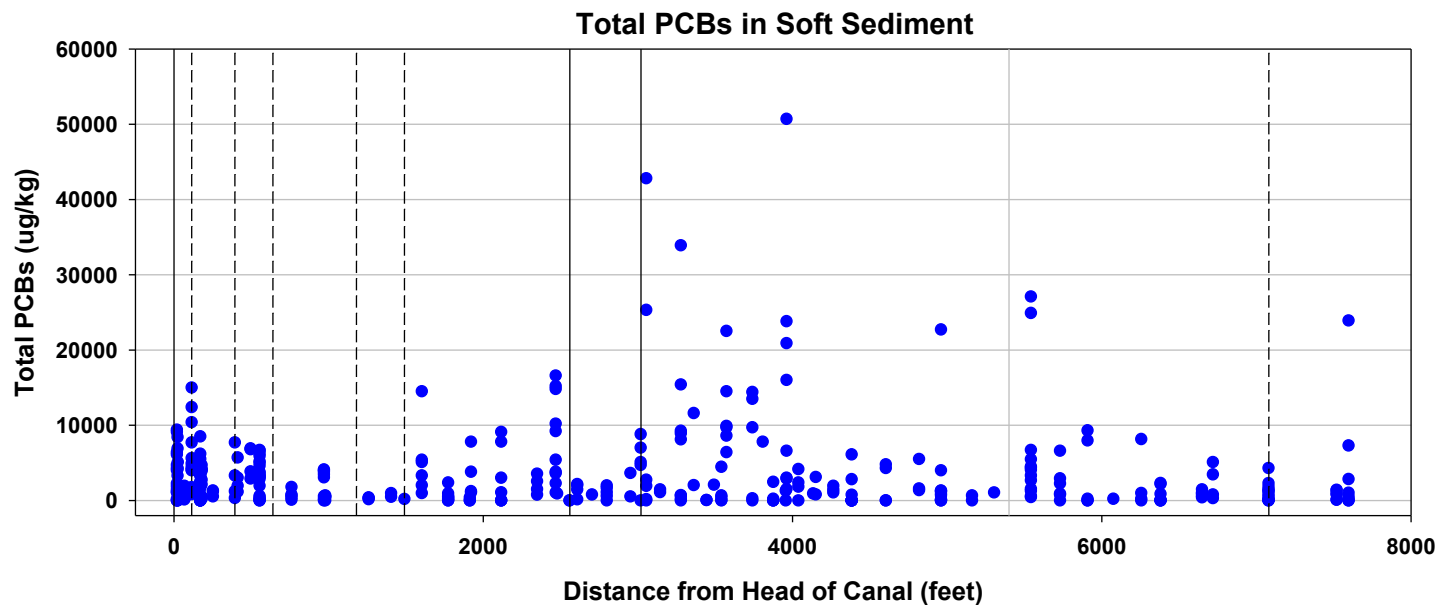


Longitudinal Mercury and PCB Profiles

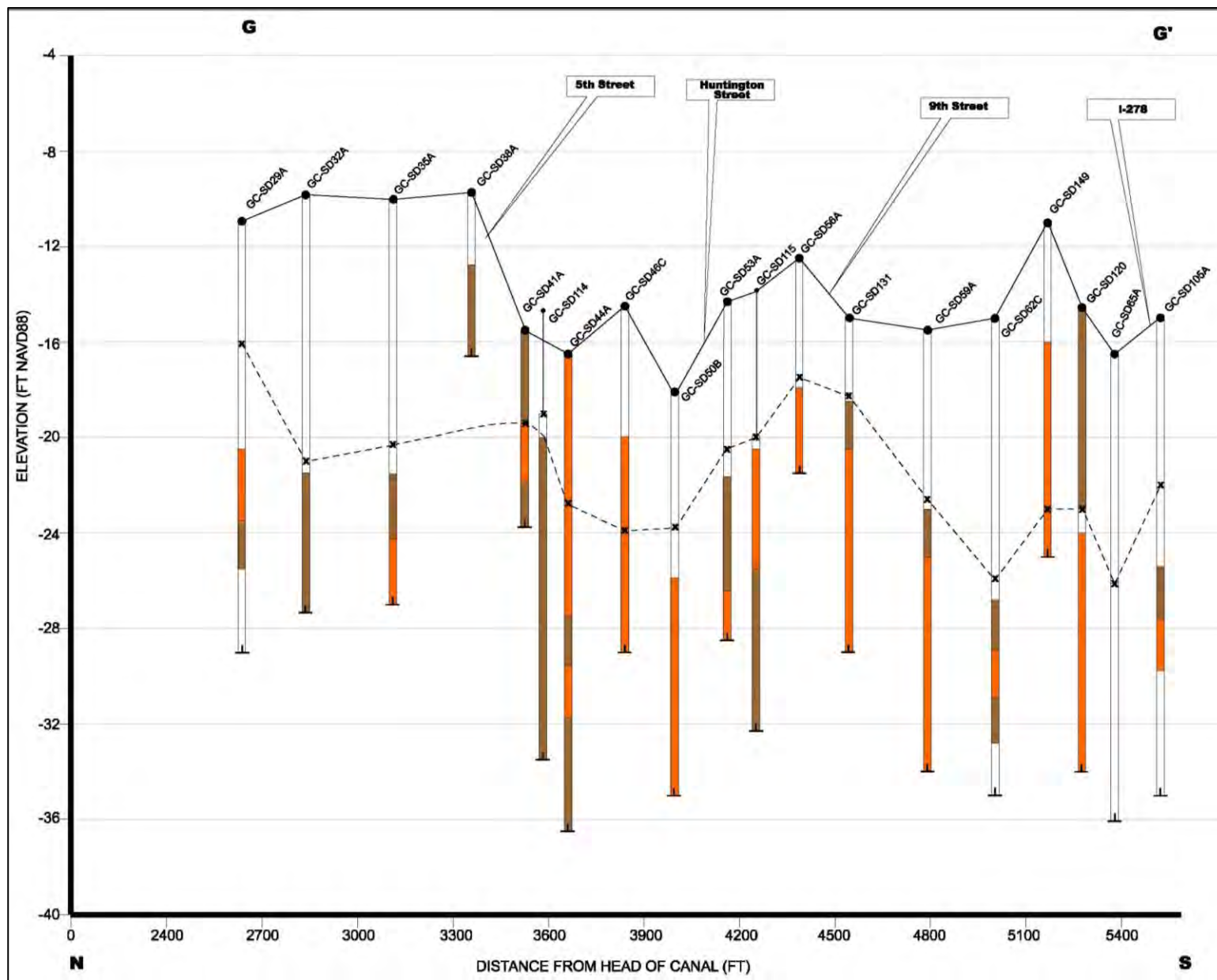
Soft



Soft



Extent of NAPL – Middle Canal



EPA well boring at Lowe's



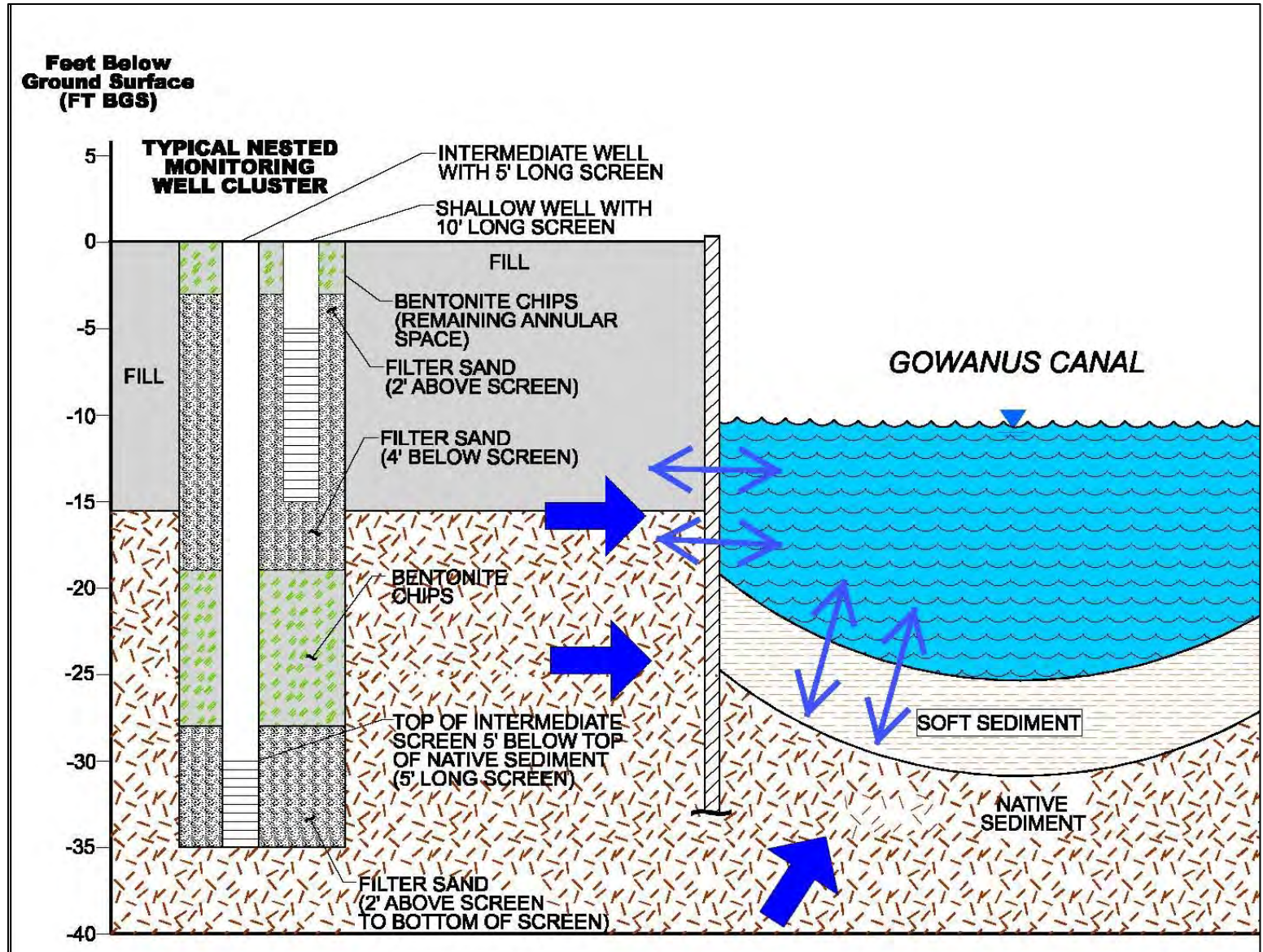
CSO Sampling Results

- ◆ **CSO water samples collected in one dry weather and three wet weather events**
- ◆ **One round of CSO sediment samples**
- ◆ **Water samples - VOCs, PAHs, and metals are discharged to the canal during overflow events; PCBs were detected in one sample**
- ◆ **Residual sediment in pipes – VOCs, PAHs, pesticides, PCBs, and metals present**

Hydrogeologic Evaluation Results

- ◆ **Shallow & intermediate groundwater generally flows toward the canal**
- ◆ **High tides can reverse local flow directions so canal surface water enters adjacent soils**
- ◆ **Large volume tidal fluctuations in surface water; comparatively smaller contribution of groundwater to the canal**

Well Depths and Groundwater Flow



Groundwater Sampling Results

- ◆ **Samples from all locations contained at least one contaminant that was higher than a screening value**
- ◆ **Metals exceeded screening values most frequently, followed by VOCs & SVOCs**
- ◆ **Measureable thickness of NAPL in 8 wells + evidence of NAPL in 4 more wells**

Risk Assessments Results

Ecological Risk Assessment Results

- ◆ **Sediment bioassays and chemical analyses indicate adverse effects to sediment-dwelling communities at most locations tested**
- ◆ **PAHs pose the greatest risk; PCBs and metals also contribute**

Ecological Risk Assessment Results (cont.)

- ◆ **Risks to wildlife from consuming contaminated prey and sediment**
 - **Plant-eating birds (e.g. black duck) – potential risk from exposure to PAHs**
 - **Omnivorous birds (e.g. heron) – potential risk from exposure to mercury**
 - **Fish-eating birds (e.g. double-crested cormorant) – no risk from ingesting fish from the canal**

Human Health Risk Assessment

◆ Evaluated potential human health risks for following exposure scenarios:

- Reasonable Maximum Exposure RME – uses the highest exposure that is reasonably expected to occur at a site
- Central Tendency Exposure CTE—more typical exposure
- Evaluated both carcinogenic risks & noncarcinogenic hazards
- Compared calculated risk levels to EPA's levels:
 - ◆ *Carcinogenic risk range - 1 in 1 million to 1 in 10 thousand*
 - ◆ *Noncarcinogenic hazards - hazard level of 1*

Human Health Risk Assessment (cont.)

◆ Recreational Use

- ◆ *Contact with water and sediment, breathing air in the canal while swimming*
- ◆ *Assumed frequency and duration (swimming) typical of most water bodies*
- ◆ *Carcinogenic risk – RME and CTE above risk range*
 - RME - 1 in thousand CTE - 3 in 10 thousand
 - Primarily associated with carcinogenic PAHs in surface water and sediment
- ◆ *Noncarcinogenic hazard - Within hazard range*

Human Health Risk Assessment (cont.)

◆ Living near canal

- ◆ *Contact with water and sediment when canal overflows and breathing ambient air*
- ◆ *Carcinogenic risk*
 - RME above risk range - 3 in 10 thousand
 - CTE below RME and within risk range
 - Primarily associated with carcinogenic PAHs in surface water and sediment.
- ◆ *Noncarcinogenic hazard - Within hazard range*

Human Health Risk Assessment Results (cont.)

◆ Fishing and crabbing in canal

- RME and CTE ingestion of fish and crabs from canal would result in risks higher than range mainly associated with PCBs
 - ◆ *Carcinogenic risks from 2 in 100 thousand to 7 in 10 thousand*
 - ◆ *Noncarcinogenic hazard from 0.6 to 27*
- Average concentrations of PCBs in fish and crab from canal were about 2 times higher than in reference area
- Risks from consuming fish and crab from reference area also were higher than risk range

6/2010 – Striper catch and keep in a turning basin



Other Factors that Influence Cleanup Approach – Bulkhead Condition



Other Factors that Influence Cleanup Approach - Debris and Cultural Resources



Conclusions

- ◆ **Chemical contamination in Gowanus Canal Sediments presents unacceptable human health and ecological risks**
- ◆ **Contaminated sites adjacent to the canal and outfall discharges are ongoing sources of contamination that will be carefully considered during the development of a cleanup approach**

Schedule

- ◆ **Feasibility Study – End of 2011**
- ◆ **Proposed Plan – 6 to 8 months after Feasibility Study completion**
- ◆
- ◆ **Selection of Remedy – End of 2012**

Sponge Park

dlandstudio

GOWANUS CANAL SPONGE PARK™ SITE AXONOMETRIC

Gowanus Canal
CONSERVANCY

State of the Arts
NYSCA

- | | | | |
|---|--|---|--|
| A WATER
REMEDiation
WETLANDS | E WETLANDS
EDUCATIONAL
FACILITY | H CONNECTION
TO BYRNE PARK | K DOUGLAS GREEN PARK |
| B ACTIVE
RECREATION
OPEN SPACE | F PASSIVE
RECREATION
OPEN SPACE | I BYRNE PARK
THE OLD STONE HOUSE
HISTORICAL SITE | L REVOLUTIONARY WAR
MONUMENT |
| C PARK AND
COMMUNITY
CENTER | G MTA F & G LINE
SMITH-9TH ST
STATION | J MTA F & G LINE
BRIDGE | M RENOVATED
POWER PLANT |
| D PUBLIC PLACE
PROPOSED
MIXED-USE
DEVELOPMENT | | | N CULTURAL
OPEN SPACE |



Gowanus Green Affordable Housing



Questions?