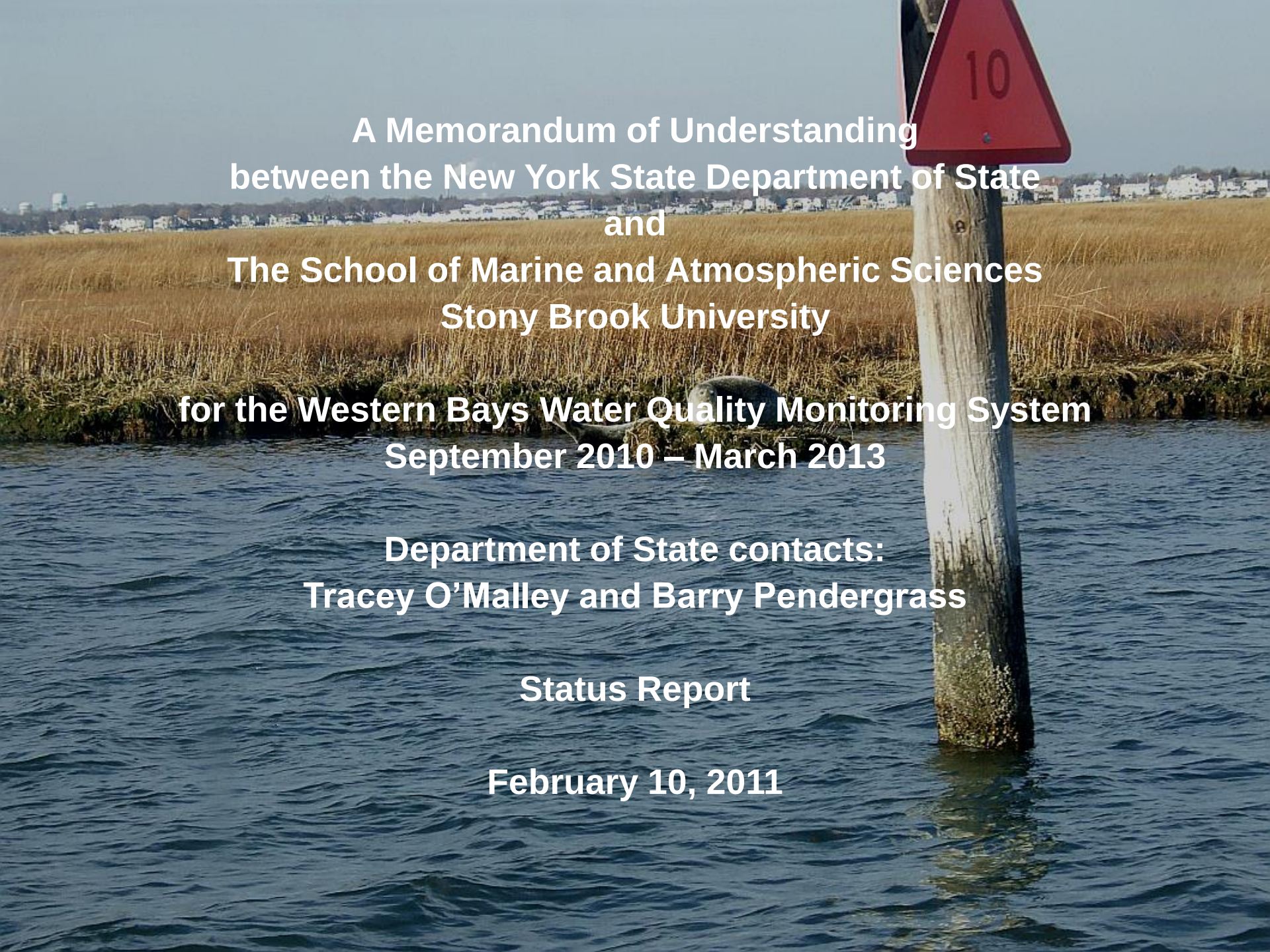


A Memorandum of Understanding between the New York State Department of State and The School of Marine and Atmospheric Sciences Stony Brook University

for the Western Bays Water Quality Monitoring System
September 2010 – March 2013

Department of State contacts:
Tracey O'Malley and Barry Pendergrass

Status Report

February 10, 2011

Work Tasks

1. Review historical water quality data.
2. Collect new tide-adjusted bathymetry.
3. Update existing hydrodynamic model with high resolution bathymetry.
4. Survey pelagic water column.
5. Collect and analyze sediment samples.
6. Estimate marsh subsidence.
7. Assess factors affecting winter flounder.

Objectives

1. Improve understanding of water quality within the South Shore Estuary Reserve.
2. Interpret existing data.
3. Collect and interpret additional data to advance understanding of water quality impairments and improve management decisions.

Contributors to this report

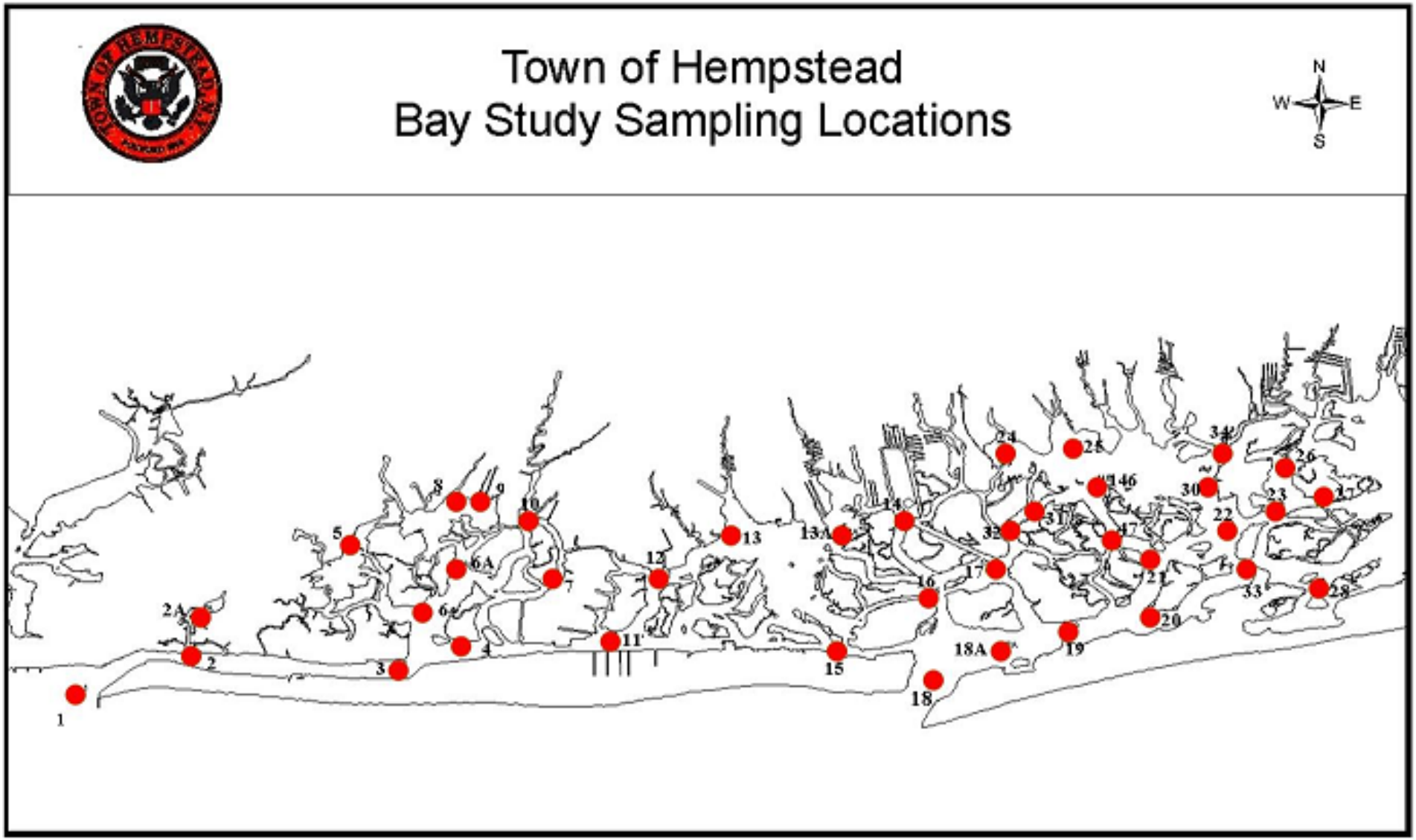
Investigators

- Henry Bokuniewicz
- Bruce Brownawell
- Kirk Cochran
- Charles Flagg
- Roger Flood
- Chris Gobler
- Larry Swanson
- Robert Wilson

Students

- Cassie Bauer
- Anne Cooper Doherty
- Ryan Wallace
- Dongming Yang

Task 1: Review historical water quality data



Historical water quality data collected from approximately 30 sites throughout Hempstead Bay

Present inventory of historical data

Surface Data (collected at 1 meter depth)

- **Temperature:** 1975-1980; 1982-1987; 1989-2010
- **Salinity:** 1975-1980; 1982-1987; 1989-2010
- **Dissolved Oxygen:** 1975-1980; 1982-1987; Nov 1990-April 1998; 2003-2010
- **Ortho-Phosphate:** 1975-1980; 1982-1987; 1989-2010
- **Nitrite:** 1975-1980; 1982-1987; 1989-1996; 2000-2010
- **Nitrate:** 1975-1980; 1982-1987; 1989-1996; 2000-2010
- **Ammonia:** 1975-1980; 1982-1987; 1989-1996; 2000-2010

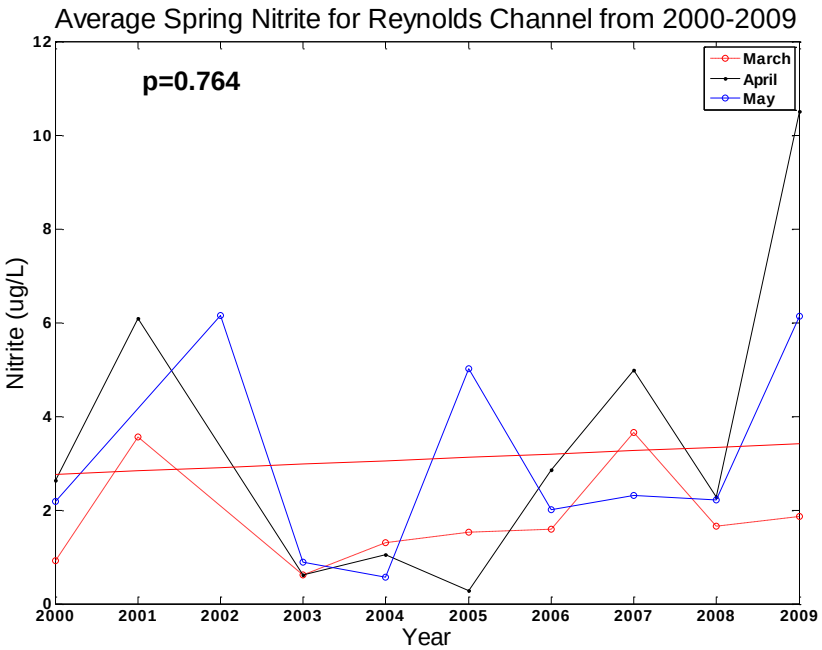
Limitations

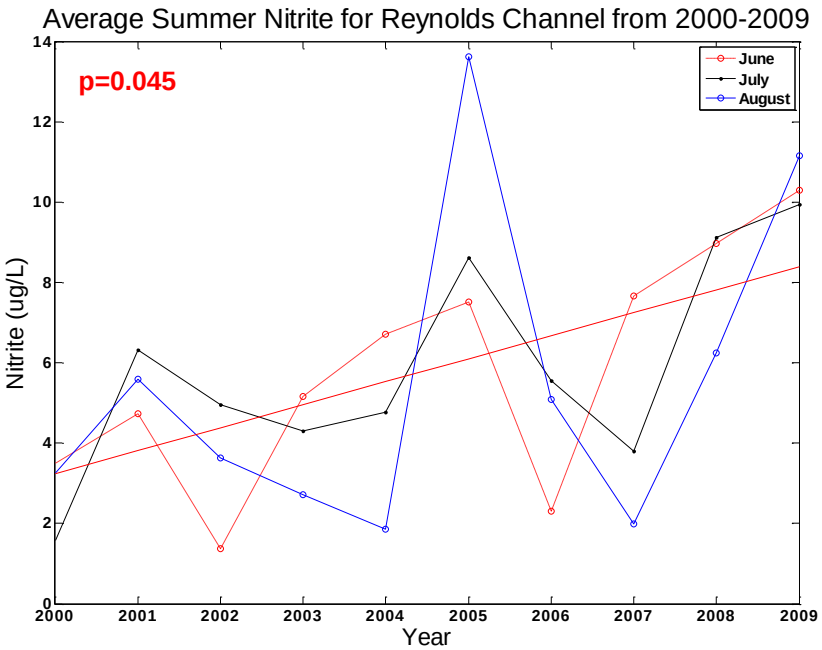
- Gaps in the record
- Only surface data

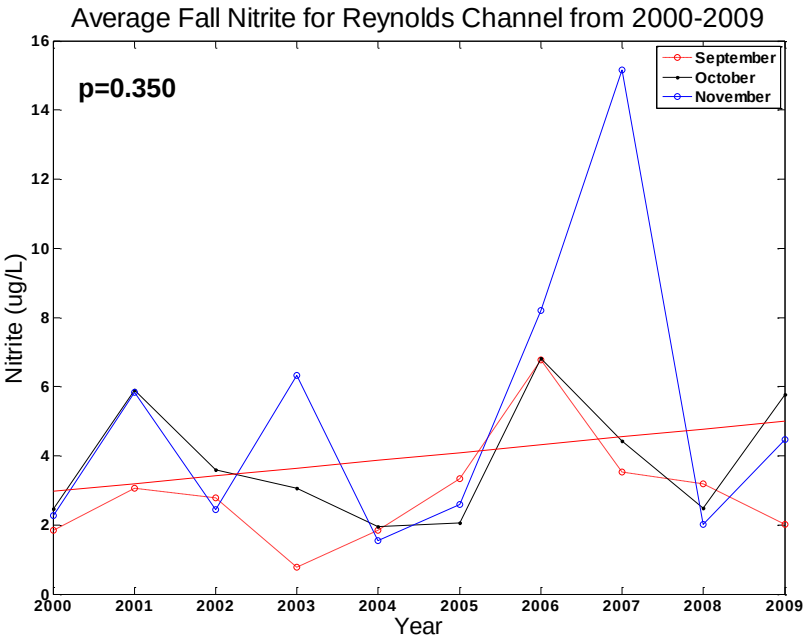
Reports provided by the Town of Hempstead

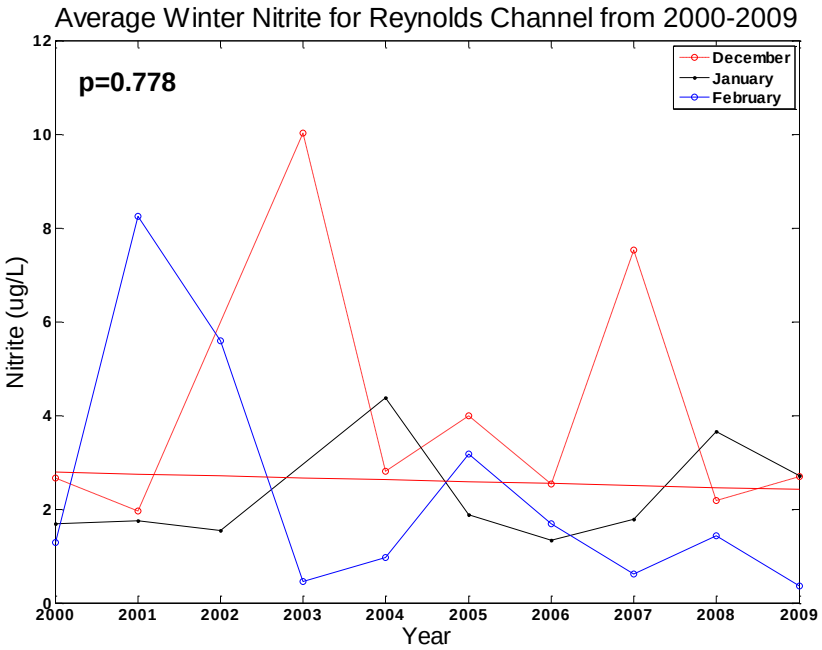
1. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Shellfish Sanitation Branch. *Hydrographic Study Bay Park STP Effluent Travel Time Dilution and Dispersion in Eastern Reynolds Channel, NY, July 9, 1986*. Submitted to Region II Shellfish Specialist, NE Technical Services Unit, Davisville, Rhode Island, October 1987.
2. *Water Quality Study, Hempstead Bay Estuary, 1968*. Town of Hempstead, LI, NY. Department of Conservation and Waterways.
3. *The Use of Selected Enrichment Experiments in Predicting the Eutrophication of an Estuary*. Contribution No. 7. Town of Hempstead, LI, NY. Department of Conservation and Waterways.
4. New York State Department of Environmental Conservation, Division of Legal Affairs, Region, Building 40 – SUNY, Stony Brook, NY 11790-2356. *Notice of Noncompliance and Demand for Suspended Penalties*. *Re: DEC v. Nassau County Department of Health, DEC File No. R1-20020627-177*. April 8, 2005.
5. New York State Department of Environmental Conservation. *In the Matter of the Alleged Violations of Articles 17 and 71 of the Environmental Conservation Law of the State of New York and Title 6, Part 750, of the Official Compilation of Codes, Rules and Regulations of the State of New York*. By Nassau County Department of Health. Order DEC File No. R1-20020627-177.
6. State of New York, Department of Environmental Conservation. *In the Matter of the Alleged Violations of Article 17 of the Environmental Conservation Law ("ECL") and Part 750 et seq, of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR").* By Great Neck Water Pollution Control District. Order on Consent Case No. CO 1-20050527-1.
7. Nassau County Municipal Sewage Treatment Facilities. State Pollutant Discharge Elimination System (SPDES), Explanation of Effluent Data. The attached document displays effluent violation data for municipally owned sewage treatment facilities in Nassau County as reported on their Discharge Monitoring Reports (DMR) from January 1, 2005 through June 30, 2010.
8. Final Quality Assurance Project Plan for Nutrient Assessment and Management in Hempstead Bay New York. Version 1.0. Prepared for: New England Interstate Water Pollution Control Commission, Boott Mills South, 116 John Street, Lowell, MA 01852. Prepared by Battelle, 1212 Route 25A, Suite 3C, Stony Brook, NY 11790. June 4, 2010.
9. State of New York, Department of Environmental Conservation. *In the Matter of the Alleged Violations of Article 17 of the Environmental Conservation Law ("ECL") and Part 750 et seq, of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York ("6 NYCRR").* By Village of Great Neck Water. Order on Consent Case No. CO 1-20050315-10.
10. New York State Department of Environmental Conservation. *In the Matter of the Alleged Violations of Articles 17 and 71 of the Environmental Conservation Law ("ECL") of the State of New York and Part 750 of Title 6 of the Official Compilation of Codes, Rules and Regulations (6"NYCRR") of the State of New York by Oyster Bay Sewer District for its facility, Oyster Bay Wastewater Treatment Plant located at 15 Bay Ave., Oyster Bay, NY.* Order on Consent. Index No. R1-20100113-4.

Average seasonal nitrite for Reynolds Channel

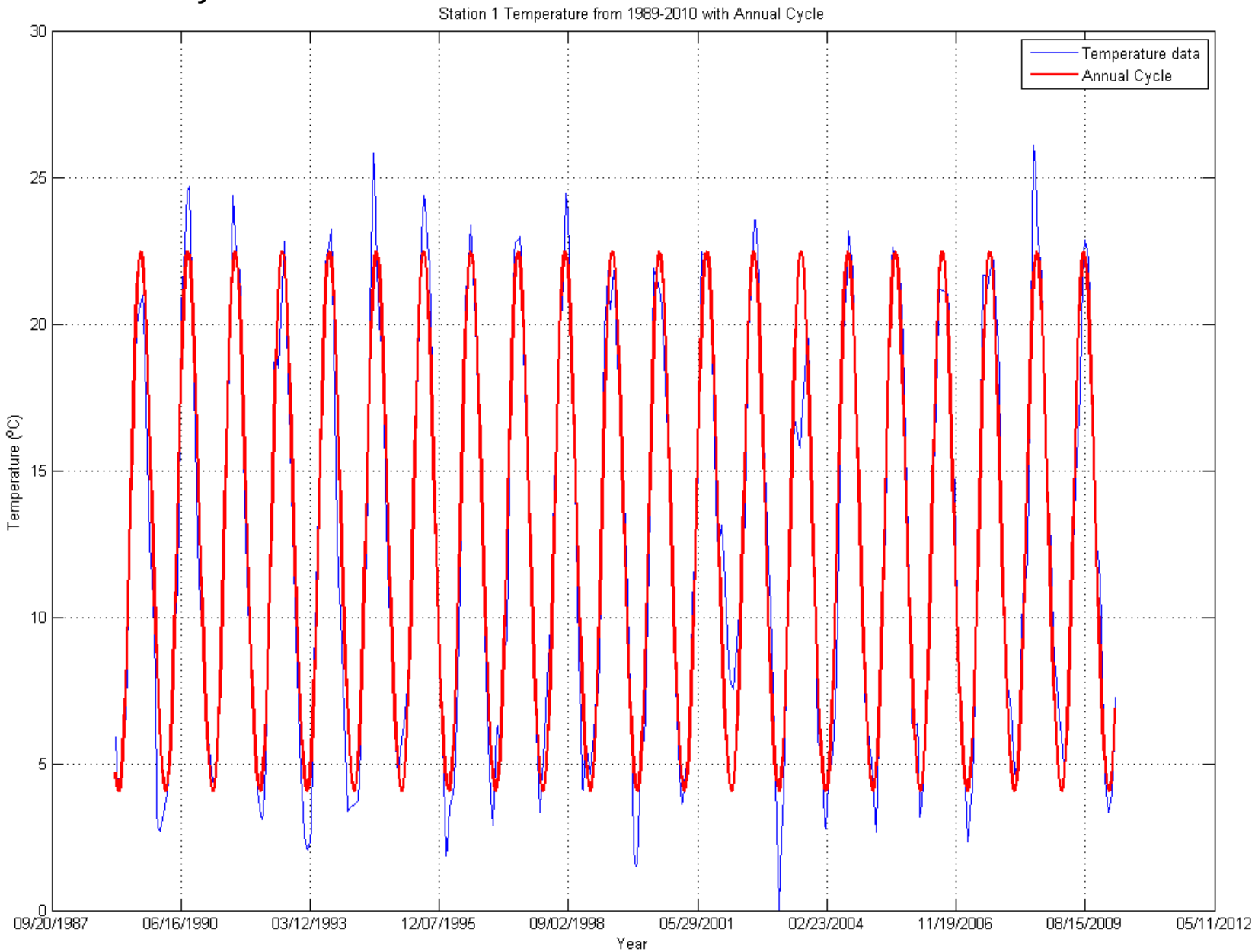




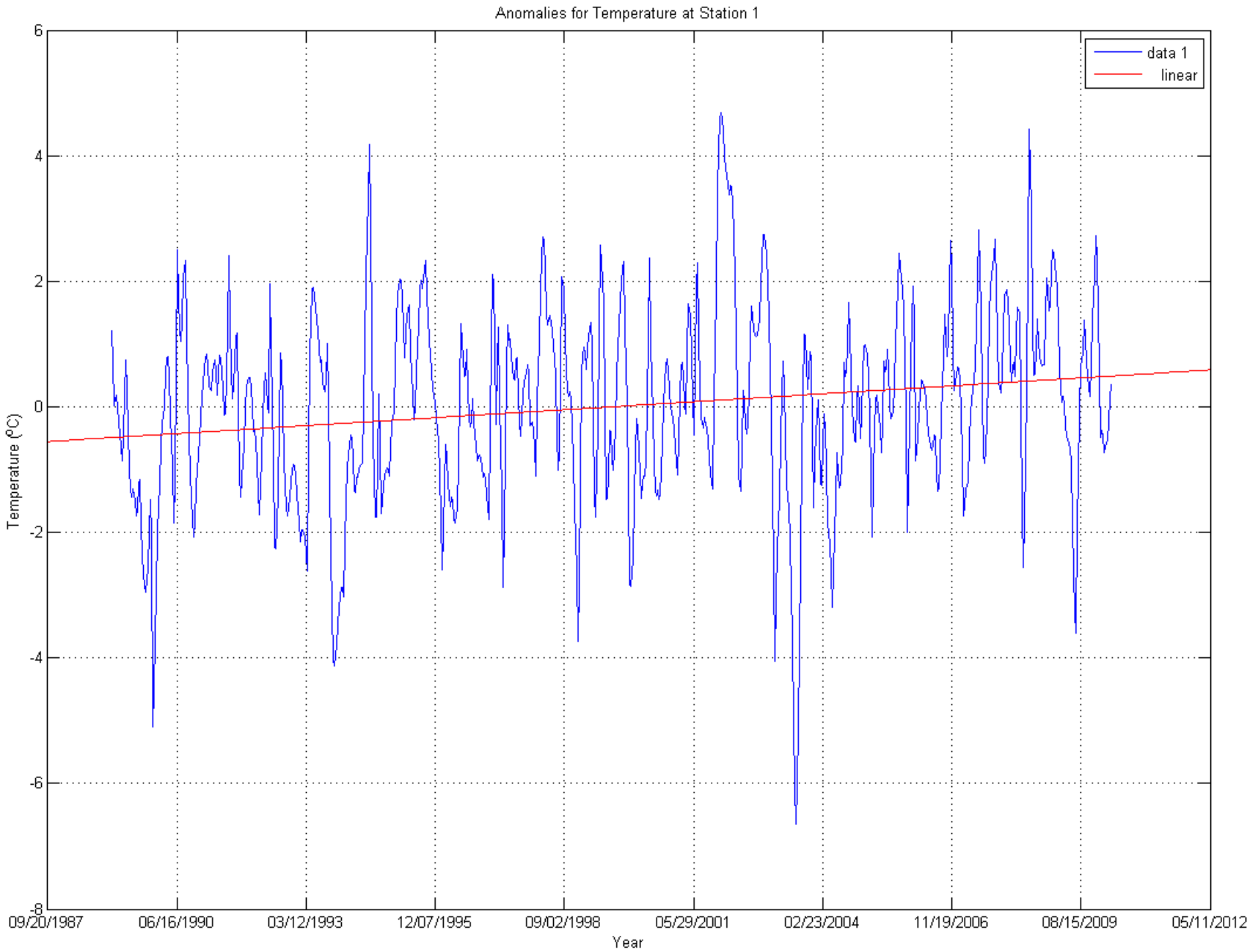




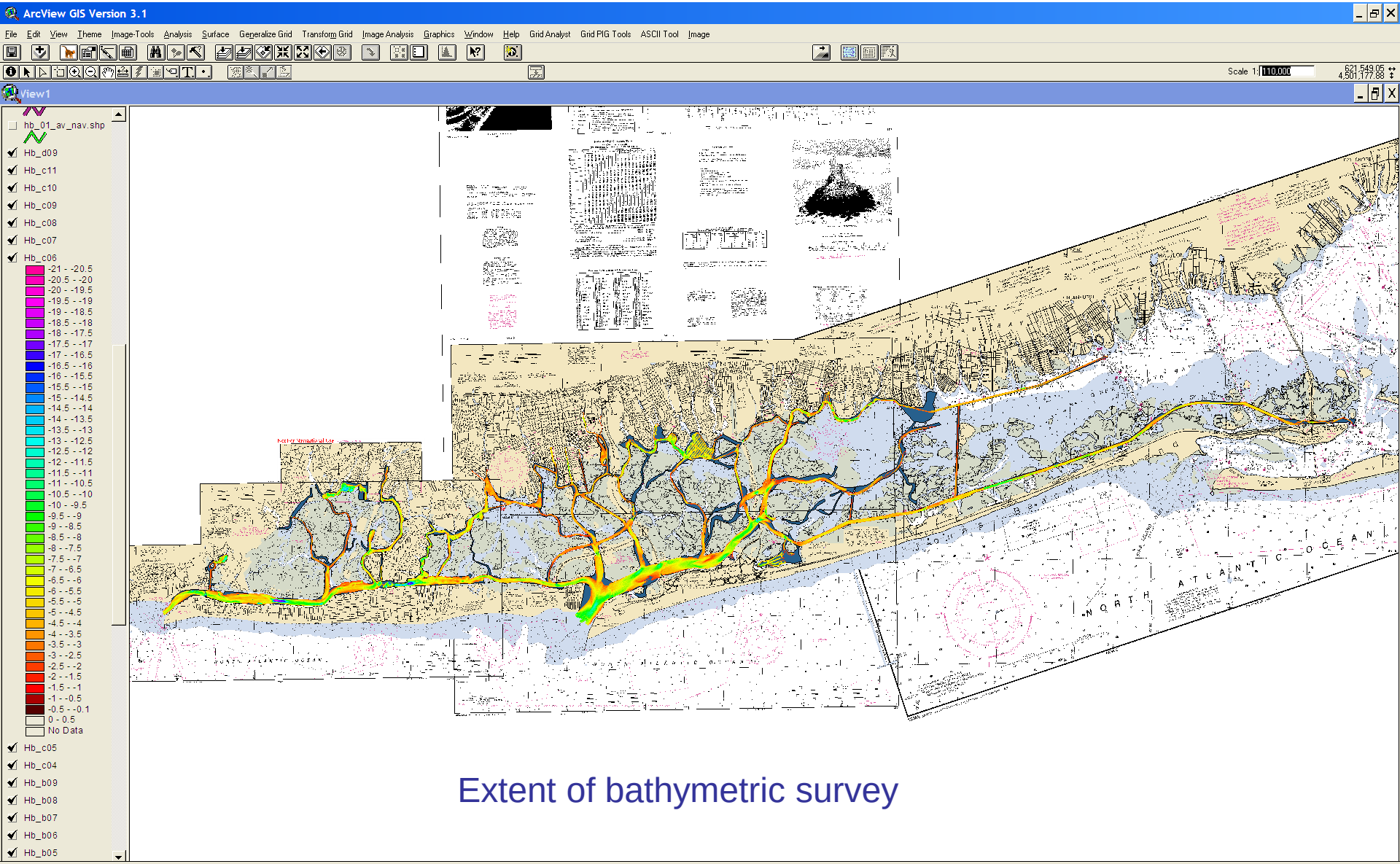
Station 1 (East Rockaway Inlet) temperature from 1989-2010 with annual cycle.



Anomalies for temperature at Station 1



Task 2. Collect new tide-adjusted bathymetry



Extent of bathymetric survey

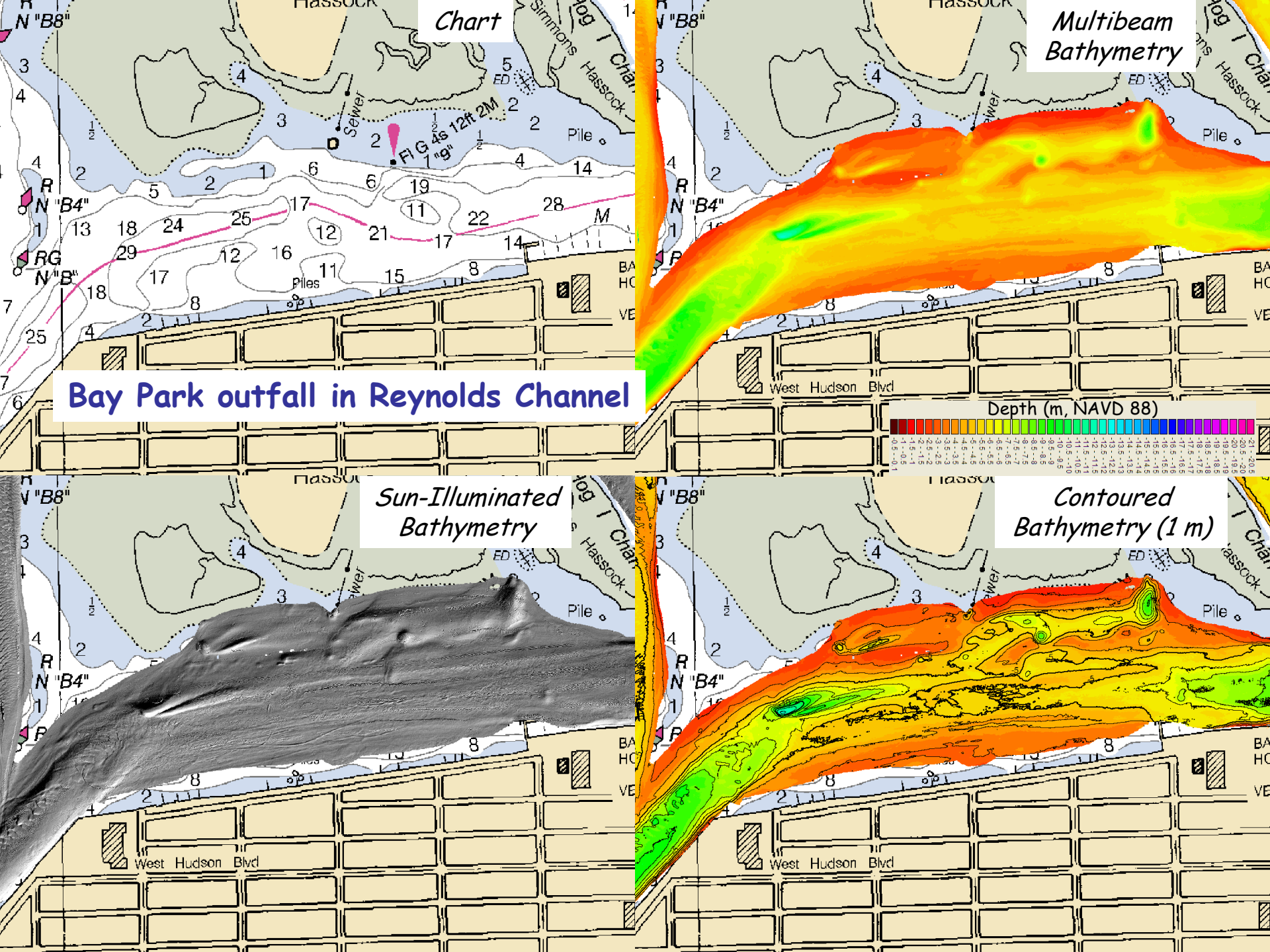


Chart
Multibeam Bathymetry
Bay Park outfall in Reynolds Channel
Depth (m, NAVD 88)
Sun-Illuminated Bathymetry
Contoured Bathymetry (1 m)
West Hudson Blvd
Pile
Piles
Sewer
Hassock
Simmons
Fl G 4s 12ft 2M
N "B8"
N "B4"
RG
N "B"

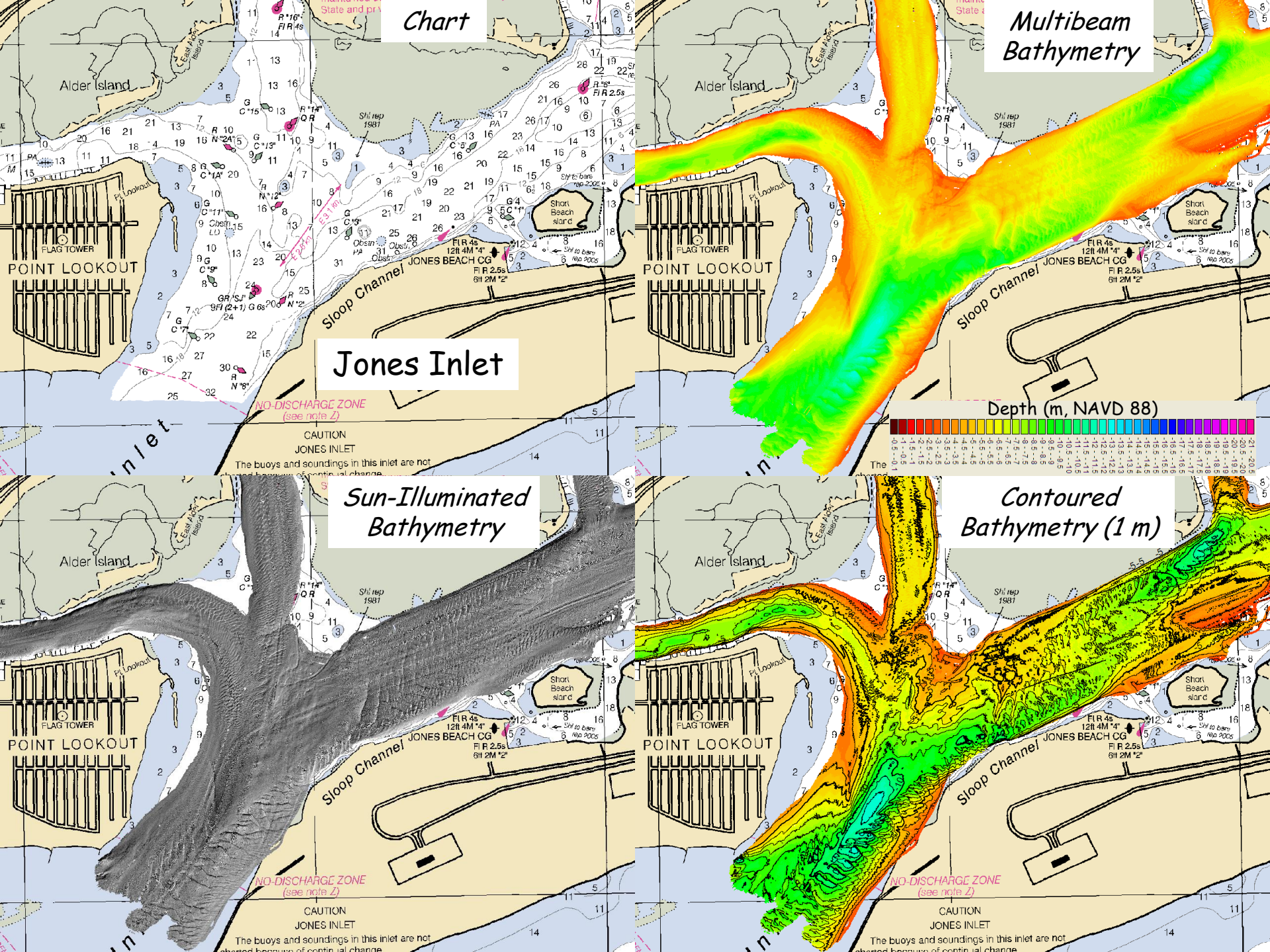
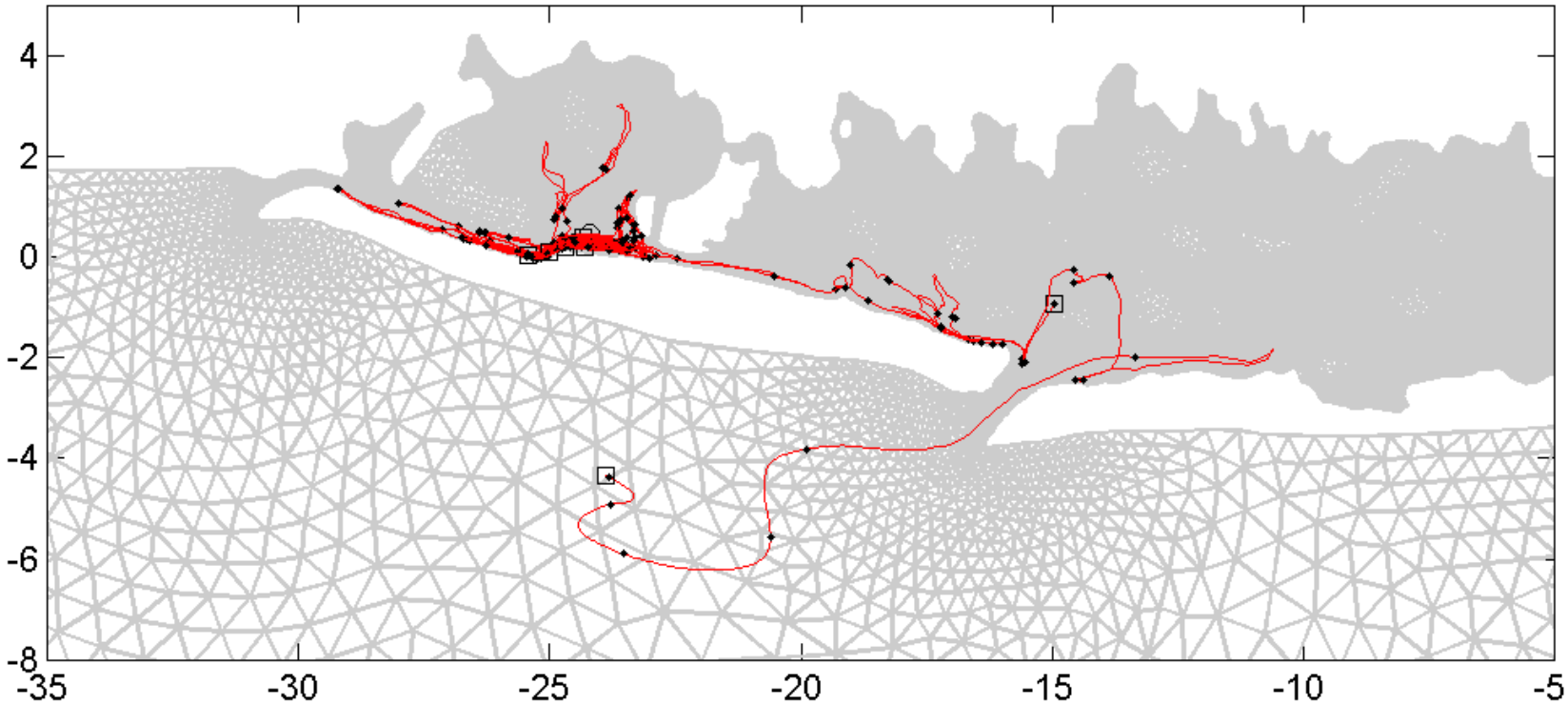


Chart
Multibeam Bathymetry
Jones Inlet
Sun-Illuminated Bathymetry
Contoured Bathymetry (1 m)
Depth (m, NAVD 88)
Alder Island
East Pole Island
FLAG TOWER
POINT LOOKOUT
Ft Lookout
Sloop Channel
JONES BEACH CG
Short Beach stand
NO-DISCHARGE ZONE
(see note Z)
CAUTION
JONES INLET
The buoys and soundings in this inlet are not

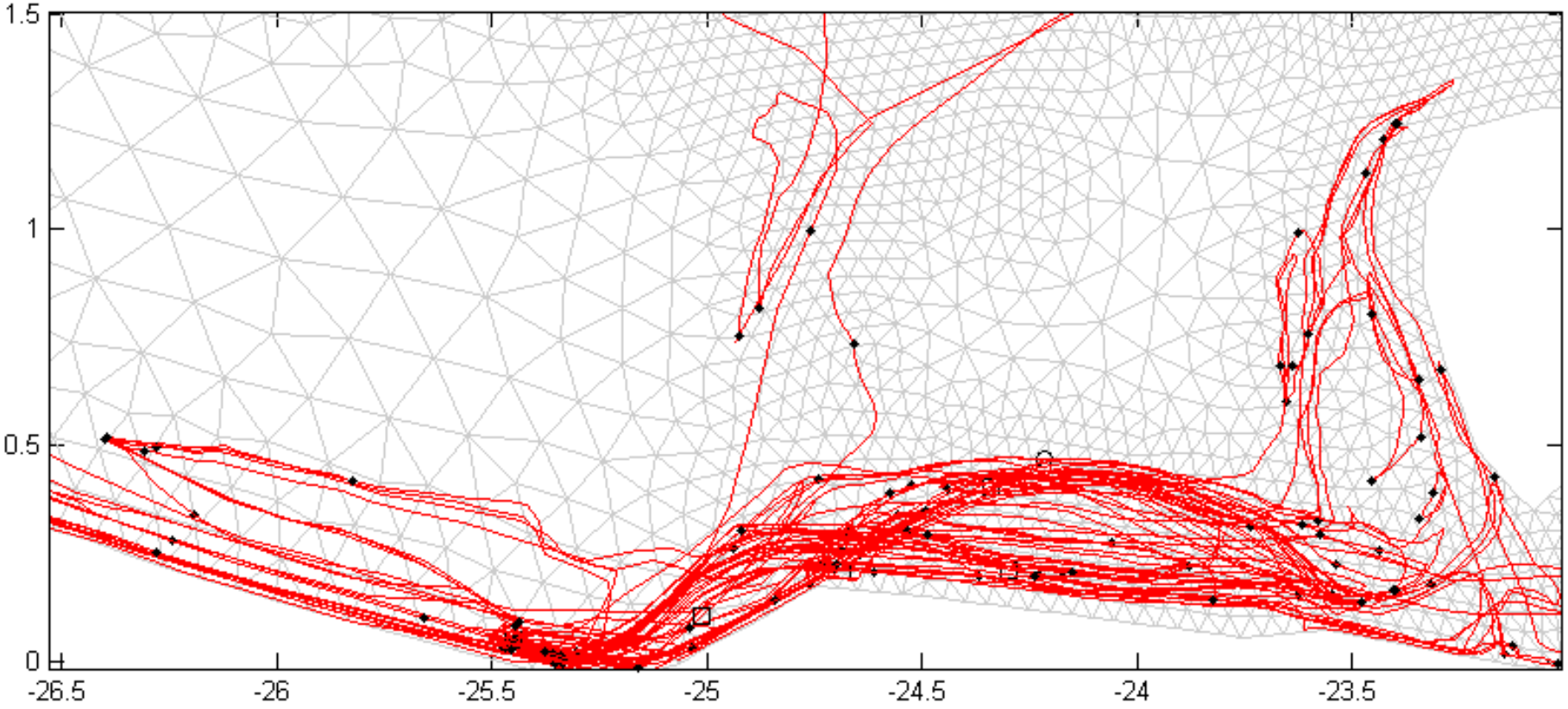
Task 3. Update existing hydrodynamic model with high resolution bathymetry.

Trace of water parcels released from Bay Park and Long Beach outfalls.



○ outfall release every 2 hours. □ end position after 12 tidal cycles (about 6 days). ● position at end of each tidal cycle.

Release point - Near Bay Park outfall.

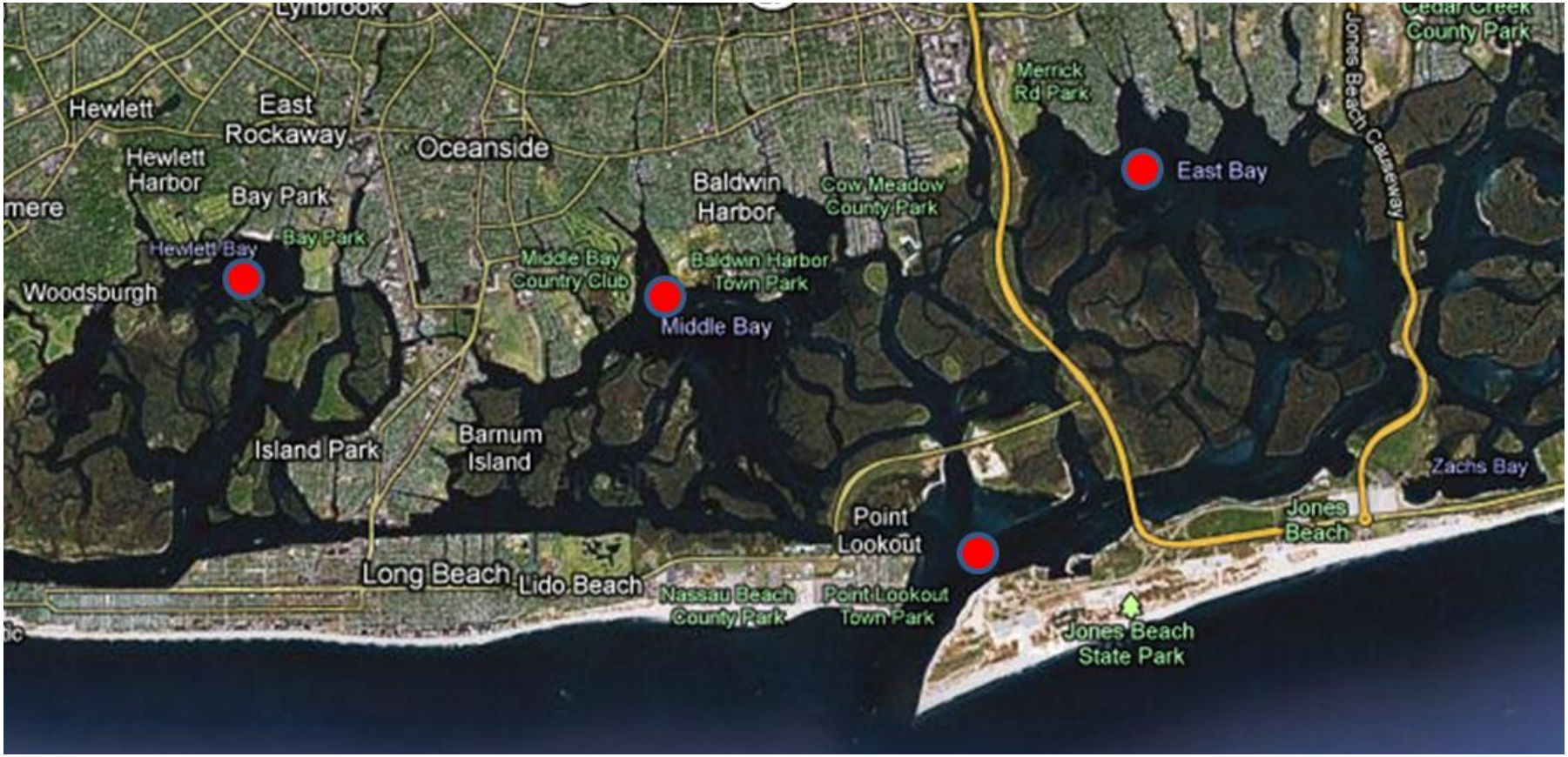


Task 4. Survey pelagic water column.

- What nutrients control the growth of primary producers in the Western Bays?

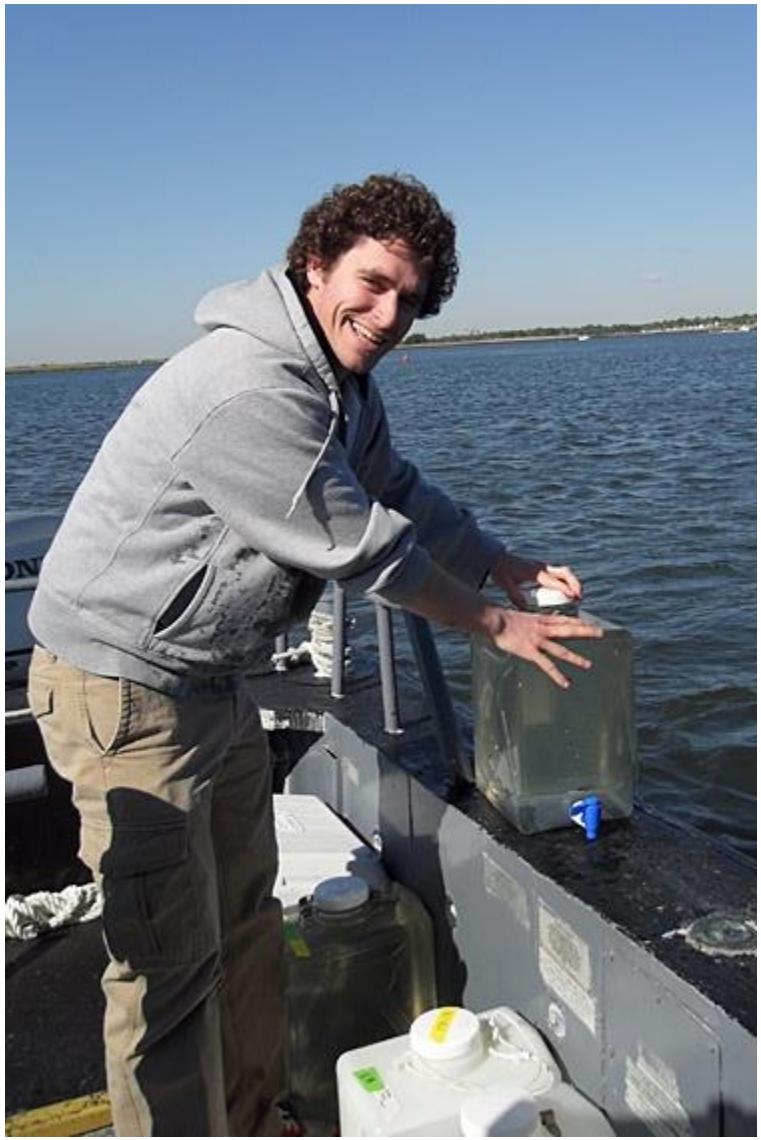
- What can be done to mitigate the occurrence of algal blooms in the Western Bays?

Primary study sites



Time series sampling

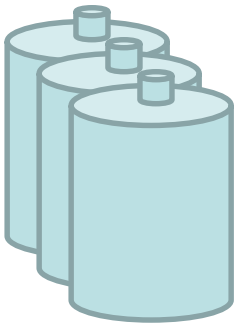
- Weekly to bi-weekly, spring through fall sampling
- Temperature, salinity, dissolved oxygen
- Chlorophyll *a*: whole, 2μm, 20μm
- Nutrients: ammonium, nitrate, phosphate, silicate
- Phytoplankton community composition
- Measurements of photosynthesis and respiration
- Use of $\delta^{15}N$ to identify nitrogen sources.



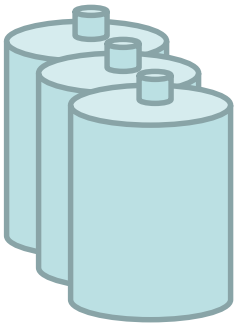
Ryan Wallace collecting water from Bay Park.

Nutrient amendment experiments

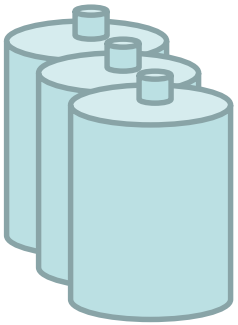
What nutrient regime favors the proliferation of phytoplankton blooms or Ulva? Can we lessen algal blooms by reducing nutrients?



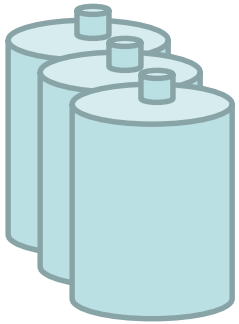
Control



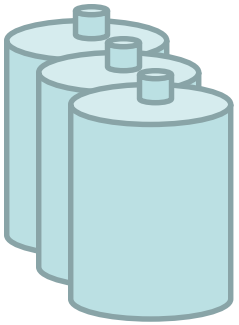
20μM N as ammonium



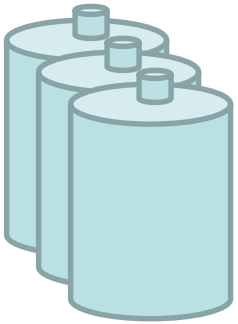
1.25μM phosphate



20μM silicate



50% dilution of nutrients

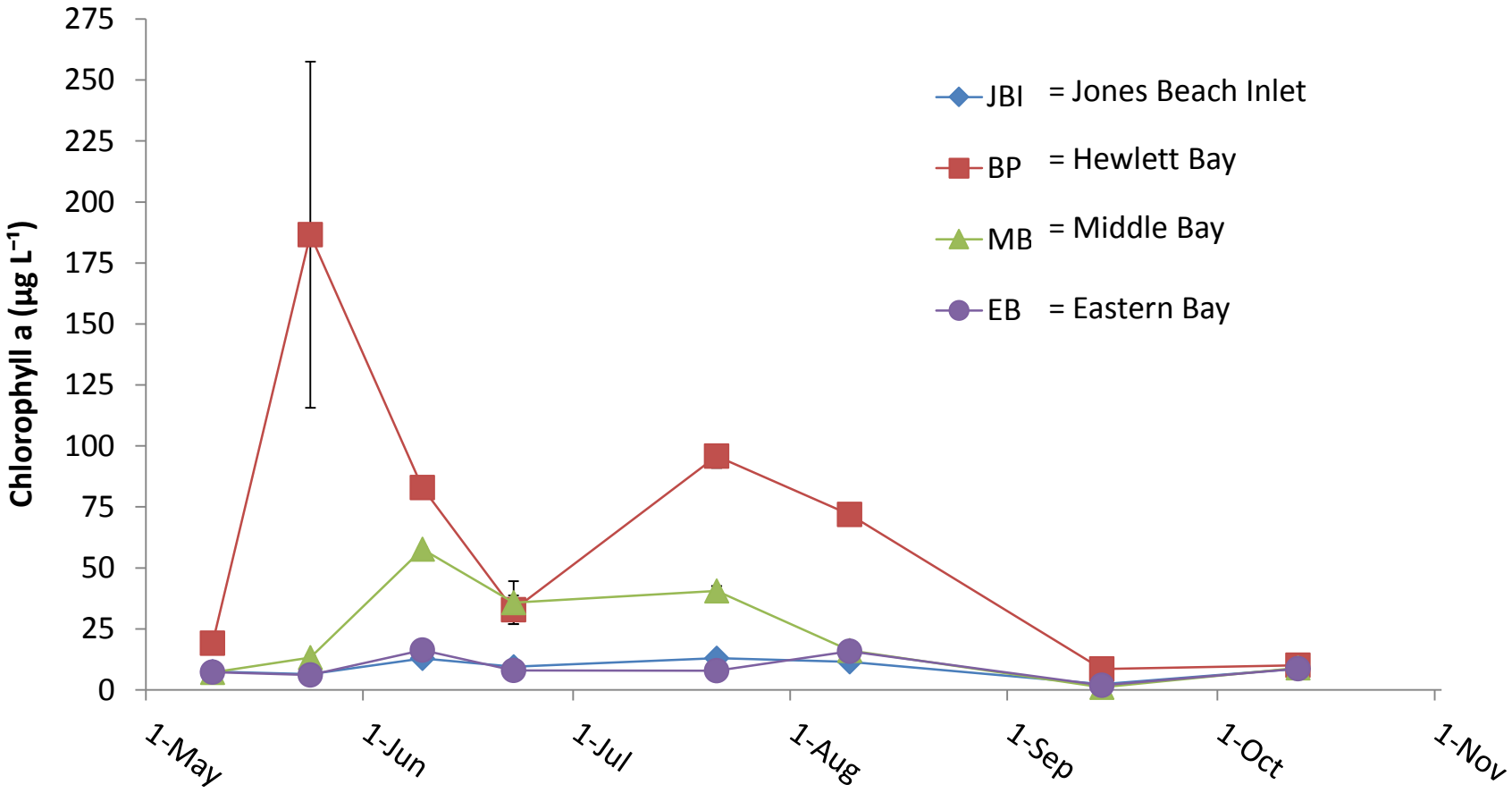


75% dilution of nutrients

- Incubated water at ambient light and temperature
- Analyzed for growth of phytoplankton and *Ulva*

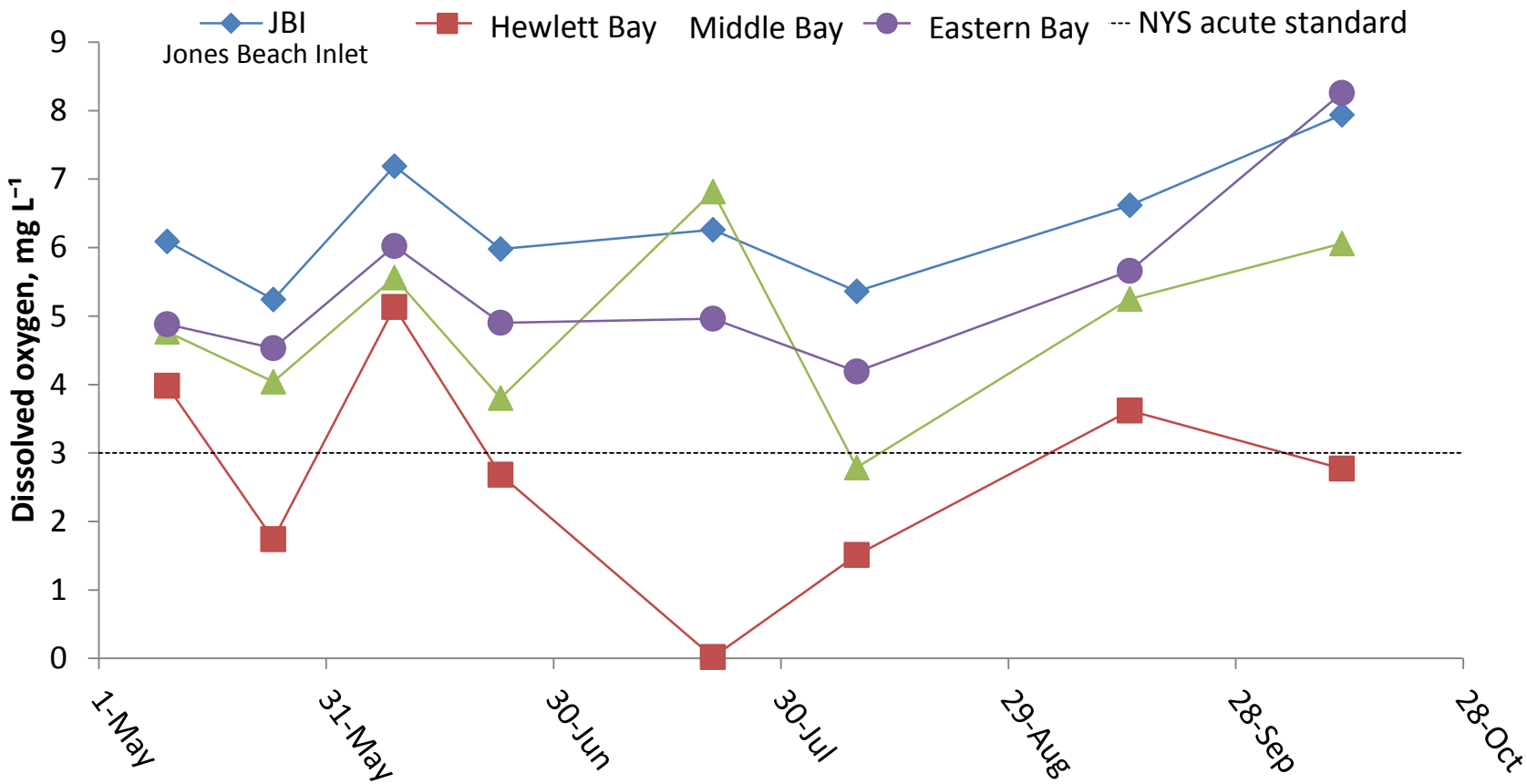
Phytoplankton biomass

Hewlett Bay, and to a lesser extent, Middle Bay experience massive phytoplankton blooms during summer.



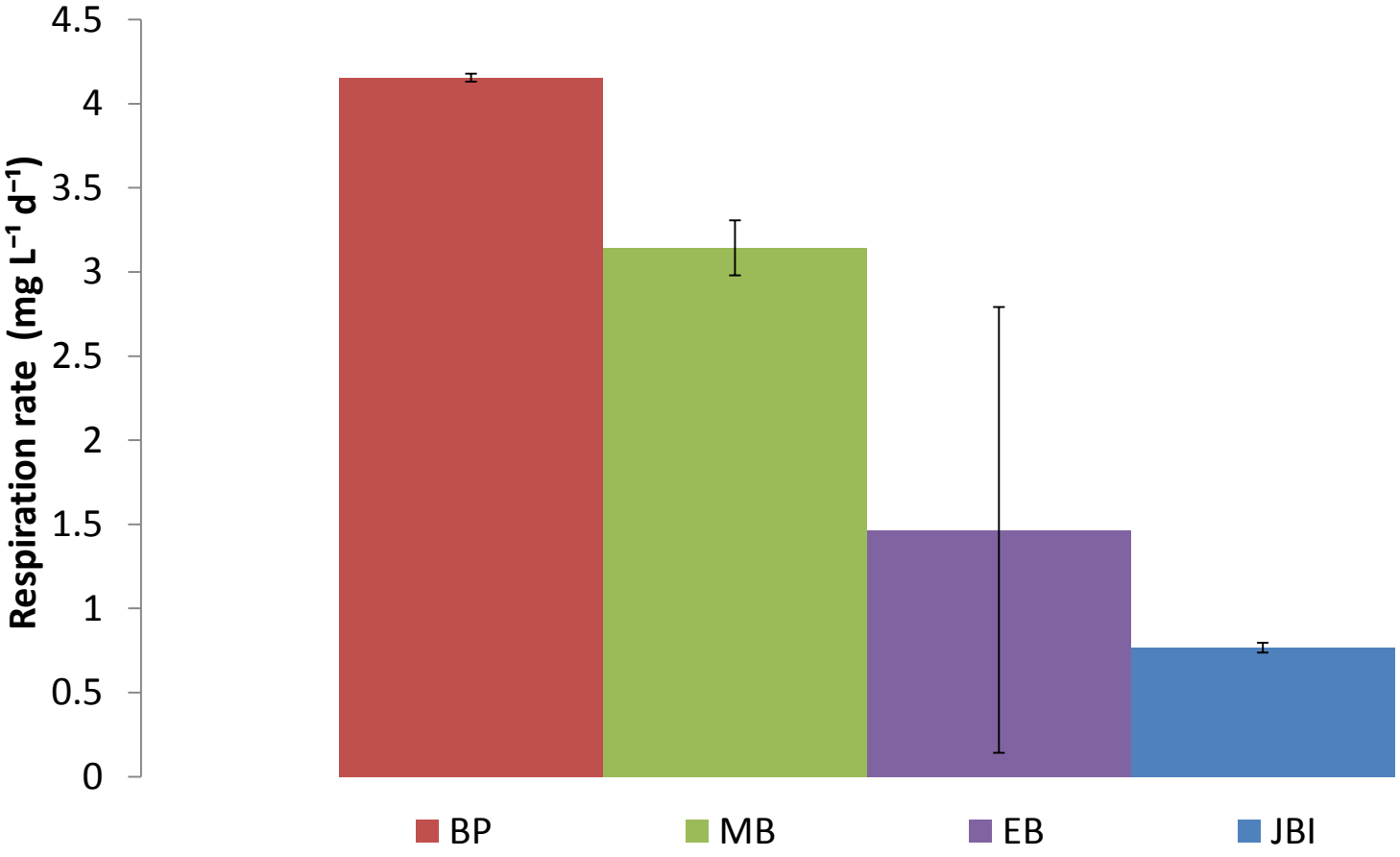
Bottom dissolved oxygen

Hewlett Bay experiences chronic bottom hypoxia during summer



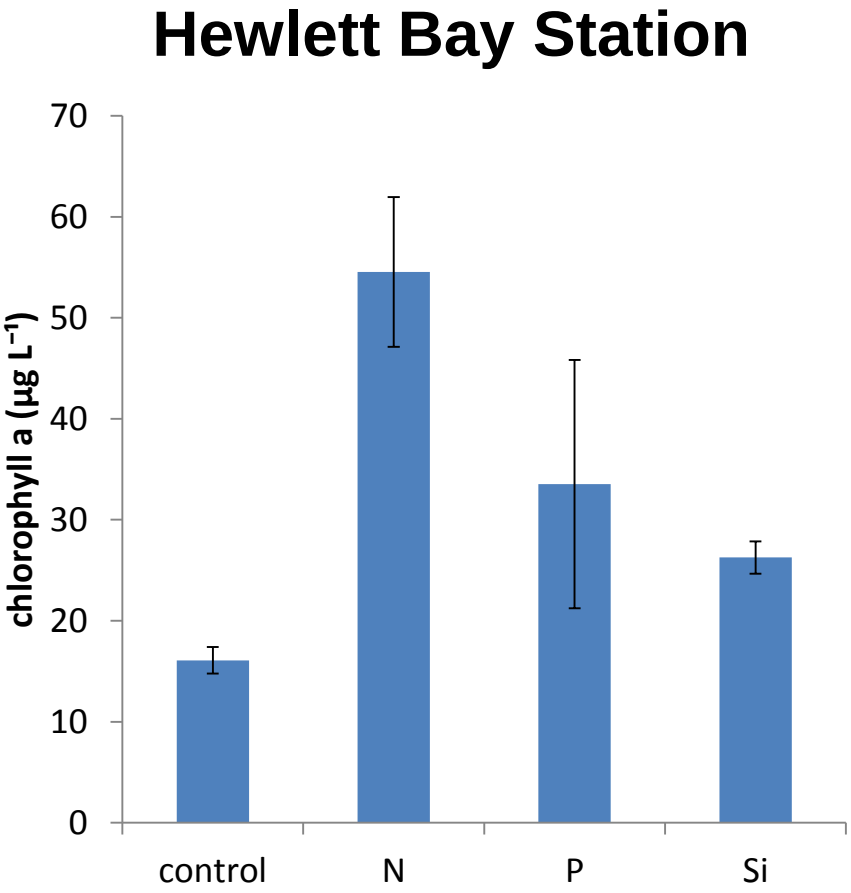
July 2010 respiration rates

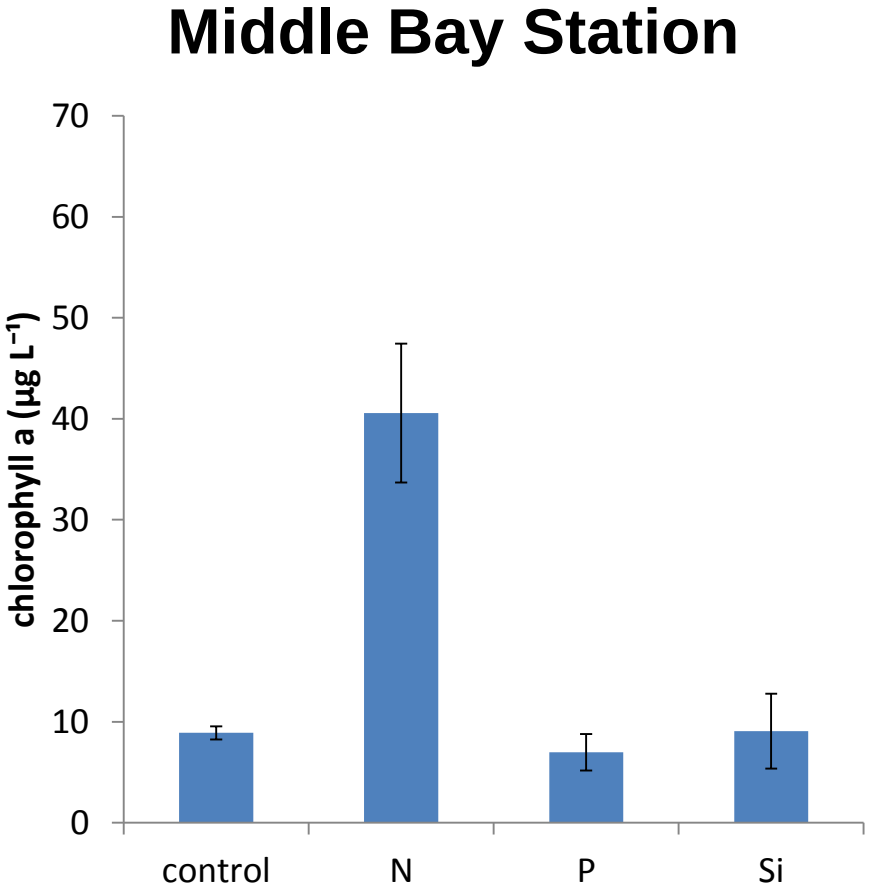
Hypoxia is promoted by rapid rates of microbial respiration in Hewlett Bay.



Nutrient enrichment experiments:

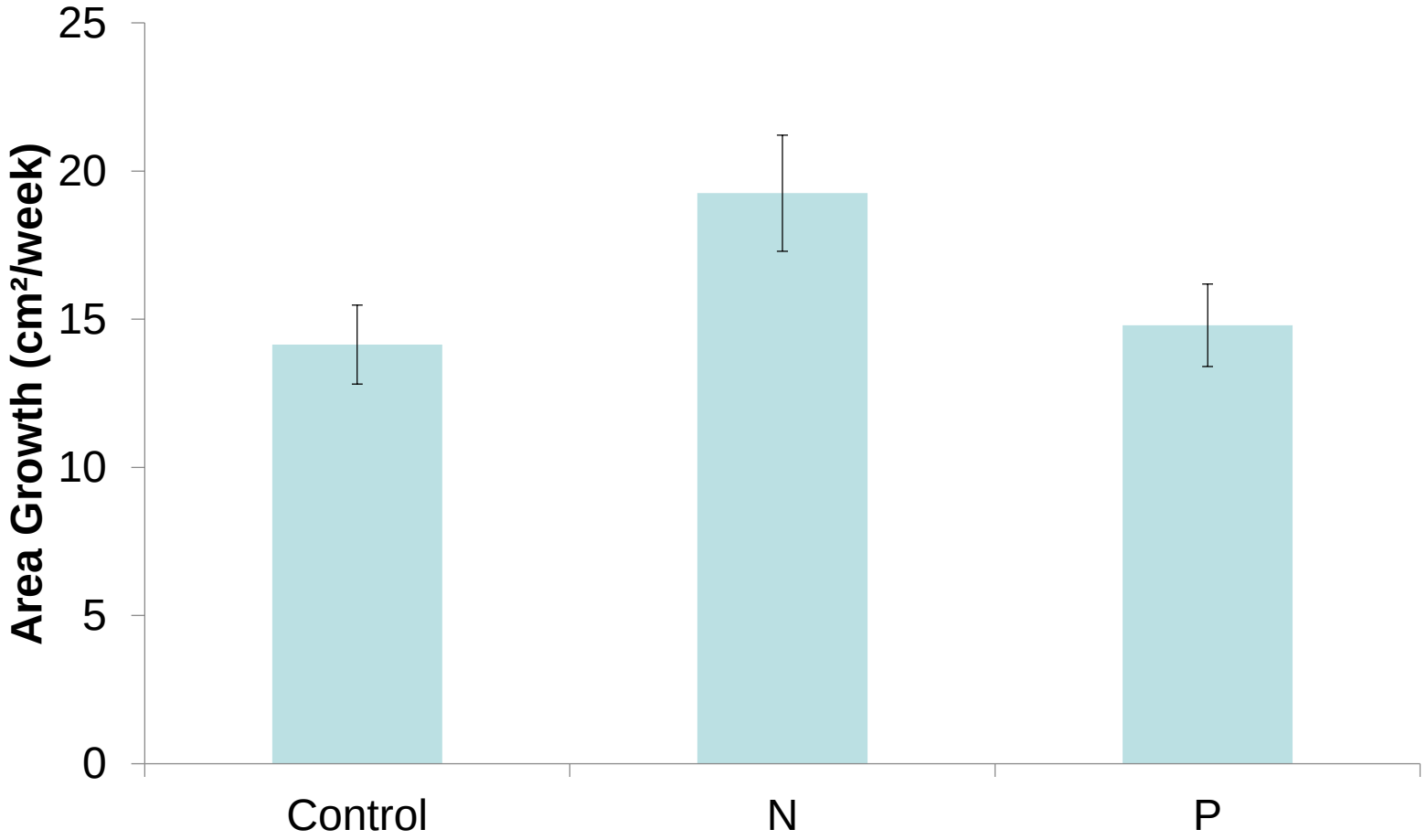
Nitrogen promotes phytoplankton growth





Nutrient enrichment experiments:

Nitrogen promotes Ulva growth

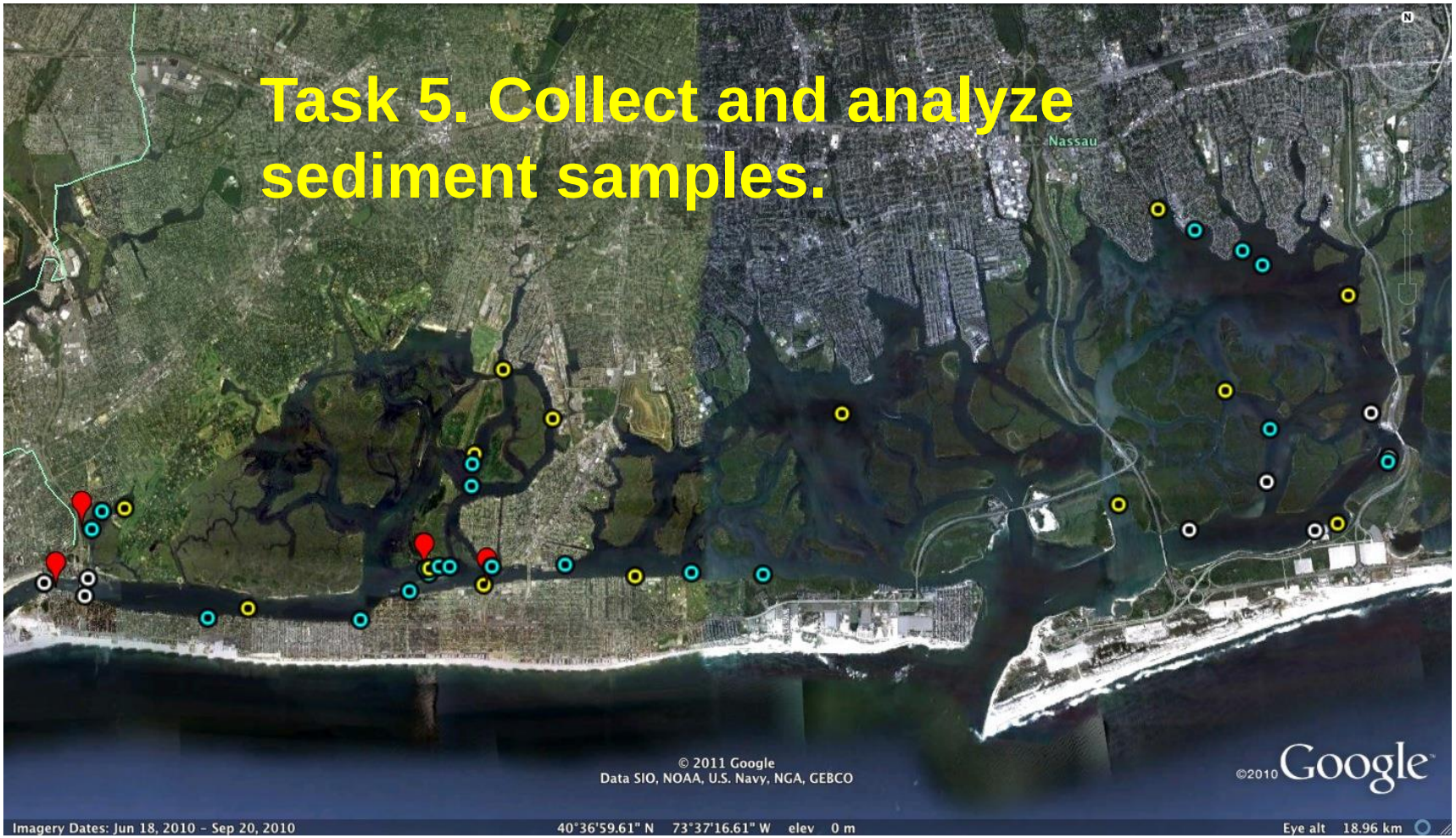


Preliminary thoughts

- **Overgrowth of *Ulva*, phytoplankton exceeding 250 µg L^{-1}, rapid microbial respiration causes hypoxia in Hewlett Bay.**

- **Nutrients (primarily nitrogen) control the growth of primary producers in the Western Bays.**

- **Lessen the discharge of nitrogen; enhance ocean flushing.**



Sample and measure unique sewage tracers (QACs), selected trace metals, and sediment properties.

Red Flags: Sewage Treatment Plant Outfalls (L – R: West Long Beach, Lawrence/Cedarhurst, Bay Park, Long Beach)

Yellow Dots: sampled, have been or are currently being analyzed

Blue Dots: sampled, not yet analyzed

White Dots: sampled but not kept because too sandy

Quaternary Ammonium Compounds - QACs

(unstudied until now in U.S. wastewaters, sludges, biosolids and sediments)

- **Fabric softeners**
- **Cosmetics and hair care – conditioners and emulsifiers**
- **Antimicrobials – preservatives and disinfectants (important part of limited arsenal in sanitation!)**
- **Nano-tech**
- **Phase transfer reagents/catalysts**
- **Oil and gas production**

Total QACs in Hempstead Bay Surface Sediment Samples Analyzed to Date

[QAC] = .5 – 53 μg/g

QAC Measurements in Surface Sediments

Location	Year	Mean (ug/g)	Median (ug/g)
NY/NJ Harbor Complex	1998	34	27
Jamaica Bay	2008	29	35
Hempstead Bay (West of Point Lookout)	**2011**	**32**	**35**

Comparable levels of QAC sewage tracers in areas that are heavily sewage-affected.

Task 6 – Estimate marsh subsidence.

- 1. Sandy Hook sea level rise is greater than the rate at The Battery. Difference is due to consolidation of 1000-foot coastal plain sediment. Difference corresponds to ~1.5 mm/year. Total sea level rise ~4.5 mm/year.

- 2. The withdrawal of groundwater generally leads to subsidence of 1/10 to 1/20 the head loss. For a 15-foot drop in the water table in Nassau over 30 or 40 years, the subsidence could have been ~6 to 15 mm/year.

Change of mean tidal range

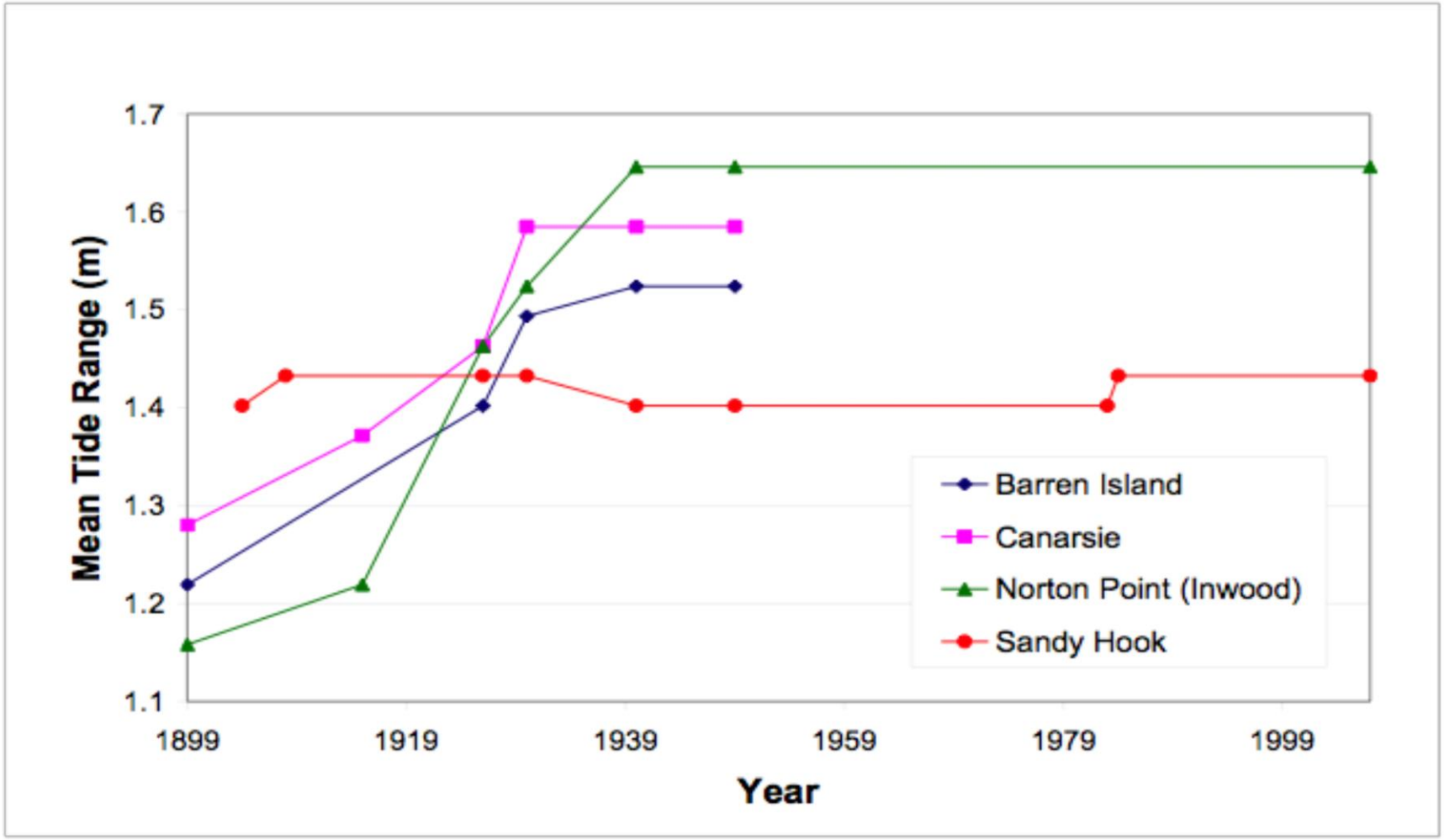


Figure 2. Change in tidal range with time at select locations in Jamaica Bay compared with the Reference Station at Sandy Hook, New Jersey.

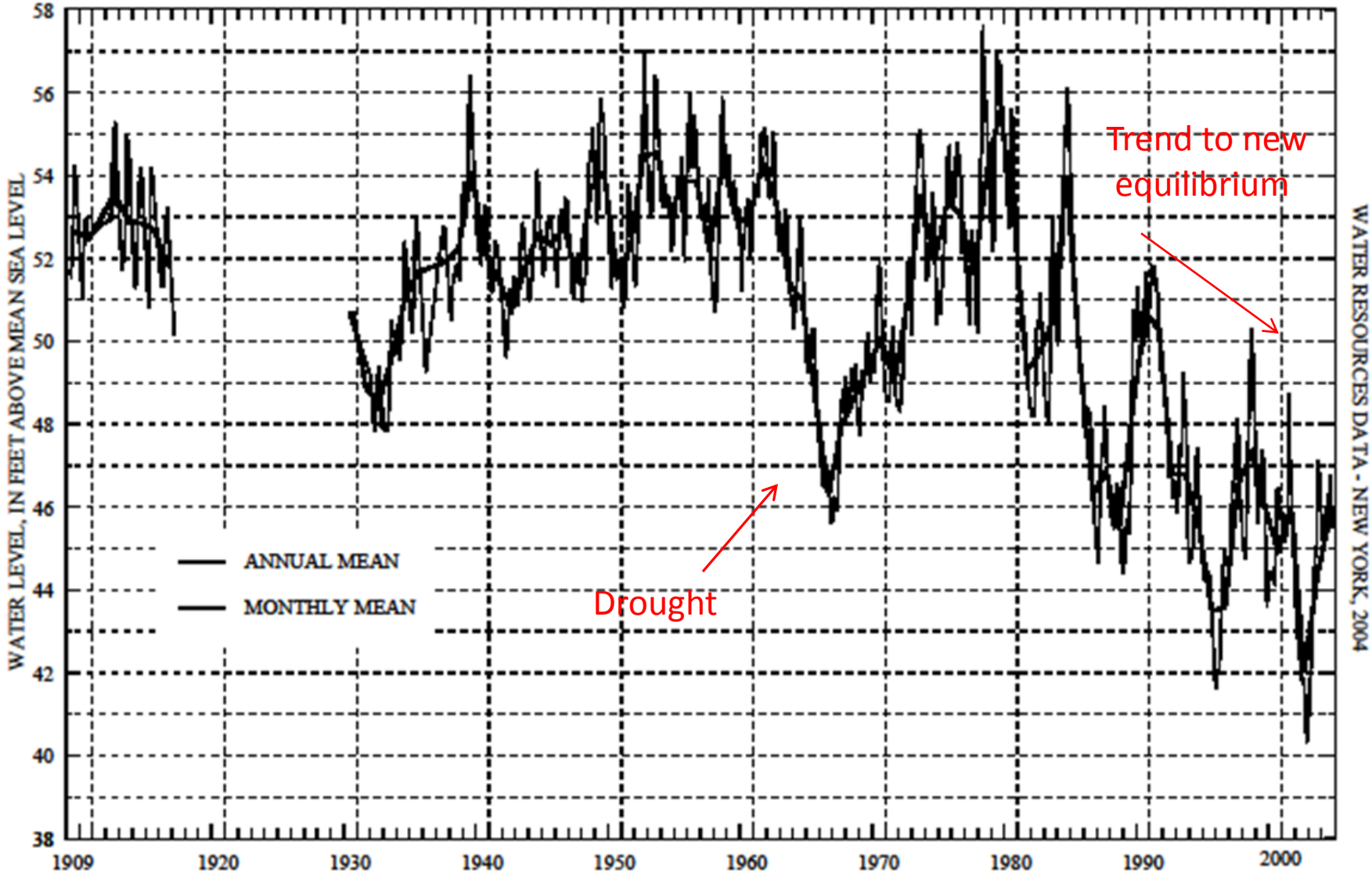


Figure 4.--Hydrograph of water-table observation well N1259 at Plainedge, NY, 1909-2004.

Hydrograph of water table observation well N1259 at Plainedge, NY, 1909-2004.

Apparent increase in marsh flooding over the last 50 to 100 years may be caused by:

- sea level rise
- increased tidal range and
- marsh subsidence