LONG-TERM AMBIENT WATER QUALITY MONITORING OF THE NY/NJ HARBOR

by the New Jersey Harbor Dischargers Group (NJHDG)

Water Quality Indicators

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NJ Water Monitoring Council Meeting

NJDEP Headquarters – Trenton, NJ

Wednesday, January 25, 2012

Who is the New Jersey Harbor Dischargers Group?

New Jersey Harbor Dischargers Group

- 9 Sewerage Agencies, operating 11 Wastewater Treatment Plants discharging to the NY/NJ Harbor Estuary and treating 614 mgd of wastewater
  - Bergen County Utilities Authority
    - now includes Edgewater Municipal Utilities Authority
  - Joint Meeting of Essex and Union Counties
  - Linden Roselle Sewerage Authority
  - Middlesex County Utilities Authority
  - North Bergen Municipal Utilities Authority
  - North Hudson Sewerage Authority
  - Passaic Valley Sewerage Commission
  - Rahway Valley Sewerage Authority
  - Secaucus Municipal Utilities Authority

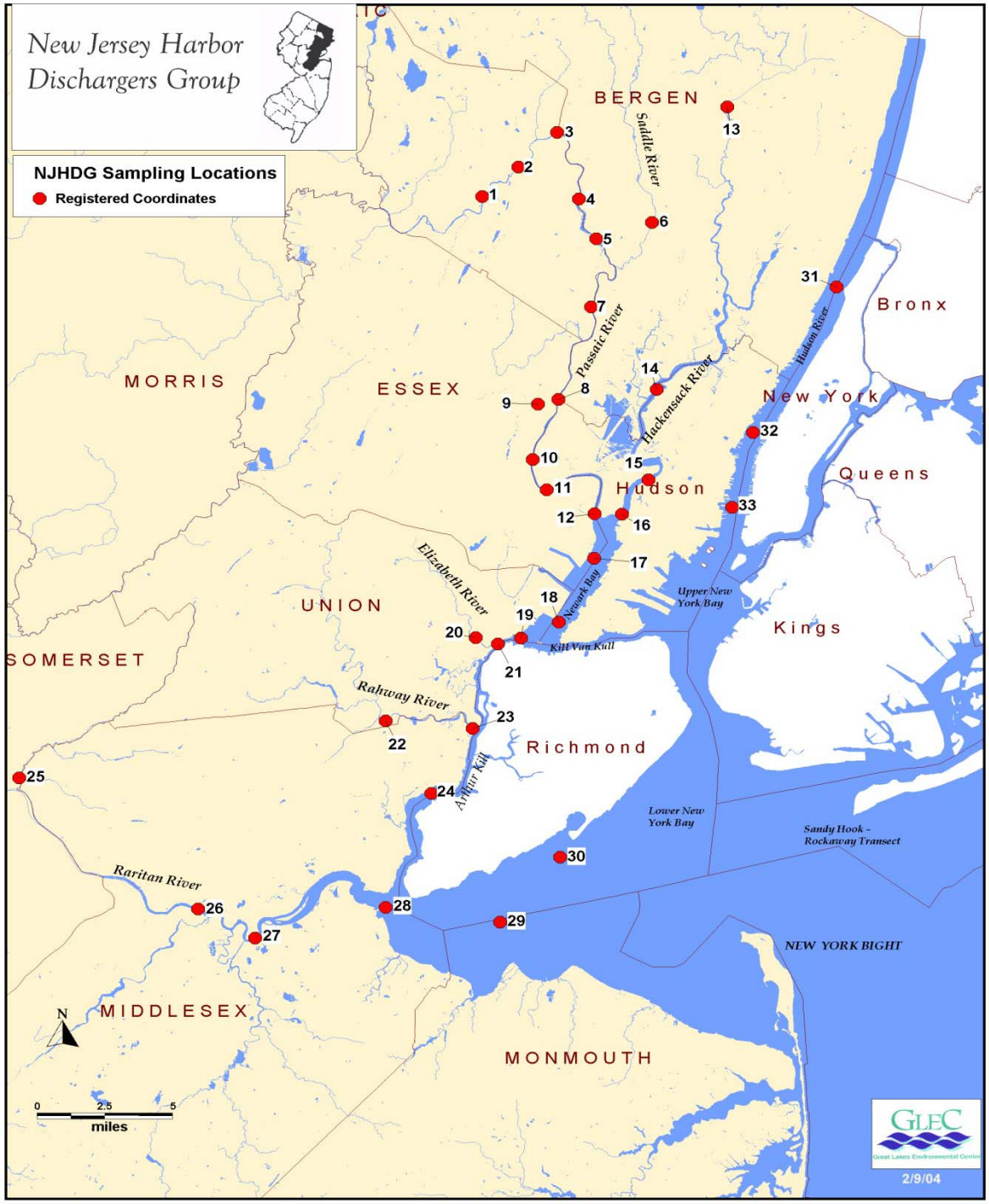
NJHDG Ambient Water Quality Monitoring Program

- Initiated late 2003
- 33 Monitoring Sites throughout NJ portion of NY/NJ Harbor Estuary
- Modeled after NYCDEP Harbor Survey Program
- Completely Volunteer Effort
  - No outside funding
  - Not mandated in any permit

NJHDG Ambient Water Quality Monitoring Program

- Goals:
  - Provide information on ambient water quality for conventional pollutants
  - Document seasonal changes
  - Document improvements resulting from implementation of pollution control programs
  - Validate water quality model results
  - Foster appropriate regulatory decisions based on current water quality measurements
  - Collectively utilize the agencies' resources to best meet water quality objectives for the Harbor

Locations


New Jersey Harbor Dischargers Group
NJHDG Sampling Locations
Registered Coordinates
BERGEN
MORRIS
ESSEX
UNION
SOMERSET
MIDDLESEX
MONMOUTH
Bronx
New York
Queens
Hudson
Kings
Richmond
Saddle River
Passaic River
Hackensack River
Hudson River
Elizabeth River
Newark Bay
Kill Van Kull
Upper New York Bay
Arthur Kill
Rahway River
Raritan River
Lower New York Bay
Sandy Hook - Rockaway Transect
NEW YORK BIGHT
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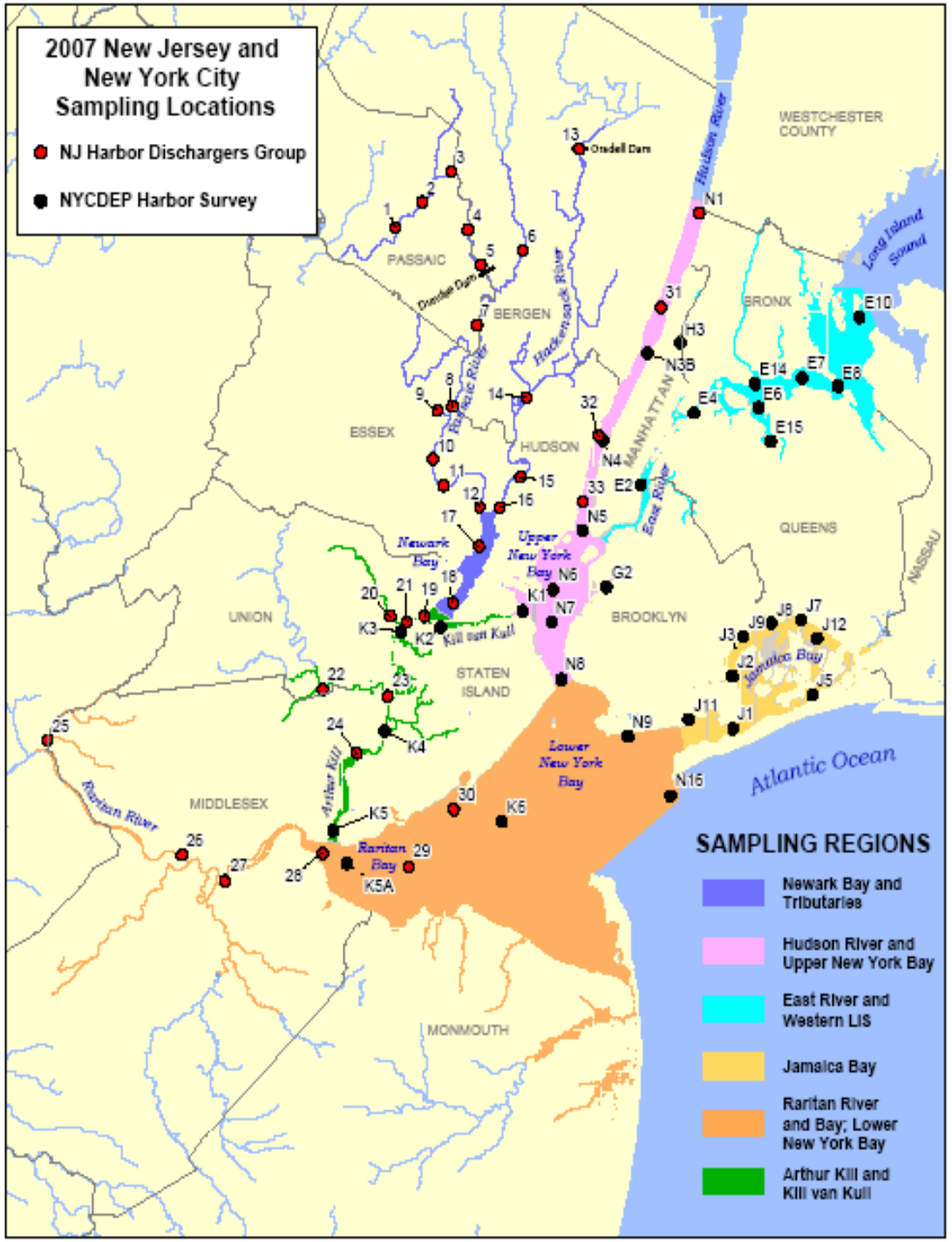
Locations



Red = NJHDG sites

Black = NYCDEP sites

Sampling Fleet

SAMPLING VESSEL

MOBILE LAB →

Sampling Approach

- Grab samples taken at each location
- Sample for all parameters at each site
  - Exception: E.coli only in freshwaters
- Shallow sites (bridge sites) are sampled mid-depth at mid-river
- Remaining deep water sites (boat sites) are sampled at 1 meter below surface and 1 meter above substrate
  - Depth > 15 feet

Sampling Frequency

- Summer
  - May – September
  - Weekly
- Winter
  - October – April
  - Monthly
  - Weather Permitting
- Tributary sites monitored twice/month in summer & once/month in winter

NJHDG Cooperating Laboratories

- Passaic Valley Sewerage Commission
- Middlesex County Utilities Authority
- Bergen County Utilities Authority

Parameters Measured

- Temperature
- pH
- Salinity
- Dissolved Oxygen (DO)
- Secchi Depth *(boat sites only)*
- Fecal coliform Bacteria
- Enterococcus Bacteria *(2007)*
- E.coli Bacteria *(2011 – FW only)*
- Chlorophyll-a *(2007)*
- Total Suspended Solids (TSS)
- Total Kjeldahl Nitrogen (TKN)
- Ammonia-Nitrogen (NH_3-N)
- Nitrate-Nitrogen (NO_3-N)
- Nitrite-Nitrogen (NO_2-N)
- Total Phosphorus (TP)
- Orthophosphate (OP)
- 5-day Carbonaceous Biochemical Oxygen Demand (CBOD-5)
- Dissolved Organic Carbon (DOC)

In-Situ Measurements

- Temperature
- pH
- Salinity
- Dissolved Oxygen (DO)
  - YSI 556 Multiparameter handheld meter

- Secchi Depth
  - Measure of water clarity or transparency
  - Secchi Disk
    - Boat Sites only

Pathogen Indicators - Bacteria

- Fecal coliform bacteria
  - All NJHDG Sites
- Enterococcus bacteria
  - All NJHDG Sites
- E.coli bacteria
  - Only Freshwater NJHDG Sites

Nutrients – Nitrogen

- Ammonia-Nitrogen (NH_3-N)
  - Rapidly oxidized by bacteria to NO_2 & NO_3 in the presence of DO
  - Source of nitrogen – essential nutrient for growth of aquatic plants and animals
  - NH_3 toxic to fish – blocks O_2 transfer to gills
- Total Kjeldahl Nitrogen (TKN)
  - TKN = Organic Nitrogen + NH_3-N
  - Total Nitrogen (TN) = TKN + NO_2-N + NO_3-N
  - Attributed to decay of organic matter

Nutrients – Nitrogen

- Nitrite-Nitrogen (NO_2-N)
  - $NH_3 \rightarrow NO_2 \rightarrow NO_3$ (Nitrification)
  - $NH_3 \leftarrow NO_2 \leftarrow NO_3$ (Nitrogen Reduction)
  - Levels of NO_2-N above 0.55 mg/L can cause nitrite poisoning in fish ("brown-blood" disease)
    - Increased methemoglobin causes blood to turn brown & makes blood unable to carry O_2 – fish suffocate

- Nitrate-Nitrogen (NO_3-N)
  - Not particularly toxic to fish
  - Essential nutrient for growth of aquatic plants and animals
  - Too much – increased algae growth, depletion of DO
    → Eutrophication

Nutrients - Phosphorus

- Total Phosphorus (TP)
  - Total of 3 forms of phosphates: orthophosphate, metaphosphate (or polyphosphate), and organic phosphate
  - Essential nutrient for growth of aquatic plants and animals
  - Too much – increased algae growth, depletion of DO
    → Eutrophication
- Orthophosphate (OP)
  - Formed by natural processes – Phosphorus cycle
  - Meta/Polyphosphate converted to Orthophosphate in water
  - "Reactive" phosphorus – Most readily available to aquatic plants and animals

Organic Matter

- 5-day Carbonaceous Biochemical Oxygen Demand (CBOD-5)
  - Amount of O_2 consumed by microorganisms during decomposition of organic matter
  - Microorganisms use O_2 to breakdown organic molecules (cellulose, sugars, etc) into $CO_2 + H_2O$
- Dissolved Organic Carbon (DOC)
  - Organic material dissolved in water – from decomposition of plant and animal material
  - Food source for microorganisms – indicator of organic loadings
  - Forms strong complexes with metals – decreases bioavailability to phytoplankton
  - Can cause toxic disinfection byproducts when chlorinated

Solids / Chlorophyll

- Total Suspended Solids (TSS)
  - Organic and mineral particles suspended in the water column
  - Reduces light penetration → lower photosynthesis rate → lower DO concentrations
  - Pollutants can bind to small silt particles – move to other areas by sediment transport

- Chlorophyll-a
  - Most abundant form of chlorophyll within photosynthetic organisms (algae & phytoplankton)
  - Indirect measure of nutrients – excess nutrients (N & P) lead to overgrowth of algae and depletion of DO

    → Eutrophication

Data Shared w/ NJDEP

- NJHDG water quality monitoring program fills data gap in NY/NJ Harbor – monitors NJ waters not currently monitored by any other agency
- All NJHDG data entered into NJDEP's Water Quality Data Exchange (WQDE) system – publically available
- NJHDG data used by NJDEP Bureau of Water Quality Standards and Assessment to determine attainment of designated uses based on compliance with SWQS

Regional Water Quality Reports

- Focus on Pathogen Indicators and Dissolved Oxygen (DO)
- Joint Publications with NYCDEP – through NY-NJ Harbor Estuary Program (HEP)

  www.harborestuary.org
- Biennial NJHDG Water Quality Reports

  www.pvsc.com

New York – New Jersey Harbor Estuary Program

New Jersey Harbor Dischargers Group

Surface Water Classifications for NJHDG Monitoring Locations

- NJHDG monitoring locations are under various NJ Surface Water Classifications
  - **FW2-NT:** Sites 1-9 (Passaic R. and Tribs)
    Site 25 (Raritan R. Head-of-Tide)
  - **SE1:** Site 13 (Hackensack R. Head-of-Tide)
    Sites 26-27 (Raritan R.)
  - **SE2:** Sites 14-15 (Hackensack R.)
    Sites 31-33 (Hudson R.)
  - **SE3:** Sites 10-12 (Passaic R.)
    Sites 16-18 (Hackensack R. / Newark Bay)
    Sites 19-24 (Arthur Kill & Tribs)
  - **Shellfish Waters (SE1):** Sites 28-30 (Raritan Bay)

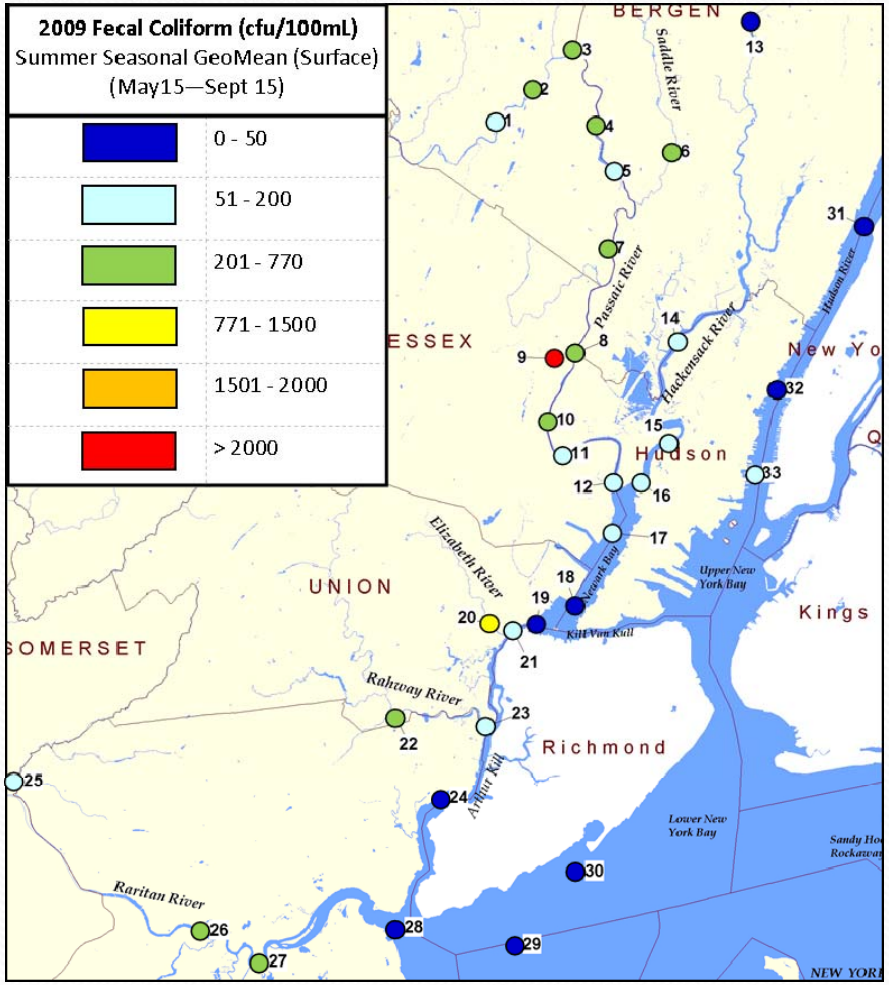
NJ Surface Water Quality Standards (SWQS)

Class	Bacteria		DO
FW2-NT *Sites 1-9, 25*	E.coli	Geometric Mean[1] ≤126 cfu/100mL Never >235 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L
SE1 *Sites 13, 26-27*	Enterococcus	Geometric Mean[1] ≤35 cfu/100mL Never >104 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L
SE2 *Sites 14-15, 31-33*	Fecal Coliform	Geometric Mean[1] ≤770 cfu/100mL	Never <4.0 mg/L
SE3 *Sites 10-12, 16-24*	Fecal Coliform	Geometric Mean[1] ≤1500 cfu/100mL	Never <3.0 mg/L
Shellfish Waters (SE1) *Sites 28-30*	Fecal Coliform[2] Enterococcus	Geometric Mean[1] ≤14 cfu/100mL 90%[3] ≤49 cfu/100mL Geometric Mean[1] ≤35 cfu/100mL Never >104 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L

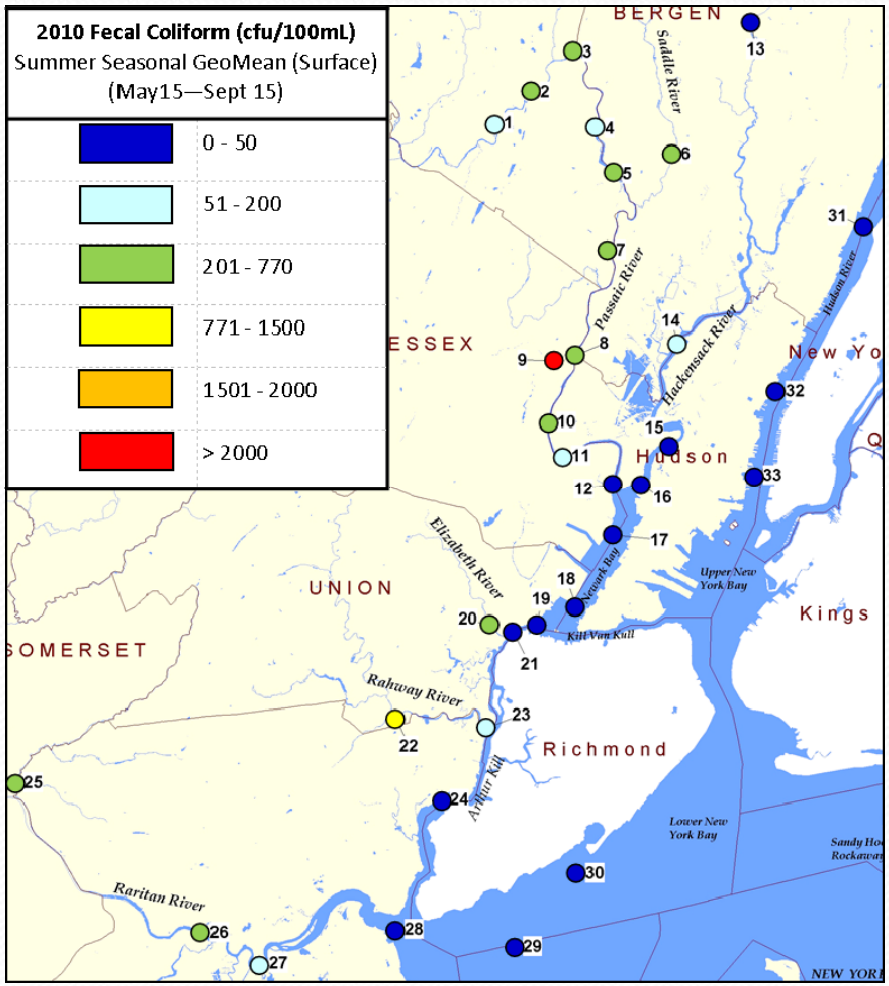
[1] Based on Geometric Mean of a minimum of 5 samples in 30 days
[2] Based on National Shellfish Sanitation Program standards for shellfish waters, direct harvest
[3] Based on total number of samples taken in a 30-day period

2009-2010 Fecal Coliform

2009

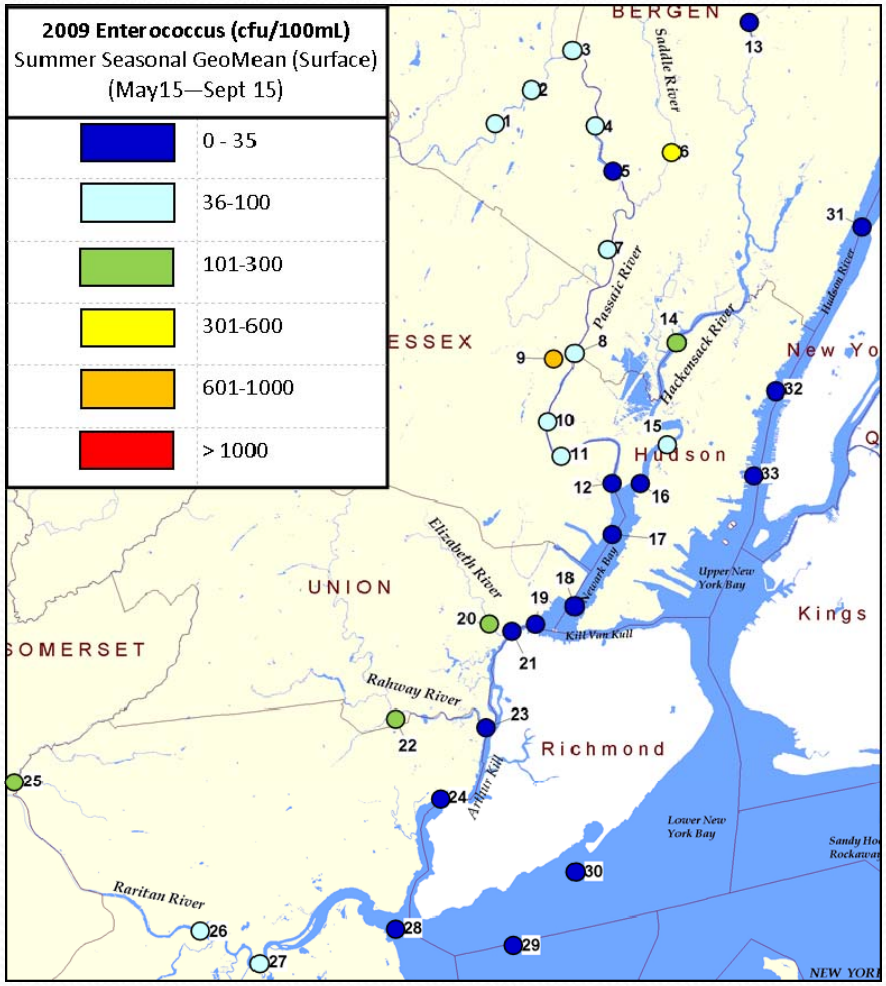


2010

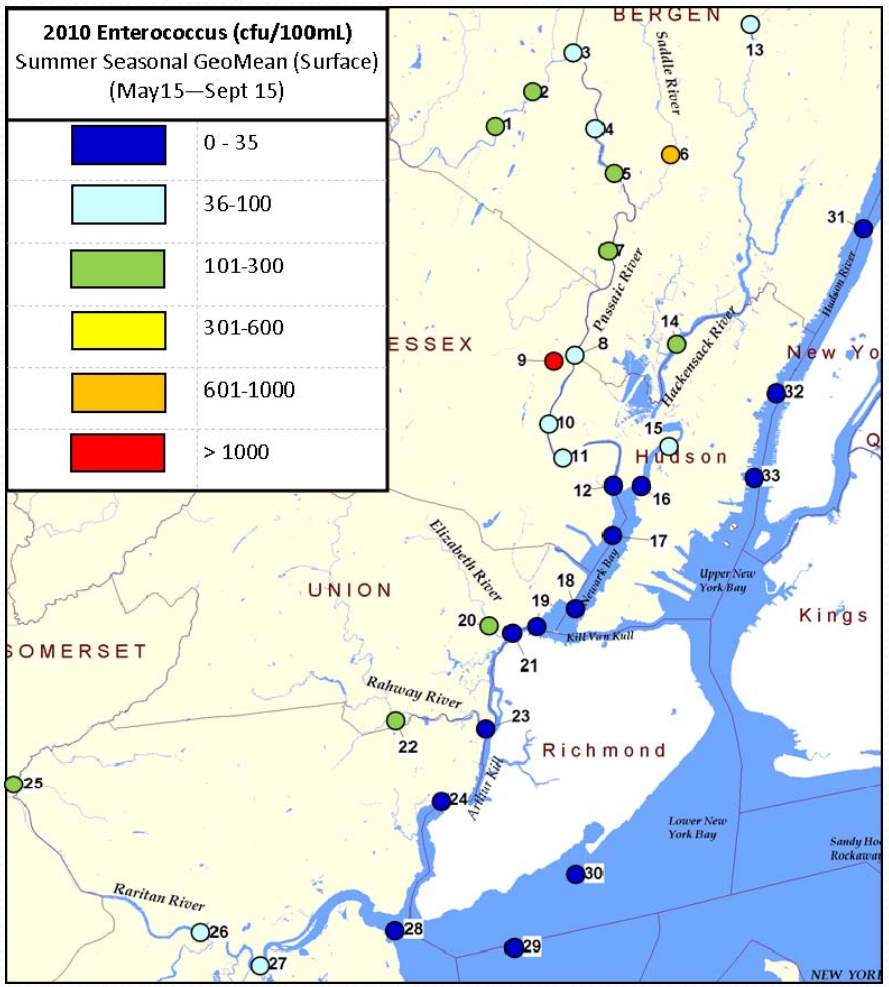


2009-2010 Enterococcus

2009

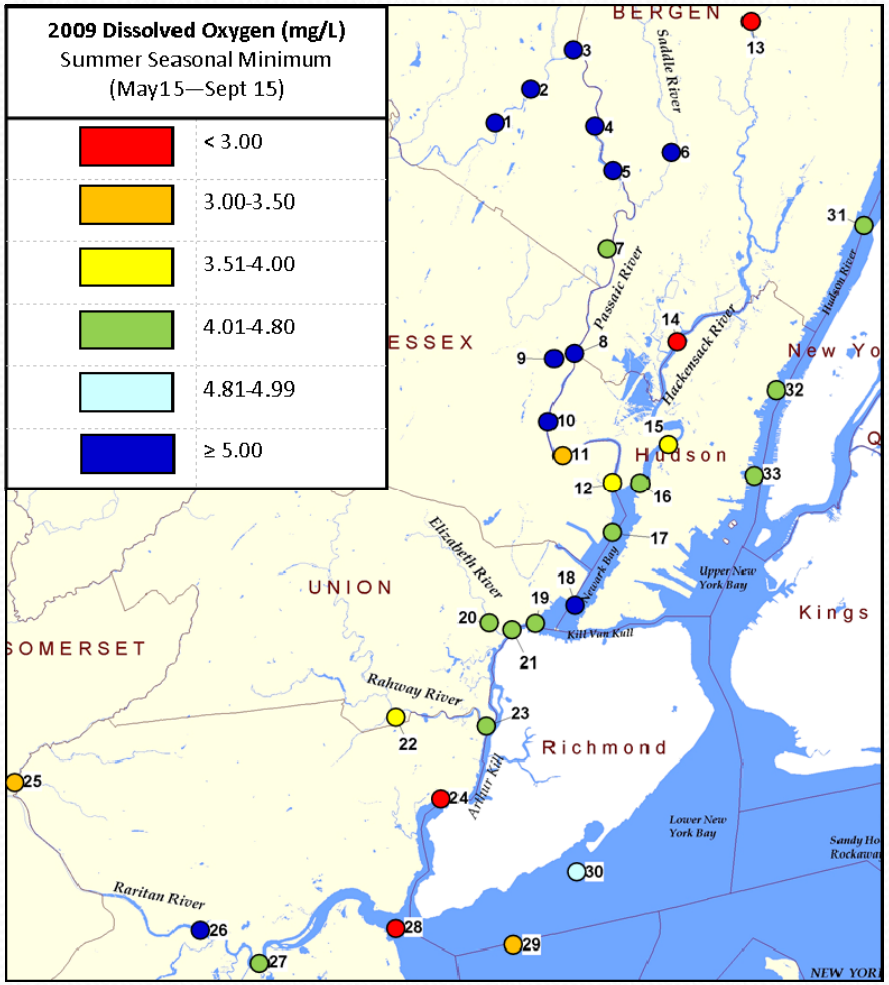


2010

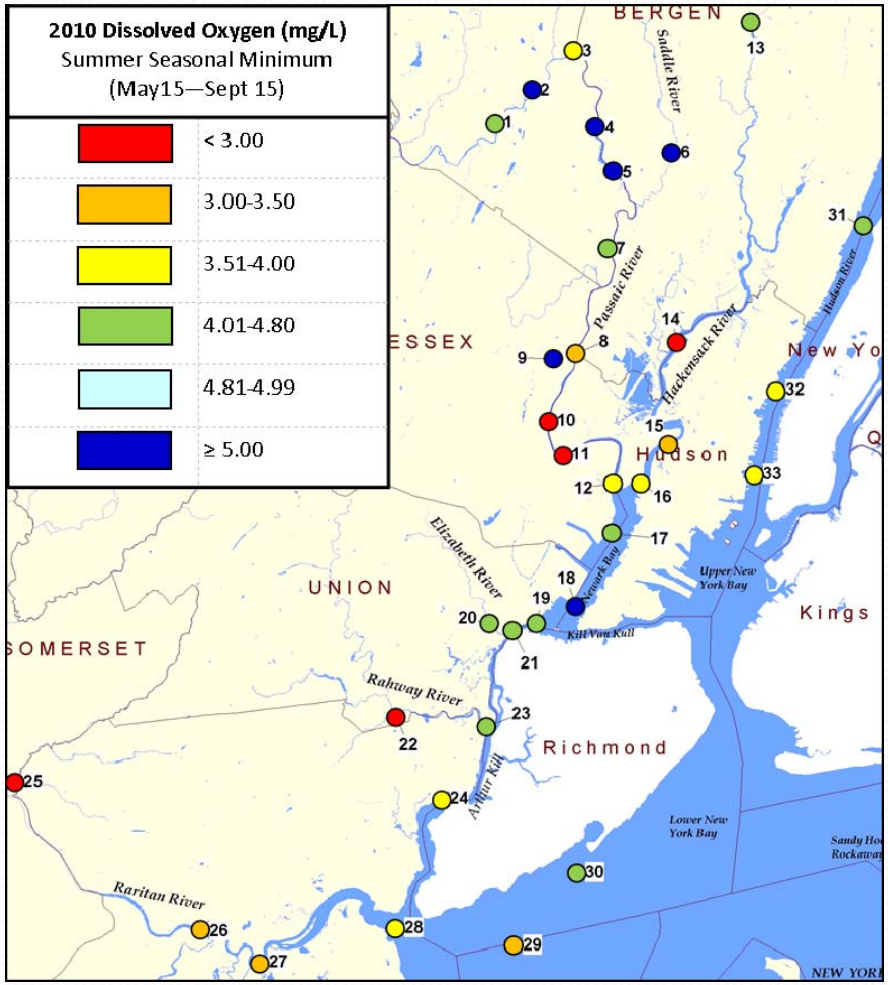


2009-2010 Dissolved Oxygen

2009



2010



Questions…

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