



NJ Department of Environmental Protection
Water Monitoring and Standards

NJ WATER QUALITY MONITORING NETWORKS 2008



State of New Jersey

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May 2008



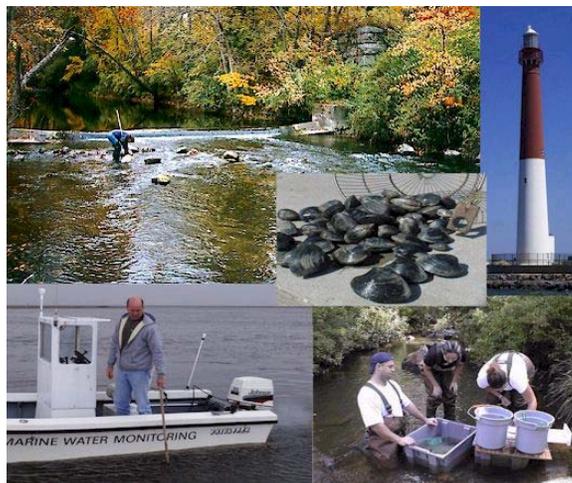
WATER QUALITY MONITORING NETWORKS 2008

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Introduction

Water Monitoring and Standards (WM&S) is the program, in the NJ Department of Environmental Protection (NJDEP), which is responsible for ambient monitoring of the state's fresh, ground and marine waters. This monitoring is performed in accordance with the objectives of the Federal Clean Water Act which are to "restore and maintain the chemical, physical and biological integrity of the Nation's waters". In order to accomplish this, states are expected to develop, adopt and maintain water quality standards which are used in assessments of the quality of the state's waters. These standards and assessments must be based on sound, up-to-date scientific information, including monitoring data. WM&S oversees the operation of the primary water quality monitoring networks for the State of New Jersey.

The mission of WM&S is the continued development and implementation of appropriate water monitoring programs using innovative approaches for the design, collection, measurement, storage, retrieval, assessment and dissemination of water quality data. The information generated from these water quality monitoring networks is used for multiple purposes including:

- ◆ evaluating water quality status and trends
- ◆ classifying waters, including shellfish water quality
- ◆ opening and closing ocean & bay bathing beaches
- ◆ assessing and ranking chemical and biological waterbody impairments
- ◆ development of Total Maximum Daily Loads (TMDLs)
- ◆ informing water quality-sensitive land use
- ◆ identifying pollution sources (both point and non-point) and relative impacts
- ◆ designing and implementing watershed management initiatives
- ◆ determining the effectiveness of pollution control programs
- ◆ responding to environmental emergencies and spills

Monitoring strategies employed by WM&S are comprised of multiple water quality assessment techniques including: habitat assessments, in-stream biological monitoring such as fish population surveys, collection of physical/chemical data on a variety of matrices (surface water, ground water, sediment), identifying pollution sources in the coastal and freshwater environment (discharges, stormwater, marinas), and sediment toxicity testing.

WM&S locates all monitoring stations via the Global Positioning System (GPS), with all locational information being downloaded into NJDEP's Geographic Information System (GIS). All physical/chemical and biological monitoring data collected are stored in the US Environmental Protection Agency's STORET water quality database or the U.S. Geological Survey's NWIS database

The following pages contain information on each of the networks that are maintained by WM&S. Included for each network is a brief description of the network (including, for appropriate networks, the parameters monitored), a map of the sampling site locations, as well as references

for the locations of the monitoring results. Additionally, at the end of the report, information is included regarding additional specialized WM&S monitoring capabilities.

FRESHWATER & BIOLOGICAL MONITORING



Ambient Biological Monitoring Network (AMNET)

In 1992, a network of over 800 stream sites was initiated in New Jersey to provide long-term biological data reflecting the quality of surface waters throughout the State. Designed and conducted by the Bureau of Freshwater and Biological Monitoring, the Ambient Biomonitoring Network (AMNET) program routinely samples and analyzes aquatic macroinvertebrate populations at each site, employing USEPA-developed Rapid Bioassessment (RBP) methods to provide an index of stream water and habitat quality.

Biomonitoring programs, including both ambient and intensive surveys, were initiated by the NJDEP because the micro and macro flora and fauna of various trophic levels can integrate the effects of water quality changes over time, thus making them efficient pollution indicators. Macroinvertebrates, largely benthic (bottom-dwelling) organisms, provide a primary, cost-effective biomonitoring tool. These organisms are ubiquitous in distribution, more stationary than fish but less transient than algae and other microscopic communities, and they are easily collected and quantified.

Establishment of the AMNET system in 1992 was facilitated by USEPA's introduction of the RBP protocols; protocols which decreased the per station level of effort so that biological surveys with large number of sites could be completed with less resources. Sites in each Water Region (Upper Delaware, Northeast, Raritan, Atlantic, and Lower Delaware) are sampled on a five-year rotational basis to allow time for recovery from possible transient environmental impacts, and to establish trends in water and habitat quality. As of March 2008, all of the network stations have been sampled three times.

Historically, the New Jersey Impairment Score (NJIS), based on family level taxonomy, was used for the entire state to make assessments at three levels of impairment; non-impaired, moderately impaired, and severely impaired. New indices were developed, based on genus level taxonomy and grouped into three distinct geographical regions: high gradient (above the Fall Line), low gradient (Coastal Plain excluding the Pinelands), and Pinelands (the boundary of the Pinelands National Reserve plus a 5-km buffer). These new indices are called High Gradient Macroinvertebrate Index (HGMI), Coastal Plain Macroinvertebrate Index (CPMI), and the Pinelands Macroinvertebrate Index (PMI). These new indices replace the NJIS and offer a greater level of resolution using four levels of assessment; excellent, good, fair, and poor.

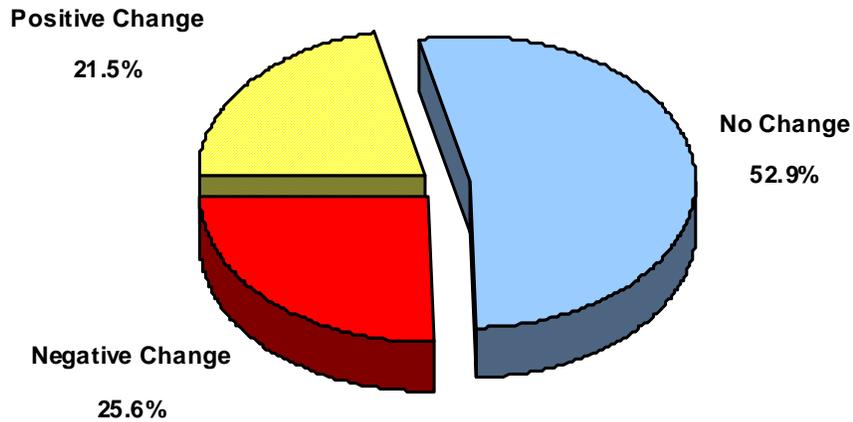
The data generated by AMNET contribute substantially to NJDEP's preparation of the Integrated Water Quality Monitoring and Assessment Report (305b water quality report and 303d impaired waterbodies list). The information is also key in selecting additional waterbodies appropriate for increased Category 1 (C1) antidegradation protections, based on a determination of exceptional ecological significance.

A summary of results from the most recently completed round of AMNET sampling is shown below. Detailed results may be found on the Bureau of Freshwater & Biological Monitoring's webpage: www.state.nj.us/dep/wms/bfm/publications.html

AMNET Round 3 Statewide Data Summary

Year	Water region	Excellent	Good	Fair	Poor	Total # sites
2002-2003	Upper Delaware	33 (23.2%)	49 (34.5%)	41 (28.9%)	19 (13.4%)	142
2003-2004	Northeast	9 (8.7%)	12 (11.7%)	55 (53.4%)	27 (26.2%)	103
2004	Raritan	28 (17.5%)	39 (24.4%)	63 (39.4%)	30 (18.8%)	160
2004-2006	Atlantic Coastal	74 (35.2%)	40 (19.1%)	76 (36.2%)	20 (9.5%)	210
2006-2007	Lower Delaware	14 (7.1%)	42 (21.4%)	90 (45.9%)	50 (25.5%)	196
Totals:		158 (19.5%)	182 (22.4%)	325 (40.1%)	146 (18.0%)	811

Percent Change in Rating Between Round 2 and Round 3 sampling



New Jersey's Ambient Biomonitoring Network 2008

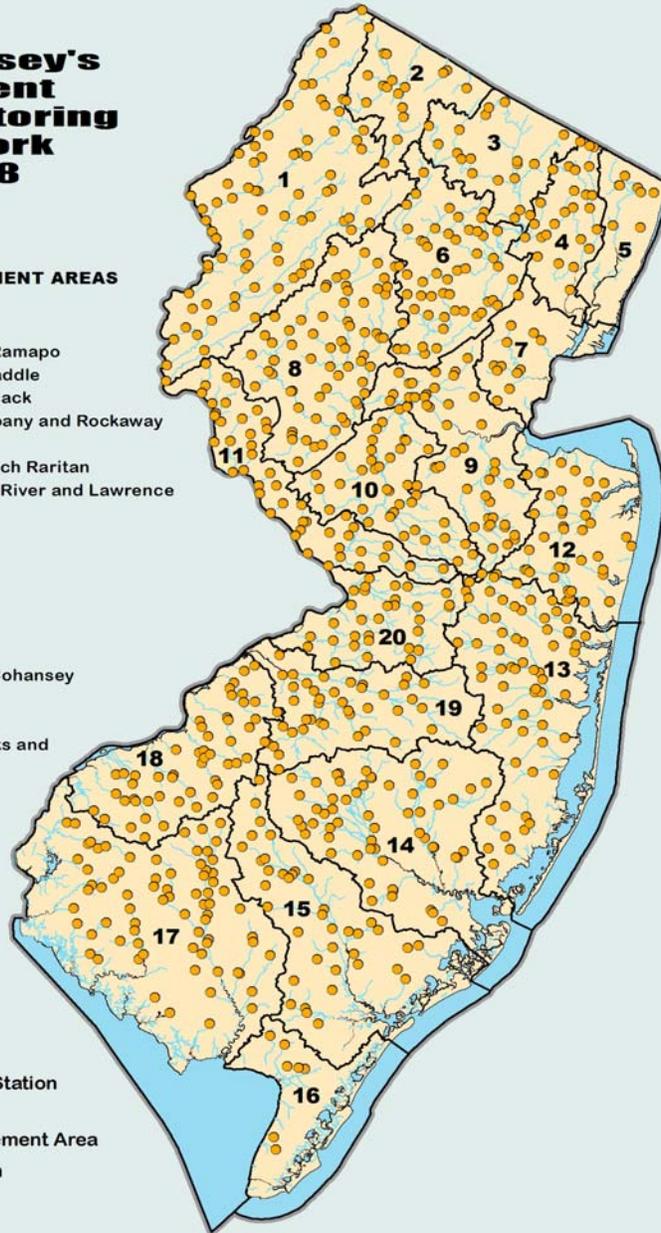
WATERSHED MANAGEMENT AREAS

1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors

● AMNET Sampling Station

⊞ Watershed Management Area

~ Major River/Stream



Fish Index of Biotic Integrity (IBI)

The Bureau of Freshwater and Biological Monitoring began implementing a Fish Index of Biotic Integrity (IBI) sampling program in 2000. The objective is to assess stream quality using the IBI. The IBI evaluates environmental conditions based on assessments of fish populations.

Once fish from sample collections have been identified, counted, examined for disease and anomalies, and recorded, several biometrics are applied to evaluate biotic integrity. Fish community analysis is accomplished using a regional modification of the original IBI (Karr *et. al.* 1986)¹ along with metric refinements completed by Bureau staff in 2005. The modified IBI uses the following ten biometrics: 1) total number of fish species, 2) number and identity of benthic insectivorous species, 3) number and identity of trout and/or sunfish species, 4) number and identity of intolerant species, 5) proportion of tolerant species, 6) proportion of individuals as generalists, 7) proportion of individuals as insectivorous cyprinids, 8) proportion of individuals as trout or proportion of individuals as piscivores (excluding American eel), 9) number of individuals in the sample and , 10) proportion of individuals with disease or anomalies. Water Monitoring & Standards is collecting samples in the northern part of the State, north of the fall line for this ongoing monitoring program. The Division of Fish and Wildlife has completed a pilot study in the southern portion of the state in an effort to develop an IBI protocol for these waters of the state. The Bureau of Freshwater and Biological Monitoring is currently evaluating this pilot study to determine if a monitoring program can be developed.

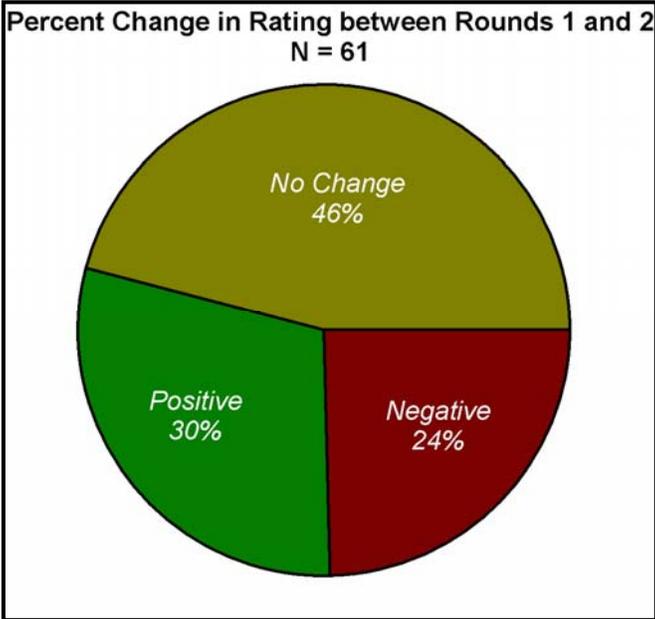
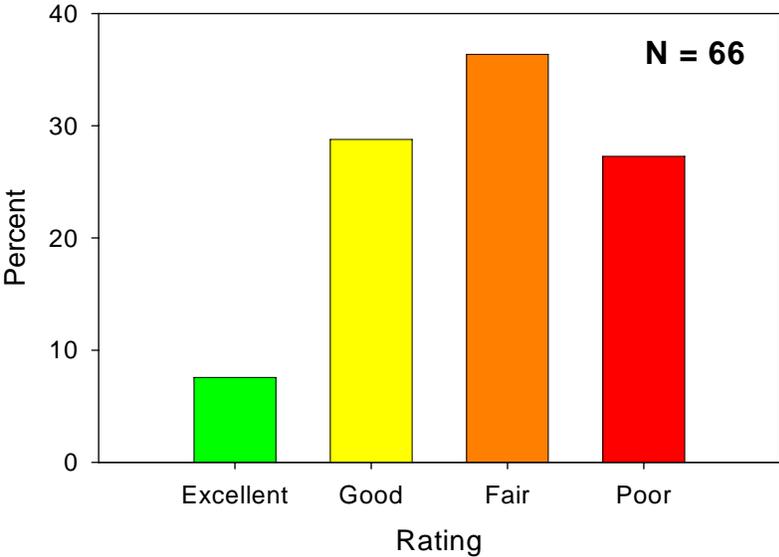
The data provided by the Fish IBI network are a component of DEP's suite of water environmental indicators. The results of this monitoring are used, in concert with available benthic macroinvertebrate data, to help the Department measure aquatic life designated use attainment, as elaborated in the *New Jersey Integrated Water Quality Monitoring and Assessment Report* (<http://www.state.nj.us/dep/wms/bwqsa/generalinfo.html>). As described in the *2006 Integrated Water Quality Monitoring and Assessment Methods* document, sites with an FIBI rating of "poor" are considered to be impacted significantly enough that, for purposes of the Department's Water Quality Monitoring and Integrated Assessment Report (40 CFR 130.7 and N.J.A.C. 7:15-6 f), they will be categorized as "impaired". Conversely, sites achieving a rating of either "Excellent" or "Good" are considered to reflect "non-impaired" fish communities. IBI assessments of "Fair" are not utilized in the integrated assessment at this point, but for the purposes of discussion, impacts are *suspected* at sites with a FIBI rating of "fair" and thus warrant further investigation.

IBI data collected from northern New Jersey are also used to identify candidate waters for upgrade to a Category One anti-degradation classification (N.J.A.C. 7:9B) based on a determination of exceptional ecological significance.

¹ Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.S. Schlosser. 1986. "Assessing biological integrity in running waters: a method and its rationale" Illinois Natural History Survey, Champaign, IL, Special Publication 5.

To date, 2 rounds of sampling of this 100 site northern New Jersey network have been completed. Fish IBI results from annual sampling seasons may be obtained by visiting the Bureau's webpage (www.state.nj.us/dep/wms/bfbm/publications.html) or by calling the Bureau at (609) 292-0427.

Round 2 Scoring (2005-2007)

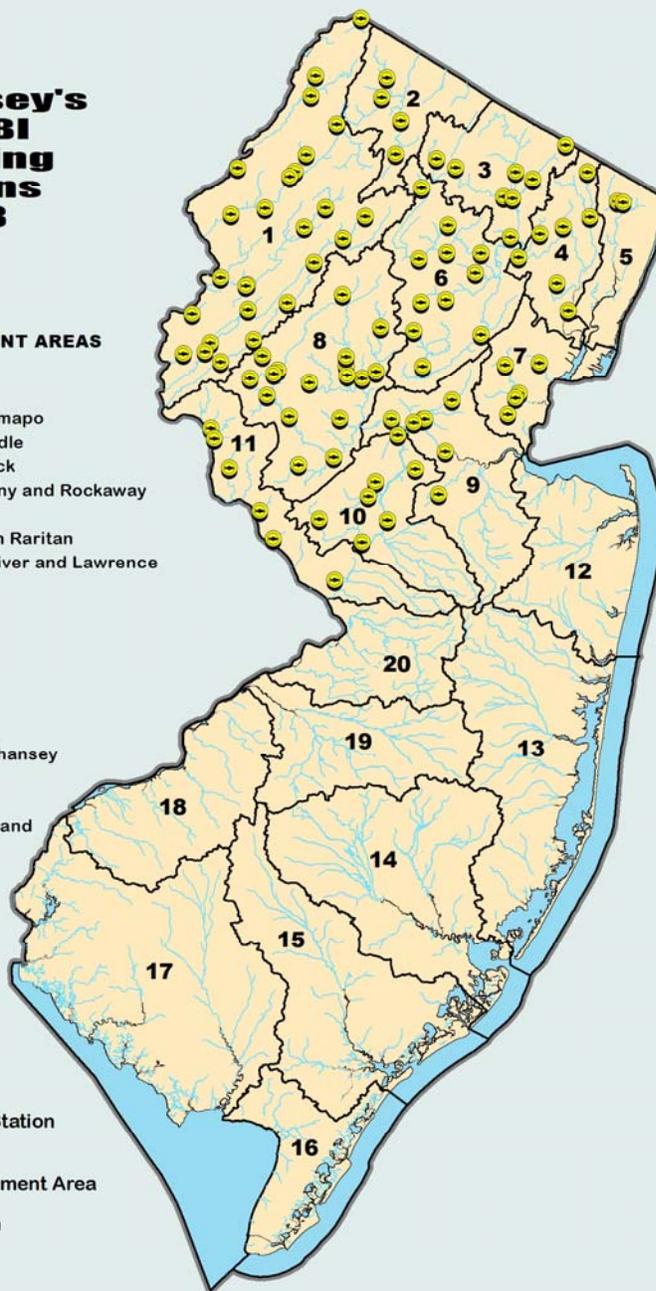


New Jersey's Fish IBI Sampling Stations 2008

WATERSHED MANAGEMENT AREAS

1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors

-  Fish IBI Sampling Station
-  Watershed Management Area
-  Major River/Stream



Ambient Lakes Monitoring Network

NJDEP's renewed ambient lake monitoring network is designed to provide the water quality data necessary to assess the ecological health of the State's lentic water resource. Reinitiated in 2005, this program involves the testing of randomly selected lakes from the state's approximately 1100 named lakes. The water quality measurements conducted at each lake include parameters such as dissolved oxygen, pH, nutrients, and chlorophyll a. Such testing will assist New Jersey in determining the status and trends in lake water quality, as needed to meet the state's Clean Water Act requirements and the Total Maximum Daily Load (TMDL)-related water quality assessment obligations.

WM&S has developed a monitoring program that will address both the NJ water program deficiencies cited in the 1999 USEPA's Office of Inspector General's Audit Report, and the needs of the watershed management and water quality assessment (305(b)/303(d)) programs. This approach comports with the guidance provided in USEPA's publication, "Elements of a State Water Monitoring and Assessment Program," March 2003, which requires that states develop and implement long-term strategies which include monitoring of all state waterbody types, including lakes. The lake monitoring network design is as follows:

1. **Target Population:** All lakes, man-made or natural, excepting water supply reservoirs, wholly or partially within the State of NJ political boundaries. A lake is defined as a permanent body of water of at least two hectares in surface, and a minimum depth of one meter. Lakes will be selected randomly, using the USEPA - Generalized Random Tessellation Stratified (GRTS) survey design, but in a manner that equalizes selections over all Omernik level III ecoregions (6 within state). The NJ GIS coverage containing approximately 1,100 polygons of named lakes will be used for the selection process.
2. **Network Stations:** The network consists of 200 lakes, each sampled once every five years, with forty lakes sampled per year. Depending on the lake size and characteristics, up to four sampling locations are monitored in each lake. Lakes not exhibiting temperature stratification are sampled at one meter below the surface, unless the lake is too shallow, in which case the sample is taken at a depth of one-foot below the surface. Lakes exhibiting stratification are sampled above and below the thermocline. Depth to bottom is measured at each station. Sampling Frequency: All lakes in the network are sampled once every five years, with each lake being sampled at least three times during the year (Spring, Summer, and Fall). A fourth winter sampling period will be added if weather conditions and resources permit.
3. **Monitoring Parameters:** Total Phosphorus, Total Kjeldahl Nitrogen, Total Nitrite+Nitrate Nitrogen, Ammonia Nitrogen, Dissolved Oxygen, Temperature, Specific Conductance, Alkalinity, Hardness, Secchi depths, and Chlorophyll a is collected and analyzed at each station. Qualitative evaluations of algal blooms and aquatic vegetation are performed at each lake.

Lakes monitoring network results will be available via the Bureau's webpage (www.state.nj.us/dep/wms/bfbm/publications.html) or by calling the Bureau at (609) 292-0427.

New Jersey's Ambient Lakes Monitoring Network 2008

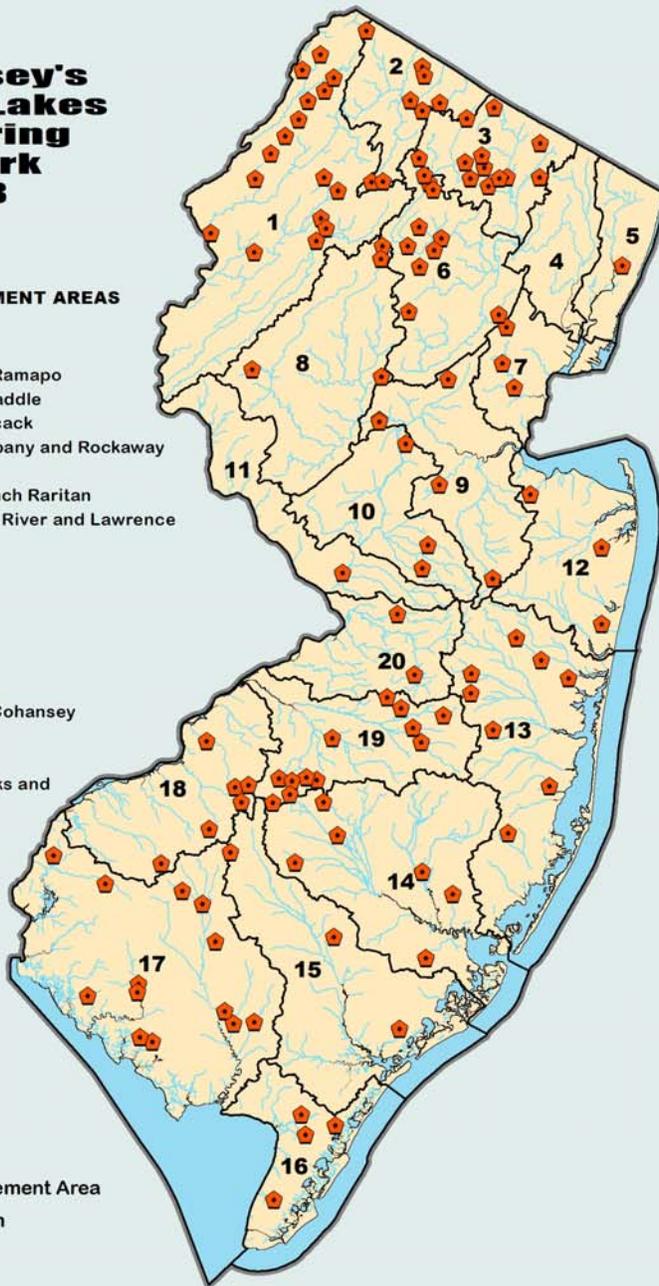
WATERSHED MANAGEMENT AREAS

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14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors

 Ambient Lakes
Monitoring Site

 Watershed Management Area

 Major River/Stream



Ambient Surface Water Quality Monitoring Network (ASWMN)

The Ambient Surface Water Quality Monitoring Network is a cooperative DEP/USGS program, established in the mid-1970's. A major redesign of the network occurred in 1997. The revised network was specifically designed to address surface water quality issues in each of the state's 20 watershed management areas addressing the following objectives: (1) track status and trends in ambient water quality; (2) establish background water quality; (3) obtain water quality data that can be correlated with specific land uses (urban/suburban, agricultural and undeveloped); and (4) coordinate water chemistry and biological monitoring networks. A second major revision occurred in 2005 with the addition of 100 additional monitoring stations to improve statewide spatial coverage for the network. These 100 additional stations are sampled for water quality by DEP and for flow by USGS.

The network is comprised of 5 station types: (1) *background / reference sites* – waterways located in undeveloped watersheds (generally county, state or federal parks and forests), (2) *land use indicator sites* – waterways which reflect a dominate land use (urban / suburban, agricultural or undeveloped) within a watershed management area, (3) *watershed integrator sites* – waterways which reflect large drainage areas and multiple pollution sources, (4) *statewide status sites* – sites randomly reselected every two years from DEP's 829 station biological (macroinvertebrate – AMNET) network and (5) *spatial infill sites* - sites added in 2005 to provide a minimum of one site in each HUC (Hydrologic Unit Code) 11. The overall ASWMN consists of 215 stations that are sampled quarterly.

Parameters monitored:

Monitored quarterly – discharge (except at statewide status sites), field parameters, filtered common ions, total and filtered nutrients, suspended solids and BOD

Monitored biannually – metals (spring – high flow and summer – low flow)

Monitored annually at selected sites – bacterial parameters (5 times in 30 days), diurnal DO, pesticides, sediment metals, sediment nutrients and sediment polyaromatic hydrocarbons.

The data collected via this Network are used in assessments for the New Jersey Integrated Water Quality Monitoring and Assessment Report. Network data are available from the following: (1) the USGS computerized data system, NWIS (<http://nj.usgs.gov>), (2) EPA's computerized data system, STORET (<http://www.epa.gov/storet/dbtop.html>) and (3) USGS annual reports “Water Resources data – New Jersey”. Additional information on this monitoring network is available from the Bureau of Freshwater & Biological Monitoring's webpage (www.state.nj.us/dep/wms/bfbm).

New Jersey's Ambient Surface Water Monitoring Network 2006

WATERSHED MANAGEMENT AREAS

1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
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11. Central Delaware
12. Monmouth
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14. Mullica
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16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
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20. Assisunk, Crosswicks and Doctors

Monitoring Station Type

- Background
- Delaware River Main Stem
- Land Use Indicator
- Land Use Indicator/Statewide Status
- Statewide Status
- Watershed Integrator
- Watershed Integrator/Statewide Status
- ▲ Spatial In-Fill

⊞ Watershed Management Area

— Major River/Stream



New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

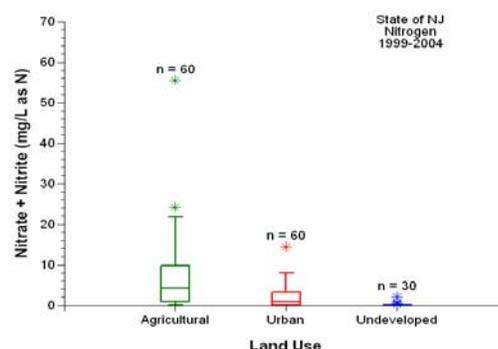
Ambient Ground Water Network - DEP/USGS

The first Ambient Ground Water Monitoring Network was established by NJDEP and USGS in 1983. The original network was designed to determine the concentration range of chemical constituents as a function of rock type. Having addressed that goal, the network was redesigned in 1998 to address the following objectives: (1) assess status and trends in newly recharged ground water; (2) define ground water quality by land use type (urban/suburban, agricultural and undeveloped); (3) determine potential ground water impacts on surface water quality; and (4) identify emerging ground water quality issues.

The redesigned network is comprised of 150 shallow wells. Network installation and the first round of sampling was completed in 2004. Well locations were identified using a stratified random approach, based on land use type. Sixty wells are located in urban/suburban settings, sixty wells are located in agricultural settings and thirty wells are located in undeveloped settings. With a sampling rate of 30 wells per year, sampling frequency for network wells is once every 5 years.

Parameters monitored:

- ♦ Field Parameters : Specific conductance, pH, alkalinity, D.O., water temperature and turbidity.
- ♦ Laboratory Parameters : Dissolved major ions and trace elements (metals), dissolved nutrients, volatile organic compounds, pesticides and gross alpha / beta.



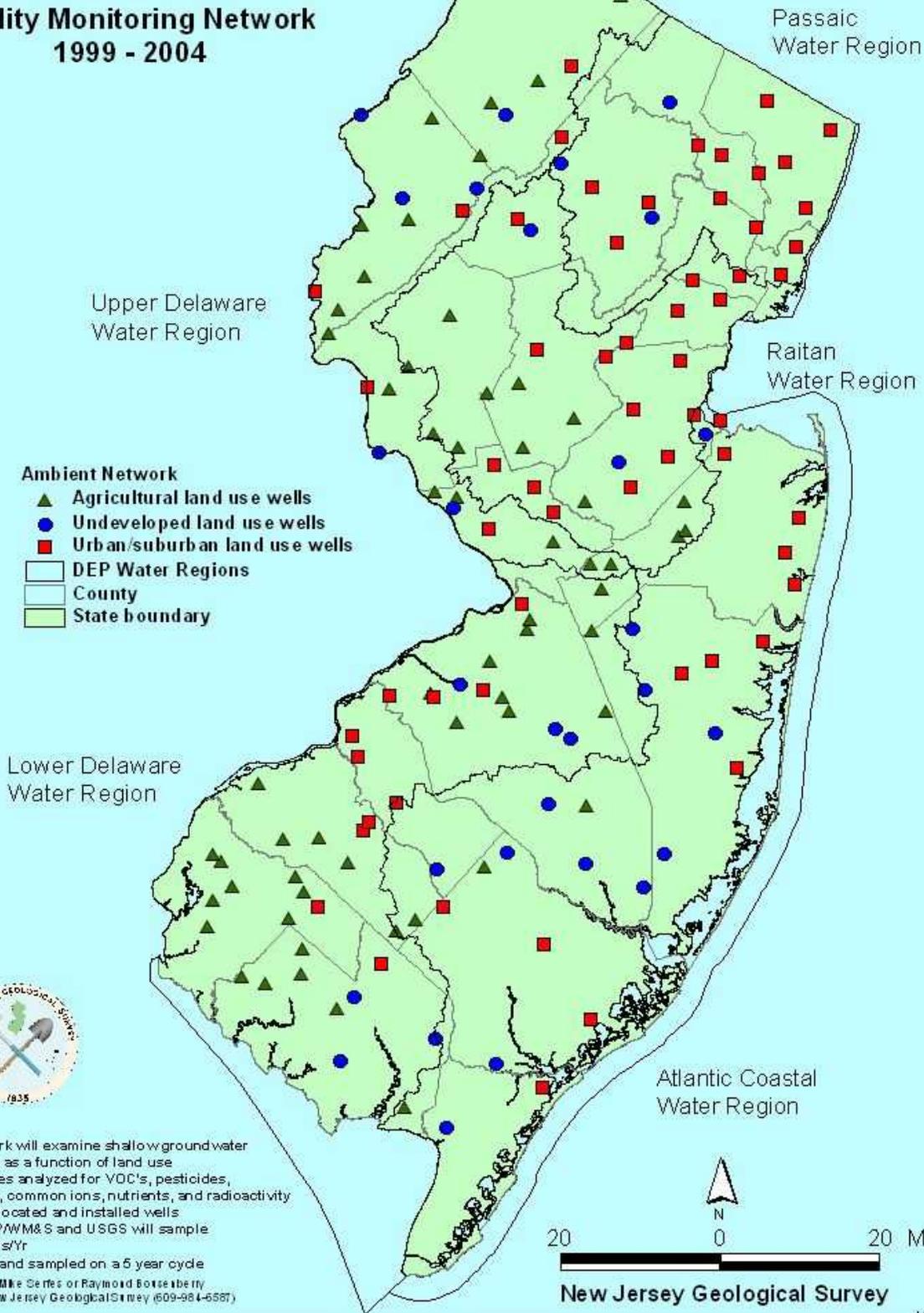
The ground-water quality data are currently available in an NJDEP I-MAP format at:

http://www.state.nj.us/dep/gis/imapnj_geosplash.htm, in annual USGS Water Resources Reports for New Jersey and online at the USGS NWIS database at, <http://waterdata.usgs.gov/nwis/>. Data summaries are available in: (1) New Jersey Geological Survey Informational Circular; New Jersey Ambient Ground Water Quality Network: Status of shallow ground-water quality, 1999 – 2004, <http://www.state.nj.us/dep/njgs/enviroed/infocirc/ambient.pdf>, (2) New Jersey Geological Survey Special Reports (Serfes, 1994 and 2004), (3) NJGS web site (Piedmont data only) (www.nj.gov/dep/njgs), (4) The Integrated Water Quality Monitoring and Assessment Report, <http://www.state.nj.us/dep/wms/bwqsa/generalinfo.html>, (5) USGS annual reports “Water Resources Data – New Jersey”, new web update water year 2006: http://nj.usgs.gov/adr/Main_Index.html and prior water years.

References:

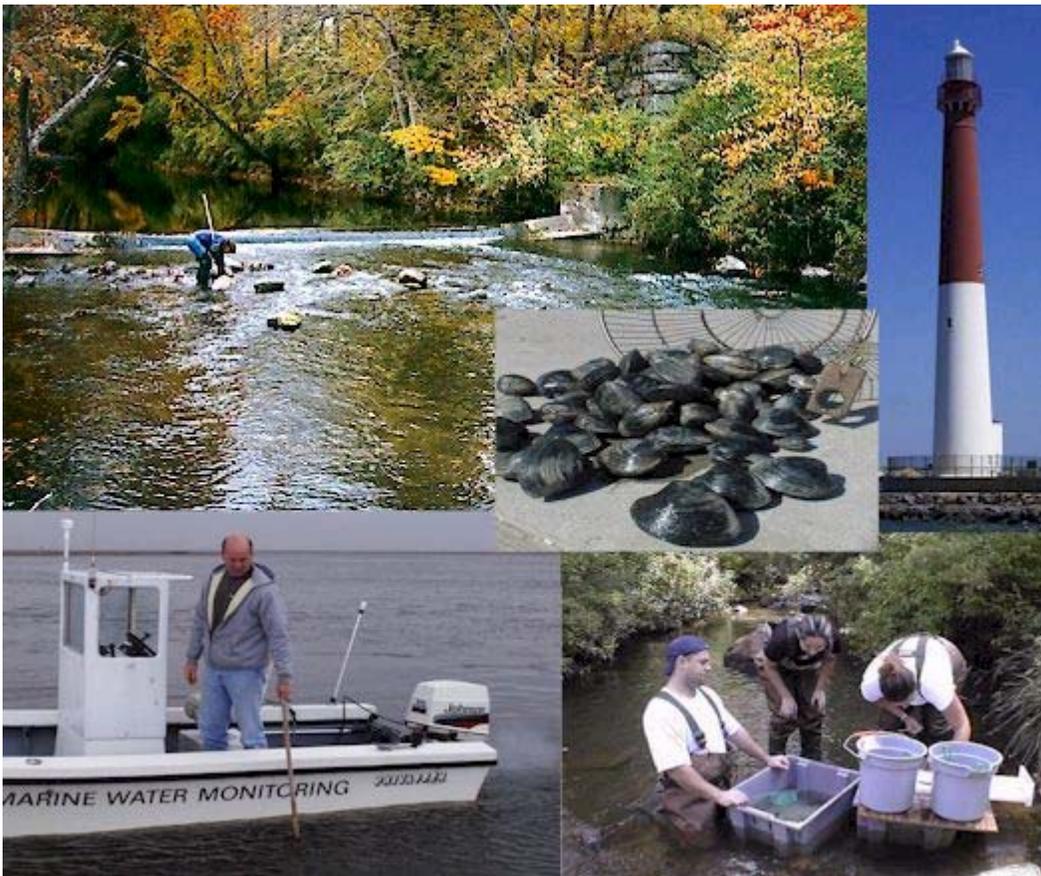
- Serfes, M.E., 2004, Ground Water Quality in the Bedrock Aquifers of the Highlands and Valley and Ridge Physiographic Provinces of New Jersey: New Jersey Geological Survey Report no. 39, 29p.
- Serfes, M.E., 1994, Natural ground-water quality in bedrock of the Newark Basin, New Jersey: New Jersey Geological Survey Report no. 35, 29p.

New Jersey's Ambient Groundwater Quality Monitoring Network 1999 - 2004



- Network will examine shallow groundwater quality as a function of land use
 - Samples analyzed for VOC's, pesticides, metals, common ions, nutrients, and radioactivity
 - N JGS located and installed wells
 - NJDEP/WMS and USGS will sample 30 wells/yr
 - Setup and sampled on a 5 year cycle
 Contact: Mike Cerfles or Raymond Borseberry at the New Jersey Geological Survey (609-984-6587)

MARINE WATER MONITORING



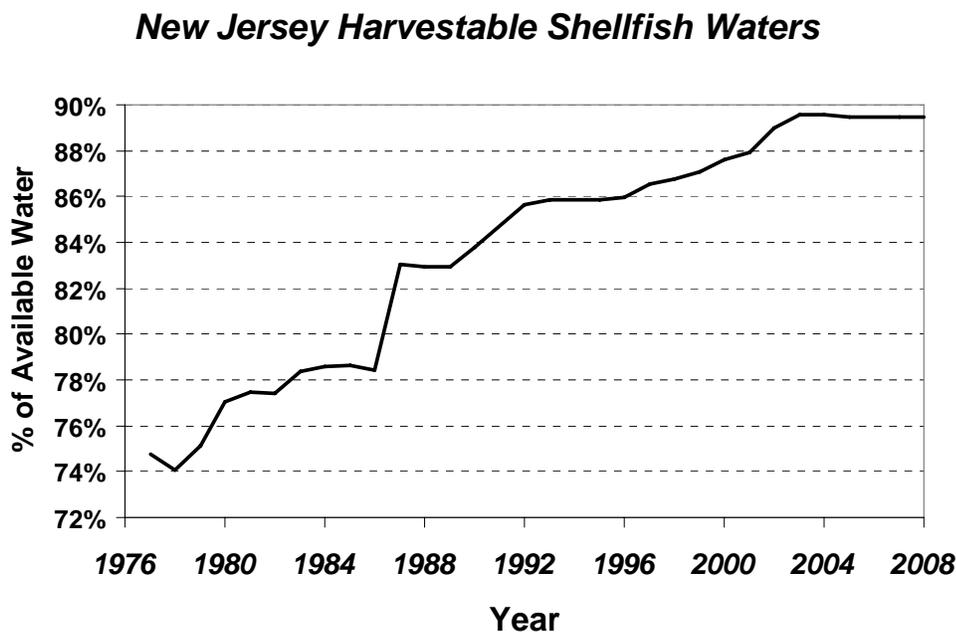
National Shellfish Sanitation Program

The National Shellfish Sanitation Program (NSSP) was established by the Surgeon General in 1925 and is active in all coastal states involved in interstate shellfish harvest and sale. Its purpose is to regulate the harvest and sale of shellfish to safeguard the public health from the consumption of contaminated shellfish. The shellfish industry represents a significant portion of New Jersey's coastal economy with an estimated dockside value of about \$80,000,000 per year. The data from the NSSP also supports a significant indicator of coastal water quality over time.

One portion of the program requires shellfish-producing states to classify their coastal waters according to suitability for safe shellfish harvest. Part of the assessment of these waters for safe shellfish harvest involves the monitoring of pollutant levels in those waters. Of principal concern are indicators of human pathogens in the water that may be transmitted to consumers through the harvest of tainted shellfish. Each year the Bureau of Marine Water Monitoring assesses the most recent water quality data and shoreline survey information for compliance with the National Shellfish Sanitation Program guidelines. Waters not in compliance are closed to shellfish harvest.

The Bureau of Marine Water Monitoring maintains a network of more than 1,600 active monitoring stations throughout the state's coastal waters. These stations are sampled between five and twelve times each year for total coliform and fecal coliform bacteria (indicators of human

pathogens). The Bureau's staff at the Leeds Point, NJ laboratory facility analyzes the samples.



New Jersey has been very successful in improving water quality for shellfish harvesting. For 15 consecutive years, New Jersey has upgraded more waters that it has downgraded for shellfish harvesting. Currently, 90% of the State's shellfish

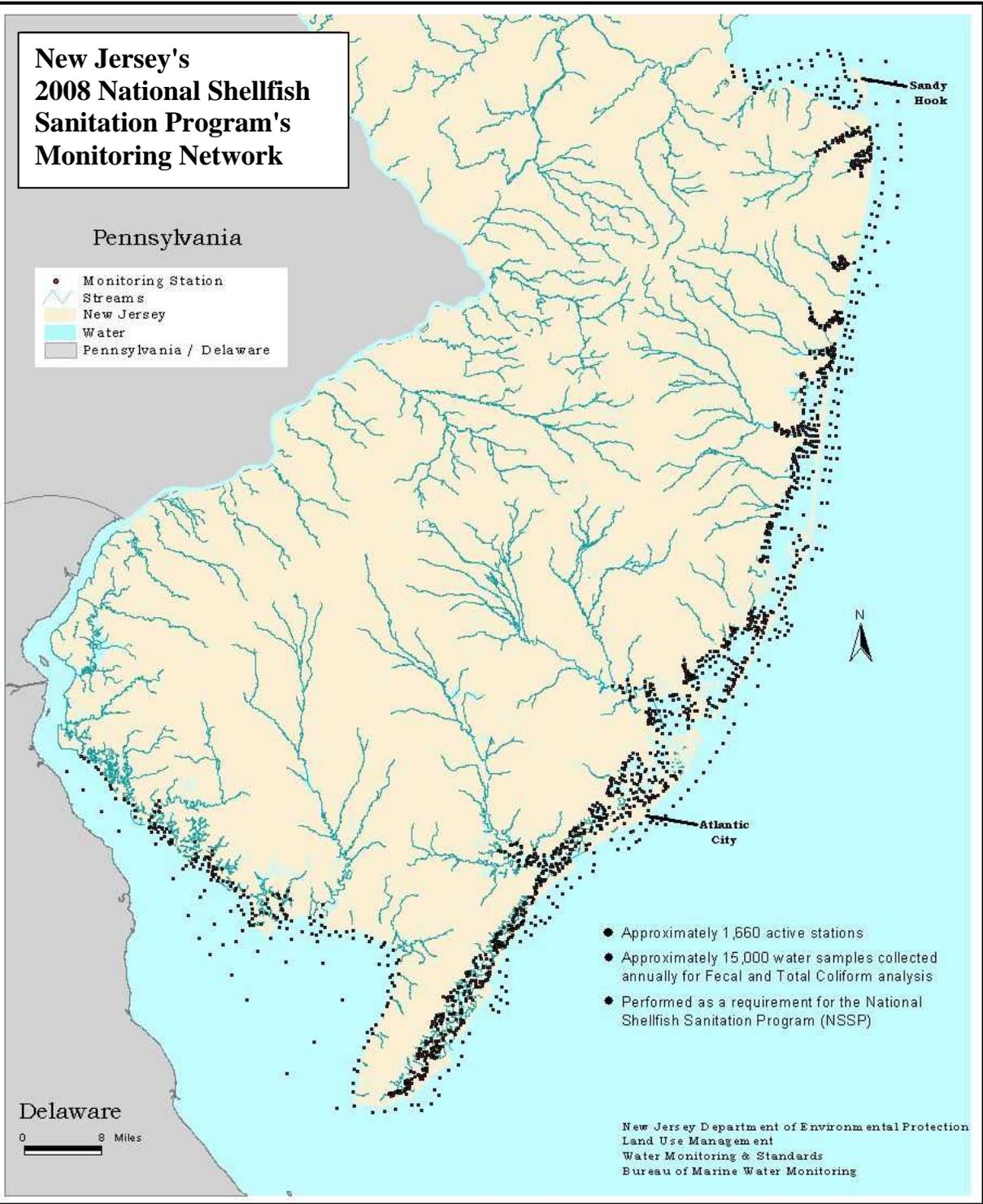
waters are harvestable. As of the last national survey of shellfish waters in the United States, New Jersey was the leading state in the restoration of coastal shellfish waters.

Further information on this program and water quality results can be found on the Bureau's web page (www.nj.gov/dep/wms/bmw).

New Jersey's 2008 National Shellfish Sanitation Program's Monitoring Network

Pennsylvania

- Monitoring Station
- ▾ Streams
- New Jersey
- Water
- Pennsylvania / Delaware



- Approximately 1,660 active stations
- Approximately 15,000 water samples collected annually for Fecal and Total Coliform analysis
- Performed as a requirement for the National Shellfish Sanitation Program (NSSP)

New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring & Standards
Bureau of Marine Water Monitoring

Beach Water Quality Monitoring - Cooperative Coastal Monitoring Program

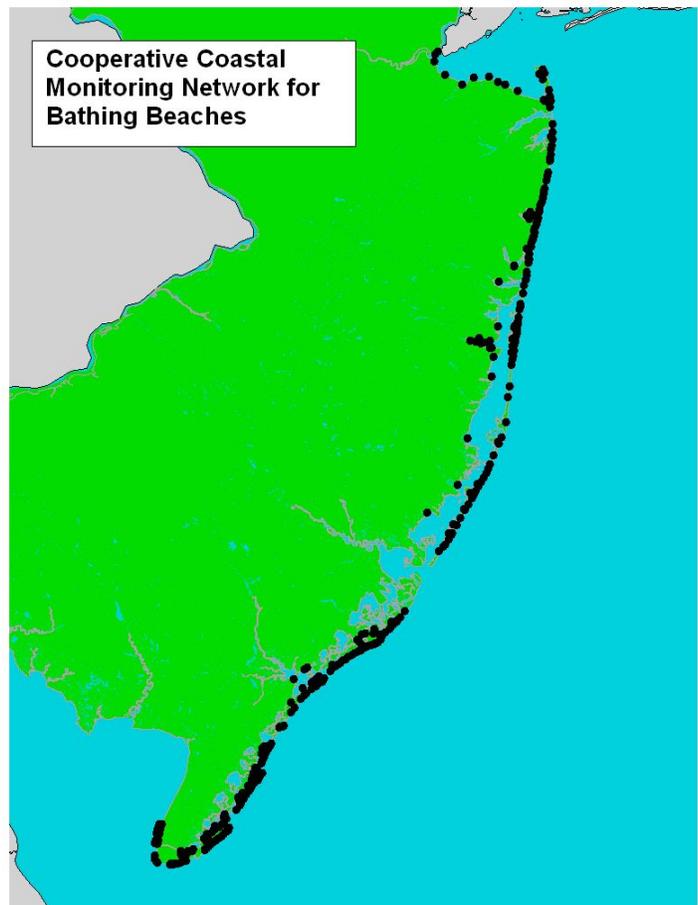
Since 1974, the New Jersey Department of Environmental Protection (DEP) has administered the Cooperative Coastal Monitoring Program (CCMP) with the participation of county and local environmental health agencies. The CCMP assesses coastal water quality and investigates sources of water pollution.

Recreational beach water quality monitoring is performed routinely on Mondays and throughout the week as necessary at 188 ocean and 76 bay monitoring stations. Nine local health agencies participate in the CCMP: the county health departments of Atlantic, Cape May, Monmouth, Middlesex and Ocean Counties; and the municipal health agencies of Atlantic City, Long Beach Township, Long Branch, and Middletown. The local health agencies collect water samples each week and perform the water analyses for enterococci bacteria concentrations at beach monitoring stations.

As part of the CCMP, aerial surveillance of nearshore coastal waters is conducted six days each week. This surveillance enables the routine evaluation of coastal water quality and the assessment of the nature and extent of public reports of ocean pollution. These flights include Raritan Bay, the Lower New York Bay, and the Atlantic Coast from Sandy Hook to Barnegat Inlet. Flights on Thursdays and Sundays are extended to include the area from Barnegat Inlet to Cape May Point.

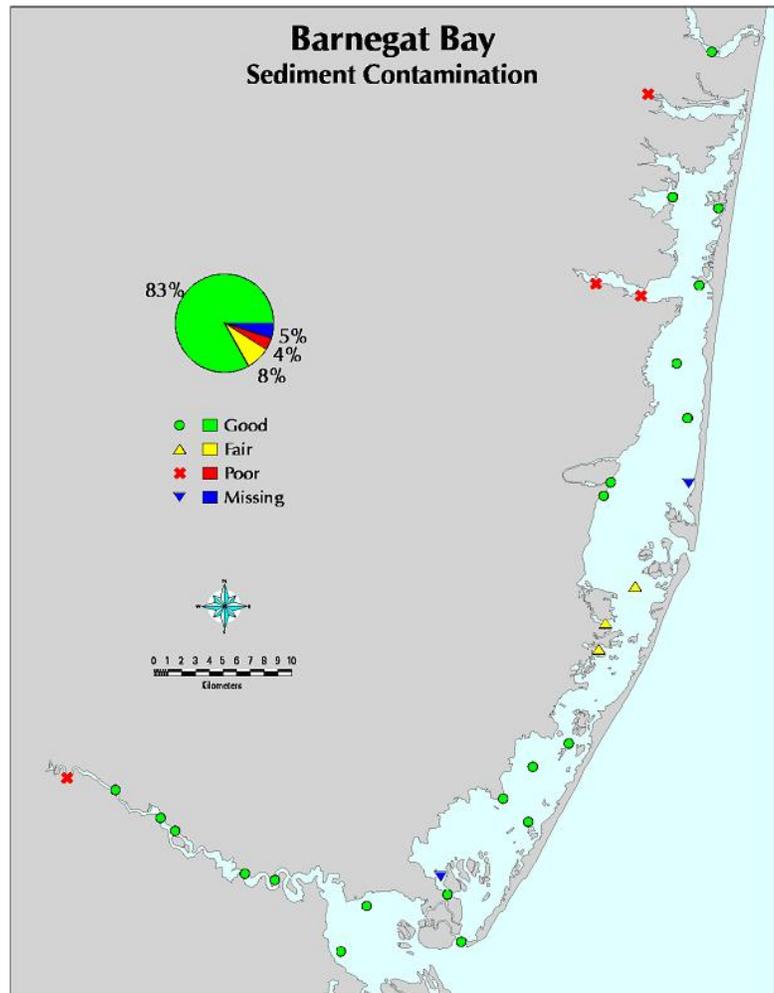
Flight activities are coordinated with the United States Army Corps of Engineers for the NY/NJ Harbor Estuary Program Floatables Action Plan in an effort to capture floating solid waste and debris, also known as floatables, with water-skimming vessels. Sources of floatables that have affected the state's coastal shores include stormwater outfalls, combined sewer overflows, operational landfills, and illegal dump sites.

Additional information can be found on the CCMP webpage (www.state.nj.us/dep/wms/bmw/BathingBeach/BBmain.html).



National Coastal Assessment Network

National Coastal Assessment (NCA) is a federally funded program to assess the ecological condition of the nation's estuarine resources. Starting in 2000, NCA's annual summer sampling involves collection of water, sediment, and benthic invertebrate samples at 35 locations in NJ's coastal bays. Samples are analyzed for water chemistry (e.g., nutrients, dissolved oxygen), sediment chemistry/toxics, sediment toxicity and benthic diversity. Results from this program are used in EPA's National Coastal Condition Reports. Results from NCA sampling are also now being used by NJDEP to assess ecosystem impairment of the NY/NJ Harbor in NJ's Integrated Assessment Report. Through a collaborative effort between EPA, NJDEP and Rutgers University, research is currently underway in New Jersey to expand NCA's assessment to the state's (and subsequently the nation's) near-shore ocean waters.



The design of the NCA program is probabilistic, which means that it can be used to estimate what percentage of the state's or nation's waters are in good, fair or poor condition. The pie chart to the right shows an example of that type of assessment of sediment contamination in the Barnegat Estuary. Red, yellow and green marks on the map show conditions measured at specific locations within the estuary.

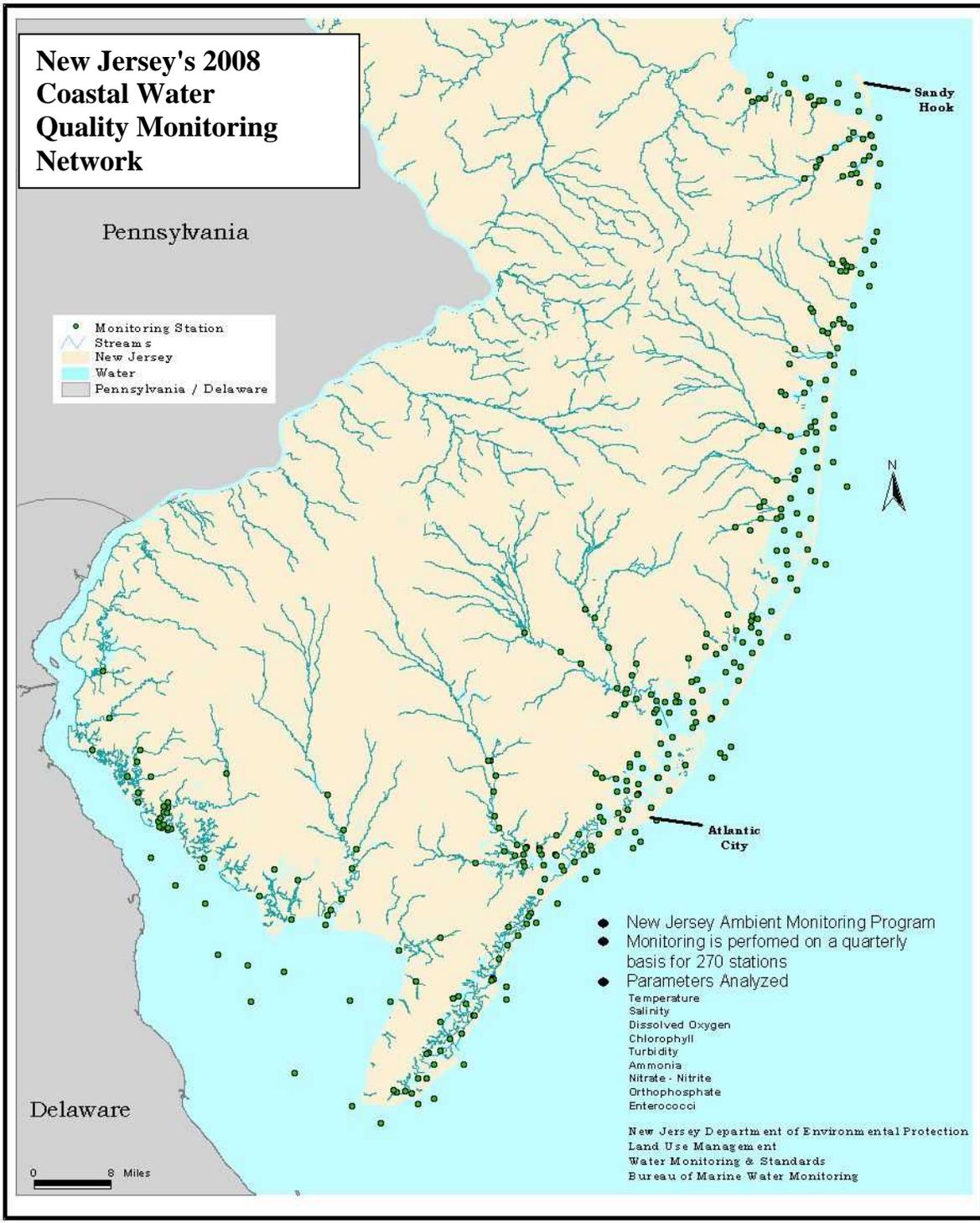
Further information on this program including sampling results can be found on the Bureau's web page (www.nj.gov/dep/wms/bmw).

Coastal Water Quality Network

The purpose of this Network is to provide basic measures of the ecological health of New Jersey's coastal waters (includes ocean, estuarine and tidal river waters). Temperature, salinity, suspended solids and oxygen measurements can provide information on the degree of environmental stress that organisms are exposed to. Nutrients (nitrogen and phosphorus) and chlorophyll relate to the amount of plant material in the water. Too much or too little plant material in the water can be detrimental to other organisms in the bay and ocean.

The Network monitors parameters such as dissolved oxygen, salinity, nitrogen, phosphorus, secchi depth, temperature, chlorophyll and suspended solids. Samples are collected four times per year (once each quarter) at approximately 270 locations.

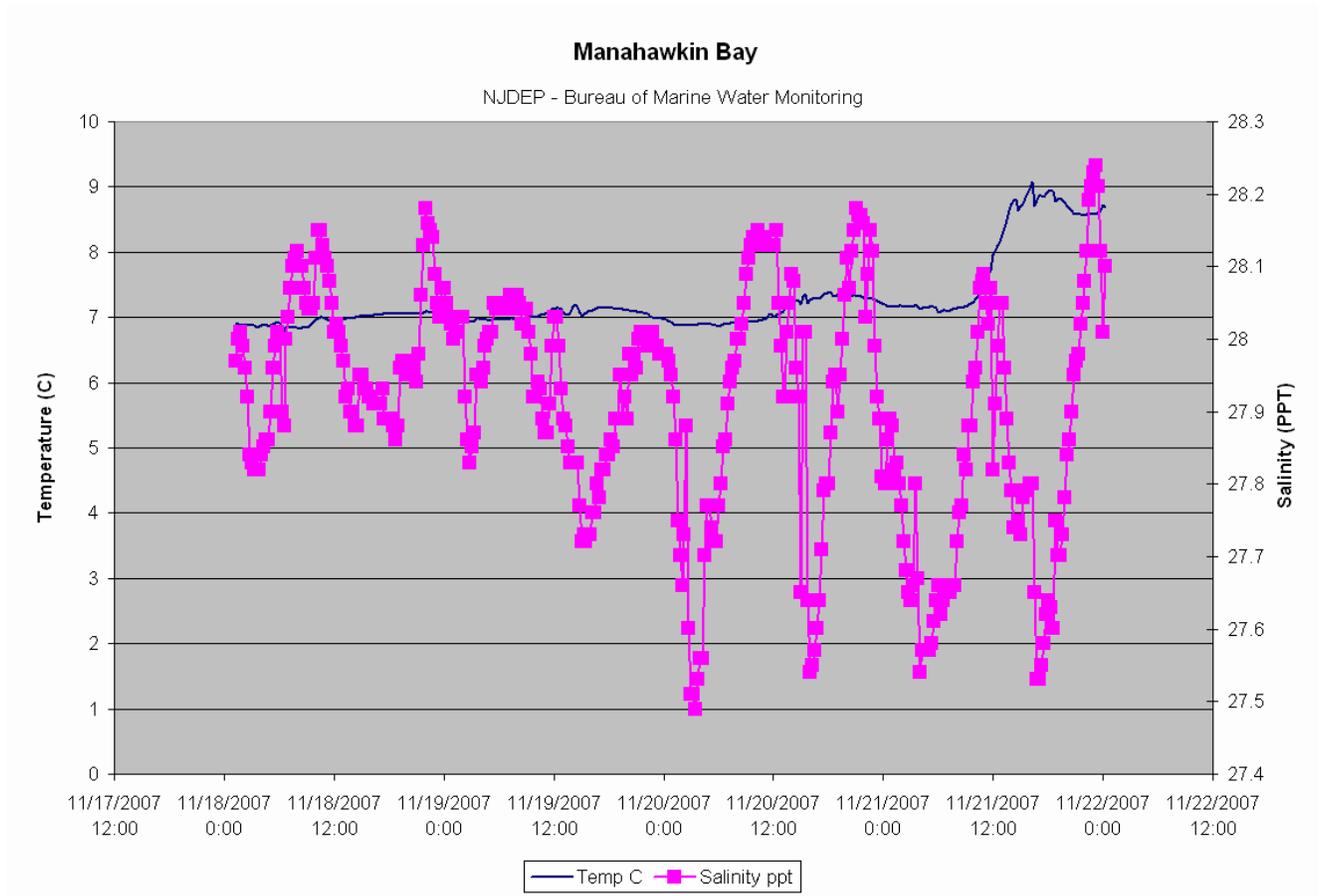
Data and results from this Network may be obtained from the Bureau's webpage (www.nj.gov/dep/wms/bmw) or by calling the Bureau at (609) 748-2000.



Cooperative Real-time Monitoring Network

In 2003, NJDEP began operation of four automated water quality monitoring buoys. The sensors measure conditions such as dissolved oxygen, salinity, temperature, pH and turbidity. They continually measure these parameters every 15 minutes and send this information to computers at the Bureau of Marine Water Monitoring. Those computers process the data, graph the results, and post the information on the Bureau's web page (<http://www.nj.gov/dep/bmw/sensorhome.htm>) - see example below. The buoys are operational from March through December. The buoy mounted sensors are removed during the winter to avoid possible ice damage.

Updates to the data occur once every two hours. Through a partnership with Monmouth University, new real-time sensors were added to this network in 2008. The current location of the existing sensors is shown in the figure on the next page.



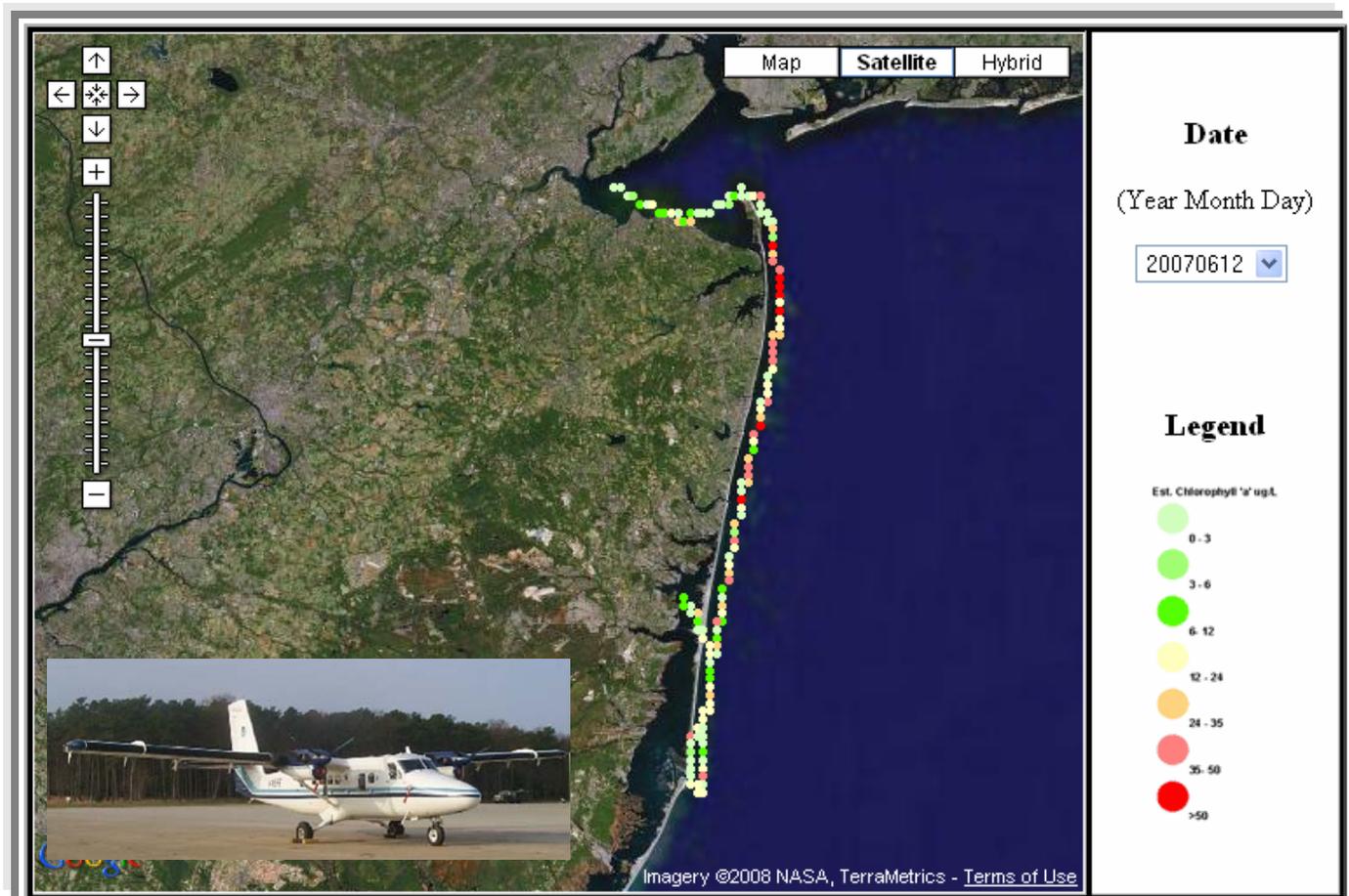


Coastal Phytoplankton Monitoring Network

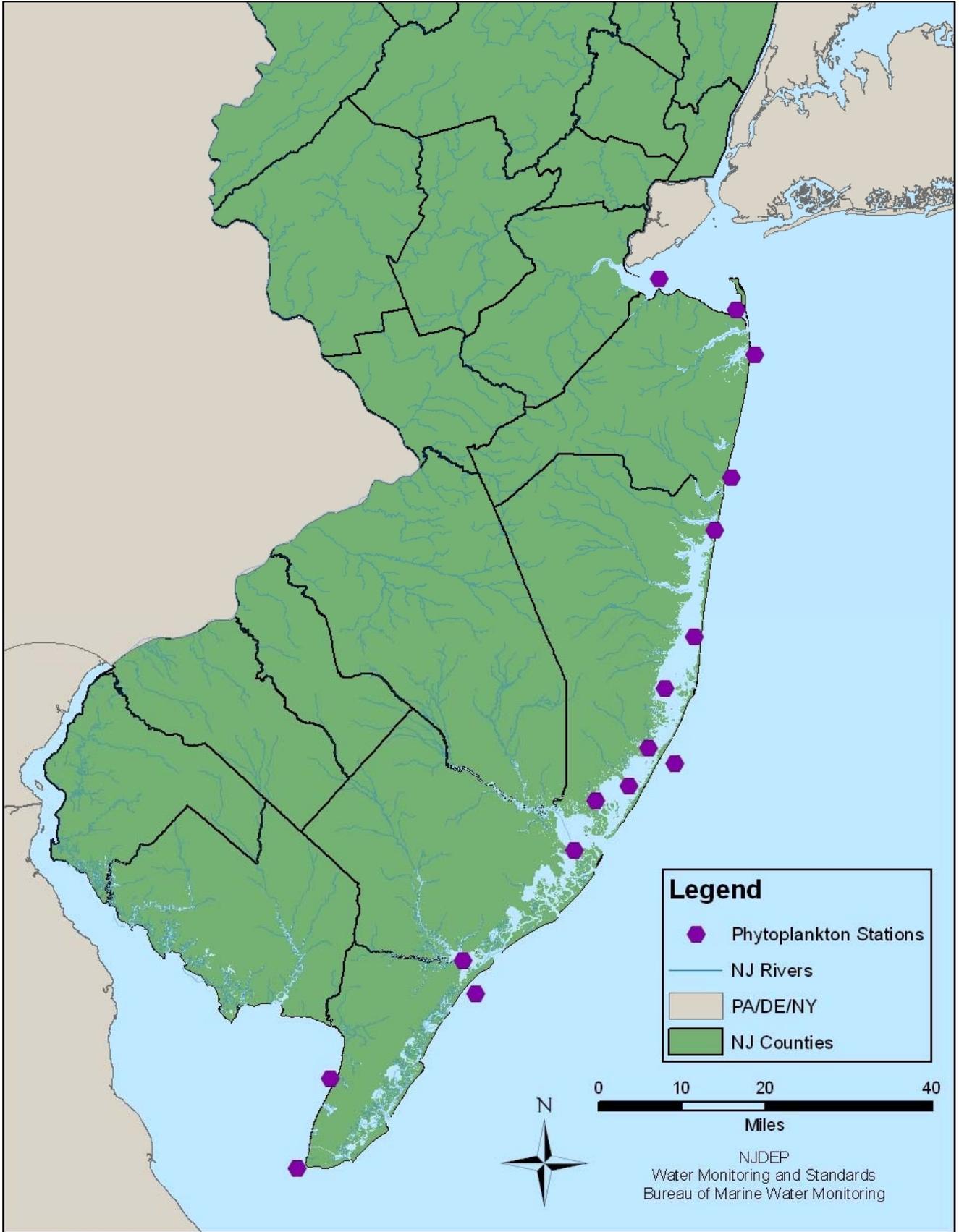
Every summer, the Bureau of Marine Water Monitoring, in collaboration with Region 2 of the U.S. Environmental Protection Agency (EPA), monitors phytoplankton populations in the waters along the 127 miles of New Jersey's coastline and major estuaries. Large-scale blooms of these organisms can produce unsightly and unhealthy water quality conditions, often referred to as red, green or brown tides, depending on the dominant varieties. When these algae die, the decay process uses significant amounts of dissolved oxygen in the water, sometimes reducing the bottom oxygen levels below tolerable levels to larger organisms, such as fish and shellfish. Some of the algal species that create red tides are known to have potentially harmful effects on human health, either through direct contact or through ingestion of shellfish that have become contaminated with the microorganisms. Fortunately, to date, New Jersey's red tides have not been of the acute toxic varieties. The results of the phytoplankton sampling also provide an estimation of the other algae present that might have effects on marine fauna and result in mild toxicity to bathers.

Under the guidelines of the National Shellfish Sanitation Program, the Bureau maintains a network of 16 stations as part of the state contingency plan to monitor for marine biotoxins. The stations are sampled biweekly from May through August each year. Samples are collected by EPA, via their helicopter, through a cooperative agreement with the NJ Department of Environmental Protection. The Bureau of Marine Water Monitoring analyzes the samples for the presence of potentially toxic forms of phytoplankton.

Starting in 2006, chlorophyll a levels have been measured as shown in the figure below by a sensor attached to a plane. This remote sensing is being applied as a means to target traditional phytoplankton water sampling by boat to locations of elevated chlorophyll a concentrations as determined through remote sensing. High chlorophyll a concentrations are indicative of a possible phytoplankton bloom. Remote sensing will compliment the more traditional fixed-station monitoring performed by the Bureau (see map on page 28).

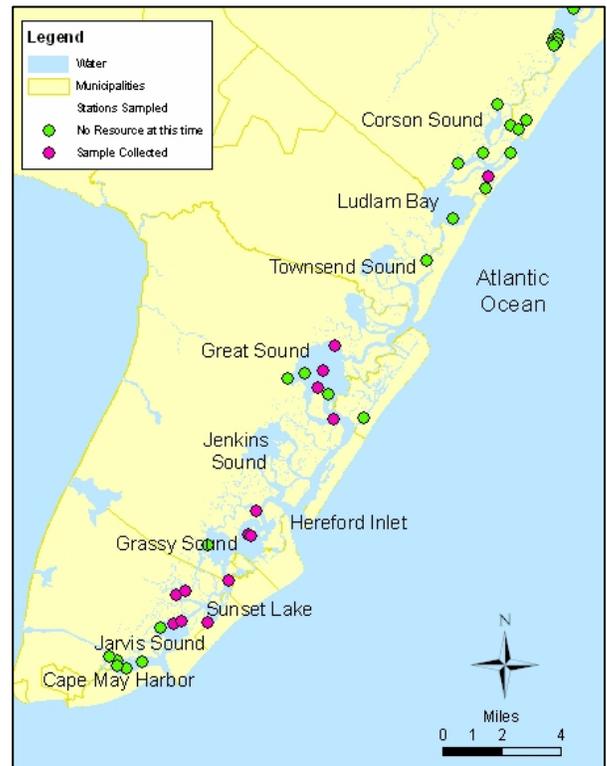
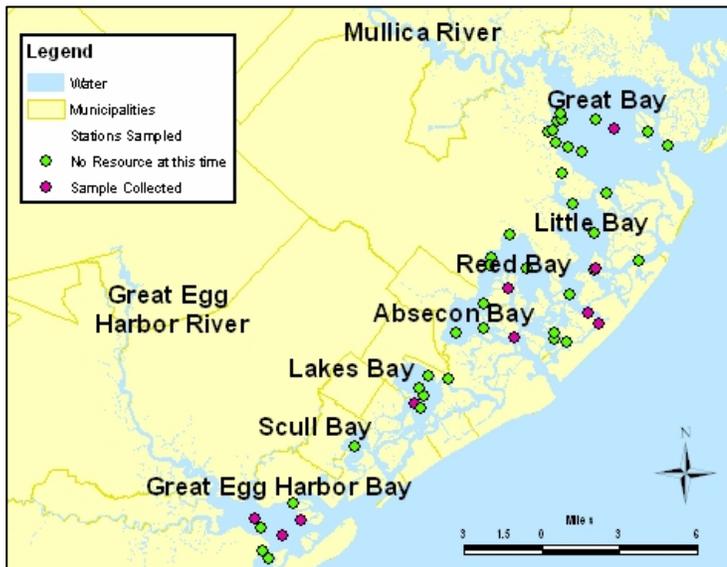


In recent years, no blooms of toxin-producing algae have been detected in New Jersey waters. A non-toxic bloom called “Brown Tide” has recurred in Barnegat Bay in recent years. Also, a non-toxic dinoflagellate bloom occurred off the coast of Ocean City, NJ in 2002. Neither of these resulted in the significant water quality and economic impacts to fisheries and tourism that occurred with blooms in the mid-1970’s and mid-1980’s along the New Jersey coast. Results from the annual phytoplankton sampling may be obtained from the Bureau’s webpage (www.state.nj.us/dep/wms/bmw) or by calling the Bureau at (609) 748-2000.



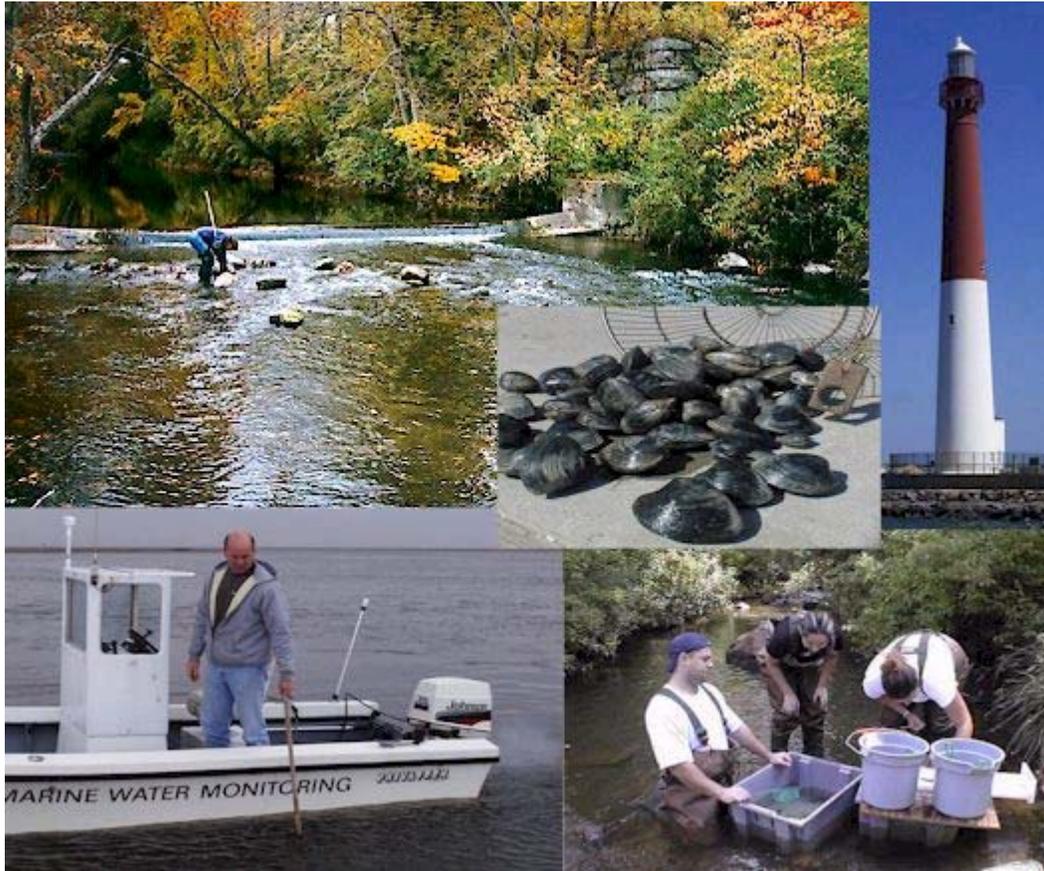
Toxic Pollutants in Shellfish Tissue

Shellfish are an important component in the economy of New Jersey. They also provide, over time, an excellent tool for monitoring coastal water quality. Monitoring toxic pollutants in shellfish can provide a long-term perspective on water quality. Shellfish filter large quantities of water and, in the process, accumulate pollutants to levels many times higher than are present in the water. This makes shellfish an excellent indicator for bioaccumulative, toxic pollutant levels in coastal waters. Regular testing of pollutants in shellfish began in Atlantic and Cape May Counties in 2005. In 2006, testing was expanded to other coastal waters of the State. Pollutants measured include toxic metals (arsenic, cadmium, chromium, mercury, lead and nickel), pesticides and total polynuclear aromatic hydrocarbons (PAH's) in shellfish tissue. Results of this monitoring are compared to established federal standards and guidelines for safe consumption of shellfish. Comparisons to historical data will be made where possible to evaluate trends in pollutant levels in shellfish tissue. Data are made available on the Bureau of Marine Water Monitoring's web page at <http://www.nj.gov/dep/wms/bmw/EMPACT.htm>.



Locations of shellfish toxics sampling in Atlantic County (above) and Cape May County (right).

OTHER WATER MONITORING CAPABILITIES



Nonpoint Source Monitoring

Nonpoint source (NPS) monitoring is used to measure the impact of pollutants from sources other than wastewater discharges. These other sources would include stormwater runoff, atmospheric deposition and boat wastes. Stormwater runoff can result in significant impacts to the quality of surface waters. For that reason, Water Monitoring and Standards has been involved in monitoring of stormwater and associated nonpoint sources of pollution since 1994.

Stormwater monitoring is performed for two primary purposes; 1) to measure the loads (quantities) of certain pollutants carried in stormwater to develop Total Maximum Daily Loads (TMDLs), and 2) to identify the actual sources of the pollutants so that corrective actions can be taken to reduce the impact of the source or to eliminate it. Water Monitoring and Standards has been involved in both types of NPS monitoring that are described below.

Determination of Total Annual Nonpoint Source Pollution Loads to Watershed Management Areas 17, 18, & 20 (Lower Delaware)

The Lower Delaware Watershed Nonpoint Source monitoring study was a multi-year surface water quality investigation. It was conducted by both the Department of Environmental Protection and the U.S. Geological Survey. Its purpose was to estimate the NPS loads of nutrients, bacteria, and suspended solids from various land use areas in Watershed Management Areas (WMA) 17, 18 & 20 (Lower Delaware).

The primary study objectives were:

1. Document current water quality before NPS and stormwater management strategies are initiated, and
2. Develop a water quality model to estimate unit NPS loads of selected constituents associated with different land uses in WMA 17, 18, & 20.

In addition, synoptic sampling was conducted during storm runoff conditions near the beginning of the baseline characterization phase of the study. This verified the modeled land-use to water quality relationships, and identified any anomalies to these relationships in the watersheds being studied. If major nonpoint sources are identified, a more focused implementation of Best Management Practices (BMPs) can be considered.

Confirmatory (303(d) or Sub-list 5) Sampling for Impaired Waters

Certain waters of the state are identified as “use impaired” due to exceedances of the Surface Water Quality Standards. Water bodies designated as “impaired” are listed in the NJDEP’s *Integrated Water Quality Monitoring and Assessment Report* (Integrated Report), which is submitted to the United States Environmental Protection Agency (USEPA) every two years. Within the Integrated Report, “impaired” water bodies are listed on Sub-list 5 (formerly 303(d)). The data used to classify these waters may be: (1) outdated and not reflective of current water quality conditions or (2) may have a positive bias due to older sample collection and analysis techniques now known to be inappropriate for ambient surface water metals monitoring. Evaluation monitoring, using newer collection procedures based on EPA’s method 1669, and “Clean Methods Techniques – to be used when sampling for trace metals in aqueous samples, NJDEPE, 1993”, in addition to updated laboratory analyses creates a metals database accurate to at least 1 part per billion (ppb). This allows for assessment relative to NJ’s Surface Water Quality Standards. The determination regarding which sites and which parameters are being monitored is made by Water Monitoring and Standards’ Bureau of Water Quality Standards and Assessment.

The current project entails 24 sites being monitored quarterly for two years (8 times total). These sites were chosen because previous data was inconclusive for one of two reasons: 1) laboratory analytical techniques available at the time of the original sampling were not able to establish reporting limits below the current surface water quality standards for certain parameters (i.e. mercury); and 2) additional sampling is warranted because, during the original sampling event, analytical results were variable even though sampling conditions were constant. In the original 303d project begun in 1998, sites were sampled at base-flow for three consecutive days. Base-flow was determined to be below long-term daily median flow with less than 30% change in the previous 24 hours. In the original project, results on one out of three days at certain sites were significantly different from the other two, which made the data suspect.

The 24 sites being sampled for this project are being sampled for a variety of parameters including, volatile organic compounds and total recoverable and dissolved mercury, copper, lead, silver and zinc. In addition, field measurements are taken for pH, dissolved oxygen (mg/L), dissolved oxygen saturation (%), water temperature, specific conductance, and turbidity. Flow measurements are also required for this which will be provided by United States Geological Survey (USGS). Some sites are located where flow measurements are available in real-time on USGS’ website. Where this information is unavailable staff will establish permanent reference points to measure water level. USGS will then conduct actual flow measurements and establish flow curves for these sites using the reference point measurements. In addition, one sampling event will be during elevated flow conditions (defined as 20% or more above long-term daily median flow).

Confirmatory Sampling For Impaired Waters 2008

WATERSHED MANAGEMENT AREAS

1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors

 Monitoring Station

 Watershed Management Area

 Major River/Stream



Sediment Toxicity Testing

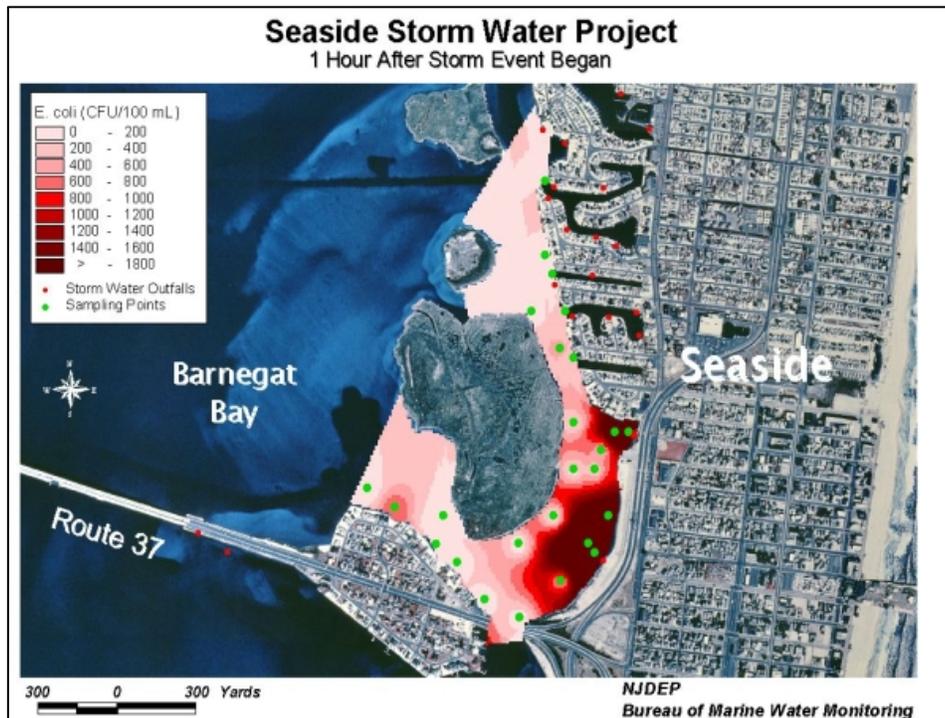
Sediment toxicity testing is performed to estimate the toxicity of sediments at sites determined to be environmentally degraded based on bioassessments of stream macroinvertebrate populations as part of the statewide Ambient Biomonitoring Network (AMNET). This is accomplished through the bioassay (toxicity testing) of sediments using the amphipod *Hyalella azteca* as the test organism. The toxicity testing measures both acute and chronic effect endpoints, the acute endpoints measuring survival and the chronic endpoints measuring growth and fecundity.

Test sites are selected from those assessed as "severely impaired" or that have shown a significant decline, based on AMNET results. Reference sites are selected from AMNET stations that are rated "non-impaired" and located within the same major water basin as the respective monitoring sites(s). AMNET routinely surveys a total of over 800 sites statewide, employing the Rapid Bioassessment Protocols developed by USEPA. AMNET sites are rated as *non-impaired*, *moderately impaired*, or *severely impaired* based on a multi-metric evaluation of the benthic macroinvertebrate species assemblages.

Toxicity is assessed by statistically comparing the monitoring station with the reference station results for significant differences. The data are used in watershed assessments, evaluation of toxic spills into ambient waters, in the Department's *Integrated Water Quality Monitoring and Assessment Report* and will be used in its stressor identification (SI) work. Results from previous applications of this testing may be found on the Bureau of Freshwater & Biological Monitoring's webpage (www.state.nj.us/dep/wms/bfbm/publications.html).

Alternate Microbial Indicator Monitoring

Traditional indicators (fecal coliform, *Enterococcus*, *E. coli*) can come from humans, but can also come from domestic animals and wild animals. There are a number of non-traditional indicators (alternate indicators) that have emerged as valuable tools for the identification of sources of fecal pollution. These new indicators can provide much better information about the source of the fecal pollution, distinguishing between human, domestic animal and wild animal sources. Some of the more promising of these new indicators include RNA Coliphage and Antibiotic Resistance Analysis (ARA). The Bureau of Marine Water Monitoring has a limited capability to test for RNA Coliphage and has successfully applied that capability to various source tracking projects over the past 12 years, including the Seaside storm water project depicted in the graph below. The Bureau has expanded its capability to include Antibiotic Resistance Analysis. Increased capacity for these new test methods was made possible by the creation of the NJDEP's Advanced Microbiology Laboratory in 2006.



In this study, two stormwater outfalls were found to be impacting this bathing area. RNA Coliphage analysis determined that one of the two outfalls was primarily of a human source while the other was not. This information directed appropriate corrective actions.

Bacteria TMDL Monitoring

Other states are using alternate indicators to address TMDLs. In Maryland, alternate indicators are being used to assist in identifying non-point source pollution and to determine bacterial loadings. Alternate indicators have also been used successfully in Virginia as a component of a TMDL and are being made a component of routine water quality monitoring. Similarly, New Jersey is applying these alternate indicators to develop more meaningful microbial TMDLs. In 2004, for example, WM&S began a statewide bacterial source trackdown study for the Department's TMDL program, using the RNA Coliphage and MAR indicators in addition to the more traditional bacterial indicators. During 2004 and 2005, 152 sites were sampled statewide as part of this study; the map below shows the stations sampled to date for this project. The future application of these indicators is awaiting the results of a data review being conducted by the Division of Watershed Management, who oversee the Department's TMDL program.

New Jersey's Bacterial TMDL Study 2008

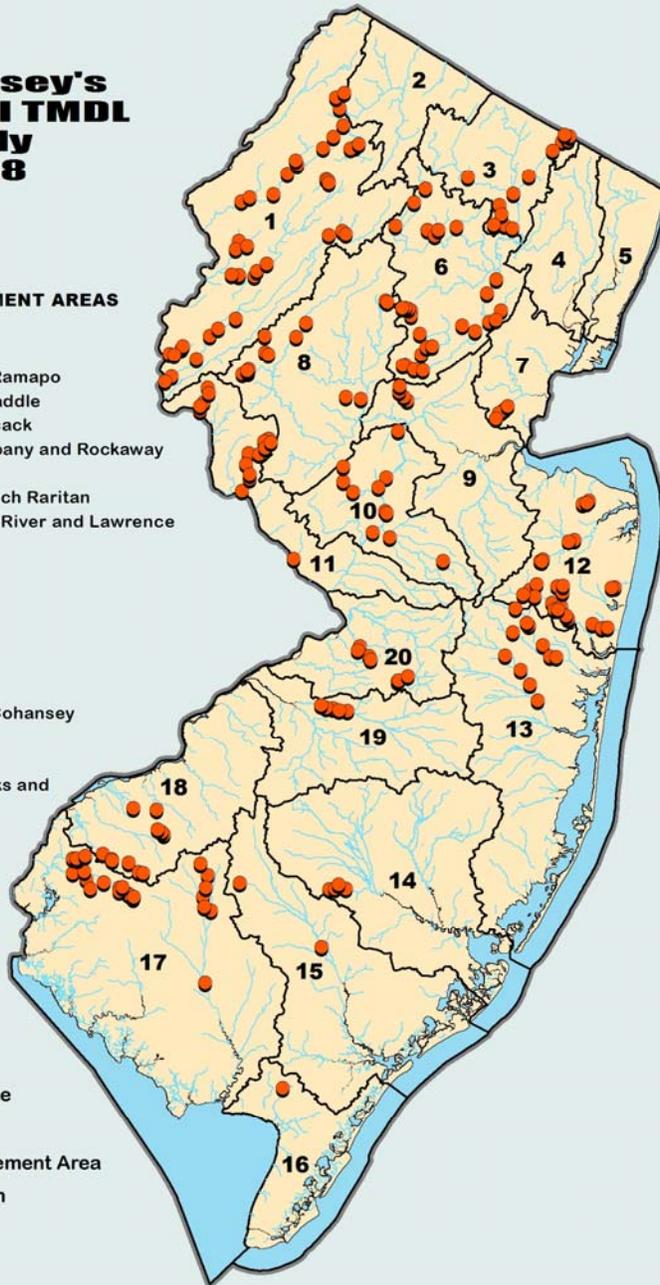
WATERSHED MANAGEMENT AREAS

1. Upper Delaware
2. Walkkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors

 Bacterial TMDL Site

 Watershed Management Area

 Major River/Stream



Stressor Identification

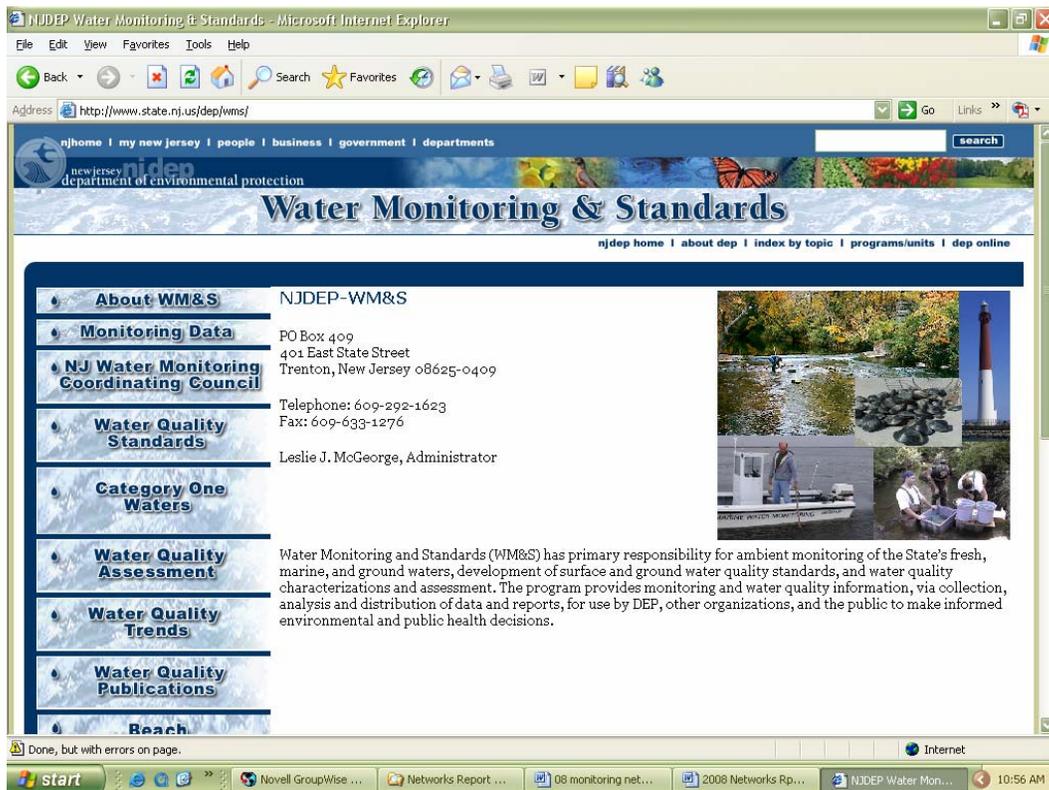
The department has currently assessed 314 sites located on non-tidal rivers and streams as impaired for Aquatic Life Support based upon the status of benthic macroinvertebrate communities. These sites have subsequently been placed on New Jersey's Sublist 5 (List of Impaired Waters or 303(d) List). Although these sites are listed as biologically impaired, there is no current information indicating what constituent would need to undergo a TMDL as required under section 303(d) of the CWA. The purpose of the Stressor Identification (SI) process, as developed by USEPA, is to identify the principal stressor(s) responsible for the degraded biological condition so that a TMDL or other appropriate management measure can be taken to remediate the impairment.

WM&S' Bureau of Freshwater and Biological Monitoring and Bureau of Water Quality Standards and Assessment, in consultation with the Division of Watershed Management, developed a strategy delineating the steps necessary to develop an SI for New Jersey. Specifically this strategy outlines 1) how to handle the large number of sites needing assessment, 2) how the two divisions will coordinate their activities and, 3) step by step, how the Department will proceed through the SI process.

Initial steps have focused on performing SI in relatively undeveloped watersheds to allow the Department to learn the process as outlined by EPA, while simultaneously coordinating the programs involved. BFBM has begun the effort in regions which will require relatively simple SI assessments because they contain few and, hopefully, easily observable causes. Also initially prioritized are sites which have shown significant downgrades in benthic macroinvertebrate communities between Rounds I and II. Once these initial priority watersheds are complete, the Department will move on to other watersheds, perhaps proceeding watershed by watershed in a manner yet to be determined.

Data Dissemination

Water Monitoring and Standards recognizes that availability of our monitoring data and results is as important as methods by which the data are collected and assessed. WM&S makes its monitoring data and results publicly available in a variety of ways. WM&S maintains a webpage (www.nj.gov/dep/wms) through which much of our data and reports are electronically available. Data generated by WM&S can also be downloaded from EPA's STORET database at <http://www.epa.gov/storet/dbtop.html> or USGS' NWIS database at: <http://waterdata.usgs.gov/nwis>. Information from both STORET and NWIS is also available through USEPA's "[Window To My Environment](#)" (WME), a powerful web-based tool providing a wide range of federal, state, and local information about environmental conditions/features in an area of your choice. Using WME, you can find our fresh and marine ambient water quality monitoring stations in your area of interest and download our water quality monitoring results directly to your personal computer. Another method to access our monitoring data is through iMapNJ ArcIntelligence (<http://www.state.nj.us/dep/gis/newmapping.htm>), which is an interactive mapping application that allows users to utilize GIS functionality over the internet. Many of our reports are also available, electronically, from the New Jersey Environmental Digital Library at Rutgers University (<http://njedl.rutgers.edu/njdlib>). Additionally, hard copies of many of our reports can be obtained by calling WM&S at (609) 292-1623.



Additional Information about the Water Monitoring and Standards Program

Contact Information

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