New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Post Office Box 409, Trenton
Water Monitoring Project

Leslie J. McGeorge, Administrator

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PARTIAL SANITARY SURVEY OF SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

1999 - 2003

Water Monitoring Report Prepared by:

Julie Nguyen

Environmental Specialist

Bureau of Marine Water Monitoring
PO Box 405 Stoney Hill Road
Leeds Point, NJ 08220

Robert Connell, Bureau Chief

STATE OF NEW JERSEY

RICHARD J. CODEY

ACTING GOVERNOR

PARTIAL SANITARY SURVEY OF SHELLFISH GROWING AREA NE-2 NAVESINK RIVER

1999 - 2003

New Jersey Department of Environmental Protection
BRADLEY M.CAMPBELL
COMMISSIONER

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EXECUTIVE SUMMARY

The water quality data presented in this Partial Sanitary Survey of Shellfish Growing Area NE-2 (Navesink River) were collected between September 1999 and September 2003 using the Systematic Random Sampling (SRS) strategy. Approximately 1,340 water samples were collected and tested for total and fecal coliform bacteria. The water quality of this shellfish growing area was good in the area classified as *Seasonally Approved (November to April)*. However, the water quality in the upper portion of the Navesink River continues to be poor and the data no longer supports the current classification of *Special Restricted*. Two stations situated in *Special Restricted* waters failed to meet the *Special Restricted* Classification, specified by the National Shellfish Sanitation Program (NSSP). Therefore, it is recommended that 152 acres of waters in the upper portion of the Navesink River be downgraded from *Special Restricted* to *Prohibited*. The proposed area would encompass all waters located west of Highway 35 Bridge (Cooper's Bridge) in Red Bank, including Swimming River and Shadow Lake.

INTRODUCTION

PURPOSE

This report is part of a series of studies having a dual purpose. The first and primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP) that are established by the Interstate Shellfish Sanitation Conference (ISSC). Reports generated under this program form the basis for classifying shellfish waters for the purpose of harvesting shellfish for human consumption. As such, they provide a critical link in protecting human health.

The second purpose is to provide input to the Integrated Water Quality Monitoring and Assessment Report, which is prepared pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the 305b portion of the Integrated Report, which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries, and ocean waters. The reports provide valuable information for the 305(b) portion of the Integrated Report, which describes the waters that are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution. Similarly, the reports utilize relevant information contained in the 305(b) portion of the Integrated Report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from reports represent two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) portion of the report describes the watershed that drains to that estuary.

The Department participates in a cooperative National Environmental Performance Partnership System (NEPPS) with the USEPA, which emphasizes ongoing evaluation of issues associated with environmental regulation, including assessing impacts on waterbodies and measuring improvements in various indicators of environmental health. The shellfish growing area reports are intended to provide a brief assessment of the growing area, with particular emphasis on those factors that affect the quantity and quality of the shellfish resource. The shellfish growing area reports provide valuable information on the overall quality of the saline waters in the most downstream sections of each major watershed. In addition, the reports assess the quality of the biological resource and provide a reliable indicator of potential areas of concern and/or areas where additional information is needed to accurately assess watershed dynamics.

HISTORY OF NSSP

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in 1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and the group continues to meet annually at various locations throughout the United States. The NSSP *Guide for the Control of Molluscan Shellfish* sets forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. It provides the basis used by the Federal Food and Drug Administration (FDA) in evaluating state shellfish sanitation programs. The five major points on which the state is evaluated by the FDA include:

1. The classification of all actual and potential shellfish growing areas as to their suitability for shellfish harvesting.
2. The control of the harvesting of shellfish from areas that are classified as restricted prohibited or otherwise closed.

3. The regulation and supervision of shellfish resource recovery programs.
4. The ability to restrict the harvest of shellfish from areas in a public health emergency, and
5. Prevention of the sale, shipment or possession of shellfish that cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

FUNCTIONAL AUTHORITY

The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and Senior Services and the Department of Law and Public Safety. The Bureau of Marine Water Monitoring (BMWM), under the authority of N.J.S.A. 58:24, classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

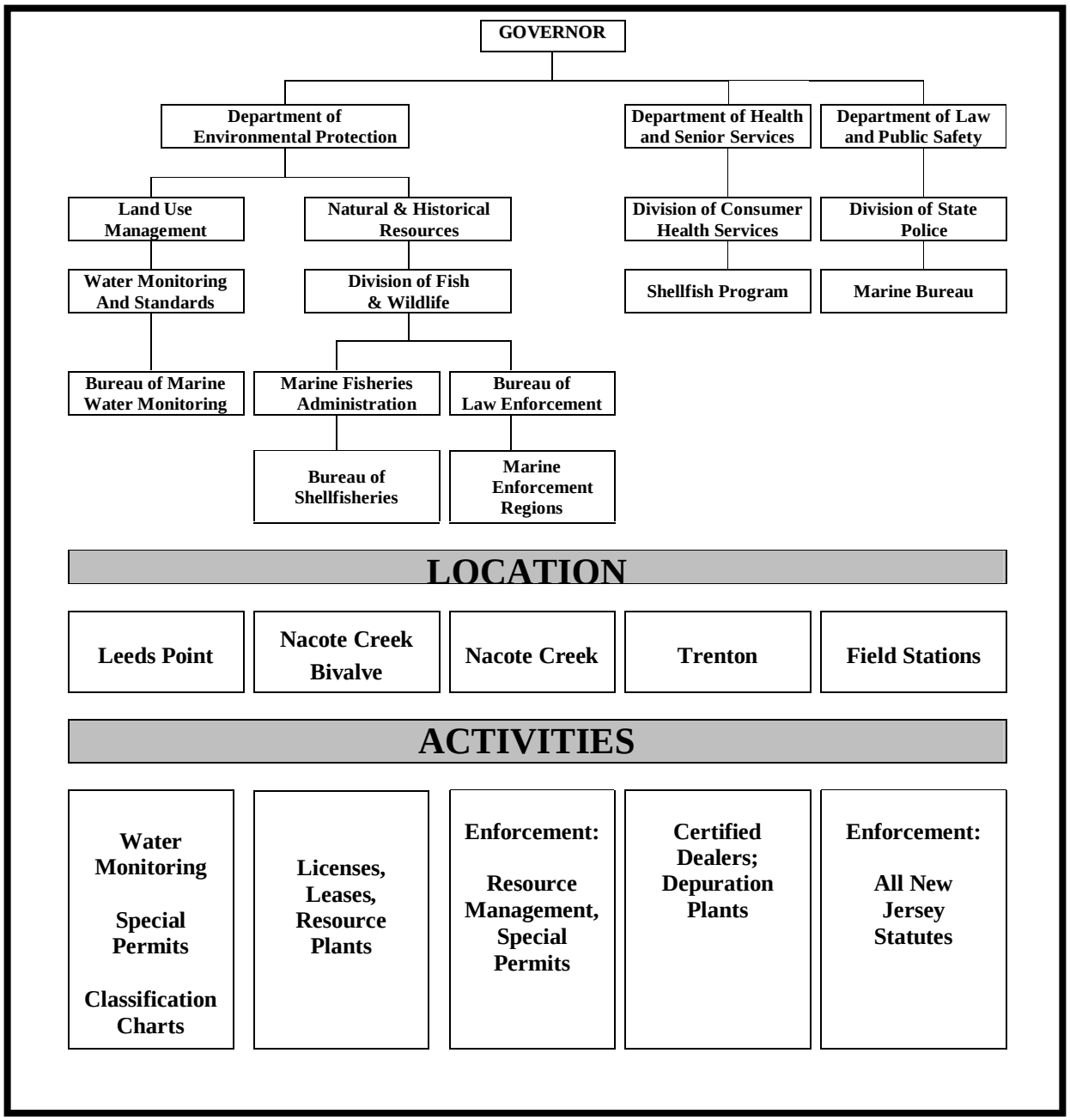
The Bureau of Shellfisheries, in the Division of Fish and Wildlife, issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau, in conjunction with the BMWM, administers the Hard Clam Relay Program.

The Bureau of Law Enforcement, in the DEP Division of Fish and Wildlife, and the Division of State Police, in the Department of Law and Public Safety, enforce the provisions of the statutes and rules mentioned above.

The Department of Health and Senior Services is responsible for the certification of wholesale shellfish establishments and, in conjunction with the BMWM, administers the depuration program.

The division of authority between the three agencies can be seen in Figure 1.

FIGURE 1: STATE OF NEW JERSEY SHELLFISH AGENCIES



IMPORTANCE OF SANITARY CONTROL OF SHELLFISH

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of diseases to humans. Shellfish borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via storm water runoff from urban and agricultural areas and from direct discharges such as wastewater treatment facilities.

Clams, oysters and mussels pump large quantities of water through their bodies during the normal feeding process. During this process the shellfish also concentrate microorganisms, which may include pathogenic microbes, and toxic heavy metals/chemicals. It is imperative that a system is in place to reduce the human health risk of consuming shellfish from areas of contamination.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. The principal components of the sanitary survey report include:

1. An evaluation of all actual and potential sources of pollution,
2. An evaluation of the hydrography of the area and
3. An assessment of water quality. Complete intensive Sanitary Surveys are conducted every 12 years with interim narrative evaluations (Reappraisals) completed on a three-year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report (Sanitary Survey) is initiated prior to its l2 year schedule. Also, if only a section of a growing area is either upgraded or downgraded from its current shellfish classification, a partial intensive report (Partial Sanitary Survey) is conducted for that shellfish growing area. Annual Reviews are written on a yearly basis for each shellfish growing area.

The following narrative constitutes this bureau's assessment of the above mentioned components and determines the current classification of the shellfish growing waters of Shellfish Growing Area NE-2, Navesink River.

GROWING AREA PROFILE

LOCATION

Shellfish growing area NE-2 (Navesink River) is located in the northern part of New Jersey, in Monmouth County (see Figure 2). This shellfish growing area encompasses all waters in the Navesink River and extends northward into the Shrewsbury River to Route 36 Bridge in the Highlands and southward to the Sea Bright-Rumson Bridge. The location of shellfish growing area NE-2 can also be found on the "2004 State of New Jersey Shellfish Growing Water Classification" charts 2.

The following municipalities are located adjacent to this shellfish growing area: Middletown, Tinton Falls, Red Bank, Fair Haven, Rumson, Highlands, and Sea Bright. The locations of the adjacent municipalities are shown in Figure 2, and the population statistics for the adjacent municipalities are shown in Table 1 (US Census Bureau).

FIGURE 2: LOCATION AND MUNICIPALITIES OF SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

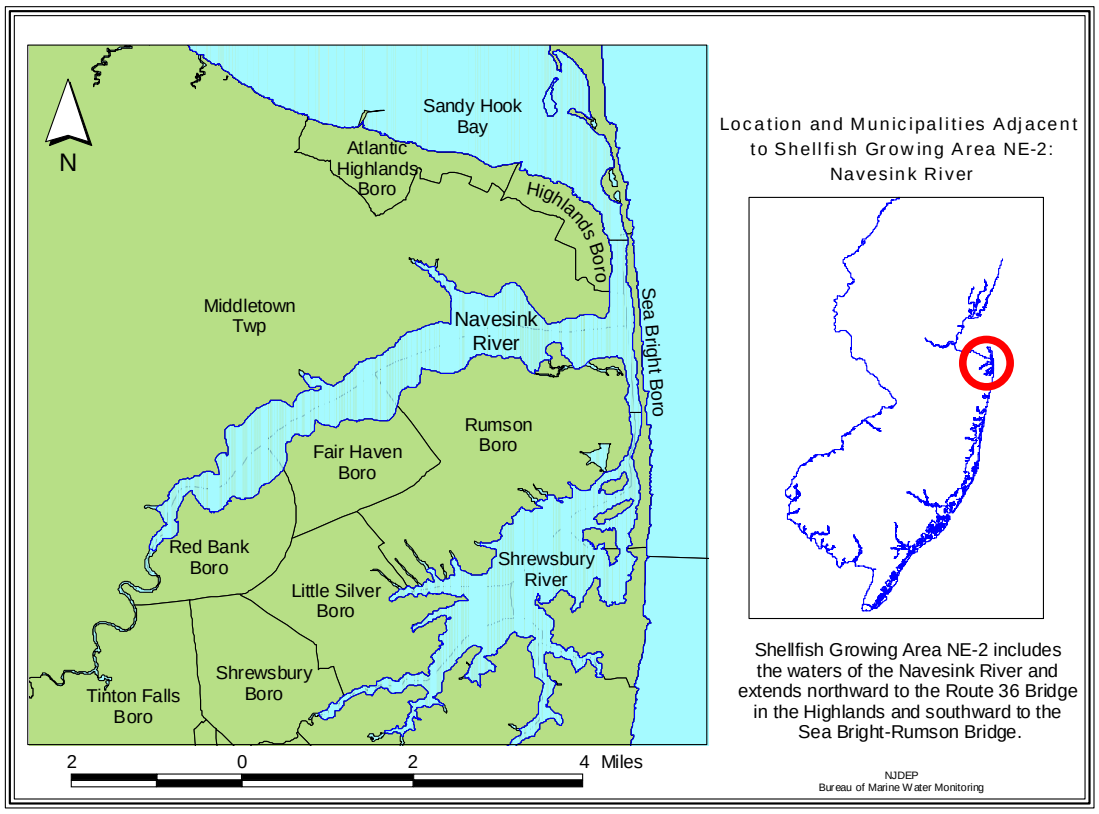


TABLE 1: POPULATION STATISTICS FOR MUNICIPALITIES ADJACENT TO SHELLFISH GROWING AREA NE-2: NAVESINK RIVER (US CENSUS BUREAU)**.**

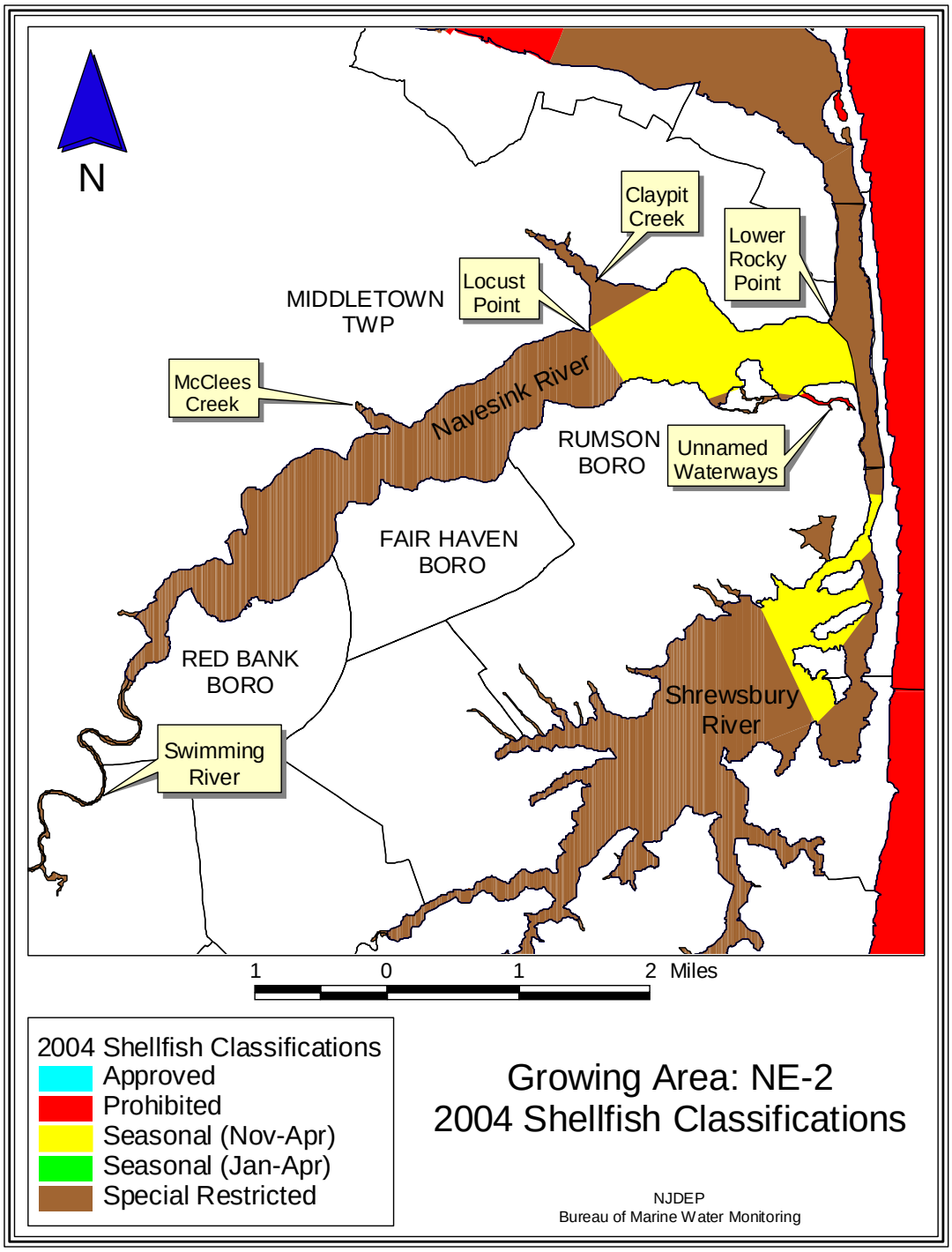
Community	Area (Sq. mi.)	Population (2003 Census)	Population Density (Persons/ sq.mi.)
Fair Haven Boro	1.0 sq.mi.	5,984	5,984
Highlands Boro	0.7 sq.mi.	5,172	7,388
Middletown Boro	40.3 sq.mi.	66,783	1,657
Red Bank Boro	1.75 sq.mi.	11,969	6,839
Rumson Boro	5.5 sq.mi.	7,117	1,294
Sea Bright Boro	1.02 sq.mi.	1,834	1,798
Tinton Falls Boro	15.15 sq.mi.	15,951	1,052

DESCRIPTION

The principal bodies of waters in shellfish growing area NE-2 are the Navesink River and a portion of the Shrewsbury River. The approximate size of this shellfish growing area is 2,526 acres, and the shellfish classifications are *Seasonally Approved (November-April)*, *Special Restricted*, and *Prohibited* for shellfish harvesting. There are approximately 677 acres of *Seasonally Approved (November-April)* waters, 1841 acres of *Special Restricted* waters, and 8 acres of *Prohibited* waters in this shellfish growing area. The *Seasonally Approved (November-April)* area can be found on the eastern end of the Navesink River, starting from the Oceanic Bridge extending northward to Locust Point and extending eastward toward Lower Rocky Point, excluding waters within Claypit Creek and smaller waterways located in the lower Navesink.

The majority of waters in this shellfish growing area are classified as *Special Restricted*. The *Special Restricted* waters are located in the western section of the Navesink River, starting from the Oceanic Bridge extending westward, including Swimming River and Shadow Lake. Other *Special Restricted* areas include Claypit Creek, Shrewsbury River, and the unnamed waterways located in the lower Navesink. A very small portion of this shellfish growing area is classified as *Prohibited*. The *Prohibited* area can be found in the lower Navesink, in the unnamed waterways. Tidal flushing for this area mainly occurs through the Shrewsbury River.

FIGURE 3: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA NE-2: NAVESINK RIVER



HISTORY OF SHELLFISH GROWING AREA

The Navesink River has been, for many years, a major source of soft clams (Mya arenaria) in New Jersey. Hard clam harvesting in the Navesink River did not begin until 1983, when the Relay Program was established. This program allows harvesting of shellfish in *Special Restricted* waters and then re-planting them into *Approved* waters for purging. Shellfish harvested for depuration process did not begin until 1996 (Zimmer, 2000). At this present time, there are seven sites in which shellfish can be harvested for depuration or relay process in the Navesink River.

In 1997, a section of the Navesink River was upgraded from *Special Restricted* to *Seasonally Approved (November to April)*. This was the result of reducing non-point source contamination to the river through an effort made by the Navesink River Watershed, Monmouth County and many state agencies, as well as the private sector. The main goal of these agencies is to restore the overall water quality of the river, which includes identifying the sources of bacterial pollution and whether it is from urban, suburban development, agricultural or marina/boating activities (Zimmer 2000).

In the 2004 Annual Review of Shellfish Growing Area NE-2 (Navesink River), classifications changes were proposed (Watkins, 2004). It was recommended that waters in the upper portion of the Navesink River be downgraded from *Special Restricted* to *Prohibited*. This resulted from continual decline of the water quality and the fact that the data do not support the existing shellfish classifications. See section on *Water Quality Studies* for further details. The last Sanitary Survey for Shellfish Growing Area NE-2 (Navesink River) was written in 1996.

METHODS

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1992).

Approximately 1,340 water samples were collected for total and fecal coliform bacteria between 1999 and 2003 and analyzed by the three tube MPN (Most Probable Number) method (the indicator density of bacteria colonies most likely to produce a particular combination of positive and negative results in test tubes) (APHA, 1970). Figures 26 show the Shellfish Growing Water Quality monitoring stations for Shellfish Growing Area NE-2. Approximately 44 stations are monitored during each sampling year. Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish,* 1999 Revision (USPHS, 1999 Revision).

Data management and analysis was accomplished using database applications developed for the Bureau.

Mapping of pollution data was performed with the Geographic Information System (GIS: ARCVIEW®).

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* or *Prohibited*. Criteria for bacterial acceptability of shellfish growing waters are provided in NSSP *Guide for the Control of Molluscan Shellfish*, 1999 Revision (USPHS, 1999 Revision).

SAMPLING STRATEGY

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition (APC) strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliform in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide and rainfall, but could be from a point source of pollution or variation could occur during a specific time of the year (Connell, 1991).

The Systematic Random Sampling (SRS) strategy requires that a random sampling plan be in place before field sampling begins. This strategy can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to the database to obtain a sample size of 30 for statistical analysis.

This shellfish growing area was sampled using the Systematic Random Sampling strategy, year-round with no tidal preferences (Assignment 37).

NSSP CRITERIA

Each shellfish-producing state is directed to adopt either the total coliform criterion, or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each sampling station. These data are viewed as adjunct information and are not directly used for classification.

The criteria were developed to ensure that shellfish harvested from the designated waters would be free of pathogenic (disease-producing) bacteria. Each classification criterion is composed of a measure of the statistical 'central tendency' (geometric mean) and the relative variability of the data set. For the Adverse Pollution Condition sampling strategy, variability is expressed as the percentage that exceeds the variability criteria (see Table 2). For the Systematic Random Sampling strategy, variability is expressed as the 90th percentile (see Table 3). Areas to be Approved under the *Seasonal* classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

TABLE 2: CRITERIA FOR ADVERSE POLLUTION CONDITION SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	**No more than 10% of samples can exceed** (MPN/100 mL)	**Geometric mean** (MPN/100 mL)	**No more than 10% of samples can exceed** (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

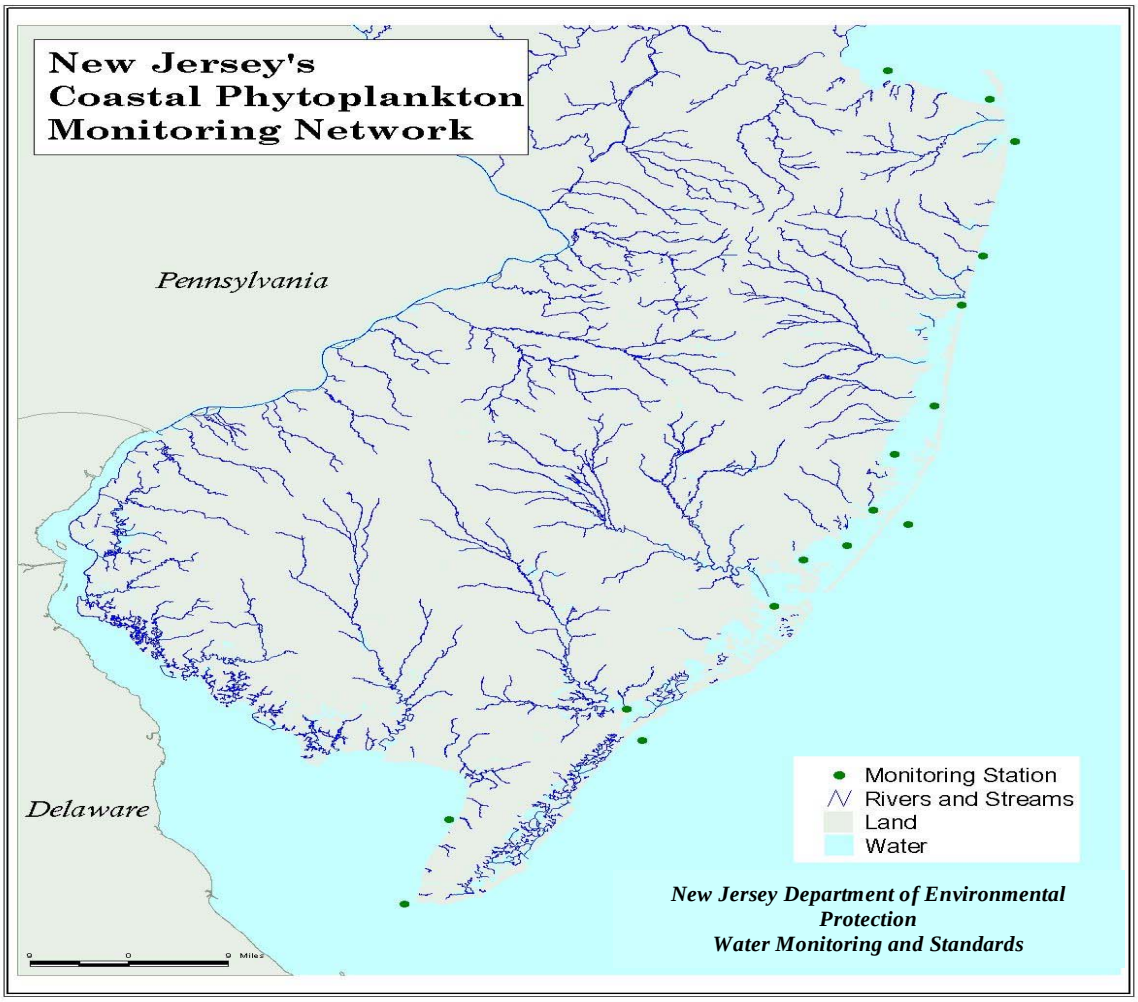
TABLE 3: CRITERIA FOR SYSTEMATIC RANDOM SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	**Estimated 90th percentile** (MPN/100 mL)	**Geometric mean** (MPN/100 mL)	**Estimated 90th percentile** (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

MARINE BIOTOXINS

The Department collects samples at regular intervals throughout the summer to determine the occurrence of marine algae that produce biotoxins (see Figure 4 for location of Phytoplankton sampling stations). Certain planktonic species have the potential to adversely affect the suitability of shellfish for human consumption. These planktonic species cause algal blooms that deplete the dissolved oxygen levels in the water. No algal blooms capable of producing biotoxins were identified in this shellfish growing area between 1999-2003. These data are evaluated weekly by the Bureau of Marine Water Monitoring in accordance with the NSSP requirements. An annual report is compiled and is available electronically at: *www.state.nj.us/dep/wmm/bmw*.

FIGURE 4: LOCATION OF PHYTOPLANKTON SAMPLING STATIONS



SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

Shoreline surveys were conducted in May of 2004. There were several new developments adjacent to this shellfish growing area. The construction of big single family homes on both sides of the Navesink River, were sighted in Middletown (see Figure 5) and the construction of new condos and townhouses adjacent to the river in Red Bank.

Other changes included the new West Front Street Bridge. The West Front Street Bridge was built by the US Army Corps of Engineers and is now used as a temporary bridge to replace the existing Front Street Bridge, which has structural damage and is unsafe for motorists. The temporary bridge is located over Swimming River, connecting Red Bank and Middletown. The bridge was opened for travel in April 2004, and is estimated to last for about ten years. The county is anticipating building a new permanent bridge to replace the old Front Street Bridge (see Figure 6).

The Locust Ave. Bridge was also under construction (see Figure 7). This bridge is located over Claypit Creek in Middletown.

FIGURE 5: CONSTRUCTION OF NEW HOMES IN SHELLFISHFISH GROWING AREA NE-2, NAVESINK RIVER

FIGURE 6: WEST FRONT BRIDGE (TEMPORARY BRIDGE)

FIGURE 7: LOCUST AVE. BRIDGE UNDER CONSTRUCTION

LAND USE

This shellfish growing area is heavily developed with urban areas (see Figure 8). Middletown, Highlands, Sea Bright, Rumson, Fair Haven, Red Bank, and Tinton Fall are very urbanized and almost all of these communities are on public sewer, with the exception of the rural areas in Middletown and about sixteen homes in Rumson. According to the Monmouth County Health Department, new homes will be connected onto city sewer and homes still on septic systems will either be connected when they are re-sold or when property improvements are made. Areas bordering the river primarily consist of single family homes, built on large lots. Most of these waterfront properties have their own private docks (see Figure 9).

Even though a significant amount of lands in this area are being use for urban development, there are still some lands devoted to forest and agriculture. Land designated as forest can be found on the eastern end of the Navesink River near Upper Rocky Point, in Middletown (see Figure 10). Agricultural lands are located further inland between Locust Point and Mclees Creek, in Middletown, and also in Tinton Falls. Agricultural lands are primarily used as pastureland and/or cropland.

Wetlands can be found sparsely throughout this shellfish growing area. Wetlands act as a barrier and a purifier against pollutants, but also utilize the nutrients obtained for plant growth. By doing so, the wetland helps to reduce pollutants entering into the shellfish growing area. Strips of marshes can be found adjoining the riverside (see Figure 11).

FIGURE 8: LAND USE PATTERNS FOR SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

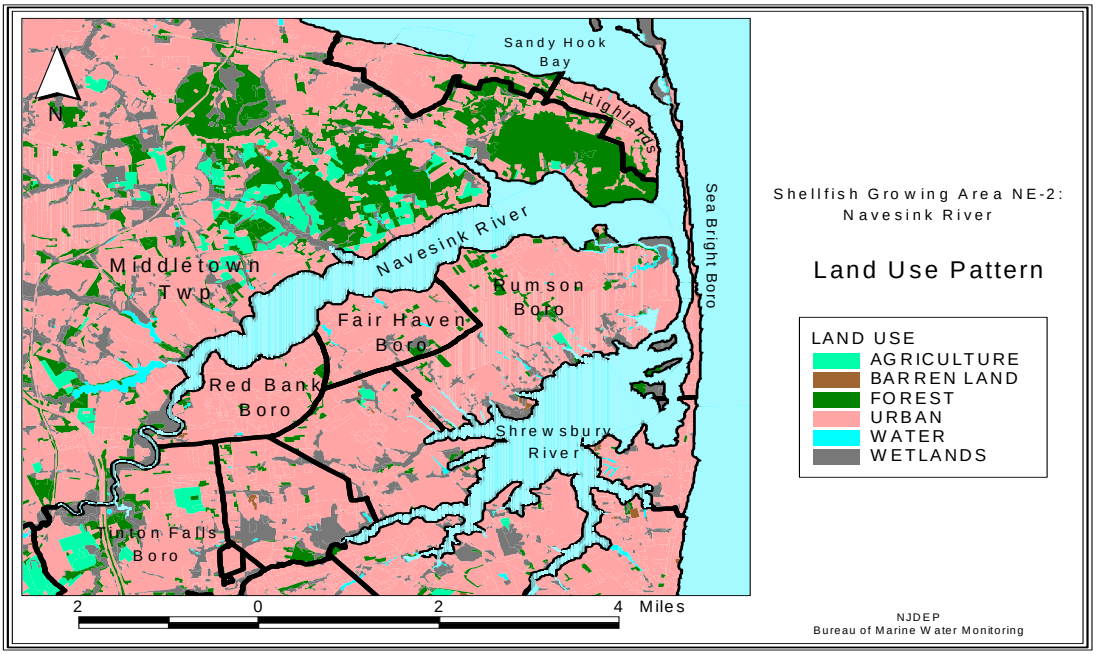


Figure 9: Homes with Private Docks in the Navesink River

FIGURE 10: HARTSHORNE WOODS PARK

FIGURE 11: STRIPE OF MARSHES ADJACENT TO SHELLFISH GROWING AREA: NE-2

EVALUATION OF BIOLOGICAL RESOURCES

In 2002, New Jersey harvested 84,776,705 pounds of shellfish meat, valued at $81,871,542. These shellfish species include hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), mussels, bay scallops (*Aequipecten irradians*), oysters (*Crassostrea virginica*), ocean quahogs (*Arctica islandica*), surf clams (*Spisula solidissima*), and sea scallops (*Placopecten magellanicus*). (www.st.nmfs.gov, 2004)

This shellfish growing area has a wide diversity of biological resources. Hard clams (*Mercenaria mercenaria*) and soft clams (Mya arenaria) exist in moderate to high densities in the Navesink River (see Figure 12 and 13). Between 1999 and 2002, approximately 825,755 clams were harvested from the Navesink River under the Special Permit Program (see Table 4). Under the Special Permit Program, shellfish can only be harvested from designated areas in *Special Restricted* waters (see Figure 14). However, they must undergo either relay or depuration process, before they can be sold commercially.

Depuration Process involves removing the shellfish from contaminated water and placing them in tanks containing clean water for several days to purge (see Figure 15). This process is normally done in a depuration plant where it is routinely monitored by state law enforcement. Currently, there are two active depuration plants, the James T. White Depuration Plant and the Clean Water Clams Depuration Plant. Both plants are located in the Highlands.

Relay Process is very similar to the Depuration Process. Shellfish harvested from *Special Restricted* waters are re-planted in a leased plot in *Approved* waters to naturally purify for 30 days before they can be re-harvested for commercial use. Both of these processes will allow adequate amount of time for the shellfish to excrete any bacteria that may have adhered to the tissue prior to harvesting (Zimmer, 2000).

FIGURE 12: HARD CLAMS RESOURCES IN THE NAVESINK RIVER

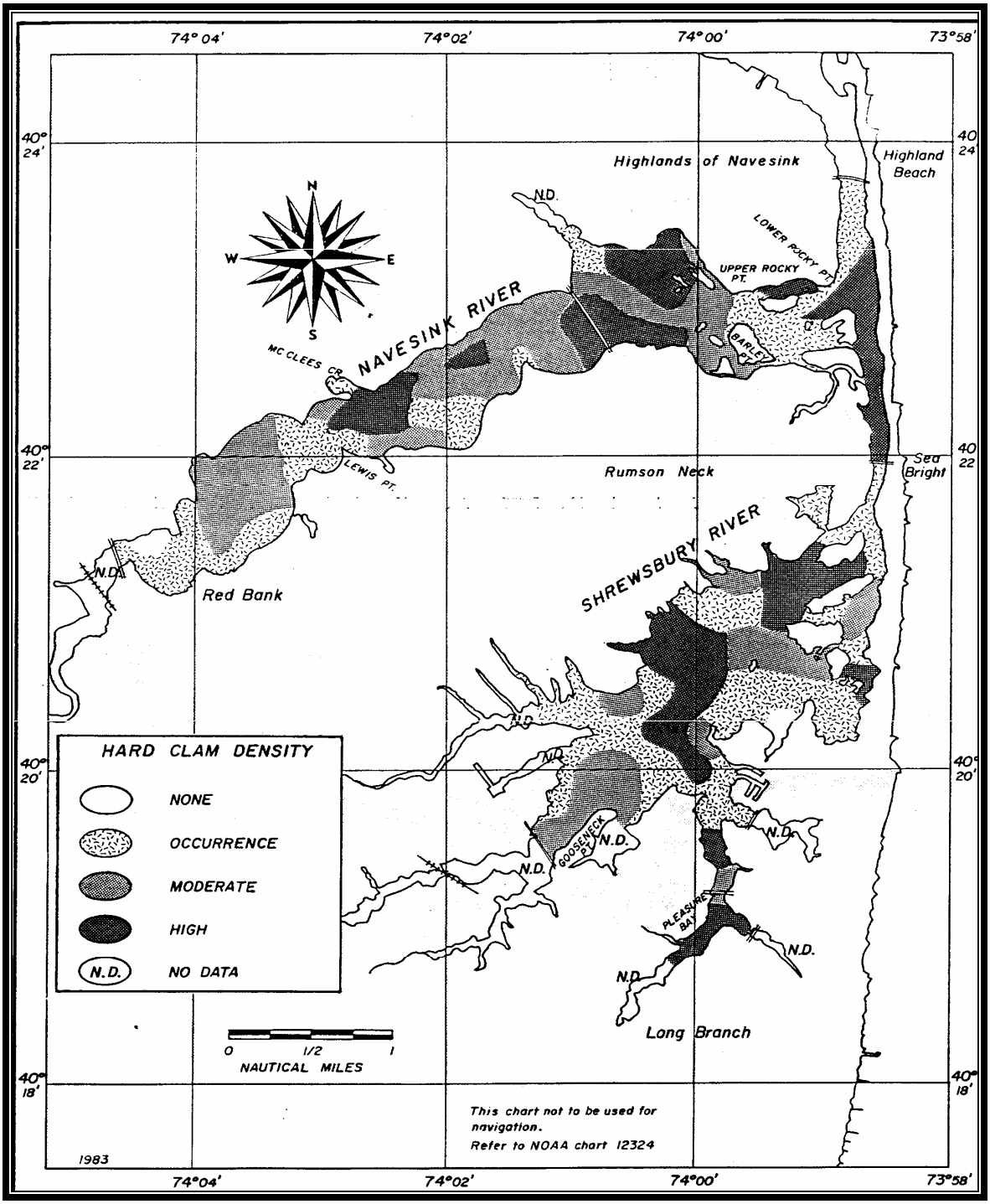


FIGURE 13: SOFT CLAMS RESOURCES IN THE NAVESINK RIVER

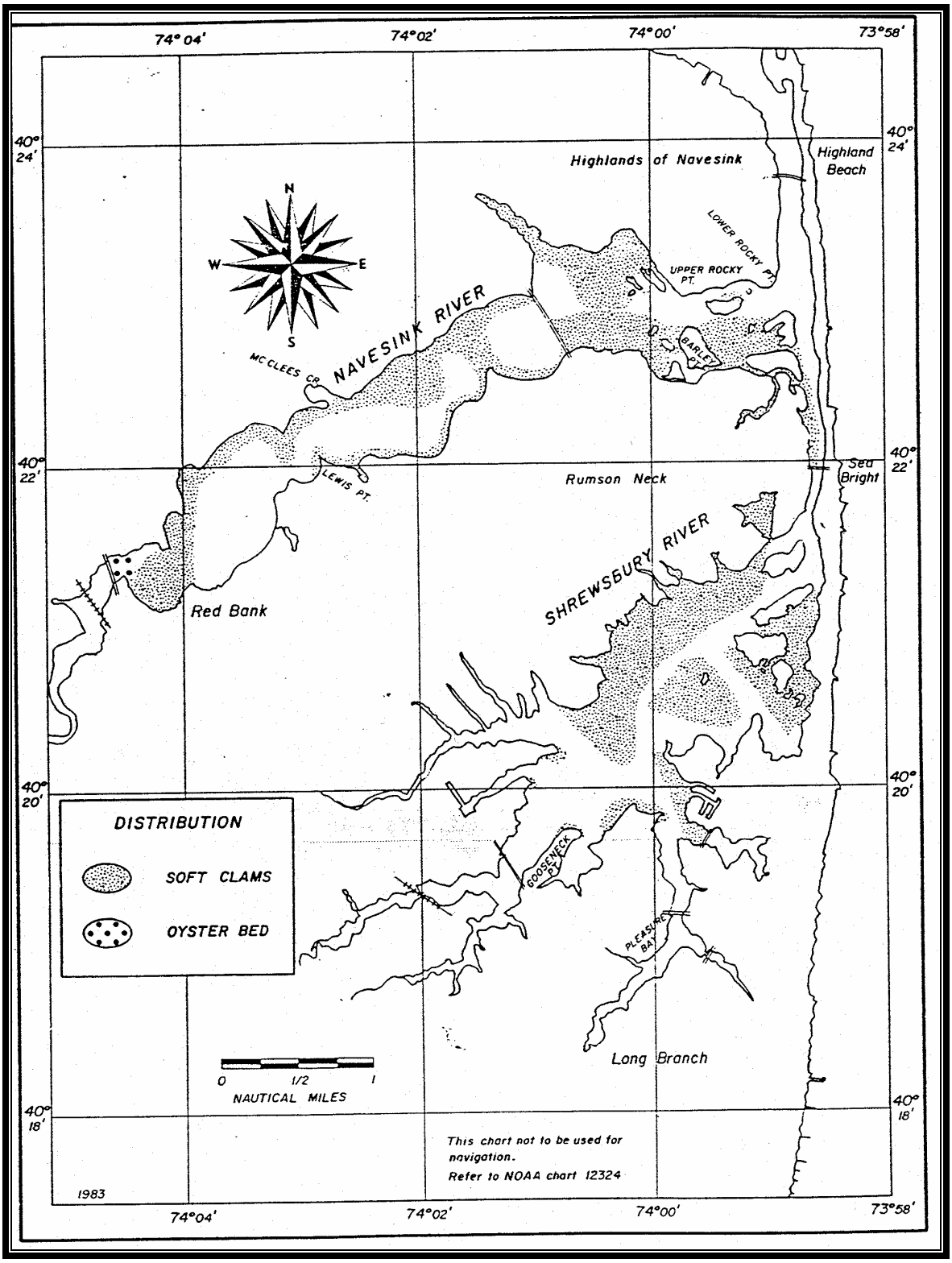


FIGURE 14: DESIGNATED HARVESTING AREAS IN SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

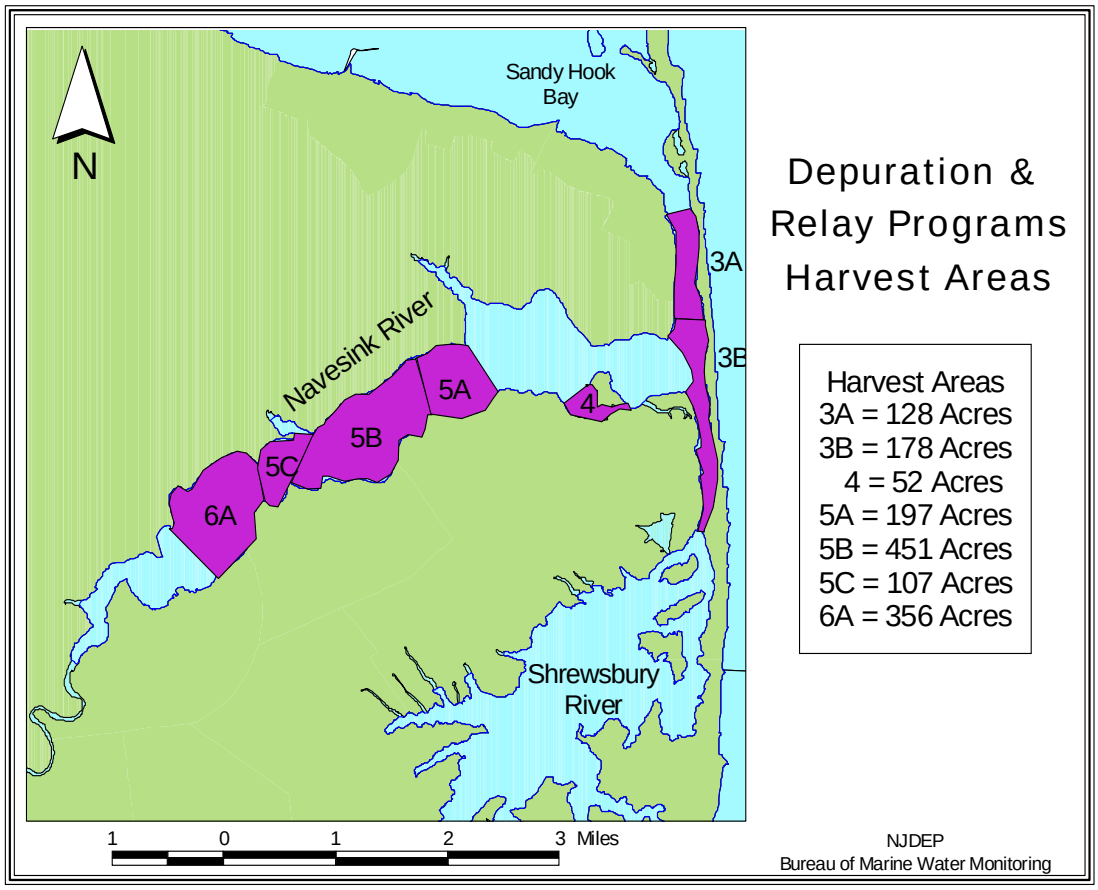


TABLE 4: HARD CLAMS HARVESTED IN THE NAVESINK RIVER UNDER THE SPECIAL PERMIT PROGRAM

YEAR	CLAMS HARVESTED FOR RELAY AND DEPURATION
1999	406,255
2000	13,045
2001	200
2002	N/A
2003	N/A
TOTAL	825,755

(Source: Michael Celestino, NJDEP Bureau of Shellfisheries, Nacote Creek)
***N/A means that data have not yet been compiled.**

FIGURE 15: CLAMS UNDERGOING PURIFICATION AT A DEPURATION FACILITY

(SOURCE: THE TIDAL EXCHANGE, HARBOR ESTUARY NEWS, CATHY YUHAS, 2003)

IDENTIFICATION AND EVALUATION OF POTENTIAL POLLUTION SOURCES

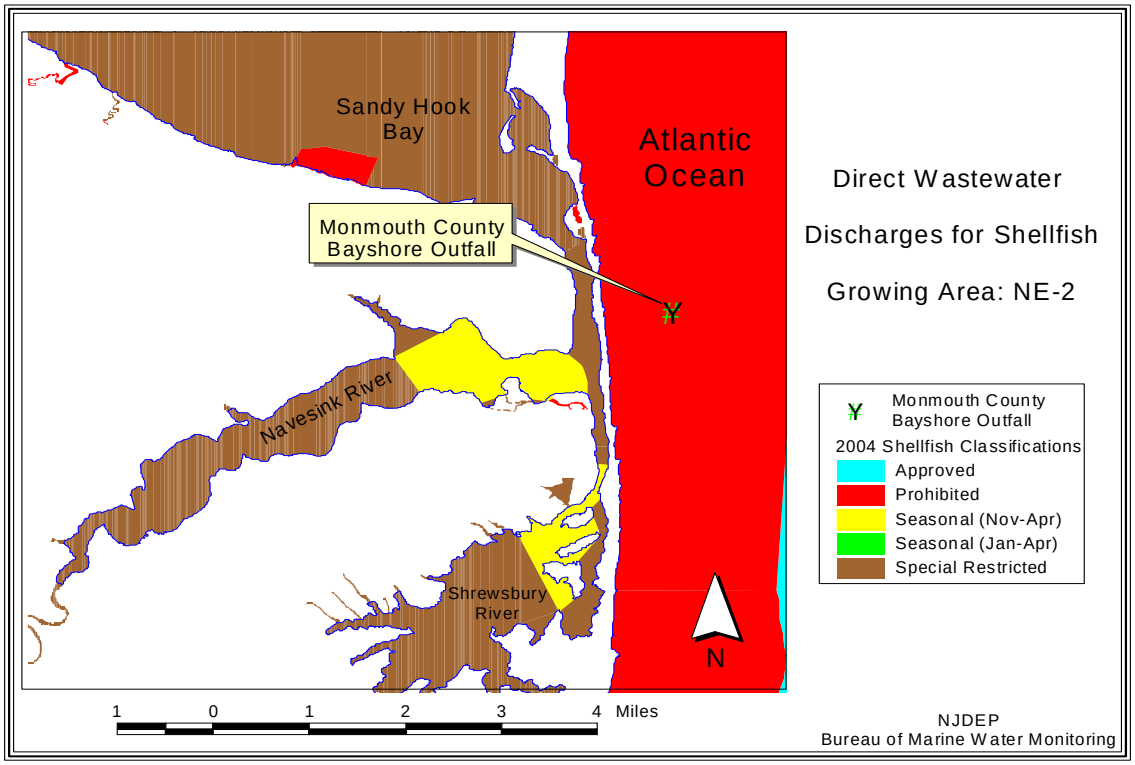
There is no permitted municipal point discharge in the Navesink River. The municipalities located on the south side of the river (Rumson, Fair Haven and Red Bank) are serviced by the Northeast Monmouth County Regional Sewer Authority. The treatment plant is located in Monmouth Beach and discharges wastewater directly into the Atlantic Ocean.

On the northern side of the Navesink River (Middletown Twp) development consisted of many single-family homes, built on large lots. Some are not be connected onto public sewer system. The Middletown Township Health Department has performed many dye-tests in the area and found no major problem associated with the septic tanks (Zimmer, 2000). Homes connected onto the public sewer system in Middletown are serviced by the Middletown Township Sewage Authority Plant, located in Belford (see Figure 16). The effluents are discharged to the Atlantic Ocean via the Monmouth County Bayshore Outfall Authority (see Figure 17).

FIGURE 16: AERIAL VIEW OF THE MIDDLETOWN SEWAGE AUTHORITY TREATMENT FACILITY IN BELFORD

(SOURCE: WWW.TOMSANJ.COM)

FIGURE 17: DIRECT WASTEWATER DISCHARGES TO THE WATERS OF SHELLFISH GROWING AREA NE-2: NAVESINK RIVER



INDIRECT DISCHARGES

There are several indirect ground water discharges, known contaminated sites, and solid waste landfills located in this shellfish growing area. Since there is a potential for pollutant inputs from these indirect sources into this shellfish growing waters, it is important to continue monitoring the water quality to determine the presence or absence of these indirect sources of pollution (APHA, 1995).

The sources of indirect ground water discharges into this shellfish growing area included gas stations and small commercial businesses. There were several ground water contaminated sites found adjacent to this shellfish growing area (see Figure 18). Most of these sites have either been closed or are currently going through the Site Remediation Program.

Figure 19 displays the known contaminated sites located adjacent to shellfish growing area NE-2. The highest concentrations of these known contaminated sites are located in Red Bank. The primary causes of these known contaminated sites are from leaking underground storage tanks. Most of these known contaminated sites are now repaired or closed.

There is one solid waste landfill located in close proximity to this shellfish growing area (see Figure 20). This landfill is the Red Bank Landfill, which is located on Sunset Avenue in Red Bank. This site is no long operating. However, there is always the possibility of leakage, which may flow into these shellfish growing waters.

The indirect ground water discharges, the currently active known contaminated sites, and the closed solid waste landfills all have the potential to impact the water quality of this shellfish growing area.

FIGURE 18: INDIRECT GROUND WATER DISCHARGES TO THE WATERS OF SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

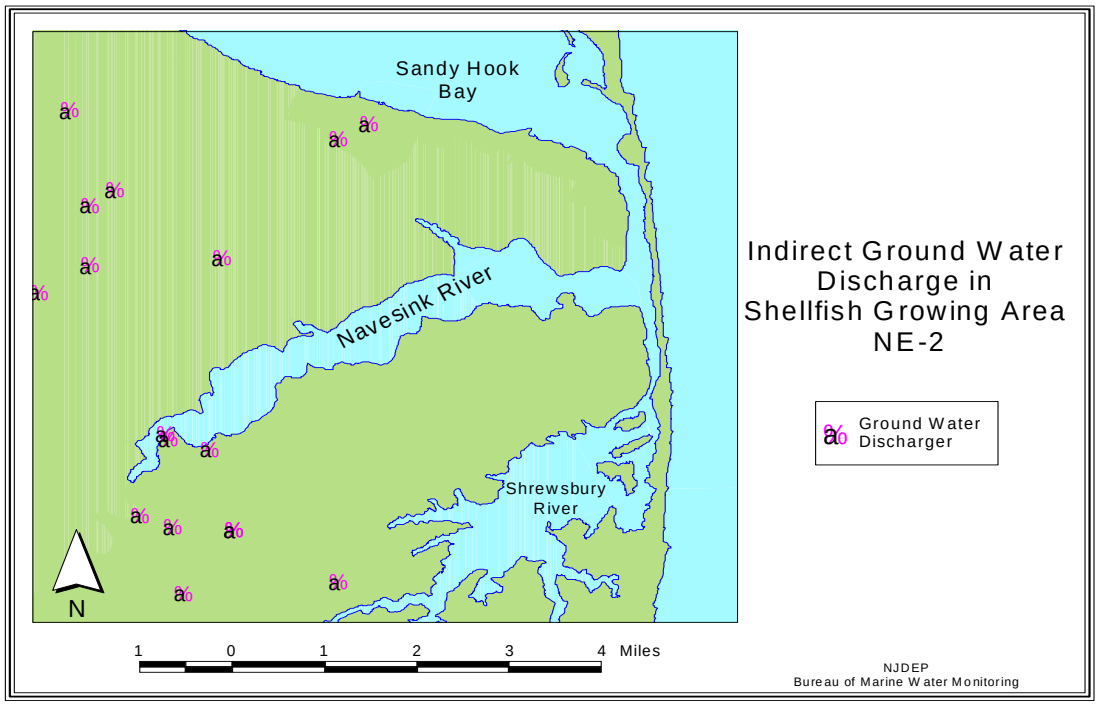


FIGURE 19: LOCATION OF KNOWN CONTAMINATED SITES ADJACENT TO SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

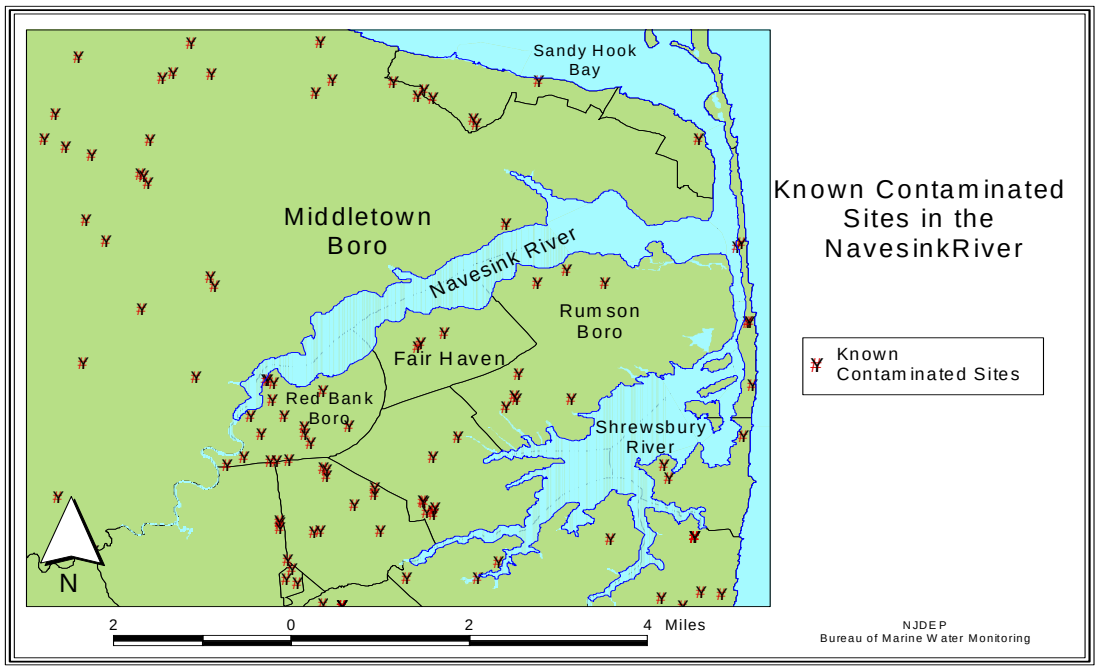
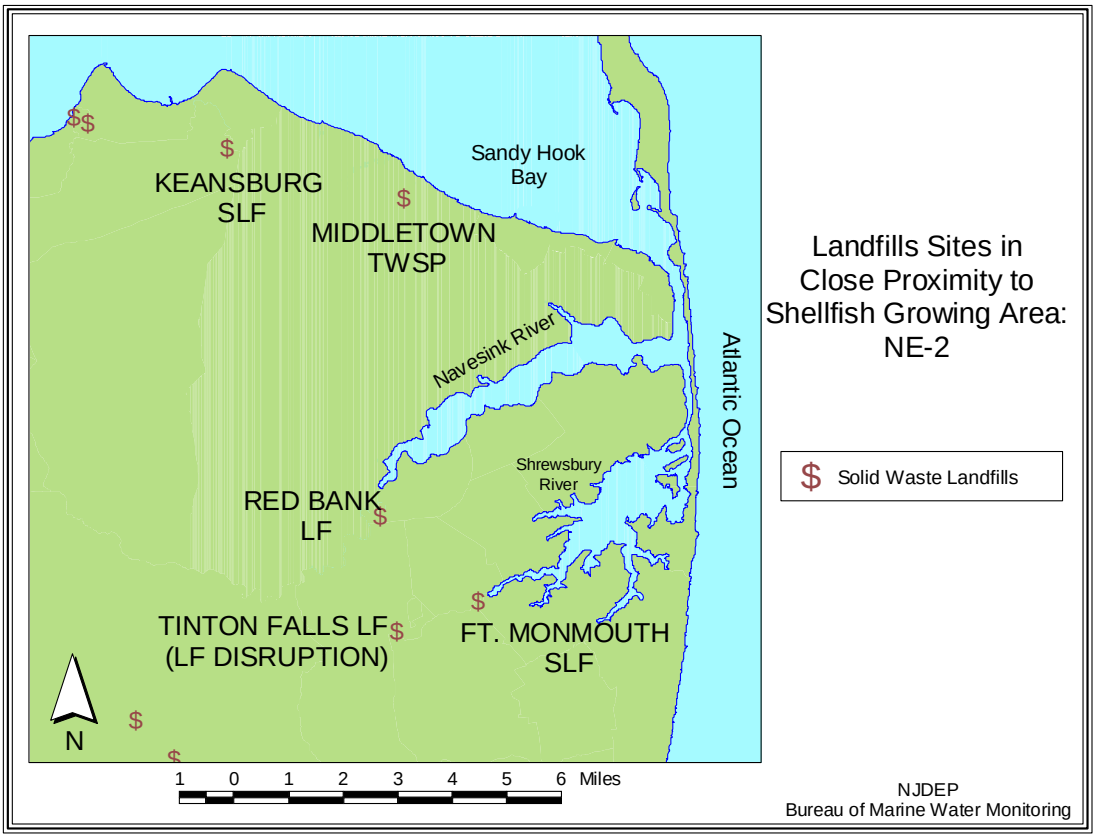


FIGURE 20: LOCATION OF SOLID WASTE LANDFILLS ADJACENT TO SHELLFISH GROWING AREA NE-2 NAVESINK RIVER



STORM WATER INPUTS

There are many stormwater outfalls located along the borders of this shellfish growing area. These stormwater outfalls have the potential to impact the water quality. Major concerns are placed on the outfalls situated in close proximity to shellfish growing waters (see Figure 21). When heavy rainfall occurs, bacteria, feces from domestic animals, and wastes from the streets are deposited into drain systems, which will eventually be carried out into shellfish waters.

Historical data collected by the Bureau of Marine Water Monitoring indicated this area was affected by rainfall. See section on *Rainfall Effects* for further details. Figure 22 shows a stormwater outfall in this shellfish growing area that drains directly into the Navesink River.

FIGURE 21: STORM WATER DISCHARGES TO SHELLFISH GROWING AREA NE-2: NAVESINK RIVER.

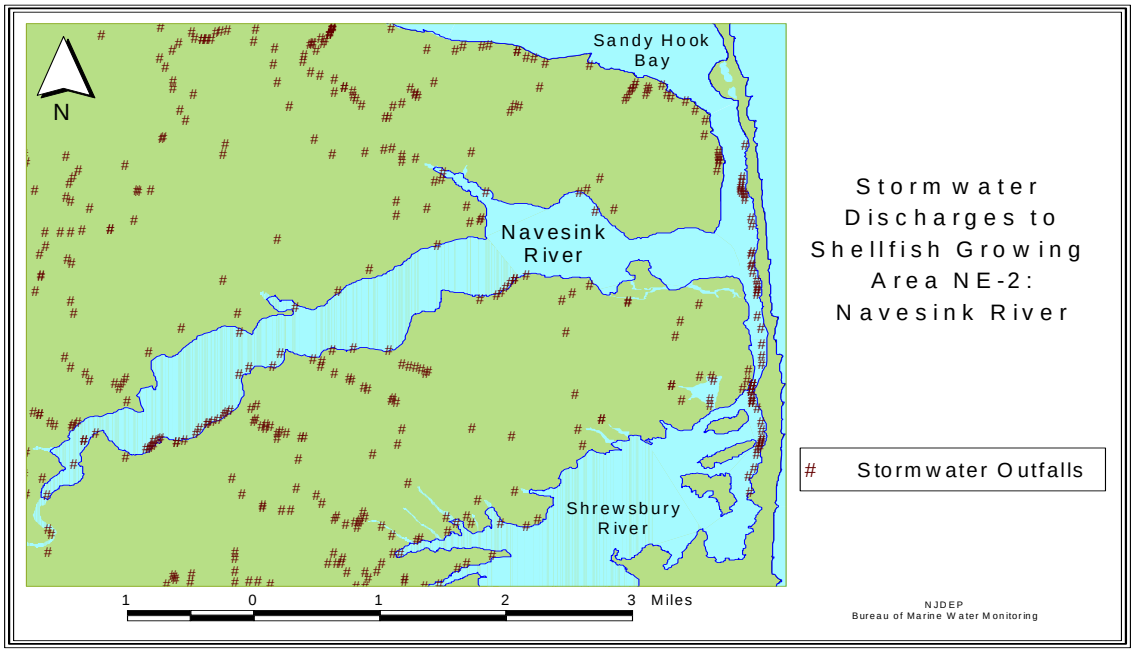


FIGURE 22: STORM WATER OUTFALL IN THE NAVESINK RIVER

MARINAS

Marina facilities have the potential to affect the suitability of shellfish growing areas for the harvest of shellfish. The biological and chemical contamination associated with marina facilities may be of public health significance. New Jersey defines a marina as "any structure (docks, piers, bulkheads, floating docks, etc.) that supports five or more boats, built on or near the water, which is utilized for docking, storing, or otherwise mooring vessels and usually but not necessarily provides services to vessels such as repairing, fueling, security or other related activities." New Jersey designates the confines of the marina as *Prohibited* for the harvest of shellfish. Adjacent waters are classified using a dilution analysis formula.

It is recognized by the NSSP *Guide for the Control of Molluscan Shellfish* (USPHS, 1999 Revision) that there are significant regional differences in all factors that affect marina pollutant loading. The *NSSP Guide for the Control of Molluscan Shellfish*, therefore, allows each state latitude in applying specified occupancy and discharge rates. The NSSP guidelines assume the worst case scenario for each factor.

EQUATION 1: MARINA BUFFER EQUATION. (ADAPTED FROM FDA. 1989):

$$BufferRadius(ft) = \sqrt{\frac{2x10^9(FC/person/day)x2(person/boat)x[(.25slips \geq 24') + (0.065 \times slips < 24')]x2}{140000(FC/M^3)xdepth(ft)x0.3048(M/ft)x\pi x2(tides/day)}}x3.28(ft/M)$$

Explanation of terms in equation:

Fecal coliform per person per day:	2×10^9
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste
Angle of shoreline:	180°, which results in factor of 2
Number of tides per day:	2
Depth in meters:	depth in feet x conversion factor
Water quality to be achieved:	140000 FC/meter ^{3}
Convert meters to feet:	3.28

Marina buffer zones may be calculated using the formula above (see Equation 1), or may be determined using a dilution analysis computer program developed by the State of Virginia and the USFDA. The formula above considers only dilution and occupancy rates. The computer program, which is used for complex configurations where the formula is unlikely to provide the needed accuracy, also considers tidal exchange and bacterial die-off.

There are 19 marinas in shellfish growing area NE-2, as shown in Figure 23 and Figure 24. The waters enclosed by the marina (the marina basin) are classified as *Prohibited*. Depending on the size of the marina, the water quality, flushing rates, and the depth of the water, shellfish waters immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally Approved* (no harvest during summer months when the marina is normally active). Marina buffer zones for this shellfish growing area were calculated using the New Jersey Marina Buffer Equation (see Equation 1). The size of each buffer zone is shown in Table 5.

FIGURE 23: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA NE-2: NAVESINK RIVER.

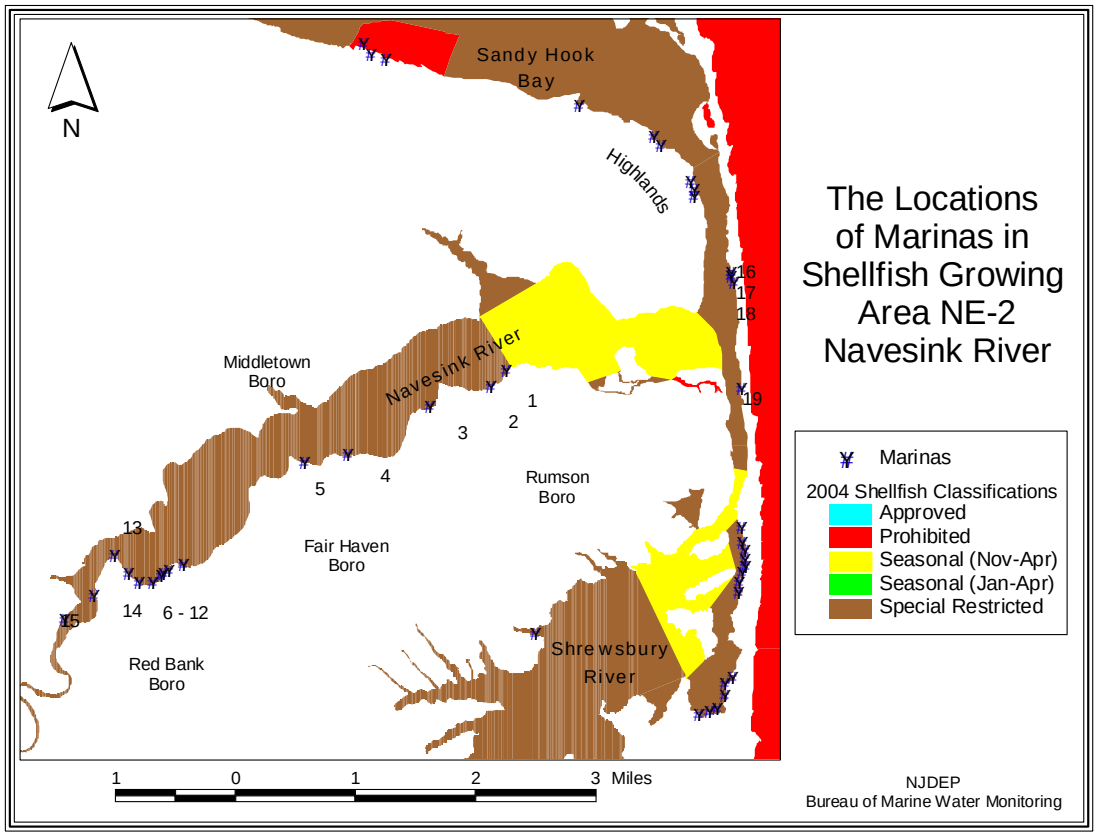


FIGURE 24: MARINA IN THE NAVESINK RIVER

TABLE 5: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA NE-2: NAVESINK RIVER

Map Key	Marina Name	# Slips > 24ft	# Slips < 24ft	Average Water Depth (ft)	Buffer Radius (ft)
1	Oceanic	50	50	6	918
2	Barnacle Bill's	50	30	5	963
3	Shrewsbury River Yacht Club	45	33	5	928
4	Fair Haven Yacht Works	90	27	6	1139
5	River Rats Sail Club	5	25	6	392
6	Irwin's Yacht Club # 1	70	34	5	1125
7	Red Bank Municipal Basin	4	25	5	411
8	Monmouth Boat Club	42	0	5	821
9	North Shrewsbury Ice Boat & Yacht Club	0	0	5	0
10	Irwin's Yacht Club # 2	20	13	5	613
11	Riverview Towers Condo Marina	12	15	5	505
12	Molly Pitcher	75	0	5	1097
13	Oyster Point	40	0	5	801

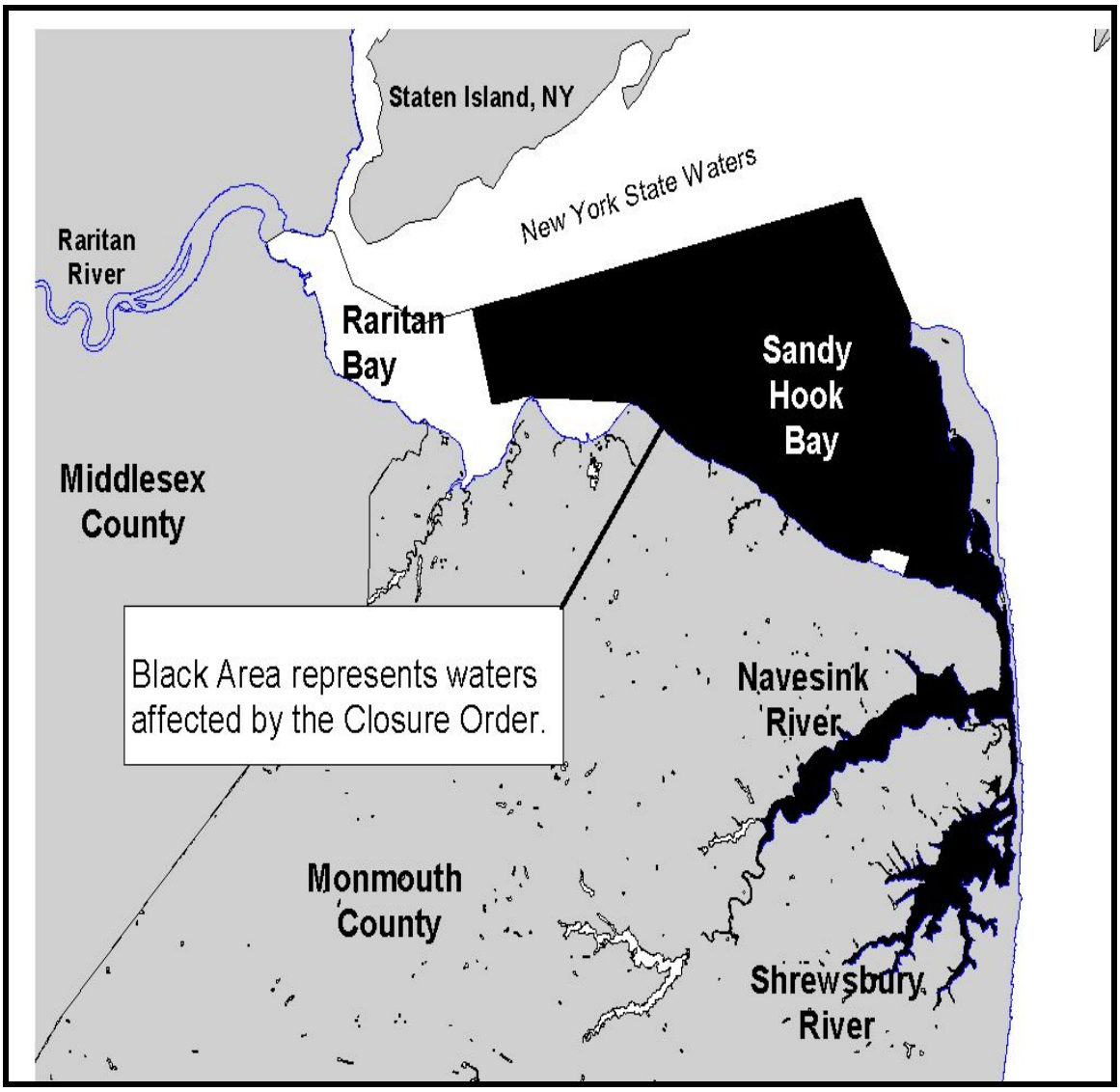
Map Key	Marina Name	# Slips > 24ft	# Slips < 24ft	Average Water Depth (ft)	Buffer Radius (ft)
14	Sea Land	2	6	5	239
15	Chris' River Plaza	10	43	5	583
16	Ocean View Marina	20	20	8	503
17	Quay Restaurant & Marina	30	0	8	549
18	Fairbanks Hotel & Marina	30	0	8	549
19	Sea Bridge Condos	25	0	8	501

SPILLS OR OTHER UNPERMITTED DISCHARGES

Between 1999 and 2003, many spills were reported to the Bureau of Marine Water Monitoring (BMWM). However, only one resulted in closure of shellfish beds in the Navesink River. On March 3, 2003, a sewer line break was identified in the Sayreville Pumping Station. According to the report sent to the NJDEP Bureau of Marine Water Monitoring, approximately 570 million gallons of sewage spilled into the Raritan Bay. An emergency closure was issued by the NJDEP for shellfish beds in the Raritan Bay, Sandy Hook Bay, Navesink River and Shrewsbury River, effective March 3, 2003. Approximately 29,427 acres of shellfish beds in the Raritan Bay, Sandy Hook Bay, Navesink River and Shrewsbury River were closed (see Figure 25).

The Bureau of Marine Water Monitoring began sampling in these areas for fecal coliform bacteria. As a result, high levels of fecal coliform were observed in the Navesink and Shrewsbury River. The levels of fecal coliform bacteria ranged between 23 and 43 MPN/100mL. Even though these levels were below the NSSP criteria for waters classified as *Special Restricted*, it had exceeded the criteria for the section of the river classified as *Seasonally Approved*. The NSSP geometric mean criterion for fecal coliform in *Seasonally Approved* waters is 14 MPN/100ml. Any shellfish harvested from the *Seasonally Approved* area (during the season it is open for harvest) can be sold directly to the marketplace without under going any purification process. Therefore, all shellfish beds in the Navesink and Shrewsbury Rivers were closed. Shellfish beds in the Navesink and Shrewsbury Rivers remained closed until April 4, 2003. At which time, only 6,000 acres of shellfish beds were re-opened for depuration purposes; clam-relaying activities remained closed. By November 2003, all of the shellfish beds in the Navesink and Shrewsbury Rivers were re-opened for harvesting.

FIGURE 25: AREAS AFFECTED BY THE SAYREVILLE SEWAGE SPILL IN 2003.



HYDROGRAPHY AND METEOROLOGY

PATTERNS OF PRECIPITATION

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region (see Table 6). Typical summer storms are localized storms associated with thunderstorms. Winter storms are frequently associated with northeasters. Hurricanes can occur during the summer and early fall.

TABLE 6: AVERAGE MID-ATLANTIC STORM EVENT INFORMATION. (SOURCES: USEPA; US DEPARTMENT OF COMMERCE).

Annual Average Number of Storms	60
Average Storm Event Duration	10 hours
Average Storm Event Intensity	0.08 – 0.09 inches/hour
Average Storm Event Volume	0.65 inches

Although the average storm event lasts approximately 10 hours, with an accumulation of 0.65 inches, it is not unusual for an individual storm volume to be 2 – 3 inches. Note the data below that show the 2-year return 6-hour storm event to be between two and three in inches, while the 2-year 24-hour return volume varies between three and four inches (see Table 7). Storm volumes greater than approximately 3.5 – 4.0 inches are much less frequent.

TABLE 7: STORM EVENT VOLUME FOR 2-YEAR STORM EVENT RECURRENCE (SOURCE: USGS**).**

Location	2-Year, 1-Hour Rainfall	2-Year, 6-Hour Rainfall	2-Year, 24-Hour Rainfall
Millville	1.33	2.33	3.02
Cape May	1.33	2.41	3.10
Atlantic City	1.47	2.67	3.65
Long Branch	1.55	3.02	4.15
Newark	1.21	2.34	3.25
Sandy Hook	1.37	2.73	3.68

HYDROGRAPHY

The two main bodies of water in this shellfish growing area are the Navesink and Shrewsbury River. The water depth in these areas ranges from 2 to 14 feet. The tidal cycle is semidiurnal, with two high tides and two low tides in a 24 hour, 50 minute period. Tidal flushing is through the Shrewsbury River.

Tidal currents can affect the water quality of a shellfish growing area, because hydrographic and meteorological characteristics, such as tidal amplitude and type, water circulation patterns, depth, salinity, stratification characteristics, rainfall patterns and intensity, and prevailing winds, may affect the distribution of pollutants in a specific area (Ingmanson and Wallace, 1989). This is why an evaluation of pollution sources and hydrographic characteristics are used to evaluate the water quality in a shellfish growing area.

Precipitation inputs to this area for the period 1999 through 2003 are shown in Table 8. There have been no significant changes in hydrographic conditions since the last reappraisal report, written in 2000. The primary weather station for this area is 8816 in Toms River. The secondary weather station for this area is 6026 in Newark, NJ. The secondary station data are used when data from the primary station are incomplete.

TABLE 8: CLIMATOLOGICAL DATA

Rainfall Recorded at NOAA's 8816 station in Toms River, NJ

Sampling Date	Precipitation		
	Day of Sampling	***Day of Sampling + Day Before***	***Day of Sampling + Previous 2 Days Before***
9/1/1999	0	0	0
11/30/1999	0	0	0
2/23/2000	0	0	0
2/28/2000	1.09	1.09	1.94
3/13/2000	0.12	1.09	1.09
6/26/2000	0	0	0
8/29/2000	0	0	0
9/11/2000	0	0	0
10/30/2000	0	0	0

Sampling Date	Precipitation		
	Day of Sampling	***Day of Sampling + Day Before***	***Day of Sampling + Previous 2 Days Before***
2/26/2001	0	0	0.18
3/12/2001	0.94	0.94	0.94
4/25/2001	0	0	0
4/30/2001	0	0	0
5/24/2001	0.005	0.105	0.205
6/25/2001	0	0.02	0.44
9/10/2001	0	0	0
10/3/2001	0	0.39	1.6
11/26/2001	0.005	0.305	0.31
1/16/2002	0	0	0.005
2/25/2002	0	0	0
3/12/2002	0	0	0
4/23/2002	0.005	0.285	0.385
4/29/2002	0	0.35	1.22
9/19/2002	0	0	0
11/6/2002	0	1.05	1.05
4/28/2003	0.005	0.385	0.635
7/15/2003	0	0.005	0.005
7/29/2003	0.14	0.2	0.2
9/10/2003	0	0	0

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

This shellfish growing area is composed of one assignment, Assignment 37 (Navesink River). Assignment 37 is sampled using SRS sampling strategy year-round. Figure 26 shows the sampling stations in this shellfish growing area. A total of 1,340 samples were collected and analyzed for Total Coliform (TC) and Fecal Coliform (FC) from 44 sampling stations listed in Assignment 37. This report includes data analyzed between September 1999 to September 2003. The statistical summaries for this area are listed in Table 9. The raw data listings for each sampling station, in accordance with the National Shellfish Sanitation Program (NSSP) criteria, are given at the end of this report in the Appendix.

COMPLIANCE WITH NSSP APPROVED CRITERIA

Approved Year- Round

Twelve sampling stations exceeded the NSSP criteria for *Approved* classification. These stations were 1000A, 1000B, 1000C, 1000E, 1002A, 1002C, 1004B, 1004D, 1006, 1006B, 1007B, and 1009. Currently, there are no *Approved* waters within this shellfish growing area. Stations described above are located in *Special Restricted* areas. Therefore, they were not assessed under the *Approved* classification. See Figure 27 for the location of these stations.

Seasonally Approved

Navesink east is classified as *Seasonally Approved (November-April),* which includes the waters starting from the Oceanic Bridge extending northward to Locust Point and extending eastward toward Lower Rocky Point, excluding waters within Claypit Creek and the smaller waterways located in lower Navesink. Harvesting of shellfish in this area is only permitted from November to April. The results generated for stations within this area did not exhibit high levels of total coliform counts and were within NSSP *Seasonally Approved* criteria. Therefore, all stations in Navesink east met the current shellfish classification.

COMPLIANCE WITH NSSP SPECIAL RESTRICTED CRITERIA

Two sampling stations in *Special Restricted* waters displayed high levels of total coliform (see Figure 28). These stations were 1000B and 1000E. Both stations are located near the Cooper's Bridge and the West Front St. Bridge in Red Bank. The results from these two stations have exceeded the NSSP criteria for *Special Restricted* classification. Downgrade of waters in this area will be necessary. See section *Interpretation and Discussion of Data* for further details.

FIGURE 26: SRS SAMPLING STATIONS IN SHELLFISH GROWING AREA NE-2: NAVESINK RIVER.

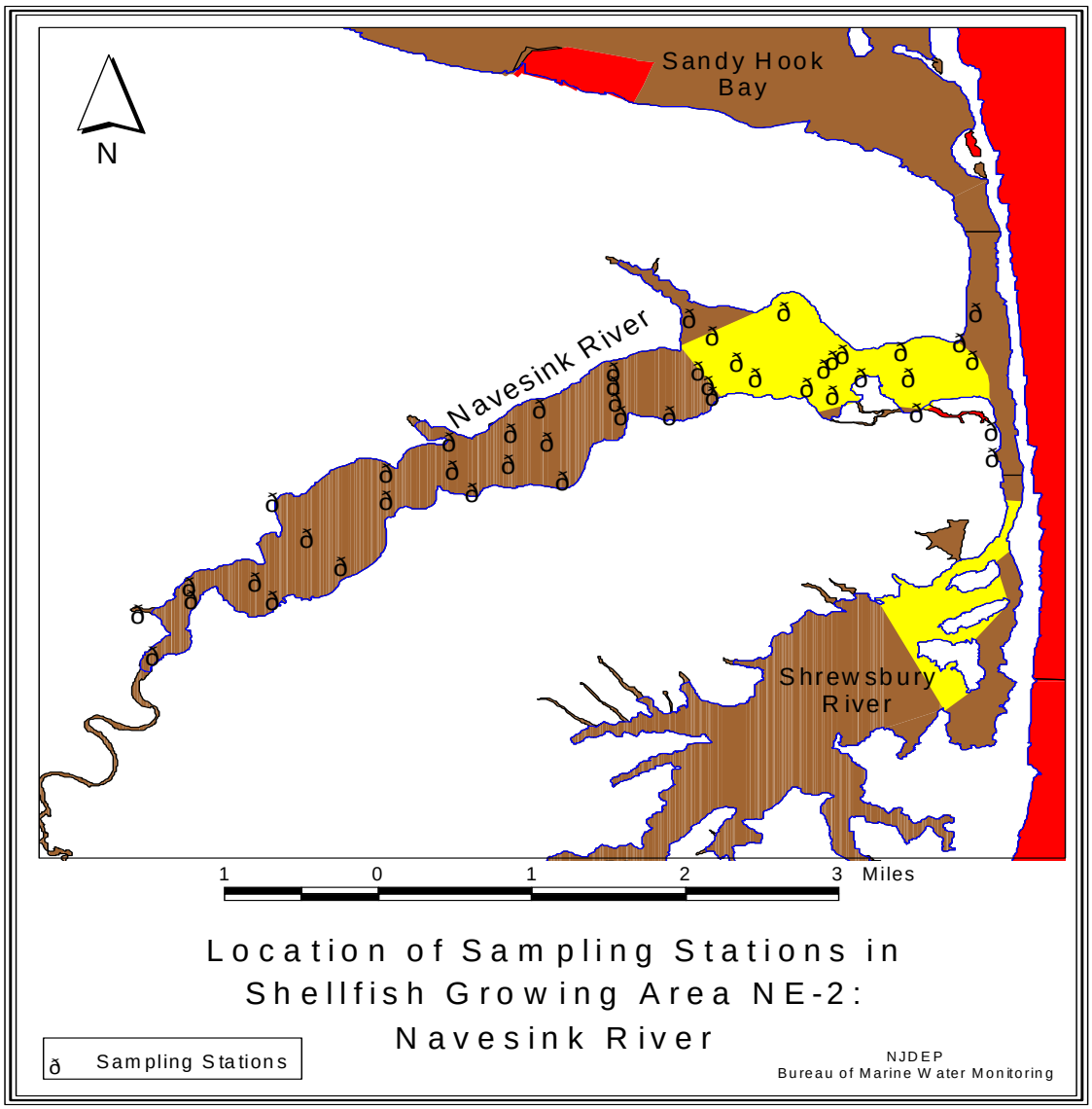


TABLE 9: WATER QUALITY SUMMARY:SRS STATIONS (09/01/99 - 09/30/03)

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N
1000A	SR	261.5	3,039.6	31	718.5	2,423.6	14	113.8	1,731.3	17
1000B	SR	453.2	3,982.3	31	973.8	3,841.1	14	241.4	2,681.2	17
1000C	SR	349.1	2,520.2	30	643.4	2,602.6	13	218.7	1,929.2	17
1000E	SR	465.3	3,522.0	31	1,105.8	3,379.1	14	228.1	1,997.8	17
1002A	SR	120.7	1,155.0	31	200.1	1,539.8	14	79.6	833.0	17
1002C	SR	297.9	3,095.1	31	740.2	2,970.7	14	140.8	1,815.9	17
1004	SR	28.9	220.0	31	57.5	300.3	14	16.4	129.3	17
1004B	SR	69.6	536.8	31	129.5	826.6	14	41.7	310.3	17
1004D	SR	120.7	983.2	31	189.5	1,045.4	14	83.2	840.7	17
1006	SR	35.7	349.7	31	58.3	385.9	14	23.8	289.2	17
1006B	SR	42.7	470.2	31	57.2	396.0	14	33.5	521.1	17
1007	SR	42.3	292.4	30	64.9	228.5	13	30.5	295.2	17
1007B	SR	40.5	445.5	31	67.3	488.5	14	26.7	369.8	17
1008A	SR	29.5	255.9	31	61.0	369.4	14	16.2	142.9	17
1008C	SR	27.6	255.3	31	47.4	350.9	14	17.7	175.3	17
1009	SR	45.5	561.8	31	64.9	638.1	14	34.0	503.6	17
1010	SR	20.9	151.3	31	38.4	174.4	14	12.7	106.3	17
1010B	SR	20.6	184.2	31	24.3	188.7	14	18.0	188.2	17
1010D	SR	30.4	267.9	30	50.4	323.7	13	20.7	210.8	17
1012	SR	17.7	131.5	31	30.1	143.7	14	11.5	102.9	17
1012A	SR	21.4	221.4	30	27.8	157.2	14	17.0	275.6	16
1012B	SR	24.7	226.5	31	33.0	184.8	14	19.5	252.9	17
1012C	SR	19.0	157.4	31	30.1	226.7	14	13.0	109.0	17
1013	SR	19.3	91.8	31	27.7	84.9	14	14.3	85.7	17
1013C	S	20.5	166.6	31	21.5	134.8	14	19.7	205.1	17

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N
1013E	S	18.0	85.4	31	25.4	95.9	14	13.6	72.5	17
1014	SR	25.5	191.6	31	35.7	219.2	14	19.3	167.1	17
1014B	S	15.4	113.9	31	29.6	205.2	14	9.0	56.2	17
1014D	S	14.1	81.8	31	18.6	96.6	14	11.3	70.8	17
1014F	S	20.9	150.9	30	29.4	138.7	14	15.5	149.7	16
1015	S	21.4	165.5	30	33.3	236.1	13	15.3	119.8	17
1016D	S	9.1	35.9	23	12.1	47.5	10	7.3	28.5	13
1016E	S	22.4	153.8	31	35.3	151.1	14	15.4	134.6	17
1017B	S	11.6	66.8	23	12.9	82.9	10	10.7	60.3	13
1018	S	16.0	99.8	31	18.2	88.6	14	14.4	111.8	17
1018B	S	14.8	89.3	31	19.7	77.4	14	11.7	93.5	17
1018D	P	11.6	76.3	31	13.9	72.9	14	10.0	80.3	17
1019	S	13.1	58.0	30	20.5	72.7	14	8.9	40.6	16
1020	SR	15.4	84.2	31	25.8	95.8	14	10.0	62.2	17
1020B	SR	10.7	61.2	31	15.6	93.2	14	7.8	41.1	17
1020D	SR	10.0	55.7	31	10.7	59.8	14	9.5	55.1	17
1020E	SR	14.1	106.2	31	14.6	79.6	14	13.8	137.2	17
1022A	SR	8.6	30.8	30	10.6	34.2	14	7.2	27.8	16

FIGURE 27: SAMPLING STATIONS EXCEEDING NSSP APPROVED CRITERIA

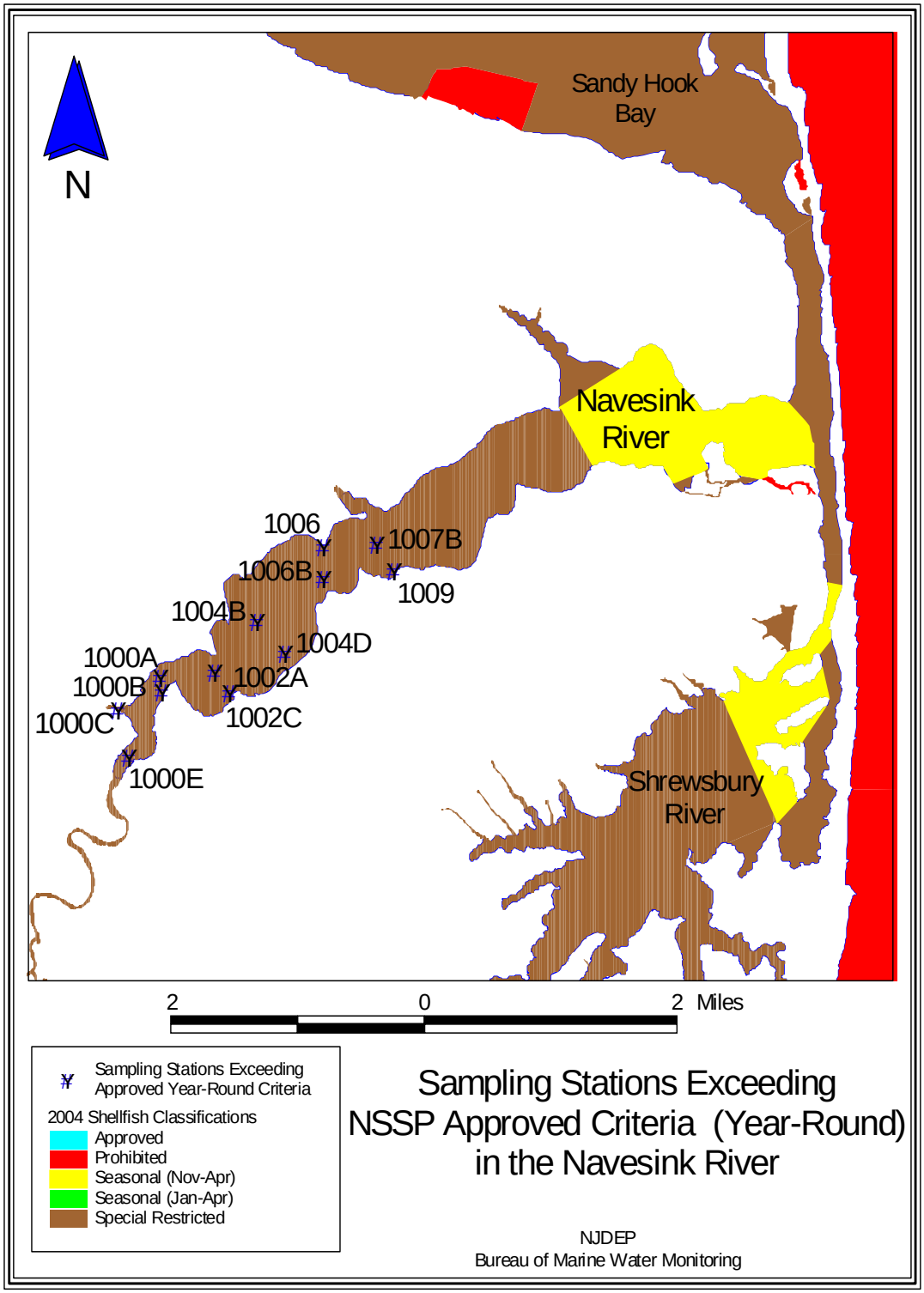
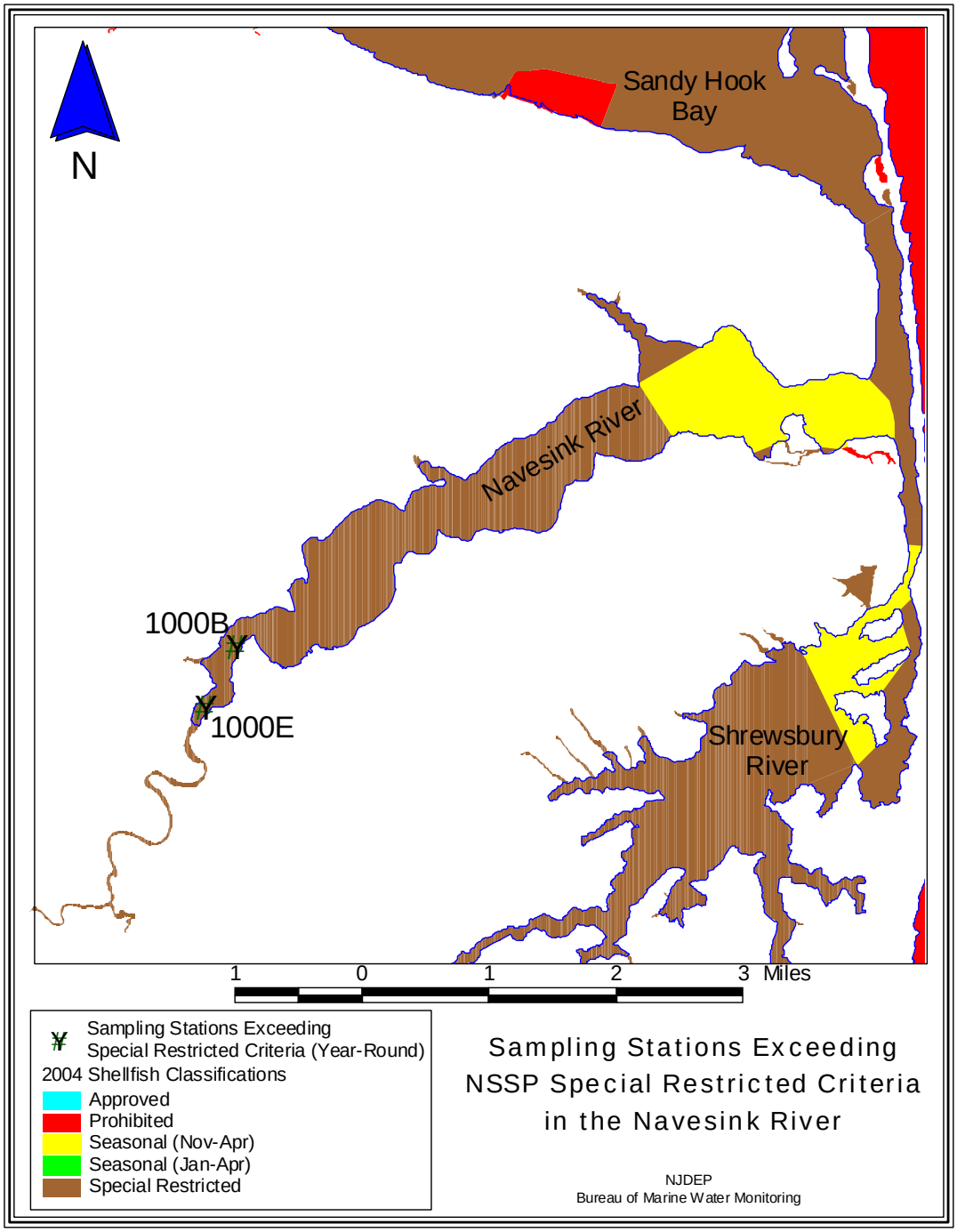


FIGURE 28: SAMPLING STATIONS EXCEEDING NSSP SPECIAL RESTRICTED CRITERIA



TIDAL EFFECTS

The tidal effects, if present, can occur under either ebb currents or flood currents. Ebb and flood currents describe the horizontal motions associated with the fall and rise of the tide in restricted regions along the coast. Tidal currents can affect the water quality of a shellfish growing area because hydrographic and meteorological characteristics, such as tidal amplitude and type, water circulation patterns, depth, salinity, stratification characteristics, rainfall patterns and intensity, and prevailing winds may affect the distribution of pollutants in a specific area (Ingmanson and Wallace, 1989). This is why an evaluation of pollution sources and hydrographic characteristics are used to evaluate the water quality in a shellfish growing area.

Tidal impacts were evaluated by performing a t-test using the Total Coliform MPN value. The MPN values from samples collected during ebb tide were compared with those collected during flood tide. In order for a station to have a tidal component, t-probability must be less than 0.05, but not zero. There were no stations in this shellfish growing area that were affected by tide.

RAINFALL EFFECTS

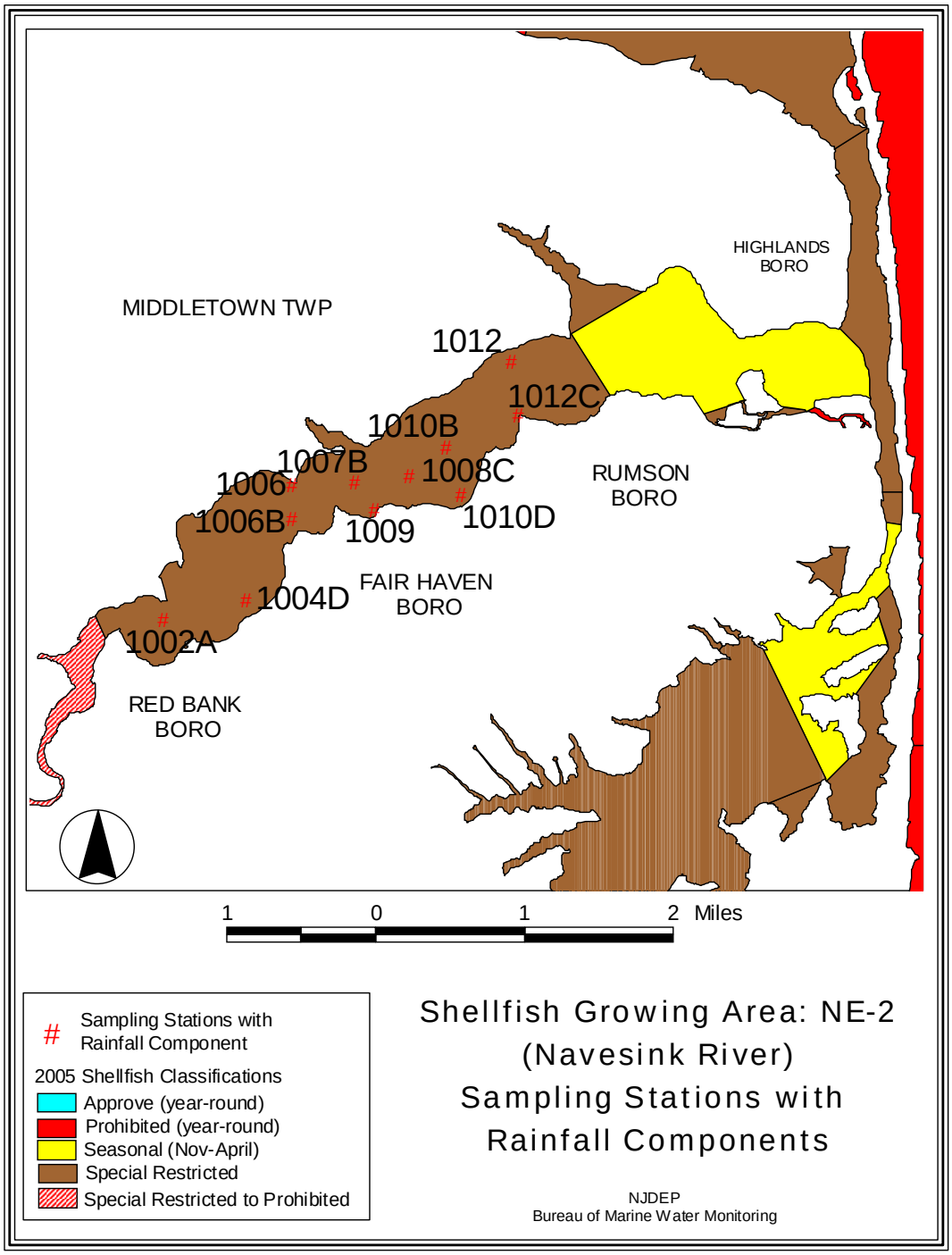
Non-point source pressures on shellfish beds in New Jersey originated in materials that enter the water via stormwater. These materials include bacteria, as well as other waste that enters the stormwater collection system. For this reason, rainfall impact was evaluated.

Rainfall impact was assessed using a t-test to compare the Total Coliform MPN values from samples collected during dry weather versus samples collected during wet weather. The Wet/Dry Statistics were calculated based on post impact time of 48 hours and a wet/dry cutoff of 0.2 inches. Rainfall amount above 0.2 inches is considered to be a wet condition. A station is considered to be rainfall impacted when t-Statistic Probability is less than 0.05, but not zeros. According to the data set analyzed for this report, there were eleven stations that were impacted by rainfall (see Table 10). All eleven stations were located in Special Restricted waters. See Figure 29 for the locations of these stations.

TABLE 10: STATIONS IMPACTED BY RAINFALL

STATION	STATUS	T-STATISTIC PROBABILITY	WET GEOMEAN	DRY GEOMEAN
1002A	SPECIAL RESTRICTED	0.026	288.1	69.7
1004D	SPECIAL RESTRICTED	0.026	270.9	72.4
1006	SPECIAL RESTRICTED	0.021	88.5	20.1
1006B	SPECIAL RESTRICTED	0.002	147.9	19.4
1007B	SPECIAL RESTRICTED	0.0002	138.5	18.7
1008C	SPECIAL RESTRICTED	0.026	65.1	16.1
1009	SPECIAL RESTRICTED	0.027	119.6	24.7
1010B	SPECIAL RESTRICTED	0.048	44.0	12.8
1010D	SPECIAL RESTRICTED	0.003	89.2	14.9
1012	SPECIAL RESTRICTED	0.045	35.8	11.4
1012C	SPECIAL RESTRICTED	0.041	40.4	11.8

FIGURE 29: RAINFALL IMPACT



SEASONAL EFFECTS

As the earth experiences variations in the tilt of its axis and its revolution around the sun, it goes through seasonal phases of summer, spring, autumn, and winter. These seasonal phases cause much variation in the atmosphere of the earth, resulting in changes in weather patterns. Temperature, precipitation, wind, and the general circulation of the atmosphere have seasonal variations that also affect the marine environment (Ingmanson and Wallace, 1989).

Shellfish are filter-feeding organisms that live in the sand, silt, and mud on the bottom of oceans and bays. They have a range of tolerance to specific environmental conditions, such as temperatures, salinity levels, oxygen levels, quantity and availability of food, and water quality. Seasonal effects on these variables will have an effect on shellfish populations. For example, different species of shellfish require very specific salinity levels for survival. Since salinity levels can have an effect on the species found in certain waters of an area, the salinity level is important for a complete understanding of the complex ecological balance in the marine environment. At a time of the year when rainfall is low, where evaporation exceeds precipitation, the salinity of the marine environment in certain areas is higher than it is in regions where precipitation exceeds evaporation. This can affect the quantity and type of shellfish found in a specific area (Ingmanson and Wallace, 1989).

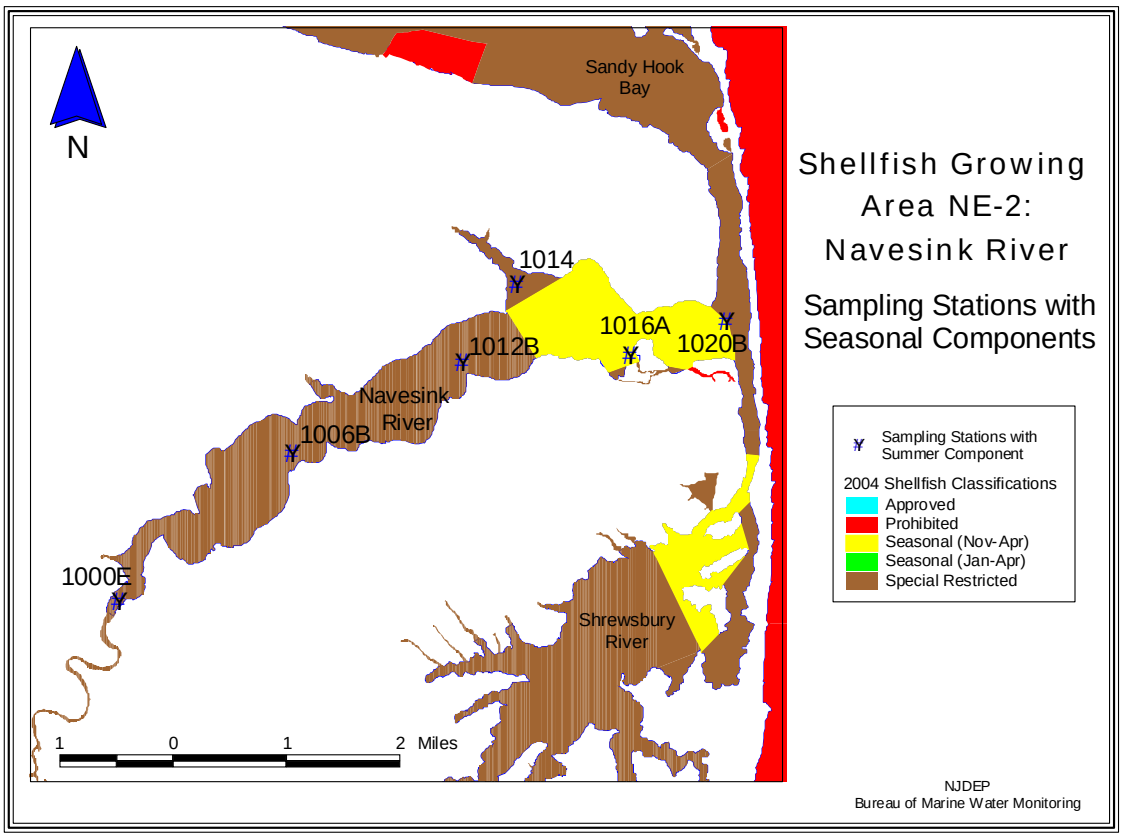
Seasonal variations also affect human activities, with generally more human activity in the warmer months of the year. An increase in human activities in or near the marine environment can have an impact on shellfish populations. Increased pressure from human activities on already stressed failing septic systems and overloaded wastewater treatment facilities can cause sewage to spill into the marine environment, which can negatively impact the water quality of a shellfish growing area by increasing the coliform levels in the water (Ingmanson and Wallace, 1989).

Seasonal effect was assessed using a t-test to compare the total coliform MPN values from samples collected during the summer season versus samples collected during the winter months. To have a seasonal component, t-probability must be less than 0.05, but not zero. Eleven sampling stations in this shellfish growing area exhibited a t-probability of less than 0.05. Table 10 lists the sampling stations that showed a correlation between seasonal effects and water quality. Figure 30 shows the location of these sampling stations.

TABLE 11: STATIONS WITH SEASONAL EFFECTS

Station	Total Coliform Geometric Mean		Probability > [T]
	Summer	Winter	
1000A	718.5	113.8	0.006
1000B	973.8	241.4	0.020
1000E	1105.8	228.1	0.004
1002C	740.2	140.8	0.009
1004	57.5	16.4	0.026
1004B	129.5	41.7	0.047
1008A	61.0	16.2	0.027
1010	38.4	12.7	0.045
1014B	29.6	9.0	0.033
1019	20.5	8.9	0.047
1020	25.8	10.0	0.048

FIGURE 30: SAMPLING STATIONS AFFECTED BY SEASONAL COMPONENT: NAVESINK RIVER.



INTERPRETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

The criteria for acceptability of shellfish growing water was based on the bacterial parameters set by the National Shellfish Sanitation Program (NSSP). Each state adopts either the Total Coliform criteria or the Fecal Coliform criteria for determining water quality.

The New Jersey Department of Environmental Protection had always based its water classification on the results generated from the Total Coliform test. Even though water classification is based on the Total Coliform criteria, the Bureau of Marine Water Monitoring does take corresponding samples for Fecal Coliform analysis. These data are, however, utilized as adjunct information and are not used for classification of shellfish growing waters. The NSSP criteria can be found on Table 2 and Table 3. The bacteriological data collected for this report are listed in the Appendix. These data were collected under the Systematic Random Sampling strategies.

Based on the data collected, twelve sampling stations exceeded the Systematic Sampling Strategy (SRS) criteria for *Approved* classification and two out of these twelve stations also exceeded the *Special Restricted* criteria. The SRS criteria for *Approved* classification are as follows: the geometric mean can not exceed 70 MPN/100 mL and the maximum 90th percentile can not exceed 330 MPN/100mL. Areas classified as

Special Restricted must meet the criteria of 700 MPN/100mL and the maximum 90th percentile can not exceed 3300 MPN/100mL. The following stations failed to meet the *Approved* classification, 1000A, 1000B, 1000C, 1000E, 1002A, 1002C, 1004B, 1004D, 1006, 1006B, 1007B, and 1009. These stations are currently located in *Special Restricted* waters. Therefore, they were assessed using the *Special Restricted* classification criteria.

Two stations (1000B and 1000E) also failed to meet the *Special Restricted* criteria. The maximum 90th percentiles were 3,982.3 MPN/100mL and 3,522.0 MPN/100mL, respectively. The results from these stations exceeded the NSSP Special Restricted criteria of 3300 MPN/100mL. Station 1000B is located near the Cooper's Bridge and Station 1000E is by Chris's River Plaza, toward Swimming River. Both stations are located in Red Bank.

According to the data set analyzed for this report, eleven stations were found to have a t-statistic probability of less than 0.05. These stations are situated in *Special Restricted* waters and the Geometric Means were higher during wet condition. The biggest difference in Geometric Means between wet and dry conditions were found in stations located in Red Bank. This suggests that

this area is heavily impacted by rainfall. The Bureau of Marine Water Monitoring has begun their investigation, to determine the source of contamination that is affecting this area.

Eleven sampling stations showed a seasonal component for water quality in this shellfish growing area (see Figure 30 and Table 10). These sampling stations were 1000A**,** 1000B, 1000E, 1002C, 1004, 1004B, 1008A, 1010, 1014B, 1019 and 1020. Seasonal effects were assessed using a t-test to compare log-transformed total coliform values for summer verses winter data. Higher total coliform geometric means during the summer than during the winter were observed for all of the stations listed above, which is most likely due to increased in boating activities. However, the total coliform levels still meet the existing shellfish classification. Since the water quality in this shellfish growing area is slightly impacted by seasonal effects, but not enough to affect the shellfish classification of this area, this shellfish growing area will continue to be sampled using the Systematic Random Sampling (SRS).

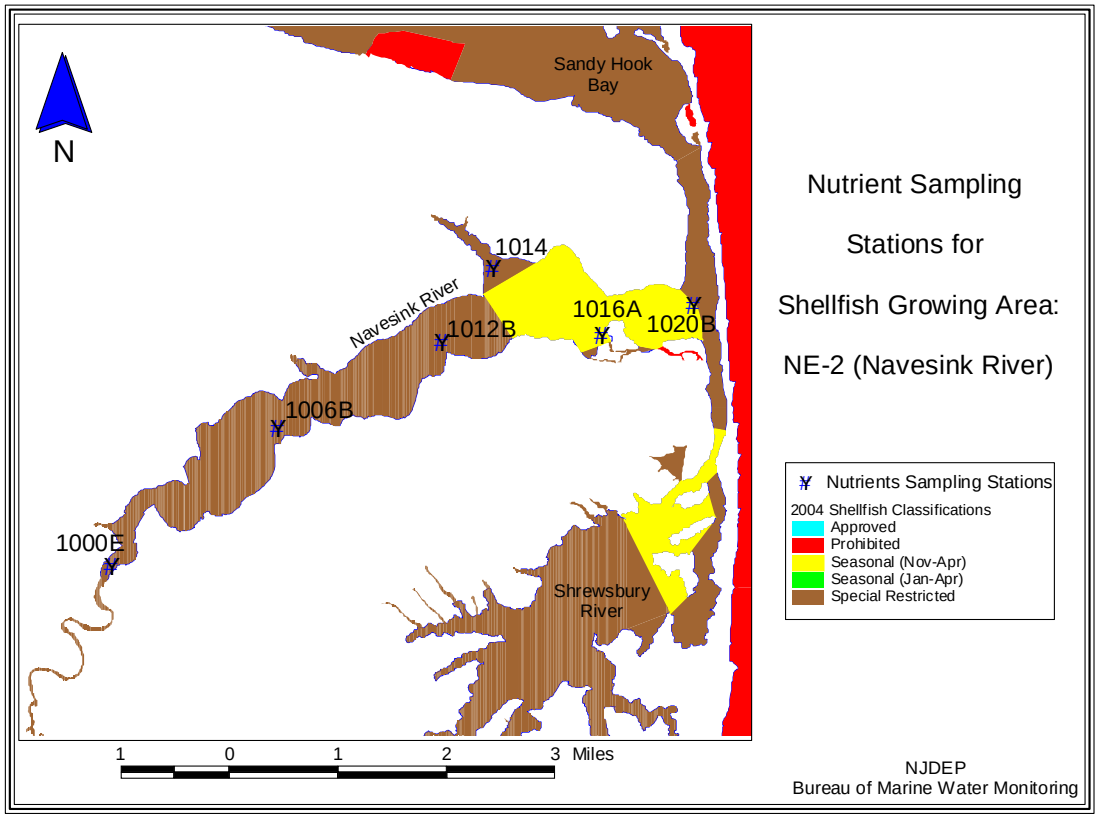
NUTRIENTS

Six stations in shellfish growing area NE-2 were sampled under the estuarine monitoring program for chemical parameters including nutrients in 2002-2003. These nutrient stations included sampling stations 1000E, 1006B, 1016A, 1020B, 1012B and 1014 (see Figure 31).

At these nutrient stations, various parameters were measured including water temperature (in Celsius), salinity levels, Secchi depth, total suspended solids, dissolved oxygen levels, ammonia levels, nitrate and nitrite levels, orthophosphate levels, total nitrogen levels, and the inorganic nitrogen to phosphorus ratios.

For detailed information concerning dissolved oxygen and nutrient levels, see the Estuarine Monitoring Report published by the NJDEP. The report, New Jersey Ambient Monitoring Program: Report on Marine and Coastal Water Quality – 2002, is available electronically at: www.state.nj.us/dep/wmm/bmw.

FIGURE 31: SAMPLING SITES COLLECTED FOR NUTRIENTS IN SHELLFISH GROWING AREA NE-2



CONCLUSIONS

BACTERIOLOGICAL EVALUATION

Water quality for shellfish growing area NE-2 continues to be good, in the portion classified as *Seasonally Approved (November to April).* Stations located in this portion of the growing area meet the NSSP *Approved* criteria during the November to April time period that it is open for harvest. However, the water quality in the upper portion of the Navesink River continues to be poor. Historical data indicated that the levels of bacteria recorded for this area have always been high. Data compiled for this report indicated two stations had failed to meet the NSSP *Special Restricted* criteria and therefore, no longer support the current classification. During a shoreline survey of this area, many storm water outfalls and marinas were found situated in close proximity to the stations with elevated levels of bacteria counts (see Figure 32). These are a potential source of contamination. According to the data, higher levels of bacteria counts were observed when there is rainfall recorded. To insure no shellfish harvesting will be permitted in this area, a classification change is recommended.

FIGURE 32: STORM DRAIN LOCATED NEAR STATION 1000B

RECOMMENDATIONS

SHELLFISH WATER CLASSIFICATION

At this point, it is recommended that a section of the upper Navesink be downgraded from *Special Restricted* to *Prohibited* due to poor water quality, which has been demonstrated by sampling results. Approximately 152 acres in this shellfish growing area is recommended for a downgrade. The proposed area will encompass all waters west of the Cooper's Bridge, including Swimming River and Shadow Lake. The Cooper's Bridge is the best landmark that can be use to delineate between *Special Restricted* and *Prohibited* waters (see Figures 33, 34, and 35). Therefore, all waters west of the Cooper's Bridge will be re-classified from *Special Restricted* to *Prohibited* year–round.

RECOMMENDED CHANGES IN MONITORING SCHEDULE

Continue sampling using the existing Systematic Random Sampling (SRS) Strategy for Assignment 37: Navesink River.

LEGAL DESCRIPTION FOR RECOMMENDED CHANGES

New Jersey Administrative Code

Old Text N.J.A.C. 7:12-3.2 (a) 3

3. [All of the Navesink River and tributaries west of the Oceanic Bridge.]

New Text N.J.A.C. 7:12-3.2 (a) 3

3. <u>All waters west of the Oceanic Bridge and ending at the Highway 35 Bridge (Cooper's Bridge) in Red Bank.</u>

New Text N.J.A.C. 7:12-2.1(a) 3.vii

vii. <u>All waters west of the Highway 35 Bridge (Cooper's Bridge) in Red Bank, including all of Swimming River, Shadow Lake, and tributaries.</u>

FIGURE 33: AREA RECOMMENDED FOR A DOWNGRADE

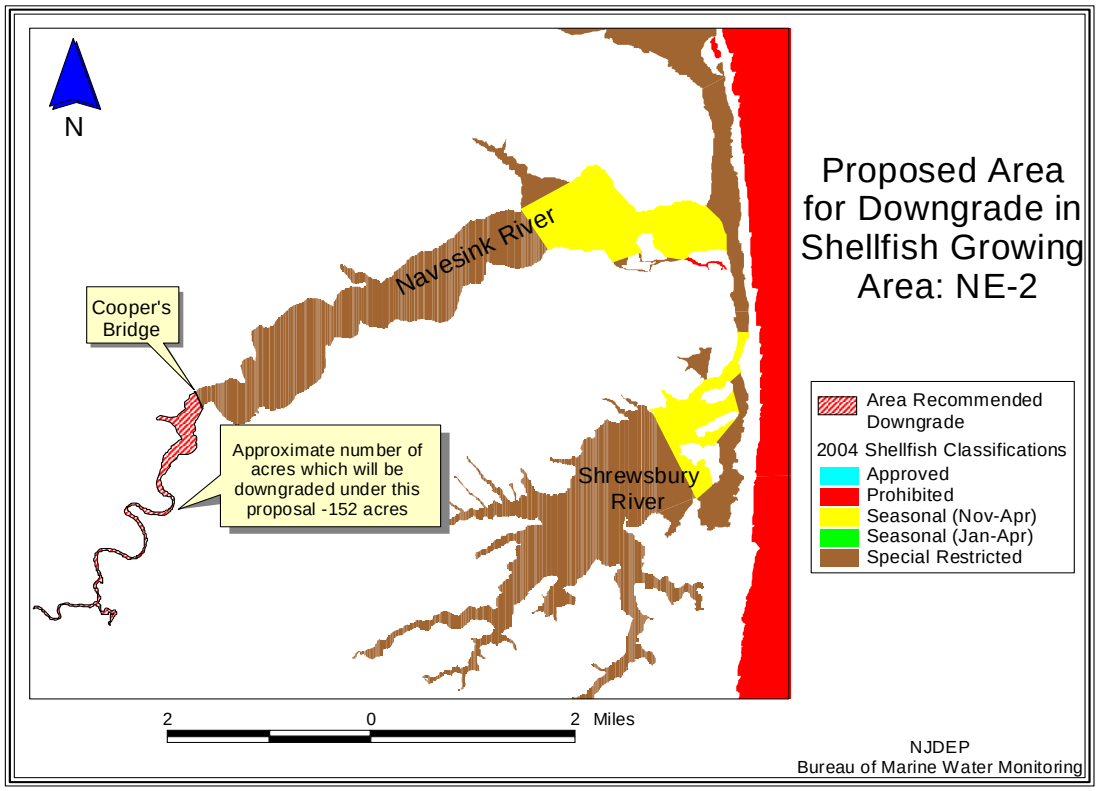


FIGURE 34: THE COOPER'S BRIDGE

FIGURE 35: PHOTO TAKEN FROM THE COOPER'S BRIDGE (AREA RECOMMENDED FOR DOWNGRADE)

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http://www.middletownnj.org/

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APPENDICES

A. Statistical Summaries

- Year-round
- Winter Only
- Summer Only

B. Seasonal Evaluation

C. Precipitation

- Rainfall Correlation
- Cumulative Rainfall
- Wet Weather Statistical Summary
- Dry Weather Statistical Summary

D. Tidal Evaluation

E. Data Listing - 1999 through 2003