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Land Use Management
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REAPPRAISAL

Delaware Bay Cape Shore

1999-2002

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New Jersey Department of Environmental Protection
BRADLEY CAMPBELL
COMMISSIONER

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EXECUTIVE SUMMARY

The water quality data presented in this Reappraisal Report were collected from January 1999 to December 2002. The Delaware Bay Cape Shore (DB-2) area consisted of waters from East Point down to Cape May Point. The DB-2 area was sample under the Adverse Pollution Control strategy. The data collected corresponds to the current shellfish classification, with the exception of one station located in *Approved* water. This station failed to meet the NSSP *Approved* criteria for Total and Fecal Coliform. The data indicated bacteria counts were only higher during the summer months, which is most likely due to boating activities and increased populations resulting from the summer tourism industry. Due to the location and its close proximity to the in compliance stations; there will be no changes made to the current classification at this time. The Bureau of Marine Water Monitoring will continue to investigate this matter. If the results remain to be out of compliance, downgrade of water for this area will be recommended in the next Annual Report.

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 State Water Quality Inventory Report, which is prepared pursuant to Section 305(b) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the New Jersey State Water Quality Inventory Report (305b) 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) 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) 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) 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 water bodies 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. As the Department implements a comprehensive watershed management program in conjunction with the NEPPS initiative, 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

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 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. Prevent 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.

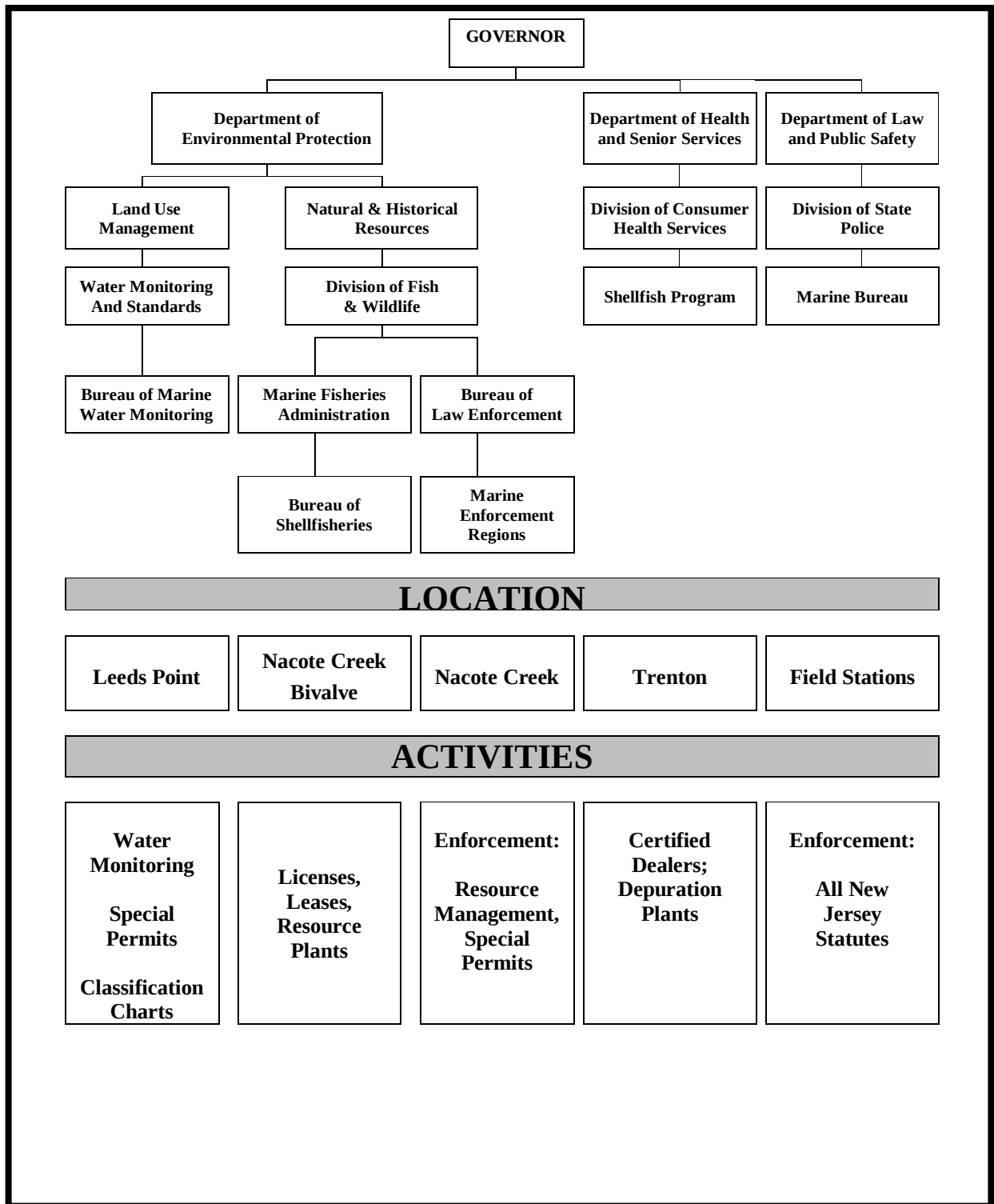
The Bureau of Shellfisheries in the Division of Fish and Wildlife issues

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.

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 runoff and direct discharges.

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.

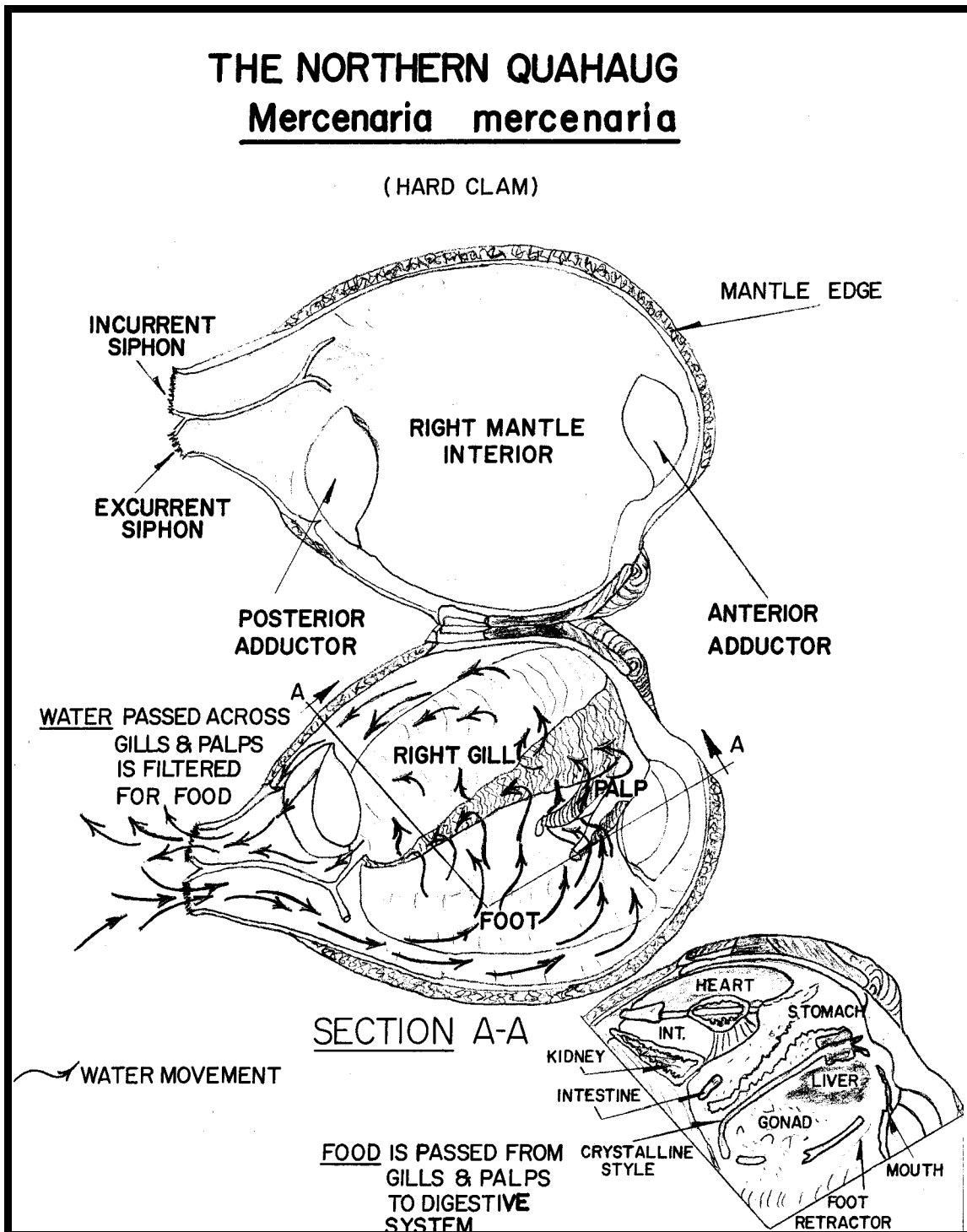
Accurate classifications of shellfish growing areas are completed through a

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 completed on a three year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report is initiated prior to its 12 year schedule.

The following narrative constitutes this bureau's assessment of the above mentioned components to comply with the three year reappraisal. Additionally, a partial shoreline survey was completed.

FIGURE 2: CROSS-SECTION OF MERCENARIA MERCENARIA



PROFILE

LOCATION

The Delaware Bay Cape Shore (DB-2) area is located in portions of Cape May County and Cumberland County on the Delaware Bay (See Figure 3). This area includes waters from Cape May Point to East Point. The DB-2 area could be found on the State New Jersey Shellfish Growing Water Classification Charts page 10.

The DB-2 area includes the following municipalities: Maurice River Township, Dennis Township, Middle Township, Lower Township, and Cape May Point. Within the five municipalities listed above, Lower Township is the most populated community in the DB-2 area. The 1990 and 2000 census estimated that the residential population for Lower

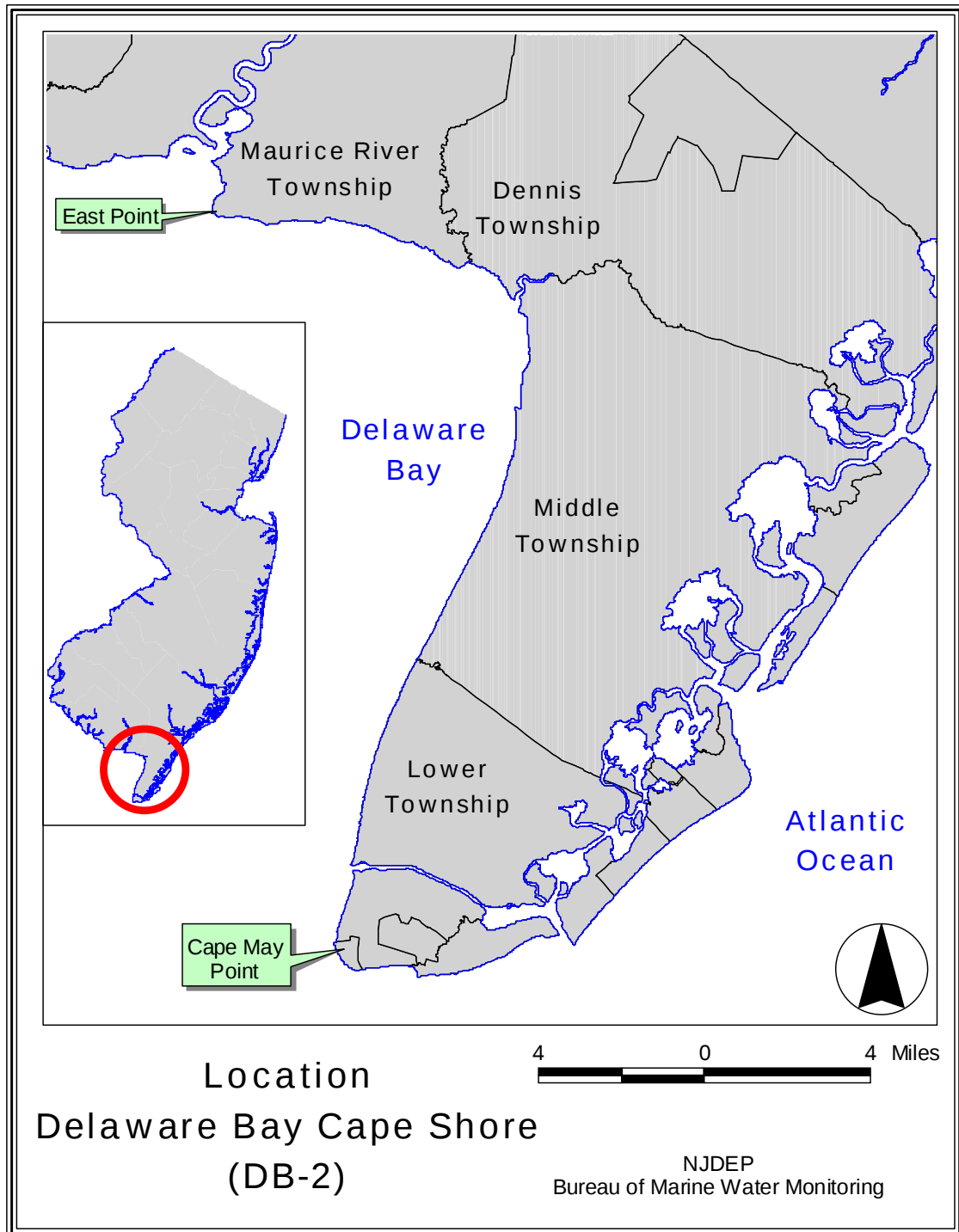
Township was 20,651 and 22,945, respectively. This was an 11.1% increase within a ten years period. According to the Cape May County population projection, by 2010 the estimated population for Lower Township will probably reach 26,288.

Population increase is expected for all municipalities listed in Table 1. This would absolutely cause an impact to the DB-2 area. As population increases so will the consumption of freshwater. In addition to the increase of water usage, population increase encourages more development of activities, thus would infringe on the wildlife habitation and water quality surrounding the area.

TABLE 1: POPULATION INFORMATION

Community	Area (Sq. mi.)	Population 1990 Census	Population 2000 Census	Population Fluctuation	Population Density (persons/sq. mi.)
Maurice River Township	93.4	6,648	6,928	4.2	74
Dennis Township	65	5,765	6,492	12.6	100
Middle Township	72	15,012	16,405	9.3	228
Lower Township	29	20,651	22,945	11.1	791
Cape May Point	<1	281	241	-14.2	241

FIGURE 3: LOCATION AND MUNICIPALITIES OF THE DELAWARE BAY CAPE SHORE



DESCRIPTION

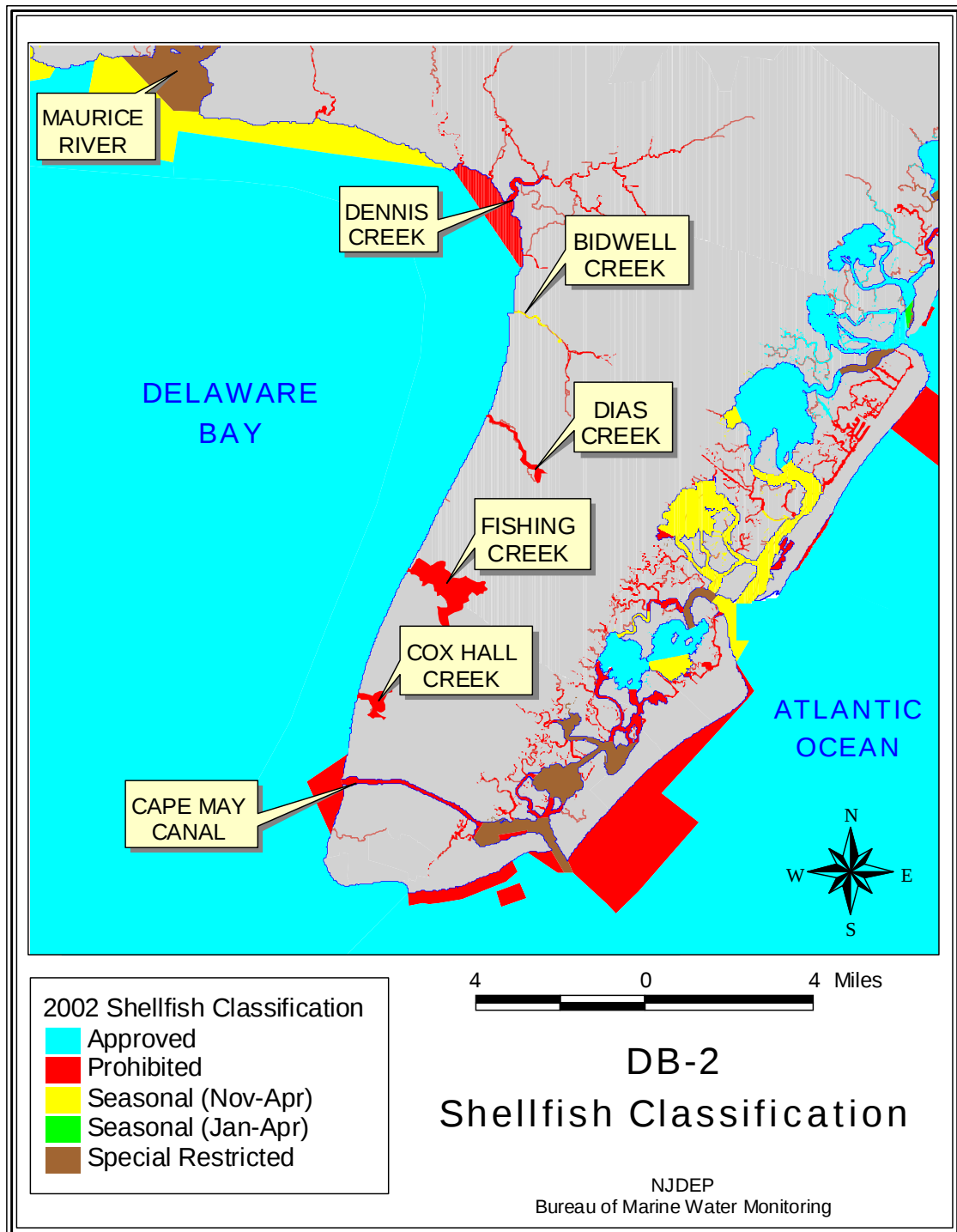
There are many waterways located within the vicinity of the Delaware Bay Cape Shore (DB-2) area. Some of the major contributing waterways includes Maurice River, Bidwell Creek, Dennis Creek, Dias Creek, Fishing Creek, Cox Hall Creek, and the Cape May Canal.

The water classification for the DB-2 area consists of *Approved*, *Prohibited*, *Special Restricted*, and *Seasonally Approved*. The majority of the waters in the DB-2 area are classified as *Approved year-round*. Waters along the shoreline from East Point to West Creek and portion of the Bidwell Creek are classified as *Seasonally Approved* from November to April, which mean that harvesting is only permitted within this time period. The majority of the waterways in the DB-2 area are either classified as *Prohibited* or *Special Restricted*. This includes the Cape May

Canal, Maurice River, Dennis Creek, Dias Creek, Fishing Creek, and Cox Hall Creek.

Shellfish harvested from *Special Restricted* area must undergo either Depuration or Relay Process before it can be sold commercially. The Depuration Process involves removing the shellfish from contaminated water and placing it in clean water for several days to purge. This process is normally done in a depuration plant where it is routinely monitored by state law enforcement. The Relay Process is very similar to a Depuration Process, with the exception that the shellfish are harvested from *Special Restricted* waters and are then planted in a leased plot in *Approved* water. The shellfish are left to purge for 30 days before it can be re-harvested for commercial use. Figure 4, shows the current Shellfish Classification for this area.

FIGURE 4: CURRENT CLASSIFICATION OF THE DELAWARE BAY CAPE SHORE



HISTORY

The Delaware Bay area was once known as the oyster capitol of world. One important resource was the American or Eastern Oyster (*Crassostrea virginica*). During the 1950's, a disease called MSX (multinucleated sphere unknown) attacked the oyster industry. The impact from this disease dramatically decreased the demand for oyster from the Delaware Bay. To this day, the oyster industries have not yet fully recovered to its initial production and harvesting. Even though, the oyster

industries had slowly diminished, but it stills one of the main resources for the Delaware Bay.

With on going pollution and contamination sources, many efforts are being deployed by the state and in cooperation with the Delaware Estuaries Program and Watershed Program, to help maintain a safe and healthy ecosystem of the Delaware Bay area.

METHODS

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

Approximately 904 water samples were collected for total and fecal coliform bacteria between 1999 and 2002 and analyzed by the three tubes MPN method according to APHA (1970). Figure 19 shows the Shellfish Growing Water Quality monitoring stations in the Delaware Bay. Approximately 41 stations are monitored during each year.

Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish*, 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*, *Special Restricted*, or *Seasonal Special Restricted*.

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 Strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms 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

Criteria for bacterial acceptability of shellfish growing waters are provided in *NSSP Guide for the Control of Molluscan Shellfish*, 1999 Revision.

pollution or variation could occur during a specific time of the year.

The Systematic Random Sampling 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.

The Delaware Bay is sampled under the Adverse Pollution strategy described above.

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% can exceed (MPN/100 mL)	Geometric mean (MPN/100 mL)	No more than 10% 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

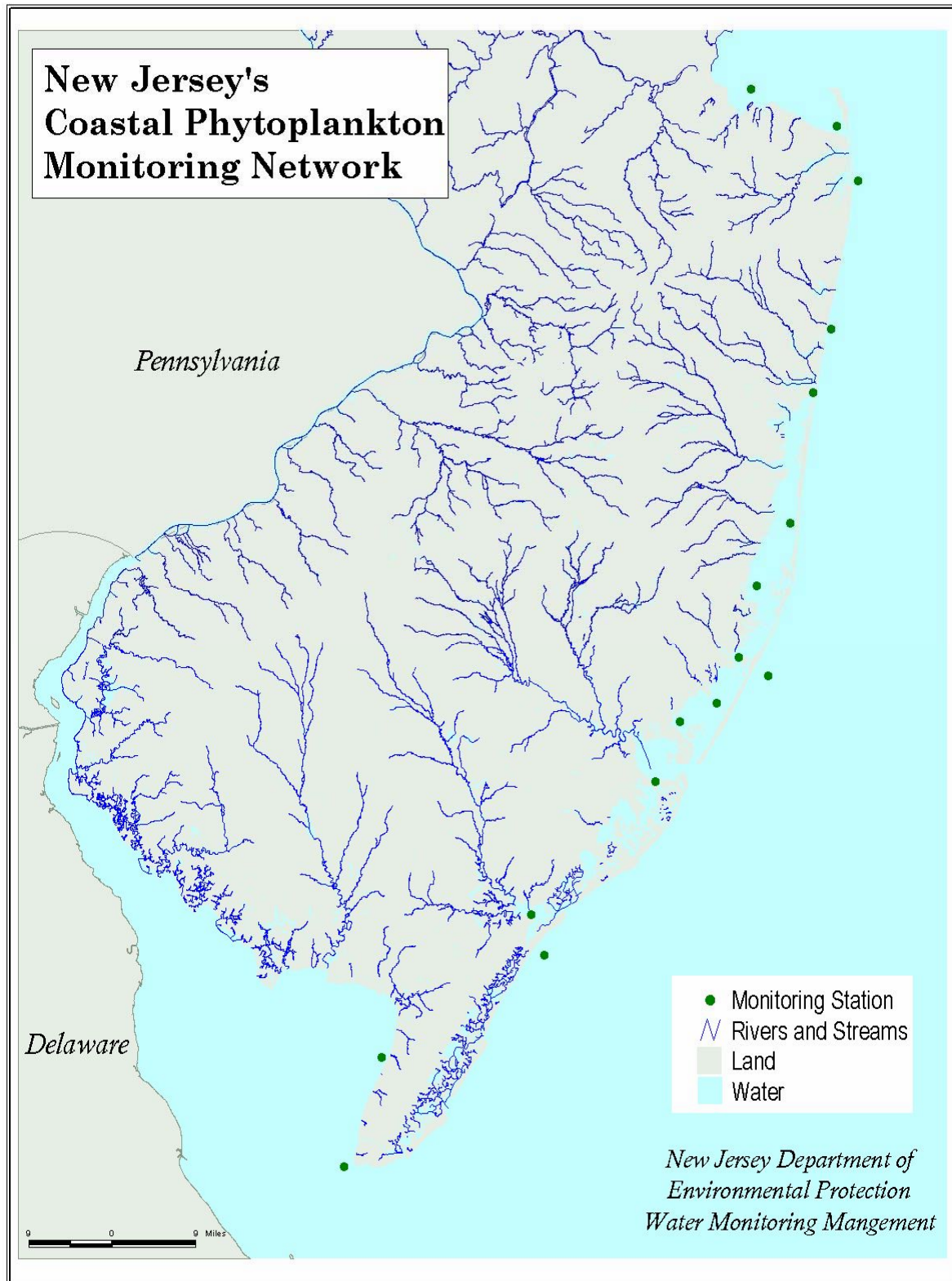
	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	Maximum 90 th percentile (MPN/100 mL)	Geometric mean (MPN/100 mL)	Maximum 90 th percentile (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

MARINE BIOTOXINS

The Department collects samples at regular intervals throughout the summer to determine the occurrence of marine biotoxins (see Figure 5 for location of Phytoplankton sampling stations). This data is 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/watershedmgt/bmw.

FIGURE 5: LOCATION OF PHYTOPLANKTON SAMPLING STATIONS



SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

There have been no significant changes since the last survey conducted in 2000. Homes built along the shore from Cape May Point to Highs Beach have been connected to the city sewer system. However, there are homes that are still on private septic system. This includes homes from Pierces Point to Reeds Beach.

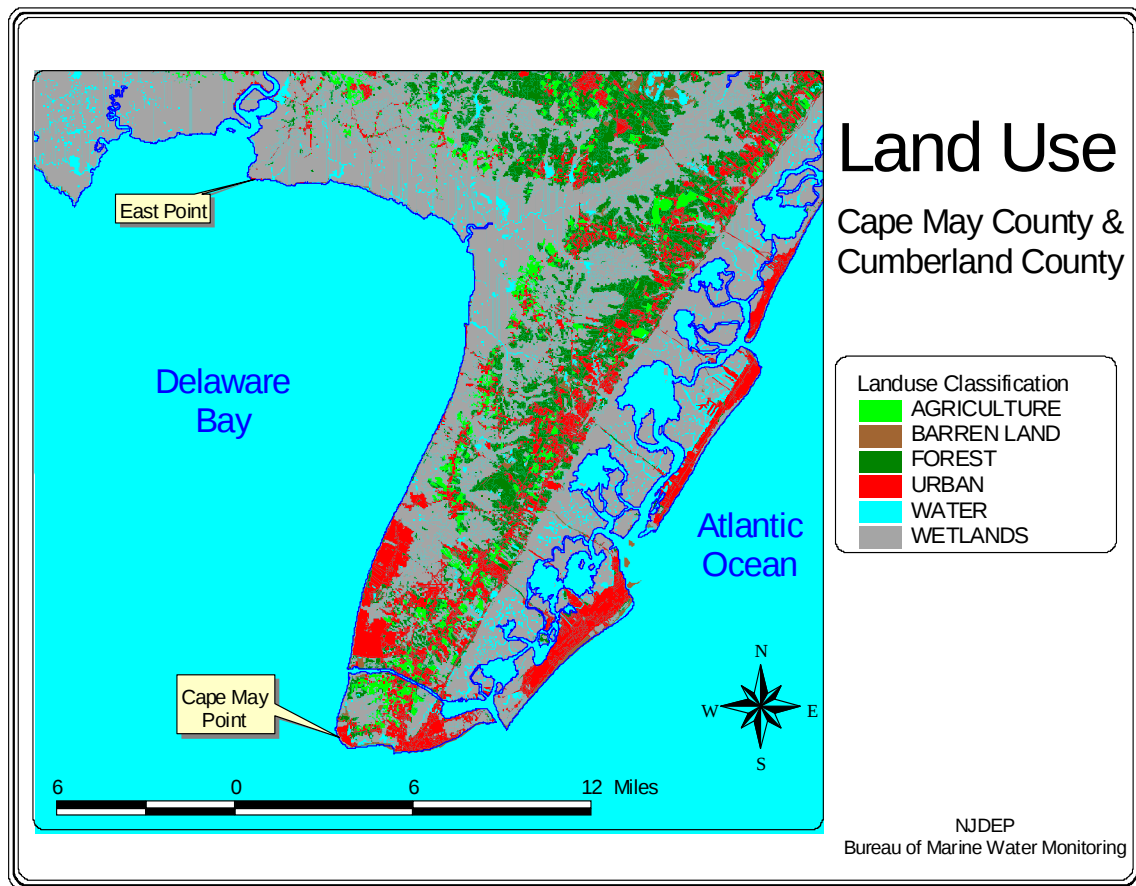
Currently, there are no plans in progress to connect these homes to the city sewer system. There has been reported of malfunction septic system in these areas by the Cape May Health Department. However, no closures of shellfish waters were issued between 1999 and 2002 for the DB-2 area.

LAND USE

Regions within the Delaware Bay Cape Shore area consisted primarily of wetland, forest, and or agriculture. Within Cumberland and Cape May County, a very small percentage of land-use are designated as urban development. Urban development includes residential and commercial areas, service and institutions, industrial and those developed for transportation and utilities. The majority of these developments are located in Lower Township, Cape May County.

In Cape May County, wetland constituted 35.2%, forest 13.1%, urban development 11.3%, agriculture 3.2%, barren land 1.1%, and the remaining area were classified as water. Unlike Cape May County, the largest percentages of land-use in Cumberland County are wetland and agriculture, with 20.4% and 19.4%, respectively. Urban development composed of less than 9%. See figure 6 for land-use patterns.

FIGURE 6: LAND USE PATTERNS



EVALUATION OF BIOLOGICAL RESOURCES

The primary biological resource for the Delaware Bay is oyster. The oyster planting ground is just north of the DB-2 area in Port of Bivalve, Cumberland County. The resource of hard clams (*Mercenaria Mercenaria*) in the DB-2 area is very minimal.

Area along the shoreline from East Point to Bidwell Ditch contains some of the best-known thriving horseshoe crab population, which uses the beaches for spawning and laying eggs. The

Delaware Bay is the 2nd largest stopover location in the Western Hemisphere for northward bound shorebirds. It was estimated that over 300,000 to more than a million shorebirds stopover at the Delaware Bay each year before heading north. The four main species of shorebirds included: Red Knot, Semipalmated Sandpiper, Ruddy Turnstone, and Sanderlings. The stopover occurs in early May through June. Migrating birds gain up to 50% of their body weight in fat by feasting on

horseshoe crab eggs and submerged vegetation. The new body fat helps fuel the birds for the next part of their journey to the breeding grounds in the Arctic.

Oil spills, excess toxins, or over harvesting of horseshoe crabs would have a devastating effect on both the horseshoe crab and migrating bird populations.

Within the DB-2 area, there are several wildlife refuges that support a large population of rare plants and animals. This includes the Heislerville Wildlife Management Area, Dennis Creek Wildlife Management Area, Cape May Wildlife Management Area, and Higbee Beach Wildlife Management Area. See Figure 8 for the location of wildlife refuge listed above.

FIGURE 7: SHELLFISH RESOURCES IN THE DELAWARE BAY CAPE SHORE AREA

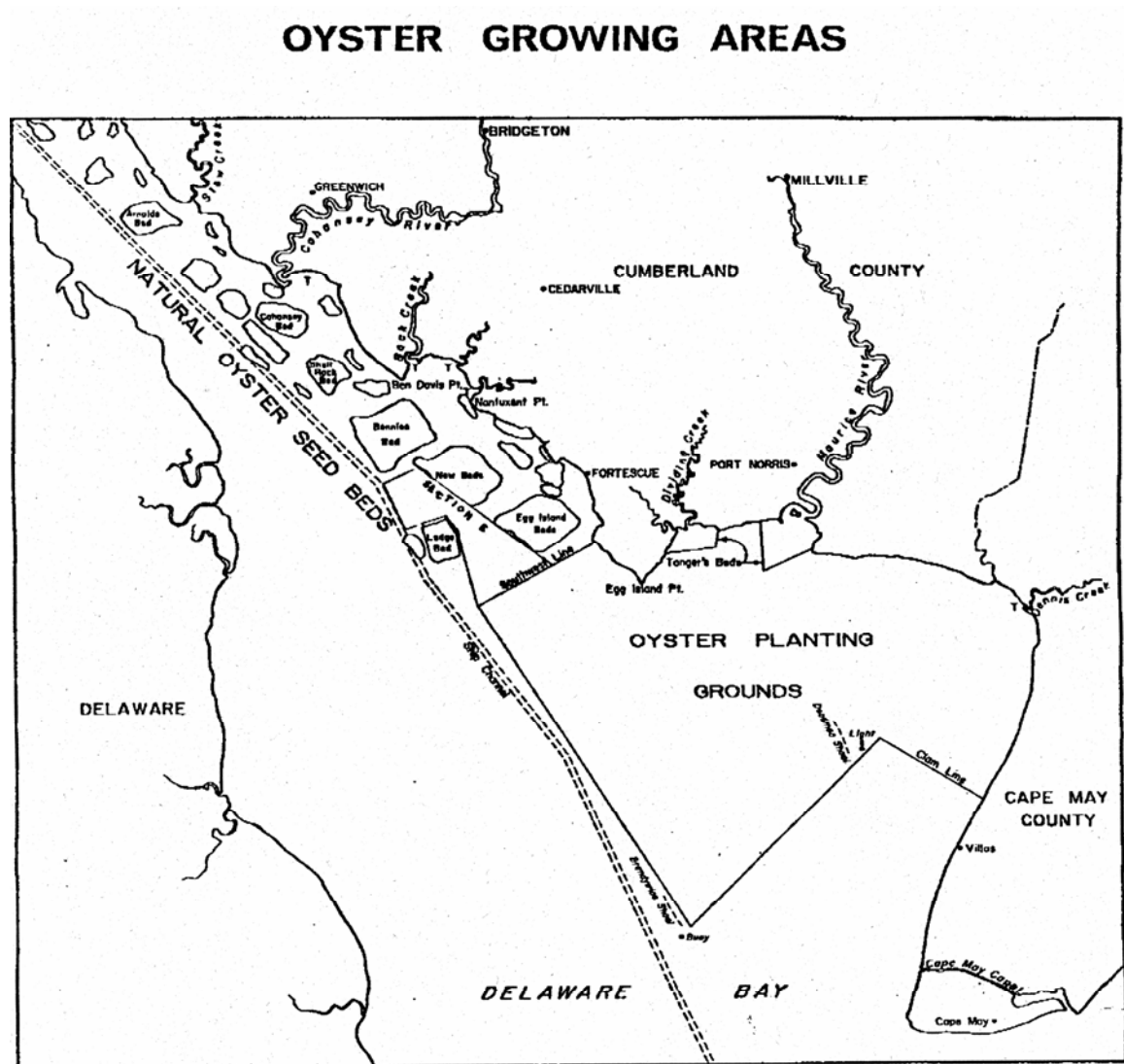
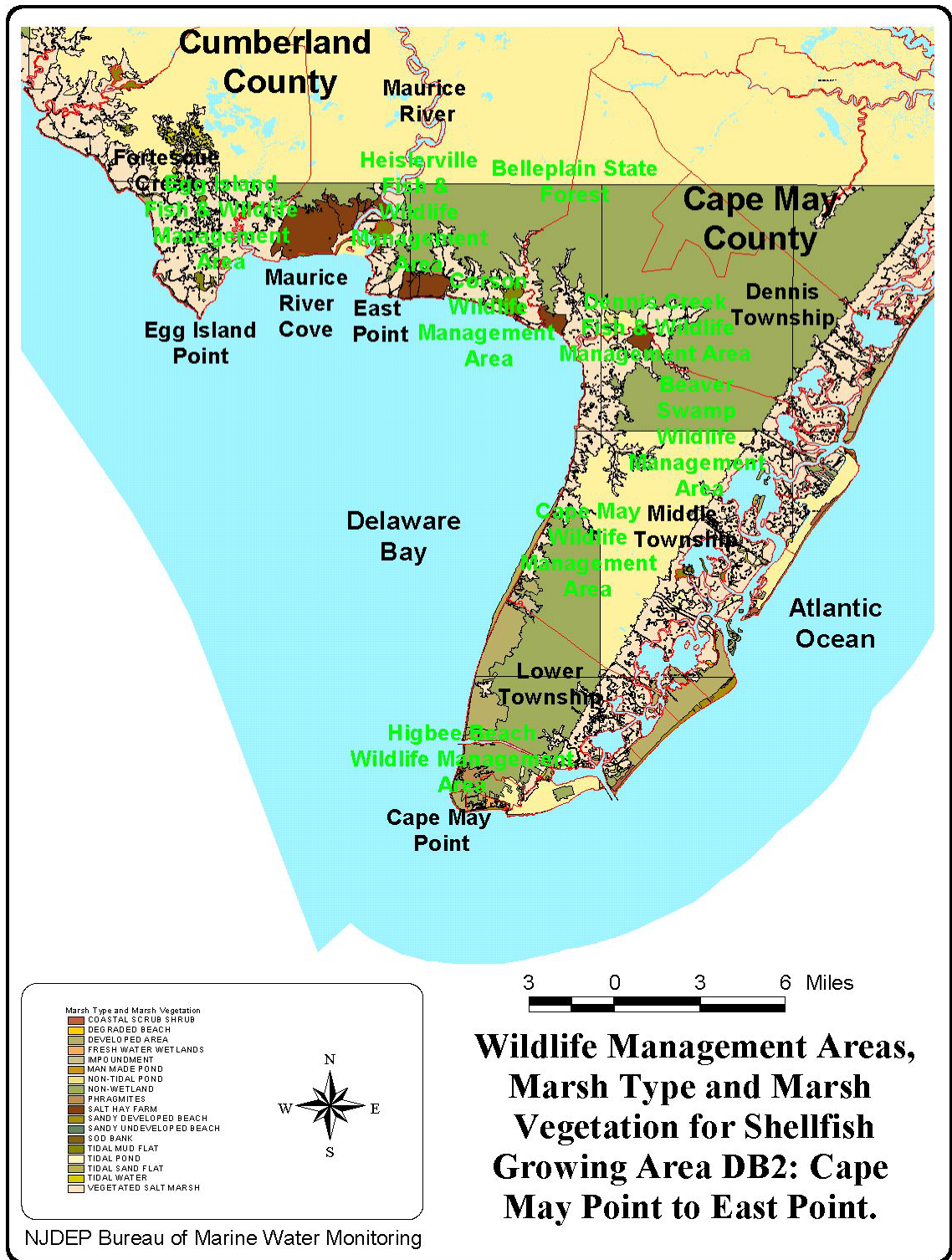


FIGURE 8: LOCATION OF OBSERVED WILDLIFE HABITAT IN SHELLFISH AREA (DB-2)



IDENTIFICATION AND EVALUATION OF SOURCES

Effluent Discharges

There are two wastewater treatment facilities located in Cape May County. The Cape May County Utilities Authority - Cape May Regional Wastewater Treatment Facility, which is located at 545 Sunset Boulevard in Cape May Point. The other wastewater treatment facility is the Lower Township Municipal Utilities Authority - Wastewater Treatment Facility. Both of

these facilities use a common discharge pipe, which discharges the effluent to the Atlantic Ocean. The discharge pipe is approximately 5500 feet off the shore of Jefferson Avenue in Wildwood Crest, New Jersey. Since the discharge is directed to the Atlantic Ocean, there is no direct impact onto the Delaware Bay. See Figure 10.

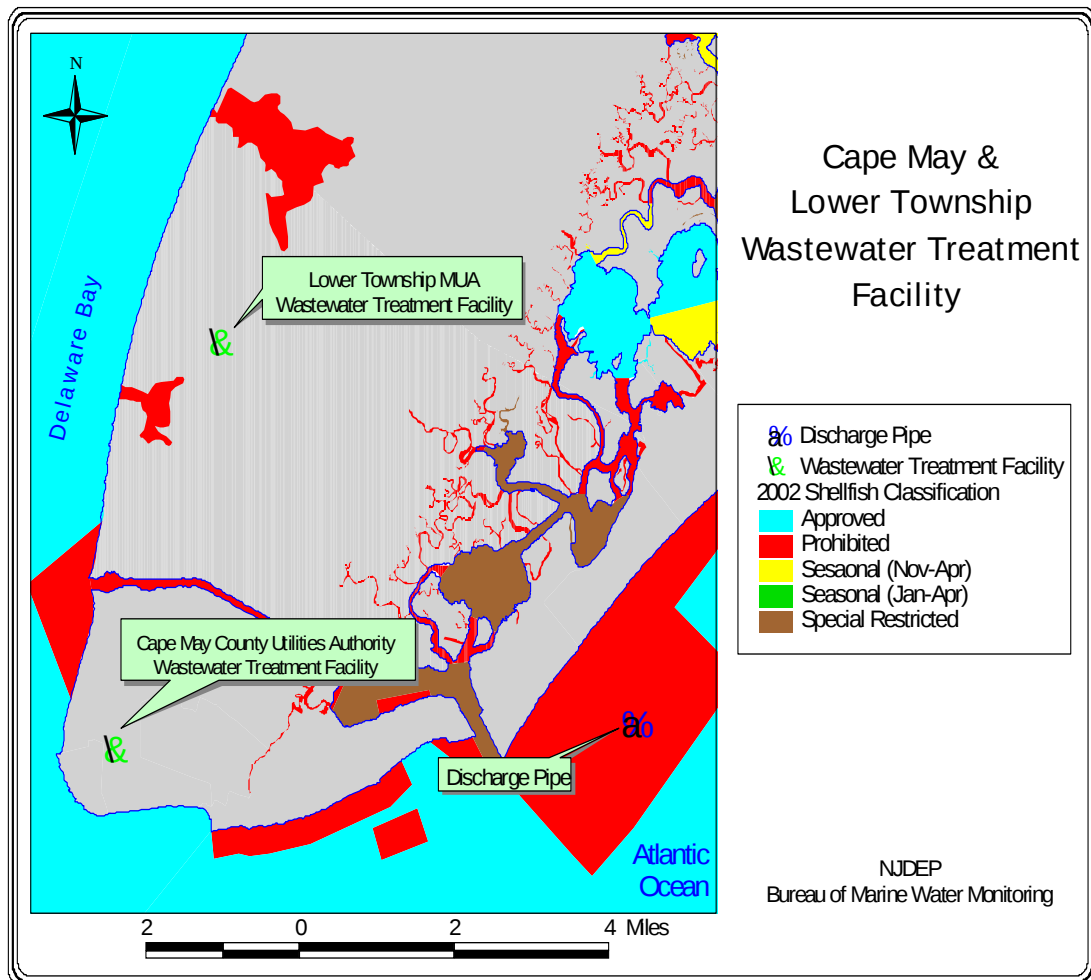
FIGURE 9: CAPE MAY REGIONAL WASTEWATER TREATMENT FACILITY



TABLE 4 : DISCHARGES FACILITIES IN THE SHELLFISH GROWING AREA (DB-2)

Discharge Facilities	Waste Type	Waste Quantity (MGD)
Cape May County Utilities Authority- Cape May Region Wastewater Treatment Facility	Sanitary	3
Lower Township Municipal Utilities Authority Wastewater Treatment Facility	Sanitary	4

FIGURE 10: DISCHARGES FACILITIES IN CAPE MAY COUNTY



Other Direct Discharges

There is no direct discharge source in the Delaware Bay Cape Shore area. The only facility that might have some impact to this area is the Southern State Correctional Facility, which is located in Cumberland County. This facility has

its own treatment facility which discharges into Riggins Ditch. Although, there was no reported of noncompliance with this facility there may still be a slight impact to Riggins Ditch.

Indirect Discharges

Indirect discharges are defined as sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have been, a discharge of contamination. Known contaminated sites are reported throughout the Delaware Bay Cape Shore area. Very few of those sites are located in close proximity to the coastline. The sites that are located near

the shoreline are usually service stations that have underground storage tank, which may have leaked. Any underground discharges are absorbed by the soil surrounding the tank, which leave very little impact to the surrounding water. There were several spills recorded between 1999 and 2002; however, the impact did not result in any closure of water within the Delaware Bay Cape Shore area.

Storm Water Inputs

The Bureau of Marine Water Monitoring had devoted many hours and efforts into the studies of storm water impact. The study was conducted along the Atlantic coast of New Jersey, from Monmouth County to Cape May County. However, there was no study done along the shoreline on the Delaware Bay side.

Most of the Delaware Bay Cape Shore residential population and urban development are located within Lower Township, Cape May County. Therefore, there are numerous storm water outfalls located throughout this area. Major concerns are placed on the storm water outfalls that are situated

along the shoreline. When heavy rainfall occurs, bacteria, feces from domestic animals, and wastes from the streets are deposited into these outfalls, which then flushes out onto the Delaware Bay, thus polluting the surrounding waters.

Figure 11 below, shows the storm water outfalls that are situated along the coast in Lower Township, Cape May County. Waters along the shore from Fishing Creek down to the Cape May Canal are currently classified as *Approved* water year-round. Historical data indicated that the water quality for this area has not been impacted by storm water.

FIGURE 11: LOCATIONS OF STORM WATER OUTFALLS IN THE DELAWARE BAY CAPE SHORE AREA

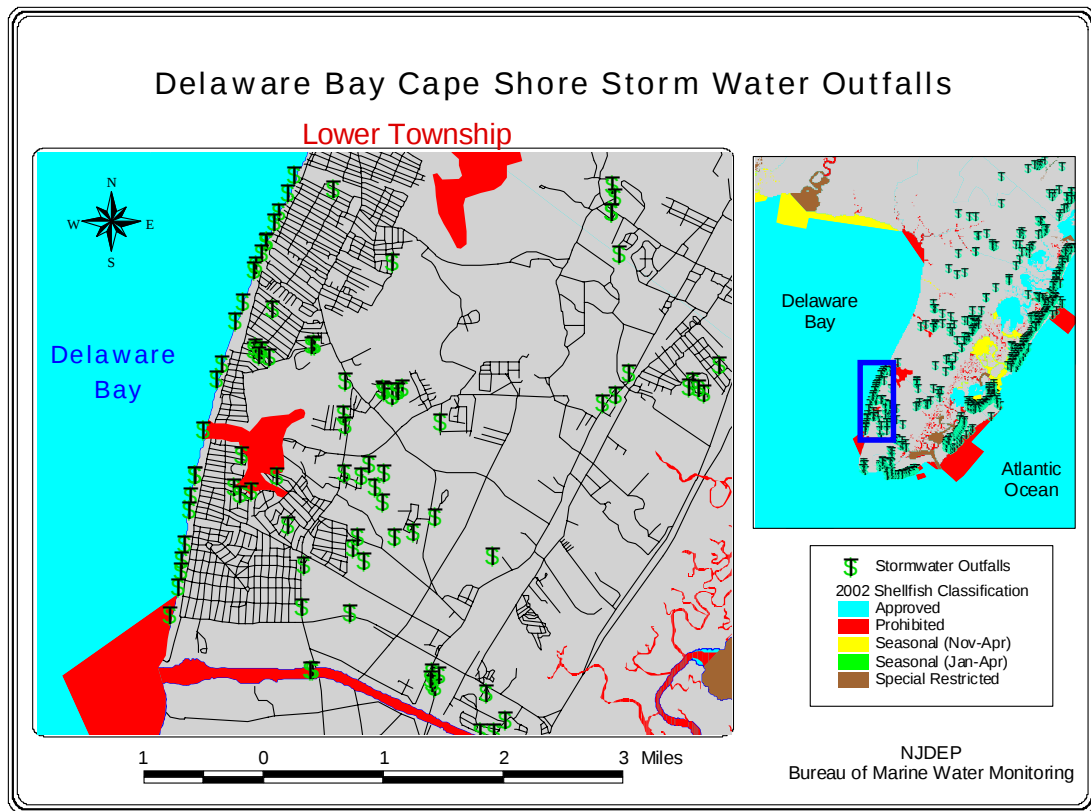


FIGURE 12: STORM WATER OUTFALLS IN THE DELAWARE BAY CAPE SHORE AREA



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" and

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*, 1997, that there are significant regional differences in all factors that affect marina pollutant loading. The manual 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):

$$BufferRadius(ft) = \sqrt{\frac{2 \times 10^9 (FC / person / day) \times 2 (person / boat) \times [(0.25 \text{ slips} \geq 24') + (0.065 \times \text{slips} < 24')] \times 2}{140000 (FC / M^3) \times depth(ft) \times 0.3048 (M / ft) \times \pi \times 2 (tides / day)}} \times 3.28 (ft / M)$$

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, or may be determined by 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 used for complex configurations where the formula is unlikely to provide the needed accuracy, also considers tidal exchange and bacterial die-off.

There are only two active marinas in the Delaware Cape Shore area, as shown in Figure 13. Both marinas are located within the Bidwell Ditch in Middle Township, Cape May County. Smokey's Inlet Marina is situated at the mouth of the Bidwell Ditch and Bayway Marina is located further down the channel. The classification of the enclosed waters depends on the water quality and the size of the marina. The current classifications of the enclosed

waters within the Bidwell Ditch are *Prohibited* and *Seasonally Approved*. Within the *Seasonally Approved* area, harvesting are only allowed during the winter months from November to April, when the marinas are inactive. The marina buffer zones were calculated using the equation described above. See Table 5.

FIGURE 13: MARINA FACILITIES LOCATED IN THE DELAWARE BAY CAPE SHORE AREA

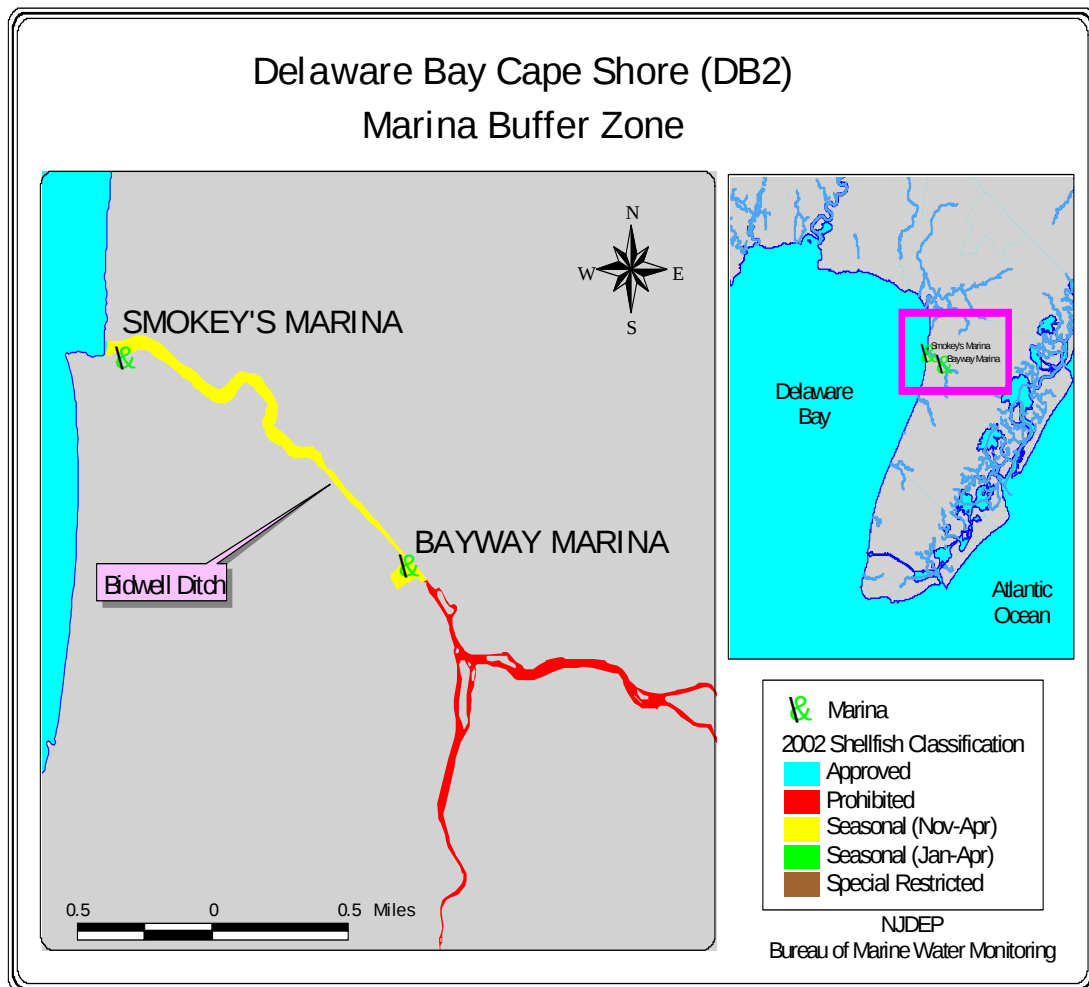


TABLE 5: MARINA FACILITIES LOCATED IN THE DELAWARE BAY CAPE SHORE AREA

Marina Name	# of Slips	Size of Buffer Area (radius; feet)
Smokey's Inlet Marina	100	590
Bayway Marina	66	1628

FIGURE 14: SMOKEY'S INLET MARINA



HYDROGRAPHY AND METEOROLOGY

PATTERNS OF PRECIPITATION

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region. 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.

Between 1999 and 2002, there were only two hurricanes that came in close proximity to the DB-2 area, Hurricane Floyd in 1999 and Hurricane Gordon in 2000. By the time these Hurricanes reached the coast of New Jersey, it had lost its intensity and was downgraded to

a tropical storm. None of the samples collected after these storms exhibited high bacteriological results.

A detailed hydrography report was completed for the 1999-2002 Delaware Bay Cape Shore Growing Area Report. Precipitation inputs to the area for the period 1999 through 2002 are shown in Table 6. There have been no significant changes in hydrography since the 2000 Sanitary Survey Report. The primary weather station for this area is 1351.

FIGURE 15: 1999 HURRICANE TRACKING MAP

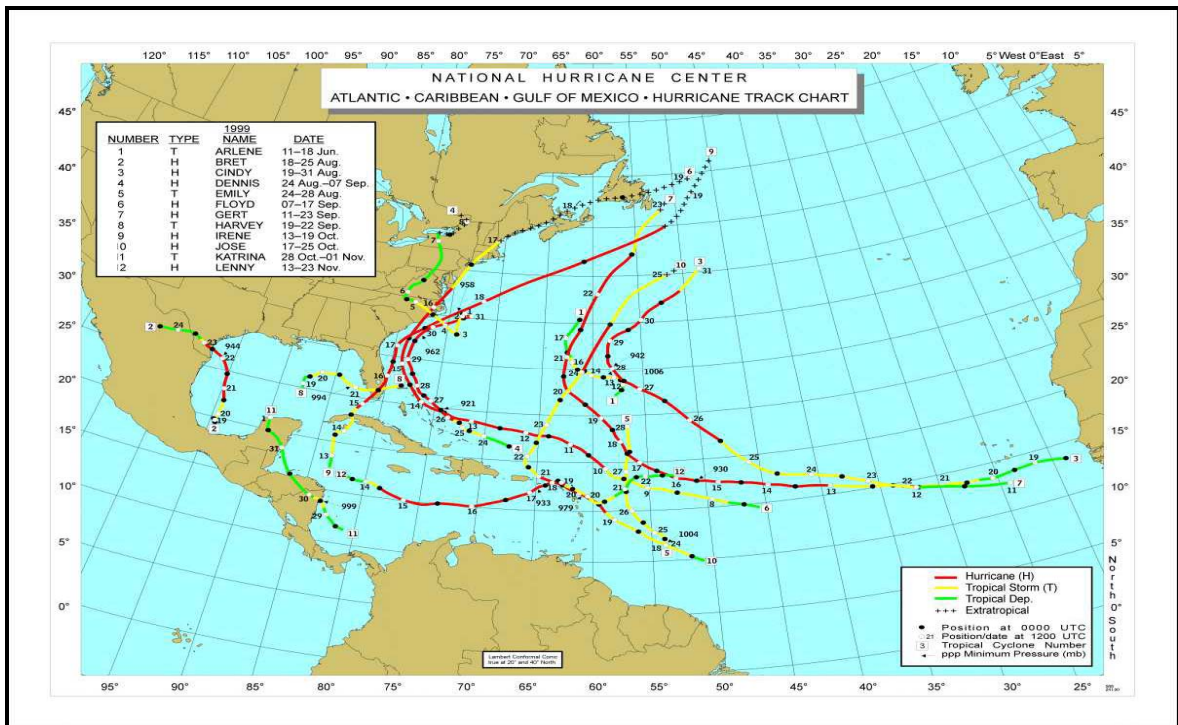


FIGURE 16: 2000 HURRICANE TRACKING MAP

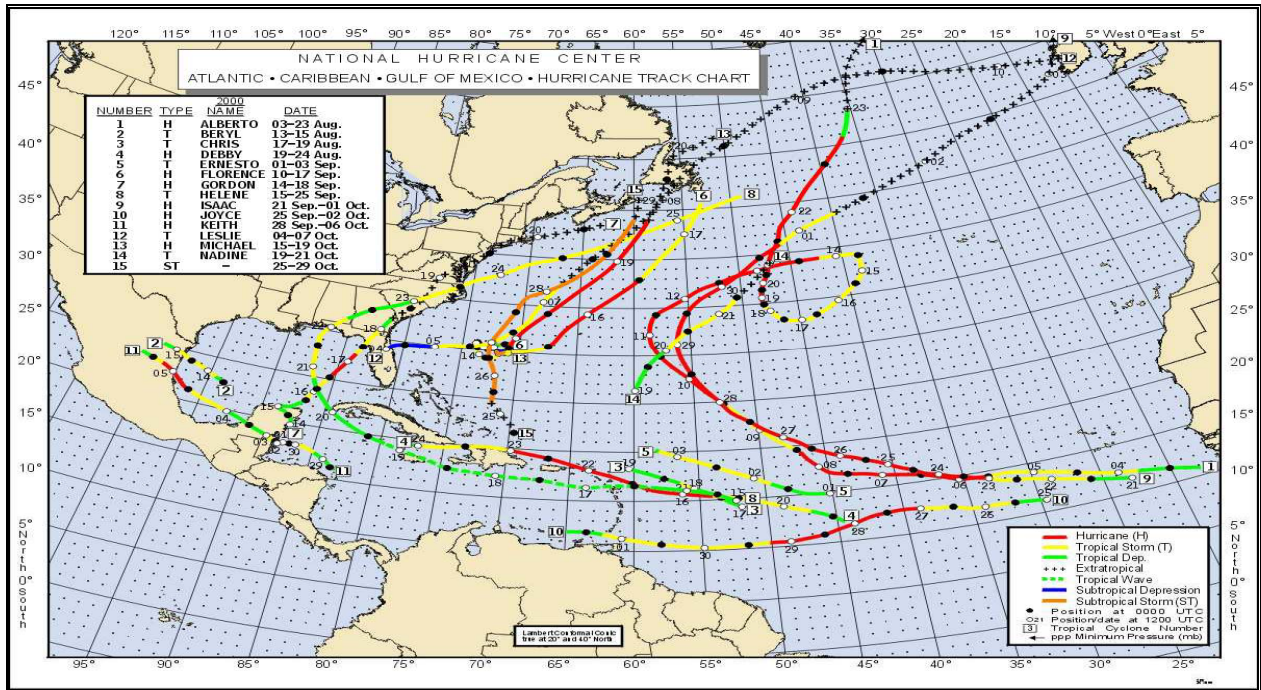


FIGURE 17: 2001 HURRICANE TRACKING MAP

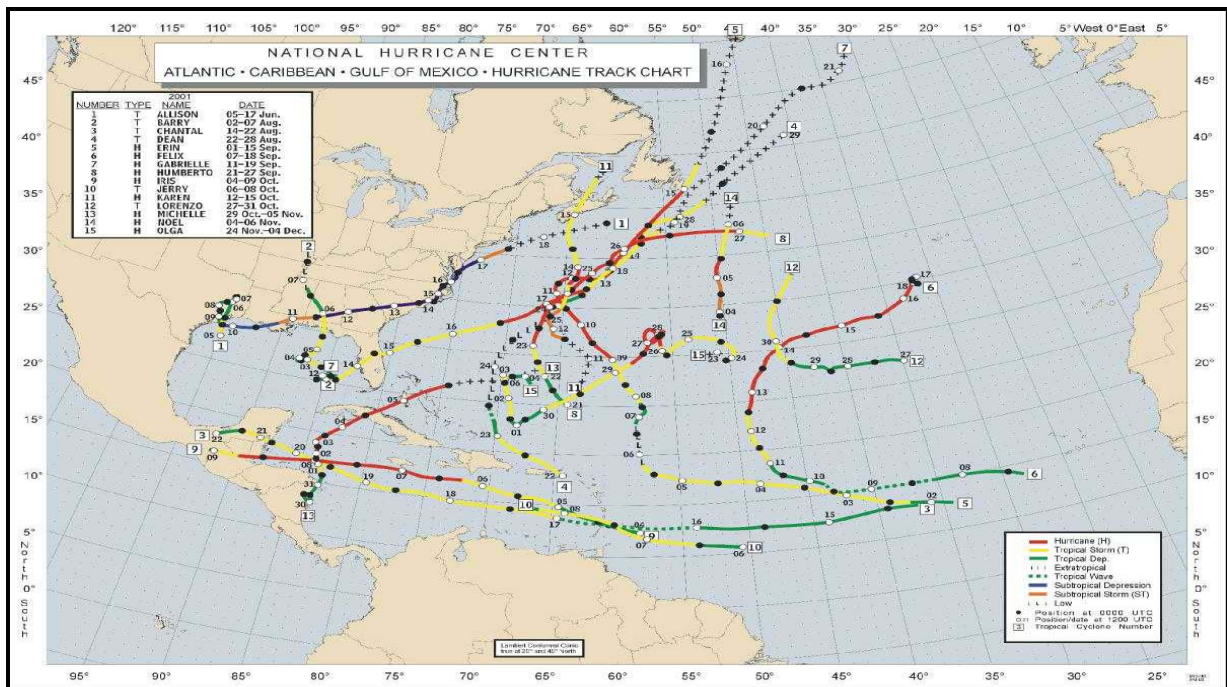


FIGURE 18: 2002 HURRICANE TRACKING MAP

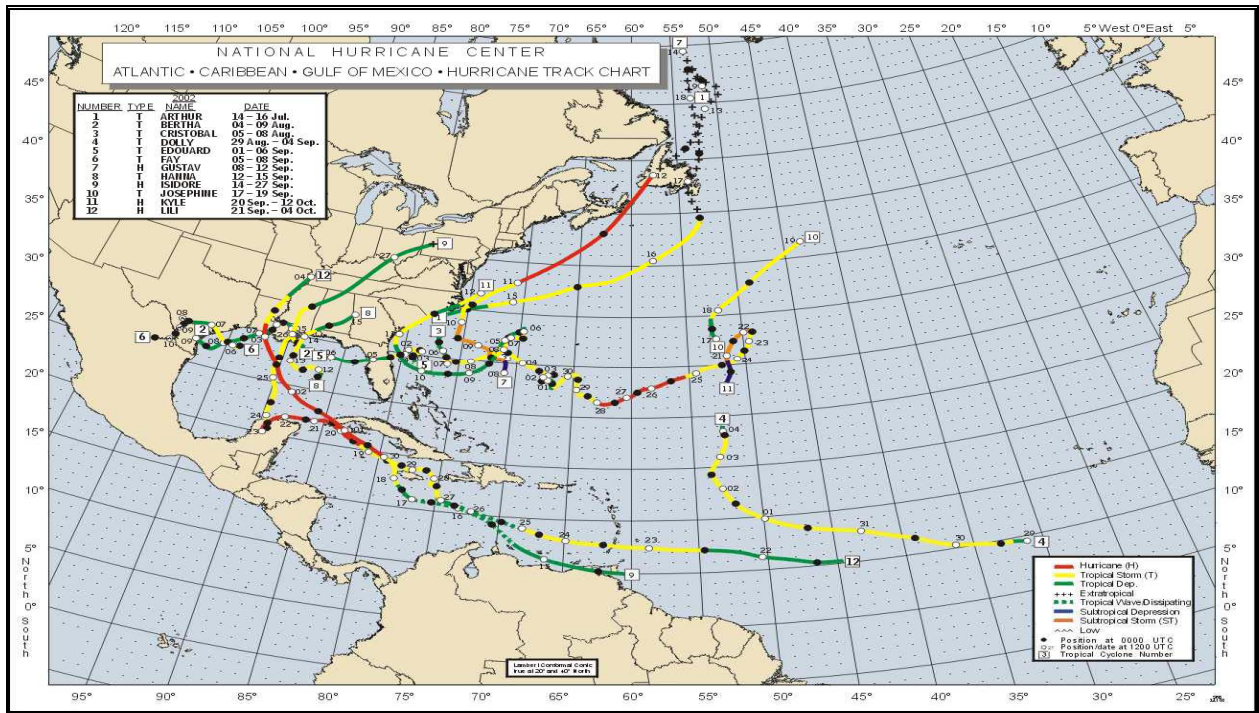


TABLE 6: CLIMATOLOGICAL DATA
Rainfall Recorded at NOAA's Station 1351

Sampling Date	Precipitation in Inches			Avg. Temp. (°F)
	Day of Sampling	Day of + 1 Day Before	Day of + 2 Days Before	
7/26/1999	0.02	0.02	0.02	81
8/6/1999	0	0	0	76
10/6/1999	0	0.32	0.62	54
10/19/1999	0	0.49	2.33	53
12/13/1999	0.11	0.11	0.11	42
1/3/2000	0	0	0	24
3/13/2000	0	0.12	0.44	41
3/28/2000	0.3	0.89	0.89	55
4/25/2000	0.64	0.64	0.64	47
4/28/2000	0	0.12	0.12	49
5/16/2000	0	0	0.005	59
6/1/2000	0	0	0	66
6/26/2000	0	0	0	78
7/10/2000	0.05	0.05	0.05	81
7/26/2000	1.09	1.28	1.31	72
7/28/2000	0	0.02	1.11	73
8/9/2000	0	0	0	82
8/18/2000	0.75	0.755	0.755	71
9/5/2000	0	0.07	0.3	61
11/8/2000	0	0	0	52
11/17/2000	0.04	0.04	0.04	48
12/5/2000	0	0	0	36
1/24/2001	0	0	0	37
2/7/2001	0	0	1.58	39

4/16/2001	0.14	0.38	0.38	31
5/2/2001	0	0	0	51
5/8/2001	0	0	0	66
6/20/2001	0	0	0	57
6/21/2001	0	0	0	77
7/16/2001	0	0	0	77
7/18/2001	0.57	0.57	0.57	77
8/3/2001	0	0	0	74
8/15/2001	0	0	1.04	76
10/1/2001	0.55	1.51	1.51	74
10/24/2001	0	0	0	52
11/26/2001	0.01	0.59	0.7	71
12/14/2001	0.01	0.02	0.04	52
1/8/2002	0	0.09	0.47	56
2/7/2002	0.58	0.58	0.58	34
3/19/2002	0	0.48	0.62	37
4/15/2002	0.04	0.04	0.04	47
4/22/2002	0	0.15	0.15	68
5/6/2002	0	0.08	0.19	56
6/18/2002	0	0	0	57
8/1/2002	0	0	0	68
8/23/2002	0.05	0.05	0.05	83
9/3/2002	0	0.02	2	80
9/9/2002	0	0	0	73
9/13/2002	0	0	0	72
9/18/2002	0	0	0.74	69
10/1/2002	0	0	0	70
12/12/2002	0	0	0	70

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

A total of 904 samples were collected and analyzed for Total Coliform (TC) and Fecal Coliform (FC) from 41 sampling stations listed in Assignment 347 and part of Assignment 332. Both assignments were sampled under the Adverse Pollution Control Strategy.

This report includes data analyzed from January 1999 to December 2002. The summary of all the raw data are provided in the appendix. The National Shellfish Sanitation Program (NSSP) criteria can be found on Table 2.

Compliance with NSSP Approved Criteria

Approved Year- Round

Most of the stations located in the *Approved* waters shows compliance with the NSSP Approved criteria, with the exception of one station. Station 3893 had detected for high Total and Fecal Coliform. This station is currently located approximately ½ - 1 mile off the

coastline, just North from the Dias Creek, and in the vicinity of the Cape May National Wildlife Refuge. Station 3893 failed to meet the NSSP *Approved* criteria, but was within the NSSP *Special Restricted* criteria.

Seasonally Approved

Waters from East Point to West Creek and in portion of the Bidwell Ditch are currently classified as *Seasonally Approved* from November to April. This means that harvesting is only permitted from November to April. These areas include the following sampling stations:

3881A, 3882, 3883A, 3884B, 3885B, 3886A, and 3890D. The results generated from these sampling stations, indicated that all were within the NSSP *Seasonally Approved* criteria for Total Coliform; therefore, met the current classification.

Compliance with NSSP Special Restricted Criteria

There are 41 sampling stations located in the DB-2 area. Four sampling stations are in *Prohibited* waters and the remaining stations are either in

Approved or *Seasonal* waters. None of the samples collected from these 41 sampling stations were above the NSSP *Special Restricted* criteria.

FIGURE 19: SAMPLING STATIONS FOR THE DELAWARE BAY CAPE SHORE AREA

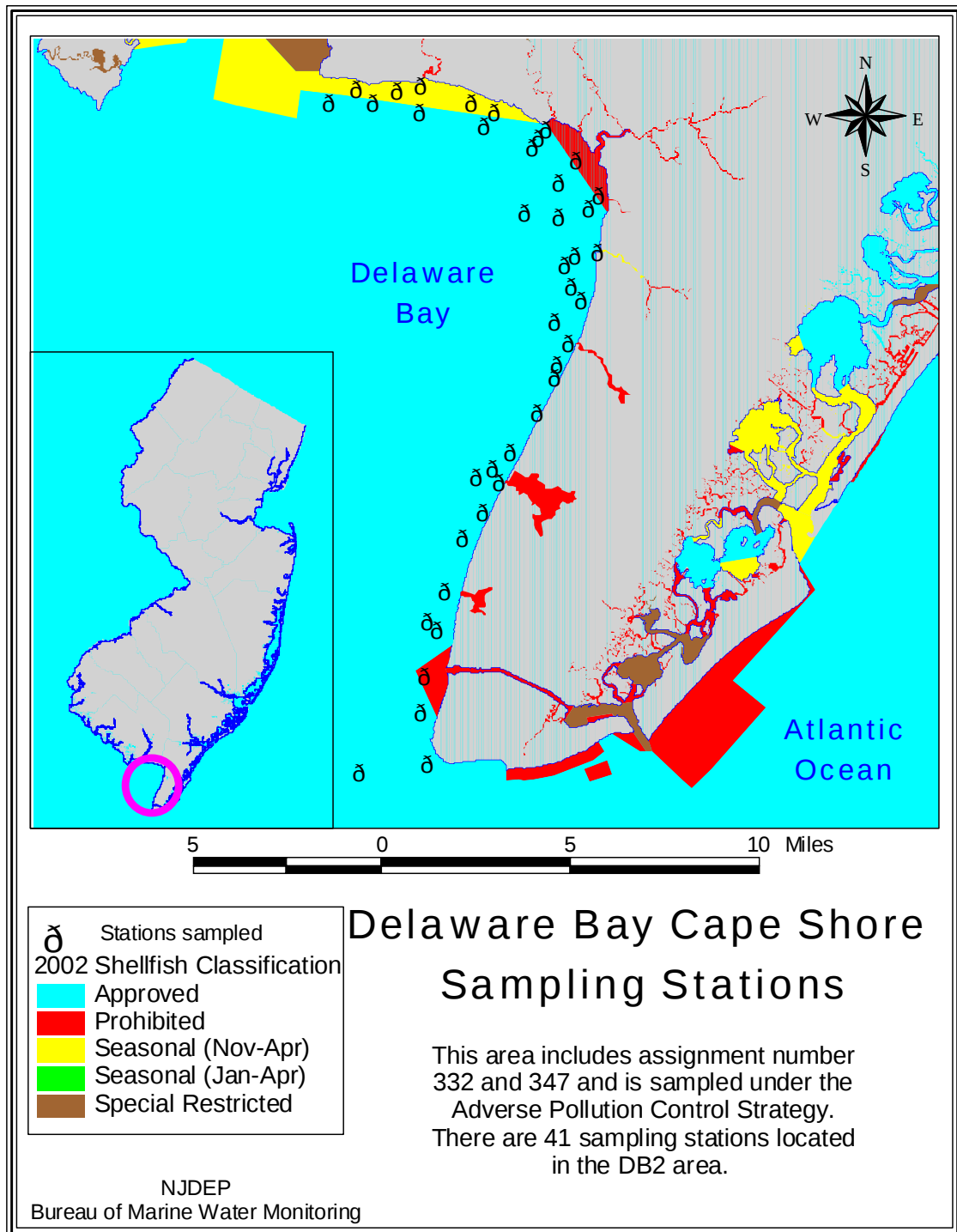


FIGURE 20: SAMPLING STATIONS EXCEEDING YEAR - ROUND APPROVED CRITERIA

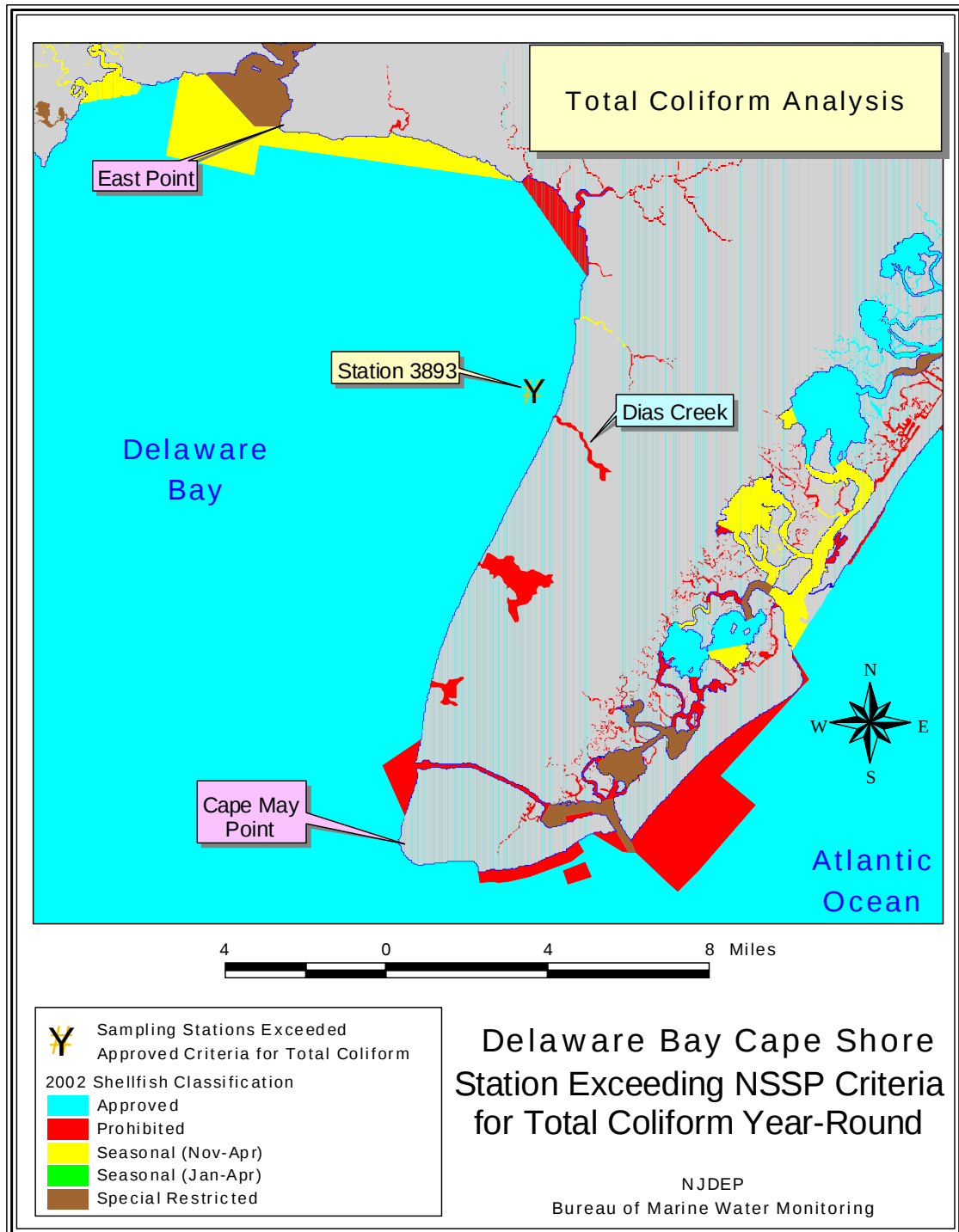


TABLE 7: WATER QUALITY SUMMARY: APC STATIONS (01/01/1999 – 12/31/2002)

		Year Round			Summer			Winter		
Station	Status	Geo Mean	%>330	N	Geo Mean	%>330	N	Geo Mean	%>330	N
3806B	A	3.8	0.0%	19	3.9	0.0%	16	3.2	0.0%	3
3807B	A	5.3	0.0%	19	4.8	0.0%	16	8.6	0.0%	3
3808B	A	5.4	0.0%	19	4.3	0.0%	16	17.7	0.0%	3
3809A	A	5.4	0.0%	19	5.0	0.0%	16	7.7	0.0%	3
3810	A	6.3	0.0%	19	5.7	0.0%	16	10.0	0.0%	3
3810B	A	4.2	0.0%	19	4.4	0.0%	16	3.2	0.0%	3
3812B	A	4.6	0.0%	18	4.7	0.0%	15	4.3	0.0%	3
3814A	A	4.2	0.0%	19	4.2	0.0%	16	4.0	0.0%	3
3816A	A	3.2	0.0%	19	3.3	0.0%	16	3.0	0.0%	3
3818	A	3.6	0.0%	19	3.1	0.0%	16	7.7	0.0%	3
3818A	A	3.7	0.0%	19	3.5	0.0%	16	4.3	0.0%	3
3819A	P	3.9	0.0%	19	3.6	0.0%	16	5.9	0.0%	3
3821A	A	3.2	0.0%	19	3.0	0.0%	16	4.3	0.0%	3
3826D	A	3.8	0.0%	19	3.2	0.0%	16	9.4	0.0%	3
3827F	A	3.4	0.0%	19	3.3	0.0%	16	4.3	0.0%	3
3880	A	19.0	0.0%	19	17.0	0.0%	16	34.9	0.0%	3
3881A	S	21.6	2.5%	40	23.7	0.0%	18	19.9	4.5%	22
3882	S	20.4	2.5%	40	30.6	5.6%	18	14.6	0.0%	22
3883A	S	11.2	2.5%	40	9.5	5.6%	18	12.8	0.0%	22
3884	A	12.4	5.3%	19	9.0	0.0%	16	68.0	33.3%	3
3884B	S	9.8	2.5%	40	7.0	0.0%	18	12.7	4.5%	22
3885B	S	11.2	0.0%	39	11.8	0.0%	17	10.8	0.0%	22
3886	A	5.5	0.0%	19	5.4	0.0%	16	6.3	0.0%	3
3886A	S	8.3	0.0%	41	7.8	0.0%	22	8.9	0.0%	19

Station	Status	Year Round			Summer			Winter		
		Geo Mean	%>330	N	Geo Mean	%>330	N	Geo Mean	%>330	N
3887	A	6.9	0.0%	19	5.4	0.0%	16	25.5	0.0%	3
3887A	A	11.9	0.0%	19	10.4	0.0%	16	24.3	0.0%	3
3887B	P	8.6	5.3%	19	6.8	0.0%	16	30.7	33.3%	3
3888F	A	6.9	5.3%	19	5.9	0.0%	16	16.1	33.3%	3
3888G	A	8.7	0.0%	19	7.9	0.0%	16	15.0	0.0%	3
3888I	P	6.1	0.0%	19	6.3	0.0%	16	5.2	0.0%	3
3889	A	6.0	0.0%	19	5.4	0.0%	16	10.0	0.0%	3
3889A	A	5.4	0.0%	19	4.1	0.0%	16	20.8	0.0%	3
3889B	P	8.7	5.3%	19	7.6	6.3%	16	18.6	0.0%	3
3890	A	6.0	0.0%	19	6.1	0.0%	16	5.5	0.0%	3
3890A	A	9.7	0.0%	19	7.6	0.0%	16	36.9	0.0%	3
3890D	S	7.1	0.0%	19	6.9	0.0%	16	7.7	0.0%	3
3891	A	6.5	0.0%	19	6.2	0.0%	16	8.6	0.0%	3
3892A	A	6.8	0.0%	19	5.9	0.0%	16	14.4	0.0%	3
3893	A	13.1	10.5%	19	13.5	12.5%	16	11.2	0.0%	3
3894A	A	5.0	0.0%	19	4.3	0.0%	16	10.1	0.0%	3
3895F	A	5.6	0.0%	19	4.9	0.0%	16	10.7	0.0%	3

Tidal Effects

Tidal impacts were evaluated by performing a t-test to compare the Total Coliform MPN value from samples collected during ebb tide versus samples collected during a flood tide. In order for

a station to have a tidal component, t-probability must be less than 0.05, but not zero. There was no sampling station in the Delaware Bay Cape Shore area that had a tidal component.

Seasonal Effect

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. According to the TC-Statistical Analysis Program, there was no sampling station in the Delaware Bay Cape Shore area that exhibits a seasonal component.

Rainfall Effects

Rainfall effect was assessed by using the correlation between the rainfall amount recorded for the day of sampling, day of sampling plus one day before, and day of sampling plus two days before. Rainfall component is based on the rainfall correlation calculated for the “day of plus

two days before.” To have a rainfall component, the correlation must be greater than 0.6. There was no station in the DB-2 area that had a rainfall correlation of greater than 0.6.

INTERPETATION 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. This data is however utilized as adjunct information and is 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 Adverse Pollution Condition Strategy.

There was only one station in the DB-2 area that failed to meet the *Approved* criteria for Total Coliform. Station No. 3893 is currently located in *Approved* water and had exceeded the acceptable criteria for Total Coliform values year-round and the summer season. According to the NSSP *Approved* criteria, no more

than 10% of the sample set can exceed 330 MPN/100 mL. The results generated for sampling station 3893 were 12.5% and 14.3% for year-round and summer season, respectively.

Upon further investigation, it was observed that rainfall could have attributed to the higher Total Coliform value analyzed. There were two particular samples that had extremely high Total Coliform counts. One sample collected on July 26, 2000 and the other on August 15, 2001. The results for Total Coliform counts were 1100 MPN/100mL and 460 MPN/100mL, respectively. During these two sampling days, over 1 inches of rainfall was recorded. See Table 8 for the rainfall correlation and rainfall amount.

Rainfall has always been known to cause run-off or flooding. When flooding or run-off occur, depending on the direction of water flow, it tends to carry contamination and pollution from other area to a new location. The Bureau of Marine Water Monitoring is currently conducting several studies such as the Storm Water Studies, to help determine the contributing factor relating to high Total and Fecal Coliform observed in these areas.

TABLE 8: RAINFALL CORRELATION WITH CUMULATIVE RAINFALL AMOUNT

Rainfall	Day of Sampling	Day of + 1 Day Before	Day of + 2 Days Before
July 26, 2000	1.09 inches	1.28 inches	1.31 inches
August 15, 2001	0	0	1.04 inches
Correlation	0.629	0.636	0.464

FECAL COLIFORMS ANALYSIS

In New Jersey, water classification is based primarily on Total Coliform analysis. However, samples were also taken for Fecal Coliform analysis. Fecal Coliform analysis was performed as a secondary test. The results were utilized as adjunct information and will not serve as bases for water classification.

There were two stations (Station 3888F and 3893) that were in *Approved* water that had Fecal Coliform counts above the acceptable criteria. According to the

NSSP criterion, no more than 10% of the sample set could exceed 49 MPN/100mL for *Approved* classification. In this case, both stations failed to meet the specification. The results for both stations were 12.5% > 49 MPN/100mL. Raw data retrieved from 1990 indicated that the Fecal Coliform counts were only higher during the summer months from May to October. The values of Fecal Coliform during the winter season from November to April were fairly low.

RELATED STUDIES

The NOAA Mussel Watch Program is a program that monitors the levels of toxins and metals in coastal waters. The blue mussel, *Mytilus edulis*, occurs worldwide, and effectively takes up toxins and metals from seawater and sediment, and concentrates the toxins and metals in their living tissues. Assays from the living tissues of this shellfish can be made easily and cheaply.

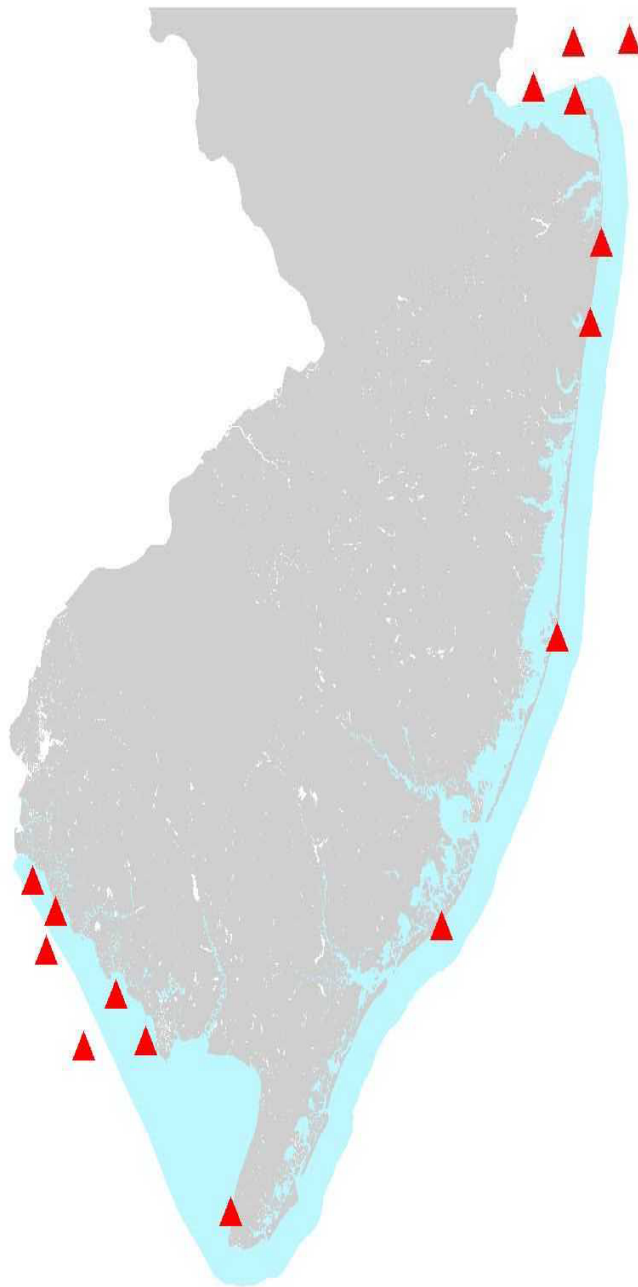
The Mussel Watch Program monitors metals such as mercury, lead, zinc, nickel, cadmium, copper, chromium, aluminum, silicon, manganese, iron, arsenic, selenium,

tin, antimony, thallium, and silver. The program also monitors toxins such as the synthetic organic compounds that are widely used in pesticides, solvents, flame-retardants, and other products. Figure 21 shows the locations of the NOAA Mussel Watch Sampling Stations in New Jersey.

There is one station within the NOAA Mussel Watch Program that is located in the DB-2 area. This station is located near Cape May Point. The NOAA Mussel Watch Program is sampled once annually. The most current results can be found on the NOAA's website.

FIGURE 21: SAMPLING SITES WHERE NOAA MUSSEL WATCH DATA HAS BEEN COLLECTED

Mussel Watch Sampling Stations



There are 15 stations sampled under the NOAA Mussel Watch program in waters adjacent to the state of New Jersey.

Although detectable levels of several toxic parameters have been measured at one or more locations, only the level of lead has been measured in New Jersey waters at levels above the FDA criteria.

Elevated levels of mercury have been found in parts of the New York Harbor.

Bureau of Marine
Water Monitoring

3/2000

NUTRIENTS

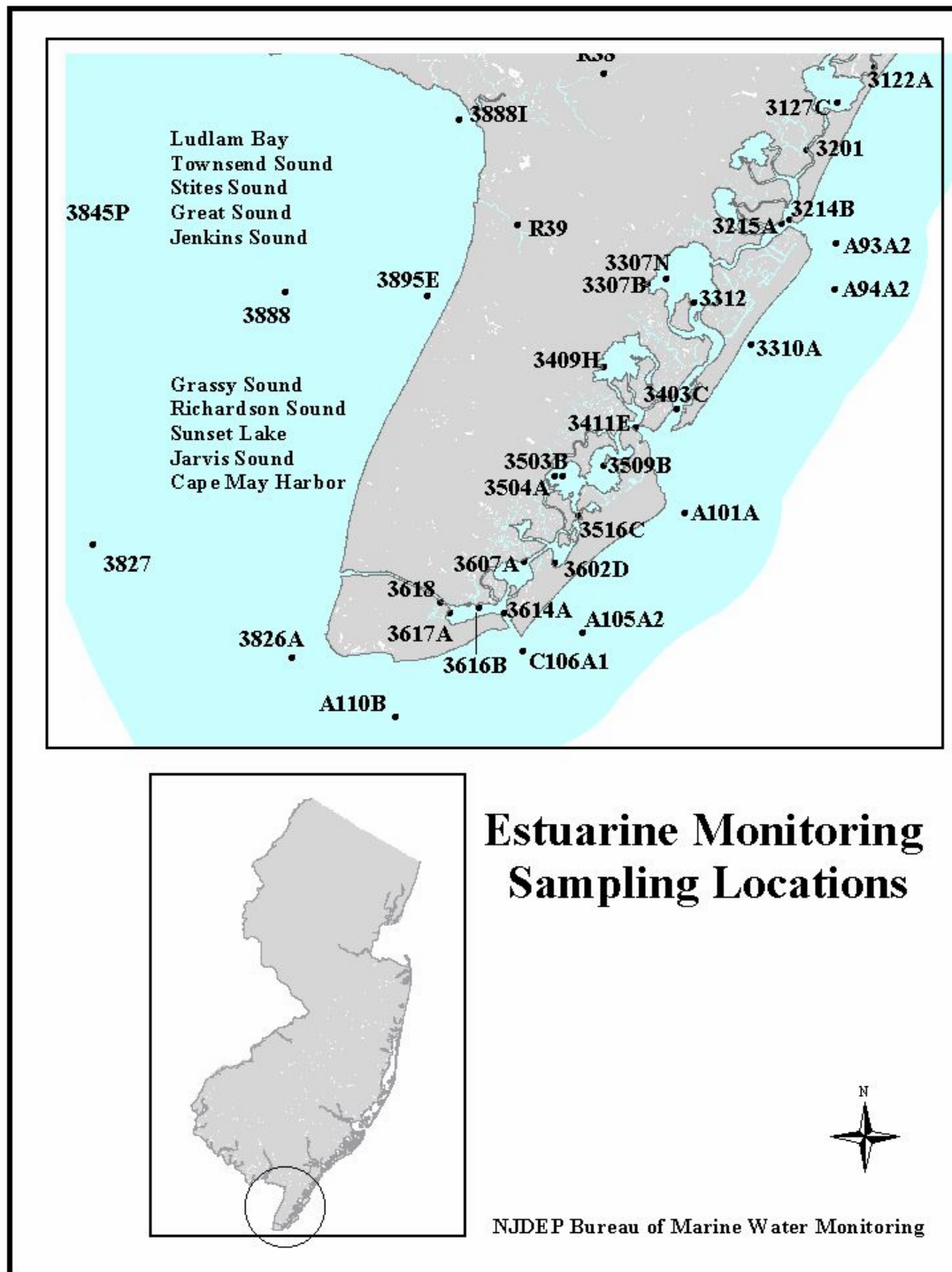
There were seven (7) stations in this shellfish growing area that are sampled under the estuarine monitoring program for chemical parameters including nutrients. These seven nutrient stations were 3826A, 3827, 3845P, 3888, 3888I, 3895E and R39. See Figure 22 for stations location, and Table 9 for nutrients data. More detailed information concerning dissolved oxygen

and nutrient levels can be found in the Estuarine Monitoring Report published by the NJDEP. The latest report ([New Jersey Ambient Monitoring Program: Report on Marine and Coastal Water Quality - 2000](#)) is available from the Bureau of Marine Water Monitoring website.

TABLE 9: NUTRIENTS DATA FOR THE DELAWARE BAY CAPE SHORE

Station	Secchi Depth (ft)	Salinity (PPT)	Dissolve Oxygen (mg/L)	Suspend Solids (mg/L)	Ammonia (ug N/L)	Nitrate & Nitrite (ug N/L)	OrthoPhosphate (P/L)	Total Nitrogen (ug N/L)
3826A	4.7	25.5	8.7	39.3	136.7	215.8	22.3	489.5
3827	4.5	25.9	8.7	33.6	72.7	133.4	21.3	437.8
3845P	2.5	21.4	8.1	31.5	102.2	178.5	56.7	589.9
3888	2.3	21.3	8.1	36.1	134.4	226.3	52.5	654.8
3888I	1.6	20.3	8.1	50.5	293.5	259.0	91.6	1023.2
3895E	1.9	20.7	8.3	56.1	190.5	323.1	76.2	901.3
R39	0.8	15.8	5.1	26.1	274.8	89.3	119.7	791.4

FIGURE 22: SAMPLING SITES WHERE DATA HAS BEEN COLLECTED FOR NUTRIENTS



CONCLUSIONS

BACTERIOLOGICAL EVALUATION

The water quality for the Delaware Bay Cape Shore area in the past has been exceptionally good. Based on the water quality data obtained from January 1999 through December 2002, the results for most of the sampling stations were within NSSP *Approved* or *Special Restricted* criteria.

There was only one station (Station 3893) located in *Approved* water that had exceeded the acceptable limit for Total and Fecal Coliform. The data obtained

indicated that more than ten percent of the samples set had exceeded 330 MPN/100 mL. From the rain data, it's possible that rain could be a contributing factor.

Before any downgrade is recommended, additional studies are necessary to further assess the water quality for this particular area. At this time, it is recommended that the current classification remain the same until additional information is obtained.

RECOMMENDATIONS

BACTERIOLOGICAL EVALUATION

There are no changes in water classification recommended for the Delaware Bay Cape Shore area at this

time. Continue the monitoring schedule as planned.

Recommended Changes in Monitoring Schedule

Since 1990, there has only been a few samples collected during the winter months. With only a few samples taken, it is hard to accurately assess the water quality for the whole year and winter

season. It is recommended that more samples be collected during the winter season to further evaluate the water quality for the whole year and winter season.

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NOAA. National Climate Data Center website, located at www.erh.noaa.gov/er/box/dailystns.shtml.

U.S. Census Bureau at www.census.gov/

U.S. Environmental Protection Agency at www.epa.gov/owow/

USGS at www.usgs.gov/

Shorebird Crisis-The Horseshoe Crabs of Delaware Bay. www.virtual/bird.com

ACKNOWLEDGMENTS

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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 2002

Ambient Monitoring Program

Reappraisal Report:

Delaware Bay Cape Shore (DB-2)

November 2004



Department of Environmental Protection
Bradley Campbell, Commissioner

State of New Jersey
Richard J. Codey, Acting Governor