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Land Use Management
Water Monitoring and Standards
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PARTIAL SANITARY SURVEY OF

SHELLFISH GROWING AREA SE-6:

GREAT SOUND TO RICHARDSON SOUND

2002 – 2007

October 2007

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PARTIAL SANITARY SURVEY OF SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND

2002 – 2007

New Jersey Department of Environmental Protection
LISA P. JACKSON
COMMISSIONER

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EXECUTIVE SUMMARY

Shellfish Growing Area SE-6, Great Sound to Richardson Sound, is located in the southeastern part of New Jersey, southwest of the city of Avalon and northwest of the city of Wildwood in Cape May County. The primary classification of this shellfish growing area is *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* and *Prohibited,* and the approximate size of this shellfish growing area is 7,083.4 acres. The water quality data presented in this Partial Sanitary Survey of Shellfish Growing Area SE-6, Great Sound to Richardson Sound, was collected between October 2002 and September 2007. This shellfish growing area is sampled using the Systematic Random Sampling (SRS) strategy for the water samples collected at the sampling stations in Holmes Cove and Holmes Creek and from Jenkins Sound to Hereford Inlet because there are no adverse pollution sources that are directly discharging into these shellfish waters, and the Adverse Pollution Condition (APC) strategy for the water samples collected at the sampling stations in Great Sound, Grassy Sound, and Richardson Sound because there are some adverse pollution sources, such as marinas and storm water outfalls, that are indirectly discharging into these shellfish waters. All of the water samples collected at the sampling stations in this shellfish growing area meet the *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* and *Prohibited* total coliform shellfish classification criteria for water quality year-round, in the summer months, and in the winter months, using the total coliform 3 tube decimal dilution analysis, and are in compliance with the total coliform criteria for the *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* and *Prohibited* classifications of this shellfish growing area, as specified by the National Shellfish Sanitation Program (NSSP). A review of the water quality data for the water samples collected at the sampling stations in Old Turtle Thorofare show that the total coliform levels for the water samples at these sampling stations improved and now meet the *Seasonally Approved (November to April)* shellfish classification criteria. Therefore, approximately 66.7 acres of *Prohibited* shellfish waters in Old Turtle Thorofare will be upgraded to the *Seasonally Approved (November to April)* shellfish classification (see Figure 1). There were no observed changes to pollution sources of this area as documented in the shoreline survey included in this report.

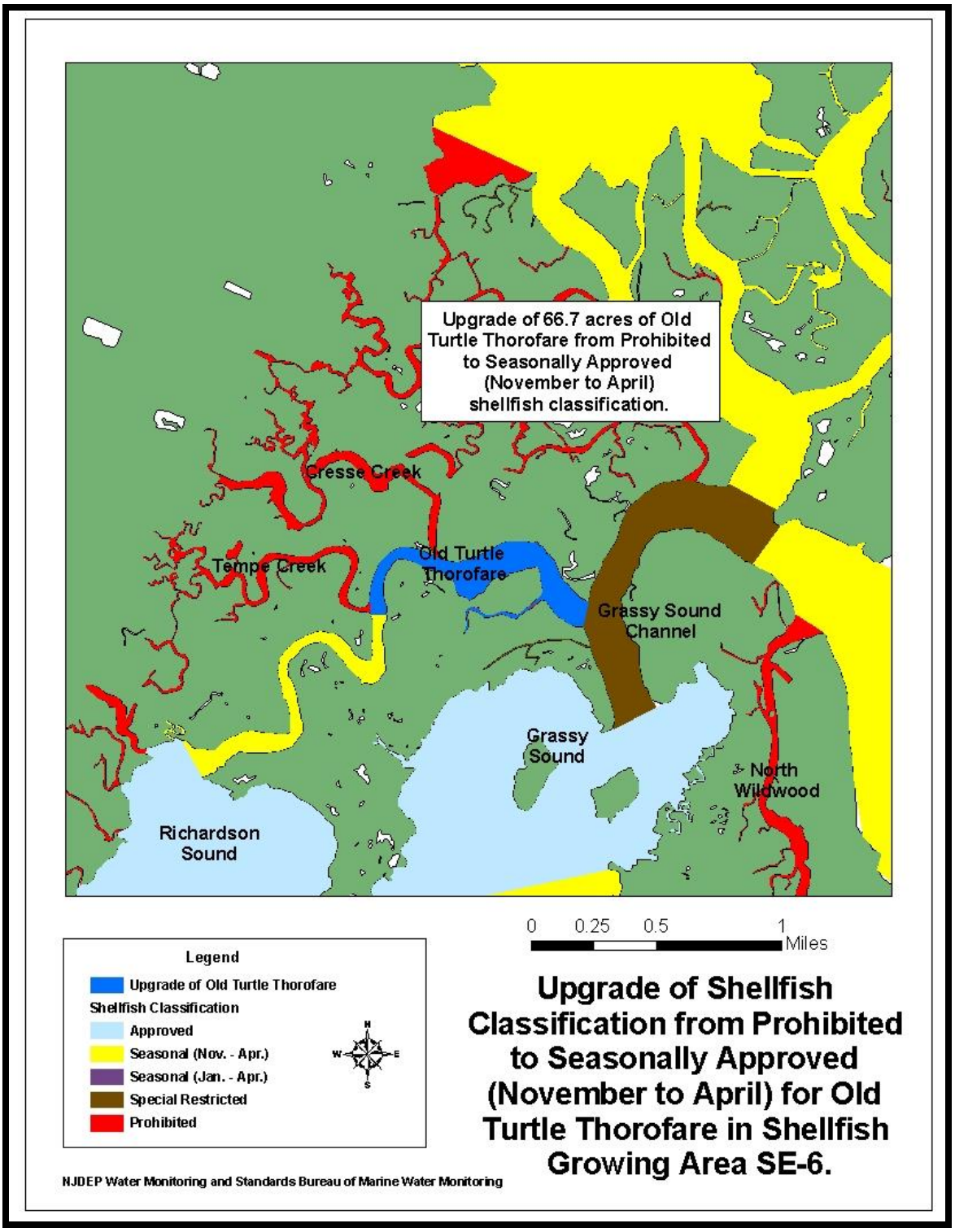

FIGURE 1: UPGRADE OF SHELLFISH CLASSIFICATION FROM PROHIBITED TO SEASONALLY APPROVED (NOVEMBER TO APRIL) FOR OLD TURTLE THOROFARE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

INTRODUCTION

PURPOSE

The primary purpose of this report 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.

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 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 Bureau of Marine Water Monitoring (BMWM), is responsible for administering and or suspension of 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 2.

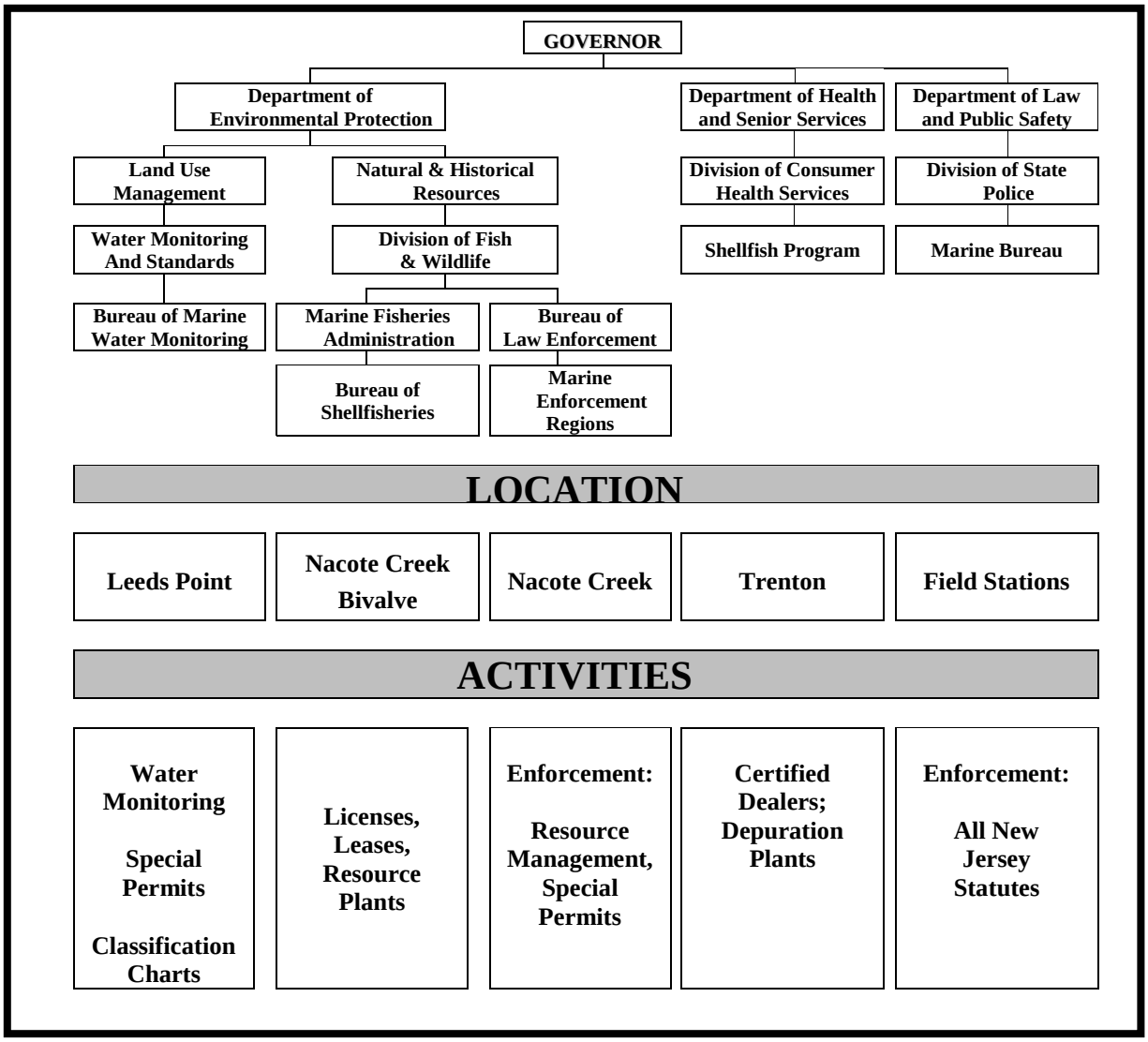

FIGURE 2: STATE OF NEW JERSEY SHELLFISH AGENCIES

IMPORTANCE OF THE 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 hydrology 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 to comply with the three year reappraisal. Additionally, a partial shoreline survey was completed for the purpose of upgrading and reclassifying a portion of the shellfish growing waters of Shellfish Growing Area SE-6: Great Sound to Richardson Sound.

GROWING AREA PROFILE

LOCATION AND DESCRIPTION

Shellfish Growing Area SE-6 is located in the southeastern part of New Jersey; southwest of the city of Avalon and northwest of the city of Wildwood in Cape May County (see Figure 3).

The waters of this shellfish growing area are bordered to the north by Avalon Boulevard (Route 601), to the west by the Garden State Parkway in Middle Township, to the south by Wildwood Boulevard (Route 47), and to the east by the municipalities of Avalon, Stone Harbor, North Wildwood, West Wildwood, and Wildwood. The locations of the adjacent municipalities are shown in Figure 3. Population statistics for the adjacent municipalities can be found in the previous sanitary survey report of this shellfish growing area, which was written in December 2004 and included the population statistics from the 2000 census of this area.

The approximate size of this shellfish growing area is 7,083.4 acres, and the shellfish classification for this growing area is *Approved*, *Seasonally Approved (November-April), Seasonally Approved (January-April), Special Restricted*, and *Prohibited* for shellfish harvesting. There are approximately 2,980.7 acres of *Approved* waters, 3,047.8 acres of *Seasonally Approved (November-April)* waters, 0.3 acres of *Seasonally Approved (January-April)* waters, 154.9 acres of *Special Restricted* waters, and 900 acres of *Prohibited* waters in this shellfish growing area. The *Approved* waters are located in Great Sound, Richardson Sound, and the north part of Grassy Sound. The *Seasonally Approved (November-April)* waters are located in Gull Island Thorofare, Cresse Thorofare, the east part of Scotch Bonnet Creek, Jenkins Sound, Nichols Channel, Dung Thorofare, Drum Thorofare, Jenkins Channel, Great Channel, the south part of Old Turtle Thorofare, and the south part of Grassy Sound. The *Seasonally Approved (January-April)* waters are located in an unnamed creek on the northwest side of Great Sound. The *Special Restricted* waters are located in Grassy Sound Channel, Taugh Creek, an unnamed creek off of Drum Thorofare in Little Sand Meadow, and two unnamed creeks on the northwest side of Great Sound. The *Prohibited* waters include the rest of the waters in this shellfish growing area. The locations of Great Sound, Jenkins Sound, Great Channel, Grassy Sound, and Richardson Sound can be seen in Figures 4, 5, 6, 8, and 9, respectively.

Tidal flushing of this area mainly occurs through Hereford Inlet and Townsends Inlet. Figure 7 shows the location of Hereford Inlet. This area can be found on Charts 9A and 9B of the "State of New Jersey 2007 Shellfish Growing Water Classification Charts" (NJDEP, 2007). The current classification of this shellfish growing area can be seen in Figure 10.

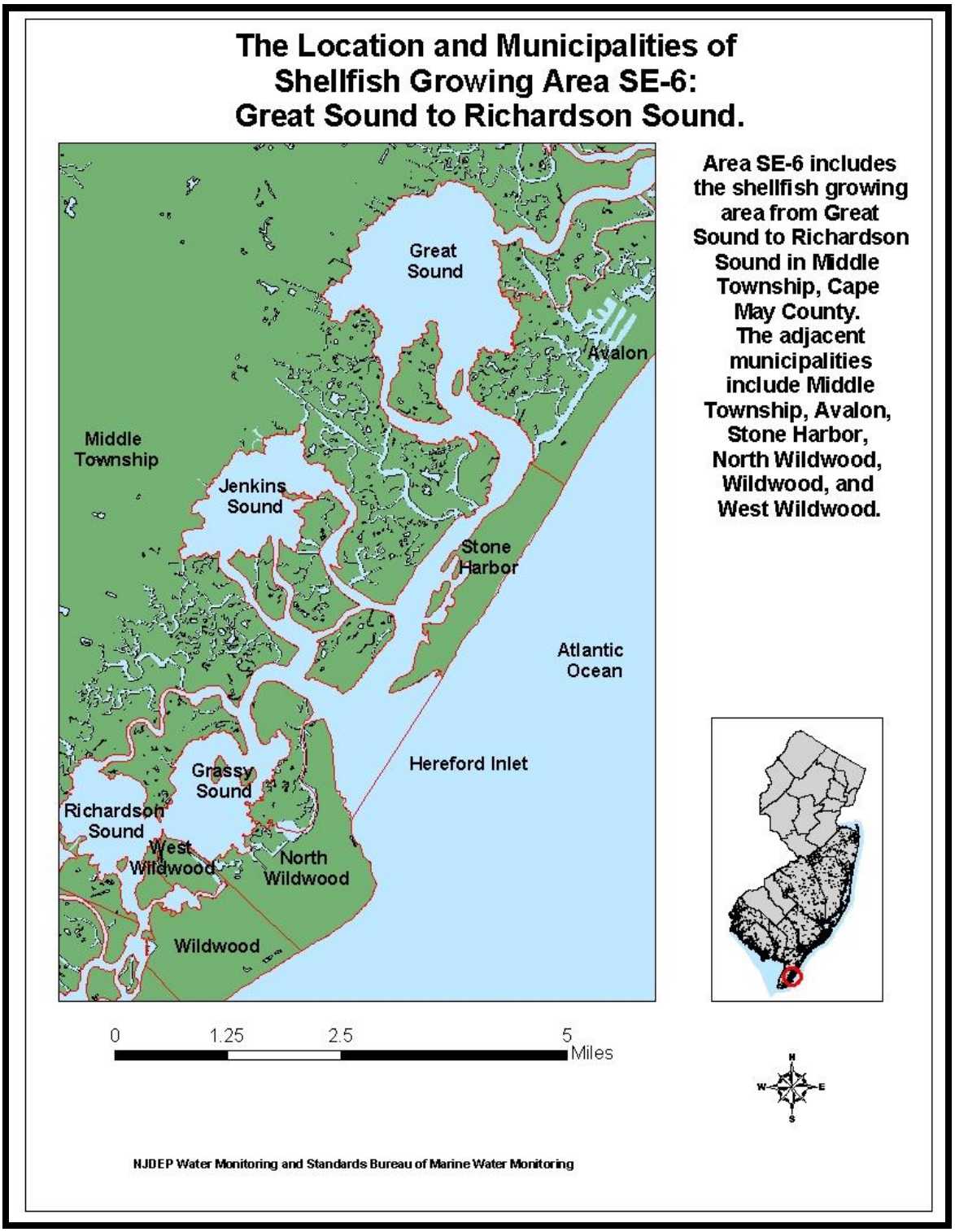

FIGURE 3: LOCATION AND MUNICIPALITIES OF SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 4: LOCATION OF GREAT SOUND, SOUTH OF AVALON BOULEVARD IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 5: LOCATION OF JENKINS SOUND, WEST OF BENNY'S LANDING IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 6: LOCATION OF GREAT CHANNEL, NORTH OF THE STONE HARBOR BRIDGE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 7: LOCATION OF HEREFORD INLET, WEST OF THE OCEAN DRIVE TOLL BRIDGE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 8: LOCATION OF GRASSY SOUND AND WILDWOOD CANAL, NORTH OF WEST WILDWOOD IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 9: LOCATION OF RICHARDSON SOUND, NORTH OF WILDWOOD BOULEVARD (ROUTE 47) IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

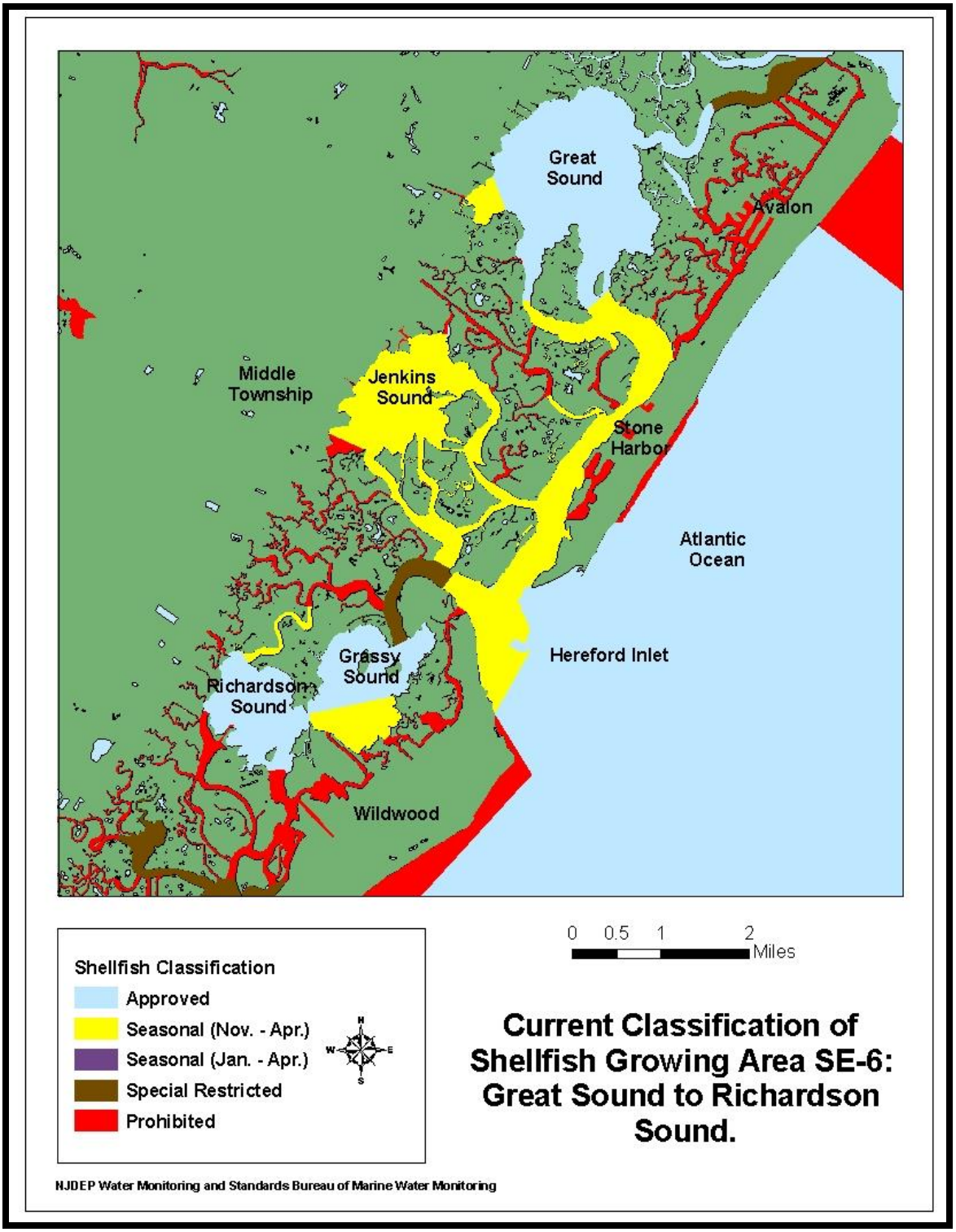

FIGURE 10: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

HISTORY OF GROWING AREA CLASSIFICATION

The waters of this shellfish growing area are primarily classified as *Approved, Seasonally Approved (November-April), Seasonally Approved (January-April), Special Restricted,* and *Prohibited* (see page 6 for description of shellfish classification of this area).

A reappraisal report for Shellfish Growing Area SE6 was written in 2005 using water quality data from 1997 to 2000. In this report, there were 5 sampling stations that showed a tidal component, 11 sampling stations that showed a correlation between total coliform MPN and rainfall, and 27 sampling stations that showed a seasonal component. The water quality of the water samples collected at all of the sampling stations in this shellfish growing area met the existing shellfish classification criteria. (Wesighan, 2005)

In the 2004 and 2005 Annual Reviews of Shellfish Growing Area SE-6 for the Great Sound to Richardson Sound area, no classification change was proposed for this shellfish growing area. No water samples collected at the sampling stations in this shellfish growing area exceeded the existing shellfish classification criteria, and the data supported the existing shellfish classification for this area (NJDEP, 2004, NJDEP, 2005).

In the 2006 Annual Review of Shellfish Growing Area SE6 for this area, all of the water samples collected at the sampling stations in this shellfish growing area met the existing shellfish classification criteria. However, a review of the water quality data for the water samples collected at the sampling stations in the *Prohibited* shellfish waters of Old Turtle Thorofare showed that the total coliform levels met the *Seasonally Approved (November-April*) shellfish classification criteria and it was proposed that approximately 66.7 acres of *Prohibited* shellfish waters in Old Turtle Thorofare be upgraded to the *Seasonally Approved (November-April*) shellfish classification (NJDEP, 2006).

The last Sanitary Survey for Shellfish Growing Area SE-6 (Great Sound to Richardson Sound) was written in 2005 using water quality data from 2000 to 2004. In this report, all of the water samples collected at the sampling stations in this shellfish growing area met the existing shellfish classification criteria and no classification changes were recommended for this area (Wesighan, 2005).

METHODS

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

Approximately 4,205 water samples were collected for total coliform bacteria between 2002 and 2007 and analyzed by the three-tube MPN method, according to APHA (1970). The shellfish growing water quality monitoring stations for this area can be seen in Figures 11, 12, and 13. Approximately 108 sampling stations are monitored during each year in Shellfish Growing Area SE-6. Water quality sampling, shoreline surveys, and watershed surveys are conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish,* 2003 Revision (USPHS, 2003 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: ArcMap®).

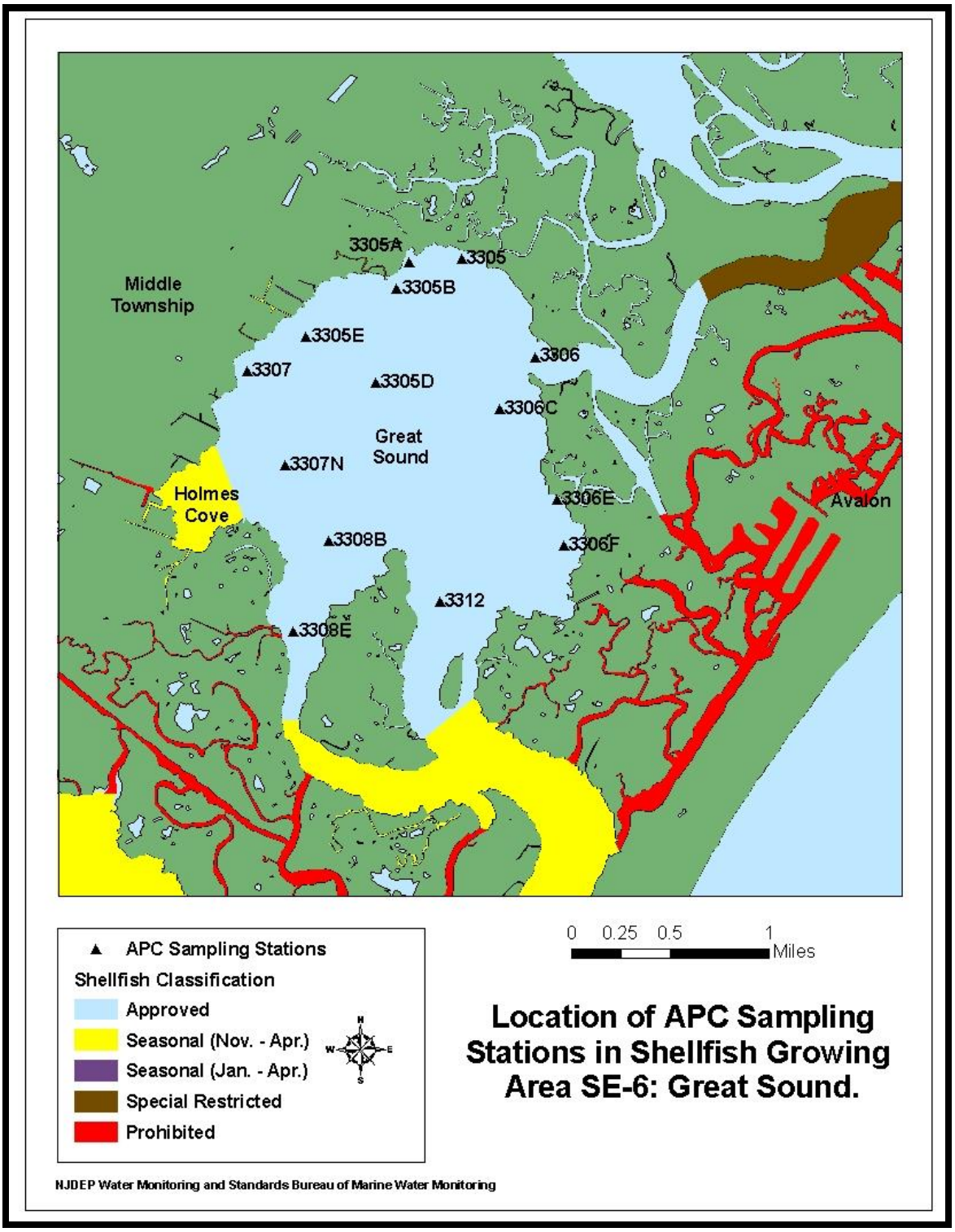

FIGURE 11: APC SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND.

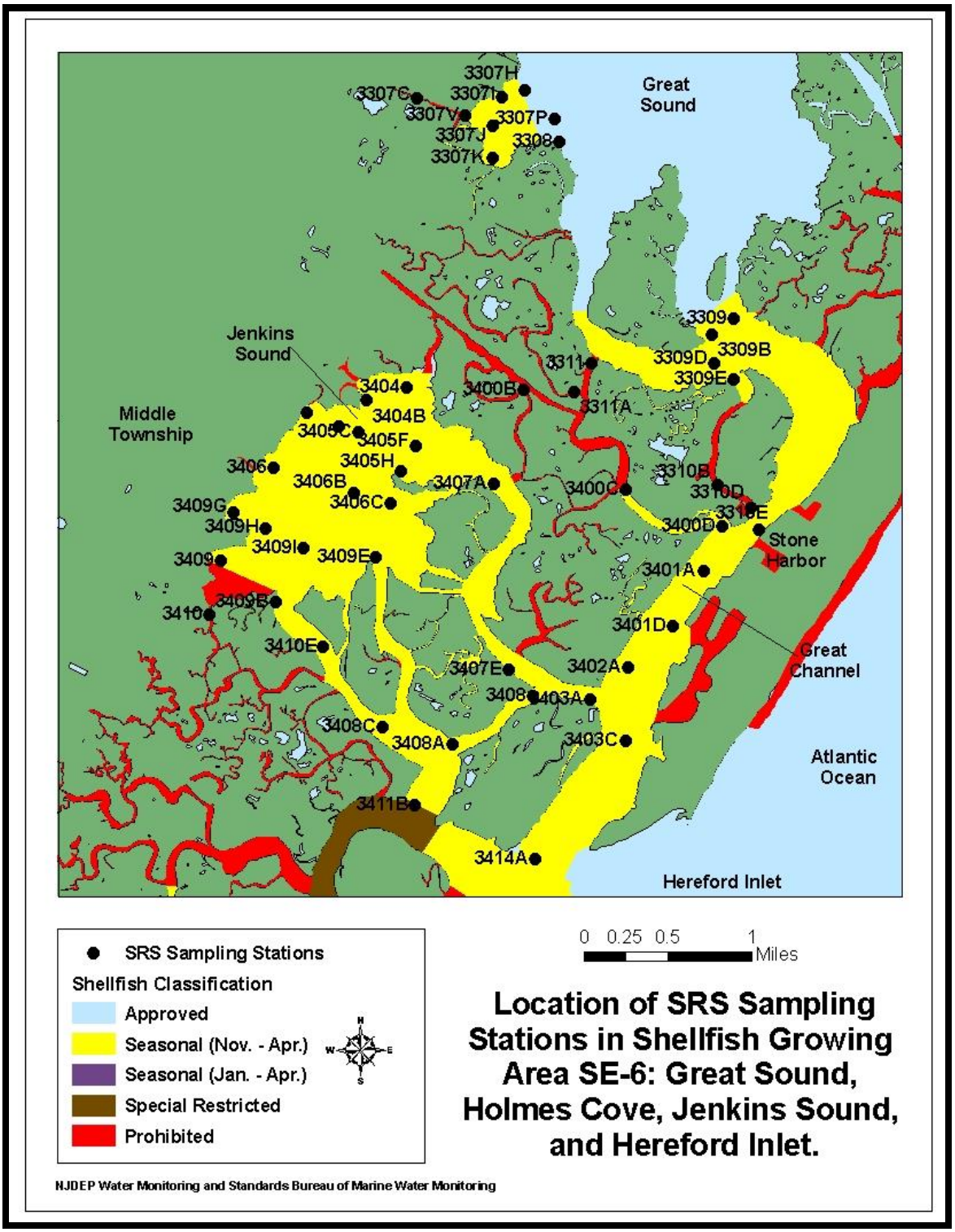

FIGURE 12: SRS SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND, HOLMES COVE, JENKINS SOUND, AND HEREFORD INLET.

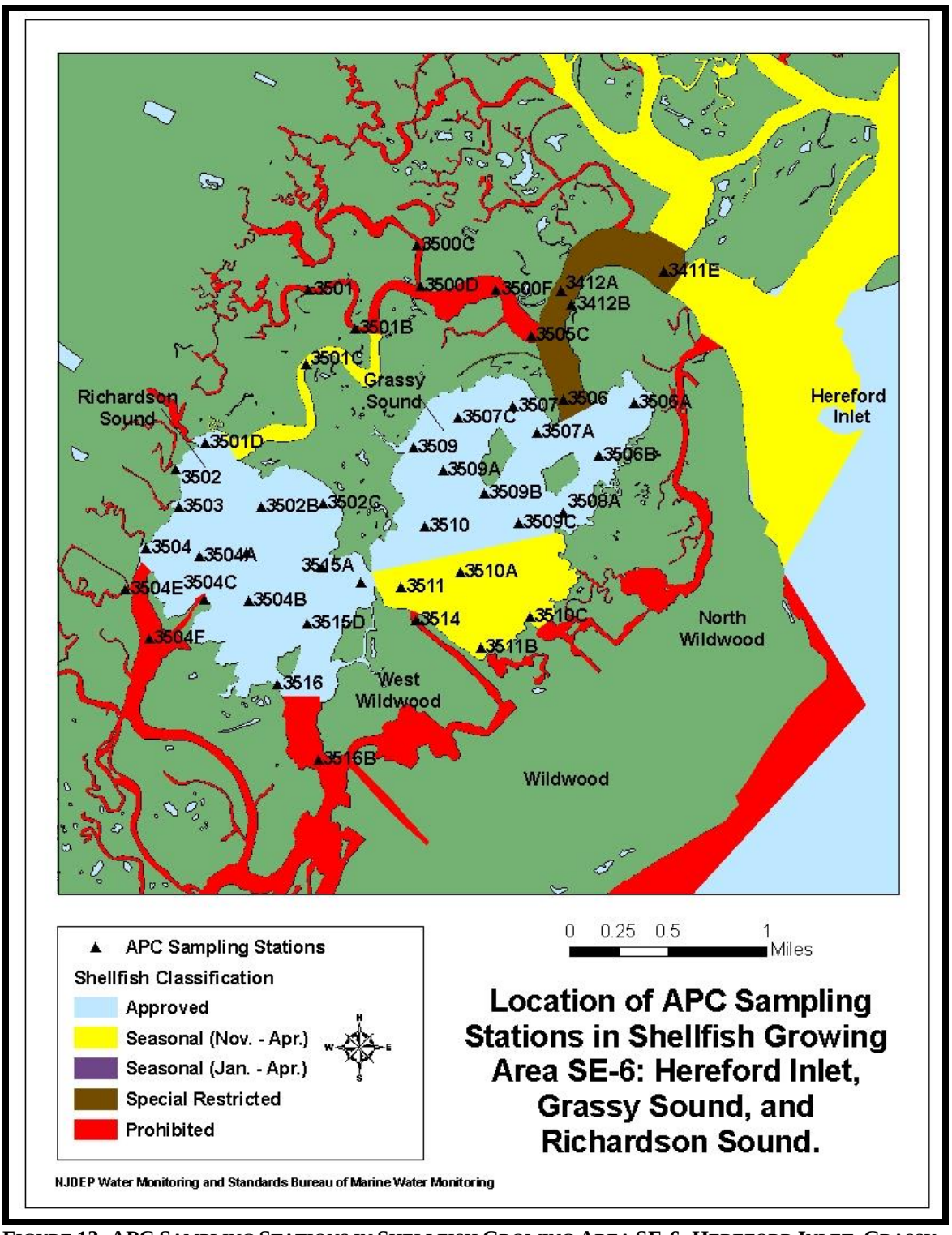

FIGURE 13: APC SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-6: HEREFORD INLET, GRASSY SOUND, AND RICHARDSON SOUND.

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

SAMPLING STRATEGY

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area. For additional information on the types of sampling strategies see the *Shellfish Growing Area Report Guidance Document*, 2007.

This shellfish growing area was sampled using the Systematic Random Sampling strategy, year-round, with a flood tide preference for the stations in Holmes Creek, Holmes Cove and from Jenkins Sound to Hereford Inlet (Assignment 255). The stations in Great Sound (Assignment 287) and the stations from Grassy Sound to Richardson Sound (Assignment 267) were sampled using the Adverse Pollution Condition strategy, year-round, with no tidal preference.

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 in specific growing areas. These data are viewed as adjunct information and are not directly used for classification. This report is based on the total coliform criteria.

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 1). For the Systematic Random Sampling Strategy, variability is expressed as the 90^{th} percentile (see Table 2).

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 1: CRITERIA FOR ADVERSE POLLUTION CONDITION SAMPLING STRATEGY (3-TUBE DECIMAL DILUTION TEST).

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

TABLE 2: CRITERIA FOR SYSTEMATIC RANDOM SAMPLING STRATEGY (3-TUBE DECIMAL DILUTION TEST).

	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

SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

The shoreline survey for Shellfish Growing Area SE-6: Great Sound to Richardson Sound was done on November 14, 2007.

There have been minor changes to this area since the 2005 sanitary survey of this shellfish growing area. Some new building constructions were seen along the adjacent shorelines of Avalon, Stone Harbor, North Wildwood, West Wildwood, and Wildwood.

Most of the private residences and facilities to the west of Great Sound in Cape May Court House, with the exception of the Cape May County Park

and Zoo, are now connected to public sanitary sewer lines.

A review of OPRA data from a standard compliance inspection for water quality at the Cape May County Park & Zoo on June 20, 2006 has revealed that the septic systems in the Cape May County Park & Zoo were failing due to improper design of the septic systems to handle the excess flows from the zoo visitors, and it was observed during the inspection that the Cape May County Park & Zoo had failed to notify the DEP of an alteration from an addition to the existing septic system during a previous system failure. A Notice of Violation was issued to the Cape May County Park & Zoo on June 22, 2006, and a standard compliance inspection on August 7, 2006 had determined that the septic systems at the Cape May County Park & Zoo were repaired and no longer failing, but were currently being pumped out from three to seven days each week until sanitary sewer lines are run into the park and zoo from the Cape May County Utilities Authority – Seven Mile/ Middle Region Wastewater Treatment Facility which is located about half a mile from the park and zoo. The two ponds in the Cape May County Park & Zoo flow into Holmes Creek and eventually into Great Sound in the north part of this shellfish growing area.

There were photographs taken during the shoreline survey of this shellfish growing area on November 14, 2007. Figures 4, 5, 6, 7, 8, and 9 show the locations of Great Sound, Jenkins Sound, Great Channel, Hereford Inlet, Grassy Sound, and Richardson Sound, Figures 21, 22, and 23 show the locations of some of the marinas in Stone Harbor and North Wildwood, Figures 34 and 35 show the location of the new upgraded area in Old Turtle Thorofare.

LAND USE

The major land use patterns for the municipalities adjacent to this shellfish growing area are urban, with some wetland areas and a few forest areas (see Figure 14).

The urban areas to the east of this shellfish growing area are the resort communities of Avalon, Stone Harbor, North Wildwood, West Wildwood, and Wildwood and the urban areas to the west of this shellfish growing area are the communities of Swainton, Cape May Court House, Mayville, and Rio Grande in Middle Township. These areas are urban-residential communities, with some commercial businesses. The populations in the resort communities of Avalon, Stone Harbor, North Wildwood, West Wildwood, and Wildwood fluctuate greatly, especially during the summer months, because these communities are known for their recreational bathing beaches, their summer tourism industry, and the seasonal boating and fishing activities. Population pressures during the summer months can potentially have an impact on the water quality of the waters in this shellfish growing area. There are currently 19 marinas in this area.

The wetlands and forest areas to the west of this shellfish growing area act as a buffer for the communities and facilities

on the western side of the bay. Since some of these communities and the Cape May County Park and Zoo are still connected to private septic systems, there is a potential for pollutant inputs from these sources into these shellfish growing waters, which is why continued monitoring of the water quality in these shellfish growing waters is so very important (APHA, 1995).

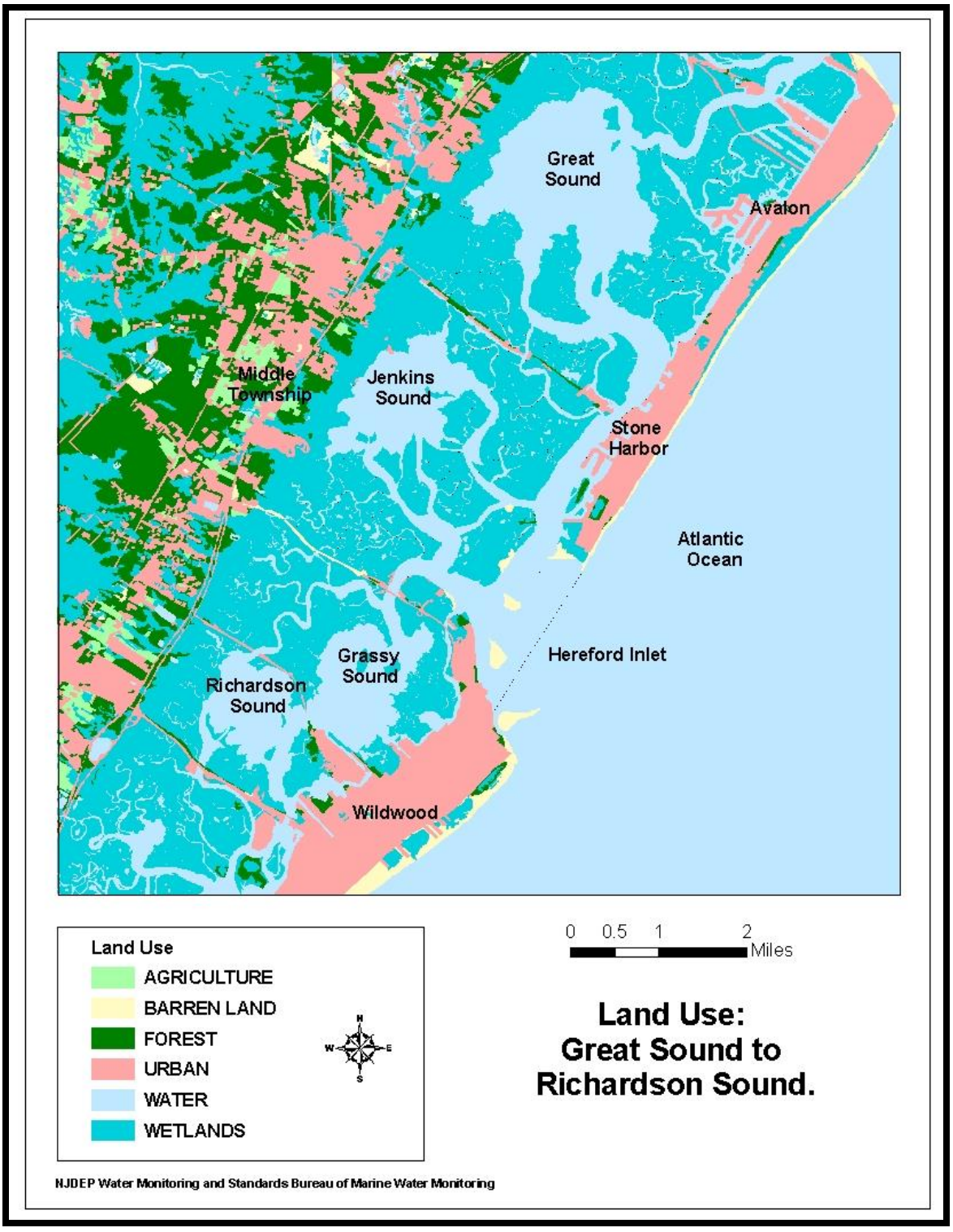

FIGURE 14: LAND USE PATTERNS FOR SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

EVALUATION OF BIOLOGICAL RESOURCES

This growing area has a wide diversity of biological resources. The total shellfish landings for New Jersey from 2002 to 2006 can be seen in Table 3 (NJDEP, 2007, NMFS, 2007). The total shellfish landings includes hard clams, soft clams, blue mussels, bay scallops, eastern oysters, ocean quahogs, surf clams, sea scallops, and blue crabs. Shellfish landing statistics had not been verified and posted for 2007 at the time this reappraisal report was written.

TABLE 3: NEW JERSEY SHELLFISH LANDINGS - 2002 TO 2006 (NMFS, 2007).

NEW JERSEY SHELLFISH LANDINGS 2002 to 2006		
YEAR	POUNDS OF MEAT (millions)	$ VALUE (exvessel)
2002	90,768,652	$88,136,826
2003	88,296,314	$94,873,590
2004	88,760,756	$139,182,589
2005	77,368,183	$131,261,937
2006	82,570,024	$107,701,202

Hard clams (*Mercenaria mercenaria)* are the primary shellfish resource that is commercially harvested in this shellfish growing area. Table 4 shows the Hard Clam Landings for 2002 to 2006 (NJDEP, 2007).

TABLE 4: HARD CLAM LANDINGS 2002 TO 2006 (NJDEP, 2007).

HARD CLAM LANDINGS 2002 to 2006		
YEAR	POUNDS OF MEAT (millions)	$ VALUE (exvessel)
2002	1,542,445	$6,402,616
2003	1,259,832	$5,228,319
2004	1,795,538	$7,409,304
2005	1,852,108	$7,555,885
2006	1,843,991	$7,614,520

Blue crabs (*Callinectes sapidus*) are also harvested in this area. Great Sound, Jenkins Sound, Grassy Sound, Richardson Sound, and Hereford Inlet are also utilized for fishing, boating, and other marine activities. Many species of fish can also be found in the waters of this shellfish growing area.

Many species of animals and vegetation can be found in the marshes of this shellfish growing area. Wildlife

populations (birds and animals) are actual contributors to water quality in Gull Island Thorofare, Cresse Thorofare, Great Channel, Jenkins Sound, Hereford Inlet, Old Turtle Thorofare, Grassy Sound Channel, and the south part of Grassy Sound. Birds sometimes may accumulate around the groins, jetties, seawalls, and bulkheads on the coast of this shellfish growing area, and fecal matter from these birds could affect the water quality.

This shellfish growing area is almost completely surrounded by a shoreline of marshes, with areas of bulkheads, erodable shorelines, and beaches composing the remainder of the shoreline. Bulkheads are located along the east and west shorelines of Great Channel (west of Stone Harbor), along the east and west shorelines of the upper section of Grassy Sound Channel, along the southwest shoreline of Grassy Sound, along the east and west shorelines of the lower section of Grassy Sound Channel, and along the east shoreline of Post Creek Basin (south of West Wildwood). Areas with an erodable shoreline include the southwest shoreline of Holmes Cove in Great Sound, a small section of the southwest shoreline of Great Channel, a small section along the north and south shorelines of the upper section of Grassy Sound Channel, along the northeast shoreline of Beach Creek, a small section along the east and west shorelines of lower Old Turtle Thorofare, a small section along the northeast shoreline of Richardson Sound, and along the southwest shoreline of Grassy Sound. The Hereford Inlet area is bordered to the north by beaches and to the south by bulkheads. The shore structures and shore types for this area are shown in Figure 15.

This area also includes a wide variety of marsh types and vegetation, including vegetated salt marshes, tidal ponds, tidal waters, tidal mud flats, tidal sand flats, non-tidal ponds, sandy developed beaches, sandy undeveloped beaches, developed areas, and small areas of coastal scrub shrub (see Figure 16). These marsh types and vegetation are located throughout the adjacent shoreline of this shellfish growing area. Hereford Inlet is bordered on the north shore with sandy developed beaches and on the south shore with developed areas. Vegetated salt marshes, tidal mud flats, tidal sand flats, and tidal waters primarily border Great Sound, Jenkins Sound, Grassy Sound, and Richardson Sound. The marsh types and vegetation for this area are shown in Figure 10.

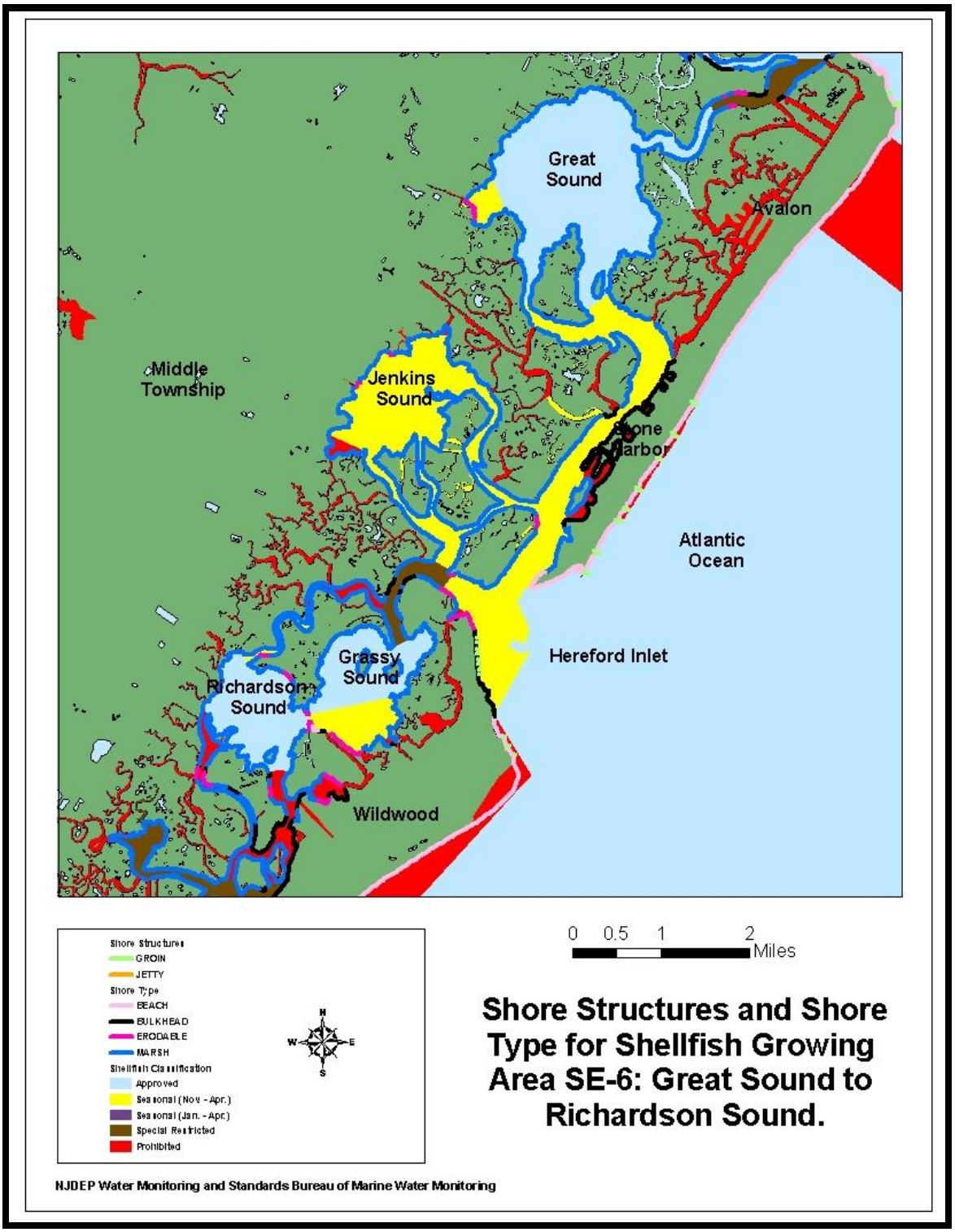

FIGURE 15: SHORE STRUCTURES AND SHORE TYPE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

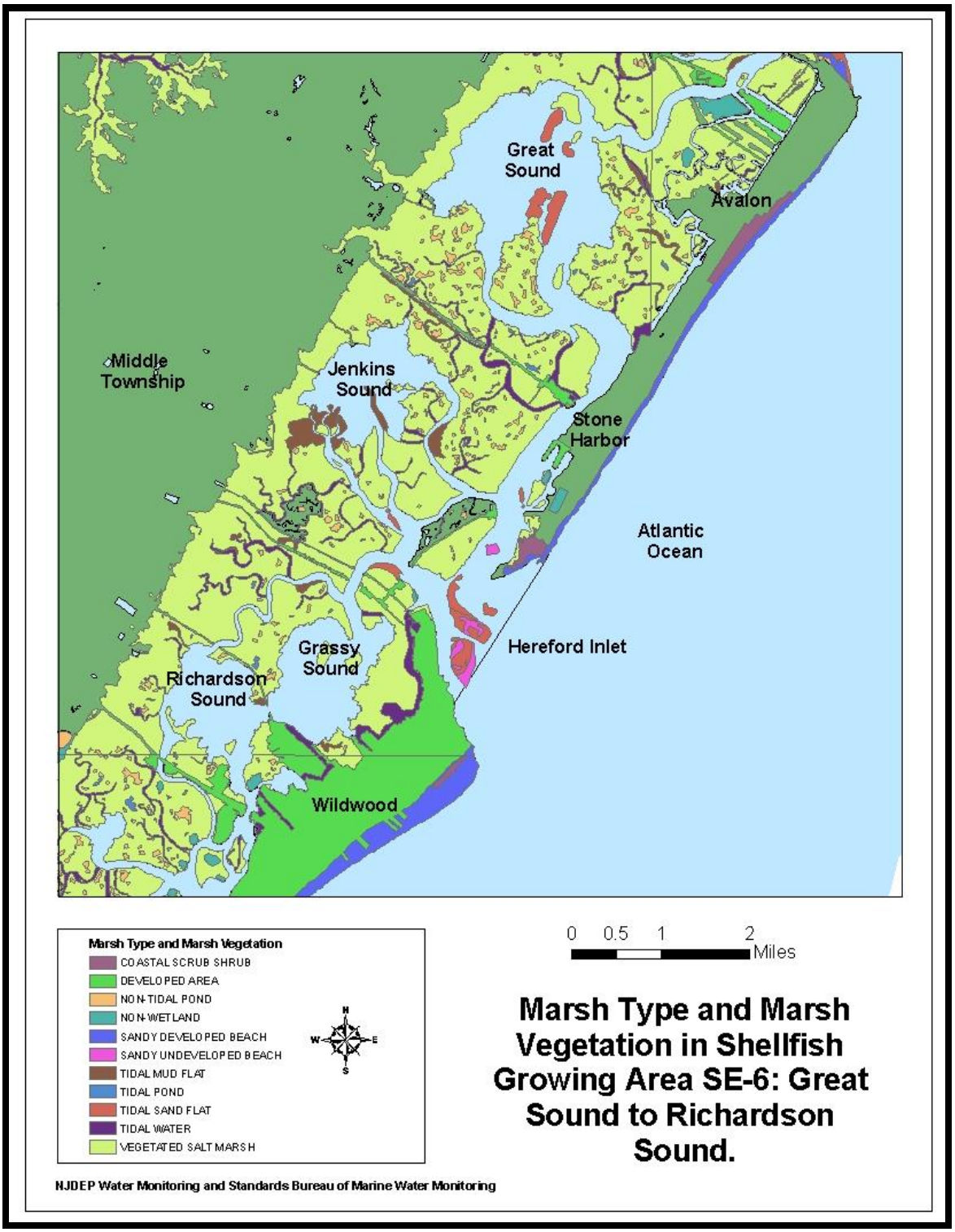

FIGURE 16: MARSH TYPE AND MARSH VEGETATION IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

IDENTIFICATION AND EVALUATION OF POTENTIAL POLLUTION SOURCES

There are eight potential indirect discharge points, several known contaminated sites, and five solid waste landfills located adjacent to this shellfish growing area (see Figures 17, 18, and 19). However, there is no evidence that they currently impact the shellfish growing water quality in this area (APHA, 1995).

Since there is a potential for pollutant inputs from these indirect sources to get into these shellfish growing waters, it is important to continue monitoring the water quality of these areas to determine the presence or absence of these indirect sources of pollution (APHA, 1995).

POTENTIAL INDIRECT DISCHARGES

There are eight potential indirect discharge points located adjacent to this shellfish growing area, which include one potential indirect ground water discharge point and seven potential indirect surface water discharge points (see Figure 17). The potential indirect ground water discharge point is the Cape May Foods Inc., located to the west of this area in Middle Township. The potential indirect surface water discharge points are the Cape May County MUA - Seven Mile Beach/ Middle Region Wastewater Treatment Facility in Middle Township, the Shell Service Station – Cape May in Middle Township, the Garden Lake Mobil Home Community in Middle Township, the Exxon Service Station 3-9619 in Middle Township, the Wildwood Lower Region Wastewater Treatment Facility in Middle Township, the Shell Service Station in Wildwood, and the Eagle Laundry Groundwater Invest. in Wildwood.

This shellfish growing area, which extends from Great Sound to Richardson Sound, has several known contaminated sites located in the adjacent areas (see Figure 18). The major concentrations of these known contaminated sites are located to the northwest in Middle Township and to the southeast in North Wildwood and Wildwood. The primary causes of these known contaminated sites are from leaking underground storage tanks. Most of these known contaminated sites are now closed.

There are five solid waste landfills located adjacent to this shellfish growing area (see Figure 19). These landfills include the Filmore Construction Sanitary Landfill #1, which is located in Middle Township, the Mar – Tee Landfill, which is located in Middle Township, the Anglesea Beach Landfill, which is located in North Wildwood, the Filmore Construction Sanitary Landfill #2, which is located in West Wildwood, and the Wildwood City Sanitary Landfill, which is located in Wildwood. The Filmore Construction Sanitary Landfill #1 was closed in 1975, the Mar - Tee Landfill was closed in 1984, the

Anglesea Beach Landfill was closed in 1974, the Filmore Construction Sanitary Landfill #2 was closed in 1978, and the Wildwood City Sanitary Landfill was closed in 1978.

The eight potential indirect discharge points, the currently active known contaminated sites, and the solid waste landfills have the potential to impact the water quality of this shellfish growing area. Therefore, the water quality in the Great Sound to Richardson Sound area is constantly monitored to determine the presence or absence of these contaminants.

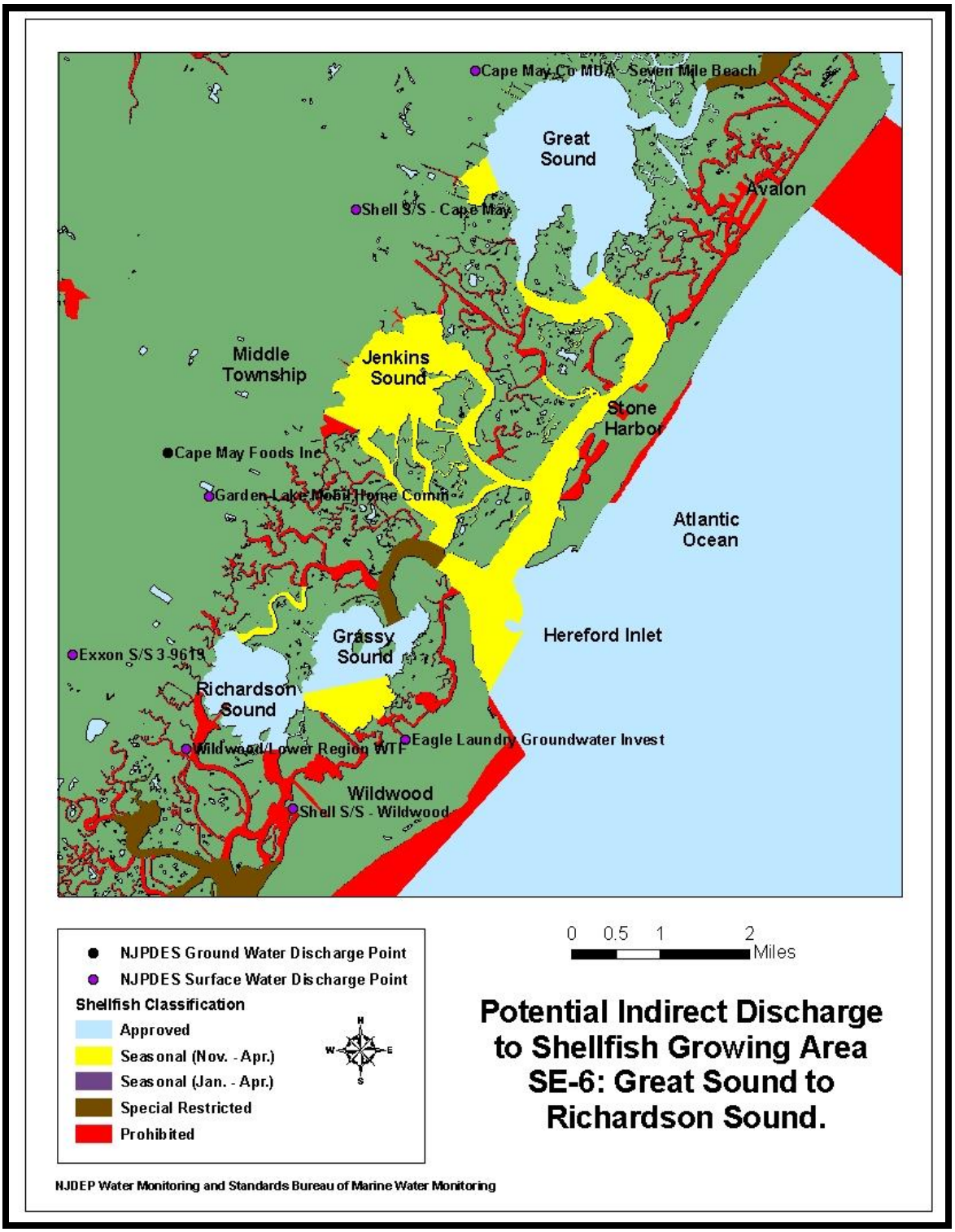

FIGURE 17: POTENTIAL INDIRECT DISCHARGES TO THE WATERS OF SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

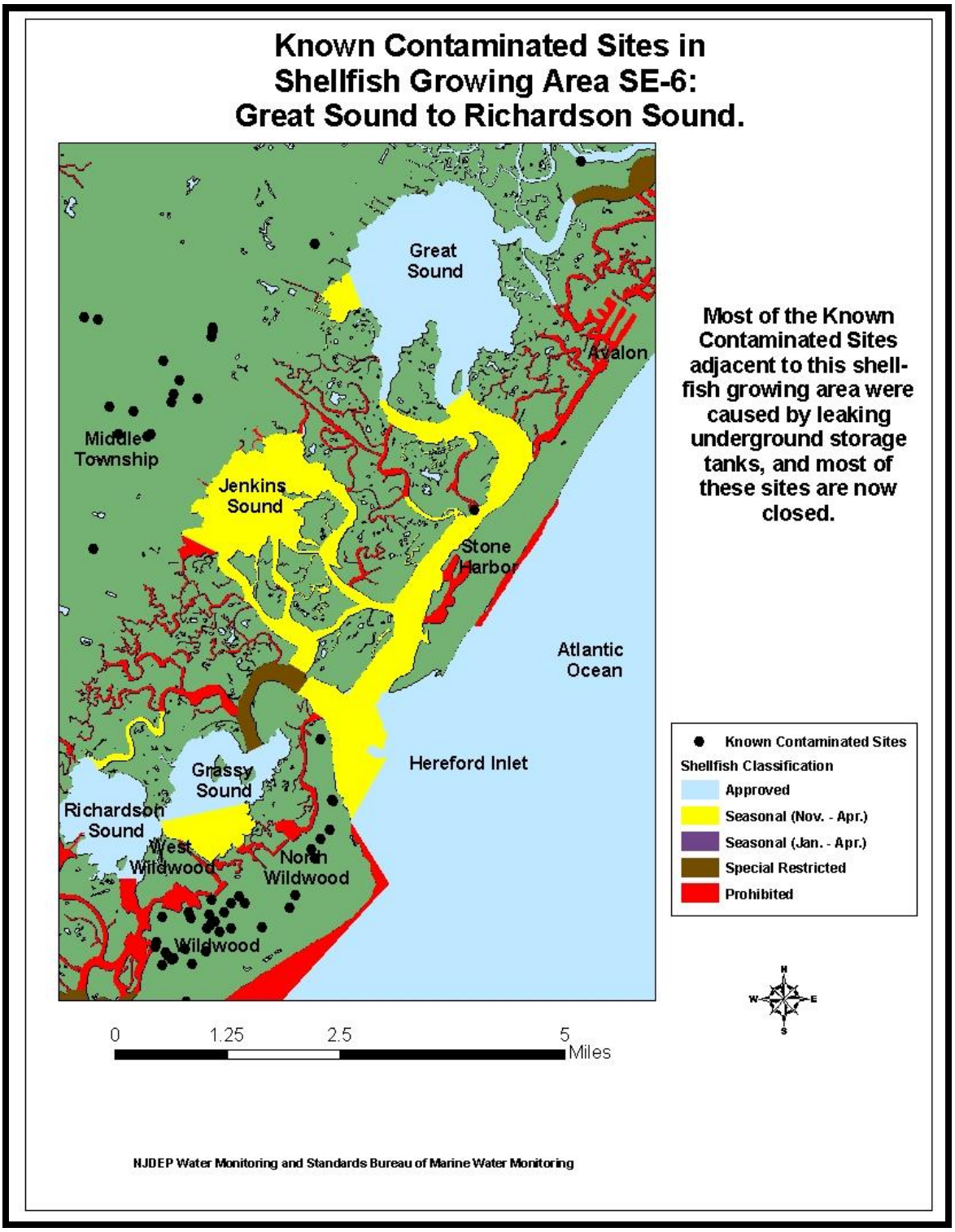

FIGURE 18: KNOWN CONTAMINATED SITES IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

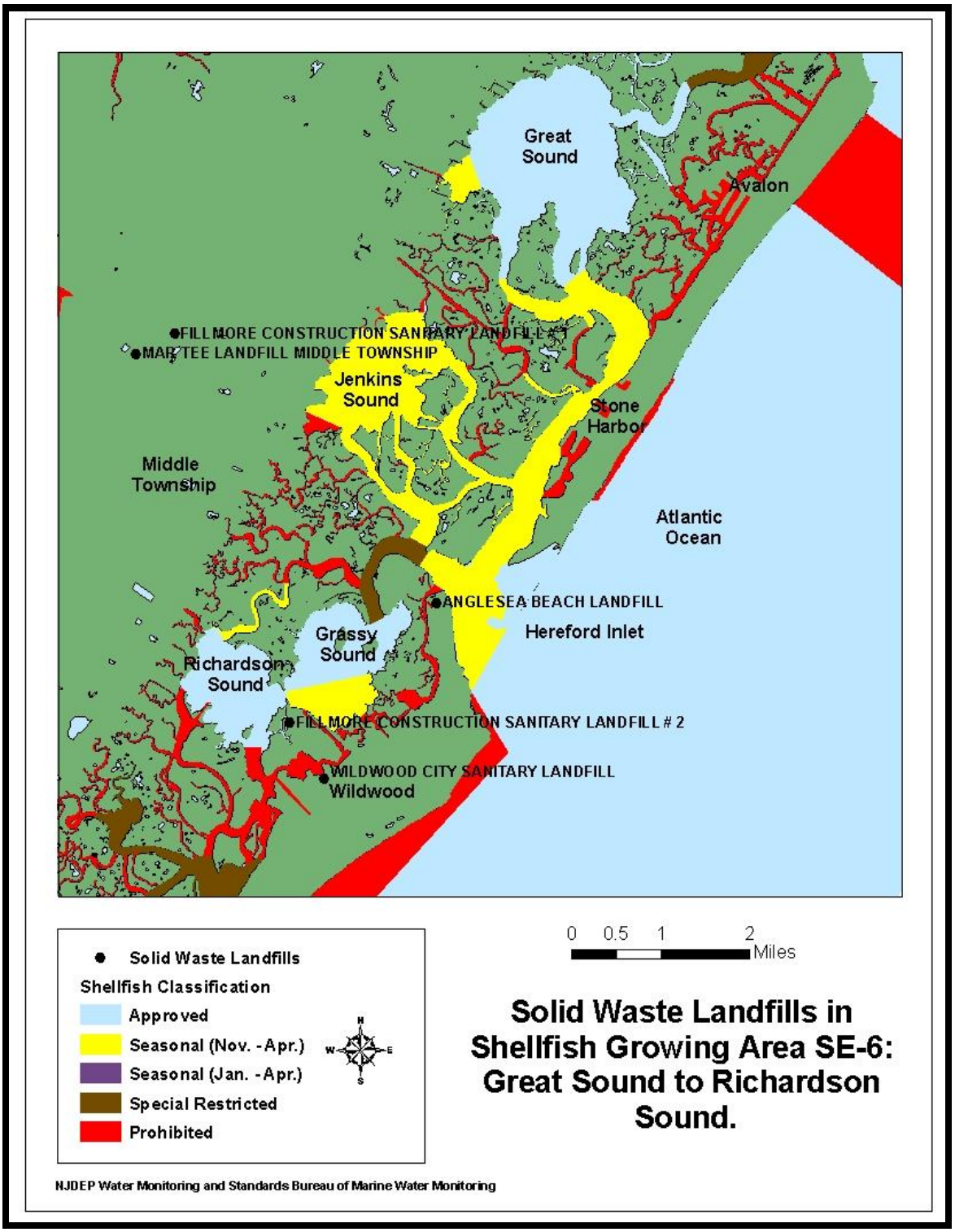

FIGURE 19: SOLID WASTE LANDFILLS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

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.

There are 19 marinas in area SE-6: Great Sound to Richardson Sound, as shown in Table 5 and Figure 20. 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. For any marina buffers going into *Approved* shellfish waters, the marina buffer is currently being recalculated using a dilution analysis computer program developed by the State of Virginia and the USFDA, and the marina buffer size will be edited in future reports. The size of each buffer zone is shown in Table 5. Figures 21, 22, and 23 show the locations of some of the marinas in Stone Harbor and North Wildwood.

For additional information on the marina equations used for buffer generation see the *Shellfish Growing Area Report Guidance Document*, 2007.

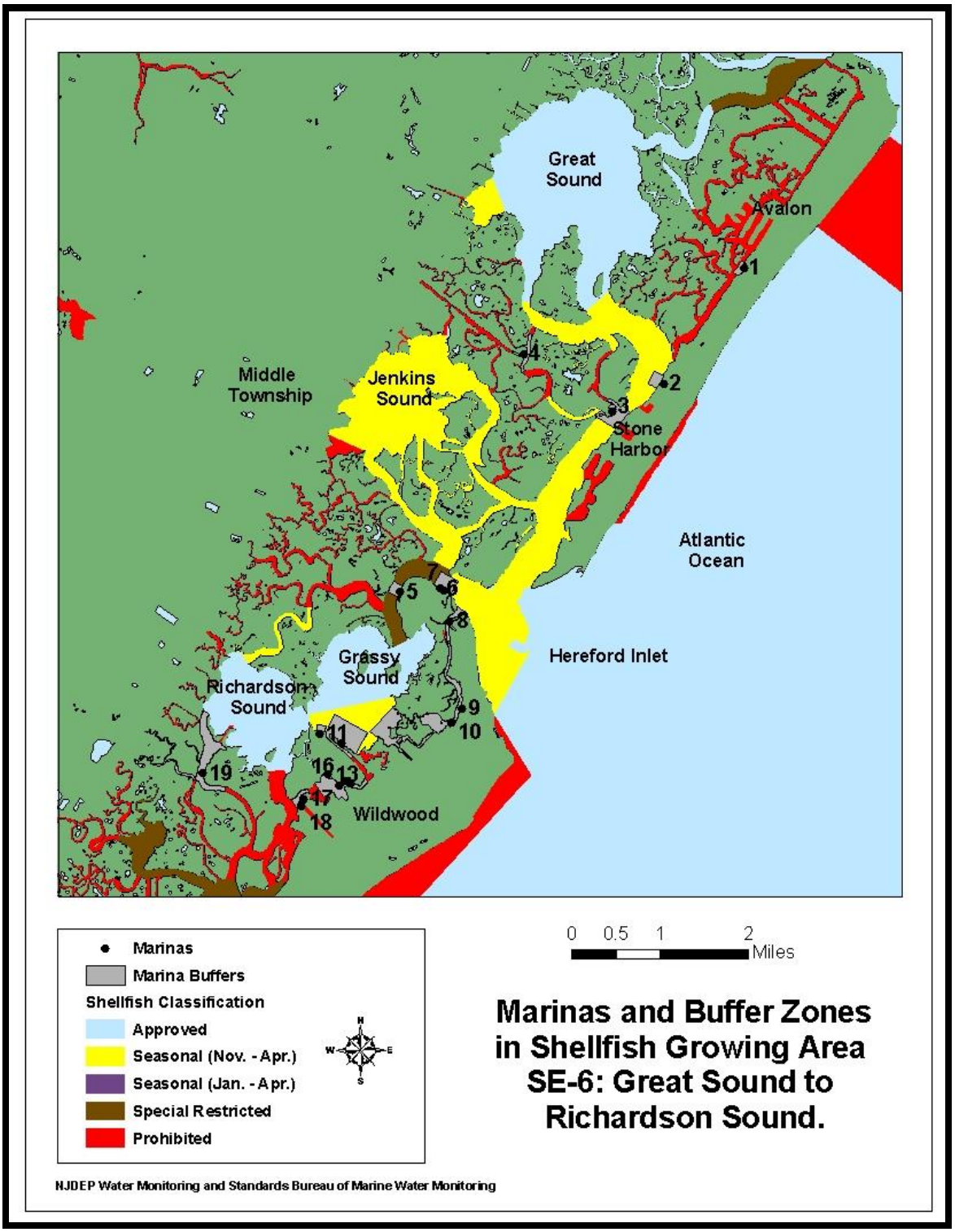

FIGURE 20: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

TABLE 5: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

Map Key	Marina Name	Location	# of Wet Slips Total/Boats > 24ft.	Size of Buffer Area (radius; feet)	Average Water Depth (ft)	Pumpout Facility
1	54th & Bay Park Marina	Stone Harbor	30/30	317	24	No
2	Stone Harbor Municipal Marina	Stone Harbor	30/30	401	15	No
3	Stone Harbor Marina	Stone Harbor	170/126	678	24	Yes
4	Camp Marine Services	Stone Harbor	30/30	430	13	Yes
5	Grassy Sound Marina	Middle Township	57/10	385	12	Yes
6	Dolphin Cove	Middle Township	21/0	468	2	Yes
7	Dad's Place Marina	Middle Township	33/0	339	6	No
8	Hereford Inlet Marina	North Wildwood	50/6	483	6	Yes
9	Ed's Canal Boat Rental	North Wildwood	8/8	327	6	No
10	North Wildwood Municipal Marina	North Wildwood	120/120	1267	6	Yes
11	Dino's Marina	West Wildwood	12/2	248	6	No
12	B & E 26th Street Marina	West Wildwood	75/75	1002	6	Yes
13	West Bay Marina	West Wildwood	36/3	394	6	No
14	Spraydock Marina	West Wildwood	28/0	312	6	No
15	Gallo's Marina	West Wildwood	30/0	323	6	No
16	Bridgeport Marina	West Wildwood	75/0	500	6	Yes
17	Hayes Waterway Marina	Wildwood	25/10	318	11	No
18	Ottens Harbor Marine Service	Wildwood	6/0	107	11	No
19	Pier 47 Marina	Middle Township	110/60	1082	5	Yes

FIGURE 21: LOCATION OF 54TH & BAY PARK MARINA IN STONE HARBOR IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 22: LOCATION OF STONE HARBOR MARINA IN STONE HARBOR IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 23: LOCATION OF NORTH WILDWOOD MUNICIPAL MARINA IN NORTH WILDWOOD IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

SPILLS OR OTHER UNPERMITTED DISCHARGES

Some of the major spills to the waters of this shellfish growing area for the time period of this report (2002 to 2007) include the following:

On July 29, 2006, a sewage spill was again reported for Ocean Drive from 75th Street to 80th Street in Avalon. According to the report received by the Bureau of Marine Water Monitoring, approximately 1,800 gallons of sewage spilled onto the ground at the intersection of these roads when a power failure at a pump station caused the sewage to overflow and spill into the stormwater drains at the end of 75th Street to 80th Street in Avalon. Long Reach is located about 120 yards west of the spill and the shellfish classification for Long Reach is *Prohibited* to shellfish harvesting. The nearest *Seasonally Approved (November-April)* shellfish water is Gull Island Thorofare, which is located about 190 yards west of the spill. However, this sewage spill was reported as terminated and the cleanup of the area was completed at the time this report was received. This sewage spill did not occur during the shellfish harvesting season, so the waters of this shellfish growing area did not need to be closed to shellfish harvesting.

On May 11, 2004 a sewage spill was reported for the Cape May County Utilities Authority – Seven Mile/ Middle

Region Wastewater Treatment Facility at 98 Compost Road in Cape May Court House, Middle Township. According to the report received by the Bureau of Marine Water Monitoring, approximately 300 gallons of sewage effluent leaked onto the ground at the facility when a scrubber discharged overnight. An unnamed creek west of Great Sound is located about 650 yards east of the spill, and the shellfish classification for this unnamed creek is *Seasonally Approved (November to April)* to shellfish harvesting. However, this sewage spill was reported as terminated and the cleanup of the area was completed at the time this report was received. This sewage spill did not occur during the shellfish harvesting season, so the waters of this shellfish growing area did not need to be closed to shellfish harvesting.

On January 28, 2004, a sewage spill was reported at the corner of 10th Street and Delaware Avenue in North Wildwood. According to the report sent to the Bureau of Marine Water Monitoring, approximately 20,000 gallons of sewage leaked into a stormwater drain from a broken 24-inch sewer main, which eventually flowed into Hoffman Canal, west of North Wildwood. The waters of Hoffman Canal are classified as *Prohibited* to shellfish harvesting. The nearest *Seasonally Approved (November-April)* shellfish water is Grassy Sound, which is located approximately a mile from the site of the sewage spill. This sewage spill was reported as terminated at the time this report was received by the Bureau of Marine Water Monitoring.

On September 4, 2003, a sewage spill was reported at the intersection of Route 47 and the exit ramp of the Garden State Parkway in Rio Grande, Middle Township. At this location, a tanker truck had flipped over on its side on Route 47 and spilled 4,000 gallons of raw sewage onto the roadway, the center median, and along the south shoulder of the road (see Figures 27 and 28). The raw sewage was reported to have spilled into the two stormwater drains along the south shoulder of Route 47 and eventually discharged into the wetlands along the south side of the road. Carino Creek is located within the wetlands to the south of Route 47 at this location and Carino Creek eventually flows into Richardson Channel. The waters of Carino Creek and Richardson Channel are classified as *Prohibited* to shellfish harvesting. The clean up of the sewage spill was begun immediately by Wildwood Crest, the West Cape May Hazardous Materials Team, the Cape May County MUA, and the Middle Township Fire & Rescue squads. The clean up of the sewage spill consisted of hosing and sweeping the street, while the water and sewage remaining on the ground was diverted to three vacuum trucks and removed. Sandbags were placed around the two stormwater drains to act as berms. A crew from Russell Reid Wastewater Management also arrived on site to assist in the clean up of the sewage spill by raking and vacuuming up the sewage from the road surface, the shoulder of the road, and the road median. They also spread lime onto the roadway, on the shoulder of the road, and in the center median for disinfection. The sewage spill was reported as being completely cleaned up by 8:00 A.M. on September 5, 2003.

On October 13, 2002, a sewage spill was reported for the area of 80th Street and Ocean Drive in Avalon. Approximately 500 gallons of sewage were reported to

have leaked from a blocked sewage pipe and flowed into the stormwater drain at the end of 80th Street, which borders the shore of Gull Island Thorofare. The waters of Gull Island Thorofare are classified as *Seasonally Approved (November-April).* This sewage spill was reported as terminated and the cleanup of the area was being done at the time this report was received by the Bureau of Marine Water Monitoring. However, this sewage spill did not occur during the shellfish harvesting season, so the waters of this shellfish growing area did not need to be closed to shellfish harvesting.

On October 15, 2002, another report of a sewage spill on Ocean Drive from 78th Street to 80th Street in Avalon was reported to the Bureau of Marine Water Monitoring. In this new report, approximately 120 gallons of sewage were reported to have leaked from a blocked force main and flowed into the stormwater drains at the ends of 78th Street to 80th Street, which border the shores of Long Reach and Gull Island Thorofare. Long Reach is located about 120 yards west of the spill and the shellfish classification for Long Reach is *Prohibited* to shellfish harvesting. Gull Island Thorofare is located about 190 yards southwest of the spill and the shellfish classification for Gull Island Thorofare is *Seasonally Approved (November-April)* to shellfish harvesting. This sewage spill was reported as terminated and the cleanup of the area was completed at the time this report was received by the Bureau of Marine Water Monitoring. This sewage spill did not occur during the shellfish harvesting season for Gull Island Thorofare, so the shellfish waters of this area did not need to be closed to shellfish harvesting.

On April 10, 2002, a sewage spill was reported for the area of Rio Grande Avenue and Hudson Avenue in Wildwood. According to the report received by the Bureau of Marine Water Monitoring, approximately 2,000 gallons of sewage leaked into the intersection of these roads from a blocked sewer line. The southern part of Grassy Sound Channel is located about 600 yards away from the spill, and the shellfish classification for this section of Grassy Sound Channel is *Prohibited* to shellfish harvesting. However, this sewage spill was reported as terminated and the cleanup of the area was completed at the time this report was received.

The locations of all reported spills to the waters in this shellfish growing area can be seen in Figure 24. Of the major spills reported for this shellfish growing area during the time period of this report (2002 to 2007), none of these spills were known to have impacted the water quality of this ocean growing area and there were no shellfish closures of this shellfish growing area due to possible impacts by these spills.

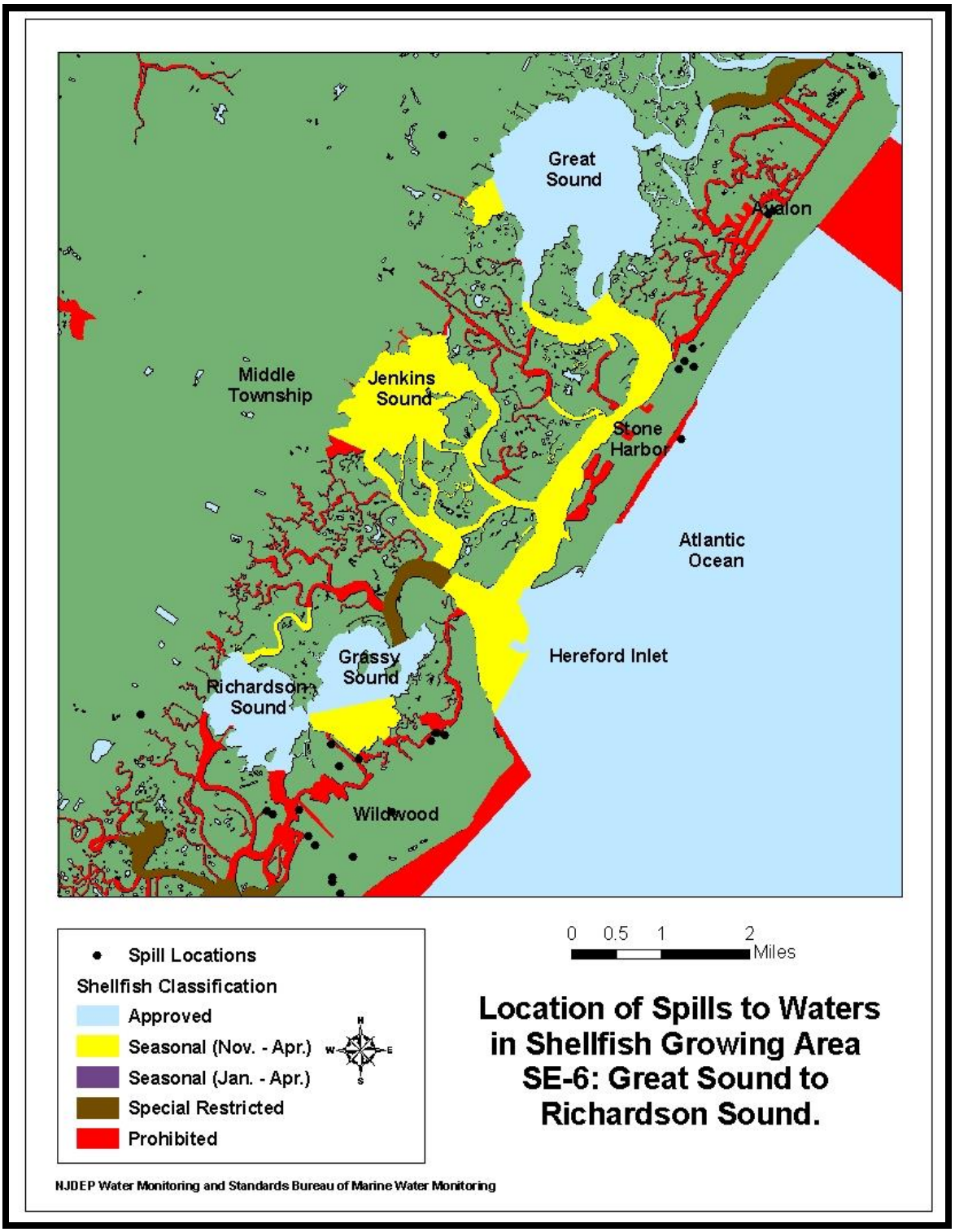

FIGURE 24: LOCATION OF SPILLS TO WATERS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

STORMWATER INPUTS

The stormwater inputs to this shellfish growing area are the result of rainwater, which would normally be absorbed into vegetated soils and used to recharge aquifers, maintain stream base flow, and maintain waterway health, instead being collected on top of impervious surfaces, such as parking lots, rooftops, and roadways, and then temporarily collected in detention basins, and finally dumped into streams, creeks, wetlands, lakes, bays, and rivers. This runoff can carry a variety of waste materials, such as domestic and wild animal fecal materials, petroleum and other toxic materials spilled from automobiles, and fertilizer and pesticide materials used on neighboring lots.

There are many stormwater outfalls located along the borders of this shellfish growing area. These stormwater outfalls mainly border Wildwood Canal, Hoffman Canal, and Beach Creek (west of Wildwood, West Wildwood, and North Wildwood), the south side of Hereford Inlet, the east side of Great Channel, Muddy Hole Creek, Stone Harbor Creek (west of Stone Harbor), Long Reach, Princeton Harbor, and Pennsylvania Harbor (west of Avalon) (see Figure 25). There are also some stormwater outfalls located to the west of this area in Middle Townships near the Garden State Parkway and Route 9 (see Figure 25).

These stormwater outfalls have the potential to impact the water quality of the north and south part of this shellfish growing area, which is why these waters are sampled using the Adverse Pollution Condition (APC) strategy. However, there is no current evidence from water quality and bathing beach data that these shellfish growing waters are directly impacted by the outflow from these stormwater outfalls.

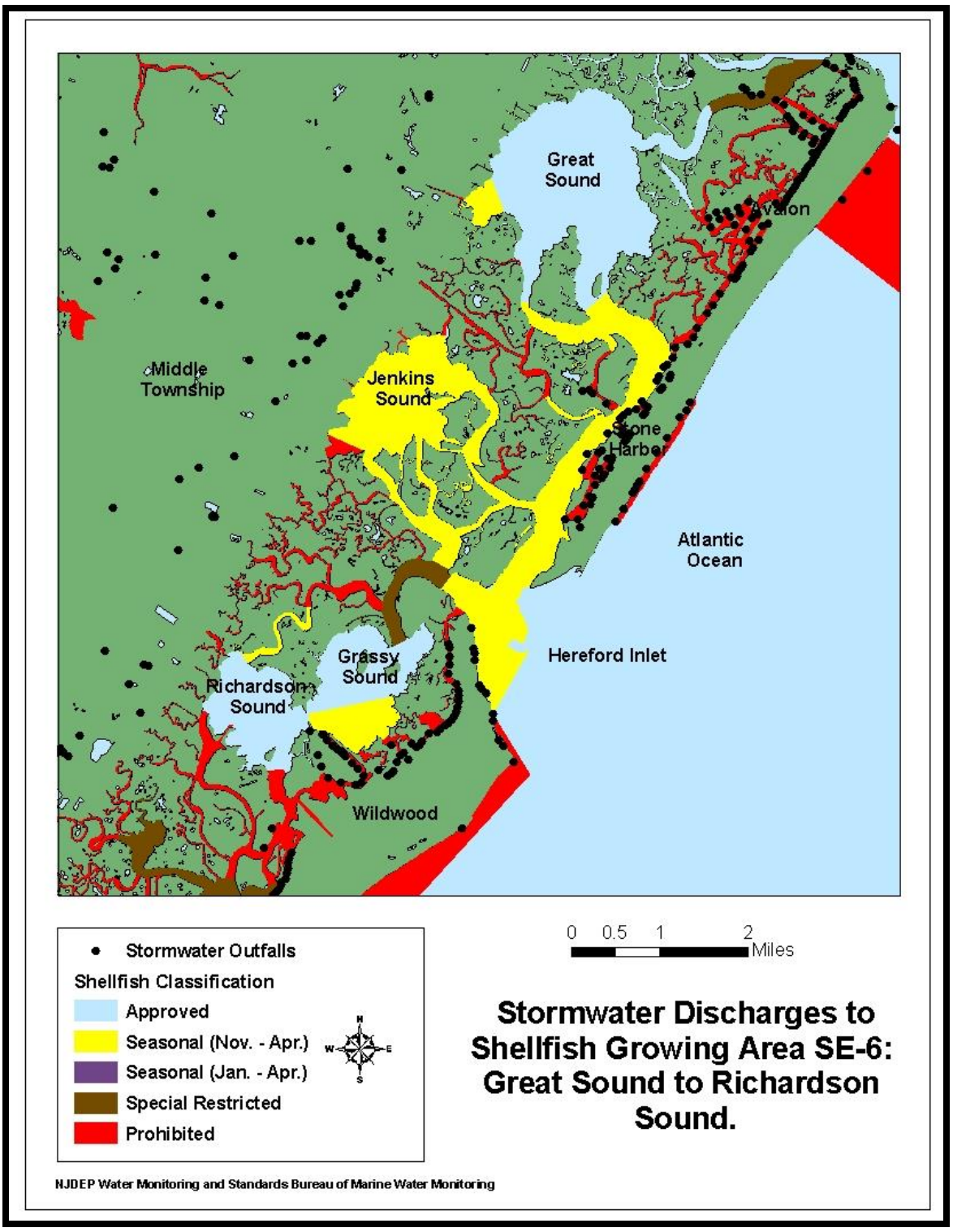

FIGURE 25: STORMWATER DISCHARGES TO SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

HYDROLOGY AND METEOROLOGY

PATTERNS OF PRECIPITATION

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region (see table of Average Mid-Atlantic Storm Event Information in the *Shellfish Growing Area Report Guidance Document*, 2007). 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.

Precipitation inputs to this area for the period 2002 through 2007 are shown in Table 7. There have been no significant changes in hydrography since the last sanitary survey report was written in 2005. The rainfall data retrieval for this area was provided by NOAA. The threeNOAA weather stations for this area are located: 1) west of Avalon in Middle Township, Cape May County, 2) west of Stone Harbor in Middle Township, Cape May County, and 3) in North Wildwood, Cape May County (see Table 6). The precipitation inputs to this area are an average of the rainfall amounts at prior 24-hour cumulative, prior 48-hour cumulative, and prior 72-hour cumulative for all of these four weather stations on a specific sampling date.

TABLE 6: TABLE OF NOAA WEATHER STATIONS FOR SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

NOAA Weather Station:	Location:	Township:	County:
RA031	West of Avalon	Middle Township	Cape May County
RA032	West of Stone Harbor	Middle Township	Cape May County
RA033	North Wildwood	North Wildwood	Cape May County

TABLE 7: PRECIPITATION DATA

Rainfall data provided by NOAA

Sampling Date	Precipitation in Inches			Wind		Temperature	
	Prior 24-hour Cumulative	Prior 48-hour Cumulative	Prior 72-hour Cumulative	Direction	Velocity mph	Water ºC	Air ºC
10/21/2002	0.00	0.00	0.00	N	N	N	N
10/24/2002	0.00	0.00	0.00	N	N	N	N
10/25/2002	0.00	0.00	0.00	N	N	N	N
11/21/2002	0.00	0.00	0.00	N	N	N	N
01/06/2003	0.10	0.10	0.15	N	N	N	N
02/06/2003	0.00	0.42	0.42	N	N	N	N
03/24/2003	0.00	0.00	0.01	N	N	N	N
03/28/2003	0.00	0.13	0.13	N	N	N	N
04/02/2003	0.00	0.00	0.18	N	N	N	N
04/08/2003	0.44	0.44	0.46	N	N	N	N
04/14/2003	0.00	0.10	1.13	N	N	N	N
04/21/2003	0.00	0.00	0.00	N	N	N	N
05/05/2003	0.00	0.00	0.00	N	N	N	N
05/12/2003	0.00	0.00	0.00	N	N	N	N
06/03/2003	0.00	0.01	0.19	N	N	N	N
06/04/2003	0.25	0.25	0.26	N	N	N	N
08/14/2003	0.00	0.00	0.00	N	N	N	N
08/20/2003	0.00	0.00	0.09	N	N	N	N
09/02/2003	0.00	0.00	0.82	N	N	N	N
09/10/2003	0.00	0.00	0.00	N	N	N	N
09/25/2003	0.00	0.47	0.47	N	N	N	N
10/08/2003	0.00	0.00	0.00	100	17	1.0	N
10/24/2003	0.00	0.03	0.03	330	8	12.0	N
11/10/2003	0.00	0.00	0.00	N	N	N	N
12/09/2003	0.01	0.01	0.24	0	5	0.0	N
01/09/2004	0.00	0.00	0.00	345	0	2.0	N
01/13/2004	0.00	0.00	0.00	230	6	10.0	N
02/25/2004	0.00	0.00	0.00	330	4	12.0	N
02/27/2004	0.00	0.00	0.00	45	4	15.0	N
03/01/2004	0.00	0.00	0.00	45	12	10.0	N
03/18/2004	0.00	0.40	0.40	180	8	5.0	N
04/19/2004	0.00	0.00	0.00	220	14	18.0	N
04/26/2004	0.00	0.00	0.10	185	12	15.0	N
04/27/2004	0.41	0.41	0.41	240	10	12.0	N
06/17/2004	0.30	0.30	0.30	28	0	0.0	N
07/19/2004	0.24	0.26	0.26	320	19	8.0	N
07/21/2004	0.01	0.01	0.24	N	N	N	N
08/12/2004	0.00	0.00	0.00	200	20	16.0	N
09/02/2004	0.00	0.01	0.22	N	N	N	N
09/20/2004	0.00	0.18	0.22	N	N	N	N
10/27/2004	0.00	0.00	0.00	20	7	13.9	7.8

Sampling Date	Precipitation in Inches			Wind		Temperature	
	Prior 24-hour Cumulative	Prior 48-hour Cumulative	Prior 72-hour Cumulative	Direction	Velocity mph	Water ºC	Air ºC
10/28/2004	0.00	0.00	0.00	50	10	13.3	5.6
11/15/2004	0.00	0.00	1.35	310	15	6.5	3.9
01/04/2005	0.00	0.00	0.00	330	8	6.7	7.2
01/06/2005	0.07	0.08	0.08	30	3	5.6	6.1
01/07/2005	0.01	0.08	0.09	0	8	5.6	3.3
01/11/2005	0.00	0.00	1.06	0	0	5.0	3.3
02/10/2005	0.02	0.04	0.04	330	12	3.3	1.1
02/14/2005	0.00	0.00	0.00	170	8	2.8	4.4
03/01/2005	0.36	0.36	0.36	300	10	3.3	-1.1
03/14/2005	0.00	0.00	0.17	330	4	3.9	2.2
04/12/2005	0.00	0.00	0.00	50	3	8.9	6.7
04/13/2005	0.00	0.00	0.00	55	8	9.4	6.1
04/14/2005	0.00	0.00	0.00	50	6	10.6	6.7
07/05/2005	0.00	0.01	0.01	200	5	22.8	21.1
08/08/2005	0.06	0.07	0.22	250	5	25.0	23.3
08/09/2005	0.00	0.06	0.07	230	5	23.9	22.2
08/10/2005	0.45	0.45	0.51	30	5	24.4	23.3
10/03/2005	0.00	0.05	0.05	10	7	20.6	21.1
10/19/2005	0.00	0.00	0.00	0	0	15.6	18.9
10/20/2005	0.00	0.00	0.00	20	6	16.7	17.8
11/07/2005	0.00	0.00	0.00	320	10	14.4	10.0
11/15/2005	0.00	0.00	0.00	220	4	13.9	12.2
01/05/2006	0.00	0.12	2.53	358	8	8.3	5.6
01/19/2006	0.72	0.74	0.74	300	6	5.0	4.4
01/27/2006	0.00	0.00	0.02	300	4	2.2	0.0
02/10/2006	0.00	0.00	0.00	310	8	2.8	2.8
02/15/2006	0.00	0.00	0.34	250	4	2.8	3.3
02/23/2006	0.07	0.07	0.07	200	4	3.9	1.1
03/03/2006	0.17	0.17	0.17	320	18	3.9	0.6
03/28/2006	0.00	0.00	0.33	0	0	6.7	7.8
05/08/2006	0.07	0.07	0.07	75	15	15.6	10.0
05/10/2006	0.00	0.01	0.07	348	6	14.4	10.6
06/06/2006	0.01	0.01	0.21	20	6	20.0	12.8
06/16/2006	0.01	0.03	0.03	320	6	20.0	21.1
06/26/2006	1.64	1.94	2.02	180	10	20.0	22.8
06/27/2006	0.00	1.64	1.94	160	12	17.8	22.2
06/28/2006	0.35	0.35	1.99	200	12	20.0	21.7
07/12/2006	0.00	0.00	0.00	220	6	14.4	20.0
07/13/2006	0.04	0.04	0.04	310	6	19.4	15.6
07/14/2006	0.02	0.07	0.07	90	4	18.3	21.1
07/26/2006	0.00	0.01	0.01	0	0	22.8	21.1
08/24/2006	0.00	0.00	0.00	40	6	21.7	21.1
09/05/2006	0.04	0.04	0.86	45	6	21.7	20.6

Sampling Date	Precipitation in Inches			Wind		Temperature	
	Prior 24-hour Cumulative	Prior 48-hour Cumulative	Prior 72-hour Cumulative	Direction	Velocity mph	Water ºC	Air ºC
09/06/2006	1.55	1.59	1.59	340	5	20.6	18.3
10/02/2006	0.15	0.15	0.15	308	6	18.3	10.6
10/04/2006	0.00	0.00	0.15	210	4	19.4	18.9
11/06/2006	0.00	0.00	0.00	280	2	11.7	5.0
11/09/2006	0.28	0.79	0.79	350	8	13.9	12.2
12/05/2006	0.00	0.08	0.08	310	16	8.3	-2.2
12/07/2006	0.00	0.00	0.00	280	4	8.9	8.9
01/04/2007	0.00	0.01	1.55	240	8	7.2	6.7
01/08/2007	0.50	0.64	0.81	240	8	11.1	12.8
01/18/2007	0.00	0.00	0.00	140	8	7.2	2.8
03/01/2007	0.00	0.00	0.00	45	4	1.7	2.2
03/07/2007	0.00	0.00	0.00	90	8	0.6	-6.1
03/15/2007	0.00	0.00	0.00	190	6	4.4	10.0
03/20/2007	0.00	0.00	0.00	320	6	3.9	7.8
03/21/2007	0.00	0.00	0.00	60	10	3.9	2.8
04/02/2007	0.03	0.03	0.03	60	1	7.8	7.2
04/05/2007	1.29	1.29	1.29	330	15	8.9	4.4
04/30/2007	0.00	0.01	0.20	250	4	11.7	13.9
05/03/2007	0.00	0.00	0.00	60	12	12.2	10.6
05/29/2007	0.00	0.01	0.01	60	9	19.4	23.9
07/12/2007	0.01	0.01	0.02	20	7	23.3	22.2
07/13/2007	0.00	0.01	0.01	260	2	18.3	25.0
07/18/2007	0.01	0.08	0.08	200	8	20.0	22.8
07/27/2007	0.00	0.00	0.00	210	4	22.2	21.7
08/15/2007	0.00	0.00	0.00	250	8	23.9	23.9

N: No data

RAINFALL EFFECTS

Non-point source pressures on shellfish beds in New Jersey originate in materials that enter the water via stormwater. These materials include bacteria, as well as other waste that enters the stormwater collection system.

Rainfall impacts were assessed by using a t-test to compare the total coliform MPN values from water samples collected during wet weather to water samples collected during dry weather from 10/1/2002 to 9/30/2007. The Wet/Dry Statistics were calculated based on a post impact time of 24 hours prior to the day of sampling and a wet/dry cutoff of 0.1 inches of rain. Any rainfall amounts above 0.1 inches are considered to be a wet condition. A sampling station is considered to be impacted by rainfall when the t-statistic probability is 0.05 or less, but not zero. Using these parameters for the rainfall data, 58 sampling stations showed an impact from rainfall for this shellfish growing area from 10/1/2002 to 9/30/2007 (see Table 8 and Figure 26).

The Bureau of Marine Water Monitoring has begun to identify particular stormwater outfalls that discharge excessive bacteriological loads during storm events. In some cases, specific discharge points can be identified. When specific outfalls are identified as significant sources, the Department works with the county and municipality to further refine the source(s) of the contamination and implement remediation activities.

TABLE 8: STATIONS IMPACTED BY RAINFALL (10/1/2002 - 9/30/2007).

Station	Status	t-Statistic Probability	Wet Count	Wet Geo Mean	Dry Count	Dry Geo Mean	Wet/Dry Difference
3305B	*Approved*	0.014	6	10.2	26	4.6	-6
3305E	*Approved*	0.017	6	32.4	26	6.6	-26
3306	*Approved*	0.006	6	14.7	26	5.4	-9
3307	*Approved*	0.002	6	88.3	26	7.2	-81
3307C	*Prohibited*	0.001	5	337.4	35	18.5	-319
3307H	*Approved*	0.004	5	75.5	36	9.6	-66
3307I	*Seasonal(Nov.-Apr.)*	0.005	5	74.8	36	9.3	-66
3307J	*Seasonal(Nov.-Apr.)*	0.000*	5	123.7	36	6.1	-118
3307K	*Seasonal(Nov.-Apr.)*	0.007	5	70.2	36	10.4	-60
3307P	*Approved*	0.003	5	72.1	36	8.6	-64
3307V	*Seasonal(Nov.-Apr.)*	0.002	5	190.0	36	13.1	-177
3308	*Approved*	0.000*	5	135.7	36	8.9	-127
3308B	*Approved*	0.039	6	13.9	25	5.0	-9

Station	Status	t-Statistic Probability	Wet Count	Wet Geo Mean	Dry Count	Dry Geo Mean	Wet/Dry Difference
3309	*Seasonal(Nov.-Apr.)*	0.000*	5	397.8	36	5.1	-393
3309B	*Seasonal(Nov.-Apr.)*	0.000*	5	228.4	36	6.0	-222
3309D	*Seasonal(Nov.-Apr.)*	0.000*	5	332.9	36	6.3	-327
3309E	*Seasonal(Nov.-Apr.)*	0.000*	5	493.4	36	6.8	-487
3310B	*Prohibited*	0.000*	5	145.1	36	5.9	-139
3310D	*Prohibited*	0.000*	5	73.0	36	6.2	-67
3310E	*Seasonal(Nov.-Apr.)*	0.000*	5	182.6	36	5.1	-178
3311	*Prohibited*	0.000*	5	224.6	36	6.2	-218
3311A	*Prohibited*	0.000*	5	279.3	36	7.3	-272
3400B	*Prohibited*	0.000*	5	334.5	36	8.6	-326
3400C	*Seasonal(Nov.-Apr.)*	0.000*	5	141.5	36	4.8	-137
3400D	*Seasonal(Nov.-Apr.)*	0.000*	5	196.5	36	5.1	-191
3401A	*Seasonal(Nov.-Apr.)*	0.000*	5	66.7	36	4.5	-62
3401D	*Seasonal(Nov.-Apr.)*	0.000*	5	82.0	35	4.0	-78
3402A	*Seasonal(Nov.-Apr.)*	0.000*	5	42.6	36	5.3	-37
3403A	*Seasonal(Nov.-Apr.)*	0.002	5	48.7	36	6.2	-43
3403C	*Seasonal(Nov.-Apr.)*	0.000*	5	22.1	36	4.4	-18
3404	*Seasonal(Nov.-Apr.)*	0.004	5	55.9	36	8.0	-48
3404B	*Seasonal(Nov.-Apr.)*	0.000*	5	99.8	36	7.1	-93
3405	*Seasonal(Nov.-Apr.)*	0.000*	5	145.9	36	6.7	-139
3405B	*Seasonal(Nov.-Apr.)*	0.000*	5	254.1	36	4.2	-250
3405C	*Seasonal(Nov.-Apr.)*	0.000*	5	42.6	36	5.3	-37
3405F	*Seasonal(Nov.-Apr.)*	0.001	5	41.5	35	5.9	-36
3405H	*Seasonal(Nov.-Apr.)*	0.000*	5	212.2	34	5.5	-207
3406	*Seasonal(Nov.-Apr.)*	0.000*	5	24.4	36	4.4	-20
3406B	*Seasonal(Nov.-Apr.)*	0.000*	5	179.9	36	7.6	-172
3406C	*Seasonal(Nov.-Apr.)*	0.000*	5	154.1	36	5.2	-149
3407A	*Seasonal(Nov.-Apr.)*	0.000*	5	228.4	36	5.6	-223
3407E	*Seasonal(Nov.-Apr.)*	0.000*	5	169.6	36	7.4	-162
3408	*Seasonal(Nov.-Apr.)*	0.000*	5	202.7	36	7.2	-196
3408A	*Seasonal(Nov.-Apr.)*	0.000*	5	132.6	36	7.9	-125
3408C	*Seasonal(Nov.-Apr.)*	0.000*	5	117.0	36	6.6	-110
3409	*Seasonal(Nov.-Apr.)*	0.000*	5	169.9	36	6.8	-163

Station	Status	t-Statistic Probability	Wet Count	Wet Geo Mean	Dry Count	Dry Geo Mean	Wet/Dry Difference
3409B	*Seasonal(Nov.-Apr.)*	0.000*	5	157.9	36	6.6	-151
3409E	*Seasonal(Nov.-Apr.)*	0.000*	5	338.1	36	6.5	-332
3409G	*Seasonal(Nov.-Apr.)*	0.000*	5	145.9	36	5.8	-140
3409H	*Seasonal(Nov.-Apr.)*	0.000*	5	151.1	36	5.4	-146
3409I	*Seasonal(Nov.-Apr.)*	0.000*	5	175.7	36	5.7	-170
3410	*Prohibited*	0.000*	5	286.2	36	5.4	-281
3410E	*Seasonal(Nov.-Apr.)*	0.000*	5	172.3	35	5.8	-166
3411B	*Special Restricted*	0.000*	5	107.0	36	5.8	-101
3414A	*Seasonal(Nov.-Apr.)*	0.000*	5	106.4	36	7.1	-99
3502B	*Approved*	0.006	6	16.9	33	5.3	-12
3509	*Approved*	0.016	6	15.3	33	6.2	-9
3510C	*Seasonal(Nov.-Apr.)*	0.000*	6	45.9	33	7.1	-39

* Value of t-Statistic Probability very close to, but not zero.

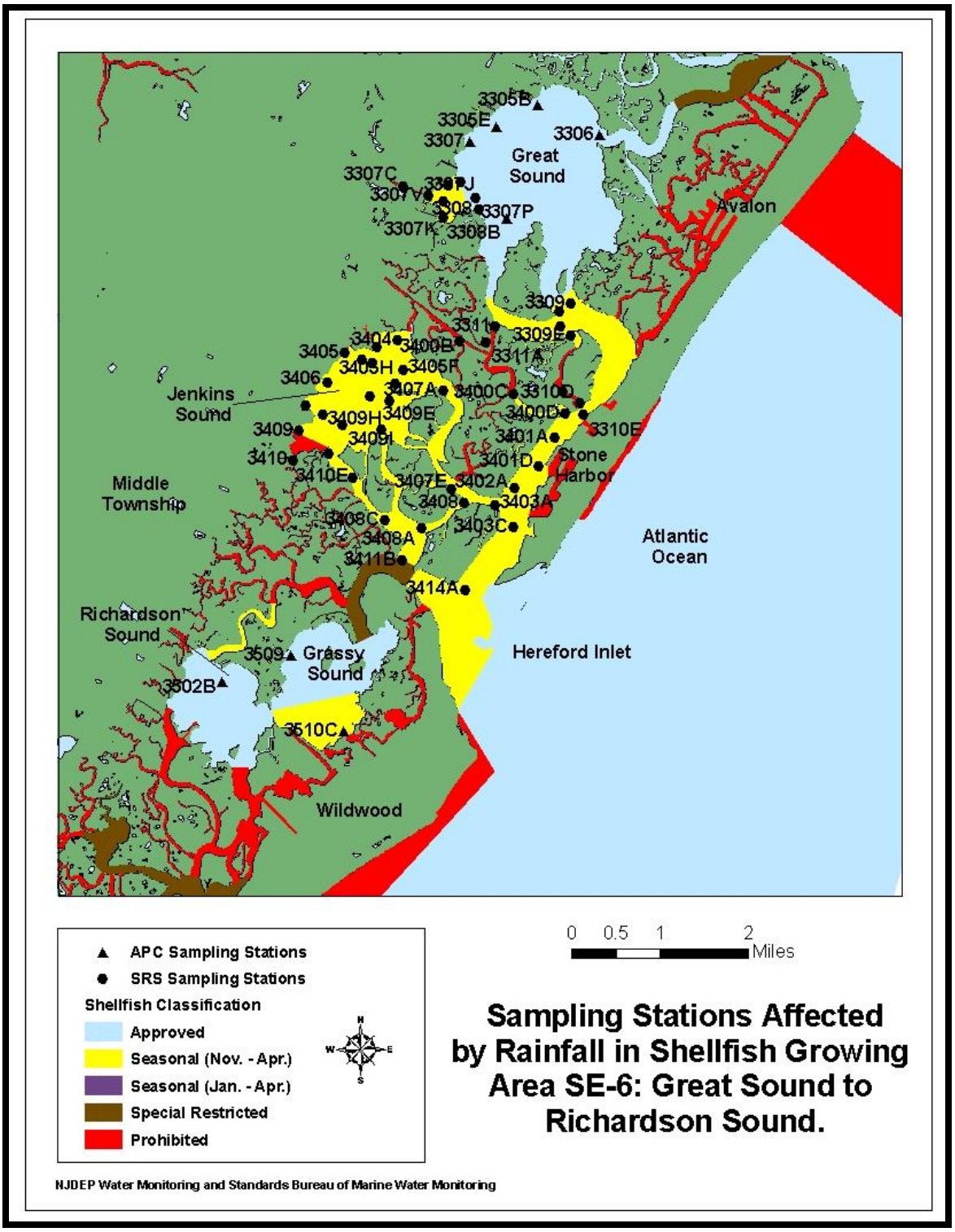

FIGURE 26: SAMPLING STATIONS AFFECTED BY RAINFALL IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

TIDAL EFFECTS

Tidal impacts were evaluated by performing a t-test on log-transformed total coliform MPN values. Table 9 lists the sampling stations in this shellfish growing area that showed a relationship between tidal effects and water quality. Figure 27 shows the location of these sampling stations. SRS sampling stations **3405H** and **3414A**, and APC sampling stations **3307**, **3504**, and **3516** showed a higher total coliform geometric mean during the ebb tide than during the flood tide because, when there is less bay water available for dilution of freshwater pollution sources during the ebb tide, the concentration of total coliform bacteria in the available water would be higher. The SRS sampling stations from Hereford Inlet to Jenkins Sound (Assignment 255) were sampled with a flood tide preference.

TABLE 9: TIDAL EFFECTS

Station	Total Coliform Geometric Mean MPN		Probability>[T]	Location	Classification
	Ebb	Flood			
3307	18.2	3.6	0.024	In Great Sound	*Approved*
3405H	13.7	4.3	0.036	In Jenkins Sound near Nichols Channel	*Seasonal(Nov.-Apr.)*
3414A	14.7	5.9	0.045	In Great Channel, west of Hereford Inlet	*Seasonal(Nov.-Apr.)*
3504	10.6	4.4	0.015	In Richardson Sound near Richardson Channel	*Approved*
3516	11.8	4.6	0.007	In Richardson Sound near Grassy Sound Channel	*Approved*

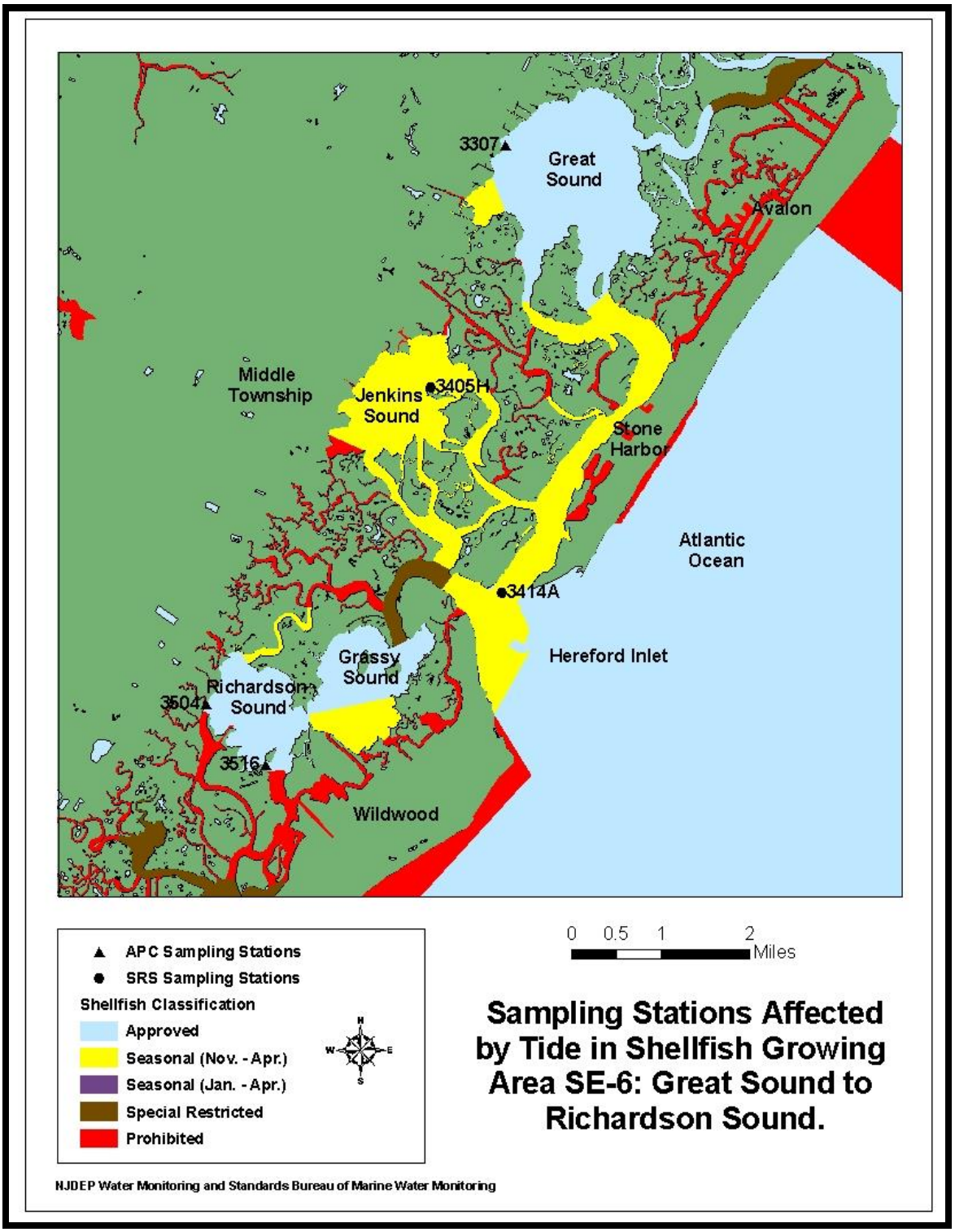

FIGURE 27: SAMPLING STATIONS AFFECTED BY TIDE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

SEASONAL EFFECTS

Temperature, precipitation, wind, and the general circulation of the atmosphere have seasonal variations that affect the marine environment.

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.

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.

Seasonal effects were assessed using a t-test to compare log-transformed total coliform values for summer versus winter data. Table 10 lists the 67 sampling stations in this shellfish growing area that showed a relationship between seasonal effects and water quality. Figure 28 shows the locations of these sampling stations. Most of these sampling stations showed a higher total coliform geometric mean during the summer than during the winter, which is most likely due to increased population pressures resulting from the summer tourism industry. However, APC sampling station **3307N**, located in Great Sound east of Holmes Cove, showed a higher total coliform geometric mean during the winter than during the summer, which could be from the impact of wild bird populations to this area. This shellfish growing area was sampled with no seasonal preference.

TABLE 10: SEASONAL EFFECTS

Station	Total Coliform Geometric Mean MPN		Probability>[T]	Location	Classification
	Summer	Winter			
3307C	65.7	12.7	0.006	Holmes Creek	*Prohibited*
3307J	15.6	5.6	0.019	Holmes Cove	*Seasonal (N.-A.)*
3307N	4.6	15.0	0.047	Great Sound	*Seasonal (N.-A.)*
3309	26.8	3.6	0.000	Gull Island Thorofare	*Seasonal (N.-A.)*
3309B	23.1	4.6	0.001	Gull Island Thorofare	*Seasonal (N.-A.)*
3309D	32.8	4.1	0.000	Gull Island Thorofare	*Seasonal (N.-A.)*
3309E	33.7	4.9	0.001	Gull Island Thorofare	*Seasonal (N.-A.)*
3310B	21.6	4.3	0.001	Great Channel	*Prohibited*
3310D	23.6	3.7	0.000	Great Channel	*Prohibited*
3310E	20.1	3.8	0.000	Great Channel	*Seasonal (N.-A.)*
3311	24.3	4.7	0.001	Scotch Bonnet	*Prohibited*
3311A	29.0	5.4	0.001	Scotch Bonnet	*Prohibited*
3312	16.3	5.0	0.016	Great Sound	*Approved*
3400B	27.4	7.7	0.011	Crooked Creek	*Prohibited*
3400C	18.2	3.5	0.000	Scotch Bonnet	*Seasonal (N.-A.)*
3400D	21.4	3.7	0.000	Great Channel	*Seasonal (N.-A.)*
3401A	12.4	3.7	0.003	Great Channel	*Seasonal (N.-A.)*
3401D	10.7	3.7	0.017	Great Channel	*Seasonal (N.-A.)*
3402A	12.9	4.2	0.005	Great Channel	*Seasonal (N.-A.)*
3403A	19.3	4.0	0.000	Great Channel	*Seasonal (N.-A.)*
3403C	7.6	4.0	0.045	Great Channel	*Seasonal (N.-A.)*
3404B	21.8	5.2	0.002	Jenkins Sound	*Seasonal (N.-A.)*
3405	18.2	6.0	0.040	Jenkins Sound	*Seasonal (N.-A.)*
3405B	13.3	4.2	0.014	Jenkins Sound	*Seasonal (N.-A.)*
3405H	16.9	5.0	0.022	Jenkins Sound	*Seasonal (N.-A.)*
3406B	20.3	7.0	0.028	Jenkins Sound	*Seasonal (N.-A.)*
3406C	14.6	4.8	0.014	Jenkins Sound	*Seasonal (N.-A.)*
3407A	21.7	4.3	0.001	Nichols Channel	*Seasonal (N.-A.)*

Station	Total Coliform Geometric Mean MPN		Probability>[T]	Location	Classification
	Summer	Winter			
3407E	27.6	5.3	0.000	Dung Thorofare	*Seasonal (N.-A.)*
3408	35.6	4.3	0.000	Great Flat Thorofare	*Seasonal (N.-A.)*
3408A	30.3	5.1	0.000	Great Flat Thorofare	*Seasonal (N.-A.)*
3408C	21.9	4.9	0.000	Jenkins Channel	*Seasonal (N.-A.)*
3409	22.7	5.3	0.000	Jenkins Sound	*Seasonal (N.-A.)*
3409B	23.1	5.0	0.000	Jenkins Sound	*Seasonal (N.-A.)*
3409E	21.9	6.0	0.010	Jenkins Sound	*Seasonal (N.-A.)*
3409G	15.5	5.4	0.025	Jenkins Sound	*Seasonal (N.-A.)*
3409H	18.2	4.3	0.001	Jenkins Sound	*Seasonal (N.-A.)*
3409I	15.2	5.6	0.044	Jenkins Sound	*Seasonal (N.-A.)*
3410	20.4	4.5	0.002	Hammock Creek	*Prohibited*
3410E	20.5	4.8	0.001	Jenkins Channel	*Seasonal (N.-A.)*
3411B	15.7	5.0	0.012	Grassy Sound Channel	*Special Restricted*
3411E	13.3	4.6	0.010	Grassy Sound Channel	*Special Restricted*
3412A	14.3	4.3	0.006	Grassy Sound Channel	*Special Restricted*
3412B	10.6	5.0	0.026	Grassy Sound Channel	*Special Restricted*
3414A	19.4	5.8	0.006	Great Channel west of Hereford Inlet	*Seasonal (N.-A.)*
3500C	12.9	4.6	0.005	Cresse Creek	*Prohibited*
3500D	11.7	4.0	0.004	Cresse Creek	*Prohibited*
3500F	12.6	5.5	0.026	Old Turtle Thorofare	*Prohibited*
3501	9.9	4.9	0.042	Tempe Creek	*Prohibited*
3501B	14.4	4.2	0.000	Tempe Creek	*Prohibited*
3501C	13.2	5.2	0.023	Old Turtle Thorofare	*Seasonal (N.-A.)*
3501D	9.3	4.9	0.012	Richardson Sound	*Approved*
3502	10.5	4.7	0.018	Richardson Sound	*Approved*

Station	Total Coliform Geometric Mean MPN		Probability>[T]	Location	Classification
	Summer	Winter			
3503	16.9	5.5	0.004	Richardson Sound	*Approved*
3505C	14.1	5.6	0.029	Old Turtle Thorofare	*Prohibited*
3506	9.0	4.5	0.031	Grassy Sound Channel	*Special Restricted*
3506A	15.0	5.7	0.017	Grassy Sound	*Approved*
3506B	13.2	5.1	0.018	Grassy Sound	*Approved*
3507	9.8	4.0	0.006	Grassy Sound	*Approved*
3507A	11.2	4.1	0.005	Grassy Sound	*Approved*
3508A	12.8	6.0	0.041	Grassy Sound	*Approved*
3509B	14.4	5.0	0.008	Grassy Sound	*Approved*
3509C	13.9	4.8	0.010	Grassy Sound	*Approved*
3510A	10.2	4.8	0.033	Grassy Sound	*Seasonal (N.-A.)*
3515C	13.2	5.4	0.014	Richardson Sound	*Approved*
3515D	20.1	5.6	0.002	Richardson Sound	*Approved*
3516B	21.5	6.3	0.001	Grassy Sound Channel	*Prohibited*

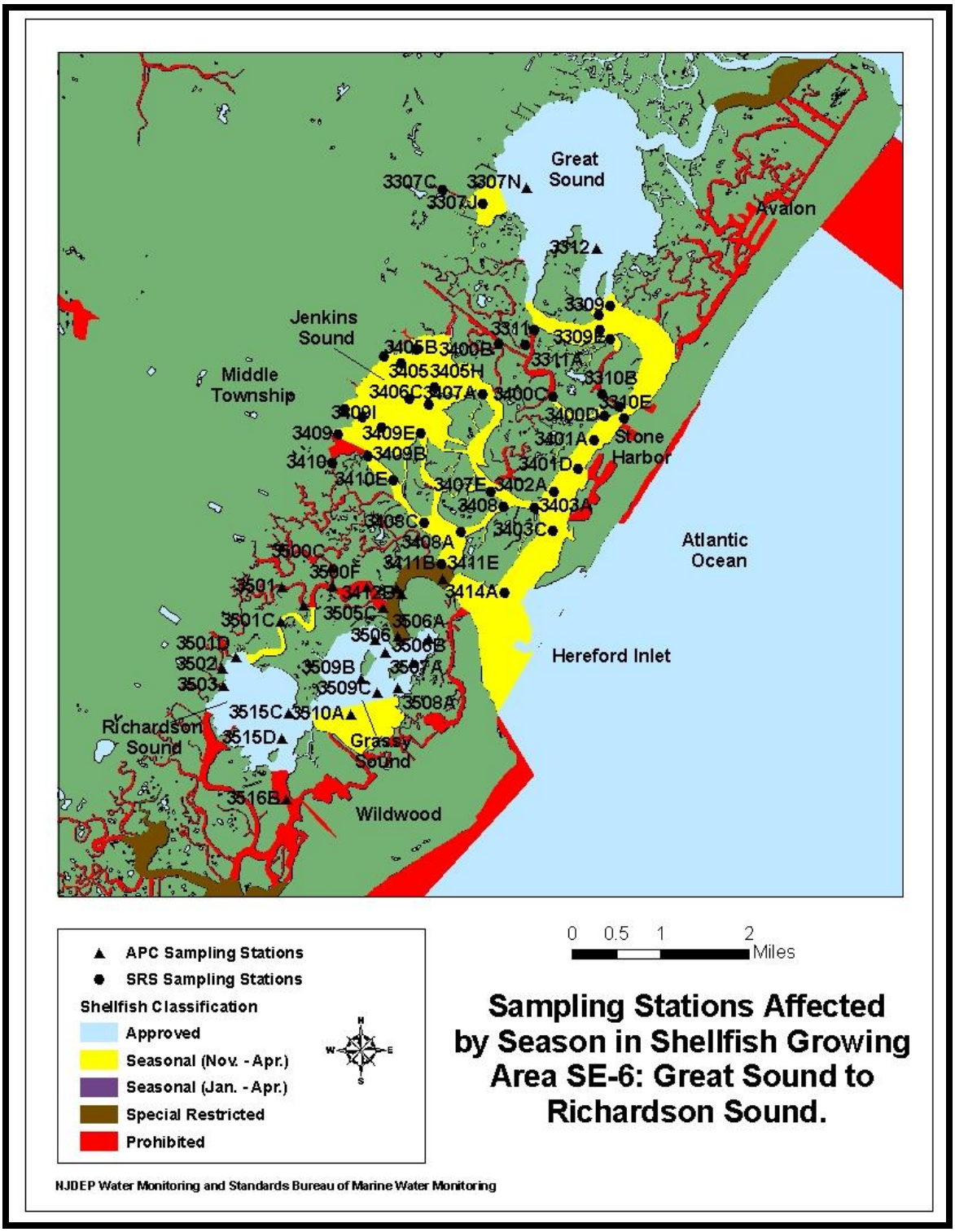

FIGURE 28: SAMPLING STATIONS AFFECTED BY SEASON IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

The statistical summaries for the areas sampled according to Systematic Random Sampling (SRS) Strategy and Adverse Pollution Condition (APC) Strategy are listed in Tables 11 and 12. This shellfish growing area is composed of three assignment areas, Assignment 255 (Hereford Inlet and Jenkins Sound), Assignment 267 (Grassy Sound and Richardson Sound), and Assignment 287 (Great Sound). The water samples collected in Assignment 255 are sampled using SRS sampling strategy year-round with a flood tide preference. The water samples collected in Assignment 267 are sampled using APC sampling strategy year round, with a sample taken once a month from October to April and two times from May to October. The water samples collected in Assignment 287 are sampled using APC sampling strategy year-round, with a water sample taken once a month from January to April and two times from May to October. Figures 11, 12, and 13 show all of the sampling stations for this area. 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.

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TABLE 11 : WATER QUALITY SUMMARY: SRS STATIONS (10/01/2002 – 9/30/2007)

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N
3307C	P	26.6	314.7	40	65.7	1144.9	18	12.7	64.4	22
3307H	A	12.4	88.1	41	11.8	103.2	18	12.8	80.4	23
3307I	S	12.0	94.2	41	16.2	162.4	18	9.5	59.9	23
3307J	S	8.8	53.6	41	15.6	160.3	18	5.6	15.0	23
3307K	S	13.2	92.0	41	13.4	133.6	18	13.0	68.9	23
3307P	A	11.2	81.7	41	14.4	126.2	18	9.1	58.0	23
3307V	S	18.1	193.9	41	30.2	543.2	18	12.2	71.5	23
3308	A	12.4	101.7	41	12.4	184.4	18	12.4	58.9	23
3309	S	8.7	76.1	41	26.8	366.3	18	3.6	5.9	23
3309B	S	9.3	70.2	41	23.1	282.3	18	4.6	9.9	23
3309D	S	10.2	108.8	41	32.8	582.1	18	4.1	8.5	23
3309E	S	11.4	130.5	41	33.7	682.6	18	4.9	13.3	23
3310B	P	8.7	69.0	41	21.6	292.0	18	4.3	9.1	23
3310D	P	8.3	62.0	41	23.6	264.5	18	3.7	5.9	23
3310E	S	7.8	51.6	41	20.1	191.0	18	3.8	7.2	23
3311	P	9.6	86.8	41	24.3	336.3	18	4.7	15.3	23
3311A	P	11.3	96.3	41	29.0	396.6	18	5.4	14.2	23
3400B	P	13.4	106.8	41	27.4	298.5	18	7.7	33.9	23
3400C	S	7.2	47.3	41	18.2	181.5	18	3.5	6.0	23
3400D	S	8.0	56.7	41	21.4	233.0	18	3.7	6.1	23
3401A	S	6.3	35.4	41	12.4	122.4	18	3.7	6.3	23
3401D	S	5.8	36.0	40	10.7	142.5	17	3.7	5.9	23
3402A	S	6.9	37.4	41	12.9	110.2	18	4.2	9.7	23
3403A	S	8.0	52.7	41	19.3	184.6	18	4.0	9.1	23

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N	Geo. Mean	Est. 90th	N
3403C	S	5.3	19.9	41	7.6	41.2	18	4.0	9.0	23
3404	S	10.2	64.8	41	9.7	81.4	18	10.6	55.1	23
3404B	S	9.8	66.9	41	21.8	182.2	18	5.2	19.3	23
3405	S	9.8	89.8	41	18.2	193.8	18	6.0	41.0	23
3405B	S	6.9	49.7	41	13.3	196.6	18	4.2	8.1	23
3405C	S	6.8	29.6	41	8.5	49.7	18	5.8	18.7	23
3405F	S	7.6	41.9	40	9.0	64.5	18	6.6	29.1	22
3405H	S	8.8	75.9	39	16.9	256.4	18	5.0	16.2	21
3406	S	5.4	20.8	41	7.1	45.2	18	4.4	8.7	23
3406B	S	11.2	81.5	41	20.3	213.9	18	7.0	29.3	23
3406C	S	7.8	51.6	41	14.6	168.6	18	4.8	12.5	23
3407A	S	8.8	69.4	41	21.7	275.6	18	4.3	10.7	23
3407E	S	10.9	82.8	41	27.6	315.1	18	5.3	13.1	23
3408	S	10.8	83.1	41	35.6	285.0	18	4.3	10.6	23
3408A	S	11.2	87.0	41	30.3	298.6	18	5.1	15.6	23
3408C	S	9.4	52.9	41	21.9	154.7	18	4.9	11.7	23
3409	S	10.0	59.4	41	22.7	160.9	18	5.3	15.8	23
3409B	S	9.8	63.5	41	23.1	196.6	18	5.0	13.9	23
3409E	S	10.5	86.5	41	21.9	311.5	18	6.0	18.9	23
3409G	S	8.6	59.1	41	15.5	188.7	18	5.4	15.5	23
3409H	S	8.1	53.9	41	18.2	167.2	18	4.3	12.7	23
3409I	S	8.7	66.2	41	15.2	218.1	18	5.6	17.3	23
3410	P	8.8	70.2	41	20.4	296.2	18	4.5	10.0	23
3410E	S	8.9	57.7	40	20.5	208.6	17	4.8	11.4	23
3411B	SR	8.3	54.2	41	15.7	171.9	18	5.0	13.7	23
3414A	S	9.9	63.0	41	19.4	193.5	18	5.8	16.3	23

TABLE 12 : WATER QUALITY SUMMARY: APC STATIONS (10/01/2002 – 9/30/2007)

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3305	A	6.1	0.0%	32	5.5	0.0%	19	7.0	0.0%	13
3305A	A	5.8	0.0%	32	6.4	0.0%	19	5.0	0.0%	13
3305B	A	5.3	0.0%	32	5.4	0.0%	19	5.2	0.0%	13
3305D	A	5.8	0.0%	32	5.7	0.0%	19	6.0	0.0%	13
3305E	A	8.9	3.1%	32	10.4	5.3%	19	7.1	0.0%	13
3306	A	6.5	0.0%	32	6.2	0.0%	19	7.1	0.0%	13
3306C	A	5.4	0.0%	32	5.3	0.0%	19	5.7	0.0%	13
3306E	A	8.0	0.0%	32	7.4	0.0%	19	9.0	0.0%	13
3306F	A	10.8	9.4%	32	13.2	15.8%	19	8.0	0.0%	13
3307	A	11.6	6.3%	32	9.0	5.3%	19	16.7	7.7%	13
3307N	A	7.4	9.4%	32	4.6	0.0%	19	15.0	23.1%	13
3308B	A	6.1	0.0%	31	4.7	0.0%	18	8.9	0.0%	13
3308E	A	7.1	0.0%	31	8.0	0.0%	18	6.0	0.0%	13
3312	A	10.1	0.0%	32	16.3	0.0%	19	5.0	0.0%	13
3411E	SR	7.3	2.6%	39	13.3	5.9%	17	4.6	0.0%	22
3412A	SR	7.2	2.6%	39	14.3	5.9%	17	4.3	0.0%	22
3412B	SR	6.9	0.0%	39	10.6	0.0%	17	5.0	0.0%	22
3500C	P	7.2	0.0%	39	12.9	0.0%	17	4.6	0.0%	22
3500D	P	6.4	0.0%	39	11.7	0.0%	17	4.0	0.0%	22
3500F	P	7.8	0.0%	39	12.6	0.0%	17	5.5	0.0%	22
3501	P	6.7	0.0%	39	9.9	0.0%	17	4.9	0.0%	22
3501B	P	7.1	0.0%	39	14.4	0.0%	17	4.2	0.0%	22
3501C	S	7.8	2.6%	39	13.2	5.9%	17	5.2	0.0%	22
3501D	A	6.5	0.0%	39	9.3	0.0%	17	4.9	0.0%	22
3502	A	6.7	0.0%	39	10.5	0.0%	17	4.7	0.0%	22

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3502B	A	6.3	0.0%	39	7.5	0.0%	17	5.5	0.0%	22
3502C	A	6.6	0.0%	39	7.7	0.0%	17	5.8	0.0%	22
3503	A	9.0	0.0%	39	16.9	0.0%	17	5.5	0.0%	22
3503B	A	7.0	0.0%	39	8.9	0.0%	17	5.8	0.0%	22
3504	A	7.2	0.0%	39	10.4	0.0%	17	5.4	0.0%	22
3504A	A	6.2	0.0%	39	8.3	0.0%	17	5.0	0.0%	22
3504B	A	6.9	0.0%	39	9.5	0.0%	17	5.4	0.0%	22
3504C	P	7.8	0.0%	39	8.0	0.0%	17	7.7	0.0%	22
3504E	P	5.7	0.0%	39	7.4	0.0%	17	4.6	0.0%	22
3504F	P	6.8	0.0%	39	7.0	0.0%	17	6.7	0.0%	22
3505C	P	8.3	0.0%	39	14.1	0.0%	17	5.6	0.0%	22
3506	SR	6.1	0.0%	39	9.0	0.0%	17	4.5	0.0%	22
3506A	A	8.7	0.0%	39	15.0	0.0%	17	5.7	0.0%	22
3506B	A	7.7	0.0%	39	13.2	0.0%	17	5.1	0.0%	22
3507	A	5.9	0.0%	38	9.8	0.0%	16	4.0	0.0%	22
3507A	A	6.4	0.0%	39	11.2	0.0%	17	4.1	0.0%	22
3507C	A	7.8	0.0%	39	11.1	0.0%	17	5.9	0.0%	22
3508A	A	8.4	0.0%	39	12.8	0.0%	17	6.0	0.0%	22
3509	A	7.2	0.0%	39	8.2	0.0%	17	6.5	0.0%	22
3509A	A	6.6	0.0%	39	9.4	0.0%	17	4.9	0.0%	22
3509B	A	7.9	2.6%	39	14.4	5.9%	17	5.0	0.0%	22
3509C	A	7.6	2.6%	39	13.9	5.9%	17	4.8	0.0%	22
3510	A	6.7	0.0%	39	7.3	0.0%	17	6.2	0.0%	22
3510A	S	6.7	0.0%	39	10.2	0.0%	17	4.8	0.0%	22
3510C	S	9.4	2.6%	39	11.8	5.9%	17	7.9	0.0%	22
3511	S	10.0	0.0%	39	12.4	0.0%	17	8.5	0.0%	22
3511B	S	8.6	0.0%	39	10.2	0.0%	17	7.5	0.0%	22

Station	Status	Year Round			Summer			Winter		
		Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3514	P	9.4	0.0%	39	10.3	0.0%	17	8.8	0.0%	22
3515A	A	7.1	0.0%	39	9.8	0.0%	17	5.5	0.0%	22
3515C	A	8.0	0.0%	39	13.2	0.0%	17	5.4	0.0%	22
3515D	A	9.8	0.0%	39	20.1	0.0%	17	5.6	0.0%	22
3516	A	8.0	0.0%	39	10.4	0.0%	17	6.5	0.0%	22
3516B	P	10.8	0.0%	39	21.5	0.0%	17	6.3	0.0%	22

COMPLIANCE WITH NSSP APPROVED CRITERIA

All of the water samples collected at the sampling stations in this shellfish growing area meets the *Approved* shellfish classification criteria (see Figure 29). However, some of the sampling stations in this growing area are located in shellfish waters which could possibly be impacted by potential sources of pollution, such as the activities in and around the marinas, and the stormwater released from the stormwater outfall pipes into the waters of this area and these shellfish waters are classified accordingly. There were no water samples collected at these sampling stations that exceeded the NSSP shellfish classification criteria for water quality in the *Approved, Seasonally Approved (November-April), Seasonally Approved (January-April), Special Restricted,* and *Prohibited* waters of this shellfish growing area.

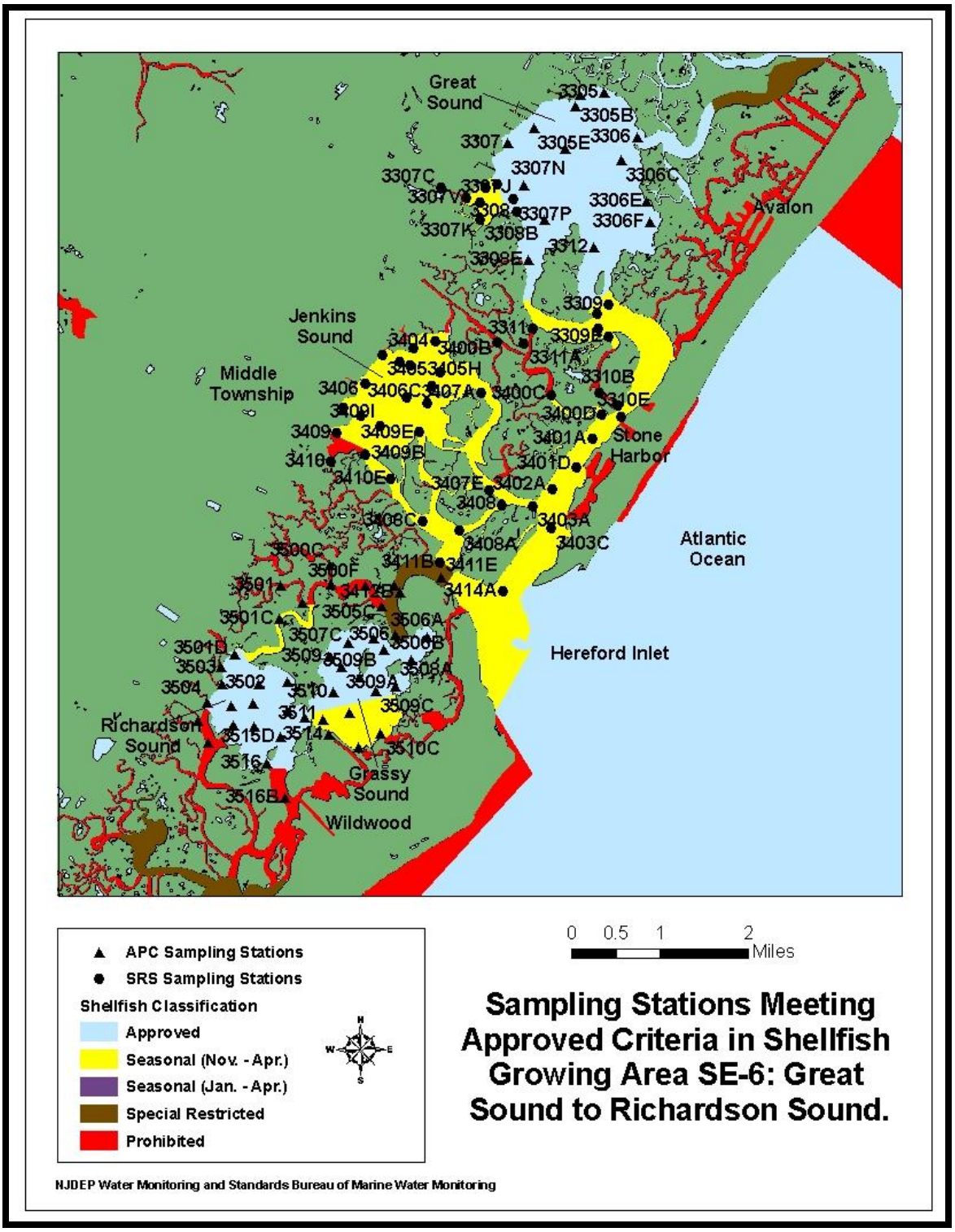

FIGURE 29: SAMPLING STATIONS MEETING APPROVED CRITERIA IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

INTERPETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

Criteria for bacterial acceptability of shellfish growing waters are provided in the National Shellfish Sanitation Program *Guide for the Control of Molluscan Shellfish* (USPHS, 2003 Revision). Each state must adopt either the total coliform criteria or fecal coliform criteria for growing water classifications. New Jersey bases growing water classifications on the total coliform criteria.

While New Jersey does make corresponding fecal coliform determinations for each total coliform determination in specific growing areas, these data are viewed as adjunct information and are not directly used for classification. Therefore, the data analysis is based on the total coliform results.

For the Systematic Random Sampling (SRS) strategy, the total coliform median or geometric mean MPN (most probable number) for the *Approved* shellfish water classification shall not exceed 70/100 mL and the estimated 90th percentile shall not exceed an MPN of 330/100 mL for the three tube decimal dilution test (see Table 2) (USPHS, 2003 Revision). Also, the total coliform median or geometric mean MPN for the *Special Restricted* shellfish water classification shall not exceed 700/100 mL and the estimated 90th percentile shall not exceed an MPN of 3300/100mL, where the three tube decimal dilution test is used for the Systematic Random Sampling (SRS) strategy (see Table 2) (USPHS, 2003 Revision).

For the Adverse Pollution Condition (APC) strategy, the data analysis is based on the total coliform results in which the total coliform median or geometric mean MPN (most probable number) for the *Approved* shellfish water classification shall not exceed 70/100 mL and not more than 10 percent of the sample shall exceed an MPN of 330/100 mL for the three tube decimal dilution test (see Table 1) (USPHS, 2003 Revision). Also, the total coliform median or geometric mean MPN (most probable number) for the *Special Restricted* shellfish water classification shall not exceed 700/100 mL and not more than 10 percent of the sample shall exceed an MPN of 3,300/100 mL, where the three tube decimal dilution test is used for the Adverse Pollution Condition (APC) strategy (see Table 1) (USPHS, 2003 Revision).

Figure 29 shows the sampling stations that meet the *Approved* total coliform criteria for water quality after being sampled with the Systematic Random Sampling (SRS) strategy and the Adverse Pollution Condition (APC) strategy. The water quality at all of the sampling stations in this shellfish growing area meets the *Approved* shellfish classification criteria for water quality. However, some of the sampling stations in this shellfish growing area are

located in shellfish waters which could possibly be impacted by potential sources of pollution, such as the activities in and around the marinas, and the stormwater released from the stormwater outfall pipes into the waters of this growing area. Therefore, these shellfish growing waters are classified accordingly, based on the potential impact by these sources of pollution. A review of the water quality data for the water samples collected at the sampling stations in Old Turtle Thorofare (APC sampling stations **3500D**, **3500F**, and **3505C**) showed that the total coliform levels for the water samples at these sampling stations improved and now meet the *Seasonally Approved (November to April)* shellfish classification criteria. Therefore, the *Prohibited* shellfish waters in Old Turtle Thorofare will be upgraded to the *Seasonally Approved (November to April)* shellfish classification.

Based on a significant correlation between total coliform MPN values from wet/dry data for 10/1/2002 to 9/30/2007, an impact from rainfall was found to occur at 58 sampling stations in this shellfish growing area (see Figure 26 and Table 8). These APC and SRS sampling stations are located throughout this shellfish growing area, in *Approved*, *Seasonally Approved (November to April)*, *Special Restricted*, and *Prohibited* shellfish waters. The Wet/Dry Statistics were calculated based on an impact time of 24 hours prior to the day of sampling and a wet/dry cutoff of 0.1 inches of rain. All of the water samples collected at these sampling stations showed a higher total coliform geometric mean during wet than dry conditions. However, the total coliform levels still meet the existing *Approved*, *Seasonally Approved (November to April)*, *Special Restricted*, and *Prohibited* shellfish classification criteria for these shellfish waters. Since the water quality in this shellfish growing area is slightly impacted by rainfall but not enough to affect the shellfish classification, this area will continue to be sampled using the Systematic Random Sampling (SRS) and Adverse Pollution Condition (APC) strategies. In the 2006 Annual Review of this shellfish growing area, 37 sampling stations showed a correlation between total coliform MPN and rainfall and most of these sampling stations also showed a rainfall correlation in this report (NJDEP, 2006).

Based on the water data collected, five sampling stations (SRS sampling stations **3405H** and **3414A**, and APC sampling stations **3307**, **3504**, and **3516**) showed a significant tidal component for water quality in this shellfish growing area (see Figure 27 and Table 9). SRS sampling stations **3405H** and **3414A** are located in Jenkins Sound near Nichols Channel and in Great Channel west of Hereford Inlet in *Seasonally Approved (November to April)* shellfish waters. APC sampling stations **3307**, **3504**, and **3516** are located in Great Sound, in Richardson Sound near Richardson Channel, and in Richardson Sound near Grassy Sound Channel in *Approved* shellfish waters. Tidal impacts were evaluated by performing a t-test on log-transformed total coliform MPN values. The water samples collected at the SRS sampling stations from Hereford Inlet to Jenkins Sound (Assignment 255) were sampled with a flood tide preference. The water samples collected at all of these tidal sampling stations showed a higher total coliform geometric mean during the ebb tide than during the flood tide because, when there is less bay

water available for dilution of freshwater pollution sources during the ebb tide, the concentration of total coliform bacteria in the available water would be higher. However, the total coliform levels for the water samples at these sampling stations still meets the existing *Approved* and *Seasonally Approved (November to April)* shellfish classification criteria for these shellfish waters. In the 2006 Annual Review of this shellfish growing area, three sampling stations showed a tidal component for water quality in this area and APC sampling station **3307** was one of the sampling stations that showed a tidal component in this report (NJDEP, 2006).

There were 67 sampling stations that showed a seasonal component for water quality in this shellfish growing area (see Figure 28 and Table 10). These APC and SRS sampling stations are located throughout this shellfish growing area, in *Approved, Seasonally Approved (November to April), Special Restricted,* and *Prohibited* shellfish waters. Seasonal effects were assessed using a t-test to compare log-transformed total coliform values for summer versus winter data. This shellfish growing area was sampled with no seasonal preference. The water samples collected at all but one of these sampling stations showed a higher total coliform geometric mean during the summer than during the winter, which is most likely due to increased population pressures resulting from the summer tourism industry. The water sample collected at APC sampling station **3307N**, located in Great Sound east of Holmes Cove, showed a higher total coliform geometric mean during the winter than during the summer, which could be from the impact of wild bird populations to this area. However, the total coliform levels at all of these sampling stations still meet the existing *Approved, Seasonally Approved (November to April), Special Restricted,* and *Prohibited* shellfish classification criteria for these shellfish waters. 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) and Adverse Pollution Condition (APC) strategies. In the 2006 Annual Review, there were 57 sampling stations that showed a seasonal component for water quality in this area and most of these sampling stations also showed a seasonal component in this report (NJDEP, 2006).

RELATED STUDIES

NUTRIENTS

According to the 2006-2007 Marine Water Sampling Assignments Schedule for Assignments 255, 267, and 287, there are 11 stations in Shellfish Growing Area SE-6 that are sampled under the estuarine monitoring program for chemical parameters including nutrients. These nutrient stations include sampling stations **3307B**, **3307N**, **3310, 3310A, 3312**, **3403C**, **3409H**, **3411E**, **3504A**, **3509B**, and **3516C** (see Figure 30 for the locations of these nutrient stations).

At these nutrient stations, the various parameters measured include 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 (Zimmer, 2001).

Water quality at the 11 nutrient stations in this shellfish growing area is consistent with the water results found throughout the State. For more detailed information concerning dissolved oxygen and nutrient levels, see the Estuarine Monitoring Report published by the NJDEP. The report is available electronically at: www.state.nj.us/dep/wms/bmw.

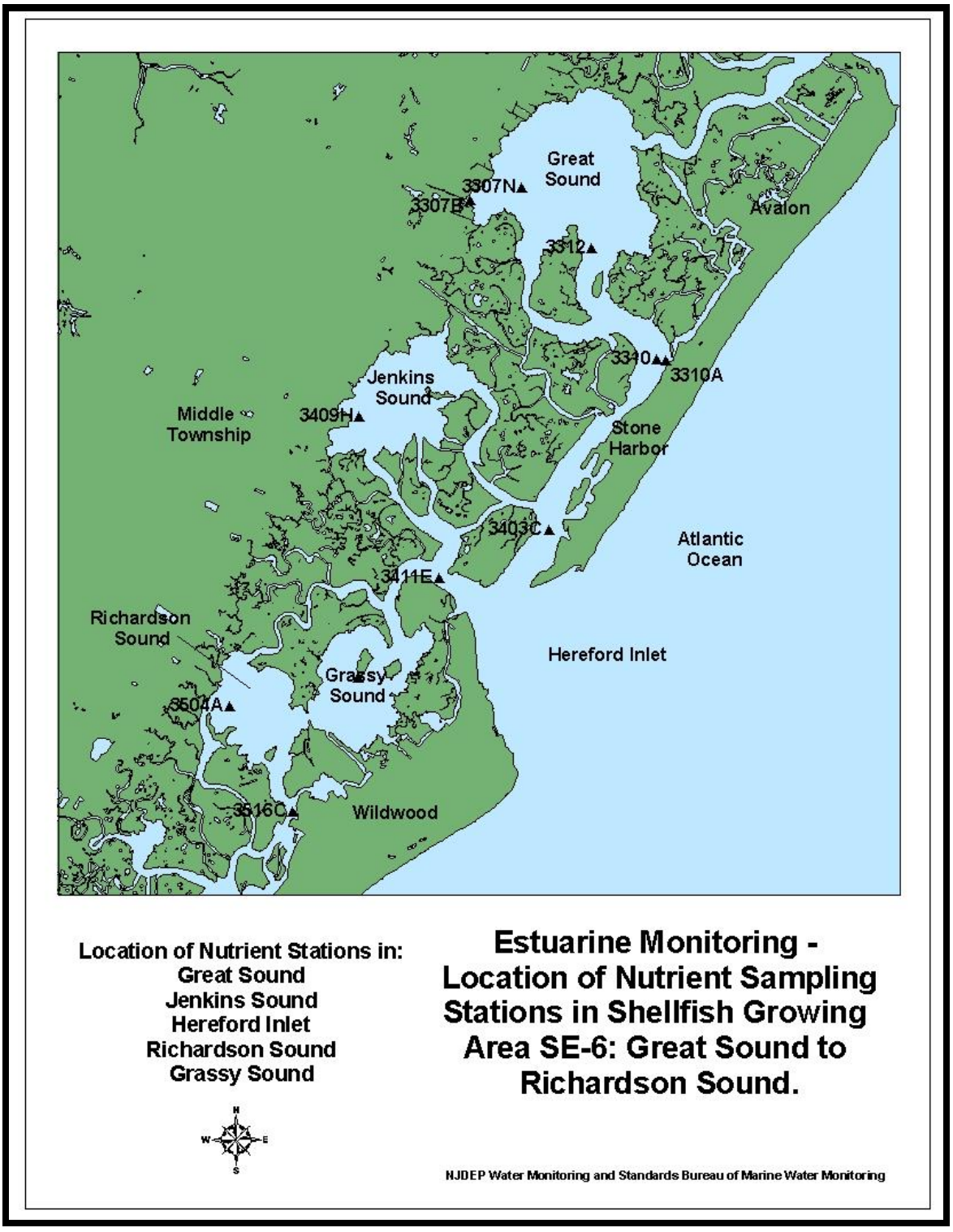

FIGURE 30: SAMPLING STATIONS WHERE ADDITIONAL DATA HAVE BEEN COLLECTED FOR NUTRIENTS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

MARINE BIOTOXINS

There are no phytoplankton sampling stations located in this shellfish growing area.

TOXICS

There are nine National Coastal Assessment (NCA) sampling stations and 12 Bureau of Marine Water Monitoring (BMWM) EMPACT sampling stations in this shellfish growing area. These sampling stations are located in Great Sound, Holmes Cove, Cresse Thorofare, Gull Island Thorofare, Great Channel, Stone Harbor Hole, Old Turtle Thorofare, Grassy Sound, Richardson Sound, and Grassy Sound Channel (see Figure 31). A review of the toxics data from 2002 to 2007 for these sampling stations showed that the levels of the contaminants and pesticides in the assays of the living tissues of the shellfish sampled did not exceed the FDA criteria.

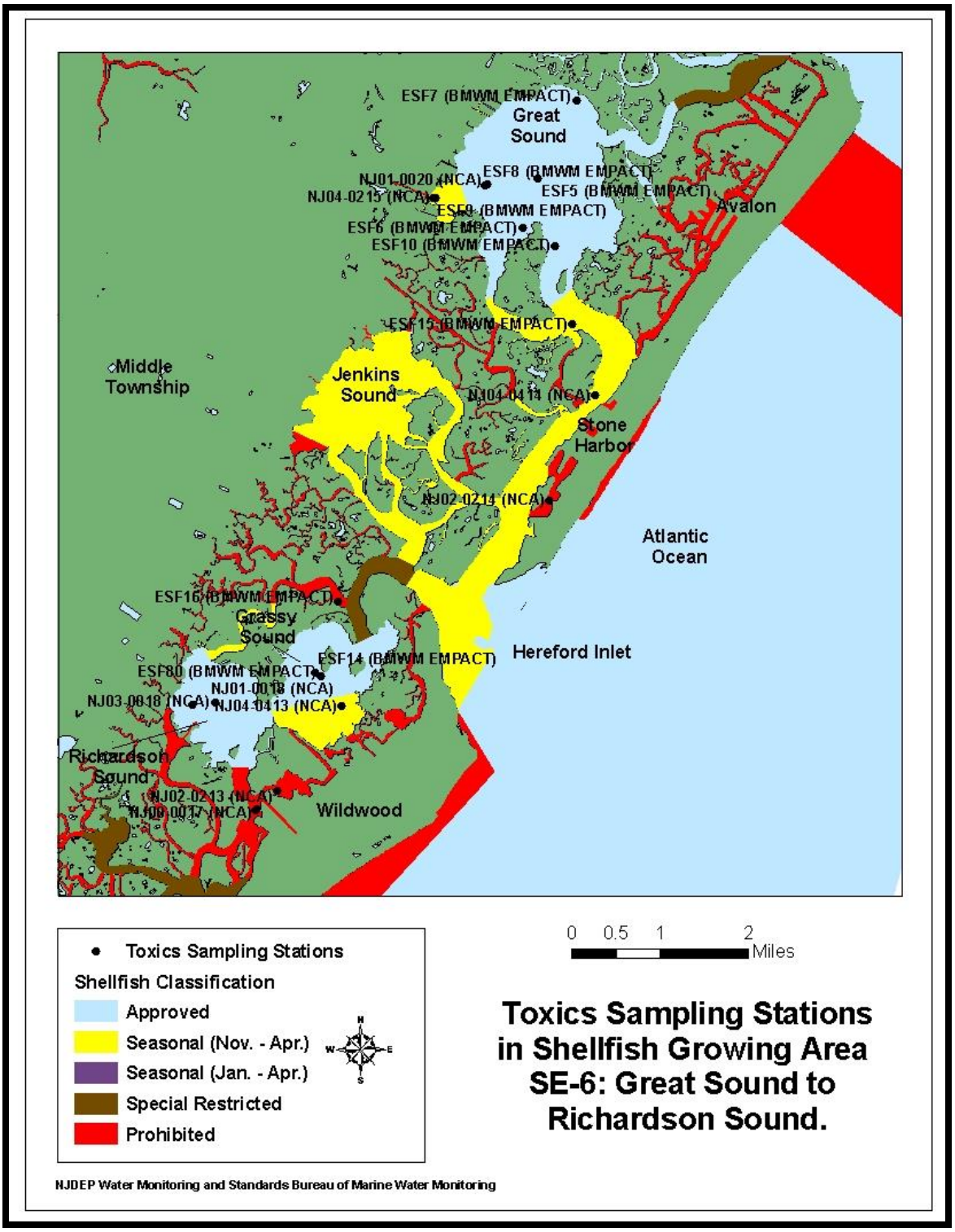

FIGURE 31: LOCATION OF TOXICS SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-5: LUDLAM BAY TO TOWNSENDS INLET.

BATHING BEACH DATA

There are 18 bathing beach sampling stations in this shellfish growing area and they are located along the western shoreline of this shellfish growing area (see Figure 32 for the locations of these bathing beach sampling stations). A review of the bathing beach data for the water samples collected at these sampling stations showed that the geometric mean levels for most of these stations generally meet the enterococcus criteria. According to the enterococcus criteria for recreational bathing beaches, the enterococcus year-round geometric mean levels cannot exceed 35, nor have specific dates during the year when the enterococcus levels exceed 104. On June 20 2007, June 28 2007, and July 6 2007, the enterococcus levels at most of the bathing beach sampling stations in this shellfish growing area exceeded the enterococcus level of 104. However, rainfall amounts were 0.25 to 0.50 inches for June 20 and 28, 2007, and 0.75 to 1.0 inches for July 6, 2007. Therefore, the bathing beach sampling stations will continue to be closely monitored during the shoreline surveys of this area, especially after rainfall events.

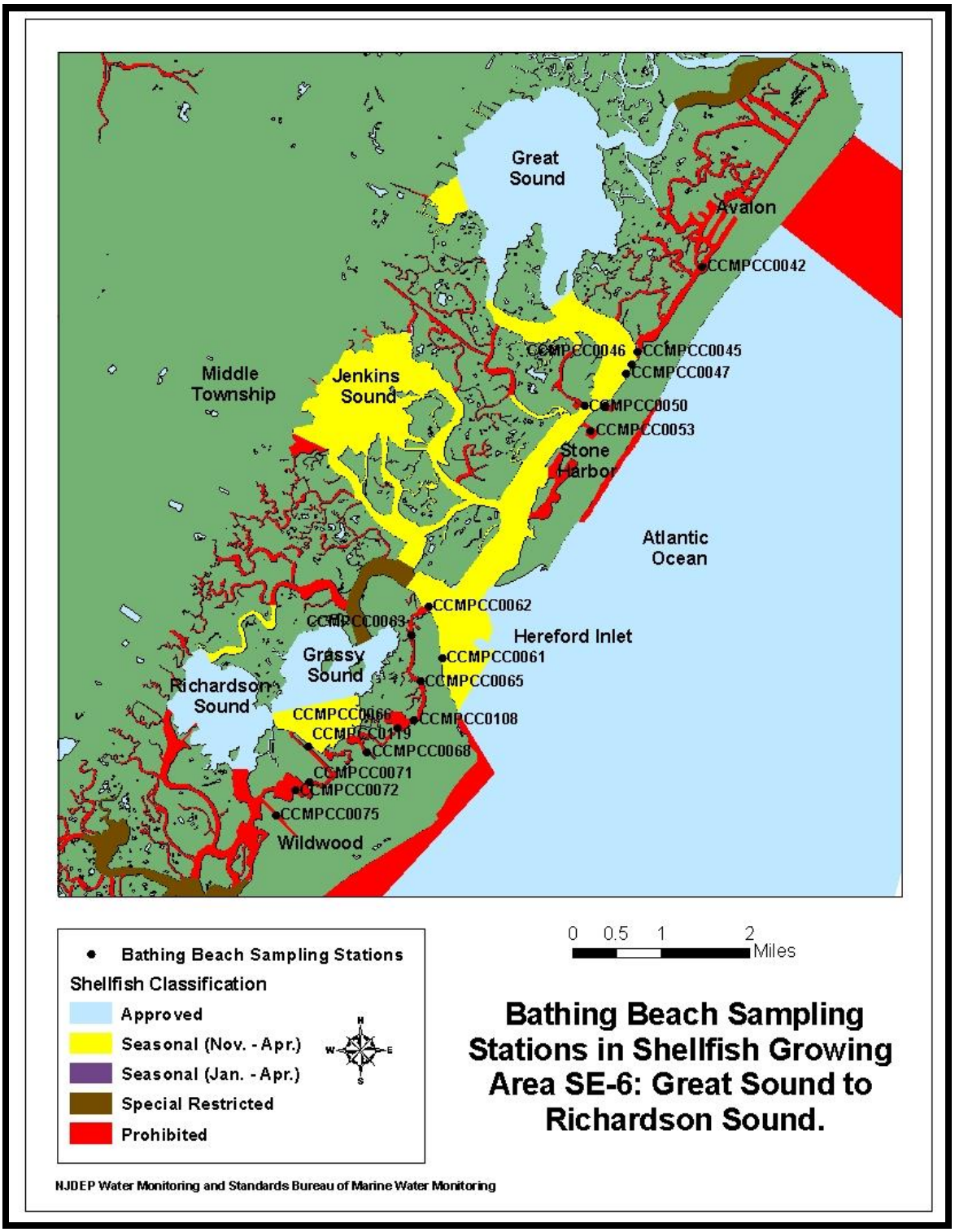

FIGURE 32: BATHING BEACH SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

CONCLUSIONS

BACTERIOLOGICAL EVALUATION

Water quality in Shellfish Growing Area SE-6: Great Sound to Richardson Sound, continues to be good, with all of the water samples collected at the sampling stations in compliance with the requirements of the *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* and *Prohibited* shellfish classification for the waters in this area, based on NSSP total coliform criteria. However, a review of the water quality data for the water samples collected at the sampling stations in Old Turtle Thorofare show that the total coliform levels for the water samples at these sampling stations have improved and now meet the *Seasonally Approved (November to April)* shellfish classification criteria. Therefore, approximately 66.7 acres of *Prohibited* shellfish waters in Old Turtle Thorofare will be upgraded to the *Seasonally Approved (November to April)* shellfish classification.

The rest of the sampling stations in this shellfish growing area are correctly classified as *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* and *Prohibited* as currently described in *N.J.A.C. 7:12.*

RECOMMENDATIONS

SHELLFISH WATER CLASSIFICATION

RECOMMENDED CLASSIFICATION CHANGES

It is recommended that approximately 66.7 acres of shellfish waters currently classified as *Prohibited* and located in Old Turtle Thorofare will be upgraded to the *Seasonally Approved (November to April)* shellfish classification.

The new upgraded *Seasonally Approved (November to April)* area will be added to the 3,047.8 acres of *Seasonally Approved (November to April)* shellfish growing waters located southwest of this area. The area to be reclassified is shown in Figures 33, 34, and 35.

The New Jersey Administrative Code (N.J.A.C. 7:12) Shellfish Water Classification & Special Permit Rules need to be revised to show the change in this shellfish water classification.

LEGAL DESCRIPTION FOR RECOMMENDED CHANGES:

In New Jersey Administrative Code 7:12-2.1 Shellfish growing water classification- Prohibited

(a) The following shellfish growing waters are classified Prohibited:

16. The Wildwoods Area (Note: Portions are also designated as Special Restricted and Seasonal. See: N.J.A.C. 7:12-3 and 4):

[v. All of Old Turtle Thorofare and its tributaries north and east of its junction with Tempe Creek]

v. [vi.] All of Tempe Creek and tributaries thereof;

vi. [vii.] All of Cresse Creek and tributaries thereof;

vii. [viii.] All of the tributaries of Richardson Sound northwest of the Intracoastal Waterway;

viii. [ix.] All of Post Creek and Ottens Harbor and tributaries thereof;

ix. [x.] All of Reubens Thorofare and tributaries thereof; and

x. [xi.] All of Taylor Creek, Jones Creek, Meadow Creek, Shell Thorofare and Punyard Creek.

In New Jersey Administrative Code 7:12-4.1 Seasonally Approved growing waters (Approved November 1 through April 30 yearly, Special Restricted May 1 through October 31, yearly)

(a) The following shellfish growing waters designated on the charts referred to in N.J.A.C. 7:12-1.1 shall be Special Restricted for the harvest of shellfish from May 1 through October 31 yearly and Approved for the harvest of shellfish from November 1 through April 30 yearly:

12. Jenkins Sound-Grassy Sound-Richardson Sound: Seasonal-Special Restricted May 1 through October 31 yearly, Approved November 1 through April 30 yearly:

iv. **All of the** [Those] waters of Old Turtle Thorofare from the mouth of Old Turtle Thorofare at Richardson Sound **and its tributaries north and east of its junction with Tempe Creek** to [a line created by two Department maintained markers on opposite banks of Old Turtle Thorofare just south of] its junction with **Grassy Sound Channel** [Tempe Creek].

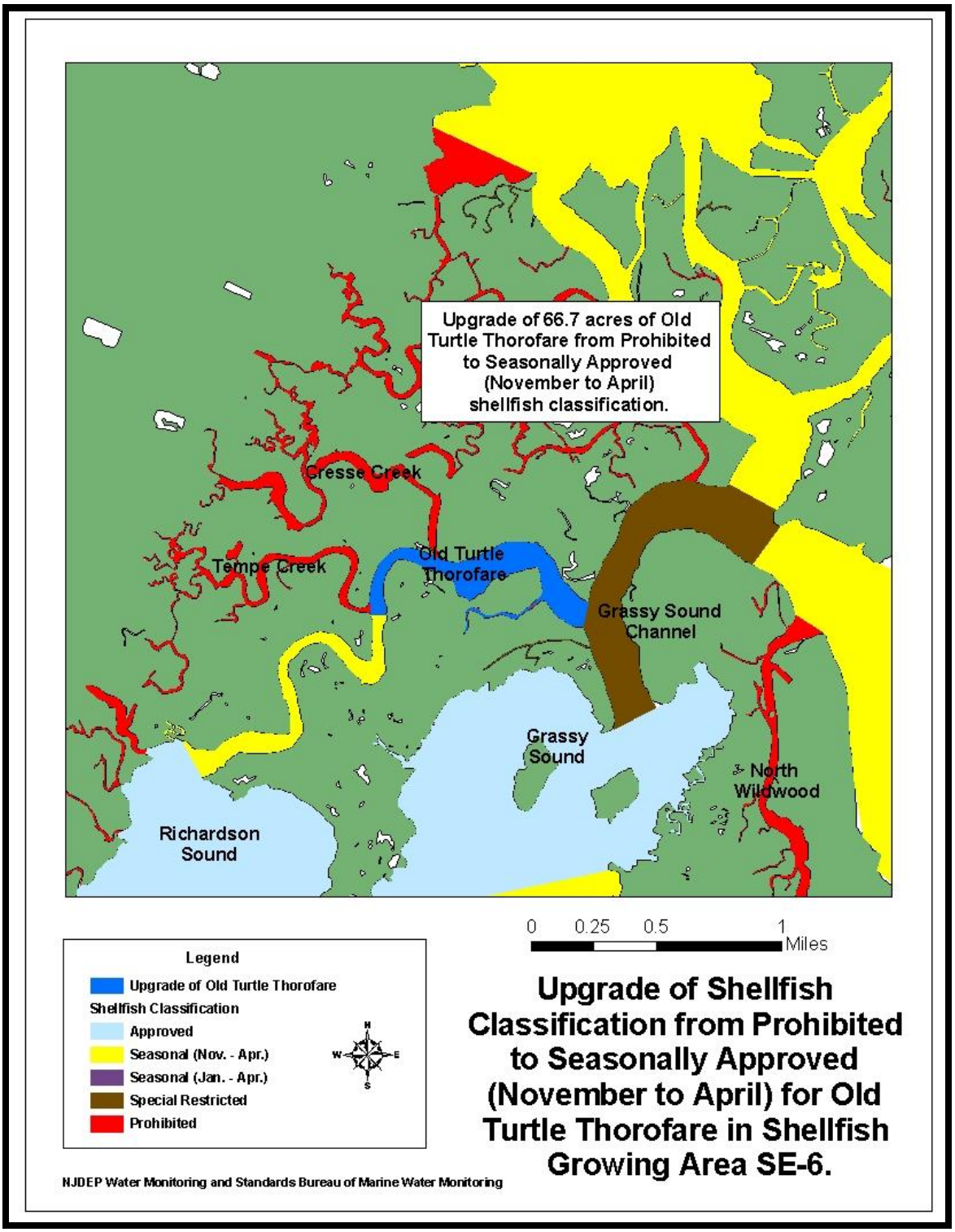

FIGURE 33: RECOMMENDED CHANGES IN SHELLFISH CLASSIFICATION IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 34: LOCATION OF OLD TURTLE THOROFARE NEAR GRASSY SOUND CHANNEL IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

FIGURE 35: LOCATION OF OLD TURTLE THOROFARE IN SHELLFISH GROWING AREA SE-6: GREAT SOUND TO RICHARDSON SOUND.

RECOMMENDED CHANGES IN MONITORING SCHEDULE

Continue sampling using the existing Systematic Random Sampling (SRS) Strategy for Assignment 255 and the existing Adverse Pollution Condition (APC) Strategy for Assignments 267 and 287. Reduce the number of runs collected per year from 10 to 5 in Assignment 267 (Grassy Sound and Richardson Sound), from 7 to 5 in Assignment 287 (Great Sound and Townsends Inlet), and from 8 to 6 in Assignment 255 (Jenkins Sound and Hereford Inlet).

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