BUREAU OF WATER
South Carolina Department of Health and Environmental Control

SHELLFISH MANAGEMENT AREA 05

2003 ANNUAL UPDATE

Shellfish Sanitation Program
Water Monitoring, Assessment and Protection Division
Environmental Quality Control - Bureau of Water
2600 Bull Street
Columbia, South Carolina 29201

July 2003

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2003 ANNUAL UPDATE
[Data Through December 2002]

Shellfish Management Area 05
Shellfish Sanitation Program

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ANNUAL UPDATE
Shellfish Management Area 05
SCDHEC EQC Bureau of Water

Data Inclusive Dates:
01 / 01 / 00 thru 12 / 31 / 02

Shoreline Survey Completed: Yes

Prior Report & Date: Annual-2002

Classification Change:
__Yes X No

(I)ncreased/(D)ecreased/(N)one:
N Approved
N Cond. Approved
N Restricted
N Prohibited

INTRODUCTION

Summary

Nonpoint source pollution impacts via rainfall and river flooding is the primary cause of shellfish growing area closures in lower Winyah Bay, Mud Bay, Oyster Bay, and portions of the North Inlet estuary. A reduction in rainfall in the area during 2001 reduced localized runoff and improved the water quality in Debidue Creek. This improvement resulted in the opening of Debidue Creek northward from Station 05-15 to Station 05-16, including the surrounding flats to the east and west of this location. Total rainfall for 2002 exceeded the 2001 total; however, no overall change in water quality data was observed.

PURPOSE AND SCOPE

The authority to regulate the harvest, sanitation, processing and handling of shellfish is granted to the South Carolina (S.C.) Department of Health and Environmental Control by Section 44-1-140 of the Code of Laws of South Carolina, 1976, as amended. The Department promulgated Regulation 61-47 which provides the rules used to implement this authority and outlines the requirements applied in regulating shellfish sanitation in the State This regulation specifically addresses classification of shellfish harvesting areas and requires that all areas be examined by sanitary and bacteriological surveys and classified into an appropriate shellfish harvesting classification.

The National Shellfish Sanitation Program (NSSP) Guide For The Control Of Molluscan Shellfish is used by the United States Food and Drug Administration (USFDA) to evaluate state shellfish sanitation programs. The NSSP Model Ordinance requires that a sanitary survey be in place for each growing area prior to its use as a source of shellfish for human consumption and prior to the area's classification as Approved, Conditionally Approved, Restricted, or Conditionally Restricted. Each sanitary survey shall be updated on an annual basis and accurately reflect changes which have occurred within the area. Requirement of the annual reevaluation include, at a minimum, field observations of pollution sources, an analysis of water quality data consisting of the past year's data in combination with appropriate previously collected data, review of reports and effluent samples from pollution sources, and review of

performance standards for discharges impacting the growing area. A brief report documenting the findings shall also be provided.

The following criteria consistent with the NSSP Model Ordinance and S. C. Regulation 61-47 are used in establishing shellfish harvesting classifications:

Approved - Growing areas shall be classified Approved when the sanitary survey concludes that fecal material, pathogenic microorganisms, and poisonous or deleterious substances are not present in concentrations which would render shellfish unsafe for human consumption. The Approved area classification shall be designated based upon a sanitary survey which includes water samples collected from stations in the designated area adjacent to actual or potential sources of pollution. For waters sampled under adverse pollution conditions, the median fecal coliform Most Probable Number (MPN) or the geometric mean MPN shall not exceed fourteen per one hundred milliliters, and not more than ten percent of the samples shall exceed a fecal coliform MPN of forty-three per one hundred milliliters (per five tube decimal dilution). For waters sampled under a systematic random sampling plan, the geometric mean fecal coliform Most Probable Number (MPN) shall not exceed fourteen per one hundred milliliters, and the estimated ninetieth percentile shall not exceed an MPN of forty three (per five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using NSSP Guidelines.

Conditionally Approved - Growing areas may be classified Conditionally Approved when they are subject to temporary conditions of actual or potential pollution. When such events are predictable as in the malfunction of wastewater treatment facilities, nonpoint source pollution from rainfall runoff, discharge of a major river, or potential discharges from dock or harbor facilities that may affect water quality, a management plan describing conditions under which harvesting will be allowed shall be adopted by the Department prior to classifying an area as Conditionally Approved. Where appropriate, the management plan for each Conditionally Approved area shall include performance standards for sources of controllable pollution, e.g., wastewater treatment and collection systems, evaluation of each source of pollution, and means of rapidly closing and subsequent reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate.

Restricted - Growing areas shall be classified Restricted when sanitary survey data show a limited degree of pollution or the presence of deleterious or poisonous substances to a degree which may cause the water quality to fluctuate unpredictably or at such a frequency that a Conditionally Approved classification is not feasible. Shellfish may be harvested from areas classified as Restricted only for the purposes of relaying or depuration and only by special permit issued by the Department and under Department supervision.

For Restricted areas to be utilized as a source of shellstock for depuration, or as source water for depuration, the fecal coliform geometric mean MPN of restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters and not more than ten percent of the samples shall exceed a MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform geometric mean MPN shall not exceed eighty-eight per one hundred milliliters and the estimated ninetieth percentile shall not exceed an MPN of two hundred and sixty (five tube decimal dilution). Computation of the estimated ninetieth percentile

shall be obtained using NSSP guidelines.

Conditionally Restricted - Growing areas may be classified Conditionally Restricted when they are subject to temporary conditions of actual or potential pollution. When such events are predictable, as in the malfunction of wastewater treatment facilities, nonpoint source pollution from rainfall runoff, discharge of a major river, or potential discharges from dock or harbor facilities that may affect water quality, a management plan describing conditions under which harvesting will be allowed shall be prepared by the Department prior to classifying an area as Conditionally Restricted. Where appropriate, the management plan for each Conditionally Restricted area shall include performance standards for sources of controllable pollution (e.g., wastewater treatment and collection systems and an evaluation of each source of pollution), and description of the means of rapidly closing and subsequent reopening areas to shellfish harvesting. Memorandums of agreements shall be a part of these management plans where appropriate. Shellfish may be harvested from areas classified as Conditionally Restricted only for the purposes of relaying or depuration and only by permit issued by the Department and under Department supervision. For Conditionally Restricted areas to be utilized as a source of shellstock for depuration, the fecal coliform geometric mean MPN of Conditionally Restricted waters sampled under adverse pollution conditions shall not exceed eighty-eight per one hundred milliliters and not more than ten percent of the samples shall exceed a MPN of two hundred and sixty per one hundred milliliters for a five tube decimal dilution test. For waters sampled under a systematic random sampling plan, the fecal coliform geometric mean MPN shall not exceed eighty-eight per one hundred milliliters and the estimated ninetieth percentile shall not exceed an MPN of two hundred and sixty (five tube decimal dilution). Computation of the estimated ninetieth percentile shall be obtained using NSSP guidelines.

Prohibited - Growing areas are classified Prohibited if there is no current sanitary survey or if the sanitary survey or monitoring data show unsafe levels of fecal material, pathogenic microorganisms, or poisonous or deleterious substances in the growing area or indicate that such substances could potentially reach quantities which could render shellfish unfit or unsafe for human consumption.

BACKGROUND INFORMATION

Area 05 consists of approximately 35,710 acres of classified shellfish growing waters. The area is comprised of two distinctly different estuarine environments, Winyah Bay and North Inlet, which are separated by an area of limited intermixing (Oyster Bay and Mud Bay). Winyah Bay, a class B type estuary according to Pritchard (1955), extends to the south-southeast approximately 12 nautical miles from the city of Georgetown, South Carolina. Winyah Bay is bounded to the north by the U. S. Highway 17 bridges traversing the Waccamaw, Black, Pee Dee, and Sampit Rivers. It is bounded to the south and east by the Atlantic Ocean, Mud Bay, and highlands of the Waccamaw Neck and to the west-southwest by approximately 20 miles of shoreline extending from the city of Georgetown and including South and Cat Islands.

North Inlet, possessing characteristics of a classical well-mixed system, is bounded to the south and west by Mud Bay, Winyah Bay, and highlands of the Waccamaw Neck, and to the north by the DeBordieu Colony Club development. The eastern boundary is defined by Debordiue Island, North Island, and the Atlantic Ocean.

The harvesting classifications of Area 05 prior to this sanitary survey were as follows:

Prohibited:

1. All portions of Mud Bay and Winyah Bay westward of a line extending from the confluence of Winyah Bay and the Intracoastal Waterway northward to the northwestern corner of the Marsh Islands and continuing across Mud Bay to the mainland marsh;
2. All tidal portions of Cat and South Islands;
3. All portions of the Estherville Minum Creek Canal.

Restricted

1. All portions of North Inlet northward of the confluence of Debidue Creek and Bass Hole Bay;
2. Southern portions of North Inlet, extending from the confluence of Noble Slough and Jones Creek southward, including Noble Slough, Haulover Creek, Boor Creek, Nancy Creek, Little Jones Creek, Dividing Creek, Sign Creek and Cotton Patch Creek;
3. Southern portions of Town Creek, from it's confluence with Sixty Bass Creek and the southern entrance to Clambank Creek, southward to Mud Bay. This includes Sawmill Creek, Town Creek, Cutoff Creek, Mud Creek, Oyster Bay, and No Mans Friend Creek;
4. Portions of Mud Bay and Winyah Bay, eastward of an imaginary line extending from the confluence of Winyah Bay and the eastern shore of the Estherville Minum Creek Canal northward to a point of intersection with the northwestern corner of the northern most Marsh Island, and from there continuing across Mud Bay to the mainland marsh. This area extends southeastward in Winyah bay to a line extending from the South Island shore, approximately 400 meters west of Mosquito Creek, to the spoil islands approximately 800 meters southeast of Malady Bush Island. This line then turns and extends southeastward to the North Island shore.

Conditionally Approved: None

Approved

1. Central portions of the North Inlet estuary not listed above;
2. Southern portions of Winyah Bay, Mother Norton Shoals, and tidal portions of Sand Island not listed above.

The shellfish industry in South Carolina is based primarily on the harvest of the eastern oyster (*Crassostrea virginica*) and hard clams, which include both the northern clam (*Mercenaria mercenaria*) and several small populations of the southern clam (*Mercenaria campechiensis*). One interstate clam relay project has been permitted and conducted in Restricted portions of Winyah Bay during the past three year review period. Southern portions of Winyah bay, seaward of the North Island lighthouse is Approved for direct recreational/commercial harvest. Commercial shellfish harvest is disallowed throughout the remainder of Area 05.

Shellfish harvesting season in South Carolina normally extends from September 16

through May 14. The South Carolina Department of Natural Resources (SCDNR) has the authority to alter the shellfish harvesting season for resource management purposes and grant permits for year-round mariculture operations. The South Carolina Department of Health and Environmental Control has the authority to prohibit shellfish harvesting when necessary to ensure that shellfish harvested in South Carolina waters are safe for human consumption.

POLLUTION SOURCE SURVEY

No substantial changes in pollution sources have occurred in Area 05 since the 2002 review. The following is a summary of existing sources within Area 05;

1. Domestic Waste Treatment Facilities - The sole domestic wastewater treatment facility within close proximity to waters suitable for the direct harvest or relaying of shellfish is the DeBordieu Colony Club facility. This facility utilizes a high degree of treatment including filtration and dilution prior to spray irrigation on the development's golf course. The National Pollutant Discharge Elimination System (NPDES) permit ND0065668, is indicated on the Map of Potential Pollution Sources.

2. Industrial Discharges - Two industrial wastewater discharges which are combined in one NPDES permit (SC0001431) are located within the boundaries of Area 05. These facilities ultimately discharge to the extreme northern portion of Winyah Bay. The permitted industrial wastewater discharges are - (1) Georgetown Steel Corporation - A major producer of wire and structural re-bar, and (2) Georgetown Steel-DRI Plant - Produces iron briquettes for steel production at Georgetown Steel. The locations of these discharges are indicated on the Map of Potential Pollution Sources.

3. Marinas & Docking Facilities - Several marinas and commercial boat docking facilities are located within Area 05; however, none of these facilities are within Approved, Conditionally Approved, or Restricted waters. All are located well upstream of any viable shellfish populations. Locations of these facilities are indicated on the Map of Potential Pollution Sources.

4. Urban and Suburban Stormwater Runoff - Several ponds and brackish water impoundments adjacent to the northern portion of North Inlet receive discharge from the DeBordieu Colony property and surrounding lands. These discharges appear to adversely affect water quality within Debidue Creek. Additionally, several ditches drain into the North Inlet estuary from the Belle W. Baruch Foundation property. These ditches drain areas that contain substantial wildlife populations; however, flow rates appear to be substantially less at these sites than at the main culverts along the northern portion of the estuary. Sites where storm water permits have been issued for land disturbing activities are included on the Map of Potential Pollution Sources as a visual indicator of land disturbing activities.

Not surprisingly, data collected following two major rainfall events (approximately 10"/24 hrs) during previous review periods indicated excessive fecal loading throughout the estuary. It is recommended that Area 05 in its entirety be placed under a precautionary closure status following a rainfall event of greater than four inches in 24 hours (as recorded at Georgetown 2-E).

5. Agricultural Runoff - Undeveloped lands adjacent to Area 05 harvest areas are primarily controlled by the Belle W. Baruch Foundation, the Tom Yawkey Wildlife Center, and the DeBordieu Colony Club. Mr. George Chastain, Forest Director for the Belle W. Baruch Foundation, indicated the facility does not utilize chemical fertilizers, pesticides, or herbicides for forestry management purposes. According to Mr. Don Lipscomb, former Forest Director for Clemson University's Baruch Forestry Institute, Lindane was used previously for spot application; however, this practice was discontinued approximately 20 years ago.

DeBordieu Colony Club utilizes various chemical compounds within the boundaries of the development, primarily for golf course maintenance. The development corporation has compiled a management plan outlining specific chemical application rates and guidelines for storage and runoff control.

6. Individual Sewage Treatment and Disposal (ISTD) Systems - Several individual sewage treatment and disposal systems are located near North Inlet waters. The University of South Carolina Marine Laboratory is serviced by a single 1500-gallon unit which utilizes a 177 gallon pump-tank and 400 linear feet of field line. Approximately 15 ISTD systems are currently being used on the Baruch Foundation's approximately 9,000 acres adjoining the North Inlet estuary. It is highly unlikely that these systems could adversely impact the estuary.

The Tom Yawkey Wildlife Center on South and Cat Islands is used for waterfowl management and is comprised of approximately 4325 acres of uplands, 6235 acres and wetlands, 314 acres of beach, and 2374 acres of impoundments and non-tidal fresh water. Approximately ten families reside on these islands in residences owned by the Yawkey Foundation. Structures other than residences include shop and maintenance facilities as well as four dormitories and a recreation hall for graduate students. All structures are serviced by ISTD systems within areas of sandy soil.

The Winyah Bay lighthouse facility located on the southwest shore of North Island includes one ISTD system permitted by the SCDHEC Division of Environmental Sanitation. This facility is no longer occupied on a regular basis.

7. Wildlife and Domestic Animals - Area 05 supports substantial populations of both wildlife and domestic animals. The lands surrounding and draining to the North Inlet and Winyah Bay estuaries support populations of feral hogs, beaver, rabbit, white-tailed deer, raccoon, opossum, alligators, various rodents, and birds typical of the coastal Carolinas. Migratory waterfowl and resident marine birds are common throughout the area.

8. Boat Traffic - Boat traffic in North Inlet primarily consists of small vessels (12-20 feet) involved in recreational and commercial fishing activities. Boating in the estuary is limited due to lack of convenient access. Two private boat ramps are within the confines of North Inlet. These are on the Belle W. Baruch Foundation property and the DeBordieu Colony Club lands. Those without access to one of these facilities must cross Winyah Bay from its western shore, travel downstream from Georgetown, or enter the estuary via its ocean inlet.

Winyah Bay's main channel depths allow commercial freighter access to the South Carolina State Ports Authority docks in Georgetown. Additionally, a small commercial fishing fleet primarily harvesting shrimp, finfish, and blue crabs operates from private docks as well as

several commercial fish houses.

The U. S. Corps of Engineers routinely dredges portions of Winyah Bay in order to maintain adequate channel depths. The Corps historically utilized open water spoil disposal. Although data obtained from lower Winyah Bay does not indicate an adverse public health concern associated with the harvesting of shellfish for relaying purposes (Moore and Cooper, 1992), the presence of dioxins prompted a search for upland spoil disposal sites.

9. Marine Biotoxins - Bivalve shellfish contamination from marine biotoxins has not been shown to be a human health concern within Area 05.

HYDROGRAPHIC AND METEOROLOGICAL CHARACTERISTICS

PHYSIOGRAPHY

Area 05 consists of approximately 35,709 acres of shellfish growing area. It is comprised of two distinctly different estuarine environments separated by an area of limited intermixing. North Inlet is a Class C type estuary, described as classical well-mixed, bar built (Pritchard, 1955), typical of the northern South Carolina and southern North Carolina coastlines. The estuary is approximately two nautical miles at its maximum width (east-west) with a maximum length of approximately seven nautical miles (north-south). Characteristic of the estuary are ebb and flood tidal deltas and protective point bars. Extensive high marsh areas of smooth cord grass *(Spartina alterniflora*) are found within the northern and central portions of North Inlet. Mixed vegetation occurs in the high marsh areas of the southern reach and is not dominated by a particular species; however, black needlerush (*Juncus roemerianus*) and big cord grass (*Spartina cynosuroides*) are abundant. Drier, brackish conditions occur in this area (Schwing and Kjerfve, 1980). Throughout the estuary, expansive mud flats and sand bars are evident during ebb tide. Intertidal oyster reefs are abundant. Main channel depths are typically less than 15 feet.

Salinities near the North Inlet mouth usually range from 32-35 parts per thousand (ppt); however, substantial rainfall commonly causes salinities to decline. Salinities of less than five ppt have been documented in the southern reach of the estuary (Schwing and Kjerfve, 1980).

Winyah Bay, in contrast, is a Class B type estuary partially mixed or moderately stratified, according to Pritchard's classification (1955). The estuary extends in a northwest-southeast direction approximately 12 nautical miles from the city of Georgetown, South Carolina. Width varies from less than one nautical mile near the ocean entrance to over four nautical miles between the Minum Creek Canal, through Mud Bay, to No Man's Friend Creek.

Water depths in Winyah Bay are typically less than 16 feet; however, main channel depths of 27 feet are maintained by the United States Army Corps of Engineers. Mud Bay, an expansive and relatively shallow area, generally exhibits depths of less than three feet measured at mean low water.

Tides - Tides in Area 05 are semidiurnal, consisting of two low and two high tides approximately every 24 hours. Predicted mean tidal range and mean spring tidal range (MHWS) at North Inlet□s Clambank Landing dock are 4.73 and 5.49 feet, respectively. Mean

tidal range in Winyah Bay varies from approximately 3.3 to 4.6 feet. Similarly, mean spring tidal range varies from approximately 4.1 to 5.4 feet (Tides and Currents for Windows, 1996).

Rainfall - The seasonal precipitation pattern in Area 05 indicates that approximately 35 percent of the annual norm of 53.25 inches occurs from June-August, during the closed season for the harvest of shellfish. Twenty-three percent occurs from September-November and is typically the result of tropical low pressure systems or thunderstorms. December-February accounts for 21 percent of the total. Winter precipitation is generally fairly uniform throughout the area. The spring months of March-May account for 21 percent of the annual rainfall. Dynamic weather patterns including widespread, intense, rapidly moving thunderstorms are quite common. Data provided by SCDNR Climatology Station Georgetown 2-E for the three year period January 01, 2000 through December 31, 2002 indicates rainfall in excess of the annual norm for the first and last years of this three year period. 2001 data indicates a reduction from the normal rainfall of 27%. This amount is representative of the drought conditions present at that time in South Carolina. (2000-58.0, 2001-39.01, 2002-62.87).

Winds - Prevailing winds for the South Carolina coast are generally southerly during the spring through summer months and northerly during the fall and winter months. Sustained wind velocities are typically less than 15 miles per hour (mph); however, intense low and high pressure systems routinely generate winds of 20-30 mph. Tropical storms and hurricanes, generating winds in excess of 45 mph, sometimes occur between June and October. "Northeasters" are not uncommon during the late fall through winter months.

River Discharges - Freshwater input to Winyah Bay originates from four major rivers: (1) the Pee Dee/Yadkin system, originating in the Blue Ridge Mountains; (2) the Waccamaw River, which meanders through the swampy coast land of Horry and Georgetown Counties from southern North Carolina; (3) the Black River; and (4) the Sampit River. Both the Black and Sampit Rivers possess smaller watersheds than the other rivers entering Winyah Bay. According to Johnson (1972), freshwater entering Winyah Bay ranges from 2000 cubic feet per second (cfs) to approximately 100,000 cfs, with a mean flow of approximately 15,000 cfs.

During periods of average flow, a salt wedge extends upriver near the U. S. Highway 17 bridges traversing the Pee Dee, Waccamaw, and Black Rivers. However, during periods of low flow, the salt wedge may extend more than 15 miles upstream of the bridges, (Allen, et al., 1984). During periods of high river flow, the salt wedge becomes more defined as vertical stratification increases. During periods of low flow, the salt wedge's leading edge all but disappears as the two water masses gradually become vertically homogeneous.

Currents - Tidal currents are reversing, flowing for approximately six hours, becoming slack, then ebbing for approximately six hours. Maximum current velocities in North Inlet are approximately 2.3 m/s (Schwing and Kjerfve, 1980). Winyah Bay current velocities are similar to those of North Inlet.

A hydrographic study conducted by Dingman, et. al. (1987) in the northern reach of North Inlet during February and March 1987, indicated that during approximately the first three hours of ebb tide, when winds are from the northeast, sheet flow occurs from Debideu Creek to Old Man Creek via Bass Hole Bay. As the tide drops below mean sea level (msl), the bottoms of the shallow water bay become exposed. A continuous water channel is cut off at this point thus

the direction of ebb flow is reversed through Debideu Creek. The flow patterns within the study area are illustrated in Figures 8 and 9.

A limited area of intermixing occurs in the southern portions of the North Inlet estuary. Depending upon the amount of freshwater inflow to Winyah Bay, net exchange between the two estuaries varies. Schwing and Kjerfve (1980) documented the existence of a nodal point in the southern portion of Jones Creek near Nancy Creek. Eighty percent of the exchange between the North Inlet and Winyah Bay systems may occur through Jones Creek (Kjerfve, 1978). On numerous occasions, Department personnel have observed plumes of brackish, discolored water slightly southward of the confluence of Jones and Nancy Creeks.. Plumes have also been observed at the confluence of Jones and Sign Creeks.

Exchange of water between the estuaries also occurs through No Man's Friend Creek but to a lesser degree. Allen, et al. (1982) found that direction of flood in No Man's Friend Creek appears to be related to tidal amplitude unless complicated by strong southerly winds. Low tidal amplitude (<5.7 feet) results in direction of flood toward Winyah Bay. Conversely, high tidal amplitude (>5.7 feet) results in flood toward North Inlet. Gaines (1973) found that during the first half of flood tide, movement of water was from North Inlet toward Winyah Bay, but during the second half of the flood, the direction reversed due to an increase in tidal gradient in Winyah Bay. Shifting tidal nodes were observed in Jones, Haulover, and Town Creeks.

WATER QUALITY STUDIES

DESCRIPTION OF THE PROGRAM

The Department currently utilizes a systematic random sampling (SRS) strategy within Area 05 in lieu of sampling under adverse pollution conditions. In order to comply with NSSP guidelines, a minimum of thirty samples are required to be collected and analyzed from each station during the review period. Sampling dates are computer generated prior to the beginning of each quarterly period thereby insuring random selection with respect to tidal stage and weather. Day of week selection criteria is limited to Mondays, Tuesdays, and Wednesdays due to shipping requirements and laboratory manpower constraints. Sample schedules are rarely altered.

During July, 1998, an updated data analysis procedure was formalized. Samples utilized for classification purposes are limited to those samples collected in accordance with the SRS for a 36 month period beginning January 1 and ending December 31. This allows for a maximum of 36 samples per station yet provides a six sample "cushion" (above the NSSP required 30 minimum) for broken samples, lab error, breakdowns, etc. This also allows each annual report to meet the NSSP Triennial Review sampling criteria.

Seven hundred and twenty surface water quality samples (<1.0 ft. deep) were collected for bacteriological analyses and classification purposes from twenty active water quality sampling stations in Area 05 during the period 01/01/00 through 12/31/02. All samples were collected in accordance with the SRS plan. The samples were collected in 120 ml amber glass bottles, immediately placed on ice and transported by bus to the South Carolina Department of Health and Environmental Control's Trident District Environmental Quality Control laboratory at North Charleston, South Carolina. An additional 120 ml water sample was included with each shipment as a temperature control. Upon receipt at the laboratory, sample sets that exceeded a 30-hour holding time or contained a temperature control >10 degrees C. were discarded. Samples collected after September 1, 1986 have been analyzed using the five tube/three dilution modified A-1 method described by Nuefeld (1985).

Surface water temperatures were measured utilizing hand-held, laboratory-quality calibrated centigrade thermometers. Salinity measurements were measured in the laboratory using automatic temperature compensated refractometers. Additional field data include ambient air temperature, wind direction, tidal stage and date and time of sampling. Tidal stages were determined Nautical Software's Tides and Currents, Version 2 (1996).

Stations 06, 07,13, and 25 exceeded a fecal coliform geometric mean MPN value of 14. No station exceeded a fecal coliform geometric mean MPN value of 88. Stations 01, 05, 06, 07, 09, 13, 20, and 25 exceeded a fecal coliform MPN estimated 90th percentile value of 43. No stations exceeded an estimated 90th percentile fecal coliform MPN value of 260. Winyah Bay, between stations 21 and 24 remain classified as Approved. The area between 20 and 21 will remain Restricted due to potential impact via southern portions of the Western Channel (Station 25). Shellfish water quality sampling stations established by the Shellfish Sanitation Section are listed on page 14. A summary table for fecal coliform data collected between 01/01/00 and 12/31/02 is included on page 18.

CONCLUSIONS AND RECOMMENDATIONS

Problems within Area 05 are primarily attributable to freshwater inflow from Winyah Bay, as well as rainfall-induced runoff from natural and engineered systems that drain the surrounding highlands that support substantial wildlife populations. River flow into Winyah Bay and subsequently into Mud Bay and Oyster Bay adversely impact the southern portions of North Inlet. The effects of nonpoint source pollution are complicated in the southern reaches of the North Inlet estuary by hydrographic and meteorological conditions. Conditions such as strong southerly-southwesterly winds combined with high river flows may temporarily increase the area of intermixing between North Inlet and Winyah Bay/Mud Bay.

Water quality within Debidue Creek is highly variable and appears to be impacted by freshwater discharges from upland pond level control structures. Correlation of rainfall amount with fecal coliform MPNs is made difficult by a lack of accurate rainfall data, as well as lag time between rainfall events and ultimate discharge. The 2001 Annual Report reclassified Debidue Creek, between stations 04 and 15 as Approved. With even a greater reduction in rainfall seen over the year 2001, the approved area was extended from Station 15 to Station 16. This extension was inclusive of the marsh areas to the west and east of Station 16, southward as noted on the maps on pages 15 and 17 of this report. Rainfall in 2002 was greater than 2001 but water quality data showed a slight improvement overall resulting in no changes to the amount of approved shellfish area. The harvesting classifications of Area 09A will remain as follows:

Prohibited:

4. All portions of Mud Bay and Winyah Bay westward of a line extending from the confluence of Winyah Bay and the Intracoastal Waterway northward to the northwestern corner of the Marsh Islands and continuing across Mud Bay to the mainland marsh;
5. All tidal portions of Cat and South Islands;
6. All portions of the Estherville Minum Creek Canal.

Restricted

5. All portions of North Inlet northward of the confluence of Debidue Creek and Bass Hole Bay;
6. Southern portions of North Inlet, extending from the confluence of Noble Slough and Jones Creek southward, including Noble Slough, Haulover Creek, Boor Creek, Nancy Creek, Little Jones Creek, Dividing Creek, Sign Creek and Cotton Patch Creek;
7. Southern portions of Town Creek, from it's confluence with Sixty Bass Creek and the southern entrance to Clambank Creek, southward to Mud Bay. This includes Sawmill Creek, Town Creek, Cutoff Creek, Mud Creek, Oyster Bay, and No Mans Friend Creek;
8. Portions of Mud Bay and Winyah Bay, eastward of an imaginary line extending from the confluence of Winyah Bay and the eastern shore of the Estherville Minum Creek Canal northward to a point of intersection with the northwestern corner of the northern most Marsh Island, and from there continuing across Mud Bay to the mainland marsh. This area extends southeastward in Winyah bay to a line extending from the South Island shore, approximately 400 meters west of Mosquito Creek, to the spoil islands approximately 800 meters southeast of Malady Bush Island. This line then turns and extends southeastward to the North Island shore.

Conditionally Approved: None

Approved

3. Central portions of the North Inlet estuary not listed above;
4. Southern portions of Winyah Bay, Mother Norton Shoals, and tidal portions of Sand Island not listed above.

All Approved areas should be placed under a precautionary closure when sustained river

flooding induced turbidity is observed. Additionally, the Approved portions of the area should be closed upon receipt of four or more inches of rain as recorded at Georgetown 2-E. This methodology is associated with the concept of the Probable Maximum Precipitation (PMP). PMP estimates for the coastal United States have been published in a series of hydro-meteorological reports (HMRs) by the National Weather Service (*National Weather Service*). PMP estimates for South Carolina's growing areas are derived from HMRs 51, 52 and 53 (*National Research Council, 1985*).

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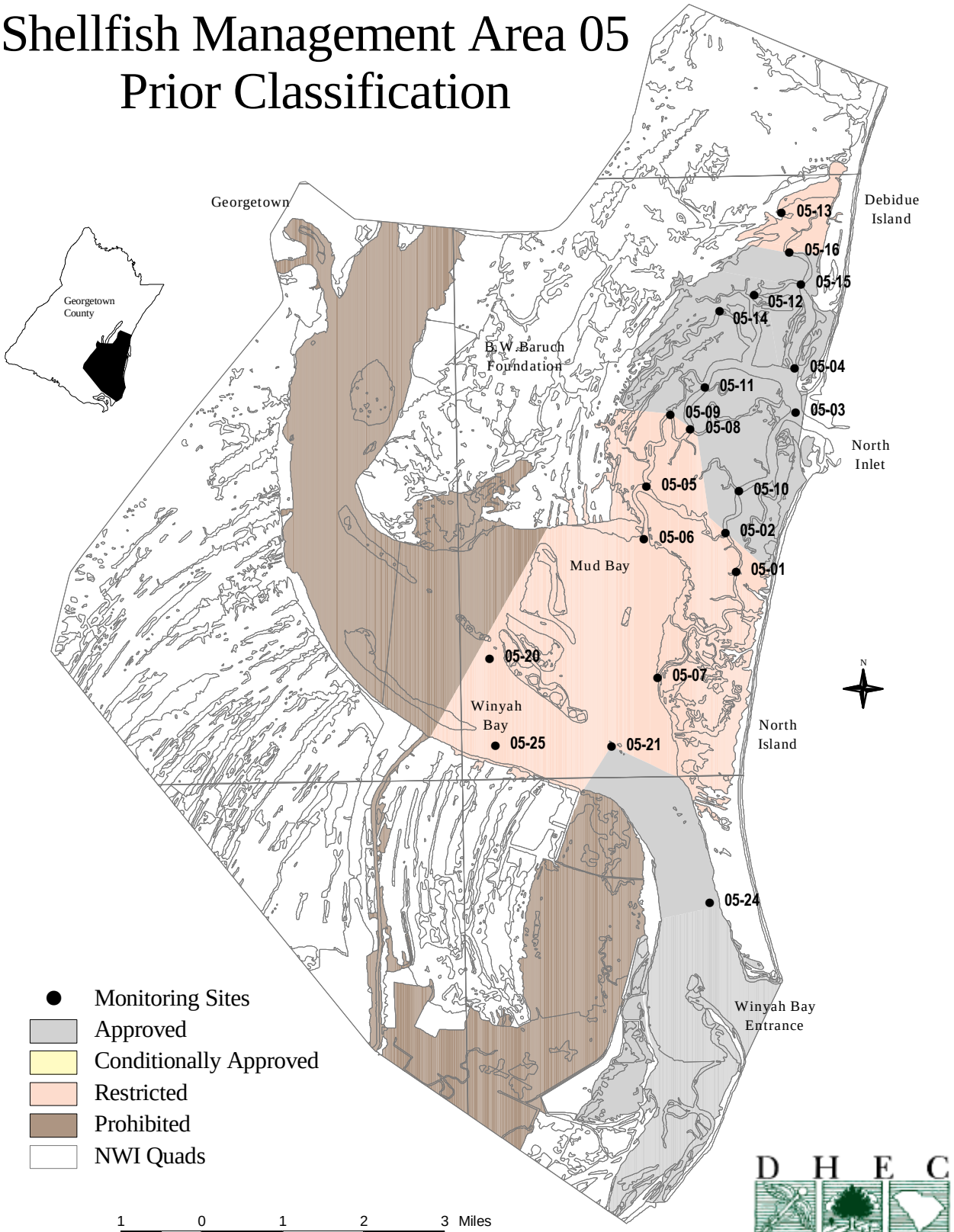
Table #1

Shellfish Management Area 05
WATER QUALITY SAMPLING STATIONS DESCRIPTION

Station	Description
01	Jones Creek at Nancy Creek
02	Noble Slough
03	North Inlet
04	Town Creek at Debidue Creek
05	Oyster Bay near Cutoff Creek
06	No Man's Friend Creek at Mud Bay
07	Jones Creek at Mud Bay
08	Town Creek at Sixty Bass Creek
09	Town Creek at Southern Reach of Clambank Creek
10	Jones Creek at Duck Creek
11	Town Creek at Bread and Butter Creek
12	Old Man Creek and Sea Creek Bay
13	Debidue Creek at Boat Basin
14	mid Channel Island, Bly Creek
15	Debidue Creek and Cooks Creek
16	Debidue Creek and Bass Hole Bay
20	Winyah Bay Main Channel, Buoy 19a, Range E
21	Winyah Bay Main Channel, Buoy 17, Range E
24	Winyah Bay Main Channel, Coast Guard Dock, Range C
25	Winyah Bay, Tip of Western Channel Island
(Total 20)	

Figure 1.
Shellfish Management Area 05
Prior Classification



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South Carolina Department of Health and Environmental Control

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Figure 2.

Shellfish Management Area 05 Current Classification

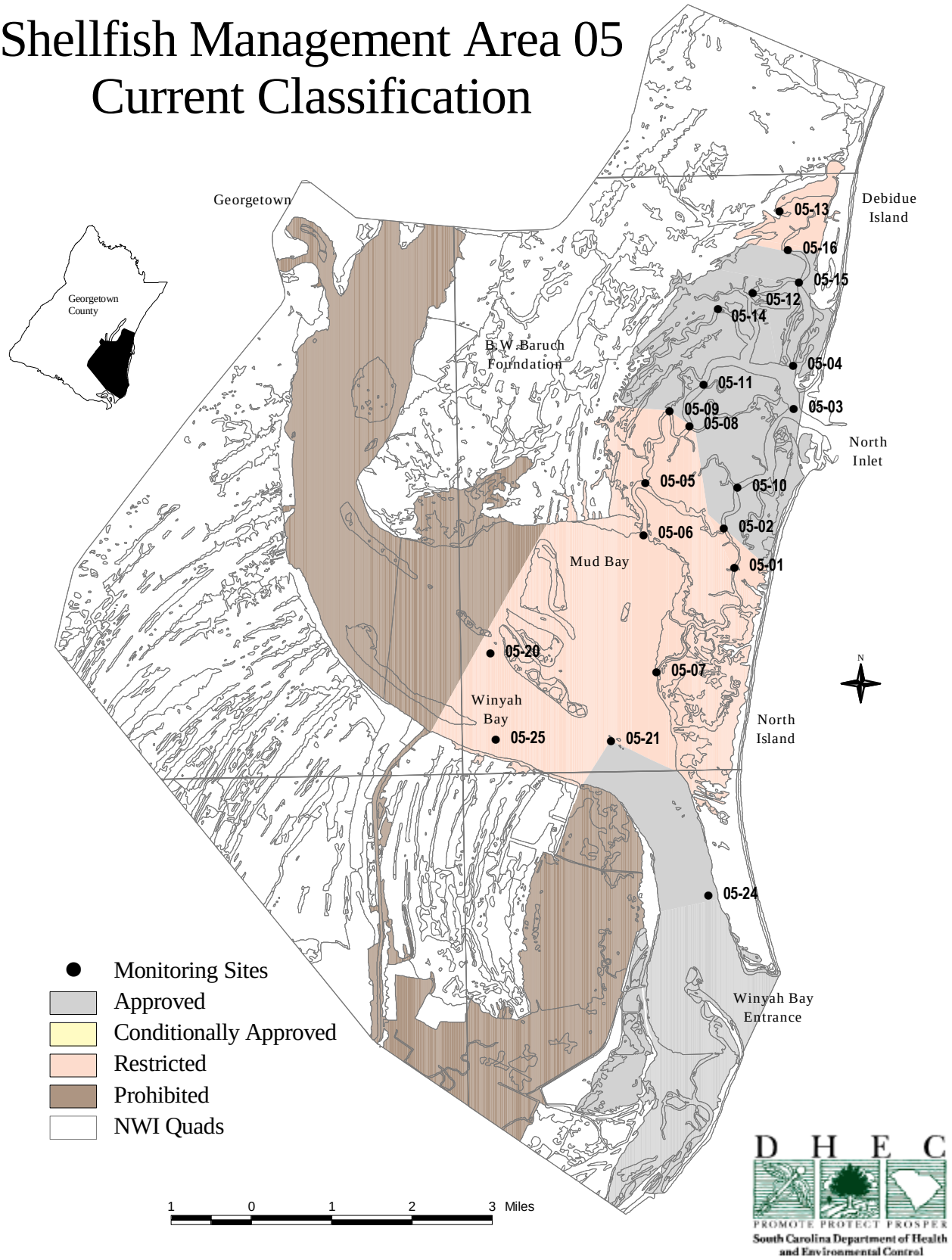

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Figure 3.
Shellfish Management Area 05
Potential Pollution Sources

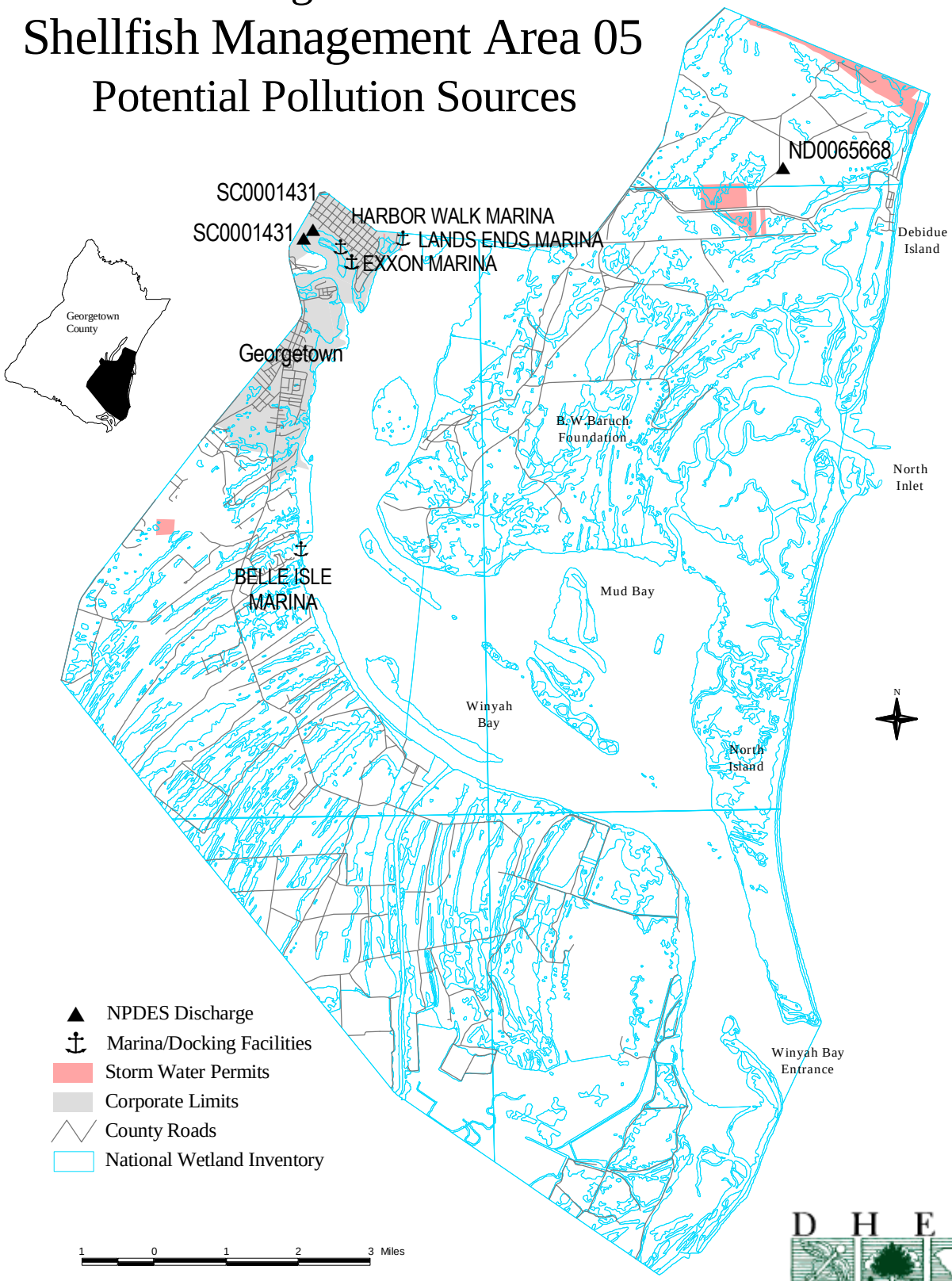

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Table #2
Shellfish Management Area 05

FECAL COLIFORM BACTERIOLOGICAL DATA SUMMARY
from Shellfish Water Quality Sampling Stations

January 01, 2000 thru December 31, 2002

Station	1	2	3	4	5	6	7	8	9	10
Samples	36	35	36	36	36	34	36	36	36	36
GeoMean	5.4	4.1	2.7	3.2	9.7	17.7	15.4	4.5	6.0	3.4
Est.90th%ile	46	19	6	11	52	90	108	25	58	12
Water Quality	R	A	A	A	R	R	R	A	R	A
Classifcation	R	A	A	A	R	R	R	A	R	A

Station	11	12	13	14	15	16	20	21	24	25
Samples	36	36	36	35	36	36	36	36	36	36
GeoMean	3.3	3.9	19.2	4.4	5.0	6.2	11.3	9.8	4.9	20.1
Est.90th%ile	10	19	147	22	26	39	53	42	22	76
Water Quality	A	A	R	A	A	A	R	A	A	R
Classification	A	A	R	A	A	A	R	R	A	R

A - Approved **CA** - Conditionally Approved **R** - Restricted
RND - Restricted/No Depuration **P** - Prohibited

Table #3

WATER QUALITY SAMPLING STATIONS DATA

Shellfish Management Area 05

BACTERIOLOGICAL DATA

Data for each shellfish station listed in this report's "Fecal Coliform Bacteriological Data Summary Table" and in other shellfish reports, can be obtained through South Carolina's Department of Health and Environmental Control - Freedom of Information office at the address below.

Freedom of Information
2600 Bull Street
Columbia, SC 29201

Any explanation or clarity needed on the report's content can be obtained by contacting the preparer(s), and/or reviewer(s) listed on the cover page.

Table #4

RAINFALL DATA

Shellfish Management Area 05
Georgetown 2-E

SOURCE:
South Carolina Department of Natural Resources
Land, Water and Conservation Division
State Climatology Office

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: SCDNR Land, Water and Conservation Division

State Climatology Office (Georgetown, SC / Station #2-E)

2001	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	--	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.33	0.00	0.00	--	0.00	--	0.90	0.00	0.00	0.00
4th	0.00	0.00	1.04	0.15	0.00	0.38	0.00	--	--	0.00	0.00	0.00
5th	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.90	0.00	0.00	0.00
6th	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.53	0.00	0.00	0.00	0.00
7th	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00
8th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00
9th	0.00	--	--	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00
10th	0.00	--	--	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
11th	0.00	--	--	0.00	0.00	0.00	0.00	--	0.40	0.00	0.00	3.43
12th	0.00	1.01	2.30	0.00	0.00	1.05	0.00	--	0.00	0.00	0.00	0.00
13th	0.00	0.17	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.05
14th	0.00	0.00	0.72	0.00	0.00	0.98	0.00	1.15	0.00	0.00	0.00	--
15th	0.00	0.00	0.00	0.03	0.00	--	0.00	0.32	0.00	0.00	0.00	--
16th	0.00	0.00	0.00	0.00	0.00	0.10	0.00	--	0.00	0.00	0.00	--
17th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	--
18th	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.23
19th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20th	0.00	0.00	2.60	0.00	0.00	0.20	0.00	0.35	0.00	0.00	0.00	0.00
21st	0.00	0.00	0.00	0.00	0.00	--	0.00	0.14	--	0.00	0.00	0.00
22nd	0.00	0.85	0.00	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00
23rd	0.00	0.00	0.00	0.00	0.61	--	0.00	--	0.00	0.00	0.00	0.00
24th	0.00	0.00	0.00	0.00	--	2.70	0.00	--	0.41	0.00	0.00	0.12
25th	0.00	0.00	0.00	0.34	--	--	0.00	--	0.41	0.00	0.00	0.00
26th	0.00	0.00	0.00	0.00	--	1.30	0.00	--	0.00	0.00	0.00	0.00
27th	0.00	0.00	0.00	0.00	0.34	0.00	0.00	--	0.00	0.00	0.00	0.00
28th	0.00	0.45	0.00	0.00	--	0.00	0.00	--	0.00	0.00	0.00	0.00
29th	0.00	--	0.82	0.00	0.68	0.00	0.00	--	0.00	0.00	0.00	0.00
30th	0.00	--	0.00	0.00	0.00	0.00	0.00	1.85	0.00	0.00	0.00	0.00
31st	0.00	--	0.00	0.00	0.08	0.00	0.00	0.00	--	0.00	--	0.00

(Monthly Figures) **Year's Rainfall Total: 33.39**

SUM	1.50	2.48	7.81	0.52	1.71	7.35	0.00	4.64	3.55	0.00	0.00	3.83
MAX	1.50	1.01	2.60	0.34	0.68	2.70	0.00	1.85	0.90	0.00	0.00	3.43
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.05	0.10	0.29	0.02	0.06	0.32	0.00	0.29	0.13	0.00	0.00	0.14

Note:"--" denotes missing data

(Shellfish Management Area 5)

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: SCDNR Land, Water and Conservation Division

State Climatology Office (Georgetown, SC / Station #2-E)

2000	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00
2nd	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00
3rd	0.00	0.00	--	0.00	0.00	0.00	0.00	0.10	--	0.00	0.00	0.20
4th	0.00	0.00	1.90	0.00	0.00	0.00	0.00	0.30	2.00	0.00	0.00	0.00
5th	--	0.00	0.10	0.00	0.00	0.10	--	0.30	0.00	0.00	0.20	0.00
6th	--	0.00	0.00	0.00	0.00	0.30	1.30	0.00	--	0.00	0.00	0.00
7th	0.60	0.00	0.00	0.00	0.00	0.00	0.00	--	1.60	0.00	0.00	0.00
8th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00
9th	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
10th	0.30	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	2.40
11th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
12th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13th	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.80	0.00	0.00	0.00	0.00
14th	0.00	0.80	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15th	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16th	0.00	0.00	0.00	--	0.00	0.00	0.20	0.00	0.00	0.00	--	0.00
17th	--	0.00	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
18th	0.20	0.00	0.10	0.10	0.00	0.00	0.00	0.00	7.20	0.00	0.00	0.00
19th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	--	0.00	1.70	0.00
20th	0.70	0.00	2.10	0.00	0.00	0.30	0.00	0.00	--	0.00	0.10	0.00
21st	0.00	0.00	0.00	0.00	0.00	0.30	--	0.00	0.10	0.00	0.00	0.00
22nd	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	--	0.00	0.00	0.00
23rd	0.30	0.00	0.00	0.00	0.00	0.00	0.50	0.00	3.70	0.00	0.00	0.00
24th	--	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00
25th	2.20	0.00	0.00	0.30	0.00	0.00	2.70	0.00	0.00	0.00	0.00	0.00
26th	0.00	0.00	0.00	0.00	2.60	0.00	0.00	0.00	0.00	0.00	1.70	0.00
27th	0.00	0.00	0.10	--	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
28th	0.00	0.00	0.10	0.40	0.70	0.00	0.30	2.20	0.00	0.00	0.00	0.00
29th	--	0.00	0.00	0.00	0.00	1.10	1.10	0.10	0.00	0.00	0.00	0.00
30th	0.30		0.00	0.30	0.00	1.70	--	0.00	0.00	0.00	0.00	0.00
31st	0.20		0.00		0.00		0.90	0.00		0.00		0.00

(Monthly Figures) **Year's Rainfall Total: 58.20**

SUM	4.80	0.80	4.40	3.10	3.30	3.80	8.80	7.80	14.60	0.00	4.20	2.60
MAX	2.20	0.80	2.10	1.10	2.60	1.70	2.70	2.20	7.20	0.00	1.70	2.40
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.18	0.03	0.16	0.11	0.11	0.13	0.31	0.27	0.63	0.00	0.14	0.08

Note:"--" denotes missing data

(Shellfish Management Area 5)

ANNUAL TABLE OF DAILY RAINFALL DATA

SOURCE: SCDNR Land, Water and Conservation Division

State Climatology Office (Georgetown, SC / Station #2-E)

2002	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1st	0.00	0.00	0.00	0.78	0.25	0.00	0.00	1.28	0.00	0.00	--	0.00
2nd	0.00	0.00	--	0.00	0.00	0.00	0.00	0.00	--	0.00	--	0.00
3rd	--	0.00	--	0.48	0.00	0.00	0.00	0.80	2.15	0.00	--	0.00
4th	--	0.00	1.50	0.00	0.00	0.00	0.00	0.23	0.00	0.00	--	0.04
5th	--	0.00	0.00	0.00	1.15	0.00	0.00	0.00	0.00	0.00	--	0.00
6th	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
7th	1.03	1.65	0.00	0.00	0.00	0.54	0.00	0.00	0.00	--	0.00	0.00
8th	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.02	--	0.00	0.00
9th	0.00	--	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00
10th	--	0.88	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.81	0.00	1.31
11th	--	0.00	0.00	0.00	0.00	0.00	0.00	--	0.00	2.09	0.00	0.00
12th	0.02	0.00	0.00	0.00	0.00	0.00	4.41	--	0.00	0.00	1.21	0.00
13th	0.66	0.00	0.55	0.00	0.55	0.00	0.00	0.54	0.00	0.00	0.00	1.42
14th	0.00	0.00	0.00	0.00	0.00	--	0.00	0.00	0.00	0.66	0.00	0.00
15th	0.52	0.00	0.00	0.00	0.00	--	1.11	0.00	--	1.45	0.00	0.00
16th	0.00	0.00	0.00	0.00	0.00	--	0.16	0.00	1.30	0.00	--	0.00
17th	0.00	0.00	0.00	0.00	0.00	--	0.30	0.00	0.00	0.00	--	0.00
18th	0.00	0.00	0.00	0.00	0.83	0.80	0.00	0.00	0.00	0.00	1.38	0.00
19th	0.00	0.00	0.00	0.00	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00
20th	0.00	--	0.02	0.00	0.00	1.95	0.00	0.37	0.00	0.00	0.00	0.00
21st	0.00	0.10	0.00	0.00	0.00	1.02	0.58	0.00	0.00	--	0.00	0.00
22nd	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	--	0.00	0.00
23rd	0.00	0.02	0.00	0.00	0.00	0.00	1.35	0.00	0.00	--	0.00	--
24th	0.00	0.00	0.00	0.00	0.00	2.64	1.27	0.42	0.12	--	0.00	--
25th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	--	0.00	--
26th	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.58	2.63	--	0.00	1.64
27th	0.00	0.00	0.69	0.72	0.00	0.27	0.00	2.11	0.00	--	0.00	0.00
28th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.62	0.00	0.00
29th	0.00		0.00	0.00	0.00	--	0.00	1.88	0.00	0.34	0.00	0.00
30th	0.00		0.00	0.00	0.00	0.22	0.00	1.52	0.00	0.00	0.00	0.00
31st	0.00		0.00		0.00		0.00			0.00		0.00

(Monthly Figures) **Year's Rainfall Total: 62.87**

SUM	2.23	2.65	2.76	2.83	3.01	7.79	10.04	11.37	6.22	5.97	3.59	4.41
MAX	1.03	1.65	1.50	0.85	1.15	2.64	4.41	2.11	2.63	2.09	1.38	1.64
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.09	0.10	0.10	0.09	0.10	0.31	0.32	0.41	0.22	0.27	0.16	0.16

Note:"--" denotes missing data

(Shellfish Management Area 5)