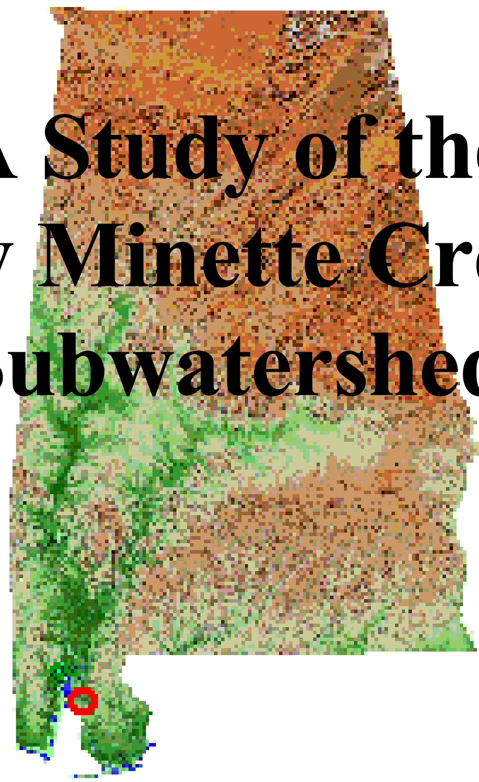
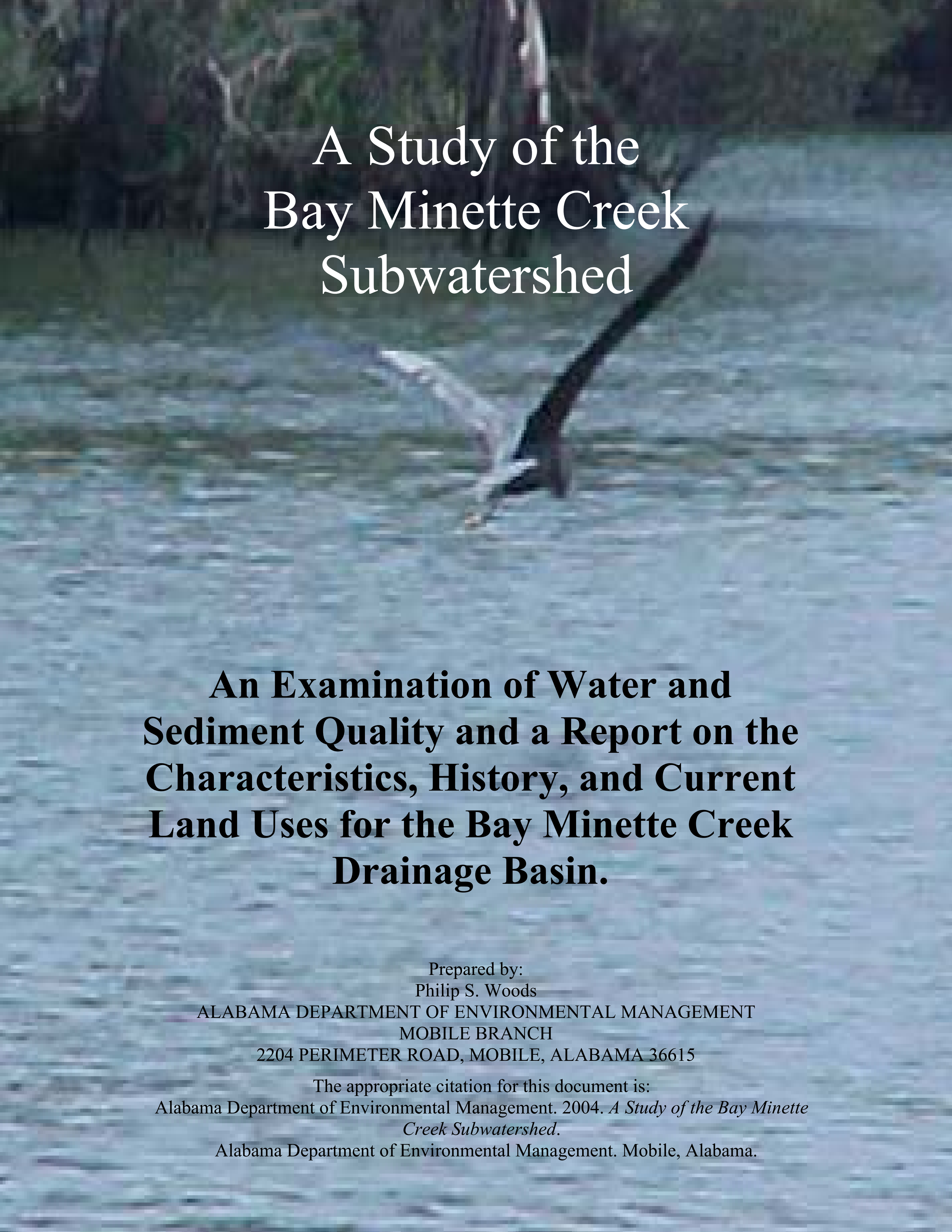
TECHNICAL REPORT

A Study of the Bay Minette Creek Subwatershed



September 2004

Alabama Department of Environmental Management
Mobile Branch
2204 Perimeter Road, Mobile, Alabama 36615



A Study of the Bay Minette Creek Subwatershed

An Examination of Water and Sediment Quality and a Report on the Characteristics, History, and Current Land Uses for the Bay Minette Creek Drainage Basin.

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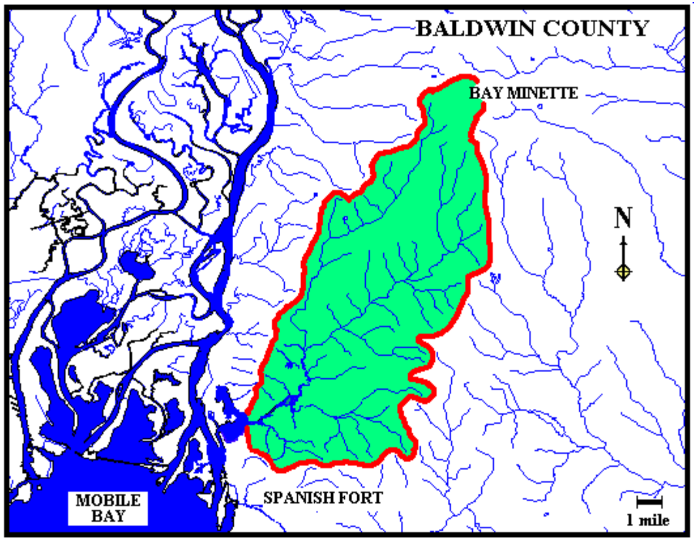
EXECUTIVE SUMMARY



BAY MINETTE CREEK SUBWATERSHED

Beginning in January 2003, and continuing through July 2004, the Mobile Branch of the Department's Field Operations Division conducted an extensive survey of the Bay Minette Creek subwatershed. Located in western Baldwin County, the Bay Minette Creek subwatershed (HUC 03160204 040) is a contributor to the Lower Tensaw River watershed, a subwatershed of the Mobile-Tensaw Delta watershed. The survey endeavored to assess the water quality of streams within the Bay Minette Creek subwatershed, to identify stream segments impaired by pollution, to identify any potential sources of impairment, and to provide support and information for the effective implementation of pollution control strategies and NPS management practices. Analyses of the data collected in the field were coupled with the information garnered on established land use and demographic characteristics of the study area to target the specified objectives of the study.

The Bay Minette Creek subwatershed is, for the larger part of its basin, rural with concentrated population centers largely restricted to the northeast section of the basin near the Town of Bay Minette. The area drained by Bay Minette Creek and its tributaries has an estimated impervious surface coverage of one percent (GSA. 2003). Apart from roadside litter, deer carcases and elevated fecal coliform bacteria concentrations following substantial rain events, field observations did not reveal any potential sources of water quality impairment. Bay Minette Creek appears on the Department's 2002 303(d) list of impaired streams because of excessive mercury concentrations. Elevated concentrations of mercury were not observed during this study. No metals concentrations exceeding the ecological response ER-L and ER-M threshold values were encountered. The majority of negative water quality indicators observed may be attributed to non point source discharge via runoff, during and immediately following rain events.

A review of the data collected during the interval of this study indicates that the Bay Minette Creek subwatershed is not severely impacted by any of the monitored pollutants. The subwatershed appears to be free from the stress of multiple point source discharges. Wildlife, both plant and animal thrive in the subwatershed. Wading birds are a common sight within the subwatershed and are indicators of a healthy ecosystem.

INTRODUCTION

As water drains off the land, it can introduce an array of pollutants into the receiving stream. Recognizing this is important to effectively monitor and protect water resources. The Alabama Department of Environmental Management (ADEM) adopted the watershed assessment strategy in 1996 as an integrated, holistic strategy for more effectively restoring and protecting aquatic ecosystems by examining water resources and the land from which water drains to those resources (ADEM. 2000). By defining a geographical region's drainage pathways and focusing on the individual basins, the ADEM is provided an objective, targeted approach toward meaningful water quality monitoring, assessment, and implementation of control strategies and NPS management practices. Over the past decade the ADEM has conducted watershed surveys in the coastal areas of Mobile and Baldwin counties as part of its "Water Quality and Natural Resource Monitoring Strategy for Coastal Alabama." These studies have included Dog River, Bon Secour River, Chickasaw Creek, Little Lagoon, Fly Creek, Three Mile Creek, and Bayou Sara. Each of the watershed studies attempts to define potential pollutant sources and explore potential avenues toward improving the water quality.

Beginning in January 2003, and continuing through July 2004, personnel from the Alabama Department of Environmental Management monitored the water quality of the surface waters within the Bay Minette Creek subwatershed (HUC 03160204 040) located in Baldwin County, Alabama. The Bay Minette Creek drainage area is a subwatershed of the Lower Tensaw River watershed, which is a subwatershed of the Mobile-Tensaw River Delta. The study was conducted in accordance with the protocols outlined in the ADEM Technical Report, *Methodology For Coastal Watershed Assessments* (2001). Seven sampling stations within the subwatershed were chosen through topographic map review and field observation. The selected stations were monitored, at least monthly, for dissolved oxygen, pH, salinity, conductivity, water temperature, total suspended solids, total dissolved solids, turbidity, fecal coliform bacteria, ammonia, nitrates/nitrites, total Kjehldahl nitrogen, ortho-phosphorous, and total phosphorous. Stations were also sampled for sediment metals concentrations.

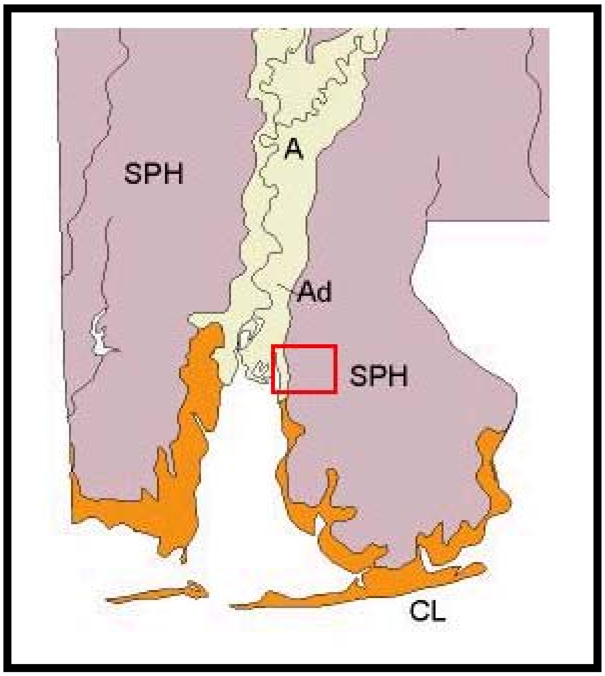
The Bay Minette Creek subwatershed is, for the most part, exclusively rural and forested with virtually no industry or commercial activity. Concentrated population centers are largely restricted to the northeast section of the subwatershed near the Town of Bay Minette. In 2002, the Geological Survey of Alabama conducted an impervious surface mapping project for Mobile and Baldwin counties. Using 1995 and 2000 LandSat multi-spectral imagery, the GSA mapped the two counties to a subwatershed level at a 5-acre scale. The Bay Minette Creek subwatershed was determined to have an estimated one percent impervious surface cover (GSA. 2003).

In presenting the water quality data derived from the study, stations are represented in groups and by individual station. Graphs are used to facilitate comparison between sample stations. Average values recorded are an arithmetic mean of the total determinations made throughout the study period. These average values are, unless otherwise specified, inclusive of all monitored levels along the water column.

PHYSICAL CHARACTERISTICS

GENERAL DESCRIPTION

Bay Minette Creek Subwatershed
HUC 03160204 040



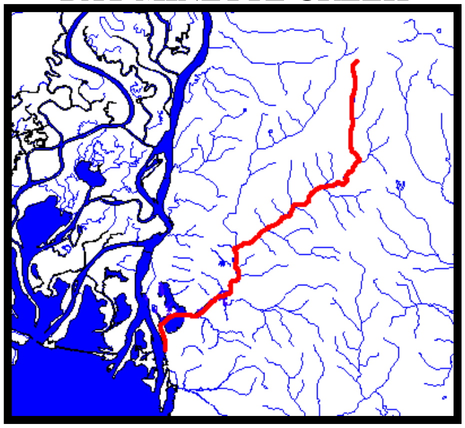
BAY MINETTE CREEK SUBWATERSHED

Baldwin County is situated in extreme lower Alabama. The Bay Minette Creek subwatershed lies entirely within and along the western edge of Baldwin County and represents a large portion of the Lower Tensaw River subwatershed. The Lower Tensaw River subwatershed comprises a total land area of greater than 112,000 acres. The physiographic regions represented in the Bay Minette Creek subwatershed are the Southern Pine Hills (SPH) and the Alluvial-Deltic Plain (A, Ad). The Southern Pine Hills, comprising the majority of the subwatershed, are underlain by terrigenous sediments. The Alluvial-Deltic Plain exhibits very little topographic relief and consists of alluvial and terrace deposits from rivers. It is located along the extreme western edge of the subwatershed.

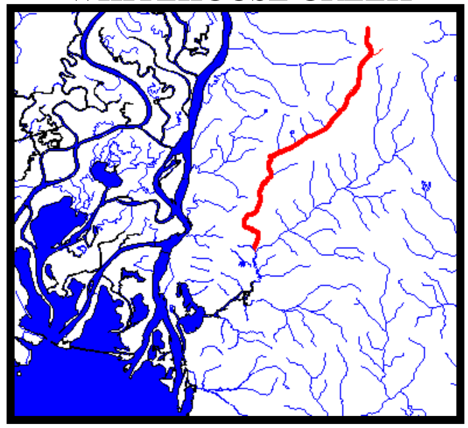
An estimated two percent of the Bay Minette Creek subwatershed is pasture land, ten percent is crop land, fifteen percent is urban land, and fifty-four percent is forested. There are fewer than seven hundred cattle in the subwatershed. Seven hundred and twenty septic tank systems have been identified within the basin (Soil and Water Conservation District. 1998.) Bay Minette Creek appears on the Department's 2000 303(d) listing of impaired streams as a result of excessive mercury concentrations.

Originating southwest of Bay Minette, in north central Baldwin County, Bay Minette Creek flows south and east for approximately 17 miles to its discharge into Bay Minette and, ultimately, to Blakely River and the Mobile Bay. From its origin to its confluence with Bay Minette, Bay Minette Creek falls less than 50 feet. This represents a vertical fall of about 2.5 feet for every mile traveled. Geographical relief present in the southwest portion of the subwatershed is greater than that demonstrated elsewhere within the drainage basin. In this section of the subwatershed, the Saluda Ridge, which runs south and west to north and east, exhibits elevations approaching 180 feet above mean sea level. This represents elevations about 100 feet greater than are observed in the remainder of the study area.

BAY MINETTE CREEK

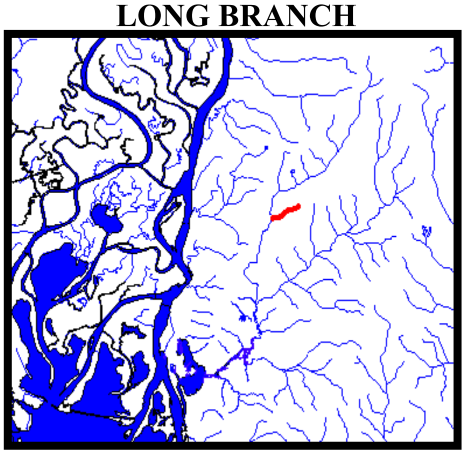


WHITEHOUSE CREEK

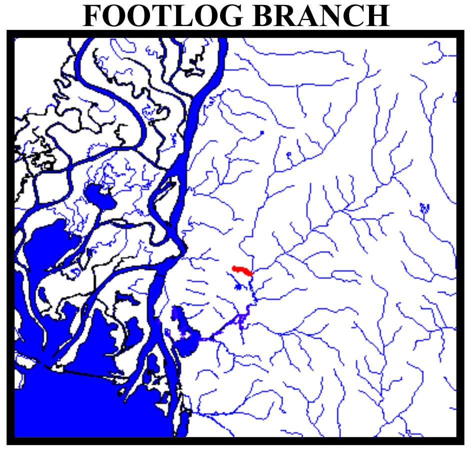


Whitehouse Creek is Bay Minette Creek's largest tributary. Its origin lies north and slightly west of that of Bay Minette Creek. From its origin to its confluence with Bay Minette Creek, Whitehouse Creek travels approximately 14 miles. Along the way, Whitehouse Creek is joined by several tributaries.

LONG BRANCH

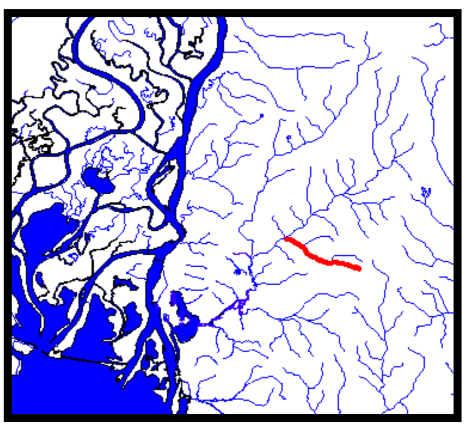


FOOTLOG BRANCH

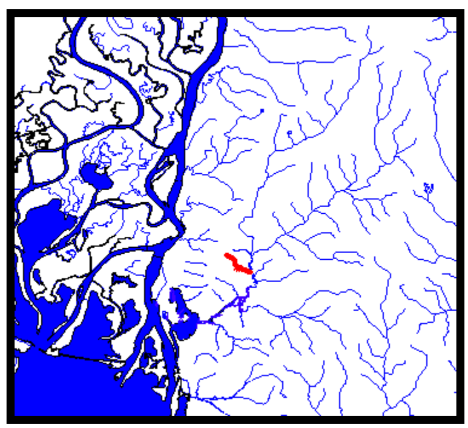


Only two of these tributaries are named. One of these, Long Branch, travels about 1 mile in a southwestern direction and joins Whitehouse Creek approximately 3 miles upstream of that creek's confluence with Bay Minette Creek. The other named tributary to Whitehouse Creek is Footlog Branch. This tributary travels south and east for a distance of less than 0.5 mile and joins Whitehouse Creek immediately upstream of that creek's confluence with Bay Minette Creek.

WILSON CREEK

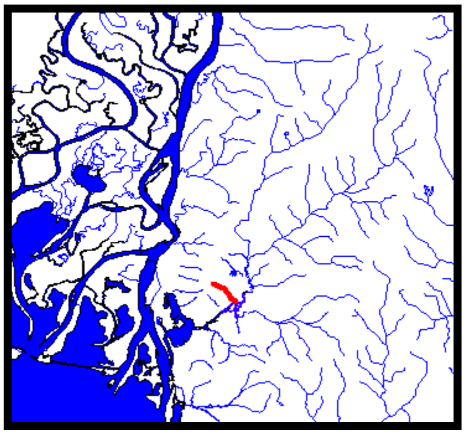


BLAKELY BRANCH

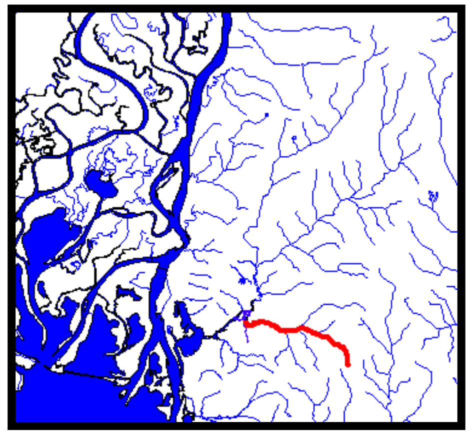


Bay Minette Creek is joined by numerous tributaries along its course. Like those of Whitehouse Creek, only a few tributaries of these have received names. The furthermost upstream named tributary is Wilson Creek. Wilson Creek travels north and west for approximately 3 miles before emptying into Bay Minette Creek a little over a mile upstream of the confluence of Bay Minette Creek and Whitehouse Creek. Further downstream, Blakely Branch travels south and east for approximately 1 mile and joins Bay Minette Creek about 0.5 mile below the confluence of Bay Minette Creek and Whitehouse Creek.

WILKINS CREEK

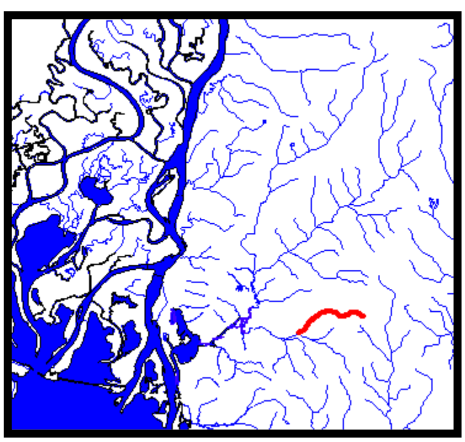


SIBLEY CREEK

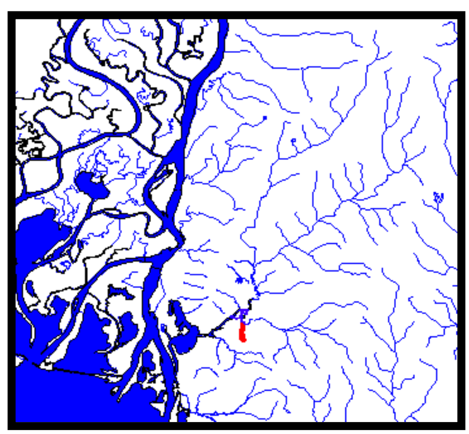


Wilkins Creek also travels south and east, roughly parallel to Blakely Branch's course, for about a mile and empties into Bay Minette Creek approximately 1 mile below Blakely Creek. Sibley Creek travels north and west for approximately 3.5 miles and joins Bay Minette Creek just downstream of the Wilkins Creek and Bay Minette Creek confluence. Hunawell Creek travels south and west and empties into Sibley Creek about 2 miles upstream of that creek's junction with Bay Minette Creek.

HUNAWELL CREEK

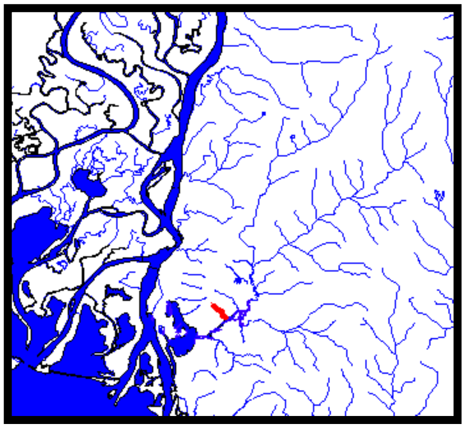


FICKLING BRANCH

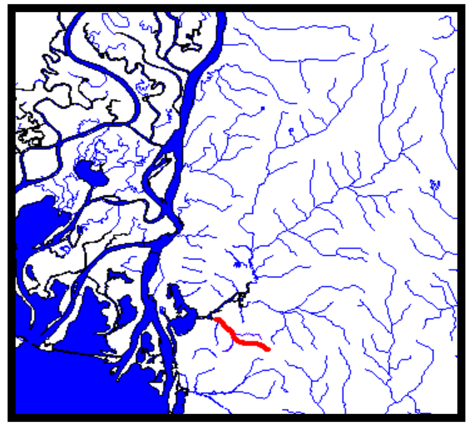


Fickling Branch travels north and west for about 0.75 mile and empties into Sibley Creek just upstream of the confluence of Sibley Creek and Bay Minette Creek. Muddy Branch travels south and east for about 0.75 mile and empties into Bay Minette Creek about 0.5 mile downstream of Wilkins Creek.

MUDDY BRANCH

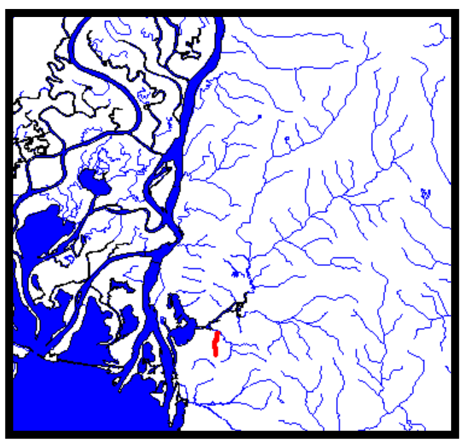


BOGGY BRANCH



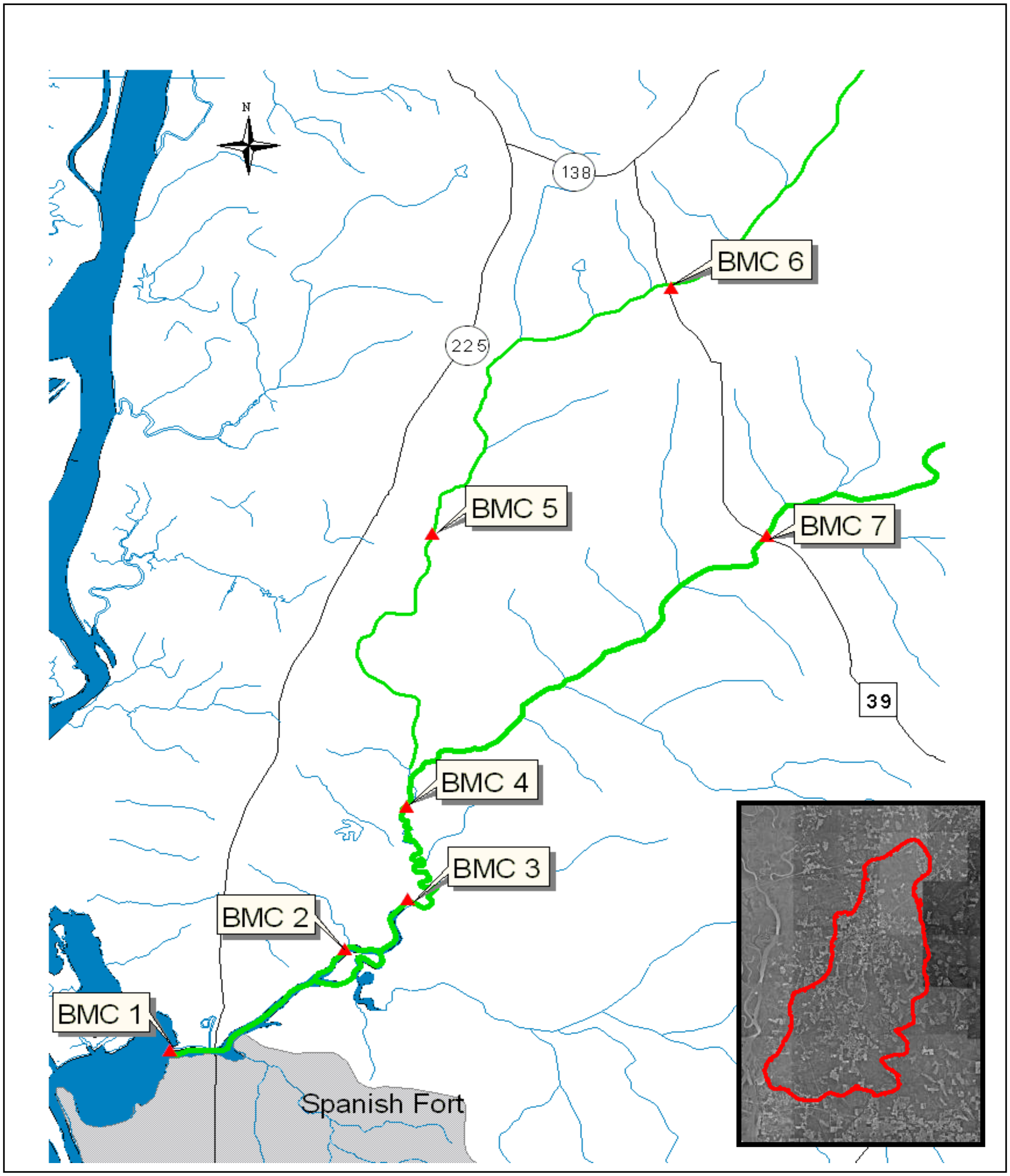
Boggy Branch originates in the southwest portion of the subwatershed and flows north and west for a distance of about 2 miles before emptying into Bay Minette Creek approximately 0.5 mile upstream of Bay Minette Creek's confluence with Bay Minette. Coleman Spring Branch is a tributary to Boggy Branch that originates north and west of Boggy Branch's origin and flows about 1 mile before meeting Boggy Branch.

COLEMAN SPRING BRANCH



<u>**Sample Stations**</u>

Bay Minette Creek Subwatershed
03160204 040



BMC 1 - Bay Minette Creek West Of Highway 229 Bridge 30^0 42' 00" 87^0 54' 30"

BMC 1 was located just upstream of Bay Minette, about 300 yards downstream of the U.S. Highway 229 Bridge, just north of Spanish Fort, Alabama. This station was accessible only by boat. Land use in the vicinity of BMC 1 was swamp forest, forest, and marsh. No substantial impervious surface area was observed bordering this station. No disturbances of the riparian zone on either bank were observed. The bottom substrate of BMC 1 consisted of fine organic muck, silt, sand, and detritus. The stream here was about 100 yards wide and as a result had no canopy cover except directly along the banks. Aquatic vegetation was abundant along both banks. Bank height averaged about one foot. Obvious high water marks of about 1.5 feet were visible on trees and other vegetation lining the banks. The photo is facing upstream across the station and toward the Highway 225 bridge.

BMC 2 - Bay Minette Creek Downstream of Whitehouse Creek 30^0 42' 54" 87^0 53' 02"

BMC 2 was located on Bay Minette Creek approximately 200 yards downstream of the confluence of Wilkins Creek and Bay Minette Creek. This station was accessible only by boat. The stream's width was approximately 50 yards at this station. Land use on both banks was forest. No substantial impervious surface area was observed. No disturbances of the riparian zones of either bank were observed. No canopy cover existed for this station except along the banks. The bottom substrate consisted of fine organic muck, silt, sand, and detritus. Aquatic vegetation was abundant along both banks. Bank height was about one foot. Obvious high water marks of about 1.5 feet were visible on trees and other vegetation lining the banks. The photo is facing upstream across the station and toward Wilkins Creek.

BMC 3 - Bay Minette Creek at Power Line Crossing **30^0 43' 21" 87^0 52' 31"**

BMC 3 was located at the power line crossing several hundred yards upstream of the confluence of Wilkins Creek and Bay Minette Creek. This station was accessible only by boat. The width of the stream at this station was about 30 yards. Land use on both banks was forest with a power line corridor. No substantial impervious surface area was observed around this station. Vegetation within the power line corridor was cut back periodically. Apart from this, no disturbances of the riparian zones of either bank were observed. No canopy cover existed for this station except along the banks upstream and downstream of the power line corridor. The bottom substrate consisted of fine organic muck, silt, sand, and detritus. Aquatic vegetation was abundant along both banks. A pitcher plant, *Sarracenia purpurea*, was present along the right bank, adjacent the power line corridor. Bank height was about one foot. Obvious high water marks of about 1.5 feet were visible on trees and other vegetation lining the banks. The photo is facing downstream across the station.

BMC 4 - Bay Minette Creek **30^0 44' 11" 87^0 52' 22"**

BMC 4 was the uppermost station accessed by boat. It was located on Bay Minette Creek about ½ mile upstream of BMC 3 and ½ mile downstream of the confluence of Bay Minette Creek and Whitehouse Creek. The stream was about 40 feet wide at this station. Land use on both banks was forest. No substantial impervious surface area was observed around this station. No disturbances of the riparian zones of either bank were observed. Canopy cover was an estimated 5%. The bottom substrate at this station consisted of mostly sand with a small amount of CPOM and detritus. Aquatic vegetation was abundant along both banks. Bank height was about one foot. Obvious high water marks of about 1.5 feet were visible on trees and other vegetation lining the banks. The photo is facing upstream toward the station.

BMC 5 Whitehouse Creek at County Road 40 **30^0 46' 37"**
87^0 52' 19"

BMC 5 was located on Whitehouse Creek about 100 feet upstream of the bridge on Baldwin County Road 40. The stream width at this station was typically around 15 feet. Land use on the right bank was rural/residential with one house and outbuildings. Land use on the left bank was swamp forest. The most significant impervious surface observed was County Road 40 and the bridge. No disturbances of the riparian zone were observed on the left bank. The vegetation of the right bank was cut periodically. Canopy cover was estimated to be about 40 percent. The bottom substrate at this station consisted of sand, silt, CPOM and detritus. Aquatic vegetation was present in small sections. Bank height on the left bank was less than a foot. Bank height on the right bank was closer to two feet. High water evidence exceeding 3 feet was observed. The photo is facing upstream across the station.

BMC 6 Whitehouse Creek at County Road 39 **30^0 48' 49"**
87^0 50' 19"

BMC 6 was located on Whitehouse Creek about 200 feet upstream of the bridge on Baldwin County Road 39. The stream width at this station was typically around 15 feet. Land use on both banks was swamp forest. The most significant impervious surface observed was County Road 39 and the bridge. No disturbances of the riparian zones of either bank were observed. Canopy cover was estimated to be about 50 percent. The bottom substrate at this station consisted of sand, silt, CPOM, and detritus. The bottom was also strewn with natural rock, boulder and cobble sized, driftwood, and old glass bottles. Aquatic vegetation was present in small sections. Bank height was about 1.5 feet. High water evidence was observed in excess of 3 feet. The photo is facing upstream across the station.

BMC 7 - Bay Minette Creek at County Road 39 **30^0 46' 36"** **87^0 49' 31"**

BMC 7 was located on Bay Minette Creek about 150 feet upstream of the bridge on Baldwin County Road 39. The stream width at this station was typically around 20 feet. Land use on both banks was swamp forest. The most significant impervious surface observed was County Road 39 and the bridge. No disturbances of the riparian zones of either bank were observed. Canopy cover was estimated to be about 40 percent. The bottom substrate at this station consisted of sand, silt, CPOM, and detritus. Aquatic vegetation was present in small patches. Bank height on the left bank was about 2 feet. Bank height on the right bank was about 1.5 feet. Flood level evidence was observed greater than 3 feet above bank height. The photo is facing upstream across the station.

GEOLOGIC UNITS, SOILS, AND HYDROGEOLOGY

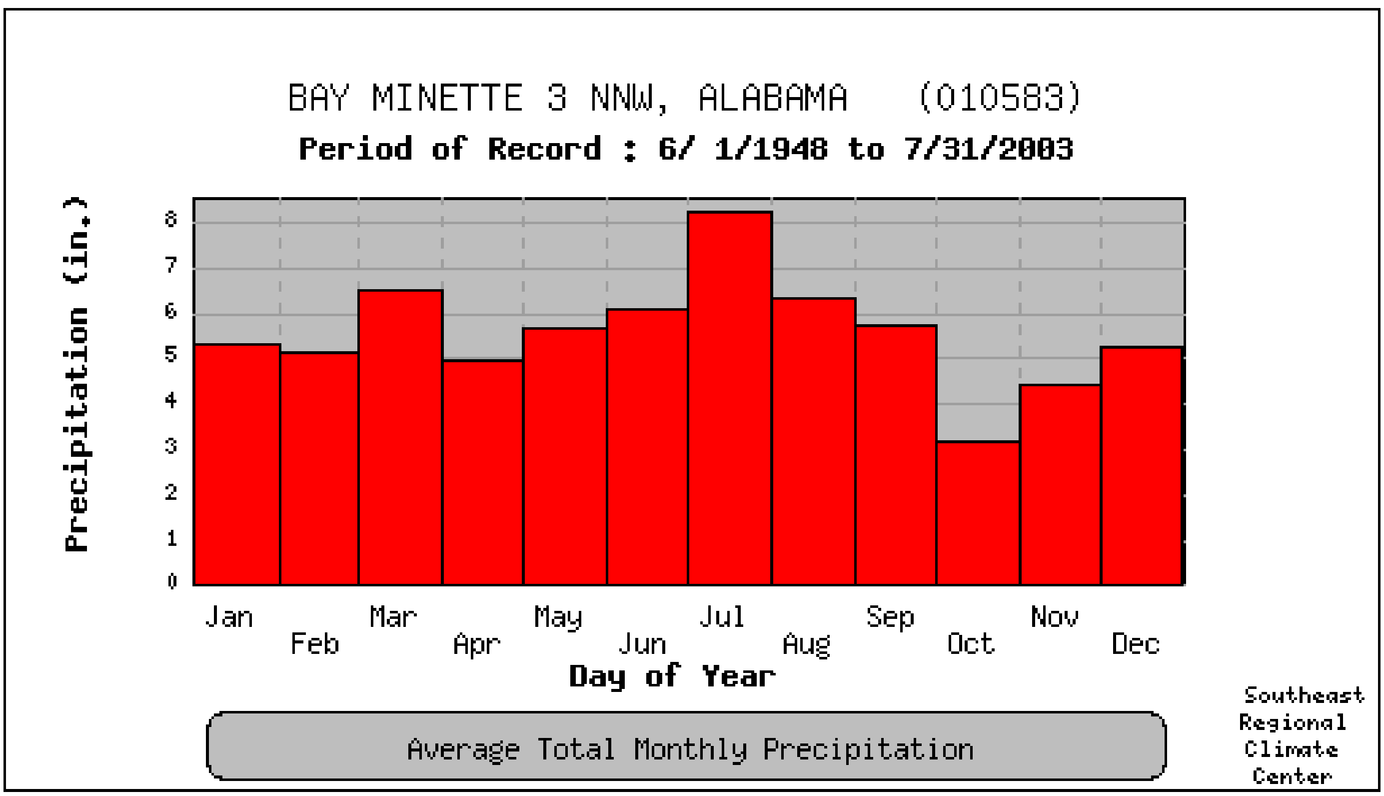
The geologic units underlying the Bay Minette Creek subwatershed were the Citronelle formation, underlain by the Miocene Series undifferentiated, followed by the Eocene and Oligocene Series undifferentiated. The Citronelle formation is confined to the areas of higher elevation since, near streams and along Mobile Bay, the layer has been eroded to expose the underlying Miocene undifferentiated. Citronelle sediments consist of nonfossiliferous moderate-reddish brown fine to very coarse quartz sand, light-gray, orange, and brown sandy clay, and clayey gravel of nonmarine origin. The sediment type often changes abruptly over short distances. The Miocene Series undifferentiated consists of clastic sedimentary deposits of marine and estuarine origin. Its width ranges from approximately 100 feet in northern Baldwin County to about 3,400 feet in southern Mobile County. The Eocene Series undifferentiated include interbedded sand, silt, clay, and some limestone. The Oligocene Series undifferentiated is comprised of Red Bluff Clay, Forest Hill Sand, Marianna Limestone, Byram Formation, and Chickasawhay Limestone.

The principal soil types encountered in the Bay Minette Creek subwatershed are Bowie fine sandy loam, Bowie fine sandy loam (thin solum), Bowie, Lakeland, and Cuthbert soils, Carnegie very fine sandy loam, Cuthbert fine sandy loam, Cuthbert, Bowie, and Sunsweet soil, Eustis loamy fine sand, Faceville fine sandy loam, Greenville loam, Hyde and Bayboro soils and muck, Kalmia fine sandy loam, Lakeland loamy fine sand, Local alluvial land, Marlboro very fine sandy loam, Norfolk fine sandy loam, Orangeburg fine sandy loam, Plummer loamy sand, Ruston fine sandy loam, Sunsweet fine sandy loam, Tifton very fine sandy loam, and Wet loamy alluvial land. The principal soil types underlying the sample stations were the Hyde and Bayboro soils and muck and Wet loamy alluvial land. The majority of the soil types are of the Bowie-Lakeland-Cuthbert association or the Bowie-Tifton-Sunsweet association (U.S. Dept. of Agriculture. Soil Conservation Service. 1964.)

The principal aquifers within the study area are the Miocene-Pliocene Aquifer and the Watercourse Aquifer. The Miocene-Pliocene Aquifer consists of the Citronelle Formation and the Miocene Series undifferentiated and is represented by beds of sand, gravel, and clay. Wells completed in this aquifer yield from 0.5 to 2.5 million gallons per day. The Watercourse Aquifer consists of alluvial, coastal, and low terrace deposits represented by interbedded sand, gravel, and clay. Where the sand is sufficiently thick, wells may yield 0.5 to 1.0 million gallons per day. The sand and gravel channels, surrounded by silty and clayey sediments, do not yield significant amounts of water but do allow the slow infiltration of recharge water. Both the Miocene-Pliocene and the Watercourse Aquifers are hydraulically connected to one another and the land's surface and, as such, are unconfined and vulnerable to contamination from runoff (Geological Survey of Alabama. 2000).

CLIMATE

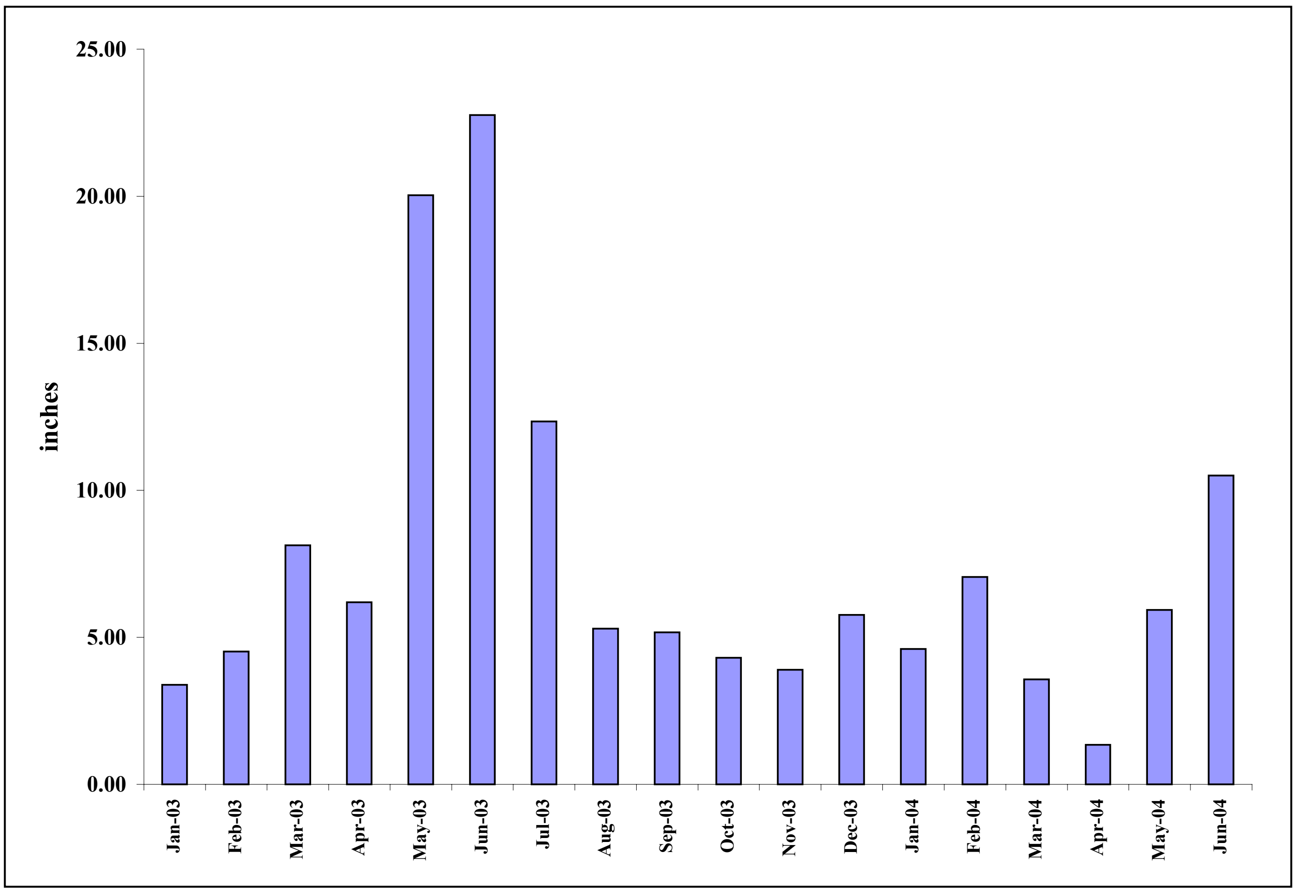
Summers in the subject subwatershed are typically hot and humid with an average temperature of 81^0 F, and an average daily maximum temperature of 91^0 F. Winters are mild, with an average temperature of 53^0 F, and an average daily minimum temperature of 43^0 F. The lowest temperature on record, 7^0 F, occurred on January 1, 1963. The highest temperature, 104^0 F, was recorded on July 25, 1952. Rain occurs year round, with the heaviest rainfall occurring in April through September. Total average yearly rainfall is approximately 64 inches. Relative humidity is high in



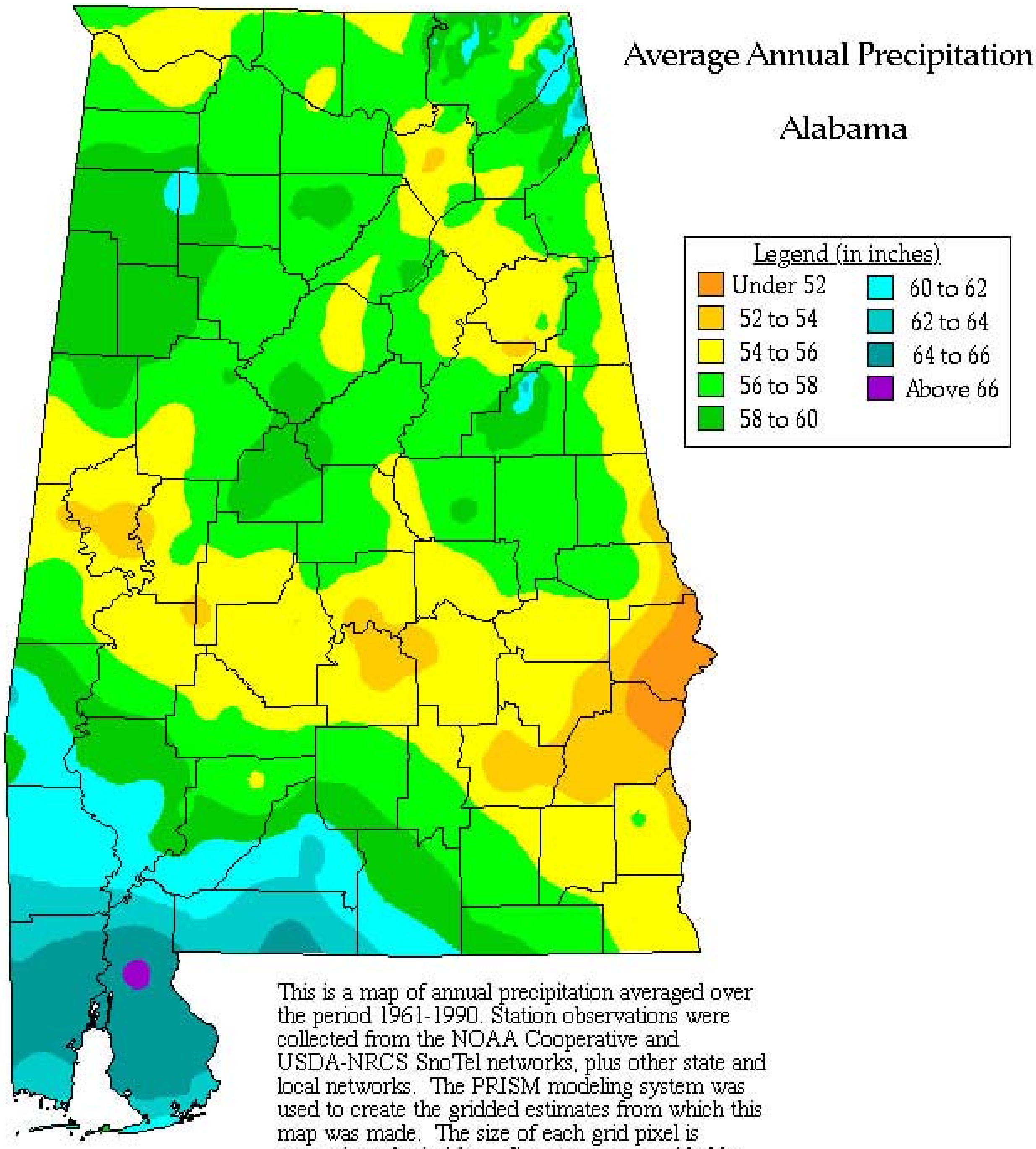
the area, averaging about 60 percent in mid afternoon. The highest relative humidity readings are, typically, at night, with measurements of about 90 percent not uncommon in the dawn hours (U.S. Geological Survey).

The inserted charts illustrate the normal average rainfall by month for the subject area and the recorded amounts of rainfall during the study period. The average rainfall during the Study period appeared to be substantially greater than the historical average. The general seasonal trend in rainfall averages appeared to follow that of the historical data with the summer months experiencing the greatest amount of rainfall and the fall months experiencing the least. Increased rainfall amounts during the spring and summer were observed in both the historical record and in the record produced during the study period. The chart below displays the precipitation amounts as recorded at the Department's National Atmospheric Deposition Program Station AL02 located within the Bay Minette Creek subwatershed.

Monthly Precipitation



As may be seen in the statewide precipitation graphic, the study area experiences an average annual rainfall that is higher than elsewhere in Alabama and is among the highest in the United States. This may be attributed to the area's close proximity to the Gulf of Mexico. Rainfall is usually of the shower type with long periods of continuous rain being rare. Precipitation is usually greatest in the summer and least in the fall. Thunderstorms may occur at any time of the year, regardless of season.



This is a map of annual precipitation averaged over the period 1961-1990. Station observations were collected from the NOAA Cooperative and USDA-NRCS SnoTel networks, plus other state and local networks. The PRISM modeling system was used to create the gridded estimates from which this map was made. The size of each grid pixel is approximately 4x4 km. Support was provided by the NRCS Water and Climate Center.

USE CLASSIFICATION

Rule 335-6-11-.02(9) establishes a Use Classification of Fish and Wildlife from its source to Mobile Bay. For those water bodies with a use classification fish and wildlife, the following water quality criteria apply:

Criteria		Limit
pH		6.0 to 8.5 s.u.
Water Temperature		≥ 90^0 F
Dissolved Oxygen		≤ 5.0 mg/l
Fecal Coliform Bacteria	June – September	≥ 100 colonies/100 ml (geometric mean)
	October - May	≥ 1000 colonies/100 ml (geometric mean)
		≥ 2000 colonies/100 ml (single sample)
Turbidity		> 50 ntu above background

(ADEM Admin. Code R. 335-6-10-.09.)

ECONOMIC DEVELOPMENT AND LAND USE

HISTORY

Bay Minette, Baldwin County's County Seat, was named for the bay, which was named after a surveyor with Jean Baptiste Le Moyne, founder of New Orleans. Baldwin County is one of the fastest growing counties in Alabama and one of the largest counties east of the Mississippi River. It was first organized as a county in 1809, ten years before Alabama's statehood. The county is named after Abraham Baldwin, a State of Georgia Legislator from Connecticut who founded the first state university, The University of Georgia, and never stepped foot in Alabama. Baldwin County's first inhabitants were the Native Americans who were drawn to the area by the abundance of its natural resources and the incredible range of its navigable waters. Recorded history denotes Baldwin County's discovery at the time of the Spanish explorers in the early sixteenth century. There is, however, a small amount of evidence to suggest that Baldwin County may have been discovered as early as the 12th century by Welsh explorers. This evidence includes archaeological remains of an ancient fort, Indian legend, and personal accounts of Daniel Boone, George Rogers Clark, and a former Governor of Tennessee. At any rate, the Spanish were well represented in the county throughout the 17th Century. Towards the end of the 17th Century, Spanish interests in the area were replaced by the French. The area fell under British control as a result of the French-Indian War. For a short period during the American Revolution, the Spanish reestablished supremacy in the area.

The earliest documented settlers of Baldwin County included persons from France, Greece, Germany, Yugoslavia, Russia, Sweden, Czechoslovakia, and Africa. These settlers built Baldwin County's agricultural, commercial, manufacturing, tourism and fishing industries. Around the turn of the 20th century, immigrants from many regions of the United States and from other countries began populating Baldwin County. Italians settled in Daphne, Scandinavians in Silverhill, Germans in Elberta, Poles in Summerdale, Greeks in Malbis Plantation, Quakers in Fairhope, Amish in Bay Minette, and Bohemians in Robertsdale, Summerdale, and Silverhill. Today, retirees from the northern United States continue to migrate to Baldwin County in substantial numbers.

The population for the Bay Minette Creek watershed, as of the 2000 census is as follows:

Bay Minette Creek Subwatershed Population	
Bay Minette	**7,820**
Spanish Fort	**5,423**

No water body within the Bay Minette Creek subwatershed was the recipient of any identified NPDES permitted or non-permitted wastewater discharge during the course of this study.

Threatened and Endangered Species

The Bay Minette Creek subwatershed exhibited a diverse and prolific array of flora and fauna and appeared to offer acceptable habitat throughout the drainage basin. Human population pressures were virtually non existent within the subwatershed. Wading birds such as the Great Blue Heron, *Ardea herodias*, Great Egret, *Casmerodius albus*, Green Heron, *Butorides virescens*, American Bittern, *Botaurus lentiginosus*, and others were ubiquitous during field patrols. It has been generally accepted that the presence or absence of such wading birds is indicative of environmental trends within an area (Geological Survey of Alabama. 1983). Also prevalent within the subject subwatershed were varying Hawk species, the Osprey, *Pandion haliaetus*, Kingfisher, *Ceryle alcyon*, and Turkey Vulture, *Cathartes aura*. All of which are indicators of ample food supply and acceptable habitat.

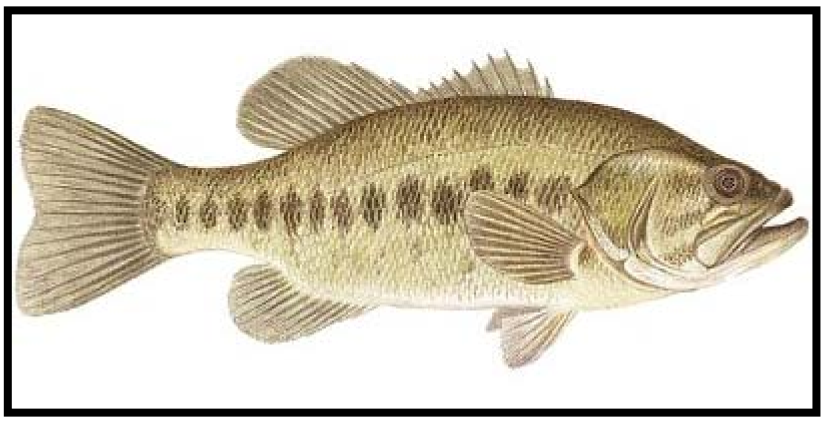
The following is a current Federal listing of threatened and endangered species for the study area.

THREATENED -	Piping plover *Charadrius melodus*
THREATENED -	Eastern indigo snake *Drymarchon corais couperi*
THREATENED -	Gopher tortoise *Gopherus polyphemus*

THREATENED -	Loggerhead sea turtle *Caretta caretta*
THREATENED -	Green sea turtle *Chelonia mydas*
THREATENED -	Gulf sturgeon *Acipenser oxyrinchus desotoi*
THREATENED -	Flatwoods salamander *Ambystoma cingulatum*
ENDANGERED -	Louisiana quillwort *Isoetes louisianensis*
ENDANGERED -	Red-cockaded woodpecker *Picoides borealis*
ENDANGERED -	Least tern *Sterna antillarum*
ENDANGERED -	Alabama red-bellied turtle *Pseudemys alabamensis*
ENDANGERED -	Kemp's ridley sea turtle *Lepidochelys kempii*
CANDIDATE SPECIES -	Black pine snake *Pituophis melanoleucus lodingi*

(Daphne Ecological Services Field Office. 2002.)

Fish Tissue Study



Micropterus Salmoides

On October 22, 1997, November 10, 1998, October 31, 2001, and October 9, 2002, Department personnel collected fish on Bay Minette Creek for tissue analyses. The collection station was located at thirty degrees forty-one minutes and fifty-eight point one seconds north, eighty-seven degrees fifty-four minutes and seven point nine seconds west, a point about one thousand feet upstream of this study's BMC 1 station. By means of electrical shock, six individuals of a selected predator fish species of sufficient size were collected at each event. The fish species selected was the largemouth bass (*Micropterus Salmoides*). The collected specimens were subsequently preserved and transported to the Department's laboratory for analysis. All fish tissue samples collected were analyzed by the Department's laboratory for contaminants with the potential to bioaccumulate. Bioaccumulation is the process through which low levels of a contaminant in the environment are concentrated in the bodies of plants and animals. These contaminants include: PCBs, arsenic, chlordane, toxaphene, mercury, mirex, DDT, DDD, DDE, dieldrin, dursban, endrin, heptachlor, heptachlorepoxide, endosulfan, hexachlorobenzene, lindane, and certain heavy metals. Fish are collected in the fall of each year, when their systems are preparing for winter and most pollutants of concern would be expected to be stored at the highest concentrations. The fish tissue monitoring program was conducted in cooperation with the Alabama Department of Public Health, the Alabama Department of Conservation and Natural Resources, and the Tennessee Valley Authority. .Data from the monitoring program was forwarded to the Alabama Department of Public Health (ADPH) to determine if new fish consumption advisories or changes to existing advisories would be necessary (ADPH. April 2002.)

Laboratory results demonstrated that, for the October 22, 1997 event, two of the six largemouth bass specimens exhibited Mercury concentrations of greater than one part per million. This resulted in a fish consumption advisory being issued for Bay Minette Creek by the ADPH. Again, for the November 10, 1998 event, two specimens exhibited Mercury levels greater than one part per million. No specimen taken during the October 31, 2001 and October 9, 2002 events exhibited Mercury concentrations in excess of one part per million. As a result of the Department's most recent fish tissue analyses, Bay Minette Creek is no longer under a fish consumption advisory. No probable sources of Mercury contamination were identified in the Bay Minette Creek subwatershed during the course of this study.

Fish Tissue Data Summary

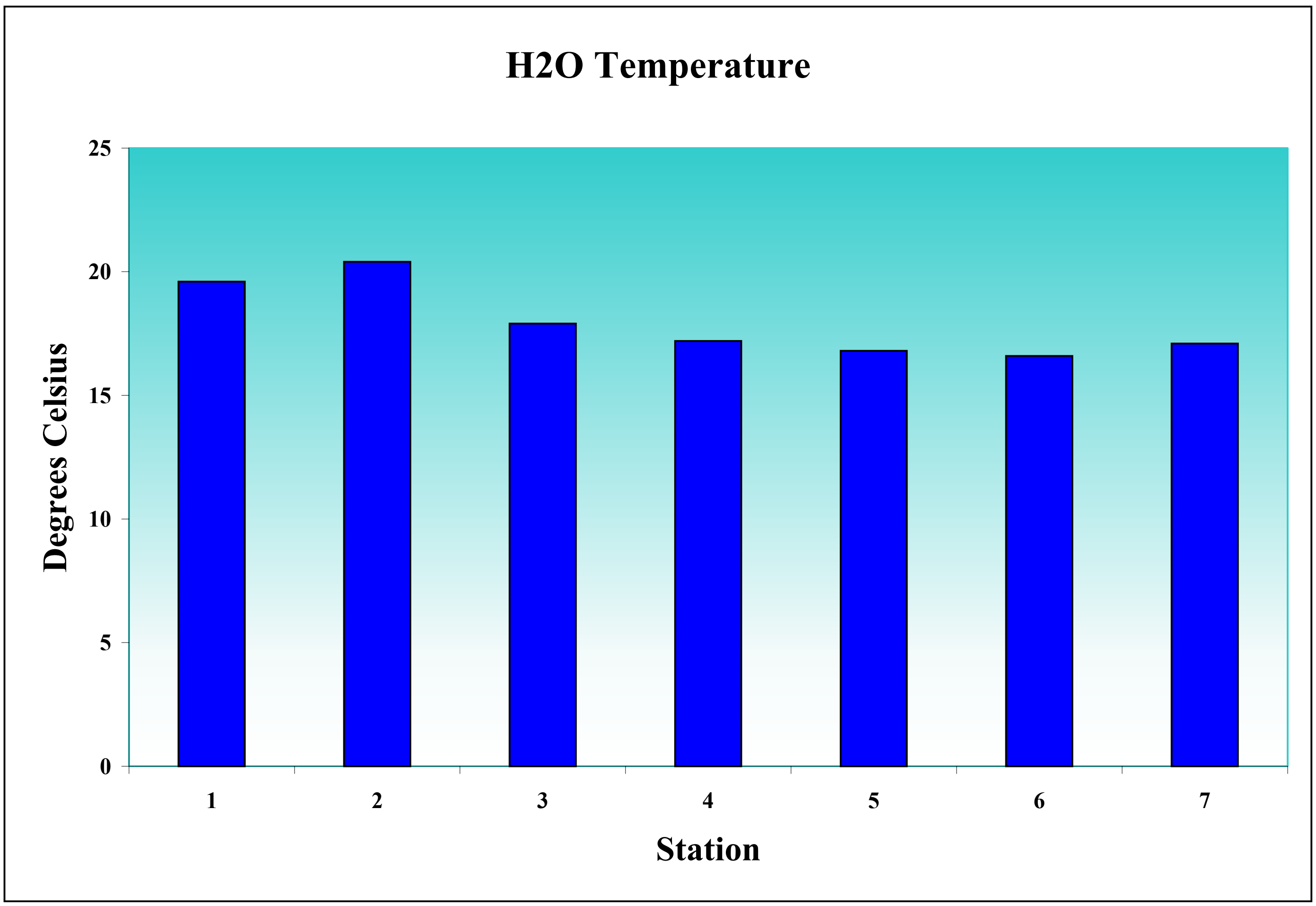
DATE	FISH #	WEIGHT ounces	LENGTH inches	SEX	Hg CONC. ppm	REMARKS
10/22/1997	1	57.8	18.5	F	0.87	Lesion
	2	16.9	13.0	F	0.75	
	3	13.1	12.3	F	0.65	
	4	21.2	14.6	M	1.40	
	5	19.4	13.5	F	1.98	
	6	14.5	12.4	F	0.57	Blind
11/10/1998	1	37.0	16.3	M	1.04	Lesion
	2	15.0	12.7	M	0.68	Lesion
	3	20.5	13.9	M	1.18	
	4	52.2	17.7	F	0.62	Deformities
	5	21.0	13.8	M	0.76	
	6	19.8	13.0	M	0.31	
10/31/2001	1	47.3	17.2	F	0.42	
	2	52.9	16.8	F	0.33	
	3	42.3	15.4	F	0.13	
	4	38.4	14.9	F	0.29	
	5	30.0	15.0	M	0.18	
	6	43.7	14.4	F	0.19	
10/09/2002	1	35.3	15.4	M	0.86	
	2	27.9	13.8	M	0.11	
	3	46.6	15.8	M	0.10	
	4	16.9	12.4	M	0.10	
	5	26.1	14.3	M	0.36	
	6	21.5	13.3	M	0.10	

WATER QUALITY

FIELD PARAMETERS

Water Temperature

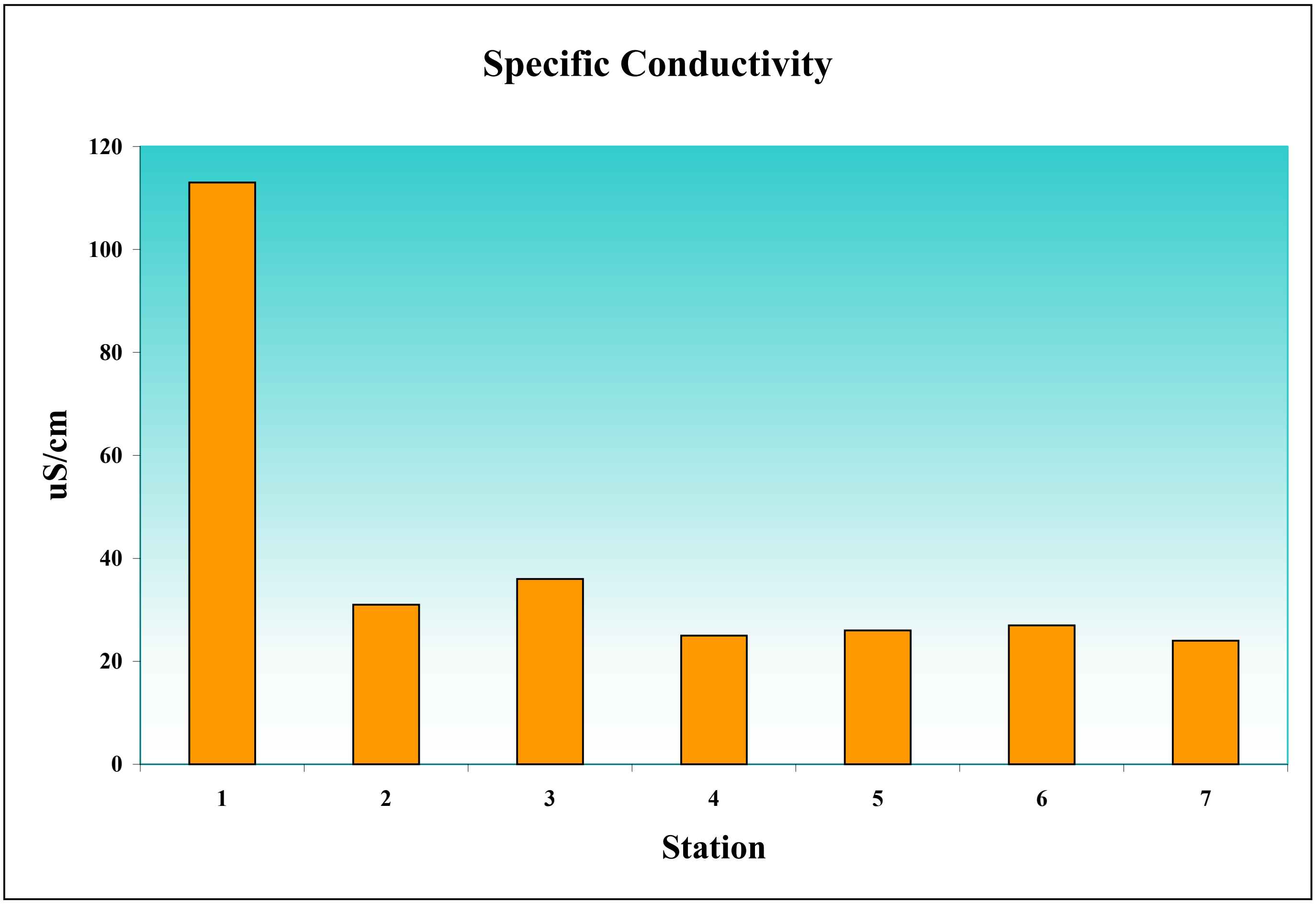
In an aquatic ecosystem, water temperature can influence dissolved oxygen concentrations, photosynthesis rates, and the metabolic processes of aquatic organisms. A number of factors contribute to the warming of a water body. These factors include, but are not limited to, ambient air temperature, runoff, man made discharges, and suspended solids concentrations. Elevated water temperatures generally result in decreased dissolved oxygen concentrations (NCSU. 1994). As discussed previously, Division 6 of the Department's Administrative Code provides that no state water with the use designation of Fish and Wildlife, or Swimming and other Whole Body Water Contact Sports shall have a temperature exceeding 90^0 F. In the course of this study, no station exhibited a water temperature in excess of 90^0 F.



The highest water temperature observed was at station BMC 3 at 87.6 ^oF. The lowest observed water temperature was at station BMC 6, 45.3 ^oF. Average water temperatures, like air temperatures, were higher in the summer and lowest in the winter months.

Specific Conductivity

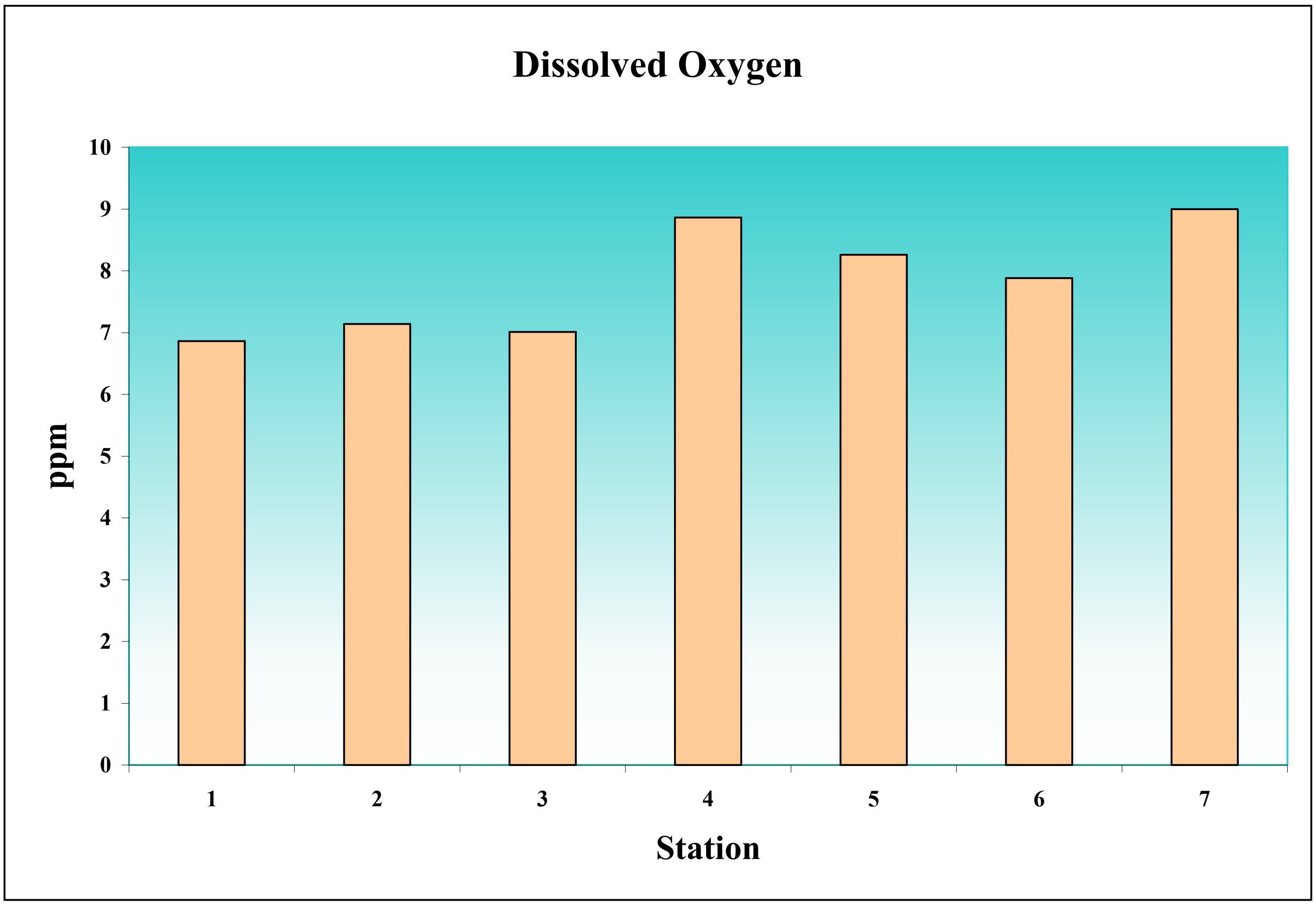
Conductivity is a measure of water's ability to conduct electricity. More specifically, it is a measure of the ionic activity and content within water. Generally, the higher the ionic concentration within water, the higher the conductivity. Temperature, however, has a pronounced effect upon conductivity values. For this reason, specific conductivity (conductivity normalized to a temperature of 25^0 C) is often used in comparative water quality studies. Specific conductivity can be a good measure of total dissolved solids and salinity. It can not, however, provide information on the type of or individual concentrations of ions present. The list of ionic forms that may be present in water and which effect water's conductivity is a long one. The list includes such ions as calcium, magnesium, sodium, potassium, sulfate, chloride, bicarbonate, nitrogen, phosphorous, iron and others. Specific conductivity values are useful as indicators of potential water quality problems. Low values generally indicate low nutrient, high quality waters, while high values suggest nutrient rich waters. Also, sudden changes in specific conductance values may be an indicator of a pollutant discharge. It should be observed, however, that higher specific conductance values are the norm in tidally influenced waters and are not, necessarily, indicators of pollutant stress, but, rather, reflect the increased ionic activity associated with saline inflow.



The inserted graph presents the average values for specific conductivity for all stations. BMC 1 demonstrated the highest specific conductivity values as a result of its proximity to Blakely River and the Mobile Bay. The lowest specific conductivity was encountered at BMC 6 on Whitehouse Creek in the upper reaches of the subwatershed. Rising specific conductivity values correlated positively with the salinity values observed during the study. Average specific conductivity was highest in the winter months and lowest in the fall months.

Dissolved Oxygen

Adequate dissolved oxygen is essential in aquatic systems for the growth and survival of biota. Dissolved oxygen levels in aquatic systems can range from 0-18 parts per million, but most natural water systems require 5-6 parts per million to support a diverse population (NCSU. 1994). Dissolved oxygen in aquatic systems is necessary for plants and animals to carry on respiration. Dissolved oxygen is defined as the amount of free molecular oxygen, O_2, dissolved in an aqueous



solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis. Regardless of its vehicle of introduction, the dissolved oxygen content in a water body may be considered one of the most important and principal measurements of water quality and indicator of a water body's ability to support aquatic life. Dissolved oxygen levels above 5 milligrams per liter (mg O_2/L) are considered optimal. Levels below 1 milligrams per liter are considered *hypoxic* (oxygen deficient). When O_2 is totally absent, the system is considered *anoxic*. Some bacteria consume oxygen during the process of decomposition. Decreases in the dissolved oxygen levels can cause changes in the types and numbers of aquatic macroinvertebrates, which live in a water ecosystem. Some organisms, like mayflies, stone flies, caddis flies, and aquatic beetles, require high dissolved oxygen levels to survive. Worms and fly larvae, which can survive in low dissolved oxygen environments, can be indicators of an unhealthy water body (NCSU. 1994).

Dissolved oxygen concentrations were, generally, higher in the upper reaches of the Bay Minette Creek subwatershed than they were at the most downstream stations. The highest dissolved oxygen concentration encountered was 12.07 parts per million at station BMC 7. The lowest dissolved oxygen concentration observed, 0.22 parts per million, was at station BMC 3. This value was recorded at the bottom of the water column. The dissolved oxygen concentration at mid depth was 9.40 parts per million, however, and 9.57 parts per million at the surface. The measurement was recorded in the winter, January 8, 2004. Yet, average dissolved oxygen levels were, on average, higher in the winter months and lowest in the fall.

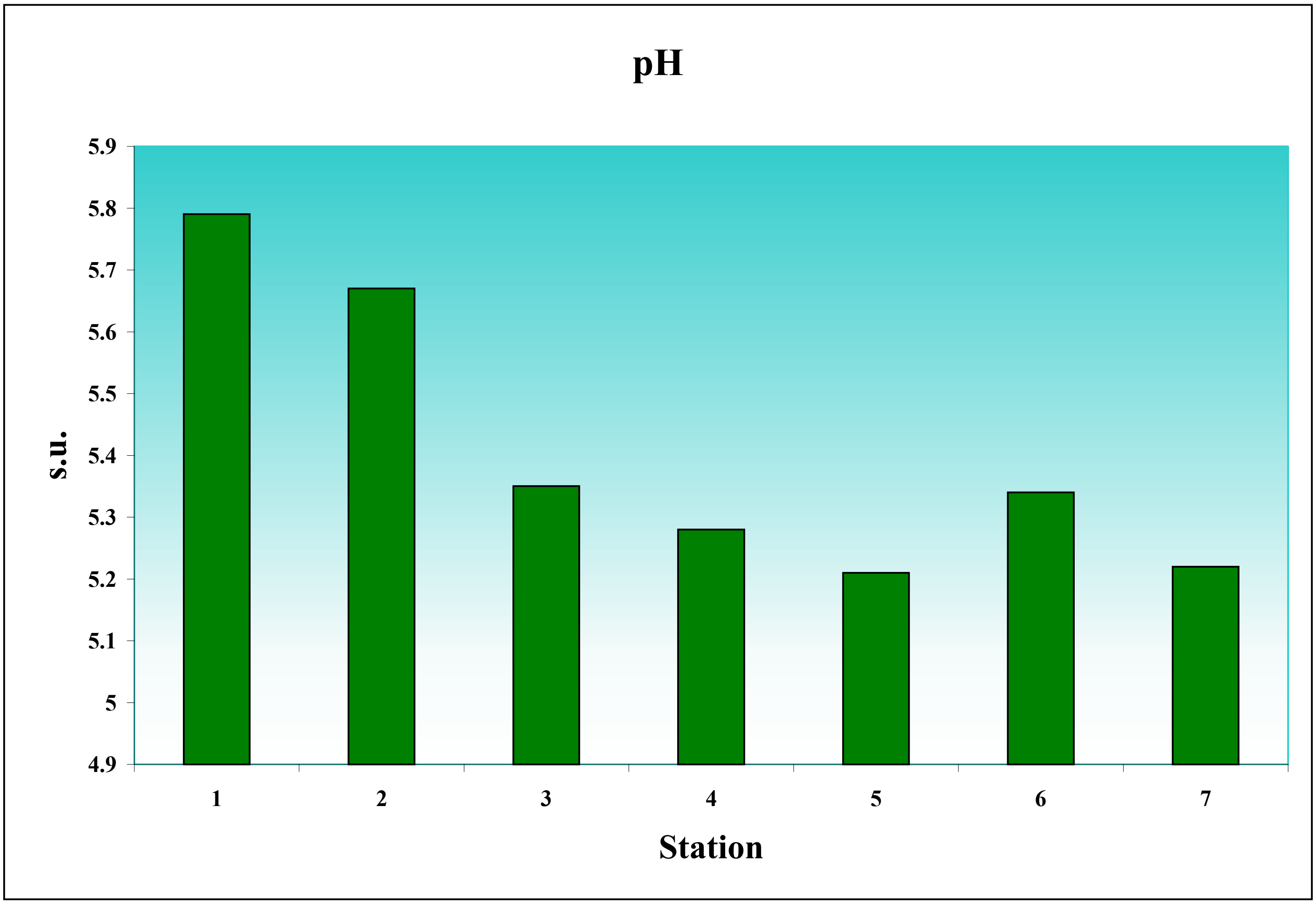
Salinity

Salinity is the total amount of dissolved salts present in water. Salt concentrations play a significant role in plant and animal habitat and water quality. Salinity affects dissolved oxygen concentrations, pH, and conductivity. The average salinity of world oceans is around 35 ppt. Freshwater, conversely, is expected to have a salinity approaching zero ppt (NOAA. 2001).

The most downstream station, BMC 1, exhibited the highest average salinity values, as would be anticipated with tidally influenced water bodies. Those stations upstream of BMC 1 consistently demonstrated salinity concentrations of around 0.01 ppt. The highest salinity value observed during the study was 0.6 parts per thousand at station BMC 1. Average salinity levels were highest in the winter months and lowest in the fall.

pH

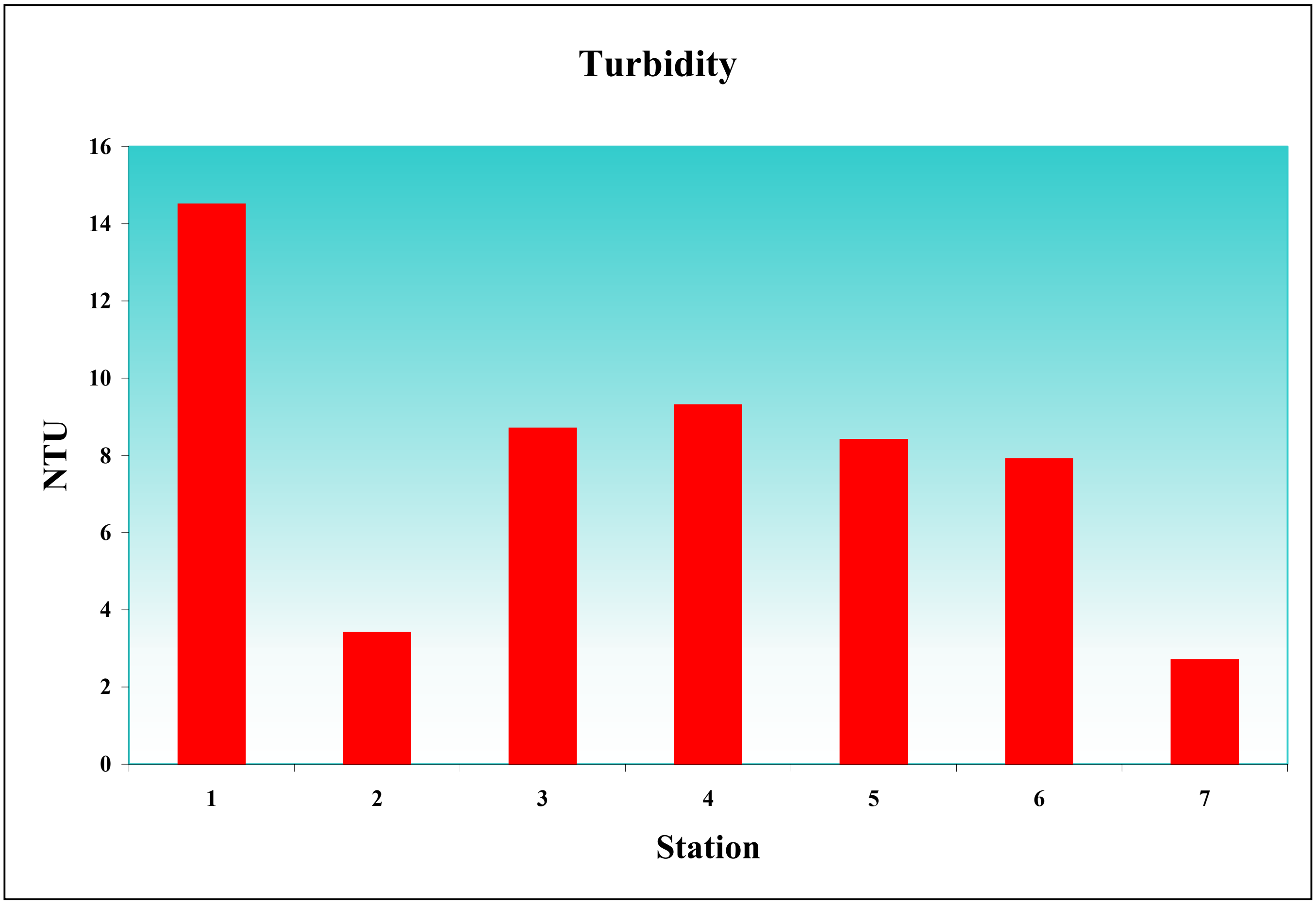
A measure of a solution's acidity is termed pH. This measure is based upon the concentration of positively charged hydrogen atoms (hydrogen ions) in a solution. For the purposes of this study, pH may be defined as the negative logarithm of the concentration of hydronium ions in solution. Hydronium ions are chosen because hydrogen ions readily associate with water molecules to form hydronium ions. In pure water, hydronium and hydroxyl ions exist in equal quantities which results in a neutral solution. Neutral solutions have a pH of 7. When hydronium ion concentrations exceed the concentration of hydroxyl ions, the solution becomes acidic. As a result, pH values falling below 7 are considered acidic solutions. Conversely, when hydroxyl ion concentrations are greater than hydronium ion concentrations, the solution is considered basic and the pH values range from greater than 7 to 14 (NCSU. 1994).



As can be seen in this section's graph, average pH values were higher in the lower reaches of the subwatershed than they were in the uppermost portions. The highest pH value was observed at station BMC 3 with 6.78 standard units. The lowest pH value, 3.82 standard units, was also observed at station BMC 3. The average pH values remained somewhat constant throughout all seasons of the study.

Turbidity

Turbidity may be described as a function of total suspended solids. But, whereas, total suspended solids are determined by weight per unit volume, turbidity is measured as the amount of light scattered from a sample, making it a measure of cloudiness or murkiness in water. Turbidity reduces the amount of light that penetrates the water. Since aquatic plants require light for growth, a reduction in the amount of available light may impair plant growth. Fish or other aquatic organisms that depend on such plants for survival, be it for food or shelter, are also impacted. Further, since aquatic plants also provide oxygen to the water body, a reduction in the number of plants results in less oxygen being introduced to the aquatic system. Compounding this problem, turbid waters are generally warmer than non-turbid waters as a result of the suspended particles absorbing the sun's electromagnetic radiation. Increases in the water's temperature decreases the amount of available



dissolved oxygen. Depleted oxygen, in turn, results in fewer aquatic invertebrates and fish (NCSU. 1994).

Apart from its impact on light penetration, turbidity offers other complications in the aquatic environment. The suspended particles that contribute to the turbidity can affect the way aquatic invertebrates and fish feed and breathe. Filter feeders are particularly impacted as their feeding mechanisms become choked by increased amounts of suspended particles. Likewise, fish can also experience clogging and damage of gills. Excessive suspended particles may also decrease aquatic organisms' disease resistance, reduce growth rates, interfere with reproductive development, or, simply, smother eggs and larvae. Turbidity can be caused by any number of sources. The most common causes are erosion, runoff, waste discharges, algal activity, and stirring of the bottom sediments (NCSU. 1994).

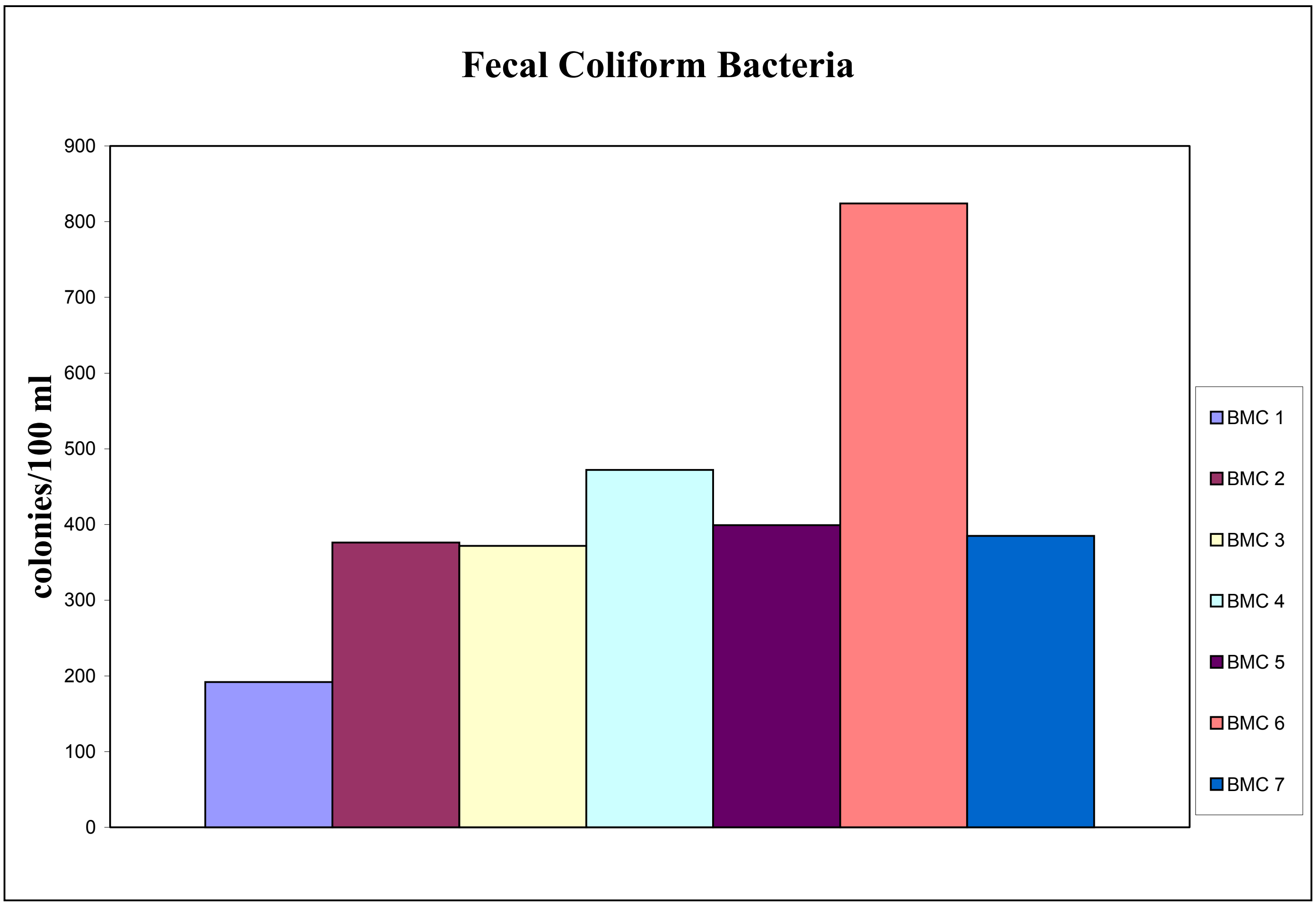
Station BMC 1 demonstrated the highest average turbidity. The highest turbidity value encountered during the course of the study was 70.1 nephelometric turbidity units (ntu) at station BMC 7. The station recording the lowest turbidity during the study was BMC 5 at 1.3 ntu. Average turbidity oxygen levels were highest in the summer months and lowest in the fall.

LABORATORY ANALYSES

Fecal Coliform Bacteria

Bacteria are prokaryotes of the Kingdom Monera. Monerans are the most numerous and the most ubiquitous organisms in the environment. Coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and warm and cold-blooded animals. These bacteria are essential for the digestion of certain foods. One of the total coliform bacteria subgroups is the fecal coliform bacteria. Of this subgroup, the most common member is *Escherichia coli.* Coliform bacteria are not considered to be pathogenic organisms, having been demonstrated to be only mildly infectious.

Fecal coliform bacteria serve as a group of indicator organisms, i.e., their presence indicates recent fecal pollution by animals or man, and the possible presence of other disease causing organisms that may potentially infect those that come into contact with the water. It is generally accepted that the



presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. Substantial numbers of these organisms in an aquatic environment gives rise to concern that pathogenic organisms, also present in fecal matter, may be present. As such, the presence of fecal coliform bacteria is an indicator that a potential health risk exists for individuals exposed to this water. Such health risks include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis and hepatitis A. It should also be noted that the presence of fecal coliform tends to affect humans more than it does aquatic creatures.

Fecal coliform bacteria can enter surface water through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from untreated human sewage. Individual home septic systems can become overloaded during rain events and allow untreated human wastes to flow into drainage ditches and nearby waters. Agricultural practices also may contribute to bacterial contamination through such practices as allowing animal wastes to wash into nearby streams, spreading manure and fertilizer on fields during rainy periods, and allowing livestock to water in streams.

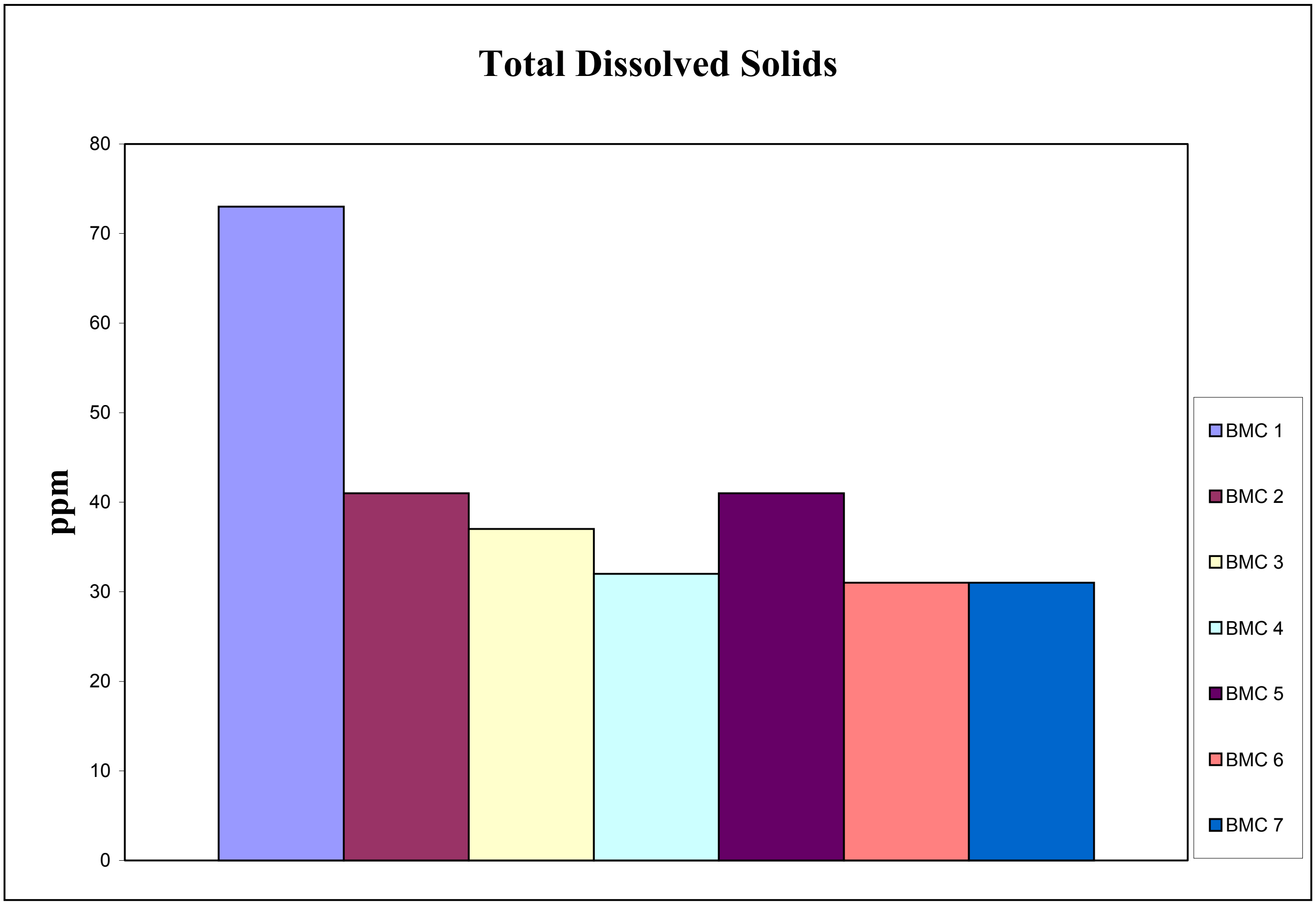
The highest concentrations of fecal coliform bacteria were observed in samples retrieved during or following substantial rain events, at times when tremendous volumes of runoff were being introduced to the streams. The highest average concentration of fecal coliform bacteria was demonstrated at station BMC 6. The highest single concentration of fecal coliform bacteria observed during the study was 5,100 colonies per 100 milliliters at station BMC 6. The lowest concentration, less than 2 colonies per 100 milliliters, was recorded at station BMC 1. On average, fecal coliform bacteria counts were highest in the summer months and lowest in the fall.

On several occasions, in sections of stream with a water use classification of Fish and Wildlife, fecal coliform concentrations exceeded the established ADEM water use criteria of 2,000 colonies/100ml. On May 21, 2003, station BMC 6 exhibited a fecal count of 5,100 colonies/100ml. On July 23, 2003, station BMC 6 had a fecal count of 3,400 colonies/100ml. On July 28, 2003, stations BMC 2 and BMC 6 had fecal counts greater than 2,000 colonies/100ml. On August 21, 2003, stations BMC 3 – 7 had fecal counts greater than 2,000 colonies/100ml.

As no geometric mean sampling was included in this study, the water quality criteria established for those waters carrying a use classification of swimming and other whole body water contact sports is not applicable in terms of comparison to the data presented.

Total Dissolved Solids

Total Dissolved Solids is a measure of the amount of material dissolved in water, or the concentration of solids in water that can pass through a filter. These solids typically include nitrate, calcium, magnesium, sodium, carbonate, bicarbonate, chloride, sulfate, phosphate, organic ions, and other ions. A certain level of these ions in water is necessary for aquatic life. Their presence effects the density of the surrounding solution. And, since density is directly correlated to the osmotic potential of water with relation to the metabolic processes of aquatic organisms, changes in total dissolved solids concentrations may have a profound effect upon those organisms. Excessively high or low total dissolved solids concentrations may even lead to impaired growth or death. High concentrations of total dissolved solids may also reduce water clarity, contribute to a decrease in photosynthesis, and serve to increase the water's temperature, thereby depleting the available dissolved oxygen (NCSU. 1994).

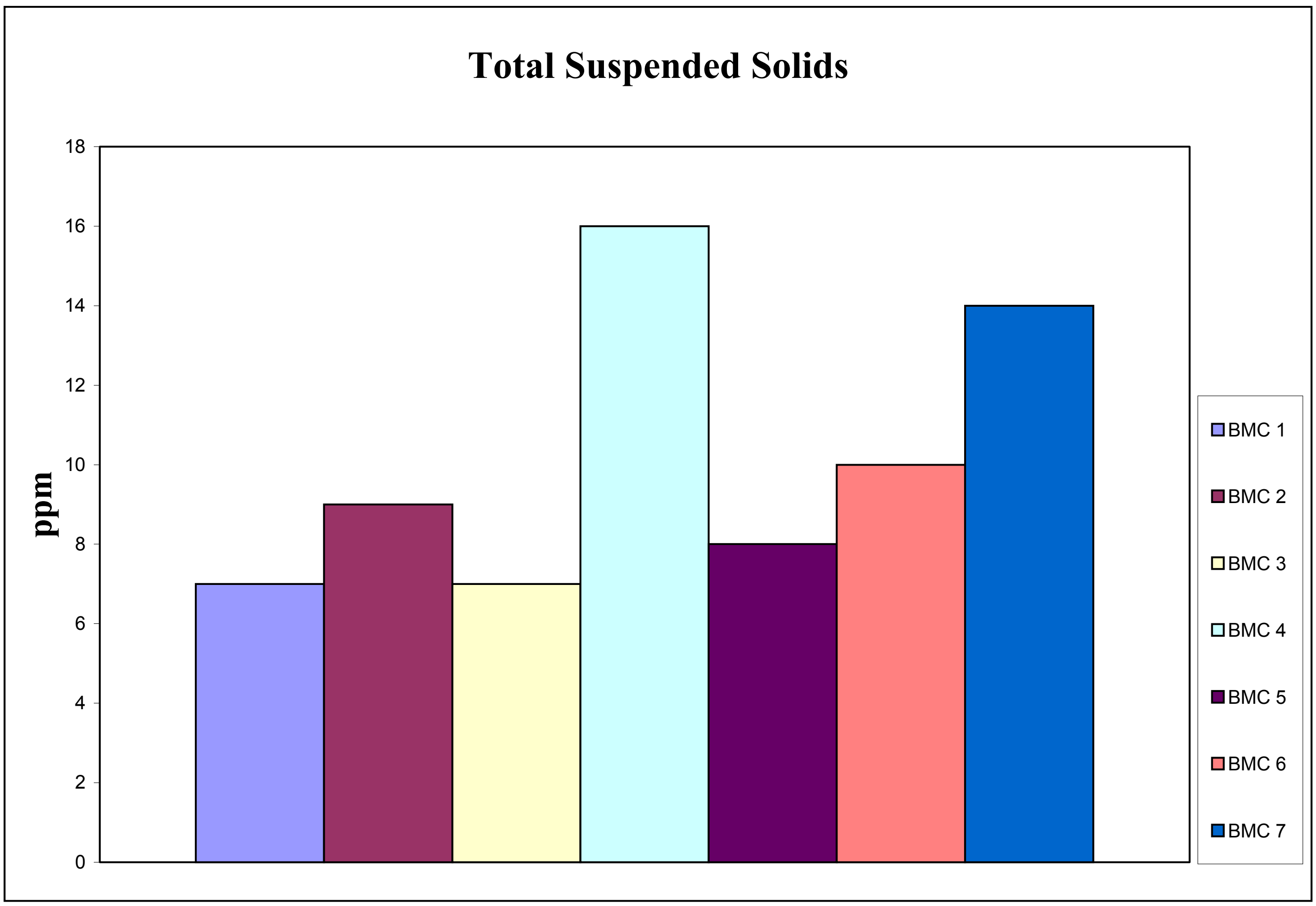


Dissolved solids concentrations tended to increase with each downstream station among the three subwatersheds. The most downstream stations consistently yielded the greatest total dissolved solids concentrations in each of the subject subwatersheds. The Bay Minette Creek subwatershed exhibited the lowest average dissolved solids concentrations for the study at 47 parts per million. The Fly Creek subwatershed had the greatest average dissolved solids concentration among the subject subwatersheds at 290 parts per million. The Three Mile Creek subwatershed demonstrated an average dissolved solids concentration of 290 parts per million. Little variation in dissolved solids concentrations was observed in those stations not influenced by tides. On average, total dissolved solids concentrations were greatest in the fall and lowest in the winter.

Total Suspended Solids

Total suspended solids (TSS) concentration is a measure of suspended solids per volume of water. The measured solids are those that can be captured by a filter. These solids include a varied assortment of materials, either mineral or organic, including, but not limited to, sand and silt, decaying plant and animal matter, and waste particulates. High concentrations of suspended solids may cause many problems for water quality. Apart from diminishing the available light, increased siltation may alter a stream's dynamics as well as destroy existing habitat. Suspended particles also serve as substrates for other pollutants such as pathogens and some heavy metals. Suspended solids, therefore, effect the aquatic system both physically and biochemically. Geology and land use are the primary factors influencing suspended solids concentrations. As watersheds develop, there is an increase in disturbed areas, a decrease in vegetation, and an increase in impervious surface area, all of which reduce the watershed's ability to filter runoff. This contributes to increases in erosion, loading of particulate matter, nutrients, and pollutants. Such overloading leads to increased algal growth among other complications, which ultimately leads to decreased dissolved oxygen levels. Further, suspended solids can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development (NCSU. 1994).

The highest average total suspended solids concentrations were observed at station BMC 4. The highest recorded single total suspended solids concentration was 41 parts per million at station BMC 4. Concentrations of total suspended solids were the highest during the summer months.



The values for loading presented in this section's table represent calculated estimates of total suspended solids loading for the entire Bay Minette Creek subwatershed. The averaged flow measurement used in arriving at the value appearing in the table was acquired by taking the arithmetic mean of the measured flow for all stations within the individual subwatershed. For the greater part of the study, total suspended solids concentrations were less than five parts per million at all stations. For this reason, the recorded value appearing in the table is preceded by the ‘ < ’ symbol.

AVERAGED TOTAL SUSPENDED SOLIDS LOADING

	Flow (MGD)	TSS (ppm)	Load (ppd)
Bay Minette Creek	18.7	< 10.0	< 1558.73

Loads, given in pounds per day units, were estimated using the following equation:

$$W = C * Q * 8.345 \text{ lbs}$$

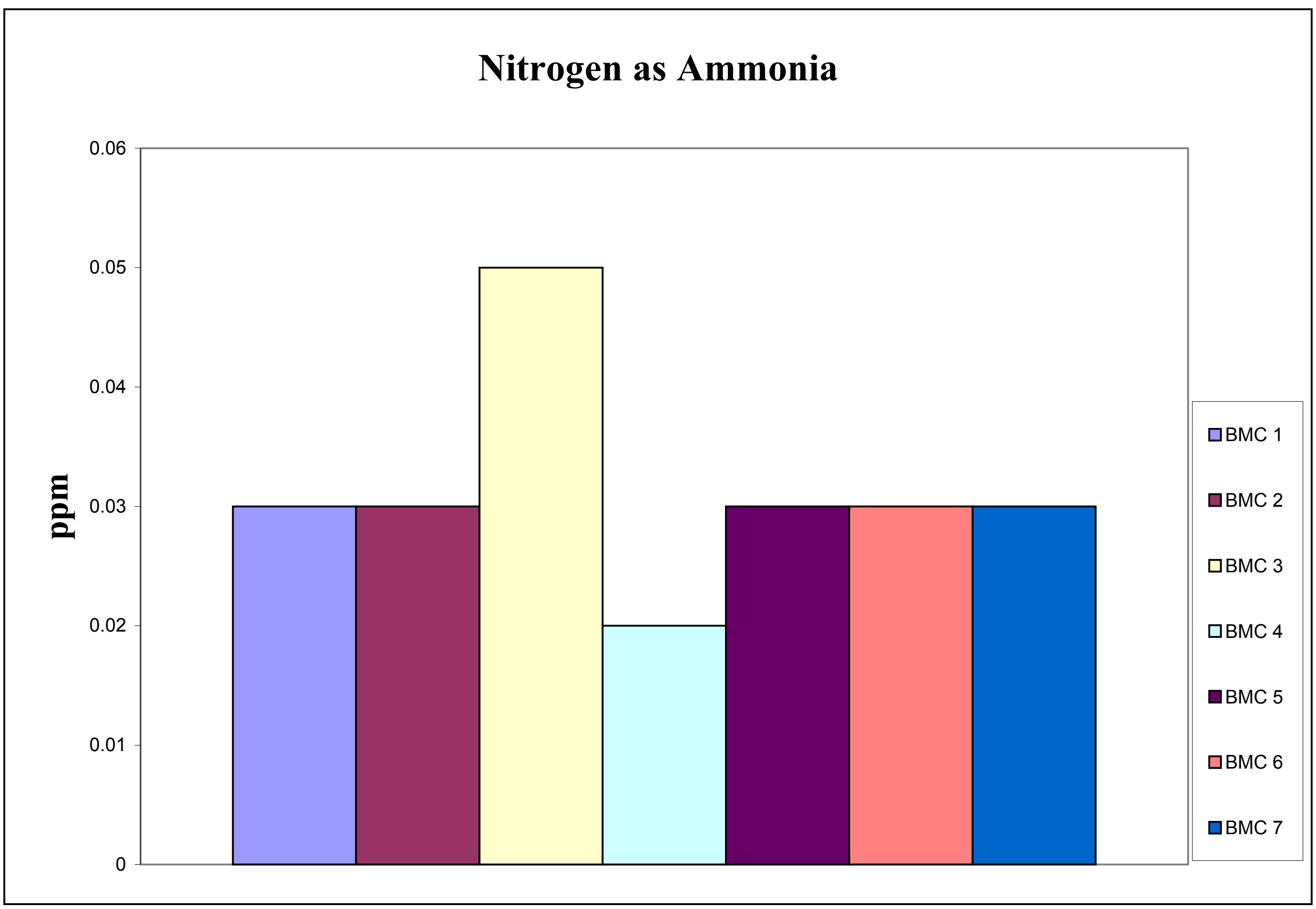
where:
W = load in pounds per day
C = measured concentration in parts per million
Q = flow in millions of gallons per day (MGD)*
8.345 lbs = weight of 1 gallon of water

*Flow was converted to MGD by multiplying the value in cubic feet per second by a factor of 0.6463169 (the dimensional equivalent in gallons per day of cubic feet per second divided by a factor of $1.0 * 10^6$)

Ammonia

Ammonia is an important source of nitrogen for plants and animals. It is a colorless gas that may be found in water, soil, and air. Ammonia is suspected to remain in the atmosphere less than two weeks, depending on weather and other factors, before being deposited or chemically altered. It is recycled naturally by a substantial number of plants and microscopic organisms that rapidly take up ammonia. Most of the ammonia in the environment comes from the natural breakdown of organic matter, like feces, and dead plants and animals. The amount of ammonia produced by man is very small compared to that produced by nature every year. The majority of man-made ammonia goes toward the manufacture of fertilizer. Ammonia is also used to manufacture synthetic fibers, plastics, and explosives (Microsoft® Encarta® Online Encyclopedia 2002).

Ammonia may be introduced to a watershed through surface water runoff, direct discharge, or directly from the atmosphere. When too much ammonia becomes available, free ammonia may accumulate in body tissues. This accumulation can lead to metabolism alterations or increases in internal pH. Factors which influence ammonia's toxicity in an aquatic environment include; dissolved oxygen concentrations, historical ammonia loading, carbon dioxide concentrations, and the presence of other toxic compounds. Generally, the total percentage of ammonia in water is expected to increase with temperature and pH. Concentrations of the principal form of toxic ammonia (NH_3), of less than half a part per million, may be toxic to some aquatic organisms. Such toxicity is directly correlated with both temperature and pH (Grimwood, M.J. & Dixon, E. 1997).

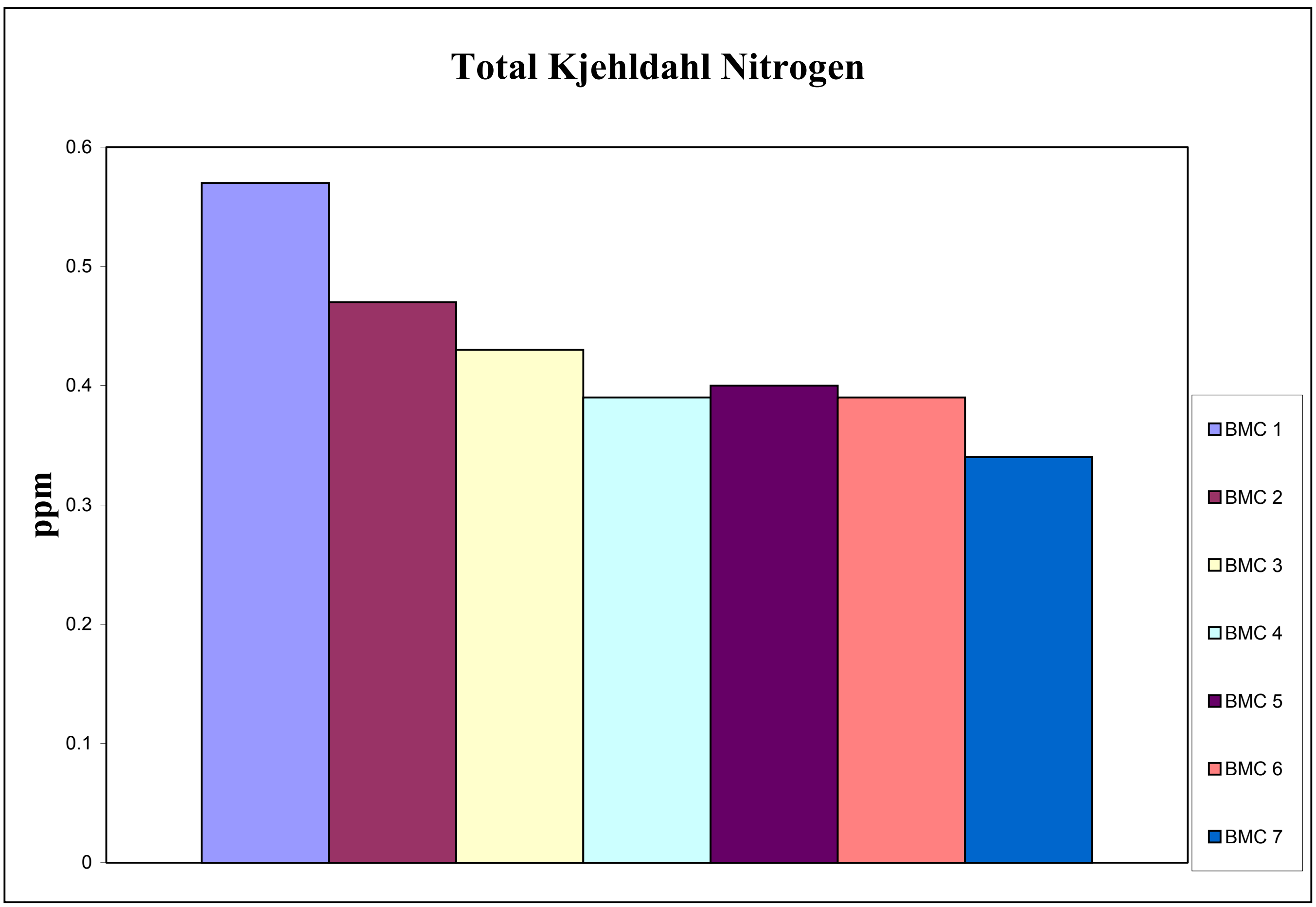


Plants appear to be more tolerant of ammonia than are animals. Invertebrates also appear to demonstrate a greater ammonia tolerance than do higher life forms (NCSU Water Quality Group. August, 1994).

Station BMC 3 exhibited the greatest average values for ammonia concentrations during the study. Station BMC 4 exhibited the lowest average values. The highest single ammonia concentration was 0.09 parts per million. Concentrations at this level were observed in stations BMC 2 and BMC 7. The highest ammonia concentrations observed for all stations were encountered following substantial rain events. Excessive ammonia concentrations were not observed at any station during the study. The average concentration of ammonia remained relatively constant throughout all seasons of the study.

Total Kjehldahl Nitrogen

It has been well established that Nitrogen is a very important nutrient to a stream ecology and that, while some nitrogen is necessary as a nutrient for aquatic plant growth, too much nitrogen adversely

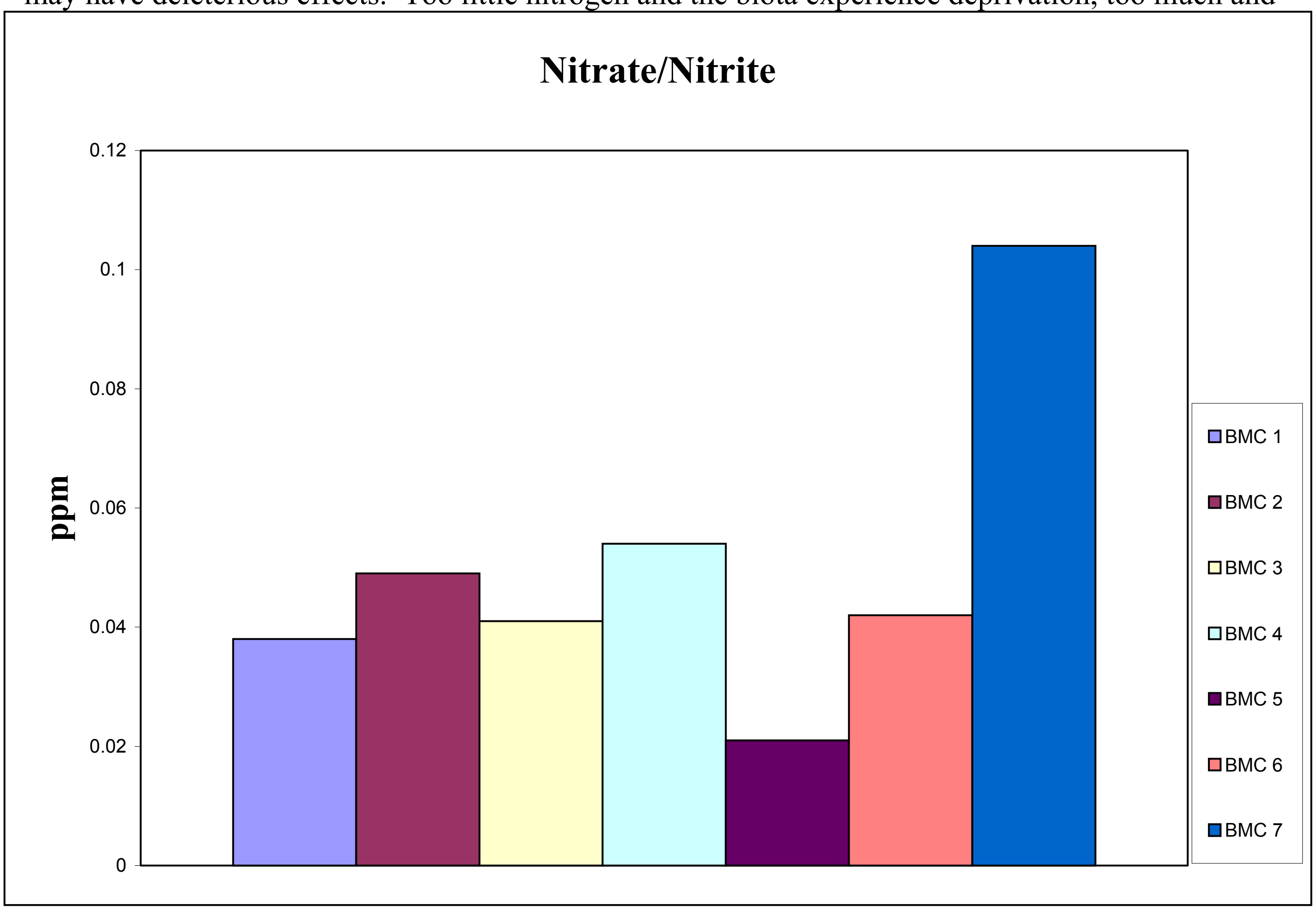


affects that ecology. Since the nitrogen cycle is very complex, and nitrogen can exist in so many forms simultaneously, the Total Kjehldahl Nitrogen (TKN) test was developed using digestion and distillation to determine the sum concentration of the various nitrogen compounds. Kjehldahl nitrogen, therefore, refers to the total of organically bound nitrogen and ammonia nitrogen. Typically, high Total Kjehldahl Nitrogen values are indicative of pollution in an aquatic system.

For the entire study period, the Bay Minette Creek subwatershed exhibited an average TKN value of 0.43 parts per million. The largest average TKN concentrations were observed at station BMC 1. The highest TKN concentration encountered during the study was 2.1 parts per million on October 23, 2003 at station BMC 1. On average, TKN concentrations were highest in the summer and fall months and lowest in the winter.

Nitrate/Nitrite

Nitrogen (N_2) is a principal component of our atmosphere and one of the planet's most abundant elements. The air we breath is composed of approximately eighty percent nitrogen. Nitrogen is found in the cells of all living things and is an essential component of proteins. Inorganic nitrogen exists in nature in the free state as a gas (N_2), or as nitrate (NO_3-), nitrite (NO_2-), or ammonia (NH_3+). Nitrogen enters the water body via runoff (animal wastes and septic tanks), municipal and industrial wastewater, and even discharges from car exhausts. In aquatic environments, nitrogen-containing compounds act as nutrients. Aquatic plants and animals continually recycle available nitrogen. Depending on the predominant form, too much or too little nitrogen in an aquatic system may have deleterious effects. Too little nitrogen and the biota experience deprivation, too much and

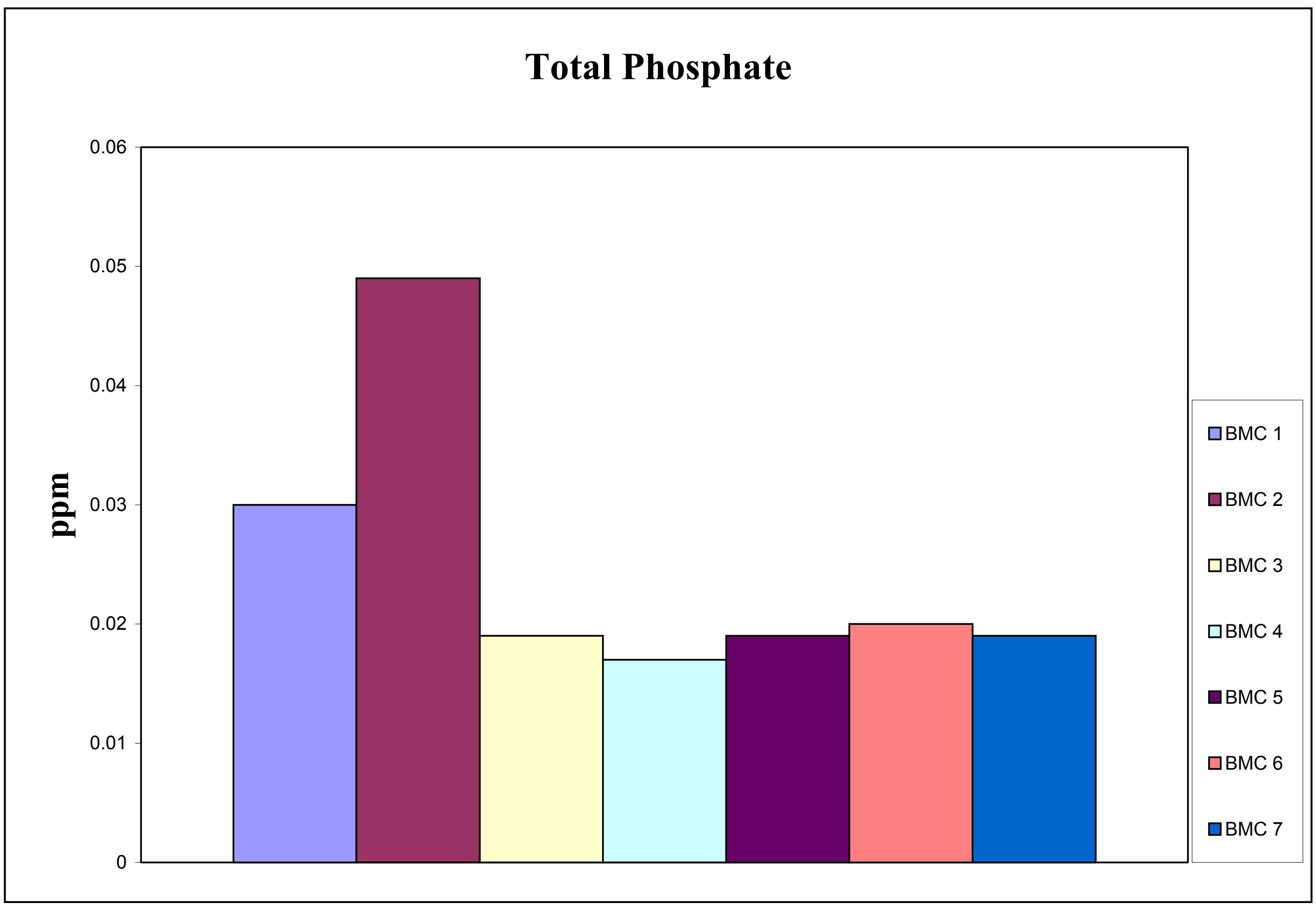


the algae, plants that are fed by nutrients, thrive and rapidly overpopulate. Such algal blooms pose a number of problems to an aquatic system. They may contribute to turbidity and substantially reduce the amount of light penetrating the water. Although algae produce oxygen as a by product of photosynthetic activity, the amount of dissolved oxygen they contribute to the aquatic system is not sufficient to overcome the oxygen demand created by their subsequent decay. The bacteria feeding upon decaying algae quickly convert nitrites to nitrates. Nitrate reactions in aquatic environments can cause oxygen depletion. The sum effect of eutrophication on aquatic systems is decreased dissolved oxygen levels. Decreased dissolved oxygen levels, in turn, lead to hypoxic or even anoxic conditions (NCSU. 1984).

The highest average nitrate/nitrite concentrations were observed at station BMC 7. The highest single concentration, 0.22 parts per million, was also observed at station BMC 7. The lowest average nitrate/nitrite concentrations were observed at station BMC 5. On average, Nitrate/Nitrite concentrations were highest in the fall months and lowest in the spring and summer.

Phosphate

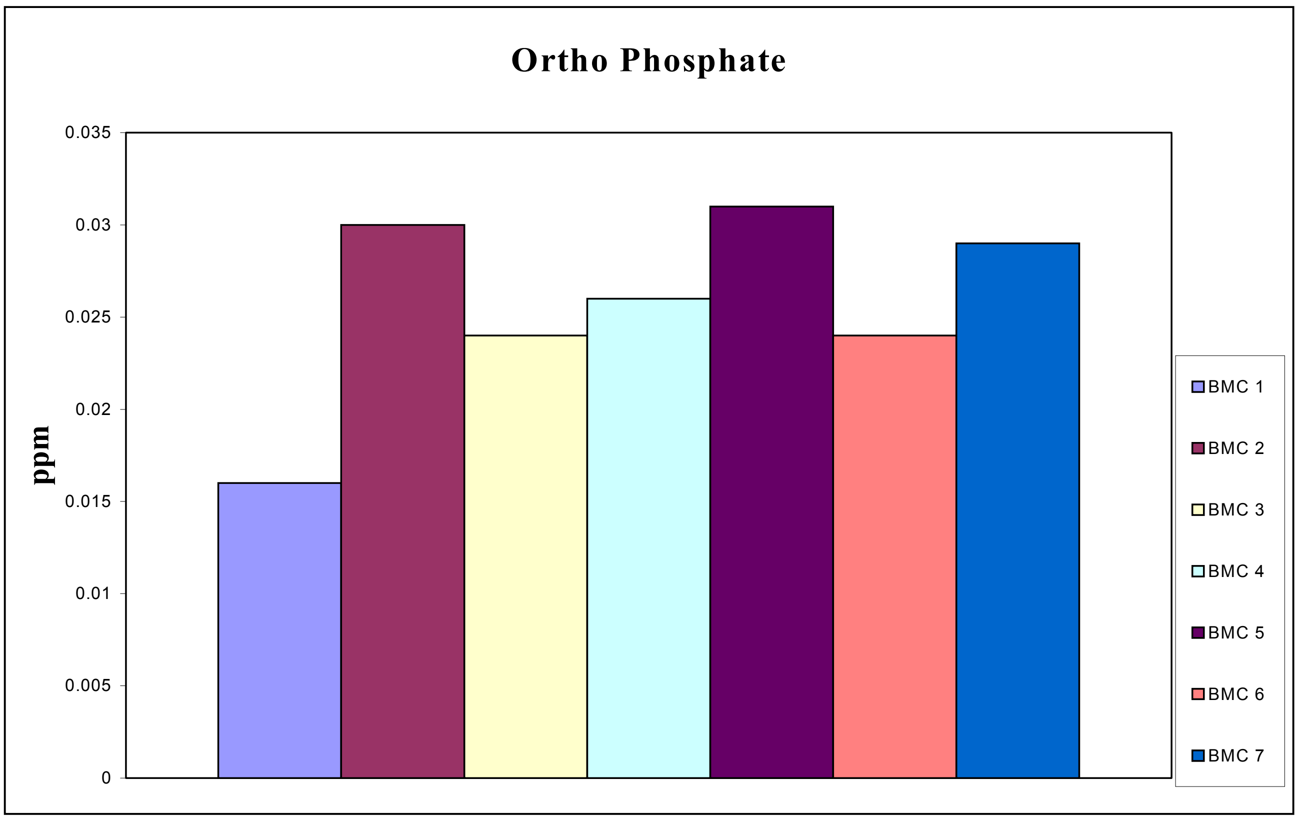
Total phosphate is a measure of both suspended and dissolved phosphates. Of high nutritive value to plants and animals, phosphates are used in fertilizers and as animal feed supplements. They are also used in the manufacture of numerous industrial chemicals. Phosphorous is a major nutritional and structural component of biota. It is also the least abundant of biota's required components. It



occurs in aquatic systems almost exclusively as phosphates. There are several classifications of phosphates: ortho phosphates, condensed phosphates, and organically bound phosphates. Phosphates occur in solution, in detritus, or in the bodies of aquatic organisms. The forms of phosphate are introduced via a variety of sources including wastewater discharge, fertilizer runoff, and runoff from sewage. Phosphorus is found in the Earth's rocks primarily as the ion ortho phosphate (PO_4^{3-}), which is the most significant form of inorganic phosphorus in aquatic systems.

The phosphorous cycle is very complex, but the majority of phosphate in aquatic systems is bound up in the particulate phase as living biota such as bacteria and plants, effectively removing it from the primary productive zone. With the algae/bacteria interaction comes a colloidal substance, through which some phosphorous is lost to the sediment, while still more is lost through hydrolyzation and conversion to ortho phosphate. Ortho phosphate, since it is soluble, is quickly taken up by macrophytes and algae. The colloidal and particulate forms of phosphorus must be replaced by regeneration of solubilized phosphorus from decomposition, precipitation, and runoff (NCSU. 1984).

Although phosphates in the aquatic environment are usually poly-phosphates or organically bound, all will degrade to ortho phosphates (reactive) with time. Overloading of phosphate concentrations



may result in the proliferation of algae or other aquatic plant life. As previously discussed, such eutrophication causes decreased dissolved oxygen levels in the water due to the accelerated decay of organic matter. Excessive ortho phosphate concentrations are an indicator of such overloading (NCSU. 1984).

The highest average total phosphate concentrations were observed at station BMC 2. The lowest average total phosphate concentrations were observed at station BMC 4. The highest single total phosphate concentration observed was 0.074 parts per million at station BMC 1. On average, total phosphate concentrations were highest in the summer and fall months and lowest in the winter.

The highest average ortho phosphate concentrations were observed at station BMC 5. The lowest average total phosphate concentrations were observed at station BMC 1. The highest single total phosphate concentration observed was 0.133 parts per million at station BMC 5. On average, ortho phosphate concentrations were highest in the summer months and lowest in the spring.

Sediment Metals

Sediments represent a temporally integrated record of chemical conditions in a watershed. Since many contaminants entering a watershed become sequestered in the sediment, examining sediment metal concentrations provide insight into past and current conditions (ADEM, 1997). The objective of the sediment metal study was to determine the concentrations of metals contained in the sediment of the three subwatersheds and compare those values across the three impervious surface regimes. The data gathered were compared to "Ecological Response" levels developed by Long et al., 1995 that establish three ranges in a given contaminant's concentration where detrimental effects are rare, occasional, and frequent. The three ranges are defined by two threshold concentrations known as Effects Range – Low (ER-L) and Effects Range – Moderate (ER-M). Values below ER-L rarely result in detrimental effects. Values exceeding ER-L, but below ER-M, result in occasional detrimental effects. Values exceeding ER-M are likely to result in detrimental effects (ADEM, 2000).

Threshold in Parts Per Million

Metal	ER – L	ER – M
Arsenic	8.2	70.0
Cadmium	1.2	9.6
Chromium	81.0	370.0
Copper	34.0	270.0
Lead	46.7	218.0
Mercury	0.15	0.71
Nickel	20.9	51.6
Zinc	150.0	410.0

(Long, 1995)

Excessive levels of arsenic in surface water may have devastating effects upon aquatic life. In significant concentrations, it is a potent poison. Arsenic may enter the surface water in a number of ways, not all anthropogenic. As may be observed in the table appearing in this section, low levels of arsenic were detected in sediment samples for stations BMC 1 and BMC 3. The detected levels were well below the ER – L and ER - M threshold levels for arsenic.

Cadmium is not usually found in its free elemental state, but rather combined with other elements. It is a common substance suspected to be present in all soils and rocks. It is also a persistent element that does not break down readily in the environment. It has been recognized as a probable carcinogen, especially when inhaled. Low levels of cadmium were detected in the sediment at stations BMC1, BMC 2, and BMC 3. None of the observed concentrations exceeded the ER – L of 1.2 parts per million.

Chromium occurs naturally in rocks, soil, air, and water. It normally appears in either trivalent or hexavalent form, depending on pH. It is a necessary trace element for the support of life functions, but, as is the case with many substances, excessive concentrations may lead to complications, i.e. acute toxicity to plants and animals. This is especially true with the hexavalent species of the element. Chromium was detected in low levels in each of the stations studied. None of the observed concentrations, however, exceeded the ER – L of 81 parts per million. Station BMC 3 exhibited the greatest concentration of sediment chromium at 24.0 parts per million.

Sediment Metals Concentrations

	Al ppm	Sb ppm	As ppm	Cd ppm	Cr ppm	Cu ppm	Fe ppm	Pb ppm
BMC 1	20000	< 0.75	1.4	0.09	14	3.9	8900	8.8
BMC 2	9200	< 0.75	< 0.5	0.03	5.2	1	2800	2.9
BMC 3	66000	< 0.75	1.8	0.11	24	4.9	14000	8.6
BMC 4	8200	< 0.75	< 0.5	< 0.025	1.3	< 0.5	290	< 1.0
BMC 5	5300	< 0.75	< 0.5	< 0.025	1.9	< 0.5	390	1.1
BMC 6	840	< 0.75	< 0.5	< 0.025	1.9	< 0.5	860	1.4
BMC 7	2700	< 0.75	< 0.5	< 0.025	1.8	< 0.5	430	< 5.0

	Mn ppm	Ni ppm	Se ppm	Ag ppm	Sn ppm	Zn ppm	Hg ppm
BMC 1	80	8.6	< 0.75	< 0.075	1.5	21	0.09
BMC 2	22	5.9	< 0.75	< 0.075	< 0.75	6.2	< 0.05
BMC 3	55	7	< 0.75	< 0.075	2.4	30	0.11
BMC 4	3	8	< 0.75	< 0.075	< 0.75	2.3	< 0.05
BMC 5	5	4.1	< 0.75	< 0.075	< 0.75	2.9	< 0.05
BMC 6	11	< 1.0	< 0.75	< 0.075	< 0.75	2	< 0.05
BMC 7	4.1	1.9	< 0.75	< 0.075	< 0.75	1.7	< 0.05

Copper is a metal that is often found in its elemental form. It was likely the first metal ever used in production by mankind. It is an essential element for normal growth and reproduction in higher plants and animals, as well as being a primary factor in the development of collagen and protective nerve coatings. Although excessive levels of copper may produce nausea and other adverse effects, deficiencies in copper are believed to be more calamitous than excess concentrations. Low levels of copper were found in the sediment at stations BMC 1, BMC 2, and BMC 3. The observed copper concentrations were well below the ER – L and ER - M threshold levels for that metal.

Lead, in sufficient concentrations, is a toxic metal to both plant and animals. This toxicity is correlated to the lead's solubility, which depends on pH and water hardness. Lead finds its way to water bodies through runoff, industrial discharge, or, even through precipitation. Station TMC 1 exhibited the highest concentration of lead in sediment. Stations BMC 1, BMC 2, BMC 3, BMC 5, and BMC 6 exhibited measurable concentrations of lead. No concentrations were encountered that exceeded the ER – L and ER - M threshold levels for lead.

Mercury is a toxic metal. It is not usually found in its free elemental state, but rather combined with other elements. Many of these mercury combinations are beneficial, but benefits aside, mercury has been identified as a bioaccumulative poison. Mercury's toxicity is dependent on its chemical form and the route of exposure. It is particularly pernicious in its methylated form. It is suspected that atmospheric deposition of mercury is the major route of that substance into the water. Mercury was not detected in concentrations exceeding the ER – L of 0.15 parts per million at any of the stations. Low levels of mercury were detected at stations BMC 1 and BMC 3.

Nickel is a hard, corrosion resistant metal that shares many properties in common with iron and cobalt. It occurs naturally in the earth's crust, generally coupled with other elements. It is also present in meteorites. Certain nickel species produce deleterious health effects in living organisms and some of the nickel forms are suspected carcinogens. Nickel was not detected in concentrations exceeding the ER – L of 20.9 parts per million at any of the stations. The greatest concentration of nickel observed in sediment samples was at station BMC 5, 8.0 parts per million. Of all the stations, only BMC 6 did not exhibit measurable concentrations of nickel.

Zinc is a metal used in the production of a number of useful alloys. It is found in many minerals. It is an essential element for many organisms. Zinc is not considered very toxic to humans or other organisms. It may be present in a water body naturally or through deposition from discharge or runoff. Since it is used in the vulcanization of rubber, high concentrations of zinc are not uncommon around roadways. Zinc was detected at every station. None of the observed concentrations exceeded zinc's ER – L of 150.0 parts per million.

MATERIALS AND METHODS

This study was conducted in accordance with the ADEM *Methodology for Coastal Subwatershed Assessments, 2001* and executed under the requirements established in the ADEM *Standard Operating Procedures and Quality Control Assurance Manual*.

The Bay Minette Creek subwatershed was delineated using U.S. Department of the Interior Geological Survey 7.5 Minute Series topographic maps. The quadrangles: Hurricane, Bay Minette, Bridgehead, and Stapleton were used in mapping the contour lines to determine the extent of the basin and to select sampling stations.

Sampling stations were selected to represent a cross section of the subwatershed. Land use determinations were obtained from the Alabama Soil and Water Conservation needs Assessment Unit. Station accessibility was a significant factor in the final designation of stations. Seven sampling stations were selected. Station BMC 1 was the furthermost downstream location, while station BMC 7 was the furthermost upstream location. At those stations accessible only by boat, field parameters were taken at the surface, mid depth, and bottom. All samples were retrieved at a depth of 15 to 30 cm below the water's surface.

Each of the stations were visited, at least monthly, and monitored for; dissolved oxygen, pH, salinity, specific conductivity, flow, and temperature, as well as sampled for total suspended solids, total dissolved solids, turbidity, fecal coliform bacteria, ammonia, nitrates/nitrites, total Kjehldahl nitrogen, ortho phosphorous, and total phosphorous. Stations were also sampled, on a one time basis, for metals concentrations in the sediment. Field parameters for all stations were taken *in-situ* using the YSI 600XLM® and the YSI 650 MDS®.

Flow measurements were obtained using the Pygmy Flow Meter. The Department's Microsoft Excel Stream Flow Calculation Worksheet was used to calculate flow based on measurements obtained using a Price vertical axis current meter, pygmy type, mounted on a top setting rod. Runoff during and immediately following significant rain events quickly impacted the drainage paths of the subwatershed. Significant rain events transformed typically wadeable streams into swollen streams too deep and/or swift for safe flow measurement.

REVIEW AND CONCLUSIONS

A review of the data collected during the interval of this study indicates that the Bay Minette Creek subwatershed is not severely impacted by any of the monitored pollutants. The subwatershed does not have any NPDES permitted wastewater dischargers and appears to be free from the stress of multiple point source discharges. Wildlife, both plant and animal thrive in the subwatershed. Wading birds are a common sight within the subwatershed and are indicators of a healthy ecosystem. Apart from elevated fecal coliform bacteria concentrations following substantial rain events, general water quality within the subwatershed may be considered acceptable to good. It may be concluded that rainfall has a substantial influence on the water quality within the subwatershed, particularly those rain events discharging significant volumes of precipitation over short periods. Fecal coliform bacteria concentrations tend to elevate during and following rain events, as do suspended solids. It is expected that increasing the amount of impervious surface cover within the subwatershed will only exacerbate these effects. Trash deposited by passing motorists was a problem within the subwatershed, if only for aesthetic reasons. It is certain, however, that such trash was no benefit to the water quality. An enhanced awareness of environmental concerns and civic duty might reasonably be expected to deter individuals from depositing their trash in such a manner. It is hoped that, with the passage of time, such activities will decline and, ultimately cease. As the volume and frequency of traffic within the subwatershed will only increase with time, continued littering will, most certainly, have a negative impact on the water quality. No obvious sources of pollutants, apart from roadside trash/debris were identified during the course of the study.

LIST OF ACRONYMS AND ABBREVIATIONS

ADEM -	Alabama Department of Environmental Management
BMC –	Bay Minette Creek
^{0}C –	degrees Celsius/centigrade
cfs –	cubic feet per second
DO –	dissolved oxygen
EPA -	Environmental Protection Agency
^{0}F -	degrees Fahrenheit
GIS -	geographic information system
mgd/MGD –	million gallons per day
mg/kg -	milligrams per kilogram
mg/l –	milligrams per liter
NPDES -	National Pollutant Discharge Elimination System
NPS -	non point source
NTU -	Nephelometric turbidity unit
P -	phosphate
ppb -	parts per billion
ppd -	pounds per day
ppm -	parts per million

ppt -	parts per thousand
s.u. –	standard units
TKN -	total Kjehldahl nitrogen
USEPA –	United States Environmental Protection Agency
USGS –	United States Geological Survey
ug/g -	micrograms per gram
uS/cm -	micro Siemens per centimeter

DEFINITIONS OF TERMINOLOGY

Aquifer -	a water bearing stratum of sand, gravel, or permeable rock
Impervious surface -	any material that prevents the infiltration of water into the soil
Non-point source -	pollutant introduction from spatially separate origins such as pollution arising from runoff during rain events
Point source -	pollutant introduction from a specific outlet
Potentiometric surface -	a surface of potential, or hydraulic head, for an aquifer
Sample –	physical evidence collected from a facility, site, or from the environment
Terrigenous -	relating to ocean sediment derived directly from the destruction of rocks on the earth's surface
Watershed -	a geographical area from which water drains along common paths. The area is bounded by topographical or other features that contain or otherwise direct the flow of water falling within the watershed.

Bibliography

Alabama Department of Economic and Community Affairs. Planning and Economic Development Division. August 2003. *Alabama County Data Book 2003*. 103 pp.

Alabama Department of Environmental Management. July 1996. *A Survey of the Bon Secour River Watershed*. 45 pp. w/ appendices.

Alabama Department of Environmental Management. August 1997. *A Survey of the Chickasaw Creek Watershed*. 80 pp. w/ appendices.

Alabama Department of Environmental Management. January 1999. *Brushy Creek Watershed Water Quality Assessment Report*. 54 pp.

Alabama Department of Environmental Management. April 2000. *A Survey of the Little Lagoon Watershed*. 36 pp. w/ appendices.

Alabama Department of Environmental Management. May 2000. *Surface Water Quality Screening Assessment of the Tennessee River Basin - 1998*. 201 pp.

Alabama Department of Environmental Management. June 2000. *Standard Operating Procedures and Quality Control Assurance Manual. Volume I*. 216 pp. w/ appendices.

Alabama Department of Environmental Management. April 2001. *A Methodology for Coastal Watershed Assessments*. 22 pp. w/ appendices.

Alabama Department of Environmental Management. May 2002. Administrative Code. Division 335-6. 376 pp.

Alabama Department of Environmental Management. January 2003. *A Survey of the Bayou Sara Watershed*. 86 pp. w/ appendices.

Alabama Department of Environmental Management. September 8, 2003. *Surface Water Analyses Collected During Mobile Targeted Brownfield Phase II*. 86 pp. w/ appendices.

Alabama Department of Public Health. April 4, 2002. *Fish Consumption Advisory.*

The American Heritage® Dictionary of the English Language. 2000.

Daphne Ecological Services Field Office**.** June 11, 2002**.** *Alabama's Federally Listed Species by County.*

Federal Emergency Management Agency. National Flood Insurance Program. July 6, 1998. *Flood Insurance Rate Map. Mobile County, Alabama*.

The Florida Department of Environmental Protection. July 1998. Perdido Ecosystem Management Strategies. 157 pp. w/ appendices.

Geological Survey of Alabama. 1983. *Sensitivity of Alabama Coastal Shoreline Habitats to Spilled Hydrocarbons*. Information Series 63. 76 pp.

Geological Survey of Alabama. 2000. *Hydrogeology and Vulnerability to Contamination of Major Aquifers in Alabama: Area 13*. Compact disc 1. 77 pp.

Geological Survey of Alabama. 2003. *Impervious Surface Mapping for Mobile and Baldwin Counties, Alaba**ma.*** 5 pp.

Grimwood, M.J. & Dixon, E. 1997. *Assessment of risks posed by List II metals to Sensitive Marine Areas (SMAs) and adequacy of existing environmental quality standards (EQSs) for SMA protection.*

Kentucky Natural Resources and Environmental Protection Cabinet. Watershed Watch Project. 2001. *Alkalinity and Water Quality*.

Long, E. R. 1992. Ranges in chemical concentrations in sediments associated with adverse biological effects. Marine Pollution Bulletin. 24(1):38-45.

Long, E. R., D. D. Macdonald, S. L. Smith, and F. D. Calder. 1995. *Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments*. Environmental Management. Volume 19. Number 1. pp 81-97.

Long, E.R., and L.G Morgan. 1990. *The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program*. NOAA Technical Memorandum. NOS OMA 52. U.S. National Oceanic and Atmospheric Administration. 175 pp.

Louis V. Loveman. 1976. *Historical Atlas of Alabama, 1519-1900*. 140 pp.

North Carolina State University Water Quality Group. August 1994. *Watershedss. A Decision Support System for Nonpoint Source Pollution Control. Water, Soil, and Hydro-Environmental Decision Support System*.

Schropp, S.J. and H.L. Windom. 1988. *A Guide to the Interpretation of Metal Concentrations in Estuarine Sediments*. Florida Department of Environmental Regulation, Tallahassee, Florida. 44 pp w/ appendix.

U.S. Department of Agriculture, Soil Conservation Service. May 1980. *Soil Survey of Mobile County, Alabama*. 134 pp. w/plates.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Southern Region Headquarters. June 2002.

U.S. Army Corps of Engineers. Water Operations Technical Support Program. April 1999. *Simplified Procedures for Eutrophication Assessment and Prediction: User Manual*. 239 pp.

U.S. Army Environmental Laboratory. Waterways Experiment Station. August 1999. *FLUX. Stream Load Computations. Version 5.1.*

U.S. Environmental Protection Agency. Fall, 1994. *The Importance of Imperviousness, Watershed Protection Techniques*. Volume 1. Number 3.

U.S. Environmental Protection Agency. 1992. The Watershed Protection Approach. Annual Report.

U.S. Geological Survey. 1988. *Geohydrology and Susceptibility of Major Aquifers to Surface Contamination in Alabama; Area 13*. Water-Resources Investigations Report 88-4080. 29 pp.

APPENDIX

FIELD PARAMETERS

30^0 41.994'
87^0 54.507'

BMC 1

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
1/9/03	1330	11.6	19	61	9.45	0.00	5.28	1.4	5.9	surface
		11.4	19	59	9.39	0.00	5.25			5.0
		10.2	19	56	9.46	0.00	5.51			10.0
2/4/03	920	13.9	13	148	9.39	0.10	6.26	1.4	6.19	surface
		13.8	13	141	9.75	0.10	6.19			5.0
		13.8	13	130	9.93	0.10	6.1			10.0
2/27/03	1105	13.9	17	35	8.04	0.02	4.76	1.2	6.3	surface
		13.8	17	35	7.43	0.02	4.73			5.5
		13.6	17	39	2.7	0.02	4.84			11.0
3/18/03	1115	18.5	30	38	7.06	0.10	4.44	1.0	10.62	surface
		18.1	30	31	6.16	0.10	4.22			7.0
		18	30	32	6.92	0.10	4.31			14.0
3/27/03	1210	21.7	29	58	7.92	0.03	5.65	0.8	9.9	surface
		21.5	29	61	7	0.03	5.69			5.8
		21.2	29	65	7.06	0.03	5.69			11.5
4/14/03	940	18.4	25	106	7.66	0.05	4.5	0.8	10.8	surface
		17.4	25	106	7.45	0.05	4.67			4.1
		16.2	25	101	1.6	0.05	4.82			8.2
4/29/03	1125	23.5	31	82	6.9	0.04	5.46	0.9	7.9	surface
		22.8	31	88	6.45	0.04	5.56			5.0
		21.8	31	116	2.05	0.05	5.69			10
5/3/03	1205	28.5	29	77	6.92	0.03	5.62	0.5	6.4	surface
		27.4	29	86	3.18	0.04	5.97			6.0
		26.2	29	151	1.14	0.07	5.94			12
5/21/03	1110	22.9	29	24	5.79	0.01	4.5	0.4	27.3	surface
		22.5	29	25	5.12	0.01	4.52			5.0
		22.1	29	29	6.57	0.01	4.56			10
6/24/03	1135	28.7	31	27	5.74	0.01	4.91	0.6	12.2	surface
		26.4	31	28	4.42	0.01	4.95			5.0
		24.3	31	26	4.91	0.01	4.82			10

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
7/28/03	1000	27.1	31	40	6.4	0.02	6.14	0.6	18.5	surface
		25.1	31	27	5.8	0.01	5.58			6.0
		24.9	31	25	5.94	0.01	5.42			12.0
8/21/03	1105	28.1	32	33	7.41	0.01	5.86	0.7	12.6	surface
		27.8	32	33	7.15	0.01	5.86			4.4
		27	32	60	0.7	0.03	6.28			8.9
9/16/03	925	25.8	25	107	6.37	0.05	6.38	0.7	13.4	surface
		25.6	25	97	5.84	0.04	6.23			4.8
		24.3	25	49	2.71	0.02	6.28			9.5
10/23/03	1240	23	28	1180	8.11	0.58	6.57	1	8.1	surface
		22.1	28	1200	7.98	0.60	6.53			5.4
		21.7	28	1103	7.7	0.55	6.45			10.8
11/25/03	1205	16.7	15	205	7.42	0.10	6.23	0.8	12	surface
		16	15	285	7.32	0.14	6.35			4.1
		16	15	376	8.02	0.20	6.37			8.1
12/4/03	1215	15	19	115	8.31	0.05	6.01	0.7	19.4	surface
		12.9	19	63	7.93	0.03	6.00			5.0
		13	19	60	8.83	0.03	6.02			10.1
12/18/03	1145	10.3	15	48	10.44	0.02	6.15	0.7	16.6	surface
		10.4	15	48	10.13	0.02	6.22			3.8
		10.3	15	51	10.8	0.02	6.13			7.6
1/8/04	940	10.9	8	75	10.81	0.03	6.51	0.4	19.6	surface
		10.9	8	95	8.7	0.04	6.34			4.7
		10.7	8	101	0.39	0.05	6.09			9.4
1/27/04	1115	13.5	10	27	6.98	0.01	5.53	0.5	18.6	surface
		13.5	10	36	7.01	0.02	5.61			4.9
		12.5	10	66	5.53	0.03	6.32			9.7
2/10/04	935	12.5	14	35	9.75	0.02	6.07	0.9	10.4	surface
		12.4	14	43	10	0.02	6.17			4.9
		12.1	14	91	10.1	0.04	5.93			9.9
2/26/04	950	13.1	7	22	8.68	0.01	5.33		43.9	surface
		13.1	7	22	7.34	0.01	5.52			5.1

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
		13.1	7	24	0.33	0.01	5.92			10.2
3/17/04	1135	18.7	25	40	8.31	0.02	6.09	0.9	10.5	surface
		17.8	25	39	7.57	0.02	6.10			4.9
		17.5	25	41	8.82	0.02	5.95			9.9
3/30/04	1125	22.1	28	62	9.58	0.03	6.43	0.8	15.2	surface
		21.3	28	60	9.18	0.03	6.29			4.7
		20.4	28	52	8.96	0.02	6.16			9.3
4/15/04	1140	19.3	26	74	10.32	0.03	6.15	1	8.7	surface
		19	26	75	8.93	0.03	6.12			4.5
		17.9	26	80	4.82	0.04	6.14			9.0
4/28/04	1145	22.2	27	111	7.81	0.05	6.34	0.5	21.3	surface
		21.9	27	111	6.94	0.05	6.27			4.5
		21.7	27	100	5.72	0.05	6.13			9.9
5/11/04	1200	24.9	28	119	7.45	0.06	6.5	0.6	19.1	surface
		24.7	28	121	6.92	0.06	6.41			5.6
		24.5	28	119	5.64	0.05	6.25			11.2
5/24/04	1140	27.4	32	123	7.18	0.06	6.41		14.8	surface
		26.9	32	116	6.77	0.05	6.32			5.6
		25.6	32	101	4.33	0.05	6.18			11.1
6/3/04	950	24.1	24	68	6.06	0.03	6.12	0.6	21.8	surface
		23.6	24	54	5.78	0.02	6.02			5.2
		23.1	24	38	5.48	0.02	6.12			10.3
7/14/04	1200	30.7	35	92	6.06	0.04	6.05	0.4	11.3	surface
		28.4	35	75	4.6	0.03	5.74			6.4
		25.9	35	50	2.95	0.02	5.68			12.8
	Average	19.6	24	113	6.86	0.06	5.79	0.8	14.5	10.2
	Maximum	30.7	35	1200	10.81	0.60	6.57	1.4	43.9	14.0
	Minimum	10.2	7	22	0.33	0.00	4.22	0.4	5.9	7.6

30^0 42.901'
87^0 53.048'

BMC 2

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
1/9/03	1315	11.07	19	51	9.49	0	5.11	2.5	3.4	surface
		9.83	19	43	9.56	0	5.1			9.6
		9.63	19	45	10.7	0	5.21			19.1
2/4/03	950	12.8	14	89	8.74	0	5.38	2.2	3.53	surface
		12.7	14	75	8.81	0	5.35			10.9
		12.7	14	75	9.28	0	5.38			22.1
2/27/03	1135	13.6	17	27	8.67	0.01	4.76	0.8	10.3	surface
		13.5	17	27	8.72	0.01	4.82			7.9
		13.5	17	27	8.83	0.01	4.95			15.8
3/18/03	1135	18.4	29	27	7.61	0.01	4.34	1.2	8.46	surface
		17.5	29	27	7.64	0.01	4.22			8.0
		17.4	29	27	7.45	0.01	4.19			16.0
3/27/03	1240	21.5	29	30	7.17	0.01	4.9	1.2	4.6	surface
		19.1	29	30	7.07	0.01	4.91			7
		17.4	29	27	7.38	0.01	4.91			14
4/14/03	1005	20.7	25	33	7.56	0.01	4.36	1.2	5.6	surface
		16	25	29	7.87	0.01	4.24			8.3
		15.64	25	30	7.4	0.01	4.28			16.5
4/29/03	1140	24.1	32	34	6.75	0.01	4.91	0.8	6.2	surface
		19.9	32	29	6.24	0.01	4.7			9.5
		19.8	32	29	6.22	0.01	4.81			19
5/13/03	1230	28.2	30	84	5.22	0.04	5.33	0.9	4.5	surface
		24.4	30	76	3.98	0.03	4.97			8
		23.5	30	117	2.44	0.05	5.52			16
5/21/03	1140	21.8	29	22	6.54	0.01	4.34	0.4	27.4	surface
		21.7	29	22	6.59	0.01	4.34			8.0
		21.7	29	21	6.74	0.01	4.35			15.5

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
6/24/03	1155	25.9	31	24	6.3	0.01	4.77	0.5	23.9	surface
		24	31	23	6.64	0.01	4.74			8.0
		23.9	31	23	6.78	0.01	4.78			16.0
7/28/03	1025	25.3	31	19	6.06	0.01	5.02	0.5	26.8	surface
		24.2	31	19	6.14	0.01	5.02			9.5
		24.2	31	19	5.86	0.01	5.04			19.0
8/21/03	1125	26.3	31	24	7.44	0.01	5.41	0.8	8.1	surface
		25.3	31	23	7.51	0.01	5.38			8.8
		25	31	23	7.6	0.01	5.38			17.6
9/16/03	950	23.6	25	25	5.84	0.01	5.3	0.4	36.5	surface
		23.5	25	25	5.84	0.01	5.3			7.9
		23.4	25	24	6.48	0.01	5.49			15.8
10/23/03	1255	23.2	28	97	7.34	0.04	5.71	1.4	4.9	surface
		18.5	28	26	7.33	0.01	5.69			8.7
		17.4	28	35	7.51	0.02	6.04			17.4
11/25/03	1225	16	16	30	7.09	0.01	5.64	1.0	5	surface
		14.7	16	29	7.15	0.01	5.67			7.7
		14.8	16	30	7.3	0.01	5.87			15.4
12/4/03	1235	13.5	20	30	9.3	0.01	5.44	0.9	5.6	surface
		11.7	20	29	9.66	0.01	5.45			8.7
		11.8	20	70	9.92	0.03	6.72			17.3
12/18/03	1200	10.5	17	25	10.05	0.01	5.5	1.6	6.4	surface
		10.08	17	25	10.08	0.01	5.49			8.6
		10.03	17	25	10.1	0.01	5.5			17.2
1/8/04	1000	12.3	8	26	9.35	0.01	5.6	1.1	6.4	surface
		12.3	8	26	9.36	0.01	5.59			8.6
		12.4	8	28	9.61	0.01	5.5			17.3
1/27/04	1130	14.2	10	26	6.71	0.01	5.09	0.6	17.2	surface
		14.1	10	26	6.64	0.01	5.09			8.2
		14	10	26	6.34	0.01	5.03			16.4
2/10/04	955	12.7	12	29	9.51	0.01	5.59	1.0	10.4	surface
		11.6	12	29	9.83	0.01	5.55			7.9

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
		11.5	12	29	10.2	0.01	5.66			15.8
2/26/04	1000	13	7	20	9.49	0.01	4.95		31.4	surface
		13	7	20	9.46	0.01	4.96			8.0
		13	7	20	9.46	0.01	4.99			16.0
3/17/04	1150	17.1	24	21	8.26	0.01	5.6	1.3	6.4	surface
		16	24	21	8.28	0.01	5.62			7.7
		15.7	24	22	8.39	0.01	5.75			15.4
3/30/04	1145	21.8	27	25	8.47	0.01	5.74	1.8	4.2	surface
		19	27	24	8.53	0.01	5.71			7.2
		17.1	27	24	8.62	0.01	5.87			14.3
4/15/03	1155	18.1	26	25	9.19	0.01	5.68	1.6	4.2	surface
		17	26	25	8.98	0.01	5.72			6.5
		16.8	26	26	8.82	0.01	5.89			13.0
4/28/04	1200	22.4	27	27	6.84	0.01	6.07	1.1	5.8	surface
		20.5	27	30	6.32	0.01	6.17			7.9
		20.3	27	30	6.95	0.01	6.37			15.9
5/11/04	1215	24.4	26	54	6.3	0.02	6.17	1.1	6.8	surface
		21.8	26	37	5.84	0.02	5.94			8.0
		20.1	26	33	6.38	0.01	6.6			16.0
5/24/04	1200	27.5	33	67	5.92	0.03	6.18		7.3	surface
		25.3	33	46	5.07	0.02	5.57			8.2
		22.7	33	31	5.32	0.01	5.61			16.4
6/3/04	1015	22.5	26	28	5.64	0.01	4.84	0.6	22.8	surface
		22	26	28	5.61	0.01	4.96			8.8
		22	26	28	5.7	0.01	5.53			17.5
6/17-18/04	1200-1215	29.1		54	4.98	0.02	5.34			surface
7/14/04	1215	30.8	31	58	5.33	0.03	5.59	0.5	6.8	surface
		26.5	31	33	4.51	0.01	5.59			8.3
		25.4	31	27	4.28	0.01	5.83			16.6
	Average	20.4	25	31	7.14	0.01	5.67	1.1	10.6	*16.4
	Maximum	30.8	33	117	10.7	0.05	6.72	2.5	36.5	*19

Minimum	9.63	7	19	2.44	0	4.19	0.4	3.4	*13

* denotes total depth

30^0 43.356'
87^0 52.514'

BMC 3

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
1/9/03	1300	10.7	18	48	9.72	0	5.03	2.4	2.8	surface
		10.14	18	46	9.85	0	4.99			7.6
		9.67	18	49	10.12	0	5.17			15.5
2/4/03	1010	12.7	14	79	8.86	0	5.32	2.6	3.01	surface
		12.5	14	72	8.91	0	5.27			6.3
		12.1	14	69	9.35	0	5.44			12.9
2/27/03	1155	14.3	20	27	8.34	0.01	4.62	0.7	12.5	surface
		13.8	20	27	7.2	0.01	4.68			8.5
		13.8	20	34	5.82	0.02	5.34			17.0
3/18/03	1145	17.2	29	25	7.99	0.01	3.82	1	9.46	surface
		17.5	29	25	8.11	0.01	3.94			9.0
		17.9	29	30	1.74	0.01	4.31			18.0
3/27/03	1310	20.6	29	26	7.31	0.01	4.79	1.1	4.3	surface
		16.7	29	24	7.69	0.01	4.85			8.5
		16.6	29	35	6.61	0.02	5.06			17.0
4/14/03	1030	18.4	26	25	8.02	0.01	4.46	0.9	4.7	surface
		15.8	26	24	8.27	0.01	4.48			8.3
		15.1	26	28	7.1	0.01	4.51			16.5
4/29/03	1150	23.4	32	29	6.98	0.01	4.71	0.65	6.6	surface
		19.6	32	27	6.02	0.01	4.76			6.5
		19.2	32	34	6.12	0.02	5.01			13.0
5/13/03	1245	28.6	31	46	5.34	0.02	5.07	0.7	3.7	surface
		23.9	31	28	5.21	0.01	4.91		F.D. 4.0	9.5
		19.6	31	59	1.17	0.03	5.46			19.0
5/21/03	1200	21.6	29	22	6.69	0.01	4.34	0.5	25.5	surface
		21.6	29	22	6.74	0.01	4.34			8.0
		21.6	29	22	7.05	0.01	4.37			16.0
6/24/03	1210	24.9	30	23	6.32	0.01	4.59	0.5	24.3	surface
		23.9	30	23	6.47	0.01	4.53			8.0

		23.9	30	23	6.68	0.01	4.56			16.0

Date dd/mm/yy	Time	H_20 Temp. ^{0}C	Air Temp. ^{0}C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
8/21/03	1150	24.8	33	22	8.21	0.01	5.30	0.8	11.9	surface
		23.9	33	22	8.24	0.01	5.29			10.0
		23.8	33	22	7.16	0.01	5.62			20.0
9/16/03	1000	23.7	26	25	6.06	0.01	5.25	0.7	17	surface
		23.1	26	25	6.12	0.01	5.25			8.1
		23	26	28	6.54	0.01	5.60			16.2
10/23/03	1310	22.6	28	35	7.42	0.01	5.94	1.5	3.6	surface
		17.8	28	23	7.87	0.01	6.13			9.0
		17.9	28	170	1.96	0.08	6.78			18.0
11/25/03	1245	15.9	16	23	7.77	0.01	5.59	1.3	3.5	surface
		14.7	16	22	7.8	0.01	5.59			9.0
		14.6	16	25	7.87	0.01	5.75			18.0
12/4/03	1250	14.4	21	27	9.51	0.01	5.30	1.6	4.8	surface
		12.1	21	26	9.96	0.01	5.59			9.3
		12.1	21	31	10.54	0.02	5.67			18.5
12/18/03	1215	11	17	23	9.66	0.01	5.57	2.2	3.7	surface
		10.5	17	23	8.68	0.01	5.84			9.3
		10.5	17	34	10.31	0.01	5.67			18.6
1/8/04	1010	12.6	8	73	9.57	0.03	5.97	1.1	4.6	surface
		12.6	8	76	9.4	0.04	6.25			7.3
		12.6	8	68	0.22	0.03	5.91			14.6
1/27/04	1145	13.8	8	25	6.78	0.01	5.06	0.8	14.9	surface
		13.6	8	26	6.36	0.01	5.24			5.4
		13.6	8	34	1.19	0.01	6.08			10.8
2/10/04	1015	11.8	13	28	10.12	0.01	5.33	1.7	5.6	surface
		10.4	13	27	10.52	0.01	5.37			7.0
		10.3	13	27	10.72	0.01	5.44			14.0
2/26/04	1015	12.8	7	21	9.51	0.01	4.95		21.7	surface
		12.8	7	21	9.16	0.01	4.99			7.2
		13	7	46	5.28	0.02	5.91			14.5
3/17/04	1205	18.2	25	20	8.21	0.01	5.52	1.4	6.8	surface

		16.4	25	20	8.26	0.01	5.69			8.0

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
		14.6	25	27	9.12	0.01	5.75			16.1
3/30/04	1200	21.7	28	22	8.69	0.01	5.65	1.9	3.1	surface
		18.1	28	22	8.82	0.01	5.59			6.8
		17	28	24	8.5	0.01	5.65			13.6
4/15/04	1215	17.6	29	30	9.03	0.01	6.05	1.5	3.7	surface
		16.6	29	112	7.91	0.05	6.32			7.5
		16.6	29	126	2.12	0.06	6.16			15.0
4/28/04	1215	21.5	28	24	6.91	0.01	6.39	1.1	5.3	surface
		19.8	28	24	5.99	0.01	6.63			7.9
		17.7	28	93	1.73	0.04	6.18			15.9
5/11/04	1230	24.1	28	30	6.18	0.01	6.36	1.3	4.4	surface
		19.9	28	24	4.54	0.01	6.42			9.7
		18	28	53	1.16	0.02	6.18			19.5
5/24/04	1215	27.1	33	35	5.27	0.01	5.45		6.3	surface
		22.1	33	25	5.17	0.01	5.53			8.6
		21.1	33	28	5.22	0.01	6.00			17.1
6/3/04	1030	22	26	27	6.29	0.01	4.81	0.7	20.5	surface
		21.5	26	27	6.3	0.01	4.83			8.4
		21.5	26	26	5.98	0.01	5.46			16.8
6/18-22/04	1200-1245	27.3		18	8.67	0.01	4.61			surface
7/14/04	1230	30.9	32	37	5.3	0.02	5.40	0.5	5.9	surface
		25.1	32	24	4.49	0.01	5.31			8.4
		24.1	32	25	3.91	0.01	5.52			16.8
	Average	17.9	24	36	7.01	0.01	5.35	1.2	8.7	*16.2
	Maximum	30.9	33	170	10.72	0.08	6.78	2.6	25.5	*20
	Minimum	9.67	7	18	0.22	0.00	3.82	0.5	2.8	*10.8

* denotes total depth

BMC 4

30^0 44.186'
87^0 52.527'

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
1/9/03	1230	10.1	18	47	10.51	0	5.14	1.5	2.5	surface
		10	18	45	10.05	0	5.16			2.3
		10.1	18	43	10.16	0	5.16			4.9
2/4/03	1040	13.6	15	72	8.89	0	5.38	1.1	2.84	surface
		13.6	15	68	9.04	0	5.38			1.7
		13.6	15	67	9.94	0	5.40			3.6
2/27/03	1230	14	22	27	8.79	0.01	4.37	0.7	14.8	surface
		14	22	27	8.82	0.01	4.34			2.6
		14	22	27	8.99	0.01	4.39			5.2
3/18/03	1210	17.12	29	24	8.41	0.01	4.20	1.1	9.39	surface
		17.12	29	24	8.44	0.01	4.16			4.5
		17.12	29	24	8.48	0.01	4.10			9.0
3/27/03	1330	19.7	29	22	8.43	0.01	4.91	1.6	3.5	surface
		17.4	29	22	8.70	0.01	5.03			3.5
		17.4	29	22	8.92	0.01	5.16			7.0
4/14/03	1100	16.7	28	23	8.69	0.01	4.7	1.3	3.7	surface
		16.4	28	23	8.77	0.01	4.74			2.5
		16.4	28	23	8.87	0.01	5.02			5.0
4/29/03	1230	21.2	33	24	8.51	0.01	4.98	1.5	3.5	surface
		18.4	33	24	8.87	0.01	5.03			3.2
		18.2	33	23	9.00	0.01	5.19			6.5
5/13/03	1325	22.1	32	25	8.00	0.01	5.06	0.8	6.3	surface
		21.4	32	25	7.95	0.01	5.27			3.0
		21.5	32	25	7.92	0.01	5.65			6.0
	field duplicate	22.2	32	25	8.03	0.01	5.05			surface
		21.4	32	25	8.08	0.01	5.27			3.0
		21.5	32	25	8.10	0.01	5.64			6.0
5/21/03	1225	21.7	29	22	6.73	0.01	4.23	0.4	25.9	surface

		21.7	29	22	6.80	0.01	4.29			3.0
		21.7	29	22	7.13	0.01	4.32			6.0

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
6/24/03	1230	23.8	31	23	6.62	0.01	4.45	0.5	33.1	surface
		23.8	31	23	6.70	0.01	4.42			2.5
		23.8	31	23	7.32	0.01	4.45			5.0
8/21/03	1220	23.7	33	22	8.47	0.01	5.08	0.2	68	surface
		23.7	33	22	8.53	0.01	5.08			3.3
		23.7	33	22	8.87	0.01	5.06			6.5
9/16/03	1025	21.8	26	22	7.53	0.01	5.45	1.1	8	surface
		21.8	26	22	7.59	0.01	5.46			4.0
		21.8	26	22	8.07	0.01	5.44			8.0
10/23/03	1340	19.4	29	22	8.35	0.01	5.82	1.7	3.4	surface
		18.5	29	22	8.44	0.01	5.94			3.3
		18.3	29	30	8.74	0.01	6.09			6.6
11/25/03	1320	13	16	22	8.99	0.01	5.72	1.2	3.3	surface
		13	16	21	8.97	0.01	5.72			2.8
		13	16	22	9.53	0.01	5.68			5.6
12/4/03	1310	14	23	27	9.71	0.01	5.29	1.6	4.8	surface
		14	23	27	9.72	0.01	5.33			3.7
		14	23	27	9.84	0.01	5.38			7.3
12/18/03	1235	9.96	18	21	10.99	0.01	5.55	1.6	3.2	surface
		9.94	18	21	11.02	0.01	5.52			2.8
		10.1	18	22	11.52	0.01	5.64			5.5
1/8/03	1040	9.4	9	22	11.37	0.01	5.68	1.7	3.3	surface
		9.4	9	22	11.27	0.01	5.68			2.6
		9.5	9	20	10.74	0.01	5.69			5.2
1/27/04	1210	12.8	8	25	6.92	0.01	5.05	1	10.5	surface
		12.7	8	25	6.89	0.01	5.06			1.7
		12.7	8	25	6.92	0.01	5.07			3.4
2/10/04	1040	11.5	11	25	10.61	0.01	5.52	2	3.5	surface
		11.5	11	25	10.73	0.01	5.53			3.0
		11.5	11	25	11.20	0.01	5.55			6.0

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Secchi Depth m	Turbidity ntu	Depth feet
2/26/04	1045	12.4	7	21	9.92	0.01	4.88		12.1	surface
		12.4	7	21	9.92	0.01	4.88			4.6
		12.4	7	20	9.97	0.01	4.89			9.2
3/17/04	1225	16.2	26	20	9.19	0.01	5.43	1.5	4.8	surface
		16.1	26	20	9.21	0.01	5.44			2.6
		16.1	26	20	9.32	0.01	5.35			5.2
3/30/04	1220	19.2	28	21	9.34	0.01	5.69	2.1	3.6	surface
		18.8	28	21	9.41	0.01	5.71			1.9
		18.8	28	21	9.45	0.01	5.78			3.8
4/15/04	1250	15	31	21	11.52	0.01	5.88	1	2.1	surface
		14.6	31	21	11.53	0.01	5.89			1.5
		14.6	31	21	11.62	0.01	5.93			3.0
Field Dupicate		14.9	31	21	11.59	0.01	5.84	1	2	surface
		14.4	31	21	11.64	0.01	5.85			1.5
		14.4	31	21	11.62	0.01	5.89			3.0
4/28/04	1235	19.1	29	22	8.83	0.01	5.74	1.3	2.9	surface
		17.7	29	22	9.15	0.01	5.82			2.6
		17.6	29	22	9.35	0.01	5.97			5.2
5/11/04	1255	20.9	29	22	7.79	0.01	5.79	1.9	3.8	surface
		19.9	29	22	7.95	0.01	5.87			3.0
		19.9	29	22	8.13	0.01	5.95			6.0
5/24/04	1235	23.8	33	22	7.26	0.01	5.47		3.6	surface
		21.2	33	22	7.70	0.01	5.74			2.6
		21.1	33	22	7.91	0.01	5.86			5.2
6/3/04	1055	21.5	26	25	6.79	0.01	4.83	0.8	17.2	surface
		21.5	26	25	6.79	0.01	4.86			3.5
		21.5	26	25	6.85	0.01	4.92			7.0
7/14/04	1300	24	34	20	6.14	0.01	5.45	1.1	4.3	surface
		23.9	34	20	5.98	0.01	5.54			2.9
		24.1	34	24	5.68	0.01	5.9			5.9
	Average	17.2	25	25	8.86	0.01	5.28	1.2	9.3	5.7
	Maximum	24.1	34	72	11.64	0.01	6.09	2.1	68.0	9.2

Minimum	9.4	7	20	5.68	0.00	4.10	0.2	2.0	3.0

BMC 5

30^0 46.623'
87^0 52.310'

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Flow cfs	Turbidity ntu	Depth feet
1/9/03	1105	8.44	20	49	10.51	0.00	4.94	19	1.3	2
2/4/03	1200	12.7	16	74	9.12	0.00	5.59	19.6	2.4	1.9
2/27/03	1025	13.9	19	25	7.58	0.01	4.2		6.8	
field dup.		13.9	19	25	7.56	0.01	4.2		6.8	
3/18/03	1020	17.5	26	25	7.82	0.01	4.09	55.4	4.7	3.5
3/27/03	1115	18.3	28	22	8.14	0.01	4.4	22.7	2.9	1.7
4/8/03	1040	18.6	21	19	6.98	0.01	4.8		5.0	
4/29/03	1045	18.7	27	17	8.41	0.01	4.41	14.2	3.3	1.7
5/13/03	1115	21.6	28	28	7.99	0.01	4.65	11.7	7.2	1.5
5/21/03	1030	21.5	27	21	5.56	0.01	4.47		16.8	
6/24/03	1050	23.8	28	21	6.4	0.01	4.46		33.4	
7/28/03	1100	23.4	22	21	5.07	0.01	5.29		41.8	
8/21/03	1035	24	33	19	6.8	0.01	4.93		32.1	
9/16/03	1125	21.5	29	23	7.49	0.01	5.43	28.1	4.0	1.9
10/23/03	1140	17.6	22	24	8.49	0.01	5.84	15.4	3.4	1.6
11/25/03	1105	11	10	22	9.23	0.01	5.8	18	2.2	1.5
12/4/03	1105	12.8	20	27	9.84	0.01	5.48	46.5	3.4	2.8
12/18/03	1055	7.8	15	22	11.04	0.01	5.61	21.9	1.8	1.7
1/8/03	1135	8	8	23	11.81	0.01	5.72		2.6	
1/27/04	1000	11.7	10	24	6.63	0.01	5.18		9.2	
2/10/04	1400	10.8	13	26	11.22	0.01	5.68	27.2	2.6	2.1
2/26/04	930	11.8	8	20	10.05	0.01	5.17		8.3	
3/17/04	1025	15.2	23	21	9.92	0.01	6.22	41.2	3.6	2.7
3/30/04	1040	19.2	25	22	9.02	0.01	5.86	18.8	9.5	1.9
4/15/04	1045	13.2	21	22	11.82	0.0	5.97	23	2.4	2.4
4/28/04	1058	17.4	25	24	8.63	0.0	5.78	25.6	3.4	2.1
5/11/04	1105	20.7	28	25	7.2	0.0	5.76	10.3	4.2	1.5

5/24/04	1040	21.9	29	25	6.86	0.0	5.63	11.1	3.8	1.5
6/2/04	1020	21.2	25	36	4.96	0.0	5.06		17.6	
7/14/04	1110	25.2	31	22	5.77	0.0	5.73	11.3	5.3	1.4

BMC 5

	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Flow cfs	Turbidity ntu	Depth feet
Average	16.8	22	26	8.26	0.01	5.21	23.2	8.4	2.0
Maximum	25.2	33	74	11.82	0.02	6.22	55.4	41.8	3.5
Minimum	7.8	8	17	4.96	0	4.09	10.3	1.3	1.4

30^0 48.824'
87^0 50.319'

BMC 6

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Flow cfs	Turbidity ntu	Depth feet
1/9/03	1020	8.4	18	46	9.63	0	5.24	17.3	1.8	1.9
2/4/03	1245	13	16	78	9.01	0	5.63	25.8	1.8	2.3
2/27/03	1000	13.9	20	27	8.49	0.01	4.26		12.4	
3/18/03	940	17.3	24	26	7.00	0.01	5.90	33.1	5.9	3.0
3/27/03	1035	17.7	26	24	7.73	0.01	4.56	22.5	2.3	2.1
4/8/03	1015	18.5	21	21	7.06	0.01	4.27		7.0	
4/29/03	1020	18	28	27	7.18	0.01	4.43	17.4	4.7	1.9
5/13/03	1020	20.5	25	29	6.02	0.01	4.53	13.4	3.0	2.0
5/21/03	1005	21.6	27	16	6.61	0.01	4.46		30.4	
6/24/03	1030	23.8	29	24	5.81	0.01	4.83		8.1	
7/28/03	1025	23	23	20	5.57	0.01	5.43		37.5	
8/21/03	1005	23.6	32	21	7.86	0.01	5.59		22.6	
9/16/03	1220	22.3	30	24	6.82	0.01	5.63	24.2	4.5	2.3
10/23/03	1050	17.7	21	25	8.06	0.01	5.68	16.8	2.8	2.3
11/25/03	1020	10.4	10	23	8.33	0.01	5.73	16.7	2.4	2.8
12/4/03	1015	13.5	18	28	9.02	0.01	5.57	36.8	2.9	3.2

12/18/03	1010	7.4	13	23	10.9	0.01	5.65	22.8	2.0	2.5
1/8/03	1155	7.87	9	25	10.86	0.01	5.72		3.0	
1/27/04	940	11.6	6	25	6.89	0.01	5.61		12.2	
2/10/04	1305	11.1	13	27	10.97	0.01	5.76	25.6	2.8	2.5
2/26/04	900	11.7	8	21	10.08	0.01	5.24		13.9	
Date dd/mm/yy	**Time**	**H_20 Temp. ^0C**	**Air Temp. ^0C**	**Sp. Cond. uS/cm**	**D.O. ppm**	**Salinity ppt**	**pH s.u.**	**Flow cfs**	**Turbidity ntu**	**Depth feet**
3/17/04	945	14.9	21	22	9.11	0.01	5.73	21.2	3.8	2.2
3/30/04	955	18.5	24	24	8.13	0.01	5.79	14.1	3.3	2.2
4/15/04	1015	12.7	20	24	11.23	0.01	5.73	10.1	2.6	2.2
4/28/04	1020	16.1	23	26	7.7	0.01	5.75	10.6	2.8	2.3
5/11/04	1025	20.3	26	26	5.7	0.01	5.74	8	3.8	2.1
5/24/04	955	21.3	29	26	5.7	0.01	5.68	9.2	4.8	2.1
6/2/04	1000	21.4	25	22	6.19	0.01	5.27		18.8	
7/14/04	1020	24.6	31	24	4.83	0.01	5.48	15.2	5.3	2.2
7/21-23/04	1315-1300	24.7		20	4.95	0.01	4.72			
	Average	16.6	21	27	7.88	0.01	5.34	19.0	7.9	2.3
	Maximum	24.7	32	78	11.23	0.01	5.9	36.8	37.5	3.2
	Minimum	7.4	6	16	4.83	0.00	4.26	8	1.8	1.9

30^0 46.599'

BMC 7

87^0 49.524'

Date dd/mm/yy	Time	H_20 Temp. ^0C	Air Temp. ^0C	Sp. Cond. uS/cm	D.O. ppm	Salinity ppt	pH s.u.	Flow cfs	Turbidity ntu	Depth feet
1/9/03	940	10.2	15	44	9.86	0	5.21	37.2	2.8	2.6
2/4/03	1330	14.2	16	75	9.68	0	5.62	34.6	3.1	2.4
2/27/03	935	14	20	25	9.12	0.01	3.91		17.9	
3/18/03	905	16.6	20	22	8.93	0.01	6.02	75.4	8.6	3.4
3/27/03	940	16.9	26	21	9.35	0.01	5.84	48.8	2.7	2.5
4/8/03	935	18.5	21	20	8.27	0.01	4.13		25.5	
4/29/03	945	18	25	22	9.6	0.01	4.5	29.5	4.0	2.3
5/13/03	925	19.6	25	23	8.91	0.01	4.5	33.2	5.3	2.1

5/21/03	935	21.3	28	24	5.58	0.01	3.85		70.1	
6/24/03	945	22.6	27	22	7.76	0.01	4.42	110.9	17.3	4.2
7/28/03	945	22.9	24	22	5.96	0.01	5.14		43.7	
8/21/03	940	23.1	31	21	9.3	0.01	5.27		43.2	
9/16/03	1310	21.2	31	21	8.22	0.01	5.63	53.5	7.0	3.2
10/23/03	1005	17.6	21	22	9.18	0.01	5.56	36.6	4.3	2.6
Date	**Time**	**H_20 Temp.**	**Air Temp.**	**Sp. Cond.**	**D.O.**	**Salinity**	**pH**	**Flow**	**Turbidity**	**Depth**
dd/mm/yy		**^0C**	**^0C**	**uS/cm**	**ppm**	**ppt**	**s.u.**	**cfs**	**ntu**	**feet**
11/25/03	920	12	5	21	9.7	0.01	6.33	38.5	3.0	2.6
12/4/03	940	14	19	26	9.74	0.01	5.15		11.6	
12/18/03	910	9.8	9	20	11.01	0.01	5.31	42.9	3.4	3
1/8/03	1240	10.3	8	21	11.36	0.01	5.82		2.8	2.8
1/27/04	910	12.9	5	22	7.43	0.01	5.18		12.6	
2/10/04	1200	12.7	12	24	10.89	0.01	5.77	52.7	3.2	3.4
2/26/04	840	12.5	8	19	10	0.01	5.13		18.8	
3/17/04	855	14.8	19	19	9.95	0.01	6.19	51.6	4.1	3.1
3/30/04	910	18.3	21	20	9.57	0.01	5.54	46.7	4.2	2.7
4/15/04	930	13.8	17	22	12.07	0.01	5.53	28.1	2.6	2.4
4/28/04	925	16.7	21	21	9.58	0.01	5.51	39.5	3.4	2.6
5/11/04	920	19.5	24	21	8.53	0.01	5.48	26.2	3.4	2.1
5/24/04	900	20.1	25	21	8.5	0.01	5.1	25.9	3.5	2.1
6/2/04	915	21.2	26	23	7.16	0.01	4.96		34.4	
7/14/04	925	23.9	27	19	7.26	0.01	5.31	35.3	8.6	2.6
7/19-21/04	1200-1300	22.5		20	7.47	0.01	4.75			
	Average	17.1	20	24	9.00	0.01	5.22	44.6	12.94	2.7
	Maximum	23.9	31	75	12.07	0.01	6.33	110.9	70.1	4.2
	Minimum	9.8	5	19	5.58	0.00	3.85	25.9	2.6	2.1

LABORATORY ANALYSIS

BMC 1

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1335	< 2	< 5.0	36	0.01	0.3	0.013	0.018	0.005
2/4/03	925	32	< 5.0	53	0.04	0.59	0.067	0.02	< 0.005
2/27/03	1105	120	< 5.0	36	< 0.01	0.41	0.041	< 0.005	0.015
Field Duplicate	1105	90	< 5.0	37	0.01	0.54	0.042	0.016	< 0.005
3/18/03	1120	52	< 5.0	39	0.01	0.45	0.036	0.062	0.005
3/27/03	1215	10	8	55	0.02	0.69	0.026	0.033	0.008
4/14/03	945	14	5	47	0.02	0.47	0.018	0.033	< 0.005
4/29/03	1130	20	< 5.0	55	0.02	0.71	0.029	0.039	
5/13/03	1210	12	5	58	0.05	0.88	0.013	0.039	0.007
5/21/03	1115	640	10	55	0.07	0.66	0.039	0.039	< 0.005
6/24/03	1140	180	9	50	0.01	0.47	0.036	0.015	< 0.005
7/28/03	1005	560	6	52	0.03	0.46	0.017	0.007	0.033
8/21/03	1110	91	9	107	0.02	0.59	0.028	0.007	0.022
9/16/03	930	91	6	81	< 0.01	0.55	0.032	0.043	0.009
10/23/03	1245	10	< 5.0	564	< 0.01	2.10	0.052	0.022	0.016
11/25/03	1210	170	8	120	< 0.01	0.49	0.095	0.04	0.04
12/4/03	1220	140	8	71	< 0.01	0.83	0.061	0.046	0.02
12/18/03	1150	95	9	46	0.01	0.66	0.058	0.027	
1/8/04	940	180	11	57	0.01	0.32	0.048	0.045	0.041
1/27/04	1115	950	6	34	0.03	0.23	0.063	0.018	
Field Duplicate	1115	700	7	26	0.02	0.23	0.064	0.024	
2/10/04	940	140	6	30	0.01	0.46	0.0122	0.023	0.018
2/26/04	955	740	11	43	0.01	0.49	0.095	0.036	
3/17/04	1140	66	6	30	0.01	0.37	0.026	0.074	0.015
3/30/04	1130	10	13	36	0.01	0.42	0.021	0.036	0.026
4/15/04	1145	100	9	65	0.01	0.29	0.039	0.032	0.032
4/28/04	1150	14	10	83	< 0.01	0.25	0.014	0.041	
5/11/04	1205	32	15	80	< 0.01	1.23	0.018	0.053	0.015
5/24/04	1145	18	10	81	< 0.01	0.32	0.017	0.04	0.013
6/3/04	955	480	11	59	0.02	0.51	0.052	0.034	0.037
7/14/04	1205	16	7	84	0.01	0.82	0.013	0.039	0.012
	Average	192	< 7.0	73	< 0.03	0.57	0.038	< 0.03	< 0.016
	Maximum	950	15	564	0.07	2.10	0.095	0.074	0.041
	Minimum	< 2	< 5.0	26	< 0.01	0.23	0.012	< 0.005	< 0.005

BMC 2

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1320	8	< 5.0	28	0.01	0.27	0.058	0.015	< 0.005
2/4/03	955	42	< 5.0	26	0.04	0.37	0.078	0.01	< 0.005
2/27/03	1135	210	< 5.0	30	0.01	0.44	0.057	0.01	< 0.005
3/18/03	1140	120	< 5.0	37	0.01	0.37	0.043	0.025	0.005
3/27/03	1245	24	< 5.0	41	< 0.01	0.56	0.02	0.014	< 0.005
4/14/03	1010	8	< 5.0	38	0.01	0.43	0.017	0.021	< 0.005
4/29/03	1145	24	< 5.0	42	0.01	0.54	0.031	0.027	
5/13/03	1235	4	< 5.0	49	0.06	1.1	0.02	0.034	0.009
5/21/03	1145	1200	10	49	0.06	0.7	0.03	0.033	< 0.005
6/24/03	1200	520	11	48	0.02	0.44	0.057	0.005	0.017
7/28/03	1030	3000	9	43	0.09	0.43	0.028	0.007	0.025
8/21/03	1130	280	9	106	0.02	0.47	0.057	0.009	0.014
9/16/03	955	1800	10	56	0.02	0.53	0.103	0.041	0.007
10/23/03	1300	18	< 5.0	74	< 0.01	0.51	0.04	0.019	0.048
11/25/03	1230	98	6	30	< 0.01	0.41	0.14	0.028	0.05
12/4/03	1240	40	< 5.0	26	< 0.01	0.54	0.061	< 0.005	0.02
12/18/03	1205	34	< 5.0	30	< 0.01	0.23	0.048	0.021	
1/8/04	1000	24	< 5.0	27	< 0.01	0.15	0.052	0.022	0.066
1/27/04	1135	1100	5	39	0.01	0.32	0.041	0.02	
2/10/04	1000	110	6	22	0.01	0.29	0.074	0.016	0.017
2/26/04	1005	960	12	34	0.02	0.39	0.048	0.033	
3/17/04	1155	82	6	21	0.01	0.28	0.057	0.016	0.012
3/30/04	1150	20	< 5.0	22	< 0.01	< 0.1	0.044	0.02	0.032
4/15/04	1200	160	8	31	0.01	0.18	0.07	0.024	0.038
4/28/04	1205	32	< 5.0	34	< 0.01	0.31	0.055	0.019	
5/11/04	1220	100	< 5.0	42	< 0.01	1.45	0.008	0.028	0.022
5/24/04	1205	92	< 5.0	53	< 0.01	0.35	0.016	0.023	0.019
6/3/04	1020	740	< 5.0	51	0.04	0.64	0.041	0.027	0.102
7/14/04	1220	44	< 5.0	59	0.01	0.47	0.016	0.023	0.032
	Average	376	< 9.0	41	< 0.03	0.47	0.049	< 0.02	< 0.03
	Maximum	3000	12	106	0.09	1.45	0.14	0.041	0.102
	Minimum	4	< 5.0	21	< 0.01	0.15	0.008	< 0.005	< 0.005

BMC 3

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1305	10	< 5.0	26	< 0.01	0.3	0.065	0.015	< 0.005
2/4/03	1015	38	< 5.0	29	0.04	0.4	0.073	0.009	< 0.005
2/27/03	1200	520	< 5.0	33	0.01	0.53	0.044	0.011	< 0.005
3/18/03	1150	240	< 5.0	34	0.01	0.41	0.039	0.011	0.005
3/27/03	1315	20	< 5.0	36	0.02	0.49	0.026	0.013	0.005
4/14/03	1035	20	< 5.0	31	0.01	0.35	0.03	0.017	< 0.005
4/29/03	1155	30	< 5.0	45	0.01	0.63	0.026	0.021	
5/13/03	1250	8	< 5.0	41	0.05	0.86	0.018	0.031	0.006
Field Duplicate	1250	<2	< 5.0	51	0.04	0.75	0.017	0.029	0.007
5/21/03	1205	1900	9	55	0.05	0.56	0.027	0.033	0.005
6/24/03	1215	1100	10	45	0.01	0.44	0.045	0.021	< 0.005
7/28/03	1055	300	6	37	0.03	0.46	0.03	0.007	0.01
8/28/03	1155	3000	10	101	0.02	0.50	0.07	0.01	
9/16/03	1050	760	5	45	0.02	0.56	0.027	0.03	0.007
10/23/03	1315	16	< 5.0	42	< 0.01	0.54	0.032	0.016	0.046
11/25/03	1250	48	< 5.0	14	< 0.01	0.33	0.061	0.026	0.04
12/4/03	1255	54	< 5.0	30	< 0.01	0.46	0.064	0.023	0.021
12/18/03	1220	14	< 5.0	24	0.01	0.17	0.058	0.016	
1/8/04	1010	18	< 5.0	30	< 0.01	0.17	0.043	0.017	0.066
1/27/04	1150	800	5	34	0.01	0.28	0.032	0.022	
2/10/04	1020	16	< 5.0	28	< 0.01	0.33	0.068	0.012	0.016
2/26/04	1020	880	6	37	0.02	0.45	0.03	0.028	
3/17/04	1210	210	< 5.0	13	< 0.01	0.26	0.048	0.014	0.016
3/30/04	1205	20	< 5.0	24	< 0.01	< 0.1	0.044	0.015	0.032
4/15/04	1220	32	6	32	0.01	0.17	0.055	0.023	0.045
4/28/04	1220	110	< 5.0	33	< 0.01	0.26	0.052	0.017	
5/11/04	1235	52	< 5.0	33	< 0.01	0.84	0.011	0.019	0.033
5/24/04	1220	100	< 5.0	40	< 0.01	0.16	0.022	0.017	0.025
6/3/04	1035	440	< 5.0	43	0.01	0.43	0.034	0.022	< 0.005
7/14/04	1235	26	< 5.0	46	0.01	0.39	0.032	0.018	0.048
	Average	372	< 7.0	37	< 0.05	0.43	0.041	0.019	< 0.024
	Maximum	3000	10	101	0.05	0.86	0.073	0.033	0.066
	Minimum	8	< 5.0	13	< 0.01	< 0.01	0.011	0.007	< 0.005

BMC 4

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1235	30	< 5.0	27	0.01	0.25	0.069	0.014	< 0.005
2/4/03	1045	18	< 5.0	20	0.04	0.51	0.082	0.009	< 0.005
2/27/03	1235	700	9	34	0.01	0.59	0.032	0.015	0.014
3/18/03	1215	98	< 5.0	33	< 0.01	0.31	0.036	0.011	0.005
3/27/03	1335	14	< 5.0	35	0.01	0.29	0.053	0.01	< 0.005
4/14/03	1105	88	< 5.0	30	0.01	0.37	0.042	0.015	< 0.005
4/29/03	1235	24	< 5.0	36	0.01	0.43	0.059	0.019	
5/13/03	1330	190	< 5.0	34	0.03	0.79	0.05	0.027	0.005
5/21/03	1230	1200	10	49	0.06	0.65	0.025	0.032	0.005
6/24/03	1235	740	12	51	0.01	0.53	0.033	0.029	< 0.005
7/28/03	1115	560	13	38	0.03	0.5	0.029	0.017	0.008
8/21/03	1225	> 3000	41	45	0.02	0.78	0.087	0.031	
9/16/03	1030	240	< 5.0	38	< 0.01	0.36	0.029	0.019	0.006
10/23/03	1345	39	< 5.0	38	< 0.01	0.36	0.089	0.012	0.026
11/25/03	1325	56	< 5.0	30	< 0.01	0.32	0.06	0.026	0.059
12/4/03	1315	560	9	34	< 0.01	0.61	0.062	0.028	0.03
12/18/03	1240	30	< 5.0	23	0.02	0.22	0.072	0.015	
1/8/04	1040	22	< 5.0	23	< 0.01	0.1	0.068	0.015	0.05
1/27/04	1215	420	7	27	0.01	0.22	0.027	0.02	
2/10/04	1045	20	8	21	< 0.01	0.16	0.086	0.011	0.016
2/26/04	1050	440	12	30	0.01	0.35	0.027	0.026	
3/17/04	1230	48	5	19	< 0.01	0.24	0.034	0.012	0.02
3/30/04	1225	100	< 5.0	25	0.01	< 0.1	0.053	0.01	0.033
4/15/04	1255	16	< 5.0	29	0.01	0.3	0.074	0.016	0.041
4/28/04	1240	46	< 5.0	29	< 0.01	0.31	0.045	0.014	
5/11/04	1300	8	< 5.0	27	< 0.01	0.5	0.072	0.016	0.018
5/24/04	1240	18	< 5.0	31	< 0.01	0.33	0.069	0.006	0.018
6/3/04	1100	210	5	43	< 0.01	0.42	0.035	0.018	0.09
7/14/04	1305	48	< 5.0	34	0.01	0.24	0.075	0.01	0.027
	Average	472	< 16	32	< 0.02	0.39	0.054	0.017	< 0.026
	Maximum	> 3000	41	51	0.06	0.79	0.089	0.032	0.09
	Minimum	8	< 5.0	19	< 0.01	< 0.1	0.025	0.006	< 0.005

BMC 5

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1110	30	< 5.0	28	0.01	0.24	0.019	0.013	< 0.005
2/4/03	1210	34	< 5.0	23	0.04	0.36	0.02	0.009	< 0.005
2/27/03	1025	270	< 5.0	25	0.01	0.56	0.014	0.011	< 0.005
3/18/03	1025	86	< 5.0	31	< 0.01	0.55	0.018	0.009	0.005
3/27/03	1120	24	< 5.0	38	< 0.01	0.38	< 0.005	0.011	< 0.005
4/8/03	1045	360	6	26	0.02	0.34	0.008	0.015	< 0.005
4/29/03	1050	52	< 5.0	43	0.01	0.58	0.01	0.021	
5/13/03	1120	58	6	40	0.05	0.63	0.015	0.03	0.007
5/21/03	1035	210	< 5.0	40	0.04	0.47	0.011	0.021	0.005
6/24/03	1055	740	10	49	< 0.01	0.48	0.024	0.024	< 0.005
7/23/03	1105	1200	9	45	0.06	0.61	0.016	0.048	0.008
8/21/03	1040	> 3000	11	45	0.01	0.77	0.073	0.042	0.009
9/16/03	1130	160	< 5.0	36	< 0.01	0.49	< 0.005	0.017	0.006
10/23/03	1145	46	< 5.0	41	< 0.01	0.43	0.032	0.01	0.038
11/25/03	1110	36	< 5.0	274	< 0.01	0.41	0.012	0.027	0.051
12/4/03	1110	75	< 5.0	23	< 0.01	0.48	0.027	0.021	0.023
12/18/03	1100	8	< 5.0	24	0.02	0.17	0.029	0.014	
1/8/04	16	16	< 5.0	23	0.01	0.15	0.03	0.017	0.05
1/27/04	1005	290	< 5.0	25	0.01	0.18	0.012	0.016	
2/10/04	1405	14	< 5.0	12	0.01	0.32	0.068	0.011	0.014
2/26/04	935	230	< 5.0	28	0.01	0.27	0.019	0.023	
3/17/04	1030	40	< 5.0	18	< 0.01	0.27	0.007	0.016	0.011
3/30/04	1045	18	< 5.0	26	0.01	0.24	0.011	0.014	0.048
4/15/04	1050	14	5	34	< 0.01	0.33	0.021	0.014	0.052
4/28/04	1105	20	< 5.0	35	< 0.01	0.31	0.005	0.017	
5/11/04	1110	16	< 5.0	38	< 0.01	0.36	0.026	0.021	0.024
5/24/04	1045	48	< 5.0	39	0.01	0.40	0.037	0.013	0.026
6/2/04	1025	1400	< 5.0	48	0.01	0.46	0.043	0.025	0.133
7/14/04	1115	26	7	40	0.03	0.46	0.035	0.016	0.04
	Average	399	< 8.0	41	< 0.03	0.40	< 0.021	0.019	< 0.031
	Maximum	> 3000	11	274	0.06	0.77	0.073	0.048	0.133
	Minimum	8	< 5.0	12	< 0.01	0.15	< 0.005	0.009	< 0.005

BMC 6

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	1025	34	< 5.0	27	0.01	0.33	0.039	0.014	< 0.005
2/4/03	1255	10	< 5.0	25	0.04	0.29	0.043	0.009	< 0.005
2/27/03	1000	700	< 5.0	37	< 0.005	0.68	0.029	0.022	0.007
3/18/03	945	54	< 5.0	34	< 0.01	0.32	0.03	0.012	0.005
3/27/03	1040	52	< 5.0	39	< 0.01	0.37	0.014	0.01	< 0.005
4/8/03	1020	300	5	28	0.02	0.33	0.018	0.017	0.005
4/29/03	1025	24	< 5.0	1	0.01	0.53	0.026	0.019	
5/13/03	1025	36	< 5.0	37	0.04	0.54	0.021	0.022	0.006
5/21/03	1010	5100	7	44	0.06	0.79	0.037	0.055	0.007
6/24/03	1030	120	< 5.0	39	0.02	0.45	0.033	0.019	< 0.005
7/23/03	1030	3400	37	37	0.07	0.68	0.042	0.065	0.007
8/21/03	1010	> 3000	9	44	0.01	0.59	0.073	0.04	0.007
9/16/03	1225	100	< 5.0	40	0.01	0.41	0.04	0.021	0.007
10/23/03	1055	100	< 5.0	38	< 0.01	0.36	0.053	0.009	0.035
11/25/03	1025	38	< 5.0	29	< 0.01	0.40	0.032	0.027	0.055
12/4/03	1020	110	< 5.0	28	< 0.01	0.65	0.049	0.021	0.024
12/18/03	1015	80	< 5.0	26	< 0.01	0.19	0.06	0.015	
1/8/04	1155	12	< 5.0	24	< 0.01	0.16	0.06	0.016	0.037
1/27/04	945	260	< 5.0	26	0.01	0.13	0.033	0.024	
2/10/04	1310	18	< 5.0	20	< 0.01	0.27	0.058	0.011	0.017
2/26/04	905	600	< 5.0	31	0.01	0.22	0.041	0.029	
3/17/04	950	56	6	16	< 0.01	0.38	0.034	0.013	0.016
3/30/04	1000	52	< 5.0	24	0.01	0.17	0.053	0.009	0.041
4/15/04	1020	18	6	29	0.01	0.47	0.08	0.009	0.042
4/28/04	1025	14	< 5.0	32	< 0.01	0.21	0.032	0.016	
5/11/04	1030	28	< 5.0	29	< 0.01	0.26	0.048	0.021	0.033
5/24/04	1000	28	5	36	0.01	0.48	0.049	0.014	0.022
6/2/04	1005	900	< 5.0	37	0.01	0.34	0.042	0.022	0.075
7/14/04	1025	24	5	47	0.03	0.45	0.05	0.013	0.025
	Average	824	< 10	31	< 0.03	0.39	0.042	0.020	< 0.024
	Maximum	5100	37	47	0.07	0.79	0.080	0.065	0.075
	Minimum	10	< 5.0	1	< 0.01	0.13	0.014	0.009	< 0.005

BMC 7

Date dd/mm/yy	Time	F. Coli. colonies/100ml	TSS ppm	TDS ppm	NH3 ppm	TKN ppm	Nitrate/Nitrite ppm	Total-P ppm	Ortho-P ppm
1/9/03	945	78	< 5.0	23	0.01	0.26	0.133	0.013	< 0.005
2/4/03	1340	120	< 5.0	24	0.05	0.6	0.12	0.008	< 0.005
2/27/03	935	900	7	41	0.02	0.62	0.042	0.023	< 0.005
3/18/03	910	100	< 5.0	30	0.01	0.30	0.098	0.011	< 0.005
3/27/03	945	78	< 5.0	27	0.01	0.53	0.093	0.009	0.005
4/8/03	940	700	24	31	0.03	0.41	0.055	0.025	0.005
4/29/03	950	260	< 5.0	32	0.01	0.41	0.095	0.017	
5/13/03	930	50	< 5.0	28	0.03	0.66	0.089	0.019	< 0.005
5/21/03	940	1100	11	79	0.09	0.77	0.046	0.05	0.007
6/24/03	945	280	11	36	0.02	0.37	0.079	0.01	< 0.005
7/23/03	950	800	27	51	0.08	0.64	0.058	0.048	0.006
8/21/03	945	> 3000	20	62	0.01	0.59	0.082	0.034	0.01
9/16/03	1315	360	5	35	< 0.01	0.35	0.045	0.019	0.007
10/23/03	1010	33	< 5.0	32	< 0.01	0.34	0.132	0.013	0.048
11/25/03	925	96	< 5.0	25	< 0.01	0.29	0.115	0.028	0.045
12/4/03	945	500	8	32	< 0.01	0.08	0.083	0.023	0.031
12/18/03	915	52	5	26	0.01	0.19	0.119	0.015	
1/8/04	1240	24	< 5.0	22	< 0.01	0.12	0.123	0.014	0.037
1/27/04	915	320	9	19	0.01	0.07	0.066	0.018	
2/10/04	1205	48	5	17	0.02	0.14	0.054	0.01	0.015
2/26/04	845	620	1	27	0.01	0.33	0.081	0.03	
3/17/04	900	150	< 5.0	13	0.01	0.17	0.176	0.011	0.017
3/30/04	915	76	< 5.0	18	0.01	< 0.1	0.207	0.01	0.038
4/15/04	935	36	7	28	0.01	0.13	0.22	0.017	0.039
4/28/04	930	68	< 5.0	25	< 0.01	0.13	0.153	0.012	
5/11/04	925	98	< 5.0	19	< 0.01	< 0.1	0.134	0.013	0.019
5/24/04	905	88	< 5.0	22	< 0.01	0.10	0.122	0.008	0.026
6/2/04	920	1000	17	46	0.01	0.39	0.106	0.03	0.128
7/14/04	935	120	7	30	0.01	0.27	0.099	0.013	0.041
	Average	385	< 14.0	31	< 0.03	0.34	0.104	0.019	< 0.029
	Maximum	> 3000	27	79	0.09	0.77	0.220	0.050	0.128
	Minimum	24	< 5.0	13	< 0.01	< 0.1	0.042	0.008	< 0.005