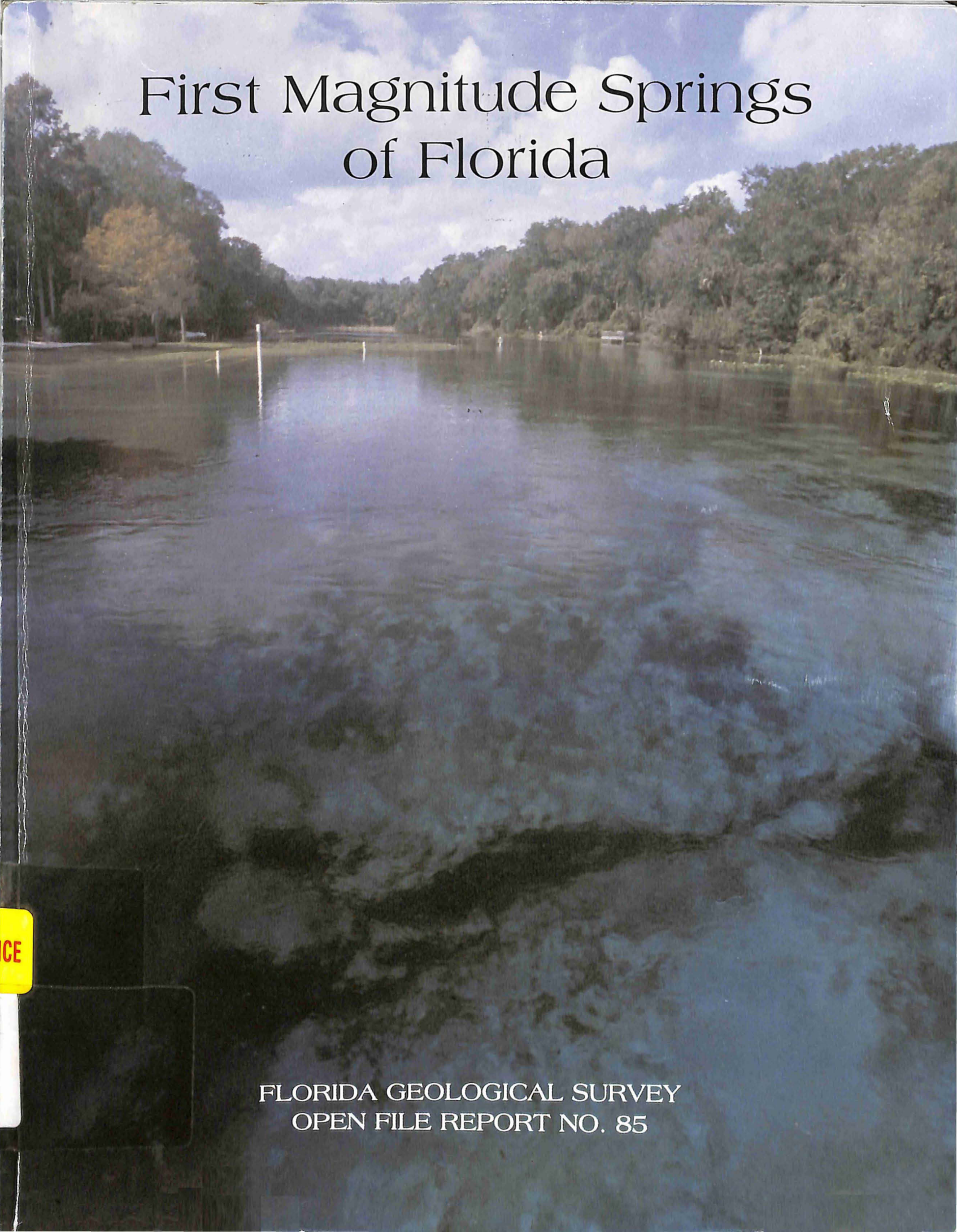


First Magnitude Springs of Florida



FLORIDA GEOLOGICAL SURVEY
OPEN FILE REPORT NO. 85

CE

FLORIDA GEOLOGICAL SURVEY
903 W. TENNESSEE STREET
TALLAHASSEE, FLORIDA 32304

Cover: Alexander Spring, Lake County (photo by Tom Scott).

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
David Struhs, *Secretary*

DIVISION OF RESOURCE ASSESSMENT AND MANAGEMENT
Edwin J. Conklin, *Director*

FLORIDA GEOLOGICAL SURVEY
Walter Schmidt, *State Geologist and Chief*

Open File Report No. 85

FIRST MAGNITUDE SPRINGS OF FLORIDA

By

Thomas M. Scott, Guy H. Means,
Ryan C. Means, and Rebecca P. Meegan

Published for the

FLORIDA GEOLOGICAL SURVEY
Tallahassee, Florida
2002

Printed for the
Florida Geological Survey

Tallahassee
2002

ISSN 1058-1391

LETTER OF TRANSMITTAL



FLORIDA GEOLOGICAL SURVEY

Tallahassee, Florida
2002

Governor Jeb Bush
Tallahassee, Florida 32301

Dear Governor Bush:

The 2001 Florida Legislature funded the Florida Springs Initiative to investigate the first order magnitude springs in the State. In response to the initiative's mandate, the Florida Geological Survey, Division of Resource Assessment and Management, Department of Environmental Protection, is publishing as its Open-file Report No. 85, *First Magnitude Springs of Florida*, by Thomas M. Scott, Guy H. Means, Ryan C. Means, and Rebecca P. Meegan. The physical characteristics, water chemistry and bacteriology of Florida's first order magnitude springs are discussed and described in this report. The information herein on Florida's largest springs, unique and treasured natural resources, provides data to be used by scientists, planners, environmental managers and the citizens of Florida.

Respectfully,

A handwritten signature in black ink that reads "Walter Schmidt". The signature is written in a cursive style with a large, stylized 'W' and 'S'.

Walter Schmidt, Ph.D.
State Geologist and Chief
Florida Geological Survey

TABLE OF CONTENTS

	Page
Introduction	1
Acknowledgements	3
Florida Spring's Task Force	3
Task Force Members and Advisors	5
Classification of Springs	6
Archaeological Significance of Springs	8
Hydrogeology of Florida Springs	9
Water Quality	13
Methodology	13
Field Parameters	13
Water Samples	14
Additional Data	14
Discharge Measurements	14
Characteristics of Spring Water	16
Descriptions of Analytes	16
Physical Field Parameters	17
Dissolved Oxygen	17
pH	17
Specific Conductance	17
Water Temperature	18
Discharge	18
Other Field Data	18
Laboratory Analytes	18
Alkalinity	18
Biochemical Oxygen Demand	18
Chloride	18
Color	18
Hardness	18
Nitrate + Nitrite	19
Organic Carbon	19
Orthophosphate	19
Potassium	19
Sodium	19
Sulfate	19
Total Ammonia	20
Total Dissolved Solids	20
Total Kjeldahl Nitrogen	20
Total Nitrogen	20
Total Suspended Solids	20
Turbidity	20
Trace Metals	20
Biological Analytes	21
Descriptions of Individual Springs and Results of Analyses	23
Alachua County	23
Hornsby Spring	23

Bay County	.26
Gainer Springs Group	.26
Gainer Spring No. 1C	.27
Gainer Spring No. 2	.27
Gainer Spring No. 3	.27
Citrus County	.31
Chassahowitzka Springs Group	.31
Chassahowitzka Main Spring	.32
Chassahowitzka No. 1	.32
Homosassa Springs Group	.35
Homosassa Springs Nos. 1, 2 and 3	.35
Kings Bay Springs Group	.39
Hunter Spring	.40
Tarpon Hole Spring	.40
Columbia County	.43
Columbia Spring	.43
Ichetucknee Springs Group	.46
Ichetucknee Head Spring	.47
Blue Hole	.47
Cedar Head Spring	.47
Mission Springs	.50
Santa Fe River Rise	.51
Treehouse Spring	.54
Gilchrist County	.57
Devil's Ear Spring	.57
Siphon Creek Rise	.60
Hamilton County	.63
Alapaha River Rise	.63
Holton Creek Rise	.66
Hernando County	.69
Weeki Wachee Spring	.69
Jackson County	.72
Jackson Blue Spring	.72
Jefferson County	.75
Wacissa Springs Group	.75
Spring No. 2	.75
Big Spring (Big Blue Spring)	.78
Lafayette County	.79
Lafayette Blue Spring	.79
Troy Spring	.82
Lake County	.85
Alexander Spring	.85
Leon County	.88
St. Marks River Rise	.88
Levy County	.91
Fanning Springs	.91
Manatee Springs	.94
Madison County	.97
Madison Blue Spring	.97

Marion County	100
Rainbow Springs Group	100
Rainbow No. 1	100
Rainbow No. 4	101
Rainbow No. 6	101
Bubbling Spring	101
Silver Glen Springs	105
Silver Springs Group	108
Main Spring	108
Reception Hall	111
Blue Grotto	111
Suwannee County	112
Falmouth Spring	112
Taylor County	115
Nuttall Rise	115
Steinhatchee River Rise	118
Union County	121
Santa Fe Spring	121
Volusia County	124
Volusia Blue Spring	124
Wakulla County	128
Spring Creek Springs Group	128
Spring Creek No. 1	128
Spring Creek No. 2	131
Wakulla Spring	132
Springs Information Resources on the Web	135
References	135
Glossary	138

Figures

1. Old photograph of the bath house at White Springs, Hamilton County, 1920s	2
2. Springs Task Force members at Madison Blue Spring	4
3. Location of first order magnitude springs.	7
4. Native American artifacts	9
5. Generalized geologic map of Florida	11
6. Karst areas related to first magnitude springs	12
7. An FGS Spring Sampling Team, 2001	17
8. Jackson Blue Springs aerial photo	22
9. Hornsby Spring	23
10. Hornsby Spring location map	24
11. Gainer Springs Group Vent 1C	26
12. Gainer Springs Group Vent 2	26
13. Gainer Springs Group location map	28
14. Chassahowitzka Main Spring	31
15. Chassahowitzka No. 1	31
16. Chassahowitzka Springs Group location map	33
17. Homosassa Springs Group	35

18. Homosassa Springs Group location map	36
19. Kings Bay Springs Group, Hunter Spring	39
20. Kings Bay Springs Group, Tarpon Hole Spring	39
21. Kings Bay Springs Group location map	41
22. Columbia Spring	43
23. Columbia Spring location map	44
24. Ichetucknee Springs Group, Ichetucknee Head Spring	46
25. Ichetucknee Springs Group, Blue Hole Spring	46
26. Ichetucknee Springs Group location map	48
27. Santa Fe River Rise	51
28. Santa Fe River Rise location map	52
29. Treehouse Spring	54
30. Treehouse Spring location map	55
31. Devil's Ear Spring	57
32. Devil's Ear Spring location map	58
33. Siphon Creek Rise	60
34. Siphon Creek Rise location map	61
35. Alapaha River Rise	63
36. Alapaha River Rise location map	64
37. Holton Creek Rise	66
38. Holton Creek Rise location map	67
39. Weeki Wachee Spring	69
40. Weeki Wachee Spring location map	70
41. Jackson Blue Spring	72
42. Jackson Blue Spring location map	73
43. Wacissa Springs Group, Big Blue Spring	75
44. Wacissa Springs Group location map	76
45. Lafayette Blue Spring	79
46. Lafayette Blue Spring location map	80
47. Troy Spring	82
48. Troy Spring location map	83
49. Alexander Spring	85
50. Alexander Spring location map	86
51. St. Marks River Rise	88
52. St. Marks River Rise location map	89
53. Fanning Spring	91
54. Fanning Spring location map	92
55. Manatee Springs main spring	94
56. Manatee Springs location map	95
57. Madison Blue Spring	97
58. Madison Blue Spring location map	98
59. Rainbow Springs Group	100
60. Rainbow Springs Group location map	102
61. Silver Glen Springs	105
62. Silver Glen Springs location map	106
63. Silver Springs Group	108

64. Silver Springs Group location map	109
65. Falmouth Spring location map	113
66. Nutall Rise	115
67. Nutall Rise location map	116
68. Steinhatchee River Rise	118
69. Steinhatchee River Rise location map	119
70. Santa Fe Spring	121
71. Santa Fe Spring location map	122
72. Volusia Blue Spring - A - Old Photo around 1900; B - 1970s photo	124
73. Volusia Blue Spring location map	126
74. Spring Creek Springs Group	128
75. Spring Creek Springs Group location map	129
76. Wakulla Spring	132
77. Wakulla Spring location map	133

Tables

1. Sampling order	14
2. Units of measurement for each analyte	16
3. Hornsby Spring water quality analysis	25
4. Hornsby Spring bacteriological analysis	25
5. Gainer Springs Group water quality analyses	29
6. Gainer Springs Group bacteriological analyses	30
7. Chassahowitzka Springs Group bacteriological analyses	32
8. Chassahowitzka Springs Group water quality analyses	34
9. Homosassa Springs Group water quality analyses	37
10. Homosassa Springs Group bacteriological analyses	38
11. Kings Bay Springs Group water quality analyses	42
12. Kings Bay Springs Group bacteriological analyses	42
13. Columbia Spring water quality analysis	45
14. Columbia Spring bacteriological analysis	45
15. Ichetucknee Springs Group water quality analyses	49
16. Ichetucknee Springs Group bacteriological analyses	50
17. Santa Fe River Rise water quality analysis	53
18. Santa Fe River Rise bacteriological analysis	53
19. Treehouse Spring water quality analysis	56
20. Treehouse Spring bacteriological analysis	56
21. Devil's Ear Spring water quality analysis	59
22. Devil's Ear Spring bacteriological analysis	59
23. Siphon Creek Rise water quality analysis	62
24. Siphon Creek Rise bacteriological analysis	62
25. Alapaha River Rise water quality analysis	65
26. Alapaha River Rise bacteriological analysis	65
27. Holton Creek Rise water quality analysis	68
28. Holton Creek Rise bacteriological analysis	68
29. Weeki Wachee Spring water quality analysis	71

30. Weeki Wachee Spring bacteriological analysis	71
31. Jackson Blue Spring water quality analysis	74
32. Jackson Blue Spring bacteriological analysis	74
33. Wacissa Springs Group water quality analyses	77
34. Wacissa Springs Group bacteriological analyses	78
35. Lafayette Blue Spring water quality analysis	81
36. Lafayette Blue Spring bacteriological analysis	81
37. Troy Spring water quality analysis	84
38. Troy Spring bacteriological analysis	84
39. Alexander Spring water quality analysis	87
40. Alexander Spring bacteriological analysis	87
41. St. Marks River Rise water quality analysis	90
42. St. Marks River Rise bacteriological analysis	90
43. Fanning Spring water quality analysis	93
44. Fanning Spring bacteriological analysis	93
45. Manatee Springs water quality analysis	96
46. Manatee Springs bacteriological analysis	96
47. Madison Blue Spring water quality analysis	99
48. Madison Blue Spring bacteriological analysis	99
49. Rainbow Springs Group water quality analyses	103
50. Rainbow Springs Group bacteriological analyses	104
51. Silver Glen Springs water quality analysis	107
52. Silver Glen Springs bacteriological analysis	107
53. Silver Springs Group water quality analyses	110
54. Silver Springs Group bacteriological analyses	111
55. Falmouth Spring water quality analysis	114
56. Falmouth Spring bacteriological analysis	114
57. Nutall Rise water quality analysis	117
58. Nutall Rise bacteriological analysis	117
59. Steinhatchee River Rise water quality analysis	120
60. Steinhatchee River Rise bacteriological analysis	120
61. Santa Fe Spring water quality analysis	123
62. Santa Fe Spring bacteriological analysis	123
63. Volusia Blue Spring water quality analysis	127
64. Volusia Blue Spring bacteriological analysis	127
65. Spring Creek Springs Group water quality analyses	130
66. Spring Creek Springs Group bacteriological analyses	131
67. Wakulla Spring water quality analysis	134
68. Wakulla Spring bacteriological analysis	134

FIRST MAGNITUDE SPRINGS OF FLORIDA

by

Thomas M. Scott, P.G. #99, Guy H. Means, Ryan C. Means, Rebecca P. Meegan

INTRODUCTION

The bank was dense with magnolia and loblolly bay, sweet gum and gray-barked ash. He went down to the spring in the cool darkness of their shadows. A sharp pleasure came over him. This was a secret and a lovely place. - Marjory Kinnan Rawlings, *The Yearling*, 1938

Mysterious, magical, even "awesome" - springs elicit an emotional response from nearly everyone who peers into the crystalline depths. The cool, clear, azure waters of Florida's springs have long been a focus of daily life during the humid, hot months of the year. Many Floridians have a lifetime of memories surrounding our springs. Visit any spring during the muggy months and you will find people of all ages partaking of Nature's soothing remedy - spring water! Marjory Stoneman Douglas, the granddame of Florida environmentalists, stated that "Springs are bowls of liquid light." Al Burt (writer/author) observed that "Springs add a melody to the land."

Springs and spring runs have been a focal point of life, from prehistoric times to the present. Undoubtedly, the ancient issuing of cool, fresh water attracted animals now long absent from Florida's landscape. Many a diver has recovered fossil remains from the state's spring runs and wondered what the forest must have looked like when the animals roamed the spring-run lowlands.

Human artifacts, found in widespread areas of the state, attest to the importance of springs to Florida's earliest inhabitants. The explorers of Florida, from Ponce de Leon to John and William Bartram and others, often mentioned the subterranean discharges of fresh water that were scattered across central and northern Florida. As colonists and settlers began to inhabit Florida, springs continued to be the focus of human activity, becoming sites of missions, towns and steamboat landings. Spring runs provided power for gristmills. Baptisms were held in the clear, cool waters and the springs often served as water supplies for local residents. Today, even bottled water producers are interested in utilizing these waters. Some springs have been valued for their purported therapeutic effects and people flocked to them to soak in the medicinal waters (Figure 1).

The recreational opportunities provided by the state's springs are numerous. Swimming, snorkeling, diving and canoeing are among the most common activities centering around Florida's springs. The springs and spring runs are magnets for wildlife and, subsequently, draw many individuals and groups to view these animals in their natural surroundings.

Spring water is a natural discharge from the Floridan aquifer system, the state's primary aquifer, and the springs provide a "window" into the aquifer allowing for a measure of the health of the aquifer. Chemical and biological constituents that enter the aquifer through recharge processes may affect the water quality and flora and fauna of springs and



Figure 1. Old photograph of the bath house at White Springs, Hamilton County, 1920s.

springs and cave systems have been negatively affected. The change in water quality is a direct result of Florida's increased population (increased eight-fold since 1940) and changed land use patterns. These changes and subsequent degradation of our springs have led to the efforts to save and restore Florida's treasured springs.

In 1947, the Florida Geological Survey (FGS) published the first Springs of Florida bulletin which documented the major and important springs in the state (Ferguson et al., 1947). This was revised in 1977, adding many springs previously undocumented and many new water quality analyses of the spring water (Rosenau et al., 1977). The Florida Geological Survey's report on first magnitude springs (this open-file report) is the initial step in revising the Springs of Florida bulletin. Nearly 300 springs were known in 1977. In 2001, at least 700 springs have been recognized in the state and more are reported each year. To date, 33 first order magnitude springs (>100 cubic feet per second - 64.6 million gallons of water per day) have been recognized in Florida, more than any other state or country (Rosenau et al., 1977). Our springs are a unique and invaluable natural resource. A comprehensive understanding of the spring systems will provide the basis for their protection and wise use.

ACKNOWLEDGEMENTS

The authors wish to acknowledge a number of individuals and thank them for their assistance in creating this volume. Gary Maddox, Laura Morse, Gail Sloane, Margaret Murray, Tom Biernacki, Cindy Cosper, Andy Roach, Paul Hansard, and Jay Silvanima, from Division of Water Resource Management, Watershed Monitoring and Data Management Section guided the spring water analyses effort. Without their knowledge and experience, the sampling, analyses and data quality and delivery could not have been accomplished within the requisite timeframe.

We would also like to acknowledge the efforts of numerous people from various Water Management Districts and State Parks who were so helpful in either collecting or helping to collect data for this project. In particular, the authors wish to thank David Hornsby from the Suwannee River Water Management District for contributing his time and expertise. We also thank Tony Countryman and Nick Wooten from the Northwest Florida Water Management District; Eric DeHaven, David DeWitt, Joe Haber, and Chris Tomlinson from the Southwest Florida Water Management District; Richard Harris from Blue Springs State Park, and Will Ebaugh from the U.S. Forest Service. There are many other anonymous individuals whose efforts benefited this project.

Many thanks go to staff members of the Florida Geological Survey. Frank Rupert organized the text, figures, tables and photographs into the digital publishable format. John Marquez, Alan Baker and Jim Cichon, with their cartographic expertise, created the many maps utilized in this report. Walt Schmidt, Jon Arthur, Rodney DeHan, Rick Copeland and Jackie Lloyd reviewed the text and data, supplying many suggestions and corrections.

Many Florida Department of Environmental Protection (FDEP) employees assisted with this project. They are: Division of Water Resource Management, Bureau of Laboratories - Sampling Training: Russel Frydenborg, Tom Frick; Bureau of Laboratories - Chemistry and Biology Analyses: Yuh-Hsu Pan, Kate Brackett, Maria Gonzalez, Amzad Shaik, Harrison Walker, Chris Armour, Tom Ebrahimizadeh, Chris Morgan, Colin Wright, Matt Curran, Dave Avrett, Rick Kimsey, Latasha Fisher, Elena Koldacheva, Keith Tucker, Elliot Healy, Dawn Dolbee, Blanca Fach, Ping Hua, Anna Blalock, Patsy Vichaikul, Akbar Cooper, Richard Johnson, Paula Peters, Gary Dearman, Virginia Leavell, Ceceile Wight, Travis Tola, Dale Simmons, Latasha Fisher, Rob Buda, Melva Campos, Karla Whiddon, Daisys Tamayo; Bureau of Watershed Management, Watershed Monitoring and Data Management Section: Tracy Wade, Thomas Seal; Division of Waste Management: Bill Martin, David Meyers. We appreciate the efforts of all these individuals.

Finally, the Florida Geological Survey Springs Team Members wish to thank Jim Stevenson, Florida Springs Task Force Chairman, for his tireless dedication to Florida's springs.

FLORIDA SPRINGS TASK FORCE

David Struhs, Secretary of the Florida Department of Environmental Protection, directed the formation of a multi-agency Florida Springs Task Force to provide recommended strategies for the protection and restoration of Florida's springs. The Task Force, consisting of sixteen Floridians who represent one federal and three state agencies, four water management districts,



Figure 2. Springs Task Force members at Madison Blue Spring (photo by T. Scott).

a state university, a regional planning council, the business community, and private citizens, met monthly from September 1999 to September 2000 (Figure 2). These scientists, planners, and other citizens exchanged information on the many factors that impact the viability of Florida's springs and the ecosystems that the springs support. They listened to guest speakers with expertise in topics relating to spring health. They discussed the conflicting environmental, social, and economic interests that exist in all of Florida's spring basins.

The Task Force members participated in the February 2000 Florida Springs Conference, *Natural Gems - Troubled Waters*, attended by over 300 people, including scientists, business owners, representatives of environmental groups, and residents from all over Florida. During the months that the Task Force met, they developed recommendations for the preservation and restoration of Florida's rich treasury of springs. The implementation of the recommendations contained in the Task Force report (Florida Springs Task Force, 2000) will help ensure that Florida's "bowls of liquid light" will sparkle for the grandchildren of the children who play in Florida's springs today.

The 2001 Florida Legislature passed the Florida Springs Initiative authorizing funds for the Department of Environmental Protection to begin investigating the status of Florida springs and strategies for protecting this precious resource.

Task Force Members and Advisors

Task Force Chairman - Jim Stevenson, Division of State Lands, FDEP

Technical Writer and Editor - Frances M. Hartnett,
Technical and Creative Writing Services

Task Force Members

Dianne McCommons Beck, FDEP
Jeff Bielling, Florida Department of Community Affairs
Greg Bitter, Withlacoochee Regional Planning Council
Hal Davis, U.S. Geological Survey
Russel Frydenborg, Division of Resource Assessment and Management, FDEP
Jon Martin, University of Florida
Gregg Jones, Southwest Florida Water Management District
Jack Leppert, Citizen
Gary Maddox, Division of Water Resource Management, FDEP
Pam McVety, Division of Recreation and Parks, FDEP
Doug Munch, St. Johns River Water Management District
Tom Pratt, Northwest Florida Water Management District
Tom Scott, Florida Geological Survey, FDEP
Wes Skiles, Karst Environmental Services
Kirk Webster, Suwannee River Water Management District

Technical Advisors

Florida Department of Environmental Protection

Karl Kurka, Office of Water Policy
Kathleen Toolan, Office of General Counsel
Joe Hand, Division of Water Resource Management
Jennifer Jackson, Division of Water Resource Management
Jim McNeal, Division of Water Resource Management

Florida Department of Community Affairs

Richard Deadman

Florida Department of Health

Tim Mayer

Florida Fish and Wildlife Conservation Commission

Kent Smith

Karst Environmental Services

Tom Morris

St. Johns River Water Management District

David Miracle

Bill Osburn

Suwannee River Water Management District

David Hornsby

US Fish and Wildlife Service

Jim Valade

FLORIDA GEOLOGICAL SURVEY

CLASSIFICATION OF SPRINGS

There are two general types of springs in Florida, seeps (water table springs) and karst springs (artesian springs). Rainwater, percolating downward through permeable sediments, may encounter a much less permeable or impermeable formation, forcing the water to move laterally. Eventually the water may reach the surface in a lower lying area and form a seep (for example the steephead seeps along the eastern side of the Apalachicola River). Karst springs form when groundwater discharges to the surface through a karst opening. The vast majority of Florida's more than 700 springs and all of the first order magnitude springs are the karst spring type.

Springs are most often classified based upon the average discharge of water. The classification listed below was utilized by Rosenau et al. (1977):

Magnitude Average Flow (Discharge)

1	100 cfs or more (64.6 mgd or more)	cfs = cubic feet per second
2	10 to 100 cfs (6.46 to 64.6 mgd)	mgd = million gallons per day)
3	1 to 10 cfs (0.646 to 6.46 mgd)	gpm = gallons per minute
4	100 gpm to 1 cfs (448 gpm)	pint/min = pints per minute
5	10 to 100 gpm	
6	1 to 10 gpm	
7	1 pint to 1 gpm	
8	Less than 1 pint/min	

Current Florida springs tabulations list 33 first order magnitude springs (modified after Rosenau et al., 1977) (Figure 3). The list includes individual springs, spring groups and river rises. This listing has created some confusion due to the grouping of hydrogeologically unrelated springs into groups and the inclusion of river rises and karst windows (Wilson and Skiles, 1989). Often, individual springs comprising a group do not have the same water source region or spring recharge basin and are not hydrogeologically related. The individual spring vents within a group may not discharge enough water to be classed as first magnitude. Wilson and Skiles (1989) recommended grouping only hydrogeologically related springs into spring groups. Spring groups are used in the report as presented by Rosenau et al. (1977).

River rises are the resurgence of river water that descended underground through a sinkhole some distance away. The resurging water may contain a significant portion of aquifer water but are primarily river water therefore should not be classified as a spring (Wilson and Skiles, 1989). River rises have continued to be considered in the first magnitude listing for this report.

Karst windows are where the roof of a cave collapsed exposing an underground stream for a short distance. One karst window is included in this report.

Future springs recharge basin delineations will identify the hydrogeological relationships between springs and facilitate changes in the first magnitude springs list and will address these issues. This will be done considering the recommendations put forth by Wilson and Skiles (1989) and by hydrogeologists representing the government, private sector and academia.

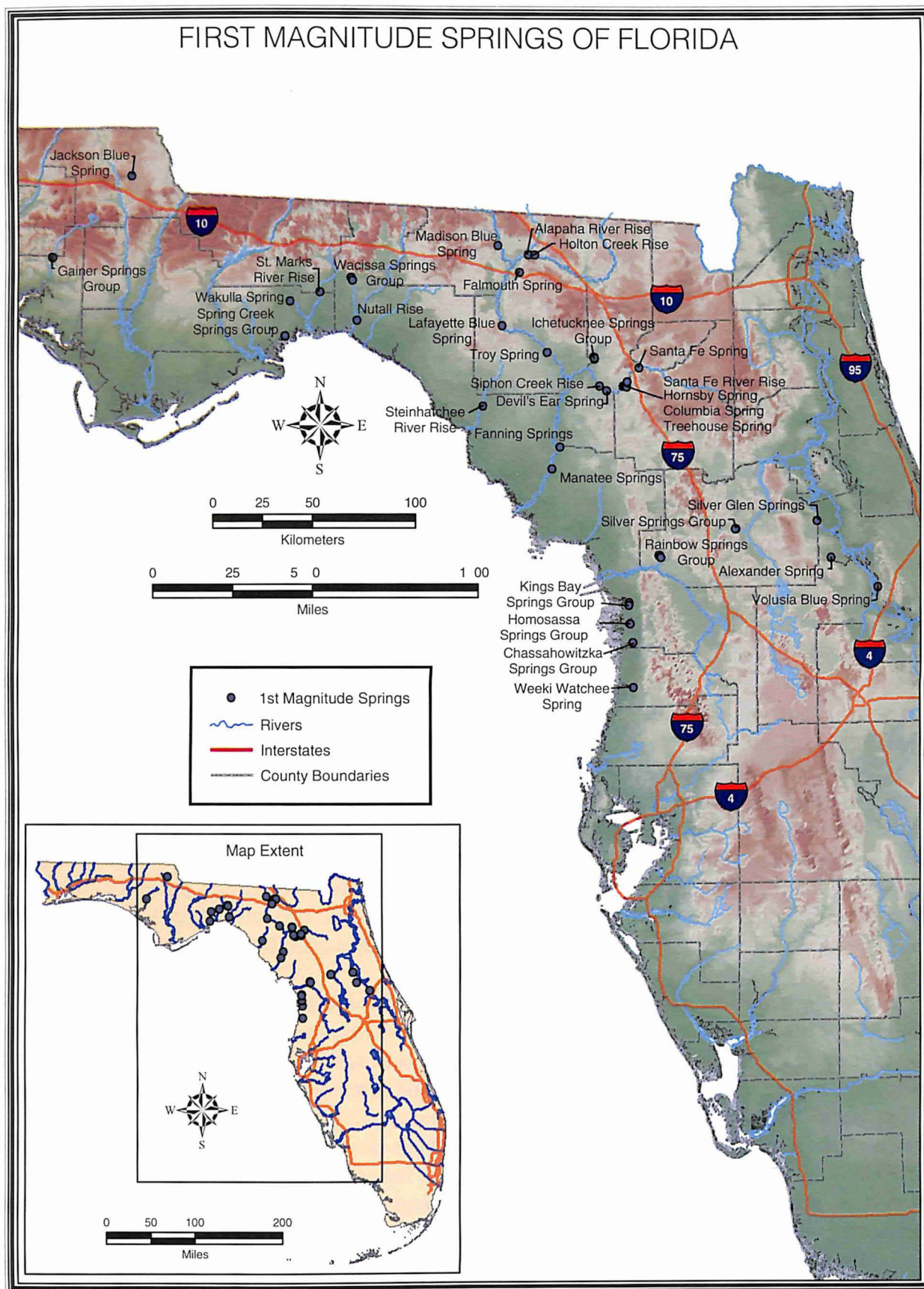


Figure 3. Location of first order magnitude springs.

FLORIDA GEOLOGICAL SURVEY

There have been inconsistencies in the naming of springs. We have attempted to make names more clear in this volume. For example, a spring site that physically has one vent is no longer referred to as springs - Wakulla Springs becomes Wakulla Spring. Also, if a river rise was called a spring, the term river rise now replaces the spring.

There are many Blue Springs in Florida. FDEP scientists have adopted the convention of referring to these springs with the county name placed before the name "Blue Spring." Thus, Blue Spring in Jackson County becomes Jackson Blue Spring.

ARCHAEOLOGICAL SIGNIFICANCE OF SPRINGS

Archaeological research has shown that Florida's springs have been important to human inhabitants for many thousands of years. Prehistoric peoples exploited the concentration of resources found in and around springs. Water, chert and game animals were all available in and near springs. Today, springs serve as recreation areas and continue to attract people because of their unique beauty.

Florida's first people, called paleoindians, left behind evidence of their culture in the form of chert, bone and ivory tools that date to more than 12,000 years before present (Figure 4) (Dunbar et al., 1988). These people coexisted with large now extinct megafaunal animals like mastodon, mammoth, ground sloth, giant beaver, and giant armadillo. During the late Pleistocene, 10,000 to 12,000 years ago, sea level was as much as 300 ft (100 m) below present levels. Deep springs and sinkholes may have been some of the only sources of fresh water in ancient Florida. Investigations at Wakulla Spring, Hornsby Spring, Ichetucknee Springs, and the Wacissa River have shown that paleoindians were living around springs and utilizing the resources of these areas.

One example of prehistoric human utilization of springs comes from Warm Mineral Springs, located in Sarasota County. Archaeologists recovered human remains from a ledge located 43 ft (13 m) below the water level that contained preserved brain material. The remains were radio-carbon dated and produced an age of 10,000 +/- 200 years before present (Royal and Clark, 1960). Other archaeological material and fossils were recovered from this site, which has proven to be one of the most important archaeological sites in the southeastern United States.

As the Pleistocene Epoch came to a close in Florida, many environmental changes were taking place. The large megafaunal animals that once had roamed the Florida landscape, were becoming extinct. Global weather patterns changed, and sea level began to rise. As these drastic changes were taking place, Florida's human inhabitants had to adapt. As water tables rose, springs became more abundant and people continued to exploit the resources in and around the springs. Prehistoric peoples living around springs built large shell middens and mounds as they disposed of the inedible portions of their food items. Numerous examples of these mounds exist throughout the state with some of the best examples being located along the St. Johns, Ocklawaha, and the Aucilla/Wacissa River systems. Abundant supplies of fresh water, aquatic food sources, chert and clay sources, and the sheer beauty of Florida's springs made them perfect habitation sites.



Figure 4 - Native American artifacts (from the Coastal Plains Institute collection).

Florida's springs are time capsules that contain valuable information about our cultural past. Prehistoric Floridians valued our state's spring resources and now modern Floridians are the stewards of a tradition that has lasted for more than 12,000 years. As our state continues to grow, more and more people will be putting demands on our natural resources. It is our modern culture's responsibility to see that Florida's springs be preserved in their natural beauty and ecological health for future generations.

HYDROGEOLOGY OF FLORIDA SPRINGS

Florida enjoys a humid, subtropical climate throughout much of the state (Henry, 1998). Rainfall, in the area of the major springs, ranges from 50 inches (127 cm) to 60 inches (152 cm) per year. As a result of this climate and the geologic framework of the state, Florida has an abundance of fresh groundwater. Scott (2001) estimated that more than 2.2 quadrillion gallons of fresh water are contained within the Floridan aquifer system (FAS).

The Florida peninsula is the exposed portion of the broad Florida Platform. The Florida Platform, as measured between the two hundred meter below sea level contour (approximately 600 ft), is more than 300 miles (483 km) wide. It extends more than 150 miles (241 km) under the Gulf of Mexico off shore from Crystal River and more than 70 miles (113 km) under the Atlantic Ocean from Fernandina Beach. The Florida peninsula is less than one half of the total platform.

FLORIDA GEOLOGICAL SURVEY

The Florida Platform is composed of a thick sequence of variably permeable carbonate sediments, limestone and dolostone, lying on older igneous, metamorphic and sedimentary rocks. The carbonate sediments may exceed 4,000 ft (1,220 m) in thickness. A sequence of sand, silt and clay with variable amounts of limestone and shell overlie the carbonate sequence (see Scott [1992 a, b] for discussion of the Cenozoic sediment sequence). In portions of the west-central and north-central peninsula and in the central panhandle, the carbonate rocks, predominantly limestone, occur at or very near the surface. Away from these areas, the overlying sand, silt and clay sequence becomes thicker. The complex Floridan aquifer system (FAS) occurs within this thick sequence of permeable carbonate sediments (see Miller, 1986; Berndt et al., 1998 for discussion of the FAS).

Natural recharge to the FAS by rain water, made slightly acidic by carbon dioxide from the atmosphere and organic acids in the soil, dissolved portions of the limestone. The dissolution enhanced the permeability of the sediments and formed cavities and caverns. Sinkholes formed by the collapse of overlying sediments into the cavities. Occasionally, the collapse of the roof of a cave creates an opening to the land surface.

Karst springs occur both onshore and offshore in Florida. Little is currently known about the offshore springs with the exception of the Spring Creek Group of springs - the largest spring in Florida (more than one billion gallons of water discharged per day) (Lane, 2001). In order to better understand the water resources of the state, the FGS has initiated a program to investigate the occurrence, discharge and water quality of the offshore springs.

Florida's first magnitude springs occur in the northern two-thirds of the peninsula and the central panhandle where carbonate rocks are at or near the land surface (Figure 5). All of these springs produce water from the upper FAS (Berndt et al., 1998) which consists of sediments that range in age from Late Eocene (approximately 38 - 36 million years old [my]) to mid-Oligocene (approximately 33 my). Miocene to Pleistocene sediments (24 my to 10,000 years) may be exposed in the springs.

The geomorphology (physiography) of the state, coupled with the geologic framework, controls the distribution of springs. The springs occur in areas where karst features (for example, sinkholes and caves) are common and the surface elevations are low enough to allow groundwater to flow at the surface. These areas are designated karst plains, karst hills and karst hills and valleys on Figure 6. The state's springs occur primarily within the Ocala Karst District and the Dougherty Karst Plain District (Scott, in preparation). Three springs, Alexander, Silver Glen and Volusia Blue occur in the Central Lakes District (Scott, in preparation).

Recharge to the FAS occurs over approximately 55% of the state (Berndt et al., 1998). Recharge rates vary from less than one inch (2.54 cm) per year to more than ten inches (25.4 cm) per year. Recharge water entering the upper FAS that eventually discharges from a spring has a variable residence time. Katz et al. (2001) found that water flowing from larger springs had a groundwater residence time of more than 20 years.

Discharge, water quality and temperature of the first order magnitude springs remain reasonably stable over extended periods of time (Berndt et al., 1998). However, because discharge

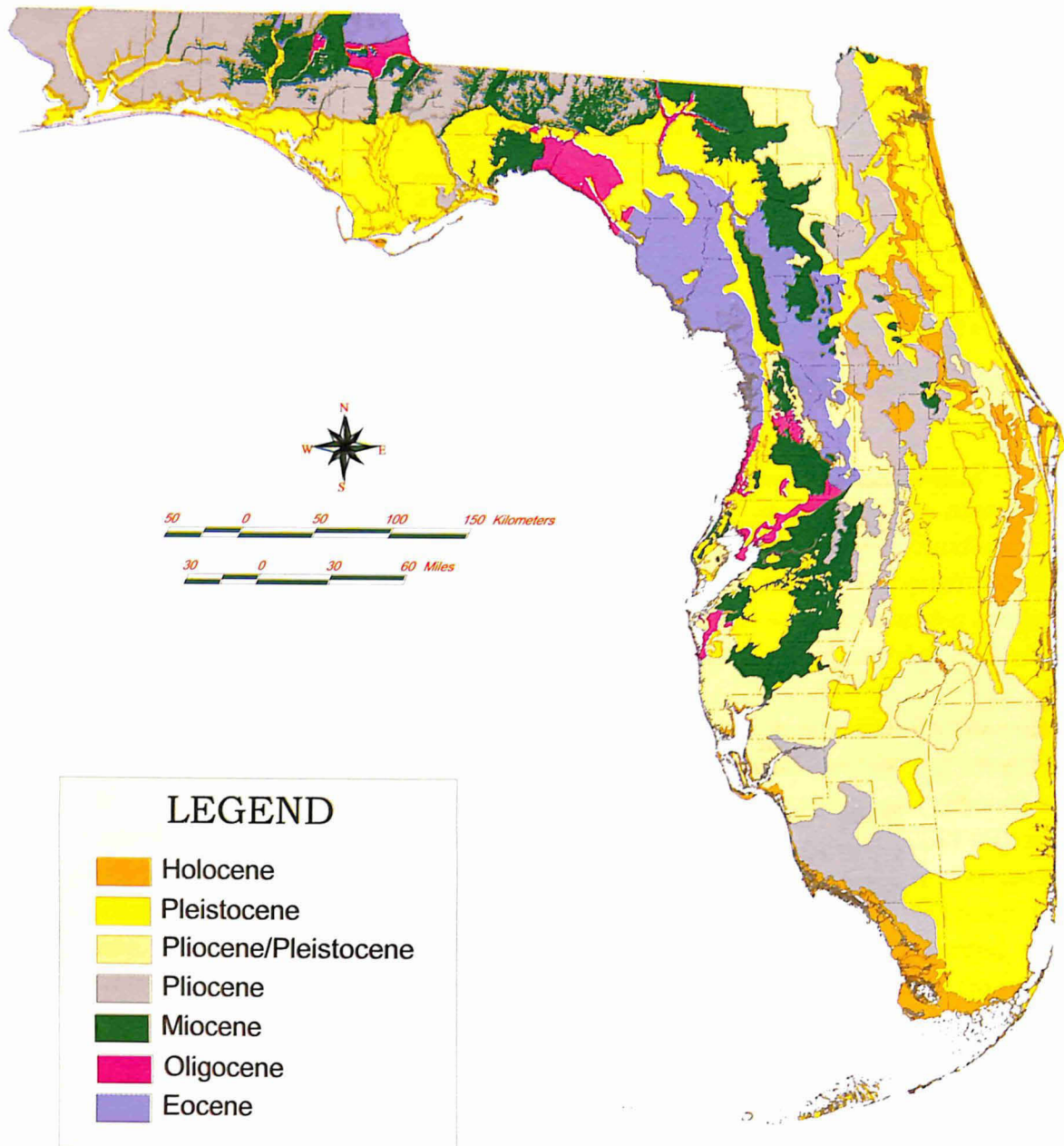


Figure 5. Generalized geologic map of Florida (modified from Scott et al., 2001).

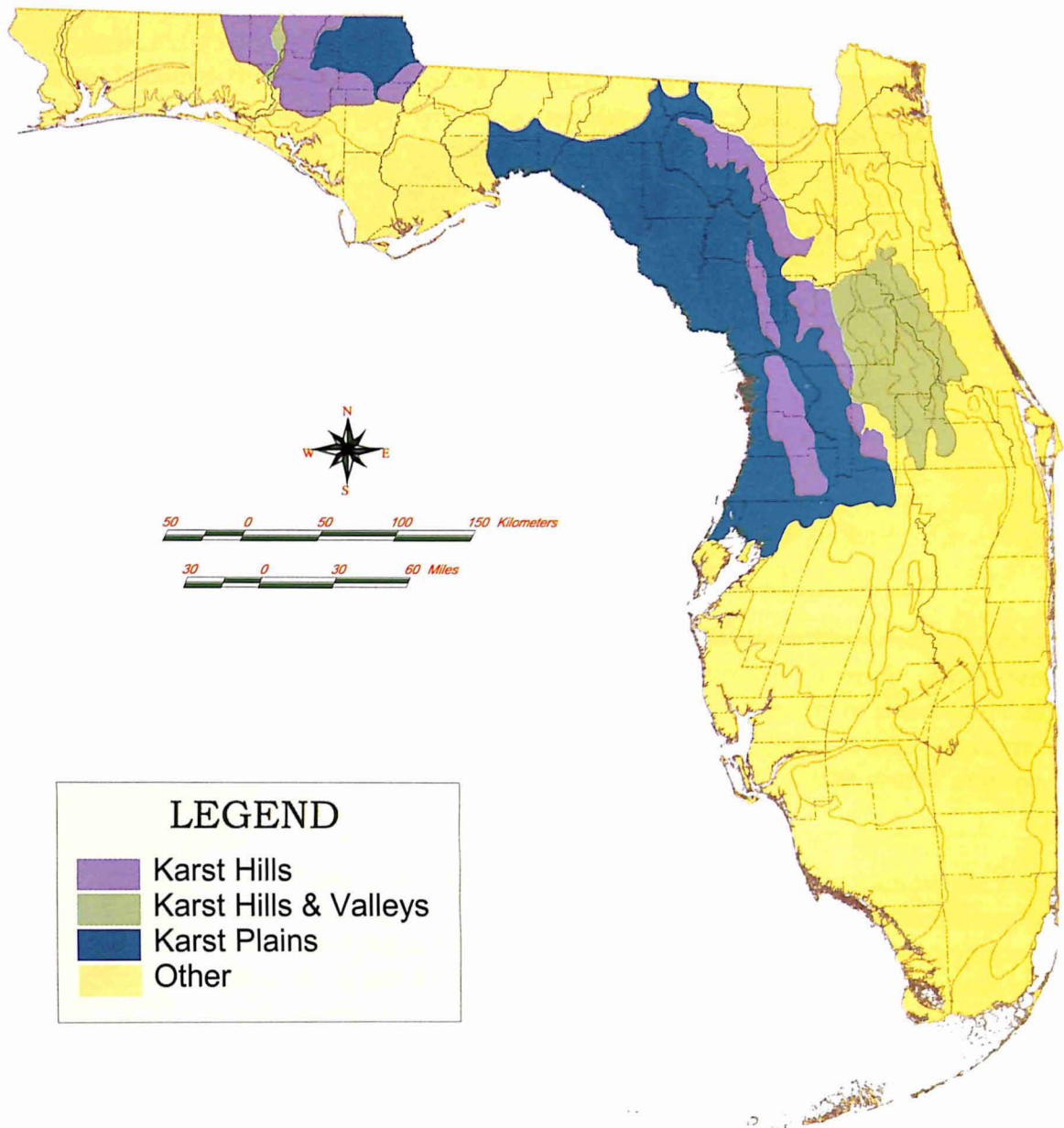


Figure 6. Karst areas related to first magnitude springs
(modified from Scott, in preparation).

rates are driven by the rate of recharge, climatic fluctuations often have a major effect on spring flow. During 1998 - 2001, Florida suffered a major drought with a rainfall deficit totaling more than 50 inches (127 cm). The resulting reduction in recharge from the drought and normal withdrawals caused a lowering of the potentiometric surface in the FAS. Many first order magnitude springs experienced a significant flow reduction. Some springs, such as Hornsby Spring, ceased flowing completely. The flow data given for each first order magnitude spring (see individual spring descriptions) reflects the drought-influenced flows.

WATER QUALITY

Methodology

Seventeen springs, eight spring groups/systems, seven river rises, and one karst window (49 vents total) were sampled from 25 September 2001 through 15 November 2001. Tidally influenced springs (10) were sampled at low tide to minimize the influence of salt water on the water-quality samples. Standard FDEP sampling protocols were followed for each sampling event (Morse et al., 2001).

Field Parameters

Temperature, dissolved oxygen, specific conductance, and pH were measured using Hydrolab Quanta and YSI data sonde (model no. 6920) and data logger (model no. 6100). Instruments were calibrated twice daily, before and after sampling events. For quality assurance purposes, field reference standards were analyzed every five to ten samples and ten equipment blanks were submitted to the FDEP Bureau of Laboratories throughout the sampling period.

To begin each sampling event, two stainless steel weights were attached to polyethylene tubing (3/8" O.D. x 0.062" wall) which was then lowered into the spring vent opening, ensuring the intake line was not influenced by surrounding surface water. Masterflex tubing was attached to the other end, run through a Master Flex E/S portable peristaltic pump (model no. 07571-00), and the discharge line was fed directly into a closed system flow chamber. The data sonde was inserted into the flow chamber and water was pumped through with a constant flow rate between 0.25 and 1 gallon/minute. No purge was required because springs are considered already purged. The field parameter values were recorded after the field meter displayed a stable reading (approximately 10 minutes). The flow chamber was removed and sampling was conducted directly from the freshly cut masterflex discharge line.

Two exceptions to this sampling method occurred at Wakulla Spring and Homosassa Springs. Both springs have pre-set pipes running down into the cave systems where the spring vents are located. In the case of Homosassa Springs, tubes from the three vents converge at an outlet box with three valves inside, one for each vent. Sampling is conducted from these valves. At Wakulla Spring, the pipe runs to a pump on shore from which sampling is conducted. The sampling system was designed and operated by Northwest Florida Water Management District (NFWFMD) (Wakulla Spring) and Southwest Florida Water Management District (SWFWMD) (Homosassa

FLORIDA GEOLOGICAL SURVEY

Springs). Each tube is purged for 10 minutes as there are gallons of water remaining in tubes from the last sampling effort. FDEP standard operating procedure for water quality sampling is then applied.

Water Samples

Seven bottles and three whirlpacks were filled with water from spring vents and analyzed by the FDEP Bureau of Laboratories following Environmental Protection Agency or Standard methods. All bottles were pre-rinsed with sample water prior to filling. Four bottles and three whirlpacks were filled with unfiltered water samples. A GWV high capacity in-line filter (0.45 μ m) was attached to the microflex tubing and the remaining three bottles were filled with filtered water samples. Bottles were filled in the order shown in Table 1.

Table 1. Sampling order.

Order	Container	Analyses	Sample Preparation
1	1 liter plastic	BOD	Unfiltered
2	1 liter plastic	Turbidity, Alkalinity, Color	Unfiltered
3	500 ml plastic	Nutrient	Unfiltered; H ₂ SO ₄ acidification
4	500 ml plastic	Metals	Unfiltered; HNO ₃ acidification
5	4oz whirlpacks (3)	Bacteria	Unfiltered
6	500 ml plastic	Anion, Alkalinity, Color	Filtered
7	500 ml plastic	Nutrient	Filtered; H ₂ SO ₄ acidification
8	250 ml plastic	Metals	Filtered; HNO ₃ acidification

Whirlpacks were placed on ice immediately after filling. Bottles for filtered and unfiltered nutrients (bottle nos. 3 and 7) were preserved with sulfuric acid followed by acidification of bottles for filtered and unfiltered metals (bottle nos. 4 and 8) using nitric acid. pH litmus paper was used to confirm acidity of pH less than or equal to 2. All water samples were placed on ice and delivered to the FDEP Bureau of Laboratories within 24 hours. Tubing and filters were discarded after each sampling event.

Additional Data

General descriptions of each spring vent were made and included the aquatic, wetland, and upland (where applicable) surroundings. Water depth was measured using a hand held Speedtech sonar depth gauge. Distances were measured with a Bushnell Yardage Pro 500 range finder. Secchi depth was obtained using a secchi disk. A Trimble XR Pro GPS system with a TDC1 data logger was used to record latitudinal and longitudinal coordinates. Field parameter, weather conditions, sampling times, water and secchi depth, and microland use information were also input into the GPS unit. Micro land uses within 300 ft of spring vent were identified and sketched.

Discharge Measurement

Where available, discharge data was obtained from the Water Management Districts, U.S. Geological Survey (USGS), and published sources. Methodology for each discharge technique is described below.

The USGS Tallahassee office operates continuous recording gauges on Fanning and Manatee Springs. Discharge rates are calculated using continuous data for gauge height and stream velocity. The latest discharge measurement used to define the rate at each spring was used in this report.

Discharge for the Devil's Ear Spring complex was measured by FDEP using an Acoustic Doppler Current Profiler (ADCP). ADCP measurements were performed following the guidelines established in the most current ADCP manuals by RD Instruments. ADCP measurements included 5 cross-sectional traverses of the stream. The discharge values from each traverse were summed and a mean was calculated to determine the discharge.

Recording gauges, operated by NFWFMD, are located on Econfinia Creek above and below the Gainer Springs complex. Readings are recorded in ten-minute increments. The difference in discharge between the two recorder stations, incorporating an eleven hour lag to travel the approximate six miles between each station, was calculated as the Gainer Springs Group flow. An average discharge rate for the day of sampling was calculated.

The NFWFMD operates a submerged flow meter within the cave system of Wakulla Springs main vent. The meter is surfaced monthly and discharge measurements are calculated from the velocity data. The most current reading was included in this report.

The discharge for Kings Bay Group was obtained from a publication prepared by the SWFWMD (Jones et al., 1998) in connection with the ambient ground-water quality monitoring program.

Provisional discharge data for Chassahowitzka, Homosassa, and Weeki Wachee springs were obtained from USGS, Tampa office. Mean discharge per day is calculated using physical discharge measurements at the springs, the stage and nearby groundwater well. The measurements control the equation and are compiled over the water year, therefore the data are provisional and subject to change when the site is computed at the end of the water year. See Yobbi and Knochenmus (1989) for more information on this methodology.

Discharge rates of the remaining nineteen springs were measured with Price-AA and Pygmy current meters by the Suwannee River Water Management District (SRWMD) (Alapaha Rise, Lafayette Blue, Madison Blue, Columbia, Falmouth, Hornsby, Ichetucknee, Santa Fe Spring, Tree House, Troy), USGS Orlando office (Alexander, Rainbow, Silver Glen, Silver Springs, Volusia Blue), and by FGS (Holton Creek, Jackson Blue, Nutall Rise, St. Marks). Vertical-axis meter discharge measurements were conducted at intervals across the spring channel such that no partial section contained more than 5 percent of the flow from the spring. At least 20 sectional readings were obtained per spring. When water depth was less than 2.5 ft (0.8 m), one velocity measurement was recorded at six-tenths of total depth. For water depths greater than 2.5 ft (0.8 m), the two-point method (velocity measurements at two-tenths and eight-tenths of total depth) was used primarily for velocity measurement in a partial section. The discharge values for each partial section were summed to obtain the total discharge measurement.

FLORIDA GEOLOGICAL SURVEY

Characteristics of Spring Water

Spring water discharges provide a means of determining the quality of water in the aquifer from which the water flows. Upchurch (1992) states that a number of factors influence ground-water chemistry. These include the precipitation chemistry, surface conditions at the site of recharge, soil type in the recharge area, mineralogy and composition of the aquifer system, nature of aquifer system porosity and structure, flow path in the aquifer, residence time of the water in the aquifer, mixing of other waters in the aquifer system, and aquifer microbiology. Refer to Upchurch (1992) for a detailed discussion of the factors affecting the chemistry of groundwater.

Descriptions of Analytes

Water quality of springs is determined by collecting and analyzing water samples (Figure 7). A series of field analytes are measured on site during sample collection. When combined, field and Bureau of Laboratories data give a snapshot of water quality at that particular time. Comparing similar data, taken over time, can give information about how water quality changes and what may be causing these changes. Analyte descriptions utilized data from Baker (1994), Champion and Starks (2001), Hornsby and Ceryak (1998), Jones et al. (1998), Maddox et al. (1992), and Smith (1992). Table 2 gives the units of measure for each analyte.

Table 2 - Units of measurement for each analyte.

Analyte	Abbreviation	Unit of Measure
Temperature	-	°C
Dissolved Oxygen	DO	mg/L
pH	-	units
Specific Conductance	Sp. Cond.	μ S/cm at 25 °C
Biochemical Oxygen Demand	BOD	mg/L
Turbidity	-	JTU (Historical) NTU (Current)*
Color	-	Platinum Cobalt Units
Alkalinity as CaCO ₃	-	mg/L
Total Dissolved Solids	TDS	mg/L
Total Suspended Solids	TSS	mg/L
Chloride	Cl	mg/L
Sulfate	SO ₄	mg/L
Fluoride	F	mg/L
Total Organic Carbon	TOC	mg/L
Total Nitrogen	NO ₃ + NO ₂	mg/L
Total Ammonia	NH ₃ + NH ₄	mg/L
Total Kjeldahl Nitrogen	TKN	mg/L
Total Phosphorus	P	mg/L
Orthophosphate as P	PO ₄	mg/L

Analyte	Abbreviation	Unit of Measure
Calcium	Ca	mg/L
Potassium	K	mg/L
Sodium	Na	mg/L
Magnesium	Mg	mg/L
Arsenic	As	μ g/L
Aluminum	Al	μ g/L
Boron	B	μ g/L
Cadmium	Cd	μ g/L
Cobalt	Co	μ g/L
Chromium	Cr	μ g/L
Copper	Cu	μ g/L
Iron	Fe	μ g/L
Manganese	Mn	μ g/L
Nickel	Ni	μ g/L
Lead	Pb	μ g/L
Selenium	Se	μ g/L
Tin	Sn	μ g/L
Strontium	Sr	μ g/L
Zinc	Zn	μ g/L

*JTU and NTU are approximately equivalent though not identical

Physical Field Parameters

Measurements of field analytes are taken directly in the field prior to water sampling. They include dissolved oxygen, pH, specific conductance, water temperature and discharge. Other data collected in the field include local geology, weather conditions and adjacent land use practices.

Dissolved Oxygen - Oxygen readily dissolves in water. The source of oxygen can be atmospheric or biological. Typically, springs that discharge water from a deep aquifer source have a low dissolved oxygen content. On the other hand, relative to springs, the dissolved oxygen content in river rise water is high. This is due to a greater exposure to the atmosphere and an increase in biological activity.

pH - pH measures the acidity or alkalinity of water. It is defined as the negative log of the activity of the hydrogen ion in a solution. Values range between 0 and 14. A low pH represents acidic, and a high pH represents alkaline conditions. A pH near 7 indicates the water is near neutral conditions.

Rainwater has a low pH and is naturally acidic. As moisture passes through the atmosphere, it picks up dissolved carbon dioxide, forming carbonic acid. In Florida, as rainwater passes through soil layers it incorporates organic acids and the acidity increases.

When acidic water enters a limestone aquifer, the acids react with calcium carbonate in the limestone and dissolution occurs. Generally, most spring water falls within a pH range of 7 to 8. During heavy rain events, spring water can drop in pH as tannic acids, from nearby surface waters, are flushed into the spring system. It should be noted that sampled river rises tend to have a lower pH than the spring systems, due to the surficial component of the water.

Specific Conductance - Specific conductance is a measure of the ability of a substance, in this case spring water, to conduct electricity. The conductance is a function of the amount and type of ions in the water. The variability of the specific conductance of spring water can be quite high when the spring is discharging saline water or when the spring is discharging into the marine environment.

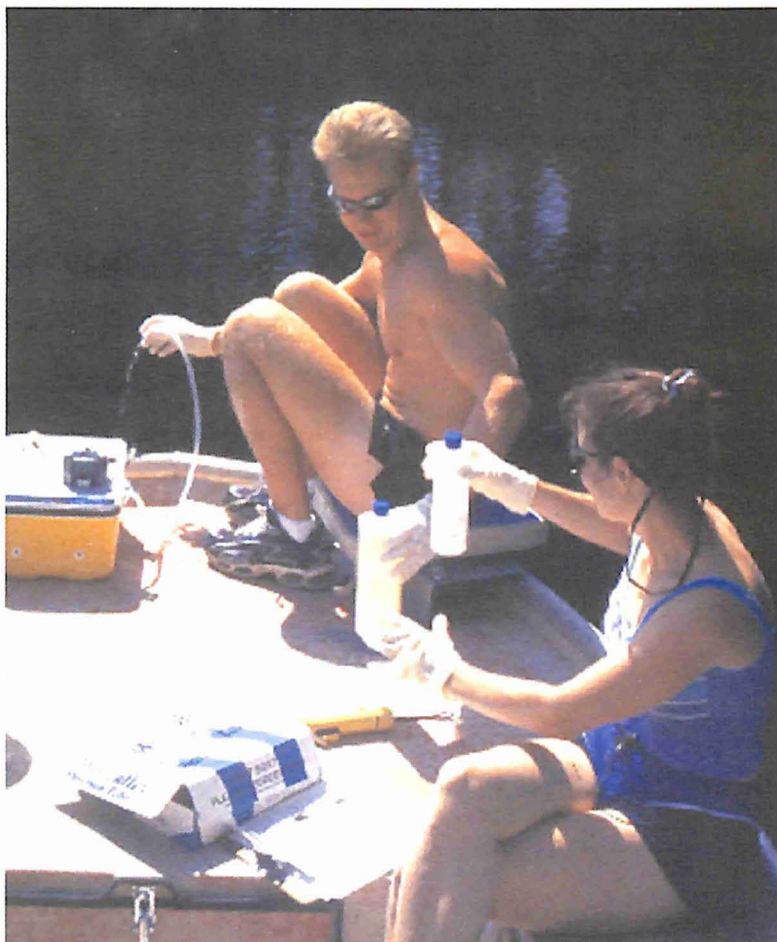


Figure 7. An FGS Spring Sampling Team, 2001
(photo by Tom Scott)

FLORIDA GEOLOGICAL SURVEY

Water Temperature - Geologic material is a good thermal insulator. It tends to buffer changes in the temperature of spring water. Thus, spring water temperature does not vary much and tends to reflect the average annual air temperature in the vicinity of the spring. This temperature can range from 68°F to 75°F (20°C to 24°C), plus or minus several tenths of a degree. Temperature plays a role in chemical and biological activity within the aquifer and can help in determining residence time of the water in the aquifer.

Discharge - Discharge, or springflow, is controlled by the potentiometric levels in the FAS. Discharge generally changes slowly in response to fluctuations in the water levels in the aquifer. Discharge is measured in cubic feet per second or gallons per day.

Other Field Data - During sample collection, total water depth, sample depth, local geology, adjacent land use and current weather conditions are noted at each spring. This generalized information can be useful in helping to determine certain water quality-related issues of the spring.

Laboratory Analytes

Alkalinity - The alkalinity of spring water is affected primarily by the presence of bicarbonate, hydroxide and carbon dioxide. Highly alkaline waters are usually associated with high pH, dissolved solids and hardness which, when combined, may be detrimental to the aquatic environment.

Biochemical Oxygen Demand - Biochemical oxygen demand (BOD) is a measure of the quantity of molecular oxygen utilized in the decomposition of organic material, during a specified incubation time, by microorganisms such as bacteria. When the BOD is high, the depletion of oxygen can have a detrimental effect on aquatic organisms. BOD is measured in mg/L. In Florida, there is no set standard for BOD in groundwater.

Chloride (Cl⁻) - Chloride is the most abundant constituent in seawater, and springs that are tidally influenced have high chloride concentrations. Chloride is added to the atmosphere via marine aerosols from the ocean. In most of Florida's springs, chloride is introduced to the spring system via rainfall. Chloride is chemically conservative and reacts very little with spring water. When chloride concentrations in drinking water exceed 250 mg/L it is considered unfit for drinking. This is the secondary standard established by the State of Florida.

Color - The color of spring water can be affected by factors such as the presence of metallic ions, tannic acids, biological activity and industrial waste. Generally, spring water in Florida is clear. Color measurements are made on filtered water samples so the true color of the water is determined. Color is reported in either color units or Platinum Cobalt units (Pt/Co). In Florida, the secondary (aesthetic) standard for groundwater is 15 color units.

Hardness - The hardness of water is a function of the presence of calcium, magnesium, and other alkali metal ions. The higher the calcium/magnesium content of the water, the harder the water. Hard water forms insoluble residues on surfaces where evaporation has taken place. Hard water, when used with soap, can also form residues on surfaces. The hardness of water is expressed either in parts per million, or in milligrams per liter, and is usually a measure of the calcium carbonate dissolved in the water.

Nitrate + Nitrite (NO_3 , NO_2) - Nitrate and nitrite are both found in spring water in Florida. Nitrate contamination recently has become a problem in Florida's springs. Nitrate found in spring water originates from fertilizers, septic tanks and animal waste that enters the aquifer in the spring recharge area. Nitrate, being a nutrient, encourages algal and aquatic plant growth in spring water, which may lead to eutrophication of the spring and associated water body. Nitrite, which is much less of a problem, can originate from sewage and other organic waste products. When nitrate levels exceed 10 mg/L in drinking water, it is potentially hazardous to infants, causing methemoglobinemia or "blue baby syndrome". For this reason, the FDEP has set the Primary Drinking Water Standard for nitrate in groundwater at 10 mg/L and nitrite at 1 mg/L.

Organic Carbon - Natural and non-naturally occurring organic carbon are present in varying concentrations in spring water in Florida. The primary source of naturally occurring organic carbon is humic substances (decaying plant material). Synthetic organics represent a minor component. There are no standards set for naturally occurring organic carbon in drinking water however, synthetic organic carbon compounds are regulated on an individual basis in Florida.

Orthophosphate (PO_4^{3-}) - Phosphate is an essential nutrient and occurs in spring water in Florida. Unfortunately, an excess of phosphate can cause run-away plant growth and the eutrophication of surface waters. The Hawthorn Group, a geological unit in Florida, is the primary source of phosphate in spring water. Other sources include organic and inorganic fertilizers, animal waste, human waste effluent and industrial waste. In Florida, there is no regulation nor standard for phosphate.

Potassium (K) - Potassium occurs in trace amounts in Florida's spring water and is derived primarily from sea water. Therefore, it occurs in higher concentration along the coast. The weathering of feldspars and clays can contribute potassium to spring water. In addition, because potassium is an essential nutrient, it is a component of fertilizers. In Florida, there is no standard for potassium and it is considered to be beneficial in moderate concentrations.

Sodium (Na) - In Florida, sodium occurring in spring water has several sources. Marine aerosols, mixing of sea water with fresh water and the weathering of sodium bearing minerals like feldspars and clays are the primary sources. The Florida Department of Environmental Regulation, in 1994, set the maximum allowable concentration of sodium in drinking water at 160 mg/L. Concentrations exceeding this standard can occur in springs that discharge from deep Floridan aquifer sources and in coastal areas where spring water and marine water mixing may occur.

Sulfate (SO_4) - Sulfate is commonly found in aquifer waters in Florida and has several sources. The two most common sources are from sea water and the dissolution of gypsum and anhydrite (naturally occurring rock types within Florida's aquifer systems). Sulfate is often used as a soil amendment to acidify soils, and thus is associated with agricultural activities. Finally, disposal and industrial waste activities release sulfate to ground water. Sulfate rich spring water can potentially be toxic to plants. In higher concentrations it affects the taste of drinking water. For this reason, the FDEP established a Secondary Drinking Water standard for sulfate of 250 mg/L.

FLORIDA GEOLOGICAL SURVEY

Total Ammonia ($\text{NH}_3 + \text{NH}_4^+$) - Ammonia (NH_3) occurs in groundwater primarily as the ammonium ion (NH_4^+) because of the prevalent pH and reduction-oxidation potential (Upchurch, 1992). Microbial activity within the soil and aquifer can convert other nitrogenous products to ammonium. There is no set standard for ammonia in Florida groundwater.

Total Dissolved Solids - Total dissolved solids is a measure of the dissolved chemical constituents, primarily ions, in spring water. Concentrations in Florida's spring water vary widely. Since most of Florida's spring water issues from carbonate aquifers, the total dissolved solid concentrations are fairly high. Higher concentrations are found in springs that are tidally influenced and springs that discharge into the marine environment. The Florida Secondary Drinking Water Standard for total dissolved solids is 500 mg/L.

Total Kjeldahl Nitrogen - This is a measure of the sum of the ammonia nitrogen and organic nitrogen in the spring water sample. The ammonia nitrogen, mainly occurring as ammonium (NH_4^+), occurs in trace amounts in spring water (see ammonia (NH_3) above). Organic nitrogen originates from biological sources including sewage and other waste. DEP regulates nitrogen, in the form of nitrates and nitrites, in drinking water in Florida (see previous descriptions above).

Total Nitrogen - The amount of nitrate, nitrite, ammonia, and organic nitrogen, when summed, gives the total nitrogen content of spring water. See description of each nitrogen compound for regulation standards in Florida.

Total Suspended Solids - This refers to the amount of solid material suspended in the water column. As opposed to turbidity, total suspended solids does not take into account the light scattering ability of the water. Total suspended solids are filtered out of the water sample and are measured in mg/L.

Turbidity - Turbidity is a measure of the colloidal suspension of tiny particles and precipitates in spring water. High turbidity water impedes the penetration of light and can be harmful to aquatic life. Most Florida springs discharge water low in turbidity. Turbidity is measured in Nephelometric Turbidity Units (NTU's).

Trace Metals

Trace metals analyzed for this report include: aluminum (Al), arsenic (As) boron (B), calcium (Ca), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), fluoride (F), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), phosphorous (P), selenium (Se), strontium (Sr), tin (Sn) and zinc (Zn). Trace metals, when present in spring water, are found in very low concentrations and are measured in parts per billion (ppb), or micrograms per liter ($\mu\text{g/L}$). In Florida, calcium and magnesium occur in higher concentrations and are therefore measured in milligrams per liter.

The naturally low abundance of trace metals in Florida's groundwater can be attributed to several factors including low natural abundance in aquifer rocks, low solubility of metal bearing minerals, high adsorption potential of metal ions on clays and organic particulates, and precipitation in the form of sulfides and oxides (Upchurch, 1992). Many biochemical processes require small amounts of trace metals however, higher concentrations can be toxic. Industrialization and

increased demand for products containing trace metals has overwhelmed the natural biogeochemical cycle, and anthropogenic sources for trace metals now far outweigh natural sources (Smith, 1992).

In Florida, lead is one of the most important metal contaminants found in groundwater. This contaminant, along with other metals, is primarily distributed in the atmosphere, water, soil and sediments. Atmospheric pollutants are often the primary source of waterborne metals. These pollutants are introduced into the atmosphere by mining operations, smelting, manufacturing activities and the combustion of fossil fuels (Smith, 1992).

Contamination of groundwater by lead is caused primarily by combustion of fossil fuels containing lead additives. Lead additives were phased out of fuels in the U.S. and Canada by 1990, but other sources of contamination including mining, smelting and refining of lead and other metals still persist. Lead bioaccumulates in aquatic organisms affecting the higher trophic levels the most. In humans, lead causes severe health problems including metabolic disorders, neurological and reproductive damage and hypertension. In Florida, the Primary Standard for lead in drinking water is 15 mg/L.

When trace metals are released into the environment, they present major problems because they are not biodegradable. These pollutants tend to stay in the environment and accumulate in foodwebs and ecosystems. In higher concentrations, other trace metals, like arsenic and cadmium, can have adverse effects on aquatic and terrestrial environments. There are Primary Standards for other trace metals found in groundwater in Florida (Florida DEP Ground Water Guidance Concentrations, 1994).

Biological Analytes

Spring water samples were analyzed for total coliform, fecal coliform, *Escherichia coli* (*E. coli*), and Enterococci. These analytes are used to assess the sanitary quality of spring water and to determine the potential for waterborne diseases (bacterial and viral). The primary source of these contaminants is fecal waste from warm-blooded animals. When detected in numbers that exceed the maximum contaminant level (MCL), coliforms may indicate that the spring has been contaminated by domestic sewage overflow or non-point sources of human and animal waste. Measurements made on these biological analytes are reported in colonies per 100 milliliters.

Total coliform bacteria are a group of closely related, mostly harmless bacteria that live in the digestive tract of animals. The extent to which total coliforms are present in spring water can indicate general water quality and the amount of fecal contamination. By further examining fecal coliforms, *E. coli* and Enterococci, it is possible to estimate the amount of human fecal contamination of the sample. Human contact with water that is contaminated with fecal wastes can result in diseases of the digestive tract including gastroenteritis and dysentery. Typhoid fever, hepatitis A, and cholera are also related to contact with fecally contaminated water.

Currently, there are criteria for bacteriological quality in Florida's ground water. Groundwater in the state has a limit on total coliform bacteria of 4 colonies per 100 milliliters. *E. coli* and Enterococci do not currently have water quality standards in Florida.



Figure 8. Jackson Blue Spring aerial photo (photo by J. Stevenson).

DESCRIPTIONS OF INDIVIDUAL SPRINGS AND RESULTS OF ANALYSES

ALACHUA COUNTY



Figure 9. Hornsby Spring (photo by T. Scott).

Hornsby Spring

Location - Lat. 29° 51' 01.3" N, Long. 82° 35' 35.5" W (NE / NE / SE / sec. 27, T. 7 S, R. 17 E). Hornsby Spring is located on Camp Kalaukua 1.4 miles (2.3 km) north of High Springs. From the intersection of US 441 and US 41 in High Springs, drive northeast on CR 236 and follow signs to Camp Kalaukua. The spring is inside the campgrounds about 300 ft (91 m) northwest of the camp entrance.

Description - Hornsby Spring has a circular spring pool measuring 155 ft (48 m) north to south and 147 ft (45 m) east to west. Its depth is 34.5 ft (10.6 m). The water is clear and slightly greenish blue. The spring has an underwater limestone ledge on the north side under a floating walkway. Algae patches are growing on limestone substrates. The spring run flows generally westward into the Santa Fe River. A small spring boil is visible near the wooden walkway. This spring is situated on the edge of the lowland floodplain of the Santa Fe River. The floodplain is forested with cypress, gum, and maple. High ground on the east side of the spring rises steeply to 6 ft (2 m) above water level, then gently rises to approximately 15 ft (4.5 m) and is a rolling sandhills terrain. The uplands are open and grassy.

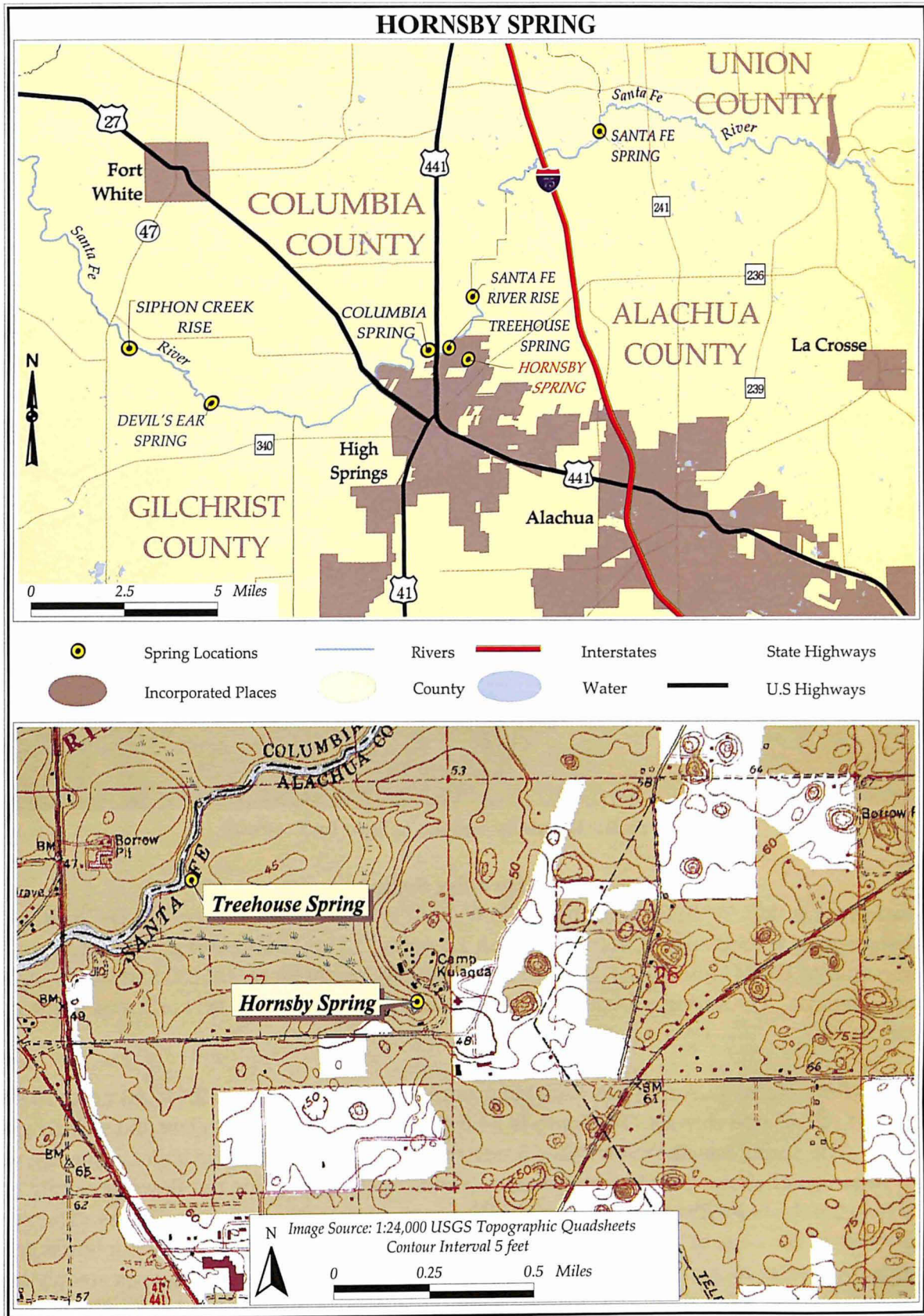


Figure 10. Hornsby Spring location map.

Table 3. Hornsby Spring water quality analysis.

Analytes	1972	2001	
		Unfilt.	Filter
Field Measures			
Temperature	22.5	22.8	-
DO	-	0.47	-
pH	8.8	7.15	-
Sp. Cond.	390	494	-
Lab Analytes			
BOD	-	0.51 I	-
Turbidity	-	0.15	-
Color	-	5 U	-
Alkalinity	130	163 J	163 A
Sp. Cond.	-	490 A	-
TDS	-	313	-
TSS	-	4 U	-
Cl	12	12	12
SO ₄	60	83	82
F	0.4	0.26	0.22
Nutrients			
TOC	-	1 I	-
NO ₃ + NO ₂	0.00	0.3 J	0.3
NH ₃ +NH ₄	-	0.011 I	0.011 I
TKN	-	0.096 I	0.094 I
P	-	0.073	0.072
PO ₄	-	0.075	-

Analytes	1972	2001	
		Unfilt.	Filter
Metals			
Ca	5.7	74.3	74.2
K	0.6	1	0.98
Na	8.5	8.46	8.55
Mg	9.6	12.8	12.6
As	-	3 U	3 U
Al	-	-	75 U
B	-	25 U	-
Cd	-	0.75 U	0.75 U
Co	-	0.75 U	-
Cr	-	2 U	2 U
Cu	-	2.5 U	2.5 U
Fe	-	35 U	35 U
Mn	-	16.7	16.2
Ni	-	2 U	2 U
Pb	-	5 U	4 U
Se	-	4 U	4 U
Sn	-	20 U	-
Sr	-	1140	-
Zn	-	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=exceeded holding time limit

Utilization - Hornsby Spring is the center feature of Camp Kalaukua, and it is developed into a swimming and recreation area. There are numerous boardwalks over and around the spring. A slide leads into the spring pool on the north side. Full facilities are located nearby.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

April 19, 1972	250
April 25, 1975	76
October 16, 2001	14.1

Table 4. Hornsby Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	10 Q
Enterococci	4 Q
Fecal Coliform	6 Q
Total Coliform	20 Q

Water Quality-Analyses conducted by the Florida Geological Survey and the Florida Department of Environmental Protection Bureau of Laboratories. Historical measurements were obtained from Bulletin No. 31, Revised (Rosenau et al., 1977).

BAY COUNTY

Gainer Springs Group



Figure 11. Gainer Springs Group Vent 1C (photo by T. Scott).

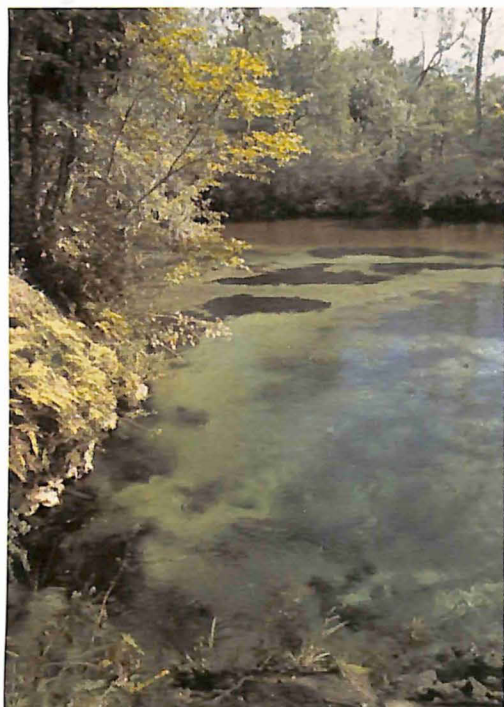


Figure 12. Gainer Springs Group Vent 2 (photo by H. Means).

Group Location - Lat. 30° 25' N, Long. 85° 32' W (southern half of sec. 4, T. 1 S, R. 13 W). Gainer springs complex is located 0.4 miles (0.7 km) downstream from the SR 20 bridge on Econfina Creek . It is best accessed by canoe, however, there is a gated dirt track on Northwest Florida Water Management District (NFWMD) land that leads to the springs group on the east side of the creek.

Group Description - At least 5 known springs associated with Gainer Springs Group are along both sides of Econfina Creek. The uplands surrounding this group are high rolling sand hills that are forested with sand pine plantations and patches of longleaf pine-turkey oak community. High ground adjoining the west side of the creek near Spring No. 2 and Spring No. 3 rises to 27 ft (8 m) above water surface and is densely forested with mixed hardwoods and pines. The creek floodplain is forested with cypress and hardwoods. Land on the west side of

the Econfina Creek at Gainer Springs is owned by Patronis, Inc (out of Panama City, Fla). The east side of the creek is owned and managed by the NFWFMD.

GAINER SPRING NO. 1C - Lat. 30° 25' 39.6" N, Long. 85° 32' 46.0" W (SW/NW/SE/sec. 4, T. 1 S, R. 13 W). Gainer Spring Nos. 1A, 1B, and 1C form a 820 ft (250 m) long spring run that enters Econfina Creek on the east side directly across from Spring No. 2. Spring No. 1C is the first spring encountered approximately 495 ft (150 m) upstream from the creek, and its pool is adjacent to the run on the southeast side. Spring pool dimensions are approximately 72 ft (22 m) east to west and 33 ft (10 m) north to south. Water issues upward from a vertical tunnel in the limestone. Shell and sand particles are suspended in the spring flow. Pool depth is 20 ft (6.1 m) measured over the vent opening. There is very little aquatic vegetation, however, algae patches in spring pool are common. The adjoining, swampy lowlands are heavily forested with cypress and mixed hardwoods. The nearest uplands to the southeast support a mixed hardwood and pine forest. There is no high ground adjacent to the spring pool.

GAINER SPRING NO. 2 - Lat. 30° 25' 38.6" N, Long. 85° 32' 54.0" W (SW/NE/SW/sec. 4, T. 1 S, R. 13 W). This spring is located directly across from the mouth of Gainer Spring No. 1 run along the west side of Econfina Creek. Spring water issues forcefully from the base of the riverbank and forms a pool along the edge of the creek. Pool diameter is approximately 60 ft (18 m) east to west and 62 ft (17 m) north to south. Pool depth is 5 ft (1.5 m). Vent diameter is approximately 5 ft (1.5 m). There is little or no aquatic vegetation, but patches of dark green algae are present. The water is light greenish blue. A concrete wall forms the south side of the spring pool. Two parallel pipes that extract drinking water run from inside the spring vent toward the top of the bluff and beyond. There are at least three other smaller vents issuing from the bank just above this spring. A 23 ft (7 m) high bluff meets Econfina Creek at Spring No. 2. A mixed hardwood and pine forest inhabits the bluff face and high ground.

GAINER SPRING NO. 3 - Lat. 30° 25' 44.3" N, Long. 85° 32' 53.9" W (NE/NE/SW/sec. 4, T. 1 S, R. 13 W). This spring is located along the west side of Econfina Creek, and is about 655 ft (200 m) upstream of Spring No. 2. It is at the head of a 325 ft (100 m) long spring run. There are at least three vent complexes in the combined spring pool. The depression is large and mostly shallow with a sandy bottom and limestone boulders. The combined spring pool diameter is about 305 ft (93 m) east to west and 125 ft (39 m) north to south. There is a forested island in the center of the combined spring pool. Some emergent vegetation exists along the pool's shores, but there is very little aquatic vegetation. Dark green algal mats are ubiquitous throughout the bottom of the spring pool. The western vent issues out of a limestone sidewall and has a small boardwalk nearby. The north vent where water quality was sampled is the largest and deepest. This spring is about 15 ft (5 m) south of a wooden wall presumably constructed for shore erosion management. Light greenish blue water issues vertically from the bottom of a 16 ft (5 m) diameter conical depression and produces a boil at the surface. The depression is 7.4 ft (2.3 m) deep over the vent. Vent diameter is about 1.5 ft (.5 m). On the eastern side of the combined spring pool, there are at least 3 other vents. Uphill to the north, there are picnic tables under a pavilion in a grassy opening. The rest of the uplands adjoining the spring pool to the west are forested with mixed hardwoods and pines.

Utilization - Gainer Spring No. 2 is owned by Patronis, a bottled-water company. Econfina

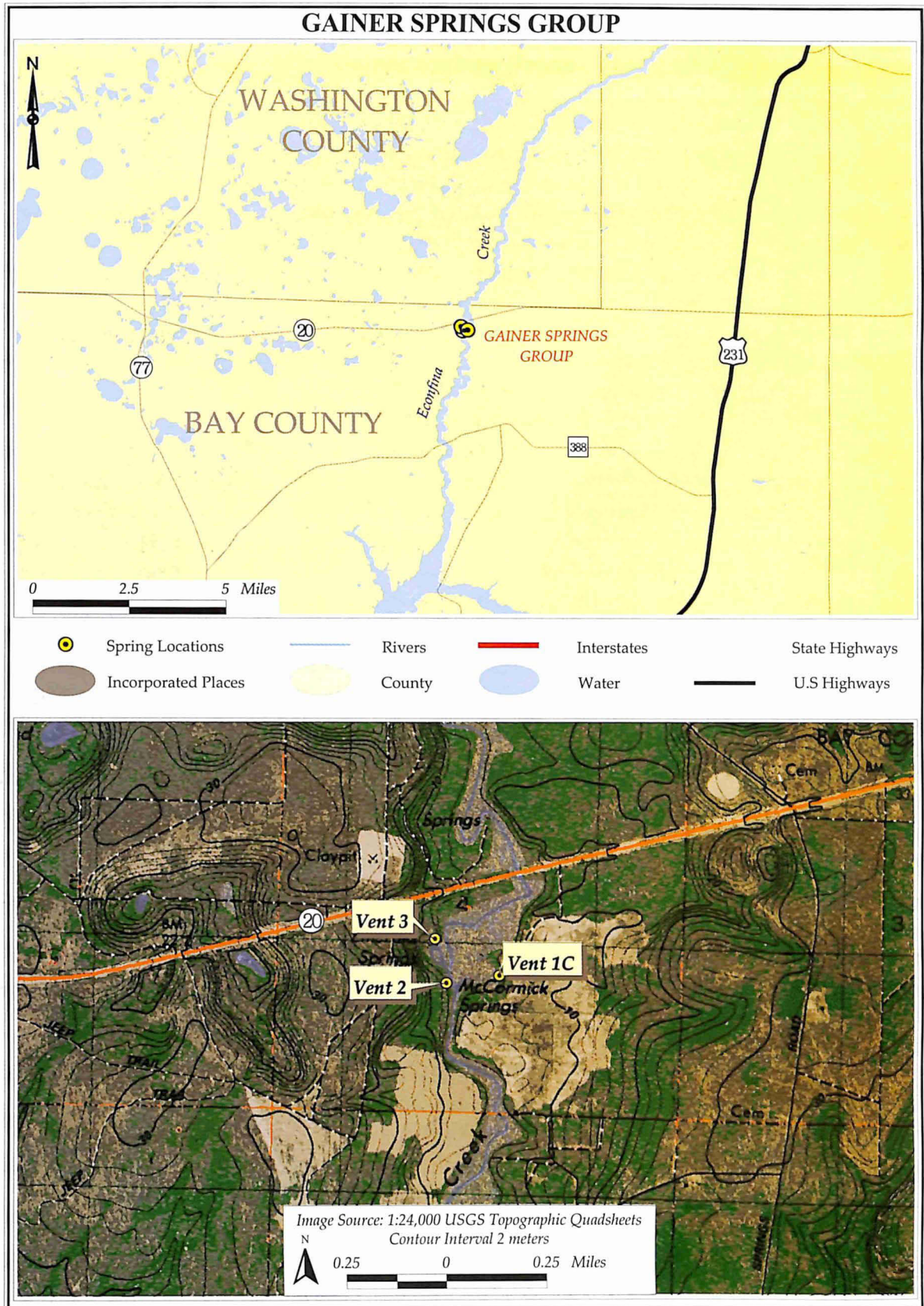


Figure 13. Gainer Springs Group location map.

Table 5. Gainer Springs Group water quality analyses.

Analytes	Vent #1				Vent #2				Vent #3			
	1962	1972	2001		1962	1972	2001		1962	1972	2001	
			Unfilt.	Filter			Unfilt.	Filter			Unfilt.	Filter
Field Measures												
Temperature	-	21.0	21.5	-	21.1	22.0	21.4	-	21.1	21.5	21.6	-
DO	-	2.8	2.12	-	-	2.5	2.27	-	-	3.0	2.18	-
pH	7.4	7.9	8.00	-	7.3	7.8	8.19	-	7.2	7.8	8.20	-
Sp. Cond.	115	127	142	-	82	108	113	-	115	125	121	-
Lab Analytes												
BOD	-	-	0.2 U	-	-	-	0.2 U	-	-	-	0.2 U	-
Turbidity	-	-	0.25	-	-	-	0.2	-	-	-	0.1	-
Color	2	5	5 U	-	7	5	5 U	-	2	10	5 U	-
Alkalinity	57	55	66	67	38	48	52	52 A	53	54	56	56
Sp. Cond.	-	-	160	-	-	-	130 A	-	-	-	130	-
TDS	-	-	79	-	-	-	60	-	-	-	61	-
TSS	-	-	4 U	-	-	-	4 U	-	-	-	4 U	-
Cl	2.5	2.5	2.5	2.5	1.5	2.0	2.3	2.3	3.0	3.0	2.9	2.8
SO ₄	1.6	0.0	2.4	2.5	0.4	0.0	2.3	2.3	0.8	0.0	2.1	2
F	0.1	0.1	0.034 I	0.035 I	0.1	0.1	0.03 I	0.029 I	0.2	0.1	0.03 I	0.029 I
Nutrients												
TOC	-	-	1.1 I	-	-	0.0	1.2 I	-	-	-	1 U	-
NO ₃ + NO ₂	-	0.10	0.17	0.16	-	0.19	0.21	0.21	-	0.09	0.19	0.18
NH ₃ + NH ₄	-	-	0.038	0.01 U	-	-	0.035	0.01 U	-	-	0.01 U	0.01 U
TKN	-	-	0.06 U	0.06 U	-	-	0.06 U	0.06 U	-	-	0.06 U	0.06 U
P	-	-	0.014	0.014	-	0.02	0.013 A	0.013	-	-	0.013	0.012
PO ₄	0.08	-	0.015	-	0.48	0.02	0.012	-	0.15	-	0.012	-
Metals												
Ca	19	19	22.7	22.5	13	16	17.5	17.2	18	17	18.1	17.8
K	0.2	0.3	0.26	0.26	0.2	0.2	0.25	0.25	0.1	0.2	0.24	0.25
Na	2.0	1.8	1.64	1.44	1.7	1.4	1.45	1.34	1.9	1.8	1.68	1.61
Mg	2.8	2.9	2.7	2.8	1.8	2.4	2.4	2.4	3.2	2.8	2.9	2.9
As	-	-	3 U	3 U	-	10	3 U	3 U	-	-	3 U	3 U
Al	-	-	-	75 U	-	-	-	75 U	-	-	-	75 U
B	-	-	10 U	-	-	-	10 U	-	-	-	10 U	-
Cd	-	-	0.75 U	0.5 U	-	0	0.75 U	0.5 U	-	-	0.75 U	0.5 U
Co	-	-	0.75 U	-	-	0	0.75 U	-	-	-	0.75 U	-
Cr	-	-	0.7 U	0.5 U	-	0	0.7 U	0.5 U	-	-	0.7 U	0.5 U
Cu	-	-	2 U	2 U	-	0	2 U	2 U	-	-	2 U	2 U
Fe	-	-	25 U	20 U	-	30	25 U	20 U	-	-	25 U	20 U
Mn	-	-	0.5 U	0.5 U	-	0	0.5 U	0.5 U	-	-	0.5 U	0.5 U
Ni	-	-	1.5 U	1.5 U	-	-	1.5 U	1.5 U	-	-	1.5 U	1.5 U
Pb	-	-	5 U	3 U	-	2	5 U	3 U	-	-	5 U	3 U
Se	-	-	3.5 U	3.5 U	-	-	3.5 U	3.5 U	-	-	3.5 U	3.5 U
Sn	-	-	9 U	-	-	-	9 U	-	-	-	9 U	-
Sr	-	80	76.1	-	-	70	41.5	-	-	50	42.4	-
Zn	-	-	4 U	3.5 U	-	30	4 U	3.5 U	-	-	4 U	3.5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit

I=Value is less than practical quantitation limit J=Estimated value Q=exceeding holding time limit

FLORIDA GEOLOGICAL SURVEY

Creek flows into Deerpoint Lake, which is a public water supply utilized by the community in Panama City area. Land around the spring group is pristine and forested. Swimming and canoeing occur frequently in all of Gainer Springs.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). Discharge reported here represents the total flow of the Gainer Springs complex. All discharge rates are measured in ft³/s.

April 11, 1962	150
September 11, 1962	174
January 30, 1963	159
September 26, 2001	556

Table 6. Gainer Springs Group bacteriological analyses.

Bacteria Results (in #/100 mL)			
Analyte	Vent No. 1	Vent No. 2	Vent No. 3
<i>Escherichia coli</i>	10 Q	6 Q	4 Q
Enterococci	10 Q	18 Q	8 Q
Fecal Coliform	14 Q	18 Q	12 Q
Total Coliform	100 Q	100 Q	80 Q

CITRUS COUNTY

Chassahowitzka Springs Group



Figure 14. Chassahowitzka Main Spring (photo by R. Means).



Figure 15. Chassahowitzka No. 1 (photo by R. Meegan).

FLORIDA GEOLOGICAL SURVEY

Group Location - Lat. 28° 42' N, Long. 82° 34' W (both spring vents are located in the center of sec. 26, T. 20 S, R. 17 E). The springs are 5.5 miles (9 km) southwest of the town of Homosassa Springs on the Chassahowitzka River. From Homosassa Springs, drive south on US 98/19 3.5 miles (5.8 km) from town. Turn west on CR 480 and follow down to the public boat access area at the end, about 1.5 miles (2.5 km).

Group Description - Chassahowitzka Springs form the headwaters of the Chassahowitzka River, which flows westerly to the Gulf of Mexico approximately 6 miles (10 km) through low coastal hardwood hammock and marsh. As many as five springs flow into the upper part of the river (Rosenau et al., 1977). The entire river is tidally influenced.

CHASSAHOWITZKA MAIN SPRING - Lat. 28° 42' 55.9" N, Long. 82° 34' 34.3" W (NE/NE/SW/sec. 26, T. 20 S, R. 17 E). This spring is at the head of a large pool that measures 147 ft (45 m) north to south and 135 ft (41 m) east to west. Depth measured over the vent is 13.5 ft (4.1 m). The spring is surrounded by lowland hardwood swamp forest with mixed hardwoods, cypress, and palm. Water is clear and greenish. The spring run from Chassahowitzka No. 1 Spring flows into the spring pool from the east. There is a boat ramp with facilities on the southwest side of the pool. Aquatic vegetation is common, including *Hydrilla* and algae. No limestone was exposed. Spring has sandy bottom. Boil is visible at low tide.

CHASSAHOWITZKA NO. 1 - Lat. 28° 42' 58.3" N, Long. 82° 34' 30.3" W (NW/NW/SE/sec. 26, T. 20 S, R. 17 E). This spring issues vertically from a small cavern in bedrock limestone. The spring pool measures 69 ft (21 m) north to south and 81 ft (25 m) east to west. Depth over the vent is 8.3 ft (2.5 m). There is an inundated natural bridge of limestone over the vent, causing two entrances. A small tannic stream flows into the northeast side of the spring pool. There is a thin layer of algae covering most of the bedrock limestone bottom of the spring pool. The surroundings are low lying land heavily forested with hardwoods and palm. The spring run flows southwest approximately 350 ft (107 m) and into Chassahowitzka Main Spring pool. Several other spring vents boil up from the bottom of the spring run about half way to the Chassahowitzka Main Spring pool.

Table 7. Chassahowitzka Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)		
Analyte	Main	No. 1
<i>Escherichia coli</i>	1 KQ	1 KQ
Enterococci	1 KQ	1 KQ
Fecal Coliform	1 KQ	1 KQ
Total Coliform	1 KQ	20 Q

Utilization - Chassahowitzka Springs and River are within the Chassahowitzka National Wildlife Refuge (U.S. Fish and Wildlife Service). They are used for swimming, snorkeling, and pleasure boating. Manatees frequent the springs and river year round, especially in winter.

Discharge - The average discharge from 1930 through 1972 (81 measurements) was 138.5 ft³/s (Rosenau et al., 1977). Current discharge estimate is provisional.

Maximum (May 18, 1966)	197.0 ft ³ /s
Minimum (July 8, 1964)	31.8 ft ³ /s
October 15, 2001	53 ft ³ /s

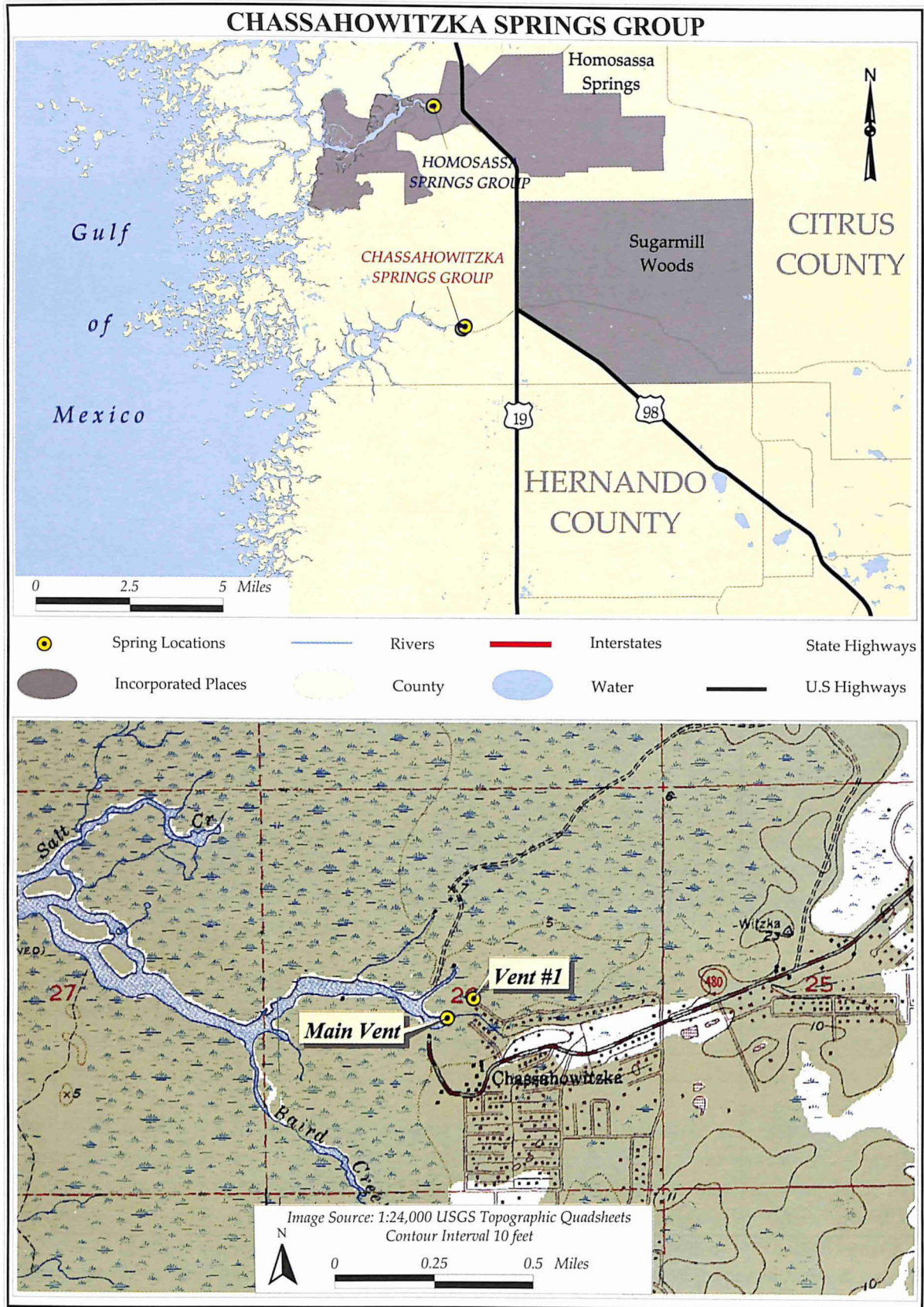


Figure 16. Chassahowitzka Springs Group location map.

FLORIDA GEOLOGICAL SURVEY

Table 8. Chassahowitzka Springs Group water quality analyses.

Analytes	1946	1970	1971	1972	1975	Main		No. 1	
						2001		2001	
						Unfilt.	Filter	Unfilt.	Filter
Field Measures									
Temperature	23.9	26.0	24.5	23.5	22.2	22.9	-	23.2	-
DO	-	-	6.1	-	5.4	3.68	-	4.10	-
pH	7.5	8.2	7.6	8.2	-	7.65	-	7.71	-
Sp. Cond.	470	500	530	1370	564	2790	-	1080	-
Lab Analytes									
BOD	-	0.2	2.5	-	-	0.2 U	-	0.2 AU	-
Turbidity	-	3	2	-	-	1.3	-	0.45	-
Color	8	10	10	10	10	5 U	-	5 U	-
Alkalinity	-	140	140	140	130	150	152	150	152 A
Sp. Cond.	-	-	-	-	-	2800	-	1100 A	-
TDS	-	-	-	-	-	1470	-	562	-
TSS	-	-	-	-	-	4 U	-	4 U	-
Cl	53	70	79	320	110	680	680	220	200
SO ₄	13	13	16	56	21	110	110	39	40
F	0.1	0.2	0.3	0.2	0.2	0.13 J	0.11	0.12 J	0.11
Nutrients									
TOC	-	-	-	-	-	1 U	-	1 U	-
NO ₃ + NO ₂	-	-	-	0.26	-	0.45 J	0.46 J	0.49 J	0.5 J
NH ₃ +NH ₄	-	-	-	-	-	0.01 U	0.025	0.01 U	0.011 I
TKN	-	-	-	-	-	0.12 I	0.12 I	0.086 I	0.1 I
P	-	-	-	-	-	0.033	0.02	0.018	0.018
PO ₄	-	-	-	-	-	0.021	-	0.021	-
Metals									
Ca	49	46	48	55	47	65.2	63.4	54.5	52.8
K	1.5	1.6	1.8	6.3	2.5	14.7	14.3	4.8	4.5
Na	29	36	40	180	60	393	411	131	121
Mg	13	11	13	29	13	54.5	54.2	23.5	22.3
As	-	-	-	-	-	3 U	3 U	7 U	3 U
Al	-	-	-	-	-	-	75 U	-	75U
B	-	-	-	-	-	186	-	68 I	-
Cd	-	-	-	-	-	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	-	-	-	0.75 U	-	0.75 U	-
Cr	-	-	-	-	-	2 U	2 U	2 U	2 U
Cu	-	-	-	-	-	2.5 U	2.5 U	2.5 U	2.5 U
Fe	-	-	-	-	-	92 I	38 I	35 U	35 U
Mn	-	-	-	-	-	4.1	1.5 I	0.5 U	0.5 U
Ni	-	-	-	-	-	1.5 U	1.5 U	1.5 U	1.5 U
Pb	-	-	-	-	-	5 U	4 U	5 U	4 U
Se	-	-	-	-	-	8.6 U	4 U	8.6 U	4 U
Sn	-	-	-	-	-	20 U	-	20 U	-
Sr	-	200	200	800	310	511	-	262	-
Zn	-	-	-	-	-	5 U	5 U	5 U	5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value shown is less than the practical quantitation limit

J=Estimated value

Homosassa Springs Group



Figure 17. Homosassa Springs Group (photo by J. Stevenson).

Group Location - Lat. 28° 47' 57.6" N, Long. 82° 35' 17.2" W (NE/SW/NE/sec. 28, T. 19 S, R. 17 E). The springs are located in the town of Homosassa Springs on the Homosassa River. From US 98 in Homosassa Springs, turn west on CR 490A, then south on access road to Homosassa Springs State Wildlife Park. Spring vent, through which all three vents issue, is just below the underwater viewing platform in the manatee rehabilitation area. Actual spring vents are within a cave system.

Group Description - Homosassa Springs Group forms the head of the Homosassa River, which flows west approximately 6 miles (10 km) to the Gulf of Mexico. Downstream from the head springs about a mile, Halls River flows in from the north. The entire river system is tidally influenced.

HOMOSASSA SPRINGS NOS. 1, 2, and 3 - All three vents issue out of the same spring pool. The pool measures 189 ft (58 m) north to south and 285 ft (89 m) east to west. Depth for each of the vents is 67, 65, and 62 ft (20.4, 19.8, and 18.8 m) for spring nos. 1, 2, and 3, respectively. The springs issue from a conical depression with limestone outcropped along the sides and bottom of the spring pool. Pool is teeming with saltwater and freshwater fishes. Water is clear and light blue. There is a large boil in center of pool. Surrounding land is Gulf Coastal Lowlands with thick hardwood-palm forest cover. Approximately 1000 ft (305 m) downstream, a fence spans across the river to keep boats out of the spring pool.

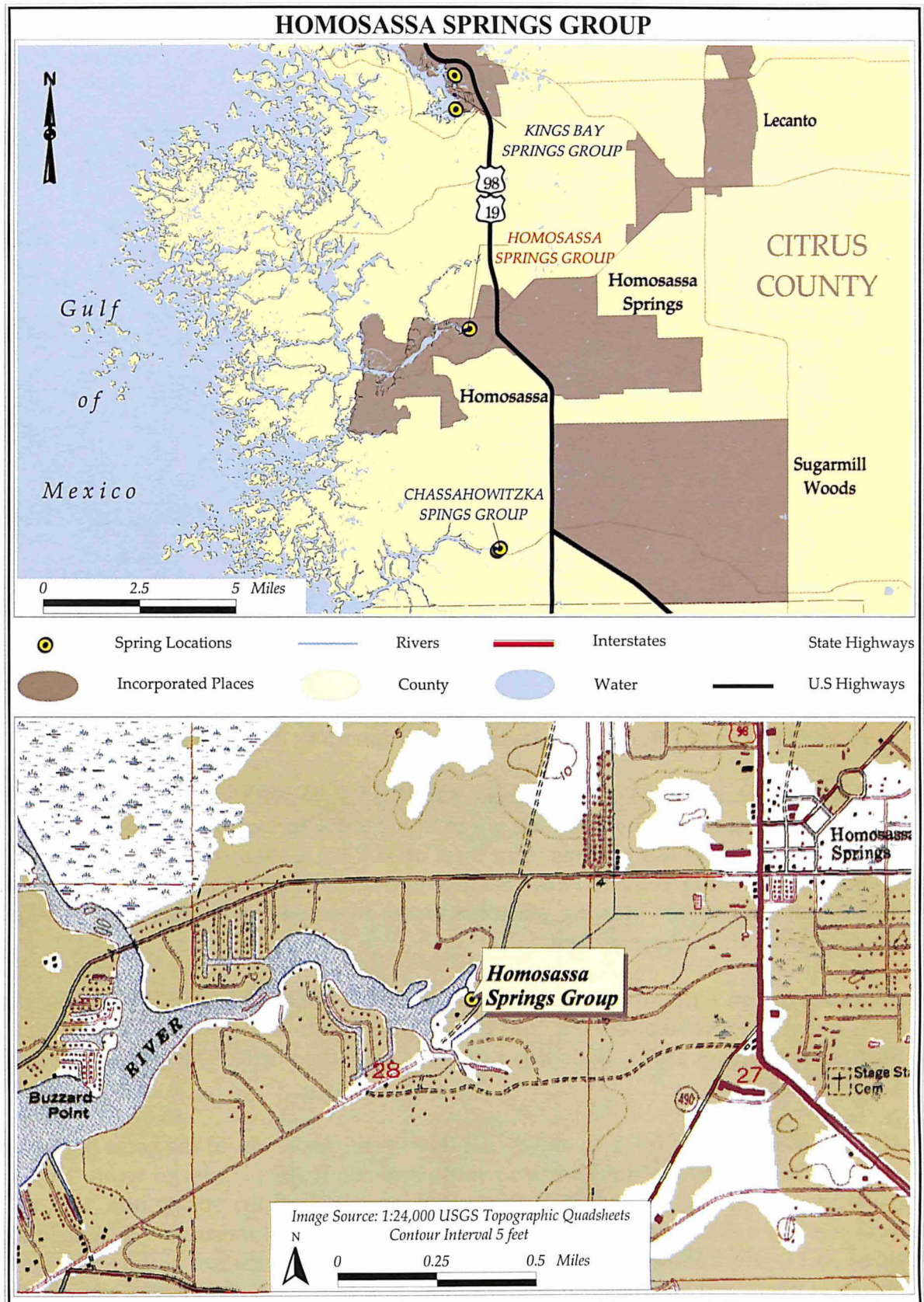


Figure 18. Homosassa Springs Group location map.

OPEN FILE REPORT NO. 85

Table 9. Homosassa Springs Group water quality analyses.

Analytes	1956	1966	1972 (april)	1972 (oct)	No. 1 2001		No. 2 2001		No. 3 2001	
					Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter
Field Measures										
Temperature	23.5	-	23.5	23.5	23.4	-	23.3	-	23.6	-
DO	-	-	4.3	-	3.97	-	3.86	-	4.09	-
pH	8.2	7.5	6.9	7.9	7.67	-	7.62	-	7.81	-
Sp. Cond.	2590	2900	2370	3740	5250	-	6330	-	1980	-
Lab Analytes										
BOD	-	-	0.1	-	0.68 I	-	0.86 I	-	0.76 I	-
Turbidity	-	-	1	-	1.3	-	0.5	-	0.25	-
Color	3	0	0	10	5 U	-	5 U	-	5 U	-
Alkalinity	110	110	120	110	120	115	120	117	110	112
Sp. Cond.	-	-	-	-	5200	-	6200	-	2000	-
TDS	-	-	-	-	2830	-	3310	-	1020	-
TSS	-	-	-	-	4 U	-	4 U	-	4 U	-
Cl	680	780	640	1100	1500	1500	1900	1900	520	510
SO ₄	95	111	84	150	220	220	260	260	74	72
F		0.3	0.2	2.0	0.14	0.12	0.14	0.13	0.1	0.093 I
Nutrients										
TOC	-	-	0	-	1 U	-	1 U	-	1 U	-
NO ₃ + NO ₂	-	-	0.26	0.20	0.51	0.51 J	0.5	0.5 J	0.53	0.55 J
NH ₃ +NH ₄	-	-	-	-	0.028	0.02 I	0.034	0.026	0.01 I	0.012 I
TKN	-	-	-	-	0.15 I	0.12 I	0.13 I	0.12 I	0.091 IQ	0.11 I
P	-	-	0.02	-	0.028 I	0.029 I	0.034 I	0.029 I	0.048 Q	0.026 I
PO ₄	-	-	0.01	-	0.018 J	-	0.021 J	-	0.011 J	-
Metals										
Ca	54	55	48	65	69.2	70	75.8	77.3	47.6	46.3 A
K		18	12	20	28.8	29.8	35.5	35.5	9.84	0.45
Na	-	420	340	600	815	814	972	986	267	3.7
Mg	56	57	48	86	100	103	123	124	39.1	37.5 A
As	-	-	0	-	3 U	3 U	3 U	3 U	3 U	3 U
B	-	-	60	-	344	-	422	-	125	-
Al	-	-	-	-	-	75 U	-	75 U	-	75 U
Cd	-	-	0	-	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	0	-	0.75 U	-	0.75 U	-	0.75 U	-
Cr	-	-	0	-	2 U	2 U	2 U	2 U	2 U	2 U
Cu	-	-	0	-	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Fe	-	-	10	-	300	89 I	190	52 I	370	35 U
Mn	-	-	0	-	21.4	13.5	5.8	4.9	19.9	0.5 U
Ni	-	-	-	-	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Pb	-	-	0	-	5 U	4 U	5 U	4 U	5 U	4 U
Se	-	-	-	-	4 U	4 U	4 U	4 U	4 U	4 U
Sn	-	-	-	-	10 U	-	10 U	-	10 U	-
Sr	-	-	490	5000	858	-	1030	-	372	-
Zn	-	-	10	-	5 U	5 U	5 U	5 U	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

FLORIDA GEOLOGICAL SURVEY

Manatees frequent the spring pool and river year round, especially in winter. The springs are tidally influenced.

Utilization - The main spring pool and adjacent land are within Homosassa Springs State Wildlife Park. The area is developed into an interpretive center for manatee and Florida wildlife education. There is a floating observation deck in the spring pool with a downstairs aquatic observation room with glass windows. Injured and rehabilitating manatees are captive in the spring pool for year round observation. Swimming is not allowed.

Discharge - The average discharge for Homosassa main spring from 1931 through 1974 (90 measurements) was 106 ft³/s (Rosenau et al., 1977). Current discharge estimate is provisional.

Maximum (August 18, 1966)	165 ft ³ /s
Minimum (September 19, 1972)	80 ft ³ /s
October 16, 2001	87 ft ³ /s

Table 10. Homosassa Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)			
Analyte	No. 1	No. 2	No. 3
<i>Escherichia coli</i>	1 KQ	1KQ	1 KQ
Enterococci	1 KQ	1 KQ	1 KQ
Fecal Coliform	1 KQ	1 KQ	1 KQ
Total Coliform	1 KQ	1 KQ	1 KQ

Kings Bay Springs Group



Figure 19. Kings Bay Springs Group, Hunter Spring (photo by R. Meegan).



Figure 20. Kings Bay Springs Group, Tarpon Hole Spring (photo by R. Means).

FLORIDA GEOLOGICAL SURVEY

Group Location - Lat. 28° 53' N, Long. 82° 35' W (sections 28 and 21, T. 18 S, R 17 E). The springs are located in Kings Bay west of the City of Crystal River. Kings Bay is approximately 60 miles (96 km) north of Tampa and 30 miles (48 km) southwest of Ocala.

Group Description - Kings Bay is the head of Crystal River. There are about 30 known springs, including Tarpon Hole and Hunter Spring, that either issue from the bottom of Kings Bay or flow into the bay from side creek heads. Their combined flow feeds Crystal River, which flows approximately 7 miles (11 km) west to the Gulf of Mexico. Surrounding land is Gulf Coastal Lowlands with brackish marsh and hardwood-palm hammock to the west and the City of Crystal River to the east. The whole system is tidally influenced, and Kings Bay is brackish. Rosenau et al. (1977) referred to these springs as the Crystal River Springs Group.

HUNTER SPRING - Lat. 28° 53' 40.0" N, Long. 82° 35' 33.0" W (NW/SW/SE/sec. 21, T. 18 S, R. 17 E). This spring issues vertically from the bottom of a conical depression near the head of a side creek channel feeding the eastside of Kings Bay. Another spring is at the head of the channel. Hunter Spring pool is circular and measures 210 ft (64 m) in diameter. Depth measured over the vent is 13 ft (4 m). Spring has sandy bottom with some limestone near the vent. The spring bottom is choked with dark green filamentous algae, and some *Hydrilla* is present. Water is clear and bluish. There is a large boil in pool center. Land on the north rises to approximately 4 ft (1.2 m) above water and is a county maintained recreational park. Land on all other sides of spring pool is extensively developed with apartments and houses. A concrete sea wall entirely surrounds pool except for outflow and inflow. There is a square swimming dock floating in the center of the spring pool. This spring was closed to swimming during summer 2001 due to high coliform bacteria levels detected in the water (Eric Dehaven, SWFWMD, pers. comm.).

TARPON HOLE SPRING - Lat. 28° 52' 54.6" N, Long. 82° 35' 41.3" W (NW/NW/SW/sec. 28, T. 18 S, R. 17 E). This spring issues from a deep, conical depression underneath Kings Bay on the south side of Banana Island. The spring pool measures approximately 450 ft (137 m) north to south and 550 ft (168 m) east to west. Depth measured over the vent is 58 ft (17.6m). Water is typically clear and bluish, but can be cloudy during high tide. There is a large boil present in center of pool. Visibility was low when visited in October 2001. Algae cover limestone substrates. Vent is a large circular hole in limestone. Nearby islands to the north are part of the Crystal River National Wildlife Refuge and have marsh grasses and hardwood-palm hammock. Land to the east is privately owned with many houses and a marina. This spring is a favorite scuba diving location and manatee observation area.

Utilization - All of Kings Bay and most of its springs are used for swimming, manatee observation, pleasure boating, and scuba diving. The west side of Kings Bay and some islands within are part of the Crystal River National Wildlife Refuge. The city of Crystal River nearly adjoins the east side of Kings Bay.

Discharge - Jones et al. (1998): 975 ft³/s

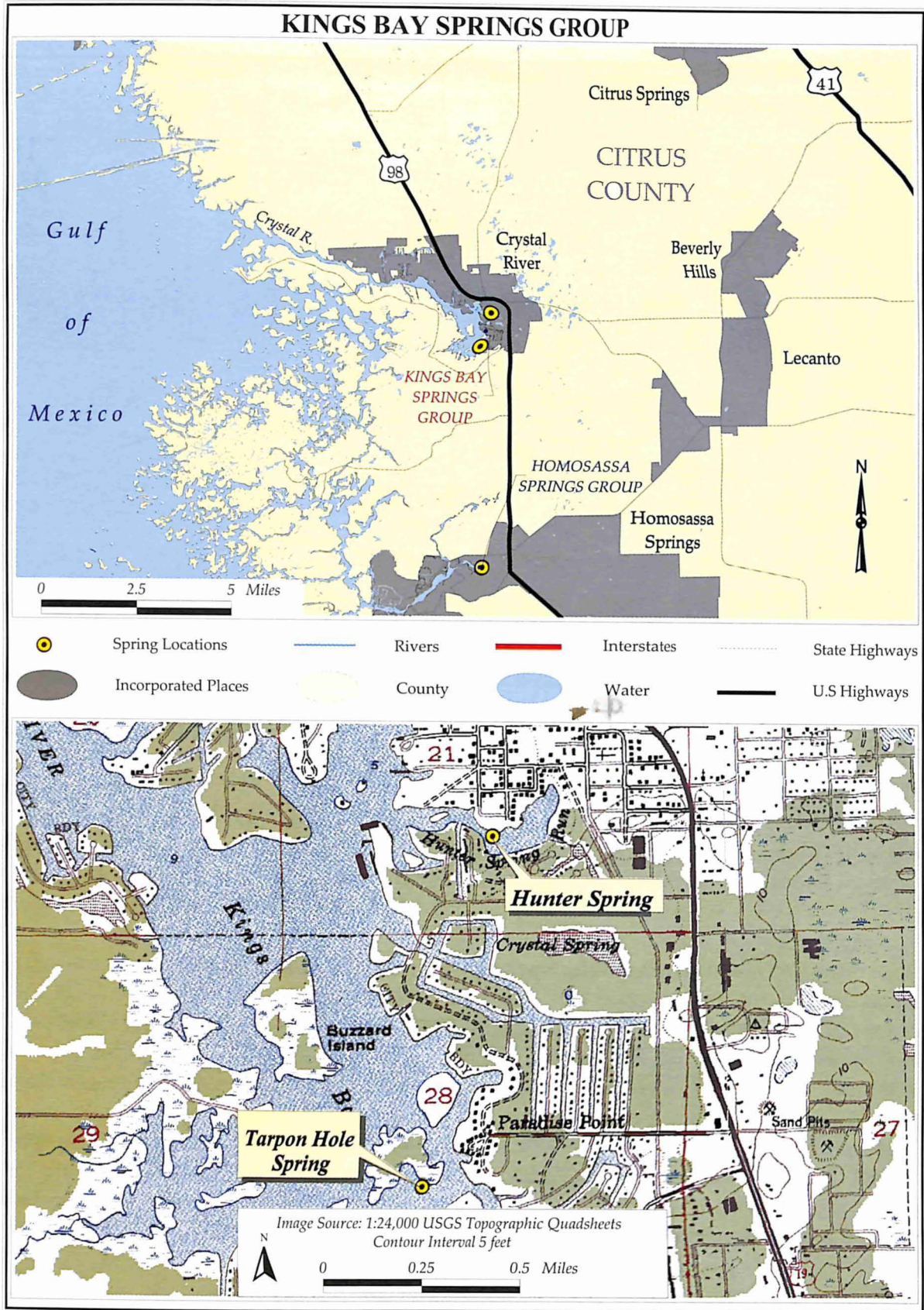


Figure 21. Kings Bay Spring Group location map.

FLORIDA GEOLOGICAL SURVEY

Table 11. Kings Bay Springs Group water quality analyses.

Analytes	Tarpon Hole		Hunter	
	2001		2001	
	Unfilt.	Filter	Unfilt.	Filter
Field Measures				
Temperature	22.9	-	23.0	-
DO	2.09	-	5.09	-
pH	7.72	-	8.02	-
Sp. Cond.	2130	-	541	-
Lab Analytes				
BOD	0.2 U	-	0.2 AU	-
Turbidity	6.8	-	0.95	-
Color	5 U	-	5 U	-
Alkalinity	124	123	87	87
Sp. Cond.	2200	-	530	-
TDS	960	-	263 Q	-
TSS	4 U	-	4 U	-
Cl	540	550	96	94
SO ₄	78	81	20	20
F	0.091 I	0.12 A	0.065 I	0.071 I
Nutrients				
TOC	1 U	-	1 U	-
NO ₃ + NO ₂	0.17	0.18 J	0.4	0.39 J
NH ₃ +NH ₄	0.01 U	0.014 I	0.01 U	0.01 U
TKN	0.084 I	0.12 I	0.06 U	0.06 U
P	0.042	0.033 I	0.023	0.024
PO ₄	0.029	-	0.028	-

Analytes	Tarpon Hole		Hunter	
	2001		2001	
	Unfilt.	Filter	Unfilt.	Filter
Metals				
Ca	52.8	53.9	30.6	31 A
K	10.2	10.3	2.1	2 A
Na	289	290	54.9	52.9 A
Mg	39.4	40	10.4	10.3 A
As	3 U	3 U	3 U	3 U
Al	-	75 U	-	75 U
B	128	-	33 I	-
Cd	0.75 U	0.75 U	0.75 U	0.75 U
Co	0.75 U	-	0.75 U	-
Cr	2 U	2 U	2 U	2 U
Cu	2.5 U	2.5 U	2.5 U	2.5 U
Fe	130 I	35 U	35 U	35 U
Mn	13.4	7.2	0.5 U	0.5 U
Ni	2 U	2 U	2 U	2 U
Pb	5 U	4 U	5 U	4 U
Se	4 U	4 U	4 U	4 U
Sn	10 U	-	10 U	-
Sr	362	-	131	-
Zn	5 U	5 U	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 12. Kings Bay Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)		
Analyte	Tarpon Hole	Hunter
<i>Escherichia coli</i>	1 KQ	1 KQ
Enterococci	1 KQ	1 KQ
Fecal Coliform	1 KQ	1 KQ
Total Coliform	1 KQ	1 KQ

COLUMBIA COUNTY

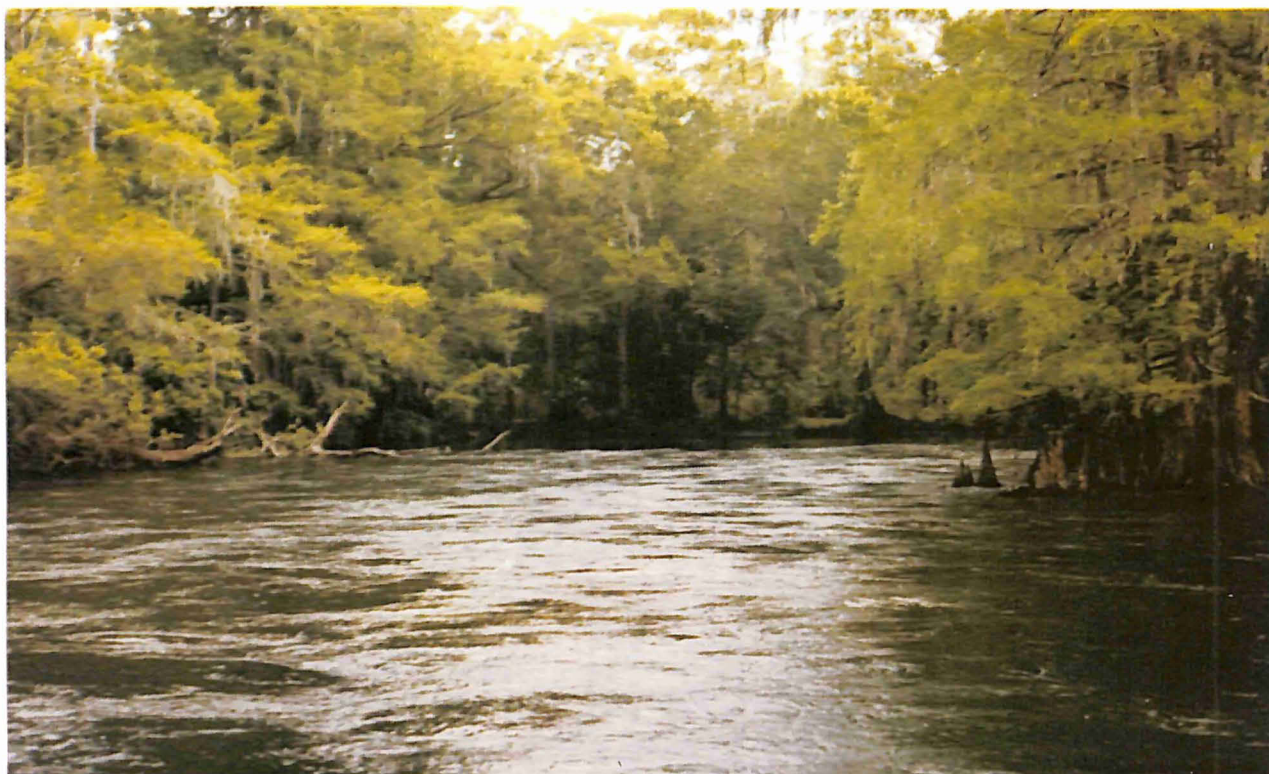


Figure 22. Columbia Spring (photo by D. Hornsby).

Columbia Spring

Location - Lat. 29° 51' 14.8" N, Long. 82° 36' 43.0" W (NW/ SE/ NE/ sec. 28, T. 7 S, R. 17 E). Columbia Spring is located 2 miles (3.2 km) northwest of High Springs on the Santa Fe River and can be accessed by small boat. From High Springs, drive north on US 441/41. Turn left at public access boat sign just before the Santa Fe River. Spring is in a cove on the northeast bank of the river, 900 ft (275 m) downstream from the boat ramp.

Description - Columbia Spring has an oval shaped pool that measures 75 ft (23 m) north to south and 150 ft (46 m) east to west. Depth is 25 ft (7.6 m). Water is typically clear, but was tannic in October 2001. It has a 30 ft (9 m) wide spring run that flows approximately 600 ft (183 m) westward to the Santa Fe River. There are native aquatic grasses in the spring run and some algae is present on most substrates. Spring run has a jagged limestone and sandy bottom. There is a 1-2 ft (0.5 m) tall man-made line of rocks that stretches across the spring run about 90 ft (27 m) west of the vent. The entire spring and spring run are within the lowland flood plain of the Santa Fe River. The flood plain in this area is heavily forested with cypress and other swamp inhabiting hardwoods. The nearest high ground is approximately 600 ft (183 m) east of the spring, and it rises to nearly 10 ft (3 m) above the flood plain. It is generally forested with mixed hardwoods and pines. A house sits atop the high ground to the east of the spring.

Utilization - This privately owned spring is a local swimming hole with pristine surroundings.

Discharge - November 1, 2001: 39.5 ft³/s

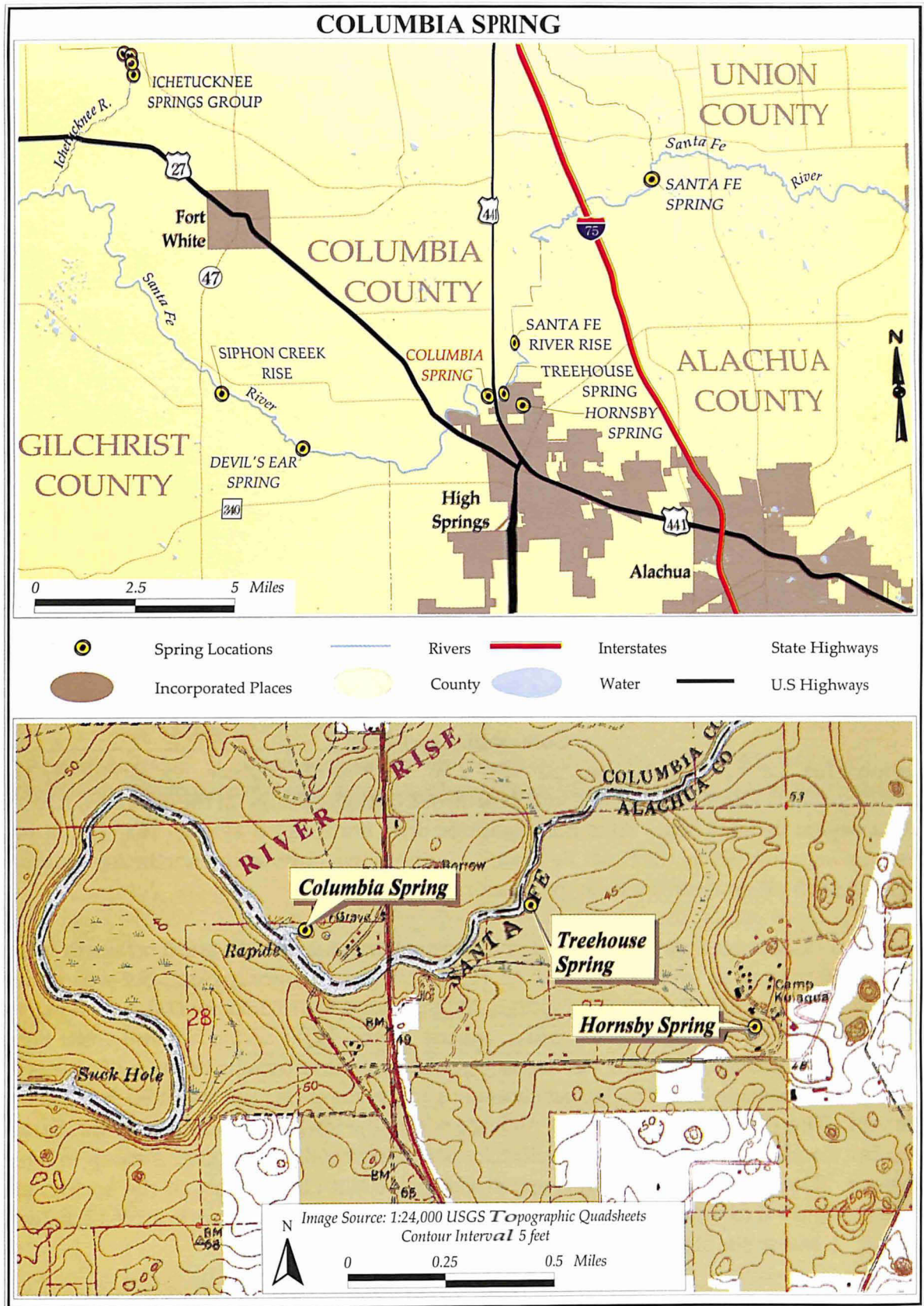


Figure 23. Columbia Spring location map.

Table 13. Columbia Spring water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	22.4	-
DO	2.29	-
pH	7.19	-
Sp. Cond.	270	-
Lab Analytes		
BOD	0.23 I	-
Turbidity	2.1	-
Color	250	-
Alkalinity	54	54
Sp. Cond.	270	-
TDS	217	-
TSS	4 U	-
Cl	28	27
SO ₄	34	34
F	0.14	0.12
Nutrients		
TOC	39	-
NO ₃ + NO ₂	0.089	0.088 J
NH ₃ +NH ₄	0.062	0.038
TKN	1.3	1.1
P	0.3	0.21
PO ₄	0.19	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	33.6	31.5
K	2	1.8
Na	12.7	12
Mg	7.1	6.6
As	3 U	3 U
Al	-	530
B	29 I	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	640	500
Mn	30.3	23.9
Ni	1.5 U	2 U
Pb	5 U	4 U
Se	8.8 U	4 U
Sn	20 U	-
Sr	358	-
Zn	5 I	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=exceeded holding time limit

Table 14. Columbia Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	26 Q
Enterococci	158 Q
Fecal Coliform	38 Q
Total Coliform	340 Q



Figure 24. Ichetucknee Springs Group, Ichetucknee Head Spring (photo by T. Scott).



Figure 25. Ichetucknee Springs Group, Blue Hole Spring (photo by T. Scott).

Ichetucknee Springs Group

Group Location - Lat. 29° 59' N, Long. 82° 45' W (section 12, T. 6 S., R. 15 E., section 7, T. 6 S, R. 16 E). The Ichetucknee Springs Group is located within the Ichetucknee Springs State Park approximately 10 miles (16.5 km) northeast of Branford. From Brandford, drive east on US 27 for 7 miles (11.2 km). Turn north onto CR 137 and continue for 1.3 miles (2 km). Turn right and go 4.2 miles (6.8 km) through the north park entrance to the parking area.

Group Description - These springs comprise a group of nine named and many unnamed springs along the upper 2.5 mile (4 km) stretch of the Ichetucknee River. The most northerly spring forms the head of the river and is named Ichetucknee Spring. From here, the river flows about 1.5 miles (2.4 km) south, then 4 miles (6.4 km) southwest to discharge into the darker tannic water of the Santa Fe River. Of the springs sampled for water quality, all are located within Columbia County except for Ichetucknee Head Spring, which is located just inside Suwannee County.

ICHETUCKNEE HEAD SPRING - Lat. 29° 59' 03.1" N, Long. 82° 45' 42.7" (SE/NE/NE/sec. 12, T. 6 S, R. 15 E). This spring forms the head of the Itchetucknee River. The spring pool measures 102 ft (31 m) east to west and 87 ft (27 m) north to south. Depth measures 17 ft (5m) over the vent. Water is clear and sky blue and issues vertically from a crack in the bedrock limestone forming a visible boil. A thin, transparent layer of algae carpets most of the bottom of the spring. Spring has sandy and rocky bottom with little or no aquatic vegetation. North and east shorelines have thick emergent grass and shrubs, west shore is near high ground sloping to approximately 15 ft (4.5 m) above water. All surrounding land is densely forested. Restroom facilities are about 200 ft (61 m) west. This spring is easily accessed by a path and is a well used swimming hole.

BLUE HOLE - Lat. 29° 58' 49.9" N, Long. 82° 45' 30.4" (SW/SW/NW/sec. 7, T. 6 S, R. 15 E). This spring is located in the spring run channel of Cedar Head Spring, which is north of Blue Hole. The spring pool and outflow greatly widens the incomming spring run, and the combined run flows south a short distance to the Ichetucknee River. The spring pool measures 87 ft (27 m) east to west and 117 ft (36 m) north to south. Depth measured over the vent is 37 ft (11.3 m). The water is sky blue, and the boil is visible on the pool surface. Water issues vertically from a cavern in bedrock limestone. The pool has a sandy and rocky bottom with abundant aquatic grass and some algae. Land around spring is heavily forested with mixed hardwoods and palm. Spring run is fenced off approximately 100 ft (31 m) south of vent. This is a swimming spot with a wooden boardwalk for spring access. A foot path leads to the spring from the north.

CEDAR HEAD SPRING - Lat. 29° 58' 59.8" N, Long. 82° 45' 31.3" (SW/NW/NW/sec. 7, T. 6 S., R. 15 E.). This is a small spring at the head of a stream that flows south into Blue Hole Spring. Spring pool is approximately 20 ft (6 m) east to west. Depth measures 6 ft (1.8 m) over the vent. No boil was present on the pool surface during October 2001 visit, although outflow stream was flowing lightly. The bottom is sandy with logs and particulate deposition. Water is clear but doesn't appear blue due to dark particulate layer on bottom. The vent is a small upwelling in the sand. A steep bank is along the west side of the spring and rises to 8 ft (2 m) above water level. There is higher ground 150 ft (46 m) east of spring across a small lowland flood plain. Cypress, gum, and maple forest occur in lowlands near water with mixed hardwood forest on higher ground. Access is limited to an obscure foot path from the west. The spring is not used for swimming because of low water level and limited access.

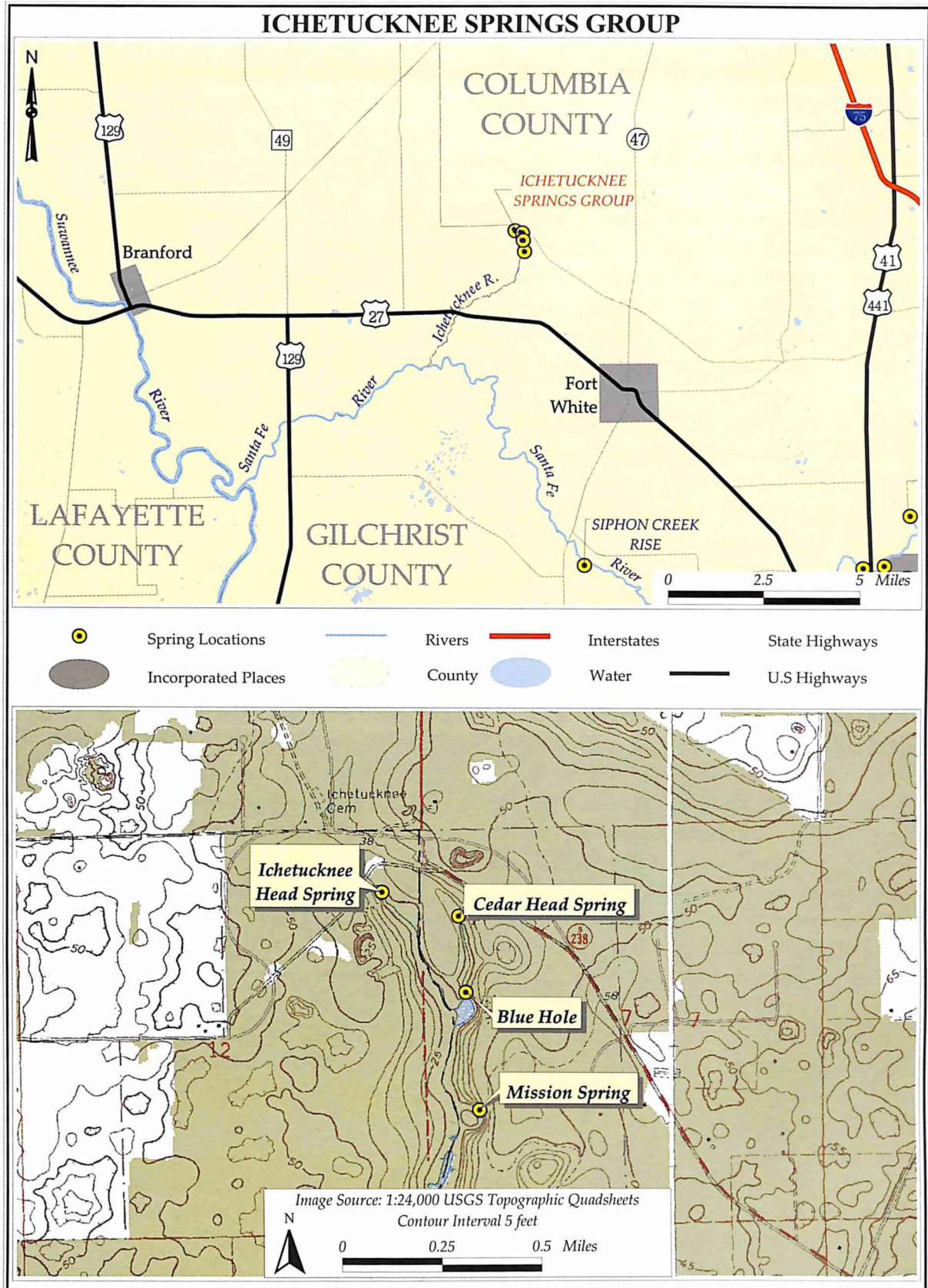


Figure 26 Ichetucknee Springs Group location map.

Table 15. Ichetucknee Springs Group water quality analyses.

Analytes	1946	1975	Main		Blue Hole		Cedar Head		Mission	
			2001		2001		2001		2001	
			Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter
Field Measures										
Temperature	22.2	21.0	22.0	-	21.9	-	21.9	-	21.8	-
DO	-	4.5	3.52	-	2.01	-	2.98	-	0.63	-
pH	7.7	7.6	7.91	-	7.49	-	7.41	-	7.91	-
Sp. Cond.	329	290	319	-	287	-	299	-	312	-
Lab Analytes										
BOD	-	2.0	0.2 UJ	-	0.2 UJ	-	0.2 UJ	-	0.2 UAJ	-
Turbidity	-	1	0.05 U	-	0.1	-	0.05 U	-	0.05 U	-
Color	0	1	5 U	-	5 U	-	5 U	-	5 U	-
Alkalinity	-	140	154	154	145	145	151	151	148	147
Sp. Cond.	-	-	320	-	290	-	300	-	310	-
TDS	-	-	183	-	171	-	168	-	172	-
TSS	-	0	4 U	-	4 U	-	4 U	-	4 U	-
Cl	3.6	4.4	3.6	3.7	4.3	4.3	3.9	3.9	5.4	5.4 A
SO ₄	8.4	6.9	8.3	8.5	4.8	4.9	5.3	5.4	8.7	8.8 A
F	0.1	0.4	0.1	0.097 I	0.11	0.11 A	0.1	0.091 I	0.14	0.13
Nutrients										
TOC	-	0.0	1 U	-	1 U	-	1 U	-	1 U	-
NO ₃ + NO ₂	-	0.37	0.83	0.84	0.7	0.72	0.86	0.89	0.51	0.53
NH ₃ +NH ₄	-	-	0.015 I	0.012 I	0.011 I	0.01 U	0.011 I	0.011 I	0.01 U	0.019 I
TKN	-	-	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
P	-	0.05	0.023	0.022 J	0.048	0.048 J	0.033	0.034 J	0.059	0.05 JA
PO ₄	-	0.05	0.02	-	0.044	-	0.027	-	0.056	-
Metals										
Ca	58	52	54.5	52.5	47.9	48.4	54	51.2	49.7	48.6
K	0.3	0.3	0.15	0.14	0.31	0.33	0.22	0.22	0.46	0.48
Na	3.1	3.4	2.12	2.02	2.67	2.45	2.37	2.26	3.65	3.53
Mg	6.6	6.0	5.8	5.8	4.7	4.8	5.3	5.2	6.3	6.4
As	-	1	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Al	-	-	-	75 U	-	75 U	-	75 U	-	75 U
B	-	-	25 U	-	25 U	-	25 U	-	25 U	-
Cd	-	0	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	0.75 U	-	0.75 U	-	0.75 U	-	0.75 U	-
Cr	-	-	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Cu	-	3	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	4.4 I	2.5 U
Fe	30	340	35 U	20 U	35 U	20 U	35 U	20 U	35 U	20 U
Mn	-	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ni	-	0	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
Pb	-	7	5 U	4 U	5 U	4 U	5 U	4 U	5 U	4 U
Se	-	-	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Sn	-	-	10 U	-	10 U	-	10 U	-	10 U	-
Sr	-	170	156	-	76	-	105	-	107	-
Zn	-	0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=exceeded holding time limit

FLORIDA GEOLOGICAL SURVEY

MISSION SPRINGS - Lat. 29° 58' 34.4" N, Long. 82° 45' 28.4" (SE/NW/SW/sec. 7, T. 6 S, R. 15 E). Mission Springs is comprised of two springs that emerge from the base of high banks about 250 ft (76 m) east of the Ichetucknee River. A small spring vent, with very low discharge, is located at the head of two shallow spring runs and is sometimes referred to as Singing Springs. One of its small runs flows northwest and the other flows southwest. Both meet the river approximately 250 ft (76 m) from each other. There is a high, forested island with steep limestone banks on its north side is the two spring runs. Another spring, sometimes referred to as Roaring Springs, discharges forcefully out of a cavern in a limestone ledge on the north side of the island into the northwest flowing run. At this point, the trickling northwest run becomes a high velocity, turbulent run with swaying aquatic grasses. Water quality was sampled for Roaring Springs. Its spring pool measures 10 ft (3 m) east to west and 15 ft (5 m) north to south. Depth measured near the limestone ledge is 3 ft (1 m). The ledge rises steeply to approximately 12 ft (4 m) above the water level. Water is clear and bluish. Algae coat the aquatic grasses in the spring run. The uplands east of the spring rise to nearly 20 ft (6 m) above the springs and are heavily forested with mixed hardwoods lower and pines on the hilltops. An historic Spanish mission once stood atop the high ground approximately 200 ft (61 ft) east of the springs.

Utilization - The springs, river, and surrounding forested land are owned by Ichetucknee Springs State Park from the US 27 bridge northward. The park is a high quality natural area that is partly developed and whose heavy public use is highly regulated in order to not disturb the natural quality. Camping, hiking, swimming, tubing, and canoeing are some of the activities that are offered in the state park

Discharge - Historical discharge rate for Ichetucknee Springs Group was obtained from Bulletin No. 31 (Rosenau et al., 1977).

May 17, 1946	197.2 ft ³ /s
October 3, 2001	186 ft ³ /s

Table 16. Ichetucknee Springs Group bacteriological analyses.

Bacteria Results (in #/100 mL)				
Analyte	Main	Blue Hole	Cedar Head	Mission
<i>Escherichia coli</i>	1 KQ	1 KQ	2 Q	1 AKQ
Enterococci	1 KQ	1 KQ	42 Q	1 AKQ
Fecal Coliform	1 KQ	1 KQ	2 Q	1 AKQ
Total Coliform	1 KQ	1 KQ	20 Q	1 AKQ

Santa Fe River Rise



Figure 27. Santa Fe River Rise (photo by T. Scott).

Location - Lat. 29° 52' 26.0" N, Long. 82° 35' 29.9" W. (SW/SW /SW/sec. 14, T. 7 S, R. 17 E). River rise is 3 miles (5 km) north of High Springs on the Santa Fe River within River Rise State Preserve. Drive north on US 441/41 from High Springs and follow signs to the river rise. During low water levels, spring must be accessed by land.

Description - Santa Fe Rise is the re-emergence of the underground Santa Fe River. The spring pool measures 175 ft (53 m) east to west and 165 ft (50 m) north to south. There is a vertical limestone ledge on the northeast side of the pool, and the depth just south measures 49 ft (15m). The water color is typically that of the Santa Fe River, which may be tannic or clear depending mainly on rainfall. No boil was observed during the October 2001 visit. The river flows southward from the vent and is approximately as wide (east to west) as the spring pool. There is a narrow band of cypress growing around pool perimeter. There are patches of duckweed around the periphery of the pool, and no aquatic vegetation could be seen through the tannic water. Several hundred yards of the Santa Fe River below Santa Fe Rise is choked with water hyacinth, and boat access to the rise is nearly impossible. Land around the river rise quickly rises to approximately 8 ft (2.5 m) above water level and levels off into a flat mesic hardwood hammock.

Utilization - The Santa Fe River Rise is a pristine, state-owned natural area.

Discharge - January 2, 2002: less than 75 ft³/s (D. Hornsby, pers. comm.).

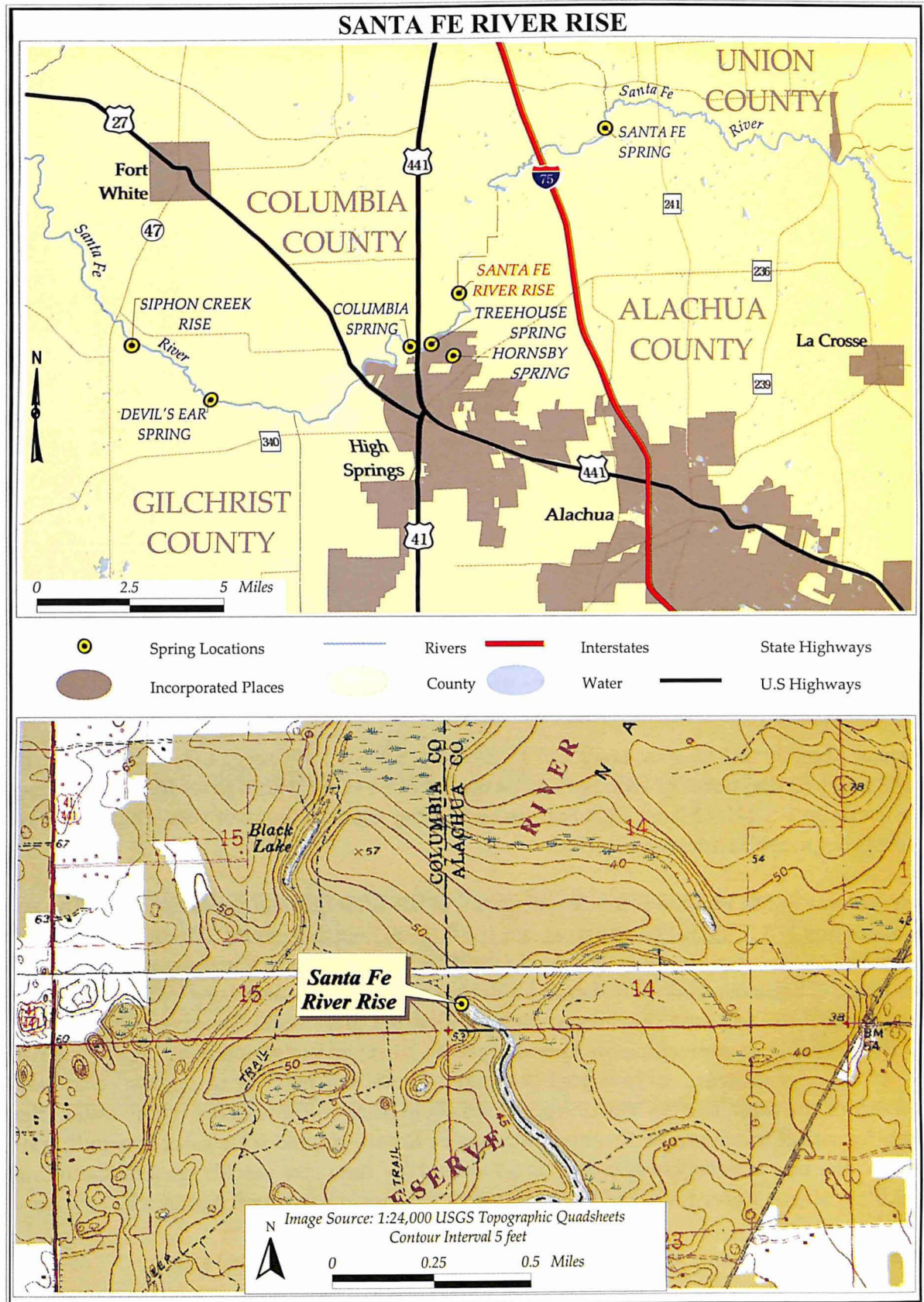


Figure 28. Santa Fe River Rise location map.

Table 17. Santa Fe River Rise water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	22.5	-
DO	3.5	-
pH	6.67	-
Sp. Cond.	259	-
Lab Analytes		
BOD	1.8	-
Turbidity	1.9	-
Color	250	-
Alkalinity	43 J	42
Sp. Cond.	260	-
TDS	228	-
TSS	4 U	-
Cl	31	32
SO ₄	34	34
F	0.12	0.12
Nutrients		
TOC	36	-
NO ₃ + NO ₂	0.058 J	0.059
NH ₃ +NH ₄	0.051 J	0.06
TKN	1.2 J	1.2 A
P	0.23	0.22 A
PO ₄	0.2	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	35 A	28.2
K	2.2 A	1.9
Na	15.1 A	12.8
Mg	8.3 A	6.6
B	33 I	-
Al	-	630 A
As	3 U	3 U
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	3.5 I
Fe	810 A	570
Mn	43.7 A	33.5
Ni	2 U	2 U
Pb	5 U	4 U
Se	4 U	4 U
Sn	20 U	-
Sr	388 A	-
Zn	6.7 I	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q= held past time limit

Table 18. Santa Fe River Rise bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	8 Q
Enterococci	12 Q
Fecal Coliform	6 Q
Total Coliform	60 Q

Treehouse Spring



Figure 29. Treehouse Spring (photo by J. Stevenson).

Location - Lat. 29° 51' 17.6" N, Long. 82° 36' 10.4" W (SW/ NE/ NW/ sec. 27, T. 7 S, R. 17 E). Treehouse Spring is approximately 2 miles (3.2 km) north of High Springs on the east bank of the Santa Fe River. The spring can be accessed by boat from a public boat ramp downstream from the spring. From High Springs, drive north on US 441/41. Turn left at public access boat sign just before the Santa Fe River. The spring is 0.6 miles (1 km) upstream from the boat ramp.

Description - Treehouse Spring is in a circular cove on the east side of the Santa Fe River. The spring discharges westward into the adjacent river. Spring pool diameter measures 125 ft (38 m) north to south and 175 ft (53 m) east to west. Pool depth is 31 ft (9.4 m). Water color was tannic, and there was no spring boil during October 2001. Water hyacinth was the only non native plant species observed in the spring pool. No other vegetation could be seen through the dark water. Land adjacent to this spring is a forested lowland flood plain. The nearest high ground is approximately 150 ft (46 m) to the east, and it rises 10-12 ft (3-4 m) higher than the flood plain and is forested with mixed hardwoods and pines.

Utilization - This spring is privately owned with pristine surroundings. There is a small rope swing on the east side and the spring is a local swimming spot.

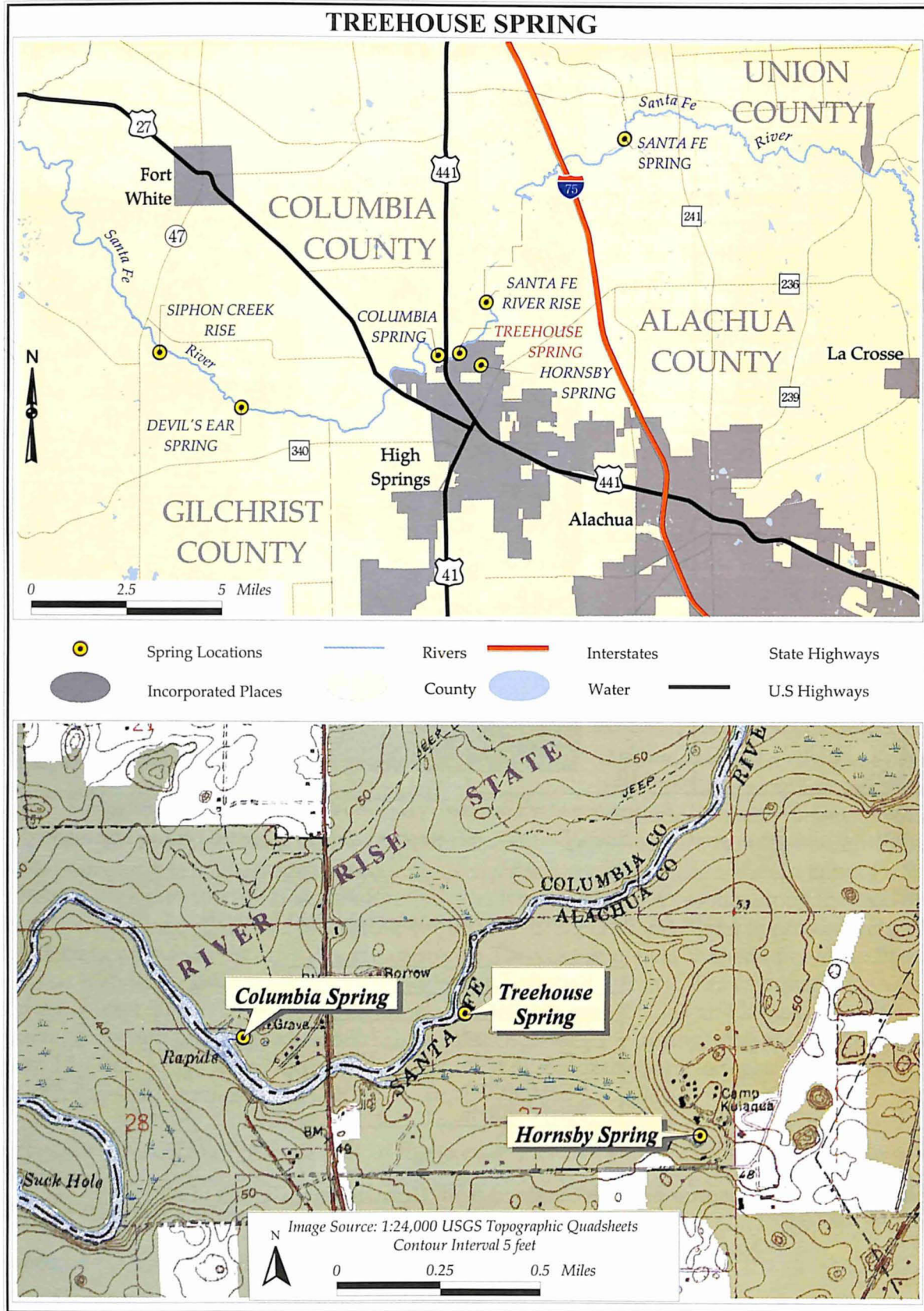


Figure 30. Treehouse Spring location map.

FLORIDA GEOLOGICAL SURVEY

Table 19. Treehouse Spring water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	21.9	-
DO	2.09	-
pH	7.31	-
Sp. Cond.	279	-
Lab Analytes		
BOD	0.2 UA	-
Turbidity	1.4	-
Color	250	-
Alkalinity	57	56
Sp. Cond.	280	-
TDS	225	-
TSS	4 U	-
Cl	27	27
SO ₄	37	37
F	0.14	0.12
Nutrients		
TOC	38	-
NO ₃ + NO ₂	0.091	0.091 J
NH ₃ +NH ₄	0.034	0.028 A
TKN	1.1	1.1
P	0.2	0.19
PO ₄	0.19	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	31.9	32.8
K	1.9	1.8
Na	12	11.8
Mg	6.8	7
As	3 U	3 U
Al	-	370
B	28 I	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	510	490
Mn	25.2	23.6
Ni	1.5 U	2 U
Pb	5 U	4 U
Se	8.8 U	4 U
Sn	20 U	-
Sr	370	-
Zn	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q= exceeded holding time limit

Table 20. Treehouse Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	14 Q
Enterococci	46 Q
Fecal Coliform	20 Q
Total Coliform	180 Q

Discharge - 1998 measurement was obtained from Hornsby and Ceryak (1998).

May 26, 1998 405.96 ft³/s
 October 30, 2001 39.9 ft³/s

GILCHRIST COUNTY

Devil's Ear Spring



Figure 31. Devil's Ear Spring (photo by H. Means).

of a 375 ft (114 m) long spring run that enters into the Santa Fe River from the south trending side. It is an elongated limestone fissure that discharges directly into the adjacent Santa Fe River. Dark water from the river contrasts distinctly with clear bluish water issuing along the side of the river. There is a large boil over the spring vent. The spring pool measures approximately 105 ft (32 m) east to west and 60 ft (18 m) north to south. The vent is an oval shaped opening in bedrock limestone with steep sides leading down to a depth of 34 ft (10.5 m). Native aquatic grasses are common around the vent opening, and some algae are on grass blades and limestone walls. The banks on the south trending side of the river (and therefore the spring) rise steeply to approximately 3 ft (1 m) above water level, then levels off. On top of the bank, a mesic hardwood forest with interspersed clearings is present.

Utilization - Devil's Ear Spring is part of the privately owned Ginnie Springs Resort. The spring is heavily used for swimming and scuba diving and is a hotspot for cave diving. Full facilities are located nearby to the east.

Discharge - Devil's Ear Complex, September 5, 2001: 206.59 ft³/s

Location - Lat. 29° 50' 07.3" N, Long. 82° 41' 47.8" W (SE/SW/NE/sec. 34, T. 7 S, R. 16 E). Devil's Ear is located among a complex of springs on the south bank of the Santa Fe River. The spring is approximately 7.5 miles (12 km) northwest of the town of High Springs within the privately owned Ginnie Springs Resort. From the intersection with US 41, drive 6.6 miles (10.6 km) west on SR 340. Turn north on a graded road and go 1.2 miles (1.9 km) to the Ginnie Springs Resort entrance. Follow the road around to the back of the office and towards the river. Turn right just before the bathhouse and follow the sand road to the parking area. Devils Ear is in a complex of three vents and is the vent nearest the Santa Fe River.

Description - Devil's Ear Spring is part of a complex of nearby springs. It is situated in the mouth

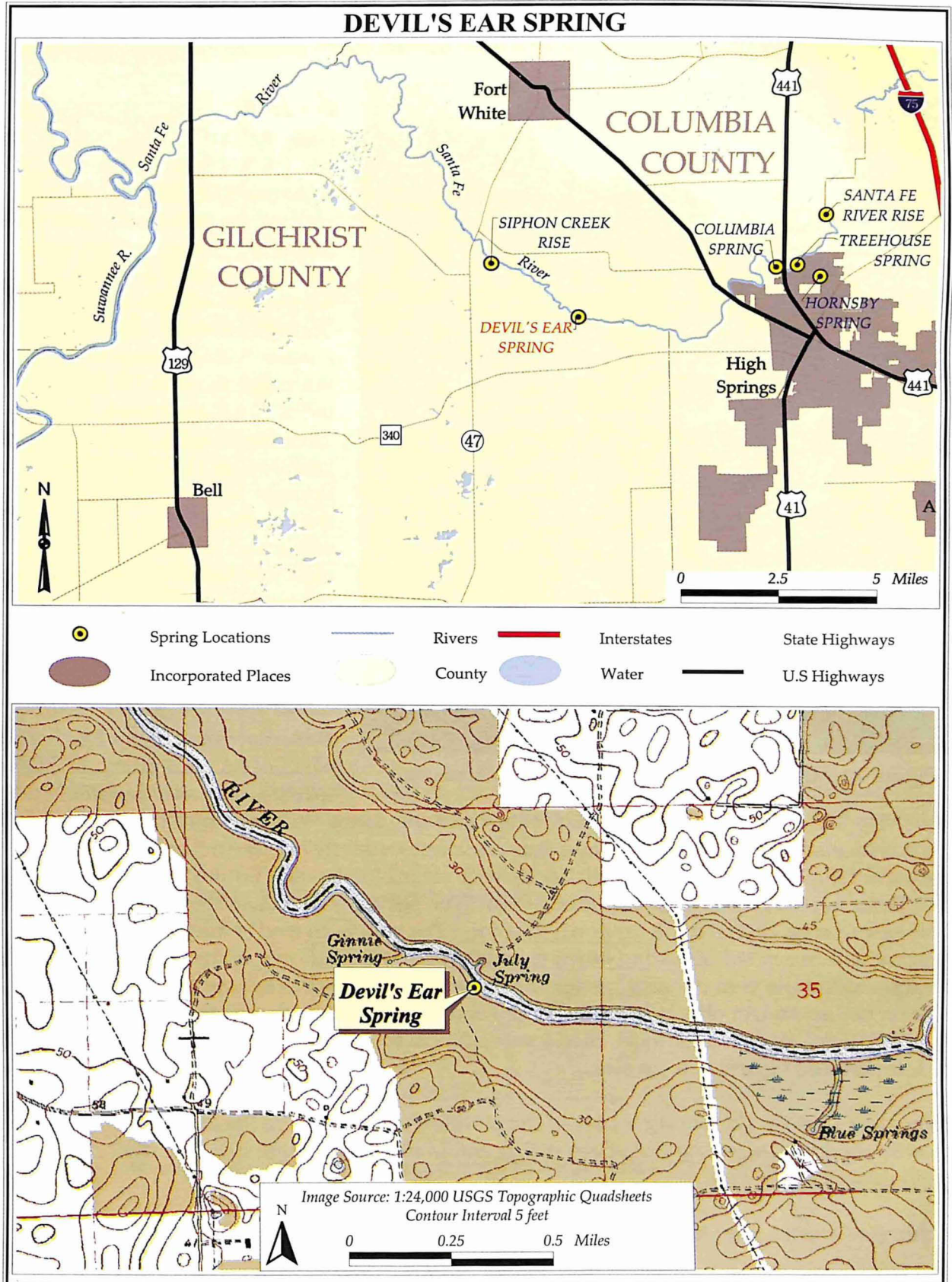


Figure 32. Devil's Ear Spring location map.

Table 21. Devil's Ear Spring water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	22.6	-
DO	3.09	-
pH	7.21	-
Sp. Cond.	372	-
Lab Analytes		
BOD	0.36 I	-
Turbidity	0.05 U	-
Color	5 U	-
Alkalinity	175 A	175
Sp. Cond.	380	-
TDS	215	-
TSS	4 U	-
Cl	6.9	6.9
SO ₄	13	13
F	0.11	0.094 I
Nutrients		
TOC	1 U	-
NO ₃ +NO ₂	1.3 J	1.4
NH ₃ +NH ₄	0.013 I	0.032
TKN	0.06 U	0.1 I
P	0.047	0.098
PO ₄	0.047	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	62	62.5
K	0.43	0.44
Na	3.84	4.05
Mg	6.5	6.4
As	3 U	3 U
Al	-	75 U
B	25 U	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	35 U	35 U
Mn	0.5 U	0.5 U
Ni	2 U	2 U
Pb	5 U	4 U
Se	8.8 U	4 U
Sn	20 U	-
Sr	151	-
Zn	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=exceeded holding time limit

Table 22. Devil's Ear Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	1 AKQ
Enterococci	2 AQ
Fecal Coliform	1 AQ
Total Coliform	25 AQ

Siphon Creek Rise



Figure 33. Siphon Creek Rise (photo by T. Scott).

Location - Lat. 29° 51' 22.3" N, Long. 82° 43' 59.0" W (SW/SW / SE/sec. 20, T. 7 S, R. 16 E). The rise is approximately 4 miles (6.4 k'm) south of Fort White on the Santa Fe River. Take SR 47 south from Fort White to the boat launch on the Santa Fe River. River rise is upstream approximately 1 mile (1.2 km). The creek rise is boiling up on the south trending side of the river at the mouth of Siphon Creek.

Description - Siphon Creek Rise is a spring that discharges from a single vent along the west bank of the Santa Fe River in the mouth of Siphon Creek. The spring pool measures 45 ft (14 m) north to south and 90 ft (27 m) east to west. Spring pool depth is 11.8 ft (3.6m). The water is tannin stained, like that of the adjacent Santa Fe River. There is a voluminous boil over the vent. Native aquatic grass grows in the vicinity of the vent, and it sways back and forth in the powerful current. The adjacent west riverbank rises steeply to 2 ft (0.6 m) above the water, exposing a fresh water shell marl. All land adjacent to the spring is lowland river floodplain with cypress, gum, and maple.

Utilization - Land around Siphon Creek Rise is pristine and owned by the SRWMD.

Discharge - Estimated by D. Hornsby, SRWMD, October 11, 2001: 120 ft³/s

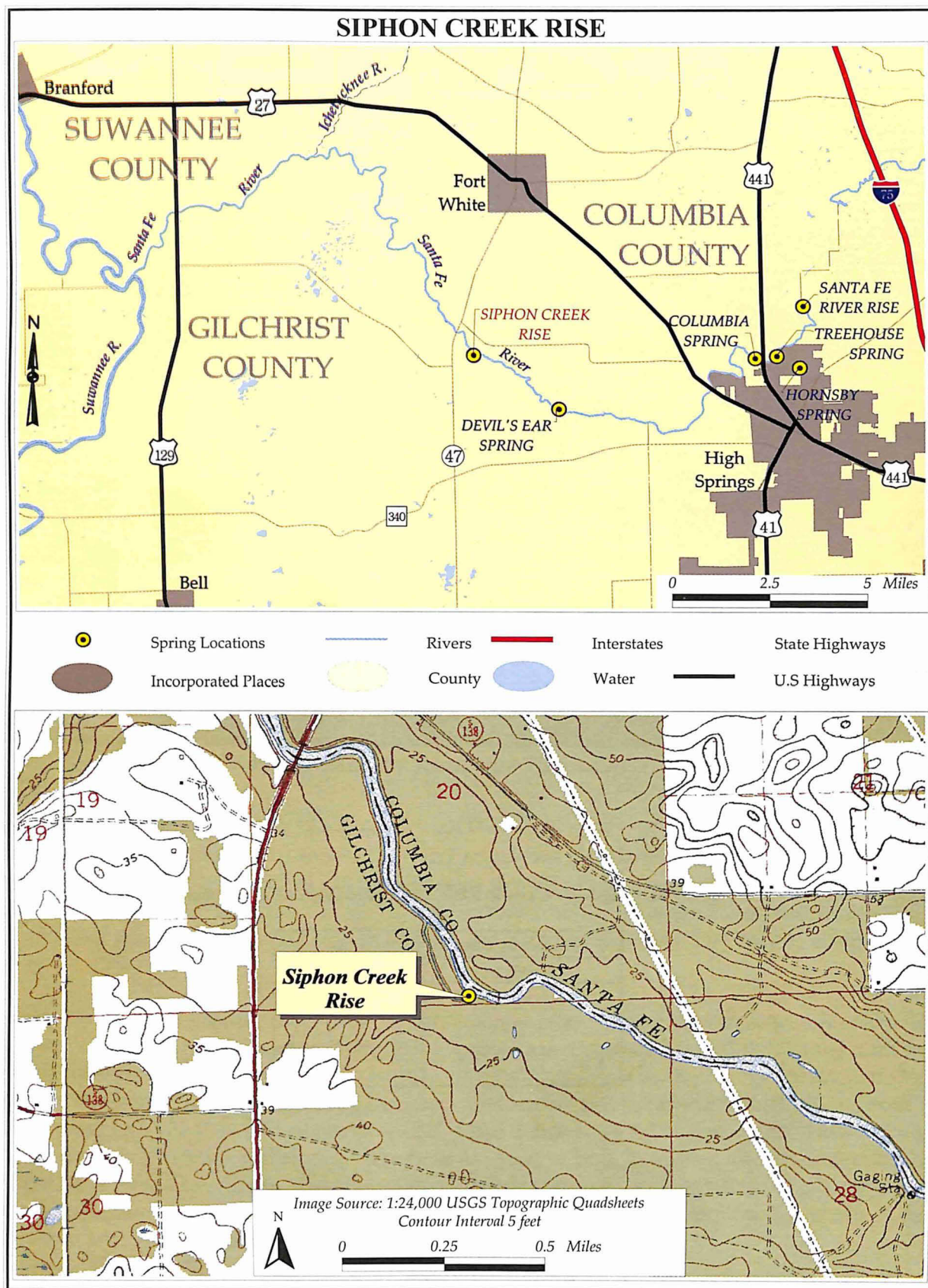


Figure 34. Siphon Creek Rise location map.

FLORIDA GEOLOGICAL SURVEY

Table 23. Siphon Creek Rise water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	22.5	-
DO	3.96	-
pH	7.39	-
Sp. Cond.	325	-
Lab Analytes		
BOD	0.43 I	-
Turbidity	0.9	-
Color	50 A	-
Alkalinity	146	147
Sp. Cond.	370	-
TDS	215	-
TSS	4 U	-
Cl	13	13 A
SO ₄	24	24 A
F	0.13	0.11
Nutrients		
TOC	6.9	-
NO ₃ + NO ₂	0.7	0.7
NH ₃ +NH ₄	0.026 J	0.027
TKN	0.34 JA	0.24
P	0.09	0.086
PO ₄	0.092	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	56.3	56.4
K	0.79	0.84
Na	6.29	7.4
Mg	6.4	6.7
As	3 U	3 U
Al	-	80 I
B	25 U	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	110 I	84 I
Mn	16.3	9.9
Ni	1.5 U	1.5 U
Pb	5 U	4 U
Se	4 U	4 U
Sn	10 U	-
Sr	245	-
Zn	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeded holding time limit

Table 24. Siphon Creek Rise bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	20 Q
Enterococci	80 Q
Fecal Coliform	24 Q
Total Coliform	260 Q

HAMILTON COUNTY

Alapaha River Rise



Figure 35. Alapaha River Rise (photo by T. Scott).

Location - Lat. 30° 26' 20.3" N, Long. 83° 05' 22.4" W (NW/SW/SE/sec. 35, T. 1 N, R. 12 E). The river rise is approximately 19 miles (31 km) southeast of Madison on the north side of the Suwannee River. Drive 8.7 miles (14 km) east of the Withlacoochee River on SR 6. Turn south and drive 2.8 miles (4.5 km), then 1 mi (1.6 km) east across the Alapaha River and 1 mile (1.6 km) southwest of a park and boat launching area on the Suwannee River. The spring is approximately .3 miles (.5 km) east.

Description - The Alapaha River Rise is the re-emergence of the underground Alapaha River. The river, issuing out of the spring vent, flows south for approximately 900 ft (274 m) until reaching the Suwannee River. The spring is composed of a single vent at the head of a circular depression, and the water is stained dark by tannins. The spring pool measures 75 ft (23 m) southeast to northwest and 108 ft (33 m) north to south. Pool depth is 71 ft (21.6 m). Some algae are present on submerged rocky substrates. There is no visible boil, however, the issuing river flows swiftly to the Suwannee River. This depression has deeply scalloped vertical limestone sidewalls that are estimated to rise 30 ft (9 m) above water level. High ground around the spring is densely forested with pines and oaks.

Utilization - Land around the river rise is state owned and in pristine condition.

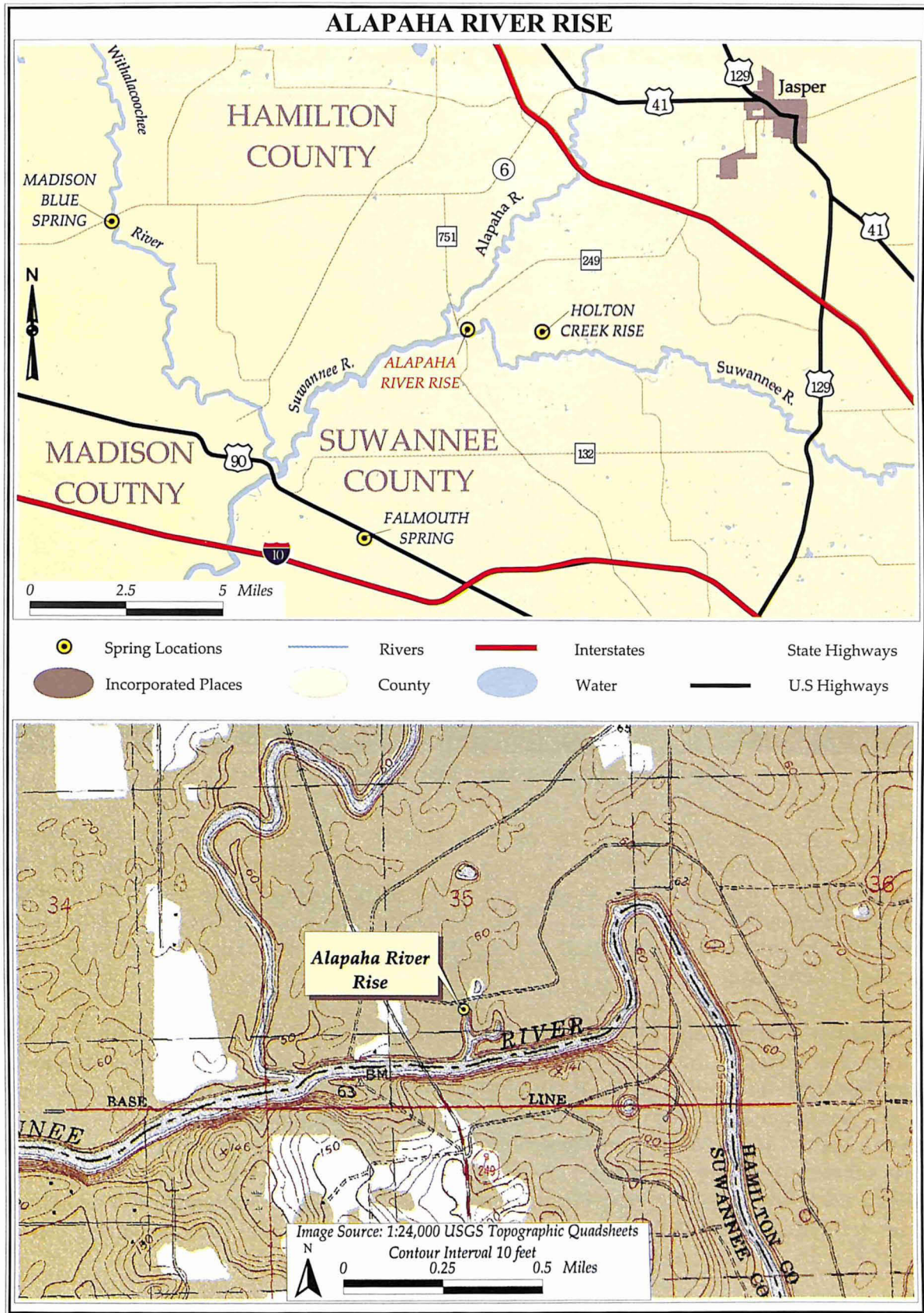


Figure 36. Alapaha River Rise location map.

OPEN FILE REPORT NO. 85

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

November 25, 1975	508
April 2, 1976	699
April 27, 1976	594
May 21, 1976	632
August 2001	594

Table 25. Alapaha River Rise water quality analysis.

Analytes	1975	2001	
		Unfilt.	Filter
Field Measures			
Temperature	19.0	21.3	-
DO	1.5	0.48	-
pH	7.6	7.11	-
Sp. Cond.	225	242	-
Lab Analytes			
BOD	-	0.56 I	-
Turbidity	-	1.2	-
Color	60	100	-
Alkalinity	83	93 J	92
Sp. Cond.	-	240	-
TDS	-	160	-
TSS	-	4 U	-
Cl	5.3	6.7 A	6.6
SO ₄	18	20 A	19
F	0.2	0.15	0.12
Nutrients			
TOC	-	12	-
NO ₃ + NO ₂	-	0.4 J	0.4
NH ₃ +NH ₄	-	0.024 J	0.038 A
TKN	-	0.43 J	0.4
P	-	0.13	0.13
PO ₄	-	0.14	-

Analytes	1975	2001	
		Unfilt.	Filter
Metals			
Ca	33	39.8	34.7
K	0.7	1.3	1.1
Na	4.2	5.68	4.87
Mg	5.0	6.5	5.6
As	-	3 U	3 U
Al	-	-	75 U
B	-	25 U	-
Cd	-	0.75 U	0.75 U
Co	-	0.75 U	-
Cr	-	2 U	2 U
Cu	-	2.5 U	2.5 U
Fe	-	310	370
Mn	-	29.6	25.2
Ni	-	1.5 U	1.5 U
Pb	-	5 U	4 U
Se	-	4 U	4 U
Sn	-	10 U	-
Sr	90	63	-
Zn	-	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q= exceeded holding time limit

Table 26. Alapaha River Rise bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

Holton Creek Rise



Figure 37. Holton Creek Rise (photo by T. Scott).

Location - Lat. 30° 26' 16.5" N, Long. 83° 03' 27.4" W (NW/SE/SW/sec. 31, T. 1 N, R. 13 E). The river rise is 11 miles (17 km) northwest of Live Oak on SRWMD land. From Live Oak, drive northwest on CR 751 (Noble's Ferry Rd.). Take the second right on a graded road after crossing over the Suwannee River. Follow SRWMD signs to Holton Creek. The spring is at the head of the creek.

Description - Holton Creek Rise discharges through Holton Creek, a run that meanders generally southeast approximately 1 mile (1.6 km) to the Suwannee River. The spring pool measures 225 ft (69 m) northwest to southeast and 177 ft (54 m) northeast to southwest. The water is tea colored, stained by tannic acids (water was reported as clear in Bulletin 31, revised). There is very little aquatic and emergent vegetation in the spring pool. The north shore is a vertical limestone ledge dropping immediately off to a depth of 100 ft (29 m); however, the bottom is highly irregular in the rest of the depression. No boil was observed during October 2001. The spring has steep sandy banks that rise to approximately 25 ft (8 m) above water level, and the high ground is forested with pines and oaks.

Utilization - Land around the spring is pristine and owned by the SRWMD. The Florida National Scenic Trail leads along the north side of Holton Creek.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977) and Springs of the Suwannee River Basin in Florida (Hornsby and Ceryak, 1998). All

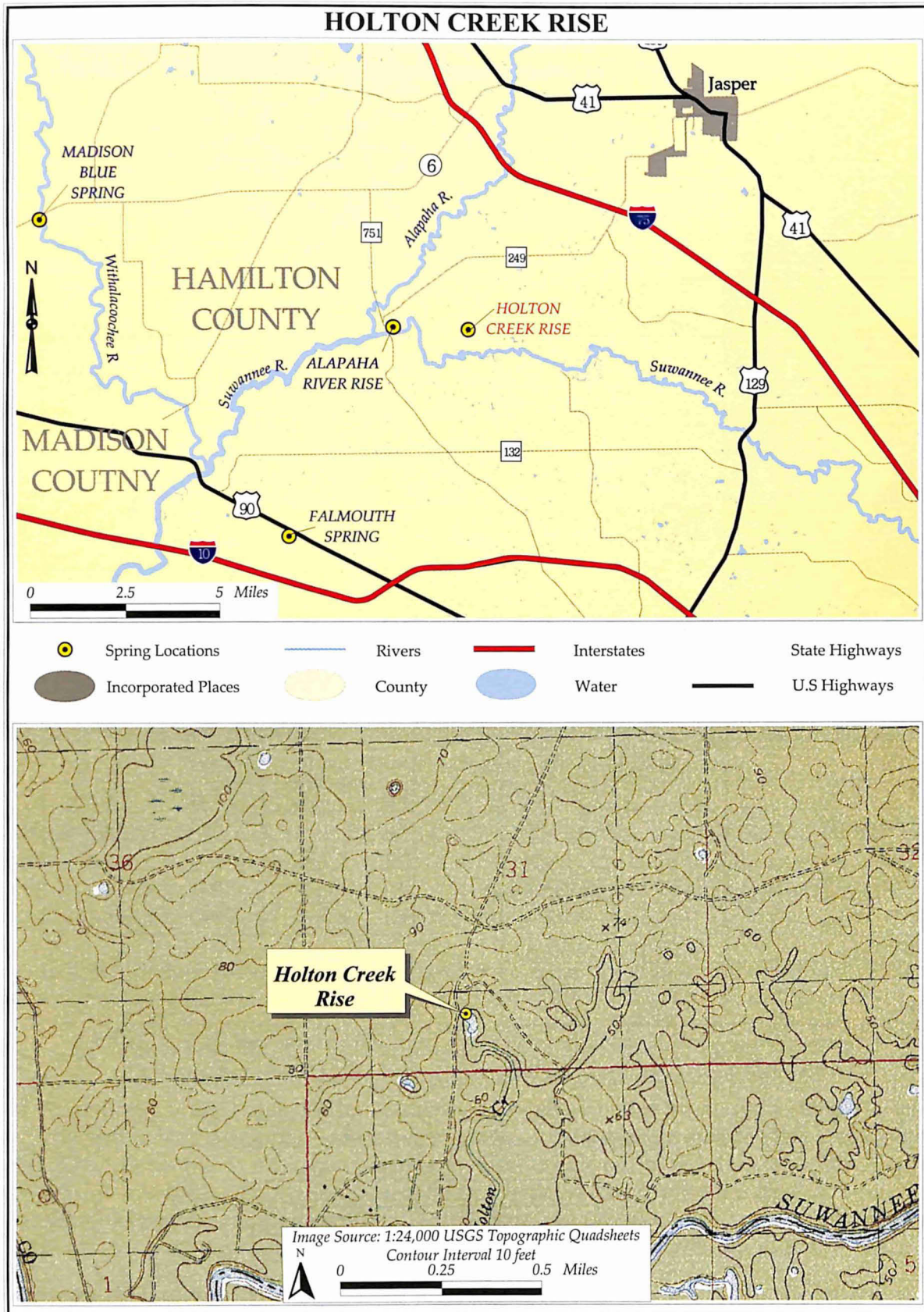


Figure 38. Holton Creek Rise location map.

FLORIDA GEOLOGICAL SURVEY

discharge rates are measured in ft³/s.

February 13, 1976	482
March 31, 1976	313
April 28, 1976	69
June 8, 1998	167
December 7, 2001	0

Table 27. Holton Creek Rise water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	22.1	-
DO	0.49	-
pH	7.00	-
Sp. Cond.	290	-
Lab Analytes		
BOD	0.6 AI	-
Turbidity	2	-
Color	140	-
Alkalinity	115 J	115
Sp. Cond.	300	-
TDS	213	-
TSS	4 U	-
Cl	6.6	6.5
SO ₄	31	30
F	0.17	0.14
Nutrients		
TOC	17	-
NO ₃ + NO ₂	0.004 U	0.004 U
NH ₃ +NH ₄	0.13 J	0.13
TKN	0.56 J	0.55 A
P	0.15	0.15
PO ₄	0.16	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	35.6	41.7
K	0.85	1
Na	5.65	5.3
Mg	7.5	9
As	3 U	3 U
Al	-	130 I
B	25 U	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	420	500
Mn	30.4	35.8
Ni	1.5 U	1.5 U
Pb	5 U	4 U
Se	4 U	4 U
Sn	10 U	-
Sr	101	-
Zn	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q= held past time limit

Table 28. Holton Creek Rise bacteriological analysis.

Bacteria Results (in #/100 ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	12 Q
Fecal Coliform	2 Q
Total Coliform	10 Q

HERNANDO COUNTY

Weeki Wachee Spring

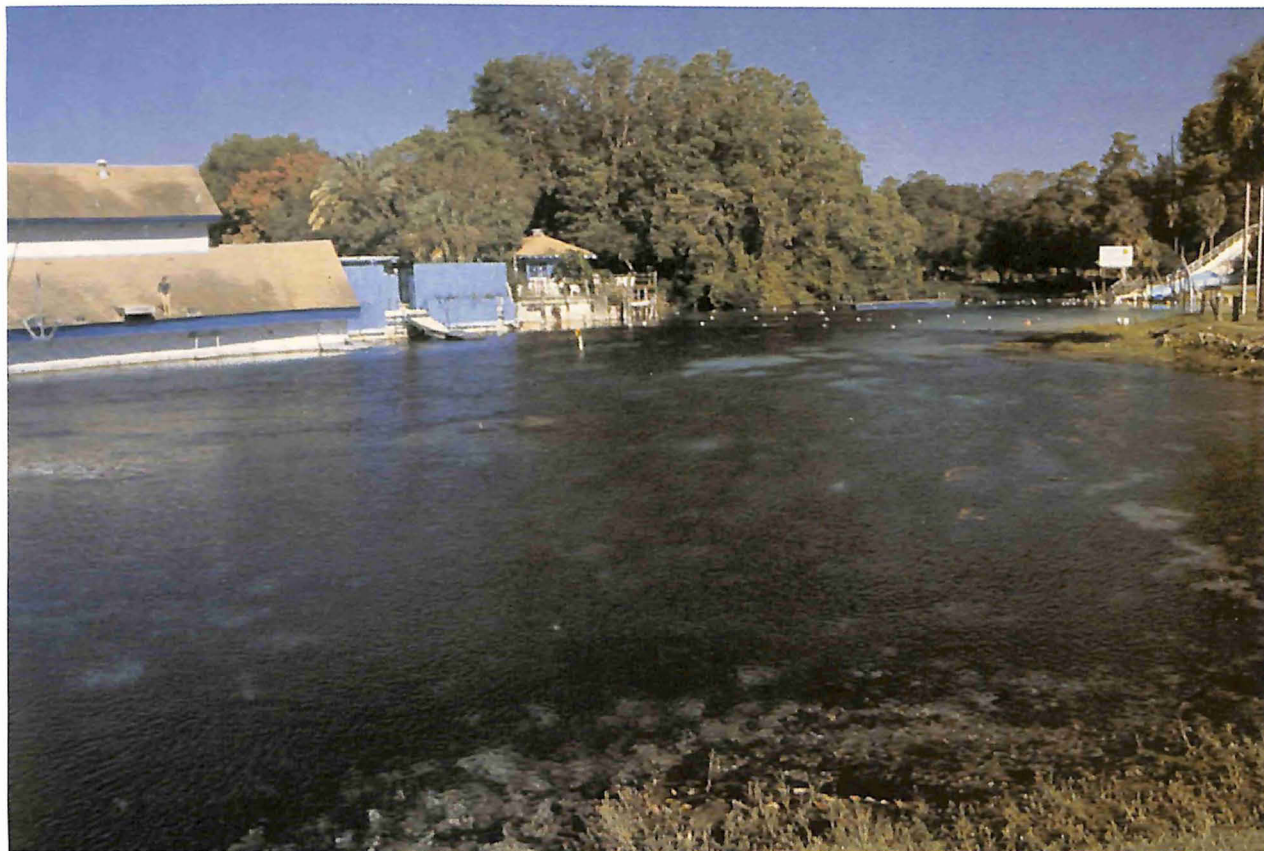


Figure 39. Weeki Wachee Spring (photo by R. Means).

Location - Lat. 28° 31' 01.9" N, Long. 82° 34' 23.4" W (NE/SW/NE/sec. 2, T. 23 S, R. 17 E). Spring is located in the town of Weeki Wachee on the west side of US 19. From the intersection of US 19 and CR 50, drive south .2 miles (.3 km). Turn right into Weeki Wachee Springs Park parking lot. Spring vent is in the large pool used for mermaid shows.

Description - Weeki Wachee Spring discharges from the bottom of a conical depression with gentle side slopes and a deep center. Spring depth is 45 ft (13.7 m) over the vent in the center of the pool. The spring pool measures 165 ft (50 m) east to west and 210 ft (64 m) north to south. Bare limestone is located near the vent, but none crops out around the pool edges. The water is clear and light greenish blue, and a boil is visible in the center of the pool. Thick, filamentous algae cover the majority of the spring bottom, and there are some native aquatic grasses in the spring pool. The spring is rich with fresh and saltwater fishes and aquatic turtles. The issuing Weeki Wachee River flows westward approximately 5 miles (8 km) into the Gulf of Mexico. The river flows through low-lying, densely forested swamp. The nearest high ground east of the spring is rolling sandhills terrain and gently rises to 15 ft (5 m) above the water level. All uplands and land adjacent to spring are developed. U.S. 19 is approximately 225 ft (69 m) east of the spring.

Discharge - Historical discharge data for Weeki Wachee Springs were measured at the Weeki Wachee River and include the flow of Weeki Wachee Spring, Little Springs, Unknown Spring No. 3, and flow from the bed of the river and the run from Little Springs. The aver-

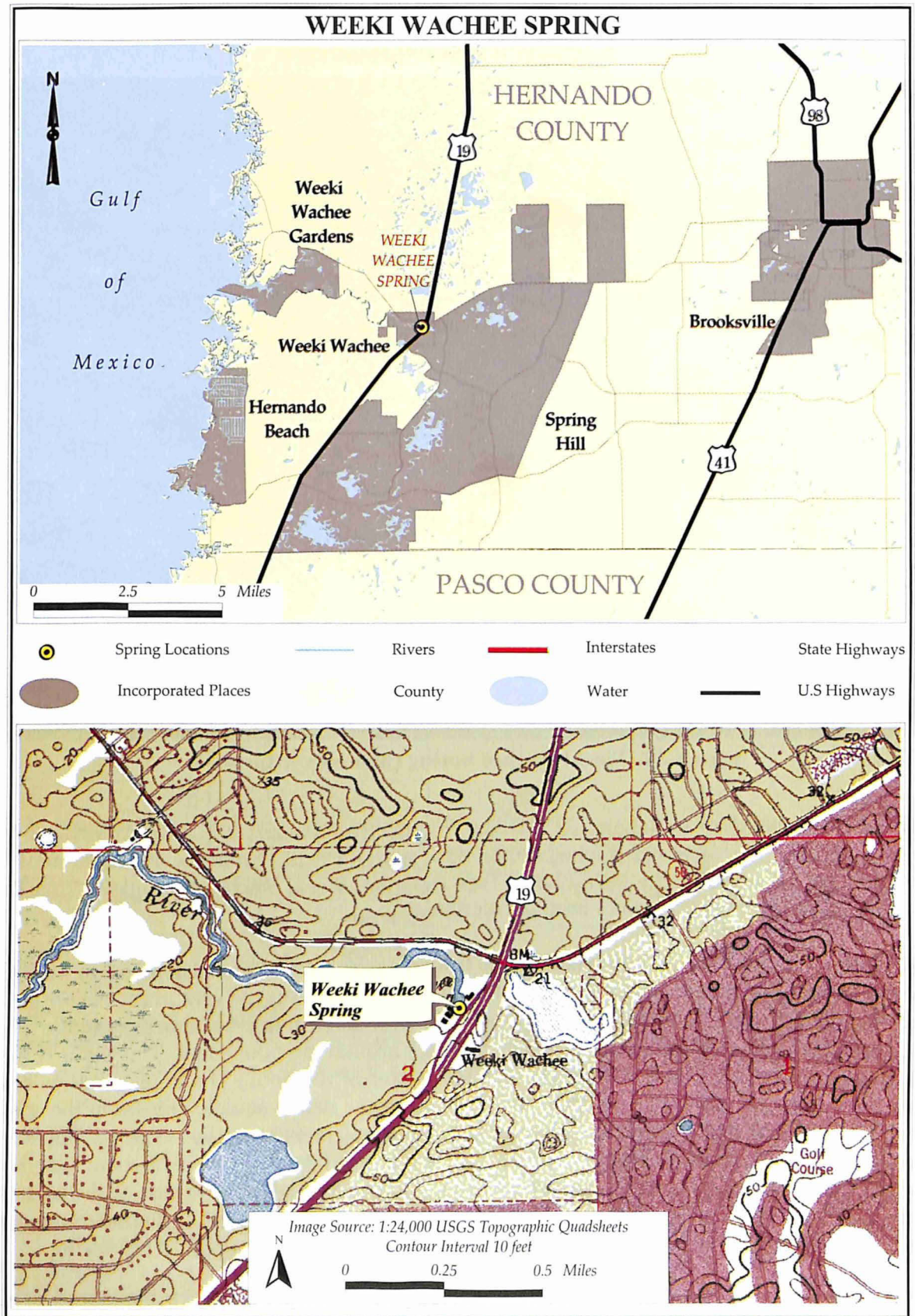


Figure 40. Weeki Wachee Spring location map.

OPEN FILE REPORT NO. 85

age discharge from 1917 through 1974 (364 measurements) was 176 ft³/s (Rosenau et al., 1977). Current discharge estimate is provisional.

Maximum (October 19, 1964)	275 ft ³ /s
Minimum (24, 1956)	101 ft ³ /s
October 18, 2001	161 ft ³ /s

Utilization - Weeki Wachee Spring is extensively developed into a tourist attraction that features underwater mermaid shows with submerged glass windows for viewing. It was recently purchased from private ownership by the Southwest Florida Water Management District (SWFWMD). The District leases the land to a private firm for the continuation of the mermaid shows. Shops and facilities are located all around the spring.

Table 29. Weeki Wachee Spring water quality analysis.

Analytes	1964	1969	1974	2001	
				Unfilt.	Filter
Field Measures					
Temperature	-	24.0	21.5	23.7	-
DO	-	2.0	-	1.3	-
pH	7.9	8.0	7.7	7.7	-
Sp. Cond.	262	275	284	320	-
Lab Analytes					
BOD	-	-	-	0.76 I	-
Turbidity	-	-	-	0.4	-
Color	3	5	1	5 U	-
Alkalinity	130	130	140	147	147
Sp. Cond.	-	-	-	320	-
TDS	-	-	-	176	-
TSS	-	-	-	4 U	-
Cl	4.0	8.0	4.6	6.7	6.6 A
SO ₄	6.4	9.6	7.4	9.2	9.2 A
F	0	0.1	0.1	0.084 I	0.1
Nutrients					
TOC	-	-	-	1 U	-
NO ₃ + NO ₂	-	-	-	0.67	0.66 J
NH ₃ +NH ₄	-	-	-	0.01 U	0.01 U
TKN	-	-	-	0.06 U	0.06 U
P	-	-	-	0.005 I	0.007 I
PO ₄	-	-	-	0.005 I	-

Analytes	1964	1969	1974	2001	
				Unfilt.	Filter
Metals					
Ca	44	48	50	49.5	50.7
K	0.3	5.0	0.6	0.31	0.32
Na	3.0	3.2	4.0	3.78	3.93
Mg	7.8	5.0	6.0	5.9	6
As	-	-	7	3 U	3 U
Al	-	-	100	-	75 U
B	-	-	-	25 U	-
Cd	-	-	0	0.75 U	0.75 U
Co	-	-	-	0.75 U	-
Cr	-	-	-	2 U	2 U
Cu	-	-	1	2.5 U	2.5 U
Fe	0	10	10	35 U	35 U
Mn	-	-	0	0.5 U	0.5 U
Ni	-	-	14	2 U	2 U
Pb	-	-	1	5 U	4 U
Se	-	-	-	4 U	4 U
Sn	-	-	-	10 U	-
Sr	-	-	150	174	-
Zn	-	-	0	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 30. Weeki Wachee Spring bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

FLORIDA GEOLOGICAL SURVEY

JACKSON COUNTY

Jackson Blue Spring



Figure 41. Jackson Blue Spring (photo by T. Scott).

Location - Lat. 30° 47' 25.9" N, Long. 85° 08' 24.3" W (SW/SE/NW/sec. 33, T. 5 N, R. 9 W). Blue Spring is about 5 miles (8 km) east of the city of Marianna at the northeast end of Merritts Mill Pond. From Marianna, drive east 1 mile (1.6 km) on U.S. 90, north 1 mile (1.8 km) on SR 71, east 3.3 miles (5.3 km) on SR 164. The spring is 0.1 mile (.2 km) southeast.

Description - Numerous springs feed Merritts Mill Pond. Jackson Blue Spring is the main spring at the head of the pond. It is situated about 10 ft (3 m) west of the diving board platform. Clear bluish water issues vertically from a conical depression. Maximum depth over the vent is 16.5 ft (5 m). Vent diameter is about 5 ft (1.5 m). Limestone is exposed near the vent, and it bears back-hoe scars. Spring pool diameter is approximately 240 ft (73 m) southwest to northeast and 233 ft (71 m) northwest to southeast. The boil is slightly visible at the surface. There is approximately 40% algae coverage on the pool bottom and very little aquatic or emergent vegetation. The spring pool is a designated swimming area separated from the rest of Merritts Mill Pond by a chain link fence across the channel approximately 100 yds (92 m) downstream. The southern shore of the spring pool meets a lowland cypress-gum forest. The northern half of the pool is bordered by high ground sloping upward to nearly 20 ft (7 m) above water level. Most of the high ground is cleared and grassy. All nearby uplands are developed with numerous buildings, concrete retaining wall near shore, slides, diving board, picnic tables, and parking area.

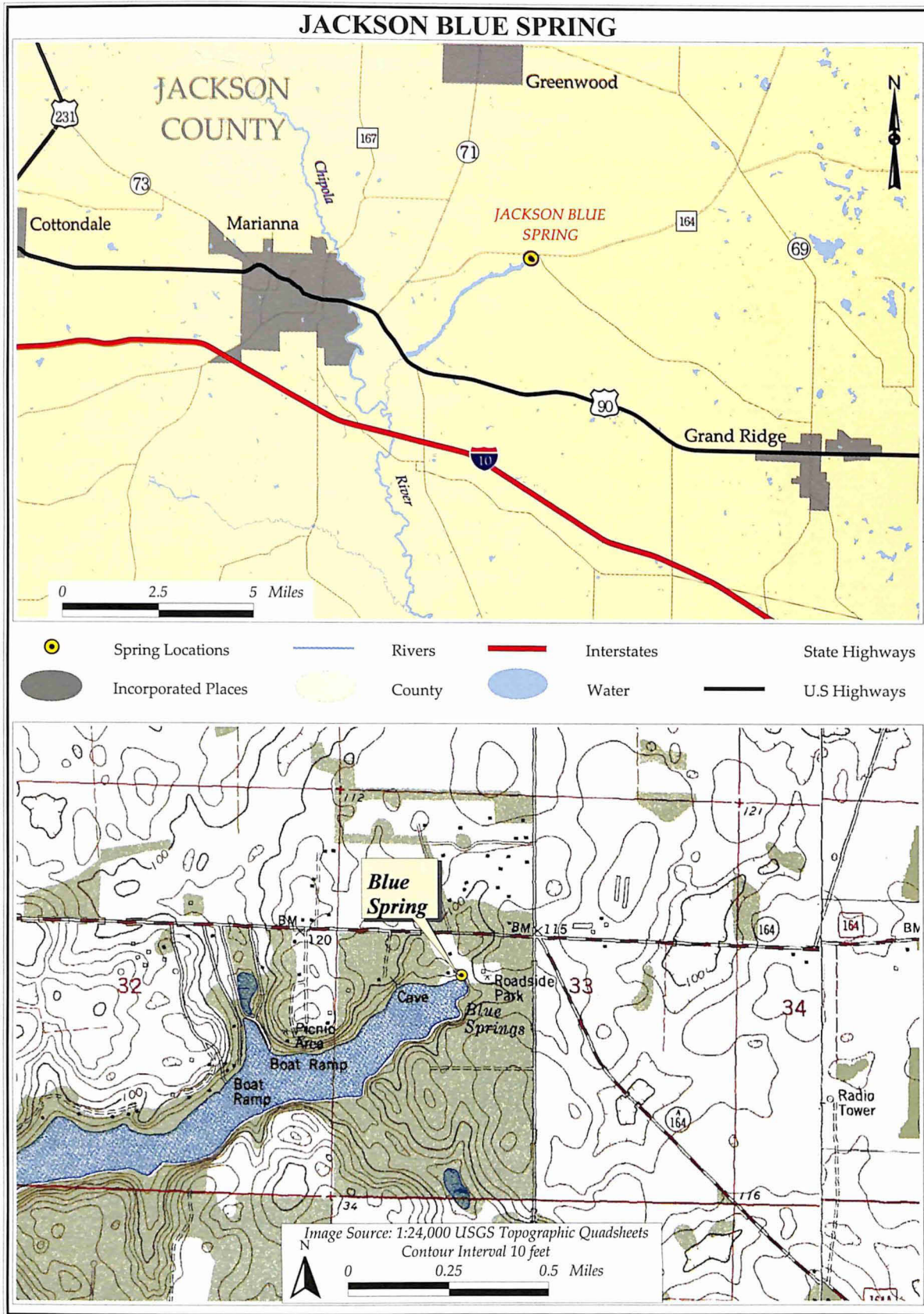


Figure 42. Jackson Blue Spring location map.

FLORIDA GEOLOGICAL SURVEY

Utilization - Jackson Blue Spring is a county swimming and recreational park.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). Current discharge measurement was calculated at Turner Landing, below the dam at Merritts Mill Pond. All discharge rates are measured in ft³/s.

January 24, 1929	134
December 22, 1934	56
May 20, 1942	265
November 15, 1946	178
January 30, 1947	178
August 6, 1973	287
December 17, 2001	61

Table 31. Jackson Blue Spring water quality analysis.

Analytes	1924	1946	1972	2001	
				Unfilt.	Filter
Field Measures					
Temperature	-	-	20.5	20.9	-
DO	-	-	7.8	7.26	-
pH	-	7.5	7.5	7.58	-
Sp. Cond.	-	-	220	243	-
Lab Analytes					
BOD	-	-	0.0	0.2 AU	-
Turbidity	-	-	0	0.05 U	-
Color	-	-	0	5 U	-
Alkalinity	-	-	98	108	109
Sp. Cond.	-	-	-	270	-
TDS	-	-	-	139	-
TSS	-	-	-	4 U	-
Cl	2.0	2.5	2.5	3.7	3.8 A
SO ₄	2.4	0.9	0.0	1	1.1 A
F	-	0.0	0.1	0.036 I	0.035 I
Nutrients					
TOC	-	-	0.0	1 U	-
NO ₃ + NO ₂	-	-	1.4	3.3	3.3
NH ₃ + NH ₄	-	-	-	0.01 U	0.01 U
TKN	-	-	-	0.074 I	0.06 U
P	-	-	0.02	0.023	0.022
PO ₄	-	-	0.02	0.02	-

Analytes	1924	1946	1972	2001	
				Unfilt.	Filter
Metals					
Ca	43	38	37	44.5	43.6
K	-	0.4	0.2	0.29	0.29
Na	2.3	1.7	1.6	1.73	1.54
Mg	1.0	2.1	2.1	2.3	2.1
As	-	-	10	3 U	3 U
Al	-	-	-	-	75 U
B	-	-	0	30 U	-
Cd	-	-	-	0.75 U	0.5 U
Co	-	-	0	0.75 U	-
Cr	-	-	1	2 U	2 U
Cu	-	-	10	2 U	2 U
Fe	-	-	-	25 U	20 U
Mn	-	-	-	0.5 U	0.5 U
Ni	-	-	-	2 U	2 U
Pb	-	-	2	5 U	3 U
Se	-	-	-	3.5 U	3.5 U
Sn	-	-	-	7 U	-
Sr	-	-	40	32 I	-
Zn	-	-	-	4 U	3.5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value shown is less than the practical quantitation limit J=Estimated value

Table 32. Jackson Blue Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	1 K
Enterococci	1 K
Fecal Coliform	1 K
Total Coliform	1 K

JEFFERSON COUNTY

Wacissa Springs Group



Figure 43. Wacissa Springs Group, Big Spring (Big Blue Spring) (photo by R. Means).

Group Location - Lat. 30° 20' N, Long. 83° 59' W (Sections 2 and 12, T. 2 S, R. 3 E). The Wacissa Springs are approximately 19 miles (30 km) southwest of Tallahassee and 1.2 miles (2 km) south of the town of Wacissa. SR 59 runs south out of Wacissa and turns sharply to the west after less than 1 mile (1.2 km). At this sharp right turn, a paved county road continues straight and ends 0.6 miles (0.9 km) beyond at a county park and boat ramp adjoining the head of the Wacissa River on the east side.

Group Description - The Wacissa Springs Group consists of at least 12 springs that give rise to the Wacissa River (Rosenau et al., 1977). Several springs are located at the head of the river near the county park. The rest are scattered along the upper 2 miles (3 km) of the river. Land along the upper part of the river is low and flat, and it supports a lush mixed hardwood-palm forest.

SPRING NO. 2 - Lat. 30° 20' 23.6" N, Long. 83° 59' 29.3" W (SE/SE/NE/sec. 2, T. 2 S, R. 3 E). This spring is located 15 ft (5 m) south of the diving board platform at the county park. There are multiple small vents near this spring. The maximum depth of the spring pool measures 8 ft (2.4 m). Spring pool diameter measures 45 ft (14 m) north to south. The spring pool is choked with *Hydrilla*, and algae are present throughout the pool. There are no adjacent uplands. Land near the spring supports cypress swamp forest and mesic hardwood forest. A sand and gravel park-

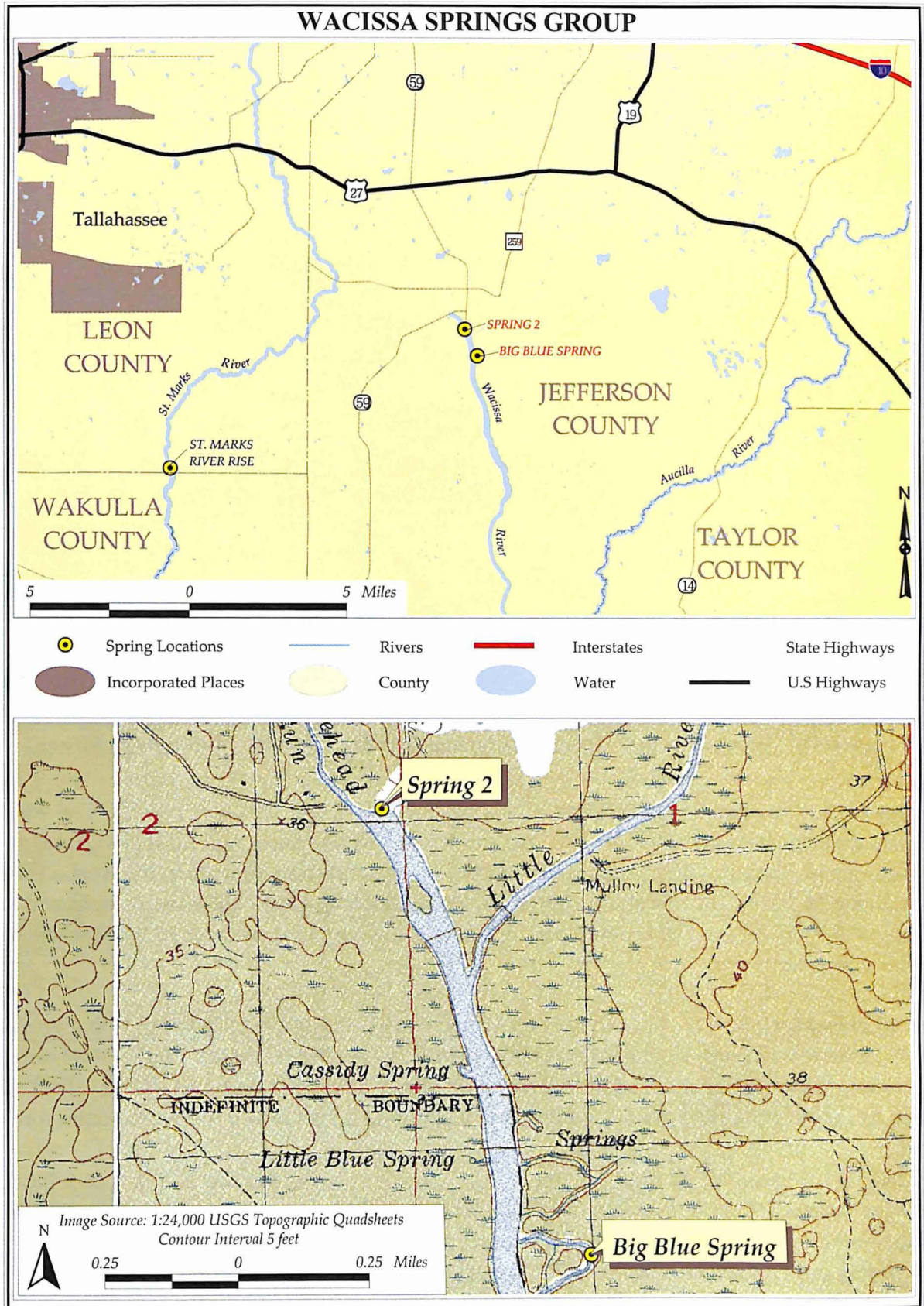


Figure 44. Wacissa Springs Group location map.

OPEN FILE REPORT NO. 85

Table 33. Wacissa Springs Group water quality analyses.

Analytes	Big Spring				Spring No. 2 (Aucilla)		
	1946	1960	2001		1972	2001	
			Unfilt.	Filter		Unfilt.	Filter
Field Measures							
Temperature	-	20.0	20.5	-	20.5	21.0	-
DO	-	-	0.9	-	3.2	5.6	-
pH	7.4	7.9	7.4	-	8.0	7.6	-
Sp. Cond.	320	318	326	-	267	272	-
Lab Analytes							
BOD	-	-	0.31 I	-	0.6	0.2 U	-
Turbidity	-	-	0.1	-	1	0.25	-
Color	2	5	5 U	-	5	5 U	-
Alkalinity	-	150	163	163	120	132	132
Sp. Cond.	-	-	370	-	-	300	-
TDS	-	-	184	-	-	159	-
TSS	-	-	4 U	-	-	4 U	-
Cl	5.1	5.0	5.1	5.1	6.0	4.9	4.9
SO ₄	6.7	6.4	6.4	6.6	5.2	5.3	5.4
F	0.1	0.2	0.13	0.13	0.3	0.14	0.14
Nutrients							
TOC	-	-	1 I	-	0	1 I	-
NO ₃ + NO ₂	-	-	0.16	0.16	0.2	0.41	0.41
NH ₃ + NH ₄	-	-	0.01 U	0.01 U	-	0.01 I	0.02 I
TKN	-	-	0.06 U	0.06 U	-	0.06 U	0.078 I
P	-	-	0.051	0.046	0.02	0.037	0.036
PO ₄	-	-	0.045	-	0.02	0.036	-
Metals							
Ca	52	52	53.8	52.9	37	41.4	40.9 A
K	0.8	0.6	0.41	0.41	0.4	0.41	0.41 A
Na	3.1	3.6	2.94	2.92 A	3.6	2.81	2.88
Mg	8.6	9.8	8.4	8.2	7.9	8.3	8.2 A
As	-	-	3 U	3 U	290	3 U	3 U
Al	-	-	-	75 U	-	-	75 U
B	-	-	30 U	-	10	30 U	-
Cd	-	-	0.75 U	0.5 U	-	0.75 U	0.5 U
Co	-	-	0.75 U	-	-	0.75 U	-
Cr	-	-	2 U	2 U	0	2 U	2 U
Cu	-	-	2 U	2 U	0	2 U	2 U
Fe	-	-	37 I	20 U	40	25 U	20 U
Mn	-	-	7.1	1.74	-	1.9 I	0.75 I
Ni	-	-	2 U	2 U	-	2 U	2 U
Pb	-	-	5 U	3 U	2.0	5 U	3 U
Se	-	-	3.5 U	3.5 U	-	3.5 U	3.5 U
Sn	-	-	7 U	-	-	7 U	-
Sr	-	-	71.4	-	140	68.4	-
Zn	-	-	4 U	3.5 U	50	4 U	3.5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value less than practical quantitation limit J=Estimated value Q=exceeding holding time limit

FLORIDA GEOLOGICAL SURVEY

ing lot borders the east side of the spring pool.

BIG SPRING (BIG BLUE SPRING) - Lat. 30° 19' 39.8" N, Long. 83° 59' 05.4" W (NW/ SE/ NW/ sec. 12, T. 2 S, R. 3 E). This spring is located approximately 1 mile (1.6 km) south of Spring No. 2 on the east side of the Wacissa River. It has two spring runs. The larger is about 66 ft (20 m) wide and flows 1300 ft (400 m) northwest and west to the Wacissa River. The other run is about 33 ft (10 m) wide and it flows southwest 1000 ft (300 m) to the Wacissa. Big Spring has one main vent nearly 6 ft (2 m) in diameter at the bottom of the circular spring pool. Pool diameter is 150 ft (47 m) northwest to southeast, 160 ft (48 m) northeast to southwest. Maximum depth of pool is 42 ft (12.8 m). The water is light greenish blue with large particles suspended, and the bottom is just visible. A boil is present on pool surface. *Hydrilla* covers nearly 50% of the depression, and some algae is present. There is no high ground immediately near the spring. The surrounding lowland forest is completely intact and is a mixture of cypress, hardwoods, and cabbage palm. A rope swing is located on the southwest side of the pool, and there is a floating wooden platform near the beginning of the larger spring run.

Utilization - Many of these springs are used as swimming and recreation areas, especially Spring No. 2 and Big Spring. The land around entire Wacissa River was purchased by the state of Florida, Conservation and Recreation Lands (CARL).

Discharge - Historical measurements reported are a combined total for the northwest and southwest runs of Big Spring (Rosenau et al., 1977). Current discharge measurement is for the Wacissa Springs group. All discharge rates are measured in ft³/s.

July 16, 1942	69.4
December 7, 1960	64.5
October 12, 1972	280
April 17, 1973	605
October 2, 2001	293

Table 34. Wacissa Springs Group bacteriological analyses.

Bacteria Results (in #/100 mL)		
Analyte	Big Spring	Spring No. 2
<i>Escherichia coli</i>	1 KQ	2 Q
Enterococci	1 KQ	46 Q
Fecal Coliform	1 AQ	4 Q
Total Coliform	1 KQ	270 Q

LAFAYETTE COUNTY

Lafayette Blue Spring

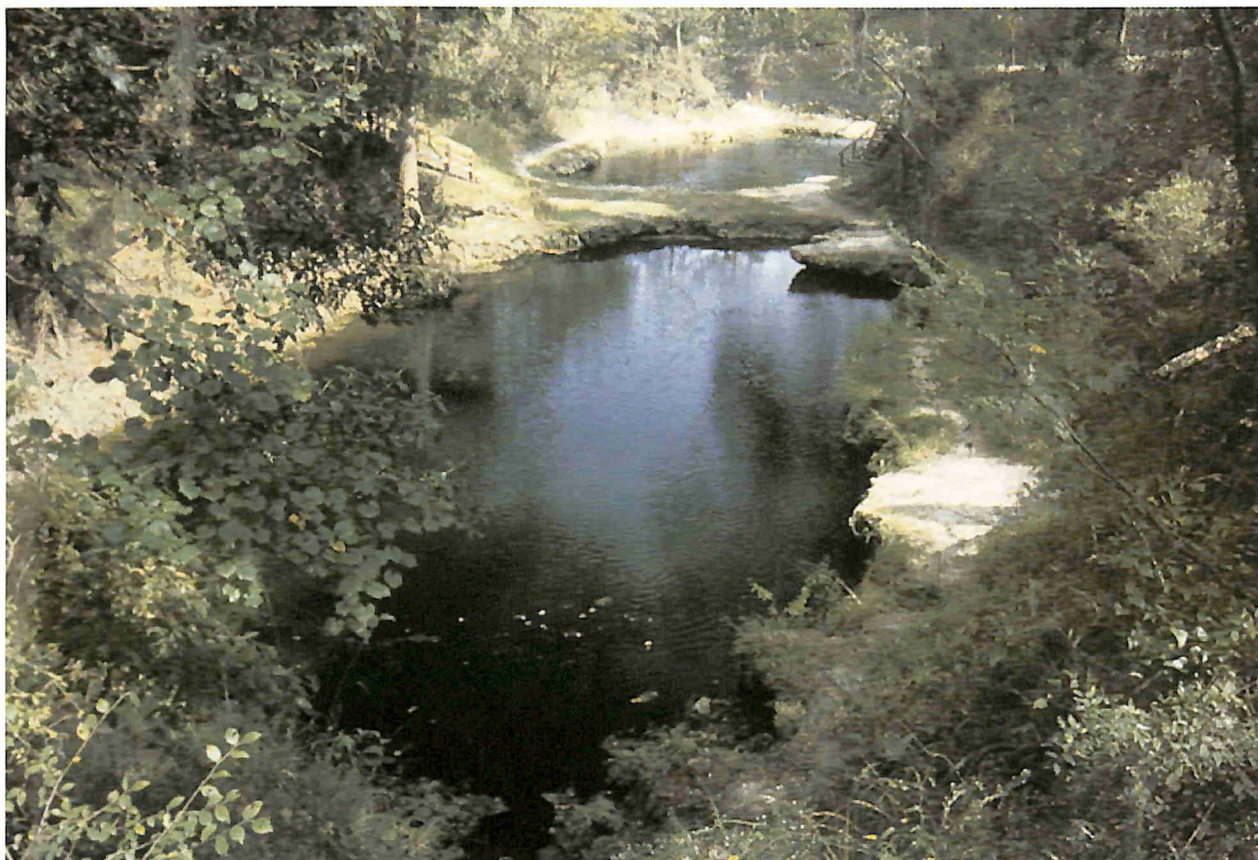


Figure 45. Lafayette Blue Spring (photo by T. Scott).

Location - Lat. 30° 07' 33.0" N, Long. 83° 13' 34.1"W (NW / SE / NW / sec. 21, T. 4 S, R. 11 E). Lafayette Blue Spring is located 7 miles (11 km) northwest of Mayo on the west side of the Suwannee River. From Mayo, drive northwest on US 27 for 4.3 miles (6.9 km). Turn right on CR 251 B and continue for 2.1 miles (3.4 km) on a gravel road. Turn east onto a dirt road and go 0.2 miles (0.3 km) to the county park entrance. Spring vent is east of the parking area in the pool farthest from the river.

Description - Lafayette Blue Spring discharges from a single horizontal vent in the south side of the sink depression. The spring pool measures 57 ft (17 m) north to south and 102 ft (31 m) east to west. Spring depth measures 21 ft (6.4 m). The water is clear and is light bluish green. Algae are very thick on rocky and sandy substrates within the spring pool and run. The issuing spring run flows east approximately 300 ft (91 m) before reaching the Suwannee River. Clear water from the spring contrasts sharply with the tannin colored water of the river. Limestone crops out throughout the spring pool and run. A 20 ft (6 m) wide land bridge stretches north to south across the spring run approximately 120 ft (37 m) east of the vent. There is a narrow band of a few cypress trees near the spring run. The spring pool is steep sided with limestone below and sand above. Adjacent high ground is approximately 20 ft (6 m) above the water level, and it is sparsely forested with a few pines and oaks.

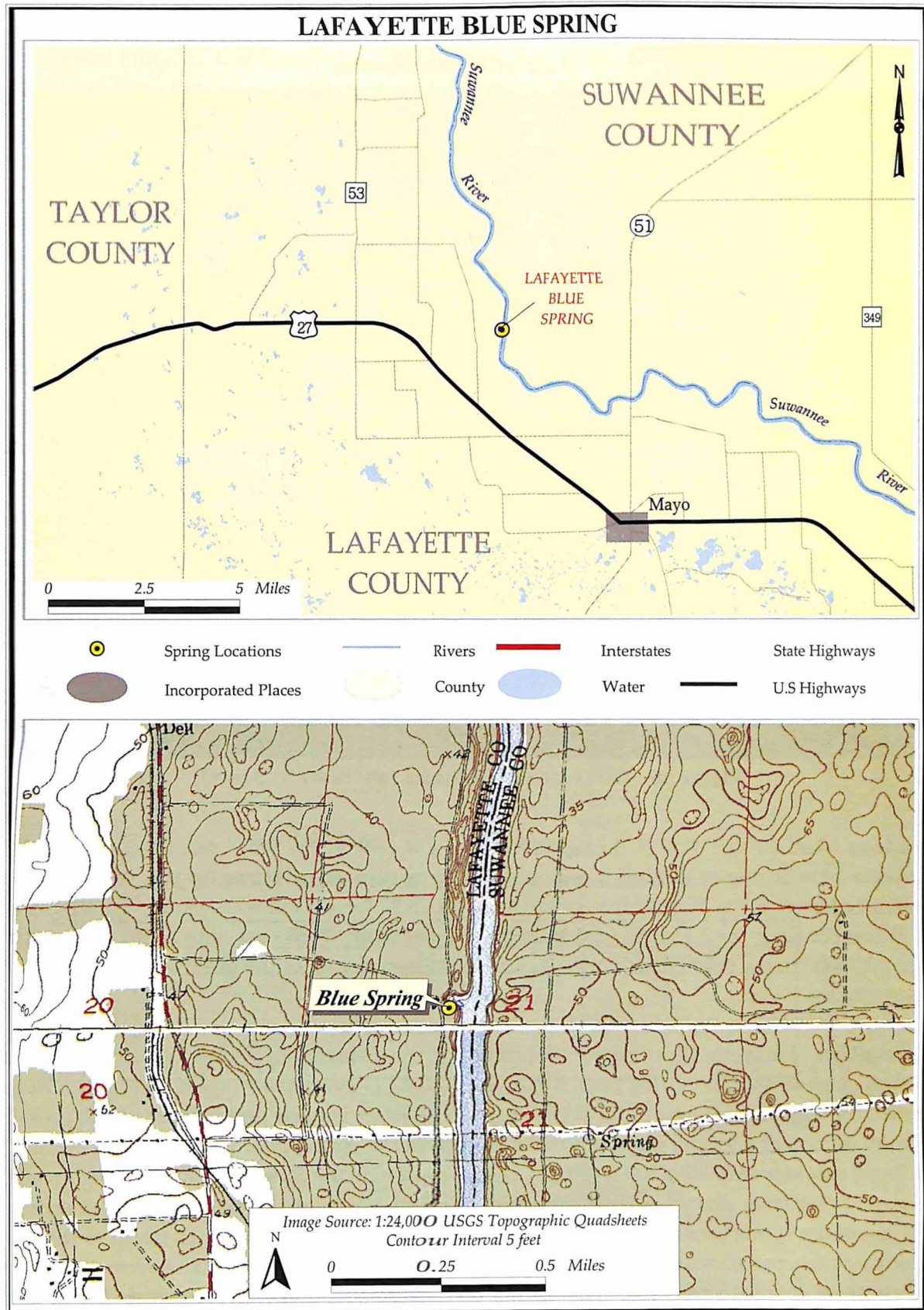


Figure 46. Lafayette Blue Spring location map.

OPEN FILE REPORT NO. 85

Utilization - This spring is developed into a county swimming and recreation park with facilities.

Discharge - Historical measurement was obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

November 23, 1973	92.8
October 24, 2001	45.9

Table 35. Lafayette Blue Spring water quality analysis.

Analytes	1973	2001	
		Unfilt.	Filter
Field Measures			
Temperature	21.5	21.7	-
DO	2.0	0.92	-
pH	7.2	7.17	-
Sp. Cond.	400	382	-
Lab Analytes			
BOD	-	0.2 AU	-
Turbidity	-	0.1	-
Color	5	5 U	-
Alkalinity	170	200	200
Sp. Cond.	-	430	-
TDS	-	233	-
TSS	-	4 U	-
Cl	7.0	9	9.2
SO ₄	8.1	13	13
F	0.0	0.1	0.088 I
Nutrients			
TOC	-	1 U	-
NO ₃ +NO ₂	-	1.8	1.8
NH ₃ +NH ₄	-	0.059	0.022
TKN	-	0.16 I	0.1 I
P	-	0.041 A	0.041
PO ₄	-	0.045	-

Analytes	1973	2001	
		Unfilt.	Filter
Metals			
Ca	54	67.2	65.3
K	1.0	0.84	0.86
Na	4.2	4.68	4.88
Mg	11	11.7	11.8
As	-	3 U	3 U
Al	-	-	75 U
B	-	25 U	-
Cd	-	0.75 U	0.75 U
Co	-	0.75 U	-
Cr	-	2 U	2 U
Cu	-	2.5 U	2.5 U
Fe	-	35 U	35 U
Mn	-	3.7	3.4
Ni	-	1.5 U	1.5 U
Pb	-	5 U	4 U
Se	-	4 U	4 U
Sn	-	10 U	-
Sr	0	94	-
Zn	-	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
 I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 36. Lafayette Blue Spring bacteriological analysis.

Bacteria Results (in #/100 ml)	
Analyte	Value
<i>Escherichia coli</i>	2 Q
Enterococci	10 Q
Fecal Coliform	6 Q
Total Coliform	40 Q

Troy Spring



Figure 47. Troy Spring (photo by T. Scott).

Location - Lat. 30° 00' 21.7" N, Long. 82° 59' 51.0" W (NW/NE/SE/sec. 34, T. 5 S, R. 13 E). Troy Spring is located 5.5 miles (8.5 km) northwest of Branford and flows into the Suwannee River. From the intersection of US 129 and US 27 in Branford, travel northwest on US 27 for 5.3 miles (8.5 km). Turn right on a paved road across highway from white house and go north 1.3 miles (2 km). As the paved road curves left, there is a small green house trailer on the right. Turn onto the dirt road that runs between the trailer and a fence line, and travel 0.6 miles (1 km) to the spring.

Description - Troy spring is an inundated sink hole with vertical limestone sidewalls. Pool depth is 61 ft (18.6 m). Pool diameter measures 138 ft (42 m) north to south and 118 ft (36 m) east to west. The spring run is about 325 ft (100 m) long and flows in a straight path eastward to the Suwannee River. A thick layer of dark green filamentous algae covers nearly all aquatic substrates. There is little to no other aquatic or emergent vegetation. Water color is distinctively greenish. Limestone is exposed around the spring pool and has a scalloped appearance. High ground surrounds the spring and rises to approximately 18 ft (6 m) above water surface. The uplands are generally forested with pines and hardwoods. There is a nearby cabin to the south.

Utilization - This spring is a swimming, snorkeling, and scuba diving hotspot. There are no public facilities. A small boat dock is located about half way down the run on the east side. Land around the spring is owned by the SRWMD.

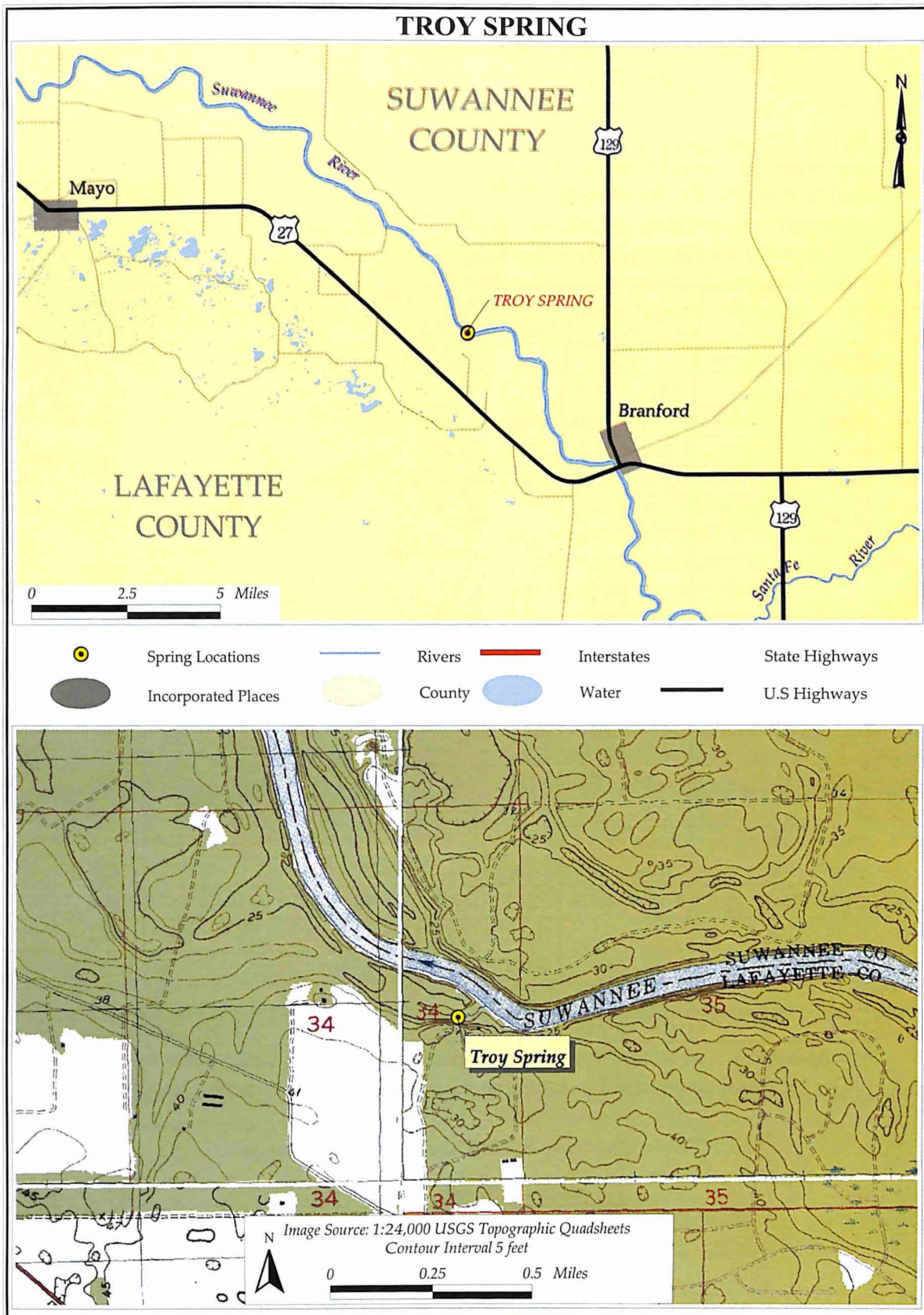


Figure 48. Troy Spring location map.

FLORIDA GEOLOGICAL SURVEY

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

July 17, 1942	149
November 26, 1960	161
May 28, 1963	148
October 16, 1973	205
October 30, 2001	106

Table 37. Troy Spring water quality analysis.

Analytes	1960	1973	2001	
			Unfilt.	Filter
Field Measures				
Temperature	21.7	21.5	21.7	-
DO	-	1.4	0.85	-
pH	7.8	7.1	7.49	-
Sp. Cond.	307	358	357	-
Lab Analytes				
BOD	-	0.2	0.25 I	-
Turbidity	-	1	0.15	-
Color	5	0	5 U	-
Alkalinity	150	150	163	164
Sp. Cond.	-	-	350	-
TDS	-	-	196	-
TSS	-	-	4 U	-
Cl	3.0	4.0	5.3	5.2
SO ₄	6.0	5.6	12	12
F	0.1	0.1	0.085 I	0.09 I
Nutrients				
TOC	-	0.0	1.8 I	-
NO ₃ +NO ₂	-	0.96	2.3	2.2
NH ₃ +NH ₄	-	-	0.012 I	0.01 U
TKN	-	-	0.075 I	0.067 I
P	-	0.03	0.034 A	0.03 A
PO ₄	-	0.02	0.024 J	-

Analytes	1960	1973	2001	
			Unfilt.	Filter
Metals				
Ca	54	56	57.3	59.3
K	0.2	1.3	0.9	0.97
Na	2.4	2.6	2.68	2.45
Mg	6.7	6.4	7	7.3
As	-	-	3 U	3 U
Al	-	-	-	75U
B	-	-	25 U	-
Cd	-	0	0.75 U	0.5 U
Co	-	0	0.75 U	-
Cr	-	0	2 U	2 U
Cu	-	10	2 U	2 U
Fe	-	-	25 U	20 U
Mn	-	-	0.73 I	0.31 I
Ni	-	-	1.5 U	1.5 U
Pb	-	6	5 U	3 U
Se	-	-	3.5 U	3.5 U
Sn	-	-	7 U	-
Sr	-	240	66.8	-
Zn	-	-	4 U	3.5 U

A=Average Value U,K=Compound not detected, value is the method detection limit

I=Value less than practical quantitation limit J=Est value Q=exceeding holding time limit

Table 38. Troy Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

LAKE COUNTY

Alexander Spring



Figure 49. Alexander Spring (photo by T. Scott).

Location - Lat. 29° 04' 52.7" N, Long. 81° 34' 33.2" W (Levy Grant 39, T. 16 S, R. 27 E). Alexander Spring is approximately 17 miles (27.5 km) northwest of Deland in the Ocala National Forest. Travel west on SR 40 from Ocala. Turn right on CR 445A just before the town of Astor. Follow 445A past the sharp turn to the east. Entrance to Alexander Springs Recreation Area will be on the right. Follow signs to parking area.

Description - Alexander Spring issues vertically from a conical depression and has a large spring pool that measures 300 ft (91 m) north to south and 258 ft (79 m) east to west. Depth is 25 ft (7.7 m). The water is clear and sky-blue. There is a large boil on the pool surface over the vent. Native aquatic grasses are plentiful. The bottom is mostly sandy with limestone outcropped near the vent with a vertical ledge running north to south near vent. There are multiple vents in a tight cluster. Thin algae patches are present on rocky substrate. High ground to the south rises gently to 12 ft (4 m) above water level. A rock wall forms the south shoreline. There is a mixed hardwood and palm forest around

the spring. Alexander Spring Run flows east trending approximately 8 river miles (13 km) until reaching the St. Johns River.

Utilization - Alexander Spring is owned by the Ocala National Forest, however, the spring is developed and operated by private concession. Camping, swimming, scuba diving, and canoeing are available with full facilities.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

February 12, 1931	112
February 7, 1933	124
April 13, 1935	162
October 15, 1935	74.5
December 3, 1935	131
April 2, 1946	101

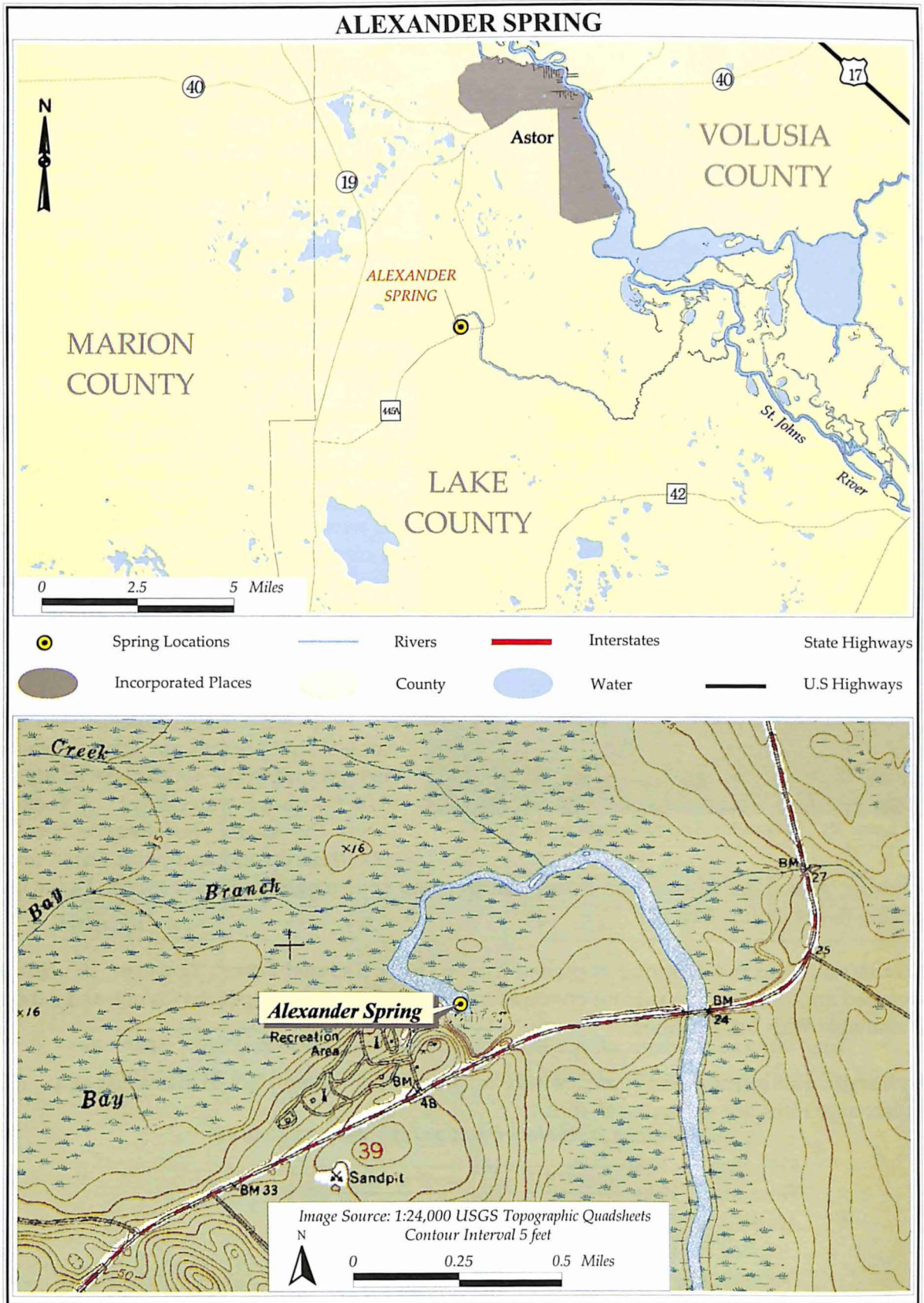


Figure 50. Alexander Spring location map.

OPEN FILE REPORT NO. 85

April 23, 1956	136
November 16, 1960	124
June 8, 1960	124
April 25, 1967	146
June 22, 1967	114
July 2, 1969	109
April 19, 1972	103
September 12, 2001	94.2

Table 39. Alexander Spring water quality analysis.

Analytes	1946	1972	2001	
			Unfilt.	Filter
Field Measures				
Temperature	-	24.0	23.6	-
DO	-	-	1.13	-
pH	6.9	7.9	7.55	-
Sp. Cond.	920	1050	1026	-
Lab Analytes				
BOD	-	0.1	0.2 AU	-
Turbidity	-	-	0.05	-
Color	0	5	5 U	-
Alkalinity	-	120	82	82
Sp. Cond.	-	-	1000	-
TDS	-	-	547	-
TSS	-	-	4 U	-
Cl	192	230	230	230
SO ₄	56	60	63	62
F	0.9	0.5	0.11	0.11
Nutrients				
TOC	-	3.0	1 U	-
NO ₃ + NO ₂	-	0.03	0.04	0.044
NH ₃ +NH ₄	-	-	0.01 U	0.01 U
TKN	-	-	0.06 U	0.074 I
P	-	0.04	0.048	0.044
PO ₄	-	0.04	0.045	-

Analytes	1946	1972	2001	
			Unfilt.	Filter
Metals				
Ca	41	44	43.4 J	43.4
K	2.3	2.0	3.9	3.9
Na	100	130	122	117
Mg	18	20	20	19.9
As	-	0	3 U	3 U
Al	-	-	-	75 U
B	-	180	47 I	-
Cd	-	0	0.75 U	0.75 U
Co	-	0	0.75 U	-
Cr	-	0	2 U	2 U
Cu	-	0	2.5 U	2.5 U
Fe	30	10	35 U	35 U
Mn	-	0.0	0.5 U	1 U
Ni	-	-	2 U	2 U
Pb	-	-	5 U	4 U
Se	-	-	4 U	4 U
Sn	-	-	10 U	-
Sr	-	-	722	-
Zn	-	10	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 40. Alexander Spring bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	10 Q

FLORIDA GEOLOGICAL SURVEY

LEON COUNTY

St. Marks River Rise



Figure 51. St. Marks River Rise (photo by H. Means).

Location - Lat. 30° 16' 33.8" N, Long. 84° 08' 56.2" W (NE/SW/SE/sec. 29, T. 2 S, R. 2 E). St. Marks River Rise is located 0.6 miles (0.9 km) south of Natural Bridge Battlefield Park. The River Rise is on private property but can be accessed by small boat. From the intersection of SR 267, drive east on US 98 to the public boat ramp sign on the east side of the St. Marks River. St. Marks River Rise is 6.5 miles (10.5 km) upstream from the boat ramp.

Description - St. Marks River Rise issues from an elongated fracture in the limestone. The river rise pool diameter measures 315 ft (96 m) east to west and 195 ft (59 m) northwest to southeast. Just south of the vent, the St. Marks River widens to 420 ft (128 m) northwest to southeast. The vent is nearly circular and its diameter is approximately 90 ft (27 m). River Rise pool depth measures 62 ft (15.7 m). The vent is limestone with almost a sheer drop on northeast side from 18 ft (5.5 m) to 48 ft (15 m). Area near the vent is choked with *Hydrilla*, and there is abundant native aquatic grass farther downstream. Some water hyacinth is present. Uplands near the spring rise gently to approximately 5 ft (1.7 m) above water level and are generally forested with a mix of pines, oaks, and cabbage palms.

Utilization - Land around the river rise is privately owned and access is restricted to dirt 4 x 4 tracks. A pipe leads into the vent from the north.

Discharge - December 18, 2001: 452 ft³/s.

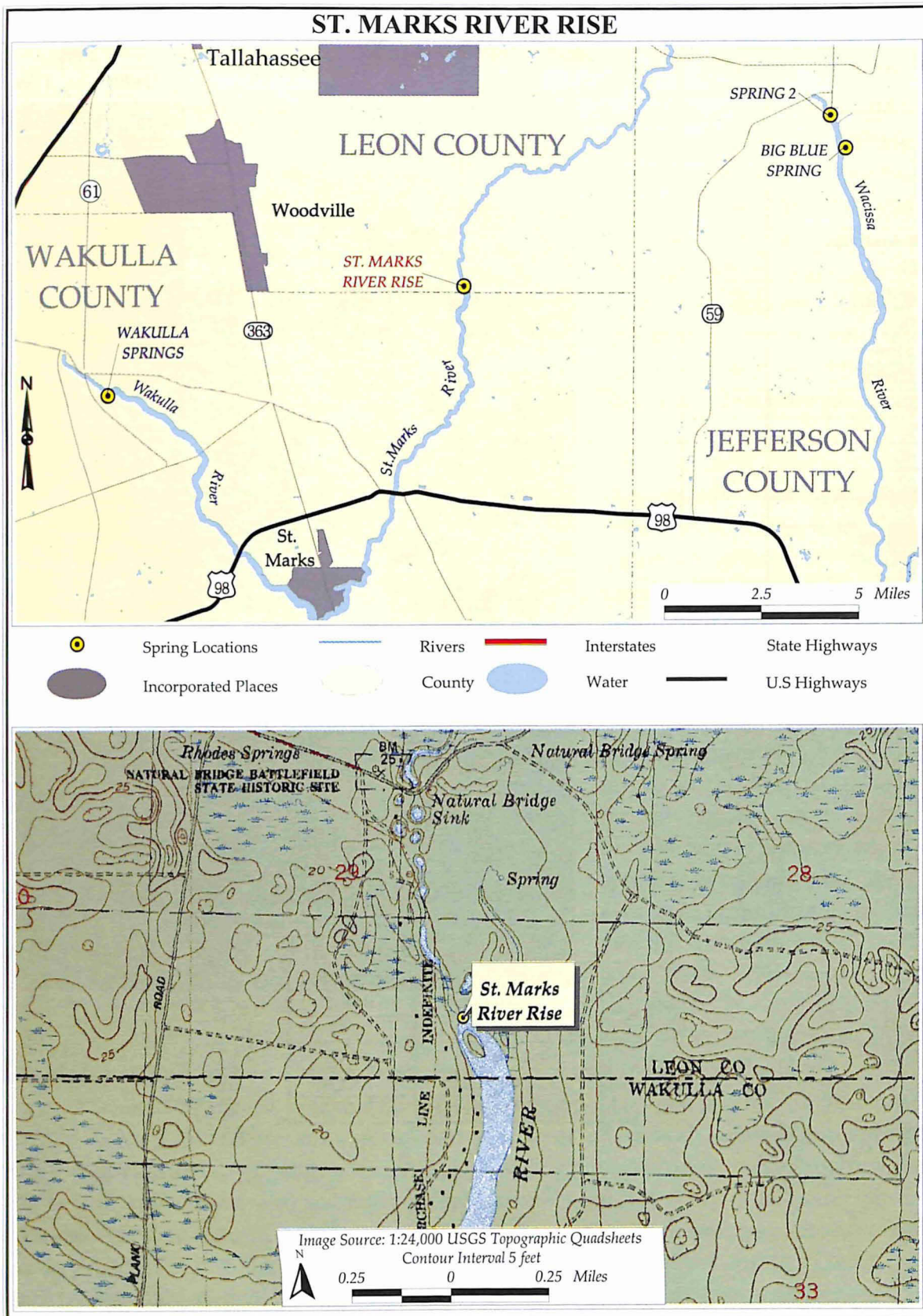


Figure 52. St. Marks River Rise location map.

FLORIDA GEOLOGICAL SURVEY

Table 41. St. Marks River Rise water quality analysis.

Analytes	1974	2001	
		Unfilt.	Filter
Field Measures			
Temperature	21.0	20.4	-
DO	1.7	3.79	-
pH	7.6	7.54	-
Sp. Cond.	270	270	-
Lab Analytes			
BOD	0.3	0.36 I	-
Turbidity	2	0.55	-
Color	8	5 U	-
Alkalinity	130	131	132
Sp. Cond.	-	280	-
TDS	-	164	-
TSS	-	4 U	-
Cl	5.4	5	4.8
SO ₄	8.8	9.1	9.1
F	0.1	0.13	0.14
Nutrients			
TOC	0	1.7 I	-
NO ₃ + NO ₂	0.14	0.21 J	0.23 A
NH ₃ +NH ₄	-	0.01 I	0.043
TKN	-	0.09 I	0.067 I
P	0.07	0.045	0.043
PO ₄	0.05	0.041	-

Analytes	1974	2001	
		Unfilt.	Filter
Metals			
Ca	39	42.4 A	42.7
K	0.5	0.46 A	0.47
Na	3.6	3.26	3.16
Mg	8.2	8.2 A	8.3
As	1	3U	3U
Al	50	-	75 U
B	-	25 U	-
Cd	3	0.75 U	0.5 U
Co	-	0.75 U	-
Cr	-	2 U	2 U
Cu	0	2 U	2 U
Fe	0	63 I	31 I
Mn	17	10.6 A	6.64
Ni	-	1.5 U	1.5 U
Pb	27	5 U	3 U
Se	-	3.5 U	3.5 U
Sn	-	7 U	-
Sr	100	84 A	-
Zn	3	4 U	3.5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value is less than practical quantitation limit J=Estimated value Q=exceeding holding time limit

Table 42. St. Marks River Rise bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	20 Q
Enterococci	64 Q
Fecal Coliform	28 Q
Total Coliform	130 Q

LEVY COUNTY

Fanning Springs



Figure 53. Fanning Spring (photo by H. Means).

Location - Lat. 29° 35' 15.3" N, Long. 82° 56' 07.1" W (SW/NE/NW/sec. 29, T. 10 S, R. 14 E). Fanning Springs is located in Fanning Springs Park in the town of Fanning Springs. Park entrance is located on the east side of the Suwannee River on US 98/19/27. Follow access road to parking lot. Spring vent is southwest of parking area.

Description - At Fanning Springs, Big Fanning Spring is in a conical depression with steep sandy and limestone banks. The vent area is nearly funnel shaped, with a sandy bottom and limestone sides, and it issues from the southeast side of the depression. The main vent issues horizontally from a small orifice in the limestone, however, multiple small boils in the sandy bottom were present when the spring was visited. Also, there are numerous tiny spring seeps flowing into the spring pool from the limestone banks. The water is bluish and clear. The spring pool measures 207 ft (63 m) north to south

and 144 ft (44 m) east to west. Depth of the spring pool measured over the vent is 12 ft (3.7 m). There is native aquatic grass in much of the shallow spring pool. Some patches of algae are present in the spring pool. There are cypress and gum trees along both sides of the spring run. Floating walkways and swimming ropes exist in the spring pool. The clear spring run flows north briefly before turning westward and flowing approximately 450 ft (137 m) to the tannic Suwannee River. Boat traffic from the river is not allowed past a floating wooden walkway across spring run. There is adjacent sandy high ground on the south and east sides of the spring. Elevations rise steeply to approximately 20 ft (6 m) above water level. The slopes are lush with ferns and mosses. Atop the high ground, there are pines and hardwoods scattered about.

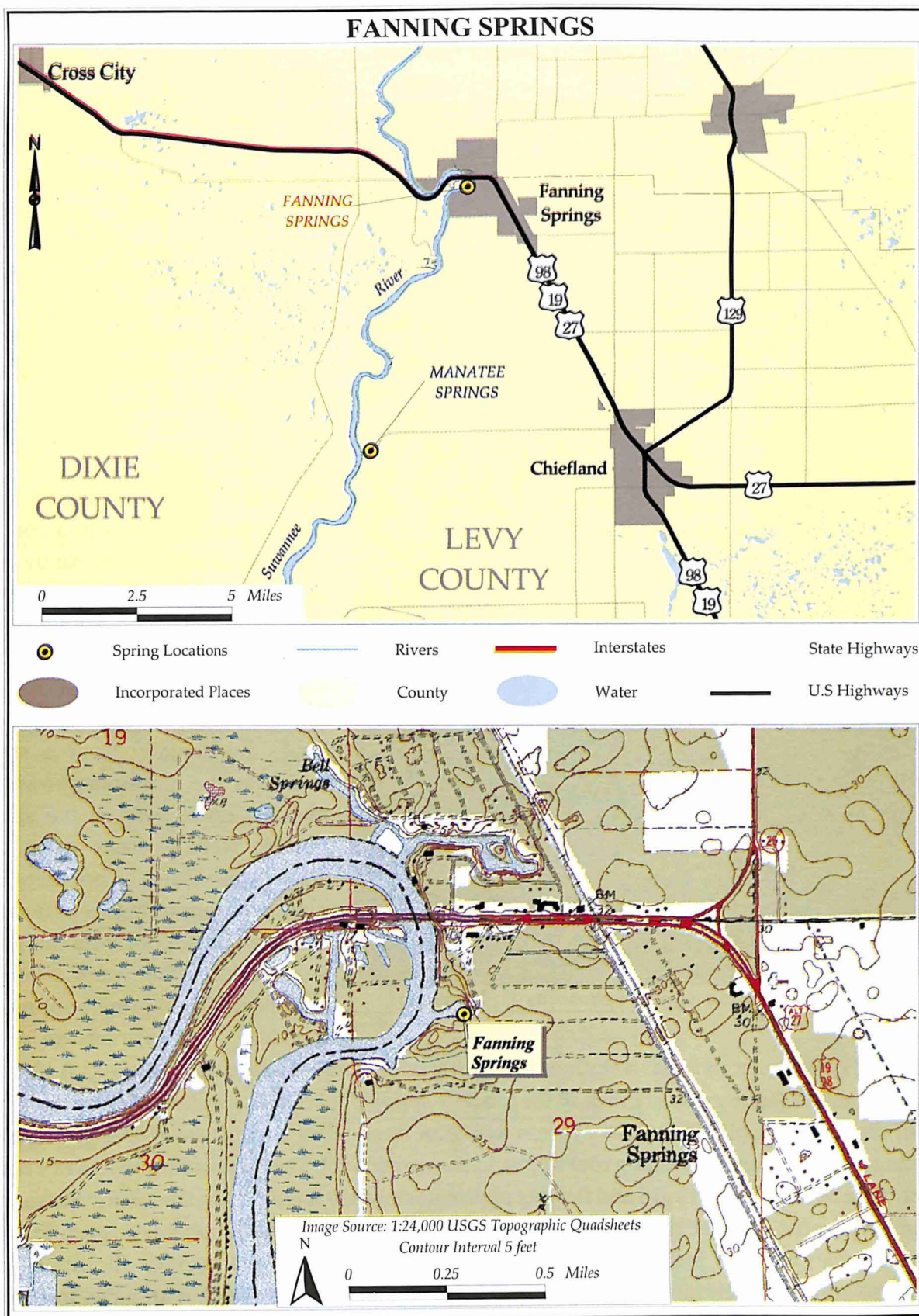


Figure 54. Fanning Spring location map.

OPEN FILE REPORT NO. 85

Utilization - Fanning Springs is a state recreation area with facilities developed for swimming and outdoor enjoyment.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

October 25, 1930	109
March 14, 1932	79.2
December 17, 1942	137
May 1, 1956	64
November 18, 1960	111
March 27, 1963	83.4
April 25, 1972	98.7
July 31, 1973	139
October 24, 2001	51.5

Table 43. Fanning Spring water quality analysis.

Analytes	1946	1956	1960	1972	2001	
					Unfilt.	Filter
Field Measures						
Temperature	23.0	23.0	22.0	22.5	22.7	-
DO	-	-	-	-	2.15	-
pH	7.3	8.0	7.9	8.0	6.97	-
Sp. Cond.	357	330	344	345	421	-
Lab Analytes						
BOD	-	-	-	-	0.2 U	-
Turbidity	-	-	-	-	0.05	-
Color	2	14	0	0	5 U	-
Alkalinity	-	170	-	160	193	192
Sp. Cond.	-	-	-	-	440 A	-
TDS	-	-	-	-	256	-
TSS	-	-	-	-	4 U	-
Cl	4.0	4.5	4.0	1.0	8.3	8.5
SO ₄	9.9	12	10	11	19	20
F	0.0	-	0.3	0.2	0.098 I	0.12
Nutrients						
TOC	-	-	-	2.0	1 U	-
NO ₃ + NO ₂	-	-	-	-	3.7	4.1
NH ₃ +NH ₄	-	-	-	-	0.01 U	0.01 U
TKN	-	-	-	-	0.06 U	0.06 U
P	-	-	-	-	0.066	0.063 A
PO ₄	-	-	-	-	0.072	-

Analytes	1946	1956	1960	1972	2001	
					Unfilt.	Filter
Metals						
Ca	66	64	66	63	77.7	77.5
K	0.6	0.1	0.1	0.2	2.4	2.5
Na	2.6	2.7	2.8	2.9	4.15	4.1
Mg	4.8	5.5	3.8	4.1	5.8	5.8
As	-	-	-	-	3 U	3 U
Al	-	-	-	-	-	75 U
B	-	-	-	-	25 U	-
Cd	-	-	-	-	0.75 U	0.75 U
Co	-	-	-	-	0.75 U	-
Cr	-	-	-	-	2 U	2 U
Cu	-	-	-	-	2.5 U	2.5 U
Fe	0.08	0.01	-	-	35 U	35 U
Mn	-	-	-	-	0.5 U	0.5 U
Ni	-	-	-	-	2 U	3 U
Pb	-	-	-	-	5 U	4 U
Se	-	-	-	-	4 U	4 U
Sn	-	-	-	-	20 U	-
Sr	-	-	-	100	77	-
Zn	-	-	-	-	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value shown is less than the practical quantitation limit J=Estimated value Q=exceeding holding time limit

Table 44. Fanning Spring bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

Manatee Springs



Figure 55. Manatee Springs main spring (photo by T. Scott).

Location - Lat. $29^{\circ} 29' 22.2''$ N, Long. $82^{\circ} 58' 36.7''$ W (SE / SW / SE / sec. 26, T. 11 S, R. 13 E). Manatee Springs is approximately 7 miles (11 km) west of Chiefland within Manatee Springs State Park. From US 19/27 in Chiefland, drive west on CR 320 to the entrance of the park. Follow park road to the main parking area, the spring is 200 ft (61 m) north of the parking lot.

Description - Manatee Springs and its issuing spring run are on the east side of the Suwannee River within the densely wooded, lowland floodplain. The spring discharges vertically in a conical sink depression. The spring pool measures 60 ft (18 m) north to south and 75 ft (23 m) east to west. The depth of the spring pool is 17 ft (7.7 m). There is a tremendous boil associated with this spring. Divers report that entry into the vent against the current is very difficult. The bottom of the spring pool is sandy with numerous submerged logs. There is a limestone ledge 3 ft (1 m) below the water surface and vertical cliff on the south side of the spring pool where wooden steps lead down into the water for swimming access. Thick algae covers approximately 75% of the inundated limestone ledge and cliff face. The water is sky blue. Native aquatic grasses inhabit the spring run. There are many cypress trees and knees on the north and east shores of the spring pool. The spring run flows southward to the Suwannee River approximately 1200 ft (365 m). Uplands on the south side of the spring rise to approximately 15 ft (4.5 m) above the water level and are developed into a swimming and recreation area underneath a thick canopy of live oak and pine. There are numerous walkways and a rock wall along the south shore of the spring pool. The north shore is relatively pristine and wooded.

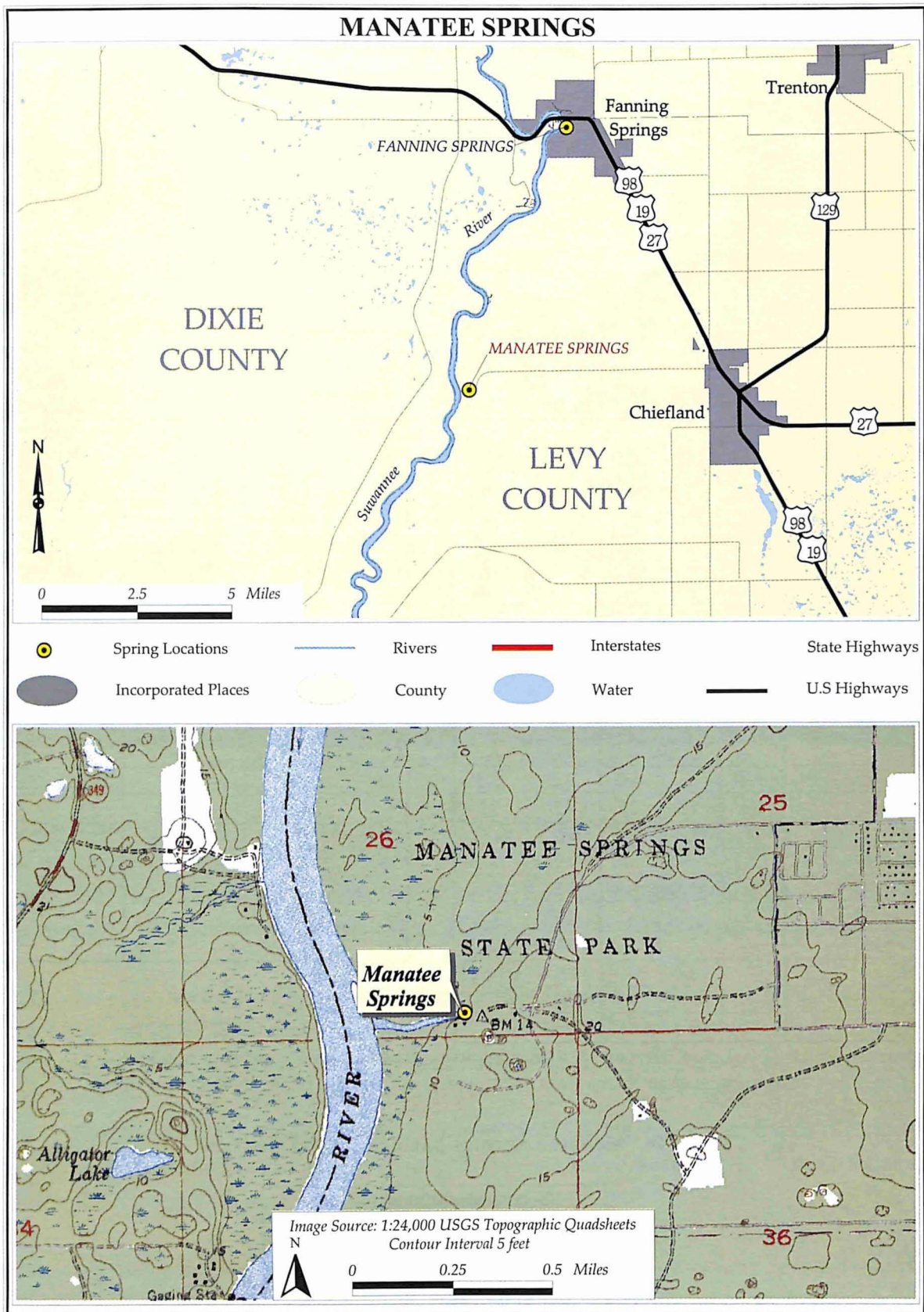


Figure 56. Manatee Springs location map.

FLORIDA GEOLOGICAL SURVEY

Utilization - The spring and its surroundings constitute Manatee Springs State Park. The area is developed for camping, hiking, swimming, scuba diving, and nature study.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s.

March 14, 1932	149	May 28, 1963	145
December 17, 1942	218	April 19, 1972	220
July 24, 1946	137	April 25, 1972	210
April 27, 1956	110	July 31, 1973	203
November 18, 1960	238	October 23, 2001	154

Table 45. Manatee Springs water quality analysis.

Analytes	1946	1956	1972	2001	
				Unfilt.	Filter
Field Measures					
Temperature	23.0	23.0	22.0	22.5	-
DO	-	-	-	1.6	-
pH	7.4	8.0	8.0	7.04	-
Sp. Cond.	402	390	413	430	-
Lab Analytes					
BOD	-	-	-	0.2 AU	-
Turbidity	-	-	-	0.2	-
Color	0	5	0	5 U	-
Alkalinity	-	180	170	198	200
Sp. Cond.	-	-	-	460	-
TDS	-	-	-	268	-
TSS	-	-	-	4 U	-
Cl	5.1	-	4.0	7.2	7.3
SO ₄	23	22	25	32	32
F	0	0.2	0.2	0.09 I	0.11
Nutrients					
TOC	-	-	-	1 U	-
NO ₃ + NO ₂	-	-	-	1.7	1.8
NH ₃ +NH ₄	-	-	-	0.011 I	0.01 U
TKN	-	-	-	0.06 U	0.06 U
P	-	-	-	0.025	0.023
PO ₄	-	-	-	0.027	-

Analytes	1946	1956	1972	2001	
				Unfilt.	Filter
Metals					
Ca	75	74	74	84.1	82.4
K	0.4	0.2	0.2	1.1	1.1
Na	2.9	3.1	3.0	3.78	3.64
Mg	6.3	7.7	5.2	6.5	6.3
As	-	3 U	3 U	3 U	3 U
Al	-	-	-	-	75 U
B	-	-	-	25 U	-
Cd	-	-	-	0.75 U	0.75 U
Co	-	-	-	0.75 U	-
Cr	-	-	-	2 U	2 U
Cu	-	-	-	2.5 U	2.5 U
Fe	-	-	-	35 U	35 U
Mn	-	-	-	0.5 U	0.5 U
Ni	-	-	-	2 U	3 U
Pb	-	-	-	5 U	4 U
Se	-	-	-	4 U	4 U
Sn	-	-	-	20 U	-
Sr	-	-	100	187	-
Zn	-	-	-	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 46. Manatee Springs bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	8 Q
Enterococci	8 Q
Fecal Coliform	6 Q
Total Coliform	310 Q

MADISON COUNTY

Madison Blue Spring



Figure 57. Madison Blue Spring (photo by T. Scott).

Location - Lat. 30° 28' 49.6" N, Long. 83° 14' 39.7" W (SW / SE / SW / sec. 17, T. 1 N, R. 11 E). Madison Blue Spring is approximately 10 miles (16 km) east of Madison on the west bank of the Withlacoochee River. From Madison, drive east on SR 6 to the Withlacoochee River. Turn south on the west side of the bridge at the park sign. Spring is 525 ft (160 m) south of the highway.

Description - This spring issues on a 45° slant from the bottom of the spring pool. Spring pool diameter is about 72 ft (22 m) north to south and 82 ft (25 m) northeast to southwest. Pool depth measures 24 ft (7.3 m). The spring has vertical limestone sidewalls. The 500 ft (152 m) long spring run flows swiftly into the tannic Withlacoochee River. There was no visible boil in Oct. 2001. Nearly 100% of the spring bottom and sides is covered with dark green algae. Sandy high ground surrounds the spring and rises to approximately 20 ft (7 m) above water level. Mixed hardwoods and pines occur along with numerous dirt pathways.

Utilization - Madison Blue Spring is state owned and managed as a county recreational park with picnic tables, parking lot, and facilities. Swimming and scuba diving occur frequently here. A wooden access platform for scuba diving is located on the north side of the pool.

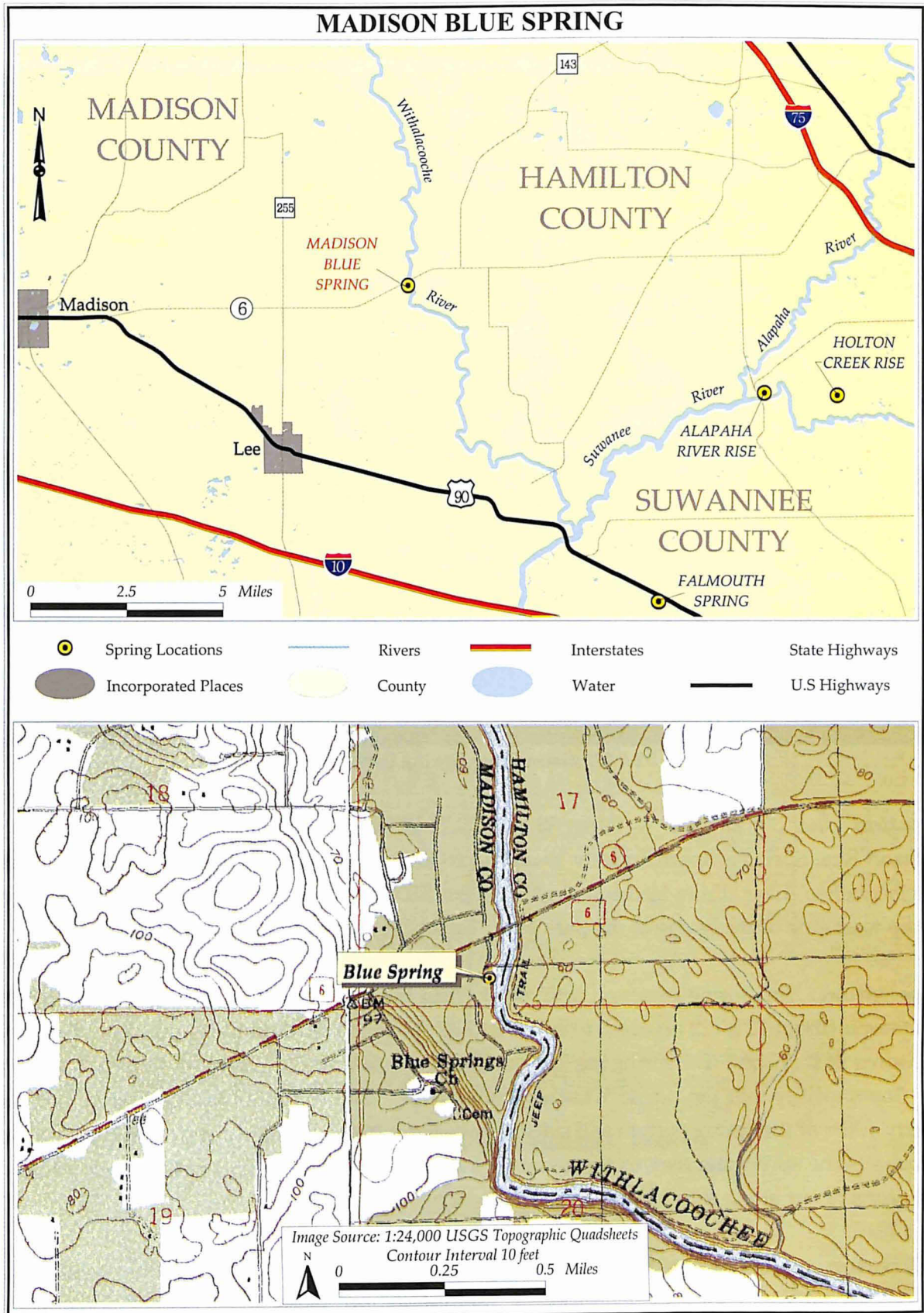


Figure 58. Madison Blue Spring location map.

OPEN FILE REPORT NO. 85

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). High water levels of the Withlacoochee River may affect spring discharge rates. All discharge rates are measured in ft³/s.

March 16, 1932	75
April 24, 1956	77.8
November 15, 1960	141
May 28, 1963	113
November 6, 1973	139
October 23, 2001	71.4

Table 47. Madison Blue Spring water quality analysis.

Analytes	1946	1960	1973	2001	
				Unfilt.	Filter
Field Measures					
Temperature	21.5	21.1	21.0	21.3	-
DO	-	-	2.5	1.8	-
pH	7.6	7.7	7.7	7.8	-
Sp. Cond.	262	257	261	277	-
Lab Analytes					
BOD	-	-	0.7	0.29 I	-
Turbidity	-	-	4.0	0.9	-
Color	0	0	5	5 U	-
Alkalinity	-	120	120	122	123
Sp. Cond.	-	-	-	280	-
TDS	-	-	-	155	-
TSS	-	-	-	4 U	-
Cl	3.6	4.0	4.0	4.7 A	4.7
SO ₄	10	9.6	11.0	14 A	14
F	0.1	0.4	0.1	0.14	0.15
Nutrients					
TOC	-	-	0.0	1 U	-
NO ₃ + NO ₂	-	-	0.01	1.3	1.4
NH ₃ +NH ₄	-	-	-	0.013 I	0.01 UQ
TKN	-	-	-	0.06 U	0.06 U
P	-	-	0.03	0.041	0.042
PO ₄	-	-	0.52	0.03 J	-

Analytes	1946	1960	1973	2001	
				Unfilt.	Filter
Metals					
Ca	39	41	40	41.3	41.4
K	0.7	0.3	0.8	0.47	0.47
Na	2.4	2.6	2.9	2.77	2.77
Mg	8.7	7.2	10	8.4	8.5
As	-	-	-	3 U	3 U
Al	-	-	-	-	75 U
B	-	-	0	25 U	-
Cd	-	-	-	0.75 U	0.5 U
Co	-	-	0	0.75 U	-
Cr	-	-	5	2 U	2 U
Cu	-	-	4	2 U	2 U
Fe	-	-	-	25 U	20 U
Mn	-	-	-	0.91 I	0.32 I
Ni	-	-	-	1.5 U	1.5 U
Pb	-	-	10	5 U	3 U
Se	-	-	-	3.5 U	3.5 U
Sn	-	-	-	7 U	-
Sr	-	-	0	56.4	-
Zn	-	-	-	4 U	3.5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than the practical quantitation limit J=Estimated value Q=exceeding holding time limit

Table 48. Madison Blue Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	6 Q
Enterococci	8 Q
Fecal Coliform	4 Q
Total Coliform	40 Q

FLORIDA GEOLOGICAL SURVEY

MARION COUNTY

Rainbow Springs Group



Figure 59. Rainbow Springs Group (photo from J. Stevenson).

Group Location - Lat. 29° 06' N, Long. 82° 26' W (sections 7, 12, and 18, T. 16 S, R. 18 E). The springs group is approximately 3.5 miles (5 km) north of Dunnellon on the Rainbow River. Drive north on US 41 from Dunnellon 3.8 miles (6.1 km) to a large sign on the east side of the road indicating the entrance to the Rainbow Springs State Park. Turn east (right) onto access road and continue 0.8 miles (1.3 km) to the parking area near the head of the Rainbow River. The springs are scattered alongside and on the bottom of the river for most of its length.

Group Description - Rainbow Springs Group forms the clear Rainbow River, which flows approximately 5.7 miles (9 m) south to the darker Withlacoochee River. Surrounding land is high rolling sandhills with pine forest and agricultural fields. Springs, in addition to those at the head of the Rainbow River, discharge from numerous limestone crevices and sandy boils in the bed of the river through much of its length.

RAINBOW NO. 1 - Lat. 29° 06' 08.9" N, Long. 82° 26' 14.9" W (SE/NW/SE/sec. 12, T. 16 S, R. 18 E). This spring is at the head of the Rainbow River. The spring pool measures 330 ft (101 m) north to south and 360 ft (110 m) east to west. The large spring pool has multiple vents. Depth over the main vent is 9.9 ft (3 m). Aquatic vegetation is patchy, including some *Hydrilla*. The bottom is sandy with occasional limestone boulders. Water is clear and sky blue. A boil is visible over the main vent. Motorized boats are restricted. There is a

designated swimming area on the west side of pool. Land around the northern half of the pool rises sharply to approximately 25 ft (8 m) above the water. Rainbow Springs State Park facilities are situated on the high ground to the north. Live oak and pines are abundant on high ground. There is dense hardwood-palm swamp forest along the pool's east and west edges.

RAINBOW NO. 4 - Lat. 29°06' 06.9" N, Long. 82° 26' 13.8" W (SE/NW/SE/sec. 12, T. 16 S, R. 18 E). This spring is approximately 350 ft (107 m) downstream from Spring No. 1. It issues from a conical depression at the bottom of the river. The circular spring pool measures approximately 75 ft (23 m) in diameter. Depth measured over the vent is 10.9 ft (3.3 m). Water is clear and sky blue. A boil is not visible due to turbulent current of the overlying river. Aquatic grasses sway in the current with very little *Hydrilla*. Algae are present but not a dominant feature. This spring is located within the State Park no motorized boat zone. Land on both sides of the river is low lying and harbors pristine hardwood swamp forest.

RAINBOW NO. 6 - Lat. 29° 05' 34.1" N, Long. 82° 25' 42.8" W (NW/SE/NW/sec. 18, T. 16 S, R. 18 E). This spring is 0.5 miles (0.8 km) upstream from boat ramp just off the south bank. It emerges from the bottom of the Rainbow River between 1 and 1.5 miles (1.6-2.4 km) downstream from the head of the river. It issues from a conical depression nearest the west bank of the river and forms a boil on the river surface. The spring pool measures approximately 60 ft (18 m) north to south and 75 ft (23 m) east to west. Depth measured over the vent is 16.9 ft (5.2 m). River and spring waters are clear and sky blue. Aquatic grasses are common in the spring pool. *Hydrilla* is present on the south side of the pool. Algae occur thinly on rocky substrate. Limestone is evident on the bottom of the spring. High ground on the west side of the river rises to nearly 20 ft (6 m) above the water. There are some pines on the hill top. This spring is downstream from the state park, and private houses are along the west bank. The east side of the river is low-lying and heavily forested state land.

BUBBLING SPRING - Lat. 29° 06' 04.5" N, Long. 82° 26' 05.5" W (SW/NW/SE/sec. 7, T. 16 S, R. 18 E). Bubbling Spring flows into the Rainbow River from the east approximately 200 ft (61 m) downstream from Spring No. 4. It is at the head of a spring run that is approximately 400 ft (122 m) long. The spring pool measures 45 ft (14 m) north to south and 75 ft (23 m) east to west. The shallow spring pool measures only 2.8 ft (0.9 m) deep over the vent. Water issues vertically from a small crevice in the limestone. The force of the boil pushes the water column approximately 6" (0.1 m) higher than the surrounding spring pool. Pool bottom is sand and limestone. Water is clear and sky blue. This spring and its run have very rich aquatic vegetation. Algae are thinly present on rocky substrate. Densely forested high ground adjoins the east side of the pool and rises to approximately 15 ft (4.5 m) above water. There is a hardwood forest canopy over the spring pool. The spring is within the state park.

Utilization - Rainbow Springs State Park owns the uppermost portion of Rainbow River. It is developed into an interpretive and recreation area with emphasis on preserving natural quality of the watershed. The east side of the river below the state park is state-owned and protected. The west side below the state park is subdivided into private lots often with houses near the river's edge.

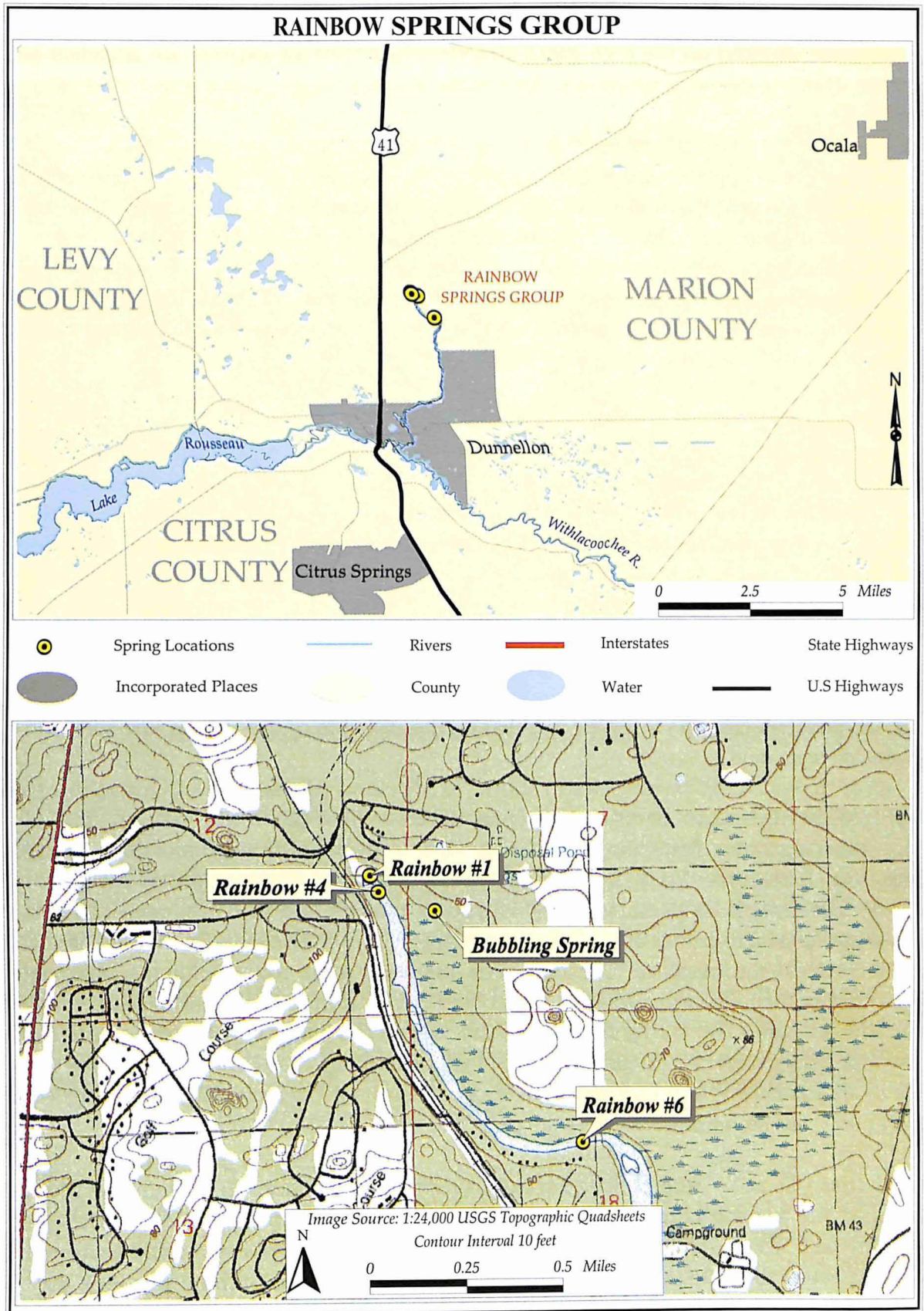


Figure 60. RainbowSprings Group location map.

OPEN FILE REPORT NO. 85

Table 49. Rainbow Springs Group water quality analyses.

Analytes	1927	1946	1974	No. 1		No. 4		No. 6		Bubbling	
				2001		2001		2001		2001	
				Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter
Field Measures											
Temperature	-	-	22.5	23.4	-	23.5	-	23.4	-	23.0	-
DO	-	-	6.0	6.61	-	5.33	-	5.71	-	4.45	-
pH	-	7.9	7.8	7.95	-	7.68	-	7.65	-	7.41	-
Sp. Cond.	-	145	121	161	-	251	-	347	-	337	-
Lab Analytes											
BOD	-	-	0.0	0.2 U	-	0.2 U	-	0.2 U	-	0.2 U	-
Turbidity	-	-	1	0.05 U	-	0.05 U	-	0.1	-	0.05 U	-
Color	-	2	0	5 U	-	5 U	-	5 U	-	5 U	-
Alkalinity	-	-	53	67 A	67 A	115	115	123	123	160	158
Sp. Cond.	-	-	-	160	-	250	-	340	-	330	-
TDS	-	-	-	89	-	134	-	207	-	192	-
TSS	-	-	-	4 U	-	4 U	-	4 U	-	4 U	-
Cl	3.0	3.5	3.3	3.9	3.8	4.4	4.4	6.5	6.5	5.4	5.2 A
SO ₄	16.0	4.7	4.3	4.8	4.8	4.9	4.8	44	44	8.2	7.9 A
F	-	0.0	0.2	0.079 I	0.095 I	0.097 I	0.11	0.12	0.13	0.11	0.13
Nutrients											
TOC	-	-	0.0	1 U	-	1 U	-	1 U	-	1 U	-
NO ₃ + NO ₂	-	-	0.17	1.2	1.2	1.3	1.3	0.9	0.92	1.1	1.1
NH ₃ +NH ₄	-	-	-	0.01 U	0.013 I	0.011 I	0.01 U	0.01 U	0.01 U	0.017 I	0.01 U
TKN	-	-	-	0.06 U	0.06 U	0.06 U	0.06 U Q	0.06 U	0.06 U	0.06 U	0.06 U
P	-	-	-	0.029	0.028	0.034	0.036	0.028	0.028	0.034	0.037
PO ₄	-	-	0.03	0.034	-	0.037	-	0.026 Q	-	0.04	-
Metals											
Ca	21	21	20	22.4 J	22.9	39.6 J	40.3	53.8 AJ	54	57.4 J	55.2
K	0.5	0.4	0.1	0.11	0.11	0.12	0.13	0.28 A	0.28	0.17	0.16
Na	1.4	2.9	2.0	2.33	2.31	2.41	2.53	3.74 A	3.68	2.97	2.85
Mg	5.1	4.0	3.1	3.6	3.7	4.9	5	6.8 A	6.8	6.3	6.1
As	-	-	-	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Al	-	-	30	-	75 U	-	75 U	-	75 U	-	75 U
B	-	-	4	25 U	-	25 U	-	25 U	-	25 U	-
Cd	-	-	0	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	-	0.75 U	-	0.75 U	-	0.75 U	-	0.75 U	-
Cr	-	-	-	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Cu	-	-	0.2	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5.2 I
Fe	-	-	0	35 U	35 U	35 U	35 U	35 U	35 U	35 U	35 U
Mn	-	-	0	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ni	-	-	3	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Pb	-	-	6	5 U	4 U	5 U	4 U	5 U	4 U	5 U	4 U
Se	-	-	-	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Sn	-	-	-	10 U	-	10 U	-	10 U	-	10 U	-
Sr	-	-	70	55	-	82	-	423 A	-	153	-
Zn	-	-	0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

FLORIDA GEOLOGICAL SURVEY

Discharge - The average discharge from 1965 to 1974 was 763 ft³/s (Rosenau et al., 1977).

Maximum (October 12, 1964) 1230 ft³/s

Minimum (October 3, 1932) 487 ft³/s

October 23, 2001 634 ft³/s

Table 50. Rainbow Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)				
Analyte	Vent No. 1	Vent No. 4	Vent No. 6	Bubbling
<i>Escherichia coli</i>	1 KQ	1 AKQ	1 KQ	1 KQ
Enterococci	1 KQ	1 AKQ	1 KQ	1 KQ
Fecal Coliform	1 KQ	1 AKQ	1 KQ	1 KQ
Total Coliform	1 KQ	1 AKQ	1 KQ	1 KQ

Silver Glen Springs

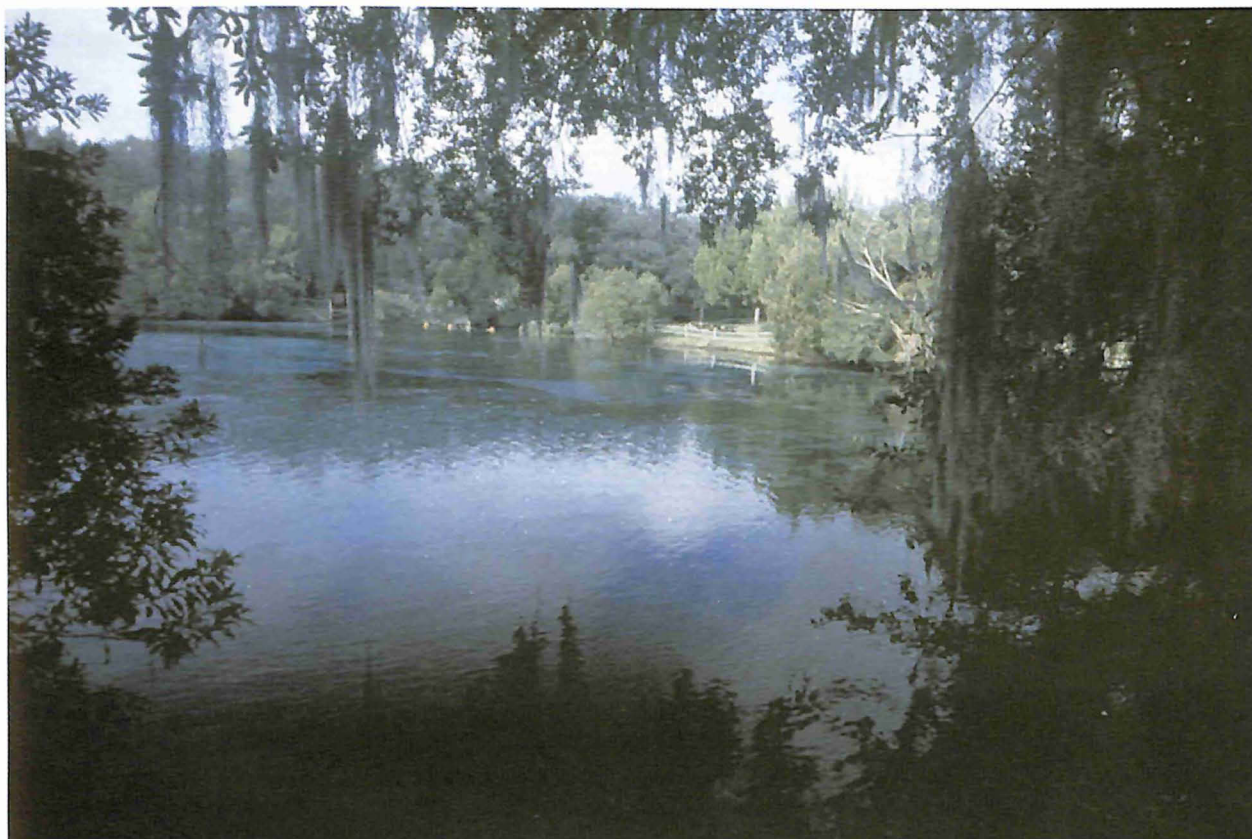


Figure 61. Silver Glen Springs (photo by T. Scott).

Location - Lat. 29° 14' 45.0" N, Long. 81° 38' 36.5" W (SE / NE / SE / sec. 25, T. 14 S, R. 26 E). Silver Glen Springs is in the Ocala National Forest 30 miles (49 km) northeast of Ocala and flows into Lake George. From Ocala, travel west on SR 40 about 45 miles (72 km). Turn north on SR 19 for approximately 6 miles (10 km) then right into Silver Glen Springs Recreation Area. The spring is south of the parking area.

Description - Silver Glen Springs has a large combined spring pool with two vents. Water quality was sampled at the east vent. The combined springs pool measures 200 ft (61 m) north to south and 175 ft (53 m) east to west. Depth is 18 ft (5.5 m). Large boils are over both vents. The east vent issues water from the bottom of a conical depression. Some patches of aquatic grass are in the combined pool, especially around the west vent. The west vent is vertical cave opening in limestone. Much of the pool has a bare sandy bottom possibly because of heavy use by swimmers. *Hydrilla* is present, but not common. Two ropes close off the springs pool to boat traffic. There are many large fresh and saltwater fishes in both vents. The spring run is approximately 200 ft (61 m) wide on average and flows east approximately 3/4 mile (1.2 km) to the St. Johns River. Uplands rise gently around springs to approximately 12-15 ft (4 m). Oak, cedar, and pine are common.

Utilization - Silver Glen Springs is owned by the Ocala National Forest and is developed and operated by private concession. There are swimming and picnic facilities. Boats are not allowed in the springs pool, however, the springs run may become crowded with hundreds

FLORIDA GEOLOGICAL SURVEY

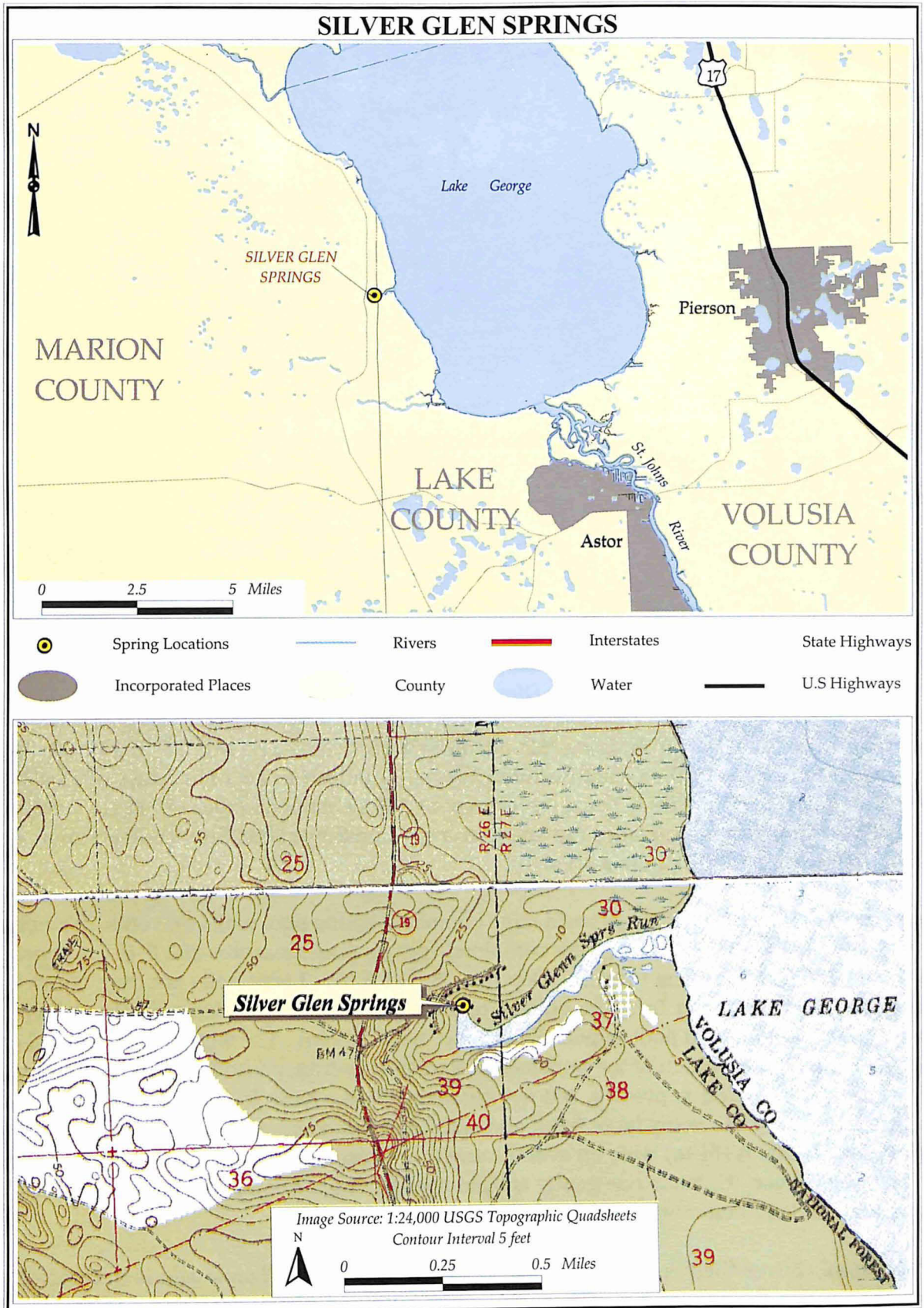


Figure 62. Silver Glen Springs location map.

OPEN FILE REPORT NO. 85

of recreational boats during peak use periods.

Discharge - Eleven discharge measurements were made between 1931 and 1972. The average discharge during this period was 112 ft³/s (Rosenau et al., 1977).

Maximum (April 12, 1935)	129 ft ³ /s
Minimum (February 7, 1933)	90 ft ³ /s
September 13, 2001	109 ft ³ /s

Table 51. Silver Glen Springs water quality analysis.

Analytes	1946	1972	2001	
			Unfilt.	Filter
Field Measures				
Temperature	22.8	23.0	23.4	-
DO	-	-	3.66	-
pH	7.4	7.8	7.64	-
Sp. Cond.	2480	2220	1810	-
Lab Analytes				
BOD	-	0.1	0.2 U	-
Turbidity	-	0	0.05 U	-
Color	0	0	5 U	-
Alkalinity	-	69	69	69
Sp. Cond.	-	-	2000	-
TDS	-	-	1050	-
TSS	-	-	4 U	-
Cl	610	520	470	480
SO ₄	200	190	170	180
F	0.0	0.2	0.12	0.12
Nutrients				
TOC	-	0.0	1 U	-
NO ₃ + NO ₂	-	0.03	0.046	0.05
NH ₃ +NH ₄	-	-	0.011 I	0.01 U
TKN	-	-	0.093 I	0.069 I
P	-	0.02	0.025	0.024
PO ₄	-	0.02	0.028	-

Analytes	1946	1972	2001	
			Unfilt.	Filter
Metals				
Ca	87	74	69.7	70.4
K	10	11	9.1	9.2
Na	330	290	238	241
Mg	46	38	35.6	35.9
As	-	0	3 U	3 U
Al	-	-	-	75 U
B	-	570	101	-
Cd	-	-	0.75 U	0.75 U
Co	-	0	0.75 U	-
Cr	-	-	2 U	2 U
Cu	-	10	2.5 U	2.5 U
Fe	80	-	35 U	35 U
Mn	-	-	1 U	2 U
Ni	-	-	2 U	2 U
Pb	-	0	5 U	4 U
Se	-	-	4 U	4 U
Sn	-	-	10 U	-
Sr	-	-	1480	-
Zn	-	20	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 52. Silver Glen Springs bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	20 Q

Silver Springs Group



Figure 63. Silver Springs Group (photo by J. Stevenson).

Group Location - Lat. $29^{\circ} 12' N$, $82^{\circ} 03' W$ (sec. 6, T. 15 S, R. 23 E). The Silver Springs Group is located approximately 6 miles (9.5 km) northeast of Ocala within the privately owned Silver Springs Park. From the intersection with US 301, drive east on SR 40 for 6.1 miles (9.8 km) to the park entrance. Turn onto the access road and continue 0.3 miles (0.5 km) to the parking area.

Group Description - The Silver Springs Group, flowing from several vents, forms the headwaters of the Silver River, a major tributary of the Ocklawaha River. There are several smaller springs in the bed or at the edges of the spring run within about 3,500 ft (1066 m) of the main orifice. The run is usually clear and the bottom at all locations in the springs and run is easily visible. The Silver River flows from its head spring eastward for approximately 5 miles (8 km) through a dense mixed hardwood and cypress swamp to the Ocklawaha River. The Ocklawaha flows northward and is a tributary to the St. Johns River. Higher sandy terrain with pine and Silver Springs community lies to the west of the springs.

MAIN SPRING - Lat. $29^{\circ} 12' 58.3'' N$, Long. $82^{\circ} 03' 09.5'' W$ (SW1/4, SW1/4, NW1/4 sec. 6, T. 15 S, R. 23 E). The main spring is approximately 200 ft (61 m) northeast of the glass-bottom boat launch area. This is the head spring of the Silver River and the largest spring of the group. The spring pool measures 300 ft (91.4 m) north to south and 195 ft (59.4 m) east to west. Depth measured over the vent opening is 33 ft (10 m). The water is clear and sky blue. Aquatic vegetation is abundant across the spring bottom, and a layer of algae covers most substrates.

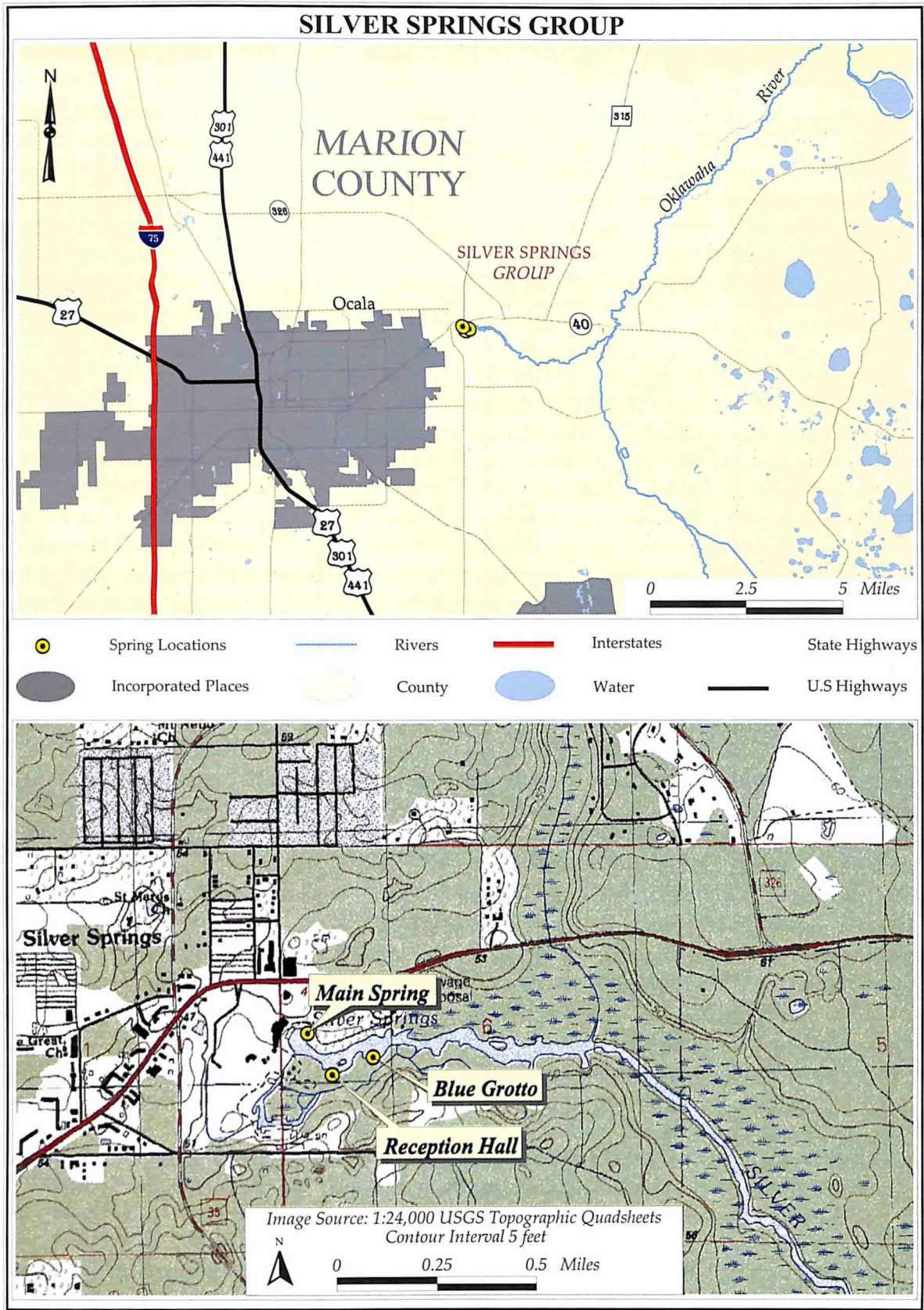


Figure 64. Silver Springs Group location map.

FLORIDA GEOLOGICAL SURVEY

Table 53. Silver Springs Group water quality analyses.

Analytes	1907	1946	1972	Main		Blue Grotto		Reception Hall	
				2001		2001		2001	
				Unfilt.	Filter	Unfilt.	Filter	Unfilt.	Filter
Field Measures									
Temperature	-	-	23.5	23.2	-	23.5	-	23.6	-
DO	-	-	-	2.38	-	3.16	-	3.73	-
pH	-	7.8	8.1	7.20	-	7.26	-	7.24	-
Sp. Cond.	-	401	420	471	-	443	-	468	-
Lab Analytes									
BOD	-	-	0.1	0.2 U	-	0.2 AU	-	0.2 U	-
Turbidity	-	-	0	0.05 U	-	0.05 U	-	0.05 U	-
Color	-	4	0	5 U	-	5 U	-	5 U	-
Alkalinity	-	-	170	176	176	153	153	158	157
Sp. Cond.	-	-	-	510	-	480	-	500	-
TDS	-	-	-	285	-	273	-	292	-
TSS	-	-	-	4 U	-	4 U	-	4 U	-
Cl	7.7	7.8	8.0	9.1	9.2	8.9	9	8.8	8.9
SO ₄	44	34	39	59	60	63	64	73	74
F	-	0.1	0.2	0.17	0.17	0.15	0.15 A	0.16	0.16
Nutrients									
TOC	-	-	8.0	1 U	-	1 U	-	1 U	-
NO ₃ +NO ₂	-	-	2.6	1.2	1.1	1.5	1.4	1.4	1.4
NH ₃ +NH ₄	-	-	-	0.01 U	0.01 U	0.01 U	0.025 A	0.011 I	0.01 U
TKN	-	-	-	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
P	-	-	0.14	0.042 A	0.044	0.038	0.039	0.037	0.038
PO ₄	-	-	0.14	0.03 J	-	0.042 J	-	0.045 J	-
Metals									
Ca	73	68	68	73.3	76.5	68.2 A	70	73	74.3
K		1.1	0.2	0.61	0.68	0.65	0.67	0.64	0.68
Na		4.0	4.3	5.92	6.87	5.91 A	6.48	6.04	6.39
Mg	9.2	9.6	9.3	10.7	11.1	11.3 A	11.4	12	12.2
As	-	-	-	3 U	3 U	3 U	3 U	3 U	3 U
Al	-	-	-	-	75 U	-	75 U	-	75 U
B	-	-	0	25 U	-	25 U	-	25 U	-
Cd	-	-	0	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	0	0.75 U	-	0.75 U	-	0.75 U	-
Cr	-	-	0	2 U	2 U	2 U	2 U	2 U	2 U
Cu	-	-	0	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Fe	-	-	20	35 U	35 U	35 U	35 U	35 U	35 U
Mn	-	-	0	1 U	1 U	1 U	1 U	1 U	1 U
Ni	-	-	-	2 U	2 U	2 U	2 U	2 U	2 U
Pb	-	-	2	5 U	4 U	5 U	4 U	5 U	4 U
Se	-	-	-	4 U	4 U	4 U	4 U	4 U	4 U
Sn	-	-	-	10 U	-	10 U	-	10 U	-
Sr	-	-	500	693	-	676 A	-	782	-
Zn	-	-	1	5 U	5 U	5 U	5 U	12 I	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

The spring is in a steep walled depression in the limestone. There was no visible boil on the water surface during the October 2001 visit; however, divers observed flow coming out of the vent.

The vent opening is a horizontal oval-shaped orifice in the base of a limestone ledge on the northeast side of the spring pool.

Most of the pool edge is a wooden retaining wall. The west side of the pool is developed into glass-bottom boat docking. All nearby uplands to the north, west, and south are developed into Silver Springs adventure theme park.

Table 54. Silver Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)			
Analyte	Main	Blue Grotto	Reception Hall
<i>Escherichia coli</i>	1 KQ	48 Q	1 AKQ
Enterococci	1 KQ	34 Q	1 AKQ
Fecal Coliform	1 KQ	52 Q	1 AKQ
Total Coliform	1 KQ	110 Q	1 AKQ

RECEPTION HALL - Lat. 29° 12' 53.0" N, Long. 82° 03' 05.7" W (NW1/4, N1/4, SW1/4 sec. 6, T. 15 S, R. 23 E). This spring is now referred to as The Abyss by most theme park personnel. It is located on the adjacent south side of the Silver River approximately 1,000 ft (304 m) downstream from Main Spring. It is one of three side springs that form a larger, conjoined spring pool. Reception Hall Spring pool is approximately 30 ft (9.1 m) in diameter and 18.7 feet (5.7 m) deep. Water discharges from a vertical crack in the limestone. The water is sky blue, and sand and shell particles are suspended in the issuing water. No boil was visible on the surface of the spring pool during October 2001. An old boat is wrecked and half buried on the north side of the pool. Aquatic vegetation is common around the outskirts of the spring pool. The area near the vent is bare sand around the limestone orifice. Uplands to the south rise to nearly 6 ft (2 m) above the water and are forested with hardwoods. To the north, on the other side of the river, the land is developed by the theme park.

BLUE GROTTTO - Lat. 29° 12' 54.9" N, Long. 82° 02' 59.6" W (NE1/4, NW1/4, SW1/4 sec. 6, T. 15 S, R. 23 E). This is the next spring pool east of the conjoined pool just mentioned. Blue Grotto is also on the adjacent south side of the Silver River. It is about 300 ft (91.4 m) east of Reception Hall Spring. The circular spring pool measures 105 ft (32 m) in diameter. Depth over the vent is 21.6 ft (6.5 m). Water discharges vertically from an orifice in the limestone. Sand and shell particles are suspended in the upwelling. A boil is visible on the water surface. There is aquatic vegetation along the outskirts of the spring pool. Bare sand surrounds the orifice. During the October 2001 visit, a 10-12 ft (3-3.6 m) alligator was lying on the bottom near the vent with a dusting of sand and shell on its back. The water is clear and sky blue. Along the south shore is a thin strip of hardwood and cypress trees. Just past is a man-made spring channel called the Fort King Waterway. It flows parallel to the Silver River and eastward. South of this channel rises high ground up to about 15 ft (4.5 m) above water surface. On these banks is an animal zoo with exotic ungulate mammals and monkeys.

Utilization - Land around the uppermost part of the Silver River is privately owned and operated by Silver Springs Adventure Park. Glass-bottomed boat tours are common along the uppermost part of the river, including these three springs.

Discharge - November 15, 2001: 556 ft³/s.

FLORIDA GEOLOGICAL SURVEY

SUWANNEE COUNTY

Falmouth Spring

Location - Lat. 30° 21' 40.2" N, Long. 83° 08' 06.0" W (NW / NE / NE / sec. 32, T. 1 S, R. 12 E). Falmouth Spring is 10 miles (16 km) northwest of Live Oak. From Live Oak, travel about 10 miles (16 km) northwest on US 90. Enter Falmouth Spring at the SRWMD sign on the left. Spring is west of the parking area, and is accessed by an interpretive hiking path.

Description - Falmouth Spring is a karst window. At the spring head, the spring pool measures 87 ft (27 m) north to south and 81 ft (25 m) east to west. Depth is 39 ft (3.7 m). The spring is in a conical sink depression. Water is greenish with tiny suspended algae particles. The spring bottom and sides are thickly covered with dark green filamentous algae. No visible boil during the October 2001 visit. Limestone is outcropped along sides. The bottom is sandy and rocky. High banks rise steeply along the spring and run to 25 to 30 ft (8 to 9 m) above water level. Surrounding high ground has mixed hardwood and pine forest. Spring run flows 450 ft (137 m) northeast until disappearing into a siphon. The east side of spring and its short run has a wooden boardwalk leading down to spring.

Utilization - Falmouth Springs is an interpretive park owned by SRWMD. Swimming is allowed.

Discharge - Historical measurements were obtained from Bulletin No. 31 (Rosenau et al., 1977). All discharge rates are measured in ft³/s. A high river stage on the Suwannee River caused a reversal of flow in February 1933.

1908	167
1913	220
February 10, 1933	365
December 9, 1942	59.6
July 22, 1946	157
November 16, 1960	183
November 15, 1973	159
November 13, 2001	1.59

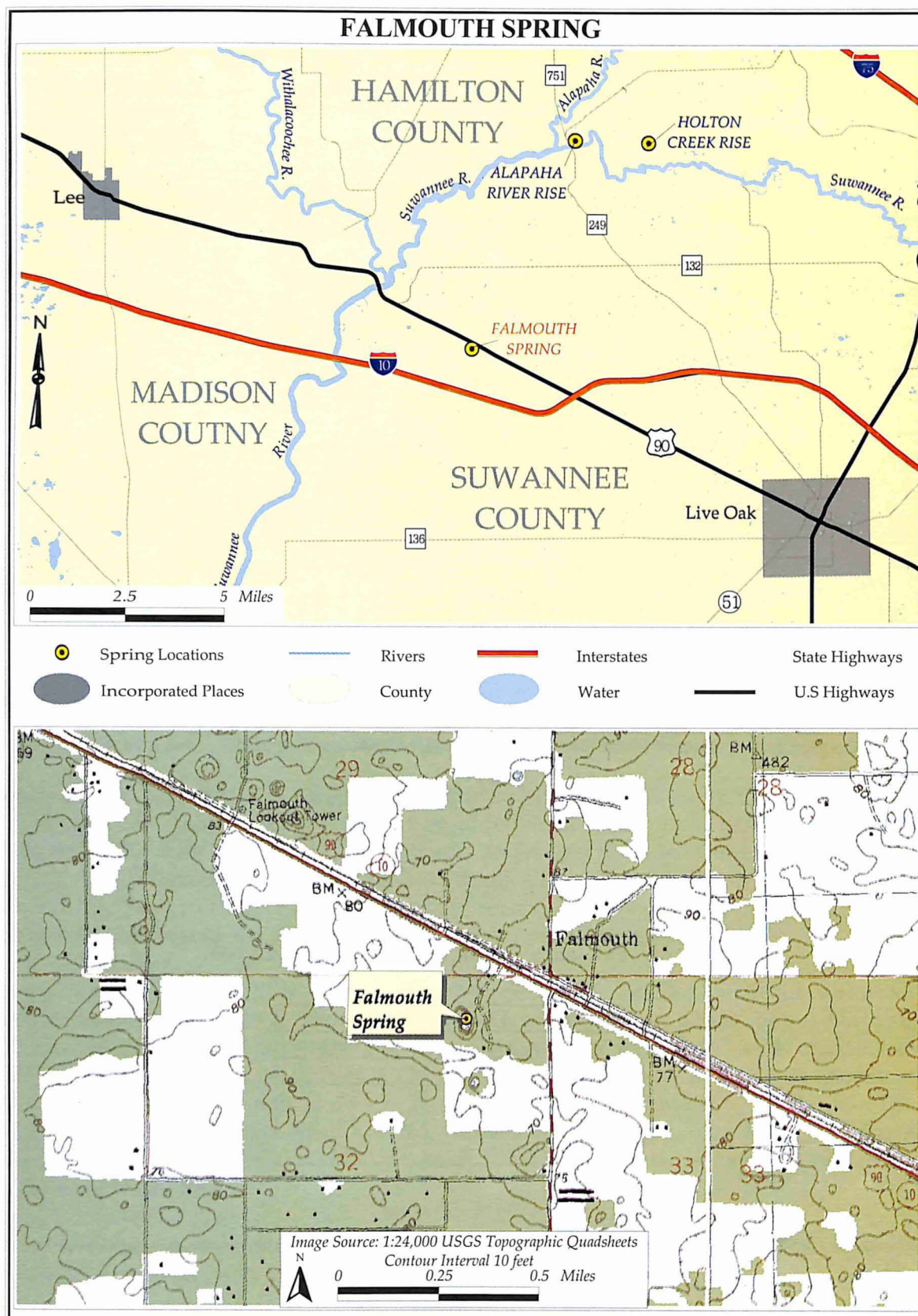


Figure 65. Falmouth Spring location map.

FLORIDA GEOLOGICAL SURVEY

Table 55. Falmouth Spring water quality analysis.

Analytes	1924	1973	2001	
			Unfilt.	Filter
Field Measures				
Temperature	-	21.0	20.7	
DO	-	1.6	1.28	
pH	-	7.3	7.10	
Sp. Cond.	-	351	373	
Lab Analytes				
BOD	-	0	0.2 AU	-
Turbidity	-	1	0.3	-
Color	-	5	5 U	-
Alkalinity	-	170	187	186
Sp. Cond.	-	-	400 A	-
TDS	-	-	210	-
TSS	-	-	4 U	-
Cl	4.0	3.4	4.1	4.1
SO ₄	9.5	9.5	11	11
F	-	0.0	0.12	0.12
Nutrients				
TOC	-	5.0	1.8 I	-
NO ₃ + NO ₂	-	0.70	0.39	0.41
NH ₃ +NH ₄	-	-	0.01 U	0.01 I
TKN	-	-	0.088 I	0.086 IQ
P	-	0.04	0.038 A	0.036
PO ₄	-	0.04	0.033	-

Analytes	1924	1973	2001	
			Unfilt.	Filter
Metals				
Ca	65	53	63.1	62.3
K	0.4	0.5	0.36	0.34
Na	3.1	2.2	2.63	2.45
Mg	9.2	12	9.1	8.8
As	-	-	3 U	3 U
Al	-	-	-	75 U
B	-	-	25 U	-
Cd	-	-	0.75 U	0.75 U
Co	-	-	0.75 U	-
Cr	-	-	2 U	0.5 U
Cu	-	-	8.8 I	8.8 I
Fe	-	-	39 I	35 U
Mn	-	-	9.3	7.5
Ni	-	-	1.5 U	1.5 U
Pb	-	-	5 U	4 U
Se	-	-	4 U	4 U
Sn	-	-	20 U	-
Sr	-	0.0	50	-
Zn	-	-	5 U	5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 56. Falmouth Spring bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	90
Enterococci	32
Fecal Coliform	74
Total Coliform	180

TAYLOR COUNTY

Nutall Rise



Figure 66. Nutall Rise (photo by J. Stevenson).

Location - Lat. 30° 09' 01.7" N, Long. 83° 57' 47.8" W (NE/NE/SE/sec. 7, T. 4 S, R. 4 E). Nutall River Rise is located on the Aucilla River approximately 28 miles (45 km) southeast of Tallahassee. The river rise is on private property and is best accessed from a public boat access off US 98. From the intersection with SR 363 (Woodville Hwy), turn east on US 98. Immediately after crossing the Aucilla River, turn north on dirt road marked by a boat ramp sign. The river rise is located approximately 0.6 miles (1 km) upstream from the boat ramp.

Description - The Aucilla River emerges from the ground at Nutall Rise and begins its last stretch unimpeded toward the Gulf of Mexico. The spring pool measures 220 ft (66 m) northwest to southeast and 282 ft (86 m) northeast to southwest. The water is typically tannic but can become clear during drought. Pool depth is 53 ft (16.2 m) measured near the vent. There is some emergent vegetation around the pool perimeter including an occasional water hyacinth mat. The surrounding land is relatively low-lying with live oak and mixed hardwoods. There is a large dolomite quarry located to the north about 0.6 miles (1 km), and this large, mechanical operation is audible from Nutall Rise.

Utilization - The entire perimeter of the river rise is bordered by trailers, docks, and houses. Multiple ladders from docks lead down into the water for swimming access.

Discharge - December 19, 2001: 360 ft³/s

FLORIDA GEOLOGICAL SURVEY

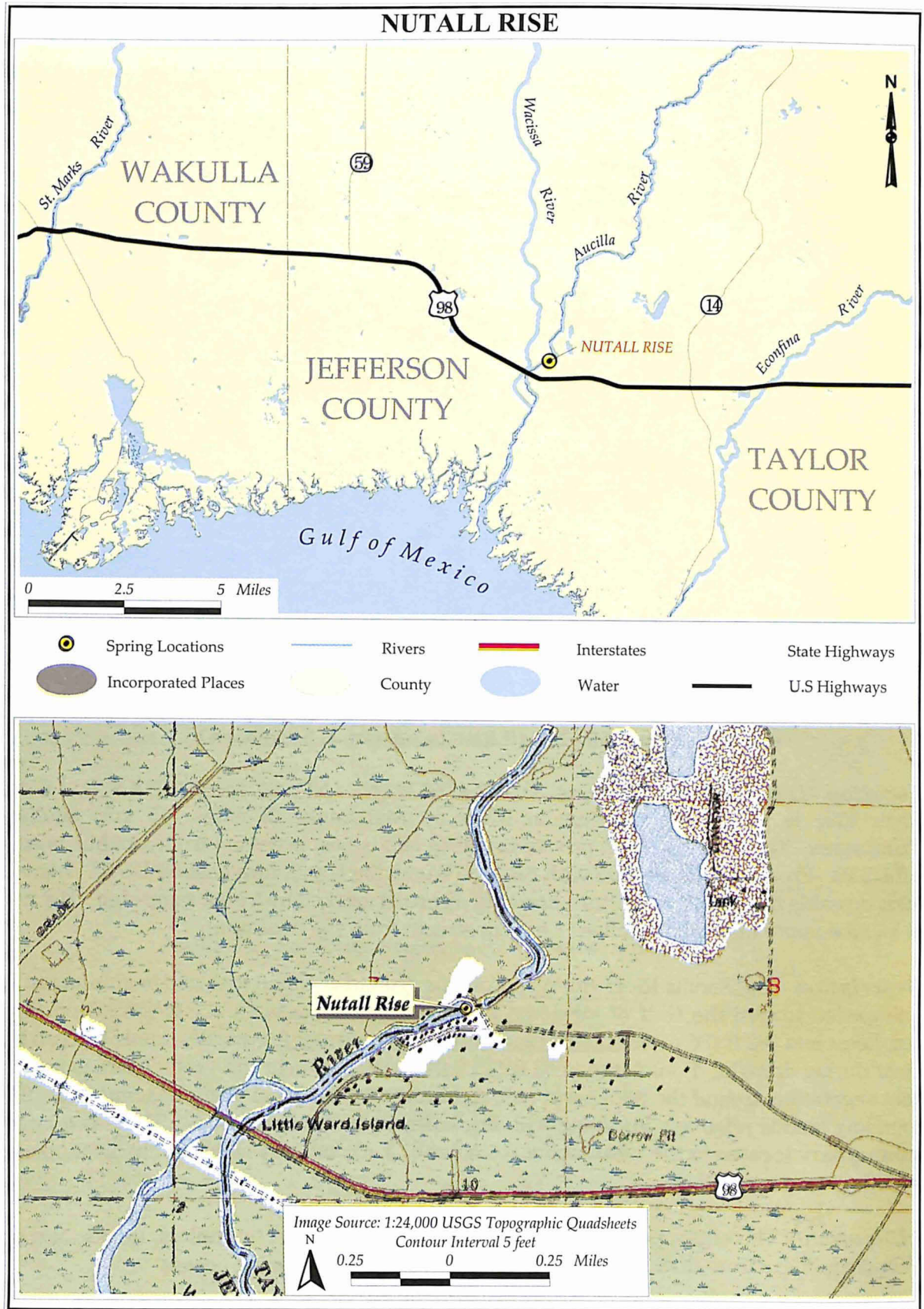


Figure 67. Nutall Rise location map.

OPEN FILE REPORT NO. 85

Table 57. Nutall Rise water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	21.3	-
DO	6.4	-
pH	7.5	-
Sp. Cond.	338	-
Lab Analytes		
BOD	0.2 AU	-
Turbidity	0.9	-
Color	20	-
Alkalinity	155	154
Sp. Cond.	340	-
TDS	196	-
TSS	4 U	-
Cl	7.6	8.1
SO ₄	14	14
F	0.15	0.14
Nutrients		
TOC	5.1	-
NO ₃ + NO ₂	0.029	0.028
NH ₃ +NH ₄	0.026	0.022
TKN	0.29 J	0.22 A
P	0.047	0.039
PO ₄	0.033	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	49.8	49
K	0.5	0.5
Na	4.61	4.65
Mg	11.1	10.9
As	3 U	3 U
Al	-	75 U
B	30 U	-
Cd	0.75 U	0.5 U
Co	0.75 U	-
Cr	0.7 U	0.5 U
Cu	2 U	2 U
Fe	299	193
Mn	33.4	24.5
Ni	1.5 U	1.5 U
Pb	5 U	3 U
Se	3.5 U	3.5 U
Sn	7 U	-
Sr	76.1	-
Zn	4 U	3.5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value less than practical quantitation limit J=Estimated value Q=exceeding holding time limit

Table 58. Nutall Rise bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	19 AQ
Enterococci	38 AQ
Fecal Coliform	23 AQ
Total Coliform	225 AQ

Steinhatchee River Rise

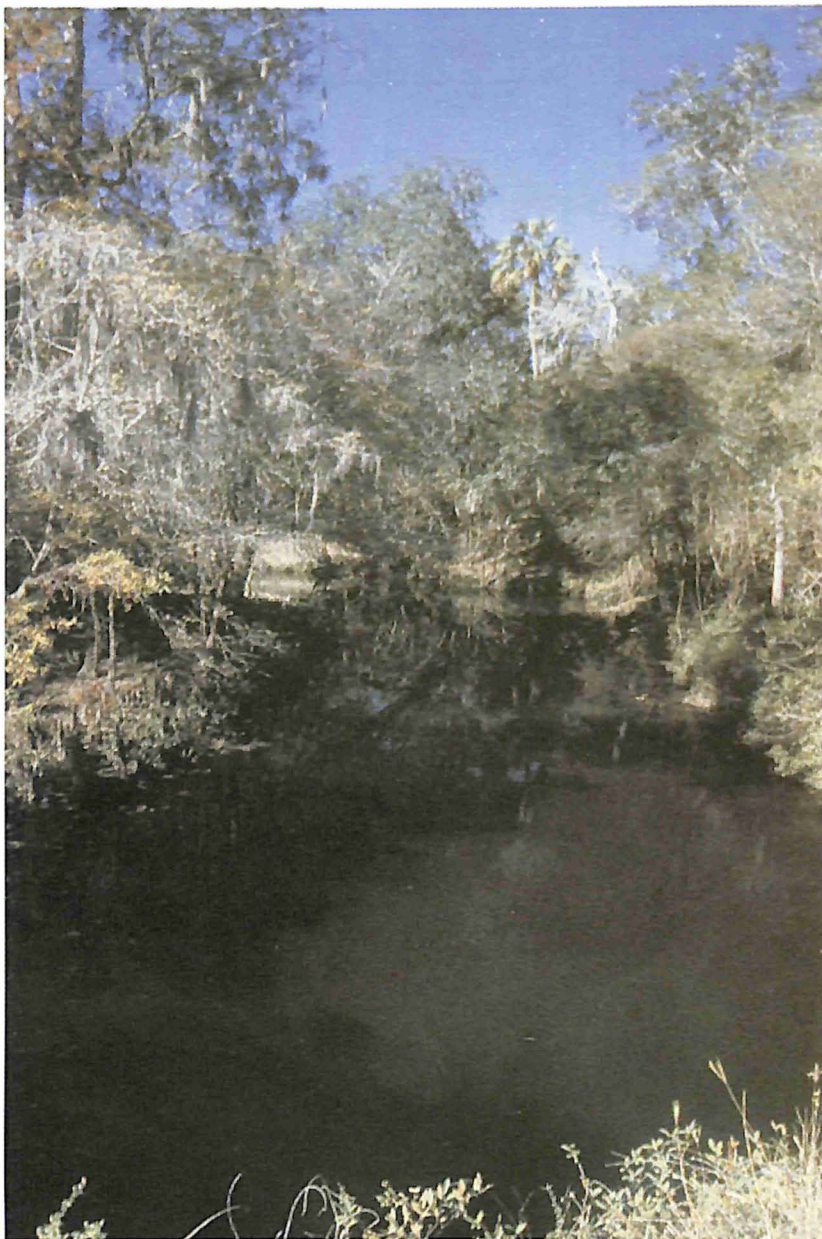


Figure 68. Steinhatchee River Rise (photo by R. Means).

Location - Lat. 29° 46' 12.0" N, Long. 83° 19' 30.1" W (NE/NW/SE/sec. 21, T. 8 S, R. 10 E). The river rise is 28 miles (46 km) southeast of Perry. From Perry, travel south on US 98/27A/19. After crossing bridges over the Steinhatchee River, veer right into grassy area. Follow to a small dirt road marked by a Public River Access sign. This dirt road ends at the river rise.

Description - Steinhatchee River Rise is the re-emergence of the Steinhatchee River from underground. There was very little flow during October 2001 visit. Spring pool measures 72 ft (22 m) north to south and 30 ft (9 m) east to west. Depth is 12 ft (3.7 m). Tannic water flow northwest out from underneath a limestone ledge. Algae are present on limestone substrate. Some cypress trees are near water's edge. The area around the rise has nearby sink depressions and elongated fissures in limestone that run into the Steinhatchee River from its banks. Uplands both north and

south of the rise have planted pines. The uplands rise steeply to 10-12 ft (3-4 m) above water level on both sides of river channel. This river rise is located in a river flood channel. High water would bring river water flowing over the rise depression from the southeast.

Utilization - Land owned by SRWMD and public access granted. No development, planted pines nearby.

Discharge - July 6, 1999: 350 ft³/s.

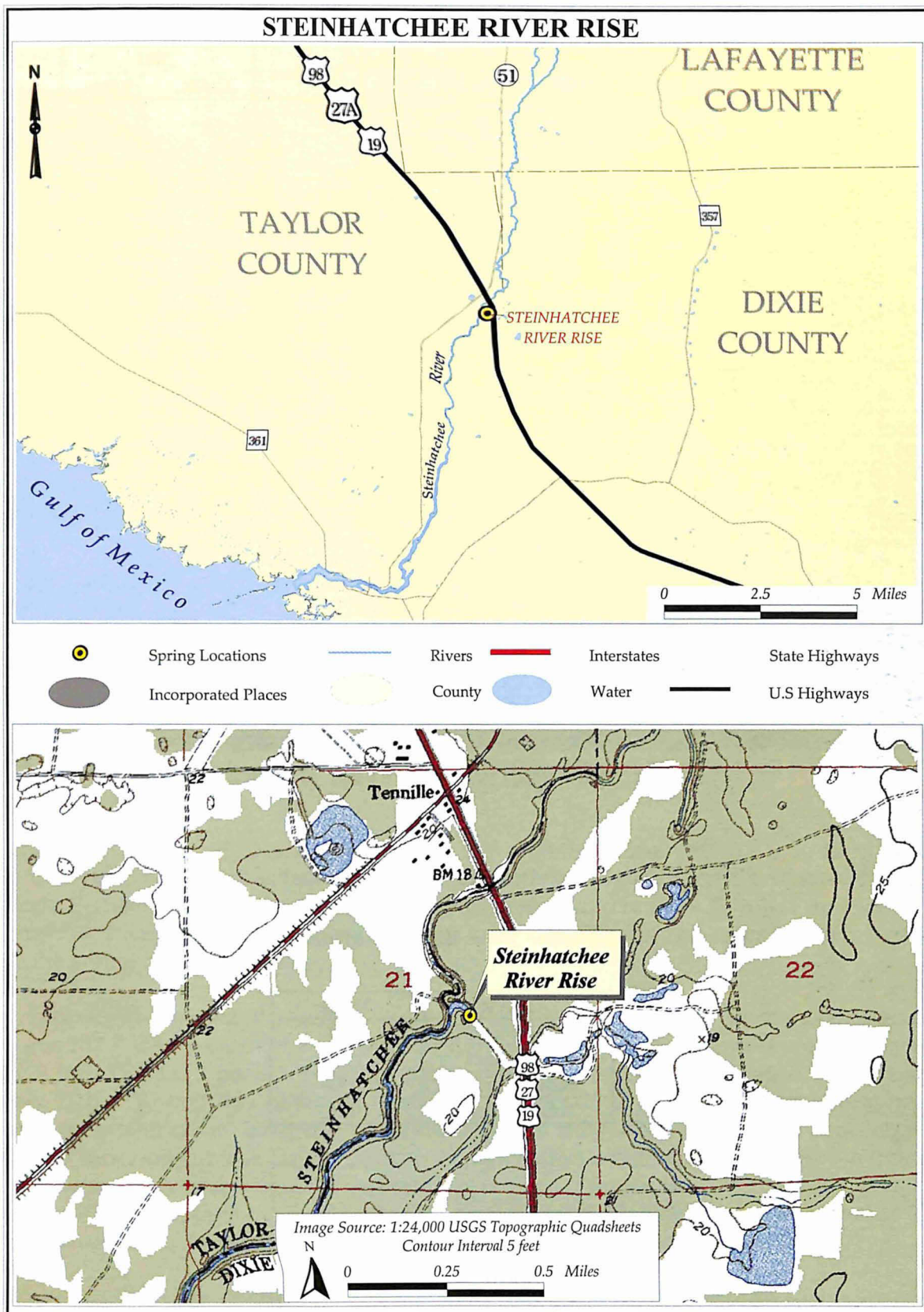


Figure 69. Steinhatchee River Rise location map.

FLORIDA GEOLOGICAL SURVEY

Table 59. Steinhatchee River Rise water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field Measures		
Temperature	21.1	-
DO	1.07	-
pH	6.98	-
Sp. Cond.	504	-
Lab Analytes		
BOD	0.4 AI	-
Turbidity	1.8	-
Color	50 A	-
Alkalinity	279	279
Sp. Cond.	560	-
TDS	322	-
TSS	4 U	-
Cl	7.6	7.2
SO ₄	11	11
F	0.12	0.12 A
Nutrients		
TOC	12 A	-
NO ₃ +NO ₂	0.056	0.053
NH ₃ +NH ₄	0.038	0.042
TKN	0.41 A	0.16 J
P	0.055 A	0.027 A
PO ₄	0.03	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	108 A	101
K	0.26 A	0.25
Na	4.15 A	4.01
Mg	8.3 A	7.9
As	3 U	3 U
Al	-	75 U
B	25 U	-
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	450 A	130 I
Mn	186 A	173
Ni	1.5 U	1.5 U
Pb	5 U	4 U
Se	4 U	4 U
Sn	10 U	-
Sr	165 A	-
Zn	5 U	5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 60. Steinhatchee River Rise bacteriological analysis.

Analyte	Value
<i>Escherichia coli</i>	6 Q
Enterococci	34 Q
Fecal Coliform	6 Q
Total Coliform	100 Q

UNION COUNTY

Santa Fe Spring



Figure 70. Santa Fe Spring (photo by T. Scott).

Location - Lat. 29° 56' 05.3" N, Long. 82° 31' 49.5" W (NW/SE/SE/sec. 29, T. 6 S, R. 18 E). Santa Fe Spring is located approximately 8 miles (13 km) northeast of High Springs on the west bank of the Santa Fe River. The spring is 2 miles (3.5 km) upstream from the I-75 bridge over the river. At this point, a narrow spring run comes in from the north. The spring is approximately 90 ft (27 m) up the spring run at the head.

Description - This spring is a large circular sink hole with steep sides. Spring pool diameter measures 192 ft (59 m) north to south and 215 ft (66 m) northeast to southwest. Spring depth is 83 ft (24 m). The water color is typically clear and tinged greenish blue though it was tannic in October 2001. No boil was observed during the October 2001 visit. The short spring run is approximately 90 ft (27 m) long, and flows southeasterly into the Santa Fe River. Some algae is present on rocky substrate in the spring run. No other aquatic vegetation could be seen through the dark water. Very little emergent vegetation is present. Cypress trees are common along the water line. The spring pool is surrounded by 15-20 ft (4.5- 6 m) high steep, sandy banks. The uplands are generally forested around the pool with live oaks and pines.

Utilization - The uplands around this spring are privately owned. At least five cabins are evenly distributed around the pool atop the high banks.

FLORIDA GEOLOGICAL SURVEY

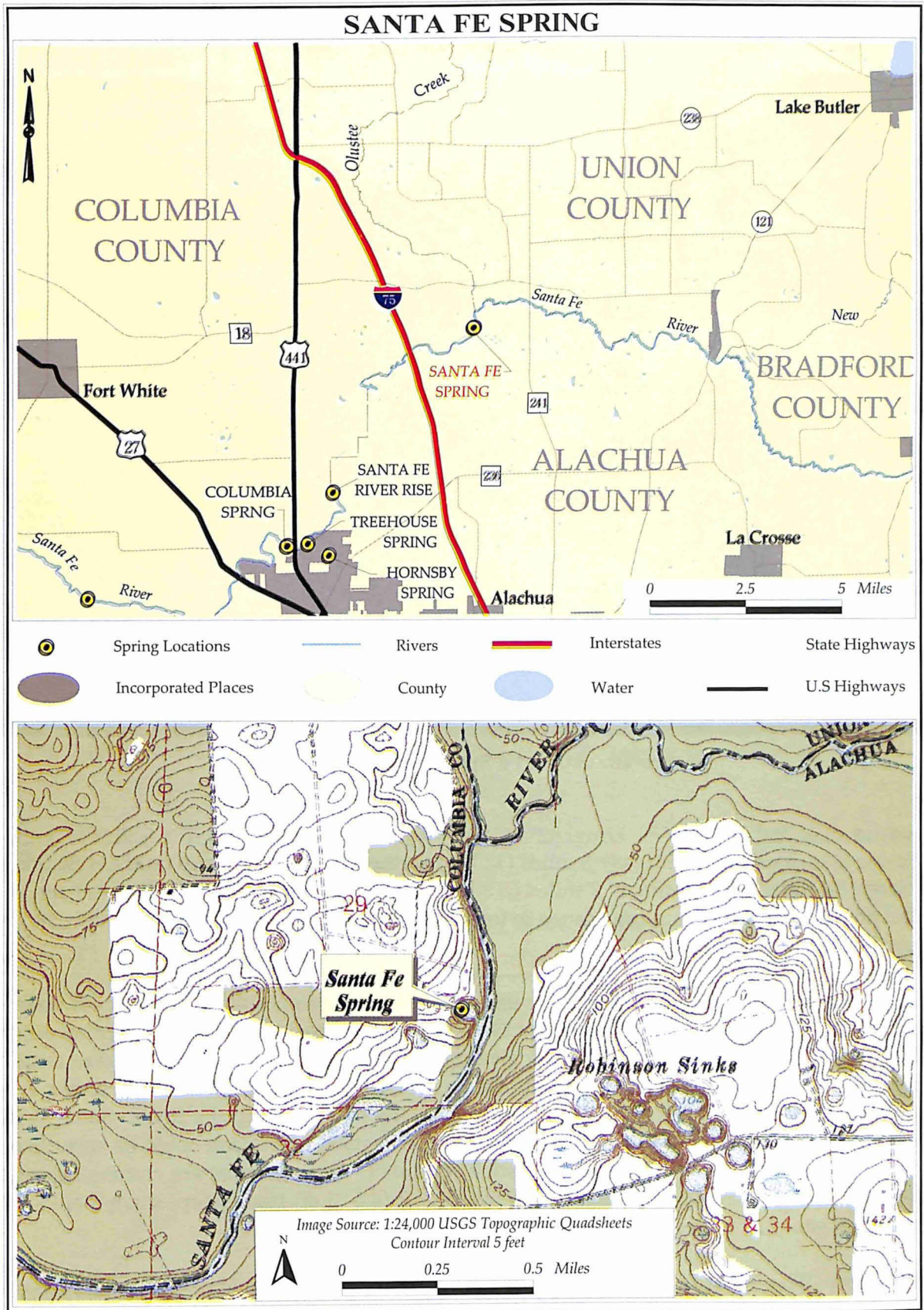


Figure 71. Santa Fe Spring location map.

OPEN FILE REPORT NO. 85

Discharge- 1998 measurement was obtained from Hornsby and Ceryak (1998).

June 1, 1998 149.99 ft³/s
November 1, 2001 47.9 ft³/s

Table 61. Santa Fe Spring water quality analysis.

Analytes	2001	
	Unfilt.	Filter
Field		
Temperatur	22.7	-
DO	0.78	-
pH	7.40	-
Sp. Cond.	271	-
Lab		
BOD	0.2 U	-
Turbidity	0.8	-
Color	120	-
Alkalinity	107	107
Sp. Cond.	270	-
TDS	193	-
TSS	4 U	-
Cl	10	9.9
SO ₄	18	18
F	0.2	0.17
Nutrients		
TOC	22	-
NO ₃ + NO ₂	0.023	0.018 J
NH ₃ +NH ₄	0.057	0.051
TKN	0.76	0.62
P	0.2	0.19
PO ₄	0.19	-

Analytes	2001	
	Unfilt.	Filter
Metals		
Ca	39.3	38.2
K	1.3	1.3
Na	5.5	5.57 A
Mg	7.9	7.8
B	25 U	
Al	-	200 I
As	3 U	3 U
Cd	0.75 U	0.75 U
Co	0.75 U	-
Cr	2 U	2 U
Cu	2.5 U	2.5 U
Fe	250	210
Mn	41	39.8
Ni	1.5 U	2 U
Pb	5 U	4 U
Se	4 U	4 U
Sn	10 U	-
Sr	276	-
Zn	5 U	5 U

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q= exceeded holding time limit

Table 62. Santa Fe Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	2 Q
Total Coliform	10 Q

FLORIDA GEOLOGICAL SURVEY

VOLUSIA COUNTY

Volusia Blue Spring



Figure 72. Volusia Blue Spring: A - Old Photo around 1900;
B - 1970s photo (courtesy of Florida State Parks)

Location - Lat. 28° 56' 51.0" N, Long. 81° 20' 22.5" W (NW / NW / NE / sec. 8, T. 18 S, R 30 E). Volusia Blue Spring is 6 miles (10 km) southwest of Deland in Blue Spring State Park. From Deland, drive south on US 17. Turn west on CR 4142 in Orange City and continue 3.25 miles (5.2 km) to Blue Spring State Park. The spring is at the head of Blue Run about .25 miles (0.4 km) north of the parking area and is reached by a wooden boardwalk trail on the east bank of the spring run.

Description - Blue Spring has a circular spring pool in a conical depression with a notable boil in the center. The water is sky blue with a greenish tinge. The spring pool measures 135 ft (41 m) north to south and 105 ft (32 m) east to west. Depth of the spring measured over the vent is 20 ft (9.3 m), however, as with the majority of Florida springs, much greater depths are attained back in the cave system. The bottom of the spring is limestone and sand. The vent is an elongated crack in the bedrock limestone. Algae are ubiquitous in the spring and its run. No other aquatic vegetation was observed during the October 2001 visit. The spring has steep sandy banks that rise to approximately 15 to 20 ft (4.5 to 6 m) above water level. The spring run also has steep sandy banks, and it flows south and west approximately 1050 ft (320 m) to the St. Johns River through dense hardwood and palm forest.

Utilization - The spring and its surroundings are owned and managed by Blue Springs State Park. It is an excellent place for nature study, swimming, scuba diving, and canoeing. Camping and hiking also are permitted in the park. Full facilities are available.

Discharge - Average discharge from March 1932 to August 1974 was 162 ft³/s (360 measurements) (Rosenau et al., 1977).

Maximum (November 1, 1960)	214 ft ³ /s
Minimum (November 6, 1935)	63 ft ³ /s
November 24, 2001	87 ft ³ /s

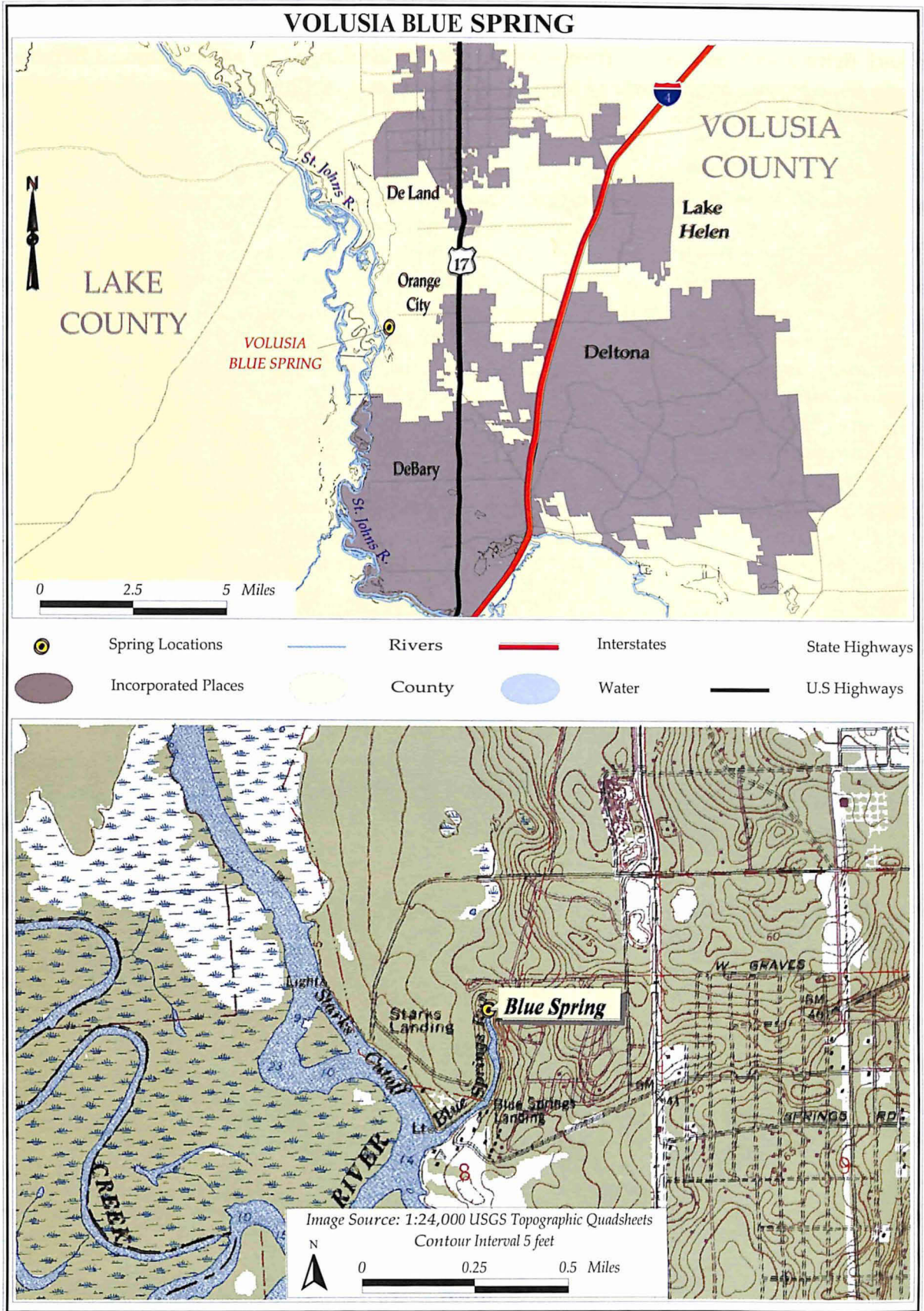


Figure 73. Volusia Blue Spring location map.

OPEN FILE REPORT NO. 85

Table 63. Volusia Blue Spring water quality analysis.

Analytes	1946	1960	1972	2001	
				Unfilt.	Filter
Field Measures					
Temperature	23.0	23.0	23.0	23.1	-
DO	-	-	-	0.45	-
pH	7.6	7.5	7.8	7.21	-
Sp. Cond.	2840	1060	1800	1402	-
Lab Analytes					
BOD	-	-	0.3	0.34 I	-
Turbidity	-	-	-	2	-
Color	5	0	0	5 U	-
Alkalinity	-	105	121	142	143
Sp. Cond.	-	-	-	1400	-
TDS	-	-	-	744 A	-
TSS	-	-	-	4 U	-
Cl	780	245	440	340	340
SO ₄	110	37	66	54	52
F	0.0	0.2	0.2	0.077 I	0.074 I
Nutrients					
TOC	-	-	-	1.7 I	-
NO ₃ + NO ₂	-	-	0.05	0.64	0.62
NH ₃ +NH ₄	-	-	-	0.027	0.04
TKN	-	-	-	0.14 I	0.2 I
P	-	-	0.07	0.067	0.064
PO ₄	-	-	-	0.063	-

Analytes	1946	1960	1972	2001	
				Unfilt.	Filter
Metals					
Ca	76	52	59	63.5 J	63.2
K	13.0	5.5	7.4	6.8	6.9
Na	419	128	260	167	170
Mg	51	20	29	23	23.1
As	-	-	0	3 U	3 U
Ba	-	-	-	-	75 U
B	-	-	-	76 I	-
Cd	-	-	2	0.75 U	0.75 U
Co	-	-	0	0.75 U	-
Cr	-	-	-	2 U	2 U
Cu	-	-	20	2.5 U	2.5 U
Fe	70	-	70	35 U	35 U
Mn	-	-	0	2.1	2
Ni	-	-	-	2 U	2 U
Pb	-	-	1	5 U	4 U
Se	-	-	-	4 U	4 U
Sn	-	-	-	10 U	-
Sr	-	-	1100	827	-
Zn	-	-	20	5 U	5 U

Barium (Ba)
Should be
Aluminum (Al)

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value is less than practical quantitation limit J=Estimated value Q=Exceeding holding time limit

Table 64. Volusia Blue Spring bacteriological analysis.

Bacteria Results (in #/100ml)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

FLORIDA GEOLOGICAL SURVEY

WAKULLA COUNTY

Spring Creek Springs Group



Figure 74. Spring Creek Springs Group (photo by J. Stevenson).

Group Location - Lat. 30° 04' N, Long. 84° 19' W, Land Grant sections 114 and 115, Hartfield Survey. Spring Creek is 7 miles (11 km) southeast of Crawfordville. From intersection of US 319 and US 98, travel northeast on US 98 approximately 5 miles (8 km). Turn south on Spring Creek Road (CR 365). A privately owned boat ramp is at end of this road.

Group Description - Spring Creek is in the flat tidal marsh typical of the northeast Gulf of Mexico. The coast has extensive hardwood hammock and grass-covered sandy areas underlain by limestone that is near and occasionally at the surface. There are 14 known springs in the Spring Creek Springs Group (Rosenau et al., 1977). Most, including Spring Creek Rise and Spring Creek Rise No. 2, discharge into the widened mouth of Spring Creek as it reaches the Gulf of Mexico. All are tidally influenced. The small fishing community of Spring Creek is situated on the highest available ground on the east side of Spring Creek mouth adjacent to many of the springs. See Lane (2001) for more information on these springs.

SPRING CREEK NO. 1 - Lat. 30° 04' 48.6" N, Long. 84° 19' 47.3" W. This spring has a voluminous boil that discharges from a 30 ft (9.1 m) wide cavern in limestone against a sea wall northwest of the old Spear's Seafood and adjacent to the dock of the ice house. The spring pool measures 153 ft (46.6 m) north to south and 150 ft (45.7 m) east to west. Depth meas-

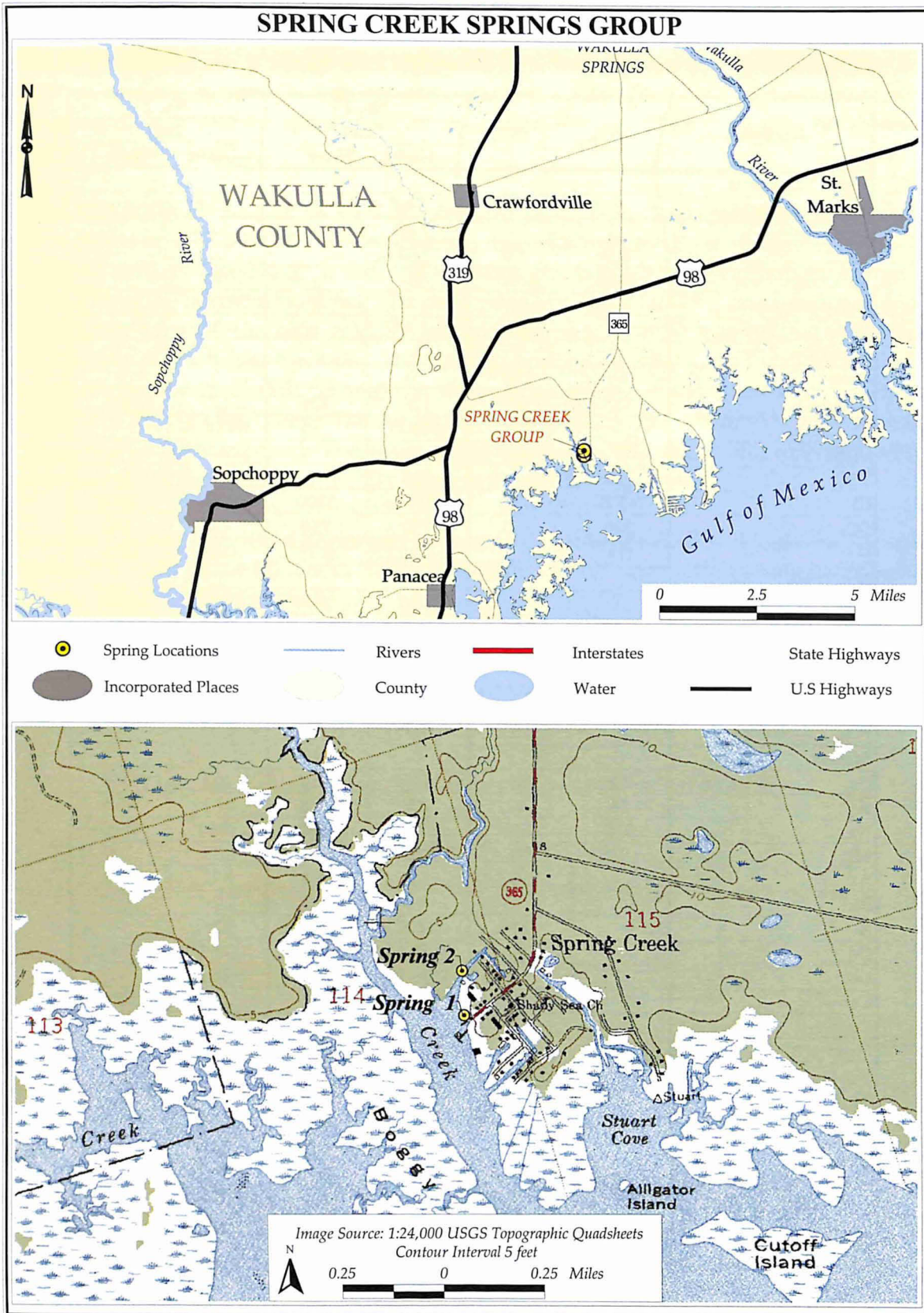


Figure 75. Spring Creek Springs Group location map.

FLORIDA GEOLOGICAL SURVEY

Table 65. Spring Creek Springs Group water quality analyses.

Analytes	1972	1973	No. 1		No. 2	
			2001		2001	
			Unfilt.	Filter	Unfilt.	Filter
Field Measures						
Temperature	19.5	22.0	21.7	-	21.6	-
DO	-	-	1.45	-	1.45	-
pH	8.0	7.0	7.07	-	7.23	-
Sp. Cond.	4300	4390	E	-	E	-
Lab Analytes						
BOD	-	-	0.2 AU	-	0.2 U	-
Turbidity	-	2	1	-	0.65	-
Color	60	200	5	-	5	-
Alkalinity	110	67	126	126	125	125
Sp. Cond.	-	-	16000	-	10000 A	-
TDS	-	-	9340 A	-	5650	-
TSS	-	-	10 I	-	5 I	-
Cl	1200	1200	5300	5300	3200	3100
SO ₄	200	360	730	730	450	440
F	0.4	0.3	0.32	0.33	0.27	0.26
Nutrients						
TOC	-	13	3.3 I	-	3.7 I	-
NO ₃ + NO ₂	0.18	0.06	0.2	0.21 J	0.22	0.22 J
NH ₃ +NH ₄	-	-	0.086	0.082 A	0.017 I	0.17
TKN	-	-	0.36	0.32 J	0.27	0.45 J
P	-	0.04	0.044	0.035	0.035	0.03
PO ₄	-	0.03	0.035	-	0.03	-
Metals						
Ca	80	55	141	142 A	102	99.8
K	26	40	106	97.6	69.1	59.5
Na	710	730	2770	2660	1880	1660
Mg	92	89	351	331	225	204
As	-	6	3 U	3 U	3 U	3 U
Ba	-	-	-	75 U	-	100 I
B	-	220	1270	-	829	-
Cd	-	1	0.75 U	0.75 U	0.75 U	0.75 U
Co	-	-	0.75 U	-	0.75 U	-
Cr	-	0	2 U	0.5 U	2 U	0.5 U
Cu	-	10	3.5 I	2.5 U	2.5 U	2.5 U
Fe	-	300	110 I	35 U	150	35 U
Mn	-	40	11.9	9.5	12.6	3.6
Ni	-	-	2 U	2 U	2 U	2 U
Pb	-	4	5 U	4 U	5 U	4 U
Se	-	-	4 U	4 U	4 U	4 U
Sn	-	-	10 U	-	10 U	-
Sr	-	800	2110	-	1360	-
Zn	-	10	25 U	14 U	25 U	5 U

A=Average Value

U,K=Compound not detected, value shown is the method detection limit

I=Value is less than practical quantitation limit J=Estimated value

Q=Exceeding holding time limit

E=instrument error

Barium (Ba)
Should be
Aluminum

ured over the vent is 43 ft (13.1 m). Water had slight cloudiness and was somewhat tannic during the October 2001 visit. Algae and a thin layer of silt covers limestone substrate. Bottom of pool and short spring run is sandy with limestone boulders and cracks. At low tide, the boil is tremendous, and the current leading into the estuary is swift. There is a conspicuous drainage pipe dripping directly into the spring pool on the northeast side. High ground to northeast harbors Spring Creek community.

SPRING CREEK NO. 2 - Lat. 30° 04' 54.4" N, Long. 84° 19' 47.6" W. This spring is located approximately half way up a 1000 ft (304 m) long channel that empties into the east side of the mouth of Spring Creek north of Rise No. 1. It also has a voluminous boil. Other spring runs enter into the spring pool from the northeast and east. Its pool measures 150 ft (45.7 m) north to south and 120 ft (36.5 m) east to west. Its high velocity outflow rushes southwest into the mouth of Spring Creek. Current is greatest at low tide. The water had slight cloudiness and was somewhat tannic during the October 2001 visit. Depth over the vertical opening in limestone from which water boils measures 75 ft (22.8 m) deep. The spring run has a sand and clay scoured bottom with abundant limestone boulders exposed. The surrounding land is brackish marsh and coastal hardwood-palm hammock. Spring Creek community borders the south side of pool.

Utilization - Spring Creek and its springs are regularly used fishing sites. Land near the springs is principally owned by the St. Marks National Wildlife Refuge, except for private lands associated with the village of Spring Creek.

Discharge - May 30, 1974 2000 ft³/s (estimated by Rosenau et al., 1977)
Nov. 1, 1996 307 ft³/s (from Davis, 1996)

Table 66. Spring Creek Springs Group bacteriological analyses.

Bacteria Results (in #/100ml)		
Analyte	No. 1	No. 2
<i>Escherichia coli</i>	1 KQ	1 AQ
Enterococci	1 KQ	1 AQ
Fecal Coliform	1 KQ	1 AQ
Total Coliform	10 Q	10 AQ

Wakulla Spring



Figure 76. Wakulla Spring (photo by T. Scott).

Location - Lat. 30° 14' 06.6" N, Long. 84° 18' 09.2" W (SW/NW/SE/sec. 11, T. 3 S, R. 1 W). Wakulla Spring is about 13.5 miles (5.6 km) south of Tallahassee. From the intersection of SR267, drive southeast 1 mile (1.8 km) on SR 61 to the entrance of Wakulla Springs State Park. Spring vent is located below diving platform, northeast of the parking area.

Description - Wakulla Spring is one of the largest and most dramatic of Florida's springs. Spring pool is roughly circular with a diameter of 315 ft (96 m) north to south. Pool depth is 185 ft (56.4 m). The vent opening is a horizontal ellipse along the south side of the pool bottom and is estimated to measure 50 ft by 82 ft (15 m by 25 m). Along with a few smaller springs nearby, including Sally Ward Spring, Wakulla Spring gives rise to the clear Wakulla River. Water clarity of the spring in October 2001 was exceptional and colored bluish. *Hydrilla* once covered much of the spring pool and adjacent river bottom, but divers have recently removed large amounts. The Wakulla River remains choked with this exotic invasive plant species. Many other aquatic and emergent plant species also are present in the spring pool and river. A mixed hardwood, cabbage palm, and cypress forest inhabits lowlands along the north and east shores of the spring and along the river. Uplands along the western shore of the spring are developed into a state park lodge and facilities. Also, there are hardwoods and large loblolly pines scattered about.

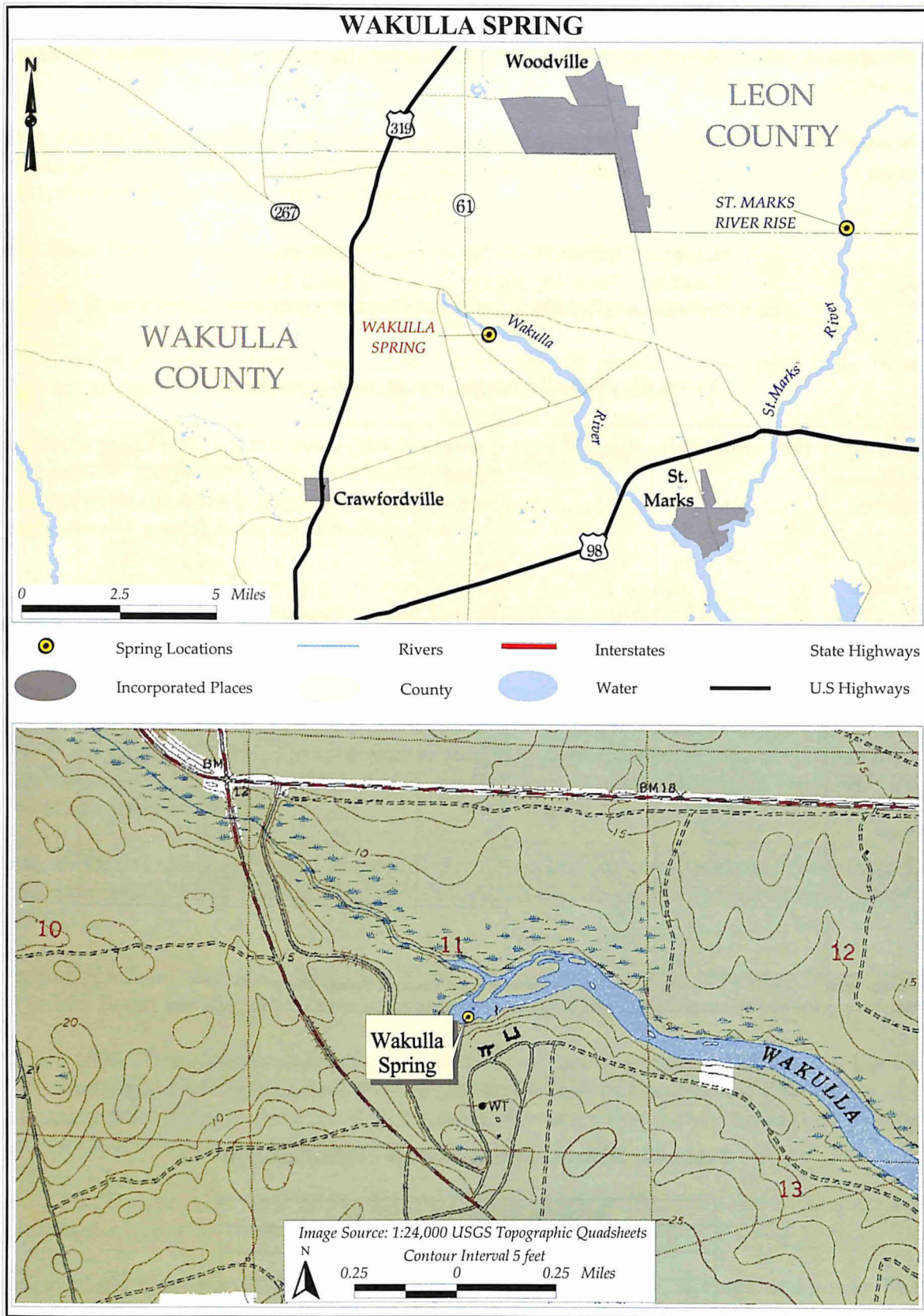


Figure 77. Wakulla Spring location map.

FLORIDA GEOLOGICAL SURVEY

Utilization - Wakulla Spring is developed into a recreational and wildlife viewing area. There are regular glass-bottomed riverboat tours, and swimming is designated in the southeast quadrant of the spring pool. The upper 3 miles (5 km) of the Wakulla River is state park owned and is a protected wildlife sanctuary.

Discharge - Wakulla Spring has the greatest known range in discharge among Florida's springs (Rosenau et al., 1977). The average flow from 1907 through 1974 was 390 ft³/s (Rosenau et al., 1977).

Maximum (April 11, 1973)	1910 ft ³ /s
Minimum (June 18, 1931)	25.2 ft ³ /s
September 27, 2001	128.9 ft ³ /s

Table 67. Wakulla Spring water quality analysis.

Analytes	1924	1946	1972	2001	
				Unfilt.	Filter
Field Measures					
Temperature	-	22.8	20.5	21.2	-
DO	-	-	3.2	2.4	-
pH	-	7.9	7.3	7.2	-
Sp. Cond.	-	277	279	328	-
Lab Analytes					
BOD	-	-	0.4	0.2 AU	-
Turbidity	-	-	1	0.05 U	-
Color	-	0	0	5 U	-
Alkalinity	-	-	130	146	148
Sp. Cond.	-	-	-	360	-
TDS	-	-	-	183	-
TSS	-	-	-	4 U	-
Cl	8	5.1	3.4	7.8	7.8 A
SO ₄	11	9.3	17	9.4	9.5 A
F	-	0.1	0.3	0.13	0.12
Nutrients					
TOC	-	-	0	1 U	-
NO ₃ + NO ₂	-	-	0.25	0.99 J	0.96
NH ₃ + NH ₄	-	-	-	0.01 U	0.01 U
TKN	-	-	-	0.06 U	0.06 U
P	-	-	0.04	0.032	0.03 A
PO ₄	-	-	0.03	0.03	-

A=Average Value U,K=Compound not detected, value shown is the method detection limit
I=Value shown is less than the practical quantitation limit J=Estimated value Q=exceeding holding time limit

Barium (Ba)
Should be
Aluminum (Al)

Table 68. Wakulla Spring bacteriological analysis.

Bacteria Results (in #/100 mL)	
Analyte	Value
<i>Escherichia coli</i>	1 KQ
Enterococci	1 KQ
Fecal Coliform	1 KQ
Total Coliform	1 KQ

SPRINGS INFORMATION RESOURCES ON THE WEB

For the interested reader, there are sources of information concerning Florida's springs on the Web. These include the following:

Springs Fever: A field and recreation guide to Florida springs by Joe Follman and Richard Buchanan. This site includes an excellent listing of web links -

<http://www.tfn.net/Museum/Springbook>

Florida State Parks System - **<http://www.dep.state.fl.us/parks/index.asp>**

The Public Broadcasting web site - **<http://www.pbs.org/wnet/nature/springs/>**

The Springs of Florida website from Karst Environmental provides numerous links to more spring's information - **<http://floridasprings.com/aboutsprings.html>**

Sites related to cave diving contain significant amounts of spring's information -

<http://web.tampabay.rr.com/mblitch/cave/>

<http://www.extendedrange.com/springstats.htm>

<http://www.geocities.com/cavedivingx2/>

Link to Florida Geological Survey's *Springs of Florida* Bulletin on-line -

http://www.flmnh.ufl.edu/springs_of_fl/aaj7320/content.html

REFERENCES

- Baker, B., (compiler), 1994, Ground water guidance concentrations: Florida Department of Environmental Protection, Division of Water Facilities, Bureau of Drinking Water and Ground Water Resources, 53 p.
- Berndt, M. P., Oaksford, E. T., and Mahon, G. L., 1998, Groundwater: *in* E. A. Fernald and E. D. Purdum (eds.), Water Resources Atlas of Florida: Tallahassee, FL: Florida State University p. 38-63.
- Champion, K.M. and Starks, R., 2001, The hydrology and water quality of springs in west-central Florida: Southwest Florida Water Management District Report, 148 p.
- Davis, H., 1996, Hydrogeologic investigation and simulation of ground-water flow in the Upper Floridan aquifer of north-central Florida and southwestern Georgia and delineation of contributing areas for selected City of Tallahassee, Florida, water supply wells: U.S. Geological Survey Water Resources Investigations Report 95-4296, 55 p.
- Dunbar, J.S., Faught, M.K., and Webb, S.D., 1988, Page/Ladson (8JE591): An underwater paleo-indian site in northwestern Florida: *Florida Anthropologist*, v. 41, p. 442-452.
- Ferguson, G.E., Lingham, C.W., Love, S.K., and Vernon, R.O., 1947, Springs of Florida: Florida Geological Survey Bulletin 31, 196 p.

FLORIDA GEOLOGICAL SURVEY

- Florida Department of Environmental Protection Ground Water Guidance Concentrations, 1994.
- Florida Springs Task Force, 2000, Florida's springs - Strategies for protection and restoration: Florida Department of Environmental Protection, 63 p.
- Henry, J.A., 1998, Weather and climate: *in* E. A. Fernald and E. D. Purdum (eds.), Water Resources Atlas of Florida, Tallahassee, FL: Florida State University, p. 16-37.
- Hornsby, D. and Ceryak, R., 1998, Springs of the Suwannee River Basin in Florida: Suwannee River Water Management District publication, 178 p.
- Jones, G.W., Upchurch, S.B., and Champion, K.M., 1998 (Revised), Origin of nutrients in ground water discharging from the Kings Bay Springs: Ambient Ground-Water Quality Monitoring Program, Southwest Florida Water Management District Report, 158 p.
- Katz, B.G., Bohlke, J.K., and Hornsby, H.D., 2001, Timescales for nitrate contamination of spring waters: Florida Scientist, v. 64, Program Issue, p. 52-53.
- Lane, B.E., 2001, The Spring Creek submarine springs group, Wakulla County, Florida: Florida Geological Survey Special Publication 47, 34 p.
- Maddox, G.L., Lloyd, J.M., Scott, T.M., Upchurch, S.B., and Copeland, R., (eds.), 1992, Florida's Ground Water Quality Monitoring Program, Background Geochemistry: Florida Geological Survey Special Publication 34, 364 p.
- Miller, J.A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina: United States Geological Survey, Professional Paper 1403-B, 91 p., 33 maps
- Morse, L., Biernacki, T., Silvanima, J., Hansard, P., Ouellette, D., and North, J., 2001, Status and temporal variability monitoring network sampling manual: Watershed Monitoring and Data Management Section, Florida Department of Environmental Protection, Tallahassee, FL, 90 p.
- Rosenau, J.C., Faulkner, G.L., Hendry, C.W., Jr., and Hull, R.W., 1977, Springs of Florida: Florida Geological Survey Bulletin 31 Revised, 461 p.
- Royal, W.D. and Clark, E., 1960, Natural preservation of human brain, Warm Springs, Florida: American Antiquity, 26, p.285-287.
- Scott, T.M., 1992a, A geological overview of Florida (upgraded and extended): Florida Geological Survey Open File Report 50, 78p.
- _____, 1992b, Chapter III - Hydrostratigraphy: *in* Maddox, G.L., Lloyd, J.M., Scott, T.M., Upchurch, S.B., and Copeland, R., (editors), 1992, Florida's Ground Water Quality Monitoring Program, Background Geochemistry: Florida Geological Survey Special Publication 34, p. 6-11.

- _____, 2001, Water sustainability in Florida - Research, policy and geologist's responsibilities: Abstracts with program, Geological Society of America annual meeting, v. 33, n. 6, p. A-200, Boston, MA.
- _____, in preparation, Geomorphic map of Florida: Florida Geological Survey Map Series.
- _____, Campbell, K.M., Rupert, F.R., Arthur, J.D., Green, R.C., Means, G.H., Missimer, T.M., Lloyd, J.M., Yon, J.W. and Duncan, J.G., 2001, Geologic map of Florida: Florida Geological Survey Map Series no. 146.
- Smith, R.P., 1992, A primer of environmental toxicology: Health Sciences, p. 142-150.
- Upchurch, S.B., 1992, Quality of water in Florida's aquifer systems: *in* Maddox, G.L., Lloyd, J.M., Scott, T.M., Upchurch, S.B. and Copeland, R. (editors), Florida's ground water quality monitoring program - Background hydrogeochemistry: Florida Geological Survey Special Publication 34, p. 12- 63
- Wilson, W. L., and Skiles, W. C., 1989, Partial reclassification of first-magnitude springs in Florida: *in* Beck, B. F., (ed.), The proceedings of the 3rd multidisciplinary conference on sinkholes and the environmental impacts of karst, Rotterdam, A. A. Balkema, p. 65-72.
- Yobbi, D. and Knochenmus, L., 1989, Effects of river discharge and high-tide stage on salinity intrusion in the Weeki Wachee, Crystal, and Withlacoochee River estuaries, Southwest Florida: U.S. Geological Survey WRI Report, 88-4116, 63 p.

FLORIDA GEOLOGICAL SURVEY

GLOSSARY

aquifer - an underground geological formation that stores water; aquifers are the source of spring water and well water.

chert - limestone replaced by quartz (silica). Used by Native Americans for variety of implements including knives and projectile points. Also known as flint.

first magnitude spring - a spring with a flow rate of 100 cubic feet per second (64.6 million gallons per day) or more.

groundwater level - the measurement, in feet, of the elevation of the top of an aquifer, as measured in a network of groundwater monitoring wells and/or supply wells. The level can fluctuate in response to aquifer recharge and groundwater withdrawals.

Hydrilla - an invasive, exotic, aquatic plant that is growing rampant in many springs and rivers.

hydrogeology - the study of subsurface waters in their geologic context.

impermeable - not permitting the passage of fluids. In the case of geologic formations, an impermeable layer of earth is one through which groundwater cannot pass.

karst - a limestone region with underground drainage and many cavities and passages caused by the dissolution of the rock.

sinkhole - a hole at the earth's surface that is formed when an underlying limestone cavity collapses.

spring recharge basin - the "area of contribution" for a spring's supply of groundwater. Spring recharge basins encompass land areas that contribute surface water and rainwater to the spring flow. The boundaries of this three-dimensional area are determined from hydrologic studies of the groundwater flow, which can then be delineated on the land surface. Within the spring recharge basin, large volumes of groundwater are contained within microscopic spaces in the limestone; however, groundwater movement is generally dominated by the flow of water through water filled conduits and fractures in the limestone aquifer.

spring run - a spring-fed stream.

FLORIDA GEOLOGICAL SURVEY
903 W. TENNESSEE STREET
TALLAHASSEE, FLORIDA 32304-7700

Walter Schmidt, State Geologist and Chief

ADMINISTRATIVE AND GEOLOGICAL DATA MANAGEMENT SECTION

Jacqueline M. Lloyd, Assistant State Geologist

Karen Achille, Secretary	Jessie "Ace" Fairley, Network Administrator
Carol Armstrong, Librarian	Jessie Hawkins, Custodian
Rebekah Brosky, Research Assistant	John Marquez, GIS Analyst
Cara Gowan, Administrative Secretary	Paula Polson, CAD Analyst
Wanda Bissonnette, Administrative Assistant	Frank Rupert, Research Geologist
Paulette Bond, Research Geologist	Carolyn Stringer, Operations & Mgmt. Consultant

GEOLOGICAL INVESTIGATIONS SECTION

Thomas M. Scott, Assistant State Geologist

Jon Arthur, Hydrogeology Group Supervisor	Tom Greenhalgh, Geologist
Alan Baker, Hydrogeologist	Eric Harrington, Engineering Technician
Kristy Baker, Research Assistant	Ron Hoenstine, Coastal Research Group Supervisor
Jim Balsillie, Coastal Geologist	Clint Kromhout, Research Assistant
Craig Berninger, Driller	Ted Kiper, Engineer
Lee Booth, Driller's Assistant	Michelle Lachance, Research Assistant
Ken Campbell, Drilling Supervisor	Jim Ladner, Coastal Geologist
Jim Cichon, Hydrogeologist	Edward Marks, Research Assistant
Bri Coane, Research Assistant	Harley Means, Geologist
Rick Copeland, Hydrogeologist	Ryan Means, Research Assistant
Jim Cowart, Research Associate	Rebecca Meegan, Research Assistant
Brian Cross, Research Assistant	Matthew Mayo, Research Assistant
Adel Dabous, Research Associate	Kerri Narwocki, Research Assistant
Rodney DeHan, Senior Research Scientist	David Paul, Research Assistant
Joe Donoghue, Research Associate	Sarah Ramdeen, Research Assistant
Erin Dorn, Research Assistant	Drew Robertson, Research Assistant
Will Evans, Research Associate	Andrew Rudin, Research Assistant
Shaun Ferguson, Research Assistant	Frank Rush, Lab Technician
Cindy Fischler, Research Assistant	Steve Spencer, Economic Mineralogist
Henry Freedenberg, Coastal Geologist	Wade Stringer, Marine Mechanic
Rick Green, Stratigrapher	Jeff Thelen, Research Assistant

OIL AND GAS SECTION

David Curry, Environmental Administrator

Paul Attwood, Asst. District Coordinator	Ed Garrett, Geologist
Robert Caughey, District Coordinator	Tracy Phelps, Secretary
Ed Gambrell, District Coordinator	David Taylor, Engineer

FLORIDA GEOLOGICAL SURVEY
903 W. TENNESSEE STREET
TALLAHASSEE, FLORIDA 32304

39380000141983



FLORIDA GEOLOGICAL SURVEY

RE