STATE OF FLORIDA

FLORIDA GEOLOGICAL SURVEY
Guy H. Means, *State Geologist and Director*

REPORT OF INVESTIGATION NO 124

2021-2023 Porter Hole Sink Dye Trace at Lake Jackson, Leon County, Florida

By

Scott Barrett Dyer, P.G. # 3009, Gary D. Fowler III, Ph.D., P.G., Mary E. Lupo Ph.D., P.G., and Clint Kromhout, P.G.

2026

ISSN 0160-1931

FLORIDA GEOLOGICAL SURVEY

CONVERSION FACTORS

UNIT	CONVERSION	TO OBTAIN
yard (yd)	multiply by 0.9144	meter (m)
mile (mi)	multiply by 1.6093	kilometer (km)
ft^3 per second (cfs)	multiply by 0.0283	cubic meter per second (m^3/s)
square miles (mi^2)	multiply by 2.59	square kilometers (km^2)
acres (ac)	multiply by 0.4047	hectares (ha)
pounds (lbs)	multiply by 0.4536	kilograms (kg)

LIST OF ACRONYMS

BLS	below land surface
FAS	Floridan aquifer system
FGS	Florida Geological Survey
GPD	gallons per day
IAS	intermediate aquifer system
ICU	intermediate confining unit
LFA	Lower Floridan aquifer
MSL	mean sea level
NWFWMD	Northwest Florida Water Management District
OUL	Ozark Underground Laboratory
SAS	surficial aquifer system
UFA	Upper Floridan aquifer
USGS	U.S. Geological Survey
WKPP	Woodville Karst Plain Project

TABLE OF CONTENTS

Conversion Factors ii
List of Acronyms ii
List of Figures iv
List of Tables iv
List of Figures and Tables: Appendix A-C iv
Acknowledgements v
Introduction 6
    Study Area 6
    Previous FGS Traces 8
Geomorphology, Geology, and Hydrostratigraphy 9
    Geomorphology 9
    Geology of Porter Hole Sink Dye Trace Study Area 10
    Hydrostratigraphy 13
        Hydrostratigraphy of the Porter Hole Sink Dye Trace Study Area 13
    Hydrology of Study Area 15
Methods 21
    Dye Introduction 21
    Sample Plan, Locations, and Methods 22
    Laboratory Analyses 27
Results and Discussion 27
    Dilution, Degradation, and Dispersion 27
    Siphoning 29
    Distribution and Density of Sample Stations 31
Conclusions 31
References 32
Appendix A: Previous FGS Traces 36
Appendix B: Lithologic Descriptions 38
Appendix C: Ozark Underground Laboratory Analyses 48

LIST OF FIGURES

Figure 1. Porter Hole Sink dye trace study area 7

Figure 2. An aerial view looking southeast across Lake Jackson's lakebed 8

Figure 3. The study area spans two geomorphic provinces, the Tallahassee Hills Province and the Woodville Karst Plain Province (Williams et al, 2022)... 10

Figure 4. Surficial geology of Porter Hole Sink study area from Scott et al. (2001). 11

Figure 5. A southward-facing view of Porter Hole Sink on August 14, 2021..... 15

Figure 6. Locations and spatial distribution of precipitation stations, river gages, and local UFA potentiometric surface contours in the study area..... 17

Figure 7. Precipitation values recorded at stations proximal to Lake Jackson and Edward Ball Wakulla Springs State Park with corresponding river stage data 19

Figure 8. Precipitation and corresponding UFA well water level data from select monitoring wells operated by the NWFWMD..... 20

Figure 9. Mixing dye in the livestock trough with residual lake water pumped from a lakebed sinkhole directly behind the canopy. 21

Figure 10. Dye gravity feeding into the Porter Hole Sink aven. Residual lake water can also be seen flowing into the aven. 22

Figure 11. Sample station locations for the Porter Hole Sink dye trace. 24

Figure 12. Twenty-two stations were monitored during portions of the trace..... 26

Figure 13. Map of consumptive use wells in the Porter Hole Sink study area 30

LIST OF TABLES

Table 1. The Method Detection Limit (MDL) values reported for the five most recommended dyes in water conditions free of turbidity and color (Aley, 2019). 23

Table 2. Evolution of the sample plan in phases throughout the duration of the project. 25

Table 3. Fluorescent properties based on type of dye relative to pH values from Aley (2019). .. 29

LIST OF FIGURES AND TABLES: APPENDIX A-C

A 1. Comprehensive overview of FGS dye traces within the study area.. 37

B 1. Lithologic description for Porter Hole Sink (W-18025). 38

B 2. Lithologic description for Edward Ball Wakulla Springs State Park (W-16887). 43

C 1. All samples analyzed for the 2021-2023 Porter Hole Sink dye trace. 48

ACKNOWLEDGEMENTS

The Florida Geological Survey (FGS) is grateful for the Northwest Florida Water Management District's (NWFWMD) financial contribution to analytical expenses incurred while conducting this investigation. Tony Countryman and Craig Freeman, staff members at the district, provided monitoring well access, well completion data, geophysical data, and consumptive use well data utilized to conduct this project.

The Porter Hole Sink dye trace would not have been possible without the commitment of the FGS staff. Everyone from our leadership team, staff geologists, and multiple full- and part-time employees from each section were instrumental in supporting the primary investigators while conducting this investigation. The authors would like to thank the FGS staff members who provided thoughtful reviews and constructive suggestions that improved this publication.

Caitlyn Snyder and Jeff Smith, staff members of Florida Department of Environmental Protection's Office of Resilience and Coastal Protection, provided dry down notifications, regular Porter Hole Sink monitoring, pool stage updates during the Porter Hole Sink dye trace, and notes that facilitated the Porter Hole Sink pool data presented in Figures 7 and 8. Caitlyn and Jeff provided essential ground support at Porter Hole Sink prior to, during, and after the dye was introduced.

Site access for sampling was crucial to this investigation. Edward Ball Wakulla Springs State Park and private landowners provided access to sampling locations for the duration of the tracer study. Jennifer Porter, with the City of Tallahassee, provided access and employees to assist in collecting samples from granular activated carbon vessels at consumptive use wells within the Porter Hole Sink study area.

INTRODUCTION

Lake Jackson, one of the largest karst lakes in Leon County, Florida, has a historical record of draining via sinkholes. There are several lines of evidence that suggest Lake Jackson is within the Wakulla Spring contribution area. Lake Jackson's historical account of draining, herein referred to as a "dry down," dates to 1829 (Lammers, 2021). Lammers offers a comprehensive compilation of historical newspaper articles, press reports, photographs, and aerial photography documenting Lake Jackson's dry downs and other "disappearing" karstic lakes (i.e., Iamonia, Lafayette, and Miccosukee) in Leon and Jefferson counties. Elias H. Sellards, Florida Geological Survey (FGS) State Geologist 1907-1919, documented and reported on the same lakes in FGS's Third Annual Report (Sellards, 1910). Sellards describes the 1907 dry down in which Lake Jackson was partially drained by Lime Sink, and that a "new sink" southeast of Lime Sink opened, draining the remaining southern portion of Lake Jackson. The new sink's location as described and mapped by Sellards (1910) is likely the first documented occurrence of Porter Hole Sink contributing to dry downs at Lake Jackson. According to Lammers (2021) there have been more than a dozen dry downs at Lake Jackson since 1829.

The initial 2021 dry down of Lake Jackson occurred between June 5, 2021, and June 7, 2021. During this period, the lake went from full pool stage to extreme lows with isolated shallow pools scattered across the southern portion of the lake. Porter Hole Sink's aven, the opening that connects the sinkhole to the underlying cave system, was observable at the base of the sinkhole's throat. The entire southern portion of Lake Jackson drained down, exposing lakebed sediments leaving channels and rivulets of sediment laden water meandering toward Porter Hole Sink. The northern lakebed did not dry down to the same extent as the southern lakebed due to a narrow, higher elevation lakebed ridge referred to as Brill Point Saddle.

On August 14, 2021, fluorescein dye was introduced into Porter Hole Sink by FGS. The dye trace was designed to test the hypothesis that dye introduced through Porter Hole Sink into the Upper Floridan aquifer (UFA) would flow south-southeast and be detected at various karst features in southern Leon, Wakulla, and Jefferson counties, and specifically at Wakulla Spring. The interaction and hydrological flow regime of the underlying aquifer system(s) in southern Leon County are not fully understood due to the karstified nature of the study area and the local stratigraphy that makes up the UFA. The goal of the trace was to provide possible insights into groundwater flow from the semi-confined UFA in west-central Leon County to the unconfined UFA in southern Leon, Wakulla and Jefferson counties.

Study Area

The study area encompasses portions of Leon, Wakulla, and Jefferson counties in the eastern Panhandle of Florida (Figure 1). Porter Hole Sink is approximately six miles northwest of Tallahassee. Hendry and Sproul (1966) described the study area (Figure 1) as having a humid subtropical climate with high annual rainfall and warm temperatures during the summer months. Precipitation contributes to fluvial surface drainage systems, lacustrine water levels, karstic terrain development, and recharge locally to the surficial aquifer system (SAS), and the Upper Floridan aquifer (UFA; Figure 1). Previous work (Wagner, 1984), unpublished reconnaissance mapping

conducted by FGS staff in 1999 (J. Balsillie and W. Evans), and observational data characterize the lake as a shallow water body containing two major sinkholes that reach depths of 25 feet or more, one is Porter Hole Sink and the other is Lime Sink. Digital elevation models constructed from the most recently available lidar data indicate that elevations surrounding Lake Jackson extend from approximately 90 feet mean sea level (MSL) to 250 feet MSL, at their highest point(s).

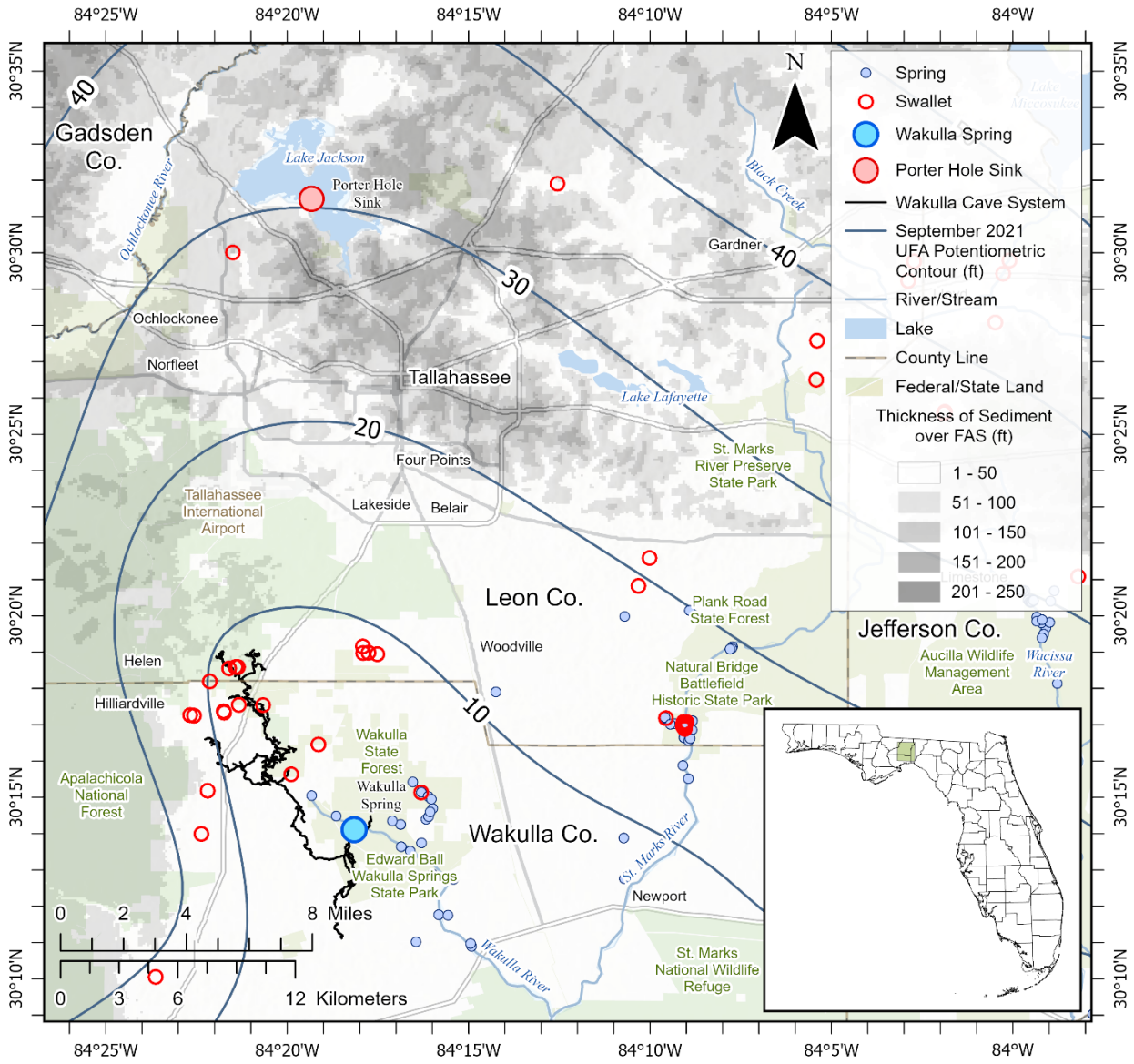


Figure 1. Porter Hole Sink dye trace study area. Porter Hole Sink, Wakulla Spring, Wakulla cave system, and other spring features are indicated. Potentiometric surface of the Upper Floridan aquifer for September 2021 from Fowler and Lupo (2024) contoured in units of feet above mean sea level. The thickness of sediment overlaying the Floridan aquifer system, estimated from FGS borehole data and top of rock formation picks, is displayed in shades of gray.

Lake Jackson is a polje (a large flat-bottomed depression formed by the coalescence of numerous sinkholes that develop over time as the underlying limestone dissolves). At Lake

Jackson, dissolution progressively decreases the elevation of the lakebed, while the banks of the basin maintain their higher elevation. The result is a singular, larger karst lake (Figure 2). The northern extent of the study area exhibits an undulating terrain with elevations of approximately 40-270 feet MSL. In comparison, the southern portion of the study area is predominantly flat and gently slopes toward the Gulf of America (referred to herein as the Gulf) and Apalachee Bay with elevations ranging from approximately 70 feet MSL, to near sea level at its southernmost extent.

The highest elevations in the northern portions of Leon and Jefferson counties are characterized by surficial siliciclastic cover sediments, which disconformably overlie UFA limestone units (Figure 1). These cover sediments influence the development of surface drainage patterns, local waterbodies, surficial and underlying karst, and the variable degree of confinement above underlying aquifers.



Figure 2. An aerial view looking southeast across Lake Jackson's lakebed, depicting numerous sinkholes proximal to Lime Sink, indicated by the red arrow. Photograph taken in 2000 by T. Scott, FGS.

Previous FGS Traces

Since 2002, the FGS has either contracted or conducted 15 dye traces in the vicinity of the study area. Eleven traces were specifically conducted to determine if the dye introduction site connected to Wakulla Spring (Appendix A). Nine traces demonstrated a connection from the introduction site to Wakulla Spring and other karst features connected to the Wakulla Cave system.

Two traces introduced dye into karst features north of the Cody Scarp in the Tallahassee Hills Province. Study area geomorphology is discussed in the next section. Only one of those two traces demonstrated a connection to Wakulla Spring, the Bird Sink trace. Both Tallahassee Hills Province introduction sites are in the eastern portion of the study area in the vicinity of Lake Miccosukee, east of Tallahassee. The Bird Sink trace detected dye at numerous sites in the Woodville Karst Plain Province. A low concentration of dye was detected at Wakulla Spring 52 days after introduction. South of the Cody Scarp, in the Woodville Karst Plain Province, eight traces introduced dye into karst. All eight traces produced detections at Wakulla Spring. The Porter Hole Sink dye trace is the first trace conducted by the FGS north of the Cody Scarp in the Tallahassee Hills Province, north and west of Tallahassee.

GEOMORPHOLOGY, GEOLOGY, AND HYDROSTRATIGRAPHY

Geomorphology

The study area is divided into two geomorphic provinces, the Tallahassee Hills Province and the Woodville Karst Plain Province (Williams et al., 2022). The boundary between the two is marked by an east-west trending topographic feature, the Cody Scarp (Figure 3), which is a Pleistocene marine escarpment (Puri and Vernon, 1964; Hendry and Sproul, 1966; Upchurch, 2007; Williams et al., 2022). Both provinces are underlain by carbonates, the dissolution of which produces the study area's karst terrain. North of the Cody Scarp, the carbonate units that comprise the UFA are overlain by siliciclastic units. These siliciclastic units are comprised of notable amounts of clay that retard infiltrating meteoric water, providing variable confinement to the UFA. South of the Cody Scarp, a veneer of quartz sand-dominant sediment covers the shallow carbonates and provides little to no impediment to infiltration and dissolution.

Lake Jackson lies within the study area's northern extent of the Tallahassee Hills Province of the Tifton Upland District (Williams et al., 2022). Compared to the study area's southern extent, the Tallahassee Hills Province has higher elevations (40-270 ft MSL; Williams et al., 2022) with a hilly terrain, fluvial surface drainage, and karst lakes perforated by sinkholes. The Tallahassee Hills Province notably contains numerous large karst lakes and swallets. The study area's southern extent primarily lies within the Woodville Karst Plain Province of the Ocala Karst District (Williams et al., 2022). The Woodville Karst Plain Province is defined by an abundance of karst features such as sinkholes, swallets, miles of subterranean caves, and more than 100 documented springs, most notably Wakulla Spring, the largest single-vent first magnitude spring in north Florida and one of the largest fresh-water springs in the world. The Woodville Karst Plain Province is characterized by lower elevations (0-60 ft MSL; Williams et al., 2022) and has relatively flat topography that gently slopes from the base of the Cody Scarp to the Gulf. For an in-depth discussion of Florida's geomorphology, the reader is referred to Williams et al. (2022).

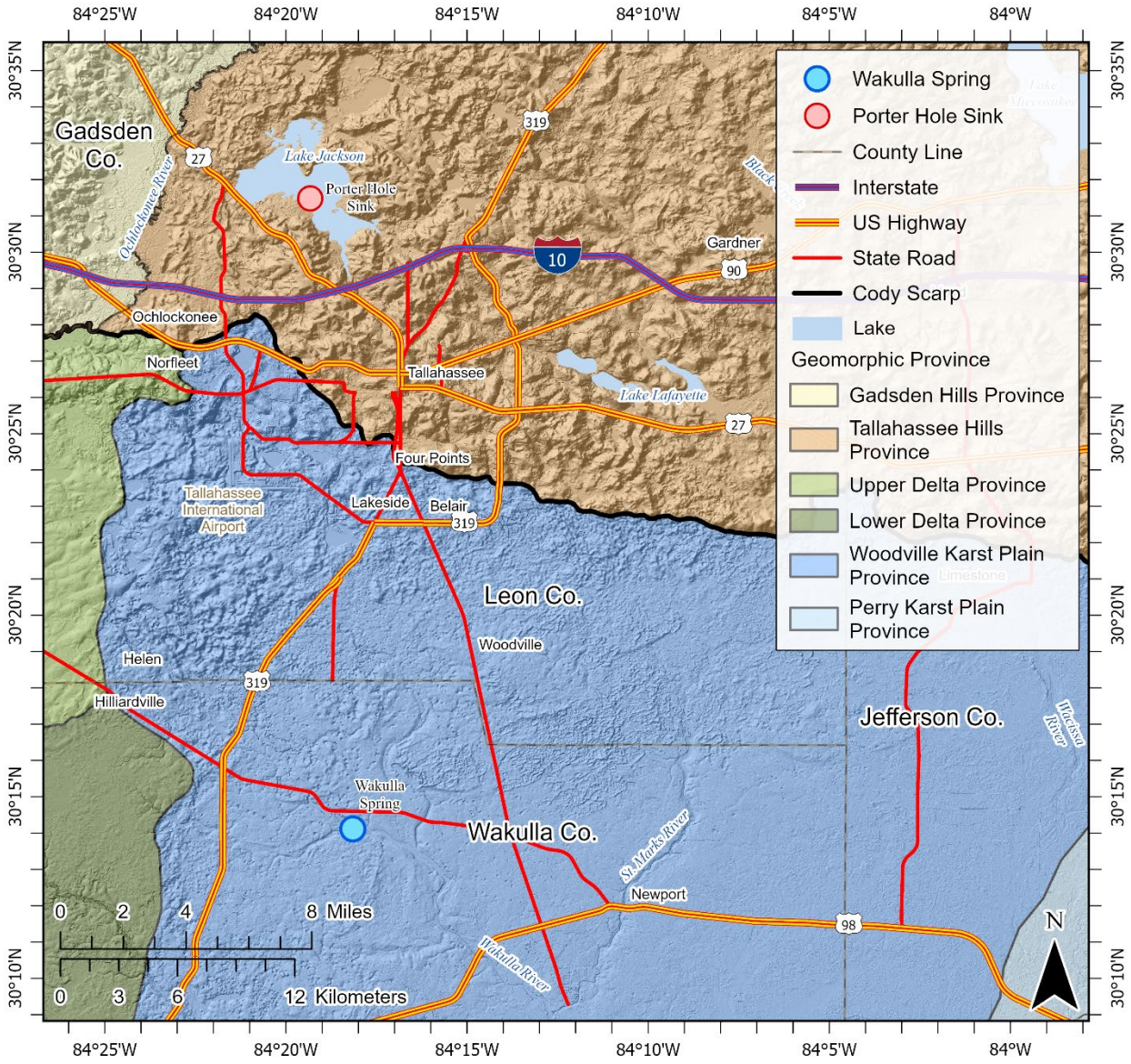


Figure 3. The study area spans two geomorphic provinces, the Tallahassee Hills Province and the Woodville Karst Plain Province (Williams et al, 2022). The Gadsden Hills Province, Upper and Lower Delta Provinces, and the Perry Karst Plain Province are indicated on the map but are not discussed as they occur just west and east of the study area.

Geology of Porter Hole Sink Dye Trace Study Area

The surficial geology of the Porter Hole Sink dye trace study area is depicted in Figure 4 and is characterized herein. Abbreviated unit designations and formation picks are provided from two FGS borehole descriptions, the locations of which are indicated in Figure 4. Borehole W-18025 is proximal to the dye injection site on Lake Jackson's lakebed, and borehole W-16887 is located downstream of Wakulla Spring within Edward Ball Wakulla Springs State Park. A detailed borehole description for each site is provided in Appendix B.

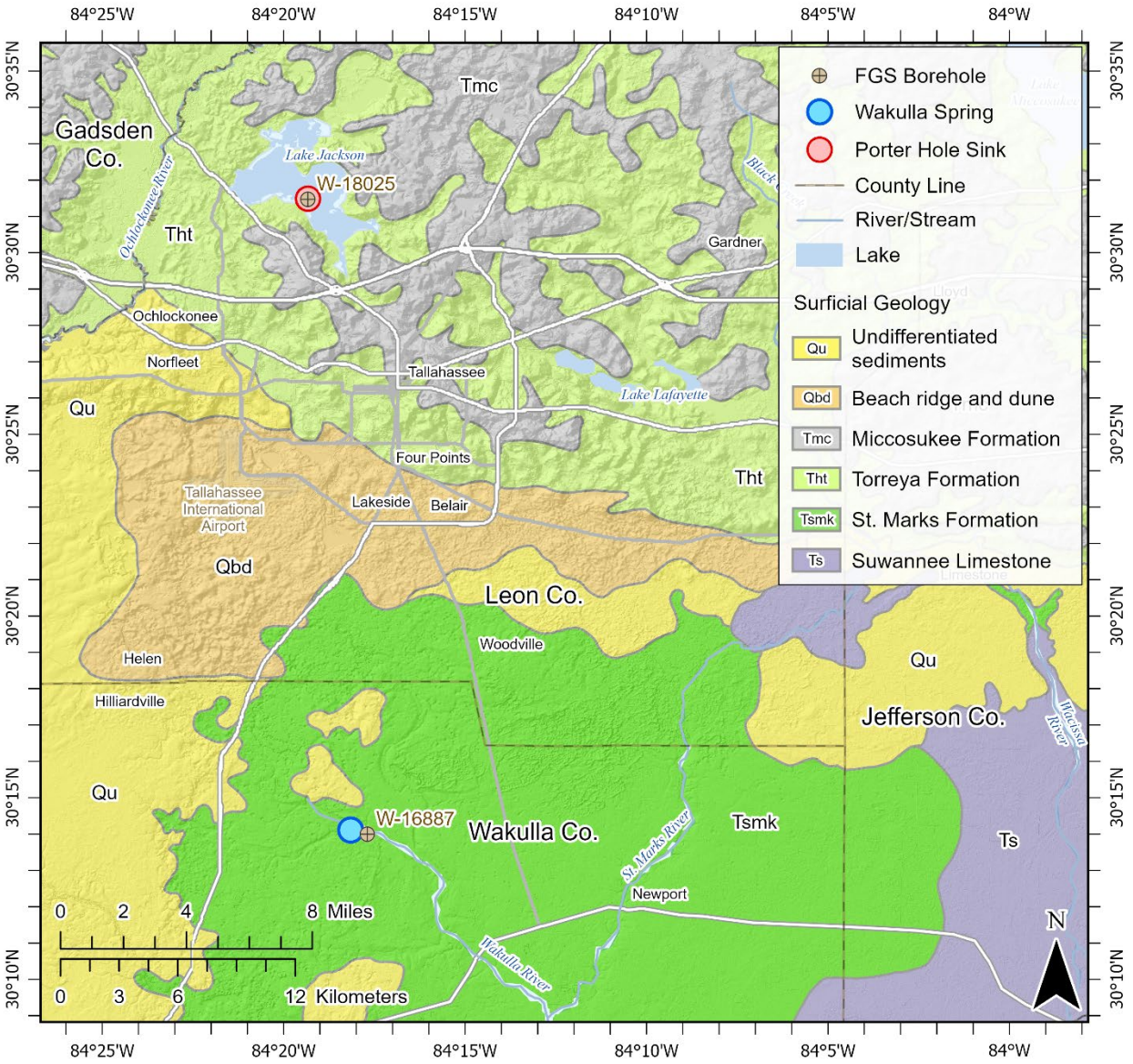


Figure 4. Surficial geology of Porter Hole Sink study area from Scott et al. (2001).

The upper Eocene Ocala Limestone underlies the entire study area. It is characterized as a white, medium- to coarse-grained, near grain supported (pack- to grainstone) carbonate. It is highly fossiliferous and typically displays a high porosity and permeability index and is variably indurated. The Ocala Limestone is overlain by the lower Oligocene Suwannee Limestone within the study area. Locally, the boundary between the two is undulatory, which suggests an unconformable contact within the study area.

The lower Oligocene Suwannee Limestone (Cooke and Mansfield, 1936; Brewster-Wingard et al., 1997), while not exposed within Porter Hole Sink or Edward Ball Wakulla Springs State Park, is present in both borehole sample sets and within Wakulla Spring's vent at depth. The Suwannee Limestone is a white to cream colored, fine- to medium-grained, matrix supported (wacke- to packstone) marine carbonate. It is fossiliferous, commonly displays vuggy and moldic

porosity, and sections of this unit are often dolomitized or silicified. Locally, the Suwannee Limestone is unconformably overlain by the lower Miocene St. Marks Formation (Hendry and Sproul, 1966) and younger sedimentary units.

The lower Miocene St. Marks Formation was first recognized by Finch (1823) as a Tampa (Aquitanian) Stage facies and was raised to a formation by Puri and Vernon (1964). It is not exposed within Porter Hole Sink but can be observed outcropping at various places within Edward Ball Wakulla Springs State Park and within the surrounding study area. The St. Marks Formation is described in both borehole sample sets and is also exposed at depth within the Wakulla Spring vent. The St. Marks Formation is a white to yellowish gray, variably indurated, fossiliferous marine limestone that commonly displays a vuggy and moldic porosity. Notably, this unit contains accessory to trace quantities of quartz sand with abundant mollusk molds and casts. The St. Marks Formation is disconformably overlain by the lower Miocene Torreya Formation (Hawthorn Group) where locally present (Rupert and Spencer, 1988; Scott, 1988). In places where the younger Miocene stratigraphic section is missing, the St. Marks Formation is unconformably overlain by younger informal siliciclastic units.

The lower Miocene Torreya Formation contains two members: the Dogtown Member and Sopchoppy Member (Banks and Hunter, 1973; Huddlestun, 1988; Scott, 1988). A thin stratigraphic section of the Torreya Formation is exposed within Porter Hole Sink and is observed in the borehole samples collected from the Lake Jackson lakebed (W-18025). In this section, neither member is recognized. The Torreya Formation in the study area consists of a white to light gray or yellowish gray carbonate comprised of calcilutite. It is moderately to well indurated, fossiliferous, and contains beds that range from clayey sand to a sandy clay with a variable carbonate component. The carbonate facies is common, although not necessarily laterally persistent, within the lower portion of the formation (Huddlestun and Hunter, 1982). Locally, the Torreya Formation is unconformably overlain by the Pliocene Miccosukee Formation (Yon, 1966). South of Tallahassee, in the Woodville Karst Plain Province, the Miocene section has been largely removed by post-depositional processes that scoured and eroded the landscape (Hendry and Sproul, 1966). The Torreya Formation represents the top of the stratigraphic section where the Pliocene Miccosukee Formation and younger units have been eroded away.

The Pliocene Miccosukee Formation was first recognized and described by Hendry and Yon (1967). The Miccosukee Formation is not observed or described at Porter Hole Sink, and the unit is absent south of the Cody Scarp in the Woodville Karst Plain Province. However, it does occur throughout the Tallahassee Hills Province and is a hydraulically important unit within the study area. Clays in this formation impede infiltrating acidic rain and surface water to the underlying Upper Floridan aquifer carbonates. The Miccosukee Formation is characterized by its grayish orange to grayish red clay that displays a mottled appearance in exposures. It is a variably consolidated, non-lithified unit comprised of interbedded clay, quartz sand, and gravel of varying coarseness and admixtures. Note that locally the Miccosukee Formation represents the top of the stratigraphic section where it is not overlain by younger siliciclastic units.

Multiple thin unnamed lithostratigraphic units overlie the Miocene carbonate and clayey units within the study area. These units are comprised largely of quartz sand and clay that range

from unconsolidated to poorly consolidated, are variably organic, contain accessory amounts of phosphate (sand and fossil material), and trace amounts of heavy minerals.

Hydrostratigraphy

There are three principal aquifer systems of regional significance in Florida: the surficial aquifer system (SAS), the intermediate aquifer system (IAS) or intermediate confining unit (ICU), and the Floridan aquifer system (FAS; Southeastern Geological Society Ad Hoc Committee, 1986). Hydrostratigraphic units and their designation(s) within the SAS, IAS/ICU, and FAS are determined principally on their hydraulic properties and their relationship to lithostratigraphic units. These properties vary statewide, and thus, lithostratigraphic and hydrostratigraphic designations are not always synonymous.

The SAS is characterized by upper Miocene to Holocene lithostratigraphic units that range from unconsolidated to poorly indurated siliciclastic sediments and are largely unconfined. The base of the SAS coincides with the top of the IAS, ICU, or FAS depending on local stratigraphic relationships. Within the study area, the base of the SAS north of the Cody Scarp coincides with laterally and vertically continuous low permeability Miocene and younger confining sediments. South of the Cody Scarp, where the low permeability Miocene and younger confining sediments are discontinuous or absent, the SAS is not present and the FAS is unconfined. The IAS and ICU are generally comprised of Miocene lithostratigraphic units (Hawthorn Group and age-equivalents) present across parts of the state. As previously indicated, each lithostratigraphic unit and its inclusion within the IAS and/or ICU is determined based on hydraulic properties governed by vertical and lateral lithologic succession and continuity. The IAS exists locally in the study area and is monitored. The FAS is characterized by a thick sequence of Paleocene to lower Miocene hydraulicly productive carbonate rocks. The FAS extends throughout the entire state of Florida and into portions of neighboring states. It is used as the primary source of drinking water and is considered the groundwater source for most of Florida's artesian springs (Southeastern Geological Society Ad Hoc Committee, 1986). The FAS is subdivided into the Upper Floridan aquifer (UFA) and the Lower Floridan aquifer (LFA). The boundary between the UFA and the LFA is defined by several factors: depth(s)/elevation(s), physical and hydraulic properties, the presence of inter- and intraformational low-permeability units that provide some level of confinement, and water chemistry (Williams and Kuniansky, 2016).

Hydrostratigraphy of the Porter Hole Sink Dye Trace Study Area

In this study, groundwater in the conduit systems supporting study area's springs is primarily within the UFA as evidenced by cave diver explorations and well data. Borehole W-18025 (Appendix B) is located within Lake Jackson's lakebed adjacent to Porter Hole Sink. The lithologic description of borehole W-18025 notes high permeability, undifferentiated sands with some clay. These sediments extend from land surface to 8.6 feet below land surface (BLS). From 8.6 to 22.2 feet BLS, a succession of siliciclastic units which include light brown to greenish clays that are interbedded with white to yellowish gray quartz sands are assigned to the Torreya Formation. At Porter Hole Sink, they are part of the ICU. However, the ICU within the larger study area is laterally discontinuous and, in some areas, absent at lower elevations, like those in the bed

of Lake Jackson. At higher elevations, north of the Cody Scarp where the Miccosukee Formation is present, the clays provide confinement of the underlying UFA and belong to the ICU. The ICU in southern Leon and Jefferson counties and eastern Wakulla County south of the Cody Scarp, has been eroded and thinned by transgressive and regressive sea level events and is largely absent. As such, the UFA is unconfined in the southern portion of the study area and in places may be overlain by unconsolidated quartz sand.

At Porter Hole Sink, the lower portion of the Torreya Formation is comprised of carbonate(s). As previously discussed, the spatial distribution and thickness of this carbonate unit varies both vertically and laterally thus limiting its ability to store groundwater and form a persistent, mappable aquifer. At Porter Hole Sink the IAS is absent but is locally present on the west side of Lake Jackson in a NWFWMD monitoring well (003403), further demonstrating that the IAS is regionally discontinuous and only locally present throughout the study area.

In the borehole description for W-18025, Torreya Formation carbonates are observed from 22.2 - 36.5 feet BLS. Below the Torreya Formation, the St Marks Formation (36.5 feet BLS) and Suwannee Limestone (67.5 feet BLS) are encountered. At Porter Hole Sink, these units represent the uppermost lithostratigraphic units of the UFA. Similarly, south of the Cody Scarp and within the study area, the St. Marks Formation in eastern Wakulla County, and the Suwannee Limestone in Jefferson County are the uppermost lithostratigraphic units of the UFA and are at or near land surface. The lithologic contrast between surficial quartz sand and the underlying carbonate formations of the UFA (6.5 feet BLS) can be seen in samples from W-16887 (Appendix B) which was drilled just downstream from the main vent at Edward Ball Wakulla Springs State Park.

Figure 5 is a photo of Porter Hole Sink during the 2021 dry down event. The white dashed line marks the contact between the Torreya Formation carbonates and the overlying lake basin sediments. The red hose, used to introduce dye, is fed into the sinkhole’s aven left of the person in white overalls.



Figure 5. A southward-facing view of the exposed aven in Porter Hole Sink on August 14, 2021. The white dashed line represents the contact between the overlying siliciclastic and underlying carbonate units of the Torreya Formation. The red hose, used to introduce dye, is fed into the aven left of the person wearing white overalls.

Hydrology of Study Area

Five major rivers in the study area include the Ochlockonee, Wakulla, St. Marks, Wacissa, and Aucilla rivers. The Ochlockonee River originates in south-central Georgia, northeast of Ochlockonee, Georgia and flows southwest into Florida where it defines the western boundary of Leon County. The Wacissa River emerges at its spring fed headwaters in Jefferson County near Wacissa, Florida and flows southward to its confluence with the Aucilla River in southeastern Jefferson County. The Wacissa River represents our most eastern sample locality. The Ochlockonee and Aucilla rivers ultimately flow into the Gulf at the Ochlockonee and Apalachee bays, respectively. The headwaters of the St. Marks River originate in eastern Leon and western Jefferson counties. The St. Marks River flows south-southwest to its noteworthy sink-and-rise complex in southeast Leon County. Once the St. Marks River emerges from its final resurgence, St. Marks River Rise, it flows southward to its confluence with the Wakulla River. Wakulla Spring is approximately 20 miles due south of Porter Hole Sink in north-central Wakulla County. The first magnitude spring is the headwater for the Wakulla River. The Wakulla River flows south-

southeast, converges with the St. Marks River near St. Marks, Florida, and then discharges into Apalachee Bay and ultimately the Gulf.

Lakes, ponds, and smaller streams in northern Leon and Jefferson counties outnumber and are morphologically dissimilar to those in southern Leon, Jefferson, and eastern Wakulla counties. The elevation and surficial siliciclastic sediments in the Tallahassee Hills Province (northern Leon and Jefferson counties) have facilitated the development of dendritic drainage basins, large karstic lakes, ponds, and sinkholes in this area. By contrast, eastern Wakulla and southern Jefferson counties lack the siliciclastic cover sequence, resulting in a more heavily karstified landscape containing sinkholes and swallets, lakes and ponds, erratic drainage patterns, and disappearing and reemerging rivers and streams.

There are over 50 swallets and more than 100 springs within Leon, Wakulla, and Jefferson counties. The largest springs in the study area are Wakulla Spring, the Spring Creek Springs Group, and the St. Marks River Rise. The Wakulla, St. Marks, and Wacissa rivers all derive most of their base flow from the UFA, via springs and river rises along their course.

The UFA water level elevation at the dye injection site was roughly 28 feet MSL based on nearby UFA water level measurements from NWFWMD well (Lake Jackson UFA – 003402; Figure 6). This is within a larger gradient of the potentiometric surface that decreases in elevation from north to south and reaches a measured low of less than five feet MSL in the southern portion of the Woodville Karst Plain and Wakulla County.

The Woodville Karst Plain is known for its karst landscape and extensive subsurface network of flooded conduit systems. The Woodville Karst Plain Project (WKPP), an exploration research dive team, has mapped more than 56 miles of this extraordinary and complex conduit network (C. Werner, 2023, personal communication). The extent of the conduit system is informally referred to as the “Wakulla Cave System”. Over several decades the dive team(s) have linked together the larger conduit system via access through karst windows, swallets, and springs.

Diver cave surveys provide insight into the litho- and hydrostratigraphic framework. The Eocene, Oligocene, and Miocene carbonates in the study area are permeable, transmissive, and hydrostratigraphically part of the FAS. However, these carbonates exhibit notable differences with respect to porosity and permeability. These characteristics are principally driven by grain size, grain type, cementation, secondary dolomitization, and recrystallization and contribute to secondary porosity development. Based on cave diver observations and geologic mapping, these well-developed conduits are predominantly contained within the Oligocene Suwannee Limestone (Lane, 1998; Werner, 1998; Werner, 2001).

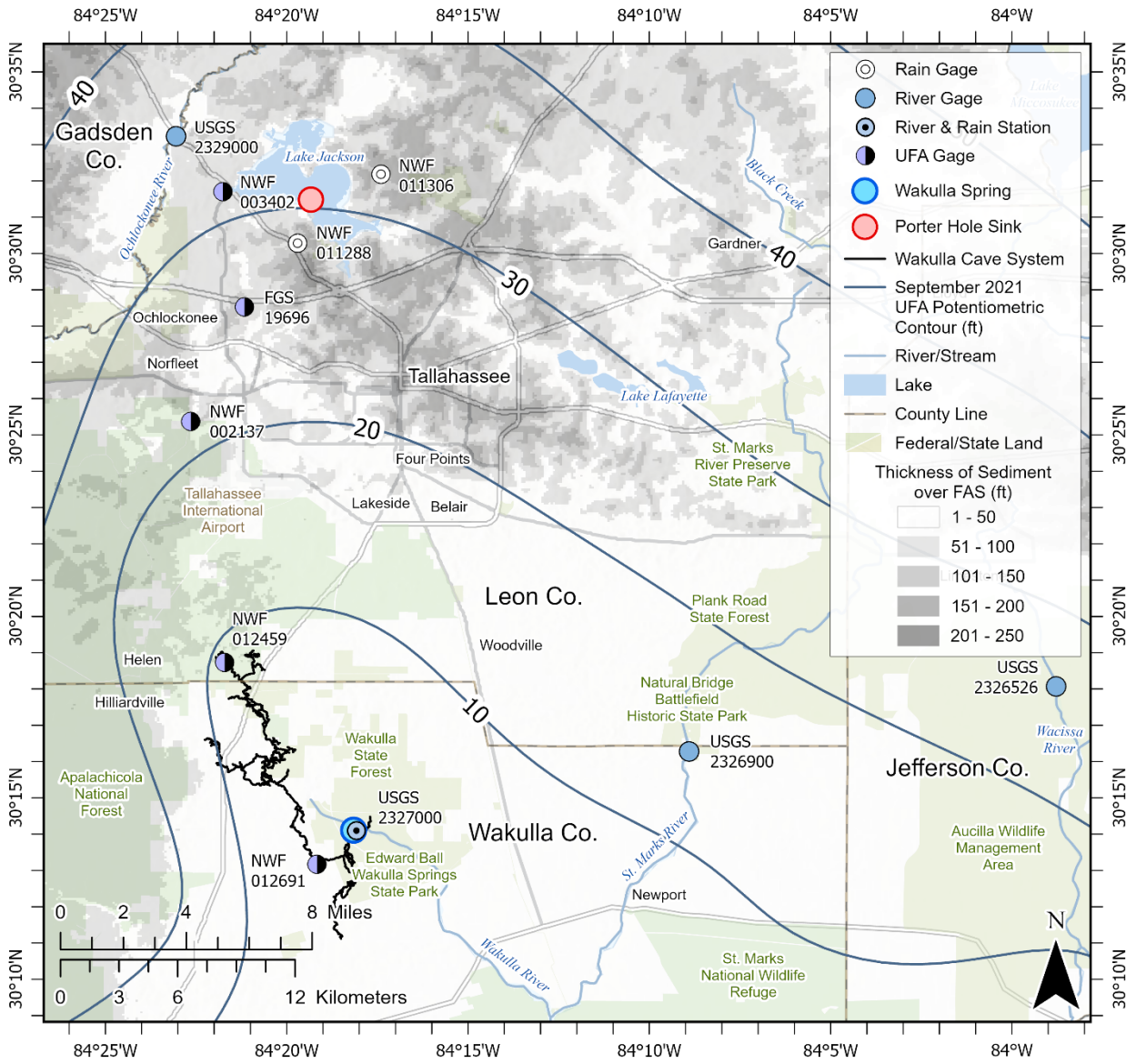


Figure 6. Locations and spatial distribution of precipitation stations, river gages, and local UFA potentiometric surface contours in the study area. UFA water level and precipitation data obtained from NWFWMD and the FGS. River gage data obtained from USGS. Potentiometric surface of the UFA for September 2021 (Fowler and Lupo 2024).

The study area experienced seasonal wet/dry periods (Figures 7 and 8) throughout the duration of the Porter Hole Sink dye trace. The locations and distribution of precipitation, river gage, and UFA water level elevations monitoring stations within the study area are indicated on Figure 6. On August 16, 2021, Tropical Storm Fred made landfall just northwest of Cape San Blas, Florida and produced a narrow swath of rainfall (5 – 9 inches) throughout the Florida Panhandle (Berg, 2021). This precipitation event, among others, was recorded at the Lake Jackson Forest Meadows City Park (NWFWMD 011306) and the Abundant Life Fellowship (NWFWMD 011288) rain gages as well as the Edward Ball Wakulla Springs State Park (USGS 02327000) rain

gage. Beginning with Tropical Storm Fred, and in the months following, a total of 20.57 and 18.95 inches of rainfall was recorded at Lake Jackson and Edward Ball Wakulla Springs State Park, respectively, from August 16, 2021 to December 31, 2021. Data from UFA wells and river gages (Figure 6) were reviewed for trends and are discussed below to provide an enhanced analysis of the hydrologic response to precipitation events in the study area (Figures 7 and 8).

Data from four USGS river gage stations were also reviewed and compared to precipitation data for the study period (Figure 7). The Ochlockonee River displays a broad, relatively more attenuated, and higher magnitude response to precipitation events and seasonal wet/dry periods. The response to precipitation events in the Wakulla, St. Marks, and Wacissa rivers is best described as "flashy" and the relative fluctuation(s) between "high" and "low" stages are noticeably more discrete. The smoother and higher magnitude stage fluctuations observed in the Ochlockonee River data are attributed to its larger drainage basin, dominant surface water component, and comparatively low groundwater contribution, a consequence of the underlying geology and limited interaction with the FAS. The distinct fluctuations and lower amplitude stage height variations observed in the Wakulla, St. Marks, and Wacissa rivers are attributed to the significant contribution of groundwater from the UFA to base flow.

Data from five (four NWFWMD and one FGS) UFA monitoring wells within the study area were reviewed and compared to precipitation events (Figure 8). Three of the monitoring wells are cased into confined to semi-confined portions of the UFA in the study area. Data from these wells display low amplitude, large wavelength fluctuations in water level elevations with broader response times. The synchronous responses observed in these three wells reflect the uniform head pressure changes within the confined UFA along the northwest margin of the study area. In contrast, water level data from two monitoring wells in the unconfined portion of the UFA in the southern portion of the study area displays more variation in response to rainfall events.

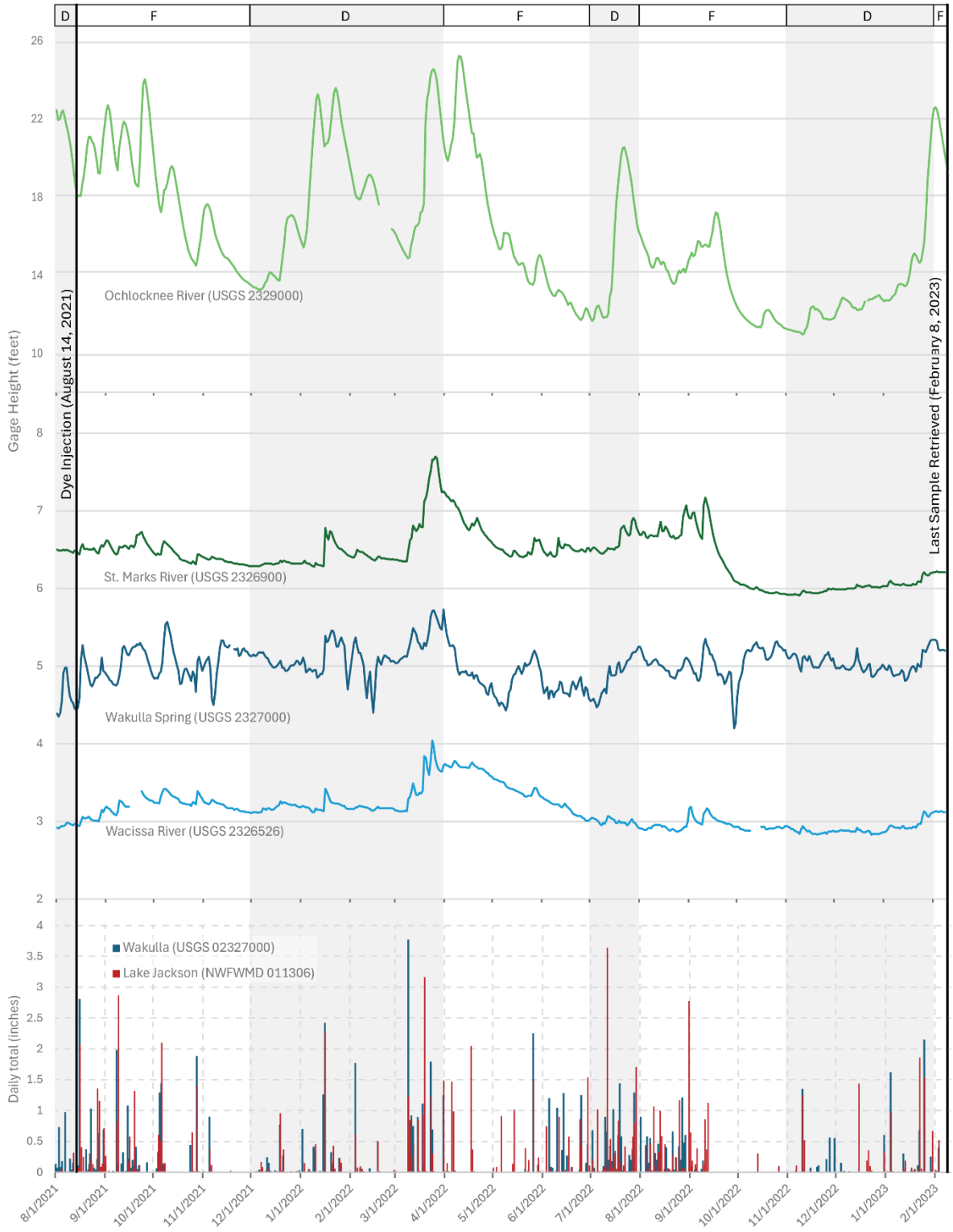


Figure 7. Precipitation values recorded at stations proximal to Lake Jackson and Edward Ball Wakulla Springs State Park with corresponding river stage data from select USGS monitoring sites. At the top of the figure panel, gray and white bars (D/F) indicate Lake Jackson's observed water level, D = Drained/draining and F = Filled/filling.

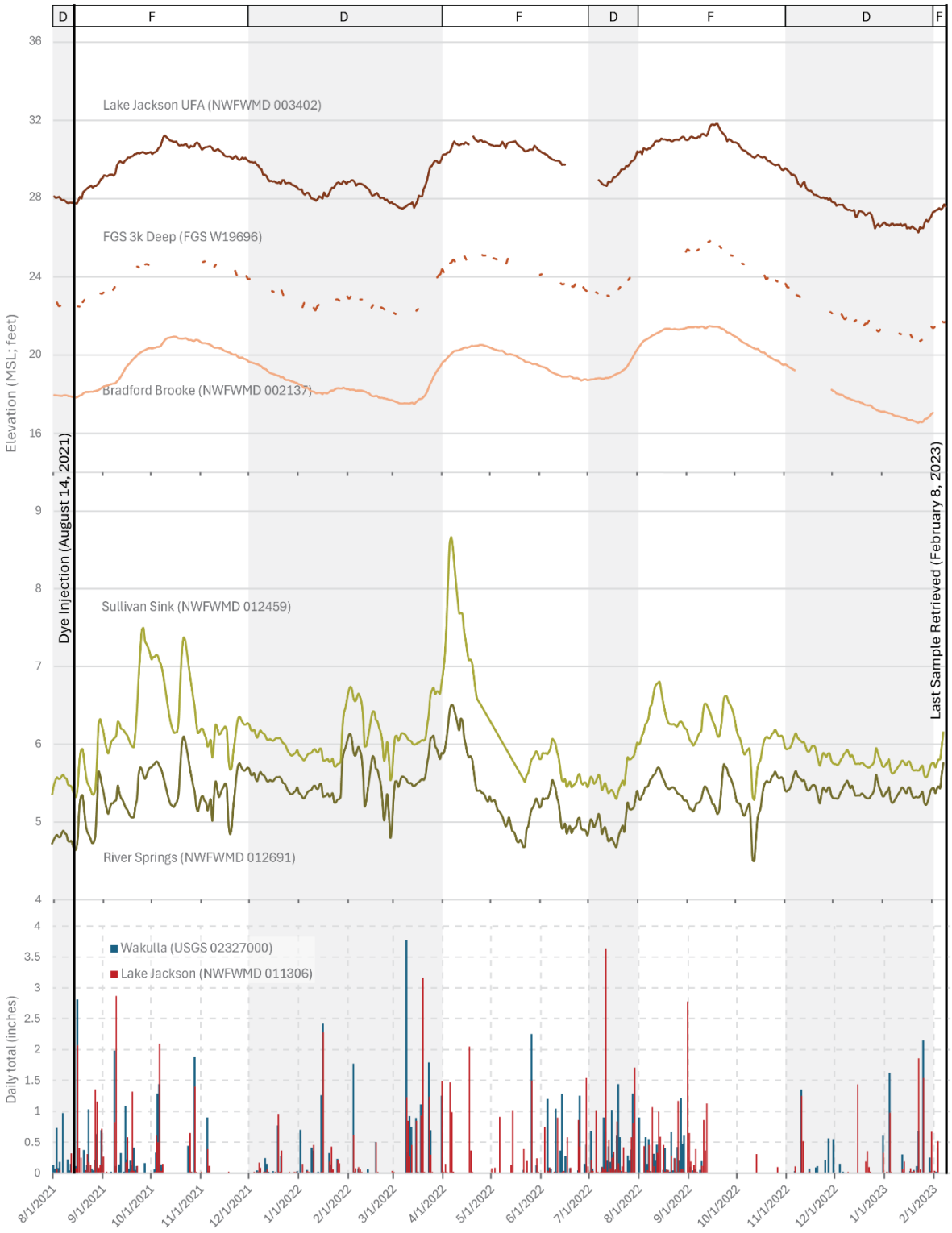


Figure 8. Precipitation and corresponding UFA well water level data from select monitoring wells operated by the NWFWMD. At the top of the figure panel, gray and white bars labeled (D/F) indicate Lake Jackson's observed water level, D = Drained/draining and F = Filled/filling.

METHODS

Dye Introduction

Porter Hole Sink was selected as the introduction site for this trace because of its large catchment area, connectivity to the UFA, and accessibility during the 2021 dry-down. The dry-down event provided the opportunity to test for a direct connection from Lake Jackson Porter Hole Sink to Wakulla Spring and to track the movement of dye at down gradient sampling locations across the study area.

On August 14, 2021, a team of FGS staff along with staff from DEP and the NWFWMD mixed 50 pounds of 75% fluorescein powdered dye with residual lake water pumped from a smaller lakebed sinkhole adjacent to Porter Hole Sink in a large livestock trough (Figures 9). The fluorescein dye-water mix was then gravity-fed through a 0.75 inch commercial-grade garden hose into Porter Hole Sink (Figure 10).



Figure 9. Mixing dye in the livestock trough with residual lake water pumped from a lakebed sinkhole to the right of the canopy.

The staff were divided into two teams. One team was devoted solely to mixing and introducing the dye. The second team provided logistical assistance between those mixing and introducing the dye. Separate teams were created to limit the possibility of cross-contamination to the best extent possible. The team working with the dye wore disposable overalls, nitrile gloves, shoe covers, and taped cuffs to limit the possibility of dye contaminating team members' clothing and skin. Post introduction, all coverings were carefully removed, sprayed liberally with a bleach solution, and sealed in thick construction trash bags for appropriate disposal. The dye was transported to and from the site in a vehicle that was not used for subsequent sampling.



Figure 10. Dye gravity feeding into the Porter Hole Sink aven. Residual lake water can also be seen flowing into the aven.

Sample Plan, Locations, and Methods

The 2021-2023 Porter Hole Sink trace was designed based on standard methods and procedures outlined in Aley (2019) and previous traces conducted and outlined in multiple FGS reports and other publications (Greenhalgh and Fowler, 2016; Greenhalgh et al., 2016; Ahmed et al., 2021). Several factors specific to the hydrologic system, dye introduction, and sampling sites were considered when selecting a dye for the Porter Hole Sink trace. These factors included adsorption potential, pH, temperature, water quality, turbidity, sediment load and type (Aley, 2019), and other dye tracing research activity within the basin. As previously stated, 50 lbs. of 75% fluorescein dye was selected for this study based on the almost 20-mile distance from Porter Hole Sink to Wakulla Spring. Fluorescein was selected because of its visual and analytical detectability (Table 1) and performance factors, namely its resistance to adsorption onto inorganic material and its proven performance in previous Florida karst traces.

Table 1. The Method Detection Limit (MDL) values reported for the five most recommended dyes in water conditions free of turbidity and color (Aley, 2019). Detection values reported here correspond to the condition parameters listed. Concentrations are in parts per billion (ppb) using Ozark Underground Laboratory dye mixtures and samples were analyzed using a Shimadzu RF 5301 spectrofluorophotometer. For parameters where water is listed, assume an adjusted pH >9.5 for Pyranine, Eosine, and Fluorescein. MDL = Method Detection Limit.

Parameter (ppb)	*Rhodamine WT*	*Sulforhodamine B*	*Pyranine*	*Eosine*	*Fluorescein*
Dye in water; instrument analysis MDL	0.015	0.008	0.010	0.015	0.002
Dye in elutant; instrument analysis MDL	0.170	0.080	0.015	0.050	0.025
Dye in water; field conditions	125-2,500	50-1,000	175-3,500	135-13,500	7-140
Dye in water; dark room	50	5	3	10	2

A total of 26 stations were sampled throughout the project period including 22 continuously monitored stations and four City of Tallahassee wells sampled once each (Figure 11). Sample sites were selected based on their distribution across the study area, proximity to perceived eastern and western limits of Wakulla Spring's contribution area, and relationship to the Wakulla Spring cave system. Various karst features either connected to, or believed to be connected to, the Wakulla Cave System and suspected to be in the potential path of dye were sampled. Several springs, spring-fed rivers, two river sites, and a river rise were monitored. The sampling locations were selected to provide a more comprehensive understanding of the interconnectivity, flow velocities and travel time of groundwater across the study area, and to monitor the three-dimensional nature of the groundwater system.

This was achieved by sampling targeted depths in UFA monitoring wells. The UFA monitoring wells were sampled with granular activated carbon packets and bailers at depths determined to be most transmissive by available borehole geophysical logs and well construction reports. When geophysical logs were not available, granular activated carbon packets were placed at a depth halfway between the bottom of the well casing and the total depth of the well, or in uncased zones where caliper logs indicated an increase in borehole diameter.

Four City of Tallahassee (COT) consumptive use wells (COT6, COT9, COT13 and COT23) were sampled during the trace (Figure 11). These wells were selected based on modelled contribution areas for COT wells (Davis and Katz, 2007). On August 18, 2021 a grab sample was collected from COT 23. To explore every potential avenue, FGS staff coordinated with COT staff to sample granular activated carbon (GAC) media from wells that had not been refreshed since before the trace began. Between June 15, 2023 and August 25, 2023 GAC media was sampled from COT6, COT9, and COT13. The GAC systems at COT6, COT9, and COT13 were backwashed and GAC media collected in sieves were sent to OUL for testing.

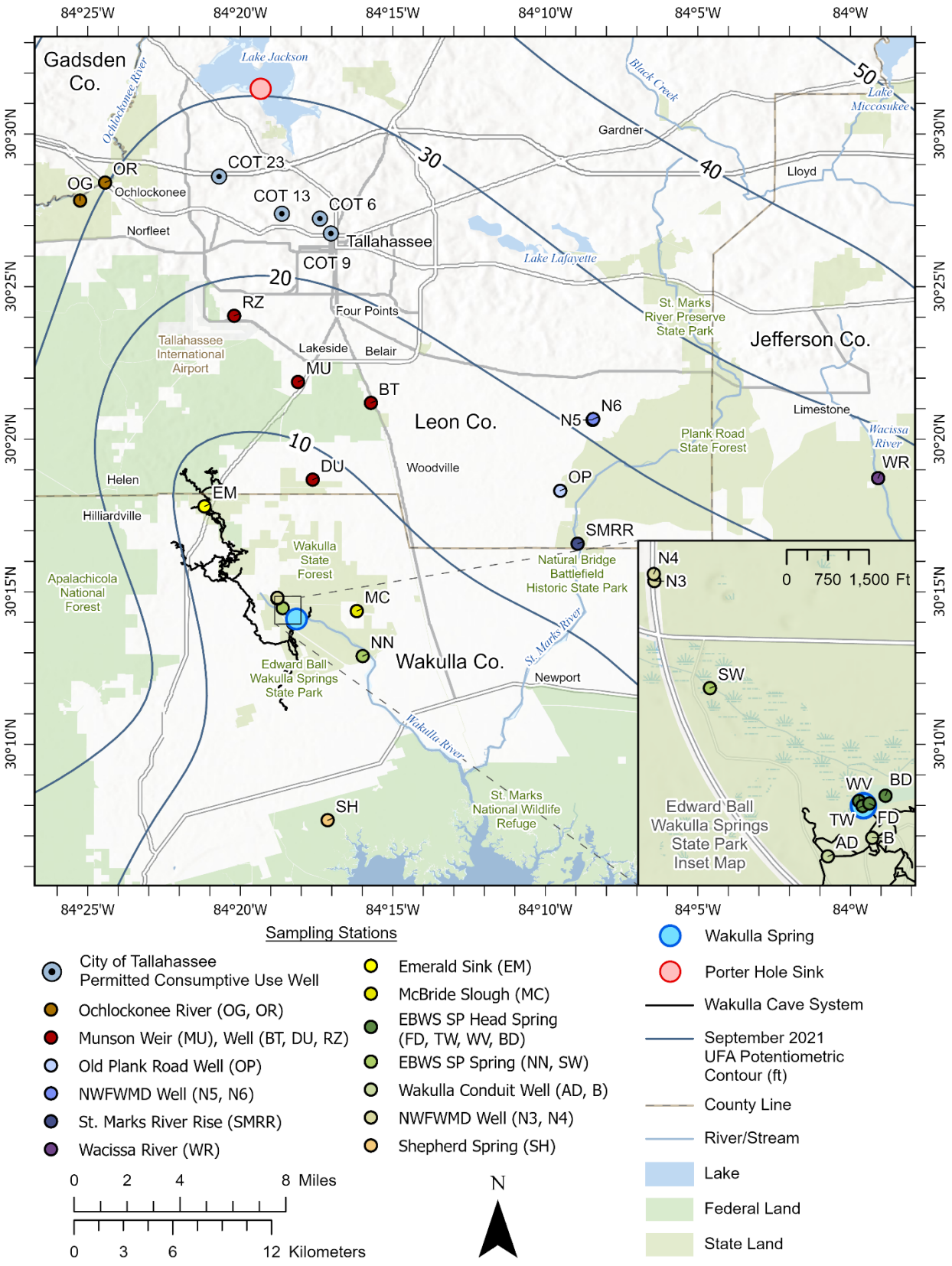


Figure 11. Sample station locations for the Porter Hole Sink dye trace.

The sample plan evolved throughout the duration of the project. Sampling intervals were extended, and some sites were dropped as the project spanned a 20-month period from the onset of background sampling (July 16, 2021) to the last three sample sites being abandoned to close out the project (February 6-9, 2023; Table 2; Figure 12).

Granular activated carbon packets were used to sample each site and water samples were also collected at each site (at time of deployment/retrieval) to provide additional confirmation of dye arrival time(s) and concentration(s). Bailers or peristaltic pumps were used to sample groundwater from UFA monitoring wells. A Teledyne ISCO® autosampler was used to collect discrete timed-interval water samples from the Wakulla Spring vent at Edward Ball Wakulla Springs State Park, a method commonly implemented to capture a breakthrough curve, thus providing higher resolution data for dye arrival, peak, tail, and duration times. Equipment blanks were collected at regular intervals. More than 1,000 samples were collected during the 2021-2023 Porter Hole Sink dye trace and almost 400 samples were analyzed (Appendix C).

Table 2. Evolution of the sample plan in phases throughout the duration of the project. Stations dropped from the sample plan and the dates they were dropped appear on the far right. Refer to Figures 11 and 12 for complete station names and locations.

Phase	*Start Date*	*Charcoal Soak Time*	*ISCO Samples per Day*	*AD, B Conduit Grab Samples*	*Stations Dropped (Date Abandoned)*
I	8/14/2021	2 weeks	4	Every 4 days	--
II	10/29/2021	3 weeks	3	Every 4 days	--
III	1/10/2022	4 weeks	2	Every 4 days	MU (1/13/2022), OR (2/7/2022), TW (2/9/2022)
IV	4/5/2022	5 weeks	1	NS	BT, DU, EM, MC, RZ, OG (4/5/2022); OP (4/12/2022)
V	7/21/2022	6 weeks	1/48 hr.	NS	N3, N4 (7/20/2022); N5, N6 (7/21/22); SH (9/7/2022)
VI	8/29/2022	4-6 weeks	1/48 hr.	NS	BD, SW, NN (1/26/2023); WV (2/6/2023); SMRR, WR (2/9/2023)

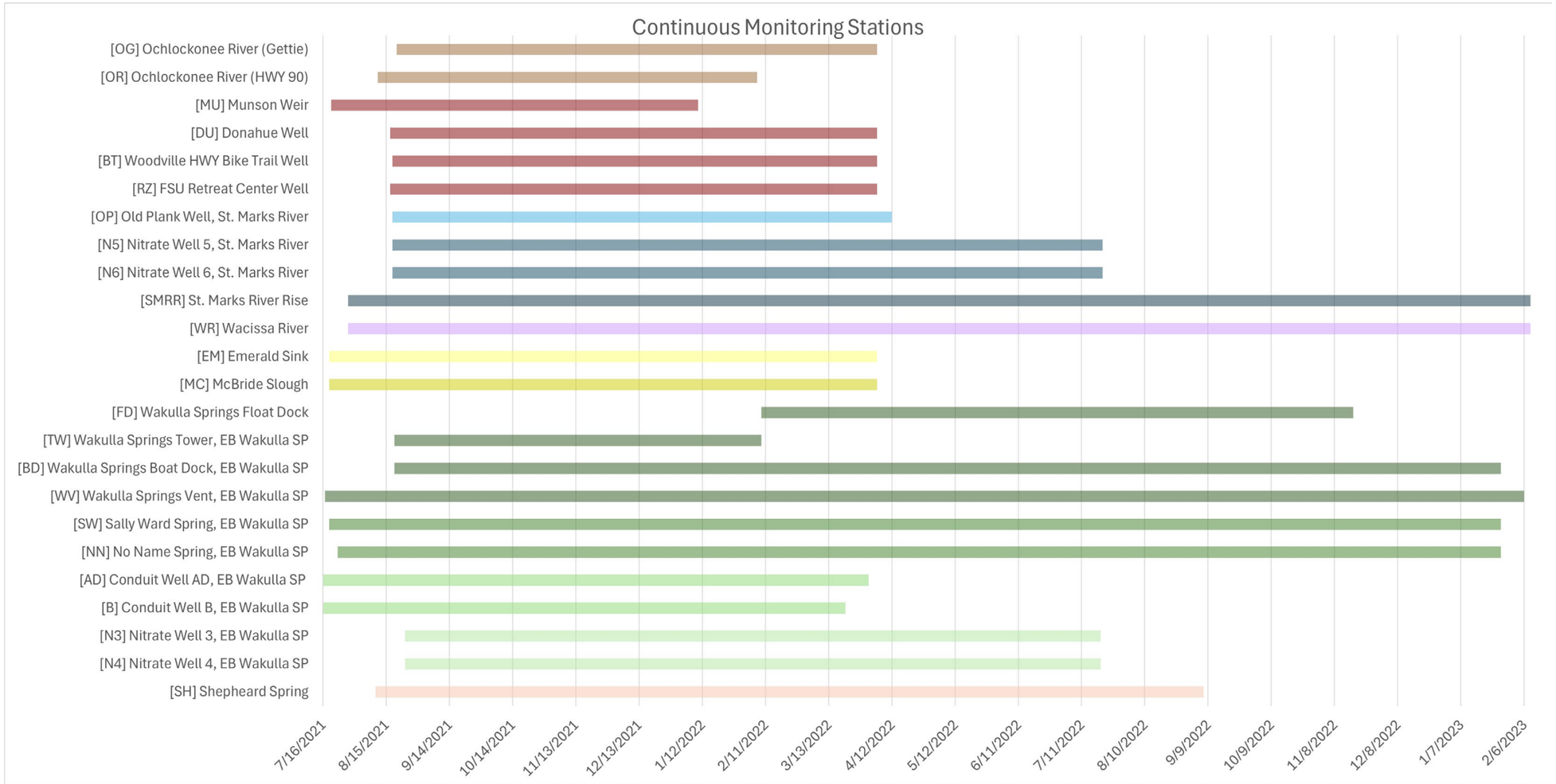


Figure 12. Twenty-two stations were monitored during portions of the trace. These sites and their respective sample durations are indicated above and grouped based on their proximity. Note: Wakulla Spring stations (FD, TW, BD) are considered here as one discrete station as they are all proximal to the main vent and were used interchangeably based on ease of access. City of Tallahassee wells are omitted from the figure above as they were sampled once.

Laboratory Analyses

The following is a general overview of laboratory sample processing steps conducted by Ozark Underground Laboratory (OUL) per their published methods. See Aley and Beeman (2015) for additional information. Granular activated carbon samples were sent to OUL for analysis. Once received by the lab, the granular activated carbon samples are cleaned by washing with non-chlorinated water to remove any residue or dirt. The samples are then eluted with OUL's mixture of 5% aqua ammonia and 95% isopropyl alcohol solution and "sufficient potassium hydroxide pellets to saturate the solution" (Aley and Beeman, 2015). To prepare for fluorescein detection, the pH of water samples is adjusted to a target value greater than 9.5. This pH adjustment allows the lab to obtain maximum fluorescence intensities and is achieved by placing the samples in a high ammonia environment. Finally, the samples are analyzed on a Shimadzu RF-5301 spectrofluorophotometer.

RESULTS AND DISCUSSION

After 18 months of sampling, there were zero detections of the fluorescein dye introduced into Porter Hole Sink. Possible reasons why dye was not detected have been distilled down to the following hypotheses: 1) an insufficient quantity of dye was used (dilution), 2) dye degradation (by low pH meteoric water), 3) dispersion, 4) partial or complete capture and/or thermal degradation of the dye by public supply and thermal exchange wells (siphoning), or 5) the spatial distribution and/or density of sample stations were not adequate for this study area. A fluorescent signature for rhodamine dye was detected twice over the course of 18 months. The origin of that detection is unknown; however, it could be residual dye from previous traces conducted in the study area by other researchers or fluorescence interference from both natural and anthropogenic compounds such as tannins, nutrient loading, and runoff.

Dilution, Degradation, and Dispersion

Dye dilution, degradation, and dispersion are the prevailing hypotheses as to why dye was not detected in this study. There are several environmental, hydrological, and anthropogenic factors that potentially affected dye detection in the samples retrieved and analyzed. The interaction between surface water and groundwater and hydrological flow regime within the UFA is not fully understood due to the karstic nature of the aquifer. The presumption, based on UFA potentiometric surface maps, and previous dye traces conducted locally, is that surface water infiltrates the aquifer, and flows down gradient, toward central Wakulla County (Figure 11 and Appendix A). When Lake Jackson maintains a consistent lake pool stage, water drains through Porter Hole Sink into the UFA. Under such conditions, lake water entering the UFA is presumably traveling along established flow paths. When the water in Lake Jackson completely drains through Porter Hole Sink, and other lakebed sinkhole features, it creates conditions of variable confinement resulting in periods of intermittent or diminished flow of lake water into the underlying UFA.

During the 2021 dry-down event, Porter Hole Sink effectively acted as a swallet, allowing lake water to rapidly recharge the underlying UFA. Field observations, coupled with recorded changing head pressure(s) and our understanding of available storage space in the UFA, are identified as mechanisms that have the potential to affect flow from Lake Jackson and Porter Hole

Sink into and through the UFA. Exploration and cave mapping via SCUBA divers in the Woodville Karst Plain has confirmed that swallets lead to complex conduit systems that can bifurcate, converge, and terminate within the UFA. The geospatial trend of these conduits at site specific locations does not always align with the dominant flow direction indicated by the regional potentiometric surface. Because of these factors, the direction and spatial extent of recharged lake water moving into and within the UFA is not fully understood. However, given our understanding of regional flow models, previous trace results in the basin, local river stage, UFA well elevation(s), and precipitation, all data indicate the dominant direction of flow and spatial extent of recharged lake water in the UFA is to the south. The ability of the UFA to accommodate and rapidly disperse the enormous volume of water from Lake Jackson within the aquifer is a function of both the transmissivity of the UFA and the head differential between the lake pool elevation of Lake Jackson (~87 feet MSL) and the UFA head elevation (~30 feet MSL; Figures 6 and 8).

Dye was introduced into the UFA on August 14, 2021 via Porter Hole Sink when the UFA potentiometric surface was at a seasonal minimum (Figure 8). During the four-day span, August 14, 2021, to August 18, 2021, the Lake Jackson area received more than three inches of rainfall. This extensive precipitation recharging Lake Jackson's 42 square mile lake basin immediately following dye introduction led to dye dilution. From August 1, 2021, through September 30, 2021, more than 13 inches of precipitation were measured and reported from two rain gages within a couple of miles of Porter Hole Sink. Precipitation of this magnitude over the study area, compounded by allogenic recharge at multiple swallets west of S.R. 369 (U.S. Highway 319) further exacerbated dilution of the dye. A concurrent study conducted by Compare and Ye (2025) similarly concluded that the volume of water introduced into the system via Tropical Storm Fred likely facilitated attenuation or dilution of traceable downgradient analytes. In the referenced study, Compare and Ye (2025) collected and analyzed samples from Lake Jackson, a UFA well at Florida State University, and Wakulla Springs and found no geochemical tracers evidencing lake water at Wakulla Spring.

Precipitation pH data acquired from the National Atmospheric Deposition Program were derived from rainfall collected at a Gadsden County, FL station (NTN Site: FL14; 30.5486 N, -84.6004 W) approximately 16 miles west of Porter Hole Sink. The precipitation reported at this station from August 10, 2021 to August 17, 2021 during the time of dye injection was measured with a pH of 5.19. It is possible the dye was chemically degraded due to low pH values associated with precipitation; however, this mechanism of degradation is considered least likely because the UFA, as a limestone aquifer, would effectively and rapidly buffer the rainwater, once in the aquifer, to a pH compatible with fluorescein stability. It is worth noting that precipitation pH values collected at that station suggest an overall trend toward neutral pH. Therefore, although pH degradation is a possibility, prior FGS experience using fluorescein for traces in similar hydrologic conditions in north Florida suggests that degradation due to pH is not a significant factor (e.g. Kincaid et al., 2007; 2012a; Ahmed et al., 2021). However, for general reference we include Aley (2019) Table 3 which reports the fluorescence and stability of fluorescein at various pH values.

No dye was detected in the GAC media from the COT wells sampled from June 15, 2023 to August 25, 2023. This is likely due to dilution, degradation, or dispersion as discussed within

this section, but could also be a result of other factors. The samples from GAC vessels were collected using a backwashing technique. Backwashing GAC vessels involves using well water to reverse flow through the vessel. This lifts the GAC within the vessel and allows granules to escape with the water exiting the system through a backflow valve. These COT wells were selected because their modelled contribution areas include Lake Jackson and the GAC media present in the vessels had not been recharged at any point during the trace. Limited sample material was collected from the vessels. Due to construction and access limitations, the vessels were unable to be selectively or serial sampled throughout the GAC column. If dye was captured by the GAC vessel(s), it is possible the carbon that captured the dye was not sampled. City of Tallahassee wells are collectively permitted to withdraw a maximum of 33.7 million gallons per day (GPD). It is also possible that any dye captured by the carbon was diluted and degraded. Lastly, well water used to backflow and sample the GAC vessel has ultimately undergone some level of chlorination and treatment. Chlorinated water would likely enhance the dilution and degradation of any dye captured at these sites.

Table 3. Fluorescent properties based on type of dye relative to pH values from Aley (2019).

Dye	*Fluorescent properties severely compromised (pH < X)*	*Fluorescent properties eliminated (pH < X)*
Eosine	4.0	2.5
Fluorescein	6.5	5.5
Pyranine	9.5	6.5
Rhodamine WT	5.0	2.5
Sulforhodamine B	3.5	2.0

Siphoning

The City of Tallahassee is situated between Porter Hole Sink and the sampling stations in Leon, Wakulla, and Jefferson counties. The infrastructure required to support the Tallahassee area has expanded significantly in the last four decades. Development has altered the predevelopment hydrology. Extraction of water from the UFA by consumptive use wells may have been a reason why there were no dye detections during the Porter Hole Sink dye trace (Figure 13).

Thermal heat exchange system wells, a type of consumptive use well that uses groundwater for heating and cooling systems are used at the two major universities and at other state and industrial buildings within the study area. The nature of these wells, both open- and closed-loop systems, their location(s), construction, and status were explored to identify any potential effects on the dye and thus our results. Based on the data available through the DEP Underground Injection Control and NWFWMD, we were unable to confirm the following: 1) the operating status of these wells during the study period; 2) how many are open- or closed-loop systems, 3) well construction depths for intake and output, or 4) an average or maximum system temperatures. Without answers to these four variables, it is not possible to reasonably assess the potential impact on the dye or the results of this study. If groundwater containing dye was intercepted by one or

more of these thermal heat systems the natural flow path and travel time could be changed. Additionally, these thermal heat systems could have the potential to thermally degrade the dye.

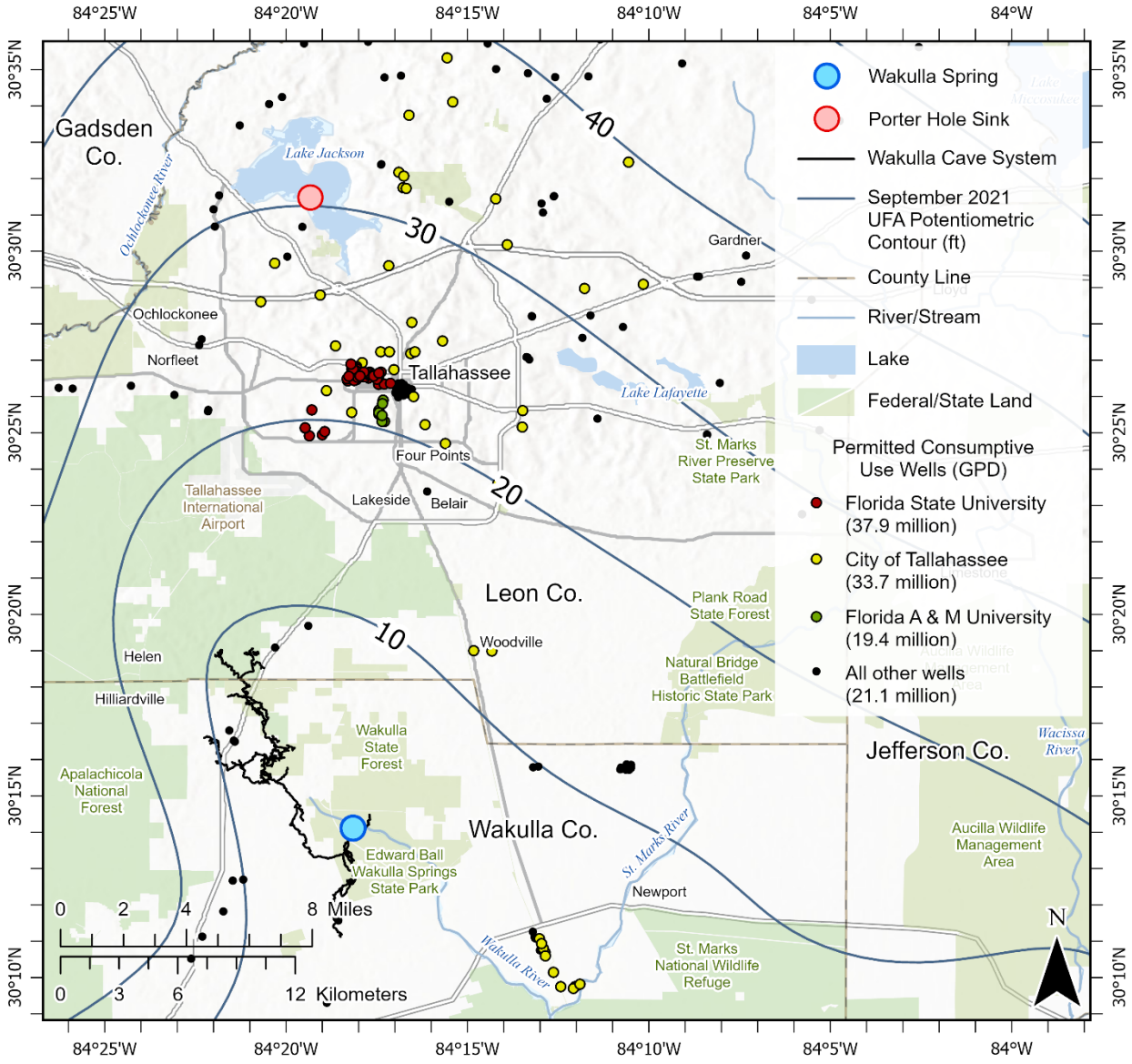


Figure 13. Map of consumptive use wells in the Porter Hole Sink dye trace study area. Well data acquired from the Northwest Florida Water Management District.

It is notable that a high density of public water supply and thermal heat system wells are within the U-shaped configuration of the UFA potentiometric contours (Figure 13). It is possible that the dilution and degradation which may have occurred within the basin by low pH meteoric water was exacerbated by the extraction, siphoning, and cycling of the dyed water by public supply and thermal exchange system wells between Porter Hole Sink and sampling stations south of Tallahassee.

A total of 255 public water supply wells are permitted in Leon and Wakulla counties. In total, these permits allow for up to 112.2 million GPD to be extracted. The combined quantity of groundwater extracted by the 255 public water supply wells, in addition to the "cycling and heating of water" by heat pump supply wells, potentially interrupted the natural groundwater flow, extracted dyed water, or further diluted the dye before reaching sampling stations down gradient within the study area. The quantity of water extracted from UFA by consumptive use wells within the study area during the Porter Hole Sink trace was not calculated, nor was the Porter Hole Sink dye trace meant to be quantitative. However, based on the well density and their position between the dye injection and sample sites, it is possible the permitted wells affected the dye trace results.

Distribution and Density of Sample Stations

The 26 sample stations were distributed primarily throughout the Woodville Karst Plain Province in Leon and Wakulla counties. Locations of major springs, such as Wakulla Spring and St. Marks River Rise, and other proximal karst features were prioritized for sampling. The Ochlockonee River and Wacissa River were monitored as the western and eastern geographic boundaries, respectively. Shepherd Spring was the most southern and distal downgradient location sampled. The stations closest to Porter Hole Sink are located on the Ochlockonee River and throughout southern Leon County (Figure 11). Future dye trace designs for Porter Hole Sink should consider establishing a sampling network of UFA monitoring well locations proximal to and downgradient of Lake Jackson. Detections at such locations would provide insight into many of the factors discussed above.

CONCLUSIONS

The 2021-2023 Porter Hole Sink dye trace was conducted with the goal of characterizing groundwater flow in the UFA between Lake Jackson, a large sinkhole lake feature located in northwest Leon County, and other downgradient significant karst features in Leon, Wakulla, and Jefferson counties. Fluorescein dye was introduced through Porter Hole Sink in August of 2021, and sampling concluded in February of 2023. No fluorescein dye was detected at any sample locations. The study was unable to confirm a connection between Porter Hole Sink and Wakulla Spring under the 2021 drawdown hydrological conditions at Lake Jackson and the numerous other potential challenges outlined above. A subsequent dye trace, designed to minimize the potential pitfalls identified in this study, may provide additional insight.

REFERENCES

Ahmed, N., Ye, M., Wang, Y., Greenhalgh, T. and Fowler, K., 2021, Using δ18O and δ2H to Detect Hydraulic Connection Between a Sinkhole Lake and a First-Magnitude Spring. Groundwater, vol. 59, no. 6, p. 856-865, https://doi.org/10.1111/gwat.13105.

Aley, T., 2019, Groundwater Tracing Handbook: A handbook prepared for the use of clients and colleagues of the Ozark Underground Laboratory 2019: Protem, MO, Ozark Underground Laboratory, 41 p.

Aley, T., and Beeman, S.H., 2015, Procedures and criteria analysis of fluorescent dyes in water and charcoal samplers: fluorescein, eosine, rhodamine WT, and suflorhodamine B dyes: Protem, MO, Ozark Underground Laboratory, 20 p.

Banks, J.E., and Hunter, M.E., 1973, Post-Tampa, Pre Chipola sediments exposed in Liberty, Gadsden, Leon and Wakulla Counties, Florida: Gulf Coast Association of Geological Societies Transactions, v. 23, p. 355-363.

Berg, R., 2021, National Hurricane Center Tropical Cyclone Report: Tropical Storm Fred (AL062021): National Hurricane Center, 56 p. https://www.nhc.noaa.gov/data/tcr/AL062021_Fred.pdf (Accessed June 2026).

Brewster-Wingard, G.L., Scott, T.M., Edwards, L.E., Weedman, S.D., and Simmons, K.R., 1997, Reinterpretation of the peninsular Florida Oligocene: an integrated stratigraphic approach: Sedimentary Geology, v. 108, no. 1-4, p. 207-228, https://doi.org/10.1016/S0037-0738(96)00055-3.

Compare, K. and Ye, M., 2025, Long- and short-term impacts of lake dry-downs on groundwater geochemistry for a sinkhole lake in Florida: Environmental Earth Sciences, v. 84, no. 698, https://doi.org/10.1007/s12665-025-12718-y.Cooke, C.W., and Mansfield, W.C., 1936, Suwannee limestone of Florida: Geological Society of America Proceedings 1935, p. 71-72.

Davis, J.H., and Katz, B.G., 2007, Hydrogeologic Investigation, Water Chemistry Analysis, and Model Delineation of contributing Areas for City of Tallahassee Public-Supply Wells, Tallahassee, Florida: U.S. Geological Survey Scientific Investigations Report 2007-5070, 67 p.

Finch, J., 1823, Geological essay on the Tertiary formation in America: American Journal of Science, v. 7, p. 31-43.

Fowler, G.D., III, and Lupo, M.E., 2024, Potentiometric Surface of the Upper Floridan aquifer September 2021: Florida Geological Survey Map Series 165, scale 1:900,000, https://doi.org/10.35256/MS165.

Greenhalgh, T.H., and Fowler, K.R., 2016, Alapaha Swallets Dye Trace Project: A report prepared for the Suwannee River Water Management District, 30 p.

Greenhalgh, T.H., Kuersteiner, K.R., and White, K., 2016, Middle Suwannee Basin Spring Recharge Area Delineation Project Suwannee and Lafayette Counties, Florida July 2014-November 2015: A report prepared for the Suwannee River Water Management District, 41 p.

Hendry, C.W., Jr., and Yon, J.W., Jr., 1967, Stratigraphy of upper Miocene Miccosukee Formation, Jefferson and Leon Counties, Florida: American Association of Petroleum Geologists Bulletin, v. 51, no. 2, p. 250-256, https://doi.org/10.1306/5D25B7CF-16C1-11D7-8645000102C1865D.

Hendry, C.W., Jr., and Sproul, C.R., 1966, Geology and Ground-Water Resources of Leon County, Florida: Florida Geological Survey Bulletin 47, 178 p., 1 pl., https://doi.org/10.35256/B47.

Huddlestun, P.F., and Hunter, M.E., 1982, Stratigraphic revision of the Torreya Formation of Florida, *in* Scott, T.M. and Upchurch, S.B., eds., Miocene of the southeastern United States, Proceedings of a Symposium Held December 4-5, 1980, Tallahassee, Florida: Florida Geological Survey Special Publication 25, p. 210, https://doi.org/10.35256/SP25.

Huddlestun, P.F., 1988, A revision of the lithostratigraphic units of the coastal plain of Georgia: the Miocene through the Holocene: Georgia Geologic Survey Bulletin 104, 162 p.

Kincaid, T.R., Denizman, C., and Davies, G., 2002, Florida State University-Geophysical Fluid Dynamics Institute/Florida Geological Survey Woodville Karst Plain Research Collaboration: Summary and Results for Fiscal-Year 2002: A report submitted to the Florida Geological Survey, 54 p.

Kincaid, T.R. and Hazlett, T.J., 2004, Florida State University-Geophysical Fluid Dynamics Institute/Florida Geological Survey Woodville Karst Plain Research Collaboration: 2003-2004 Progress Report (with Poster), 139 p., 1 poster.

Kincaid, T.R., Hazlett, T.J., Loper, D., Davies, G., Day, K., Werner, C., and McClean, J., 2005, Hydrogeological Investigations in the Woodville Karst Plain: Science, Education and Outreach between the Florida Geological Survey and Florida State University for the Fiscal Year July 1, 2004 through June 30, 2005, 68 p.

Kincaid, T.R., Hazlett, T.J., Davies, G., Werner, C., and Loper, D., 2007, Hydrogeologic Characterization and Modeling of the Woodville Karst Plain, North Florida: Report of Investigations: 2005-2006, 89 p.

Kincaid, T.R. and H2H Associates, LLC, 2009, Woodville Karst Plain Hydrologic Research Program: Report on Tasks Performed in 2008 under FGS Contract GW272, 78 p.

Kincaid, T.R., Loper, D., Chicken, E., Dimova, N., and Burnett, W.C., 2010, Woodville Karst Plain Hydrologic Research Program: Report on Tasks Performed in 2009 under FGS Contract GW275, 59 p.

Kincaid, T.R., Meyer, B.A., and Day, K.E., 2012a, Woodville Karst Plain Hydrologic Research Program: Report on Tasks Performed in 2011 and 2012 Under FDEP Contract RM100

Amendment #3: A report prepared for University of West Florida and the Florida Geological Survey, 562 p.

Kincaid, T.R., Davies, G.J., Werner, C., and DeHan, R.S., 2012b, Demonstrating interconnection between a wastewater application facility and a first magnitude spring in a karstic watershed: Tracer study of the Southeast Farm Wastewater Reuse Facility, Tallahassee, Florida: Florida Geological Survey Report of Investigation 111, 192 p., https://doi.org/10.35256/RI111.

Lammers, J., 2021, History and Chronology of Lake Draining Episodes: Leon and Jefferson Counties, Florida: WFSU, https://blog.wfsu.org/blog-coastal-health/wp-content/uploads/2021/06/Leon-Lakes-Draining-Chronology_June-2021.pdf (Accessed June 2026).

Lane, E., 1998, The Florida Geological Survey: An Illustrated Chronicle and Brief History: Florida Geological Survey Special Publication 42, 70 p., https://doi.org/10.35256/SP42.

Puri, H.S., and Vernon, R.O., 1964, Summary of the geology of Florida and a guidebook to the classic exposures: Florida Geological Survey Special Publication 5 (Revised), 312 p., 11 pl., https://doi.org/10.35256/SP05R.

Rupert, F.R., and Spencer, S., 1988, Geology of Wakulla County, Florida: Florida Geological Survey Bulletin 60, 46 p., https://doi.org/10.35256/B60.

Sellards, E.H., Gunter, H., and Harper, R.M., Third Annual Report, 1909-10: Florida Geological Survey Annual Report 3, 397 p., https://doi.org/10.35256/AR03.

Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, compilers, 1986, Hydrogeological units of Florida: Florida Geological Survey Special Publication 28, 8 p., https://doi.org/10.35256/SP28.

Scott, T.M., 1988, The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida: Florida Geological Survey Bulletin 59, 148 p., https://doi.org/10.35256/B59.

Scott, T.M., 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 the State of Florida: Florida Geological Survey Map Series 146, scale 1:750,000, https://doi.org/10.35256/MS146.

Upchurch, S.B., 2007, An introduction to the Cody Escarpment, north-central Florida: A report prepared for the Suwannee River Water Management District, 13 p.

Wagner, J.R., 1984, Hydrogeologic assessment of the October 1982 draining of Lake Jackson, Leon County, Florida: Northwest Florida Water Management District v. 84, no. 1, 44 p.

Werner, C.L., 2000, Groundwater flow pattern analysis from cave exploration in the Woodville Karst Plain, Florida, *in* Schmidt, W., Lloyd, J.M., and Collier, C., compilers, The Wakulla Springs Woodville Karst Plain Symposium Transactions, October 9, 1998: Florida Geological Survey Special Publication 46, p. 37-43, https://doi.org/10.35256/SP46.

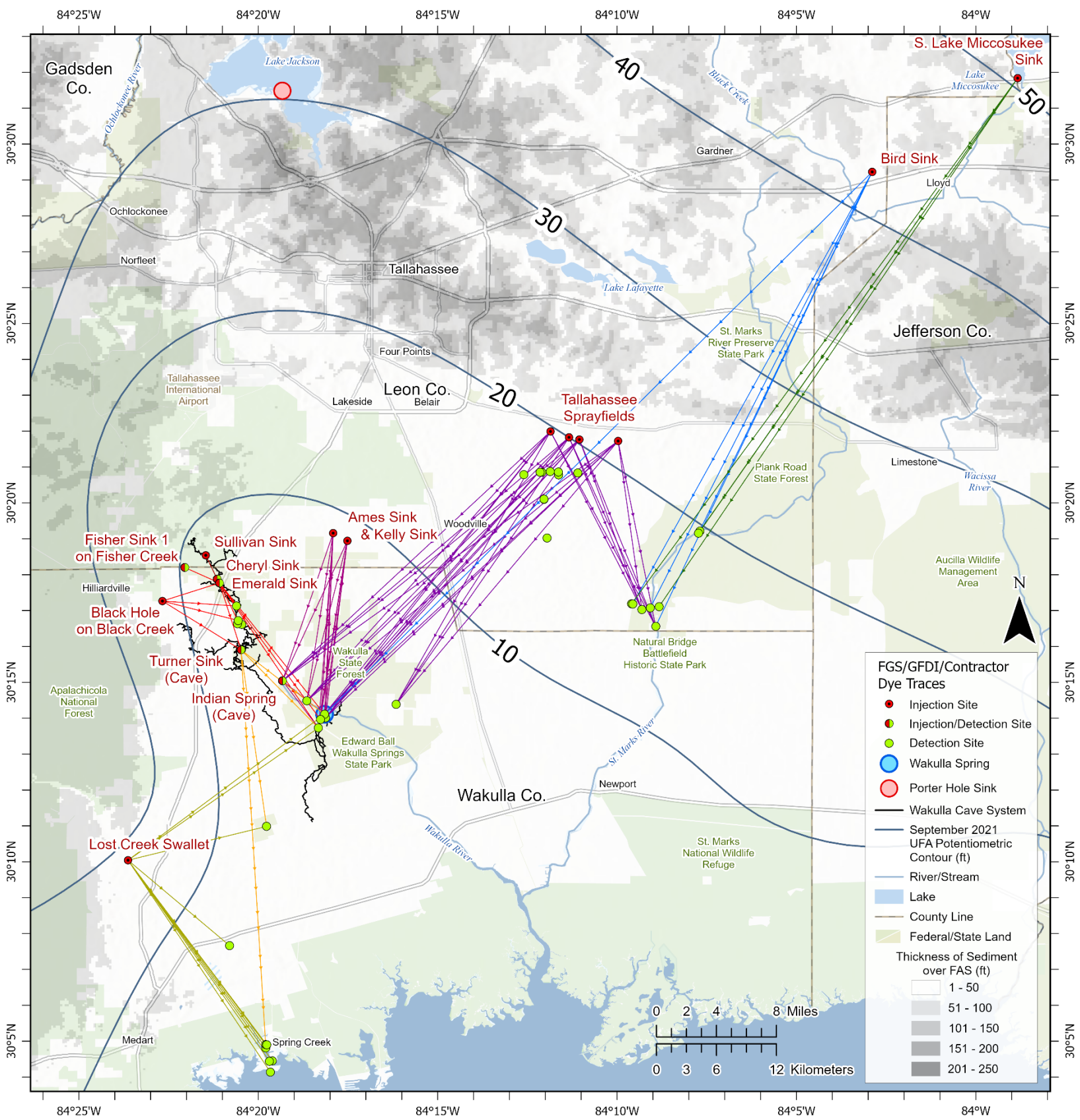
Werner, C.L., 2001, Preferential Flow paths in Soluble Porous Media and Conduit System Development in Carbonates of the Woodville Karst Plain, Florida [M.S. Thesis]: Tallahassee, Florida State University, 180 p.

Williams, C.P., Scott, T.M., and Upchurch, S.B., 2022, Florida Geomorphology Atlas: Florida Geological Survey Special Publication 59, 238 p., https://doi.org/10.35256/SP59.

Williams, L.J., and Kuniansky, E.L., 2016, Revised hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina (ver. 1.1, March 2016): U.S. Geological Survey Professional Paper 1807, 140 p., 23 pls., http://dx.doi.org/10.3133/pp1807.

Yon, J.W., Jr., 1966, Geology of Jefferson County, Florida: Florida Geological Survey Bulletin 48, 115 p., 1 pl., https://doi.org/10.35256/B48.

APPENDIX A: PREVIOUS FGS TRACES



Symbol	Trace Year	Trace Name	Injection Site	Detection Site(s)	Short Reference
	2002	Sullivan - Cheryl	Sullivan Sink	Cheryl Sink	Kincaid et al., 2002
	2002	Cheryl - Emerald	Cheryl Sink	Emerald Sink	Kincaid et al., 2002
	2004	Leon Sinks Cave - Wakulla Cave	Emerald Sink	Upper River Sinks, Turner Sink, Wakulla Conduit Well (K, A/K, A/D Tunnels), Wakulla Spring	Kincaid et al., 2004
	2004	Black Creek - Leon Sinks Cave	Black Hole on Black Creek	Emerald Sink, Fish Hole, River Sinks, Turner Sink, Wakulla Spring	Kincaid et al., 2004
	2004	Fisher Creek - Leon Sinks	Fisher-1 Sink on Fisher Creek	Emerald Sink	Kincaid et al., 2004
	2004	Ames Sink	Ames Sink	Indian Spring, Sally Ward Spring, Wakulla Conduit Well (K, D, B Tunnels), Wakulla Spring	Kincaid et al., 2005; Kincaid et al., 2007
	2004	Kelly Sink	Kelly Sink	Indian Spring, Sally Ward Spring, Wakulla Conduit Well (K, D, B Tunnels), Wakulla Spring	Kincaid et al., 2005; Kincaid et al., 2007
	2004	Turner	Turner Sink (Cave)	Wakulla Spring, Wakulla Conduit Well (K Tunnel), Revell Sink, Spring Creek Spring (#1, #2)	Kincaid et al., 2005; Kincaid et al., 2007
	2005	Indian	Indian Spring (Cave)	Wakulla Conduit Well (K Tunnel), Wakulla Spring	Kincaid et al., 2005; Kincaid et al., 2007
	2007	Tallahassee Spray Fields	SE06 (1333) - Well; SE40 (1311) - Well; SE11S (7269) - Well	SE Well (10, 21, 22A, 51, 53), USGS Well (SJ1, SJ2), McBride Slough (Composite), Indian Spring (Cave), Sally Ward Spring, Wakulla Conduit Well (B Tunnel), Wakulla Spring	Kincaid et al., 2007; Kincaid et al., 2012b
	2007	Tallahassee Spray Fields	Turf Pond Sink	SE Well (10, 21, 22A, 51, 53), USGS Well (SJ1, SJ2, SJ7), McBride Slough (Composite), Indian Spring (Cave), Monroe Spring, St. Marks River Rise, Sally Ward Spring, Wakulla Conduit Well (B Tunnel), Wakulla Spring	Kincaid et al., 2007; Kincaid et al., 2012b
	2008	Lost Creek	Lost Creek Swallet	Wakulla Spring, Wakulla Conduit Well (K Tunnel), Revell Sink, Punch Bowl Sink, Spring Creek Spring (#1, #2, #10)	Kincaid et al., 2009
	2009	Lost Creek	Lost Creek Swallet	Revell Sink, Punch Bowl Sink, Spring Creek Spring (#1, #2, #3, #8, #10, #11)	Kincaid et al., 2010
	2012	Bird	Bird Sink	Horn Spring, Rhodes Spring #2 (Composite), Natural Bridge Swallet, St. Marks River Rise, Wakulla Spring	Kincaid et al., 2012a
	2018	Lake Miccosukee (South)	Lake Miccosukee Sinks South	Burned out Bridge (Composite), Horn Spring, Natural Bridge Spring, Rhodes #2 (Composite)	Ahmed et al., 2021

A 1. Comprehensive overview of dye traces within the study area. These traces were completed through multiagency partnerships from 2002-2012 (FGS, FSU, WKPP, and Hazlett-Kincaid).

APPENDIX B: LITHOLOGIC DESCRIPTIONS

B 1. Lithologic description for Porter Hole Sink (W-18025).

Florida Department of Environmental Protection

Florida Geological Survey GEODES

Well Number: W-18025 (DEP - Porter Hole Sink)

Total Depth: 119

Elevation: 78 feet (Unknown)

County: Leon

Location:
Sec 34 T.2N.,R.1W.

Drill Completion Date:
01/06/2000

Other Logs:

USGS Quad:
Lake Jackson 24k

Lat/Long:
30° 31' 28" N; 84° 19' 20" W

Owner/Driller:
DEP - Division of State Lands

Described By:
R. DALE FRIERSON

Verified By PG:

Comments:
DEP State Lands (K. Campbell, J. Balsillie, J. Stalvey). Coded by D. Frierson & entered by D. Paul 3/6/2000. Site: Porter Hole Sink.

Location Accuracy Status: within the Section (640 acres)

Suggested Citation: Florida Department of Environmental Protection, Well Number: W-18025 (DEP - Porter Hole Sink) Borehole Description Summary by R. DALE FRIERSON: Florida Geological Survey GEODES Database version 1.0, accessed 29 Jan 2025, https://geodes.kyrasolutions.com

Geological Formation Picks		
0 - 8.6 ft	UDSC	Undifferentiated Sand and Clay
8.6 - 36.5 ft	TORR	Torreya Formation
36.5 - 67.5 ft	SMRK	St. Marks Formation
67.5 - 119 ft	SWNN	Suwannee Limestone

0 - .9 ft Sand; Color: Dark Gray (N3) to Black (N1); Porosity: Intergranular, Possibly High Permeability; Grain Size: Fine; Range: Very Fine to Medium; Roundness: Angular to Sub-angular; Sphericity: Medium; Poor Induration; Cement Type: Clay Matrix, Organic Matrix; Sedimentary Structures: Bioturbated; Accessory Minerals: Clay - 15%, Organics - 5%; Other Features: Granular; General Fossils: No Fossils

.9 - 1.8 ft Sand; Color: Light Brownish Gray (5YR 6/1) to Brownish Gray (5YR 4/1); Porosity: Intergranular, Possibly High Permeability; Grain Size: Fine; Range: Very Fine to Medium; Roundness: Angular to Sub-angular; Sphericity: Medium; Poor Induration; Cement Type: Clay Matrix; Sedimentary Structures: Bioturbated; Accessory Minerals: Clay - 2%, Organics - 1%; Other Features: Granular; General Fossils: No Fossils

1.8 - 2.5 ft Clay; Color: Light Brownish Gray (5YR 6/1) to Brownish Gray (5YR 4/1); Porosity: Intergranular, Possibly High Permeability; Good Induration; Cement Type: Clay Matrix; Sedimentary Structures: Bioturbated; Accessory Minerals: Organics - 1%, Quartz Sand - 25%; Other Features: Granular; General Fossils: No Fossils

B 1. Continued (W-18025 DEP - Porter Hole Sink).

2.5 - 2.8 ft Sand; Color: Light Brownish Gray (5YR 6/1) to Brownish Gray (5YR 4/1); Porosity: Intergranular, Possibly High Permeability; Grain Size: Fine; Range: Very Fine to Medium; Roundness: Angular to Sub-angular; Sphericity: Medium; Poor Induration; Cement Type: Clay Matrix; Sedimentary Structures: Bioturbated, Laminated; Accessory Minerals: Clay - 2%, Organics - 1%; Other Features: Granular; General Fossils: No Fossils; Comments: INTERVAL CONTAINS ~0.5 CM LAMINATIONS OF HIGHLY ORGANIC QUARTZ SAND SIMILAR TO INTERVAL 0-0.9 FEET.

2.8 - 3 ft Sand; Color: Dark Gray (N3) to Black (N1); Porosity: Intergranular, Possibly High Permeability; Grain Size: Fine; Range: Very Fine to Medium; Roundness: Angular to Sub-angular; Sphericity: Medium; Moderate Induration; Cement Type: Clay Matrix, Organic Matrix; Sedimentary Structures: Bioturbated; Accessory Minerals: Clay - 15%, Organics - 1%; Other Features: Granular; General Fossils: No Fossils

3 - 8.6 ft Sand; Color: Very Light Orange (10YR 8/2) to Grayish Orange (10YR 7/4); Porosity: Intergranular, Possibly High Permeability; Grain Size: Very Fine; Range: Very Fine to Medium; Roundness: Sub-angular to Sub-rounded; Sphericity: Medium; Moderate Induration; Cement Type: Clay Matrix; Sedimentary Structures: Streaked, Mottled; Accessory Minerals: Clay - 5%, Heavy Minerals - 1%, Iron Stain - 1%; Other Features: Granular; General Fossils: No Fossils; Comments: LITHOLOGY CHANGES ABRUPTLY TO CLAY @ 8.6 FEET COINCIDENT WITH A BREAK IN THE CORE.

8.6 - 16 ft Clay; Color: Light Brown (5YR 5/6) to Moderate Brown (5YR 4/4); Porosity: Intergranular, Low Permeability; Good Induration; Cement Type: Clay Matrix, Iron; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Iron Stain - 15%, Quartz Sand - 5%; Other Features: Plastic; General Fossils: No Fossils; Comments: IRON CONTENT INCREASES WITH DEPTH FROM ~5% TO ~15%.

16 - 18 ft Sand; Color: White (N9) to Very Light Gray (N8); Porosity: Intergranular, Possibly High Permeability; Grain Size: Fine; Range: Very Fine to Medium; Roundness: Sub-angular to Sub-rounded; Sphericity: Medium; Poor Induration; Cement Type: Clay Matrix; Accessory Minerals: Clay - 1%, Heavy Minerals - 1%; Other Features: Granular; General Fossils: No Fossils; Comments: CLAY CORE SURROUNDED BY SAND FROM ABOVE DUE TO DRILLING.

18 - 19.2 ft Clay; Color: Light Greenish Gray (5G 8/1) to Greenish Gray (5G 6/1); Porosity: Intergranular, Low Permeability; Moderate Induration; Cement Type: Clay Matrix, Iron; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Iron Stain - 10%, Quartz Sand - 1%; Other Features: Plastic; General Fossils: No Fossils; Comments: INTERVAL CONTAINS LENSES OF VERY FINE SAND IN MOTTLED GREEN TO BROWN CLAY AS WELL AS CAVINGS OF SAND FROM ABOVE. CLAY CONTENT INCREASES DOWN CORE.

19.2 - 20.3 ft Sand; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Low Permeability; Grain Size: Very Fine; Range: Very Fine to Fine; Roundness: Angular to Sub-angular; Sphericity: Medium; Poor Induration; Cement Type: Clay Matrix; Sedimentary Structures: Interbedded, Banded; Accessory Minerals: Clay - 25%; Other Features: Granular, Sucrosic; General Fossils: No Fossils

20.3 - 20.8 ft Clay; Color: Light Yellowish Orange (10YR 8/6) to Dark Yellowish Orange (10YR 6/6); Porosity: Intergranular, Low Permeability; Moderate Induration; Sedimentary Structures: Brecciated, Banded, Mottled, Streaked; Accessory Minerals: Iron Stain - 5%, Quartz Sand - 35%; Other Features: Granular, Speckled; General Fossils: No Fossils; Comments: QUARTZ SAND MODE IS FINE, SUB-ROUNDED, AND OF MODERATE SPHERICITY.

20.8 - 21.3 ft Sand; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Low Permeability; Grain Size: Very Fine; Range: Very Fine to Fine; Roundness: Angular to Sub-angular; Sphericity: Medium; Poor Induration; Sedimentary Structures: Brecciated, Interbedded, Banded; Accessory Minerals: Clay - 25%; Other Features: Granular, Sucrosic; General Fossils: No Fossils

21.3 - 22.2 ft Clay; Color: Light Yellowish Orange (10YR 8/6) to Dark Yellowish Orange (10YR 6/6); Porosity: Intergranular, Low Permeability; Good Induration; Cement Type: Clay Matrix; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Iron Stain - 5%, Organics - 1%; Other Features: Plastic; General Fossils: No Fossils

22.2 - 24.8 ft Calcilutite; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability, Pinpoint; Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 5%; Grain Size: Microcrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Bioturbated; Accessory Minerals: Clay - 1%, Iron Stain - 1%; Other Features: Medium Recrystallization, Chalky; General Fossils: Worm Traces, Fossil Fragments; Comments: INTERVAL CONTAINS CAVITY FROM 24.75-26.5FEET.

B 1. Continued (W-18025 DEP - Porter Hole Sink).

24.8 - 28 ft Calcilutite; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability, Pinpoint; Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 5%; Grain Size: Microcrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Bioturbated; Accessory Minerals: Clay - 1%, Iron Stain - 1%; Other Features: Medium Recrystallization, Chalky; General Fossils: Worm Traces, Fossil Fragments

28 - 30 ft Calcilutite; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability, Pinpoint; Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 5%; Grain Size: Microcrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Interbedded, Streaked; Accessory Minerals: Clay - 40%, Iron Stain - 5%; Other Features: Medium Recrystallization, Chalky; General Fossils: Fossil Fragments; Comments: INTERVAL CONTAINS INTERBEDDING OF CLAY WITH CALCILUTITE. CORE APPEARS IN SPIRAL FORM FROM DRILLING. INTERVAL IS POSSIBLE CAVITY FILL OF LIMESTONE WITH CLAY.

30 - 34.5 ft Calcilutite; Color: White (N9) to Very Light Gray (N8); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Crystals; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Mottled; Accessory Minerals: Clay - 1%, Iron Stain - 1%, Quartz Sand - 1%; Other Features: Medium Recrystallization, Chalky; General Fossils: No Fossils

34.5 - 36.5 ft Clay; Color: Very Light Green (10G 8/2) to Light Grayish Green (10G 6/2); Porosity: Intergranular, Low Permeability; Moderate Induration; Cement Type: Clay Matrix; Sedimentary Structures: Mottled, Streaked, Bioturbated; Accessory Minerals: Calcilutite - 1%, Iron Stain - 10%, Quartz Sand - 30%; Other Features: Plastic; General Fossils: Fossil Molds, Plant Remains, Benthic Foraminifera

36.5 - 37.5 ft Calcilutite; Color: White (N9) to Pinkish Gray (5YR 8/1); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 40%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Mottled; Accessory Minerals: Clay - 5%, Iron Stain - 1%, Quartz Sand - 1%; Other Features: Medium Recrystallization, Chalky; General Fossils: Mollusks, Fossil Fragments, Fossil Molds, Benthic Foraminifera

37.5 - 38.5 ft Calcilutite; Color: White (N9) to Very Light Gray (N8); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 40%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization, Fossiliferous; General Fossils: Mollusks, Planktonic Foraminifera, Benthic Foraminifera; Comments: INTERVAL CONTAINS VISIBLE ARCHAIAS AND SORITES.

38.5 - 39 ft Calcilutite; Color: White (N9) to Pinkish Gray (5YR 8/1); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Crystals, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Iron Stain - 1%, Organics - 1%, Quartz Sand - 2%, Spar - 5%; Other Features: Medium Recrystallization, Chalky, Fossiliferous; General Fossils: Mollusks, Fossil Fragments, Fossil Molds, Benthic Foraminifera; Comments: POSSIBLE ORGANICS AND CLAY CAVITY FILL @ 39.0 FEET. INTERVAL CONTAINS VISIBLE ARCHAIAS AND SORITES.

39 - 41 ft No Sample

41 - 45 ft Dolostone; Color: Grayish Orange (10YR 7/4) to Dark Yellowish Orange (10YR 6/6); Porosity: Intercrystalline, Intercrystalline, Vugular; Alteration: Medium (10-50%); Crystallinity: Fibrous; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Dolomite, Sparry Calcite, Calcilutite Matrix; Other Features: Calcareous, Speckled, Crystalline, Fossiliferous; General Fossils: Fossil Molds, Benthic Foraminifera

45 - 49.8 ft No Sample; Comments: DRILLER'S NOTE STATES NO RECOVERY FROM 45.0 TO 49.8 FEET.
49.8 - 50.6 ft Limestone; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Crystals, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Sparry Calcite; Accessory Minerals: Dolomite - 1%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera

B 1. Continued (W-18025 DEP - Porter Hole Sink).

50.6 - 51 ft No Sample; Comments: DRILLER'S NOTE STATES NO RECOVERY FROM 50.6 TO 51.0 FEET.

51 - 52 ft Limestone; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Crystals, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Sparry Calcite; Accessory Minerals: Dolomite - 1%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera

52 - 55.5 ft Limestone; Color: White (N9) to Very Light Gray (N8); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Crystals, Skeletal Cast; Allochemical Constituents: 70%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Sparry Calcite; Accessory Minerals: Dolomite - 1%, Spar - 20%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera; Comments: DRILLER'S NOTE STATES THEY GOT ONLY PARTIAL RECOVERY WITH THE INTERVAL COMPRESSED, MISSING SOME SECTION ABOVE 55.0 AND BELOW 52.3, POSSIBLY DUE TO CAVITIES.

55.5 - 65 ft Limestone; Color: White (N9) to Very Light Gray (N8); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Crystals, Skeletal Cast; Allochemical Constituents: 40%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Good Induration; Cement Type: Sparry Calcite; Accessory Minerals: Spar - 35%; Other Features: Crystalline; General Fossils: No Fossils

65 - 67.5 ft Calcilutite; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Poor Induration; Cement Type: Calcilutite Matrix; Accessory Minerals: Spar - 5%; Other Features: Chalky, Muddy; General Fossils: No Fossils; Comments: CORE COMPRESSED FROM 65.0-67.5 FEET, WITH POCKETS OF SPAR IN LOWER PORTION.

67.5 - 73 ft Limestone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Crystals, Calcilutite, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Sparry Calcite; Accessory Minerals: Spar - 50%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera, Fossil Fragments, Fossil Molds; Comments: CORE IS SLIGHTLY COMPRESSED OVER ABOVE INTERVAL.

73 - 74.8 ft Clay; Color: Light Olive Gray (5Y 5/2) to Grayish Olive (10Y 4/2); Porosity: Intergranular, Low Permeability; Moderate Induration; Cement Type: Clay Matrix; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Heavy Minerals - 1%, Quartz Sand - 2%; Other Features: Plastic; General Fossils: No Fossils; Comments: QUARTZ SAND IN INTERVAL IS OF MODE VERY FINE TO FINE, ROUNDED, AND OF MODERATE SPHERICITY. A SINGLE PIECE OF LIMESTONE SIMILAR TO ABOVE UNIT: A MIX OF CLAY AND LIMESTONE FROM 73.0-73.2 FEET.

74.8 - 80.2 ft Limestone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Crystals, Calcilutite, Skeletal Cast; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Sparry Calcite; Accessory Minerals: Spar - 30%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera, Fossil Fragments, Fossil Molds; Comments: CORE IS COMPRESSED OVER ABOVE INTERVAL WITH POSSIBLES CAVITIES.

80.2 - 83 ft Clay; Color: Light Olive Gray (5Y 5/2) to Grayish Olive (10Y 4/2); Porosity: Intergranular, Low Permeability; Moderate Induration; Cement Type: Clay Matrix; Sedimentary Structures: Mottled, Streaked, Banded; Accessory Minerals: Calcarenite - 5%, Quartz Sand - 5%; Other Features: Plastic; General Fossils: No Fossils

83 - 83.8 ft Limestone; Color: Very Light Gray (N8) to Light Gray (N7); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Crystals, Calcilutite, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Sparry Calcite; Accessory Minerals: Spar - 20%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera, Cones, Organics

83.8 - 85 ft No Sample; Comments: NO RECOVERY; POSSIBLE CAVITY.

B 1. Continued (W-18025 DEP - Porter Hole Sink).

85 - 86 ft Limestone; Color: Very Light Gray (N8) to Light Gray (N7); Porosity: Vugular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Crystals, Calcilutite, Skeletal Cast; Allochemical Constituents: 60%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Sparry Calcite, Clay Matrix; Sedimentary Structures: Mottled, Streaked; Accessory Minerals: Clay - 30%, Spar - 20%; Other Features: Crystalline, Fossiliferous; General Fossils: Mollusks, Benthic Foraminifera, Cones, Organics

86 - 88 ft Clay; Color: Light Olive Gray (5Y 5/2) to Grayish Olive (10Y 4/2); Porosity: Intercrystalline, Low Permeability; Moderate Induration; Cement Type: Clay Matrix, Calcilutite Matrix; Sedimentary Structures: Mottled, Streaked, Interbedded; Accessory Minerals: Calcarenite - 40%, Quartz Sand - 1%; Other Features: Medium Recrystallization, Crystalline, Fossiliferous, Plastic; General Fossils: Mollusks, Benthic Foraminifera, Cones, Organics; Comments: CONTACT BETWEEN UPPER TWO UNITS IS GRADATIONAL WITH INTERBEDDED CLAY AND LIMESTONE.

88 - 108 ft Calcilutite; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Poor Induration; Cement Type: Calcilutite Matrix; Accessory Minerals: Silt-Size Dolomite - 15%; Other Features: Muddy; General Fossils: No Fossils; Comments: FERRO-MAG MINERAL CONTENT INCREASES WITH DEPTH. SECTION IS MISSING ABOVE 94.0 FEET. CORE IS COMPRESSED FROM 98.0-108.0 FEET.

108 - 109.5 ft Calcilutite; Color: Very Light Gray (N8) to Light Gray (N7); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Skeletal Cast; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Poor Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Dolomite - 1%, Spar - 5%; Other Features: Muddy, Crystalline, Fossiliferous, Dolomitic; General Fossils: Mollusks, Fossil Molds, Benthic Foraminifera, Cones

109.5 - 112.5 ft Calcilutite; Color: Very Light Gray (N8) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Intraclasts; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Poor Induration; Cement Type: Calcilutite Matrix, Dolomite; Accessory Minerals: Silt-Size Dolomite - 10%, Spar - 5%; Other Features: Chalky, Low Recrystallization, Dolomitic; General Fossils: No Fossils

112.5 - 115.8 ft Limestone; Color: White (N9) to Very Light Gray (N8); Porosity: Intercrystalline, Possibly High Permeability; Alteration: Low (0-10%); Grain Type: Calcilutite, Intraclasts, Skeletal Cast; Allochemical Constituents: 0%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Microcrystalline; Moderate Induration; Cement Type: Calcilutite Matrix, Dolomite; Accessory Minerals: Silt-Size Dolomite - 15%, Spar - 10%; Other Features: Chalky, Medium Recrystallization, Dolomitic, Fossiliferous; General Fossils: Echinoid, Benthic Foraminifera, Fossil Fragments, Fossil Molds, Mollusks

115.8 - 119 ft Limestone; Color: Light Gray (N7) to Moderate Light Gray (N6); Porosity: Intercrystalline, Possibly High Permeability; Alteration: Low (0- 10%); Grain Type: Calcilutite, Skeletal Cast, Oolite; Allochemical Constituents: 5%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Very Fine; Moderate Induration; Cement Type: Calcilutite Matrix, Dolomite; Accessory Minerals: Silt-Size Dolomite - 15%, Spar - 10%; Other Features: Chalky, Medium Recrystallization, Dolomitic, Fossiliferous; General Fossils: Benthic Foraminifera, Fossil Fragments, Fossil Molds, Mollusks; Comments: OUTSIDE OF CORE HAS GYPSUM BLOOMS.

Disclaimer of Liability: With respect to documents and information available from the Florida Geological Survey (FGS), regardless of where published (i.e., online, publications, etc.,), is provided for general informational purposes only. FGS, the Florida Department of Environmental Protection (DEP), and the State of Florida (State) make no warranty, expressed or implied, regarding the accuracy, completeness, reliability, availability, or usefulness of any information, apparatus, product, or process including the warranties of merchantability and fitness for a particular purpose arising out of the use or inability to use the data; or represents that its use would not infringe privately owned rights. FGS, DEP, and the State are not responsible for any indirect, special, incidental, or consequential damages for the use or reliance upon FGS information and any views or opinions associated with such information.

Use: As a professional courtesy, the FGS asks that due credit be given when our data sets are used by other individuals or entities. Further, since some or all of the data yielded from each FGS project were developed using public funds, no proprietary rights may be attached to FGS products wholly or in part, nor may FGS products be sold to the U.S. government or the State as part of any procurement of products or services.

B 2. Lithologic description for Edward Ball Wakulla Springs State Park (W-16887).

Florida Department of Environmental Protection

Florida Geological Survey GEODES

Well Number: W-16887 (WK Springs Core - Wakulla)

Total Depth: 206

Elevation: 12 feet (Unknown)

County: Wakulla

Location:
Sec 11 T.3S.,R.1W.

Drill Completion Date:
12/08/1992

Other Logs:

USGS Quad:
Crawfordville East 24k

Lat/Long:
30° 13' 59.7" N; 84° 17' 41.7" W

Owner/Driller: Wakulla Springs

Described By:
TYLER A. BARNETT

Verified By PG:
CLINT KROMHOUT, P.G.#: 2522

Comments:
This description was conducted in support of the National Groundwater Monitoring Project for station: "Wakulla Composite".

Location Accuracy Status: within a Parcel (< 5 acres)

Suggested Citation: Florida Department of Environmental Protection, Well Number: W-16887 (WK Springs Core - Wakulla) Borehole Description Summary by TYLER A. BARNETT: Florida Geological Survey GEODES Database version 1.0, accessed 29 Jan 2025, https://geodes.kyrasolutions.com

Geological Formation Picks		
0 - 6.5 ft	PLSC	Pleistocene Sands
6.5 - 100 ft	SMRK	St. Marks Formation
100 - TD ft	SWNN	Suwannee Limestone

0 - 2 ft Sand; Color: Very Light Gray (N8) to Brownish Gray (5YR 4/1); Grain Size: Very Fine; Range: Very Fine to Coarse; Roundness: Angular to Sub-rounded; Sphericity: Low; Unconsolidated; Accessory Minerals: Organics - 5%, Plant Remains - 5%; Comments: Poorly sorted quartz sand. Plant remains are mostly grass roots.

2 - 4.5 ft Sand; Color: Yellowish Gray (5Y 7/2) to Very Light Orange (10YR 8/2); Grain Size: Very Fine; Range: Very Fine to Coarse; Roundness: Angular to Sub-rounded; Sphericity: Low; Unconsolidated; Accessory Minerals: Organics - <1%, Plant Remains - <1%; Comments: Poorly sorted quartz sand. Plant remains are mostly grass roots.

4.5 - 5.33 ft Sand; Color: Very Light Orange (10YR 8/2) to Dark Yellowish Orange (10YR 6/6); Grain Size: Fine; Range: Very Fine to Coarse; Roundness: Angular to Sub-rounded; Sphericity: Low; Poor Induration; Cement Type: Clay Matrix, Calcilutite Matrix; Accessory Minerals: Calcilutite - 3%, Clay - 5%; Comments: Clayey sand with some sandy, calcilutite cemented clasts.

B 2. Continued (W-16887 WK Springs Core - Wakulla).

5.33 - 6.5 ft Sand; Color: Grayish Brown (10YR 6/2) to White (N9); Grain Size: Fine; Range: Very Fine to Coarse; Roundness: Angular to Sub- angular; Sphericity: Medium; Poor Induration; Cement Type: Calcilutite Matrix, Clay Matrix; Accessory Minerals: Calcilutite - 20%, Clay - 3%; Other Features: Calcareous; General Fossils: Benthic Foraminifera; Comments: Archaias sp. noted.

6.5 - 23.25 ft Limestone; Color: White (N9) to Light Greenish Gray (5GY 8/1); Porosity: Intergranular; Grain Type: Calcilutite, Biogenic, Skeletal; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Fine; Poor Induration; Cement Type: Calcilutite Matrix, Clay Matrix, Sparry Calcite; Accessory Minerals: Clay - 5%, Quartz Sand - 3%; Other Features: Chalky; General Fossils: Benthic Foraminifera, Fossil Fragments; Comments: Mudstone to wackestone. Pale green expansive clay stringers occur throughout. Sample has a mottled appearance, ranging from sandy pale orange sections to pale green portions with heavy clay content, to pure while calcilutite rich sections, to light yellow recrystallized sections. Identifiable benthic forams are sparsely distributed and consist primarily of soritids such as Archaias sp. and Sorites sp.

23.25 - 31.5 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Calcilutite, Skeletal, Crystals; Allochemical Constituents: 50%; Grain Size: Very Fine; Range: Cryptocrystalline to Granule (2-4 mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Clay - <1%, Quartz Sand - <1%; Other Features: Chalky, Fossiliferous, Medium Recrystallization; General Fossils: Gastropods, Benthic Foraminifera, Miliolids, Fossil Molds, Fossil Fragments, Mollusks; Comments: Wackestone to packstone range. Archaias sp. and gastropod molds and other mollusk molds are the dominant fossils. One large gastropod mold measured 3 cm diameter while most are 1 cm diameter. Yellow very fine calcite crystals and micritic limestone infills gastropod molds. Small (.5 cm to 1 cm) bivalve molds occur. Trace quartz sand embedded in limestone matrix. Pale orange and pale green colors occur sporadically among dominantly white to yellow calcilutite matrix, linked to iron oxidation and green clays.

31.5 - 33 ft Limestone; Color: White (N9) to Light Greenish Gray (5GY 8/1); Porosity: Intergranular; Grain Type: Calcilutite, Biogenic, Skeletal; Allochemical Constituents: 10%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Medium; Poor Induration; Cement Type: Calcilutite Matrix, Clay Matrix; Accessory Minerals: Clay - 7%, Quartz Sand - 1%; Other Features: Chalky; General Fossils: Benthic Foraminifera, Fossil Fragments; Comments: Pale green expansive clay stringers occur throughout. Identifiable benthic forams are sparsely distributed and primarily soritids such as Archaias sp. and Sorites sp.

33 - 43 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Calcilutite, Skeletal, Pelloid; Grain Size: Very Fine; Range: Cryptocrystalline to Granule (2-4 mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Clay - <1%, Quartz Sand - 2%; Other Features: Chalky, Fossiliferous, Medium Recrystallization; General Fossils: Gastropods, Benthic Foraminifera, Miliolids, Fossil Molds, Fossil Fragments, Mollusks; Comments: Wackestone to packstone range. Soritids, gastropod molds and bivalve molds are the dominant fossils. Yellow very fine calcite crystals or micritic limestone infills many molds. Two zones of abundant mollusc molds with subsequently higher porosity occur at 35.5'-36' and 41'-43' BLS. Recrystallized 1.4 cm diameter Kuphus tube noted at 35' ft depth BLS.

43 - 46.5 ft Limestone; Color: White (N9) to Light Greenish Gray (5GY 8/1); Porosity: Intergranular, Pinpoint; Grain Type: Calcilutite, Skeletal; Grain Size: Microcrystalline; Range: Cryptocrystalline to Medium; Poor Induration; Cement Type: Calcilutite Matrix, Clay Matrix; Accessory Minerals: Clay - 10%, Quartz Sand - 2%; Other Features: Chalky; General Fossils: Benthic Foraminifera, Fossil Molds; Comments: Clay rich interval. A few mollusk molds occur at the bottom of this interval where a transition to packstone begins.

46.5 - 52.5 ft Packstone; Color: White (N9) to Grayish Brown (10YR 6/2); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Calcilutite, Skeletal, Crystals; Allochemical Constituents: 40%; Grain Size: Cryptocrystalline; Range: Cryptocrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite, Clay Matrix; Accessory Minerals: Clay - 1%, Quartz Sand - 3%; Other Features: Medium Recrystallization; General Fossils: Gastropods, Coral, Mollusks, Benthic Foraminifera, Fossil Molds, Fossil Fragments, Miliolids; Comments: This interval is distinguished by the appearance of coral. The corals create pinpoint porosity and are intermittently heavily recrystallized. Several dark brown sections of recrystallized coral occur alongside layers rich in quartz sand with green clay.

52.5 - 61 ft Wackestone; Color: Yellowish Gray (5Y 8/1) to Grayish Brown (10YR 6/2); Porosity: Intergranular; Grain Type: Calcilutite, Skeletal, Pelloid; Grain Size: Microcrystalline; Range: Cryptocrystalline to Gravel (>2mm); Poor Induration; Cement Type: Calcilutite Matrix, Clay Matrix; Accessory Minerals: Clay - <1%, Quartz Sand - 2%; Other Features: Chalky, Low Recrystallization; General Fossils: Mollusks, Fossil Molds, Fossil Fragments, Benthic Foraminifera, Gastropods; Comments: Minor amounts of moldic porosity. Some moderately to well indurated nodules of heavily recrystallized packstone occur which appear to contain many milliolids. A few layers of clay occur.

B 2. Continued (W-16887 WK Springs Core - Wakulla).

61 - 70.5 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Calcilutite, Pelloid, Skeletal; Grain Size: Very Fine; Range: Cryptocrystalline to Gravel (>2mm); Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Miliolids, Mollusks, Gastropods, Coral, Fossil Molds, Fossil Fragments; Comments: Interval is distinguished by an increase in foraminifera and peloids. Induration is moderate near the top and bottom of this interval.

70.5 - 76 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intercrystalline, Pinpoint, Moldic; Grain Type: Calcilutite, Pelloid, Skeletal; Grain Size: Very Fine; Range: Cryptocrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Chalky, Low Recrystallization; General Fossils: Benthic Foraminifera, Coral, Miliolids, Fossil Molds, Fossil Fragments; Comments: Alternations between poor and moderate induration occur. Moderate induration correlates with sporadic occurrences of tan coral boundstone with a high density of pinpoint porosity and increased re-crystallization. While poor induration correlates to crumbly calcilutite rich sections.

76 - 85.3 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Calcilutite, Pelloid, Skeletal; Grain Size: Very Fine; Range: Cryptocrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Miliolids, Fossil Molds, Coral, Gastropods, Fossil Fragments, Mollusks; Comments: Moderate to good induration. Re-crystallization increases with depth. Abundant foraminifera, but most are only identifiable as milliolids.

85.3 - 95 ft Packstone; Color: Yellowish Gray (5Y 8/1) to Very Light Gray (N8); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Skeletal, Pelloid, Calcilutite; Allochemical Constituents: 80%; Grain Size: Very Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: High Recrystallization; General Fossils: Benthic Foraminifera, Gastropods, Coral, Fossil Molds, Fossil Fragments, Miliolids, Mollusks; Comments: High to medium recrystallization. Induration increases with depth and ranges from moderate to good.

95 - 100 ft Packstone; Color: Very Light Orange (10YR 8/2) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Intergranular; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 85%; Grain Size: Very Fine; Range: Microcrystalline to Gravel (>2mm); Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Clay - <1%, Iron Stain - <1%; Other Features: High Recrystallization; General Fossils: Benthic Foraminifera, Fossil Molds, Fossil Fragments, Miliolids, Mollusks, Gastropods, Coral; Comments: A subtle, but potentially important change in lithology occurs here. Coral is still present, but in smaller abundances than intervals up borehole. Tan sections of recrystallized coral have disappeared. Induration, recrystallization, and density have increased relative to intervals above. The majority of the allochems are very fine to fine grains of detrital limestone, and forams (milliolids are the primary identifiable foram component) or their fragmented tests. the dominant color is now a very pale orange. A section of vuggy, iron stained, karstification with trace clay deposits occurs at approximately 97' ft depth BLS. Chalky calcilutite matrix abundance has decreased. High to medium recrystallization

100 - 104 ft Packstone; Color: Very Light Orange (10YR 8/2) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Pinpoint, Vugular; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 85%; Grain Size: Very Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: High Recrystallization; General Fossils: Benthic Foraminifera, Fossil Molds, Fossil Fragments, Miliolids, Mollusks, Gastropods, Coral; Comments: High to medium recrystallization

104 - 109 ft Grainstone; Color: Very Light Orange (10YR 8/2) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Pinpoint, Moldic; Grain Type: Pelloid, Skeletal; Allochemical Constituents: 90%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Fossil Fragments, Fossil Molds, Miliolids, Gastropods, Mollusks; Comments: Peloids, and foraminifera tests are the dominant constituent in this interval.
Gastropod and mollusk molds are present but sparsely. Milliolids are the only identified foraminifera. There are surely other foraminifera present, but re-crystallization blurs the edges of most allochems.

B 2. Continued (W-16887 WK Springs Core - Wakulla).

109 - 113 ft Grainstone; Color: Very Light Orange (10YR 8/2) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Moldic, Pinpoint; Grain Type: Pelloid, Skeletal, Crystals; Allochemical Constituents: 90%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Clay - <1%, Iron Stain - <1%; Other Features: High Recrystallization; General Fossils: Benthic Foraminifera, Cones, Gastropods, Fossil Fragments, Fossil Molds, Mollusks, Coral; Index Fossils: Fallotella sp.; Comments: Assemblage of foraminifera has shifted to include fallotella sp. and others. Gastropod casts which are intermittently clustered with very fine to fine calcite crystals, are the dominant fossil after forams. High to medium recrystallization.

113 - 116.25 ft Packstone; Color: Very Light Orange (10YR 8/2) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Vugular, Moldic; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 75%; Grain Size: Fine; Range: Cryptocrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Iron Stain - <1%; Other Features: Medium Recrystallization, Chalky; General Fossils: Benthic Foraminifera, Gastropods, Fossil Fragments, Fossil Molds, Mollusks, Coral, Cones; Index Fossils: Fallotella sp.; Comments: Packstone to grainstone. A single cone was found at the beginning of this interval. Abundant milliolids, other forams and similar sized (very fine to fine) unidentified peloids.

116.25 - 118 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Pinpoint; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 80%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix; Other Features: Chalky; General Fossils: Benthic Foraminifera, Miliolids, Mollusks, Fossil Fragments, Fossil Molds; Comments: Calcilutite rich with little re-crystallization. Packstone to grainstone

118 - 144 ft Grainstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Pinpoint, Moldic; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 90%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Poor Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Low Recrystallization, Poor Sample; General Fossils: Benthic Foraminifera, Fossil Fragments, Fossil Molds, Mollusks, Coral, Spicules; Index Fossils: Pararotalia (Rotalia) mexicana; Comments: Many well preserved Pararotalia mexicana in this interval. This interval is dominantly foraminifera and peloid composed grainstone, of low density. A minor portion of this interval is intermittently (1"in to 3"in long sections) highly recrystallized packstone of good induration. These sections correlate with sparsely occurring coral and mollusk molds. Calcilutite content increases down borehole. Generally poor recovery is evidenced by the fact that only 12 feet of actual core is present to represent 26 feet of borehole.

144 - 156 ft Grainstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Pinpoint; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 90%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Poor Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Low Recrystallization; General Fossils: Benthic Foraminifera, Fossil Fragments, Fossil Molds, Spicules, Cones; Index Fossils: Pararotalia (Rotalia) mexicana, Fallotella sp.; Comments: Grainstone to packstone .This interval is dominantly foraminifera and peloid composed grainstone, of low density. Calcilutite content increases down borehole, especially near the 156' depth mark.

156 - 157.5 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Moldic, Vugular, Intergranular; Grain Type: Skeletal, Pelloid, Calcilutite; Allochemical Constituents: 85%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Fossil Molds, Coral, Gastropods, Mollusks, Miliolids, Cones; Index Fossils: Fallotella sp., Pararotalia (Rotalia) mexicana; Comments: Change in texture, porosity and overall fossil assemblage.

157.5 - 160 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular, Moldic, Pinpoint; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 80%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Accessory Minerals: Clay - <1%; Other Features: Chalky, Medium Recrystallization; General Fossils: Benthic Foraminifera, Fossil Molds, Fossil Fragments, Gastropods, Coral, Mollusks, Cones, Spicules; Comments: Moldic porosity from coral and gastropods. Calcilutite rich matrix which makes individual allochem identification difficult. Medium to low recrystallization.

B 2. Continued (W-16887 WK Springs Core - Wakulla).

160 - 177 ft Packstone; Color: White (N9) to Yellowish Gray (5Y 8/1); Porosity: Intergranular; Grain Type: Calcilutite, Pelloid, Skeletal; Allochemical Constituents: 50%; Grain Size: Microcrystalline; Range: Microcrystalline to Gravel (>2mm); Poor Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Chalky, Low Recrystallization; General Fossils: Benthic Foraminifera, Spicules; Comments: This interval is a calcilutite rich micro-fossiliferous packstone. From 152.5' ft to 153' ft BLS a section of gastropod/coral/mollusk rich, moldic porosity, packstone occurs.

177 - 178 ft Packstone; Color: Yellowish Gray (5Y 8/1) to White (N9); Porosity: Intergranular, Vugular, Pinpoint; Grain Type: Skeletal, Skeletal Cast, Pelloid; Allochemical Constituents: 85%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization, Poor Sample; General Fossils: Benthic Foraminifera, Spicules, Fossil Molds, Fossil Fragments, Mollusks, Gastropods, Cones; Comments: No good core here, just well indurated chunks of packstone rubble with abundant mollusk molds. Medium to low recrystallization

178 - 186 ft Packstone; Color: Yellowish Gray (5Y 8/1) to Very Light Gray (N8); Porosity: Intergranular, Pinpoint; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 90%; Grain Size: Medium; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Low Recrystallization; General Fossils: Benthic Foraminifera, Spicules, Cones, Mollusks, Gastropods, Miliolids, Fossil Fragments, Fossil Molds; Index Fossils: Fallotella sp.; Comments: Packstone to grainstone. Modal grain size of forams has increased. Abundant cones.

186 - 198 ft Packstone; Color: Yellowish Gray (5Y 8/1) to Very Light Gray (N8); Porosity: Moldic, Intergranular, Pinpoint; Grain Type: Pelloid, Skeletal, Calcilutite; Allochemical Constituents: 90%; Grain Size: Medium; Range: Microcrystalline to Gravel (>2mm); Good Induration; Cement Type: Sparry Calcite, Calcilutite Matrix; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Cones, Miliolids, Spicules, Fossil Fragments, Fossil Molds, Mollusks, Gastropods, Coral; Comments: Packstone to grainstone. Abundant mollusk and gastropod molds. Abundant cones. Interval is distinguished by an increased induration and coral presence. Induration decreases and calcilutite increases from 197' to 198' ft BLS.

198 - 200 ft Packstone; Color: Yellowish Gray (5Y 8/1) to Yellowish Gray (5Y 8/1); Porosity: Intergranular; Grain Type: Pelloid, Calcilutite, Skeletal; Allochemical Constituents: 65%; Grain Size: Fine; Range: Microcrystalline to Coarse; Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; General Fossils: Benthic Foraminifera, Cones; Index Fossils: Fallotella sp.; Comments: This interval is distinguished by a poor to moderate induration, a generally low density, a lack of moldic porosity and a relatively (to adjacent intervals) high calcilutite content.

200 - 205 ft Packstone; Color: Yellowish Gray (5Y 8/1) to White (N9); Porosity: Intergranular, Moldic, Pinpoint; Grain Type: Pelloid, Calcilutite, Skeletal; Allochemical Constituents: 80%; Grain Size: Fine; Range: Microcrystalline to Gravel (>2mm); Moderate Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Cones, Miliolids, Fossil Fragments, Fossil Molds, Mollusks, Gastropods, Coral, Spicules; Index Fossils: Fallotella sp.; Comments: Induration is variable, from poor and crumbly to good. Sections with good induration are more recrystallized, lighter colored and have pinpoint porosity (likely due to coral). Some of the spicules noted may be echinoid spines.

205 - 206.5 ft Packstone; Color: Yellowish Gray (5Y 8/1) to White (N9); Porosity: Intergranular; Grain Type: Pelloid, Calcilutite, Skeletal; Allochemical Constituents: 85%; Grain Size: Very Fine; Range: Microcrystalline to Gravel (>2mm); Good Induration; Cement Type: Calcilutite Matrix, Sparry Calcite; Other Features: Medium Recrystallization; General Fossils: Benthic Foraminifera, Miliolids, Fossil Molds, Fossil Fragments, Cones.

Disclaimer of Liability: With respect to documents and information available from the Florida Geological Survey (FGS), regardless of where published (i.e., online, publications, etc.,), is provided for general informational purposes only. FGS, the Florida Department of Environmental Protection (DEP), and the State of Florida (State) make no warranty, expressed or implied, regarding the accuracy, completeness, reliability, availability, or usefulness of any information, apparatus, product, or process including the warranties of merchantability and fitness for a particular purpose arising out of the use or inability to use the data; or represents that its use would not infringe privately owned rights. FGS, DEP, and the State are not responsible for any indirect, special, incidental, or consequential damages for the use or reliance upon FGS information and any views or opinions associated with such information.
Use: As a professional courtesy, the FGS asks that due credit be given when our data sets are used by other individuals or entities. Further, since some or all of the data yielded from each FGS project were developed using public funds, no proprietary rights may be attached to FGS products wholly or in part, nor may FGS products be sold to the U.S. government or the State as part of any procurement of products or services

APPENDIX C: OZARK UNDERGROUND LABORATORY ANALYSES

C 1. All samples analyzed for the 2021-2023 Porter Hole Sink dye trace. Refer to Figure 11 and 12 for station name acronym explanations. COC = chain of custody. ND = non-detect.

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
1	MB	McBride	7/19/21 1315	7/26/21 1435	Charcoal	ND
1	EM	Emerald Sink	7/19/21 1400	7/26/21 1320	Charcoal	ND
1	MU	Munson	7/20/21 1000	7/26/21 1159	Charcoal	ND
1	NN	No Name Sp.	7/23/21 1317	7/26/21 1520	Charcoal	ND
1	WKV	Wakulla Springs Main Vent		7/16/21 1345	Water	ND
1	AD	Conduit AD		7/16/21 1457	Water	ND
1	B	Conduit B		7/16/21 1532	Water	ND
1	MB	McBride Slough		7/19/21 1317	Water	ND
1	SW	Sally Ward		7/19/21 1345	Water	ND
1	WKV	Wakulla Vent - ISCO R1 Sample 3		7/17/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R1 Sample 7		7/18/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R1 Sample 11		7/19/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R1 Sample 15		7/20/21 0400	Water	ND
1	AD	Conduit AD		7/20/21 1010	Water	ND
1	B	Conduit B		7/20/21 1120	Water	ND
1	MU	Munson Weir		7/21/21 1008	Water	ND
1	WKV	Wakulla Vent - ISCO R2 Sample 1		7/21/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R2 Sample 5		7/22/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R2 Sample 9		7/23/21 0400	Water	ND
1	AD	Conduit AD		7/23/21 1103	Water	ND
1	B	Conduit B		7/23/21 1138	Water	ND
1	NN	No Name		7/23/21 1317	Water	ND
1	WKV	Wakulla Vent - ISCO R3 Sample 1		7/24/21 0400	Water	ND
1	WKV	Wakulla Vent - ISCO R3 Sample 5		7/25/21 0400	Water	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
1	WKV	Wakulla Vent - ISCO B2 Sample 9		7/26/21 0400	Water	ND
1	AD	Conduit AD		7/26/21 1050	Water	ND
1	B	Conduit B		7/26/21 1055	Water	ND
1	MU	Munson Weir		7/26/21 1150	Water	ND
1	EM	Emerald Sink		7/26/21 1315	Water	ND
1	MB	McBride Slough		7/26/21 1435	Water	ND
1	NN	No Name Spring		7/26/21 1520	Water	ND
1	SW	Sally Ward Spring		7/26/21 1600	Water	ND
2	PS	PS-N-C-8/11-1642	7/26/21 1435	8/11/21 1635	Charcoal	ND
2	SMRR	SMRR-NE-C-8/12-1110	7/28/21 1233	8/12/21 1110	Charcoal	ND
2	WR	WR-TR-C-8/12-1235	7/28/21 1600	8/12/21 1235	Charcoal	ND
2	NN	NN-C-8/10-1715	7/26/21 1520	8/10/21 1715	Charcoal	ND
2	MC	MC-C-8/10-1540	7/26/21 1435	8/10/21 1540	Charcoal	ND
2	EM	EM-C-8/10-1440	7/26/21 1345	8/10/21 1440	Charcoal	ND
2	MU	MU-C-8/10-1340	7/26/21 1159	8/10/21 1340	Charcoal	ND
Data above this line are pre-introduction background sampling. Data below this line are post-introduction sampling. Dye introduction occurred 8/14/2021.						
3	OR	OR-C-8/24-1000	8/11/21 1545	8/24/21 1000	Charcoal	ND
3	RZ	RZ-C-082421-1040	8/17/21 1620	8/24/21 1040	Charcoal	ND
3	MU	MU-C-082421-1130	8/10/21 1340	8/24/21 1130	Charcoal	ND
3	DU	DU-C-082421-1200	8/17/21 1510	8/24/21 1200	Charcoal	ND
3	N3	N3-C-082421-1255	8/19/21 1100	8/24/21 1255	Charcoal	ND
3	BT	BT-C-8/24-1405	8/18/21 1200	8/24/21 1405	Charcoal	ND
3	N4	N4-C-8/24-1320	8/19/21 1120	8/24/21 1320	Charcoal	ND
3	EM	EM-C-8/25-1430	8/10/21 1440	8/25/21 1430	Charcoal	ND
3	WR	WR-TR-C-8/25-1045	8/12/21 1235	8/25/21 1045	Charcoal	ND
3	SMRR	SMRR-NE-C-8/25-1205	8/12/21 1110	8/25/21 1205	Charcoal	ND
3	OP	OP-C-8/25-1245	8/18/21 1545	8/25/21 1245	Charcoal	ND
3	SH	SH-C-8/25-1150	8/10/21 1125	8/25/21 1150	Charcoal	ND
3	N5	N5-C-8/25-1315	8/18/21 1330	8/25/21 1315	Charcoal	ND
3	N6	N6-C-8/25-1340	8/18/21 1445	8/25/21 1340	Charcoal	ND
3	NN	NN-C-8/25-1335	8/10/21 1715	8/25/21 1335	Charcoal	ND
3	MC	MC-C-8/26-1245	8/10/21 1540	8/26/21 1245	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
3	SW	SW-C-8/26-1310	8/10/21 1620	8/26/21 1310	Charcoal	ND
3	BD	BD-C-8/26-1515	8/19/21 1333	8/26/21 1515	Charcoal	ND
3	TW	TW-C-8/26-1525	8/19/21 1358	8/26/21 1525	Charcoal	ND
3	PS	PS-N-C-8/14-1810	8/11/21 1642	8/14/21 1810	Charcoal	ND
3	PS	PS-S-C-8/14-1820	8/11/21	8/14/21 1820	Charcoal	ND
4	WV	WV-I-R5-B13		8/2/21 0400	Water	ND
4	B	B-G-8/2-1055		8/2/21 1055	Water	ND
4	AD	AD-G-8/2-1105		8/2/21 1105	Water	ND
4	WV	WV-I-R7-B21		8/11/21 0400	Water	ND
4	B	B-G-8/11-1150		8/11/21 1150	Water	ND
4	AD	AD-G-8/11-1245		8/11/21 1245	Water	ND
4	WV	WV-I-R9-B10		8/20/21 1000	Water	ND
4	B	B-G-8/20-1542		8/20/21 1542	Water	ND
4	AD	AD-G-8/20-1554		8/20/21 1554	Water	ND
4	RZ	RZ-EB-8/24-1035		8/24/21 1035	Water	ND
4	COT23	COT-23-8/18-0900		8/18/21 0900	Water	ND
4	T2	T2-8/25		8/25/21	Water	ND
4	NAL2	NAL2-EB2-8/25-1350		8/25/21 1350	Water	ND
4	OP	OP-EB-8/25-1250		8/25/21 1250	Water	ND
4	WV	WV-EB-8/25-1600		8/25/21 1600	Water	ND
4	AD	AD-EB-8/25-1855		8/25/21 1855	Water	ND
4	B	B-EB-8/25-1807		8/25/21 1807	Water	ND
5	OG	OG-C-8/27-1327	8/20/21 1240	8/27/21 1327	Charcoal	ND
5	BD	BD-C-9/2-1216	8/26/21 1515	9/2/21 1216	Charcoal	ND
5	OR	OR-C-9/9-1540	8/24/21 1000	9/9/21 1540	Charcoal	ND
5	WR	WR-OS-C-9/9-1056	8/25/21 1045	9/9/21 1056	Charcoal	ND
5	SMRR	SMRR-NE-C-9/9-1225	8/25/21 1205	9/9/21 1225	Charcoal	ND
5	OP	OP-C-9/9-1345	8/25/21 1245	9/9/21 1345	Charcoal	ND
5	N5	N5-C-9/9-1405	8/25/21 1315	9/9/21 1405	Charcoal	ND
5	N6	N6-C-9/9-1415	8/25/21 1340	9/9/21 1415	Charcoal	ND
5	BT	BT-C-9/9-1450	8/24/21 1405	9/9/21 1450	Charcoal	ND
5	RZ	RZ-C-9/9-1510	8/24/21 1040	9/9/21 1510	Charcoal	ND
5	SW	SW-C-9/9-1100	8/26/21 1315	9/9/21 1100	Charcoal	ND
5	MC	MC-C-9/9-1131	8/26/21 1250	9/9/21 1131	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
5	DU	DU-C-9/9-1402	8/24/21 1214	9/9/21 1401	Charcoal	ND
5	N4	N4-C-9/9-1442	8/24/21 1330	9/9/21 1442	Charcoal	ND
5	EM	EM-C-9/9-1607	8/25/21 1500	9/9/21 1607	Charcoal	ND
5	N3	N3-C-9/9-1508	8/24/21 1304	9/9/21 1508	Charcoal	ND
5	OG	OG-C-9/9-1719	8/27/21 1533	9/9/21 1719	Charcoal	ND
5	WV	WV-I-R13-B10		9/1/21 2200	Water	ND
5	WV	WV-I-R14-B21		9/7/21 1600	Water	ND
6	AD	AD-G-9/2-1019		9/2/21 1019	Water	ND
6	B	B-G-9/2-1030		9/2/21 1030	Water	ND
6	B	B-EB-9/2-1031		9/2/21 1031	Water	ND
6	NAL	NAL-EB-8/30-1051		8/30/21 1051	Water	ND
6	WV	WY-EB-9/2-1100		9/2/21 1100	Water	ND
6	TB	TB-9/2-0900		9/2/21 0900	Water	ND
6	DU	DU-EB-9/9-1403		9/9/21 1403	Water	ND
6	TB	TB-9/9/21		9/9/21 NT	Water	ND
7	BD	BD-C-9/10-1405	9/2/21 1222	9/10/211405	Charcoal	ND
7	NN	NN-C-9/10-1240	8/25/21 1400	9/10/21 1240	Charcoal	ND
7	MU	MU-C-9/14/21-1335	8/24/21 1130	9/14/21 1335	Charcoal	ND
7	N3	N3-C-9/20-1310	9/9/21 1508	9/20/21 1310	Charcoal	ND
7	N4	N4-C-9/20-1320	9/9/21 1442	9/20/21 1320	Charcoal	ND
7	SW	SW-C-9/20-1230	9/9/21 1100	9/20/21 1230	Charcoal	ND
7	NN	NN-C-9/20-1205	9/10/21 1240	9/20/21 1205	Charcoal	ND
7	BD	BD-C-9/20-1140	9/10/21 1405	9/20/21 1140	Charcoal	ND
7	AD	AD-EB-9/10-1143		9/10/21 1240	Water	ND
7	WV	WV-EB-1-9/14-1300		9/14/21 1300	Water	ND
7	B	B-EB-9/20-1250		9/20/21 1250	Water	ND
7	TB	TB-9/20		9/20/21 0945	Water	ND
8	AD	AD-G-9/10-1140		9/10/21 1140	Water	ND
8	B	B-G-9/10-1153		9/10/21 1153	Water	ND
8	WV	WV-I-R16-B14		9/13/21 2200	Water	ND
8	WV	WV-I-R18-B14		9/19/21 2200	Water	ND
9	TB	TB-C-9/21		9/21/21 1000	Charcoal	ND
9	SH	SH-C-9/21-1255	8/25/21 1150	9/21/21 1255	Charcoal	ND
9	MC	MC-C-9/21-1440	9/9/21 1131	9/21/21 1440	Charcoal	ND
9	OR	OR-C-9/22-1042	9/9/21 1540	9/22/21 1042	Charcoal	ND
9	OG	OG-C-9/22-1111	9/9/21 1725	9/22/21 1111	Charcoal	ND
9	WR	WR-OS-C-9/23-1125	9/9/21 1056	9/23/21 1125	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
9	SMRR	SMRR-C-9/23-1300	9/9/21 1225	9/23/21 1300	Charcoal	ND
9	OP	OP-C-9/23-1355	9/9/21 1345	9/23/21 1355	Charcoal	ND
9	N5	N5-C-9/23-1415	9/9/21 1405	9/23/21 1415	Charcoal	ND
9	N5	N5-EB-9/23-1420		9/23/21 1420	Water	ND
9	EM	EM-C-9/23-1220	9/9/21 1607	9/23/21 1220	Charcoal	ND
9	MU	MU-C-9/23-1333	9/14/21 1335	9/23/21 1333	Charcoal	ND
9	BT	BT-C-9/23-1051	9/9/21 1450	9/23/21 1051	Charcoal	ND
9	DU	DU-C-9/23-1126	9/9/21 1402	9/23/21 1126	Charcoal	ND
9	RZ	RZ-C-9/23-1410	9/9/21 1510	9/23/21 1410	Charcoal	ND
9	AD	AD-G-9/10-1140		9/10/21 1140	Water	ND
9	B	B-G-9/10-1153		9/10/21 1153	Water	ND
9	WV	WV-I-R16-B14		9/13/21 2200	Water	ND
9	WV	WV-I-R18-B14		9/19/21 2200	Water	ND
9	WV	WV-EB-9/16-1400		9/16/21 1400	Water	ND
9	AD	AD-G-9/16-1445		9/16/21 1445	Water	ND
9	AD	AD-EB-9/16-1500		9/16/21 1500	Water	ND
9	B	B-G-9/16-1440		9/16/21 1440	Water	ND
9	TB	TB-9/21		9/21/21 1000	Water	ND
9	N6	N6-C-9/23-1425	9/9/21 1415	9/23/21 1425	Charcoal	ND
9	WV	WV-EB-9/24-1330		9/24/21 1330	Water	ND
9	WV	WV-I-R19-B14		9/23/21 2200	Water	ND
10	TW	TW-C-9/27-1156	9/10/21 1442	9/27/21 1156	Charcoal	ND
10	BD	BD-C-9/27-1150	9/20/21 1140	9/27/21 1150	Charcoal	ND
10	TB	TB-9/27		9/27/21 1100	Water	ND
10	B	B-EB-9/27-1300		9/27/21 1300	Water	ND
10	AD	AD-G-9/24-1529		9/24/21 1529	Water	ND
10	B	B-G-9/24-1538		9/24/21 1538	Water	ND
10	WV	WV-EB-9/30-1040		9/30/21 1040	Water	ND
10	WV	WV-I-R21-B10		9/29/21 2200	Water	ND
11	NN	NN-C-10/4-1208	9/20/21 1205	10/4/21 1208	Charcoal	ND
11	SW	SW-C-10/4-1331	9/20/21 1230	10/4/21 1331	Charcoal	ND
11	BD	BD-C-10/04-1513	9/27/21 1150	10/4/21 1513	Charcoal	ND
11	MC	MC-C-10/04-1547	9/21/21 1440	10/4/21 1547	Charcoal	ND
11	WR	WR-OS-C-10/4-1200	9/23/21 1125	10/4/21 1200	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
11	SMRR	SMRR-C-10/4-1310	9/23/21 1300	10/4/21 1310	Charcoal	ND
11	OP	OP-C-10/4-1340	9/23/21 1355	10/4/21 1340	Charcoal	ND
11	N5	N5-C-10/4-1400	9/23/21 1415	10/4/21 1400	Charcoal	ND
11	N6	N6-C-10/4-1420	9/23/21 1425	10/4/21 1420	Charcoal	ND
11	WV	WV-I-R22-B16		10/4/21 1000	Water	ND
11	AD	AD-EB-10/04-1423		10/4/21 1423	Water	ND
11	WV	WV-I-EB-10/4-1230		10/4/21 1230	Water	ND
11	TB	TB-10/4		NDT	Water	ND
12	N3	N3-C-10/7-1256	9/20/21 1310	10/7/21 1256	Charcoal	ND
12	N4	N4-C-10/7-1311	9/20/21 1320	10/7/21 1311	Charcoal	ND
12	DU	DU-C-10/7-1346	9/23/21 1126	10/7/21 1346	Charcoal	ND
12	BT	BT-C-10/7-1455	9/23/21 1051	10/7/21 1455	Charcoal	ND
12	EM	EM-C-10/7-1410	9/23/21 1220	10/7/21 1410	Charcoal	ND
12	OR	OR-C-10/8-1050	9/22/21 1042	10/8/21 1050	Charcoal	ND
12	OG	OG-C-10/8-1110	9/22/21 1111	10/8/21 1110	Charcoal	ND
12	RZ	RZ-C-10/8-1145	9/23/21 1410	10/8/21 1145	Charcoal	ND
12	AD	AD-G-10/4-1412		10/4/21 1412	Water	ND
12	B	B-G-10/4-1431		10/4/21 1431	Water	ND
12	WV	WV-I-R23-B12		10/7/21 1000	Water	ND
12	WV	WV-EB-10/7-1220		10/7/21 1220	Water	ND
12	TB	TB-10/8		10/8/21 0930	Water	ND
12	RZ	RZ-EB-10/8-1147		10/8/21 1147	Water	ND
13	SH	SH-C-10/13-1343	9/21/21 1255	10/13/21 1343	Charcoal	ND
13	MU	MU-C-10/11-1301	9/23/21 1333	10/11/21 1301	Charcoal	ND
13	BD	BD-C-10/14-1345	10/4/21 1513	10/14/21 1345	Charcoal	ND
13	TB	TB-10/7		10/11/21 1000	Water	ND
13	TB	TB-10/14		10/14/21 1000	Water	ND
13	WV	WV-EB-10/14-1320		10/14/21 1320	Water	ND
13	B	B-EB-10/14-1448		10/14/21 1448	Water	ND
13	B	B-G-10/11-1540		10/11/21 1540	Water	ND
13	AD	AD-G-10/11-1531		10/11/21 1531	Water	ND
13	WV	WV-I-R25-B8		10/14/21 1000	Water	ND
14	NN	NN-C-10/18-1147	10/4/21 1208	10/18/21 1147	Charcoal	ND
14	SW	SW-C-10/18-1414	10/4/21 1331	10/18/21 1414	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
14	MC	MC-C-10/18-1440	10/4/21 1547	10/18/21 1440	Charcoal	ND
14	N3	N3-C-10/19-1128	10/7/21 1058	10/19/21 1128	Charcoal	ND
14	N4	N4-C-10/19-1145	10/7/21 1311	10/19/21 1145	Charcoal	ND
14	EM	EM-C-10/19-1205	10/7/21 1410	10/19/21 1205	Charcoal	ND
14	MU	MU-C-10/19-1237	10/11/21 1305	10/19/21 1237	Charcoal	ND
14	DU	DU-C-10/19-1322	10/7/21 1346	10/19/21 1322	Charcoal	ND
14	BT	BT-C-10/19-1405	10/7/21 1455	10/19/21 1405	Charcoal	ND
14	RZ	RZ-C-10/19-1430	10/8/21 1145	10/19/21 1430	Charcoal	ND
14	OG	OG-C-10/19-1511	10/8/21 1010	10/19/21 1511	Charcoal	ND
14	SMRR	SMRR-C-10/20-1021	10/4/21 1310	10/20/21 1021	Charcoal	ND
14	N5	N5-C-10/20-1050	10/4/21 1400	10/20/21 1050	Charcoal	ND
14	N6	N6-C-10/20-1100	10/4/21 1420	10/20/21 1100	Charcoal	ND
14	OP	OP-C-10/20-1120	10/4/21 1340	10/20/21 1120	Charcoal	ND
14	WR	WR-OS-C-10/20-1210	10/4/21 1200	10/20/21 1210	Charcoal	ND
14	OR	OR-C-10/19-1525	10/8/21 1050	10/19/21 1525	Charcoal	ND
14	BD	BD-C-10/21-1205	10/14/21 1350	10/21/21 1205	Charcoal	ND
14	FSUWELL	FSUWELL-G-08/20-21		8/20/21 NT	Water	ND
14	TB	TB-10/18		10/18/21 NT	Water	ND
14	EB	EB-B-10/18-1348		10/18/21 1348	Water	ND
14	B	B-G-10/18-1345		10/18/21 1345	Water	ND
14	AD	AD-G-10/18-1400		10/18/21 1400	Water	ND
14	DU	DU-EB-10/19-1325		10/19/21 1325	Water	ND
14	WV	WV-I-R27-B12		10/21/21 1000	Water	ND
14	B	B-G-10/25-1135		10/25/21 1135	Water	ND
14	AD	AD-G-10/25-1145		10/25/21 1145	Water	ND
14	AD	AD-EB-10/25-1147		10/25/21 1147	Water	ND
14	TB	TB-10/25		10/25/21 NT	Water	ND
15	T1	T1-8/25		8/25/21 0835	Water	ND
15	WV	WV-G-8/25-1650		8/25/21 1650	Water	ND
15	AD	AD-G-8/25-1851		8/25/21 1851	Water	ND
15	B	B-G-8/25-1758		8/25/21 1758	Water	ND
15	WV	WV-I-R11-B24		8/26/21 0930	Water	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
15	DU	DU-G-8/17-1510		8/17/21 1510	Water	ND
15	RZ	RZ-G-8/17-1620		8/17/21 1620	Water	ND
15	WV	WV-I-R8-B13		8/15/21 0400	Water	ND
15	OP	OP-G-8/18-1545		8/18/21 1545	Water	ND
15	BT	BT-G-8/18-1200		8/18/21 1200	Water	ND
15	N5	N5-G-8/18-1340		8/18/21 1340	Water	ND
15	N6	N6-G-8/18-1445		8/18/21 1445	Water	ND
15	N3	N3-G-8/19-1100		8/19/21 1100	Water	ND
15	N4	N4-G-8/19-1120		8/19/21 1120	Water	ND
15	BD	BD-G-8/19-1333		8/19/21 1333	Water	ND
15	TW	TW-G-8/19-1358		8/19/21 1358	Water	ND
15	WV	WV-I-R9-B1		8/18/21 0400	Water	ND
15	OG	OG-G-8/20-1240		8/20/21 1240	Water	ND
15	WV	WV-I-R10-B9		8/22/21 1600	Water	ND
15	WV	WV-I-R10-B16		8/24/21 1000	Water	ND
15	TW	TW-G-9/2-1257		9/2/21 1257	Water	ND
15	WV	WV-I-R12-B10		8/28/21 2200	Water	ND
15	WV	WV-I-R14-B4		9/3/21 1000	Water	ND
15	WV	WV-I-R14-B11		9/5/21 0400	Water	ND
15	MU	MU-G-9/9-1638		9/9/21 1638	Water	ND
15	WV	WV-I-R15-B8		9/9/21 1600	Water	ND
15	WV	WV-I-R16-B6		9/11/21 2200	Water	ND
15	MU	MU-G-9/14/21-1340		9/14/21 1340	Water	ND
15	WV	WV-I-R18-B5		9/17/21 1600	Water	ND
15	WV	WV-I-R17-B4		9/15/21 1000	Water	ND
15	EM	EM-G-9/23-1220		9/23/21 1220	Water	ND
15	BT	BT-G-9/23-1056		9/23/21 1056	Water	ND
15	WV	WV-I-R19-B3		9/21/21 0400	Water	ND
15	WV	WV-I-R20-B5		9/25/21 1600	Water	ND
15	WV	WV-I-R20-B11		9/27/21 0400	Water	ND
15	B	B-G-9/27-1255		9/27/21 1255	Water	ND
15	AD	AD-G-9/27-1310		9/27/21 1310	Water	ND
15	WV	WV-I-R22-B6		10/1/21 2200	Water	ND
15	TW	TW-G-10/04-1453		10/4/21 1453	Water	ND
15	MU	MU-G-10/7-1515		10/7/21 1515	Water	ND
15	AD	AD-G-10/7-1235		10/7/21 1235	Water	ND
15	B	B-G-10/7-1230		10/7/21 1230	Water	ND
15	EM	EM-G-10/7-1415		10/7/21 1415	Water	ND
15	RZ	RZ-G-10/8-1146		10/8/21 1146	Water	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
15	BD	BD-G-10/12-1407		10/12/21 1407	Water	ND
15	BD	BD-I-R1-B6		10/13/21 2200	Water	ND
15	WV	WV-I-G-10/7-B1-B7		10/11/21 1428	Water	ND
15	WV	WV-I-R26-B9		10/16/21 1600	Water	ND
15	WV	WV-I-R26-B16		10/18/21 1000	Water	ND
15	WV	WV-I-R27-B7		10/20/21 0400	Water	ND
15	TW	TW-C-10/21-1140	10/14/21 1525	10/21/21 1140	Charcoal	ND
16	MC	MC-C-1112-0940	10/18/21 1440	11/12/21 0940	Charcoal	ND
16	NN	NN-C-1112-1015	10/18/21 1440	11/12/21 1015	Charcoal	ND
16	SW	SW-C-11/09-1332	10/18/21 1414	11/9/21 1332	Charcoal	ND
16	TW	TW-C-10/29-1040	10/21/21 1140	10/29/21 1040	Charcoal	ND
16	TW	TW-C-1112-1120	10/29/21 1040	11/12/21 1120	Charcoal	ND
16	MC	MC-C-1203-1010	11/12/21 0940	12/3/21 1010	Charcoal	ND
16	NN	NN-C-12/3-1102	11/12/21 1015	12/3/21 1102	Charcoal	ND
16	SW	SW-C-1203-1025	11/9/21 1332	12/3/21 1025	Charcoal	ND
16	TW	TW-C-12/3-1128	11/12/21 1120	12/3/21 1128	Charcoal	ND
17	MC	MC-C-12/20-1030	12/3/21 1010	12/20/21 1030	Charcoal	ND
17	NN	NN-C-12/20-1105	12/3/21 1102	12/20/21 1105	Charcoal	ND
17	SW	SW-C-12/20-1040	12/3/21 1025	12/20/21 1040	Charcoal	ND
17	TW	TW-C-12/20-1245	12/3/21 1128	12/20/21 1245	Charcoal	ND
17	BD	BD-C-12/20-1230	12/3/21 1155	12/20/21 1230	Charcoal	ND
18	MC	MC-C-1/13-1230	12/20/21 1030	1/13/22 1230	Charcoal	ND
18	NN	NN-C-0113-1120	12/20/21 1105	1/13/22 1120	Charcoal	ND
18	SW	SW-C-1/13-1240	12/20/21 1040	1/13/22 1240	Charcoal	ND
18	TW	TW-C-1/13-1200	12/20/21 1245	1/13/22 1200	Charcoal	ND
18	WR	WR-TR-C-11/10-1105	9/9/21 1055	11/10/21 1105	Charcoal	ND
19	TW	TW-C-2/9-830	1/13/22 1200	2/9/22 0830	Charcoal	ND
19	MC	MC-C-2/9-1110	1/13/22 1230	2/9/22 1110	Charcoal	ND
19	SW	SW-C-2/9-1120	1/13/22 1240	2/9/22 1120	Charcoal	ND
19	SH	SH-C-2/9-1155	1/13/22 1345	2/9/22 1155	Charcoal	ND
19	NN	NN-C-2/9-1358	1/13/22 1120	2/9/22 1359	Charcoal	ND
19	WR	WR-OS-C-2/10-1118	1/12/22 1155	2/10/22 1118	Charcoal	ND
19	SMRR	SMRR-C-2/10-1219	1/12/22 1255	2/10/22 1219	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
19	TB	TB-2/9		2/9/22 1518	Water	ND
20	BD	BD-C-2/25-1100	2/9/22 1050	2/25/22 1100	Charcoal	ND
21	NN	NN-C-3/7/22-1327	2/9/22 1359	3/7/22 1327	Charcoal	ND
21	SW	SW-C-3/7-1450	2/9/22 1120	3/7/22 1450	Charcoal	ND
21	BD	BD-C-3/7-1357	2/25/22 1100	3/7/22 1357	Charcoal	ND
21	BD	BD-C-3/10-1314	3/7/22 1357	3/10/22 1314	Charcoal	ND
21	MC	MC-C-3/10-1348	2/9/22 1100	3/10/22 1348	Charcoal	ND
22	BD	BD-C-3/25-1130	3/10/22 1314	3/25/22 1130	Charcoal	ND
24	SMRR	SMRR-C-11/10-1318	10/20/21 1021	11/10/21 1318	Charcoal	ND
24	SMRR	SMRR-C-11/16-1150	11/10/21 1318	11/16/21 1150	Charcoal	ND
24	SMRR	SMRR-C-12/2-1313	11/16/21 1150	12/2/21 1313	Charcoal	ND
24	SMRR	SMRR-C-12/21-1140	12/2/21 1313	12/21/21 1140	Charcoal	ND
24	SMRR	SMRR-C-1/12-1255	12/21/21 1140	1/12/22 1255	Charcoal	ND
24	SMRR	SMRR-C-3/8-1154	2/10/22 1219	3/8/22 1154	Charcoal	ND
24	WR	WR-TR-C-12/2-1205	11/10/21 1105	12/2/21 1205	Charcoal	ND
24	WR	WR-TR-C-12/21-1135	12/2/21 1205	12/21/21 1135	Charcoal	ND
24	WR	WR-OS-C-1/12-1155	12/21/21 1135	1/12/22 1155	Charcoal	ND
24	WR	WR-OS-C-3/8-1052	2/10/22 1118	3/8/22 1052	Charcoal	ND
24	SH	SH-C-1/13-1345	12/28/21 1013	1/13/22 1345	Charcoal	ND
24	SH	SH-C-11/29-1338	11/9/21 1155	11/29/21 1338	Charcoal	ND
24	SH	SH-C-11/9-1155	10/13/21 1343	11/9/21 1155	Charcoal	ND
24	SH	SH-C-12/28-1013	11/29/21 1338	12/28/21 1013	Charcoal	ND
24	SH	SH-C-3/7-1140	2/9/22 1155	3/7/22 1140	Charcoal	ND
24	SH	SH-C-4/4-1150	3/7/22 1140	4/4/22 1150	Charcoal	ND
24	EM	EM-C-11/18-1123	10/19/21 1205	11/8/21 1123	Charcoal	ND
24	EM	EM-C-11/30-1100	11/8/21 1123	11/30/21 1100	Charcoal	ND
24	EM	EM-C-12/17-1048	11/30/21 1100	12/17/21 1048	Charcoal	ND
24	EM	EM-C-1/10-1215	12/17/21 1048	1/10/22 1215	Charcoal	ND
24	EM	EM-C-2/7-1030	1/10/22 1215	2/7/22 1030	Charcoal	ND
24	EM	EM-C-3/10-1020	2/7/22 1030	3/10/22 1020	Charcoal	ND
24	EM	EM-C-4/5-0920	3/10/22 1020	4/5/22 0920	Charcoal	ND
24	OG	OG-C-11/8-1448	10/19/21 1511	11/8/21 1448	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
24	OG	OG-C-11/29-1102	11/8/21 1448	11/29/21 1102	Charcoal	ND
24	OG	OG-C-12/16-1035	11/29/21 1102	12/16/21 1035	Charcoal	ND
24	OG	OG-C-1/12-1410	12/16/21 1035	1/12/22 1410	Charcoal	ND
24	OG	OG-C-2/7-1240	1/12/22 1410	2/7/22 1240	Charcoal	ND
24	OG	OG-C-3/8-1436	2/7/22 1240	3/8/22 1436	Charcoal	ND
24	OG	OG-C-4/5-1240	3/8/22 1436	4/5/22 1240	Charcoal	ND
24	BD	BD-C-4/4-1450	3/25/22 1130	4/4/22 1450	Charcoal	ND
24	MC	MC-C-4/5-1058	3/10/22 1348	4/5/22 1058	Charcoal	ND
25	NN	NN-C-4/4-1324	3/7/22 1327	4/4/22 1324	Charcoal	ND
25	SW	SW-C-4/4-1358	3/7/22 1450	4/4/22 1358	Charcoal	ND
25	WR	WR-OS-C-04/12-1157	3/8/22 1052	4/12/22 1157	Charcoal	ND
25	SMRR	SMRR-C-04/12-1435	3/8/22 1154	4/12/22 1435	Charcoal	ND
25	BD	BD-C-4/19-1130	4/4/22 1450	4/19/22 1130	Charcoal	ND
26	NN	NN-C-5/5-1210	4/4/22 1324	5/5/22 1210	Charcoal	ND
26	BD	BD-C-5/5-1315	4/19/22 1130	5/5/22 1315	Charcoal	ND
26	SW	SW-C-5/5-1344	4/4/22 1358	5/5/22 1344	Charcoal	ND
27	SMRR	SMRR-C-5/10-1507	4/12/22 1430	5/10/22 1507	Charcoal	ND
27	WR	WR-OS-C-5/10-1236	4/12/22 1157	5/10/22 1236	Charcoal	ND
27	SH	SH-C-5/16-1150	4/4/22 1150	5/16/22 1150	Charcoal	ND
27	BD	BD-C-5/19-1247	5/5/22 1315	5/19/22 1247	Charcoal	ND
28	BD	BD-C-6/6-1307	5/19/22 1247	6/6/22 1307	Charcoal	ND
29	SW	SW-C-6/13-1159	5/5/22 1344	6/13/22 1159	Charcoal	ND
29	SH	SH-C-6/14-1135	5/16/22 1150	6/14/22 1135	Charcoal	ND
29	BD	BD-C-6/20-1137	6/6/22 1307	6/20/22 1137	Charcoal	ND
29	WR	WR-OS-C-6/21-1140	5/10/22 1236	6/21/22 1140	Charcoal	ND
29	SMRR	SMRR-C-6/21-1310	5/10/22 1507	6/21/22 1310	Charcoal	ND
30	BD	BD-C-7/5-1403	6/20/22 1137	7/5/22 1403	Charcoal	ND
31	BD	BD-C-7/19-1120	7/5/22 1403	7/19/22 1120	Charcoal	ND
31	FD	FD-C-7/19-1155	6/13/22 1400	7/19/22 1155	Charcoal	ND
31	NN	NN-C-7/19-1239	6/14/22 1400	7/19/22 1239	Charcoal	ND
31	SW	SW-C-7/19-1310	6/13/22 1159	7/19/22 1310	Charcoal	ND
31	SMRR	SMRR-C-7/21-1355	6/21/22 1310	7/21/22 1355	Charcoal	ND
31	WR	WR-TR-C-7/21-1153	6/21/22 1136	7/21/22 1153	Charcoal	ND
31	SH	SH-C-7/20-1255	6/14/22 1135	7/20/22 1255	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
32	BD	BD-C-8/29-1258	7/19/22 1120	8/29/22 1258	Charcoal	ND
32	NN	NN-C-8/29-1206	7/19/22 1239	8/29/22 1206	Charcoal	ND
32	SW	SW-C-8/29-1238	7/19/22 1310	8/29/22 1238	Charcoal	ND
33	WR	WR-OS-C-9/1-1203	7/21/22 1153	9/1/22 1203	Charcoal	ND
33	SMRR	SMRR-C-9/1-1315	7/21/22 1355	9/1/22 1315	Charcoal	ND
34	SH	SH-C-9/7-1337	7/20/22 1255	9/7/22 1337	Charcoal	ND
35	SMRR	SMRR-C-9/29-1506	9/1/22 1315	9/29/22 1506	Charcoal	ND
35	BD	BD-C-9/29-1133	8/29/22 1258	9/29/22 1133	Charcoal	ND
35	FD	FD-C-9/29-1213	8/29/22 1431	9/29/22 1213	Charcoal	ND
35	NN	NN-C-9/29-1056	8/29/22 1206	9/29/22 1056	Charcoal	ND
35	SW	SW-C-9/29-1022	8/29/22 1238	9/29/22 1022	Charcoal	ND
35	WR	WR-OS-C-9/30-1040	9/1/22 1203	9/30/22 1040	Charcoal	ND
36	WR	WR-OS-C-10/11-1132	9/30/22 1040	10/11/22 1132	Charcoal	ND
36	SMRR	SMRR-C-10/11-1305	9/29/22 1506	10/11/22 1305	Charcoal	ND
36	BD	BD-C-10/12-1136	9/29/22 1133	10/12/22 1136	Charcoal	ND
36	NN	NN-C-10/12-1058	9/29/22 1056	10/12/22 1058	Charcoal	ND
36	SW	SW-C-10/12-1030	9/29/22 1022	10/12/22 1030	Charcoal	ND
37	WR	WR-OS-11/16-1240	10/11/22 1132	11/16/22 1240	Charcoal	ND
37	BD	BD-C-11/17-1126	10/12/22 1136	11/17/22 1126	Charcoal	ND
37	NN	NN-C-11/17-1229	10/12/22 1058	11/17/22 1229	Charcoal	ND
37	SW	SW-C-11/17-1307	10/12/22 1030	11/17/22 1307	Charcoal	ND
37	SMRR	SMRR-C-11/17-1416	10/12/22 1309	11/17/22 1416	Charcoal	ND
38	WR	WR-OS-CH-1219-1330	11/16/22 1240	12/19/22 1330	Charcoal	ND
38	BD	BD-C-12/21-1249	11/17/22 1126	12/21/22 1249	Charcoal	ND
38	NN	NN-C-12/21-1214	11/17/22 1229	12/21/22 1214	Charcoal	ND
38	SW	SW-C-12/21-1129	11/17/22 1307	12/21/22 1129	Charcoal	ND
38	SMRR	SMRR-CH-12/19-1220	11/17/22 1416	12/19/22 1220	Charcoal	ND
39	BD	BD-C-1/26-1246	12/21/22 1249	1/26/23 1246	Charcoal	ND
39	NN	NN-C-1/26-1141	12/21/22 1214	1/26/23 1141	Charcoal	ND

C 1. Continued (All samples analyzed).

COC	*Station*	*Sample name*	*Deployed*	*Retrieved*	*Type*	*Fluorescein Detect*
39	SW	SW-C-1/26-1051	12/21/22 1129	1/26/23 1051	Charcoal	ND
39	WV	WV-I-R66-B19		1/26/23 1457	Water	ND
40	SMRR	SMRR-C-2/9-1350	12/19/22 1220	2/9/23 1350	Charcoal	ND
40	WR	WR-OS-C-2/9-1225	12/19/22 1330	2/9/23 1225	Charcoal	ND
41	COT6	COT#6-06/15/23-0830 (Sieved charcoal and H_2O)		6/15/23 0830	Charcoal	ND
41	COT9	COT#9-06/15/23-0912 (Sieved charcoal and H_2O)		6/15/23 0912	Charcoal	ND
41	COT13	COT#13-06/15/23-0947 (Sieved charcoal and H_2O)		6/15/23 0947	Charcoal	ND