



# Weeki Wachee Springs State Park

## Approved Management Plan - 2022





# FLORIDA DEPARTMENT OF Environmental Protection

Marjory Stoneman Douglas Building  
3900 Commonwealth Boulevard  
Tallahassee, FL 32399

**Ron DeSantis**  
Governor

**Jeanette Nuñez**  
Lt. Governor

**Shawn Hamilton**  
Secretary

April 11, 2022

Mr. Brian Fugate  
Division of Recreation and Parks  
Department of Environmental Protection  
3900 Commonwealth Boulevard, MS 525  
Tallahassee, Florida 32399-3000

**RE: Weeki Wachee Springs State Park – Lease No. 4817**

Dear Mr. Fugate,

On **April 8, 2022**, the Acquisition and Restoration Council (ARC) recommended approval of the **Weeki Wachee Springs State Park** management plan. Therefore, Division of State Lands, Office of Environmental Services (OES), acting as agent for the Board of Trustees of the Internal Improvement Trust Fund, hereby approves the **Weeki Wachee Springs State Park** management plan. The next management plan update is due April 8, 2032.

Pursuant to s. 253.034(5)(a), F.S., each management plan is required to “describe both short-term and long-term management goals and include measurable objectives to achieve those goals. Short-term goals shall be achievable within a 2-year planning period, and long-term goals shall be achievable within a 10-year planning period.” Upon completion of short-term goals, please submit a signed letter identifying categories, goals, and results with attached methodology to the Division of State Lands, Office of Environmental Services.

Pursuant to s. 259.032(8)(g), F.S., by July 1 of each year, each governmental agency and each private entity designated to manage lands shall report to the Secretary of Environmental Protection, via the Division of State Lands, on the progress of funding, staffing, and resource management of every project for which the agency or entity is responsible.

Pursuant to s. 259.032, F.S., and Chapter 18-2.021, F.A.C., management plans for areas less than 160 acres may be handled in accordance with the negative response process. This process requires small management plans and management plan amendments be submitted to the Division of State Lands for review, and the Acquisition and Restoration Council (ARC) for public notification. The Division of State Lands will approve these plans or plan amendments submitted for review through delegated authority unless three

Mr. Brian Fugate

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April 11, 2022

or more ARC members request the division place the item on a future council meeting agenda for review. To create better efficiency, improve customer service, and assist members of the ARC, the Division of State Lands will notice negative response items on Thursdays except for weeks that have State or Federal holidays that fall on Thursday or Friday. The Division of State Lands will contact you on the appropriate Friday to inform you if the item is approved via delegated authority or if it will be placed on a future ARC agenda by request of the ARC members.

Pursuant to s. 259.036(2), F.S., management areas that exceed 1,000 acres in size, shall be scheduled for a land management review at least every 5 years.

Conditional approval of this land management plan does not waive the authority or jurisdiction of any governmental entity that may have an interest in this project. Implementation of any upland activities proposed by this management plan may require a permit or other authorization from federal and state agencies having regulatory jurisdiction over those particular activities. Pursuant to the conditions of your lease, please forward copies of all permits to this office upon issuance.

Sincerely,

Deborah Burr  
Office of Environmental Services  
Division of State Lands



An Equal Opportunity Employer

# Southwest Florida Water Management District

2379 Broad Street, Brooksville, Florida 34604-6899

(352) 796-7211 or 1-800-423-1476 (FL only)

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Pasco
- Brian J. Armstrong, P.G.**  
Executive Director

March 11, 2022

Tyler Maldonado, AICP  
Florida Department of Environmental Protection  
Division of Recreation and Parks  
Attention: Office of Park Planning  
3800 Commonwealth Boulevard MS#525  
Tallahassee, Florida 32399-3900

Subject: Weeki Wachee Springs State Park Unit Management Plan

Dear Mr. Maldonado:

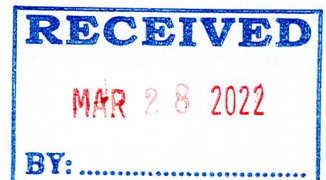
This letter is written to advise you that on February 22, 2022, the Governing Board of the Southwest Florida Water Management District (District) approved the 2021 Weeki Wachee Springs State Park Unit Management Plan. Pursuant to the Lease Agreement between the District and the State of Florida Department of Environmental Protection (FDEP), Division of Recreation and Parks dated November 1, 2008, notice shall be deemed duly given if in writing and transmitted by hand delivery with receipt or by registered mail, return receipt requested, first class postage prepaid, or by facsimile transmission; therefore, please accept this letter as notice of the approval.

The District appreciates the opportunity to continue our successful partnership with the FDEP. Please contact me at 800-423-1476, extension 4472, should you have any questions or comments regarding the foregoing.

Sincerely,

Ellen Morgan Morrison  
Bureau Chief, Land Resources Bureau

EM:cs



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## Executive Summary

Weeki Wachee Springs State Park is a cultural icon that represents the early days of the tourism economy in Florida. The world-famous roadside attraction had its official grand opening in 1947 after a group of investors fulfilled the dream of creating a place where tourists could marvel at real-life mermaids performing underwater acrobatics in the crystal-clear waters of Weeki Wachee Springs. This vision was accomplished through the underwater skills and innovations of Newton Perry and the architectural brilliance of Robert E. Collins. Today, the Underwater Theater at Weeki Wachee Springs remains one of the state's most remarkable feats of engineering, architecture, and entertainment.

Newton Perry was an accomplished swimmer and underwater performer who had previously worked at both Silver Springs and Wakulla Springs. Perry was well-known in the film industry as a consultant for underwater scenes and was highly involved with movies being shot at all three locations. It was Perry who devised the underwater airlock (ca. 1956) and air hoses that allowed the performers to remain underwater for long periods of time without needing to surface for air.

The iconic Underwater Theater was the creation of architect Robert E. Collins. The original theater was completed in 1947 and early iterations of the underwater shows entertained audiences for 12 years until the American Broadcasting Company (ABC) purchased the themed attraction and began a complete renovation of the theater in 1959 to accommodate larger audiences. This is when Collins added the iconic clamshell roof, tile fish mosaics, auditorium seating, and 6-foot glass windows.

The visible groundwater features of the park consist primarily of the Weeki Wachee headspring and the smaller magnitude Twin Dees Spring. These two springs, together with several smaller springs outside the park make up the Weeki Wachee Springs Complex. The combined flow of these springs and the tributaries they feed make up the Weeki Wachee River. Weeki Wachee Spring is one of 33 first magnitude springs in Florida. To be classified as a first magnitude spring, median discharge of water must be at least 100 cubic feet/second (cfs). Discharge data from the 1931-2015 period of record indicate an average discharge of 171 cfs from the main spring.



# **Weeki Wachee Springs State Park**

## **Central Park Theme**

*The enchanting waters of Weeki Wachee Springs were transformed into a magical entertainment experience, which now depend on the health and maintenance of the spring and its vulnerable watershed.*

## **Primary Interpretive Themes**

### *Mermaid Shows*

*The roadside attraction's early innovations with underwater apparatuses led the mermaid shows of Weeki Wachee Springs to become a global cultural icon.*

### *Uplands*

*Maintaining the scrub habitats surrounding the spring protects its remaining recharge area from development and contributes to maintenance of water quality.*

### *Spring Run*

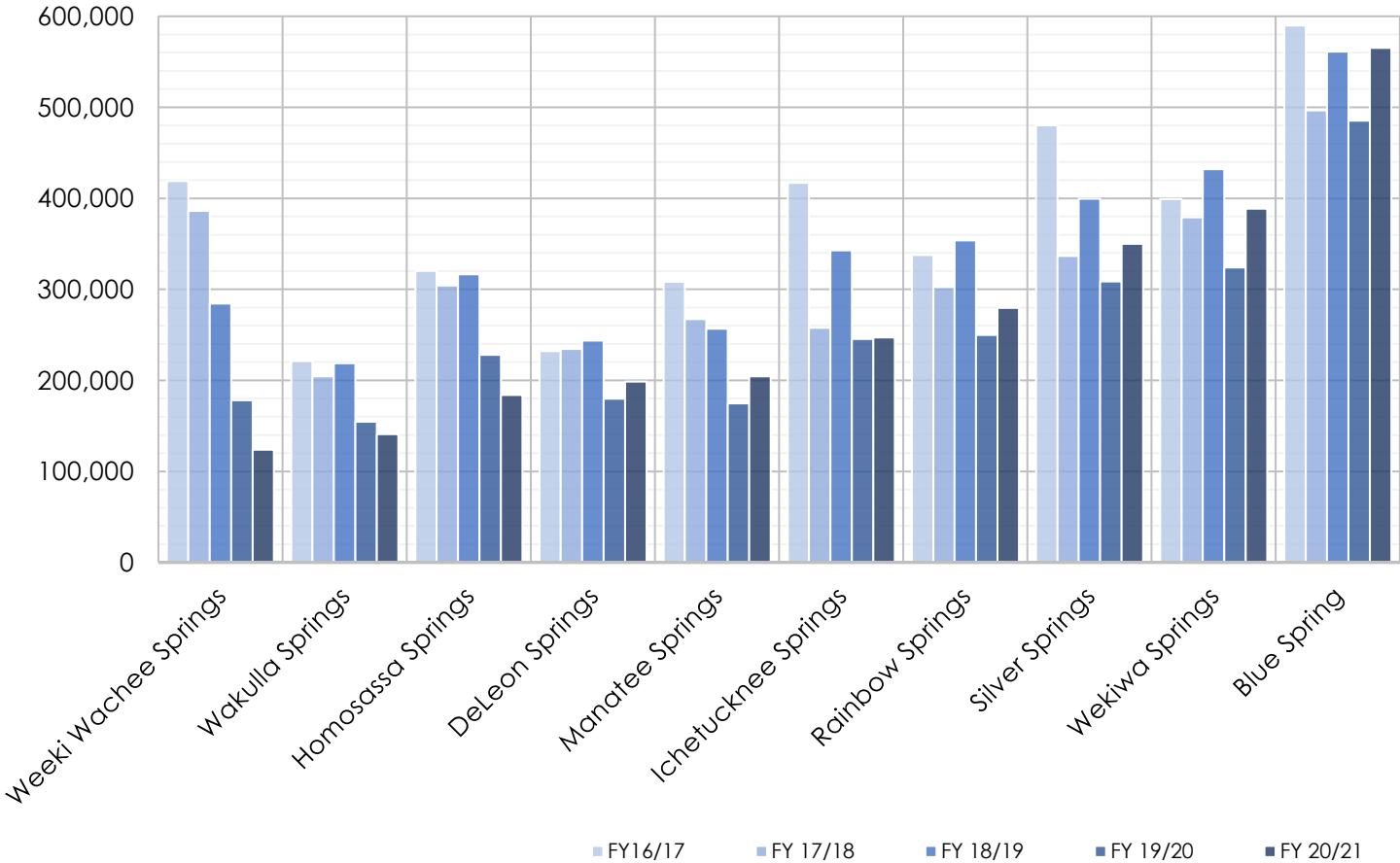
*Responsible recreation on the Weeki Wachee River is a safeguard for the water clarity and delicate vegetation of this ecological treasure.*

### *Water Quality and Quantity*

*The health of the Weeki Wachee River relies on collaborative regional management efforts that prioritize nitrogen reduction and water conservation.*

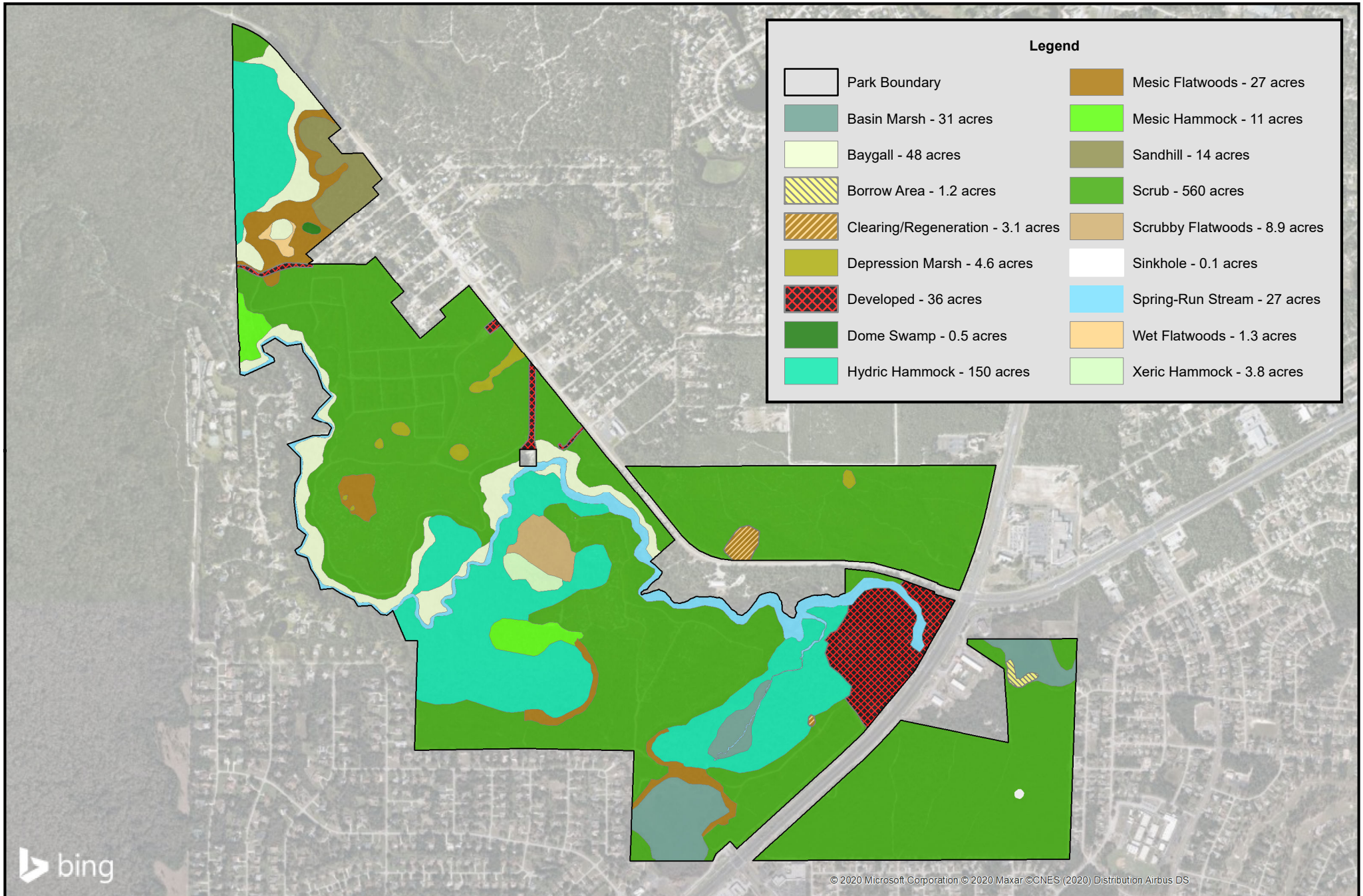
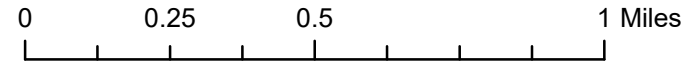
Natural Communities and Altered Landcover Types		
Natural Communities	Acreage	Percentage
Scrub	560	60.4%
Hydric Hammock	150	16.2%
Baygall	48	5.2%
Basin Marsh	31	3.3%
Mesic Flatwoods	27	2.9%
Spring-Run Stream	27	2.9%
Sandhill	14	1.5%
Mesic Hammock	11	1.2%
Scrubby Flatwoods	8.9	0.9%
Depression Marsh	4.6	0.5%
Xeric Hammock	3.8	0.4%
Wet Flatwoods	1.3	0.1%
Dome Swamp	0.5	0.05%
Sinkhole	0.1	0.01%
Altered Landcovers	Acreage	Percentage
Developed	36	3.8%
Clearing/Regeneration	3.1	0.3%
Borrow Area	1.2	0.1%
<b>Total Acreage</b>	<b>927</b>	<b>100%</b>

**Annual Attendance  
Fiscal Year (FY) 2016-2021**





# Weeki Wachee Springs State Park Natural Community Map



## Ten-Year Resource Management Goals and Objectives

### Goal: Protect soil resources in the park.

Objective A	Control erosion by monitoring, stabilization, and unauthorized trail closures.
-------------	--

### Goal: Protect water quality/quantity and restore hydrology in the park.

Objective A	Conduct an assessment of the park's hydrological restoration needs.
-------------	---

### Goal: Restore and maintain natural communities/habitat of the park.

Objective A	Develop and implement a point bar restoration plan for the spring-run.
-------------	--

Objective B	Continue to monitor submerged aquatic vegetation in the spring-run.
-------------	---

Objective C	Improve 575 acres of scrub, scrubby flatwoods, and sandhill.
-------------	--

Objective D	Maintain 615 acres of the park within the optimum fire return interval.
-------------	---

Objective E	Complete a comprehensive flora and fauna survey.
-------------	--

### Goal: Maintain, improve, or restore imperiled species populations and habitats in the park.

Objective A	Continue to update baseline imperiled species occurrence inventory lists.
-------------	---

Objective B	Monitor and document 1 selected imperiled animal species.
-------------	---

### Goal: Remove invasive species from the park and maintain as necessary.

Objective A	Annually treat at least 18 infested acres of invasive plant species.
-------------	--

Objective B	Develop a comprehensive invasive plant management plan.
-------------	---

Objective C	Maintain and publish the landscaping manual for the park.
-------------	---

Objective D	Implement decontamination protocols for the park.
-------------	---

Objective E	Manage Lyngbya and other aquatic species.
-------------	---

Objective F	Implement control measures on 1 invasive animal species in the park.
-------------	--

### Goal: Protect, preserve, and maintain the cultural resources of the park.

Objective A	Continue to compile reliable documentation for all cultural resources.
-------------	--

Objective B	Assess and evaluate all recorded cultural resources in the park.
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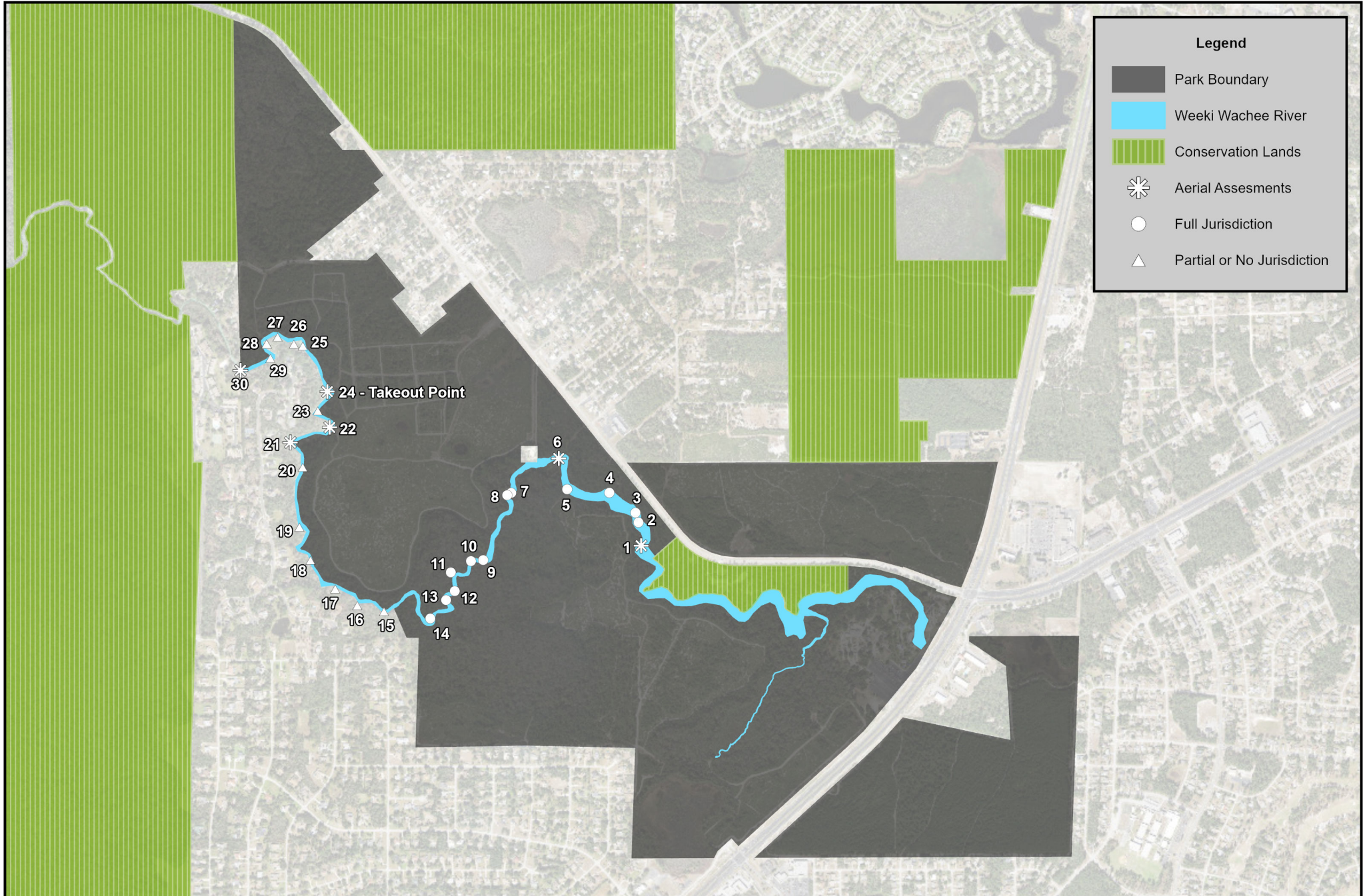
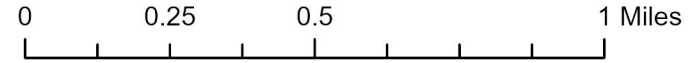
Objective C	Maintain all NR-eligible or listed resources in good condition.
-------------	---

Objective D	Complete DHR's Archaeological Resource Management (ARM) training.
-------------	---

Objective E	Complete historic preservation projects.
-------------	--



# Weeki Wachee Springs State Park Point Bar Map



## Point Bar Monitoring

The Carrying Capacity Study (Wood 2020) identified a total of 34 impacted point bars along the river within the study area. Thirty of the 34 points bars are within or adjacent to the park boundary, which is an important distinction that has management jurisdiction implications. The Carrying Capacity Study also conducted a point bar aerial assessment that involved interpreting historical aerial imagery from 2008 to 2017 and calculating an estimated loss of vegetation over the past decade. The calculations are shown in the table below. Six point bars with the clearest aerial imagery were selected, one of which is now the site associated with the new kayak takeout point. Point Bar 1 is shown in the images to the right, and Point Bar 24 is on the opposite side of the river from the new kayak takeout point. Establishing an increased staff and management presence at the new kayak takeout point should work to discourage docking and in-water activities at this point bar. For the purposes of visitor use management, the data shown below represents the baseline conditions of the point bars. All of these point bars will be monitored over the course of this planning period to help managers determine the effectiveness of management actions.



The six point bars that will be selected for long-term monitoring are intended to be representative samples that demonstrate the effectiveness of management actions on the river as a whole. Improving conditions at these six point bars will not only represent overall resource improvement on the river, but it will also suggest that user behavior has improved and indicate that docking and in-water activities have been reduced, if not eliminated altogether. Declining conditions would represent further resource degradation and signal to managers that user behavior has not been adequately addressed.

**Point Bar Aerial Assessment – Vegetation Loss in Square Feet**

Point Bar	PB 1	PB 6	PB 21	PB 22	PB 24	PB 30
<b>2008 Aerial</b>	7,031 ft <sup>2</sup>	11,661 ft <sup>2</sup>	7,493 ft <sup>2</sup>	8,508 ft <sup>2</sup>	7,012 ft <sup>2</sup>	3,213 ft <sup>2</sup>
<b>2017 Aerial</b>	5,337 ft <sup>2</sup>	10,603 ft <sup>2</sup>	6,063 ft <sup>2</sup>	7,008 ft <sup>2</sup>	6,201 ft <sup>2</sup>	2,237 ft <sup>2</sup>
<b>Net Loss</b>	<b>1,694 ft<sup>2</sup></b>	<b>1,058 ft<sup>2</sup></b>	<b>1,430 ft<sup>2</sup></b>	<b>1,500 ft<sup>2</sup></b>	<b>811 ft<sup>2</sup></b>	<b>976 ft<sup>2</sup></b>
<b>Percent Loss</b>	<b>-24%</b>	<b>-9%</b>	<b>-19%</b>	<b>-18%</b>	<b>-11%</b>	<b>-30%</b>

## Visitor Use Management

The DRP manages visitor use to sustain the quality of park resources and the visitor experience in a manner that is consistent with the purposes of the park. The dynamic nature of visitor use requires a deliberate and adaptive approach to managing resource impacts from recreational activity. To manage visitor use, the DRP will rely on a variety of management tools and strategies. The DRP will be guided by the “precautionary principle” that states if there is a threat of irreversible harm to park resources, a lack of full scientific certainty will not delay management action (Kriebel et al., 2001).

Several management actions are planned to be implemented irrespective of any further observation of user impact to the river point bars. It is expected that these management actions will help enforce existing park rules, mitigate resource impacts, and improve user behavior. Objectives that will be implemented over the long term will be discussed in the VUM Objectives section. The management actions that will be implemented in the immediate term can be classified according to three categories: user education, rule enforcement, and resource protection.

Over the next two years, DRP staff will be working toward the short-term objective of developing and implementing the point bar monitoring protocol discussed in this management plan update. During these two years, it will be necessary to collect data to track resource conditions and identify the most effective adaptive management techniques. In addition to monitoring efforts, the paddle launch capacities will remain capped at 280 vessels per day. This capacity will be subject to adaptive management by park management, and any changes will be informed and supported by the data that will be collected over the long-term. The data will be documented and stored systematically in order to produce condition reports.

<b>Management Actions</b>	
<b>User Education</b>	
	<ul style="list-style-type: none"> <li>○ Update kayak rental information to include emphasis on existing park rules and resource protection</li> <li>○ Improve concession area to highlight resource importance and interpret user responsibilities</li> <li>○ Conduct community outreach to provide information on river protection</li> </ul>
<b>Rule Enforcement</b>	
	<ul style="list-style-type: none"> <li>○ Develop park signage to demarcate the new park boundary and inform users of the rules on the river within the park boundary</li> <li>○ Continue to work with local law enforcement and FWC to monitor river activity</li> <li>○ Consider establishing game cameras at known problem areas</li> </ul>
<b>Resource Protection</b>	
	<ul style="list-style-type: none"> <li>○ Seek approval to deploy protective barriers to block access to point bars</li> <li>○ Develop signage at impacted point bars to inform river users on the resource impact of docking/wading</li> <li>○ Explore replanting native vegetation to encourage regrowth and discourage user access</li> </ul>



# Introduction

Weeki Wachee Springs State Park is a cultural icon that represents the early days of the tourism economy in Florida. The world-famous roadside attraction had its official grand opening in 1947 after a group of investors fulfilled the dream of creating a place where tourists could marvel at real-life mermaids performing underwater acrobatics in the crystal-clear waters of Weeki Wachee Springs. This vision was accomplished through the underwater skills and innovations of Newton Perry and the architectural brilliance of Robert E. Collins. Today, the Underwater Theater at Weeki Wachee Springs remains one of the state's most remarkable feats of engineering, architecture, and entertainment.

## Significance of the Park

On January 22, 2020, the Weeki Wachee Springs District was listed on the National Register of Historic Places under all four criteria reviewed by the National Park Service. The four criteria include significant historical events, prominent persons, distinctive architecture, and the potential to yield valuable prehistoric or historic knowledge.

Newton Perry was an accomplished swimmer and underwater performer who had previously worked at both Silver Springs and Wakulla Springs. Perry was well-known in the film industry as a consultant for underwater scenes and was highly involved with movies being shot at all three locations. It was Perry who devised the underwater airlock (ca. 1956) and air hoses that allowed the performers to remain underwater for long periods of time without needing to surface for air.

The iconic Underwater Theater was the creation of architect Robert E. Collins. The original theater was completed in 1947 and early iterations of the underwater shows entertained audiences for 12 years until the American Broadcasting Company (ABC) purchased the themed attraction and began expanding the theater in 1959 to accommodate larger audiences. This is when Collins added the iconic clamshell roof, tile fish mosaics, auditorium seating, and 6-foot glass windows. Shortly after, Collins was also commissioned to design the Mermaid Wall (ca. 1963). Other notable pieces that correspond to ABC's emphasis on marketing and advertising include the adagio statue and marquee.

The spring itself has been used since prehistoric times as evidenced by artifacts found at archaeological sites on the property and the Safety Harbor burial mound. While the mound has been exposed to disturbance from construction, it is believed that enough of the mound is still intact for it to be listed in the NRHP. Information obtained from the undisturbed profile could add to our understanding of the people who lived in this area and their interactions with other cultures.



## **Park Interpretation**

Interpretation is a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and meanings inherent in the resource. Interpretive themes are the key concepts for communicating the meanings inherent in a Florida State Park. A central park theme is a short, dynamic interpretive statement that reflects the significance of a park by highlighting distinctive features and essential visitor experiences. In addition to a central park theme, each park has primary interpretive themes. These themes serve as a starting point for park staff to plan interpretive and educational content by outlining the main stories of the park's natural and cultural resources. Further interpretive planning can branch off from these themes but should ultimately help reinforce the main interpretive messages of the park.

## **Central Park Theme**

The enchanting waters of Weeki Wachee Springs were transformed into a magical entertainment experience, which now depend on the health and maintenance of the spring and its vulnerable watershed.

## **Primary Interpretive Themes**

### Mermaid Shows

The roadside attraction's early innovations with underwater apparatuses led the mermaid shows of Weeki Wachee Springs to become a global cultural icon.

### Uplands

Maintaining the scrub habitats surrounding the spring protects its remaining recharge area from development and contributes to maintenance of water quality.

### Spring Run

Responsible recreation on the Weeki Wachee River is a safeguard for the water clarity and delicate vegetation of this ecological treasure.

### Water Quality and Quantity

The health of the Weeki Wachee River relies on collaborative regional management efforts that prioritize nitrogen reduction and water conservation.

## **Interpretive Application**

Interpretation is a DRP priority for the inherent value of visitor engagement and as a tool for promoting stewardship and conservation. Interpretation also plays an important role in achieving many other park management objectives.

### Non-Personal Interpretation

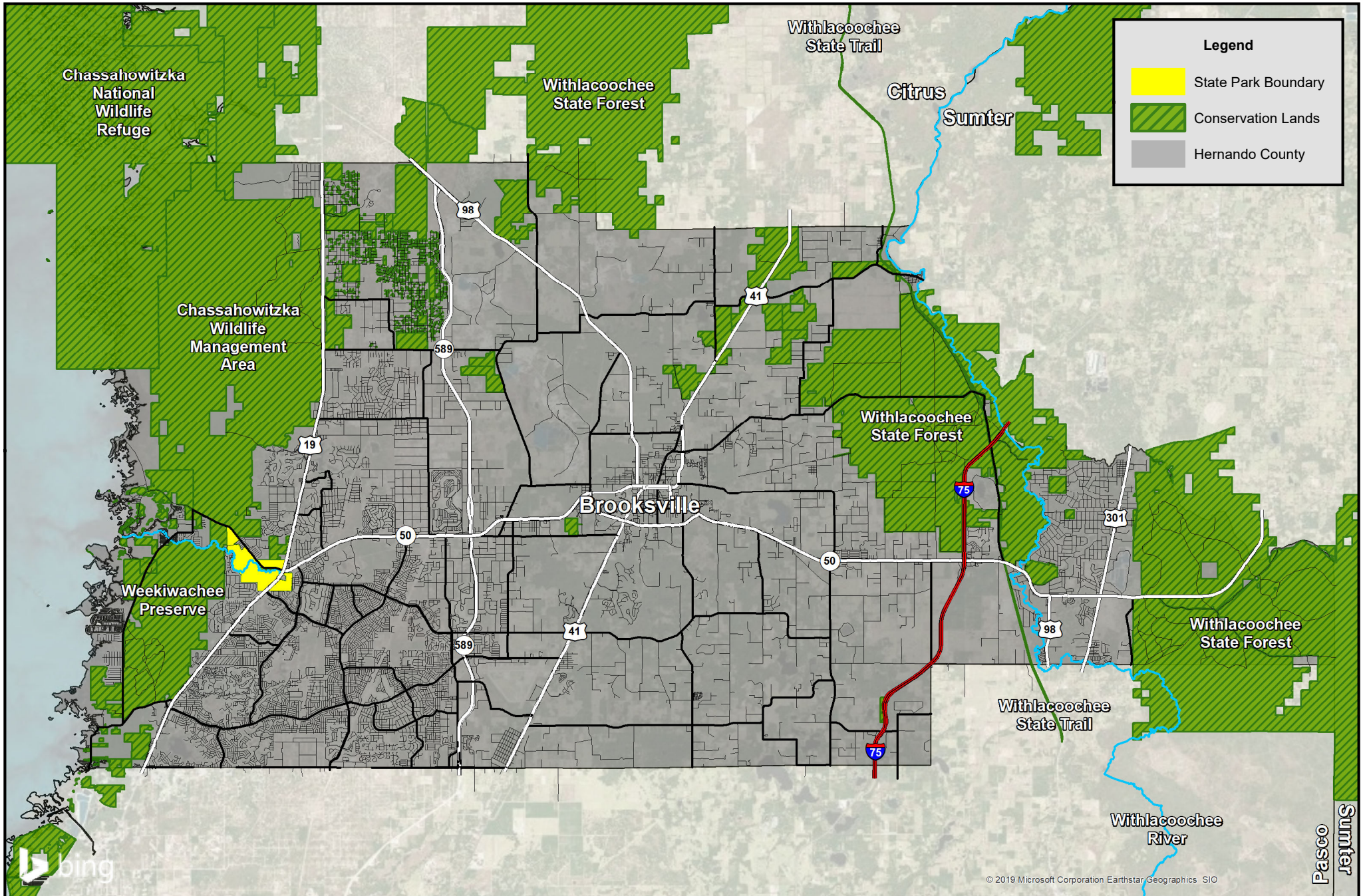
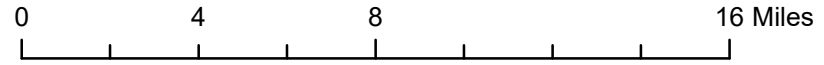
Interpretive elements which do not require a person to deliver a message (signs, exhibits, brochures, kiosks, etc.).

### Personal Interpretation

One person or persons providing interpretation to another person or persons. It can be planned or impromptu.



# Weeki Wachee Springs State Park Hernando County Vicinity Map





## Acquisition History

There are three leases associated with the management of Weeki Wachee Springs State Park. Two leases have been issued by the Board of Trustees of the Internal Improvement Trust Fund (Trustees), and the third involves the Southwest Florida Water Management District (SWFWMD). The terms of the three management leases are as follows:

<b>Management Lease</b>	<b>Start Date</b>	<b>Term Length</b>	<b>Acreage</b>
<i>SWFWMD Lease Agreement</i>	11/01/2008	50 Years	509.83
<i>Submerged Lease #270345153</i>	11/25/2009	25 Years	28.54
<i>Trustees Lease #4817</i>	03/16/2018	10 Years	388.91

Weeki Wachee Springs State Park is designated single use to provide public outdoor recreation and conservation. There are no legislative or executive directives that constrain the use of this property (see Addendum 1). A legal description of the park property can be made available upon request to the Florida Department of Environmental Protection.

Weeki Wachee Springs State Park is classified as a State Park in the DRP's unit classification system. In the management of a State Park, a balance is sought between the goals of maintaining and enhancing natural conditions and providing various recreational opportunities. Natural resource management activities are aimed at management of natural systems. Development in the park is directed toward providing public access to and within the park, and to providing recreational facilities, in a reasonable balance, that are both convenient and safe. Program emphasis is on interpretation on the park's natural, aesthetic, and educational attributes.

## Secondary and Incompatible Uses

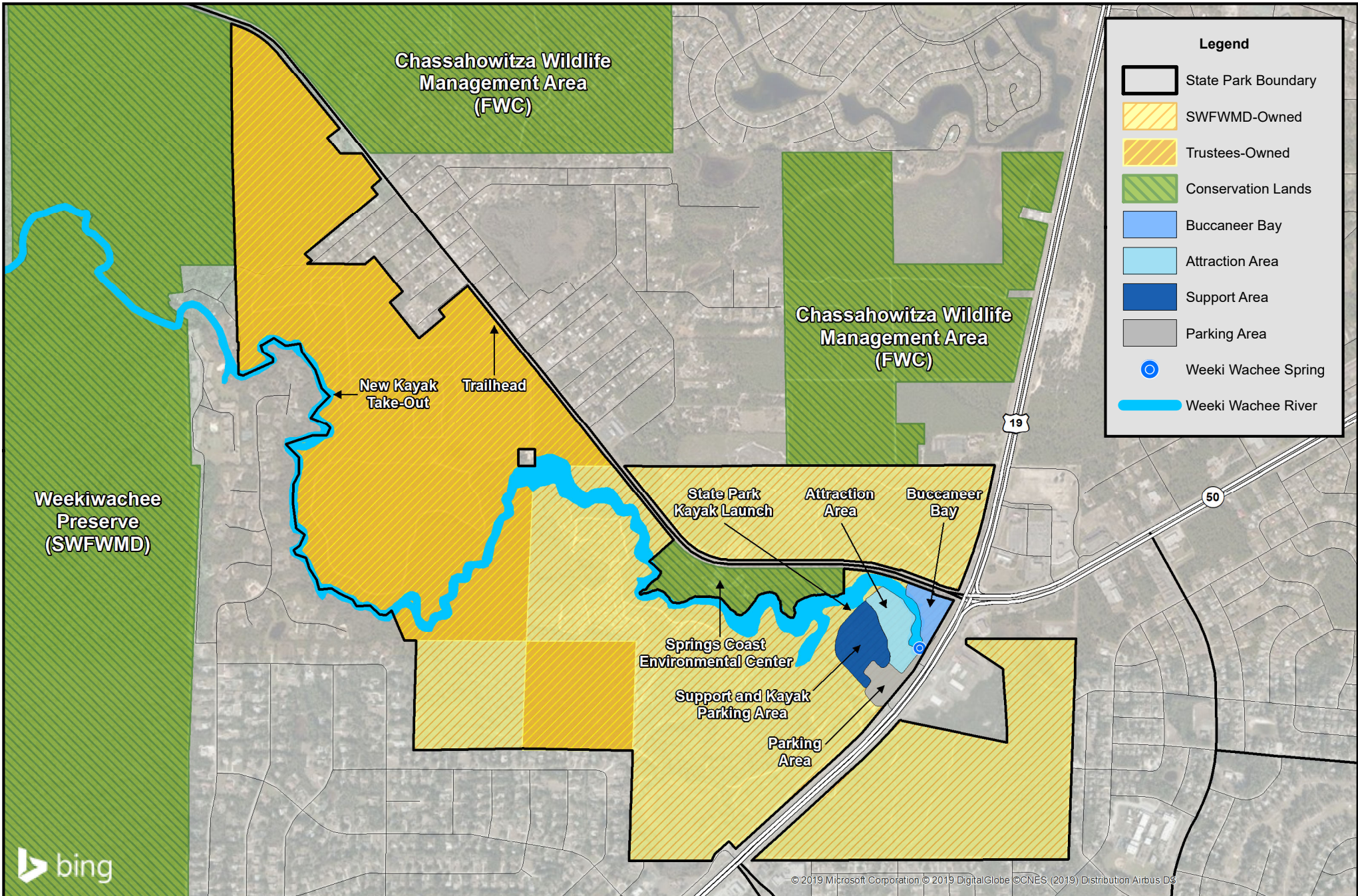
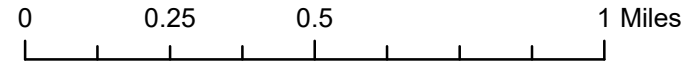
In accordance with 253.034(5) F.S., the potential of the park to accommodate secondary management purposes was analyzed. These secondary purposes were considered within the context of the DRP's statutory responsibilities and the resource values of the park. For this park, it was determined that no secondary purposes could be accommodated. The DRP has determined that uses such as water resource development projects, water supply projects, stormwater management projects, linear facilities and sustainable agriculture and forestry (other than forest management activities specifically identified in this plan) would not be consistent the management purposes of the park. Arthropod control plans are not in place for SWFWMD and sensitive environmental lands.

## Contract Services

The DRP may provide the services and facilities outlined in this plan either with its own funds and staff or through an outsourcing contract. Private contractors may provide assistance with natural resource management and restoration activities or a concessionaire may provide services to park visitors in order to enhance the visitor experience. A concessionaire may also be authorized to provide specialized services when the required capital investment exceeds that which DRP can elect to incur. Decisions regarding outsourcing, contracting with the private sector, the use of concessionaires, etc. are made on a case-by-case basis in accordance with the policies set forth in DRP's Operations Manual (OM).



# Weeki Wachee Springs State Park Reference Map



## Management Authority and Responsibility

In accordance with Chapter 258, Florida Statutes and Chapter 62D-2, Florida Administrative Code, the Division of Recreation and Parks (DRP) is charged with the responsibility of developing and operating Florida's recreation and parks system. These are administered in accordance with the following policy:

*It shall be the policy of the Division of Recreation and Parks to promote the state park system for the use, enjoyment, and benefit of the people of Florida and visitors; to acquire typical portions of the original domain of the state which will be accessible to all of the people, and of such character as to emblemize the state's natural values; conserve these natural values for all time; administer the development, use and maintenance of these lands and render such public service in so doing, in such a manner as to enable the people of Florida and visitors to enjoy these values without depleting them; to contribute materially to the development of a strong mental, moral, and physical fiber in the people; to provide for perpetual preservation of historic sites and memorials of statewide significance and interpretation of their history to the people; to contribute to the tourist appeal of Florida.*

Many operating procedures are standardized system-wide and are set by internal direction. These procedures are outlined in the OM that covers such areas as personnel management, uniforms and personal appearance, training, signs, communications, fiscal procedures, interpretation, concessions, public use regulations, resource management, law enforcement, protection, safety and maintenance.

## General Park Management Goals

The following park goals express DRP's long-term intent in managing the state park:

- Provide administrative support for all park functions
- Protect water quality and quantity
- Restore hydrology to the extent feasible and maintain the restored condition.
- Restore and maintain the natural communities/habitats
- Maintain, improve, or restore imperiled species populations and habitats
- Remove exotic and invasive species and conduct needed maintenance-control.
- Protect, preserve and maintain the cultural resources
- Provide public access and recreational opportunities
- Develop and maintain necessary capital facilities and infrastructure

## Management Coordination

The Florida Department of Agriculture and Consumer Services (FDACS), Florida Forest Service (FFS), assists DRP staff in the development of wildfire emergency plans and provides the authorization required for prescribed burning. The Florida Fish and Wildlife Conservation Commission (FWC) assists staff in the enforcement of state laws pertaining to wildlife, freshwater fish and other aquatic life existing within the park. In addition, the FWC aids DRP with wildlife management programs, including imperiled species management. The Florida Department of State (FDOS), Division of Historical Resources (DHR) assists staff to ensure protection of archaeological and historical sites.





# Management Objectives

This section compiles the management goals and objectives expressed in the separate parts of this management plan. Estimated costs for the ten-year planning period of this plan are provided for each objective, and the costs are summarized under standard categories of land management activities. Measures are identified for assessing progress toward completing each objective. The timeframes for completing each objective are:

- Continuous (C) – to be performed on a continuous basis
- Short-Term (ST) – to be completed within two years of the approval date
- Long-Term (LT) – to be completed or started within the plan’s lifespan
- Unfunded Need (UFN) – to be identified for potential future funding

Many of the objectives identified in the plan can be implemented using existing staff and funding. However, a number of continuing activities and new activities with measurable quantity targets and projected completion dates are identified that cannot be completed during the life of this plan unless additional resources for these purposes are provided. The plan’s recommended objectives, time frames, and cost estimates will guide the DRP’s planning and budgeting activities over the period of this plan.

It must be noted that these recommendations are based on the information that exists at the time the plan was prepared. A high degree of adaptability and flexibility must be built into this process to ensure that the DRP can adjust to changes in the availability of funds, improved understanding of the park’s natural and cultural resources, and changes in statewide land management issues, priorities, and policies.

Statewide priorities for all aspects of land management are evaluated each year as part of the process for developing the DRP’s annual legislative budget requests. When preparing these annual requests, the DRP considers the needs and priorities of the entire state park system and the projected availability of funding from all sources during the upcoming fiscal year. In addition to annual legislative appropriations, the DRP pursues supplemental sources of funds and staff resources wherever possible, including grants, volunteers and partnerships with other entities.

The DRP’s ability to accomplish the specific objectives identified in the plan will be determined largely by the availability of funds and staff for these purposes, which may vary from year to year. Consequently, the target planning period and estimated costs may need to be adjusted during the ten-year management planning cycle.

<b>Goal I: Provide administrative support for all park functions.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Continue day-to-day administrative support at current levels.</b>	Administrative support ongoing	C	\$2,575,000
<b>Objective B</b>	<b>Expand administrative support as new facilities are developed or as other needs arise.</b>	Administrative support expanded	UFN	\$500,000

<b>Goal II: Protect soil resources in the park.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Control soil erosion through monitoring, stabilization, and unauthorized trail closures.</b>	# of square feet stabilized	C	\$5,000
<b>Goal III: Protect water quality and quantity in the park, restore hydrology to the extent feasible and maintain the restored condition.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Conduct/obtain an assessment of the park's hydrological restoration needs.</b>	Assessment conducted or obtained	UFN	\$10,000
<b>Goal IV: Restore and maintain natural communities/habitat of the park.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Develop and implement a point bar restoration plan for the spring-run stream.</b>	Restoration plan developed	ST, C	\$750,000
<b>Objective B</b>	<b>Continue to monitor submerged aquatic vegetation in the spring-run stream.</b>	# of monitoring events conducted	C	\$60,000
<b>Objective C</b>	<b>Conduct natural community improvement activities on 575 acres of scrub, scrubby flatwoods, and sandhill.</b>	# of acres improved	LT	\$100,000
<b>Objective D</b>	<b>Maintain 615 acres of the park within the optimum fire return interval.</b>	# of acres maintained	LT	\$54,000
<b>Objective E</b>	<b>Complete a comprehensive flora and fauna survey and update the park's baseline plant and animal list</b>	Plant and animal list updated	C	\$10,000
<b>Goal V: Maintain, improve, or restore imperiled species populations and habitats in the park.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Continue to update baseline imperiled species occurrence inventory lists for plants and animals.</b>	Imperiled species lists updated	C	\$5,000
<b>Objective B</b>	<b>Monitor and document 1 selected imperiled animal species.</b>	Population survey conducted	C	\$15,000

<b>Goal VI: Remove exotic and invasive plants and animals from the park and conduct needed maintenance control.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Annually treat at least 18 infested acres of plant species in the park.</b>	# of infested acres treated	C	\$900,000
<b>Objective B</b>	<b>Develop a comprehensive invasive management plan for the park.</b>	EPM plan developed	ST	\$5,000
<b>Objective C</b>	<b>Maintain and publish the landscaping manual for the park.</b>	Landscaping manual published	ST	\$2,500
<b>Objective D</b>	<b>Implement decontamination protocols for the park.</b>	# of protocols implemented	ST	\$1,000
<b>Objective E</b>	<b>Manage Lyngbya and invasive aquatic species.</b>	# of acres treated	UFN	\$50,000
<b>Objective F</b>	<b>Implement control measures on 1 exotic animal species in the park.</b>	# of hogs removed	C	\$50,000
<b>Goal VII: Protect, preserve, and maintain the cultural resources of the park.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Continue to compile reliable documentation for all cultural resources.</b>	Documents compiled	C	\$15,000
<b>Objective B</b>	<b>Assess and evaluate all recorded cultural resources in the park.</b>	# of resources evaluated	C	\$20,000
<b>Objective C</b>	<b>Maintain all NR-eligible or listed resources in good condition.</b>	# of resources in good condition	C	\$1,250,000
<b>Objective D</b>	<b>Send staff to complete DHR's Archaeological Resource Management (ARM) training.</b>	% of staff ARM trained	LT	\$2,000
<b>Objective E</b>	<b>Complete historic preservation projects.</b>	# of projects completed	UFN	\$15,000

<b>Goal VIII: Provide public access and recreational opportunities at the park.</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Maintain the current public access and recreational uses at the park.</b>	Current access maintained	C	\$8,570,000
<b>Objective B</b>	<b>Continue to provide and develop interpretive programs.</b>	# of interpretive programs	C	\$50,000
<b>Goal IX: Develop and maintain the capital facilities and infrastructure necessary to implement the recommendations of the Conceptual Land Use Plan (CLUP).</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Maintain all public and support facilities in the park.</b>	Facilities maintained	C	\$3,500,000
<b>Objective B</b>	<b>Improve/repair facilities in 4 existing use areas.</b>	# of facilities improved	UFN	\$9,378,000
<b>Objective C</b>	<b>Construct 0.75 miles of road and facilities in 2 new use areas.</b>	# of facilities constructed	UFN	\$1,474,000
<b>Goal X: Prevent resource degradation from user impacts and maintain a high-quality visitor experience</b>		<b>Measure</b>	<b>Planning Period</b>	<b>Estimated Manpower and Expense Cost (10-years)</b>
<b>Objective A</b>	<b>Develop and implement visitor use management monitoring protocol.</b>	Monitoring protocol developed	ST	\$750,000
<b>Objective B</b>	<b>Improve education and interpretation.</b>	# of new interpretation	ST	\$10,000
<b>Objective C</b>	<b>Maintain paddle launch capacities at 280 vessels per day.</b>	# of vessels launched per day	ST	\$10,000
<b>Objective D</b>	<b>Conduct biennial visitor satisfaction surveys.</b>	# of surveys conducted	UFN	\$40,000

# **Physical Geology and Hydrology**

## **Geology**

The geology in the park is characteristic of that of most of the Springs Coast region, which extends from just south of the Big Bend to about the Anclote River (Noss and Bland 1990). In this region, the subsurface consists of thick layers of underlying limestone and dolomite that were deposited over millions of years in coral reefs. The upper limestone layers are often very near the surface and covered in mostly quartz-derived sandy soils of varying depths.

The formation nearest the surface is the Suwannee Limestone of the Oligocene series, deposited 30 to 37 million years ago. It is characterized as cream to tan, grainy to chalky, and highly fossiliferous. Beneath that lies the Ocala Group of the Eocene series, approximately 300 feet thick, formed of white, soft coquina limestone with hard micritic limestone in the deeper layers. Beneath that is the deepest formation to outcrop in Florida, the Avon Park Formation of the early Eocene. Formed nearly 45 million years ago, it is made up of hard dolomite in the upper layers and softer limestone in the lower layers (Noss and Bland 1990; Jones et al. 1997).

At the surface, Pleistocene era deposits form marine terraces. The Pamlico Terrace is the dominant terrace in western Hernando County. It is characterized by a gently sloping or nearly horizontal surface formed by wave action of an ancient sea (Noss and Bland 1990). The clays and quartz sands deposited on the ancient shoreline are still visible in the gently undulating topography of the region.

The karst features that underlay the Pamlico Terrace dominate the visible geologic landscape. These features are the result of dissolution of the underlying limestone by the action of surface and ground water movement. This movement of water slightly acidified by atmospheric and soil carbonic acid, over time has produced numerous sinkholes, underground drainage systems, and other subterranean conduits between otherwise confining layers. The results of this subterranean dissolution of rock often manifest in very visible surface features like springs, sinks and sinkhole lakes.

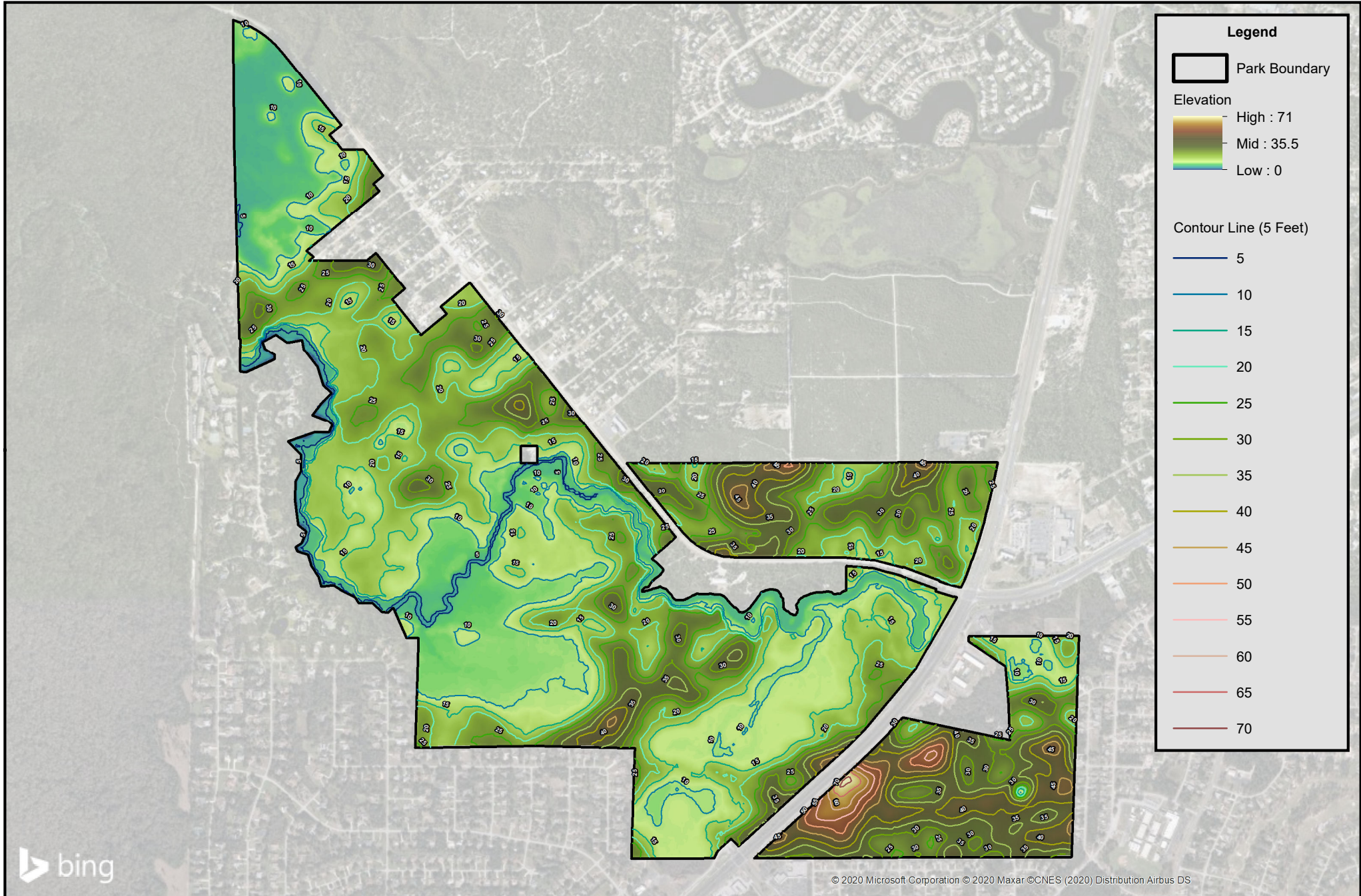
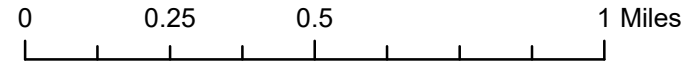
The four dominant visible karst features in the park are the two springs, Weeki Wachee Spring and Twin Dees, or Little Spring, a small sinkhole on the main park parcel, and the paleo-sink on the parcel east of U.S. Highway 19. The springs are karst openings to the Upper Floridan aquifer. In this part of the state, the freshwater part of the Floridan aquifer is formed by Suwannee and Ocala limestones and the Avon Park Formation (Knochenmus and Yobbi 2001).

## **Topography**

The topography of Weeki Wachee Springs State Park is typical of the local physiography, classified as Gulf Coastal Lowland by White (1970), and more specifically as the Weeki Wachee Dune Field by Brooks (1981). The Weeki Wachee Dune Field is an approximately 32-mile long and 5- to 10-mile wide region characterized as an area of paleo-sand dunes and solution basins with elevations not exceeding 90 feet (Brooks 1981). These ancient dunes form a gently sloping relief in the uplands and nearly level lowlands. The park sits on the western edge of the Weeki Wachee Dune Field near the gradation to the Coastal Swamp or Chassahowitzka Coastal Strip physiographic region.



# Weeki Wachee Springs State Park Topography Map



**Legend**

- Park Boundary
- Elevation**
  - High : 71
  - Mid : 35.5
  - Low : 0
- Contour Line (5 Feet)**
  - 5
  - 10
  - 15
  - 20
  - 25
  - 30
  - 35
  - 40
  - 45
  - 50
  - 55
  - 60
  - 65
  - 70

The topographic relief of the park is the result of changing sea levels during the Pleistocene Epoch that deposited quartz sand and clayey sand as dunes along ancient shorelines. The deposition of these soils resulted in the formation of marine terraces. This same wave action carved out the flat, horizontal coastline that currently supports hammocks and swamps west of the Dune Field.

Elevations in the upland scrub habitat in the park range from just over 70 feet above sea level to less than 20 feet above sea level. The elevations of the lowland hydric hammock habitats are nearly level, ranging from 20 feet to 10 feet above sea level over a much greater distance. The topography drops sharply and variably along the banks of the Weeki Wachee River. The outside bends of the river tend to be much steeper, while sand deposition on the inside of the bends tends to form more shallow slopes.

## **Soils**

According to the [Natural Resources Conservation Service](#), seven soil types are found at Weeki Wachee Springs State Park (see Soils Map). There are no known mineral resources at the park. For detailed information on soils, see Addendum 4. Soils associated with the different natural communities at the park are noted in the natural community descriptions in this plan.

Five of the soil types found in the park are classified as poorly drained, depressional soils typical of low lying or hydric habitats. These are designated as Anclote fine sand; Basinger fine sand; Basinger fine sand, depressional; Myakka fine sand; and Okeelanta-Terra Ceia association. The other soil types represented in the park are typical of more upland habitats, and include Myakka fine sand, Candler fine sand, and Paola fine sands, 0 to 8 percent slopes. Potential impacts to these soil types come from installation and maintenance of firebreaks, trails, feral hog rooting, and runoff from nearby roadways.

The soils of the hydric hammock and baygall bordering the Weeki Wachee River are vulnerable to erosion due to boat wakes. Several areas along the river have erosion where unauthorized recreational foot traffic along and up the riverbank has led to increased soil erosion along the river. Rooting by feral hogs (*Sus scrofa*) exposes bare soil and can lead to soil erosion.

## **Soil Management Objectives**

### **Goal: Protect soils resources in the park.**

A major factor contributing to the erosion potential of the upland soils are the numerous roads that have been installed both historically and more recently as a part of the restoration and routine management activities of the previous site manager. An additional concern with the roads is the direction and slope as it relates to conveyance of water. The park road along the buffer on the south side of the river is close to some of the steep slopes to the river. Heavy rain events and continued vehicle use may contribute to erosion of the road. Portions of the northwestern section of the road are as much as 30 centimeters lower than the adjacent vegetated scrub to the south, indicating that loss of soil may already be happening. Monitoring of this portion of the road will be required to quantify any further soil loss. If erosion continues, the road may be restricted to use only as a firebreak. Additional stabilization of the road may also be required.

## **Objective A: Control soil erosion through monitoring, stabilization, and unauthorized trail closures.**

- Action 1 Monitor firebreaks, service roads, trails, and the river bank for soil erosion.

Changes in topography with areas of steep slope, plus generally loose sandy soils make erosion a concern after heavy rain events along unimproved service roads, firebreaks, and along the road shoulder of US-19, and CR-550, boat wakes and trails leading up the bank of the Weeki Wachee River, and in the area around Buccaneer Bay. Currently there is evidence of erosion in WW-03B, WW-07, WW-13, WW-15, WW-26, WW-28, WW-29, WW-35, WW-36. The erosion in WW-13, 35 and 36 is associated with the slopes along the road shoulder of US-19, and CR-550. This erosion should be addressed in coordination with FDOT and Hernando County Public Works. Erosion along service roads and firebreaks should be documented and addressed. Firebreaks should be maintained with the minimum amount of soil disturbance to keep them functional.

- Action 2 Develop and implement plan to address erosion issues through stabilization, trail closures, or working with local roadway managers.

Coordinate with those responsible for local roadway shoulder maintenance at FDOT and Hernando County Public Works to address concerns about runoff from roadways leading to erosion, or sand deposition into the park. Develop an annual work plan to address erosion concerns by stabilizing some areas with rock or other approved material, elimination mineral firebreaks on steep slopes where it is possible and using vegetation and logs to block unauthorized trails.

## **Hydrology**

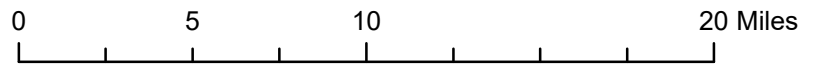
The **Weeki Wachee springshed** is an approximately 260-mi<sup>2</sup> region, covering a portion of southern Hernando County and northern Pasco County within the Springs Coast Basin (FDEP 2018). The primary source of groundwater to the springshed is the Upper Floridan Aquifer (UFA) (Champion and Starks 2001). The UFA is largely unconfined in this area of the state due to the absence or very thin presence of an intermediate confining unit (Sepulveda 2002). Recharge to the UFA is typically high in the central and eastern portions of the Springs Coast region due to the unconfined nature of the aquifer and the frequency of shallow limestone outcrops and surface sediments that contain low levels of potentially confining materials like clay (Champion and Starks 2001). Surface run-off is influenced by factors such as impervious surfaces, distance to receiving bodies of water, and substrate morphology. For more detailed information about the Weeki Wachee Springshed including on-going monitoring and restoration efforts see the [Weeki Wachee Surface Water Improvement and Management \(SWIM\) Plan](#) (SWFWMD 2017).

A positive correlation has been shown to occur between area rainfall and flow at the main headspring (Heyl 2008). The average annual rainfall for Hernando County is 55 inches per year (SWFWMD 2017). The publication of the minimum flows and levels (MFL) for the Weeki Wachee River in 2008 provided a synopsis of changes over time. The goal of the MFL determination is to set the limit of further withdrawals and thus prevent significant harm to water resources or river ecology. There has been a 63 cfs linear decline in discharge in the study period between 1961 and 2004 (Heyl 2008). A number of modeling strategies were applied to determine how much of the decline was attributable to anthropogenic impacts within the springshed compared to climatic factors.



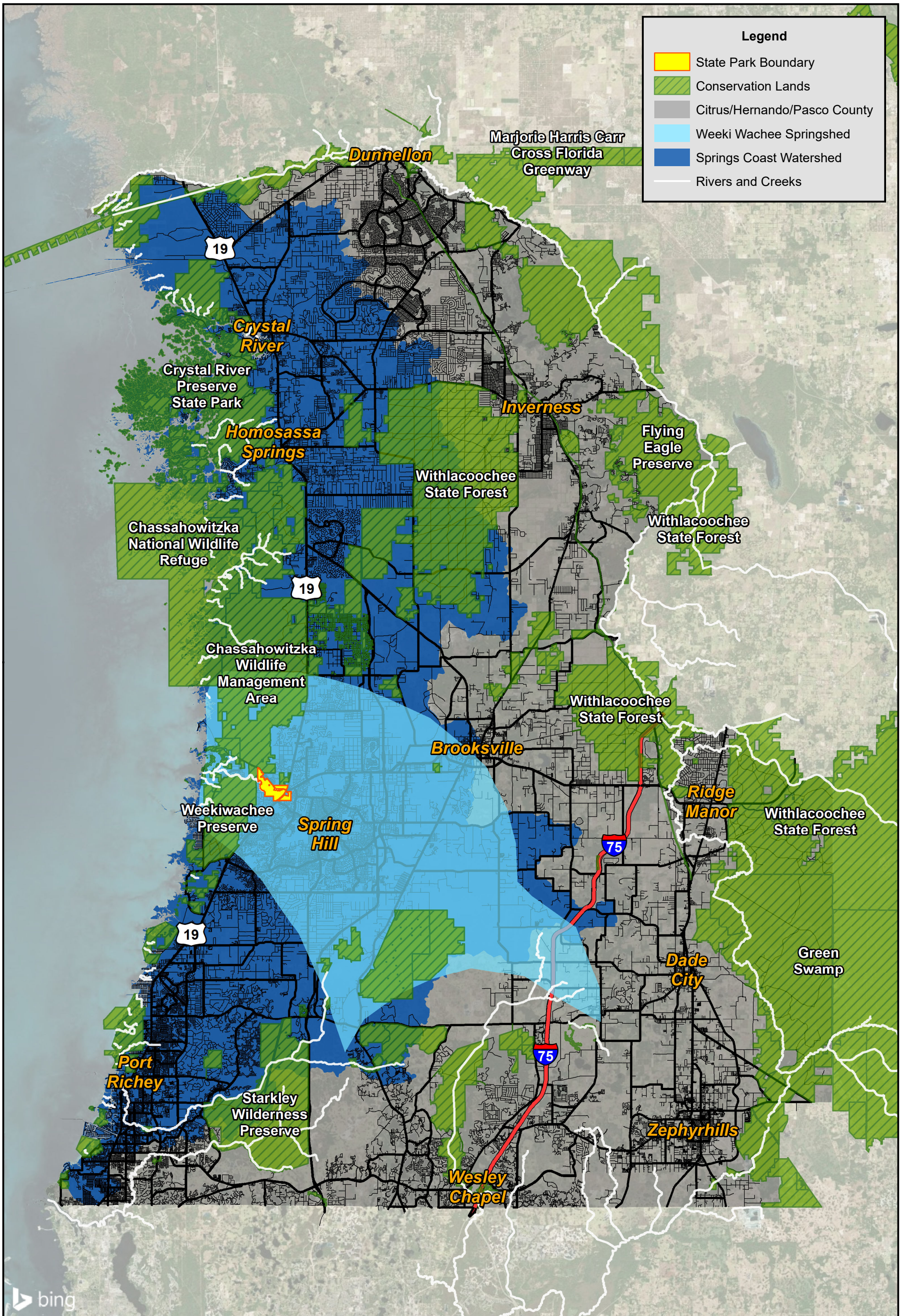


# Weeki Wachee Springs State Park Regional Hydrology Map



**Legend**

- State Park Boundary
- Conservation Lands
- Citrus/Hernando/Pasco County
- Weeki Wachee Springshed
- Springs Coast Watershed
- Rivers and Creeks





The average reduction in discharge due to anthropogenic impacts was estimated to be 17 cfs. While the MFL applies to the river, it is also intended to protect the spring as the main source of water flow.

The visible groundwater features of the park consist primarily of the Weeki Wachee headspring and the smaller magnitude Twin Dees or Little Spring. These two springs, together with several smaller springs outside the park (Salt Spring, Mud River Spring, and Hospital Hole) make up the Weeki Wachee Springs Complex (Jones et al. 1997; Champion and Starks 2001). The combined flow of these springs and the tributaries they feed make up the Weeki Wachee River.

**Weeki Wachee Spring** is one of 33 first magnitude springs in Florida (Florida Springs Task Force, 2000). To be classified as a first magnitude spring, median discharge of water must be at least 100 cubic feet/second (cfs) or 64.6 million gallons of water per day (mgd) (Scott 2004). Discharge data from the 1931-2015 period of record indicate an average discharge of 171 cfs from the main spring (SWFWMD 2017). [Real-time water level data](#) is readily available from USGS for the [spring](#) and [river](#). The WMD's [Weeki Wachee Springs Spring Dashboard](#) has an overview of current metrics for the springhead and river with some historical context.

The spring is located approximately 800 feet southwest of the intersection of State Road 50 and U.S. Highway 19. The spring consists of a conical pool that is 165 ft wide east to west and 210 ft wide north to south (Scott 2004). The pool slopes gently down 10 feet to the start of the main vent. From there, the vent forms a north-south trending fracture that narrows at a depth of 185 feet to a small fracture, which is a 20-foot by 3-foot opening (Jones et al. 1997). During periods of peak flow, water can pass through the narrow fracture at 5 miles per hour. Limestone rock is exposed near the vent, but most of the pool is covered by sandy substrate (Scott 2004). Beyond the fracture, the cave turns to a more horizontal trajectory and forms a room-like tunnel that is 55 feet wide, 28 feet high and 220 feet long (Karst Underwater Research, Inc. 2008).

**Twin Dees Spring**, located about 0.5 miles southwest of Weeki Wachee Spring, is a much smaller third magnitude spring (1-10 cfs average discharge). The pool is 36 feet wide east to west and 75 feet wide north to south. Two vent openings separated by a natural dam make up the spring, giving the pool the appearance of two springs side by side when the spring is not flowing. The main spring vent is in the southwest pool and is about 4 feet in diameter and 50 feet deep (Rosenau 1977). Prior exploration and mapping of the subterranean caves and passages revealed no hydrogeologic connection between Twin Dees and Weeki Wachee Spring (Karst Underwater Research, Inc. 2008). However, in September 2014 a connection into the mainspring was discovered. And with this discovery, divers have been able to map and explore over 30,868 linear feet of subterranean passages and some areas with a depth of more than 400 feet (Karst Underwater Research, Inc. 2019).

**Surface water.** The major surface water features of the park are the Weeki Wachee River (Weeki Wachee Springs Run) and the Twin Dees Spring Run. Other surface water features include basin and depression marshes, and a sinkhole that periodically holds water (described in the natural community section of this plan).

The Weeki Wachee River flows approximately 7.52 miles to the Gulf of Mexico, but only approximately 3 miles of the river are within or along the boundary of the state park. The primary source of water in the river is the first magnitude headspring. When flowing,

Twin Dees Spring also contributes surface flow to the river within the park. The river also receives some surface run-off and seepage during periods of heavy rainfall as well as discharge from springs downriver. The surface watershed is estimated to cover 38 square miles of the central portion of western Hernando County (Heyl 2008). Average velocity for the river in the park as reported by Frazer et al. (2006) for the 2003-2005 study period was 0.16 m/s. Average depth in the river as measured for the same study period ranged from 0.8 to 2.0 meters deep, with depth within the park boundary averaging less than 1.5m (Frazer et al. 2006).

Twin Dees Spring Run is a shallow waterway, approximately 10 feet wide and 1.5 feet deep, that runs 0.2 miles from the headspring to the Weeki Wachee River (Scott 2004). Water flow through the run is intermittent. The headspring is the main source of water in the run, but it also receives surface run-off and likely some seepage flow from the adjacent hydric hammock to the east. The surrounding basin marsh is influenced by surface water from both the spring run as well as the adjacent hydric hammock.

**Water quality.** The Weeki Wachee River and spring system is classified as an Outstanding Florida Water (OFW). Weeki Wachee Spring was designated an Outstanding Florida Spring (OFS) under the 2016 [The Florida Springs and Aquifer Protection Act](#) which requires FDEP to adopt a recovery or prevention strategy for each spring to ensure the MFL and nutrient reductions are met. Discharge from the Weeki Wachee headspring is freshwater and not influenced by tidal fluctuations. Average water temperature is 23.3°C. The groundwater is considered hard and alkaline due to the presence of calcium carbonate dissolved from the limestone layers of the UFA. Dissolved oxygen, ammonia and phosphorus levels are low as is typical of groundwater discharge (Frazer et al. 2006).

Nitrate concentrations have been the main water quality concern for Weeki Wachee Spring. A water quality study to quantify declining water quality in 30 Springs Coast springs by Jones et al. (1997) found that nitrate concentrations were increasing across the region with nitrate concentrations in Weeki Wachee showing nitrate levels 50 times higher than background levels. In 2001 the Florida Department of Environmental Protection Florida Springs Initiative started collecting quarterly monitoring data; as well as, a number of other monitoring studies that have corroborated this trend in nitrates (Champion and Starks 2001, Frazer et al. 2001 and 2006, Haber 2005, Cohen et al. 2007; Harrington et al. 2008). This was followed by the verification of the nutrient impairment and the establishment of a Nutrient [Total Maximum Daily Load \(TMDLs\) for the Weeki Wachee Spring and River](#) in June 2014. The nutrient TMDLs goals are an annual arithmetic mean nitrate concentration of 0.28 mg/L at the spring vent of Weeki Wachee Spring and an in-stream annual arithmetic mean nitrate concentration of 0.20 mg/L for the Weeki Wachee River (freshwater segment) (FDEP 2014). In 2018 the [Basin Management Action Plan](#) (BMAP) was established by FDEP to provide the roadmap to meet these TMDLs requirements.

Data indicate that the majority of the nitrate in the system is inorganic in nature (Jones et al. 1997). Based on land use cover, inorganic sources in the springshed come primarily from inorganic fertilizers applied to agricultural fields and groves, golf courses, residential lawns, and improved pasture (Jones et al. 1997). Other nitrate sources are organic, most likely from septic tank leachate, livestock waste, other sources of human and animal waste, and algae. The elevated nitrate levels have contributed heavily to a drastic shift in vegetative composition in the spring. Historical photographs and reports on the spring indicate a lush growth of desirable submerged native aquatic vegetation.

Findings by Stevenson et al. (2007) showed that thick mattes of *Lyngbya wollei* algae could become a self-sustaining nitrate source. Data collected from within and below the mat indicate higher levels of nitrate than in the water column above. Possible sources are from nitrate present in the substrate and nitrate build-up from periodic breakdown of algae within the mat.

Water quality of stormwater run-off adjacent to the spring has also been a concern. The proximity of the headspring and river to major highways, coupled with decades of intensive use of the headspring environs have increased the potential for contaminants and nutrients to flow directly into the spring and river. In the recent past, projects completed by SWFWMD have improved the stormwater retention and run-off in certain areas, including the park kayak launch area.

The main challenges for the management of the natural resource for the future are the trends of increasing nitrate concentration in the system and reduction in historic flows (maintaining velocity) in the system. Decreasing water velocity and increasing nitrates are likely both drivers for several issues including changes in the plant and animal community. The decrease in velocity can increase sedimentation, particles that settle-out can smother SAV decreasing native plant coverage and allow algae to proliferate (King 2014). To resolve these issues, action is needed regionally and beyond the boundary of the park and will require the community to enact the elements of the 2017 SWIM Plan and BMAP.

## **Hydrological Management Objectives**

**Goal: Protect water quality and quantity in the park, restore hydrology to the extent feasible and maintain the restored condition.**

The natural hydrology of most state parks was impaired prior to acquisition to one degree or another. Florida's ecosystems are adapted to natural drainage patterns and seasonal water level fluctuations, and variations in these factors frequently determine the types of natural communities that occur on a particular site. Even minor changes to natural hydrology can result in the loss of plant and animal species from a landscape. Restoring state park lands to original natural conditions often depends on returning natural hydrological processes and conditions to the park. Hydrological restoration is done primarily by filling or plugging ditches, removing obstructions to surface water "sheet flow," installing culverts or low-water crossings on roads, and installing water control structures to manage water levels.

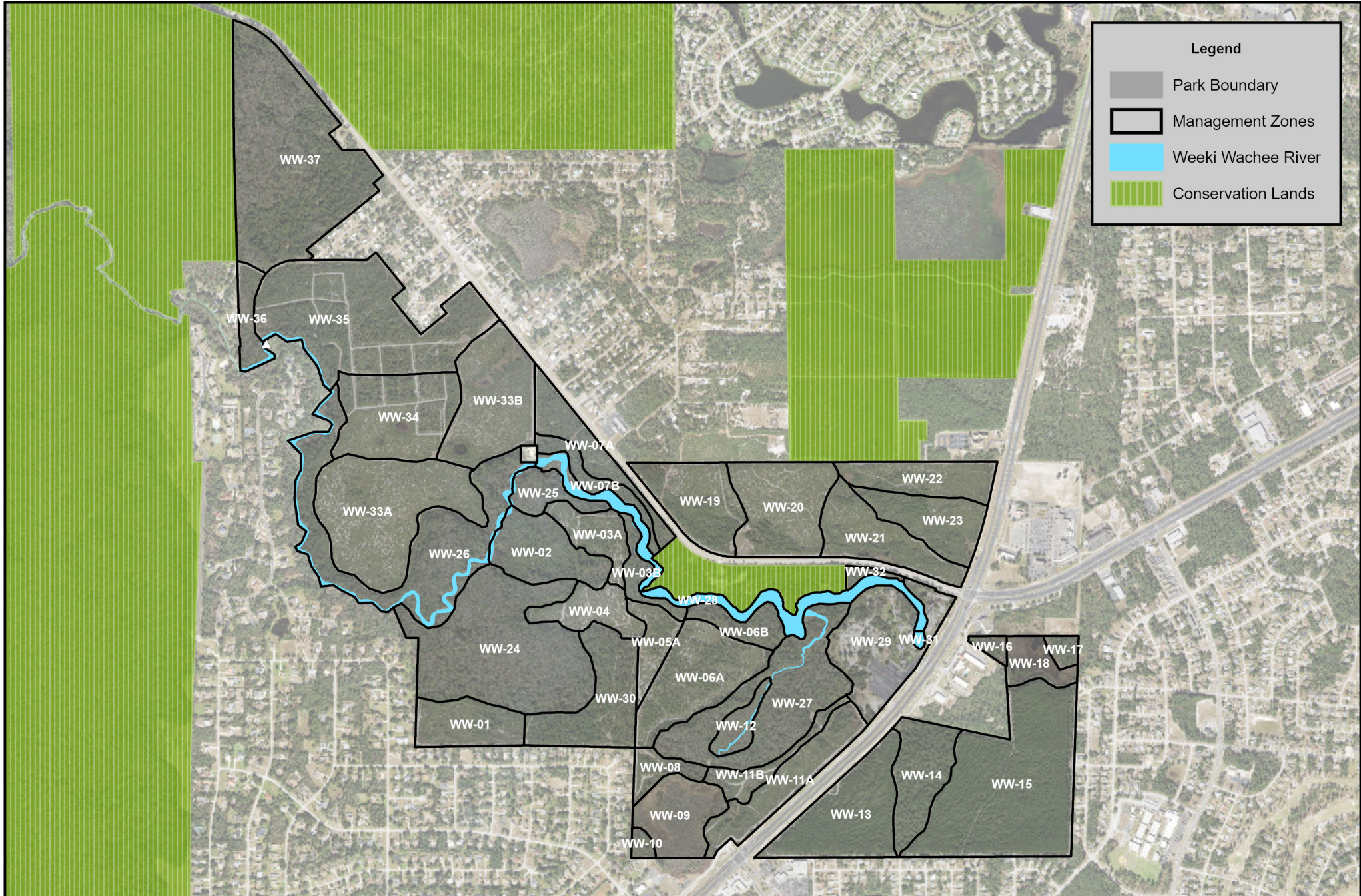
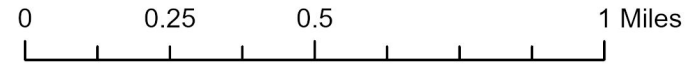
***Objective A: Conduct/obtain an assessment of the park's hydrological restoration needs.***

- Action 1 Continue to support water quality and quantity and biological assessment monitoring in the aquatic cave system, spring, and spring run being conducted by SWFWMD, Florida Springs Institute, KARST Underwater research, and others.

As described in the water resources section of this plan water quality and quantity monitoring in the spring system is well documented by SWFWMD and other researchers. The Florida Park Service, through the research and collection permit program, will allow continued access to the park's water resources for these important monitoring efforts.



# Weeki Wachee Springs State Park Management Zones Map



## Natural Communities and Habitats

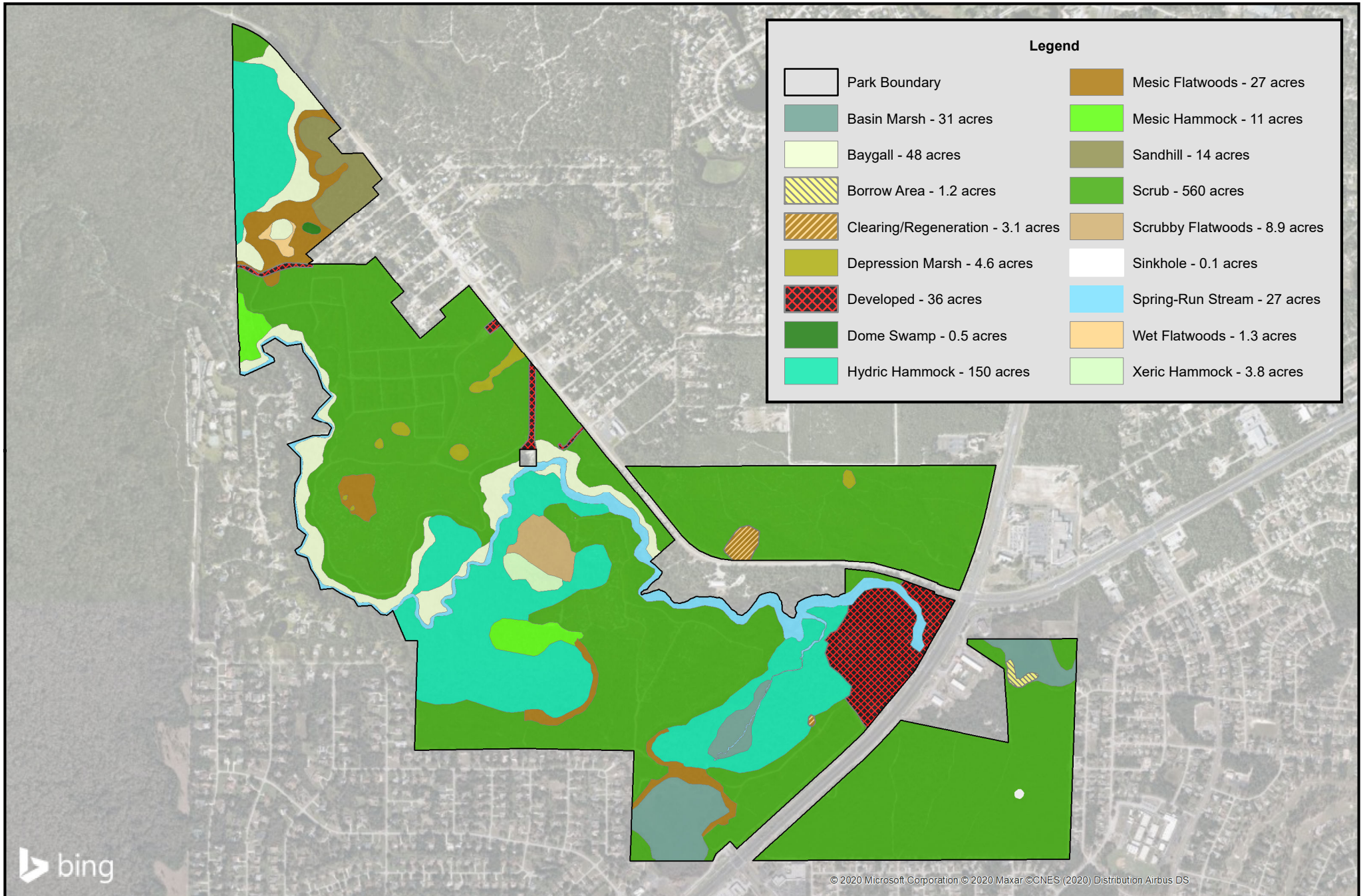
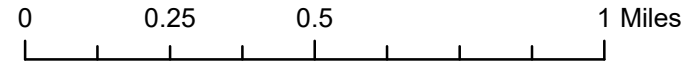
The system of classifying natural communities employed in this plan was developed by the Florida Natural Areas Inventory (FNAI). The premise of this system is that physical factors such as climate, geology, soil, hydrology, and fire frequency generally determine the species composition of an area. Some physical influences, such as fire frequency, may vary from FNAI's descriptions for certain natural communities in this plan. The park contains 14 distinct natural communities as well as altered landcover types. A list of known plants and animals occurring in the park is contained in Appendix 5.

<b>Table 1. Natural Communities and Altered Landcover Types</b>		
<b>Natural Communities</b>	<b>Acreage</b>	<b>Percentage</b>
Scrub	560	60.4%
Hydric Hammock	150	16.2%
Baygall	48	5.2%
Basin Marsh	31	3.3%
Mesic Flatwoods	27	2.9%
Spring-Run Stream	27	2.9%
Sandhill	14	1.5%
Mesic Hammock	11	1.2%
Scrubby Flatwoods	8.9	0.9%
Depression Marsh	4.6	0.5%
Xeric Hammock	3.8	0.4%
Wet Flatwoods	1.3	0.1%
Dome Swamp	0.5	0.05%
Sinkhole	0.1	0.01%
<b>Altered Landcovers</b>	<b>Acreage</b>	<b>Percentage</b>
Developed	36	3.8%
Clearing/Regeneration	3.1	0.3%
Borrow Area	1.2	0.1%
<b>Total Acreage</b>	<b>927</b>	<b>100%</b>

<b>Habitat/Landcover Types</b>	<b>Acreage</b>	<b>Percentage</b>
Upland	626	67.5%
Wetland	234	25.2%
Altered	40	4.3%
Riverine	27	2.9%
Karst	0.1	0.01%



# Weeki Wachee Springs State Park Natural Community Map





## **Mesic Flatwoods – 27 acres**

The mesic flatwoods in the park exist primarily as an ecotonal community between the xeric scrub and sandhill communities and wetlands including baygall, basin marsh and hydric hammock communities. The habitat is characterized by the presence of a saw palmetto (*Serenoa repens*) understory and a sparse canopy of slash pine (*Pinus elliotii*). The mesic flatwoods at the park are commonly associated with the Myakka fine sands soil type.

At present the community is generally in poor condition because of a long absence of fire resulting in an invasion of laurel oak (*Quercus laurifolia*), loblolly bay (*Gordonia lasianthus*), and sweetbay magnolia (*Magnolia virginiana*) trees from the adjacent hydric hammock and baygall. These trees have shaded the habitat, resulting in decreased species diversity. Restoration of this community will require removal of the large hardwood trees and careful application of prescribed fire to restore the shrub diversity and herbaceous vegetation. Where feasible the mesic flatwoods should be allowed to burn into the ecotone of the adjacent wetland communities. To burn under drier conditions a mowed firebreak near the wetland is preferred over the construction of mineral breaks. Air potato (*Dioscorea bulbifera*), skunk vine (*Paederia foetida*) and cogongrass (*Imperata cylindrica*) are the priority invasive species for survey and treatment in the mesic flatwoods. Current coverage of invasive plant species is less than one percent.

Following restorative resource management activities, the mesic flatwoods community should consist of an open canopy of slash pine and few hardwoods. Saw palmetto and native shrubs should comprise no more than 50 percent of the groundcover, with the remainder consisting of native herbs. The understory should be less than 3 feet in height. Shrub species will likely include saw palmetto, gallberry (*Ilex glabra*), fetterbush (*Lyonia lucida*), runner oak (*Quercus pumila*), shiny blueberry (*Vaccinium myrsinites*), wax myrtle (*Myrica cerifera*) and American beautyberry (*Callicarpa americana*). Herbaceous species will likely include crowngrass (*Paspalum* sp.) and threeawn grasses (*Aristida* sp.) and wildflowers like blackroot (*Pterocaulon pycnostachyum*), gayfeathers (*Liatris* sp.), Chapman's goldenrod (*Solidago odora* var. *chapmanii*), and rose-rush (*Lygodesmia aphylla*). The Optimal Fire Return Interval for this community is 1-3 years.

## **Mesic Hammock – 11 acres**

Mesic hammock occurs in pockets in the ecotone between hydric hammock and scrub or the scrub and wetlands associated with the Weeki Wachee River. The canopy consists of live oaks (*Quercus virginiana*), pignut hickory (*Carya glabra*), southern magnolia (*Magnolia grandiflora*) and a few cabbage palms (*Sabal palmetto*) with an open understory of shrubs, a few saw palmetto. The groundcover is leaf litter with a few ferns and partridge berry (*Mitchella repens*). Air potato and skunk vine are the priority invasive plant species for survey and treatment in the mesic hammock. Current coverage of invasive plant species is less than one percent. Some evidence of feral hog (*Sus scrofa*) rooting is evident in the hammock, and the hog population should be kept in check through trapping and removal. Mesic hammocks do not require fire, however fires in adjacent fire-type communities should be allowed to burn the ecotone between the scrub and hammock where feasible to do so. With the exception of a few invasive plants, the mesic hammock appears to be in the desired condition.

## **Sandhill – 14 acres**

Sandhill occurs in a pocket west of CR-550 and north of Cyclops Drive on property that was formerly managed by FWC. Excessively drained candler fine sand soils are associated with the sandhill. The sandhill is overgrown and in poor condition because of fire exclusion and has been invaded by several hardwood species, including laurel oak, myrtle oak (*Quercus myrtifolia*), Chapman's oak (*Q. chapmanii*), sand live oaks (*Q. geminata*), common persimmon (*Diospyros virginiana*), and two species of cherry Carolina laurel-cherry (*Prunus caroliniana*) and black cherry (*P. serotina*). A few sand pine (*Pinus clausa*) have also invaded the sandhill. Aerial imagery shows the sandhill was timbered in 2007 to thin dense pines, but there is no evidence of a follow-up prescribed burn. Longleaf pine (*Pinus palustris*) and turkey oak (*Q. laevis*) are present in the canopy and are the desired species. In addition to the species listed above the understory includes bluejack oak (*Q. incana*), big flower pawpaw (*Asimina obovata*), American beautyberry (*Callicarpa americana*), and saw palmetto. Where there are opening in the understory, Florida greeneyes (*Berlandiera subacaulis*), wiregrass (*Aristida* spp.), and Florida paintbrush (*Carphephorus corymbosus*). Gopher tortoises (*Gopherus polyphemus*) are observed from hatchlings to adults and their burrows are also found in these openings. In addition to the lack of fire, residents in the adjacent neighborhood have dumped rubbish (tires, glass, and other debris) plus yard waste into the sandhill. The boundary with the neighborhood is also the area where most invasive plant species are located, including Camphor tree (*Cinnamomum camphora*), Chinaberry (*Melia azedarach*), air potato, skunk vine, lantana (*Lantana strigocamara*), and torpedograss (*Panicum repens*).

To get the sandhill to desired conditions, invasive plants should be treated, understory hardwoods and sand pines will need to be harvested and removed, rubbish should be removed, then begin restoration burning. After the initial restoration burn the sandhill should be evaluated to determine if there should be supplemental plantings of longleaf pines and wiregrass in the groundcover.

## **Scrub – 560 acres**

Two sub-types of scrub habitat occur in the park. The most widespread scrub type dominating the upland landscape is early successional oak scrub. It is characterized by deep, well-drained white sand soils (Paola fine sands), a shrub layer dominated by the xeric oak species *myrtle*, *sand live*, and *Chapman's*, and a sparse groundcover with persistent patches of open, bare sand. Up until 2002, the scrub was overgrown. Exclusion of fire for decades had resulted in invasion of the oak scrub by sand pine trees (*Pinus clausa*) and elimination of bare sand areas that are critical to many scrub endemics. In 2002, SWFWMD began restoration of 304 acres of the scrub. The restoration consisted mainly of removing the mature sand pine trees. In addition to timbering, 60 acres were mechanically mowed with a hydro-ax to reduce the height of the scrub oaks. A 94-acre prescribed fire was conducted in September 2004. A 70-foot buffer along the river corridor was left to protect water quality in the river (Barnwell 2004).

Surveys following the restoration showed a positive response by scrub vegetation. The rapid return of scrub endemic species such as Florida rosemary (*Ceratiola ericoides*), Curtiss' milkweed (*Asclepias curtissii*), garberia (*Garberia heterophylla*), and scarlet calamint (*Calaminthe coccinea*) along with numerous other herbaceous grasses and wildflowers was observed (Barnwell 2004). Other species observed in the early

successional oak scrub include southern black racer (*Coluber constrictor priapus*), eastern diamondback rattlesnake (*Crotalus adamanteus*), eastern towhee (*Pipilo erythrophthalmus*), and gopher tortoise (*Gopherus polyphemus*).

Prescribed fire has not yet been applied to the parcels east of U.S. Highway 19. Regrowth of sand pine trees on logged, but not burned, management zones is dense in some areas. Much of the scrub habitat that underwent logging without burning is currently in need of sand pine and hardwood removal before the reintroduction of prescribed burning.

Active management of the early successional scrub will require application of prescribed fire on a 5 to 15-year interval. Mechanical reduction of vegetation will likely be required in advance of prescribed burning to maintain safe burning conditions while still meeting ecological objectives. The river buffer has been included in the burn zone units of the park and will be burned on an interval appropriate to the habitat conditions. Since no restoration timbering was done within the buffer, some low impact removal of sand pine trees may be required prior to burning. Since the Weeki Wachee River is an Outstanding Florida Water, all resource management activities within the river buffer will be done in accordance with the FDACS Silviculture Best Management Practices (FDACS 1991, revised 2008).

The second sub-type of scrub known to occur in the park is sand pine scrub. Two areas of sand pine scrub are notable, with one located on the parcel east of U.S. Highway 19 and appears as a distinctive wedge of dense vegetation in 2004 and later aerial photographs, now it is management zone WW-14. The soil is identical, and the shrub layer is nearly identical, to the surrounding early successional oak scrub. The major distinction between the two is the presence of the mature sand pine trees. This area burned in a wildfire in 1976 and the wedge shape is enhanced by the fire plow roads persistent on either side. The fire killed the standing adult pines, but in the absence of prescribed fire since, sand pines have re-established. The second sand pine scrub area is in WW-30, which was added to the park in 2018, that was previously managed by FWC. This sand pine scrub is long-unburned and in senescence, with many leaning or fallen mature sand pines. Additional small pockets of mature sand pines can be found along the higher bluffs along the Weeki Wachee River.

Aerial photographs from 1944 and 1951 indicate a mosaic of vegetation in this area, with some presence of canopy trees, presumably sand pine. Photographs of the attraction taken in 1947 and 1948 also show mature sand pines on the parcel east of U.S. Highway 19. In a contiguous vegetative mosaic, fire would be expected to advance in a more natural pattern, consuming only receptive fuels and leaving areas unburned for some time, allowing establishment of mature sand pine scrub pockets in the landscape. Consequently, the historical presence of some climax sand pine community in this area is expected.

Due to the adjacent urban development, the catastrophic conditions of sand pine scrub fires will not permit the burning of this area in its present condition without mechanical removal of sand pines.

Following continued resource management activities in the scrub communities of the park, early successional oak scrub should predominate, and include sand live oak, myrtle oak and Chapman's oak. Saw palmetto, scrub wild olive (*Cartrema floridana*), Florida rosemary and rusty lyonia (*Lyonia ferruginea*) should also be present. The scrub oak

canopy should vary in height from 3 – 8 feet and there should be a variety of oak age classes/heights between different scrub patches. Bare patches of sand supporting imperiled and endemic plant species listed above, should be present. Sand pine should not be dominant in abundance, percent cover or height. Some areas of mature sand pine may persist. The Optimal Fire Return Interval for this community in the park will likely be between five and 15 years.

Within the scrub north of CR-550 in WW-19 and WW-20 there is approximately two-acres mapped as clearing/regeneration that were cleared in the past. Currently, weedy, early successional species, including ragweed (*Ambrosia artemisiifolia*), yankeeweed (*Eupatorium compositifolium*), blackberries (*Rubus* spp.), and invasive grasses including, cogongrass, rose natalgrass, and West Indian dropseed (*Sporobolus jacquemontii*). This area will be allowed to naturally succeed back to scrub, with invasive plant treatment and prescribed fire as the management tools.

### **Scrubby Flatwoods – 8.9 acres**

This habitat type occurs as a small section along the west side of the main park parcel. At present, the habitat is heavily overgrown due to the long absence of fire. The saw palmettos are extremely dense, having long ago crowded out most of the shrubs and groundcover species typical of scrubby flatwoods. Xeric oak species, primarily sand live oak and myrtle oak are present as very tall shrubs, most over ten feet tall. In addition, present as overgrown shrubs are rusty lyonia and scrub wild olive. There are virtually no ground covers species present due to shading. A slash pine canopy of moderate density also occurs over most of the scrubby flatwoods. The needle fall from the pines has created a litter layer 2-3 feet thick in some areas. The first restoration burn was conducted November 14, 2014 which resulted in the reduction of duff and heavy ground fuels, and a reduction in the slash pine canopy. Shrubs, including saw palmetto, are still too dense and tall in the flatwoods. The scrubby flatwoods would benefit from restoration pine thinning, plus mechanical reduction in fuels followed by a growing season fire to help reduce hardwoods. Following active restoration, application of prescribed fire on a 5 to 8-year interval will maintain shrub height and density to that appropriate for scrubby flatwoods. More comprehensive species assessments will also be done over time.

It appears overall to be a small transitional zone between the scrub and hydric hammock. The Paola fine sand soil type and slightly higher elevation have contributed to the establishment of more xeric species.

Following restorative resource management activities in the scrubby flatwoods community, the canopy should be dominated by sparse (averaging 1-3 trees greater than 15 feet tall per acre) slash pine or longleaf pines. Mature sand pines should be few. The scrub oak mid-story should consist of myrtle oak, sand live oak, and Chapman's oak, which should vary in height from 3 – 8 feet representing a variety of age classes/heights. Other shrubs should include saw palmetto, rusty lyonia, shiny blueberry and tarflower (*Befaria racemosa*). Groundcover of herbaceous species should be less than 40 percent and bare open sandy patches should be present. The Optimal Fire Return Interval for this community is likely to be 5-8 years.

## **Sinkhole/Sinkhole Lake – 0.1 acres**

There are two known sinkholes in the park. One, very small sinkhole is located in the northern portion of the main park parcel, just off the park road. It is characterized as a sandy, conical depression with limestone outcrops. Vegetation in the sinkhole is similar to that of the surrounding scrub/hammock ecotone near the river.

The larger sinkhole is located on the park parcel east of U.S. Highway 19 and is large enough to be visible on aerial photography (around 75 feet in diameter). Historical 1951 aerials show standing water in the sinkhole. During the development of the 2011 management plan, there was no standing water and the bottom was vegetated primarily with buttonbush (*Cephalanthes occidentalis*) and Carolina redroot (*Lachnanthes caroliniana*), indicating the occurrence of some seasonal inundation, or at least saturation. In October 2019, the sinkhole was filled with water. Buttonbush was growing in the water, with the pads of American white water lilies (*Nymphaea odorata*) floating at the surface. The perimeter of the sink is vegetated primarily with saw palmetto, gallberry (*Ilex glabra*), and scrubby oaks. The sinkhole is not easily accessible so dumping should not be an issue but it should be monitored for occurrences of invasive plant species. The sinkhole should be monitored at least two times a year to determine if it holds water long enough to be reclassified as a sinkhole lake. If the sinkhole holds water for more than six months a year it should be considered a sinkhole lake. A hydrogeologic connection to Weeki Wachee Spring or Twin Dees Spring has yet to be determined for this sinkhole.

Management of the sinkhole will be done concurrent with management of the surrounding scrub natural community. The upland vegetation on the slopes will be protected from unnatural disturbance to prevent erosion. Regular application of prescribed fire to the surrounding scrub should carry into the sinkhole and maintain the low stature of the shrubs and saw palmetto that vegetate the sinkhole slopes. The sinkhole will be kept free of invasive plant species.

## **Wet Flatwoods – 1.3 acres**

Wet flatwoods occur as low pockets within mesic and scrubby flatwoods and as an ecotone along wetlands like baygall. Wet flatwoods have a canopy of slash pine, with an open understory of shrubs with pockets of gallberry (*Ilex glabra*), fetterbush (*Lyonia lucida*), and saw palmetto. The hydrophytic grass, warty panicum (*Kellochloa verrucosa*) and blue maidencane are common in the groundcover, with sedges (*Carex* spp.), and Baldwin's spikerush (*Eleocharis baldwinii*). Herbs like musky mint (*Hyptis alata*), and cinnamon fern are also common.

The wet flatwoods on the former FWC property had a dense cover of pine trees prior to 2007 and was logged with the adjacent mesic flatwoods and sandhill in 2007. It was not burned after the timber harvest. However, it still has an open understory, but loblolly bay (*Gordonia lasianthus*), oaks, and shrubs are encroaching from the nearby baygall and hydric hammock. The destructive rooting of feral hogs is evident in the wet flatwoods. To get to desired conditions, with a diverse groundcover and an open canopy of slash pines the wet flatwoods should be burned with the adjacent sandhill and mesic flatwoods at a 1-3 year fire return interval. Feral hog populations need to be controlled through trapping and removal to reduce the damage done to the groundcover and young pine trees (from rubbing) in the wet flatwoods.

### **Xeric Hammock – 3.8 acres**

A pocket of xeric hammock occurs in WW-02, in a transitional area between scrubby flatwoods and hydric hammock in an area where it is sheltered from fire in most wind directions, with the exception of northeast. The xeric hammock is on well-drained Paola fine sands. The closed canopy consists of the xeric oak species found in the scrub and scrubby flatwoods (myrtle, sand live, and Chapman's), large rusty lyonia and a few scattered sand pines. The mid-story includes sparkleberry (*Vaccinium arboretum*) and scrub wild olive. There is no significant groundcover vegetation, with the ground covered in leaf litter. Fire from the adjacent scrubby flatwoods will be allowed to burn into the xeric hammock, and if intense enough, could revert the hammock back to scrub or scrubby flatwoods. During invasive plant surveys in 2019, no invasive species were detected, however skunk vine and cogongrass were observed in nearby areas. The hammock should be monitored for damage by hog rooting, especially during the seasonal acorn mast. The xeric hammock is considered in good condition. Hogs should be trapped and removed from the park to keep population levels low enough to prevent significant damage from rooting.

### **Basin Marsh – 31 acres**

There are three basin marshes in the park. The Basinger fine sand, depressional soil type is characteristic of the basin marshes. The hydroperiod of these soils may be anywhere from six to nine months. The first is located on the north side of the parcel east of U.S. Highway 19. The marsh is relatively intact, except for an approximately  $\frac{3}{4}$ -acre area, shaped like a capital L, in the southwest corner that was excavated between 1959 and 1974. It is not clear why the wetland was excavated. The excavated area is mapped as borrow area, an altered landcover type. There are tussocks, or rafts of floating vegetation, in the borrow area, and on these tussocks the invasive Peruvian primrose-willow can be found. In the open water American white water lilies are common. Other than treating invasive plant species, no restoration measures are planned for the borrow area.

This basin marsh wetland likely receives direct and indirect run-off from the adjacent highway and commercial property. There are several stormwater treatment/detention areas associated with roadways and more recent commercial developments that eventually discharge into this marsh. The northern portion of the marsh is not on state park property. There is little encroachment of hardwoods, likely due to lack of adjacent seed source. The marsh should be burned when the adjacent oak scrub is burned. Florida sandhill cranes (*Grus canadensis pratensis*) have been reported to nest in the marsh (Barnwell, pers. comm.). A survey for sandhill crane nesting will be done prior to any burning in the crane nesting season. Japanese climbing fern (*Lygodium japonicum*), skunk vine, and camphor trees are found around the perimeter of this marsh.

The second basin marsh is located on the south boundary of the main park parcel. It has also been impacted by urban run-off from the adjacent U.S. Highway 19 and urban housing development. As with the previous marsh, there is some stormwater treatment/detention associated with roadways and commercial development that eventually discharges into this marsh. The slope down to the marsh is steep on the south side but is somewhat protected by a berm formed from remnant uplands left undeveloped. The vegetative structure of the marsh is mostly herbaceous on the north and west sides, turning to wooded swamp in the center and to the south and west. Historical aeriels indicate the swamp areas were previously covered by herbaceous

vegetation. The exclusion of fire and the altered hydrology of the marsh have likely permitted the establishment of woody species, including red maple (*Acer rubrum*), dahoon holly (*Ilex cassine*), swamp dogwood (*Cornus foemina*), and elderberry (*Sambucus nigra* subsp. *canadensis*). The marsh has been invaded by Chinese tallow (*Sapium sebiferum*), an invasive tree, on the southwest side. The marsh should be burned as often as the adjacent upland community, and the invasive trees treated or removed. The seasonal high water line on the hardwoods is very high, indicating deep, standing water during seasonally wet periods. Therefore, fire alone may not eliminate the trees. If this is the case, the area may be managed as basin swamp. A population of the state-threatened Florida joint-tail grass (*Coelorachis tuberculosa*) has been documented in the marsh

The third basin marsh surrounds the Twin Dees Spring Run and forms the ecotone between the hydric hammock and the spring run. When viewed aerially the marsh has a drumstick shape that is the result of being wider around braiding in the spring run as it leaves the springhead. As the spring run nears the main river, the marsh gives way to hydric hammock. The herbaceous vegetation of the marsh consists primarily of sawgrass (*Cladium jamaicense*) and patches of marshhay cordgrass (*Spartina patens*). In the absence of fire, the marsh has also been invaded by woody species like Carolina willow (*Salix caroliniana*), red maple, saltbush (*Baccharis glomeruliflora*), and wax myrtle. The state-threatened cardinalflower (*Lobelia cardinalis*) is commonly observed in this marsh. There is no obvious impact to the marsh from direct anthropogenic hydrologic alteration. However, the hydrologic input to the marsh is dependent on flow from Twin Dees Spring, which is intermittent, and from seepage off the adjacent uplands. Both of these are dependent on local seasonal rainfall.

Management of the Twin Dees basin marsh will consist of monitoring for occurrence of invasive plant species and the application of prescribed fire on an appropriate interval with the ecological goal of eliminating and preventing further establishment of encroaching hardwood species.

Proposed management of the basin marsh communities at the park should result in emergent herbaceous and low shrub species dominant over most of the area, and an open vista. Trees should be few and in the deeper portions of the marshes. There should be little accumulation of dead grassy fuels due to frequent burning; the soil surface will likely be visible through the vegetation when the community is not inundated. Dominant vegetation should include maidencane (*Panicum hemitomum*), blue maidencane (*Amphicarpum muehlenbergianum*), cut grass (*Leersia* sp.), sawgrass, pickerel weed (*Pontederia cordata*), arrowheads (*Sagittaria* sp.), buttonbush, St. John's wort (*Hypericum* sp.), and Carolina willow. The Optimal Fire Return Interval for this community is 2-10 years depending on fire frequency of adjacent communities.

### **Baygall – 48 acres**

The baygall at the park tends to be linear in nature and forms as bands between the upland communities and hydric hammock; or the uplands and Weeki Wachee River. The soils are peaty and receive seepage from the adjacent upland communities. The canopy consists of loblolly bay, sweetbay, and swamp bay (*Persea palustris*) with an occasional slash pine. The understory includes fetterbush, dahoon holly (*Ilex cassine*), wax myrtle, and saw palmetto. Vines are abundant, especially species of greenbriers (*Smilax* spp.), grapes (*Vitis* spp.), and sawtooth blackberry (*Rubus pensilvanicus*). Cinnamon fern (*Osmundastrum cinnamomeum*) and netted chain fern (*Woodwardia areolata*) are found

in the generally sparse groundcover. Laurel wilt is a fatal disease of swamp bays, and other species in the laurel family, has killed many of the red and swamp bays in the park. The disease has spread throughout Florida and is caused by an invasive fungus (*Raffaelea lauricola*) spread by an invasive pest redbay ambrosia beetle (*Xyleborus glabratus*). There are not successful management techniques for stopping the spread of this disease in wild bay trees. Baygall is not a fire dependent natural community, and frequent fire will keep baygall species from invading nearby fire-type natural communities like wet and mesic flatwoods. With a more aggressive prescribed fire program the acreage of baygall will likely decrease over what is currently mapped. Skunk vine, and Japanese climbing fern are invasive plant species found in the baygall that will require management actions to keep them at maintenance levels.

### **Depression Marsh – 4.6 acres**

Several depression marshes are located in the scrub. The depression marsh located on the park parcel north of County Road 550 is a slight depression in the surrounding scrub. To date the hydroperiod is unknown, but the vegetative structure in the marsh is indicative of the presence of some saturated soil for most of the year. The upper reaches of the marsh are dominated by broomsedge (*Andropogon* sp.), but closer to the center Carolina redroot dominates, which typically has more affinity for saturated soils. The ecotone between the scrub and the marsh is dominated by gallberry and ericaceous shrubs. The smaller depression marsh in WW-33B can be over three feet deep and has a hydroperiod long enough to support American white waterlily. The small marsh in WW-34 has sawgrass covering about a quarter of it. A couple of the depression marshes appear suitable as breeding ponds for gopher frogs (*Lithobates capito*). A frog call survey is recommended to inventory what species are using the wetlands in the park.

During dry periods hog damage can be severe, with most of the wetlands having soils disturbed by rooting. Hog trapping and removal is recommended.

Active management of the depression marsh will consist of monitoring for occurrences of invasive plant species, hog activity and application of prescribed fire concurrent with burning the adjacent scrub to prevent encroachment of woody species.

Following regular application of proposed management activities in the depression marsh, emergent herbaceous species should dominate, and there should be an open vista. Trees should be absent. Dominant vegetation should include maidencane, bluestem, pickerel weed, arrowheads and St. John's wort. The Optimal Fire Return Interval for this community is 2-10 years depending on the fire frequency of the adjacent scrub community.

### **Dome Swamp – 0.5 acres**

There is a small dome swamp of less than an acre north of Cyclops Drive. The dome canopy is a mixture of pond cypress (*Taxodium ascendens*), red maple (*Acer rubrum*), sweetbay, and swamp tupelo (*Nyssa biflora*). Groundcover is sparse with Royal ferns (*Osmunda regalis* var. *spectabilis*) and cinnamon ferns dominating. The perimeter of the dome swamp has a few invasive species including Chinaberry, Chinese tallow, Brazilian pepper (*Schinus terebinthifolia*), air potato, and skunk vine, with some wild taro in the interior. Hydrology of the swamp does not appear to have been modified to drain it, and water level fluctuations support swamp trees.



## Hydric Hammock – 150 acres

Hammock communities that are subject to periodic flooding are considered hydric hammocks. These hammocks often occur associated with springs and karst seepage (FNAI 1990). This climax community type primarily occurs adjacent to the spring-run communities in the park, and is part of a larger area known as the Weeki Wachee Swamp, at elevations less than 20 feet above sea level. The hydric soils are predominantly Okeelanta-Terra Ceia association and Anclote fine sand, and may be inundated during the rainy season for three to six months, or more. Despite the proximity to a major spring-run river, this community type is not considered a bottomland or floodplain community due to its hydrology. While the flow from Weeki Wachee Spring varies seasonally, the variation is not so much as to regularly overflow the riverbanks and flood the adjacent low-lying land. Rather, the water source of this hammock is groundwater flowing down slope over the underlying limestone, as well as some surface water in the rainy season. The organic sediment is not thick, indicating a shorter hydroperiod than that typical of a swamp community type. The frequency of fire occurring in the hammock is very low. The hydrology, fire frequency and organic matter accumulation justify the classification of this community type as hydric hammock (Ewel 1990).

The underlying karst topography results in lowland depressions or bowls along the course of both the Weeki Wachee Spring run and the Twin Dees Spring Run. While the plant species in the hammocks are similar, the microclimate created by proximity to the spring runs and hammock creeks results in some species variability. Typical plants found in the canopy are cabbage palm (*Sabal palmetto*), laurel oak, sweetgum (*Liquidambar styracifolia*), American elm (*Ulmus americana*) and sweetbay magnolia. Mid-story species generally consist of elderberry, laurel cherry (*Prunus caroliniana*), swamp bay, wax myrtle (*Myrica cerifera*), and highbush blueberry (*Vaccinium corymbosum*). Groundcover species are typically ephemeral forbs, sedges, and ferns, such as lizard tail (*Saururus cernua*), marsh fern (*Thelypteris kunthii*), netted chain fern (*Woodwardia aureolata*), and common blue violet (*Viola sororia*). Southern magnolia and red cedar (*Juniperus virginiana*) are also scattered throughout.

In the more hydric parts of the hammock loblolly bay, Virginia willow (*Itea virginica*), royal fern, swamp dogwood, jack-in-the-pulpit (*Arisaema triphyllum*), swamp tupelo, and needle palm (*Rhaphidophyllum hystrix*) can be found. Typical birds include red-bellied woodpecker (*Melanerpes carolinus*), white-eyed vireo (*Vireo griseus*), Carolina wren (*Thryothorus ludovicianus*), and northern cardinal (*Cardinalis cardinalis*).

No active management of the hydric hammock is required other than monitoring for negative impacts such as hydrologic alteration, erosion, invasive plant infestation, anthropogenic impacts and monitoring any species of special concern such as threatened or endangered species. Hydrologic impacts would likely come primarily from alterations to the community's upslope, altering the input of surface water and flow of karst seepage. Invasive plant species documented in the hydric hammock are skunk vine, Japanese climbing fern, and various ornamentals escaped from cultivation at the attraction. Most ornamentals are confined to the areas near the attraction, with those in natural areas to be eliminated or managed.

## Spring-run Stream – 27 acres

Vegetation in the river is primarily submerged aquatic macrophytes and filamentous algae. Southern water nymph (*Najas guadalupensis*) and eelgrass (*Vallisneria americana*) are common occurrences as well as the occasional occurrence of spring tape (*Sagittaria kurziana*) and the invasive hydrilla (*Hydrilla verticillata*). Supplemental plantings of spring tape, eelgrass and emergent aquatic plants were installed in the headspring and upper river as part of the 2008 spring restoration by SWFWMD. The initial infestation of the nuisance algae, *Lyngbia wollei*, was removed in 2008, but it continues to persist as re-growth in the headspring and on submerged vegetation in the upper river. Florida manatee (*Trichechus manatus latirostris*), alligator (*Alligator mississippiensis*), striped mullet (*Mugil cephalus*), bluegill (*Lepomis macrochirus*), mangrove snapper (*Lutjanus griseus*), peninsular cooter (*Pseudemys floridana peninsularis*) and Florida red-bellied turtle (*Pseudemys nelsoni*) are present. The spring-run stream has a diverse assemblage of native aquatic turtles, with nine species documented by researchers in 2015 (Munscher et al., 2017).

Emergent vegetation along the banks of the spring run and on vegetated sand bars include areas of point bar marsh with sawgrass, crinum lily (*Crinum americanum*), bull-tongue sagittaria (*Sagittaria lancifolia*), herb-of-grace (*Bacopa monnieri*), and smallfruit beggarticks (*Bidens mitis*). On these point bars there is also some woody vegetation including cypress, Virginia willow, saltbush and Carolina willow. On some point bars, recreational activities along the river has impacted the vegetation through trampling and loss of vegetation when people exit their vessels. This leads to increasing erosion, and increased turbidity in the river (Wood 2020). Existing conditions of point bars in the park will be documented (within 6 months); this will be followed by quarterly monitoring. For those point bars showing vegetation loss or erosion from recreational use, a restoration plan will be developed which could include signage and barriers to allow for natural recovery, or in areas with significant vegetation loss or erosion, other restoration measures to be taken, including replanting and erosion control.

Vegetation in the Twin Dees spring run is sparse, but red-top panicum (*Coleataenia rigidula*), crinum lily, lanceleaf sagittaria (*Sagittaria latifolia*), and smallfruit beggarticks are present. Invertebrates such as the native bivalve, *Villos amygdala* and native apple snail (*Pomacea paludosa*) are also present. Numerous tracks from wading birds and raccoons (*Procyon lotor*) are obvious in the bed of the run in the absence of flow.

In addition to removing the nuisance algae, invasive species along the spring run will need to be removed or treated. The FWC aquatic plant permit for herbicide treatment and hand removal will need to be amended to include wild taro (*Colocasia esculenta*), water lettuce (*Pistia stratiotes*), Japanese climbing fern, torpedograss (*Panicum repens*), and other invasive species commonly found along the shoreline.

The desired condition for the spring-run stream is to have flows, water clarity, and temperatures maintained to benefit desirable native submerged aquatic vegetation, with reduced nitrate levels and coverage of nuisance algae. Point bars will be vegetated with native emergent wetland vegetation, and not eroding. Invasive plant coverage will be less than one percent.

## **Aquatic Cave – No acreage available**

This natural community is not represented on the natural communities map. The underground cave system at the park is quite extensive, and ongoing research by Karst Underwater Research has mapped much of the system and the interconnection between Twin Dees vents and the head spring. There are several imperiled cave adapted invertebrates found in the system, including Hobbs cave amphipod (*Cranogonyx hobbsi*), Florida cave amphipod (*C. grandimanus*), and north Florida spider cave crayfish (*Trogocambarus maclanei*).

The caves are formations that have resulted from dissolution of the upper limestone layer by the movement of water. The caves of both springs have been explored by divers. On-going exploration efforts by cave divers will continue to investigate the water chemistry, sedimentation, geology and species of the subterranean caves. Blind cave crayfish (*Cambarus* sp.) have been observed. The aquatic caves will be protected against disturbance and alterations that may affect water flow and microclimate, or that may cause increases in pollution.

## **Natural Community Management Objectives**

**Goal: Restore and maintain the natural communities/habitats of the park.**

The DRP practices natural systems management. In most cases, this entails returning fire to its natural role in fire-dependent natural communities. Other methods to implement this goal include large-scale restoration projects as well as smaller scale natural communities' improvements. Following are the natural community management objectives and actions recommended for the state park.

### Natural Community Restoration

In some cases, the reintroduction and maintenance of natural processes is not enough to reach the desired future conditions for natural communities in the park, and active restoration programs are required. Restoration of altered natural communities to healthy, fully functioning natural landscapes often requires substantial efforts that may include mechanical treatment of vegetation or soils and reintroduction or augmentation of native plants and animals. For the purposes of this management plan, restoration is defined as the process of assisting the recovery and natural functioning of degraded natural communities to desired future condition, including the re-establishment of biodiversity, ecological processes, vegetation structure and physical characters.

Examples that would qualify as natural community restoration, requiring annual restoration plans, include large mitigation projects, large-scale hardwood removal and timbering activities, roller-chopping and other large-scale vegetative modifications. The key concept is that restoration projects will go beyond management activities routinely done as standard operating procedures such as routine mowing, the reintroduction of fire as a natural process, spot treatments of invasive plants, and small-scale vegetation management.

**Objective A: Develop and implement a point bar restoration plan for the spring-run stream.**

- Action 1      Develop monitoring protocols, survey and document condition of all point bars identified in the park on the Weeki Wachee River.
- Action 2      Monitor 6 point bars quarterly and an additional 14 point bars annually
- Action 3      Develop improvement or restoration plans for point bars where recreation use (visitor impacts) have reduced vegetation coverage or increased erosion.
- Action 4      Implement restoration plan

Within six months of UMP approval have monitoring protocols in place and document all of the point bars under state park management identified in the Carrying Capacity Study (Wood 2020). Six point bars identified in the Visitor Use Management section of this plan will then be monitored quarterly to document improvements or deterioration. Fourteen additional point bars under the park’s jurisdiction will be monitored annually. In addition to point bars, other areas of bank erosion will be monitored and documented. For point bars and other areas of erosion, a restoration plan will be developed that will include options like signage, closing off areas, and planting vegetation. These efforts will be conducted in collaboration with the Southwest Florida Water Management District.

**Objective B Continue to monitor submerged aquatic vegetation in the spring run stream.**

- Action 1      Continue to monitor six transects using the quadrat protocol.
- Action 2      Summarize survey data in an annual report

Continue monitoring submerged aquatic vegetation to determine if the actions taken to restore point bars improves the cover of submerged aquatic vegetation, of if additional measures are required. Erosion from point bars can lead to smothering of submerged aquatic vegetation (SAV). SAV can also be uprooted by boat propellers and unauthorized swimming and wading. Monitoring will be conducted in collaboration with SWFWMD.

Natural Community Improvement

Improvements are similar to restoration but on a smaller, less intense scale. This typically includes small-scale vegetative management activities or minor habitat manipulation. Following are the natural community/habitat improvement actions recommended at the park.

**Objective C: Conduct natural community/habitat improvement activities on 575 acres of scrub, scrubby flatwoods, and sandhill natural community.**

- Action 1      Selectively timber approximately 240 acres of sand pines and hardwood prior to restoration prescribed burning.
- Action 2      Mechanically treat overgrown understory vegetation prior to restoration prescribed burning.
- Action 3      Develop and implement restoration/habitat improvement plan for sandhill where groundcover will not support frequent, low intensity, prescribed fire treatment.

In 2018 approximately 240 acres of sand pines were identified for removal in multiple management zones. Sand pines and larger hardwoods (scrub oaks), will need to be cut prior to the reintroduction of fire into many of the scrub management zones and the areas of mesic flatwoods and sandhill. Sand pines and hardwoods will need to be harvested and taken offsite to reduce the amount of smoke produced during the planned restoration prescribed fires to follow the harvest. Silviculture best management practices will be followed for any selective thinning in near the buffer to the Weeki Wachee River, designated outstanding Florida water (FDACS 2008). Post-harvest zones will be evaluated to see if additional mechanical treatment would be required prior to burning.

In a few smaller pockets of uplands (WW-3A, 10, 16, and 17) mechanical treatment (mowing) of overgrown understory vegetation is needed prior to restoration burning. The understory in the scrubby flatwoods of WW-02 would also benefit from mechanical treatment to reduce the height of saw palmetto and some of the larger shrubs/hardwoods prior to burning. Twenty-five total acres of mechanical treatment is required for these zones however this excludes acreage that needs to be treated after the proposed timber harvest and management zone evaluation listed above.

Because of the long period of fire exclusion, thick understory and shading in the sandhill (WW-37), supplemental planting of wiregrass and longleaf pines on approximately 20 acres will likely need to follow a sand pine/hardwood harvest, and post-harvest fuel reduction (timber litter) prescribed burn.

### Prescribed Fire Management

Prescribed fire is used to mimic natural lightning-set fires, which are one of the primary natural forces that shaped Florida's ecosystem. Prescribed burning increases the abundance and health of many plant and wildlife species. A large number of Florida's imperiled species of plants and animals are dependent on periodic fire for their continued existence. Fire-dependent natural communities gradually accumulate flammable vegetation; therefore, prescribed fire reduces wildfire hazards by reducing these wildland fuels. All prescribed burns and wildlife suppression in the Florida state park system are conducted with authorization from the FDACS, Florida Forest Service (FFS).

The park's burn plan is updated annually because fire management is a dynamic process. To provide adaptive responses to changing conditions, fire management requires careful planning based on annual and very specific burn objectives. In order to track fire management activities, the DRP maintains the Natural Resource Tracking System (NRTS). NRTS allows staff to track various aspects of each park's fire management program. NRTS is used for annual burn planning which allows the DRP to document fire management goals and objectives on an annual basis. Each annual burn plan is developed to support and implement the broader objectives and actions outlined in this ten-year management plan. Each quarter reports are produced that track progress towards meeting annual burn objectives.

### ***Objective D: Maintain 615 acres of the park within the optimum fire return interval.***

- |          |   |
|----------|---|
| Action 1 | Develop/update annual burn plan   |
| Action 2 | Manage fire-dependent communities by burning between 53-170 acres annually. |

Table 2 contains a list of all fire-dependent natural communities found within the park, their associated acreage and optimal fire return interval, and the annual average target for acres to be burned.

<b>Table 2. Prescribed Fire Management</b>		
<b>Natural Community</b>	<b>Acreage</b>	<b>Optimal Fire Return Interval (Years)</b>
Scrub	560	5-15
Sandhill	14	1-3
Mesic Flatwoods	27	1-3
Scrubby Flatwoods/Xeric Hammock	12	5-15
Wet Flatwoods	1	1-3
Depression Marsh	4	5-15
Basin Marsh	31	2-10
<b>Annual Target Acreage</b>		
<b>53 – 170</b>		

Prescribed fire at the park is complicated by the fact the park is bisected by major high use roadways including US-19, SR-50, and CR-550. In addition to the roadways, most of the park boundary is considered urban interface, with residential or commercial development adjacent to the park. A great deal of care, planning, and outreach is needed to successfully burn at the park.

Most of the burnable acres at the park is scrub with a fire return interval (FRI) of 5-15 years. Some areas in the park would be classified as the sand pine scrub variant (WW-3B, 6B, 14, 30, and a few other pockets) with a mature sand pine canopy, and understory of oaks and rosemary. The goal is to manage the scrub closer to early successional without a canopy of mature sand pines because of difficulty of controlling fire in sand pine scrub near the urban interface. Prior to state park management (on both former SWFWMD and FWC sites), sand pines were harvested, with some prescribed burning done afterwards. Areas that were not burned within a couple of years of the sand pine harvest, now have stands of 10-15 year old sand pines established that will need to be removed. Recent attempts to burn the management zones with stands of the 10-15 year old sand pines have not been successful in any significant reduction in their number. Half of the scrub acreage would benefit from hardwood removal and sand pine harvest, before prescribed fires are attempted, this is especially true for the zones east of US-19 (WW-13-18), and the mature sand pine scrub in WW-30. After the sand pine harvest/hardwood removal, management zones will be assessed for any additional mechanical treatment needs to safely burn. Because of smoke management concerns, the zones east of US-19 will likely need to be divided and burned in smaller acreage than the existing management zones. Scrub along the river corridor has also not been burned or harvested. Care should be taken to ensure burning adjacent to the river does not exacerbate any erosion issues along the river. In areas of scrub with Florida rosemary, an attempt should be made to leave pockets of rosemary unburned if the area being burned is less than 15 years post-burn, and there are no mature seed producing rosemary in the zone.

The sandhill, mesic flatwoods, and wet flatwoods, will be treated together, since they are in the same management zone WW-37 and will be under the same FRI of 1-3 years. Under FWC management, pine thinning was conducted in 2007, but there is no evidence that it was followed by a prescribed burn. Currently most of the area has a thick understory of hardwoods and a few sand pines that will need to be removed before restoration burning is conducted. The existing firebreak that was maintained by FWC around the outparcel does not appear to be fully within the park boundary. A fire break along the west boundary will need to be established by tying the upland fire-type community to the hydric hammock which will serve as a natural fire break. In the ecotone between the uplands and the wetlands being used as natural fire breaks a corridor of taller vegetation will be allowed to persist in an area identified by FWC as a buffer for black bear movement along the baygall and hydric hammock.

Scrubby flatwoods and xeric hammock will be treated together, since they are both in the same management zone WW-02 and have similar species composition. The scrubby flatwoods was burned in 2014 after a long period of fire exclusion. The burn was successful in reducing some of the thick duff found in the zone, reducing the pine canopy. Before the next prescribed burn the zone would benefit from additional pine thinning and hardwoods reduction plus mechanical treatment of the shrub layer. After the mechanical treatment additional restoration burns should be conducted to continue to reduce the dead fuels and incrementally reduce the amount of duff. The xeric hammock will not receive mechanical treatment but fire from the adjacent scrubby flatwoods will be allowed to burn into it. After mechanical treatment and a restoration burn, a FRI of 5-15 years is appropriate.

Two of the three basin marshes are not completely within the boundary of the state park, so they will require additional planning and prep before prescribed burning is attempted. The third, is surrounded by the hydric hammock associated with Twin Dees spring and spring run. The optimum FRI would be 2-10 years to keep hardwoods from overtaking and turning the area into a swamp. The depression marshes are embedded in scrub, so the FRI will be set with the upland natural community of 5-15 years.

Because of the changes in elevation and topography at the park and potential for erosion, firebreaks should be maintained with as little soil disturbance as needed to keep them functional. In some area, a light surface raking should be sufficient to break up the fuels and keep the break functional. Special care should be taken near cultural sites.

***Objective E: Complete a comprehensive floral and faunal survey and create/update the park's baseline plant and animal list.***

- Action 1 Complete a comprehensive survey.
- Action 2 Update the baseline plant and animal list.

The addition of 389 acres to the lease in 2018 added natural communities previously not found within the park that will require additional plant and animal surveys and updates to the plant and animal list. Since November 2008 when Weeki Wachee became a state park, an understanding of the diversity of plant and animals in the park has greatly improved through observations, herbarium collections, and documentation research done in the park. Additional work is still needed to identify the grass and sedge species, reptiles and amphibians, and small mammals. Plant inventories after prescribed fire will be a priority to help document some of the more ephemeral species that bloom shortly after fire.





## Imperiled Species

Imperiled species are those that are (1) tracked by FNAI as critically imperiled (G1, S1) or imperiled (G2, S2); or (2) listed by the U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA)– National Marine Fisheries Service (NMFS), Florida Fish and Wildlife Conservation Commission (FWC) or the Florida Department of Agriculture and Consumer Services (FDACS) as endangered, threatened or of special concern.

The scrub habitat type in the park is not only imperiled globally and within Florida, it has high potential for the occurrence of imperiled species. A combination of fire suppression and habitat fragmentation due to urbanization has greatly reduced not only the amount of scrub habitat in Florida, but also the quality of the available habitat. The survival of a number of species endemic to the scrub community is dependent on the open sandy gaps and reduction of competing species that result from the cyclical occurrence of fire. Species such as the Florida scrub-jay, scrub pinweed and Curtiss' milkweed can become locally extirpated in the absence of fire.

Significant scrub restoration was done by SWFWMD in 2002 by removing sand pines and reducing climax vegetation height and density using mechanical treatment and prescribed fire. Soon after restoration, field surveys indicated a strong positive response by a number of species. Surveys conducted in June 2003 located more than 100 occurrences of Curtiss' milkweed. The state-endangered Curtiss' milkweed is a scrub endemic documented as rare and occurring patchily in the dry, sterile white sands of peninsular Florida scrubs (Ward 1979). Herbarium records indicate that Curtiss' milkweed was documented near Weeki Wachee Spring by John K. Small in 1922 (Putz and Minno 1995). Positive responses of imperiled plant species were also noted in post restoration surveys by SWFWMD for the state-threatened garberia and nodding pinweed (*Lechea cernua*) (Barnwell 2004). Habitat condition will be monitored as an indicator of the general status of endemic, threatened and/or endangered scrub plants. Additional species-specific monitoring will be conducted as necessary in conjunction with resource management activities, primarily prescribed burning and mechanical treatment.

While Florida scrub jays are not currently known to occur in the park, they have been historically documented. An adult jay was last seen in 2006 in the eastern portion of the main park parcel, near U.S. Highway 19, by SWFWMD staff (Barnwell, pers. comm.). The closest known occurrence of scrub jays is in the city of Hudson, about 14 miles south of Weeki Wachee in a residential development. Birds have also been documented in eastern Hernando County in the Richloam tract of the Withlacoochee State Forest (FWC). Continued maintenance of the scrub through application of prescribed fire and mechanical treatment where needed should ensure habitat conditions suitable to imperiled scrub species, both plant and animal.

Gopher tortoises have been well documented in the park. A burrow survey conducted by SWFWMD following scrub restoration efforts found 35 burrows (Barnwell 2004), and additional surveys that followed found over 100 active or inactive burrows. In January of 2019 FWC conducted a pilot survey using the Line Transect Distance Sampling protocols to determine tortoise encounter rates prior to conducting a full survey to estimate the tortoise population. During the pilot survey 12 burrows were found along the transects with 6 of them occupied. The encounter rate was deemed too low to conduct a full survey until the condition of the scrub, scrubby flatwoods, mesic flatwoods, and sandhill is improved. The FWC recommendations for gopher tortoise habitat improvements are

similar to what has already been suggested in the natural community description and assessment section, with sand pine and hardwood removal and mechanical treatment being a priority to improve tortoise herbaceous forage. Restoration of the flatwoods communities should benefit the gopher tortoise population since the density of desirable herbaceous species is typically higher in mesic flatwoods than scrub.

West Indian manatees have been well-documented in the Weeki Wachee River. Employees of Weeki Wachee Spring's attraction have observed manatees consistently in the spring during the winter months. Manatees typically number about six to seven but can number up to as many as 13 (Athanson, pers. comm.). The United States Fish and Wildlife Service (USFWS) has designated Weeki Wachee Spring as a primary warm-water refuge site due to the constant temperature of groundwater from the main headspring, consistent use of the spring and river by manatees, and the location of the spring relative to other thermal refuge sites (USFWS 2007). The freshwater and macrophytic vegetation make the river a year-round refuge.

The factors influencing manatee numbers in the spring are not well understood. One concern for manatees in the headspring is the lack of submerged aquatic vegetation for manatees to feed on. Historical photos of performers in the spring basin clearly show a thick carpet of vegetation, most likely spring tape (*Sagittaria kurziana*) and eelgrass (*Vallisneria americana*). Currently the spring basin has very little macrophytic vegetation. Up until 2008, a dense growth of undesirable algae, primarily *Lyngbya wollei*, smothered the bottom, likely preventing the growth and establishment of aquatic plants. A restoration effort, begun in 2008 by SWFWMD, to remove the fouling algae and sediments and replant native vegetation has been completed.

A 2006 survey to determine the accessibility of major Florida springs to manatees found that accumulation of sand near the mouth of the spring pool, presumably from Buccaneer Bay, may create a hindrance to manatee passage and should be monitored (Taylor 2006). Historical 1944 aerials, as well as old attraction photographs, show a large sandy area clearly visible at the mouth of the headspring. However, since upland vegetation had already been cleared up slope, the source of the sand is questionable. A site visit by FWC and Nature Conservancy staff in July 2009 to determine what, if any, improvements to the Weeki Wachee River may be needed to improve manatee access to the headspring found no obvious impediments to access present at that time. Corrective actions will be taken to eliminate any future impediments to manatee use of the upper river or headspring.

Recreational use of the Weeki Wachee River has the potential to negatively impact manatees. Two incidents of manatee mortality due to collision with watercraft were documented at the confluence of the Mud River and the Weeki Wachee River, in 1998 and 2004 (FWC-FWRI). More recently a manatee was also struck and killed July 30, 2019 on the Weeki Wachee River.

American alligators regularly occur on the river and occasionally in the headspring. No special management action is called for at this time but monitoring for any negative interactions between alligators and recreational users is needed.

Florida black bears are no-longer listed and have not been documented on the state park property, but they have been well documented on the adjacent Weeki Wachee Preserve and Chassahowitzka Wildlife Management Area (Kelly et al. 1997). The state park is within the documented primary range of the Chassahowitzka subpopulation of the Florida

black bear (FWC 2019). Park staff should coordinate with FWC on management actions that may impact the Chassahowitzka subpopulation. An area in WW-37 was identified as a bear travel corridor/buffer, and vegetation within this area will not be mechanically reduced in the ecotone along the hydric hammock as a bear travel corridor. Although no longer listed as imperiled, southern bald eagles have been observed at the park and a nest has been documented in the park south of the river. National Bald Eagle Management Guidelines will be followed to reduce disturbance near nesting eagles (USFWS 2007).

Table 3 contains a list of all known imperiled species within the park and identifies their status as defined by various authorities. It also identifies the types of management actions that are currently being taken by DRP staff or others and identifies the current level of monitoring effort. Explanations for federal and state status as well as FNAI global and state rank are provided in Addendum 6.

Monitoring will consist of non-targeted observation and documentation (Tier 1), as well as targeted presence and absence monitoring (Tier 2). Non-targeted observation and documentation includes documentation of species presence through casual/passive observation during routine park activities (i.e., not conducting species-specific searches). Documentation may be in the form of Wildlife Observation Forms, or other district specific methods used to communicate observations. Targeted presence and absence monitoring efforts include monitoring methods/activities that are specifically intended to document presence/absence of a particular species or suite of species.

The main management actions will include managing imperiled species habitat through prescribed fire (1), invasive plant removal (2), hydrological maintenance/restoration (4), hardwood removal (6), and mechanical treatment (7). Other management actions involve protection from visitor impacts (10) and outreach/education efforts (13). Imperiled bird species management could include the creation of artificial cavities (5).

**Table 3. Imperiled Species Inventory**

Common Name Scientific Name	Imperiled Species Status				Management Actions	Monitoring Level
	FWC	USFWS	FDACS	FNAI		
<b>PLANTS</b>						
Curtiss' milkweed <i>Asclepias curtissii</i>			LE		1,2 6,7	Tier 1 Tier 2
Chapman's sedge <i>Carex chapmannii</i>			LT	G3S3	2,4	Tier 1
Florida jointtail grass <i>Coelorachis tuberculosa</i>			LT	G3S3	1,2,4	Tier 1
Garberia <i>Garberia heterophylla</i>			LT		1,2 6,7	Tier 1
Nodding pinweed <i>Lechea cernua</i>			LT	G3S3	1,2 6,7	Tier 1 Tier 2
Cardinal flower <i>Lobelia cardinalis</i>			LT		2,4	Tier 1

**Table 3. Imperiled Species Inventory**

Common Name Scientific Name	Imperiled Species Status				Management Actions	Monitoring Level
	FWC	USFWS	FDACS	FNAI		
Southern tubercled orchid <i>Platanthera flava</i>			LT		2,4	Tier 1
Atamasco-lily <i>Zephyranthes atamasca</i>			LT		2,10	Tier 1
<b>INVERTEBRATES</b>						
Florida cave amphipod <i>Cranogonyx grandimanus</i>				G2G3 S2S3	4	Tier 1
Hobbs cave amphipod <i>Cranogonyx hobbsi</i>				G2G3 S2S3	4	Tier 1
North Florida spider crayfish <i>Troglocambarus maclanei</i>				G2S2	4	Tier 1
<b>REPTILES</b>						
American alligator <i>Alligator mississippiensis</i>	FT (S/A)	SAT		G5,S4	4,10, 13	Tier 1
Gopher tortoise <i>Gopherus polyphemus</i>	ST			G3,S3	1,2,6,7 0,13	Tier 1 Tier 2
<b>BIRDS</b>						
Florida sandhill crane <i>Antigone canadensis pratensis</i>	ST			G5T2,S 2	1,2 7,4	Tier 1
*Florida scrub-jay <i>Aphelocoma coerulescens</i>	FT	T		G2?, S2	1,2 6,7	Tier 1
Little blue heron <i>Egretta caerulea</i>	ST			G5,S4	2,4	Tier 1
Tricolored heron <i>Egretta tricolor</i>	ST			G5,S4	2,4	Tier 1
Southeastern American kestrel <i>Falco sparverius paulus</i>	ST			G5T4,S 3	1,2,5 6,7	Tier 1
Wood stork <i>Mycteria americana</i>	FT	T		G4,S2	2,4	Tier 1
Roseate spoonbill <i>Platalea ajaja</i>	ST			G5,S2	2,4	Tier 1
American redstart <i>Setophaga ruticilla</i>				G5,S2	2	Tier 1
<b>MAMMALS</b>						
Florida Manatee <i>Trichechus manatus latirostris</i>	FT	T		G2,S2	4,10 13	Tier 1

# **Imperiled Species Management Objectives**

**Goal: Maintain, improve or restore imperiled species populations and habitats in the park.**

Ongoing inventory and monitoring of imperiled species in the state park system is necessary to meet the DRP's mission. Long-term monitoring is also essential to ensure the effectiveness of resource management programs. Monitoring efforts must be prioritized so that the data collected provides information that can be used to improve or confirm the effectiveness of management actions on conservation priorities. Monitoring intensity must at least provide the minimum data needed to make informed decisions to meet conservation goals. Not all imperiled species require intensive monitoring efforts on a regular interval. Priority must be given to those species that can provide valuable data to guide adaptive management practices. Those species selected for specific management action and those that will provide management guidance through regular monitoring are addressed in the objectives below.

In the preparation of this management plan, DRP staff consulted with staff of the FWC's Imperiled Species Management Section or that agency's Regional Biologist and other appropriate federal, state and local agencies for assistance in developing imperiled animal species management objectives and actions. Likewise, for imperiled plant species, DRP staff consulted with FDACS. Data collected by the USFWS, FWC, FDACS and FNAI as part of their ongoing research and monitoring programs will be reviewed by park staff periodically to inform management of decisions that may impact imperiled species in the park.

## ***Objective A: Continue to update baseline imperiled species occurrence inventory lists for plants and animals.***

Action 1      Update imperiled species list as new species are discovered in the park

Imperiled species are well-documented at the park. As the plant and animal inventories for the park are improved, if new imperiled species are observed and documented they will be added to the park inventory list.

## ***Objective B: Monitor and document 1 selected imperiled animal species.***

Action 1      Implement monitoring protocols for 1 imperiled animal species, including those listed in Action 1 above and

The gopher tortoise is the only species currently in need of population monitoring at the park. A program following the Line Transect Distance Sampling (LTDS) protocol (Smith et al. 2009) will be instituted after natural community improvements are conducted in the scrub, sandhill and scrubby flatwoods communities. This will be used as a baseline to monitor the effects of habitat improvement on the park's tortoise population. Most tortoises are currently encountered on the periphery of management zones where there is less shading and availability of groundcover vegetation for food is better. FWC tortoise conservation biologists recommended a full LTDS survey after conducting a pilot survey for tortoises at the park.



## Invasive Species

Invasive species are plants or animals not native to Florida. Invasive species out-compete, displace or destroy native species and their habitats, often because they have been released from the natural controls of their native range, such as diseases and predatory insects. If left unchecked, invasive plants and animals alter the character, productivity and conservation values of the natural areas they invade. Invasive animal species include non-native wildlife species, free ranging domesticated pets or livestock, and feral animals. Because of the negative impacts to natural and cultural resources attributed to invasive animals, the DRP actively removes invasive animals from parks, with priority given to those causing the greatest ecological damage. In some cases, native wildlife may also pose management problems or nuisances within state parks. A nuisance animal is an individual native animal whose presence or activities create special management problems. Nuisance animals are dealt with on a case-by-case basis in accordance with the DRP's Nuisance and Invasive Animal Removal Standard.

### Plants

Invasives plant management data is maintained using DEP's Natural Resources Tracking System (NRTS) database. Species surveys and treatment data are recorded in the database to help assess the presence of problematic aquatic and uplands species, formulate treatment plans, and evaluate changes in populations and cover class over time. The DRP calculates the acreage of invasive plants proposed for treatment using the mathematical concept of infested area. This concept takes a defined area of land (Gross Area Acres) and multiplies that number of acres by a defined percent cover of invasive plants (Cover Class) to estimate the infested acres. This calculation provides an estimation of acres covered by the invasive plants if the plants were accumulated into one area. This methodology helps to estimate the actual acres of infestation, which can be useful for estimating chemical needs, and changes in infestation over time. The table below shows the park's Annual Exotic Treatment Reports that are stored in NRTS.

<b>Table 4. Exotic Plant Species Management Annual Exotic Treatment Reports (2011 – 2021)</b>									
<b>Fiscal Year</b>	<b>Infested Acres Planned</b>	<b>Q1 July/Sept</b>	<b>Q2 Oct/Dec</b>	<b>Q3 Jan/Mar</b>	<b>Q4 Apr/June</b>	<b>Gross Area Worked</b>	<b>Infested Acres Treated</b>	<b>% of Plan Met</b>	<b>Infested Acres</b>
11/12	0.3	0	0.932	0.007	0.027	6.152	0.966	100%	1.26
12/13	1.11	0.053	0.055	0.149	0.098	1.331	0.354	32%	1.26
13/14	1.26	0.203	0	0	2.821	4.21	3.024	100%	20.674
14/15	1.26	5.749	2.545	0	0.19	13.8	8.484	100%	21.883
15/16	1.58	2.913	0.247	0.002	0	3.76	3.162	100%	13.772
16/17	6.132	0.65	1.964	0.977	6.236	23.989	9.827	100%	14.508
17/18	5.74	0.834	0.467	1.064	3.362	10.657	5.726	100%	25.608
18/19	6.32	1.837	1.25	0.672	1.908	9.515	5.668	90%	27.611
19/20	4.53	1.698	2.334	2.411	1.2	37.72	7.643	100%	47.136
20/21	25.71	1.617	3.515	9.304	9.781	58.91	24.218	94%	47.136

Currently, the most problematic FISC-listed invasive species in the natural communities' uplands are skunk vine, air-potato, camphor tree, Chinaberry, Chinese tallow, tuberous sword fern, and several invasive grasses, including cogongrass. In the main headspring and spring run, wild taro is the main challenge. Generally, the cover of invasive plants in the uplands natural areas is low, at less than 5%. In the uplands, except for skunk vine and air potato, most infestations are within 75 feet of the park boundary, with the highest concentrations along fence-lines shared with private residences. In most of those areas, the infestation is the result of plants used in landscaping growing into the park.

In the developed area (WW-29), there are several non-native plant species planted and maintained in the landscaping; these are sources for continued and expanded invasion. This is visible in the peripheral areas of the attraction, where the adjacent natural communities are infested with these plants, encroaching well into WW-27. Nearly all of the park's invasive plant management resources used in this area and its adjacent zones. Species such as wild taro, elephant ear (*Xanthosoma sagittifolium*), wedelia (*Sphagneticola trilobata*), camphor-tree (*Cinnamomum camphora*), and American evergreen (*Syngonium podophyllum*) have escaped cultivation or spread from landscape-clearing debris left in the park, to form often dense patches and spread over the adjacent native plants. Other invasive plant species are present as scattered or localized occurrences, such as cogon grass (*Imperata cylindrica*), torpedo grass (*Panicum repens*), and Chinese tallow. Overall, the infestations of FISC-listed invasive species are around 40% cover in the developed area. Removal of FISC species, even in the historic landscaping sites, is imperative. If any of these species are ones which the park would like to present from a historic aspect, interpretive signage or other educational strategies should be used.

There are aquatic invasive and nuisance species at the park. The primary nuisance species at the park is the blue-green algae, *Lyngbya wollei*. Dense mats of this alga formed in the headspring because of increased nitrate levels in groundwater flowing from the spring. The SWFWMD restoration of the main spring in 2008 removed the primary infestation of *L. wollei* and provided for contractor treatment of invasives on the south bank of the river east of the tour boat dock. Since the initial removal work, staff and volunteers have worked diligently to minimize the presence of the alga.

Invasive plant species use many strategies for spreading, and preventing infestation is difficult. Seeds, spores, and vegetative plant parts that can grow into new plants, are carried by the wind or water, or dropped by birds, animals, visitors and equipment. The predominant introduction sites are on and along such vectors. But there are a few preventive activities that are key: do not introduce or plant non-native plants at the park; decontaminate equipment, such as mowers, boats, trucks, etc., before coming into the park or moving within the park to the next site; and watch for early emergence of a non-native plant patch, with a rapid response to remove it (Early Detection – Rapid Response or EDRR) if needed.

To know what is appropriate to plant at the park, a draft Landscaping Guide has been created; this guide includes a landscaping map and plant lists to describe which non-native plants to remove from the developed areas, and which plants are safe to continue planting and where they can be planted. Regarding decontamination, to be effective, clear protocols for equipment cleaning need to be developed and followed at the park, whether by staff, volunteers or contractors. The protocols should also address ways to encourage visitors to follow the same habits, by providing interpretive programs and materials and offering cleaning stations.



EDRR is essential to good infestation management, is more likely to result in eradication of a problem and should be included in every invasives management plan. This is true whether the plant is an acknowledged FISC category species or if it is a non-native plant emerging as invasive at the park and not yet part of a FISC list. Some examples of the important “non-FISC” invasive plants at the park that were deliberately introduced, but that now need to be managed, include: loquat (*Eriobotrya japonica*); giant reed (*Arundo donax*); bamboo (*Pseudosasa japonica*, *Bambusa* spp. and others); citrus (*Citrus x aurantium* and others); and banana trees (*Musa* spp.). Major challenges to effective EDRR of non-FISC invasives management are knowing what “belongs” in the park, determining a non-native plant’s threat potential, and then determining the best strategies for removing those that pose a threat.

No formal invasive plant management plan has been developed for the park to date, beyond applying the NRTS tool for creating an Annual Treatment Plan at the beginning of each Fiscal Year. The NRTS tool allows the park to select infestation areas to target for the year and offers a Notes section to allow for an explanation of the choice or provide direction to staff for that area for that year. Successful planning requires that the data in NRTS is as accurate as possible, which means that all infestable gross acres are surveyed, that the surveys are less than two years old, and that the surveyors can identify a broad spectrum of problematic plant species. A more comprehensive park-specific invasive plant treatment plan will be developed for the park following more intensive surveys and GPS mapping of infested sites. Treatment priority is normally given to occurrences of invasive plants in the intact natural communities, where infestations can be quickly brought under control, and to areas where infestations threaten rare plant or animal species. This certainly should be implemented at the park, however, the developed area in the park is such a serious concern, therefore the first few years of this plan the immediate priority should be a major removal of most of the park’s source invasives, starting with those demonstrating the highest potential to spread to adjacent natural communities. A comprehensive plan will also address species-specific concerns, such as how to manage air-potato without harming beetles if present, or how to manage plants, such as the grasses, that require multiple chemical treatments annually or that require other tools be included, such as fire or mowing, or both.

To remove or treat invasive plants in the spring, spring run, or along the shoreline of the river an aquatic plant control permit is required from FWC. The 2018(9) permit currently allows for mechanical or hand removal of *Lyngbya*. The permit will need to be amended to include a longer stretch of the river to cover the addition of the former FWC managed property, and to treat/remove other invasive species in addition to *Lyngbya*.

## **Animals**

Feral hogs (wild pigs) occur in the undeveloped areas of the park and cause significant ecological damage unless their numbers are kept low. They are predators of ground-nesting birds and snakes, plus they dig up large areas looking for tubers and roots. The rooted areas alter fire behavior and hydrologic flow. The upturned soil also provides a planting bed for invasive plant species. Hog damage is most notable in and around wetlands in the park, with depression marshes and wet flatwoods natural communities showing the most evidence of hog rooting. A hog removal program should be instituted to reduce the population and limit negative ecological effects and damage caused by hogs. Hiring a hog trapper, or training park staff to trap and remove hogs should be investigated.

# **Invasive Species Management Objectives**

**Goal: Remove invasive plants and animals from the park and conduct needed maintenance control.**

The DRP actively removes invasive species from state parks, with priority being given to those causing the most ecological damage. Removal techniques may include mechanical treatment, prescribed fire, herbicides or biocontrol agents.

***Objective A: Annually treat at least 18 infested acres of invasive plant species in the park.***

- Action 1      Annually update the park's Annual Treatment Plan in NRTS. Every annual plan will include at least one full treatment across all *gross* acres of WW-29 (estimated at about 24 infestable acres) and the 14 gross acres across north WW-27.
- Action 2      Annually provide adequate chemical, equipment and staff or volunteers to meet the treatment goals of the work plan.

This Objective's goal is high to reflect the need for more intense management of the worst infestations at the park. As WW-27, WW-29 and all of the more heavily infested areas around the park's boundaries are worked each year (approximately 150 to 250 gross acres), then reasonable adaptive management would allow for a decrease in numbers of infested acres required to be treated annually. The true goal for those areas is to continue active annual control until a Cover Class of 1 or less for each area is reached.

***Objective B: Develop a comprehensive invasive plant management (EPM) plan for the park.***

- Action 1      Assess current conditions for the park and whether all surveys are complete and current.
- Action 2      From Survey Summary reports, determine the park's approach to prioritizing their work.
- Action 3      Develop a plan that incorporates frequency and timing of repeat treatments, types of treatments, recipes, based on the priorities.

Surveys are considered to be complete if all infestable acres (acres where plants can grow, e.g., acres not under concrete, pavement, buildings, etc.) have been surveyed. Surveys are current if they are less than two years old. If surveys are not complete or current, managing such issues are to be part of the EPM plan. To determine the treatment plans, while priorities can be organized by species, zone, cover class, etc., the priority management needs to balance a focus on the park's worst areas while still managing the threat of infestations spreading along the park boundaries. From there, develop a plan that incorporates frequency and timing of repeat treatments, types of treatments, and recipes based on the priorities. The plan should also consider the impacts of pests and pathogens, such as lethal bronzing disease, on native species and should include monitoring protocols to detect infected species.

**Objective C: Maintain and publish the landscaping manual for the park.**

- Action 1 Update the existing draft – incorporate species’ name changes, changes in status with FISC and the UF/IFAS Weed Risk Assessment (WRA) tool.
- Action 2 Emphasize that native plant species found naturally occurring at the park are always the first choice for landscaping.
- Action 3 For the historic landscaping plots within the designated mapped area, verify that only benign non-natives are on the “OK to Plant” list. If and as these species are planted or maintained in the park, their appearance elsewhere in the park is to be monitored; if spreading occurs, the species is removed from this list and from the park.
- Action 4 Make this manual readily available to all staff and volunteers, with printed and electronic copies.
- Action 5 Repeat Actions 1-4 every three to five years, as plant names and habits can change.

**Objective D: Implement decontamination protocols for the park.**

- Action 1 Work with BNCR to develop protocols and obtain training.
- Action 2 Implement the protocols and continue to train staff.
- Action 3 Verify that vendors (mowers, landscapers, outfitters, etc.) are also observing the protocols.

There are many ways to manage equipment decontamination. For example, many parks keep an air compressor with the vehicle to blow seed and plant materials into the currently infested area before moving to another part of the park. At the time of writing, BNCR is working to develop a protocol and training requirements to help parks manage this issue.

**Objective E: Manage Lyngbya and other aquatic species.**

- Action 1 Amend FWC aquatic plant control permit to include additional river frontage and include all invasive species to be treated.
- Action 2 Set annual goals for the river area and species to be worked.

Establish an annual budget with sufficient resources to complete the goals.

**Objective F: Implement control measures on one invasive animal species in the park.**

- Action 1 Contract or develop an in-house feral hog removal program at the park.

Feral hogs are damaging the groundcover in the wet flatwoods, depression marshes, and dome swamp. To limit this damage hog populations will need to be reduced through trapping and removal. This can be done through a contract trapper, or in-house by trained park staff.



# Cultural Resources

This section addresses the cultural resources present in the park that may include archaeological sites, historic buildings and structures, cultural landscapes, and collections. The Florida Department of State (FDOS) maintains the master inventory of such resources through the Florida Master Site File (FMSF). State law requires that all state agencies locate, inventory, and evaluate cultural resources that appear to be eligible for listing in the National Register of Historic Places (NRHP). Addendum 7 contains the FDOS, Division of Historical Resources (DHR) management procedures for archaeological and historical sites and properties on state-owned or controlled properties, the criteria used for evaluating eligibility for listing in the NRHP, and the Secretary of the Interior's Standards and Guidelines definitions for the various preservation treatments (Restoration-RS, Rehabilitation-RH, Stabilization-ST, and Preservation-P). For the purposes of this plan, significant archaeological site, significant structure, and significant landscape means those cultural resources listed or eligible for listing in the NRHP. Archaeological site, historic structure, or historic landscape refer to resources that are 50 years of age or those that will be during the term of this plan.

## **Condition Assessment**

Evaluating the condition of cultural resources will be accomplished using a three-part evaluation scale expressed as good, fair, and poor.

### Historic Buildings and Structures

- **Good** describes a condition in which only normal scheduled maintenance or minor repairs are required.
- **Fair** describes a condition in which there are several larger repairs required which cause the resource to not be able to function as intended if left in disrepair. A fair assessment is usually a cause for concern and should be acted on before the physical integrity is compromised.
- **Poor** describes an unstable condition where there is palpable, accelerating decline, and physical integrity is being compromised quickly. A resource in poor condition requires significant major repairs and is not able to fully function as intended. A poor condition suggests immediate action is needed to reestablish physical stability.

### Archaeological Sites

- **Good** describes a condition of stability and physical wholeness, where no obvious deterioration other than normal occurs.
- **Fair** describes a condition in which there is a discernible decline in the condition between inspections. This decline is typically from an isolated event rather from repetitive or continuous ones. Some examples include a storm event, or a single case of looting where no additional repeat damage is observed. A fair assessment is usually a cause for concern.
- **Poor** describes an unstable condition where there is palpable, accelerating decline, and physical integrity is being compromised quickly. A resource in poor condition suffers obvious declines in physical integrity from year to year, such as from coastal erosion or continuous looting. A poor condition suggests immediate action is needed.

## Level of Significance

Applying the criteria for listing in the National Register of Historic Places involves the use of contexts as well as an evaluation of integrity of the site. A cultural resource's significance derives from its historical, architectural, ethnographic or archaeological context. Evaluation of cultural resources will result in a designation of NRL (National Register or National Landmark Listed or located in an NR district), NR (National Register eligible), NE (not evaluated) or NS (not significant) as indicated later in this section. Only the State Historic Preservation Office can make a final determination of significance.

There are no criteria for determining the significance of collections or archival material. Usually, the significance of a collection is based on what or whom it may represent, and what information it can provide. Any records depicting critical events in the park's history, including construction and resource management efforts, would all be significant.

## National Register of Historic Places

The National Park Service's National Register of Historic Places is the official list of sites and properties throughout the country that reflect the prehistoric occupation and historical development of our nation, states, and local communities. This list includes sites, buildings, structures, objects, and districts that have been documented and identified as being significant in American history, architecture, archaeology, engineering or culture.

In order to be listed in the National Register, the State Historic Preservation Office (SHPO) must first make a determination of eligibility for the property. The SHPO will look at the property's age, significance, and integrity. Properties must be significant at the local, state, or national level under at least one of four criteria in order to be determined to be eligible for listing.

**A: Event** – The property is associated with an event that has made a significant contribution to the broad patterns of our history.

**B: Person** – The property is associated with the life of a person significant in our history.

**C: Design/Construction** – The property embodies the distinctive characteristics of a type, period, method of construction, artistic value, or work of a master.

**D: Information Potential** – The property has yielded or is likely to yield important information about our history or prehistory.

If the property is deemed to be eligible, a formal nomination proposal will be written and submitted to the SHPO. Upon Receipt of a nomination proposal for an eligible property, the following procedures will be carried out:

1. The nomination proposal and all accompanying documentation will be evaluated by the professional staff of the Bureau of Historic Preservation. If possible, a staff member will visit the site as a part of the evaluation process.

2. The owner(s) of the property and the chief local elected officials will be notified in writing that the property is being proposed for nomination and given the opportunity to comment on the property.
3. The proposal will be submitted for consideration and recommendation by the Florida National Register Review Board which is charged with reviewing all nomination proposals to the National Register of Historic Places from the State of Florida.
4. Upon the favorable recommendation of the Review Board, a final draft of the nomination will be prepared for the submission by the State Historic Preservation Officer to the Keeper of the National Register in Washington, D.C.
5. The Keeper of the National Register will undertake the final review and make the final decision whether or not to list the property. The Keeper has 45 days to make a formal determination.
6. The owner is then notified in writing as to the final decision.

On January 22, 2020, the Weeki Wachee Springs District was listed on the National Register of Historic Places under all four criteria.

Criteria A: Entertainment/Recreation

Criteria B: Newton Perry

Criteria C: Architecture (Robert E. Collins)

Criteria D: Prehistoric/Historic Archaeology

## **National Register Contributing Cultural Resources**

Nine historic structures and four historic objects are associated with the development of the Weeki Wachee tourist attraction from the late 1950's until the early 1970's. The most significant of these structures is the 1959-60 Weeki Wachee Spring Mermaid Theater (8HE391), designed by architect Robert Collins. This structure, which replaced the 1947 underwater theater, features an underwater diving tube which allows performers to enter the spring underwater and large glass windows designed specifically to showcase underwater performances. Notable architectural features are a scalloped roof and an elaborate interior tile mosaic of underwater scenes.

One historic airlock (HE877) remains at the bottom of the spring and was a key component of early underwater shows. This airlock was constructed sometime before 1956 and is comprised of a plastic dome bolted to a steel ring. It was created by Newt Perry to extend time underwater by allowing mermaids to swim beneath the dome and breath the compressed air that is pumped into the dome portion of the airlock.

The remaining structures and objects are remnant decorative or support structures of the Weeki Wachee attraction. The original marquee (HE878), mermaid entrance walls and the Adagio Statue (HE658) (relocated in 1978 from a fountain in front of the original entrance walls (HE659) to its present location) were designed to enhance the front entrance to the park and to entice passing tourists on US 19. The maintenance shop and prop shed provided necessary support functions for the attraction, while the cottages provided housing for Weeki Wachee performers and staff.

The Weekiwachee mound (8HE12) is the most prominent of the six archaeological sites in the park. This sand burial mound is located about 180 meters north of the spring and is currently roped off and marked by signage. Analysis of pottery from the mound indicated construction during the Safety Harbor period (AD 900 – 1650), the terminal

pre-contact and initial contact cultural period. More intriguing was the presence of Spanish glass beads, dating from the earliest known period of European contact, interred in the mound with Native American burials. There may be a village site associated with the mound that has since been obscured by development. The Weekiwachee mound is one of three important Safety Harbor sites in this region that along with prehistoric artifacts contained a significant number of European beads. At all three sites glass beads were found with aboriginal burials, indicating contact with the Spanish during the early 16<sup>th</sup> century (c. 1525 AD -1550 AD).

**Table 5. National Register Contributing Cultural Resources**

<b>Resource Groups</b>					
<b>FMSF#</b>	<b>Name</b>	<b>Period of Significance</b>			
HE880	Weeki Wachee Springs District	1947-1969 1525-1550			
HE660	Weeki Wachee Springs Support Structures	1960-1969			
<b>Historic Structures</b>					
<b>FMSF#</b>	<b>Name</b>	<b>Culture/Period</b>	<b>Significance</b>	<b>Condition</b>	<b>Treatment</b>
HE391	Underwater Theater	1960	NRL	G	P
HE649	Employee Cottage #1	1969	NRL	G	P
HE650	Employee Cottage #2	1969	NRL	G	P
HE651	Employee Cottage #3	1969	NRL	G	P
HE652	Employee Cottage #4	1969	NRL	G	P
HE653	Manager Cottage #1	1969	NRL	G	P
HE654	Manager Cottage #2	1969	NRL	G	P
HE655	Utility & Storage Bldg.	1962	NRL	G	P
HE656	Prop Building	1962	NRL	G	P
HE658	Adagio Statue	ca. 1966	NRL	G	P
HE659	Mermaid Wall	1963	NRL	G	P
HE878	Marquee	ca. 1966	NRL	F	P
HE877	Underwater Airlock	ca. 1956	NRL	G	P
<b>Archaeological Sites</b>					
HE012	Weekiwachee	Archaic (8500 BC–1000 BC) Safety Harbor (1000 AD– 1500 AD) First Spanish (1513-1599)	NRL	G	P



## Non-Contributing Cultural Resources

Eight buildings and structures are currently considered non-contributing the National Register district, however, these could potentially be reevaluated and incorporated in when they turn 50 years of age in 2027. Since these buildings and structures will become historic during the span of this plan, any potential projects involving these should take into account the need for DHR consultation starting in 2027.

Fifteen archaeological sites are currently recorded within the park boundary that do not contribute to the National Register district. These sites are mostly scatterings of prehistoric and/or historic artifacts such as pieces of broken pottery, stone tools, and metal fragments. Within the park boundary are artifact scatters left behind from prehistoric campsites, prehistoric and historic trash piles, military activities, and activities related to the construction of the Weeki Wachee attraction. In many cases, there is not enough information currently known about a site to determine a time period more specific than "prehistoric" or "historic", but in some of the sites do have identifying artifacts that associate them with the Archaic (8500 B.C. -1000 B.C.) and Weeden Island (A.D. 450-1000) cultures, as well as the American Civil War to present times.

All of the archaeological sites listed shall be managed using preservation treatments. Preservation includes protection from damage from resource management, natural causes, construction or human damage including looting.

**Table 6. Non-Contributing Cultural Resources**

Historic Structures					
FMSF#	Name	Culture/Period	Significance	Condition	Treatment
HE881	Admission Building	ca. 1977	NE	G	P
HE882	Gift Shop	ca. 1977	NE	G	P
HE883	Banquet Hall	ca. 1977	NE	G	P
HE884	Mermaid Galley Restaurant	ca. 1977	NE	G	P
HE885	Grandstand	ca. 1977	NE	G	P
HE886	Arbor	ca. 1977	NE	G	P
HE887	Cedar Bridge	ca. 1977	NE	G	P
HE888	Observation Deck	ca. 1977	NE	F	P
	Picnic Pavilions (3)	Unknown	NE		
	Exotic Bird Theater	Unknown	NE		
	Metal Utility Building	Unknown	NE		
	Wildlife Office	Unknown	NE		
	Captain's Quarters	Unknown	NE		

**Table 6. Non-Contributing Cultural Resources**

Historic Structures					
FMSF#	Name	Culture/Period	Significance	Condition	Treatment
	Kayak Rental Building	Unknown	NE		
	Gift Stand	Unknown	NE		
	Administration Building	Unknown	NE		
	Wilderness Building	Unknown	NE		
	Restroom	Unknown	NE		
Archaeological Sites					
HE059	Lykes 4	Unknown	NE		P
HE393	Winding Waters	Prehistoric	NE		P
HE057	Lykes 2	Weeden Island (A.D. 450-1000)	NE		P
HE056	Lykes 1	Weeden Island (A.D. 450-1000)	NE		P
HE392	Weeki Wachee Wall	20 <sup>th</sup> Century	NE		P
HE058	Lykes 3	Weeden Island (A.D. 450-1000)	NE		P
HE309	Military Landing	19 <sup>th</sup> Century	NE		P
HE060	Lykes 5	Unknown	NE		P
HE436	River Country	Archaic (8500 B.C. -1000 B.C.)	NE		P
HE031	Berkeley 1	Weeden Island (A.D. 450-1000)	NS		NA
HE572	Weeki Wachee Pond #1	Archaic	NS		NA
HE703	Weeki Wachee Canoe Launch	Archaic	NS		NA
HE490	US19/SR 50 Intersection	Archaic	NS		NA
HE704	Weeki Wachee Lithic Scatter	Prehistoric	NE		P
HE365	Pond A Site	Prehistoric (see survey #18266)	NS	NA	NA

**Significance**

NRL National Register Listed  
 NR National Register Eligible  
 NE Not Evaluated  
 NS Not Significant

**Condition**

G Good  
 F Fair  
 P Poor  
 NA Not Accessible  
 NE Not Evaluated

**Recommended Treatment**

RS Restoration  
 RH Rehabilitation  
 ST Stabilization  
 P Preservation  
 R Removal  
 N/A Not Applicable

## Collections

Most of the park's collection contains objects associated with the Weeki Wachee tourist attraction and the mermaids. The collection constitutes approximately 100 to 125 cubic feet of archival material. Some of these items have remained on park grounds since its days as an attraction, but many items were saved from destruction by former mermaids and staff and then donated back to the park. The majority of the archival material is film, photographs, and slides. A few historic documents, props, and costumes also are included in the collection.

The collections are currently stored in several places and are in fair to poor condition. Historic films, photographs, slides, and paper archives are currently stored in an air-conditioned room in the administration building. Some of the films are under refrigeration. A few historic costumes still exist and are located in the mermaid theater in a poorly climate-controlled area. Several historic props are located in an un-air-conditioned maintenance building.

The historic films are the most critically threatened items in the Weeki Wachee collection and need immediate attention. As these films have been stored under a variety of conditions over the years, they are in varying degrees of deterioration. Some of the films have been refrigerated to slow the process of their decline, but they may be lost forever if they are not properly treated by a professional film conservator within the near future.

The historic costumes and props are also important as there are very few of these items still in existence. Many of these remnants of the Weeki Wachee attraction have been lost or destroyed. The costumes and the props which are currently stored in the maintenance building need to be in an air-conditioned, insect-free, low humidity (30-50%) environment to assure their preservation. The props need to be evaluated as to their condition and conservation needs. Currently, the park has no organized collections management program. A Scope of Collection Statement needs to be developed, as well as an inventory or catalog, a housekeeping manual, and a record keeping system.



1969 Postcard Collection – Credit: Florida Memory

# **Cultural Resource Management Objectives**

Cultural resources are individually unique, and collectively, very challenging for the public land manager whose goal is to preserve and protect them in perpetuity. The DRP will implement the following goals, objectives and actions, as funding becomes available, to preserve the cultural resources found in Weeki Wachee Springs State Park.

## **Goal: Protect, preserve and maintain the cultural resources of the park.**

The management of cultural resources is often complicated because these resources are irreplaceable and extremely vulnerable to disturbances. The advice of historical and archaeological experts is required in this effort.

*Activities related to land clearing, ground disturbing activities, major repairs, alterations, or additions to historic structures listed or eligible for listing in the National Register of Historic Places, or that have not had a formal determination of eligibility must be submitted to the FDOS, Division of Historical Resources (DHR) for review and comment prior to undertaking the proposed project.*

Recommendations may include, but are not limited to, concurrence with the project as submitted, monitoring of the project site by a DHR certified archaeological monitor, cultural resource assessment survey by a qualified professional archaeologist, modifications to the proposed project to avoid or mitigation of potential adverse effects. In addition, any demolition or substantial alteration to any historic structure or resource must be submitted to the DHR for consultation and the DRP must demonstrate that there is no feasible alternative to removal and must provide a strategy for documentation or salvage of the resource. Florida law further requires that DRP consider the reuse of historic buildings in the park in lieu of new construction and must undertake a cost comparison of new development versus rehabilitation of a building before electing to construct a new or replacement building. This comparison must be accomplished with the assistance of the DHR.

## **DHR Matrix for Ground Disturbing Activities on State Lands**

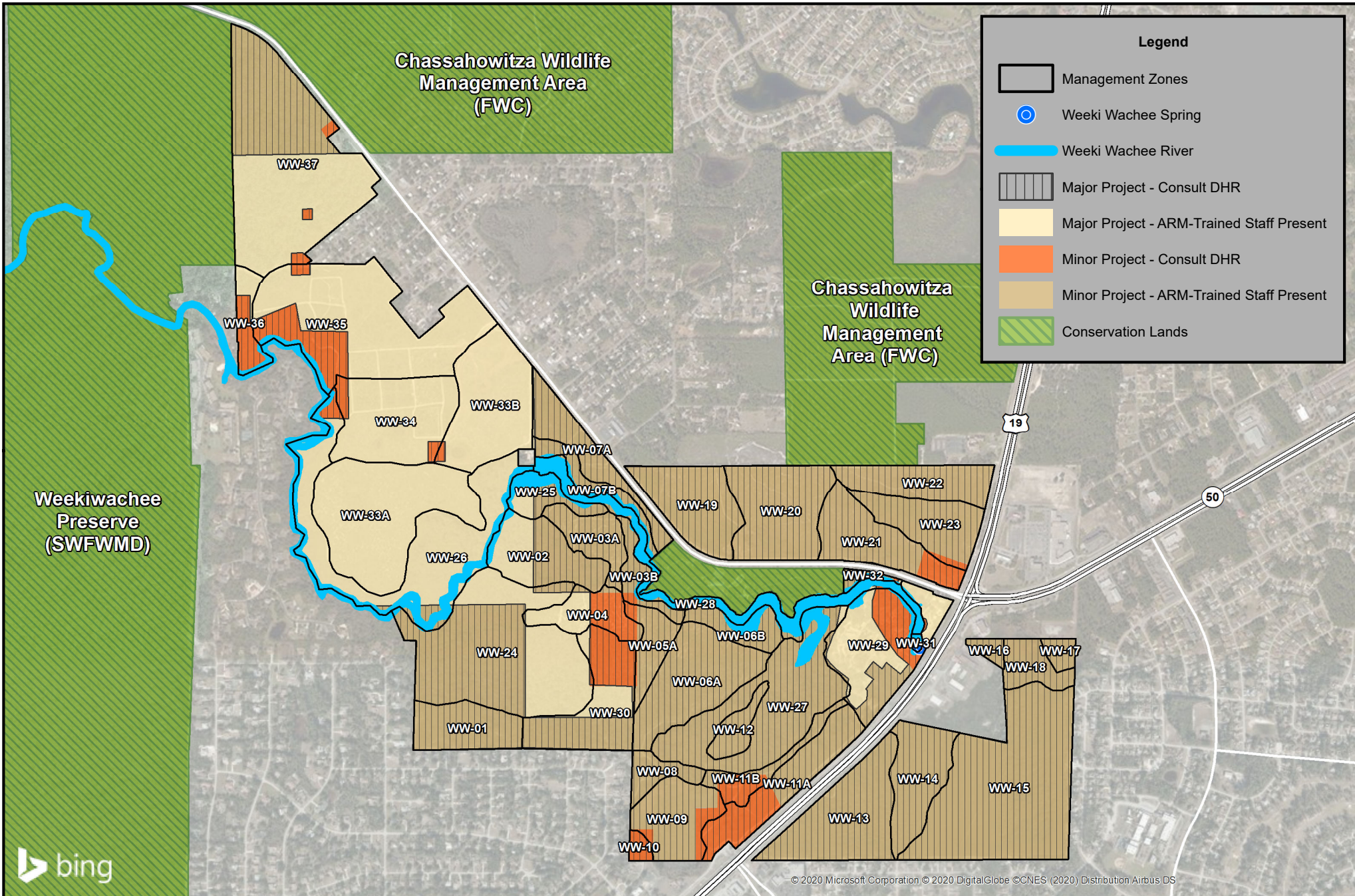
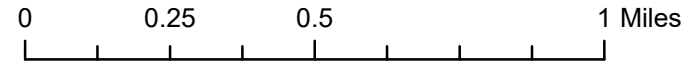
The DHR Matrix for ground disturbing activities on state lands is a tool that DHR developed and designed to help streamline the DHR Compliance and Review process for state land managers. While it does not eliminate the need for DHR consultation for ground disturbing projects, it does narrow down the scope of what does and does not need to be submitted. Projects will fall into one of three categories depending on the extent of ground disturbance, and where the project is occurring.

- Proceed with project as planned.
- Proceed with ARM monitoring during project activities.
- DHR will need to be consulted.

Ground disturbance is categorized as either minor or major. See below. Map # is a graphic representation of the matrix applied to Weeki Wachee Springs State Park.



# Weeki Wachee Springs State Park DHR Matrix for Ground Disturbance



## Minor Disturbances

- Bicycle racks
- Cable burial with blade-type devices
- Campsite markers
- Emergency holes (for safety, accident or emergency repairs)
- Fireplaces/grills
- Flagpoles
- Garbage can or recycle bin posts
- Gardening (existing activity)
- Horse hitching posts
- Kiosks on post
- Lifeguard stands
- Lightning arresters
- Plantings (shrubbery, seedlings or plugs)
- Poles for utilities, lights, speakers
- Prescribed burns (not initial)
- Road/trail barriers & signs
- Roller chopping (light-empty tank)
- Sign posts
- Fire ring installation
- Boardwalks, catwalks or piers
- Equipment racks
- Fire lane maintenance
- Playground equipment installation
- Temporary open shelter construction
- Septic tank/drainage (replacement, no enlargement)
- Stabilizing existing unpaved roads (not historic)
- Unpaved road maintenance (disking, harrowing, plowing, etc.)
- Decks or Platforms
- Drainage swale maintenance
- Fence posts and railings
- Parking lot boundary posts
- Monument construction
- Tower construction
- Well drilling (includes catchment basins)

## Major Disturbances

- Prescribed burns (initial)
- Mechanized invasive plant removal (not hand pulling)
- Concrete slab installation
- Docks
- Dredging
- Public utilities (trenched)
- New fire line construction
- Beach construction
- Initial roller chopping
- Sewage treatment plant construction
- Water/sewer line installation
- Tree trunk removal (big trees)
- Tree or big plant planting or root ball removal
- Drainage swale construction
- Foundation repair or stabilization
- Mobile home installation
- Telephone lines (trenched)
- Terracing for erosion control
- Water retention area construction
- Septic tank/drain field installation (new or enlargement)
- Bridge Construction
- Garden installation (new areas)
- Animal burials
- Clivis (restroom) installation
- Sidewalk installation
- Picnic shelter with slab
- Borrow pits

### ***Objective A: Continue to compile reliable documentation for all cultural resources.***

- |          |   |
|----------|---|
| Action 1 | Ensure all known sites, buildings, and structures are recorded or updated in the Florida Master Site File.                              |
| Action 2 | Conduct Phase 1 archaeological survey for areas that have not been professionally surveyed to identify any currently unknown resources. |
| Action 3 | Continue to catalog and record collections objects, photos, and archives into DRP database (PastPerfect).                               |

A thorough inventory of all cultural resources is critical to their preservation and protection.

**Objective B: Assess and evaluate all recorded cultural resources in the park.**

- Action 1      Implement yearly monitoring of all cultural resources within the park.
- Action 2      Complete an Historic Structures Report for each historic building and structure determined to be eligible for listing in the National Register that receives a condition assessment of Fair or Poor. Emphasis should be placed on prioritizing stabilization, restoration and rehabilitation projects over the life of the plan for these resources.
- Action 3      Complete National Register eligibility determinations for archaeological sites, historic buildings, and structures that have not been formally evaluated by the SHPO.
- Action 4      Complete a Scope of Collections.
- Action 5      Create a Collections Management Plan.

All cultural resources should be monitored on a yearly basis to note any signs of deterioration, and to provide park staff with insights into any foreseeable actions that may need to be taken in order to prevent further and/or higher cost remediations. Below is a list of the kinds of information that should be gathered during monitoring.

Archaeological Sites

- Location?
- Are any artifacts visible?
- Any observed threats to the site?
- Overall condition of site?

Historic Buildings and Structures

- Location?
- Current use?
- Internal repair needs?
- External repair needs?
- Any evidence of infestation or mold?
- Evidence of damage (natural or otherwise)?

Collections Storage Facilities

- Is the temperature between 68 and 72 degrees Fahrenheit and relative humidity between 30% and 50% constantly?).
- Is pest control being done regularly?
- What is the housekeeping plan?
- How are collections being kept secure?

A Scope of Collections needs to be developed to guide acquisition of collection items, along with an administrative history, which will help interpret the history of the park.

The University of Central Florida conducted a History Harvest on September 14, 2019 to collect and digitize historic memorabilia and oral histories. Park staff should contact this program to ensure that the park also has copies of the information collected.

To assist with the creation of a collections management plan, the park should apply for the Collections Assessment for Preservation (CAP) Program through the American Institute for Conservation and the Foundation for Advancement in Conservation. The assessment is a study of all of an institution's collections, buildings, and building systems, as well as its policies and procedures relating to collections care. Participants who complete the program receive an assessment report with prioritized recommendations to improve collections care. CAP is often a first step for small institutions that wish to improve the condition of their collections.

**Objective C: Maintain all NR-eligible or listed resources in good condition.**

- Action 1 NR-listed or eligible structures should be prioritized for yearly maintenance funds.
- Action 2 Staff should report any NR listed or eligible resources that are not in good condition to BNCR.

Information obtained from yearly monitoring should be used to coordinate preventative maintenance and to plan for foreseeable high-cost expenses. BNCR will work with park staff to create an action plan for any resources that are not in good condition.

**Objective D: Continue to have staff complete DHR's Archaeological Resource Management (ARM) training.**

- Action 1 All staff who have not previously completed the two-day ARM training course, and those who completed it prior to 2012, should complete this training at least once during the span of this management plan.

The ARM Training course is revised and updated regularly as new information and procedural changes are made. Due to potential changes, only a small selection of staff should be sent at a time staggered over the span of the plan to ensure that the park has the most up-to-date information.

**Objective E: Complete the following historic preservation projects.**

- Action 1 Repoint stonework on marquee sign.
- Action 2 Repoint stonework on base of adagio statue.
- Action 3 Clean and repaint adagio statue.
- Action 4 Clean and repaint mermaid wall.
- Action 5 Plant native vegetation around the employee cottages.
- Action 6 Plant native vegetation around the arbor.
- Action 7 Digitize and preserve film and photo collections.
- Action 8 Create a plan for interpreting cultural resources to the public.

These are potential projects that should be completed as time and funds allow. Most of these would be ideal candidates for CSO projects, DHR historic preservation grants, or volunteer opportunities.

Repointing projects should confirm to the guidelines set forth in the National Park Service Preservation Briefs 2: Repointing Mortar Joints in Historic Masonry Buildings. A proper repointing job should last at least 30 years. If done improperly, it could cause damage to the masonry units, will require repointing again much sooner, and will diminish the appearance of the structure. If the project is to be bid out, ensure that the specifications stipulate that masons must have a minimum of five years' experience with repointing historic masonry to be eligible to bid on the project.

Preservation and digitization of film and photo collections are time sensitive priority. Park staff should consider contacting the University of Central Florida's History Harvest Program for possible a potential partnership in this endeavor.



## **Capital Facilities and Infrastructure**

Land use planning and park development decisions for the state park system are based on the dual responsibilities of the DRP. These responsibilities are to preserve representative examples of original natural Florida and its cultural resources, and to provide outdoor recreation opportunities for Florida's citizens and visitors. These dual responsibilities inform all recreational and infrastructure development considerations. Balancing equitable access to recreational opportunities and preservation of Florida's resources is the main priority when developing recreation and land use proposals.

The general recreation and land use planning process begins with an analysis of the natural and cultural resources of the unit, proceeds through the creation of a conceptual land use plan, and culminates in the actual design and construction of park facilities. Input on the plan is provided by experts in environmental sciences, cultural resources, park operation, and management. Additional input is received through public meetings and advisory groups with key stakeholders. With this approach, the DRP's objective is to provide high-quality facilities for resource-based recreation throughout the state with a high level of sensitivity to the natural and cultural resources at each park.

This section of the management plan includes an inventory and brief description of the existing recreational uses, facilities, and special conditions on use. Specific areas within the park that will be given special protection are also identified. The Capital Facilities section then summarizes the Conceptual Land Use Plan (CLUP) for the park and identifies large-scale repair/renovation projects, new building/infrastructure projects, and/or new recreational amenities that are recommended to be implemented over the next ten-year planning period. Any adjacent lands that should be acquired to improve management of the park are also identified as a part of the park's Optimum Boundary.

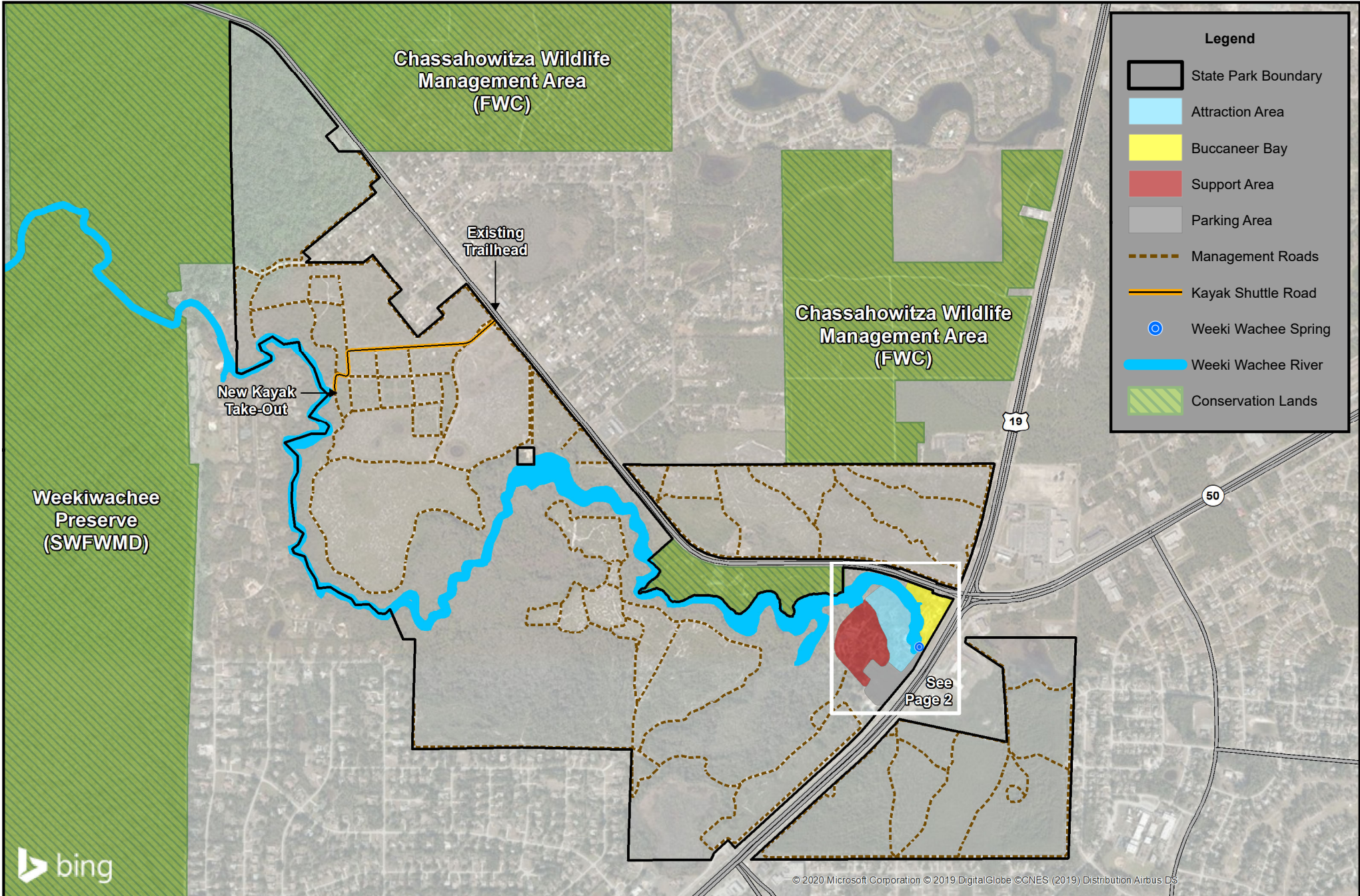
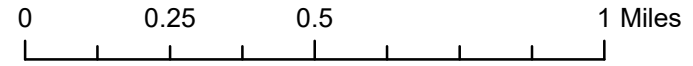
### **Existing Facilities**

Prior to 2018, the park's acreage was 538 acres. In 2018, the park added 389 acres to its management boundary and the park's acreage now totals approximately 927 acres. This recently added acreage was previously managed by FWC as a part of the Chassahowitzka Wildlife Management Area and had relatively few management facilities or recreational amenities. A network of management roads divided the land into smaller management units, and a small trailhead on Cortez Boulevard allowed visitors to hike the dirt roads. These roads continue to double as trails. An erosion-control terraced structure was developed by FWC in 1999, and following an amendment to the 2011 UMP, this structure was utilized to construct a takeout point for visitors paddling the river from the state park launching point near the springhead. One segment of the existing management roads was stabilized and will be used as a tram road for the concession shuttle service to pick up and transport visitors back to the kayak launching area.

Although the park totals nearly 930 acres, a majority of the park's visitation and activity occurs within about 32 acres concentrated around the Weeki Wachee springhead. These 32 acres can be grouped into four main categories: the historic attraction area, the Buccaneer Bay waterpark, staff support areas, and the two main parking areas. Accessed from an area adjacent to the park's support facilities, the kayak launch and river corridor receive significant visitor usage, and paddling has remained one of the most popular recreational activities at the park. The two following maps show the park in its entirety (Base Map Page 1) and the main use areas of the park (Base Map Page 2).



# Weeki Wachee Springs State Park Base Map - Existing Facilities





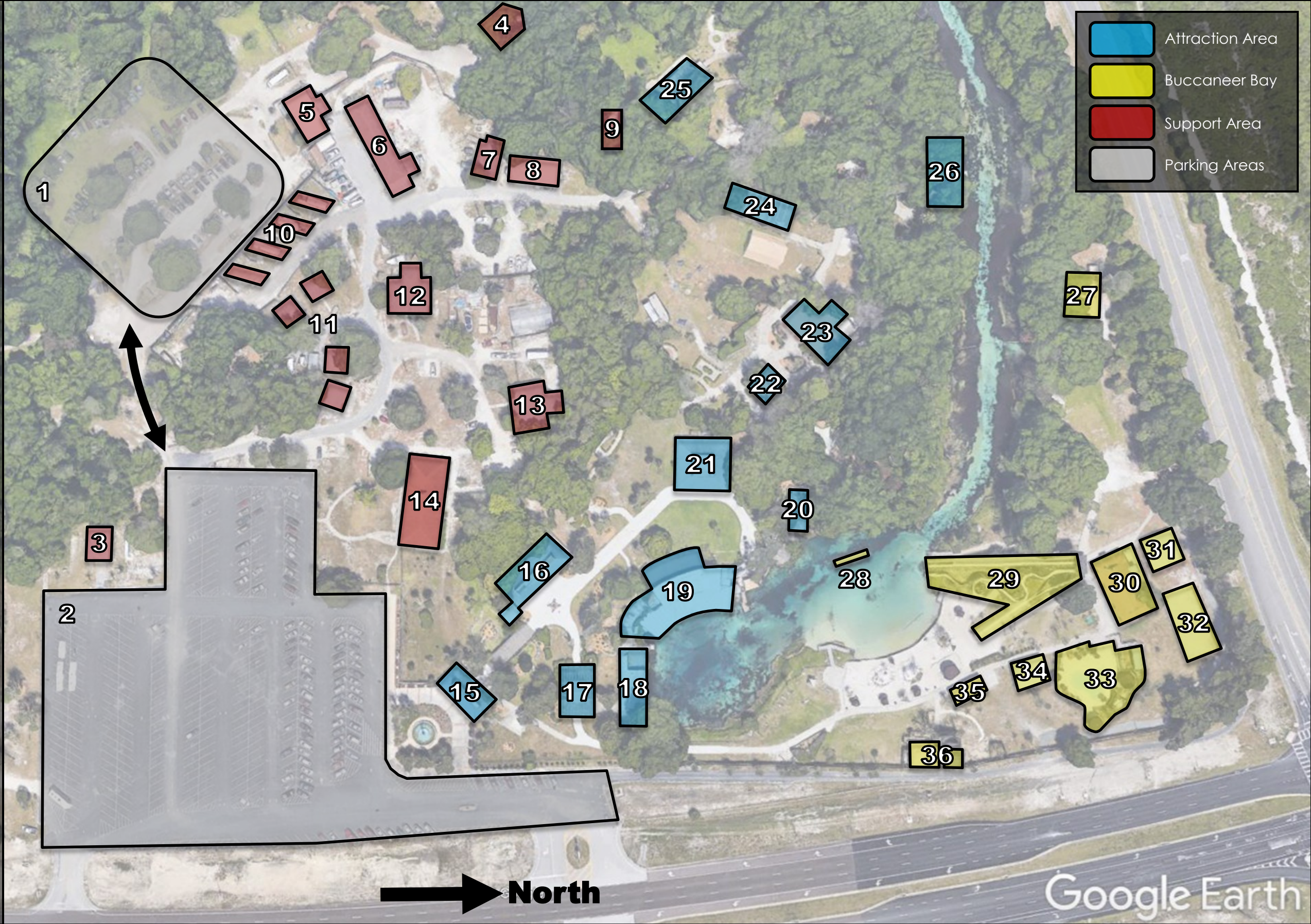
# Weeki Wachee Springs State Park

## Base Map — Existing Facilities Page 2

### Main Recreational Use and Staff Support Areas

#### Attraction Area — Buccaneer Bay — Support Area — Parking

- 1 — Kayak Parking Area (~85 spaces)
- 2 — Main Parking Area (~300 spaces)
- 3 — Storage Building
- 4 — Kayak Storage & Launch Area
- 5 — Kayak Concession Building
- 6 — Maintenance Shop Building
- 7 — Shop & Storage Building
- 8 — Employee Office & Breakroom
- 9 — Wildlife Office
- 10 — Volunteer RV Campsites (4)
- 11 — Historic Cottages (4)
- 12 — Assistant Park Manager Residence
- 13 — Park Manager Residence
- 14 — Administrative Offices Building
- 15 — Visitor Entrance & Ticket Booths
- 16 — Gift Shop
- 17 — Decorative Arbor
- 18 — Spring Overlook & Waiting Area
- 19 — Mermaid Theater
- 20 — Captain's Quarters
- 21 — Banquet Hall
- 22 — Restroom
- 23 — Galley Restaurant
- 24 — Grandstand Seating Area
- 25 — Wildlife Theater & Seating
- 26 — Tour Boat Dock
- 27 — Pavilion
- 28 — Floating Platform & Swim Area
- 29 — Buccaneer Bay Slides
- 30 — Food & Beverage Concession
- 31 — Pavilion
- 32 — Sand Volleyball Court
- 33 — Splash Pool Area
- 34 — Tube Storage Corral
- 35 — Tiki Bar
- 36 — Tower & First Aid Building



<span style="display: inline-block; width: 20px; height: 10px; background-color: blue; border: 1px solid black;"></span>	Attraction Area
<span style="display: inline-block; width: 20px; height: 10px; background-color: yellow; border: 1px solid black;"></span>	Buccaneer Bay
<span style="display: inline-block; width: 20px; height: 10px; background-color: red; border: 1px solid black;"></span>	Support Area
<span style="display: inline-block; width: 20px; height: 10px; background-color: grey; border: 1px solid black;"></span>	Parking Areas

**North**

Google Earth



The park entrance from US 19 and the two parking areas allow visitors to access the main use areas at the park. The larger of the two parking areas services the attraction area and Buccaneer Bay, while the smaller parking area is adjacent to kayak concession building and launch area. The following lists inventory the facilities found at the park, organized by the use areas in which the facilities are located (Base Map Page 1/2).

Attraction Area

- Ticketing Booths
- Gift Shop
- Decorative Arbor
- Covered Waiting Area
- Mermaid Theater
- Banquet Hall
- Captain’s Quarters
- Restroom
- Galley Restaurant
- Grandstand Seating
- Wildlife Theater
- Tour Boat Dock

Buccaneer Bay

- Pavilions (2)
- Concession Building
- Sand Volleyball Court
- Waterpark Slides (3)
- Splash Pool Area
- Inflatable Tube Corral
- First Aid/Staff Building
- Former Slide Tower
- Floating Swim Platform

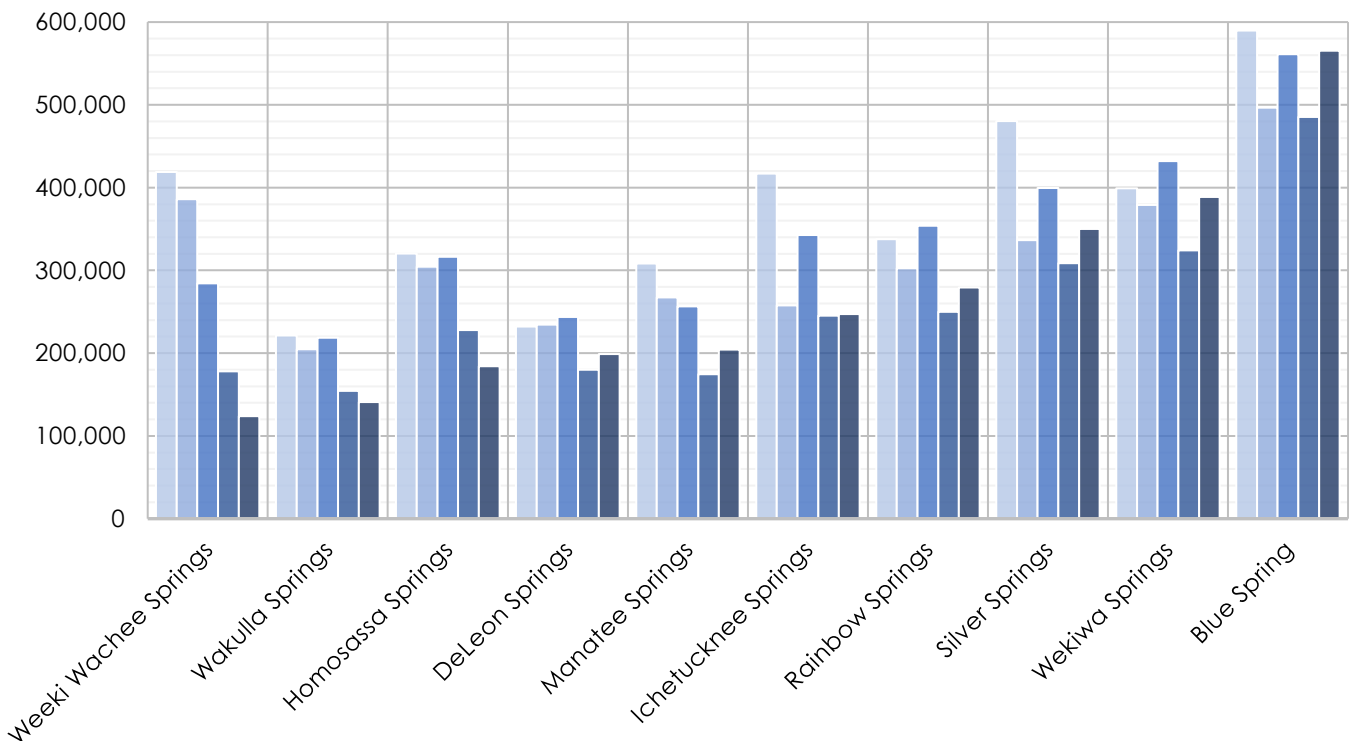
Support Area

- Residences (2)
- Administrative Office
- Employee Offices (2)
- Storage Buildings (2)
- Maintenance Shop
- Historic Cottages (4)
- Volunteer RV Sites (4)
- Concession Area
- Vessel Storage Area
- Paddle Launch

**Recreational Use and Visitor Attendance**

Weeki Wachee Springs State Park recorded 123,757 visitors in FY 2020/2021. By DRP estimates, the FY 2020/2021 visitors contributed \$20.4 million in direct economic impact to the region, the equivalent of adding 286 jobs to the local economy (FDEP 2021). Over the past five years, the park has averaged about 376,000 visitors and \$35 million in direct economic impact per year.

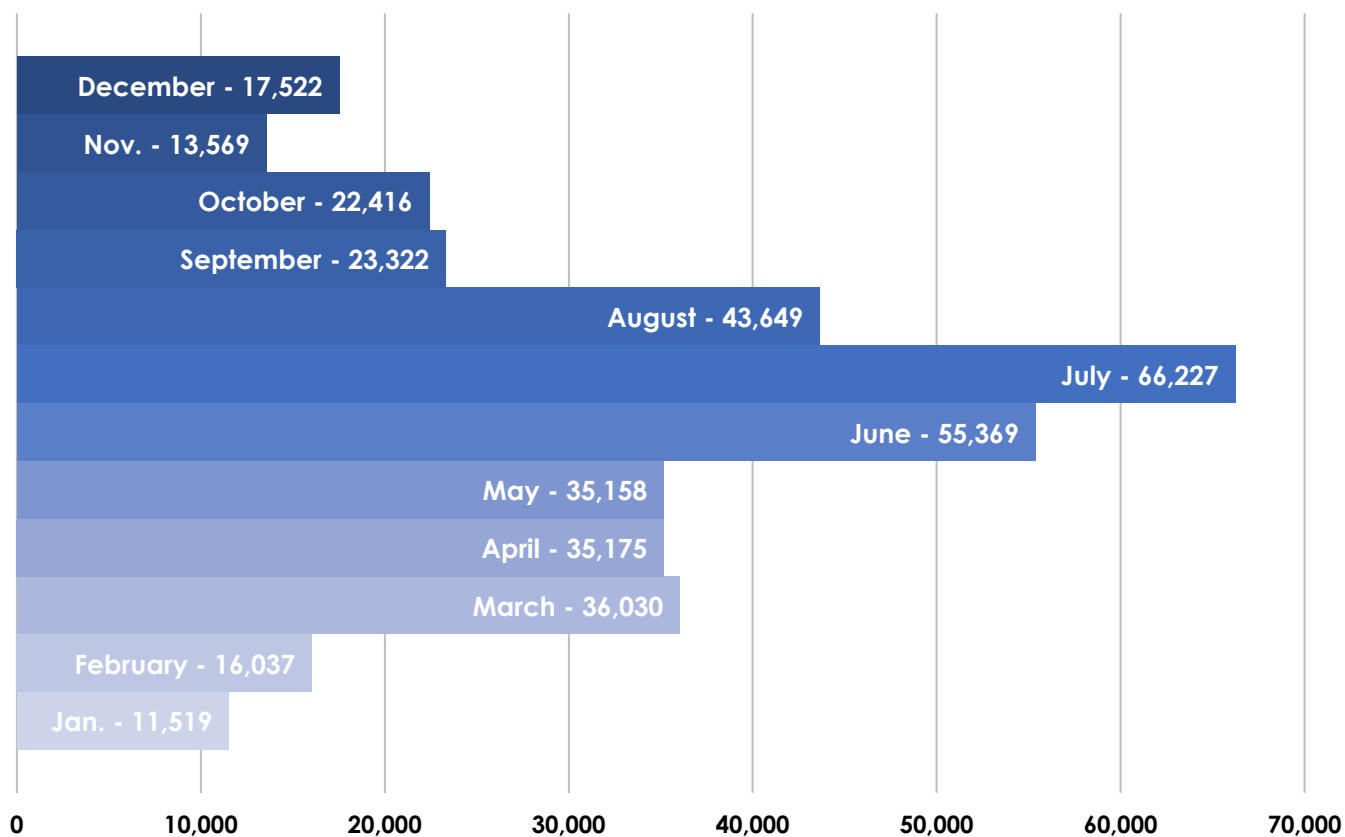
**Annual Attendance: Fiscal Year (FY) 2016-2021**



The hundreds of thousands of visitors that visit Weeki Wachee Springs State Park every year are attracted to the park by three main recreational features: the underwater mermaid shows at the Mermaid Theater, waterpark activities at Buccaneer Bay, and paddling trips on the Weeki Wachee River. Interpretation and shows are the main recreational uses at the attraction area, the area of the park in which the Mermaid Theater is located. The underwater mermaid show is the main attraction in this area, but there are also other interpretive opportunities such as the wildlife shows at the wildlife theater and interpretive boat tours that transport visitors along a segment of the Weeki Wachee River. A gift shop, small concession, and full-service restaurant supplement the day use recreational activities taking place at the attraction area. Buccaneer Bay was developed in 1982 prior to the establishment as Weeki Wachee Springs State Park (2008) and provides typical waterpark amenities, albeit at a much smaller scale compared to modern waterparks. The waterpark contains three waterslides, springhead swimming area, splash pool area, food and beverage concession, tiki bar, inflatable tube rental, beach lounging area, and two shaded pavilion structures. The third major attraction for the park is paddling the Weeki Wachee River. This recreational opportunity allows visitors to launch their own paddling vessel or offers concession-managed rental vessels. Management strategies for paddling on the Weeki Wachee River will be discussed in the Visitor Use Management (VUM) section of this plan.

As shown in the graph below, the month that has averaged the most visitation over the past five years is July. The monthly visitation in July accounts for nearly 18% of the total annual attendance, and the visitation between May-August accounts for approximately 53% of the yearly total. Adding March and April to that four-month time period pushes the six-month percentage of annual attendance to 72%. In other words, the Fall and Winter months (September-February) typically account for less than 30% of the total annual attendance at Weeki Wachee Springs State Park. Historical attendance data has implications for visitor use management and will be discussed further in the VUM section.

**Weeki Wachee Springs State Park Average Monthly Attendance**



## **Conceptual Land Use Plan**

The Conceptual Land Use Plan (CLUP) is the long-term, optimal development plan for Weeki Wachee Springs State Park based on current conditions and knowledge of the park's resources, landscape, and social setting. If a conceptual land use proposal from previous updates to a park's management plan has not been completed over the specified planning period, it can be carried over into subsequent updates if it continues to conform with the overall vision for the park. The Conceptual Land Use Plan and proposals can be modified or revised as new information becomes available regarding the park's natural and cultural resources or as trends in recreational use change over time. In addition, the acquisition of new parkland can present new recreational opportunities or support facility needs. These modifications routinely take place during the management plan update process but can also be accomplished through a management plan amendment process. The planning period for this management plan is ten years, and conceptual land use proposals can be implemented at any time during this ten-year period, as funding becomes available.

During the development of the Conceptual Land Use Plan, the DRP assessed the potential impact of development proposals on the park resources and applied this generalized assessment to the overall vision for future infrastructure and recreational amenities. Once a conceptual land use proposal receives funding to be implemented, resource impacts are assessed at the site-specific level and are evaluated by the DRP. At that stage, design elements and design constraints are investigated in greater detail. Municipal sewer connections, advanced wastewater treatment, or best available technology systems are applied for on-site sewage disposal. Development of impervious surfaces is minimized to the greatest extent feasible in order to limit the need for stormwater management systems, and all facilities are designed and constructed using best management practices to limit and/or avoid resource impacts. Federal, state, and local permitting and regulatory requirements are addressed during the design and construction phase of implementation. This includes the design of all new park facilities to be consistent with the universal access requirements of the Americans with Disabilities Act (ADA).

## **Future Land Use and Zoning**

A majority of the land adjacent to and surrounding the park is developed through a combination of suburban, low-to-medium density residential and US 19 frontage for commercial businesses. Substantial land acreage to the west of the park is under conservation managed by FWC and SWFWMD. Given the current residential footprints and conservation lands, it does not seem likely that large development projects will impact the park boundary. In addition, there are no plans to widen US 19. Expansion and widening of SR 50 could potentially impact the park boundary, but there are no plans for such an expansion.

The DRP works with local governments to apply land use designations to parks that provide consistency with comprehensive plans and zoning codes, as well as permit typical state park uses and facilities necessary for resource-based recreation.

The park itself is currently zoned for conservation and recreation. All concepts to be discussed as a part of the CLUP are supported by the mission of the DRP and Florida Park Service, and all projects to be implemented over the next ten years will abide by local zoning and permitting regulations.

## Public Access and Recreational Opportunities

**Goal: Provide public access and recreational opportunities at the park.**

The existing recreational activities and programs of this state park are appropriate to the natural and cultural resources contained in the park and should be continued.

### Physical Capacity

Managing public access at all Florida State Parks is inherently linked to how visitors physically transport themselves to the park and, once there, navigate between the different use areas within the park. In some cases, parks near dense urban areas can be accessed by public transit or alternative transportation like bicycles. However, in most cases, state parks are outside of urban areas and are destinations for out-of-state visitors and can only be accessed by personal vehicles or tour buses. Given the reliance on personal vehicles, the size of parking areas is considered a physical constraint and has a significant influence on the number of visitors that can access a park.

For most state parks, visitors enter the park through a single entrance and ranger station. Each different use area within the park is usually serviced by a dedicated parking area, and visitors can navigate between the use areas. Weeki Wachee Springs State Park is unique in that there are two main parking areas that exist outside of the formal entrances to the park. The main paved parking area and its overflow parking area service the entrance to the attraction area and Buccaneer Bay, while the kayak launch parking area services the paddling launch and access to the river. There is a small trailhead parking area on the north side of the park, which receives minimal use and does not factor significantly into the park’s physical capacity. These parking areas determine the physical capacity of the park, and therefore also determine the number of visitors that can access the park. The figures in the table below represent how many visitors the parking areas can support and do not represent how many visitors should be allowed to access the park’s resources. Determinations on the number of visitors and the ideal experience the park should accommodate will be discussed in the VUM section.

**Table 7. Parking Area Physical Capacities**

Parking Area	Main Paved Parking	Overflow Main Parking	Kayak Launch Parking	Trailhead Parking	Total
Number of Parking Spaces	300	50	85	5	440
Visitors per Vehicle	3	3	3	3	
Visitors at One Time	900	150	255	15	1,320
Turnover Rate	3	3	2	2	
Visitors Daily	2,700	450	510	30	3,690



The physical capacity for Weeki Wachee Springs State Park has been determined by identifying the recreational uses and activities available to visitors, approximately the physical constraints associated with accessing those uses, and applying a median number of visitors per vehicle. This calculation establishes the visitors at one time figure for each parking area. The one-time number is then multiplied by a daily turnover rate that estimates how many times the parking areas will be cycled through by different groups of visitors throughout the day. The totals for each parking area are added together to determine the total visitors at one time and total daily visitors.

The table above inventories all of the existing parking areas at the park. For these areas, the physical or operational constraints of accessing and utilizing the parking spaces are considered constant, non-variable inputs into the physical capacity equation. These constants are then multiplied by visitors per vehicle, which is considered to be a variable input. It is known that some vehicles will have one to two visitors while others could contain six to eight. For the purposes of this plan, the established assumption is that each vehicle contains three visitors. The other assumption is that visitors utilizing the main parking area will spend about three hours in the attraction area and Buccaneer Bay, which determines the turnover rate that is used to calculate total daily visitors.

***The Turnover Rate is calculated by dividing a 9-hour summer day by the estimated number of hours spent in the park.***

***9 Hours = Turnover Rate of 1  
8 Hours = Turnover Rate of 1.125  
7 Hours = Turnover Rate of 1.285  
6 Hours = Turnover Rate of 1.5  
5 Hours = Turnover Rate of 1.8  
4 Hours = Turnover Rate of 2.25  
3 Hours = Turnover Rate of 3  
2 Hours = Turnover Rate of 4.5  
1 Hour = Turnover Rate of 9***

These calculations of the park's physical capacity are based on the idea that parking spaces are considered physical constraints that only allow a certain number of visitors to access the park's use areas at one time. A single parking space cannot be used simultaneously by multiple vehicles. Although vehicles can contain a variable number of visitors, the total number of parking spaces physically limits the number of visitors that can access the park's resources. Without an increase to the physical space allocated to parking, an increase in the physical capacity of the park cannot take place. Conversely, a reduction in allocated parking can lower the maximum capacity of visitors able to access the park. These calculations, however, do not attempt to establish how many people should be allowed to access the park.

***Objective A: Maintain the current public access and uses at the park.***

The park will continue to maintain the parking areas used to access the park and will continue to offer the historical recreational opportunities found at Weeki Wachee Springs State Park. The main recreational uses will continue to be the underwater mermaid shows, waterpark activities at Buccaneer Bay, and paddling on the Weeki Wachee River.

***Objective B: Continue to provide and develop interpretive programs.***

Interpretation of the cultural history and legacy of the mermaids will continue to be one of the main interpretive themes at the park. Other interpretation that will continue includes shows at the wildlife theater and interpretation of the sensitive natural ecosystem that supports the first magnitude spring and spring-run. One development proposal to be discussed below is the potential for a visitor center that could be used to showcase the legacy of the roadside attraction and mermaids with an interpretive museum. Curation of park artifacts and the development of interpretive programs will be needed if this new visitor center facility is funded and constructed.

## Capital Facilities and Infrastructure

***Goal: Develop and maintain the capital facilities and infrastructure necessary to implement the recommendations of the Conceptual Land Use Plan (CLUP).***

The existing facilities of this state park are appropriate to the natural and cultural resources contained in the park and should be maintained. New construction, as discussed below, is recommended to improve the quality and safety of the recreational opportunities, to improve the protection of park resources, and to streamline the efficiency of park operations. The following is a summary of the improved, renovated, and new facilities needed to implement the Conceptual Land Use Plan (CLUP) for Weeki Wachee Springs State Park.

A majority of the proposals in the CLUP are aimed at improving the visitor experience in the park's main use areas. Development and improvement concepts in the attraction area and the main paved parking area are largely aligned with the vision set forth in the park's 2014 Master Plan, which will be discussed further below and is found in Addendum 10. Given a headspring retaining wall and stormwater management project taking place in Buccaneer Bay, the 2014 Master Plan vision for that portion of the park cannot be achieved and alternative concepts are proposed. The major new development proposal involves the creation of a new park entrance and establishment of a traditional ranger station entrance area. The parking area redesign and stormwater improvement proposals of the master plan will continue to be pursued. The new entrance road, however, will connect with the existing main parking area from the south as opposed to directly from US 19. Developing a new entrance and rerouting visitors into the parking areas will allow the current entrance to be abandoned and revegetated to create a natural buffer between US 19 and Weeki Wachee Spring. All proposed concepts are discussed below.

***Objective A: Maintain all public and support facilities in the park.***

All capital facilities, trails, and roads within the park will be kept in proper condition through the daily or regular work of park staff and/or contracted help.

***Objective B: Improve/repair facilities in 4 existing use areas.***

Major repair projects for park facilities may be accomplished within the ten-year planning period of this management plan, if funding is made available. These include the modification of existing park facilities to bring them into compliance with the Americans with Disabilities Act (a top priority for all facilities maintained by DRP). The following discussion of recommended improvements are organized by use area within the park.

### Attraction Area

- Add Pavilions (2)
- Improve Walkway Lighting
- Relocate Banquet Hall
- Improve Captain's Quarters
- Develop Visitor Center
- Assess Grandstand

The underwater mermaid theater is the most notable feature of the attraction area. This facility has recently undergone an extensive renovation process and will continue to be one of the park's main attractions. A majority of the proposal concepts for this area of the park are intended to implement the vision of the 2014 Master Plan. The graphic on the next page shows the redesigned attraction area.

The main redesign element of the master plan is the development of a central corridor with clear sightlines from the entrance of the park to a newly created fountain in the center of the use area and then to the tour boat dock. The fountain concept is located at the site of the Banquet Hall facility, which would require that structure to be relocated. The Banquet Hall space could be integrated into the proposed visitor/interpretive center. This new facility would house an interpretive museum dedicated to the history of the park and the cultural legacy associated with the mermaid shows and underwater theater. The visitor center would also have reservable meeting space and could be used to accommodate community events. To the west of the Banquet Hall and future fountain site, the Garden of the Stars area will be improved through walkway lighting updates and the addition of two pavilions. To the east, Captain's Quarters will be improved, and a deck will be constructed to allow outdoor seating overlooking the springhead. Lastly, an assessment should be completed on the grandstand seating structure to determine the feasibility of renovating or demolishing the amenity. Consideration should also be given to incorporating the grandstand into an event area that would utilize the open space between the grandstand and visitor center concept. Proper orientation of the visitor center could allow the structure to be aligned with and centered on the orientation of the grandstand, and a stage could be constructed on the backside of the visitor center to create an event space that would use the grandstand for seating. The specific design, siting, and orientation of these proposed improvements would be determined during the design and construction process if project funding is allocated.



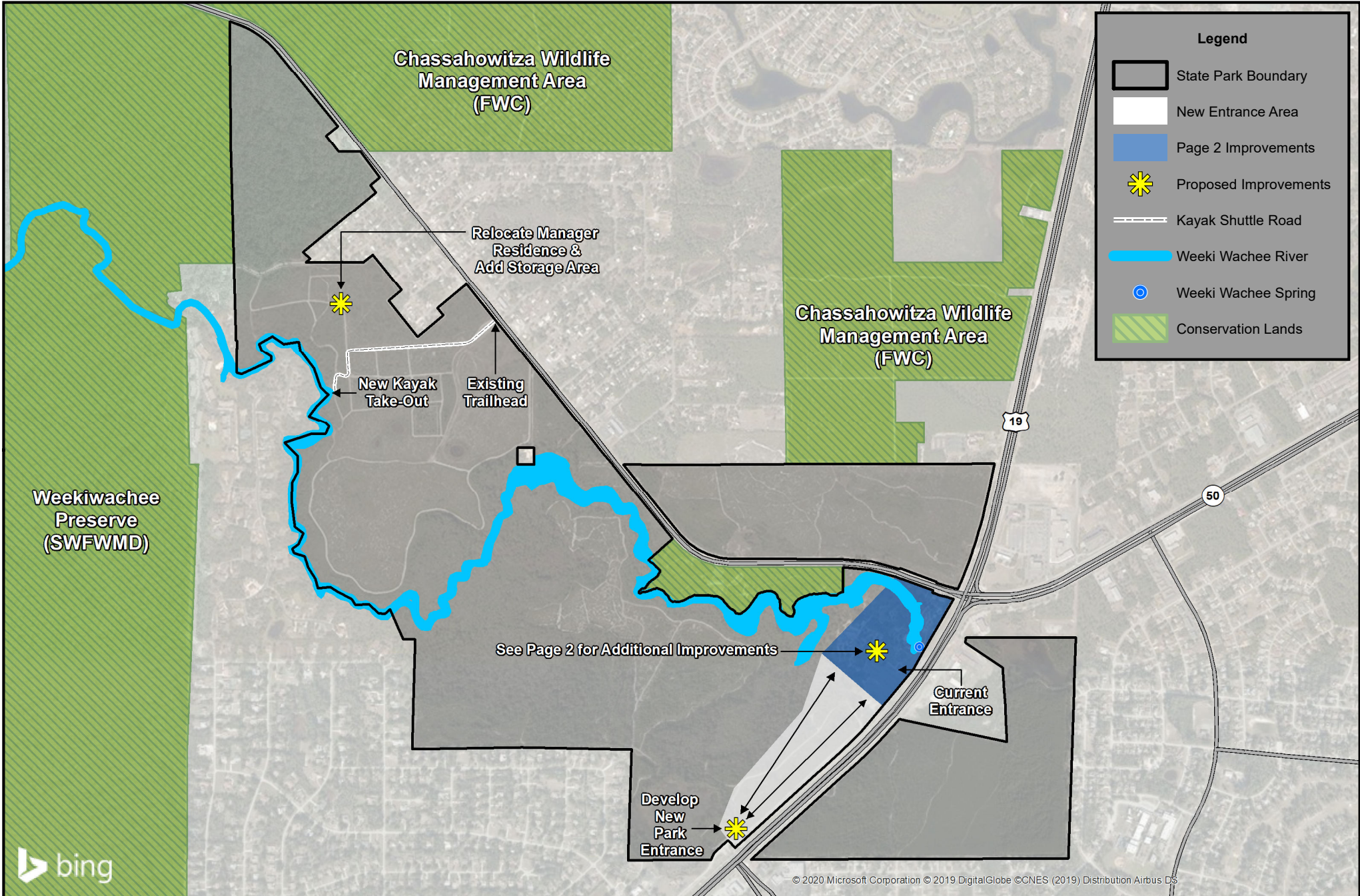
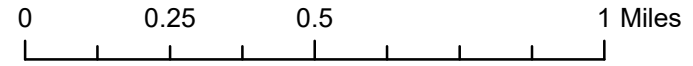
### Buccaneer Bay

- Improve Retaining Wall
- New Stormwater Facility
- Relocate Office
- Remove Tower
- Add Pavilions (6)
- Expand Splash Pool Area
- Expand Concession Building
- Relocate Tube Corral

The 2014 Master Plan also laid out a vision for the redevelopment of the waterpark activities at Buccaneer Bay. Due to project conflicts, the Buccaneer Bay concepts in the master plan will be unable to be implemented in full. A project to improve the retaining wall around the springhead is in the process of being implemented, and the project will include a new stormwater facility north of the slides and existing concession building.



# Weeki Wachee Springs State Park Conceptual Land Use Plan (CLUP) Map



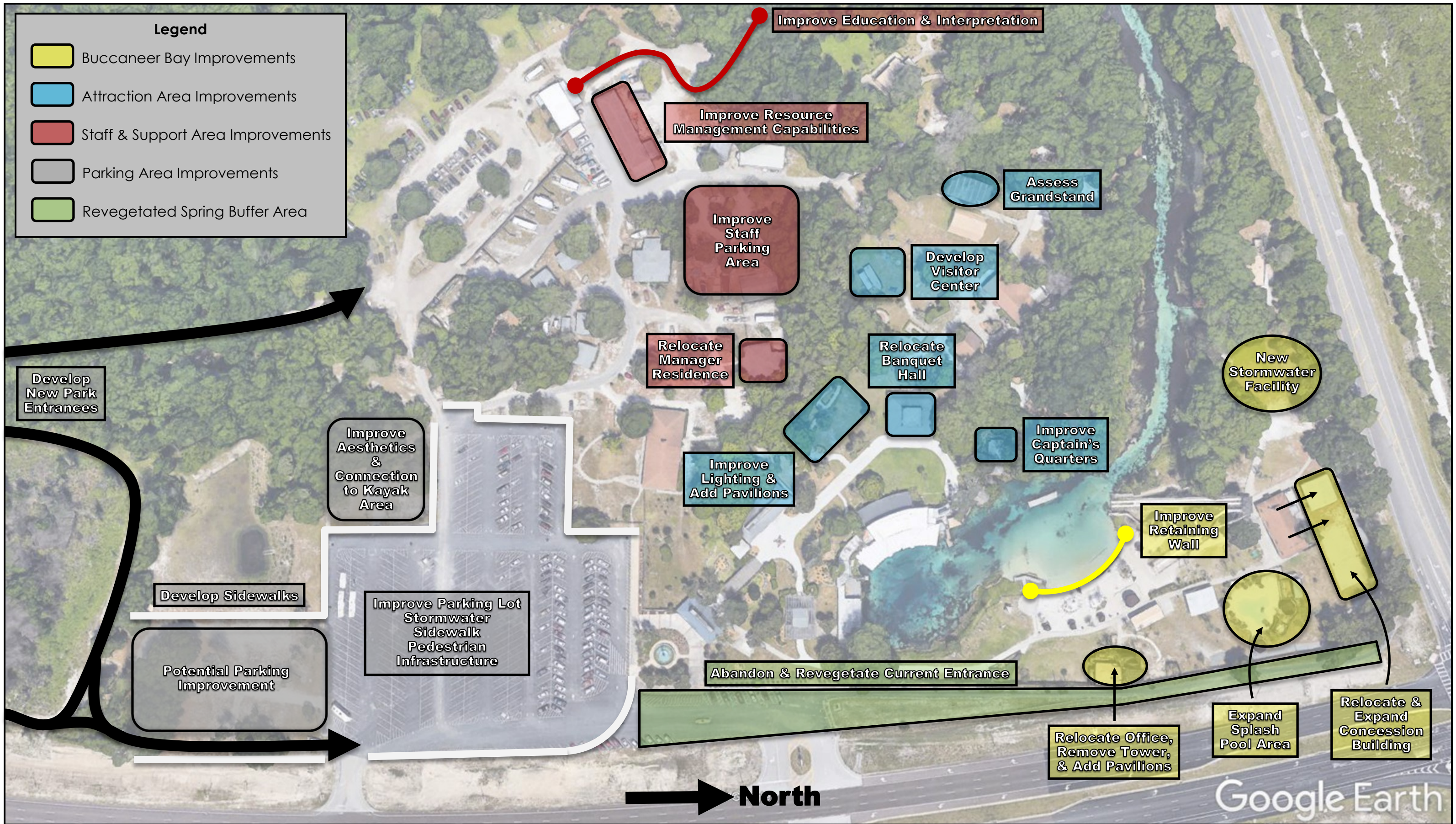


# Weeki Wachee Springs State Park Conceptual Land Use Plan (CLUP) Map — Page 2

## Future Capital Improvement Projects — Ten-Year Planning Period

\*Intended for planning purposes and external communication

\*\*Not to scale





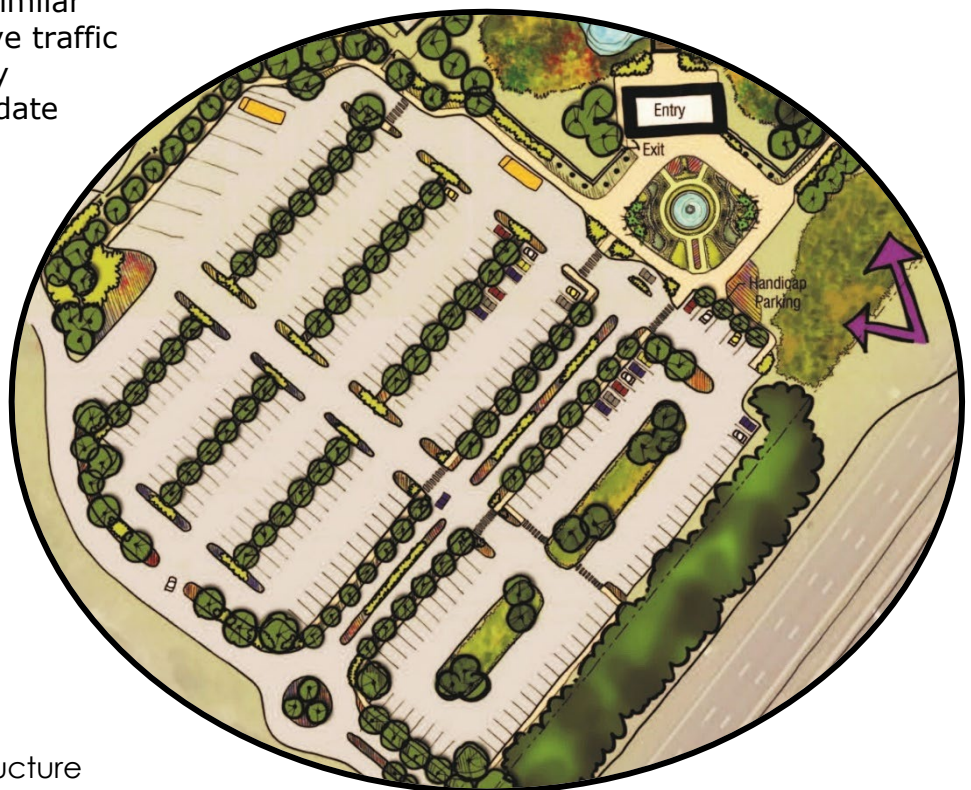
The springhead retaining wall and stormwater improvement project takes precedent over the concepts proposed in the master plan, and only development proposals expressed in this management plan update will be considered for Buccaneer Bay. In order to streamline operations and reallocate underutilized spaces, the existing concession building should be moved and expanded to replace the footprints of the existing pavilion and sand volleyball court. The new concession building will include the traditionally offered services and should also include office space to house the relocated first aid and lifeguard functions of the building adjacent to the former slide tower. Once these functions are re-established at the new concession building, the first aid building and former slide tower should be removed. Several small and medium pavilions (up to 4 and 2, respectively) are proposed to be developed in the footprints of the removed and relocated existing structures. The existing inflatable tube corral should be relocated and repurposed as a pavilion. Finally, the expansion of the splash pool area to include an additional play area should be explored. In general, the long-term vision for Buccaneer Bay is to transition toward a more resource-oriented recreational area. As stated in the previous approved UMP, the water slides at Buccaneer Bay will be maintained until it is no longer economically feasible.

### Parking Areas

- Redesign Main Parking Area
- Improve Connectivity
- Develop Sidewalks
- Redevelop Overflow Area

The main paved parking area at the park is approximately 4 acres in size and accommodates about 300 vehicles. In addition, there is an unpaved area south of the main paved parking that is used for overflow parking and can accommodate another 50 vehicles. The size of unpaved parking area is about 1.5 acres. These two parking areas service the main entrance to the park, which manages access to the attraction area and Buccaneer Bay. The current configuration of the main parking area can cause vehicle stacking issues on US 19 as drivers attempt to drop visitors off in front of the gate and creates conflict if vehicles try to navigate around stopped and waiting vehicles. The configuration, traffic flow, and design elements of the main parking area should be redesigned to accommodate a similar number of vehicles, help improve traffic circulation and pedestrian safety within the parking area, and update stormwater management green and gray infrastructure.

The graphic to the right shows a redesigned main parking area as proposed by the 2014 Master Plan. As funding is allocated, alternative parking area designs can be proposed as a part of the design and construction process. However, any alternative developed should share similar design elements and considerations.



Design elements to be considered should include a similar vehicle capacity relative to the existing parking area. The redesigned parking area should also have dedicated large bus and RV parking spaces. To improve traffic circulation, the visitor drop-off area should be separated from parking spaces and include a dedicated drop-off lane in order to minimize conflict between the visitors already parked unloading their vehicles and the visitors trying to drop off. Native vegetation and bioswales should be incorporated throughout the redesigned parking area to improve stormwater management capabilities and to create natural buffers that could potentially provide shading and reduce the heat island effect, creating a more pleasant visitor experience on hot summer days. Lastly, connectivity within the redesigned parking area and with the kayak parking area should be improved. Sightlines between the two parking areas are obstructed and need to be addressed to improve vehicle and pedestrian safety. Sidewalks and other pedestrian infrastructure should also be explored. All redesign concepts should consider how the redesigned parking area will be incorporated into the new entrance road concept, which will be discussed in further detail below.

### Support Area

- Relocate Manager Residence
- Improve Staff Parking Area
- Improve Capabilities
- Improve Kayak Launch Area

The Park Manager and Assistant Park Manager residences are both located in the park's support area, which is directly adjacent to the attraction area and main paved parking area. In order to develop additional resource management facilities and capabilities, the Park Manager residence should be relocated to a different area of the park. This will allow the structure to be repurposed for office, shop, or storage space. The staff parking area near the residence will also be improved and expanded to provide space for all staff to park in the support area, freeing up parking spaces in the main paved parking area. While not fully within the staff support area, the kayak launch for concession rentals and personal vessels is located adjacent to a privacy fence separating this recreational area from the maintenance shop. As a part of the park's visitor use management strategies, interpretive and educational amenities should be improved along the walkway to the kayak launch. This concept will be discussed further in the VUM section.

### ***Objective C: Construct 0.75 miles of road and facilities in 2 new use areas.***

The development proposals in this objective differ from the previous objective because these concepts are located in areas that are not currently developed and impacts to the natural landscape could take place. These concepts have been proposed in areas that have been determined to be areas where impacts are minimal and deemed acceptable. If these projects are funded for implementation, design alternatives will be developed, and impacts will be minimized and/or avoided to the extent possible.

### Entrance Area

- New Entrance Road
- Construct Ranger Station

Traditionally, state park units are accessed by one main park entrance and roadway that clearly delineates a transition from urban, suburban, or rural context to a natural area and creates a sense of arrival once in the park. The map on the following page illustrates possible new entrance alignments to facilitate a typical state park visitor experience and improve park ingress and egress safety.

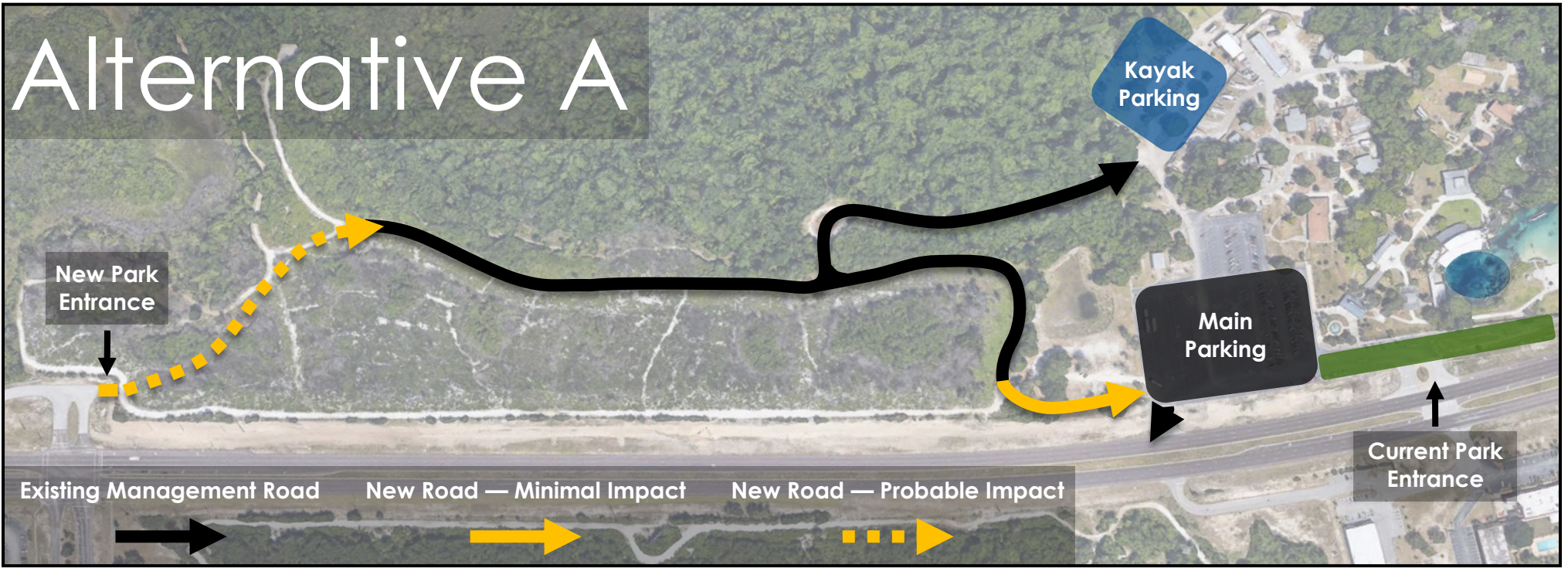




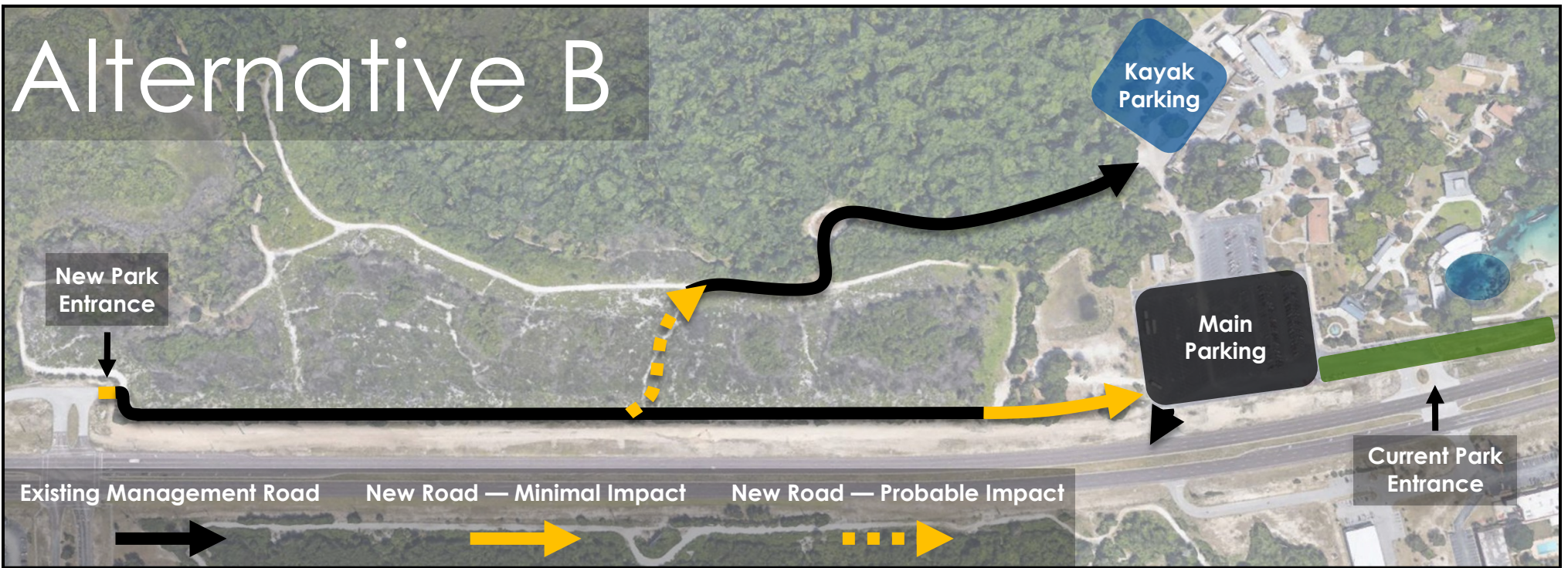
# Weeki Wachee Springs State Park Entrance Alignment Potential Alternatives

\* Intended for planning purposes only  
\*\* Other alternatives could be developed  
\*\*\* Not to scale

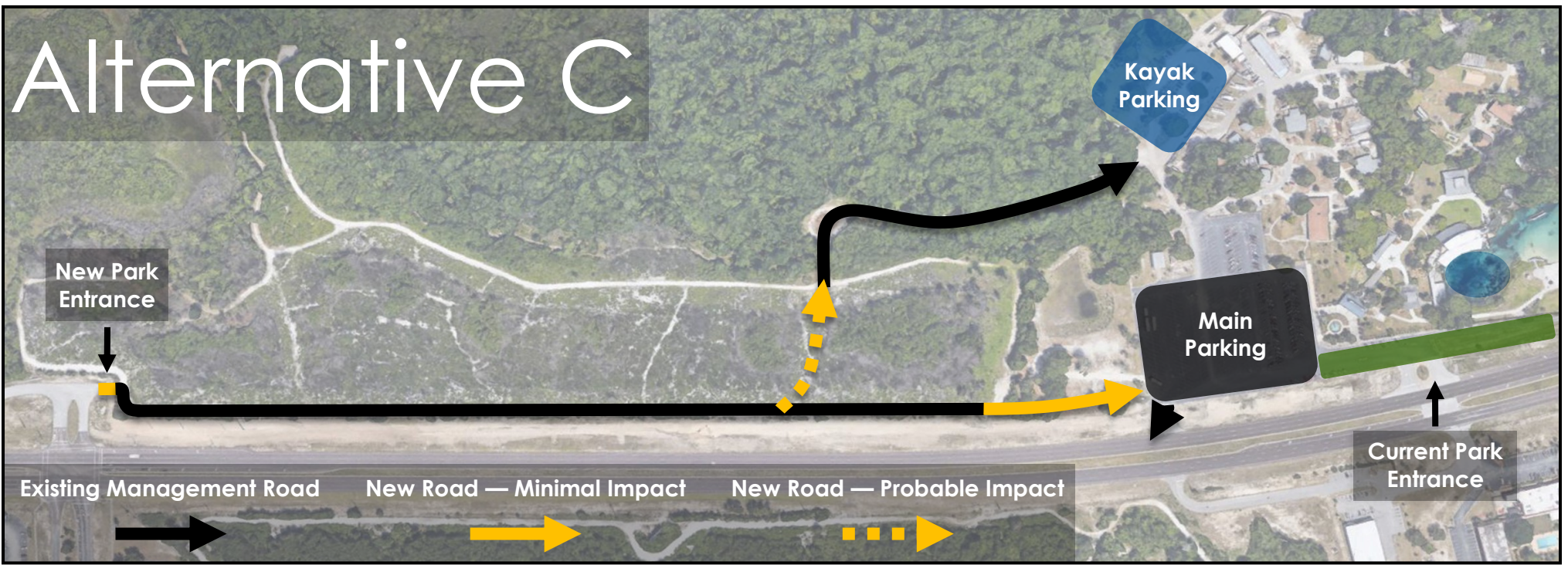
## Alternative A



## Alternative B



## Alternative C



## Alternative D





Similar to the main paved parking area redesign concept, additional alternatives can be considered as a part of the design and construction phase once funding has been allocated for the project. The entrance alternatives map is intended to showcase a range of possible options and is not necessarily intended to determine a preferred alternative. Resource impacts will need to be further analyzed and studied in-depth prior to making a final decision. However, certain goals of a new entrance road and ranger station should be considered during the design phase. The main goals of a new park entrance road are to create a traditional state park visitor experience and to develop independent entrance roads to the main paved parking area and the kayak parking area. The current entrance to the park is used by all visitors, which can cause conflicts between vehicles travelling to and from the kayak parking area and visitors in the main parking area. In addition, the current park entrance is also used as an exit and visitors travelling north on US 19 have to cross up to six lanes of traffic when exiting the park. The new entrance should improve visitor safety within in the park, as well as for vehicles leaving the park.

A four-way traffic signal currently exists at the intersection of Northcliffe Boulevard and US 19. On the west side of US 19, Northcliffe Boulevard terminates into the park boundary and turns south, creating the Beryl Road service road. The northern extension of Beryl Road also terminates into the park boundary. In addition, northbound US 19 traffic has a 400-foot left turn lane onto Northcliffe Boulevard and southbound traffic has a 350-foot right turn lane at the intersection. These roadway characteristics are perfectly suited to facilitate traffic in and out of the park in a safe and efficient manner. Moving the current entrance about 0.6 miles south on US 19 would require building new infrastructure, including an entrance/ranger station and approximately 0.75 miles of road. Existing management roads should be stabilized and/or paved for the new entrance road to the largest extent possible, and the ranger station should be sited in a location that services visitors before the road split off toward the two main parking areas. One-way roads are preferred in order to mitigate natural community impact, but two-way roads could be accommodated if narrow road widths are pursued. Natural community impacts should be carefully considered given the nearby basin marsh habitat and the scrub habitat through which the management roads traverse. The existing management road that forks toward the kayak parking area traverses through hydric hammock natural communities, likely limiting the extent to which that road could be widened and/or paved. Regarding Alternatives A-D and any other possible alignments, considerations for the visitor experience and natural community impact should be carefully weighed and balanced appropriately. For example, Alternative A may offer the most benefits in terms of the visitor experience but also represents potentially the most impact to the natural communities. On the other hand, Alternatives B-D have varying levels of minimal impact but do not provide as desirable of a visitor experience given their proximity to US 19. If funding becomes available for this concept, resource impacts should be incorporated into a cost-benefit analysis for each alternative developed.

### Residence Area

- Construct New Residence
- Add Small Storage Area

As proposed above, the Park Manager residence should be relocated from the park's main support area. The new residence should be located on the portion of the property that was recently added to the park boundary and should be sited north of the kayak concession shuttle road. To supplement resource management efforts, a small storage area should be included to help with staging prescribed fire equipment. Flammable storage facilities and a pole barn are desirable.

## Capital Facilities & Infrastructure – Estimated Costs

<b>Attraction Area</b>		<b>\$3,135,000</b>
○	<i>Add Pavilions (2)</i>	<i>\$54,000</i>
○	<i>Improve Captain's Quarters</i>	<i>\$138,000</i>
○	<i>Assess Grandstand</i>	<i>\$35,000</i>
○	<i>Develop Visitor Center</i>	<i>\$2,500,000</i>
○	<i>Relocate Banquet Hall</i>	<i>\$353,000</i>
○	<i>Develop Aesthetic Fountain</i>	<i>\$55,000</i>
<b>Buccaneer Bay</b>		<b>\$5,304,000</b>
○	<i>Improve Retaining Wall</i>	<i>\$700,000</i>
○	<i>Develop Stormwater Facility</i>	<i>\$300,000</i>
○	<i>Expand Concession Building</i>	<i>\$2,100,000</i>
○	<i>Add pavilions (6)</i>	<i>\$204,000</i>
○	<i>Expand Splash Pool</i>	<i>\$2,000,000</i>
<b>Parking Areas</b>		<b>\$924,000</b>
○	<i>Develop Parking Redesign</i>	<i>\$35,000</i>
○	<i>Redesign Main Parking Area</i>	<i>\$525,000</i>
○	<i>Plant Native Vegetation</i>	<i>\$364,000</i>
<b>Support Area</b>		<b>\$15,000</b>
○	<i>Improve Staff Parking Area</i>	<i>\$10,000</i>
○	<i>Update Interpretation</i>	<i>\$5,000</i>
<b>Entrance Area</b>		<b>\$1,068,000</b>
○	<i>Develop New Entrance Road</i>	<i>\$794,000</i>
○	<i>Construct Ranger Station</i>	<i>\$274,000</i>
<b>Residence Area</b>		<b>\$406,000</b>
○	<i>Construct Residence</i>	<i>\$373,000</i>
○	<i>Add Small Storage Area</i>	<i>\$33,000</i>
<b>Total</b>		<b>\$10,852,000</b>

## Land Acquisition and Optimum Boundary

The optimum boundary map reflects lands considered desirable for direct management by the DRP as part of the state park. These parcels may include public or privately-owned land that would improve the continuity of existing parklands, provide the most efficient boundary configuration, improve access to the park, provide additional natural and cultural resource protection, or allow for future expansion of recreational activities. Parklands that are potentially surplus to the management needs of DRP are also identified. As additional needs are identified through park use, development, and research, and as land use changes on adjacent property, modification of the park's optimum boundary may be necessary.

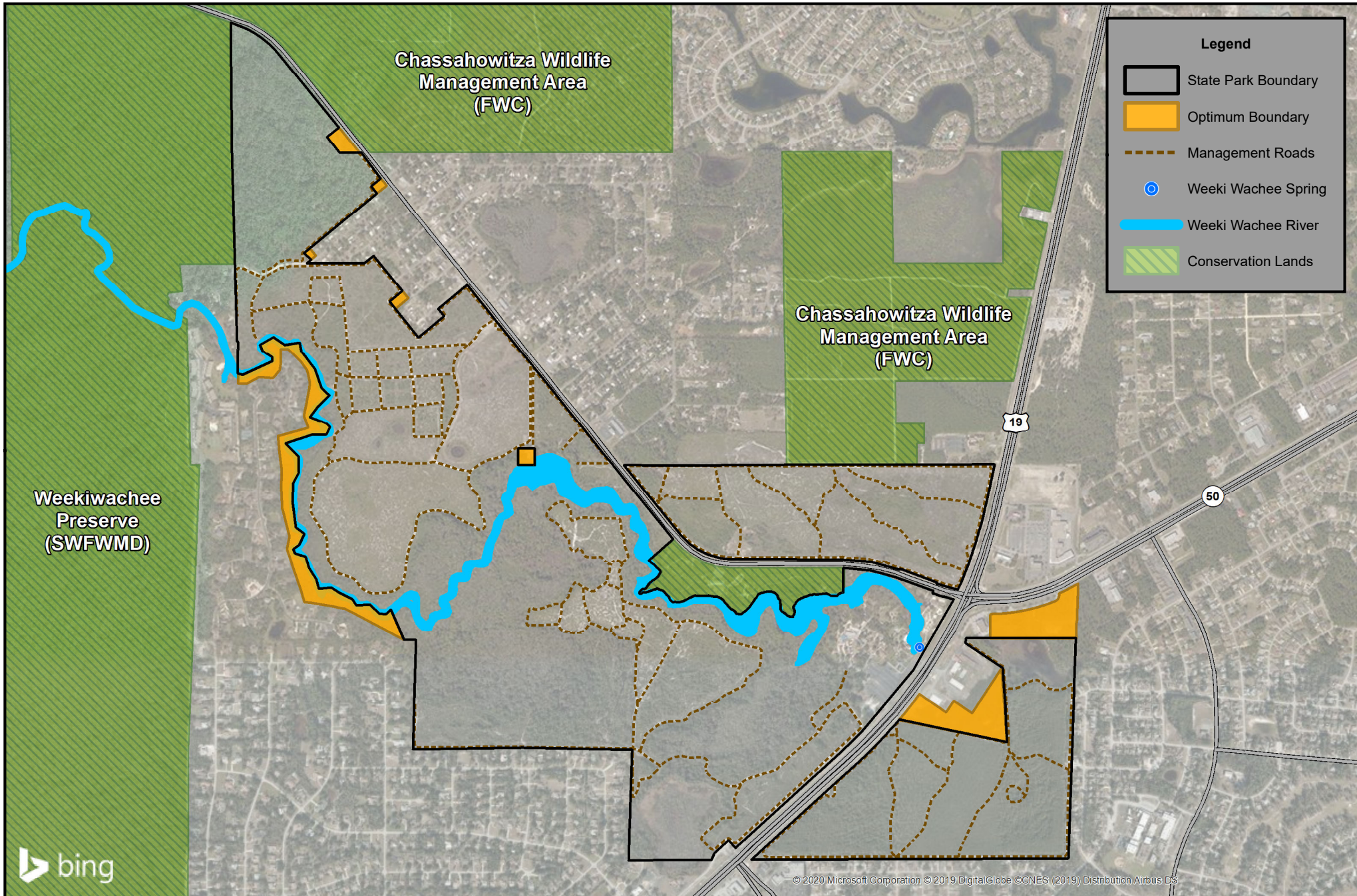
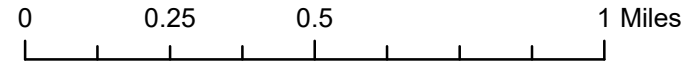
Identification of parcels on the optimum boundary map is intended solely for planning purposes. It is not to be used in connection with any regulatory purposes. Any party or governmental entity should not use a property's identification on the optimum boundary map to reduce or restrict the lawful rights of private landowners. Identification on the map does not empower or suggest that any government entity should impose additional or more restrictive environmental land use or zoning regulations. Identification should not be used as the basis for permit denial or the imposition of permit conditions.

Adjacent lands identified for the park's optimum boundary and potential acquisition include ten parcels totaling approximately 42.6 acres. Most of the parcels identified represent land acquisition opportunities to improve resource management access and expand the acreage under management authority of the DRP. One small parcel that is less than one acre in the center of the property is an inholding, and the DRP routinely seeks to acquire inholdings to improve operational management capabilities for park staff. The largest of the parcels identified is about 19 acres and is owned by the Waters of Weeki Wachee Property Owners Association. Acquisition of this parcel would extend the areas on the Weeki Wachee River in which the DRP can legally enforce Florida Administrative Code (FAC) 62-D rules and regulations. Currently, the areas on the river where the DRP can legally enforce FAC 62-D are only the areas where the DRP has management authority of the uplands on both sides of the river. The recent addition of property into the park boundary extended the management authority of DRP further downriver, but that legal authority now stops at the area where the DRP only manages the northern and eastern bank of the river. Adding this parcel would allow the park to extend its management authority on the river to where the new park boundary ends.

At this time, there are no lands within the park boundary that are identified as surplus to the management needs of the park. Lands considered for surplus will be re-evaluated during the next management plan update process.



# Weeki Wachee Springs State Park Optimum Boundary Map



**Legend**

- State Park Boundary
- Optimum Boundary
- Management Roads
- Weeki Wachee Spring
- Weeki Wachee River
- Conservation Lands



# **Visitor Use Management**

The mission of the Florida Park Service directs staff to maintain an appropriate and proportional balance between recreational use and resource protection. The inherent challenge in achieving this mission is highlighted by growing public concern over potential resource impacts from popular recreational activities at many state parks. Previous attempts to manage visitor capacity at state parks were borrowed from the biological sciences and the concept of ecological carrying capacity. The DRP adapted this concept and developed recreational carrying capacity guidelines that were based on the recreational suitability of a given natural community, the type of recreational activity, the square footage associated with the activity, and the personal space needed to achieve a desirable visitor experience. Using this information, an optimal number of visitors per activity was calculated and identified in state park management plans.

In order to improve visitor capacity guidelines, the DRP researched alternative visitor management strategies and a new management strategy was adopted. This new Visitor Use Management (VUM) strategy is intended to provide guidelines for park staff to adaptively manage appropriate visitor capacities and quality visitor experiences while preserving natural and cultural resources. The Visitor Use Management Framework developed by the Federal Interagency Visitor Use Management Council was used as the guiding framework for DRP's VUM strategy. The Weeki Wachee Natural System Carrying Capacity Study (referred to as the Carrying Capacity Study) commissioned by SWFWMD and Hernando County has been carefully considered, and the overall goals and objectives of the park's VUM strategy have been significantly influenced by the results of the study.

## **Purpose of VUM**

The purpose of the Weeki Wachee Springs State Park VUM strategy is to identify potential management actions to address visitor capacity issues at the park. Over the past ten years, paddling the Weeki Wachee River has exploded in popularity and visitors from around the country and world travel to the park for the opportunity to experience this unique resource. In addition, the first magnitude spring and world-renowned underwater mermaid performances attract visitors to the main day use areas. The park's popularity has seen attendance grow from 147,000 visitors in 2010 to its peak of nearly 419,000 visitors in 2016 and down to about 285,000 visitors in 2019. Major repair and renovation projects were implemented between 2018-2019, and it can be expected that attendance will rebound and sustain yearly visitor attendance closer to the five-year average annual attendance of approximately 376,000 visitors per year.

While the attraction area and Buccaneer Bay is better equipped to handle large volumes of visitation and still provide a high-quality visitor experience, the Weeki Wachee River is more sensitive to increased visitor use and susceptible to significant resource damage as a result of visitor impact. As was confirmed by the Carrying Capacity Study, the river has experienced resource degradation from visitor behavior that is not entirely linked to the total number of visitors that recreate on the river. This is one of the main reasons the traditional numerically based recreational carrying capacity is unable to achieve a desirable outcome. In this case, visitor behavior has been shown to have a direct impact to the resource, and a cap on the number of users alone cannot address the underlying cause of resource impacts.

Instead, this VUM strategy recommends addressing visitor use through a holistic approach that considers visitor capacity, behavior, and experience to inform a range of management options and responses. An emphasis will be placed on resource monitoring efforts to track and analyze visitor impacts over time. As opposed to calculating a recreational carrying capacity number for each activity at the park, the VUM strategy will be focused on tracking specific resource indicators over time and setting thresholds that signal to managers that corrective measures should be taken. In this strategy, a suite of management actions will be offered that range from increased education and improved interpretation to partial or complete restrictions of certain recreational activities. The VUM strategy sets the foundation for long-term monitoring efforts to help adaptively manage visitor use. However, given the results of the Carrying Capacity Study, proactive management actions should also be implemented in the short-term. Short and long-term objectives will be discussed below. Prior to outlining the goals and objectives of this VUM strategy, the main issues at the park will be identified and the key points of the Carrying Capacity Study will be summarized.

## Identification of Key Issues

Most issues that have been raised at public meetings are related to the management of the Weeki Wachee River. These issues have been categorized according to the five themes below. The concerns expressed are largely interrelated and some will require collaboration among key stakeholders and managers of the river.

- *Natural Resource Impacts*: Chief among the issues that have been both anecdotally expressed and confirmed by the Carrying Capacity Study, impacts to the submerged aquatic and emergent vegetation and erosion of the riverbanks have had a cumulative effect over years of visitor use. These impacts have been shown to be related to users docking at point bars for in-water activities and trampling vegetation.
- *Overcrowding on Busy Days*: Although overcrowding would presumably be related to resource impact, overcrowding may have a larger impact on a visitor's experience while on the river. Many busy days throughout the year attract visitors seeking a social and group experience and could discourage use by visitors in search of a serene and tranquil experience.
- *Perceived Lack of Paddling Experience*: One of the main issues raised by local residents is the perceived lack of paddling experience by visitors to the state park. This undereducation on proper paddling techniques can lead to conflicts between users and could exacerbate resource impacts. Inexperienced paddlers may also understand less about the sensitive habitat associated with the river.
- *Vessel and User Conflicts*: In addition to varying levels of paddling experience, the number of vessels and users on the river at given times during the busy season can cause conflicts not only with other paddlers but also with motorized boats that share recreational access to the river. These conflicts can cause an impact to river resources, as well as diminish the visitor experience.
- *Multiple Access Points*: Compounding the complexity of issues on the river, users can access the river from multiple locations including private homes, private businesses, private parks, county parks, and the state park. Respecting the lawful enjoyment of the river by property owners must be carefully considered alongside enforcement and user education efforts conducted by local, regional, and state jurisdictions.



## Weeki Wachee Natural System Carrying Capacity Study

Between June 2018 and June 2019, Wood Environment and Infrastructure Solutions, Inc. conducted the data gathering and analysis process for the Carrying Capacity Study. According to Wood (2020), "The intention of the study was not to set a specific value of vessels or users allowed on the river, but to collect and analyze data that relates human use to water quality, hydrologic, geomorphic, or ecological degradation of the river". The study area spanned from the headspring at Weeki Wachee Springs State Park to Rogers Park. In order to frame the study, the river was segmented by similar characteristics into four Functional Process Zones (FPZ), and four monitoring stations were selected in each FPZ in areas that could be representative of overall activity within the given FPZ. A fifth monitoring station was added for five of the nine field sampling dates after a lightning strike knocked over a tree frequently used for rope swinging. Wood staff collected observational data, social surveys, and water samples on the nine field sampling dates to the right. Video cameras and water quality data collectors were deployed for two weeks at a time at each monitoring station, and the equipment was deployed six times over the course of the study. An experimental trampling assessment, comparative spring-run assessment, and turbidity trend analysis was also conducted as a part of the final study. The entire Carrying Capacity Study can be found in Addendum 9.

The main component of the Carrying Capacity Study that informs this VUM strategy is the assessment of recreational use on the river. It was shown that the majority (87%) of users were kayaking on the river, and although the number of kayaks (vessels) is correlated with an increase in turbidity, the number of vessels alone cannot be attributed to the resource damage shown in the two images below. The images show the same point bar in the river in 2008 and 2017. The image from 2008 represents a relatively healthy, ecologically intact point bar. Over years of use, the cumulative effect of users docking their vessels and trampling the vegetation has significantly impacted the point bars, as shown in the 2017 image. A key takeaway by the DRP is that while a restriction on the number of users allowed to access the river could certainly help reduce the probability of resource impacts, a capacity limit alone cannot address resource impacts if docking and in-water activities are not sufficiently addressed.

### Equipment Deployment

- June 29 - July 16, 2018
- Aug. 28 - Sept. 17, 2018
- Dec. 5 - Dec 19, 2018
- Feb. 6 - Feb. 19, 2019
- April 10 - April 24, 2019
- May 22 - June 5, 2019

### Field Sampling Dates

- July 5, 2018
- Aug. 7, 2018
- Sept. 3, 2018
- Oct. 2, 2018
- Dec. 19, 2018
- Feb. 19, 2019
- April 24, 2019
- May 27, 2019
- June 23, 2019



## **Goal of VUM**

Although there will be management objectives associated with maintaining appropriate visitor use of the attraction area and Buccaneer Bay, the main goal of the park's VUM strategy is to prevent further resource degradation and sustain a high-quality visitor experience on the Weeki Wachee River. The image of the impacted point bar on the previous page is only one such example of cumulative visitor impact, and the Carrying Capacity Study identified 30 point bars with varying degrees of resource impact within or adjacent to the park boundary. A VUM strategy requires consistent resource monitoring efforts sustained over time, and the point bars identified by the Carrying Capacity Study represent areas of the river that should be monitored to determine if management actions are improving resource conditions or if additional management measures are needed. Resource monitoring efforts will be detailed in the VUM components section.

In addition to regularly documenting resource conditions, it is also important to track visitor satisfaction to ensure that the desirable visitor experience is consistently achieved. Acknowledging that visitor experience parameters are inherently subjective, it should be noted that the visitor experience zones to be established for the park are intended to be generalized characterizations that inform visitors and managers on the type of experience that should be expected when recreating in certain areas of the park. These zones are effective in contrasting different use areas within the park and creating distinctions between the different types of experiences that should be promoted. The desired visitor experience for various areas of the park will be coupled with resource monitoring efforts to develop visitor use and capacity guidelines for this VUM strategy.

## **Visitor Experience Zones**

In order to maintain a satisfactory visitor experience, it is important to determine the type of experience that is desired within different areas throughout the park. Visitor experience zones (VEZ) are a series of geographic designations that will help guide visitor use and experience expectations in different areas of a state park. These designations allow the DRP to improve communication with stakeholders on the desired visitor experience within areas of the park and help preserve a diversity of recreational opportunities. The VEZ designations can also help guide management of appropriate visitor capacities based on the desired visitor experience for each designation. The following designations are used for Weeki Wachee Springs State Park (see VEZ Map).

### **Developed**

The developed areas include the large majority of day use and support areas within parks. Recreation infrastructure, including parking, roads, walking paths, and picnic areas are mostly paved and provide a level of visitor comfort most commonly associated with conventional day use activities. Landscapes are mostly altered and include native vegetation in a modified natural setting that allows recreational activities to take place in largely open spaces. Socialization within and outside groups is typical, and the presence of other visitors is expected. Areas designated as developed are usually the most visited areas within parks, and a high concentration of visitors should be expected. This designation typically incorporates a primarily vehicle-oriented site layout with substantial parking and meandering roads. There is an obvious and highly visible management presence throughout the visitor areas with groupings of support buildings separated from the main visitor use areas.

## **Natural**

The natural designation is most often associated with a scenic transportation or activity corridor. It is the area that characterizes the experience of the visitor while traveling between use areas. Natural areas may also transition into fully undeveloped areas. Most park visitors will experience this setting from a vehicle travelling to a use area along a park road. These areas can be used as multi-modal corridors where visitors recreate in the roadway or on shared-use paths alongside vehicles travelling to a park's various use areas. The presence of others is expected and tolerated, although the density of visitors is much less than would be expected in areas designated as developed. Most visitor activities are limited to passive day use recreational opportunities such as hiking, biking, paddling, and wildlife viewing. Recreational amenities in natural areas are typically linear trails and/or observation areas that facilitate active physical activities and confine recreation to discrete areas to minimize wider impacts to natural resources. Occasional support facilities are found in the natural area, and unpaved management roads can be found in these areas for access to undeveloped areas that undergo resource management activities.

## **River Corridor**

The river corridor designation was established specifically for Weeki Wachee Springs State Park. On the spectrum of desired visitor experiences, the river corridor designation falls between the developed and natural designations. It shares similarities with both designations in that the river corridor is a linear paddling trail that confines visitors to a discrete recreational area while inviting high levels of recreational use, including social and interpretive experiences. In other words, the river corridor receives forms of visitation associated with areas designated as developed but has characteristics more closely associated with natural areas. The key distinction that should be made with the developed designation is the river corridor is not equipped from an ecological perspective to handle the levels of visitation that are designated for developed areas. Desired visitor experiences for the river corridor range from a wilderness experience that can be enjoyed by individuals or small groups throughout the weekdays to a more social and interpretive experience that allows higher recreational use on the weekends. All desired experiences prioritize the ecological sensitivities of the river's natural resources.

## **Undeveloped**

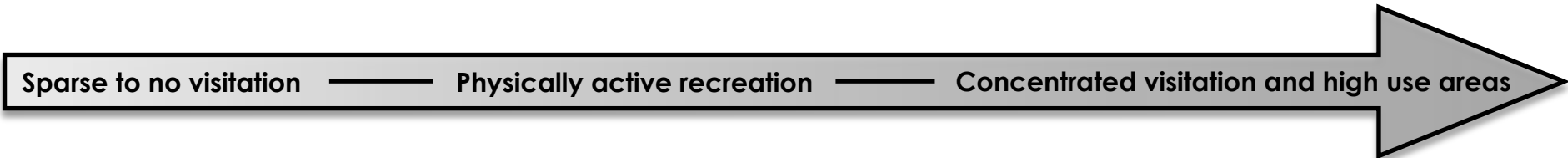
A sense of tranquility and immersion in nature are the desired experiences for the undeveloped designation. The opportunity to experience a mostly undisturbed area with little human imprint and feel senses of challenge, adventure, risk, and minimalism are all important characteristics of the undeveloped designation. This is where longer distance hiking trails, primitive camping, and wildlife viewing opportunities are located. Undeveloped areas have very limited to no recreational development or amenities, with development footprints minimized to unpaved roads and firebreaks used for resource management activities. Priority is given to creating an austere and rustic visitor experience. There is little evidence of visitor presence with a leave no trace policy promoted. Given the effort and advanced preparation required to experience these areas, it can be expected that undeveloped areas will be visited most frequently by nature enthusiasts and more experienced outdoor recreationists. Smaller acreage parks will likely offer hiking and/or wildlife viewing opportunities in these areas, as opposed to larger parks that may offer primitive tent-camping in these areas.



# Weeki Wachee Springs State Park Visitor Experience Zones (VEZ) Designations

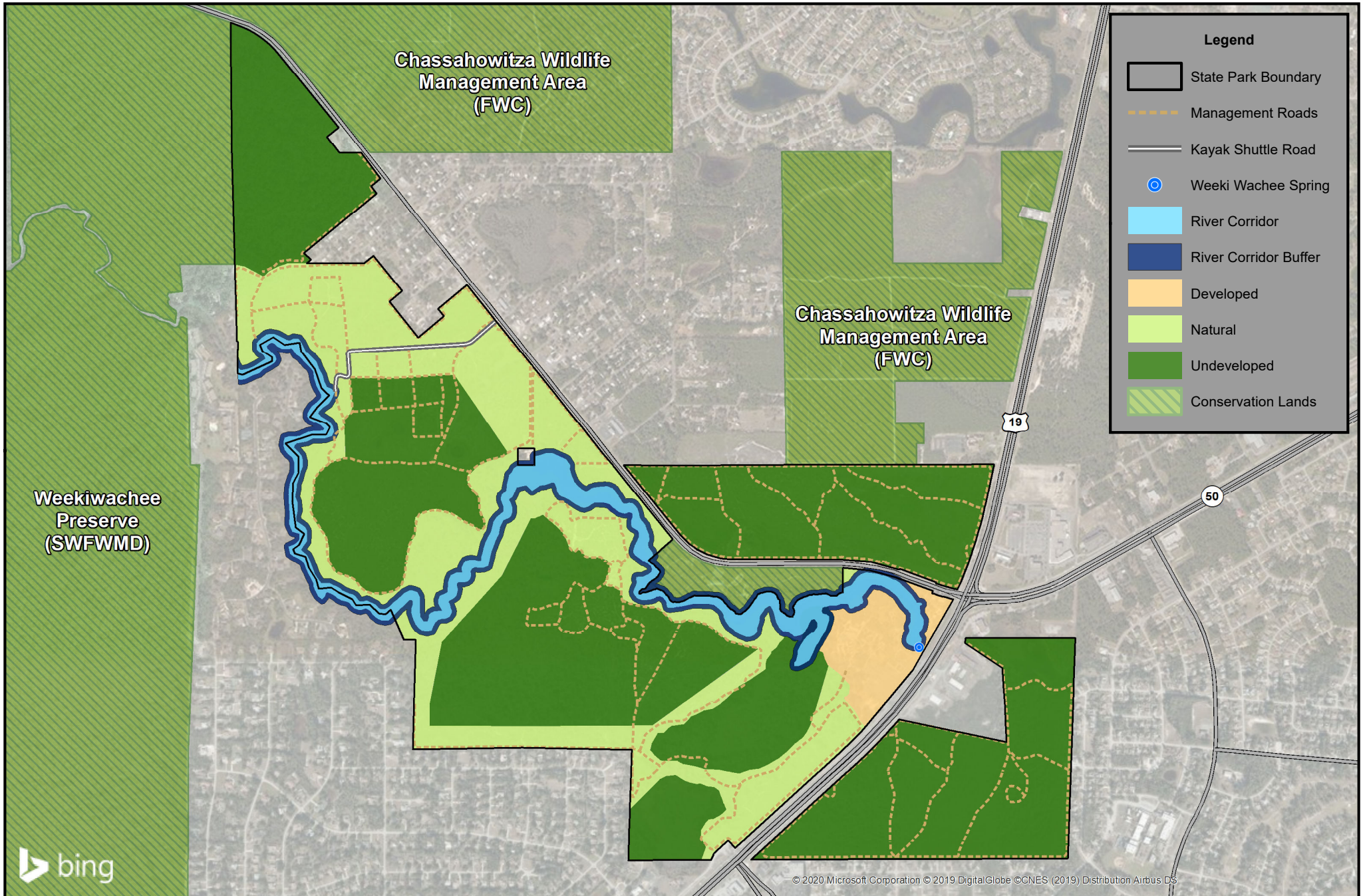
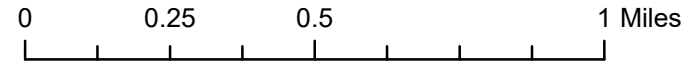
\*Park images as representative examples

Wilderness	Undeveloped	Natural	River Corridor	Developed	Urban
					
Kissimmee Prairie	O'Leno	Wakulla Springs	Weeki Wachee	Faver-Dykes	Silver Springs
<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Undisturbed</li> <li>* Solitude</li> <li>* Isolated</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Permit-based</li> <li>* Primitive camps</li> <li>* Long hikes</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Limited access</li> <li>* Self-reliance</li> <li>* Low use areas</li> </ul>	<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Tranquil</li> <li>* Minimalism</li> <li>* Challenging</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Hiking/biking</li> <li>* Wildlife viewing</li> <li>* Primitive camps</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Immersive</li> <li>* Leave no trace</li> <li>* Low use areas</li> </ul>	<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Connectivity</li> <li>* Multi-modal</li> <li>* Curated</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Road biking</li> <li>* Fitness walking</li> <li>* Hiking</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Exercise/fitness</li> <li>* Multi-use</li> <li>* Low-mid use</li> </ul>	<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Sensitive</li> <li>* Ecological</li> <li>* Unique</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Paddling</li> <li>* Boat tours</li> <li>* Wildlife viewing</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Nature-based</li> <li>* Social activity</li> <li>* Mid-high use</li> </ul>	<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Central</li> <li>* Slightly altered</li> <li>* Group-based</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Picnicking</li> <li>* RV Camping</li> <li>* Interpretation</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Family friendly</li> <li>* Park quality</li> <li>* High use areas</li> </ul>	<p><b><u>Characteristics</u></b></p> <ul style="list-style-type: none"> <li>* Densely built</li> <li>* Impervious</li> <li>* Concentrated</li> </ul> <p><b><u>Recreation</u></b></p> <ul style="list-style-type: none"> <li>* Attractions</li> <li>* Restaurants</li> <li>* Lodging</li> </ul> <p><b><u>Experience</u></b></p> <ul style="list-style-type: none"> <li>* Park-specific</li> <li>* Concessions</li> <li>* High use areas</li> </ul>





# Weeki Wachee Springs State Park Visitor Experience Zones (VEZ) Map



**Legend**

- State Park Boundary
- Management Roads
- Kayak Shuttle Road
- Weeki Wachee Spring
- River Corridor
- River Corridor Buffer
- Developed
- Natural
- Undeveloped
- Conservation Lands



## Key Components of VUM

It has been observed and documented that as a result of years of cumulative user impact, the Weeki Wachee River has experienced significant resource degradation. There is evidence that a majority, if not all, of the resource impacts observed on the river can be attributed to in-water user activity. State Park rules require that visitors remain in their vessels while on the river, but as shown by the Carrying Capacity Study, the observed resource impacts are related to in-water activities when users dock their vessels at point bars and trample the submerged and emergent vegetation. These trampled areas become sandy beach point bars, which invites further impactful usage and creates destination points for river users. In order to achieve the overall goal of this VUM strategy, monitoring efforts will be established to track the conditions of point bars on the river to help managers determine if conditions are improving or if additional management actions are required. In addition to resource monitoring, objectives will be proposed to improve education and encourage rule compliance on the river. Four key components of this VUM strategy include:

- Determine the **CURRENT CONDITIONS** of the areas to be monitored
- Select **INDICATORS** that will represent improving or declining conditions
- Identify **MANAGEMENT ACTIONS** directed at influencing user behavior
- Implement **MONITORING** program to determine if further action is needed

## Current Conditions

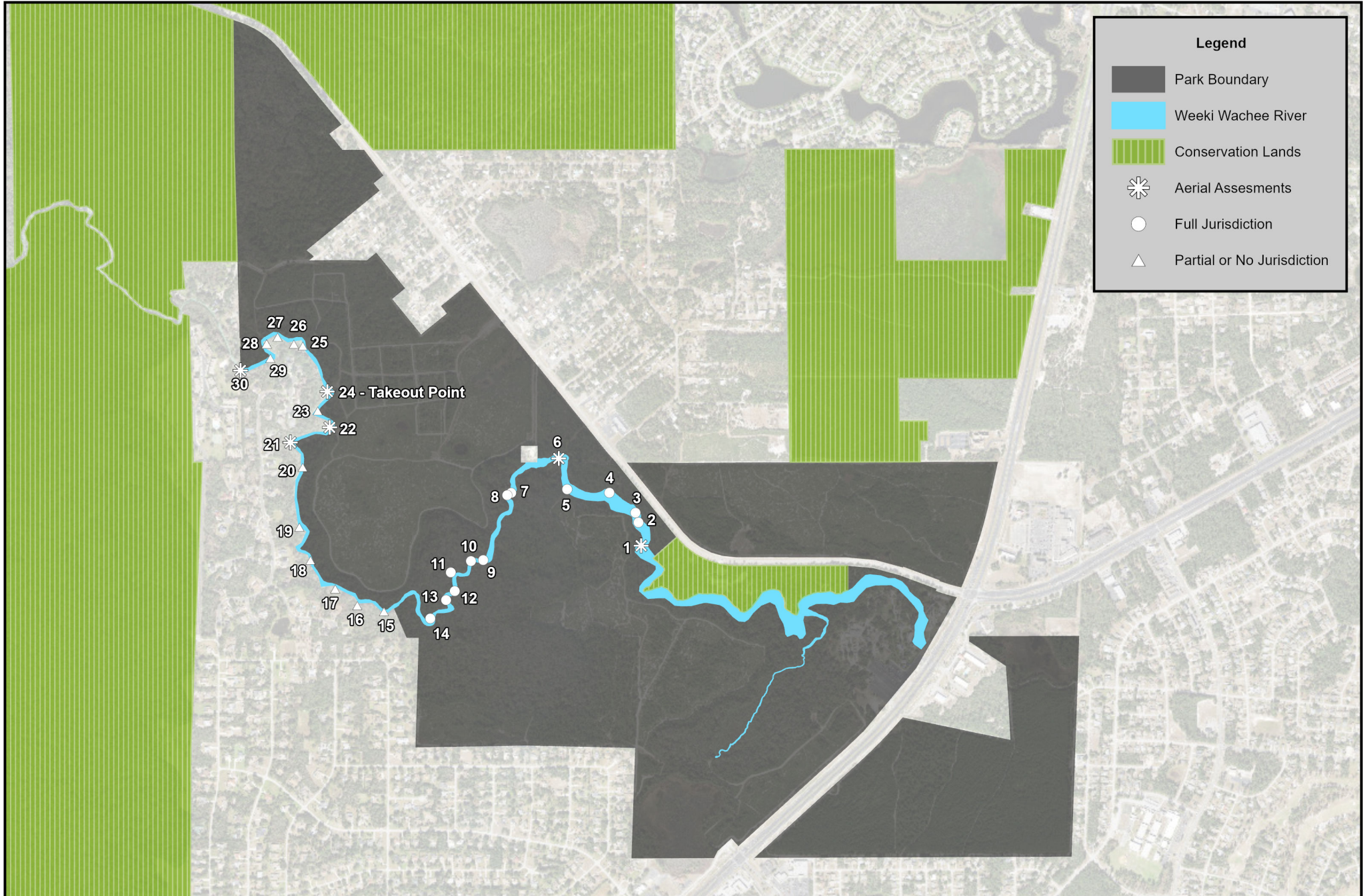
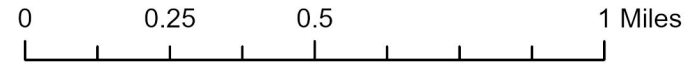
The Carrying Capacity Study identified a total of 34 impacted point bars along the river within the study area. Among the 34 points bars, 30 are within or adjacent to the park boundary. This is an important distinction that will be discussed in the Objectives section. The Carrying Capacity Study also conducted a point bar assessment that involved interpreting historical aerial imagery from 2008 to 2017 and calculating an estimated loss of vegetation over the past decade. Six point bars with the clearest aerial imagery were selected, one of which is now the site associated with the new kayak takeout point. The table below summarizes the Carrying Capacity Study’s findings. Point Bar 1 is the same point bar shown in the images in the Carrying Capacity Study section above, and Point Bar 24 is on the opposite side of the river from the new kayak takeout point. Establishing an increased staff and management presence at the new kayak takeout point should work to discourage docking and in-water activities at this point bar. The data shown below represents the baseline conditions of the point bars. All of these point bars will be monitored over the course of this plan to help managers determine the effectiveness of management actions.

**Table 8. Point Bar Aerial Assessment – Vegetation Loss in Square Feet**

Point Bar	PB 1	PB 6	PB 21	PB 22	PB 24	PB 30
<b>2008 Aerial</b>	7,031 ft <sup>2</sup>	11,661 ft <sup>2</sup>	7,493 ft <sup>2</sup>	8,508 ft <sup>2</sup>	7,012 ft <sup>2</sup>	3,213 ft <sup>2</sup>
<b>2017 Aerial</b>	5,337 ft <sup>2</sup>	10,603 ft <sup>2</sup>	6,063 ft <sup>2</sup>	7,008 ft <sup>2</sup>	6,201 ft <sup>2</sup>	2,237 ft <sup>2</sup>
<b>Net Loss</b>	<b>1,694 ft<sup>2</sup></b>	<b>1,058 ft<sup>2</sup></b>	<b>1,430 ft<sup>2</sup></b>	<b>1,500 ft<sup>2</sup></b>	<b>811 ft<sup>2</sup></b>	<b>976 ft<sup>2</sup></b>
<b>Percent Loss</b>	<b>-24%</b>	<b>-9%</b>	<b>-19%</b>	<b>-18%</b>	<b>-11%</b>	<b>-30%</b>



# Weeki Wachee Springs State Park Point Bar Map



## Indicators

The six point bars that will be selected for long-term monitoring are intended to be representative samples that demonstrate the effectiveness of management actions on the river as a whole. Improving conditions at these six point bars will not only indicate overall resource improvement on the river, but it will also suggest that user behavior has improved and indicate that docking and in-water activities have been reduced, if not eliminated altogether. Declining conditions would indicate further resource degradation and signal to managers that user behavior has not been adequately addressed.

The main indicator associated with these monitoring efforts will be the square footage of vegetation at each point bar. Given that aerial imagery does not update as regularly as needed for this monitoring, it is recommended that monitoring is conducted with drone photography. This will require dedicated park staff or volunteers that have completed the necessary drone pilot certifications, or the images can be obtained from a third-party. Imagery and vegetation square footage data should be documented routinely and stored systematically in order to prepare publicly available condition reports.

## Management Actions

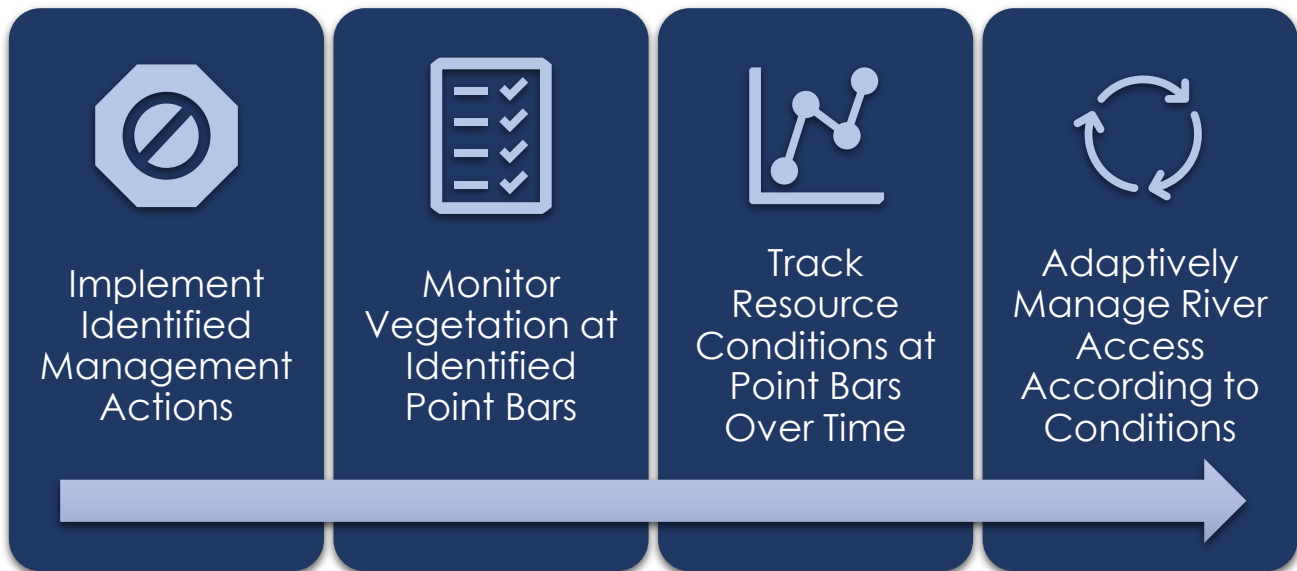
The DRP manages visitor use to sustain the quality of park resources and the visitor experience in a manner that is consistent with the purposes of the park. The dynamic nature of visitor use requires a deliberate and adaptive approach to managing resource impacts from recreational activity. To manage visitor use, the DRP will rely on a variety of management tools and strategies. The DRP will be guided by the “precautionary principle” that states if there is a threat of irreversible harm to park resources, a lack of full scientific certainty will not delay management action (Kriebel et al., 2001).

Several management actions are planned to be implemented irrespective of any further observation of user impact to the river point bars. It is expected that these management actions will help enforce existing park rules, mitigate resource impacts, and improve user behavior. Objectives that will be implemented over the long term will be discussed in the VUM Objectives section. The management actions that will be implemented in the immediate term can be classified according to three categories: user education, rule enforcement, and resource protection.

**Table 9. Management Actions**

User Education	Rule Enforcement	Resource Protection
<ul style="list-style-type: none"> <li>○ Update kayak rental information to include emphasis on existing park rules and resource protection</li> <li>○ Improve concession area to highlight resource importance and interpret user responsibilities</li> <li>○ Conduct community outreach to provide information on river protection</li> </ul>	<ul style="list-style-type: none"> <li>○ Develop park signage to demarcate the new park boundary and inform users of the rules on the river within the park boundary</li> <li>○ Continue to work with local law enforcement and FWC to monitor river activity</li> <li>○ Consider establishing game cameras at known problem areas</li> </ul>	<ul style="list-style-type: none"> <li>○ Seek approval to deploy protective barriers to block access to point bars</li> <li>○ Develop signage at impacted point bars to inform river users on the resource impact of docking and wading</li> <li>○ Explore replanting native vegetation to encourage regrowth and discourage user access</li> </ul>





## VUM Objectives

The Key Components section outlines the monitoring efforts that should be implemented over the long-term as a part of this VUM strategy. However, there are also management objectives that should be implemented immediately to work toward encouraging desirable user behavior on the river and ensuring a positive visitor experience at the park overall. Short and long-term objectives are proposed to further these efforts. The diagram above represents the order of operations for VUM at the park. Management actions will be implemented immediately, resources conditions at the point bars will be monitored over time, and access to the river will be adaptively managed.

### ***Objective A: Develop and implement monitoring protocol.***

It is recommended that six point bars (1, 6, 14, 21, 23, 30) should be monitored at least quarterly for the next ten years. Dedicated DRP/SWFWMD staff should be assigned to coordinating the monitoring efforts discussed throughout this VUM strategy, and district staff should assist where needed. Central office staff can support the park and district with database management and report production. Annual monitoring efforts should be expanded to the 14 point bars that are fully within the park boundary. While there are also 16 other point bars that are adjacent to the park boundary, the DRP does not have management authority to enforce FAC 62-D on the river in areas where the park boundary does not include the uplands on both sides of the river. The 14 point bars that are fully within the park boundary are subject to the enforcement of FAC 62-D.

### ***Objective B: Improve education and interpretation.***

One of the most effective ways to encourage appropriate user behavior on the river is through improved education and interpretation. The infrastructure around the support area and kayak launch should be improved and upgraded when funding becomes available to implement new educational and interpretive efforts. In addition, the interpretive panels along the kayak launch should be updated with a combination of attractive interpretive displays and scientific information related to the spring run habitat and protection efforts. The goal of these educational and interpretive updates is to remind visitors of the sensitivity associated with the unique natural resource and encourage users to join park staff in the protection of the river.

***Objective C: Maintain paddle launch capacities at 280 vessels per day.***

The VUM strategy discussed throughout this section is based on the adaptive management framework, which is an iterative process in which management decisions are continuously informed and improved in accordance with observed and documented resource conditions. Resource indicators are monitored, management actions are implemented when necessary, and adjustments are made as appropriate. Although the purpose of this new VUM strategy is to replace the traditional recreational carrying capacity tables found in previous UMPs, it has been deemed necessary to continue to cap the number of vessels launching from the park. This capacity objective will be subject to adaptive management by park management, and any changes will be informed and supported by the data that will be collected over the long-term.

***Objective D: Conduct or obtain biennial visitor satisfaction surveys.***

The DRP should conduct or obtain visitor satisfaction surveys at least once every two years. The purpose of the survey will be to inform management decisions on the visitor experience throughout the park and provide park staff with data to manage an ideal capacity at Buccaneer Bay and the attraction area. Unlike the observable impacts from users on the river, visitors to the main areas of the park have a negligible impact to the surrounding natural resources, and the main concern for park management should be maintaining a high-quality visitor experience. In order to better understand visitor expectations regarding an ideal experience, visitor satisfaction surveys should collect quality of experience data to be used to implement best management practices.

***Objective E: Participate in a multi-agency working group.***

The DRP fully supports the recommendation of the Carrying Capacity Study to convene a multi-agency working group to bring together the various public agencies and private stakeholders to collaboratively address issues related to the Weeki Wachee River. Representatives of the DRP will be selected to participate in the multi-agency working group and will coordinate as appropriate with leadership within the DRP.

## **Addendum 1—Acquisition History**



## Weeki Wachee Springs State Park Acquisition History

LAND ACQUISITION HISTORY REPORT					
<b>Park Name</b>	Weeki Wachee Springs State Park				
<b>County</b>	Hernando County, Florida				
<b>Leases</b>	Trustees submerged lands Lease No.270345153, Trustees Lease No. 4817, and SWFWMD Lease				
<b>Current Park Size</b>	927.3 acres				
<b>Purpose of Acquisition</b>	The Board of Trustees of the Internal Improvement Trust Fund of the State of Florida acquired the initial portion of Weeki Wachee Springs State Park, via Conservation Easement, to preserve and protect the conservation values of the property as well as its natural, scenic, historical, forested, and an open space conditions.				
Acquisition History (includes only a parcel whose acquisition acreage is 10 acres or more)					
Parcel Name or Parcel DM-ID	Date Acquired	Initial Seller	Initial Purchaser	Size in acres	Instrument Type
DMID312887	8/14/2001	The Southwest Florida Water Management District	The Board of Trustees of the internal Improvement Trust Fund of the State of Florida	131.988	Deed of Conservation Easement
DMID11623	9/22/1994	Lykes Development Corporation	The Board of Trustees of the internal Improvement Trust Fund of the State of Florida	40.029	Warranty Deed
DMID14449	12/30/1996	Suntrust Bank, Nature Coast, as Trustee of Underwood Family Trust	The Board of Trustees of the internal Improvement Trust Fund of the State of Florida	12.27	Warranty Deed
Management Lease					
Parcel Name or Lease Number	Date Leased	Initial Lessor	Initial Lessee	Current Term	Expiration Date
Sovereignty Submerged Lands Lease 270345153	11/25/2009	The Board of Trustees of the Internal Improvement Trust Fund of the State of Florida	The State of Florida Department of Environmental Protection, Division of Recreation and Parks	Twenty-Five (25) years	11/24/2034
Lease No. 4817	3/16/2018	The Board of Trustees of the Internal Improvement Trust Fund of the State of Florida	The State of Florida Department of Environmental Protection, Division of Recreation and Parks	Ten (10) years	3/15/2028
Lease Agreement with the southwest Florida Water Management District and DEP/DRP	1/12/2008	The Southwest Florida Water Management District	The State of Florida Department of Environmental Protection, Division of Recreation and Parks	Fifty (50) years	10/31/2058
Outstanding Issue	Type of Instrument	Brief Description of the Outstanding Issue		Term of the Outstanding Issue	
Restriction	Deed of Conservation Easement	According to the Deed of Conservation Easement, the grantee (in this case, the Board of Trustees of the internal Improvement Trust Fund of the State of Florida) or its successor in interest or assigns can require the grantor (in this case, the Southwest Florida Water Management District) to restore if the grantee finds the grantor is in violation of any of the terms and conditions of the easement.		In perpetuity	

# Weeki Wachee Springs State Park Acquisition History

15-770-211X

## LEASE AGREEMENT WEEKI WACHEE SPRINGS STATE PARK

This Lease is made and entered into this 1<sup>st</sup> day of November, 2008, between the GOVERNING BOARD OF THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, hereinafter referred to as the "DISTRICT", and the STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, DIVISION OF RECREATION AND PARKS, hereinafter referred to as the "LESSEE".

### WITNESSETH:

WHEREAS, DISTRICT holds title to certain lands and property located in Hernando County known as the Weekiwachee Preserve; and

WHEREAS, DISTRICT is empowered to enter into cooperative land management agreements with state agencies or local governments to provide for coordinated and cost-effective management of lands, pursuant to Section 373.1391 (4), Florida Statutes; and

WHEREAS, DISTRICT and LESSEE agree that it is in the public's interest for DISTRICT'S lands to be managed and maintained by LESSEE, in such a way to ensure balance between public access, general public recreational purposes, and restoration and protection of the land's natural state and condition in accordance with Section 373.1391, Florida Statutes; and

WHEREAS, LESSEE desires to lease DISTRICT'S lands for the public purpose of managing and maintaining Weekiwachee Preserve as the Weeki Wachee Springs State Park ("State Park").

NOW, THEREFORE, for and in consideration of the mutual covenants and agreements hereinafter contained, DISTRICT agrees to lease the below described premises to LESSEE subject to the following terms and conditions:

1. **DESCRIPTION OF PREMISES:** The property subject to this Lease is situated in the County of Hernando, State of Florida, and is more particularly described in Exhibit "A" attached hereto and hereinafter called the "Leased Premises". Unless stated otherwise, all legal descriptions and exhibits of or related to this Lease include all sovereignty lands which are located within the property described herein. The Leased Premises shall be used for the dedication and operation of the Weeki Wachee Springs State Park. A portion of the Leased Premises is subject to a conservation easement which is attached hereto as Exhibit "B" and incorporated herein by reference and LESSEE'S rights under this Lease are subject to the terms, conditions and restrictions of such conservation easement.
2. **TERM:** The term of this Lease shall be for a period of fifty (50) years, commencing on November 1, 2008, at 5:01 p.m., and ending on October 31, 2058, unless sooner terminated pursuant to the provisions of this Lease. Thereafter, this Lease is renewable, in the parties' sole discretion, in fifty-year increments, unless terminated as otherwise set forth herein. The parties' obligations under this Lease are contingent upon LESSEE taking possession of the Leased Premises and assuming the management and maintenance of the state park as contemplated herein. If LESSEE abandons the State Park or ceases to use the Leased Premises for the purposes stated herein for a period of two (2) consecutive years, then this Lease will automatically terminate.
3. **PURPOSE:** LESSEE shall manage the Leased Premises only for the conservation and protection of natural and historical resources and for public outdoor recreation that is compatible with the conservation and protection of these public lands, as set forth in subsection 259.032(11), Florida Statutes, and Section 373.59, Florida Statutes, as amended, along with other authorized uses necessary for the accomplishment of this purpose as designated in the Management Plan required by paragraph 8 of this Lease.

## Weeki Wachee Springs State Park Acquisition History

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4. **QUIET ENJOYMENT AND RIGHT OF USE:** LESSEE shall have the right of ingress and egress to, from and upon the Leased Premises for all purposes necessary to the full quiet enjoyment by LESSEE of the rights conveyed herein.

5. **AUTHORIZED USES:** Authorized uses for the purposes of this Lease shall be defined as those management activities that LESSEE is authorized to perform under this Lease and the approved Management Plan. The authorized uses shall be consistent with statutory requirements that require that the Leased Premises be managed and maintained in an environmentally acceptable manner to restore and protect in its natural state and condition, including permitting of compatible recreational use. The authorized uses shall at a minimum always include essential site management measures including, but not limited to, security, resource protection, public access and recreational use, habitat management and enhancement of land use control.

6. **A. DISTRICT'S RIGHTS:** LESSEE expressly acknowledges and agrees that DISTRICT may engage in construction activities necessary for the primary purposes of water management or water supply and that these rights are paramount and superior to the uses authorized by this Lease. In the event DISTRICT places any improvements on the Leased Premises, it will be responsible for operating and maintaining the improvements and for securing and maintaining insurance coverage on the improvements, unless the improvements are for the use and benefit of LESSEE.

**B.** DISTRICT specifically reserves the right, for its officers, employees, agents and assigns, to enter upon and travel through and across the Leased Premises that are the subject of this Lease at any time, for inspection, construction, maintenance, environmental monitoring and studies or for any purpose necessary or convenient in connection with any water or resource management activities. In the event DISTRICT places any structure on the Leased Premises, it will be responsible for the maintenance of the structure. DISTRICT will provide reasonable notice to LESSEE of any such activities prior to their commencement.

7. **UNAUTHORIZED USES:** LESSEE shall, through its agents and employees, prevent the unauthorized use of the Leased Premises or any use thereof not in conformance with approved interim management activities, this Lease, or the approved Management Plan.

8. **MANAGEMENT PLAN:** LESSEE shall prepare and submit an updated Management Plan for State Park that includes management recommendations for the Leased Premises, in accordance with Section 253.034, Florida Statutes, and Chapter 18-2, Florida Administrative Code, within twelve (12) months of the effective date of this Lease and at least every ten (10) years thereafter as required by subsection 253.034(5), Florida Statutes. The Management Plan and all future updates shall be submitted to DISTRICT for review, comment and approval. The Leased Premises shall not be developed or physically altered in any way other than what is necessary for security and maintenance of the Leased Premises without the prior written approval of DISTRICT until the Management Plan is approved. The Management Plan shall emphasize the original management concept for the Leased Premises as approved by DISTRICT at the time of acquisition which established the primary public purpose for which the Leased Premises was acquired. The approved Management Plan shall provide the basic guidance for all management activities. LESSEE shall not use or alter the Leased Premises except as provided for in the approved Management Plan without the prior written approval of DISTRICT. The Management Plan shall identify management strategies for exotic species, if present. The introduction of exotic species is prohibited, except when specifically authorized by the approved Management Plan.

# Weeki Wachee Springs State Park Acquisition History

9. RIGHT TO INSPECT:

DISTRICT or its duly authorized agents and employees shall have the right, with reasonable notice, to inspect the Leased Premises and works and operations thereon of LESSEE in any matter pertaining to this Lease.

10. INSURANCE REQUIREMENTS: LESSEE is insured through the State of Florida Department of Financial Services. LESSEE shall be financially responsible for any loss due to failure to obtain insurance coverage for any improvements or structures located on the Leased Premises which are operated and maintained by LESSEE, and LESSEE'S failure to maintain such policies shall constitute a breach of this Lease.

11. LIABILITY: LESSEE shall assist in the investigation of injury or damage claims either for or against DISTRICT or the State of Florida pertaining to LESSEE'S respective areas of responsibility under this Lease or arising out of LESSEE'S respective management programs or activities and shall contact DISTRICT regarding the legal action deemed appropriate to remedy such damage or claims. LESSEE shall maintain a program of insurance covering its liabilities as prescribed by Section 768.28, Florida Statutes, and shall be responsible for the acts or omissions of its officers, employees, servants, and agents in the event that such acts or omissions result in injury to persons or property. DISTRICT'S liability is further limited by the provisions of Section 373.1395, Florida Statutes. However, nothing in the Lease is intended or is to be construed as a waiver of sovereign immunity as provided to the parties signatory hereto under Section 768.28, Florida Statutes, or as otherwise provided by law.

12. ARCHAEOLOGICAL AND HISTORIC SITES: Execution of this Lease in no way affects any of the parties' obligations pursuant to Chapter 267, Florida Statutes. The collection of artifacts or the disturbance of archaeological and historic sites on the Leased Premises is prohibited unless prior authorization has been obtained from the State of Florida Department of State, Division of Historical Resources. The Management Plan shall be reviewed by the Division of Historical Resources to insure that adequate measures have been planned to locate, identify, protect and preserve the archaeological and historic sites and properties on the Leased Premises.

13. EASEMENTS: All easements including, but not limited to, utility easements are expressly prohibited without the prior written approval of DISTRICT. Any easement not in effect at the time of the Lease, or not approved in writing by DISTRICT, shall be void and without legal effect.

14. SUBLEASES: This Lease is for the purposes specified herein and subleases of any nature are prohibited, without the prior written approval of DISTRICT. Any sublease not approved in writing by DISTRICT, shall be void and without legal effect.

15. SURRENDER OF LEASED PREMISES: Upon termination or expiration of this Lease, LESSEE shall surrender the Leased Premises to DISTRICT. In the event no further use of the Leased Premises or any part thereof is needed, written notification shall be made to DISTRICT at least one (1) year prior to the release of all or any part of the Leased Premises. Notification shall include a legal description, this Lease and parcel number, and an explanation of the release. Upon termination of this Lease, all improvements, including both physical structures and modifications to the Leased Premises deemed by LESSEE and DISTRICT as "permanent" shall become the property of DISTRICT. All improvements, including both physical structures and modifications to the Leased Premises deemed by LESSEE and



## Weeki Wachee Springs State Park Acquisition History

DISTRICT to be "temporary" shall be removed at the discretion of DISTRICT and expense of LESSEE. DISTRICT shall give written notice to LESSEE of its intent to remove such temporary improvements prior to the termination of this Lease. The remaining improvements shall become the property of DISTRICT, unless DISTRICT gives written notice to LESSEE to remove any or all such "temporary" improvements at the expense of LESSEE. Prior to surrender of all or any part of the Leased Premises, DISTRICT'S representative(s) shall perform an onsite inspection and the keys to any buildings or gates on the Leased Premises shall be turned over to DISTRICT. If the Leased Premises and improvements located thereon do not meet all conditions set forth in paragraph 22 herein, LESSEE shall pay all costs necessary to meet the prescribed conditions.

16. BEST MANAGEMENT PRACTICES: LESSEE shall implement applicable Best Management Practices for all activities conducted under this Lease in compliance with paragraph 18-2.018(2)(h), Florida Administrative Code, which have been selected, developed, or approved by DISTRICT, LESSEE, or other land managing agencies for the protection and enhancement of the Leased Premises.

17. PUBLIC LANDS ARTHROPOD CONTROL PLAN: LESSEE shall identify and subsequently designate to the respective arthropod control district or districts within one (1) year of the effective date of this Lease all of the environmentally sensitive and biologically highly productive lands contained within the Leased Premises, in accordance with Section 388.4111, Florida Statutes, and Chapter 6E-13, Florida Administrative Code, for the purpose of obtaining a public lands arthropod control plan for such lands.

18. ORIGINALS: This Lease is executed in two (2) originals, each of which shall be considered an original for all purposes.

19. UTILITY FEES: LESSEE shall be responsible for the payment of all charges for the furnishing of gas, electricity, water and other public utilities to the Leased Premises and for having all utilities turned off when the Leased Premises are surrendered.

20. ASSIGNMENT: This Lease shall not be assigned in whole or in part nor shall control of the facilities be assigned, sold or changed without the prior written approval of DISTRICT. Any assignment or change of control made either in whole or in part without the prior written consent of DISTRICT shall be void and without legal effect.

21. PLACEMENT AND REMOVAL OF IMPROVEMENTS: All buildings, structures, and improvements shall be constructed at the expense of LESSEE in accordance with plans prepared by professional designers. Removable equipment and removable improvements placed on the Leased Premises shall remain the property of LESSEE and may be removed by LESSEE upon termination of this Lease.

22. OPERATION AND MAINTENANCE OF LEASED PREMISES AND IMPROVEMENTS: LESSEE shall maintain the real property contained within the Leased Premises and any improvements located thereon, in a state of good condition, working order and repair including, but not limited to, keeping the Leased Premises free of trash or litter, and maintaining all planned improvements as set forth in the Management Plan. All costs for operation and maintenance of the Leased Premises and improvements, except those constructed or placed upon the Leased Premises by DISTRICT, shall be at the sole cost and expense of LESSEE.

# Weeki Wachee Springs State Park Acquisition History

23. OBLIGATION TO PAY: LESSEE'S AND THE STATE OF FLORIDA'S PERFORMANCE AND OBLIGATION TO PAY UNDER THIS LEASE AGREEMENT IS CONTINGENT UPON AN ANNUAL APPROPRIATION BY THE LEGISLATURE.

24. REPORTS: LESSEE will provide DISTRICT with copies of any and all reports, models, studies, maps, videos or other documents relating to the Leased Premises.

25. ENTIRE UNDERSTANDING: This Lease sets forth the entire understanding between the parties and shall only be amended with the prior written approval of all parties.

26. DEFAULT BY LESSEE AND TERMINATION BY DISTRICT: DISTRICT may terminate this Lease if LESSEE violates the terms of this Lease. Lease violations shall include the following:

- A. LESSEE fails to submit a Management Plan in accordance with the terms of this Lease, or
- B. LESSEE fails to implement or complete the actions, tasks or other aspects of the Management Plan for essential site management, subject to the provisions of Paragraph 23 herein, or
- C. LESSEE constructs any permanent structures or other improvements that have not been authorized by DISTRICT, either directly or indirectly through the approval of the Management Plan, or
- D. LESSEE destructs or degrades natural systems, rare or endangered habitats that are targeted for preservation, or
- E. LESSEE violates federal, state or local laws, rules, regulations, or ordinances, or
- F. LESSEE causes the Leased Premises to be contaminated with hazardous wastes or other pollutants or fails to properly secure the Leased Premises to prevent or impede illegal dumping or degradation of natural habitats, or other unauthorized uses, or
- G. LESSEE fails to comply with the other terms of this Lease.

27. VIOLATIONS: If DISTRICT, in its sole opinion, finds that LESSEE has committed a violation of this Lease, DISTRICT will notify LESSEE in writing as to the nature of the violation and shall direct LESSEE on how LESSEE is to proceed to remedy, resolve, or rectify the Lease violation. LESSEE will have sixty (60) days from the receipt of the notification in which to perform the following:

- A. Proceed in a manner or provide a schedule for the prompt implementation of corrective action, or
- B. Advise DISTRICT how LESSEE will implement its own corrective action, including a schedule for completion, provided it addresses the Lease violation.

If LESSEE fails to respond to DISTRICT'S notification regarding a Lease violation or fails to implement corrective action, LESSEE will be in default of this Lease and DISTRICT may, at its sole option, terminate this Lease and recover from LESSEE all damages DISTRICT may incur by reason of the default, including, but not limited to, the cost of recovering the Leased Premises, or maintain this Lease in full force and effect and exercise all rights and remedies herein conferred upon DISTRICT.

28. NO WAIVER OF DEFAULT: The failure of DISTRICT to insist in any one or more instances upon strict performance of any one or more of the terms and conditions of this Lease shall not be construed as a waiver of such terms and conditions, but the same shall continue in full force and effect, and no waiver by DISTRICT of any one of the provisions hereof shall in any event be deemed to have been made unless the waiver is set forth in writing and signed by DISTRICT.

29. TERMINATION: LESSEE or DISTRICT, may terminate this Lease for convenience by giving one (1) year notice in writing of its intent to do so provided, however, LESSEE'S obligations pursuant to paragraphs 32 shall survive the termination of this Lease.

# Weeki Wachee Springs State Park Acquisition History

30. PROHIBITIONS AGAINST LIENS OR OTHER ENCUMBRANCES: Fee title to the Leased Premises is held by DISTRICT. LESSEE shall not do or permit anything that purports to create a lien or encumbrance of any nature against the Leased Premises including, but not limited to, mortgages or construction liens against the Leased Premises or against any interest of DISTRICT therein.

31. CONDITIONS AND COVENANTS: All of the provisions of this Lease shall be deemed covenants running with the land included in the Leased Premises, and construed to be "conditions" as well as "covenants" as though the words specifically expressing or imparting covenants and conditions were used in each separate provision.

32. DAMAGE TO THE PREMISES:

A. LESSEE shall not do, or suffer to be done, in, on or upon the Leased Premises or as affecting said Leased Premises or adjacent properties, any act which may result in damage or depreciation of value to the Leased Premises or adjacent properties, or any part thereof.

B. LESSEE shall not generate, store, produce, place, treat, release or discharge any contaminants, pollutants or pollution, including, but not limited to, hazardous or toxic substances, chemicals or other agents on, into, or from the Leased Premises or any adjacent lands or waters in any manner not permitted by law. For the purposes of this Lease, "hazardous substances" shall mean and include those elements or compounds defined in 42 USC Section 9601 or which are contained in the list of hazardous substances adopted by the United States Environmental Protection Agency (EPA) and the list of toxic pollutants designated by the United States Congress or the EPA or defined by any other federal, state or local statute, law, ordinance, code, rule, regulation, order or decree regulating, relating to, or imposing liability or standards of conduct concerning any hazardous, toxic or dangerous waste, substance, material, pollutant or contaminant. "Pollutants" and "pollution" shall mean those products or substances defined in Chapters 376 and 403, Florida Statutes, and the rules promulgated thereunder, all as amended or updated from time to time. In the event of LESSEE'S failure to comply with this paragraph, LESSEE shall, at its sole cost and expense promptly commence and diligently pursue any legally required closure, investigation, assessment, cleanup, decontamination, remediation, restoration and monitoring of (1) the Leased Premises, and (2) all off-site ground and surface waters and lands affected by LESSEE'S such failure to comply, as may be necessary to bring the Leased Premises and affected off-site waters and lands into full compliance with all applicable federal, state, or local statutes, laws, ordinances, codes, rules, regulations, orders and decrees, and to restore the damaged Leased Premises to the condition existing immediately prior to the occurrence which caused the damage. LESSEE'S obligations set forth in this paragraph shall survive the termination or expiration of this Lease. Nothing herein shall relieve LESSEE of any responsibility or liability prescribed by law for fines, penalties and damages levied by governmental agencies, and the cost of cleaning up any contamination caused directly or indirectly by LESSEE'S activities or facilities. Upon discovery of a release of a hazardous substance or pollutant, or any other violation of local, state or federal law, ordinance, code, rule, regulation, order or decree relating to the generation, storage, production, placement, treatment, release or discharge of any contaminant, LESSEE shall report such violation to all applicable governmental agencies having jurisdiction, and to DISTRICT, all within the reporting periods of the applicable governmental agencies.

33. TAXES AND ASSESSMENTS: If any ad valorem taxes, intangible property taxes, personal property taxes, mechanic's or materialman's liens, or other taxes or assessments of any kind are assessed or levied lawfully on the Leased Premises based on LESSEE'S use thereof during the term of this Lease, LESSEE shall pay same within thirty (30) days after receiving written notice thereof from

# Weeki Wachee Springs State Park Acquisition History

DISTRICT. Provided, however, LESSEE shall not be responsible for payments in-lieu-of taxes required under Sections 373.5905 and 259.0322, Florida Statutes, or any successor statute. In the event LESSEE fails to pay all the lawful taxes assessed or levied on the Leased Premises within thirty (30) days after receiving written notice thereof from DISTRICT, DISTRICT may, at its sole option, pay said taxes subject to immediate reimbursement thereof in full together with any interest thereon at the maximum rate allowed by law and any administrative costs thereof incurred by DISTRICT, including reasonable attorney's fees. Failure of LESSEE to pay said taxes shall constitute default under this Lease.

34. NON-DISCRIMINATION: LESSEE shall not discriminate against any individual because of that individual's race, color, religion, sex, national origin, age, handicap, or marital status with respect to any activity occurring or conducted on the Leased Premises.

35. SIGNAGE: At all public entrances, public information signage located on the leased premises shall inform the public of the cooperative project between LESSEE and DISTRICT.

36. FEES AND REVENUES:

A. LESSEE may charge an entrance or user fee to the visitors and users of the Leased Premises.

B. LESSEE may implement revenue-producing initiatives that are compatible with the management plan and purposes for which the Leased Premises were acquired.

37. COMPLIANCE WITH LAWS: LESSEE agrees that this Lease is contingent upon and subject to LESSEE obtaining all applicable permits and complying with all applicable permits, regulations, ordinances, rules, and laws of the State of Florida or the United States or of any political subdivision or agency of DISTRICT.

38. FINANCIAL STATEMENTS AND RECORDS: LESSEE agrees to provide DISTRICT with annual financial reports. The reports will contain, at a minimum, a Balance Sheet, Income Statement and a Statement of Cash Flows. All reports and statements will comply with generally accepted accounting principles. LESSEE will permit DISTRICT to examine or audit all related financial records and documents during or following the term of the Lease.

39. TIME: Time is expressly declared to be of the essence of this Lease.

40. GOVERNING LAW: This Lease shall be governed by and interpreted according to the laws of the State of Florida.

41. SECTION CAPTIONS: Articles, subsections and other captions contained in this Lease are for reference purposes only and are in no way intended to describe, interpret, define or limit the scope, extent or intent of this Lease or any provisions thereof.

42. BINDING EFFECT: This Lease will be binding upon and inure to the benefit of the parties hereto, and their successors and assigns.

43. AMENDMENTS: This Lease may be amended in writing by mutual consent of DISTRICT and LESSEE.

44. NOTICES: Any and all notices, requests or other communications hereunder shall be deemed to have been duly given if in writing and if transmitted by hand delivery with receipt therefore, or by

## Weeki Wachee Springs State Park Acquisition History

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registered mail posted prior to the expiration date for such notice, return receipt requested, first class postage prepaid, and by facsimile transmission as follows:

To LESSEE: STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION  
DIVISION OF RECREATION AND PARKS  
OFFICE OF PARK PLANNING  
3900 COMMONWEALTH BOULEVARD, MS#525  
TALLAHASSEE, FL 32399-3000  
FACSIMILE: (850) 245-3074

To DISTRICT: SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT  
2379 BROAD STREET  
BROOKSVILLE, FL 34604-6899  
ATTENTION: DIRECTOR  
LAND RESOURCES DEPARTMENT  
FACSIMILE: (352) 754-6877

45. CONDITION OF LEASED PREMISES: This Lease is made by DISTRICT without representations or warranties of any kind. DISTRICT assumes no liability or obligation to LESSEE with reference to the condition of the Leased Premises or the suitability of the Leased Premises for any improvements. The Leased Premises are hereby leased by DISTRICT to LESSEE in an "as is" condition, with DISTRICT assuming no responsibility for the care, repair, maintenance or improvement of the Leased Premises for the benefit of LESSEE.

46. NON-WAIVER OF REGULATORY AUTHORITY: Nothing contained in this Lease shall be construed as a waiver of or contract with respect to the regulatory and permitting authority of DISTRICT as it now or hereafter exists under applicable laws, rules, and regulations.

The remainder of this page is intentionally left blank

# Weeki Wachee Springs State Park Acquisition History

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT  
BY ITS GOVERNING BOARD

*Quentin C. Whitehead*  
Witness

By: *C.A. "Neil" Combee Jr.* (SEAL)  
C.A. "Neil" Combee Jr., Chair

*JUDITH C. WHITEHEAD*  
Print/Type Witness Name

ATTEST: *Jennifer E. Closshey*  
Jennifer E. Closshey, Secretary

*[Signature]*  
Witness



*H. Paul Seftt, Jr.*  
Print/Type Witness Name

STATE OF FLORIDA  
COUNTY OF HERNANDO

The foregoing instrument was acknowledged before me this 23<sup>rd</sup> day of October 2008 by and C.A. "Neil" Combee Jr., Jennifer E. Closshey, Chair and Secretary, respectively, of the Governing Board of the Southwest Florida Water Management District, on behalf of the District, who are personally known to me.



*Elaine S. Vergara*  
Notary Public, State of Florida

Print/Type Notary Name \_\_\_\_\_  
Commission Number: \_\_\_\_\_  
Commission Expires: \_\_\_\_\_

Approved as to Form and Legality  
By: *[Signature]*  
Office of General Counsel

APPROVED BY:	INITIALS	DATE
ATTORNEY	<i>MBM</i>	<i>10/27/08</i>
MANAGER	<i>[Signature]</i>	<i>10/27/08</i>
DIRECTOR	<i>[Signature]</i>	<i>10/27/08</i>

# Weeki Wachee Springs State Park Acquisition History

Debra Shaifer  
Witness

Debra Shaifer  
Print/Type Witness Name

Millard E. Wetzel  
Witness

Millard E. Wetzel  
Print/Type Witness Name

DEPARTMENT OF ENVIRONMENTAL PROTECTION  
DIVISION OF RECREATION AND PARKS

By: Mike Bullock (SEAL)  
Mike Bullock, Director

"LESSEE"

State of Florida  
County of Leon

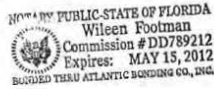
The foregoing instrument was acknowledged before me this 31 day of October, 20 08,  
by Mike Bullock as Director, on behalf of Division of Recreation and Parks, State of Florida Department of  
Environmental Protection. He is personally known to me.

[Signature]  
Notary Public, State of Florida

Print/Type Notary Name

Commission Number:

Commission Expires:



Approved as to form and legality

By: [Signature]  
DER Attorney





**Addendum 2—Advisory Group Summary Report**





# Weeki Wachee Springs State Park Preliminary Advisory Group Meeting

*Meeting Summary — October 22, 2019*

**Purpose of the Meeting:** Engage stakeholders and interested residents at the beginning stages of the management planning process; Explain the DRP's management planning process and address known topics of concern; Facilitate dialogue on issues such as carrying capacity and park improvements; Gather input and suggestions to incorporate into the draft management plan to be presented to the public at a later stage.

**Summary of the Meeting:** The meeting was facilitated by Tyler Maldonado. He began by having DRP staff introduce themselves. Advisory group members and others were then asked to introduce themselves and briefly state their reasons for participating in the meeting. A majority of the participants stated they were attending to see what the DRP was planning for the park.

Following introductions, the management plan process timeline (see agenda) was discussed. It was stated that initial site visits and internal staff meetings had taken place in June, and the DRP is now looking to invite advisory group members into the management plan development process. It was explained that the DRP is waiting for the results of the Weeki Wachee River carrying capacity study before a draft plan is finalized. Once a draft plan has been developed, the advisory group will be reconvened to review the document and a general public meeting will be conducted to present draft proposals. After these public meetings, the draft plan will be revised accordingly and submitted for final approval.

The main substance of the meeting came from advisory group and public comments. Everyone in attendance was given the chance to address the entire group and provide their comments to DRP staff. The room was arranged with long tables shaped into a rectangle with participants facing each other. Dialogue between staff and participants was encouraged.

Overall, advisory group members and interested residents are unhappy with the management of the river. This displeasure is not solely targeted at the DRP, and it was expressed that the park's management has improved since 2016. However, it is now an expectation of the public that local, regional, and state agencies will work together to collaboratively create a plan of action to address overcrowding concerns. Improving education on paddling techniques, boating etiquette, and aquatic habitat protection was suggested by many as an area in need of increased attention and resources. Participants stated the current carrying capacity guidelines unintentionally disadvantage after-hour events. They did not, however, support reinterpreting the current guidelines but do support developing a new tool to manage public access. It was stated that distinctions should be drawn between using natural resources for recreational purposes and using man-made structures for community events and CSO fundraisers. Advisory group members largely supported the vision for the park laid out in the 2013 Master Plan, and specifically expressed support for the interpretive museum concept where the legacy of the mermaid attraction could be highlighted alongside educational exhibits on the importance of the karst landscape and spring-run ecosystem. Further public engagement is expected.

## **Attendance**

### *Recreation and Parks Staff*

- Brian Fugate
- BJ Givens
- Mark Abrizenski
- Chris Becker
- Chris Oliver
- Tyler Maldonado
- Daniel Alsentzer

### *Appointed Stakeholders*

- Steven Dicks
- Victor Echaves
- Shannon Turbeville
- Fritz Musselmann
- Morris Porton
- Brett Hemphill
- Mary Ann Johnson
- Christie Williams
- Sheila Smith
- Gail Anderson
- David Letasi
- Tom St. Clair
- Jill Lingard
- Kevin Grover
- Alys Brockway
- Carmen Sanders

### *Interested Residents*

- Aja Moore
- Heather Barker
- Joe Gagliano
- George Peters
- Susan Foster
- Kathleen Gosline
- Bill Scherer
- John Cutten
- Rita King
- Pam Napp
- Ann Russo
- Michelle Pardue
- Andrew Russo
- John Duryee
- George Foster
- Donna Tschautre
- Shirley Hartman
- Erika Smith
- Robert Stern

## Weeki Wachee Springs State Park Advisory Group



### Weeki Wachee Springs State Park Draft Unit Management Plan Advisory Group Public Meeting December 9, 2021 — 5:30 pm



#### Review of the Weeki Wachee Natural System Carrying Capacity Study

Between June 2018 and June 2019, Wood Environment and Infrastructure Solutions, Inc. conducted the data gathering and analysis process for the carrying capacity study. The study area spanned from the headspring at Weeki Wachee Springs State Park to Rogers Park and involved the following:

- Collected observational data, social surveys, and water samples
- Deployed monitoring equipment at five stations for 2 weeks at a time over 6 different periods
- Conducted experimental trampling, spring-run comparisons, and turbidity trend analysis
- Calculated point bar loss of vegetation between 2008 and 2017, shown in the table below

It was shown that the majority of users are kayaking, and although the number of kayaks is correlated with an increase in turbidity, the number of vessels alone cannot be attributed to the resource damage. The cumulative effect of users docking their vessels and trampling vegetation has significantly impacted point bars along the river. In addition to launch capacities, docking and in-water activities must be addressed.

The six point bars shown below have been selected for quarterly monitoring to determine the effectiveness of management actions on the river. Improving conditions at these six point bars will not only indicate overall resource improvement on the river, but it will also suggest that user behavior has improved and indicate that docking and in-water activities have been reduced, if not eliminated altogether. Declining conditions would indicate further resource degradation and signal to managers that user behavior has not been adequately addressed. The management objectives on the next page represent the measures that will be implemented by park staff to address resource impacts on the Weeki Wachee River.

#### Point Bar Aerial Assessment – Vegetation Loss in Square Feet

Point Bar	PB 1	PB 6	PB 21	PB 22	PB 24	PB 28
<b>2008 Aerial</b>	7,031 ft <sup>2</sup>	11,661 ft <sup>2</sup>	7,493 ft <sup>2</sup>	8,508 ft <sup>2</sup>	7,012 ft <sup>2</sup>	3,213 ft <sup>2</sup>
<b>2017 Aerial</b>	5,337 ft <sup>2</sup>	10,603 ft <sup>2</sup>	6,063 ft <sup>2</sup>	7,008 ft <sup>2</sup>	6,201 ft <sup>2</sup>	2,237 ft <sup>2</sup>
<b>Net Loss</b>	<b>1,694 ft<sup>2</sup></b>	<b>1,058 ft<sup>2</sup></b>	<b>1,430 ft<sup>2</sup></b>	<b>1,500 ft<sup>2</sup></b>	<b>811 ft<sup>2</sup></b>	<b>976 ft<sup>2</sup></b>
<b>Percent Loss</b>	<b>-24%</b>	<b>-9%</b>	<b>-19%</b>	<b>-18%</b>	<b>-11%</b>	<b>-30%</b>

# Weeki Wachee Springs State Park Advisory Group



## Weeki Wachee Springs State Park Advisory Group

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### Weeki Wachee River Management Objectives

Several management actions are planned to address user impacts to the river point bars. It is expected that these management actions will help enforce existing park rules, mitigate resource impacts, and improve user behavior. The management actions that will be implemented are classified according to three categories: user education, rule enforcement, and resource protection.

- Update kayak rental information to include emphasis on existing park rules
- Require concession vessels launching from the park to exit the river at the new kayak takeout
- Improve concession area to highlight resource importance and interpret user responsibilities
- Conduct community outreach to provide information on river protection
- Develop park signage to demarcate the new park boundary and inform users of park rules
- Continue to work with local law enforcement and FWC to monitor river activity
- Consider establishing game cameras at known problem areas
- Seek approval to deploy protective barriers to block access to point bars
- Develop signage at impacted point bars to interpret the resource impact of docking/wading
- Explore replanting native vegetation to encourage regrowth and discourage user access

Over the next two years, DRP staff will implement a point bar monitoring protocol. During these two years, data will be collected to track resource conditions and identify the most effective adaptive management techniques. The 6 point bars in the table and map will be monitored at least quarterly for the next ten years. Annual monitoring efforts should be expanded to other impacted point bars, as necessary.

In addition to monitoring efforts, the paddle launch capacity will remain capped at 280 vessels per day. This capacity will be subject to adaptive management by park management, and any changes will be informed and supported by the data that will be collected over the long-term. The collected point bar data will be documented and stored systematically in order to produce condition reports.



## Weeki Wachee Springs State Park Advisory Group

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### Additional Management Plan Objectives

A major focus of the Weeki Wachee Springs State Park draft management plan is addressing resource impacts to the river and monitoring conditions with intergovernmental partners. However, the draft plan also addresses several other natural, cultural, and recreational facility management needs. The DRP's ability to accomplish specific objectives identified in the plan will be determined largely by the availability of funds and staff for these purposes, which may vary from year to year. Additional objectives include:

- Continue to support water quality, quantity, and biological assessment monitoring
- Monitor fire breaks, roads, trails, and the river bank for soil erosion
- Continue to monitor submerged aquatic vegetation in the spring run
- Conduct habitat improvement on 575 acres of scrub, scrubby flatwoods, and sandhill
- Maintain 615 acres within the optimum fire return interval
- Complete a comprehensive floral and faunal survey
- Implement monitoring protocols for the gopher tortoise
- Annually treat at least 18 infested acres of exotic plant species
- Develop a comprehensive exotic plant management plan
- Maintain and publish the landscaping manual for the park
- Implement exotic species decontamination protocols
- Manage Lyngbya and other aquatic species in the river
- Implement nuisance species control measures on feral hogs
- Annually assess and evaluate all recorded cultural resources
- Maintain all National Register-eligible or listed resources in good condition
- Complete historic preservation projects for iconic cultural resources
- Improve recreational facilities in the attraction area and Buccaneer Bay
- Construct a new park entrance road and redesign the existing parking areas

### Public Comment

To review the draft plan in its entirety, please go to the Florida Department of Environmental Protection Division of Recreation and Parks public participation website, here:

[floridadep.gov/parks/public-participation](http://floridadep.gov/parks/public-participation)

Public comments that are received by **December 28** will be included in the official record. Please direct written comments to the Office of Park Planning email address, here:

[FLStateParkPlanning@floridadep.gov](mailto:FLStateParkPlanning@floridadep.gov)

Weeki Wachee Springs State Park Advisory Group

PLEASE SIGN IN (PRINT CLEARLY)

WEEKI WACHEE SPRINGS STATE PARK  
ADVISORY GROUP PUBLIC MEETING  
DECEMBER 9, 2021

PRINT NAME

E-MAIL

- |                     |                              |
|---------------------|------------------------------|
| 1. GAIL ANDERSON    | gail.anderson fla@gmail.com  |
| 2. Brett Hemphill   | brett@karstwater.org         |
| 3. MARSHA DANIELSON | marshad813@hotmail.com       |
| 4. Tommy BLACKMAN   | NA                           |
| 5. Dawn Velsor      | dawnv@hernandocounty.us      |
| 6. Eugene Kelly     | gmkelly@tampabay.rr.com      |
| 7. Shirley HARTMAN  | hartman_6088@msn.com         |
| 8. Keith Singleton  | ksing188@gmail.com           |
| 9. Tyler Singleton  | Tylerjamesingleton@gmail.com |
| 10. Vicki Smith     | 1957mermaid@gmail.com        |



Weeki Wachee Springs State Park Advisory Group

PLEASE SIGN IN (PRINT CLEARLY)

WEEKI WACHEE SPRINGS STATE PARK  
ADVISORY GROUP PUBLIC MEETING  
DECEMBER 9, 2021

PRINT NAME

E-MAIL

- |                                  |                                |
|----------------------------------|--------------------------------|
| 1. Tom St Clair                  | tomstclair8@gmail.com          |
| 2. Frank Garsano                 | frank.garsano@watermatters.org |
| 3. Doug Koop                     | doug.koop@swfwmd.state.fl.us   |
| 4. Aja Moore                     | aja.marie24@gmail.com          |
| 5. JIM TAIT                      | JIM41@WJTAIT.COM               |
| 6. Joann Davidhizar              | Jedporter@aol.com              |
| 7. Tammy J. Heon                 | theon@findasadventurecoast.com |
| 8. Robert Davidson aka Kayak Bob | sherdavi@hotmail.com           |
| 9. Michael Scinta                | michael.scinta@myfwc.com       |
| 10.                              |                                |

## **Weeki Wachee Springs State Park Advisory Group**

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### Weeki Wachee Springs State Park Unit Management Plan

Review Comments Submitted by:  
Florida Native Plant Society  
December 28, 2021

These review comments are submitted for consideration during the update of the Weeki Wachee Springs State Park Unit Management Plan.

#### Prescribed Fire Management

Discussion of the Park's scrub habitat clearly acknowledges that control of sand pines will be a priority given the high frequency of occurrence the species has attained across the Park due to a long history fire suppression. The removal of sand pines across a portion of the scrub, conducted after the Park was placed in public ownership, in association with implementation of a prescribed burning program, has resulted in substantial improvement and Park staff are to be commended for the progress. Conditions for conducting prescribed burns at this Park are extremely challenging; however, burns will continue to be necessary to counteract re-establishment of sand pines and to improve conditions for the resident imperiled species that are dependent on those habitats.

While the plan commits to controlling sand pine through harvests, mechanical treatments and prescribed burning, it does not include any kind of schedule or timeframe for removal. Avoiding inclusion of a schedule or specific timeframe allows for staff to exercise maximum flexibility; however, we believe the absence of a schedule is a major shortcoming of the Plan. This is underscored by the combination of a 10-year planning horizon for the plan, and commitments made in the discussion of prescribed fire management. These include the stated commitment to burn 53-170 acres annually (page 37) and the objective to maintain 615 acres within the optimum fire return interval (Objective D, page 38). Only 89 acres (<14%) of the fire-maintained upland plant communities are something other than scrub. As we "read between the lines", it is difficult to surmise how the prescribed fire commitments can be met without also implementing a timely program to harvest or otherwise address the overgrowth of sand pine. Substantial stands of scrub must be burned annually to meet these commitments over the 10-year span of the plan, so substantial stands of scrub must likewise be restored through sand pine removal.

Please do not back off on the prescribed burning commitments currently included in the plan! They are ambitious, and also appropriate. We believe they are necessary to properly account for imperiled species concerns and to prevent backsliding on the progress that has already been made in scrub restoration. We simply recommend that a timely schedule for sand pine removal also be included – one that complements the prescribed burning targets.

#### Imperiled Species

The discussion of imperiled species acknowledges the imperiled status of the scrub community and the presence of three scrub endemic plant species (Nodding pinweed, Garberia and Curtiss' milkweed). The well-drained sands of the scrub areas also account for the vast majority of the Park's potentially suitable habitat for gopher tortoises, and continued restoration of the scrub could conceivably create conditions suitable for emigration or reintroduction of the Florida Scrub-jay. We were pleased by the Plan's clear focus on scrub restoration through a combination of sand pine harvests, mechanical treatments and

## Weeki Wachee Springs State Park Advisory Group

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applications of prescribed fire. We consider these to be the most important resource management needs in the upland portions of the Park.

Knowing exactly where the imperiled plants occur or are concentrated may be essential to ensuring they are not inadvertently eliminated, or seriously reduced in numbers or frequency, by the aggressive management actions needed to advance the restoration and/or improvement of the scrub habitats where they reside. This is especially true of Curtiss' milkweed, which is characterized by plants that usually occur singly and widely separated from one another, and are difficult to see during much of the year since above-ground vegetation dies back annually. During a field tour of the scrub stand located west of the spring conducted prior to establishment of the State Park, the Hernando Chapter of FNPS observed several flowering Curtiss' milkweed plants. During a more recent field trip of the same scrub stand facilitated by Park staff (April 13, 2019) and attended by members of both the Hernando County and Nature Coast (Pasco County) Chapters of FNPS, we did not observe any plants. We do not know whether the species has been observed in the other scrub units.

Local members of FNPS could serve as a resource for conducting surveys of the Park's scrub stands to help determine how secure the population of Curtiss milkweed is within the Park, and to more accurately identify where plants occur. Ideally, surveys for Curtiss' milkweed should be conducted from May-July to coincide with peak flowering season. Nodding pinweed and Garberia should also be distinguishable during that period, although those species are much more ubiquitous and appear to be relatively secure in the park. Such surveys could also be coordinated in cooperation with FWC to include the adjacent scrub under their management, and could add additional species to the current plant list developed for the Park. The plan may not be the appropriate place to commit a local particular NGO to future cooperative ventures; however, this provides an example of how a local NGO could be a valuable asset, and it might be appropriate for the plan to acknowledge that the Park would be open to, or welcome, assistance or participation by local NGO's.

At the least, we recommend that the discussion of imperiled species acknowledge the need for surveys to ascertain where these species occur, and account for special considerations to avoid inadvertent damage to these important plant populations. Simple precautions would almost certainly be undertaken to avoid damage to known gopher tortoise burrows; imperiled plants are similarly fixed in space, may be similarly vulnerable to physical damage, and no less deserving of consideration.

### Invasive Species

The draft plan provides a fairly comprehensive discussion and plan of action to control invasive species. It correctly commits to employing a strategy of Early Detection – Rapid Response. We believe successful implementation of EDRR requires that staff be cognizant of likely invaders should they appear on the property. Expanding numbers of white leadtree (*Leucaena leucophylla*) and silktree mimosa (*Albizia julibrissin*) are appearing in the coastal portions of Hernando County. The County has also adopted an ordinance requiring all landowners to eradicate any Brazilian pepper or lead tree that occur on their property. FNPS recommends the Plan acknowledge these circumstances and ensure the staff are trained to identify these species if they ever occur in the Park so they can be quickly eradicated.

**A minor note: the discussion of invasive species references the Florida Exotic Pest Plant Council, or FLEPPC. It has been renamed the Florida Invasive Species Council ([floridainvasivespecies.org](http://floridainvasivespecies.org)).**

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### Lethal Bronzing Disease

Lethal Bronzing Disease (LBD) has emerged as a major threat to Florida's native cabbage palm, and similar to the Early Detection-Rapid Response strategy for dealing with invasive species, we recommend that the plan acknowledge the importance of staff monitoring for evidence of LBD so infected trees can be recognized and removed quickly to reduce the likelihood of transmission to uninfected trees. There are a number of useful references for information on LBD available on-line, including:

Bahder, B.W. and E.E. Helmick. 2019. Lethal Bronzing Disease (LBD).  
<https://edis.ifas.ufl.edu/pdf/PP/PP16300.pdf>

### Recreational Use Component – Creation of Interpretive Trail

The discussion of recreational use identifies the mermaid shows, water park and paddling as the primary recreational draws (page 70). The truth of this statement is obvious; it is equally obvious that no other uses are actively accommodated or encouraged. The vast majority of the Park property is virtually invisible to visitors, despite the natural significance of the scrub community that dominates the land area of the Park. Indeed, non-scrub portions of the property only account for about 180 acres, most of which is either wetland, open water or the developed facilities around the springhead.

The size of the Park, access constraints, and the predominance of sandy soils limit the range of resource-based recreational uses that could be considered compatible or able to provide a positive user experience (e.g., bicycling, equestrian use and camping are neither compatible, nor could they allow a positive user experience at this Park). However, creation of an interpretive trail on the primary park parcel would provide an amenity that both complements the existing public usage and is entirely compatible with the Park's sensitive resources. Such a trail could provide access to nearly the full range of natural communities represented on the property, including a scenic view of the river, and present outstanding opportunities for sharing interpretive information with the public. FNPS recommends that development of an interpretive trail should be considered the highest priority need for expanding the public's compatible use and enjoyment of the Park.

### Interpretive Information on Water Quality and Quantity

We are pleased the plan mentions that interpretive elements will be incorporated into the Park facilities to highlight pertinent resource management issues. One of the four Primary Interpretive Themes listed on page 2 is the Spring Run, and it is easy to envision the scope of interpretive elements devoted to that theme given the extensive discussion of the Carrying Capacity study and the management measures that will be implemented to reduce the physical impacts resulting from incompatible use by paddlers and other users of the river. Likewise, it is easy to envision the content of interpretive elements devoted to the Uplands theme given the plan's comprehensive discussion of habitat restoration, fire management, and imperiled species. However, there is very little plan content that points to how the Water Quality and Quantity theme will be interpreted.

The discussion of hydrology (pages 16-21) includes a generalized discussion about sources of nitrates in springs, but does not cite FDEP's rather definitive description of the issue in 2018's Weeki Wachee Basin Management Action Plan. To the extent that the discussion of hydrology frames how the issue will be addressed in the Park's interpretive elements, the generalized discussion should be amended to be more specific to Weeki Wachee Spring. We know from studies conducted by FDEP and SWFWMD that agricultural runoff, pasture fertilization and animal waste are insignificant sources of nitrates in this springshed. We are hopeful the educational value of any interpretive displays devoted to water quality

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and quantity will be maximized by being as specific to the Weeki Wachee springshed as possible by emphasizing the need for well-managed use of fertilizer on turf and widespread conversion from on-site sewage treatment to centralized systems.

This section of the Plan is also the appropriate place to acknowledge that sea level rise will result in higher levels of salinity encroaching up the river towards the springhead, and that any future reductions in springflow would increase the pace and extent of related impacts on the natural systems of the downstream estuary, the river and the Park. Interpretive elements related to water quantity issues could highlight the role that springflow will play in maintenance and long-term productivity of the estuary. This is an opportunity to educate the public about ecosystem connections that extend far beyond the Park boundary, and increase the value of the public's protection of such Weeki Wachee Spring.

Finally, the landscaping in many developed areas of the Park includes many nonnative species, and many that could not be characterized as Florida Friendly in terms of irrigation or fertilizer needs. While we concede the Park's history and cultural values allow room for inclusion of some exotic (non-invasive) ornamentals, it would be appropriate for the Park to convert some of the landscaping to native species to illustrate for visitors some of the native plant species present in the Park's preserved upland plant communities and demonstrate that the use of native plants in landscaping can be attractive while also reducing fertilizer usage and water consumption across the basin. Local chapters of FNPS could provide assistance with such landscaping.

### New Entrance Road

The proposal to develop a new entrance road to the Park (page 80) may pose the greatest threat to natural resources of any use or facility improvement included in the plan. If development of a new entrance road is truly necessitated by traffic congestion at the US19/SR50 intersection, then Alternative D is the only alignment that would avoid significant displacement of natural areas in the Park while also minimizing future constraints on prescribed burning within that section of the Park. Alignments B and C would minimize impacts to natural areas by using segments of existing trail roads to accommodate the entrance road; however, they would also impinge on the ability to burn in an area that already represents a severe challenge to burning. There would be virtually no prescription for wind direction that would avoid placement of smoke over either US19, or the new Park entrance road. If a decision on the preferred alignment cannot be made in the current plan, then we recommend that the plan at least acknowledge the potential future constraints on use of prescribed fire. This may be especially pertinent to long-term management of the basin marsh at the intersection of Northcliffe Boulevard and US19, which may represent the only occurrence of Florida joint-tail grass (*Coelorachis tuberculosa*) within the Park.



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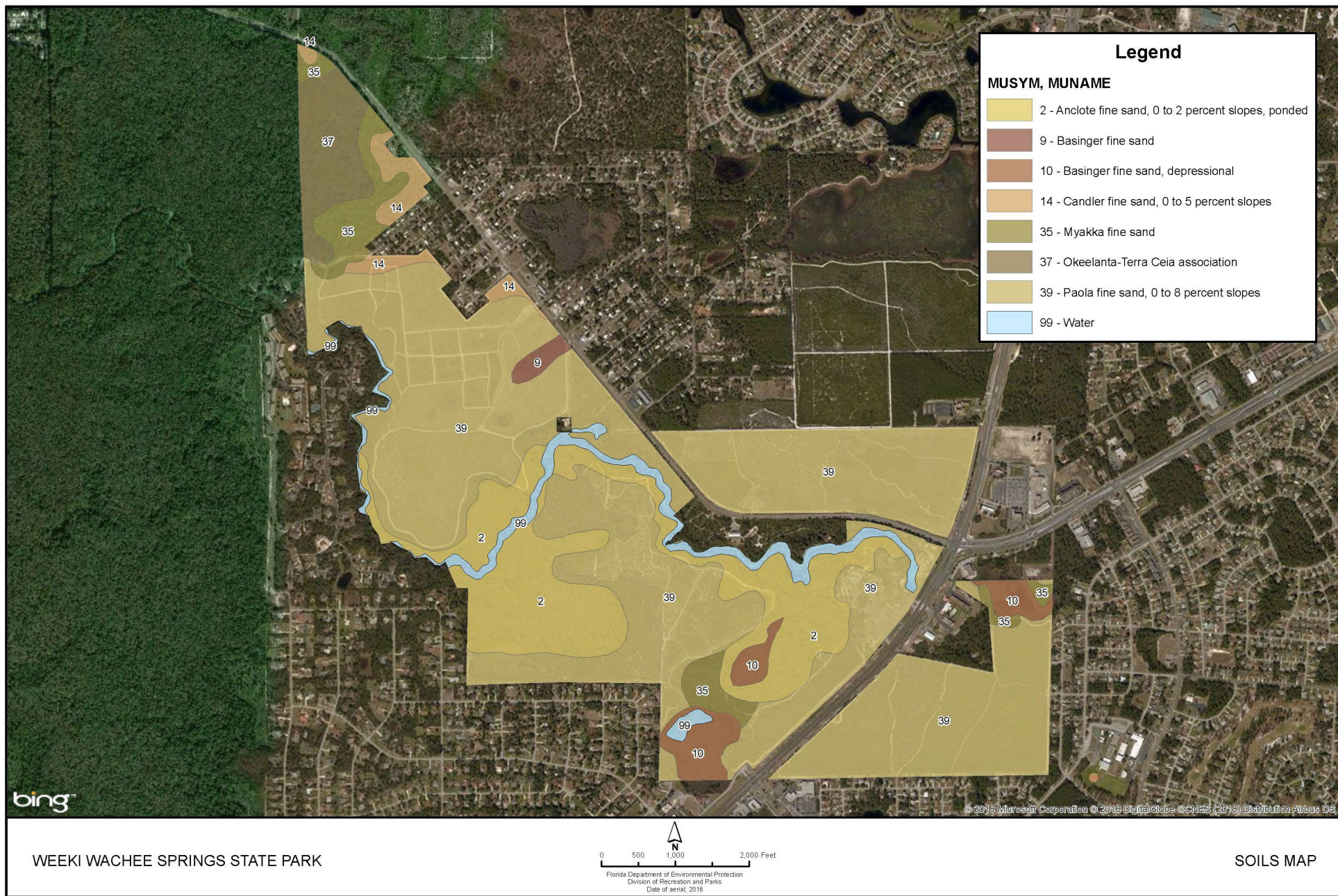


## **Addendum 4—Soil Descriptions**





# Weeki Wachee Springs State Park Soil Descriptions





## **Weeki Wachee Springs State Park Soil Descriptions**

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**(2) Anclote fine sand** - This is a poorly drained soil in depressional areas. Slopes are usually concave and less than 2 percent.

Typically, the surface layer is black fine sand about 7 inches thick. The subsurface layer is very dark gray fine sand about 7 inches thick. Below that is fine sand. The upper 6 inches of it is grayish brown, the next 10 inches is light brownish gray, and the next layer is gray to a depth of 80 inches or more.

Included with this soil in mapping are small areas of Basinger soils, depressional, and Delray, Floridana, and Pompano soils. Also included are similar soils that have a thin surface layer of muck. Included soils make up about 15 percent of any mapped area.

In most years, under natural conditions, the water table is above the surface for 3 to 6 months during wet seasons and recedes to a depth of more than 20 inches during dry seasons. This soil has medium available water capacity to a depth of about 14 inches and low available water capacity below this depth. Permeability is rapid throughout. Internal drainage, however, is slow because it is impeded by a shallow water table. Natural fertility and organic matter content are high to a depth of about 14 inches and low below this depth.

Natural vegetation consists of cypress, cabbage palms, bay, and pond pine. Grasses include maidencane, giant cutgrass, low panicums, sand cordgrass, and other perennial grasses.

**(9) Basinger fine sand** - This is a poorly drained, nearly level soil in poorly defined drainageways and sloughs in the flatwoods. Slopes are less than 2 percent.

Typically, the surface layer is black fine sand about 3 inches thick. The subsurface layer is light brownish gray fine sand to a depth of about 8 inches. The subsoil is grayish brown fine sand that has discontinuous lenses of tending to a depth of about 40 inches, is light gray fine sand. To a depth of 80 inches or more is white fine sand.

Included with this soil in mapping are similar soils that differ by having a surface layer 10 to 13 inches thick. Also included are small areas of Anclote, Myakka, and Pompano soils. Included soils make up about 15 percent of any mapped area.

This soil has a water table at a depth of less than 10 inches for 2 to 6 months annually and at a depth of 10 to 30 inches for periods of more than 6 months in most years. This soil has very rapid permeability throughout. The available water capacity is very low. Natural fertility is low.

A large part of this soil is in natural vegetation of open forest of longleaf and slash pine. The understory consists of wax myrtle, St. Johnswort, pineland three-awn, and saw-palmetto.

## **Weeki Wachee Springs State Park Soil Descriptions**

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**(10) Basinger fine sand, depressional** - This is a poorly drained soil in depressional areas in the flatwoods. It also is along the edges of lakes. Slopes are smooth to concave and range from 0 to 2 percent.

Typically, the surface layer is black fine sand about 7 inches thick. The subsurface layer is light gray sand about 18 inches thick. The subsoil is mixed dark brown and gray fine sand about 11 inches thick. To a depth of 80 inches or more is light gray fine sand.

Included with this soil in mapping are small areas of Anclote, Delray, Floridana, and Pomano soils. Also included are similar soils that have a thin organic surface layer and similar soils that have a black surface layer 10 to 14 inches thick. Many areas mapped as this soil in the Richloam Wildlife Management Area have a 10-14 inch thick black surface layer. Included soils make up about 25 percent of any mapped area.

This soil is covered with standing water for periods of 6 -9 months or more in most years. Natural fertility is low, and response to fertilization is moderate. The internal drainage is naturally slow, and response to artificial drainage is rapid. This soil has low available water capacity.

A large acreage is in natural vegetation of bay, cypress, pop ash, cabbage palm, and water oaks. Other areas are covered with maidencane, St. Johnswort, water lilies, pickerelweed, and other plants that tolerate wetness.

**(14) Candler fine sand, 0 to 5 percent slopes** – This is a nearly level to gently sloping, excessively drained soil in very large to small areas on uplands.

Typically, the surface layer is dark grayish brown fine sand about 4 inches thick. The subsurface layer is fine sand to a depth of about 48 inches. The upper 5 inches is brown, the next 11 inches is light yellowish brown, and the next 28 inches is brownish yellow. Below a depth of 48 inches is very pale brown fine sand containing lamellae of brown loamy fine sand about 1/16 to 1/8 inch thick and 1 to 4 inches long.

Included with this soil in mapping are small areas of Arredondo, Astatula, Lake, and Tavares soil. Also included are similar soils that have slopes of more than 5 percent. Included soils make up about 5 percent of any mapped area. This soil has very low available water capacity in the upper 48 inches and low available water capacity below that depth. Permeability is very rapid in the upper 48 inches of the profile and rapid below. Natural fertility is low. The water table is below a depth of 80 inches.

Few areas of this soil have been cleared. Native vegetation consists of bluejack, post and turkey oaks; and scattered longleaf and slash pines; and a sparse understory of Indiangrass, chalky bluestem, pineland three-awn, panicum and annual forbs.

## **Weeki Wachee Springs State Park Soil Descriptions**

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**(35) Myakka fine sand** - This is a nearly level, poorly drained soil in broad areas in the flatwoods. Slopes are smooth to concave and range from 0 to 2 percent.

Typically the surface layer is black fine sand about 5 inches thick. The subsurface layer is light gray fine sand about 20 inches thick. The subsoil is weakly cemented fine sand about 17 inches thick. The upper 4 inches is very dark grayish brown, the next 5 inches is very dark gray, and the lower 8 inches is dark reddish brown. The next layer is light brownish gray fine sand to a depth of about 50 inches and light gray fine sand below.

Included with this soil in mapping are similar soils that differ from Myakka fine sand by having a black surface layer more than 8 inches thick. Also included are small areas of Adamsville, Basinger, Eau Gallie, and Pompano soils. Limestone boulders, 2 to 6 feet in diameter, are in some areas of this soil at a depth of about 16 percent of any mapped area.

The water table is at a depth of less than 10 inches for 1 to 4 months in most years and recedes to a depth of more than 40 inches during very dry seasons. Myakka soils have medium available water capacity in the subsoil but very low available water capacity in the other layers. Permeability is rapid in the surface layer and substratum and moderate or moderately rapid in the subsoil. These soils have slow internal drainage and slow runoff. Natural fertility is low.

The natural vegetation is longleaf and slash pines with an understory of saw-palmetto, runner-oak, inkberry, wax myrtle, huckleberry, pineland three-awn, and scattered fetter bushes.

**(37) Okeelanta-Terra Ceia association** - This association consists of very poorly drained soils in regular and repeating patterns. The landscape is a broad, low swamp area which is interspersed with a few low ridges. The Okeelanta soils are around the edges of the mapping unit, where the organic material is thinner. This association makes up a large part of Weekiwachee and Chassahowitzka Swamps. Mapped areas are mostly long and very broad, and individual areas of each soil range from about 25 to 300 acres.

Okeelanta soils make up about 60 percent of this association. Typically, they have layers of black and very dark gray muck to a depth of about 27 inches. Below the muck is light gray fine sand.

Okeelanta soils have a water table at or near the surface except during extended dry periods. They have rapid permeability, very high available water capacity, very high organic matter content, and moderate natural fertility.

Terra Ceia soils make up as much as about 30 percent of the association. Typically, Terra Ceia soils are black and dark grayish brown muck to a depth of 65 inches or more.

Terra Ceia soils have a water table on or above the surface except during extended

## **Weeki Wachee Springs State Park Soil Descriptions**

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dry periods. Runoff is slow. Internal drainage and permeability are rapid. These soils have very high available water capacity, very high organic matter content, and moderate natural fertility.

Minor soils make up about 10 percent of the association. Anclote soils are the most extensive of the minor soils. Also included are small areas of Myakka, Basinger, Delray and Tavares soils. These soils, with the exception of Delray soils, are on low ridges scattered throughout the association.

This association is still in natural vegetation, which consists mostly of sweetgum, cypress, longleaf pine, cabbage palm, water oaks, and an understory of maidencane, sawgrass, royal, cinnamon ferns, and various aquatic plants.

**(39) Paola fine sand, 0-8 percent slopes** - This is an excessively drained, nearly level to sloping soil on high ridges and hillsides in the sandhill areas of the county. Slopes are smooth to concave.

Typically, the surface layer is gray fine sand about 3 inches thick. The subsurface layer is white fine sand to a depth of about 26 inches. The subsoil is brownish yellow fine sand with a few tongues of white fine sand from the subsurface layer mixed in. Very pale brown fine sand extends to a depth of 80 inches, and white fine sand extends to a depth of 99 inches or more.

Included with this soil in mapping are small areas of Astatula, Candler, and Tavares soils. In most places included soils make up less than 10 percent of any mapped area.

The water table is below a depth of 72 inches. Paola soils have very low availability water capacity and very low natural fertility. Permeability is very rapid throughout the profile.

Few areas of this soil have been cleared. The native vegetation consists of sand pine, scrub live oak, scattered turkey and bluejack oaks, and an undergrowth of scattered saw-palmetto, creeping dodder, rosemary, cacti, mosses, and lichens.

### **(99) Water**

**Addendum 5—Plant and Animal List**





## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
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### LICHENS

Cup lichen..... *Cladonia leporina*  
Greygreen reindeer lichen..... *Cladonia rangiferina*

### PTERIDOPHYTES

Giant leather fern..... *Acrostichum danaeifolium*  
Southern wood fern..... *Dryopteris ludoviciana*  
Scouring rush..... *Equisetum hyemale* var. *affine*  
Japanese climbing fern\*..... *Lygodium japonicum*  
Tuberous sword fern\*..... *Nephrolepis cordifolia*  
Wild Boston fern..... *Nephrolepis exaltata*  
Royal fern..... *Osmunda regalis* var. *spectabilis*  
Cinnamon fern..... *Osmundastrum cinnamomeum*  
Golden polypody..... *Phlebodium aureum*  
Resurrection fern..... *Pleopeltis michauxiana*  
Tailed bracken..... *Pteridium aquilinum* var. *pseudocaudatum*  
Whisk fern..... *Psilotum nudum*  
Chinese ladder brake\*..... *Pteris vittata*  
Sand spikemoss..... *Selaginella arenicola*  
Widespread maiden fern;  
Southern shield fern..... *Thelypteris kunthii*  
Ovate marsh fern..... *Thelypteris ovata*  
Marsh fern..... *Thelypteris palustris* var. *pubescens*  
Shoestring fern..... *Vittaria lineata*  
Netted chain fern..... *Woodwardia areolata*  
Virginia chain fern..... *Woodwardia virginica*

### GYMNOSPERMS

Red cedar..... *Juniperus virginiana*  
Sand pine..... *Pinus clausa*  
Slash pine..... *Pinus elliotii*  
Longleaf pine..... *Pinus palustris*  
Oriental arborvitae\*\*..... *Platycladus orientalis*  
Yew plum-pine\*\*..... *Podocarpus macrophyllus*  
Pond-cypress..... *Taxodium ascendens*  
Bald-cypress..... *Taxodium distichum*  
Florida arrowroot; coontie..... *Zamia integrifolia*

### ANGIOSPERMS

#### MONOCOTS

Yellow colicroot..... *Aletris lutea*  
Shellflower; shell ginger\*..... *Alpinia zerumbet*

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Blue maidencane.....	<i>Amphicarpum muehlenbergianum</i>	
Florida bluestem .....	<i>Andropogon floridanus</i>	
Bushy bluestem .....	<i>Andropogon glomeratus</i>	
Splitbeard bluestem.....	<i>Andropogon ternarius</i>	
Broomsedge bluestem.....	<i>Andropogon virginicus</i> var. <i>virginicus</i>	
Jack-in-the-pulpit.....	<i>Arisaema triphyllum</i>	
Tall threeawn .....	<i>Aristida patula</i>	
Hillsborough threeawn .....	<i>Aristida purpurascens</i> var. <i>tenuispica</i>	
Bottlebrush threeawn.....	<i>Aristida spiciformis</i>	
Wiregrass .....	<i>Aristida stricta</i>	
Giant reed* .....	<i>Arundo donax</i>	
Sprenger's asparagus fern**....	<i>Asparagus aethiopicus</i>	
Cast iron plant* .....	<i>Aspidistra elatior</i>	
Big carpetgrass.....	<i>Axonopus furcatus</i>	
Hedge bamboo; Silverstripe* ...	<i>Bambusa multiplex</i>	
Capillary hairsedge .....	<i>Bulbostylis ciliatifolia</i>	
Chapman's sedge .....	<i>Carex chapmannii</i> .....	36
Longhair sedge .....	<i>Carex comosa</i>	
Bristly-stalked sedge .....	<i>Carex leptalea</i>	
Long's sedge .....	<i>Carex longii</i>	
Fountaingrass** .....	<i>Cenchrus setaceum</i>	
Coastal sandbur .....	<i>Cenchrus spinifex</i>	
Featherfingergrass* .....	<i>Chloris</i> sp.	
Jamaican swamp sawgrass .....	<i>Cladium jamaicense</i>	
Florida jointtail grass; Piedmont grass.....	<i>Coelorachis tuberculosa</i> .....	26
Beaked panicum .....	<i>Coleataenia anceps</i>	
Ciliate redtop panicum .....	<i>Coleataenia longifolia</i>	
Redtop panicum .....	<i>Coleataenia rigidula</i>	
Wild taro; dasheen; coco yam*	<i>Colocasia esculenta</i>	
Common dayflower* .....	<i>Commelina diffusa</i> var. <i>diffusa</i>	
Seven-sisters; String lily .....	<i>Crinum americanum</i>	
Bermudagrass** .....	<i>Cynodon dactylon</i>	
Umbrella plant* .....	<i>Cyperus involucratus</i>	
Fragrant flatsedge .....	<i>Cyperus odoratus</i>	
Strawcolored flatsedge .....	<i>Cyperus strigosus</i>	
Durban crowfootgrass* .....	<i>Dactyloctenium aegyptium</i>	
Variable witchgrass.....	<i>Dichantherium commutatum</i>	
Cypress witchgrass.....	<i>Dichantherium ensifolium</i> var. <i>ensifolium</i>	
Slender crabgrass .....	<i>Digitaria filiformis</i> var. <i>filliformis</i>	
Air-potato* .....	<i>Dioscorea bulbifera</i>	
Indian goosegrass* .....	<i>Eleusine indica</i>	
Baldwin's spikerush; roadgrass.	<i>Eleocharis baldwinii</i>	
Green-fly orchid .....	<i>Epidendrum conopseum</i>	
Feather lovegrass* .....	<i>Eragrostis amabilis</i>	
Elliott's lovegrass .....	<i>Eragrostis elliottii</i>	
Coastal lovegrass .....	<i>Eragrostis refracta</i>	

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Red lovegrass.....	<i>Eragrostis secundiflora</i> subsp. <i>oxylepis</i>	
Purple lovegrass.....	<i>Eragrostis spectabilis</i>	
Centipede grass* .....	<i>Eremochloa ophiuroides</i>	
Pinewoods fingergrass.....	<i>Eustachys petraea</i>	
Slender fimbry .....	<i>Fimbristylis autumnalis</i>	
Toothpetal false reinorchid;		
Mignonette orchid.....	<i>Habenaria floribunda</i>	
Waterspider false reinorchid.....	<i>Habenaria repens</i>	
Spring-run spiderlily .....	<i>Hymenocallis rotata</i>	
Cogon grass* .....	<i>Imperata cylindrica</i>	
Soft rush .....	<i>Juncus effuses</i> subsp. <i>solutus</i>	
Lesser creeping rush.....	<i>Juncus repens</i>	
Warty panicgrass .....	<i>Kellochloa verrucosa</i>	
Virginia dwarf dandelion .....	<i>Krigia virginica</i>	
Carolina redroot .....	<i>Lachnanthes carolina</i>	
Big blue lilyturf** .....	<i>Liriope muscari</i>	
Monkeygrass; bordergrass** ...	<i>Liriope spicata</i>	
Chinese fan palm*.....	<i>Livistona chinensis</i>	
Rose natalgrass*.....	<i>Melinis repens</i>	
Southern water nymph.....	<i>Najas guadalupensis</i>	
Monk orchid* .....	<i>Oeceoclades maculata</i>	
Golden club; Neverwet.....	<i>Orontium aquaticum</i>	
Woodsgrass.....	<i>Oplismenus setarius</i>	
Maidencane.....	<i>Panicum hemitomon</i>	
Torpedograss* .....	<i>Panicum repens</i>	
Bahiagrass* .....	<i>Paspalum notatum</i> var. <i>saurae</i>	
Vaseygrass* .....	<i>Paspalum urvillei</i>	
Green arrow arum .....	<i>Peltandra virginica</i>	
Water lettuce.....	<i>Pistia stratiotes</i>	
Nun's hood orchid* .....	<i>Phaius tancarvilleae</i>	
Split-leaf philodendron**.....	<i>Philodendron bipinnatifidum</i>	
Southern tubercled orchid.....	<i>Platanthera flava</i> .....	36
Needle palm .....	<i>Rhapidophyllum hystrix</i>	
Lady palm** .....	<i>Rhapis excelsa</i>	
Starrush whitetop.....	<i>Rhynchospora colorata</i>	
Shortbristle horned beaksedge .	<i>Rhynchospora corniculata</i>	
Pinebarren beaksedge.....	<i>Rhynchospora intermedia</i>	
Narrow fruit horned beaksedge.	<i>Rhynchospora inundata</i>	
Sandyfield beaksedge .....	<i>Rhynchospora megalocarpa</i>	
Southern beaksedge .....	<i>Rhynchospora microcarpa</i>	
Millet beaksedge .....	<i>Rhynchospora miliacea</i>	
Shortbeak beaksedge; Baldrush	<i>Rhynchospora nitens</i>	
Tracy's beaksedge.....	<i>Rhynchospora tracyi</i>	
Dwarf palmetto; Bluestem palm	<i>Sabal minor</i>	
Cabbage palm .....	<i>Sabal palmetto</i>	
Sugarcane plumegrass .....	<i>Saccharum giganteum</i>	
American cupscale.....	<i>Sacciolepis striata</i>	

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Threadleaf arrowhead .....	<i>Sagittaria filiformis</i>	
Grassy arrowhead .....	<i>Sagittaria graminea</i> var. <i>graminea</i>	
Springtape .....	<i>Sagittaria kurziana</i>	
Bulltongue arrowhead .....	<i>Sagittaria lancifolia</i>	
Common arrowhead; duck potato .....	<i>Sagittaria latifolia</i>	
Threesquare bulrush .....	<i>Schoenoplectus pungens</i>	
Fringed nutrush .....	<i>Scleria ciliata</i>	
Tall nutgrass; whip nutrush.....	<i>Scleria triglomerata</i>	
Low nutrush .....	<i>Scleria verticillata</i>	
Saw palmetto .....	<i>Serenoa repens</i>	
Giant bristlegrass .....	<i>Setaria magna</i>	
Yellow bristlegrass; knotroot foxtail.....	<i>Setaria parviflora</i>	
Narrowleaf blue-eyed grass .....	<i>Sisyrinchium angustifolium</i>	
Annual blue-eyed grass* .....	<i>Sisyrinchium rosulatum</i>	
Earleaf greenbrier .....	<i>Smilax auriculata</i>	
Saw greenbrier .....	<i>Smilax bona-nox</i>	
Cat greenbrier; Wild sarsaparilla .....	<i>Smilax glauca</i>	
Laurel greenbrier; Bamboo vine	<i>Smilax laurifolia</i>	
Sarsaparilla vine .....	<i>Smilax pumila</i>	
Johnsongrass* .....	<i>Sorghum halepense</i>	
Sand cordgrass.....	<i>Spartina bakeri</i>	
Marshay cordgrass; Saltmeadow cordgrass.....	<i>Spartina patens</i>	
Peace lily** .....	<i>Spahtiphyllum wallissii</i>	
Prairie wedgescale.....	<i>Sphenopholis obtusata</i>	
West Indian dropseed* .....	<i>Sporobolus jacquemontii</i>	
St. Augustinegrass .....	<i>Stenotaphrum secundatum</i>	
American evergreen* .....	<i>Syngonium podophyllum</i>	
Bartram's airplant .....	<i>Tillandsia bartramii</i>	
Ballmoss.....	<i>Tillandsia recurvata</i>	
Spanish moss .....	<i>Tillandsia usneoides</i>	
Bluejacket; Ohio spiderwort .....	<i>Tradescantia ohiensis</i>	
Tall redtop; Purpletop tridens ...	<i>Tridens flavus</i> var. <i>flavus</i>	
Purple sandgrass.....	<i>Triplasis purpurea</i>	
Eastern gamagrass; Fakahatcheegrass.....	<i>Tripsacum dactyloides</i>	
Guineagrass* .....	<i>Urochloa maxima</i>	
American eelgrass; Tapegrass ..	<i>Vallisneria americana</i>	
Arrowleaf elephant's ear* .....	<i>Xanthosoma sagittifolium</i>	
Adam's needle .....	<i>Yucca filamentosa</i>	
Atamasco-lily; Rain lily.....	<i>Zephyranthes atamasca</i> var. <i>atamasca</i> .....	88
Bitter ginger** .....	<i>Zingiber zerumbet</i>	

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
<b>DICOTS</b>		
Red maple .....	<i>Acer rubrum</i>	
Showy milkwort .....	<i>Asemeia violacea</i>	
Hammock snakeroot .....	<i>Ageratina jucunda</i>	
Silktree; Mimosa* .....	<i>Albizia julibrissin</i>	
Golden trumpet* .....	<i>Allamanda cathartica</i>	
Common ragweed .....	<i>Ambrosia artemisiifolia</i>	
Bastard false indigo .....	<i>Amorpha fruticosa</i>	
Scarlet milkweed* .....	<i>Asclepias curassavica</i>	
Curtiss' milkweed .....	<i>Asclepias curtissii</i> .....	14
Nodding nixie .....	<i>Apteria aphylla</i>	
Scratchthroat* .....	<i>Ardisia crenata</i>	
Bigflower pawpaw .....	<i>Asimina obovata</i>	
Dwarf pawpaw .....	<i>Asimina pygmea</i>	
Netted pawpaw .....	<i>Asimina reticulata</i>	
Fern-leaf yellow false foxglove..	<i>Aureolaria pectinata</i>	
Silverling .....	<i>Baccharis glomeruliflora</i>	
Groundsel tree; Sea myrtle.....	<i>Baccharis halimifolia</i>	
Herb-of-Grace .....	<i>Bacopa monnieri</i>	
Orchidtree; Mountain ebony* ...	<i>Bauhinia variegata</i>	
Tarflower .....	<i>Bejaria racemosa</i>	
Rattan vine; Alabama supplejack .....	<i>Berchemia scandens</i>	
Florida greeneyes.....	<i>Berlandiera subacaulis</i>	
Beggarticks; Romerillo .....	<i>Bidens alba</i>	
Smallfruit beggarticks .....	<i>Bidens mitis</i>	
False nettle; Bog hemp .....	<i>Boehmeria cylindrica</i>	
Red spiderling; Wineflower .....	<i>Boerhavia diffusa</i>	
Paper mulberry* .....	<i>Broussonetia papyrifera</i>	
Scarlet calamint.....	<i>Calamintha coccinea</i>	
Straggler daisy*.....	<i>Calyptocarpus vialis</i>	
American beautyberry.....	<i>Callicarpa americana</i>	
Trumpet creeper .....	<i>Campsis radicans</i>	
Coastalplain chaffhead; Florida paintbrush .....	<i>Carphephorus corymbosus</i>	
False vanillaleaf; Pineland purple .....	<i>Carphephorus odoratissimus</i> var. <i>subtropicanus</i>	
Wild olive; American devilwood	<i>Cartrema americanum</i>	
Scrub wild olive.....	<i>Cartrema floridanum</i>	
Pignut hickory.....	<i>Carya glabra</i>	
Spadeleaf.....	<i>Centella asiatica</i>	
Spurred butterfly pea.....	<i>Centrosema virginianum</i>	
Common buttonbush .....	<i>Cephalanthus occidentalis</i>	
Florida rosemary; Sand heath ..	<i>Ceratiola ericoides</i>	
Coontail.....	<i>Ceratophyllum demersum</i>	
Night-flowering jessamine* .....	<i>Cestrum nocturnum</i>	

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Partridge pea.....	<i>Chamaecrista fasciculata</i>	
Maryland goldenstar .....	<i>Chrysopsis mariana</i>	
Coastalplain goldenaster.....	<i>Chrysopsis scabrella</i>	
Spotted water hemlock .....	<i>Cicuta maculata</i>	
Camphortree* .....	<i>Cinnamomum camphora</i>	
Nuttall's thistle.....	<i>Cirsium nuttallii</i>	
Watermelon; Citron* .....	<i>Citrullus lanatus</i>	
Atlantic pigeonwings.....	<i>Clitoria mariana</i>	
Tread-softly; Finger rot .....	<i>Cnidocolus stimulosus</i>	
Canadian horseweed.....	<i>Conyza canadensis</i>	
Swamp dogwood; Stiff dogwood	<i>Cornus foemina</i>	
Florida scrub frostweed .....	<i>Crocanthemum nashii</i>	
Slender scratchdaisy.....	<i>Croptilon divaricatum</i>	
Rabbitbells .....	<i>Crotalaria rotundifolia</i>	
Michaux's croton; rushfoil.....	<i>Croton michauxii</i>	
Gooseberry gourd* .....	<i>Cucumis anguria</i>	
Cantaloupe* .....	<i>Cucumis melo</i>	
Whitetassles.....	<i>Dalea carnea</i> var. <i>carnea</i>	
Feay's prairieclover.....	<i>Dalea feayi</i>	
Summer farewell.....	<i>Dalea pinnata</i> var. <i>pinnata</i>	
Angel trumpet*.....	<i>Datura</i> sp.	
Western tansymustard .....	<i>Descurainia pinnata</i>	
Zarabacoa comun*.....	<i>Desmodium incanum</i>	
Threeflower ticktrefoil*.....	<i>Desmodium triflorum</i>	
Carolina ponysfoot.....	<i>Dichondra caroliniensis</i>	
Virginia buttonweed.....	<i>Diodia virginiana</i>	
Common persimmon.....	<i>Diospyros virginiana</i>	
Noyau vine.....	<i>Distimake dissectus</i>	
Pink sundew .....	<i>Drosera capillaris</i>	
Mexican tea* .....	<i>Dysphania ambrosioides</i>	
Tall elephantsfoot.....	<i>Elephantopus elatus</i>	
American burnweed; Fireweed..	<i>Erechtites hieracifolia</i>	
Oakleaf fleabane .....	<i>Erigeron quercifolius</i>	
Loquat* .....	<i>Eriobotrya japonica</i>	
Dog-tongue wildbuckwheat .....	<i>Eriogonum tomentosum</i>	
Coralbean; Cherokee bean.....	<i>Erythrina herbacea</i>	
Dogfennel .....	<i>Eupatorium capillifolium</i>	
Yankeeweed .....	<i>Eupatorium compositifolium</i>	
Falsefennel.....	<i>Eupatorium leptophyllum</i>	
Mohr's thoroughwort.....	<i>Eupatorium mohrii</i>	
Lateflowering thoroughwort .....	<i>Eupatorium serotinum</i>	
Painted leaf.....	<i>Euphorbia cyathophora</i>	
Slender flattop goldenrod .....	<i>Euthamia caroliniana</i>	
Carolina ash; Pop ash .....	<i>Fraxinus caroliniana</i>	
Cottonweed; Plains snakecotton	<i>Froelichia floridana</i>	
Florida milkpea .....	<i>Galactia floridana</i>	
Soft milkpea .....	<i>Galactia mollis</i>	

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Pursh's milkpea.....	<i>Galactia purshii</i>	
Eastern milkpea .....	<i>Galactia volubilis</i>	
Sticky willy; Goosegrass .....	<i>Galium aparine</i>	
Stiff marsh bedstraw.....	<i>Galium tinctorium</i>	
Garberia .....	<i>Garberia heterophylla</i> .....	13,14,15
Blue huckleberry .....	<i>Gaylussacia frondosa</i>	
Yellow jessamine.....	<i>Gelsemium sempervirens</i>	
Gopher apple.....	<i>Geobalanus oblongifolius</i>	
Loblolly bay.....	<i>Gordonia lasianthus</i>	
Spanish daisy; bitterweed.....	<i>Helenium amarum</i>	
Climbing hydrangea.....	<i>Hydrangea barbara</i>	
Manyflower marshpennywort....	<i>Hydrocotyle umbellata</i>	
Whorled marshpennywort.....	<i>Hydrocotyle verticillata</i> var. <i>triradiata</i>	
Coastalplain St. John's-wort.....	<i>Hypericum brachyphyllum</i>	
Peelbark St. John's-wort.....	<i>Hypericum fasciculatum</i>	
Fourpetal St. John's-wort.....	<i>Hypericum tetrapetalum</i>	
Virginia marsh St. John's-wort..	<i>Hypericum virginicum</i>	
Musky mint; Clustered bushmint .....	<i>Hyptis alata</i>	
Carolina holly; Sand holly .....	<i>Ilex ambigua</i>	
Dahoon .....	<i>Ilex cassine</i> var. <i>cassine</i>	
Large gallberry; Sweet galberry	<i>Ilex coriacea</i>	
Possumhaw .....	<i>Ilex decidua</i>	
Gallberry; Inkberry.....	<i>Ilex glabra</i>	
American holly .....	<i>Ilex opaca</i> var. <i>opaca</i>	
Yaupon.....	<i>Ilex vomitoria</i>	
Carolina indigo.....	<i>Indigofera caroliniana</i>	
Hairy indigo* .....	<i>Indigofera hirsuta</i>	
Trailing indigo* .....	<i>Indigofera spicata</i>	
Tievine .....	<i>Ipomoea cordatotriloba</i>	
Scarlet creeper .....	<i>Ipomoea hederifolia</i>	
Cypressvine*.....	<i>Ipomoea quamoclit</i>	
Saltmarsh morning glory .....	<i>Ipomoea sagittata</i>	
Virginia willow .....	<i>Itea virginica</i>	
Piedmont marshelder .....	<i>Iva microcephala</i>	
Mother-of-millions* .....	<i>Kalanchoe x houghtonii</i>	
Lantana; Shrub verbena* .....	<i>Lantana strigocamara</i>	
Nodding pinweed.....	<i>Lechea cernua</i> .....	14,15
Deckert's pinweed .....	<i>Lechea deckertii</i>	
Virginia pepperweed .....	<i>Lepidium virginicum</i>	
Fewflower gayfeather.....	<i>Liatris pauciflora</i> var. <i>pauciflora</i>	
Shortleaf gayfeather .....	<i>Liatris tenuifolia</i>	
Canada toadflax.....	<i>Linaria canadensis</i>	
Sweetgum.....	<i>Liquidambar styraciflua</i>	
Cardinal flower .....	<i>Lobelia cardinalis</i> .....	26,59
Japanese honeysuckle* .....	<i>Lonicera japonica</i>	
Coral honeysuckle .....	<i>Lonicera sempervirens</i>	

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Peruvian primrosewillow*	<i>Ludwigia peruviana</i>	
Creeping primrosewillow	<i>Ludwigia repens</i>	
Skyblue lupine	<i>Lupinus diffusus</i>	
Rose rush	<i>Lygodesmia aphylla</i>	
Rusty staggerbush	<i>Lyonia ferruginea</i>	
Coastalplain staggerbush	<i>Lyonia fruticosa</i>	
Fetterbush	<i>Lyonia lucida</i>	
Southern magnolia	<i>Magnolia grandiflora</i>	
Sweetbay	<i>Magnolia virginiana</i>	
Black medick*	<i>Medicago lupulina</i>	
Chinaberrytree*	<i>Melia azedarach</i>	
White sweetclover*	<i>Melilotus albus</i>	
Creeping cucumber	<i>Melothria pendula</i>	
Climbing hempvine	<i>Mikania scandens</i>	
Sensitive brier	<i>Mimosa quadrivalvis var. angustata</i>	
Partridgeberry; Twinberry	<i>Mitchella repens</i>	
Lax hornpod	<i>Mitreola petiolata</i>	
Spotted beebalm	<i>Monarda punctata</i>	
Wax myrtle; Southern bayberry	<i>Morella cerifera</i>	
Florida watercress	<i>Nasturtium floridanum</i>	
Peppervine	<i>Nekemias arborea</i>	
American white waterlily	<i>Nymphaea odorata</i>	
Swamp tupelo	<i>Nyssa biflora</i>	
Southern beeblossom	<i>Oenothera simulans</i>	
Pricklypear	<i>Opuntia humifusa</i>	
Piedmont leatherroot	<i>Orbexilum lupinellus</i>	
Common yellow woodsorrel	<i>Oxalis corniculata</i>	
Skunk vine*	<i>Paederia foetida</i>	
Coastalplain palafox	<i>Palafoxia integrifolia</i>	
Florida pellitory	<i>Parietaria floridana</i>	
Virginia creeper; Woodbine	<i>Parthenocissus quinquefolia</i>	
Purple passionflower	<i>Passiflora incarnata</i>	
Red bay	<i>Persea borbonia var. borbonia</i>	
Swamp bay	<i>Persea palustris</i>	
Swamp smartweed	<i>Persicaria hydropiperoides</i>	
Oak mistletoe	<i>Phoradendron leucarpum</i>	
Turkey tanglefoot fogfruit	<i>Phyla nodiflora</i>	
Drummond's leafflower	<i>Phyllanthus abnormis</i>	
Mascarene island leafflower*	<i>Phyllanthus tenellus</i>	
Walter's groundcherry	<i>Physalis walteri</i>	
Pokeweed	<i>Phytolacca americana</i>	
Pennyroyal	<i>Piloblephis rigida</i>	
Pitted stripeseed	<i>Piriqueta cistoides subsp. caroliniana</i>	
Narrowleaf silkgrass	<i>Pityopsis graminifolia</i>	
Virginia plantain; Southern plantain	<i>Plantago virginica</i>	
Rosy camphorweed	<i>Pluchea baccharis</i>	

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence



## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Camphorweed .....	<i>Pluchea camphorata</i>	
Orange milkwort .....	<i>Polygala lutea</i>	
Yellow milkwort.....	<i>Polygala rugelii</i>	
Coastalplain milkwort.....	<i>Polygala setacea</i>	
Large flower jointweed.....	<i>Polygonum nesomii</i>	
October flower.....	<i>Polygonum polygamum</i> var. <i>polygamum</i>	
Carolina laurelcherry.....	<i>Prunus caroliniana</i>	
Black cherry .....	<i>Prunus serotina</i>	
Blackroot .....	<i>Pterocaulon pycnostachyum</i>	
Formosa firethorn** .....	<i>Pyracantha koidzumii</i>	
Carolina desert chicory.....	<i>Pyrrhopappus carolinianus</i>	
Chapman's oak .....	<i>Quercus chapmanii</i>	
Sand live oak.....	<i>Quercus geminata</i>	
Bluejack oak.....	<i>Quercus incana</i>	
Turkey oak.....	<i>Quercus laevis</i>	
Laurel oak.....	<i>Quercus laurifolia</i>	
Dwarf live oak .....	<i>Quercus minima</i>	
Myrtle oak.....	<i>Quercus myrtifolia</i>	
Water oak .....	<i>Quercus nigra</i>	
Running oak .....	<i>Quercus pumila</i>	
Virginia live oak .....	<i>Quercus virginiana</i>	
Wild radish* .....	<i>Raphanus raphanistrum</i>	
West Indian meadowbeauty .....	<i>Rhexia cubensis</i>	
Fringed meadowbeauty .....	<i>Rhexia petiolata</i>	
Winged sumac .....	<i>Rhus copallinum</i>	
Snoutbean .....	<i>Rhynchosia</i> sp.	
Tropical Mexican clover*.....	<i>Richardia brasiliensis</i>	
Rough Mexican clover*.....	<i>Richardia scabra</i>	
Swamp rose .....	<i>Rosa palustris</i>	
Sand blackberry.....	<i>Rubus cuneifolius</i>	
Sawtooth blackberry .....	<i>Rubus pensilvanicus</i>	
Carolina wild petunia .....	<i>Ruellia caroliniensis</i>	
Heartwing dock.....	<i>Rumex hastatulus</i>	
Smallflower mock buckthorn ...	<i>Sageretia minutiflora</i>	
Coastalplain willow .....	<i>Salix caroliniana</i>	
Lyreleaf sage.....	<i>Salvia lyrata</i>	
Southern river sage .....	<i>Salvia misella</i>	
American elder; Elderberry .....	<i>Sambucus nigra</i> subsp. <i>canadensis</i>	
Lizard's tail.....	<i>Saururus cernuus</i>	
Brazilian pepper* .....	<i>Schinus terebinthifolia</i>	
Whitetop aster; dixie aster.....	<i>Sericocarpus tortifolius</i>	
Piedmont blacksenna .....	<i>Seymeria pectinata</i>	
Florida bully .....	<i>Sideroxylon reclinatum</i>	
Rufous Florida bully .....	<i>Sideroxylon rufohirtum</i>	
Tough bully .....	<i>Sideroxylon tenax</i>	
Pinebarren goldenrod.....	<i>Solidago fistulosa</i>	
Leavenworth's goldenrod .....	<i>Solidago leavenworthii</i>	

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Plants

Common Name	Scientific Name	Primary Habitat
Chapman's goldenrod .....	<i>Solidago odora</i> var. <i>chapmanii</i>	
Twistedleaf goldenrod .....	<i>Solidago tortifolia</i>	
Rough hedgehyssop.....	<i>Sophronanthe hispida</i>	
Roughfruit scaleseed.....	<i>Spermolepis divaricata</i>	
Wedelia; Creeping oxeye* .....	<i>Sphagneticola trilobata</i>	
Florida hedgenettle.....	<i>Stachys floridana</i>	
Common chickweed* .....	<i>Stellaria media</i>	
Climbing aster .....	<i>Symphyotrichum carolinianum</i>	
Rice button aster.....	<i>Symphyotrichum dumosum</i>	
Elliott's aster .....	<i>Symphyotrichum elliotii</i>	
Common dandelion* .....	<i>Taraxacum officinale</i>	
Shrub sunflower* .....	<i>Tithonia diversifolia</i>	
Eastern poison ivy .....	<i>Toxicodendron radicans</i>	
Chinese tallowtree* .....	<i>Triadica sebifera</i>	
American elm .....	<i>Ulmus americana</i>	
Chinese elm** .....	<i>Ulmus parviflora</i>	
Eastern purple bladderwort .....	<i>Utricularia purpurea</i>	
Sparkleberry; Farkleberry .....	<i>Vaccinium arboreum</i>	
Highbush blueberry .....	<i>Vaccinium corymbosum</i>	
Darrow's blueberry .....	<i>Vaccinium darrowii</i>	
Shiny blueberry .....	<i>Vaccinium myrsinites</i>	
Wand mullein* .....	<i>Verbascum virgatum</i>	
Texas vervain .....	<i>Verbena halei</i>	
Sandpaper vervain .....	<i>Verbena scabra</i>	
Walter's viburnum .....	<i>Viburnum obovatum</i>	
Sweet viburnum** .....	<i>Viburnum odoratissimum</i>	
Common blue violet.....	<i>Viola sororia</i>	
Florida grape .....	<i>Vitis cinerea</i> var. <i>floridana</i>	
Muscadine.....	<i>Vitis rotundifolia</i>	
Tallowwood; hog plum .....	<i>Ximenia americana</i>	
Oriental false hawksbeard* .....	<i>Youngia japonica</i>	

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
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### MOLLUSKS

Clam*	<i>Corbicula fluminea</i>	59
Mud snail	Hydrobiidae <i>sp.</i>	59
Dusky ancyliid	<i>Laevapex focus</i>	59
Thiarid	<i>Melanoides sp.</i>	59
Red-rim melania	<i>Melanoides tuberculata</i>	59
Alligator silt-snail	<i>Notogillia wetherbyi</i>	59
Carib physa	<i>Physella cubensis</i>	59
Mesa rams-horn	<i>Planorbella scalaris</i>	59
Freshwater snail	<i>Pleuocera floridensis</i>	59
Florida applesnail	<i>Pomacea paludosa</i>	59
Peaclam	Sphaeriidae <i>sp.</i>	59
Fingernail clam	<i>Sphaerium sp.</i>	59
Florida rainbow	<i>Villosa amygdala</i>	59

### ANNELIDS

Oligochaete worm	<i>Allonais inaequalis</i>	59
Oligochaete worm	<i>Dero digitate</i>	59
Oligochaete worm	<i>Dero furcate</i>	59
Leech	Glossiphoniidae <i>sp.</i>	59
Leech	<i>Helobdella elongata</i>	59
Leech	<i>Helobdella sp.</i>	59
Leech	<i>Helobdella stagnalis</i>	59
Oligochaete worm	<i>Limnodrilus hoffmeisteri</i>	59
Oligochaete worm	<i>Lumbriculus variegatus</i>	59
Common earthworm	<i>Lumbricus terrestris</i>	MTC
Oligochaete worm	Naididae <i>sp.</i>	59
Oligochaete worm	<i>Nais magnaseta</i>	59
Oligochaete worm	<i>Nais pardalis</i>	59
Oligochaete worm	<i>Nais pseudobtusa</i>	59
Oligochaete worm	<i>Pristina leidy</i>	59
Oligochaete worm	Tubificinae <i>sp.</i>	59

### ARTHROPODS

Two-winged fly	<i>Ablabesmyia mallochi</i>	59
Common green darner	<i>Anax junius</i>	MTC
White peacock	<i>Anartia jatrophae</i>	MTC
Two-winged fly	<i>Antichaeta sp.</i>	59
Two-striped forceptail	<i>Aphylla williamsoni</i>	59
Powdered dancer	<i>Argia moesta</i>	59
Blue-ringed dancer	<i>Argia sedula</i>	59
Mite	<i>Artactides sp.</i>	59
Small minnow mayfly	<i>Baetis intercalaris</i>	59

\* Non-native Species

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
Isopod.....	<i>Caecidotea sp.</i> .....	59
Halloween pennant.....	<i>Celithemis eponina</i> .....	MTC
Biting midge .....	<i>Ceratopogonidae sp.</i> .....	59
Caddisfly.....	<i>Cheumatopsyche sp.</i> .....	59
Little black caddisfly .....	<i>Chimarra sp.</i> .....	59
Florida cave crangonyctid .....	<i>Crangonyx grandimanus</i> .....	60
Hobb's cave amphipod .....	<i>Crangonyx hobbsi</i> .....	60
Non-biting midge .....	<i>Chironomidae sp.</i> .....	59
Two-winged fly .....	<i>Cladotanytarsus sp.</i> .....	59
Narrow-winged damselfly .....	<i>Coenagrionidae sp.</i> .....	59
Dobsonfly .....	<i>Corydalus cornutus</i> .....	59
Two-winged fly .....	<i>Corynoneura sp.</i> .....	59
Two-winged fly .....	<i>Cryptochironomous sp.</i> .....	59
Two-winged fly .....	<i>Dicrotendipes sp.</i> .....	59
Two-winged fly .....	<i>Diptera sp.</i> .....	59
Beetle .....	<i>Dubiraphia sp.</i> .....	59
Moth .....	<i>Elophila sp.</i> .....	59
Dance fly .....	<i>Empididae sp.</i> .....	59
Prince baskettail.....	<i>Epithea princeps</i> .....	59
Mayfly .....	<i>Ephemeroptera sp.</i> .....	59
Eastern pondhawk.....	<i>Erythemis simplicicollis</i> .....	MTC
Seaside dragonlet.....	<i>Erythrodiplax Berenice</i> .....	MTC
Little blue dragonlet.....	<i>Erythrodiplax minuscula</i> .....	MTC
Zebra Swallowtail.....	<i>Eurytides marcellus</i> .....	MTC
Mite .....	<i>Geayia sp.</i> .....	59
Beetle .....	<i>Gyrinus sp.</i> .....	59
Zebra heliconian .....	<i>Heliconius charithonia</i> .....	MTC
Speckled Peter.....	<i>Helicopsyche borealis</i> .....	59
Two-winged fly .....	<i>Hemerodromia sp.</i> .....	59
Stream mayfly .....	<i>Heptageniidae sp.</i> .....	59
Smoky rubyspot.....	<i>Hetaerina titia</i> .....	MTC
True bug.....	<i>Heteroptera sp.</i> .....	59
Amphipod .....	<i>Hyalella azteca sp.</i> .....	59
Netspinning caddisfly .....	<i>Hydropsychidae sp.</i> .....	59
Caddisfly.....	<i>Hydropsyche rossi</i> .....	59
Micro caddisfly .....	<i>Hydroptila sp.</i> .....	59
Mite .....	<i>Hygrobatas sp.</i> .....	59
Mite .....	<i>Krendowskia sp.</i> .....	59
Mite .....	<i>Lebertia sp.</i> .....	59
Slaty skimmer .....	<i>Libellula incesta</i> .....	59
Long-horn caddisfly .....	<i>Leptoceridae sp.</i> .....	59
Mayfly .....	<i>Maccaffertium exiguum</i> .....	59
Georgia river cruiser .....	<i>Macromia illinoiensis georgina</i> .....	59
Beetle .....	<i>Microcylloepus sp.</i> .....	59
Mysid shrimp .....	<i>Mysida sp.</i> .....	59
Caddisfly.....	<i>Nectopsyche pavida</i> .....	59

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
Tavares white miller caddisfly...	<i>Nectopsyche tavana</i> .....	59
Caddisfly.....	<i>Neotrichia sp.</i> .....	59
Caddisfly.....	<i>Oecetis avara</i> .....	59
Caddisfly.....	<i>Ochrotrichia sp.</i> .....	59
Caddisfly.....	<i>Orthotrichia sp.</i> .....	59
Caddisfly.....	<i>Oxyethira sp.</i> .....	59
Blue dasher.....	<i>Pachydiplax longipennis</i> .....	MTC
Decapod .....	<i>Palaemonetes sp.</i> .....	59
Two-winged fly .....	<i>Paracladopelma sp.</i> .....	59
Two-winged fly .....	<i>Paratanytarsus sp.</i> .....	59
Moth .....	<i>Parapoynx sp.</i> .....	59
Two-winged fly .....	<i>Pentaneura sp.</i> .....	59
Eastern tiger swallowtail.....	<i>Papilio galucus</i> .....	MTC
Moth .....	<i>Petrophila santafealis</i> .....	59
Scuttle fly .....	Phoridae sp. ....	59
Two-winged fly .....	<i>Polypedilum convictum</i> .....	59
Two-winged fly .....	<i>Polypedilum scalaenum</i> .....	59
Two-winged fly .....	<i>Pseudochironomus sp.</i> .....	59
Two-winged fly .....	<i>Psychoda sp.</i> .....	59
Moth fly .....	Psychodidae sp. ....	59
True bug.....	<i>Rhagovelia choreutes</i> .....	59
Two-winged fly .....	<i>Rheotanytarsus sp.</i> .....	59
Eastern lubber grasshopper .....	<i>Romalea microptera</i> .....	MTC
Red imported fire ant.....	<i>Solenopsis invicta</i> .....	MTC
Two-winged fly .....	<i>Stenochironomus sp.</i> .....	59
Beetle .....	<i>Stenelmis sp.</i> .....	59
Russet-tipped clubtail .....	<i>Stylurus plagiatus</i> .....	MTC
Two-winged fly .....	Tanypodinae sp. ....	59
Two-winged fly .....	<i>Tanytarsus sp.</i> .....	59
Two-winged fly .....	<i>Thienemanniella similis</i> .....	59
Two-winged fly .....	<i>Thienemanniella xena</i> .....	59
True bug.....	<i>Treobates sp.</i> .....	59
Caddisfly.....	Tricoptera sp. ....	59
Mayfly .....	<i>Tricorythodes albilineatus</i> .....	59
North Florida spider crayfish ....	<i>Troglocambarus maclanei</i> .....	60
Long-tailed skipper.....	<i>Urbanus proteus</i> .....	MTC
Carpenter bee.....	<i>Xylocopa virginica</i> .....	MTC

### FISH

Sheepshead .....	<i>Archosargus probatocephalus</i> .....	59
Yellow bullhead.....	<i>Ameiurus natalis</i> .....	26, 59
Creville jack .....	<i>Caranx hippos</i> .....	59
Common snook.....	<i>Centropomus undecimalis</i> .....	59
Everglades pygmy sunfish .....	<i>Elassoma evergladei</i> .....	59
Swamp darter.....	<i>Etheostoma fusiforme</i> .....	26, 59

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
Golden topminnow .....	<i>Fundulus chrysotus</i> .....	26, 59
Eastern mosquitofish .....	<i>Gambusia affinis</i> .....	26, 59
Least killifish .....	<i>Heterandria formosa</i> .....	26, 59
American flagfish .....	<i>Jordanella floridae</i> .....	26, 59
Warmouth.....	<i>Lepomis gulosus</i> .....	59
Bluegill .....	<i>Lepomis macrochirus</i> .....	59
Redear sunfish.....	<i>Lepomis microlophus</i> .....	59
Spotted sunfish.....	<i>Lepomis punctatus</i> .....	59
Florida gar .....	<i>Lepisosteus platyrhincus</i> .....	59
Bluefin killifish .....	<i>Lucania goodei</i> .....	26, 59
Gray snapper.....	<i>Lutjanus griseus</i> .....	59
.....	.....	.....
Florida largemouth bass .....	<i>Micropterus salmoides floridanus</i> .....	59
Striped mullet.....	<i>Mugil cephalus</i> .....	59
Golden shiner .....	<i>Notemigonus crysoleucas</i> .....	59
Coastal shiner.....	<i>Notropis petersoni</i> .....	59
Sailfin molly .....	<i>Poecilia latipinna</i> .....	26, 59
Atlantic needlefish .....	<i>Strongylura marina</i> .....	59

### AMPHIBIANS

Southern cricket frog .....	<i>Acris gryllus</i> .....	26, 31
Two-toed amphiuma .....	<i>Amphiuma means</i> .....	59
Oak toad.....	<i>Anaxyrus quercicus</i> .....	MTC
Southern toad.....	<i>Anaxyrus terrestris</i> .....	MTC
Pine woods treefrog .....	<i>Dryophytes femoralis</i> .....	MTC
Barking treefrog.....	<i>Dryophytes gratiosus</i> .....	MTC
Squirrel treefrog .....	<i>Dryophytes squirellus</i> .....	MTC
Greenhouse frog*.....	<i>Eleutherodactylus p. planirostris</i> .....	MTC
Eastern narrow-mouthed toad ..	<i>Gastrophyne carolinensis</i> .....	MTC
American bullfrog .....	<i>Lithobates catesbeianus</i> .....	MTC
Southern leopard frog .....	<i>Lithobates sphenoccephalus</i> .....	MTC
Cuban treefrog*.....	<i>Osteopilus septentrionalis</i> .....	88
Ornate chorus frog .....	<i>Pseudacris ornate</i> .....	MTC
Eastern spadefoot .....	<i>Scaphiopus holbrookii</i> .....	MTC

### REPTILES

#### Crocodylians

American alligator .....	<i>Alligator mississippiensis</i> .....	26, 59
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#### Turtles

Florida softshell turtle .....	<i>Apalone ferox</i> .....	59
North American snapping turtle	<i>Chelydra serpentina</i> .....	59
Florida chicken turtle .....	<i>Deirochelys reticularia chrysea</i> .....	59
Gopher tortoise.....	<i>Gopherus polyphemus</i> .....	13,15

\* Non-native Species

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\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
Striped mud turtle .....	<i>Kinosternon baurii</i> .....	59
Ornate diamondbacked terrapin	<i>Malaclemys terrapin macrospilota</i> .....	59
Peninsula cooter.....	<i>Pseudemys peninsularis</i> .....	59
Suwannee cooter .....	<i>Pseudemys concinna suwanniensis</i> .....	59
Florida red-bellied cooter .....	<i>Pseudemys nelsoni</i> .....	59
Loggerhead musk turtle .....	<i>Sternotherus minor minor</i> .....	59
Common musk turtle .....	<i>Sternotherus odoratus</i> .....	59
Florida box turtle .....	<i>Terrapene bauri</i> .....	MTC
Red-eared slider* .....	<i>Trachemys scripta elegans</i> .....	59
Yellow-bellied slider .....	<i>Trachemys scripta scripta</i> .....	59

### Lizards

Green anole .....	<i>Anolis carolinensis</i> .....	15
Brown anole* .....	<i>Anolis sagrei</i> .....	MTC
Eastern six-lined racerunner ....	<i>Cnemidophorus sexlineatus sexlineatus</i> ....	14, 15
Southeastern five-lined skink ...	<i>Eumeces inexpectatus</i> .....	MTC
Broad headed Skink.....	<i>Eumeces laticeps</i> .....	MTC
Indo-Pacific house gecko* .....	<i>Hemidactylus garnotii</i> .....	88
Mediterranean house gecko* ....	<i>Hemidactylus turcicus</i> .....	88
Eastern fence lizard .....	<i>Sceloporus undulatus</i> .....	14, 15
Ground skink .....	<i>Scincella lateralis</i> .....	MTC

### Snakes

Florida cottonmouth.....	<i>Agkistrodon piscivorus conanti</i> .....	MTC
Southern black racer.....	<i>Coluber constrictor priapus</i> .....	MTC
Eastern coachwhip.....	<i>Coluber flagellum flagellum</i> .....	MTC
Eastern diamondback rattlesnake.....	<i>Crotalus adamanteus</i> .....	MTC
Brahminy blind snake* .....	<i>Indotyphlops braminus</i> .....	88
Coral Snake.....	<i>Micrurus fulvius</i> .....	MTC
Florida water snake .....	<i>Nerodia fasciata pictiventris</i> .....	26, 59
Florida rough green snake .....	<i>Opheodrys aestivus carinatus</i> .....	26,59
Eastern rat snake .....	<i>Pantherophis alleghaniensis</i> .....	MTC
Cornsnake.....	<i>Pantherophis guttatus</i> .....	MTC
Peninsula ribbon snake.....	<i>Thamnophis saurita sackenii</i> .....	MTC

## BIRDS

### Grebes

Pied-billed grebe .....	<i>Podilymbus podiceps</i> .....	59
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### Pelicans

American white pelican .....	<i>Pelecanus erythrorhynchos</i> .....	OF
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### Cormorants

Anhinga .....	<i>Anhinga anhinga</i> .....	26,59
Double-crested cormorant .....	<i>Phalacrocorax auritus</i> .....	59

\* Non-native Species

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
<b>Wading birds</b>		
Great egret .....	<i>Ardea alba</i> .....	26,59
Great blue heron .....	<i>Ardea herodias</i> .....	26,59
Cattle egret.....	<i>Bubulcus ibis</i> .....	MTC
Green heron .....	<i>Butorides virescens</i> .....	26,59
Little blue heron.....	<i>Egretta caerulea</i> .....	26,59
Snowy egret.....	<i>Egretta thula</i> .....	26,59
Tri-colored heron .....	<i>Egretta tricolor</i> .....	26,59
White ibis.....	<i>Eudocimus albus</i> .....	MTC
Wood stork .....	<i>Mycteria americana</i> .....	26,59
Roseate spoonbill .....	<i>Platalea ajaja</i> .....	26,59
<b>Ducks and Geese</b>		
Mottled duck .....	<i>Anas fulvigula</i> .....	59
Mallard .....	<i>Anas platyrhynchos</i> .....	26,59
Muscovy duck* .....	<i>Cairina moschata</i> .....	88
Red-breasted merganser .....	<i>Mergus serrator</i> .....	26,59
<b>Vultures</b>		
Turkey vulture .....	<i>Cathartes aura</i> .....	MTC, OF
Black vulture .....	<i>Coragyps atratus</i> .....	MTC, OF
<b>Hawks, Eagles and Kites</b>		
Cooper's hawk .....	<i>Accipter cooperii</i> .....	MTC
Short-tailed hawk.....	<i>Buteo brachyurus</i> .....	OF
Red-tailed hawk.....	<i>Buteo jamaicensis</i> .....	14, OF
Red-shouldered hawk .....	<i>Buteo lineatus</i> .....	MTC
Northern harrier.....	<i>Circus cyaneus</i> .....	26
Swallow-tailed kite .....	<i>Elanoides forficatus</i> .....	OF
Bald eagle.....	<i>Haliaeetus leucocephalus</i> .....	15, 39, 59
Osprey .....	<i>Pandion haliaetus</i> .....	OF
<b>Turkey and Quail and Fowl</b>		
Northern bobwhite.....	<i>Colinus virginianus</i> .....	14, 15
Wild turkey .....	<i>Meleagris gallopavo</i> .....	10, 14, 15
Indian peafowl* .....	<i>Pavo cristatus</i> .....	88
<b>Moorhen</b>		
Common moorhen.....	<i>Gallinula chloropus</i> .....	26, 59
<b>Cranes</b>		
Florida sandhill crane .....	<i>Grus canadensis pratensis</i> .....	26, OF
<b>Limpkin</b>		
Limpkin .....	<i>Aramus guarauna</i> .....	59

\* Non-native Species

\*\*Non-native species Attraction-only occurrence



## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
<b>Gulls</b>		
Ring-billed gull.....	<i>Larus delawarensis</i> .....	OF
Laughing gull.....	<i>Leucophaeus atricilla</i> .....	OF
<b>Doves</b>		
Common ground-dove .....	<i>Columbina passerina</i> .....	MTC
Mourning dove.....	<i>Zenaida macroura</i> .....	MTC
<b>Owls</b>		
Great horned owl .....	<i>Bubo virginianus</i> .....	9, 15, 36
Barred owl .....	<i>Strix varia</i> .....	9, 15, 36
<b>Goatsuckers and swifts</b>		
Chimney swift.....	<i>Chaetura pelagica</i> .....	OF
Common nighthawk.....	<i>Chordeiles minor</i> .....	15, OF
<b>Kingfishers</b>		
Belted kingfisher .....	<i>Megaceryle alcyon</i> .....	26, 59
<b>Woodpeckers</b>		
Northern flicker.....	<i>Colaptes auratus</i> .....	13,14,15
Pileated woodpecker .....	<i>Dryocopus pileatus</i> .....	MTC
Red-bellied woodpecker.....	<i>Melanerpes carolinus</i> .....	MTC
Downy woodpecker .....	<i>Picoides pubescens</i> .....	MTC
Hairy woodpecker.....	<i>Picoides villosus</i> .....	13,14,15
<b>Flycatchers</b>		
Eastern wood-peewee .....	<i>Contopus virens</i> .....	10,36
Eastern phoebe.....	<i>Sayornis phoebe</i> .....	MTC
Great crested flycatcher .....	<i>Myiarchus crinitus</i> .....	MTC
<b>Vireos</b>		
White-eyed vireo.....	<i>Vireo griseus</i> .....	, 15,
Red-eyed vireo .....	<i>Vireo olivaceus</i>	
Blue-headed vireo .....	<i>Vireo solitarius</i> .....	15,
<b>Jays and Crows</b>		
Florida scrub-jay .....	<i>Aphelocoma coerulescens</i> .....	15
American crow.....	<i>Corvus brachyrhynchos</i> .....	MTC, OF
Fish crow .....	<i>Corvus ossifragus</i> .....	OF
Blue jay.....	<i>Cyanocitta cristata</i> .....	MTC
<b>Titmice</b>		
Tufted titmouse .....	<i>Baeolophus bicolor</i> .....	MTC
Carolina chickadee .....	<i>Poecile carolinensis</i> .....	15

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
<b>Wrens</b>		
Carolina wren .....	<i>Thryothorus ludovicianus</i> .....	MTC
<b>Gnatcatchers and Kinglets</b>		
Blue-gray gnatcatcher.....	<i>Poliophtila caerulea</i> .....	MTC
Ruby-crowned kinglet .....	<i>Regulus calendula</i> .....	MTC
<b>Thrushes</b>		
Hermit thrush .....	<i>Catharus guttatus</i> .....	15
Eastern bluebird.....	<i>Sialia sialis</i> .....	15
American robin .....	<i>Turdus migratorius</i> .....	MTC
<b>Thrashers</b>		
Gray catbird .....	<i>Dumetella carolinensis</i> .....	MTC
Northern mockingbird .....	<i>Mimus polyglottos</i> .....	MTC
Brown thrasher .....	<i>Toxostoma rufum</i> .....	14, 15
<b>Waxwings</b>		
Cedar waxwing .....	<i>Bombycilla cedrorum</i> .....	OF
<b>Warblers</b>		
Prairie warbler .....	<i>Dendroica discolor</i> .....	MTC
Yellow-throated warbler .....	<i>Dendroica dominica</i> .....	MTC
Black and white warbler .....	<i>Mniotilta varia</i> .....	MTC
Northern parula .....	<i>Parula americana</i> .....	MTC
Prothonotary warbler .....	<i>Protonotaria citrea</i> .....	MTC
Ovenbird.....	<i>Seiurus aurocapillus</i> .....	MTC
Yellow-rumped warbler .....	<i>Setophaga coronate</i> .....	MTC
Palm warbler .....	<i>Setophaga palmarum</i> .....	MTC
Pine warbler .....	<i>Setophaga pinus</i> .....	MTC
American redstart .....	<i>Setophaga ruticilla</i> .....	10,36
<b>Sparrows</b>		
Eastern towhee.....	<i>Pipilo erythrophthalmus</i> .....	MTC
Swamp sparrow .....	<i>Melospiza georgiana</i> .....	26, 59
Chipping sparrow .....	<i>Spizella passerina</i> .....	14, 15
<b>Meadowlarks, Blackbirds and Orioles</b>		
Red-winged blackbird.....	<i>Agelaius phoeniceus</i> .....	26
Common grackle .....	<i>Quiscalus quiscula</i> .....	MTC
Eastern meadowlark .....	<i>Sturnella magna</i> .....	MTC
<b>Cardinals, Grosbeaks, and Buntings</b>		
Northern cardinal .....	<i>Cardinalis cardinalis</i> .....	MTC
Painted bunting.....	<i>Passerina ciris</i> .....	MTC

\* Non-native Species

\*\*Non-native species Attraction-only occurrence

## Weeki Wachee Springs State Park Animals

Common Name	Scientific Name	Primary Habitat
<b>Finches</b>		
House finch*	<i>Haemorhous mexicanus</i>	88
American goldfinch	<i>Spinus tristis</i>	MTC
<b>MAMMALS</b>		
<b>Didelphids</b>		
Virginia opossum	<i>Didelphis virginiana</i>	MTC
<b>Cingulates</b>		
Nine-banded armadillo*	<i>Dasypus novemcinctus</i>	MTC
<b>Lagomorphs</b>		
Eastern cottontail	<i>Sylvilagus floridanus</i>	MTC
<b>Rodents</b>		
Golden mouse	<i>Ochrotomys nuttalli</i>	14, 15
Black rat*	<i>Rattus rattus</i>	88
Eastern gray squirrel	<i>Sciurus carolinensis</i>	MTC
<b>Carnivores</b>		
Coyote*	<i>Canis latrans</i>	MTC
Bobcat	<i>Felis rufus</i>	MTC
River otter	<i>Lontra canadensis</i>	59
Raccoon	<i>Procyon lotor</i>	MTC
Florida black bear	<i>Ursus americanus floridanus</i>	MTC
<b>Artiodactyls</b>		
White-tailed deer	<i>Odocoileus virginianus</i>	15,
Feral hog*	<i>Sus scrofa</i>	MTC
<b>Sirenia</b>		
Florida manatee	<i>Trichechus manatus latirostris</i>	59

\* Non-native Species

\*\*Non-native species Attraction-only occurrence



## **Addendum 6—Imperiled Species Ranking Definitions**



## **Imperiled Species Ranking Definitions**

---

The Nature Conservancy and the Natural Heritage Program Network (of which FNAI is a part) define an element as any exemplary or rare component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave or other ecological feature. An element occurrence (EO) is a single extant habitat that sustains or otherwise contributes to the survival of a population or a distinct, self-sustaining example of a particular element.

Using a ranking system developed by The Nature Conservancy and the Natural Heritage Program Network, the Florida Natural Areas Inventory assigns two ranks to each element. The global rank is based on an element's worldwide status; the state rank is based on the status of the element in Florida. Element ranks are based on many factors, the most important ones being estimated number of Element occurrences, estimated abundance (number of individuals for species; area for natural communities), range, estimated adequately protected EOs, relative threat of destruction, and ecological fragility.

Federal and State status information is from the U.S. Fish and Wildlife Service; and the Florida Fish and Wildlife Conservation Commission (animals), and the Florida Department of Agriculture and Consumer Services (plants), respectively.

### **FNAI GLOBAL RANK DEFINITIONS**

- G1 ..... Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or fabricated factor.
- G2 ..... Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
- G3 ..... Either very rare or local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
- G4 ..... apparently secure globally (may be rare in parts of range)
- G5 ..... demonstrably secure globally
- GH..... of historical occurrence throughout its range may be rediscovered (e.g., ivory-billed woodpecker)
- GX..... believed to be extinct throughout range
- GXC ..... extirpated from the wild but still known from captivity or cultivation
- G#? ..... Tentative rank (e.g., G2?)
- G#G# ..... range of rank; insufficient data to assign specific global rank (e.g., G2G3)
- G#T# ..... rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1)
- G#Q ..... rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q)
- G#T#Q..... same as above, but validity as subspecies or variety is questioned.

## **Imperiled Species Ranking Definitions**

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- GU.....due to lack of information, no rank or range can be assigned (e.g., GUT2).
- G? .....Not yet ranked (temporary)
- S1 .....Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
- S2 .....Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
- S3 .....Either very rare or local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
- S4 .....apparently secure in Florida (may be rare in parts of range)
- S5 .....demonstrably secure in Florida
- SH.....of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
- SX .....believed to be extinct throughout range
- SA .....accidental in Florida, i.e., not part of the established biota
- SE .....an exotic species established in Florida may be native elsewhere in North America
- SN .....regularly occurring but widely and unreliably distributed; sites for conservation hard to determine
- SU .....due to lack of information, no rank or range can be assigned (e.g., SUT2).
- S?.....Not yet ranked (temporary)
- N .....Not currently listed, nor currently being considered for listing, by state or federal agencies.



## **Imperiled Species Ranking Definitions**

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### **LEGAL STATUS**

#### **FEDERAL**

##### **(Listed by the U. S. Fish and Wildlife Service - USFWS)**

- LE..... Listed as Endangered Species in the List of Endangered and Threatened Wildlife and Plants under the provisions of the Endangered Species Act. Defined as any species that is in danger of extinction throughout all or a significant portion of its range.
- PE..... Proposed for addition to the List of Endangered and Threatened Wildlife and Plants as Endangered Species.
- LT..... Listed as Threatened Species. Defined as any species that is likely to become an endangered species within the near future throughout all or a significant portion of its range.
- PT..... Proposed for listing as Threatened Species.
- C ..... Candidate Species for addition to the list of Endangered and Threatened Wildlife and Plants. Defined as those species for which the USFWS currently has on file sufficient information on biological vulnerability and threats to support proposing to list the species as endangered or threatened.
- E(S/A)..... Endangered due to similarity of appearance.
- T(S/A)..... Threatened due to similarity of appearance.
- EXPE, XE..... Experimental essential population. A species listed as experimental and essential.
- EXPN, XN.... Experimental non-essential population. A species listed as experimental and non-essential. Experimental, nonessential populations of endangered species are treated as threatened species on public land, for consultation purposes.

#### **STATE**

##### **ANIMALS .. (Listed by the Florida Fish and Wildlife Conservation Commission - FWC)**

- FE..... Federally-designated Endangered
- FT..... Federally-designated Threatened
- FXN ..... Federally-designated Threatened Nonessential Experimental Population
- FT(S/A) ..... Federally-designated Threatened species due to similarity of appearance

## **Imperiled Species Ranking Definitions**

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ST ..... Listed as Threatened Species by the FWC. Defined as a species, subspecies, or isolated population, which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat, is decreasing in area at a rapid rate and therefore is destined or very likely to become an endangered species within the near future.

SSC ..... Listed as Species of Special Concern by the FWC. Defined as a population which warrants special protection, recognition or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance or substantial human exploitation that, in the near future, may result in its becoming a threatened species.

### **PLANTS .... (Listed by the Florida Department of Agriculture and Consumer Services - FDACS)**

LE..... Listed as Endangered Plants in the Preservation of Native Flora of Florida Act. Defined as species of plants native to the state that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue, and includes all species determined to be endangered or threatened pursuant to the Federal Endangered Species Act of 1973, as amended.

LT..... Listed as Threatened Plants in the Preservation of Native Flora of Florida Act. Defined as species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in such number as to cause them to be endangered.

## **Addendum 7—Cultural Information**



## **Management Procedures for Archaeological and Historical Sites and Properties on State-Owned or Controlled Properties**

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**These procedures apply to state agencies, local governments, and non-profits that manage state-owned properties.**

### **A. General Discussion**

Historic resources are both archaeological sites and historic structures. Per Chapter 267, Florida Statutes, *'Historic property' or 'historic resource' means any prehistoric district, site, building, object, or other real or personal property of historical, architectural, or archaeological value, and folklife resources. These properties or resources may include, but are not limited to, monuments, memorials, Indian habitations, ceremonial sites, abandoned settlements, sunken or abandoned ships, engineering works, treasure trove, artifacts, or other objects with intrinsic historical or archaeological value, or any part thereof, relating to the history, government, and culture of the state.'*

### **B. Agency Responsibilities**

Per State Policy relative to historic properties, state agencies of the executive branch must allow the Division of Historical Resources (Division) the opportunity to comment on any undertakings, whether these undertakings directly involve the state agency, i.e., land management responsibilities, or the state agency has indirect jurisdiction, i.e. permitting authority, grants, etc. No state funds should be expended on the undertaking until the Division has the opportunity to review and comment on the project, permit, grant, etc.

State agencies shall preserve the historic resources which are owned or controlled by the agency. Regarding proposed demolition or substantial alterations of historic properties, consultation with the Division must occur, and alternatives to demolition must be considered. State agencies must consult with Division to establish a program to location, inventory and evaluate all historic properties under ownership or controlled by the agency.

### **C. Statutory Authority**

Statutory Authority and more in-depth information can be found at:

<https://www.dos.myflorida.com/historical/preservation/compliance-and-review/regulations-guidelines/>

### **D. Management Implementation**

Even though the Division sits on the Acquisition and Restoration Council and approves land management plans, these plans are conceptual. Specific information regarding individual projects must be submitted to the Division for review and recommendations.

## **Management Procedures for Archaeological and Historical Sites and Properties on State-Owned or Controlled Properties**

---

Managers of state lands must coordinate any land clearing or ground disturbing activities with the Division to allow for review and comment on the proposed project. Recommendations may include but are not limited to approval of the project as submitted, cultural resource assessment survey by a qualified professional archaeologist, modifications to the proposed project to avoid or mitigate potential adverse effects.

Projects such as additions, exterior alteration, or related new construction regarding historic structures must also be submitted to the Division of Historical Resources for review and comment by the Division's architects. Projects involving structures fifty years of age or older, must be submitted to this agency for a significance determination. In rare cases, structures under fifty years of age may be deemed historically significant. These must be evaluated on a case by case basis.

Adverse impacts to significant sites, either archaeological sites or historic buildings, must be avoided. Furthermore, managers of state property should make preparations for locating and evaluating historic resources, both archaeological sites and historic structures.

### **E. Minimum Review Documentation Requirements**

In order to have a proposed project reviewed by the Division, certain information must be submitted for comments and recommendations. The minimum review documentation requirements can be found at:

[https://www.dos.myflorida.com/media/31392/minimum\\_review\\_documentation\\_requirements.pdf](https://www.dos.myflorida.com/media/31392/minimum_review_documentation_requirements.pdf).

\* \* \*

Questions relating to the treatment of archaeological and historic resources on state lands should be directed to:

Division of Historical Resources  
Bureau of Historic Preservation  
Compliance and Review Section

R. A. Gray Building  
500 South Bronough Street  
Tallahassee, FL 32399-0250

Phone: (850) 245-6333  
Toll Free: (800) 847-7278  
Fax: (850) 245-6435  
Email: [StateLandsCompliance@DOS.MyFlorida.com](mailto:StateLandsCompliance@DOS.MyFlorida.com)

## **Eligibility Criteria for National Register of Historic Places**

---

The criteria to be used for evaluating eligibility for listing in the National Register of Historic Places are as follows:

- 1)** Districts, sites, buildings, structures, and objects may be considered to have significance in American history, architecture, archaeology, engineering, and/or culture if they possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
  - a)** are associated with events that have made a significant contribution to the broad patterns of our history; and/or
  - b)** are associated with the lives of persons significant in our past; and/or
  - c)** embody the distinctive characteristics of type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; and/or
  - d)** have yielded, or may be likely to yield, information important in prehistory or history.
  
- 2)** Ordinarily cemeteries, birthplaces, or graves of historical figures; properties owned by religious institutions or used for religious purposes; structures that have been moved from their original locations; reconstructed historic buildings; properties primarily commemorative in nature; and properties that have achieved significance within the past 50 years shall not be considered eligible for the *National Register*. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:
  - a)** a religious property deriving its primary significance from architectural or artistic distinction or historical importance; or
  - b)** a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
  - c)** a birthplace or grave of an historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life; or
  - d)** a cemetery which derives its primary significance from graves of persons of transcendent importance, from age, distinctive design features, or association with historic events; or reconstructed building, when it is accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and no other building or structure with the same association has survived; or a property primarily commemorative in intent, if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or
  - e)** a property achieving significance within the past 50 years, if it is of exceptional importance.

## Preservation Treatments as Defined by Secretary of Interior's Standards and Guidelines

---

**Restoration** is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

**Rehabilitation** is defined as the act or process of making possible a compatible use for a property through repair, alterations and additions while preserving those portions or features that convey its historical, cultural or architectural values.

**Stabilization** is defined as the act or process of applying measures designed to reestablish a weather resistant enclosure and the structural stability of an unsafe or deteriorated property while maintaining the essential form as it exists at present.

**Preservation** is defined as the act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project.



**Addendum 8—Local Government Comprehensive Plan Compliance**



## Local Government Comprehensive Plan Compliance

---

**From:** [Degagne, Demi](#)  
**To:** [Planning@hernandocounty.us](mailto:Planning@hernandocounty.us)  
**Cc:** [Maldonado, Tyler](#)  
**Subject:** County Comprehensive Planning Compliance Review Request RE Weeki Wachee Springs State Park Unit Management Plan  
**Date:** Tuesday, December 28, 2021 9:51:43 AM  
**Attachments:** [image001.png](#)

---

Good Morning,

The Florida Department of Environmental Protection, Division of Recreation and Parks, Office of Park Planning is responsible for the unit management planning of all Florida State Parks. As part of this planning process, prior to the unit management plan being presented to its Acquisition and Restoration Council for consideration, the Office of Park Planning is now required to connect and communicate with the area's agency that is responsible for the local comprehensive plan to determine if the park unit management plan is in compliance with the comprehensive plan. Specifically, we want to make sure we are accurately citing the future land use and zoning designations for the park and would like to confirm that our proposed developments in the conceptual land use section comply with those designations. The existing facilities section will also need to be reviewed.

We would like to have our Weeki Wachee Springs State Park unit management plan reviewed. The draft plan is available at the following link: <https://floridadep.gov/parks/parks-office-park-planning/documents/weeki-wachee-springs-state-park-2021-draft-unit>

Please let us know who the contact is for these request, along with an approximate turn-around time for the review. If you need any clarification regarding the document or its contents, please contact Tyler Maldonado at [tyler.maldonado@floridadep.gov](mailto:tyler.maldonado@floridadep.gov) or 850.245.3051. Mr. Maldonado, who has been copied with this communication, is the Planning Consultant assigned to handle the park's management planning and will be able to answer any questions you may have.

Thank you, in advance, for your time, help and direction.



**Demi P. Degagne**

Florida Department of Environmental Protection  
Division of Recreation and Parks/Office of Park Planning  
Government Operations Consultant and  
Park Planning Administrative Assistant  
[Demi.Degagne@floridadep.gov](mailto:Demi.Degagne@floridadep.gov)  
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Direct: 850.245.3052



**Addendum 9—Weeki Wachee Natural System Carrying Capacity Study**



**WEEKI WACHEE NATURAL SYSTEM CARRYING CAPACITY STUDY-ANALYSIS AND REPORTING (WW06)**

**TASK #4  
FINAL REPORT**

Prepared for



***Southwest Florida Water Management District***

Brooksville, Florida

and

***Hernando County***

Brooksville, Florida

Prepared by

***Wood Environment & Infrastructure Solutions, Inc.***

1101 Channelside Drive, Suite 200

Tampa, FL 33602

Wood Project No. 600308x23

TWA NO. 19TW0002077

February 2020



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## **EXECUTIVE SUMMARY**

### **Introduction**

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by Southwest Florida Water Management District (SWFWMD) to conduct an ecologically-based carrying capacity study to evaluate the effects of recreational use on the natural systems of the Weeki Wachee River in western Hernando County, Florida. The Weeki Wachee River is a first magnitude spring run fed primarily by the main headspring and a few other smaller spring vents. From the headspring, the river flows approximately 7.5 miles to the Gulf of Mexico, which provides tidal influence on the lower part of the river. The headspring is located within the Weeki Wachee Springs State Park (State Park), which features a water park and the famous underwater mermaid show. The State of Florida designated the spring and the river segment within the State Park as an Outstanding Florida Spring (OFS) and an Outstanding Florida Water (OFW), respectively. Weeki Wachee Springs and River have exceptionally clear water and abundant natural vegetation and wildlife, making the river a destination for visitors from around the world. SWFWMD designated the springs and river as a Surface Water Improvement and Management (SWIM) priority water body and developed a SWIM Plan in 2017 to provide a strategy to effectively conserve, manage, and restore this very important natural resource.

### **Study Purpose**

The Weeki Wachee River is a popular recreation destination. Its growing popularity and increased visitor traffic have led to concerns about potential degradation of the river and its ecosystems. Preliminary site investigation suggested that exposed sandy beaches on river bends (point bars) have resulted, in part, from vegetation and soil losses due to recreational use. The carrying capacity study was designed to collect scientifically-based data associated with recreational activities along with better understanding the relationships between recreation, water quality, ecological, hydrological, and geomorphological characteristics. The collected data were used to assess potential impacts of recreation on the river and to help guide future studies and management decisions relating to recreation along the Weeki Wachee River.

### **Study Components**

This study was designed to include multiple weights of evidence in regard to recreational impact, such as the following components, which are explained in detail in later sections.

- Collection of water quality data using grab samples and continuous sonde deployments that were coupled with recreational counts in the field and from video camera footage.
- Characterization of recreation by analyzing and summarizing recreational data collected by this study and State Park vessel launch data.
- A fluvial geomorphology assessment, including interpretation of aerials for changes in point bar vegetation, experimental assessment of vegetation trampling, comparative assessment within a similar, less-impacted spring run, and a cumulative assessment of point bars throughout the Weeki Wachee River.



- Multivariate statistical analyses with water quality, recreational and hydrologic data to assess relationships between recreational use and environmental responses.

### **Water Quality and Recreational Use Data Collection**

Water quality and human use (recreational activity) data were collected over the course of one year, from July 2018 to June 2019 at four stations along the river that were selected to represent various intensities of recreational use.

### **Characterization of Recreation**

The long-term dataset of vessels launched from the State Park (July 2012-June 2019) showed significantly increasing trends in average daily launches, with a long-term average of approximately 185 vessels per day and a maximum of 687 vessels per day. The highest number of vessels launched daily from the State Park were recorded in May 2016.

The field and camera user count data collected during the study showed that higher numbers of vessels and users occurred on holidays and weekends as compared to weekdays. At downstream stations closer to Rogers Park, higher user counts were also recorded as compared to upstream stations closer to the State Park. Approximately 50% of vessels counted at downstream stations were found to be traveling upstream. This is compared to only 3 to 10% of vessels travelling upstream at the upstream stations that were closer to the State Park. Throughout the river, approximately 90% of all vessel traffic was composed of kayaks, while paddleboards, motorboats, and canoes made up the remaining 10%. The station closest to Rogers Park received the most motorboat traffic, docked vessels, and people wading/swimming, although the station located at the original park exit sign had the highest percentage of passing vessels that stopped to dock at the point bar. Results from the social surveys found that the majority of visitors claimed to enjoy the river and recommended it as a place to view wildlife and crystal-clear water and about 80% of them docked and recreated on point bars. However, many visitors found the river to be overcrowded, and several long-time visitors noticed changes in submerged aquatic vegetation and an increase in the number of visitors over the years.

### **Fluvial Geomorphology Assessment**

Fluvial geomorphology, or the interaction of flowing water with its environment, is influenced by climate, topography, soils, land use, and activities within the river and its watershed. A series of assessments were performed to gain an understanding of the geomorphology of the Weeki Wachee River and how it has been potentially impacted from recreation.

To observe and document apparent changes in vegetation and morphology of point bars through time, a series of aeriels were assessed for vegetated cover. The 2008 imagery showed intact (fully vegetated) point bars, while subsequent aeriels up to 2017 (most recent available) showed cumulative reductions in vegetation starting as early as 2011, which predated when count data were recorded by the State Park. The pattern of vegetation loss since 2008 suggests that a threshold of impactful use occurred before the peak in recreational use, which occurred in May 2016. Since the initial impacts predated the available launch count data, caution should be used



when trying to use vessel launch numbers and apparent recreational damage to the point bars based on aerial imagery as a means for assigning a number of users when developing a management plan for recreational use. The in-water and on-bar activities likely had a great impact on the bar morphology and vegetative coverage and need to be a major consideration in management decisions.

An experimental recreational trampling assessment was conducted to measure impacts to vegetation and soils on three vegetated point bars within the State Park boundary. The initial trampling event occurred in May 2019 with follow-up visits after 2 weeks and 6 months after the trampling event to observe initial impacts (after 2 weeks) and during the reestablishment period (after 6 months). Two weeks and six months after the trampling impact occurred, all trampled plots showed increases in exposed soil and dead vegetation, with observable reductions in relative vegetative cover and organic soils within the soil profiles. During the reestablishment/recovery stage (six months after the trampling impact), it was evident that the trampled plots were still highly altered, but that wetter conditions likely influenced the potential recovery of the soils and vegetation. Overall, the experimental trampling assessment showed that 1) even a small amount of trampling can greatly impact vegetation and organic soils, 2) trampling increases turbidity in the river, and 3) vegetation on the submerged edges of the point bars are most likely to be extensively impacted. In addition, a follow up visit at the one-year mark (May 2020) that represents hydrologic conditions similar to the trampling event is needed to better assess recovery status of the impacted plots.

To view the apparent recreational impacts at the Weeki Wachee River in a larger context of first magnitude spring runs, a comparative site assessment was conducted between four randomly selected point bars each on the Weeki Wachee River and at Alexander Springs Run, which is less impacted and has similar fluvial geomorphic characteristics. Overall, the point bars at Alexander Springs were more ecologically intact than those at Weeki Wachee, with full vegetation coverage and ample organic soils. The point bars that were evaluated at Weeki Wachee often exhibited bare, sandy "denuded" zones, where vegetation and organic soils have been lost to damage and erosion. Another important recreationally-induced geomorphic feature common at Weeki Wachee point bars, but not observed at Alexander Springs, was a scarp, or ledge on impacted bars where vegetation and organic soils appear to have been carved out by vessel docking and/or trampling. The scarps were generally around 1 to 2 ft tall, which was interpreted as the approximate depth of organic soil loss on the impacted point bars.

To evaluate the overall condition of point bars along the Weeki Wachee River, a cumulative assessment of point bars was conducted at 10 randomly selected point bars between the State Park and Rogers Park. Similar to the comparative study methodology, topographic, vegetation, and soil data were collected in each ecological zone. Denuded zones and scarps were observed at most of the bars averaging 74 ft in length, 13 ft in width, with 1 to 2 ft scarp depths. Along the river, 24 additional scarps were observed and measured. Using the approximated areas of denuded bar zones and depth of scarps at the 34 point bars assessed, it appears that an estimated 1,000 CY of organic soils and 20,000 square ft of vegetated bar area may have been lost.



## **Statistical Analysis to Assess Recreational Impacts**

Turbidity was selected as a representative response variable to assess relationships between recreation and impacts to water clarity and quality of the river. Recreational use and turbidity data from the study period were used in multivariate statistical analyses to test if recreational variables and turbidity are related, while controlling for spatial and temporal variability. The statistical analyses provided empirical evidence that cumulative number of vessels/users and in-water activities such as docking, wading, and swimming contributed significantly to turbidity along the river, which suggests that recreation has negative effects on water quality. Although turbidity concentrations were found to be relatively low in comparison to state water quality standards and other rivers, small changes in turbidity could have ecological implications on submerged aquatic vegetation by increasing sedimentation and reducing light availability.

## **Management Options**

The data and observations from this study were used to develop a preliminary list of possible management options that could potentially reduce further recreational impacts. The options provided for consideration include additional river stewardship education through recreational guidance signage and outreach programs, reestablishment of key vegetation communities and organic soils on impacted point bars, continued removal of rope swings, changes in boat docking practices to reduce direct impacts to vegetation, or reinforcement of banks or trees susceptible to erosion. Possible regulatory management options include extension of State Park regulations and restrictions down to Rogers Park, partial or complete restrictions on exiting vessels, evaluation of restricting vessel types, sizes, or engine sizes, and evaluation of possible further restrictions on the number of users or vessels allowed to access the river per day. Potential additional studies or plans to provide more information and additional management options include revisiting the trampling plots after one full year of recovery, studies of tree falls, bank undercutting, and sufficiency of tree snags as habitat, studies on sufficiency of clearing ordinances and wetland buffer distances along the riverfront, development of a river-wide management plan, and a study tracking effectiveness of implemented management options. Finally, to effectively review results from this study and proposed management options, a multi-agency working group should be convened to work together to pursue a path to implement the most appropriate options that would align with jurisdictions. Effective methods to enforce the selected management options could also be evaluated by the working group.



## 1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by Southwest Florida Water Management District (SWFWMD) to conduct an ecologically-based carrying capacity study to evaluate the effects of recreational use on the natural systems of the Weeki Wachee River in Hernando County, Florida (**Map 1**). The study is intended to provide information that will assist resource management decision making to reduce, mitigate, and manage ecological impacts on natural systems from recreational usage. This report provides a description of the resource and study purpose (Section 1), water quality and recreational use data collection (Section 2), a characterization of recreation (Section 3), a fluvial geomorphic assessment (Section 4), a statistical analysis to assess recreational impacts (Section 5), and management options to balance recreation and environmental factors (Section 6).

### 1.1. Location and Hydrology

The Weeki Wachee River in western Hernando County is fed primarily by the first magnitude (spring that discharges greater than 100 cubic feet per second, cfs) main headspring. The headspring and upper part of the river is located within Weeki Wachee Springs State Park (State Park) and discharges an average of approximately 170 cfs<sup>1</sup> (**Map 1**). Smaller spring vents such as Twin Dees (near the headspring), Salt Spring, Mud River Spring, and Hospital Hole also discharge along the length of the river (DRP 2011). The river extends approximately 7.5 miles from the headspring to the Gulf of Mexico and the lower river is tidally influenced. Weeki Wachee Springs is designated as an Outstanding Florida Spring (OFS), and all waters within the State Park are designated as Outstanding Florida Waters (OFW). The State Park also features a water park and the famous underwater mermaid show and is open to visitors year-round. Weeki Wachee Springs and River have exceptionally clear water and abundant natural vegetation and wildlife, making the river a destination for visitors from around the world. SWFWMD designated the springs and river as a Surface Water Improvement and Management (SWIM) priority water body and developed a SWIM Plan in 2017 to provide a strategy to effectively conserve, manage, and restore this very important natural resource.

For purposes of this study, the river was divided into 4 functional process zones (FPZs<sup>2</sup>) from the headspring at Weeki Wachee Springs State Park to Rogers Park, the downstream end of the study area (**Map 2**). FPZ-1 extends from the headspring to just below the previous State Park boundary<sup>3</sup> and is characterized as more karst with limestone rock outcroppings and high banks with upland bluffs. FPZ-2 extends from the previous State Park boundary to just below the new State Park boundary and is more alluvial in nature. Here, the channel is deep and narrow with numerous tight bends exhibiting well-developed point bars. It courses through a meander belt consisting of a mix of high and low banks with both wetland and upland floodplain communities. FPZ-3 extends

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<sup>1</sup> Average calculated from stream flow data at USGS station 02310500 (February 1917-February 2010).

<sup>2</sup> An FPZ is a portion of a stream valley with an internally consistent set of existing or projected controlling biophysical conditions that are based on geomorphic characteristics. Moreover, FPZs are segments of the stream that share common flow, channel, and habitat characteristics.

<sup>3</sup> The State Park boundary was extended approximately 1-mile downstream of the original boundary in October 2018.





from just below the new State Park boundary (**Map 2**) to approximately 1 mile upstream of Rogers Park and is characterized by more uniformly low banks with wetland communities that experience overbank flooding during the wet season. Part of this segment is tidally-influenced. FPZ-4 begins 1 mile upstream of Rogers Park and exhibits a wider and shallower channel than the other FPZ segments. This suggests it is an area subject to greater sediment accumulation as the river increasingly approaches the tide, which was also noted by a sediment transport study that was conducted to support the restoration and design of a section of the lower Weeki Wachee River (VHB 2019). It is also the most developed segment with private homes, associated sea walls, and various canal inputs.

## **1.2. History of Cultural Resources**

A group of developers and investors entered a 30-year lease with the City of St. Petersburg in 1946 for the land surrounding the headspring, and the first underwater theater for mermaid shows was opened in 1947. Weeki Wachee Springs gained popularity and was operated as one of Florida's premier roadside tourist attractions. The 12 historic structures associated with the mermaid show attractions are included in the park's cultural resources along with 6 archaeological sites (DRP 2011).

The Buccaneer Bay waterpark was opened in 1982, featuring a sand beach, waterslides, and a swimming area. Sand of an unknown origin was brought to the headspring to create the Buccaneer Bay beach in 1982, and when the sand was periodically transported downstream from rain events, it was dredged and reapplied to the beach, until construction of a retaining wall in 2006 to hold the sand in place (DRP 2011).

Approximately two miles downstream of the State Park, the Florida Fish and Wildlife Commission (FWC) opened "The Bluffs", which are the Weeki Wachee Tract of the Chassahowitzka Wildlife Management Area (shown in Map 2) for public recreation after acquiring the land in 1995 (FWC 2007). Between 1997 and 2003, large sections of the natural sandhill bluff eroded, contributing sand into the river that has been transported downstream over time (FWC 2007)

## **1.3 History of State Park**

The Florida Department of Environmental Protection (FDEP) Division of Recreation and Parks (DRP) manages the Weeki Wachee Springs State Park (previously Weeki Wachee Park attraction), which includes the underwater theater, Buccaneer Bay waterpark, and the river cruise near the headspring (DRP 2011). On November 1, 2008, DRP leased 538 acres of property surrounding the spring and river from SWFWMD under a 50-year lease, and the lease states that the DRP manages the State Park only for the conservation and protection of natural and historical resources and for public recreation that is compatible with the conservation and protection of the property (DRP 2011). In February 2010, the DRP became authorized to operate underwater structures related to the amphitheater and waterpark, operate a boat tour, and to launch kayaks/canoes through a 25-year sovereign submerged lands lease agreement with the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida (DRP 2011).



## 1.4 Purpose of Study

The growing popularity of the Weeki Wachee River as a recreational amenity has led to concerns from riverfront property owners, residents, river advocates, and state and local government officials about the state of the river and the ecosystems it sustains. The purpose of the carrying capacity study was to record and document spatial and temporal data associated with recreation occurring in the river along with water quality, ecological, hydrological, and geomorphological data to assess the effects of recreational activities on the river system. The intention of the study was not to set a specific value of vessels or users allowed on the river, but to collect and analyze data that relates human use to water quality, hydrologic, geomorphic, or ecological degradation of the river. The data and findings of this study can be used to inform management actions relating to recreation on the Weeki Wachee River.

This approach recognizes that entities with jurisdiction to manage the river and associated ecosystems may elect to protect the river through a variety of means in addition to, or in lieu of, limiting the types and numbers of vessels. This is apparent given that some of the most severe alterations to the river are associated with people leaving their vessels and trampling habitat. Some examples of potential protective approaches include banning harmful activities, installing ecological restoration treatments, increasing public education and enforcement of existing restrictions, and providing designated sites engineered for vessel docking and other recreational activities away from ecologically sensitive areas, among others. Successful management of the river will likely require a multi-faceted strategy combining vessel limits with other approaches, especially activity restrictions. The first step to recovering areas of the river that have already been impacted and to protect areas that have not yet been impacted, is to scientifically describe the harm in association with recreational use and quantify it using the best available information, which is the intent of this report.

The study approach includes interpretation of existing data, new data collection, and an onsite field experiment. Given that harm has already occurred in some areas on the river, this study is at least partially forensic in its design relying on weight-of-evidence from multiple lines of investigation and a body of existing data to draw conclusions. Existing available data include high-resolution aerial photographs from multiple years, river flow, sediment transport, water quality, and the number of vessels originating from the State Park over various time frames. The study also includes a variety of original data development aimed at concurrently documenting visitor usage and recreational activity with water quality changes, habitat loss, channel morphology changes, and user perspectives. Those aspects of the study enabled Wood's scientists to make direct observations regarding how the river is being used and what impacts occur during such use. The study also includes a field experiment regarding the sensitivity of point bar vegetation to trampling, and a biophysical comparison of relatively untrampled point bars from another intact and less impacted spring-fed river. That combination of experimentation and comparison aims to describe what a healthy point bar should look like and enhances understanding of how and why the Weeki Wachee's point bars depart from a more natural condition. As will be discussed in more detail, much emphasis was placed on evaluating point bar ecological condition as these are highly altered and heavily recreated on the river. Healthy point bars can be sensitive indicators of a



healthy river and disturbance of point bars can contribute to disbursement of an abnormal magnitude and distribution of sediment transport into downstream areas of the river.

In summary, this study examines and describes past and present recreational impacts along the river, plus an experimental test of point bar sensitivity to human trampling that can be used to better inform decisions regarding caps on users and restrictions on harmful activities in ecologically sensitive areas.



## **2.0 WATER QUALITY AND RECREATIONAL USE DATA COLLECTION**

In the data collection phase of the study (TWA 18TW0001601), Wood, in collaboration with SWFWMD and FDEP via in-kind services agreements, performed water quality sampling and lab analysis and human use sampling through visitor counts and surveys, as described in the following sections.

### **2.1. Instantaneous Sampling: Field Counts/Grab Samples**

#### **2.1.1 Sampling Events and Locations**

Wood collected water quality and human use data during 9 sampling events from July 2018 to June 2019 at four stations: WW1, WW2, WW3, and WW4 (**Map 3**) During 5 of the 9 events, an additional site, WW5, was monitored by a SWFWMD staff member. Sampling stations were selected based on data collected during a field reconnaissance conducted by Wood staff on 6/19/2018. This reconnaissance and previous investigations strongly suggested impacts to formerly vegetated point bars at river bends, which subsequently became exposed sandy beaches. Thus, the goal of the site selection was to select point bars which covered varying degrees of recreational use and which spanned the various FPZs. Point bars are geomorphic features occurring along the inner bend where sand is deposited forming a gently sloped bar. The outer portions of these bends are characterized by deeper pools. The relatively shallow depths and gentle slopes of point bars are welcoming locations to dock a vessel for a break from paddling or disembark to wade, swim, or snorkel into the deeper waters of the outer bend.

The first sampling station selected, WW1, was chosen as a control site, as it is within the State Park boundary where visitors have always been informed not to exit their vessels. Sampling location WW2 was selected because it was the point bar located immediately beyond (i.e. downstream) the original State Park boundary exit sign<sup>4</sup>, where visitors were first allowed to dock and exit their vessels and recreate. During the field reconnaissance, it was observed to be one of the most popular recreation point bars along the river. Sampling location WW3 was chosen because it is a point bar toward the middle of the river run that experiences a moderate amount of recreation. It is located just upstream of “the Bluffs,” which is currently being constructed as an early take-out location (midpoint) within the new State Park boundary. Sampling location WW4 was chosen because it is a point bar toward the downstream end of the run (near Rogers Park) that experiences high recreation from visitors traveling both upstream and downstream and because it had a rope swing at the time of site selection.<sup>5</sup> WW5 is a high recreation site with a tree jump and a rope swing (one on each bank), located upstream of WW4 but within the same FPZ.

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<sup>4</sup> In October 2018, the State Park boundary was extended to the “new Park exit sign” location shown in **Map 3**. However, the “original Park exit sign” was never removed during the study. Because the original Park exit sign was never removed, users continued to dock and exit their vessels at WW2 at the same rate as was observed prior to the extension of the park boundary. Therefore, the new State Park boundary sign appeared to have no effect on the study.

<sup>5</sup> The rope swing tree at WW4 was struck by lightning and fell between the August and September 2018 events; therefore, the rope swing was only present for the first two sampling events.



Sampling events occurred once per month during the high recreation season (May-September), and every other month during the low recreation season (October-April). The sampling events also included holidays such as 4<sup>th</sup> of July long weekend, Labor Day, and Memorial Day. The dates of sampling events are provided below. Note that events with an asterisk indicate sampling events that included WW5.

- July 5, 2018 (4<sup>th</sup> of July long weekend)
- August 7, 2018
- September 3, 2018 (Labor Day)
- October 2, 2018\*
- December 19, 2018\*
- February 19, 2019\*
- April 24, 2019
- May 27, 2019 (Memorial Day)\*
- June 24, 2019\*

### **2.1.2** Data Gathered

Human use data were gathered in the form of hourly total counts of both vessels and users. A “vessel” was defined as one boat of any type (kayak, canoe, motorboat, paddleboard, or other), and a “user” was defined as a human individual in a vessel (kayaker, canoer, motorboat driver or passenger, etc., not including infants, dogs, or other pets on board). Vessel counts were tracked in both the upstream and downstream directions, which is termed a “pass” in either direction and each directional pass was counted individually. Additionally, staff recorded hourly totals of vessels docked on the point bar and hourly totals of people that exited their boats to wade, swim, or recreate on the point bar. Staff also noted types of recreational activities at the point bars, size of boat motors (when possible), and any obvious changes in water level, vegetation, or soils. Photographs were taken at each point bar at the beginning of each sampling event and are provided in **Appendix A**. At the downstream stations (WW4 and WW5), social surveys were conducted with randomly selected groups of users to get information on vessel launch locations, recreation times and activities, and any concerns related to recreational use of the river. The standard questionnaire used in the social surveys is provided in **Appendix B**.

Additionally, tree jump/rope swing data were collected at sites WW4 and WW5. The hourly total number of rope swing jumps was recorded at WW4 for the July and August events, but the tree was struck by lightning and fell before the September event. The hourly totals of rope swing/tree jumps were collected at site WW5 for the October, December, February, May, and June events.

For the first two sampling events, the hourly counts began at 8:30, and were taken on the half hour until 16:30. Because users were observed on the river before 8:30 and were mostly off the river by 16:00, the sampling schedule was shifted to span from 8:00 to 16:00 for subsequent events to capture the earlier recreational usage.



Water quality sampling was also conducted during the 9 sampling events. Water quality parameters related to recreationally-induced sediment transport and subsequent water clarity declines were selected to assess potential effects of recreation on water quality conditions. The sediment/clarity surrogate parameters that were evaluated as part of this study were total suspended solids (TSS), volatile suspended solids (VSS), and turbidity, which have been found to be good proxies for modeling optical water clarity in clear spring-fed systems such as Weeki Wachee River in other studies (Szafraniec 2014). The evaluation was based on answering the question that asked if recreation at certain levels may be impacting water clarity and quality conditions in the river.

At each station, two grab sample bottles were filled 0.3 m below the water surface once every two hours, with the first sample at 8:00 and the last sample at 16:00 (8:30-16:30 for the first two events), for a total of 5 samples (10 bottles) per site, per event. Quality control samples (i.e. field blank and a duplicate) were also collected during each sampling event. The samples were preserved on ice and transported to the FDEP Analytical Chemistry Laboratory in Tallahassee, where they were analyzed as part of an in-kind services agreement for this project. The FDEP lab analyzed the grab samples for TSS, VSS, and turbidity. It should be noted that if severe weather was forecast, grab sample collection times were adjusted to an hourly basis. Weather related time adjustments occurred during the September and December sampling events.

## **2.2. Continuous Sampling: Video Camera/Sonde Deployments**

### **2.2.1 Video Camera Deployment and Counts**

Video cameras were installed across from and facing the point bars at sampling sites WW1, WW2, WW3, and WW4 to make observations on vessels, users, vessel docking, users wading/swimming, and presence of wildlife over two-week intervals. The digital video data were collected by Wood, delivered to SWFWMD. Counts and observations were recorded as part of in-kind services by SWFWMD staff. To correspond to field count data, the video-recorded users (total), vessel passes (upstream and downstream), docked vessels, and people wading/swimming were recorded as hourly totals, with time intervals matching the field sampling events (8:30-16:30 for the first two deployments and 8:00-16:00 for the remaining deployments).

The video cameras were deployed for 6 two-week periods overlapping the field sampling events. The camera deployment schedule was as follows:

- 6/29/2018 – 7/16/2018
- 8/28/2018 – 9/17/2018
- 12/5/2018 – 12/19/2018
- 2/6/2019 – 2/19/2019
- 4/10/2019 – 4/24/2019
- 5/22/2019 – 6/5/2019



### **2.2.2 Water Quality Sensor Deployment/Retrieval**

This monitoring component was accomplished as part of a collaborative effort that included in-kind services from both the SWFWMD Data Collection Bureau (DCB) and the FDEP's Southwest Regional Operation Center. The SWFWMD DCB staff provided 4 calibrated multiparameter water quality data collection sondes to the FDEP ROCS staff to deploy at the 4 sampling locations (WW1, WW2, WW3, WW4). Each sonde collected continuous dissolved oxygen, temperature, specific conductance, pH, and turbidity, recorded at 30-minute intervals (on the hour and half-hour). The FDEP ROCS and SWFWMD DCB staff coordinated on data retrieval, proper QA/QC, and sonde maintenance at the end of each deployment period. The water quality sonde data were processed and compiled by Wood and used for statistical analysis. The sondes were deployed for 6 two-week periods during the same time periods that the cameras were deployed.

### **2.3. Changes Observed During the Study**

Over the course of the study (June 2018-July 2019), several changes occurred on the river that may pertain to the study and should be noted but were not found to influence the results of the study. The changes observed during the study are provided below:

- The State Park boundary was extended approximately 1-mile downstream of the previous location. New exit signs were erected at the new boundary; however, the previous upstream boundary exit signs remained in place throughout and after the study was complete. It was observed that users still docked and exited their vessels upon reaching the previous boundary sign at similar rates as before the boundary was moved further downstream. Therefore, the Park boundary change did not influence data collection results.
- In October 2018, the State Park began limiting launches by the number of users on the river per day rather than by the number of vessels per day. In addition to the existing 4-hour time limit, launches from the State Park ended by noon. Additionally, a disposables ban was enacted in January 2019, whereby no disposable items (including any alcohol) can be brought into the State Park through a thorough cooler and bag check at the State Park's concession. Although these changes did not affect the results of the study based on the number and temporal distribution of the samples collected, accounting for these changes is highly useful information because it shows that activity restrictions such as the disposable ban can be a productive management tool and it also shows that user limits can be effectively enforced at controlled access points.
- Garbage cans were observed at stations WW4 and WW5 during the September sampling event. They were placed there temporarily to curb litter. Based on Wood and FDEP's staff observations during the sampling events, it did not appear that the garbage cans drew more people to stop at those point bars. However, during one event the garbage can at WW5 appeared to have been knocked over by wildlife. The garbage cans were removed and do not appear to have influenced data collection results.



- The tree used for jumping/swinging at WW4 was struck by lightning and fell after the 8/17/2018 sampling event. The numbers of people that stopped at WW4 were still relatively high even after the tree fell, but it appeared that fewer people may have stopped once that tree was gone. As might be expected, this shows that rope swings may draw people to stop and recreate at areas focused near them.
- In May 2019, Hernando County Sheriffs increased controls on the river by providing a marine patrol deputy. The patrol staff noted that patrol presence noticeably changed types of recreational behaviors on the river.
- Lastly, photographs were taken at each sampling site at the start of each sampling event. A series of photographs by site is provided in **Appendix A**. Samplers at WW2 and WW4, the high recreation bars, observed increased erosion over time at particular spots on their respective point bars as users docked their vessels onto the banks.





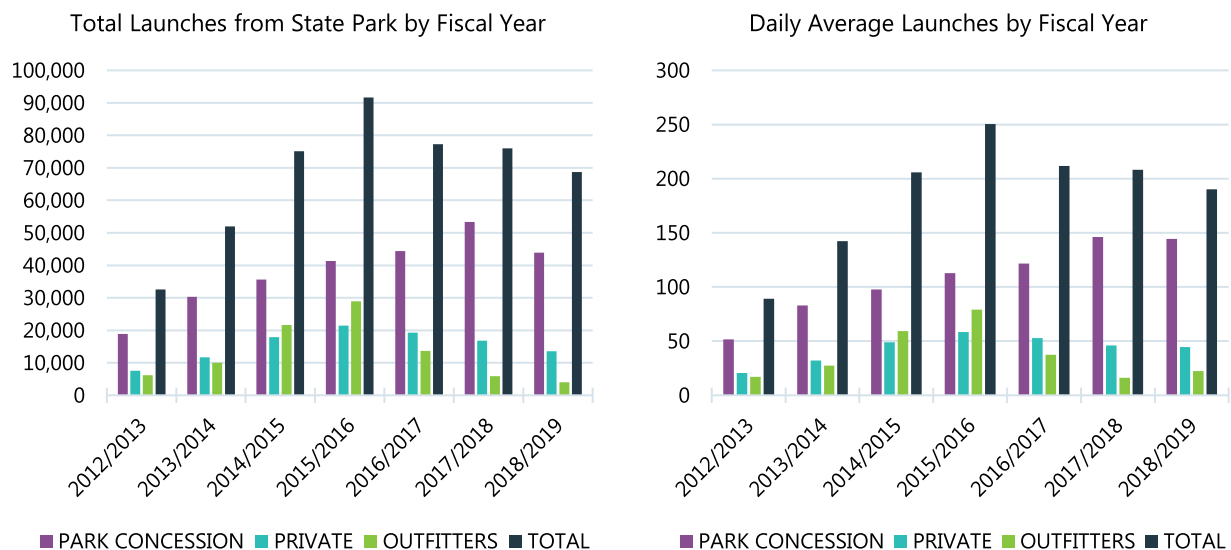
### 3.0 CHARACTERIZATION OF RECREATION

Several datasets were used to characterize the counts and types of vessels and recreational activities along the Weeki Wachee River. Field and camera count data provided spatial and temporal recreational vessel/user data during the study period (July 2018-June 2019), while counts of vessel launches from the State Park provided a long-term dataset to assess historical patterns and trends.

#### 3.1. State Park Count Data

The State Park provided daily total counts of vessels launched from their facilities from 7/1/2012 to 6/1/2019 (State Park fiscal year, FY, starts July 1<sup>st</sup> and ends June 30<sup>th</sup>). **Figure 3.1** shows the total vessel launches (left panel) and the daily average launches (right panel) for each FY by type (park concession, private, outfitter, and total). The total and daily average launches from the State Park increased each FY by approximately 20,000 vessel launches per year and 50 vessel launches per day between FY 2012/2013 and FY 2015/2016, when vessel launches peaked at approximately 90,000 per year and an average of 250 per day. While no data for launches from the State Park area were available prior to 2012, staff have stated that the vendor owned 60 kayaks in years prior.

**Figure 3.1 – Long-Term State Park Vessel Launch Data (by Fiscal Year)**

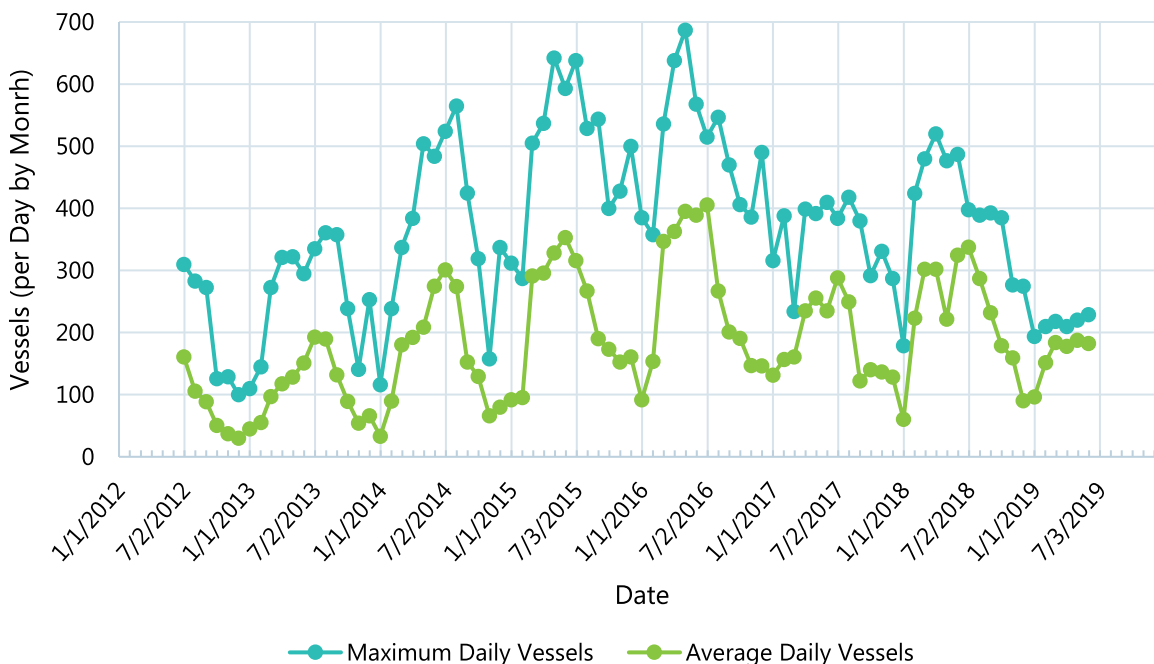


**Figure 3.2** shows maximum and average daily total vessel launches from the State Park by month. The plot shows a seasonal pattern in recreation, with peak use in summer months and lower use in winter months. Total vessel launches peaked in May 2016, with an average of approximately 400 vessels per day and a maximum of nearly 700 vessels per day. It should be noted that the Weeki Wachee Springs State Park Unit Management Plan (UMP) (approved June 28, 2011) estimated the optimum carrying capacity of the canoe/kayak use on the river to be 280 users per



day<sup>6</sup>, which is approximately equivalent to 192 vessels per day (calculated from a regression equation using Wood study data of kayaks and canoes vs. users: Users = 1.46\*Vessels). A change to the way the UMP was being enforced occurred in October 2018. Additionally, the disposables ban went into effect in January 2019. The new enforcements occurred later during the study and may have reduced the number of vessels that launched from the State Park. But it is unknown what other factors may have also led to the reduction from previous years.

**Figure 3.2 – State Park Daily Total Vessels (Max and Average Monthly Values)**



### 3.2. Field Count Data

#### 3.2.1 Total Counts

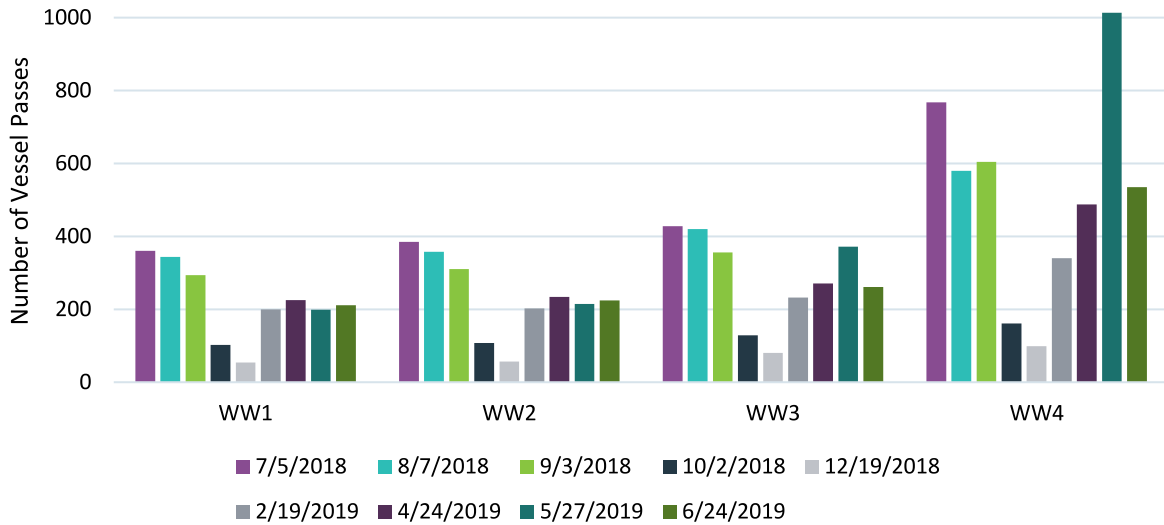
During 9 sampling events, Wood field staff tracked the number of users and vessels that passed each sampling location, as well as the direction they were headed (upstream or downstream). The total daily vessel passes observed on each sampling day are shown in **Figure 3.3**. Note that the total daily counts include vessels passing the sampling station in both directions, as this provides quantification of the total activity near the point bar. Therefore, vessels/users who travel in both the upstream and downstream direction are counted twice in the total counts. During the high recreation season (May-September), approximately 200-400 vessels per day passed by the upper sampling sites, WW1, WW2, and WW3, while approximately 700-1000 vessels passed by the furthest downstream sampling site, WW4. In the lower recreation season (October-April), approximately 50-200 vessels per day passed the upper stations, while 100-400 vessels per day passed the downstream station. The daily total number of vessel passes was tightly correlated

<sup>6</sup> The basis for this recommendation was not provided in the 2011 State Park Unit Management Plan.



with the daily total number of users (Users = 1.46\*Vessels, R<sup>2</sup>=0.99) and therefore follows a similar distribution. **Appendix B** shows the total daily users observed on each sampling day.

**Figure 3.3 – Daily Total Number of Vessel Passes by Sample Site**

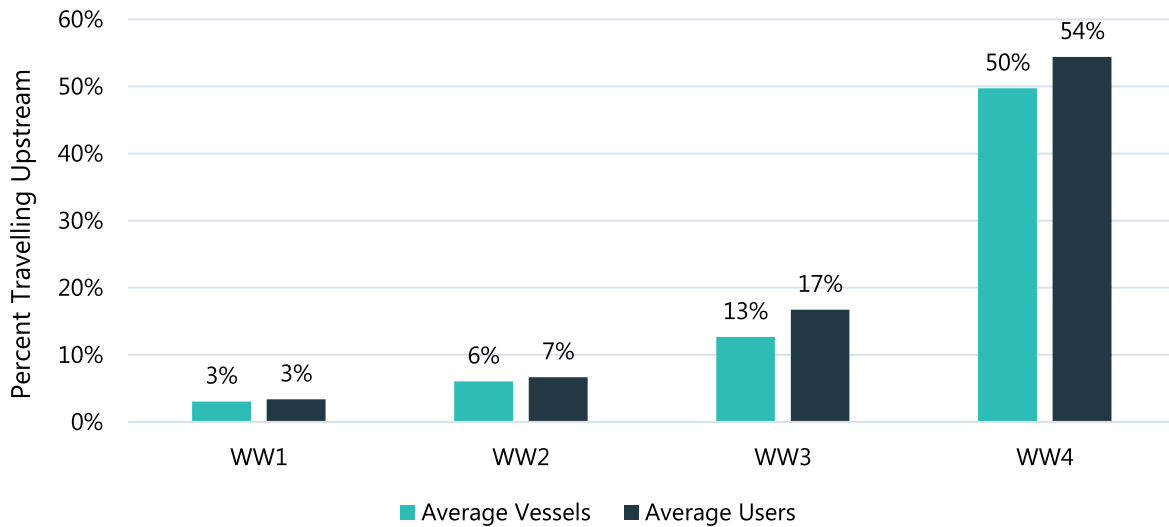


### 3.2.2 Travel Direction

While the total count of vessels or users traveling upstream and downstream provides quantification of the total activity near the point bar, the truest count of individual vessels on the river is the number of vessels traveling downstream since almost all users/vessels traveling upstream must come back downstream. As shown in **Figure 3.4**, station WW4, the furthest downstream site, had the most vessels that traveled upstream (mostly from Rogers Park, other commercial vendor locations or private launch areas). On average, 50% of vessels and 54% of users were travelling upstream at WW4, while WW1 had the least vessels/users travelling upstream (3%). This finding highlights that any limits set to curb recreational use on the river should also consider enforcement downstream at Rogers Park and other vendor locations in addition to the State Park launch restrictions. Additional figures in **Appendix B** show the distribution of downstream versus upstream vessels by site and by sampling event.



**Figure 3.4 – Percent of Vessels and Users Traveling Upstream at Each Station**



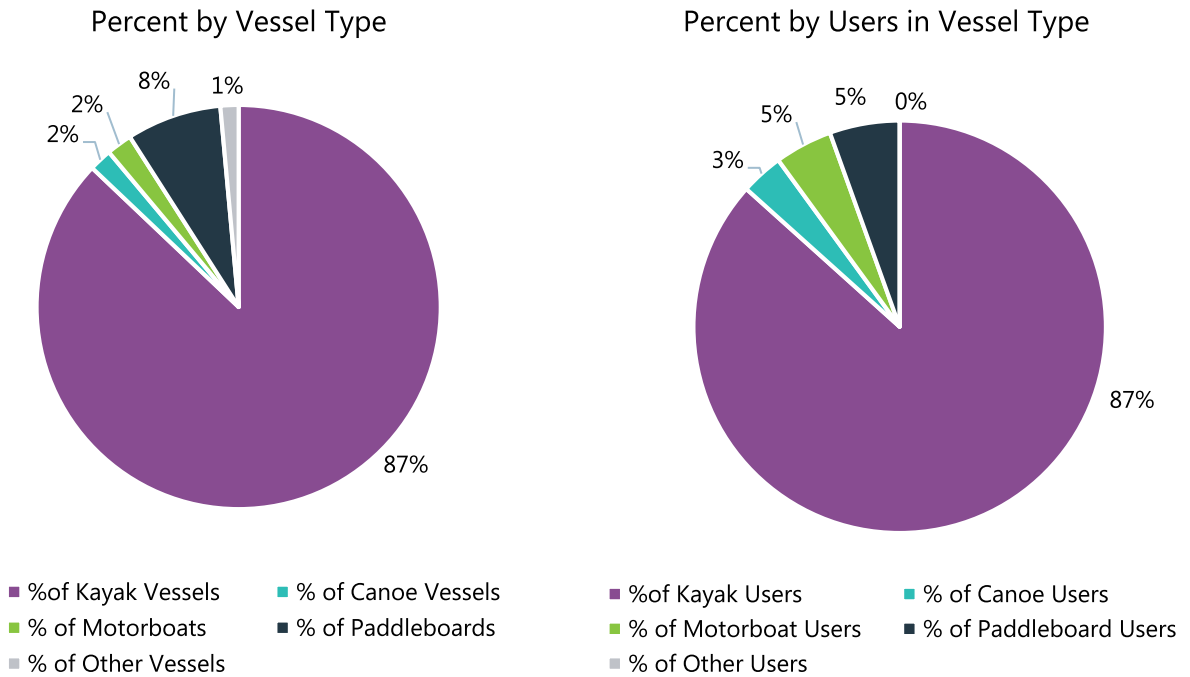
### 3.2.3 Vessel Type

The type of vessel (kayak, canoe, paddleboard, motorboat, or other) was also noted during field counts, and the overall percent of each vessel type (left panel) and percent of users in each vessel type (right panel) over all stations and for all events are shown in **Figure 3.5**. It should be noted that these values include the number of users/vessels observed at each sampling location traveling in the downstream direction only (which is a truer representation of total people on the river on a given day). Additional figures in **Appendix B** show the detailed distribution of vessel types by site and sampling event and the average percent of vessel types per site. The number of motorboats traveling only downstream is also shown in **Appendix B**. Additionally, **Table 3.1** shows the average number of users per vessel type, calculated with user and vessel data collected at all sample locations during the sampling events. Motorboats had the highest number of users per vessel while paddleboards had the fewest.

The data show that kayaks are the dominant vessel type used on the Weeki Wachee River. At the upstream sampling locations (WW1 and WW2), 90% of all vessels were kayaks, followed by 8% paddle boards and 1-2% canoes and motorboats (**Figure 3.5**). The downstream stations (WW3 and WW4) are closer to areas with access to boat ramps such as Rogers Park, Weeki Wachee Marina, and privately-owned docks along the river and canals where visitors can launch motorboats. For the most part, there is not much restriction other than boat rental availability or the number of available trailer parking spots for privately owned boats that are non-river residents. Even at these downstream stations, kayaks made up approximately 85% of all vessels, with paddleboards at 7%, motorboats at 3%, and canoes at 2%. Averaging across all stations and events, motorboats made up approximately 2% of all vessels on the river, but they do transport over twice as many users as kayaks on a per vessel basis. Overall, users traveling by motorboat made up approximately 5% of all users on the river.



**Figure 3.5 – Overall Percentage of Vessel and User Types from Field Count Data**



Note: Values are overall averages for all stations using only downstream travel direction data.

**Table 3.1 – Average Number of Users per Vessel Type**

Vessel Type	Average Number of Users/Vessel
Kayak	1.5
Canoe	2.5
Motorboat	3.4
Paddleboard	1.1

**3.2.4 Motorboat Engine Size**

Another metric counted during field sampling events was the size of motors on motorboats. **Table 3.2** summarizes the average daily count of each motorboat engine type observed at each site. The motor sizes most commonly observed were less than 10 horsepower (hp), followed closely by 10-50 hp. Note that the Weeki Wachee Marina rents out boats with a 9.9 hp engine, and these were commonly observed at WW4 (the downstream-most sampling site). Larger motors, some with more than 100 hp were observed, but only at the downstream stations. It should be noted that the data used in this assessment were adjusted for vessels returning downstream, to avoid double-counting motorboats. **Appendix B** provides a further breakdown of observed motorboat engines



by site by sampling event. Although the number of motorboats did not make up a large percentage of the total number of boats on the river, it should be noted that prop scars from motorboats were observed in some shallower downstream areas that contained submerged aquatic vegetation. The prop scars appeared to occur when motorboats were in shallow and narrow areas when attempting to pass groups of kayakers.

**Table 3.2 – Average and Range of Daily Count of Motorboat Engine Types (Field Counts)**

Site	PWC*	Trolling	<10HP	10-50 HP	60-100 HP	>100HP	Unknown	Total
WW1	0 (0-1)	0 (0-0)	1 (0-4)	1 (0-6)	0 (0-0)	0 (0-0)	1 (0-5)	3 (0-8)
WW2	0 (0-3)	0 (0-0)	0 (0-1)	0 (0-0)	0 (0-0)	0 (0-0)	3 (0-8)	3 (0-9)
WW3	1 (0-2)	1 (0-4)	5 (0-17)	1 (0-4)	0 (0-3)	0 (0-1)	1 (0-2)	8 (0-24)
WW4	1 (0-4)	2 (0-7)	6 (0-19)	5 (0-17)	2 (0-5)	1 (0-3)	0 (0-1)	17 (1-48)

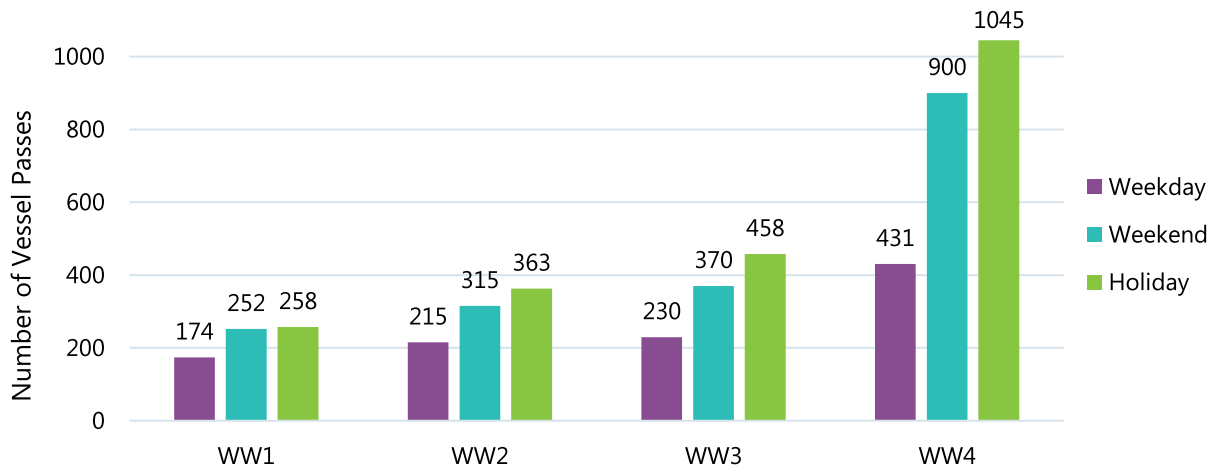
Note: Top number is the average, parentheses include the range (minimum-maximum). \*PWC: Personal watercraft.

### 3.2.5 Vessel Counts by Day Type

Camera count data were used to estimate the average number of vessel passes by site among the various deployment events by day type (weekday, weekend, holiday) since they cover a longer period of record than the field counts (**Figure 3.6**). As expected, holidays had the highest vessel counts, followed by weekends, and weekdays. It should be noted that these values are totals (upstream and downstream), which explains why site WW4, the downstream-most site that receives approximately half of its vessels/users coming in the upstream direction, shows higher vessel values than the other sites. **Appendix B** provides additional vessel count data segregated by site and by camera deployment to show daily vessel distributions across sites and across seasons.



**Figure 3.6 – Average Number of Vessel Passes by Day Type**



Note: Data source is camera count data

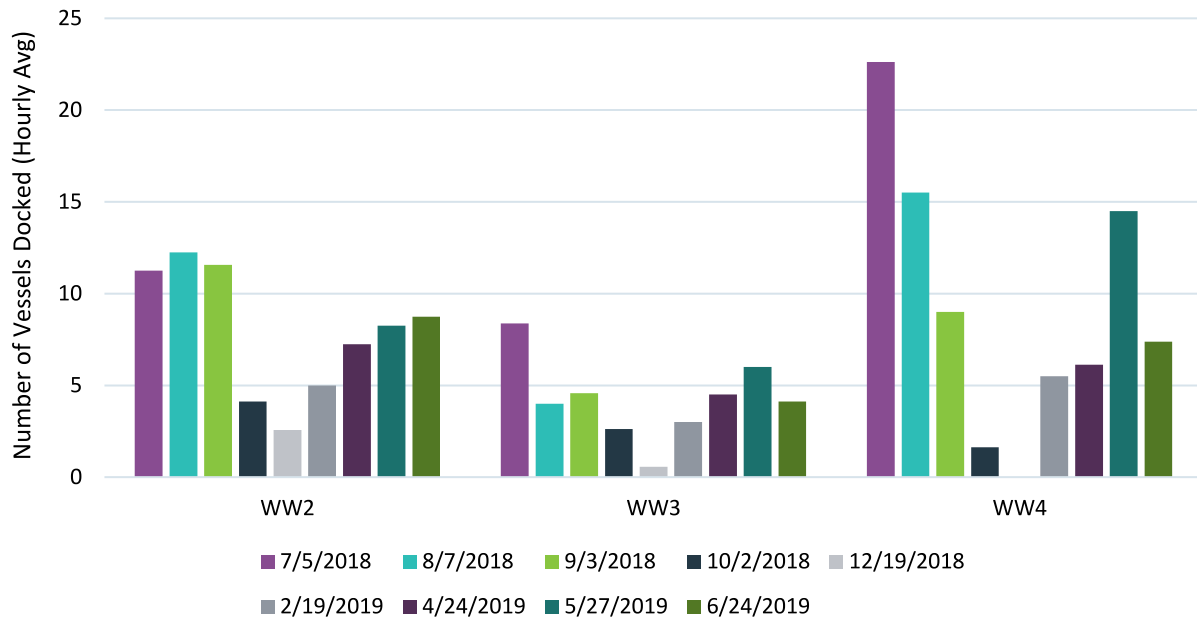
### 3.3. Recreational Use of Point Bars

#### 3.3.1 Docking/Wading

The number of vessels docking and the number of people exiting vessels to recreate (i.e. wading/swimming) on the point bars were also recorded during sampling events (field and camera observations). Field observations showed that docking of vessels flattened and/or damaged vegetation on the bars, exposing roots and the underlying soil matrix, which was subsequently washed away 1) during rain events, 2) when water levels increased, or 3) from boat wake. The average number of vessels docking on point bars per hour was calculated and is shown in **Figure 3.7**. Station WW1 is within the original State Park boundary, where visitors are not allowed to dock or leave their vessels, so it is not included in the plots (all values were zero). The 4<sup>th</sup> of July holiday saw the highest average number of vessels docked per hour, with an average of 22 docked per hour at WW4, which was when the rope swing was still active. All three sites follow a similar pattern with higher numbers per hour docking during the high recreation months (May-September) and fewer numbers per hour docking in the low recreation months (October-April). It should be noted that the average number of vessels per hour decreased over the course of the study at both WW2 and WW4. The decrease at WW2 may be due to fewer vessels launching from the State Park during the higher recreation months, which may be related to the enforcement of user versus vessel limits and also perhaps due to the disposables ban (less partying was observed occurring at this bar post ban). **Figure 3.8** shows a photo of users docked and recreating at the point bar at station WW5, including people wading, swimming and using the rope swing. The decrease in number of people docked at WW4 may have been due to the rope swing tree falling down. The average number of people on the point bar wading and swimming per hour was also calculated and is shown in **Appendix B**; it follows a similar distribution as the vessels but with higher numbers per hour since there are typically 1.46 users per vessel.



**Figure 3.7 – Average Number of Vessels Docked Per Hour by Site**



**Figure 3.8 – Rope Swing, Docked Vessels, and People Wading and Swimming at WW5**



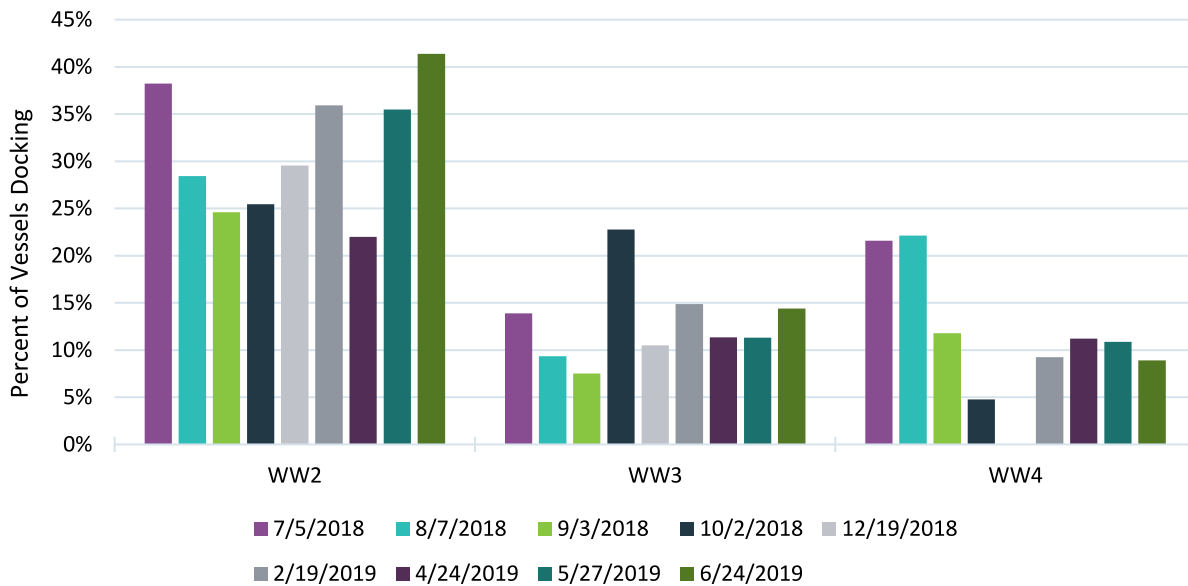
**Figure 3.9** shows the percentage of passing vessels that docked at each point bar. The number of vessels docked per people wading and swimming are notably higher during the higher recreation season, but the percentage of vessels docking remains relatively stable throughout the year at WW2 and WW3. Station WW2 had the highest percentage of passing vessels that docked on the point bar (between 20% and 40%), likely because it was directly downstream of the original





State Park boundary exit sign and was historically the first place that State Park visitors were allowed to exit their boats. It should be noted that although the State Park boundary was extended about a mile downstream in October 2018, the percentage of vessels docking at WW2 did not decrease through the end of the study. Field staff stationed at WW2 also noted that most visitors either did not know or did not acknowledge that the State Park boundary had moved further downstream since the original exit sign was still in place. WW3 was the least recreated of the sampling stations, likely because it is a smaller point bar located just downstream of a large, heavily recreated bar so many people have recently stopped at a point bar by the time they pass WW3. While station WW4 generally has more overall traffic than WW2, a smaller percentage of passing vessels stopped at WW4 than at WW2. Based on observations of field staff stationed at WW4, this is likely due to the following reasons: 1) users travelling downstream are often in a hurry to make their pick-up time at Rogers Park; 2) this portion of the river is tidally-influenced and users tend to pass the bar when water levels are higher; 3) the water is more tannic/less clear in this segment; and 4) the tree used for jumping/swinging was struck by lightning and fell after the 8/17/2018 sampling event and fewer people stopped at WW4 once that tree was gone and those that did seemed to stay for less time. Despite these factors, WW4 was still a heavily recreated point bar with obvious impacts from recreational use.

**Figure 3.9 - Percent of Vessels Docking (per hour) by Site**



### 3.3.2 Rope Swing/Tree Jumps

The number of jumps from trees and rope swings were also counted during sampling events at sampling location WW4, and at an added location, WW5, after the tree at WW4 fell. Additional figures in **Appendix B** show the number of jumps from trees or rope swings per hour by event and site. It should also be noted that station WW5 had jumping trees on both the left and right banks. At both WW4 and WW5, holidays tended to have the highest amount of tree jumps,



reaching up to 47 jumps in one hour. During the remaining events, the frequency of tree jumps tended to peak between noon and 13:00 with 10-30 jumps per hour. As previously mentioned, the absence of the rope swing tree at WW4 appears to have had a direct effect on the number of users docking at the bar. While many users still utilized the bar for recreation, they did not tend to stay as long or stop as frequently. It can also be seen from **Figure 3.10** that the tree roots are uncovered in both photos, which is likely due to trampling along the bar to access the rope swing on the tree.

**Figure 3.10 – Rope Swing at Site WW4 Before and After Tree Fall**



### 3.4. Social Surveys

Field staff at the downstream-most sampling sites (WW4 and WW5) conducted exit interviews with randomly selected groups of visitors using a standard set of questions (provided in **Appendix B**). Over the course of the study, 82 groups (327 individuals) were interviewed. Up to 10 interviews were conducted per field sampling day, which were spread throughout the day. Of the surveyed groups, visitors noted similar recreational reasons for stopping on point bars, such as picnicking, swimming, and taking a break from travelling in their respective vessels. Visitors reported to enjoy the river, suggesting that they would recommend the Weeki Wachee River as a place to view wildlife and the crystal-clear water. Those with negative comments about their experience noted that there were too many people on the river. In general, visitors in motorboats complained there



were too many inexperienced kayakers on the river, while kayakers complained there were too many inexperienced motorboat drivers on the river. When asked about the rope swings, not many of the people interviewed had used them due to safety concerns. Several long-time visitors noticed changes in submerged aquatic vegetation and an increase in the number of visitors over the years. Summarized survey results are provided in **Table 3.3**.

**Table 3.3 – Summary of Social Survey Responses**

Survey Metric	Percent of Total Surveyed
First time groups	38%
Returning groups	70%
Groups sharing returning and first-time users	7%
Users launching before noon	99%
Users renting watercrafts	59%
Users owning watercrafts	41%
Users docking under 30 minutes	62%
Users docking over 30 minutes	17%
Users that did not dock	12%
Users launching from Weeki Wachee State Park	39%
Users launching from Rogers Park or Kayak Shack	30%
Users launching from Weeki Wachee Marina	4%
Users launching from SUP Weeki	1%
Users launching from private residences	9%
Users reporting human & boat congestion	25%
Hernando County residents reporting congestion	8%

### 3.5. Summary of Recreational Activities

Data collected by Wood during 9 sampling events between July 2018 and June 2019 found that during the higher recreation season (May-September), the number of vessels observed per day along the Weeki Wachee River ranged between approximately 200 and 600, with higher numbers of vessels being observed at the downstream end, nearer to Rogers Park. During the lower-recreation season, (October-April), fewer total vessels were observed per day, ranging from approximately 50 to 200. The highest counts were observed on holidays, followed by weekends and weekdays. While total vessel and user numbers are important for quantifying impacts to the river system, it is also important to note that these totals include travelers going in both directions. Looking at the downstream only direction provides the most accurate count of the number of vessels/users on the river in a given day because those travelling upstream must come back downstream. Near the State Park, only between 3 to 10% of the vessels observed were travelling upstream, while in the lower reaches of the river, near Rogers Park, approximately half of the vessel traffic was travelling upstream indicating that approximately half the users observed at WW4 came from the State Park and half came from Rogers Park, private river-access residences or from



downstream vendors. At all stations, the majority of vessel traffic was composed of kayaks (85-90%), while paddleboards, motorboats, and canoes make up 7-8%, 1-4%, and 1-3%, respectively. The highest number of motorboats were observed at the downstream-most station (WW4), with the most common motor sizes observed being less than 10 horsepower (hp), followed closely by 10-50 hp. The highest number of vessels docking and users wading/swimming per hour was observed at the downstream-most station (WW4), but the highest percent of passing vessels that docked occurred at the historic State Park exit (WW2). Data and observations also showed that visitors jumped from trees up to 40 times per hour and that jumping trees/rope swings contribute to the popularity of a bar as a docking location and damage to the point bar from trampling. From the social surveys, it appears that approximately 40% of users launch from upstream at the State Park, while 30% launch from downstream at Rogers Park or Kayak Shack, and the remainder launch from various marinas and private residences on the downstream end of the river. While it appears that many visitors believe the river is crowded, they also do enjoy the clear waters and natural systems of Weeki Wachee.



## 4.0 FLUVIAL GEOMORPHOLOGY ASSESSMENT

Fluvial geomorphology can be described as the interaction of flowing water with its environment; which affects channel shape and size, bed substrate, flow, velocity, vegetation, and river corridor ecology and biodiversity. Many factors influence the geomorphology of a stream, including climate, soil types, groundwater influence, topography, vegetation, land use in the contributing watershed, and activities within the stream or along the streambanks. The discipline of fluvial geomorphology can help to understand the processes occurring within a stream system. Various fluvial geomorphic assessments were performed as part of this study to assess whether the Weeki Wachee River diverges from expected self-sustaining characteristics, and to assess whether divergence can be linked to recreation. These included an aerial point bar interpretation (**Task 2.1**), recreational trampling assessment (**Task 2.3**), comparative site assessment (**Task 2.1**), cumulative assessment (**Task 2.2**), and assessment of leaning trees as described in the subsequent sections. **Map 4** shows the locations of the point bars used in each analysis.

### 4.1. **Aerial Point Bar Interpretation**

Point bars with clear expanses of beach-like sand are a recreational draw for visitors to the Weeki Wachee River; however, these are not normally observed in Florida spring runs. While the natural bed material of the Weeki Wachee River is comprised predominantly of sand, point bars in Florida spring runs generally support herbaceous vegetation and subsequently accumulate organic soils on the bar. An assessment of vegetative cover over the past decade at selected point bars within the Weeki Wachee River was conducted to observe whether a pattern of progressive vegetation and organic soil loss has occurred.

#### 4.1.1 Methodology

Using aerial imagery from Google Earth Pro software (image source Landsat/Copernicus), apparent changes in vegetation and morphology on selected point bars were observed through time. The 6 point bars used in aerial interpretation were selected because they had the clearest views of bar vegetation in the available aerials over the last decade. The vegetated area of each bar was calculated by setting reference points at the forested edge and tracing the vegetated limits of the exposed sand of the bar. Vegetated area did not include submerged aquatic vegetation or algae, and approximations aimed to account for overhanging trees. The vegetated areas for each year with a clear aerial image were compared to calculate a change in vegetative cover.

#### 4.1.2 Results

**Figure 4.1** shows the point bar at Wood Station WW2 (the historic exit of the State Park) in 2008 compared to 2017, and the vegetation loss of approximately 1600 ft<sup>2</sup>. This side by side comparison clearly shows the magnitude of vegetation and subsequent organic soil loss at this point bar, and kayaks can even be seen docked in the 2017 image on the right. **Figure 4.2** shows the cumulative percent reduction in vegetation among all 6 point bars assessed compared to the average daily vessels launched from the State Park in each fiscal year (FY 2012/2013 plotted as 2013, etc.). State



Park launch data were used in the assessment because no other long-term user data from downstream of the State Park (i.e. private residents, Rogers Park or other vendors) were available. Based on previously discussed results, up to 50% of the total users in the downstream areas came from downstream of the State Park. Using the available information from the State Park, **Figure 4.2** clearly shows that as the average daily vessels launched from the State Park increased, so too did the cumulative reduction in point bar vegetation. However, it should be noted that the State Park launch data only dates back to July 2012, while reductions in vegetative cover occurred between the available aerials from 2008 and 2011.

**Appendix C** provides a full suite of imagery comparisons and vegetated areas for all 6 point bars assessed. Among the sites, impacts can already be seen occurring sometime prior to 2011, while cumulative reductions in vegetation and changes in point bar morphology can be observed through the most recent assessed aerial in 2017. While 2016 is notably when the number of vessels launched from the State Park reached their peak and it coincides with a large trend in vegetation loss, the trend of vegetation loss commenced well before such levels of use.

The vegetation loss pattern since 2008 suggests that a threshold of impactful use occurred at least several years before vessels peaked in 2016. In river morphology and stream ecology, there is a concept of lag time. Impacts may be occurring for several years but have not yet reached a threshold at which rapid changes occur, such as the large-scale reduction in vegetation and organic soils observed in the 2016 aerials. There may be secondary effects, which would not occur had it not been for the first impact. For example, once a space is opened in the point bar vegetation, more docking occurs because of that opening and it in turn creates a larger opening. Once the organic soil is lost to physical disturbance and further erosion, the sand below is exposed which makes the point bar even more inviting for stopping. Another secondary effect is that vegetation loss exposes easily transportable sand, releasing it downstream and enabling some point bars to enlarge (aggrade). This truncates the open channel width and increases the fluvial forces on the opposite streambank, which can greatly accelerate erosion at the outer bends.

Because the initial impacts pre-date the State Park count data, and no information is available from downstream users, caution should be used when trying to assign a carrying capacity number based solely on the State Park vessel launch numbers. The initial impacts occurred prior to the available user counts. It is clear, however, that more vessels and users correspond with more impacts to point bars. In addition to limiting the number of users launching at a given entry point, albeit from the State Park and/or from downstream of the State Park, to reduce or prevent impacts to point bars, the activities that occur on the river, such as docking/exiting the vessels would need to be limited or restricted.

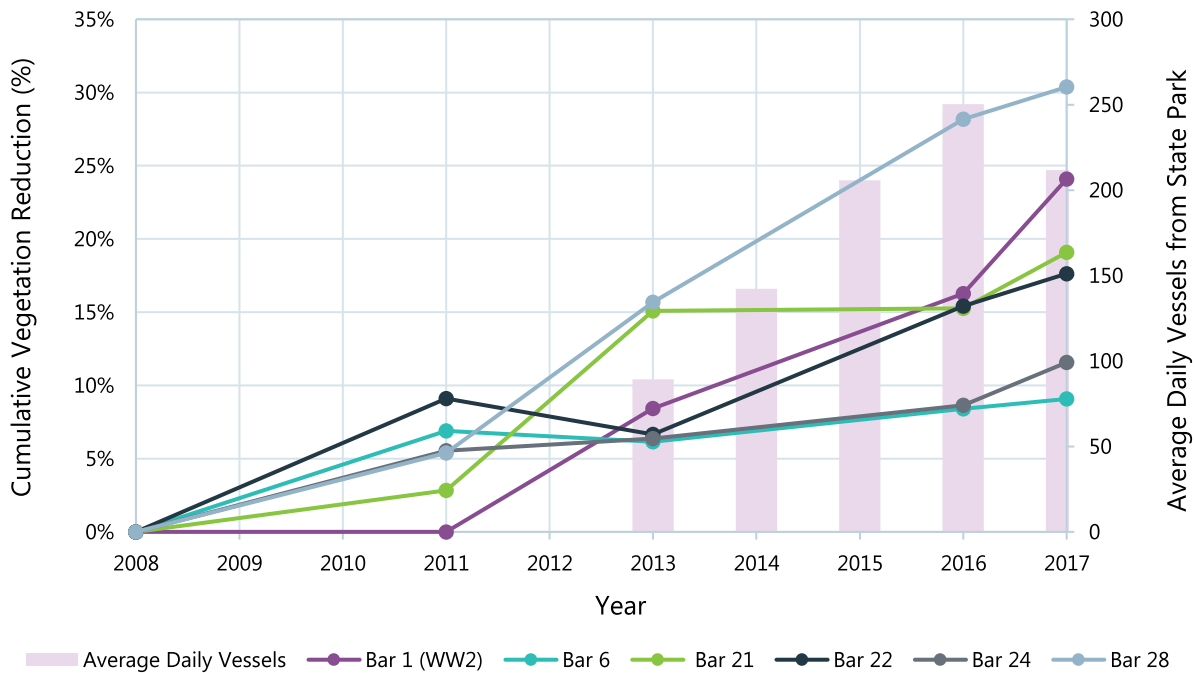


**Figure 4.1 – Reduction in Vegetation from 2008 to 2017 at Weeki Wachee Point Bar 1**



Note: Historic aerial imagery sourced from ESRI ArcGIS Online Imagery Services and/or freely available downloadable imagery from SWFWMD and FDOT. Left Image: Aerial 10/2008; Bar vegetated area = 7,031 sq. ft. Right Image: Aerial 6/2017; Bar vegetated area = 5,337 sq. ft.

**Figure 4.2 – Cumulative Percent Reduction of Vegetation on Point Bars Compared to Average Daily State Park Vessel Launches**



Note: Cumulative vegetation reduction is calculated as (vegetated area in year X – vegetated area in 2008)/vegetated area in 2008. The earliest State Park vessel launch data begins in June 2012. Point bar locations shown in **Map 4**.



## 4.2. Experimental Recreational Trampling Assessment

An experimental trampling assessment was conducted to measure the impact, intensity of recreational disturbance, and potential recovery of plant communities and soils within the Weeki Wachee River. Disturbances caused by trampling events often have extensive implications for the health and function of natural ecosystems. Studies involving even low levels of visitor traffic on natural systems have shown that recreational trampling can have negative effects on vegetation and soils (Jägerbrand and Alatalo 2015; Pertierra et al. 2013). Commonly documented effects on vegetation include changes in species diversity, composition, growth patterns, percent cover and an increased abundance of opportunistic and rapidly colonizing invasive species (Cole 2004; Kuss and Hall 1991; Pickering and Growcock 2009). Concurrent changes to soil compaction and water-holding capacity can also lead to erosional sources of sediment transport and sedimentation, decreased water clarity, and loss of submerged aquatic vegetation within the river. Vegetative controls on spring run morphology are significant in preserving the key functions and health of riverine ecosystems such as the Weeki Wachee River (Kiefer et al. 2015).

### 4.2.1 Methodology

A total of 3 point bars with intact herbaceous vegetation were selected at random for the experimental trampling assessment (**Map 4**). These sites were located within the previous State Park boundary where vessels are not supposed to dock and clear impacts to point bar vegetation were not observed. The initial trampling event was conducted on 5/28/2019, with a two-week follow-up site visit to assess immediate impacts on 6/12/2019, and a 6-month interim follow-up site visit to assess potential reestablishment within the recovery period on 11/24/2019. Additional follow-up site visits at the 1-year mark (May 2020) and 2-year marks (May 2021) since trampling should also be conducted to assess potential recovery from trampling. It is important to note that the trampling event occurred during low water levels, and the bar substrates were merely saturated and not under standing water. Therefore, the recovery assessments should also occur during similar hydrologic conditions. The interim reestablishment assessment in November 2019 occurred during high water levels and the bars were all under almost a foot of water. The information gleaned from the interim assessment provided good information on how the bars were beginning to recover under varying hydrologic conditions, which are important for management considerations.

Adapting methodology from Cole and Bayfield (1993), 5 equally-dimensioned lanes (**Figure 4.3**) of different trampling intensities, each with two subplots, were identified on each of the 3 experimental point bars. Upon site selection, pin flags were placed at each subplot corner and photographs documenting vegetation cover and height were taken. Photographs of trampling sites with applied treatments, and their respective soil profiles can be found in **Appendix D**.

Percent vegetation cover and species type along with soil matrix profiles were identified for each subplot (10 subplots per bar) prior to trampling. Percent cover was recorded as 0, 0.2 (if between 0 and 0.5%), 1, 5, 10, 15, 20, 30, 40, 50, 60, 70, 80, 90 or 100% for vegetation, with the same percentage categories used for dead vegetation and bare soils. One soil matrix profile was taken

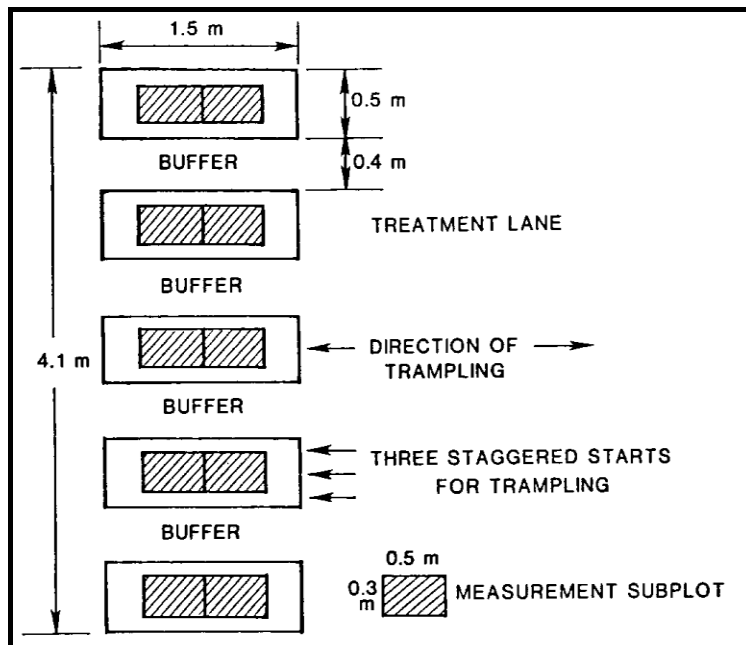




within each subplot using a tubular soil sampler to document the thickness and type of overlaying soil layers. Soil types were documented as detritus, peat, muck, sand, silt, clay, combinations or other when present in the upper 30 cm of the soil core.

Each of the 5 lanes was randomly assigned a trampling intensity (0, 25, 50, 100, or 200 passes), with one pass defined as walking at a natural gait in one direction. Trampling was performed by the same individual to provide consistency across sites. After receiving the designated intensity of trampling, the immediate effects to soil and vegetation were recorded and photographed. Signage informing that the site was restricted was placed onto construction fencing that was held up by steel rebar was installed as a barrier at each trampling site to restrict site access to the research plots (**Figure 4.4**).

**Figure 4.3 – Layout of Recreational Trampling Assessment Lanes**



Cole and Bayfield (1993)



**Figure 4.4 – Construction Fence Barrier**



The soils and vegetation cover were recorded again, repeating all measurements for each subplot two weeks and six months after the initial trampling event to document both the short-term and long-term impacts caused by recreational trampling. Relative cover (RC) was calculated as the primary measure of vegetation change for the periods occurring two weeks after trampling (impact assessment) and six months (interim reestablishment assessment during recovery period) after trampling. Impact refers to the amount of damage resulting from the initial trampling event while recovery refers to the rate at which vegetation reestablished after the trampling event. Using Cole and Bayfield's equation to calculate RC, the percent coverages of all plant species within each subplot were summed, and then a mean sum of cover was derived for each plot.

$$RC = 100\% * cf * (\text{surviving cover on trampled subplots}) / (\text{initial cover on trampled subplots})$$

Where  $cf = (\text{initial cover on control subplots}) / (\text{surviving cover on control subplots})$

Additional statistical interpretations were performed to examine the effects of trampling intensity on the vegetation and soils of the study sites through periods of impact, reestablishment and recovery.



**Figure 4.5 – Pre and Post Trampled Vegetation and Organic Soils**



#### **4.2.2 Results**

One-way ANOVA with Tukey and Fisher pairwise tests for comparison of means was performed on just the pre-trampled vegetation percent coverage values for each trampling lane (average of both subplots in each lane) to establish that none of the lanes had statistically different pre-trampled percent vegetation cover. The results showed no statistical difference in vegetation cover of pre-trampled plots.

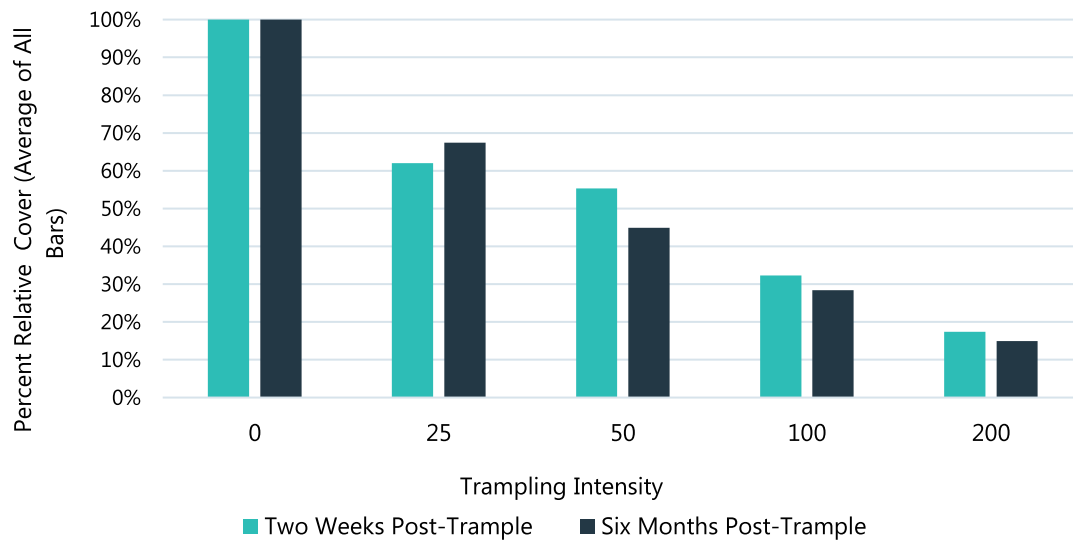
Overall, it appeared that vegetated cover was lower 2 weeks after trampling for all intensities, while some reestablishment at different stages of recovery were observed for each intensity at 6 months post-trampling. Relative cover values were used for analysis because they account for seasonal or water-level-dependent changes in vegetated cover by normalizing values with the results of the untrampled plots (percent cover values are shown for each plot in **Appendix D**). **Figure 4.6** shows the average percent relative cover of vegetation for the 2-week and 6-month periods after trampling. These results suggest that relative vegetation cover decreases with increasing trampling intensity.

The vegetation relative cover data from the 3 experimental bars and trampling intensities (except for 0 passes, which was the control), were pooled and used to conduct a nonparametric Wilcoxon Signed Rank test, which compared the medians of the pre-trample and 2-week post-trample data for similarity. The test was significant at a p-value less than 0.05, showing that the percent vegetation cover was significantly lower after trampling, for all trampling intensities. The same test was conducted to compare the pre-trample and 6-month post-trample data. The test was significant at a p-value less than 0.05, suggesting that vegetation had not yet begun to significantly reestablish 6 months after the original trample date.



Linear regression plots (in **Appendix D**) for each trample site show a positive relationship between trampling intensity and reduction in percent of vegetation cover. To assess differences in effects of trampling intensities, one-way ANOVA with Tukey and Fisher pairwise tests along with a Dunnett Multiple Comparisons test (with trampling intensity 0 as the control) were performed on the relative cover of vegetation dataset (2-weeks and 6-months after trampling). For the 2-week post-trampled dataset, the Fisher test for difference in means showed that relative cover was significantly less (at  $\alpha=0.05$ ) than the control at a trampling intensity of 200, but not at intensities of 25, 50, or 100. For the 6-month post-trampled dataset, the Tukey and Dunnett comparisons tests showed that relative cover was significantly less (at  $\alpha=0.05$ ) than the control at trampling intensities of 100 and 200, and the Fisher comparison test showed that relative cover was significantly less than the control at trampling intensities of 50, 100, and 200. Overall, based on the various statistical analyses, the higher trampling intensities showed greater reductions in relative vegetation coverage.

**Figure 4.6 – Percent Relative Cover Two Weeks and Six Months After Trampling (Average of All Trample Bars)**

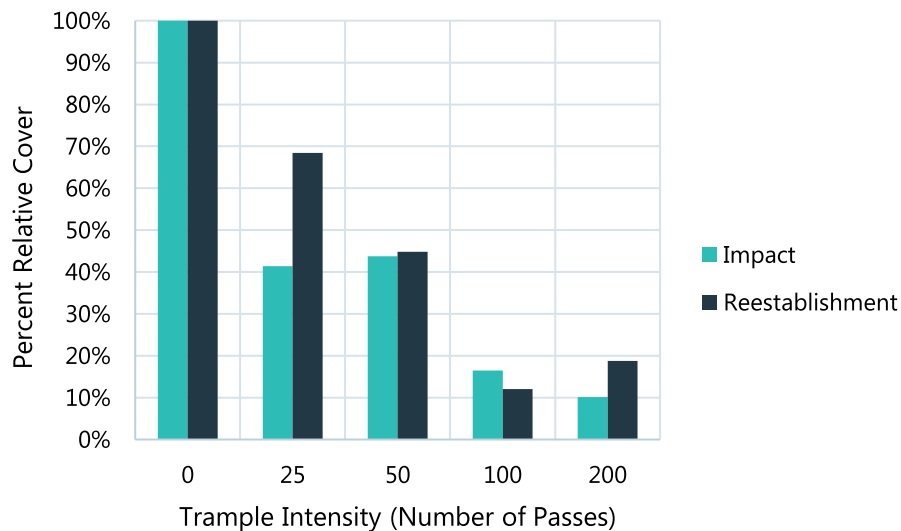


**Figures 4.7 - 4.9** show the relationship between relative cover and the intensity of trampling received to the study site after the initial 2-week period (impact) and 6-month period (interim reestablishment). Impact is defined as 2 weeks after trampling because it leaves sufficient time to observe plant deaths due to trampling (as opposed to immediately after trampling when vegetation still appear alive but flattened). After the 2-week impact period, the recovery period begins with some reestablishment of mostly opportunistic invasive vegetation, and the first interim recovery observations were taken at 6 months. It should be noted that recovery may take much longer than 6 months (depending on environmental and seasonal factors), and that 12-month recovery data will be collected, although it will occur outside of the carrying capacity study contract period. Overall, after the initial 2-week trampling event, percent relative cover decreased in response to the increasing trampling intensity across all 3 bars.

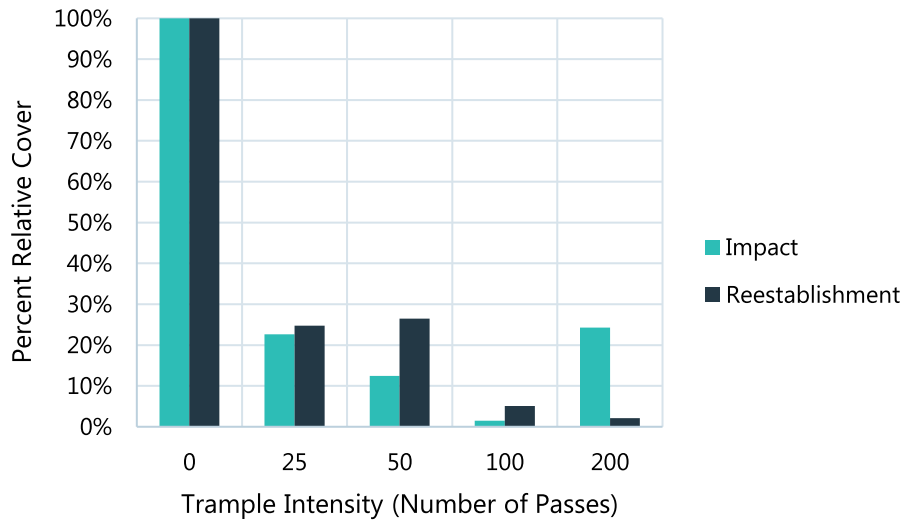


At the interim 6-month point in the recovery period, it appeared that the trampled plots were in different stages of recovery, depending on their environments. Overall, it appeared that higher water levels and onset of winter may have been limiting factors in vegetation recovery, as dead and bare coverage, even in the un-trampled control lanes were observed at all bars. In addition to these overall observations, each of the three bars appeared to have different recovery responses. At Bar 1, where there is lower flow than at Bars 2 and 3, organic sediments had begun collecting in the submerged trampled plots, but presumably high water levels prevented reestablishment of many species that were present before trampling. On the bar that remained above the waterline (Bar 2), the dead, trampled *Cladium jamaicense* (sawgrass) appeared to have created a physical barrier (similar to mulch) on the top of many of the plots, potentially limiting reestablishment of vegetation. Bar 3 was also submerged but located on an outer bend that appears to receive higher flows/velocities than at Bar 1. At Bar 3, it appears that organic sediments were not accumulating (presumably due to higher flows), however, floating vegetation such as *Pistia stratiotes* had been transported by flow into the plots. Additionally, dense submerged vegetation and vines (such as *Najas guadalupensis*, *Diodia virginiana*, and *Mikania scandens*) had grown into the trampled plots that were originally dominated by larger emergent herbaceous species (such as *Typha sp.* and *Sagittaria lancifolia*), which creates the appearance of a high recovery (>100%) of total vegetation cover, but with different, ephemeral species. Therefore, at the one-year mark, it will be important to assess the vegetation in terms of a more qualitative metric such as types of communities that colonized, reestablished or recovered, rather than a total percent coverage as a quantitative metric to assess recovery.

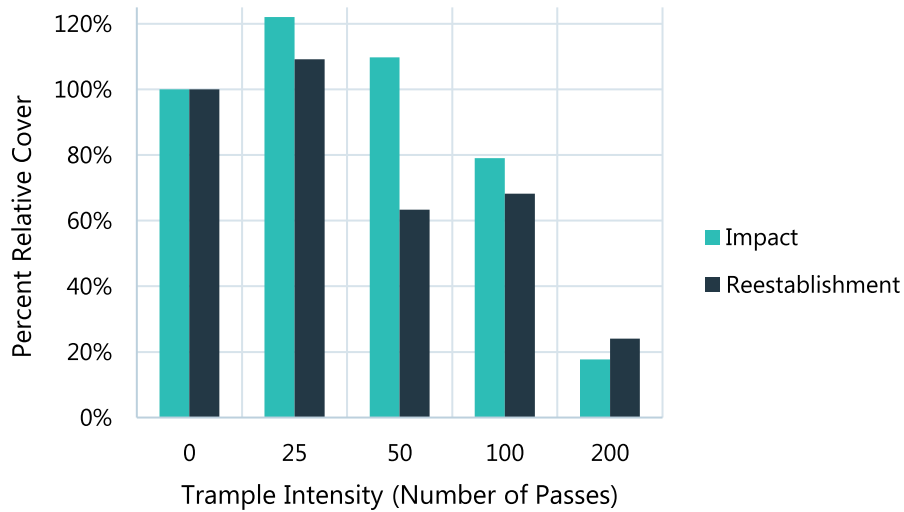
**Figure 4.7 – Relative Cover After Impact and Reestablishment at Trample Bar 1**



**Figure 4.8 – Relative Cover After Impact and Reestablishment at Trample Bar 2**



**Figure 4.9 – Relative Cover After Impact and Reestablishment at Trample Bar 3**



Common vegetation described at trampling sites prior to trampling were primarily composed of herbaceous vascular plants. **Table 4.1** provides a list of dominant species at each trampling location. Floating-leaf aquatic plants were noted as part of the vegetative survey but were not used in the calculation of total percent cover.



**Table 4.1 – Dominant Vegetation at Trampling Sites**

Trample Bar 1	Trample Bar 2	Trample Bar 3
<i>Cyperus haspan</i>	<i>Cladium jamaicense</i>	<i>Typha sp.</i>
<i>Boehmeria cylindrica</i>	<i>Cicuta maculata</i>	<i>Sagittaria lancifolia</i>
<i>Cicuta maculata</i>	<i>Vitis rotundifolia</i>	<i>Ludwigia sp.</i>
<i>Hydrocotyle umbellata</i>	<i>Cyperus haspan</i>	<i>Polygonum sp.</i>
<i>Cladium jamaicense</i>	<i>Colocasia esculenta</i>	<i>Boehmeria cylindrica</i>
<i>Sagittaria lancifolia</i>	<i>Ludwigia sp.</i>	<i>Cicuta maculata</i>
<i>Mikania scandens</i>	<i>Boehmeria cylindrica</i>	<i>Micranthemum umbros</i>
<i>Alternanthera philoxeroides</i>	<i>Toxicodendron radicans</i>	<i>Diodia sp.</i>
<i>Bacopa monnieri</i>	<i>Polygonum sp.</i>	<i>Hydrocotyle umbellata</i>
<i>Colocasia esculenta</i>	<i>Micranthemum umbros</i>	<i>Mikania scandens</i>
<i>Cynodon dactylon</i>	<i>Mikania scandens</i>	<i>Pistia stratiotes*</i>
<i>Micranthemum umbros</i>		
<i>Pistia stratiotes*</i>		

\**Pistia stratiotes* is a floating leaf aquatic plant and was not included in percent cover values

The soil profile data collected before and two weeks after trampling were used to identify loss of organic matter from recreational trampling. If there was substantial organic content in the top 6-10 cm of the profile, the subplot was marked as “organics present”. If the core was primarily sand, it was assigned “organics not present”. The binary dataset was used to perform McNemar’s test (non-parametric statistical test), which tests whether paired proportions are significantly different (i.e. if soils before trampling and 2 weeks after trampling were significantly different). When comparing the soils before and 2 weeks after trampling, the test was significant with a p-value less than 0.05 suggesting that organic soils decreased significantly after the initial trampling event. The test was also significant (p-value <0.05) when comparing the soils before and 6 months after trampling, suggesting that the organic soils were still significantly reduced 6 months after trampling. When comparing the soils data 2 weeks after and 6 months after trampling, the test was not significant, indicating that there was no significant loss or recovery of organic soils during the 2-week and 6-month period. Overall, these results suggest that soils can be significantly impacted within 2 weeks of trampling, and that those impacts may persist until at least 6 months after trampling.

Trampling events at submerged bars were often subject to higher cases of soil disturbance than events on non-submerged bars. It is worth noting that saturation of soils and/or depth of water in trampling lane appears to intensify effects of trampling and potential for recovery. Wet soils displace under foot and adhere to footwear, so vegetation is not only trampled, but can also be uprooted and buried. Areas originally containing lower amounts of water, expressed increased water pooling after the initial trampling, which is consistent with changes in soil compaction. In the submerged point bars, disturbed soils from trampling also appeared to be more susceptible to washout during rain events. It should also be noted that the submerged vegetation at the edge of the bars appears to be especially susceptible to trampling because these water depths are conducive to safely exiting a kayak (or other vessels).

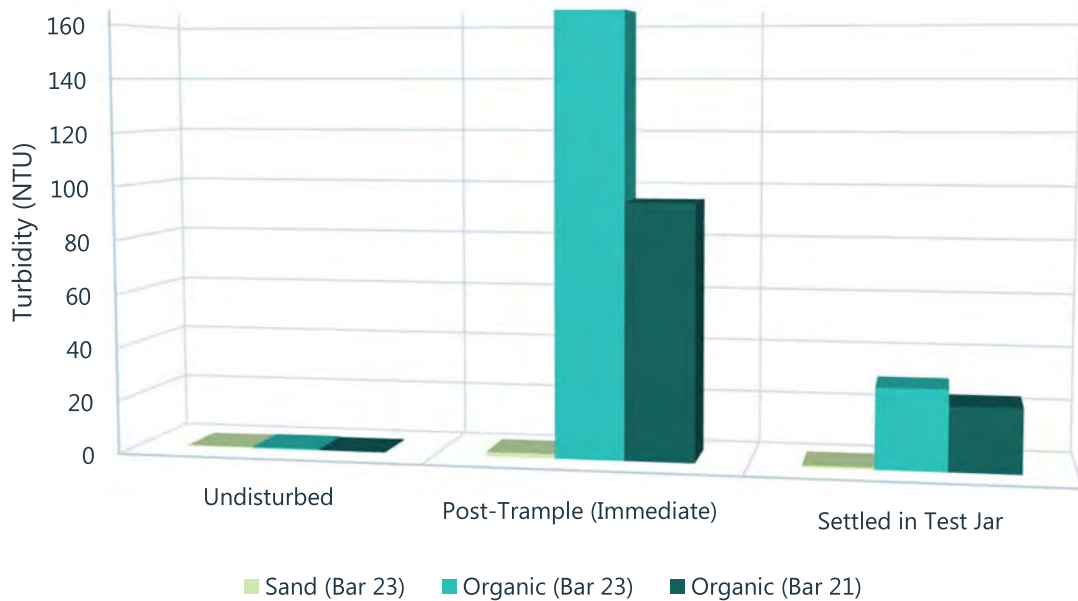


Turbidity was measured in triplicates and averaged at select bars to describe water clarity before and after recreational trampling. As an undisturbed control, turbidity measurements were taken from the boat above areas with clean sand and areas composed of mostly organics. Turbidity was then measured at the same sites immediately after soils were disturbed by trampling activity, and again after the sample had been allowed to settle for 5-10 minutes in a test jar. **Table 4.2** and **Figure 4.10** show the measured values of turbidity at select bars.

**Table 4.2 – Turbidity (NTU) Values at Trample Sites Before and After Trampling**

Substrate Material (Location)	Average Turbidity (NTU)		
	Undisturbed	Post-Trample (Immediate)	Settled in Test Jar
Sand (Bar 23)	0.36	1.6	0.8
Organic (Bar 23)	0.57	164.9	30.0
Organic (Bar 21)	0.27	95.0	24.0

**Figure 4.10 – Comparison of Turbidity (NTU) at Bar 21 and Bar 23**





### **4.2.3 Summary of Recreational Trampling Assessment**

The experimental trampling assessment provided documentation of vegetation and soil sensitivity in select shoreline sites of the Weeki Wachee River. After the initial trampling event, each of the 3 subplots showed increases in exposed soil and dead vegetation. As expected, areas trampled at variable intensities were subject to fluctuating amounts of vegetation and soil disturbance. Percent relative cover of vegetation declined substantially as trampling intensity increased after the initial 1-week and 6-month trampling events. Percent relative cover was somewhat variable at the six-month interim reestablishment event suggesting each subplot is at a different stage of recovery influenced not only by trampling intensity, but multiple other environmental variables. The reestablishment of vegetation after six months of recovery appeared to be influenced by water level, flows, seasonal climate, and surrounding vegetation. Submerged bars were often newly colonized by floating-leaf aquatic plants such as *Pistia stratiotes* and traveling vines such as *Mikania scandens*, thus changing the community composition. Soil profiles taken after initial impact showed decreases in surface organic matter, signifying disruptions from soil compaction and disturbance. The loss of organic soils was significant two weeks after trampling, and continued to be significant 6 months after trampling, with no significant change in presence of organic soils between two weeks and 6 months.

Recreation-induced vegetation trampling has been shown to adversely impact the herbaceous shoreline of the Weeki Wachee River. Limiting or fully restricting vessel docking along the shorelines in general or setting up specific areas for docking and recreation at designated areas that have been engineered for that purpose could decrease the amount of vegetation loss and erosion along the river.

## **4.3. Comparative Site Assessment**

### **4.3.1 Site Selection**

Wood selected a spring-fed river containing point bars with intact vegetative cover to provide a comparative reference site from which to assess ecological impacts observed at point bars on the Weeki Wachee River (such as vegetation and organic soil loss). Candidate spring runs included Alexander Springs Run and Juniper Spring Run in the Ocala National Forest and Rock Springs Run in Orange County. These rivers were reviewed via aerial imagery and site visits to find a site with similar fluvial geomorphic characteristics such as meander pattern, bend geometry, and hydrologic regime to the Weeki Wachee River. Alexander Springs Run was selected as the comparative site for the Weeki Wachee River because it had similar geomorphic patterns, dimensions, and flow regime. It also displays fewer impacts from recreation versus Rock Springs Run, which is heavily eroding in some areas. While the Alexander Springs Run in the studied section is not entirely pristine (it has some rope swings, docks, short segments of cleared shoreline, an eroded kayak/small boat launch, and an actively eroded bluff), it has numerous vegetated and intact point bars available to study lacking erosional scarps or other evidence of impacts from recreational use of the bars.



Juniper Spring Run has intact point bars and low impacts but was rejected as a candidate for the comparative study because it is much narrower than the Weeki Wachee River and has a different flow regime. Of note, Juniper Spring Run is heavily recreated by kayakers, but user impacts are managed by 1) prohibitions on disposables, 2) enforcing a late-morning curfew on livery launches, and 3) the fact that the river is quite swift and narrow which is a major disincentive to swimming and wading. Therefore, very few, if any, users exit their vessels in Juniper Spring Run. It would make an interesting case study for these reasons, but it is geomorphically dissimilar, demonstratively smaller river with reduced point bar development versus the Weeki Wachee River, and therefore did not meet the criteria to be included as a comparison site for the purpose of this study.

#### 4.3.2 Methodology

Four point bars from both Alexander Springs Run and Weeki Wachee River were randomly selected to be included in the comparative assessment (**Maps 4** and **5**). Each of the 8 selected point bars was mapped using survey equipment to collect relative horizontal and vertical information at and within various ecological breaks and zones. A series of up to 5 cross-sections covering the point bar and spanning the various zones were mapped, and soil and vegetation data were recorded within each zone. Detailed information including comparative flow duration curves, photographs, point bar maps, representative cross-sections, and soil and vegetation data for each comparative point bar are provided in **Appendix E**.

#### 4.3.3 Results

**Table 4.3** provides a general list and definitions of the various ecological zones encountered during the comparative assessment, as well as the general plant species and soils observed within those zones. In general, the Alexander Springs Run reference point bars were more intact than those in the Weeki Wachee River and included an open water zone, emergent vegetation zone, shrubby flow-way, and forested zone (**Figure 4.11**). One point bar also included a deeper aquatic zone. Point bars at the Weeki Wachee River typically included an open water zone, a denuded bar zone (that should contain aquatic vegetation), and a forested zone (**Figure 4.12**). Two of the Weeki Wachee sites had a truncated emergent vegetation zone that was only present at the upstream end/head of the point bar, while the downstream portion of the point bar was denuded. Where the denuded bar zones in the Weeki Wachee River encountered an intact vegetated zone (whether it be emergent or forested), an approximate 1-foot high scarp or vertical wall was typically observed (BRK-2, **Figure 4.13**). This scarp can be defined as a ledge feature on the impacted point bars where soils and vegetation appear to have been directly carved out by vessel docking and trampling activities, and it can be interpreted as the approximate depth of organic soil loss occurring at the point bar. By comparison, no scarps or denuded bars were observed at Alexander Springs Run. Many exposed roots were also often observed at the Weeki Wachee River sites within the forested zone, which would otherwise be covered and protected by several feet of organic soil material if the material was not removed by disturbance and erosion (**Figure 4.14**).



**Table 4.3 – Ecological Zones Observed at Comparative Point Bars**

Zone	Description	Representative Vegetation	Representative Soil Type
Open Water	Mainstream channel	--	Sand
Aquatic	Deeper zone with aquatic floating and/or submerged plant species	<i>Nuphar advena</i>	Organic
Emergent	Shallow bar area with herbaceous and early successional plant species	<i>Baccharis halimifolia</i> , <i>Cephalanthus occidentalis</i> , <i>Cladium jamaicense</i> , <i>Cyperus spp.</i> , <i>Mikania scandens</i> , <i>Pontederia cordata</i> , <i>Sagittaria lancifolia</i> , <i>Sagittaria latifolia</i> , <i>Salix caroliniana</i> , <i>Woodwardia virginica</i>	Organic
Flow-way	Backwater area landward of the emergent zone, slightly deeper and lacking groundcover	<i>Cephalanthus occidentalis</i> , <i>Cornus foemina</i> , <i>Cyperus spp.</i> , <i>Myrica cerifera</i> , <i>Salix caroliniana</i>	Organic
Denuded Bar	Shallow ledge devoid of expected vegetation (was historically vegetated and may now have a larger footprint due to sedimentation)	None*	Sand
Forested	Wetland forest structure with trees, shrubs, and groundcover canopies	<i>Cyperus spp.</i> , <i>Acer rubrum</i> , <i>Baccharis halimifolia</i> , <i>Cephalanthus occidentalis</i> , <i>Cladium jamaicense</i> , <i>Cornus foemina</i> , <i>Gordonia lasianthus</i> , <i>Ilex cassine</i> , <i>Magnolia virginiana</i> , <i>Myrica cerifera</i> , <i>Nyssa sylvatica</i> , <i>Sabal palmetto</i> , <i>Serenoa repens</i> , <i>Taxodium distichum</i> , <i>Woodwardia virginica</i>	Organic

Note: \*Benthic filamentous macroalgae may be present on top of the sand substrate.

**Figure 4.11 – Alexander Springs Comparative Point Bar**



**Figure 4.12 – Weeki Wachee Comparative Point Bar**



**Figure 4.13 – Weeki Wachee Scarp Example (Point Bar 1)**



Note: Example of a scarp (unnatural vertical wall), representing BRK-2 as a breakpoint in the point bar mapping exercise.



**Figure 4.14 – Weeki Wachee Exposed Roots Example (Point Bar 33)**



Of the 8 point bars mapped, 3 at Alexander Springs Run and 2 at Weeki Wachee River had an emergent vegetation zone. The emergent zone at Alexander point bars averaged 61 feet long by 19 feet wide with an average area of 910 square feet, while the emergent zone at Weeki Wachee point bars averaged 106 feet long by 23 feet wide with an average area of 2043 square feet (**Table 4.4**). Note that the emergent zone for the Weeki Wachee River appears to be substantially larger because one of the point bars (#1/WW2) has a very large (although much impacted) emergent zone. By comparison, the denuded point bars observed in the Weeki Wachee River averaged 72 feet long by 12 feet wide with an average area of 779 square feet. What is now denuded at the Weeki Wachee River was likely once intact with vegetation and organic soils based on both the comparable site point bar mapping results and the vegetation losses observable over time on aerial photographs of the Weeki Wachee River.

At both Alexander Springs Run and Weeki Wachee River, the emergent zone contained organic soils ranging from 0.2 to 3 feet thick, while the denuded zones at Weeki Wachee were just sand. The average depth of the emergent zone relative to the bankfull stage was 1.7 feet at Alexander Springs Run. The average depth of the waterward edge of the denuded bar at Weeki Wachee (BRK1, which presented itself as a sand ledge) was 1.9 feet, while the average depth of the landward edge of the denuded bar where the scarp occurred (BRK2) was 1.1 feet, indicating that the current edge of the point bar at Weeki Wachee has a similar bankfull depth to the intact point bars at Alexander Springs Run (**Table 4.4**).



**Table 4.4 – Summary of Comparative Site Assessment Point Bar Dimensions**

Site	Zone	Length (ft)	Average Width (ft)	Area (sq. ft)	*Average Depth Relative to Bankfull (ft)	Organic Soil Thickness (ft)	Average Estimated Organic Soil (cy)
<b>Alexander Spring Run</b>	Emergents (n=3)	61 (48-71)	19 (16-22)	910 (726-1213)	1.7 (1.5-1.8)	0.5 - 3	57
<b>Weeki Wachee River</b>	Emergents (n=2)	106 (20-191)	23 (8-38)	2043 (156-3930)	0.1 (0.1-0.2)	0.2 - 3	34
	Denuded (n=4)	72 (49-99)	12 (9-16)	779 (325-1204)	BRK1 Sand Ledge: 1.9 (1.3-2.4) BRK2 Scarp Toe: 1.1 (0.9-1.3)	Sand only	-31

Note: Top number is the average, parentheses include the range (minimum-maximum).

\*Average depth relative to bankfull indicates the relative elevation of the soil surface.

Using the mapped areas of point bar zones and the depth of organic soils in each zone, an estimated volume of organic soils at each bar was calculated for Alexander Springs Run and Weeki Wachee River. The emergent vegetation zones of Alexander Springs point bars were compared to the emergent vegetation and denuded point bar zones of Weeki Wachee (inferring from historic aerial interpretation that denuded point bars historically contained vegetation). Averaging organic volumes at each site, Alexander Springs emergent zones characteristically contained 57 cubic yards of organic soils per bar, Weeki Wachee emergent zones contained an average of 34 cubic yards of organic soils per bar, and Weeki Wachee denuded zones are estimated to have lost an average of 31 cubic yards per bar, when multiplying the area by the depth of soil loss (**Table 4.4**). Denuded zone organic soil loss was estimated by multiplying the average zone area by the average scarp depth.

**4.4. Cumulative Assessment**

**4.4.1 Methodology**

A cumulative assessment was conducted to document organic soil and vegetation losses at Weeki Wachee River point bars by measuring apparent denudation surface areas and soil loss thicknesses at 10 randomly selected point bars from the State Park to Rogers Park. The random selection included at least 2 point bars in each functional process zone, at least 1 of which was forested and 1 of which was herbaceous (locations in **Map 4**). General dimensions (length, width, depth), soil, and vegetation data were recorded within each ecological zone at the 10 selected point bars. The data gathered in this assessment, as well data collected at reference point bars in



the comparative study, were then used to estimate soil and vegetation losses at denuded point bars, and to gain an understanding of the average conditions of the point bars along the Weeki Wachee River. Detailed information including photographs, measurements, and soil and vegetation data for each cumulative assessment point bar are provided in **Appendix F**.

Of the 10 point bars assessed on the Weeki Wachee River, 9 exhibited a denuded zone with scarps and soil loss that appear to be from recreational use, while 1 remained largely intact. It should be noted that at point bars classified as forested, it was unclear whether emergent herbaceous vegetation zones had been lost or if the dense canopy had never provided conditions to support emergent vegetation. It is also worth noting that similarly dense forested areas of Alexander Springs Run did support emergent, herbaceous vegetation zones. Therefore, the assumption would be that the forested bars on Weeki Wachee River should also have an herbaceous emergent zone to be considered intact and unimpacted. The denuded zones measured at the cumulative assessment point bars averaged 74 feet long and 13 feet wide, with an average area of 1,038 square feet and an average scarp thickness of 1.4 feet (**Table 4.5**).

To estimate the amount of organic soil lost at each denuded cumulative assessment site, each site's average scarp thickness was multiplied by the area of the denuded zone. Using this approach, it can be estimated that nearly 500 cubic yards of organic soil has been lost from the measured cumulative assessment point bars across over 9,300 square feet of measured denuded zone (**Table 4.5**). Reference bar soil thicknesses were also considered for use to estimate soil thickness loss at denuded bars. However, organic soil depths within intact emergent zones at both Alexander Springs Run and Weeki Wachee River ranged from less than 1 foot to over 3 feet (**Appendix E**). Due to the wide range of organic soil depths encountered at these reference point bars, the scarp thickness was assumed to be the most accurate depth for estimating organic soil losses at each particular point bar; however, using scarp thickness is a forensic estimate of actual organic soil loss with degree of uncertainty regarding if it is an over- or under-estimation.

**Table 4.5 – Summary of Cumulative Assessment Denuded Point Bar Dimensions (n=9)**

Summary Statistic	Length (ft)	Average Width (ft)	Area (sq. ft)	Average Scarp Thickness (ft)	Estimated Organic Soil Volume Loss (cy)
Minimum	49	3	134	0.9	9
Maximum	116	26	2575	1.8	149
Average	74	13	1038	1.4	55
<b>Total</b>	<b>670</b>	<b>--</b>	<b>9338</b>	<b>--</b>	<b>498</b>

Note: Area displayed in table is not equal to length\*width in table. Area of each point bar was calculated with bar's individual length and average width, but table shows minimum, maximum, and average dimensions across all bars.

In addition to the detailed assessment of the 10 selected point bars described above, locations and estimated dimensions of an additional 24 point bars with scarps that appeared to be from recreational use were documented along the river (**Map 4**). The goal of this additional data



collection was to obtain more comprehensive information to help estimate total organic soil losses along the river. It should be noted that this additional assessment was conducted with rough measurements, not measured with the more detailed methods described above in earlier sections. The measurements and calculations were intended to provide a general estimate of total soil volume loss along the length of the river.

The length of each scarp was estimated, and the thickness of each scarp was measured at 1 representative location along the scarp. The 24 additional bars with scarped areas averaged 37 feet long and 1.1 feet thick (**Table 4.6**). To estimate the amount of organic soil lost at each additional scarp, each site’s average scarp thickness was multiplied by the estimated length and by the average width of the cumulative assessment sites’ denuded zone (13 feet). Using this approach, it was estimated that nearly 500 cubic yards of organic soil has been lost from these additional scarps (**Table 4.6**). Using the estimated lengths and the average 13-foot width, the additional scarps have an associated denuded zone area of approximately 12,000 square feet.

**Table 4.6 – Summary of Additional Observed Scarp Dimensions (n=24)**

Parameter	Length (ft)	Scarp Thickness (ft)	Estimated Organic Soil Loss (cy)
Minimum	15	0.8	7
Maximum	110	2.0	51
Average	37	1.1	20
<b>Total</b>	<b>880</b>	<b>--</b>	<b>485</b>

Totaling the estimated organic soil losses from the cumulative assessment sites and the additional scarp sites, approximately 1,000 cubic yards of organic soil has been lost from point bars within the Weeki Wachee River study area. Denuded zone surface area totals over 20,000 square feet, which may be an indication of how much vegetation has been lost. As demonstrated in the trample study, once vegetation has been trampled and lost, the denuded point bar no longer holds organic soils. These soils wash away, exposing the sand below, which then becomes easily transportable and is redistributed, causing downstream point bar dimensions to shift over time. Due to these shifts, the apparent denuded zones measured in this study may be smaller or larger in size than the actual footprint of vegetation and soil losses that have occurred over time. Irrespective of the quantitative accuracy of the amount of soil involved, it is clear that the Weeki Wachee River’s point bar equilibrium and ecological integrity have been severely compromised.

#### **4.5. Inventory of Leaning Trees**

While conducting cumulative assessments on Weeki Wachee River, it was noted that many trees were leaning over or into the water at an angle that would make the trees susceptible to an impending tree fall, particularly within FPZ-3. Many of the leaning trees had roots that appear to have been exposed from soil washout/erosion and moderate to severe bank undercutting. Along the spring run from the State Park to Rogers Park, 76 leaning trees were observed (56 in FPZ-3, 26 in FPZ-2). Overall, the leaning trees appeared to be on outer bends of the river. At one outer





bend, at the Weeki Wachee Christian Camp, 1 large bay tree had fallen during the end of the study, exposing the root system and disturbing the soils of the bank. Along the same outer bend at the Christian Camp, several more leaning trees were noted along with approximately 6 feet of bank undercutting (**Figure 4.15**). Bank undercutting increases potential for tree fall when trees are rooted into the undercut bank, which can create a hazard and obstruction for navigation when the tree falls into the river. Outer bends with severe undercutting can also be associated with point bar enlargement, which appears to be occurring on several bars.

The Hernando County staff that maintain and remove fallen trees noted that many of the fallen trees they remove used to be rope swing or jumping trees. Jumping trees and rope swings appear to have multiple effects on point bar and bank morphology. The tree is a recreational draw, attracting vessels to dock and users to wade and swim, which may expose shoreline to enhanced vulnerability to scour and accelerated erosion of the banks. The energy transferred to the water from the impact of individuals jumping from heights can produce additional erosive forces not normal for the river in the form of waves. If enough soil is lost that the roots can no longer hold the tree in place, it may fall, tearing soil up with the roots, and leaving exposed soils that can then be washed downstream.

**Figure 4.15 – Leaning Trees on Right Bank at Weeki Wachee Christian Camp**



#### **4.6. Desktop GIS Inventory**

GIS software in conjunction with ground-truthing in the field were used to create an inventory of features that provide recreational access to the river such as docks, boat ramps, seawalls, and other (including earthen ramps, stairs, and cleared grass slopes (**Table 4.7**). Additionally, GIS was used to assess the available parking spaces at the State Park and Rogers Park, along with any other identifiable vendor parking areas (**Table 4.8**). All discernable vessel vendors (**Table 4.9**) were contacted for rental data; however, no data were provided. It should also be noted that from



desktop inventory, it appears that other businesses (such as bait shops or restaurants/bars) may rent kayaks to launch at the State Park or Rogers Park. It also appears that vacation property rentals on canals provide kayaks to patrons.

**Table 4.7– Inventory of Docks and Seawalls**

Feature	Count
Docks	75
Boat ramps	3
Seawalls	33
Access/Other*	23

Note: \*Access/Other category includes any feature that provides access to the water, such as ramps, staircases, and cleared grass slopes

**Table 4.8 – Available Parking at Launch Locations**

Location	Type of Vehicle	Type of Parking Space	Number of Parking Spots
Rogers Park	Regular vehicles,	Paved	56
	Trailers	Paved	16
State Park main parking lot	Regular vehicles	Paved	351
State Park kayak launching site parking lot	Regular vehicles	Grass/Gravel	150
State Park kayak launching RV parking	RV's	Asphalt/Gravel	4

Note: Weeki Wachee Kayak Shack (across from Rogers Park) has 40 grassed parking spaces. Parking at Weeki Wachee Marina does not appear to be in designated spaces, but the surrounding paved area can reasonably accommodate 20-30 vehicles.

**Table 4.9 – Summary of Vendors Contacted for Rental Data**

Vendor Name	Contact Information
Weeki Wachee Kayaking	8103 Cortez Blvd, Weeki Wachee, FL 34607 (352)-684-7180 <a href="mailto:weekiwacheekayakinginfo@gmail.com">weekiwacheekayakinginfo@gmail.com</a>
SUP Weeki	6895 East Richard Drive, Weeki Wachee, Florida 34607 (727) 480 4294 <a href="mailto:info@supweeki.com">info@supweeki.com</a>
Kayaks & Attractions	7383 Shoal Line Blvd, Weeki Wachee, FL 34607 (352) 796-2289
Weeki Wachee Marina	7154 Shoal Line Blvd, Weeki Wachee, Florida 34607 352-596-2852 <a href="http://weekiwacheemarina.com">weekiwacheemarina.com</a>
Weeki Wachee The Kayak Shack	5414 Darlene St, Spring Hill, FL 34607 (352) 610-4169



#### **4.7. Summary of Fluvial Geomorphology Assessment**

From interpretation of aerial imagery, it is apparent that point bars along the Weeki Wachee River have lost vegetation and organic soils since 2008 (the oldest available clear aerial imagery). An experimental study of recreational trampling showed that even a small amount of trampling can impact vegetation and cause organic soil losses, and that trampling increases turbidity, especially when it occurs in organic soils. The trampling study also showed that vegetation on the submerged edges of point bars are the most likely to be extensively impacted.

The less-impacted comparison sites at Alexander Springs Run showed that point bars, even in densely forested reaches, support emergent herbaceous vegetation and contain organic substrates, while point bars surveyed at the Weeki Wachee River had a denuded zone devoid of emergent vegetation or the emergent zone was truncated. The comparative study results provided another layer of evidence and documented that point bars in Weeki Wachee River have been impacted in comparison to Alexander Spring Run and approximately 30 cy/bar has been lost from Weeki Wachee River point bars.

The cumulative assessment showed that 9 out of 10 point bars on the Weeki Wachee River were impacted and had denuded herbaceous zones, with only 1 out of 10 assessed bars remaining intact. In addition, 33 point bars showed that approximately 1-2 ft of organic soil depth has been lost at many point bars on the river along with up to 20,000 square feet of estimated vegetation loss based on the sizes of the denuded zones observed. The denudation on this set of bars likely resulted in something on the order of 1,000 cubic yards of organic soil alone (approximately 60 dump truck loads).



## 5.0 STATISTICAL ANALYSIS TO ASSESS RECREATIONAL IMPACTS

The historic aerials, physical assessments, and experiments detailed in previous sections consistently suggest that recreation has impacted the vegetation, soils, and morphology of the river. Experimental turbidity recordings before and after trampling showed that trampling leads to increases in turbidity. The data collected as part of this project were analyzed, along with other environmental data to determine if statistically significant relationships exist between recreation and water quality parameters, specifically turbidity. Turbidity is caused by light scatter from fine particles floating in the water and a variety of activities can increase the load of such particles, including trampling, docking, wave induction, and prop wash from motorboats. Increased turbidity reduces water clarity and light penetration through the water column, which can affect the photosynthesis of submerged aquatic plant communities. Increased turbidity may also indicate suspension of sediments that may redeposit and smother aquatic plants and other benthic habitats. Florida spring runs characteristically have very low turbidity, so elevated turbidity indicates potential water quality issues related to recreational activity if it can be measured to increase during such activities.

Wood concurrently sampled turbidity, total suspended solids (TSS), and volatile suspended solids (VSS) at varying levels of recreational use to statistically assess associations between these variables. All three variables essentially measure the number of suspended particles in the water column and are typically co-variables when the variables are used as proxies for water clarity, quality, and to assess potential sediment transport. However, during quality control processing and screening (i.e. review of laboratory qualifier codes and other reported quality controls), the TSS and VSS data were found to be below detection and were not used for statistical analyses. The processed and screened turbidity dataset was found to be adequate for statistical analyses and were used for several different statistical tests as described below. It should be noted that because turbidity can increase absent recreational influence in response to rainfall, and due to algal production as the day unfolds, Wood accounted for such responses in the statistical assessments.

### 5.1. **Exploratory Analysis with Long-Term Data**

#### 5.1.1 Turbidity Trend Analysis

Trend analysis was performed on the quarterly average time series of SWFWMD ambient turbidity data from stations 20923 (SWFWMD WW1, Wood WW2), 20600 (SWFWMD WW3, near Wood WW3), and 20650 (SWFWMD WW5, between Wood WW4 and Rogers Park) using the USGS Fortran code for the nonparametric Seasonal Kendall Test, which acknowledges and adjusts for potential autocorrelation (Helsel et al. 2006). The trend analysis was performed on time series with and without outliers (defined as greater than 2\*standard deviation). Overall, the results showed significant increasing trends at all stations from 2006 to 2019 (except for station 20600 with outliers.) The complete trend analysis results are shown in **Table 5.1**.



**Table 5.1 – Long-term Turbidity Seasonal Kendall Trend Analysis Results**

Station	Parameter (NTU)	Tau	Selected p-value	Slope (NTU/quarter)	Trend
20923	Turbidity	0.246	<b>0.032</b>	0.006	<b>Significant increasing</b>
20923	Turbidity (no outliers)	0.368	<b>&lt;0.001</b>	0.010	<b>Significant increasing</b>
20600	Turbidity	0.103	0.279	0.013	No significant trend
20600	Turbidity (no outliers)	0.331	<b>0.001</b>	0.024	<b>Significant increasing</b>
20650	Turbidity	0.387	<b>&lt;0.001</b>	0.032	<b>Significant increasing</b>
20650	Turbidity (no outliers)	0.225	<b>0.027</b>	0.026	<b>Significant increasing</b>

Note: Period of record for stations –20923 (2/27/2006 – 4/22/2019), station 20600 (10/13/2005 – 4/22/2019), station 20650 (10/13/2005 – 4/22/2019).

### 5.1.2 Correlation Analysis

The long-term State Park vessel data (daily vessel launch totals from 7/1/2012 – 6/1/2019) were compared to the long-term SWFWMD turbidity data using nonparametric Spearman’s Rho correlation analysis. The same three SWFWMD turbidity stations used in trend analysis were used for correlation analysis, but the data were not converted to quarterly average series. The State Park daily vessel launch counts were summarized at a monthly time step as several metrics (total vessels per month, average daily vessels by month, and maximum daily vessels by month). Daily discharge data from USGS station 2310525 and daily rainfall data from SWFWMD station 20912 were converted to monthly average (discharge) and monthly total (rainfall) series and included in the correlation matrix.

The complete results of the Spearman Rho correlation are shown in **Table 5.2**. Turbidity at all stations was positively, significantly correlated to State Park vessels counts, meaning that with higher vessel counts, turbidity is also higher. The strongest correlation between vessel counts and turbidity was found at the station near the State Park boundary (20923). The lower strength of correlation between turbidity and number of vessels at the more downstream stations may be due to half of the vessels entering the river from downstream and not the State Park. Therefore, the State Park vessel count data only account for a portion of the total recreational activity that may be affecting turbidity at the downstream sites. The correlation would likely be stronger at the downstream stations if long-term data were available for vessels traveling from downstream to the lower stations to achieve a truer total number of vessels that may be influencing turbidity values. Vessel counts were also negatively, significantly correlated to rainfall and positively, significantly correlated to discharge. These values may be explained by lower recreation during rain events and the possible overlap of the summer high-recreation season with the wet season. At this time step, rainfall was not significantly correlated to turbidity.



**Table 5.2 – Results of Spearman Rho Correlation Analysis**

	Turbidity at 20923	Turbidity at 20600	Turbidity at 20650	Monthly Total Vessels	Avg Daily Vessels (by month)
Turbidity at 20923		0.581 <b>0.001</b>			
Turbidity at 20650	0.322 <b>0.094</b>	0.348 <b>0.069</b>			
Monthly Total Vessels	0.588 <b>0.001</b>	0.374 <b>0.05</b>	0.365 <b>0.056</b>		
Avg Daily Vessels (by month)	0.559 <b>0.002</b>	0.356 <b>0.063</b>	0.374 <b>0.05</b>	0.998 <b>0</b>	
Max Daily Vessels (by month)	0.518 <b>0.005</b>	0.294 0.129	0.163 0.408	0.881 <b>0</b>	0.872 <b>0</b>
Discharge	0.205	0.203	0.312	0.426	0.436
	0.295	0.3	0.106	<b>0.024</b>	<b>0.02</b>
Rainfall	-0.047	-0.251	-0.257	-0.479	-0.497
	0.81	0.197	0.186	<b>0.01</b>	<b>0.007</b>

Note: The top value in cell is Spearman's Rho, bottom is p-value. Bold p-values indicate statistical significance at alpha=0.05. Bold italic p-values indicate statistical significance at alpha=0.1. Green shading indicates positive, significant correlation. Red shading indicates negative, significant correlation.

## 5.2. Statistical Analyses with Field, Camera, and Sonde Data

The exploratory analysis with long-term data showed a correlation between number of vessels launched from the State Park and turbidity, so the relationship was further explored in more detail and with a tighter sampling frequency using data collected as part of this study (details regarding data collection intervals and protocols are provided in **Section 2**). Two independently collected datasets were used to identify if relationships exist between turbidity and recreational use in the river at Wood’s monitoring stations:

- Continuous turbidity (FNU) data were collected *in situ* via a sonde instrument (deployed and retrieved by FDEP). Concurrent continuous recreational use data recorded by video cameras (deployed and retrieved by Wood) was transcribed by SWFWMD from recorded video footage. This coupled dataset is referred to as the ‘continuous dataset.’
- On the 9 sampling events conducted by Wood, grab samples were collected in the field and analyzed in the FDEP laboratory for turbidity (NTU). Concurrent recreational use data (user and vessel counts) were collected in the field by Wood. This dataset is referred to as the ‘grab-sample dataset.’

Each of the datasets listed above also included daily rainfall and spring discharge (flow) data recorded at SWFWMD station 20912 and USGS station 2310525, respectively (same data as used in correlation analysis).



The statistical analyses treated turbidity as the response variable. As is common for water quality data, the turbidity data were log-normally distributed. Therefore, to meet assumptions for the applicable parametric and linear analyses, the turbidity data were  $\log_{10}$  transformed prior to analysis. The results should be interpreted in terms of explanatory variables' influence on the *order of magnitude* of turbidity, and not simply on the absolute value.<sup>7</sup>

Explanatory variables in each analysis included the sampling site (spatial variation), seasonal and daily effects (temporal variation), user counts, vessel counts, rainfall (in.), and spring discharge (cfs). User counts, vessel counts, and rainfall were broken out into several variables ('predictors') used in the statistical models (**Table 5.3**). Based on the raw count data, various hourly and cumulative user and vessel counts were developed: the number of users present during the one hour prior to sampling (e.g., hourly users, *user.hour*) and the running count of users up until the sampling time each day (e.g., hourly cumulative users, *user.cumu*).

**Table 5.3 – Summary of Variables used in Analyses**

Variable Name	Description	Unit	Type
turb.ntu	turbidity analyzed in lab (grab sample)	NTU	continuous
turb.fnu	turbidity recorded by sonde	FNU	continuous
site	turbidity sampling site (WW1, WW2, WW3, or WW4)		categorical
date	turbidity sampling date		categorical
time	turbidity sampling time		categorical
rain.in.d0	rainfall on sampling date	in	continuous
rain.in.d1	rainfall one day prior to sampling date	in	continuous
rain.in.d2	rainfall two days prior to sampling date	in	continuous
rain.in.d3	rainfall three days prior to sampling date	in	continuous
rain.in.tot	total rainfall during sampling date and the three days prior	in	continuous
flow.cfs	spring discharge	cfs	continuous
user.hour	count of users during the one hour prior to sampling time		discrete
user.cumu	cumulative count of users on the sampling date, up until the sampling time		discrete
swim.hour	count of people wading/swimming during the one hour prior to sampling time		discrete
swim.cumu	cumulative count of people wading/swimming on the sampling date, up until the sampling time		discrete
vessTOT.hour	count of vessels (all types) during the one hour prior to sampling time		discrete
vessTOT.cumu	cumulative count of vessels (all types) on the sampling date, up until the sampling time		discrete
dockTOT.hour	count of docked vessels (all types) during the one hour prior to sampling time		discrete

<sup>7</sup> The log transformation replaces each observed turbidity value with the base-10 logarithm of that value: The logarithm function returns the exponent to which 10 must be raised to produce the original value. For instance, the logarithm of 10 is 1, and the logarithm of 100 is 2, because  $10^1=10$  and  $10^2=100$ . Therefore, an increase of one on the logarithmic scale represents a tenfold increase in turbidity.



Variable Name	Description	Unit	Type
dockTOT.cumu	cumulative count of docked vessels (all types) on the sampling date, up until the sampling time		discrete
dockHP.hour	count of docked human-powered vessels during the one hour prior to sampling time		discrete
dockHP.cumu	cumulative count of docked human-powered vessels on the sampling date, up until the sampling time		discrete
dockMP.hour	count of docked motorized vessels during the one hour prior to sampling time		discrete
dockMP.cumu	cumulative count of docked motorized vessels on the sampling date, up until the sampling time		discrete

### 5.2.1 Data Exploration

Based on results shown in **Figure 5.1**, turbidity values are low relative to most water bodies. However, it's important to note that even small changes in turbidity in spring systems can have substantial effects on water clarity since the submerged aquatic vegetation communities that are commonly found in spring systems such as Weeki Wachee River require greater light availability (Szafraniec 2014). Therefore, maintaining low turbidity concentrations (between 0.2 to around 1 NTU, which varies based on distance from the headspring and associated inflows) in Weeki Wachee River is relevant for both aesthetic and ecological reasons.

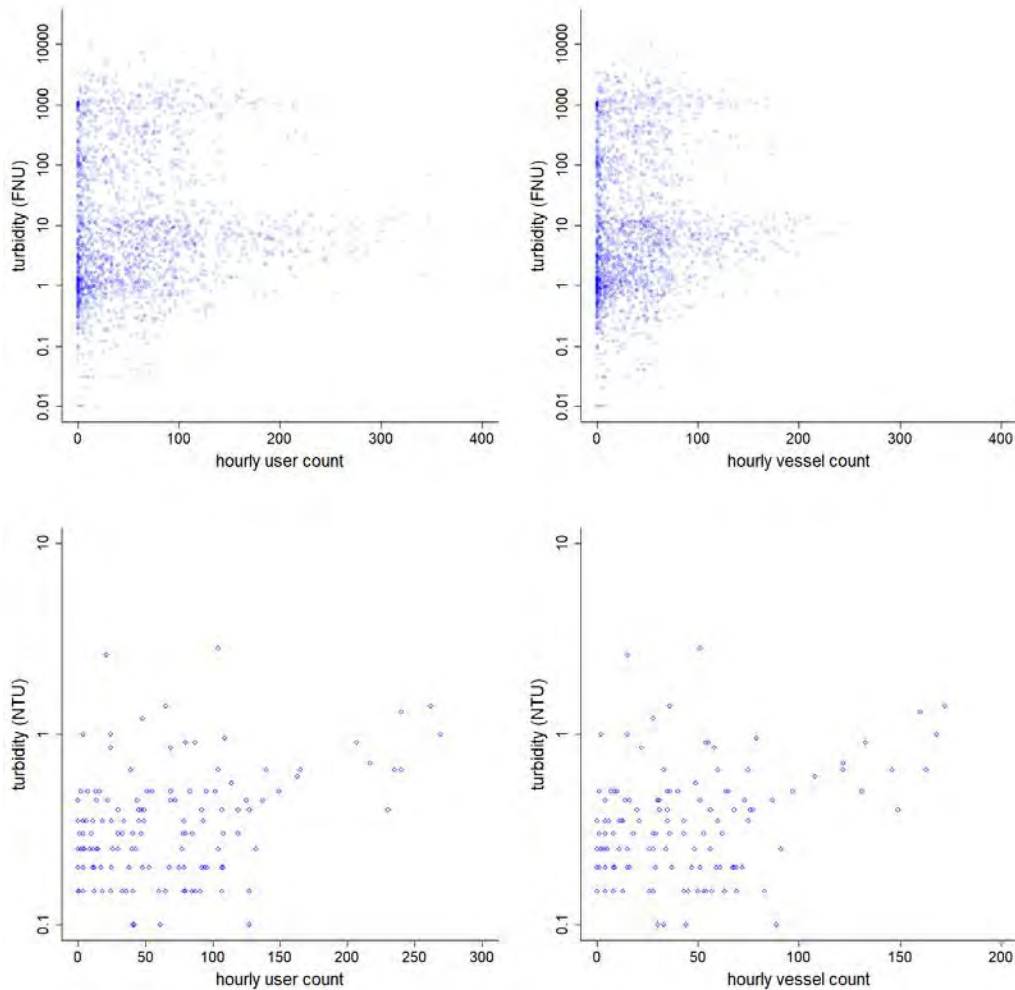
Upon examining linear relationships between turbidity and recreational parameters, recreational use did not exhibit a straightforward linear relationship to turbidity, as illustrated in **Figure 5.1**. Therefore, more advanced statistical techniques were required to isolate recreational effects from other, potentially confounding effects (e.g., spatial variability, seasonality, hydrological effects). Further, results from the scatterplots did not show clear evidence of a user/vessel count vs. turbidity breakpoint that would be considered statistically significant, which might justify estimation of a recreational carrying capacity—the recreational intensity below which the effects on turbidity were minimal. This is likely due to the additional effect of user activities on the river that included docking, exiting vessels, wading, swimming, etc. that influences turbidity and potential impact as much if not more than if users did not exit their vessels. It appears that the grab-sample dataset showed patterns of higher turbidity values with higher vessel/user counts. Therefore, a potential threshold may be drawn from the results for management purposes if other recreational activities (e.g.) are taken into consideration since these activities are influencing turbidity values as well.

Two statistical methods were used to assess the impact of recreational use on turbidity in the Weeki Wachee River: random forests and linear mixed effects models. These methods were applied to each of the datasets in separate analyses. The large number of observations in the sonde dataset provided sufficient statistical power and enabled analysis across sites and by individual site; the smaller grab-sample dataset was analyzed without disaggregating by site.





**Figure 5.1 – Scatterplots of Turbidity vs. Hourly User and Vessel Counts**



Note: The top two figures depict the continuous dataset, and the bottom two depict the grab-sample dataset. The y-axes are hourly turbidity on a logarithmic scale.

### 5.2.2 Random Forest Methodology

Using R package 'gbm' (Greenwell et al. 2019; R Core Team 2018), random forests with gradient boosting were applied to rank predictors according to their 'relative influence' on turbidity. A *random forest* model develops an ensemble of 'decision trees' that each partition the predictor space using random subsets of predictors; while each tree is a weak predictor, the collective prediction skill of the ensemble is generally much greater (James et al. 2013). *Gradient boosting* improves prediction skill by sequentially fitting trees to the residuals from previous trees. *Cross-validation*, which is training the model on random subsets of data ('training data') and testing the model on each out-of-sample data set ('test data'), was applied to optimize tuning parameters that control the algorithm (the loss function and the number of sequential trees in each model).



The boosted random forest model provides a *relative influence* metric that reflects each predictor's contribution to improved prediction skill across the ensemble (Ridgeway 2019).

Modeling with random forests offers increased ability to detect complex, nonlinear relationships between predictors and the response, and typically increases out-of-sample prediction skill as compared to classical regression. However, these advantages come with a trade-off: The random forests' results are less interpretable, and inferences about predictor-response relationships are limited to the relative-influence ranking. This is in contrast to least-squares regression, which quantifies the relationships with a coefficient estimate for each predictor. Consequently, results from the random forest models are presented only as a preliminary indicator of the variables with the greatest influence on turbidity. The results gain credibility to the extent that cross-validation demonstrates skillful prediction on out-of-sample data.

The out-of-sample prediction skill of each model was measured using Nash-Sutcliffe efficiency (NSE):

$$NSE = 1 - \frac{\sum_{i=1}^n (\hat{y}_i - y_i)^2}{\sum_{i=1}^n (y_i - \bar{y})^2} = 1 - \left( \frac{RMSE}{\sigma} \right)^2$$

where  $y_i$  and  $\hat{y}_i$  are the  $i^{\text{th}}$  observed and predicted values of the response variable, respectively;  $\bar{y}$  was the mean of the observed response values. Equivalently, the NSE can be expressed in terms of the ratio between the root-mean-squared error (RMSE) of the model and the standard deviation ( $\sigma$ ) of the response data, as above. A value of  $NSE=0$  indicates that the model predicts the mean response value; values below zero indicate that the mean is a better predictor than the model; values above zero indicate that the model is a better predictor than the mean; and a value of  $NSE=1$  indicates a perfect fit between the predicted and observed response values. A minimum threshold of  $NSE \geq 0.50$  was adopted as an acceptance criterion for the prediction skill of each model (Moriassi et al. 2007). Next, the random forest results were used to inform specification of linear mixed effects models that tested the identified predictor-turbidity relationships for statistical significance.

### 5.2.3 Linear Mixed Effects Model Methodology

A *linear mixed effect model* (LMEM) is a generalized form of least-squares regression that estimates coefficients for *fixed effects* (measured variability in the explanatory variables) and their statistical significance, while controlling for *random effects*—unmeasured variability attributed to spatial or temporal replication (Galecki and Burzykowski 2013).

Ordinary least-squares regression estimates response values according to the equation

$$\hat{\mathbf{y}} = \mathbf{X}\boldsymbol{\beta}$$

where  $\hat{\mathbf{y}}$  is the  $n \times 1$  vector containing predicted values of the response variable (e.g., turbidity);  $\mathbf{X}$  is the  $n \times (p+1)$  design matrix, whose first column is a vector of 1's and whose subsequent  $p$  columns each contain  $n$  observed values of a predictor; and  $\boldsymbol{\beta}$  is the  $(p+1) \times 1$  coefficient vector  $[\beta_0, \beta_1, \beta_2, \dots, \beta_p]^T$ , whose first element is the estimated intercept and whose subsequent elements are the slopes estimated for  $p$  predictors. The intercept represents the baseline value of the



response (given no influence from the predictors), and each slope represents the estimated adjustment to the mean response value given a unit change in a predictor.

A linear mixed effects model adds a term to the above regression equation to estimate intercepts (and optionally, slopes) for random effects:

$$\hat{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}\boldsymbol{\alpha}$$

where  $\mathbf{X}$  is the design matrix for fixed effects;  $\boldsymbol{\beta}$  is the fixed-effects coefficient vector;  $\mathbf{Z}$  is the design matrix for random effects; and  $\boldsymbol{\alpha}$  is the random-effects coefficient vector (Galecki and Burzykowski 2013). The  $\boldsymbol{\alpha}$  vector may include random intercepts and slopes, or random intercepts only. Each random intercept represents an adjustment to the baseline intercept  $\beta_0$ , based on membership of an observation in a random-effects group. For instance, a random intercept for each sampling site would adjust the baseline turbidity values for each site (assuming no influence from the fixed-effects predictors).

The R package 'nlme' was used to develop the mixed effects models (Pinheiro et al. 2018; R Core Team, 2018). Specification of each LMEM was informed by the results from the corresponding random forest model. The LMEMs tested whether the five top-ranked predictors identified by each random forest model were statistically significant ( $\alpha=0.05$ ) predictors of turbidity (log-transformed), while controlling for spatial and temporal variability as random effects. Akaike's Information Criterion (AIC) was applied to select the variables for inclusion as random effects (from among sampling site, date, and time, as applicable, Akaike 1973). The AIC balances goodness of fit with model complexity (the number of parameters in the model) to select the most efficient model from a set of candidate models.

For each mixed-effects model, the Pearson residuals were examined to ensure that the residuals were unstructured with respect to fitted values, fixed effects values, and random effects values. Further, the prediction skill of each model using the NSE metric was computed (see the previous section). Here, NSE is equivalent to the familiar coefficient of determination  $R^2$ , in that it reflects the amount of variance from the mean explained by the model. The NSE values reported for mixed-effects models were computed using the full set of turbidity data and predictions. The p-values are reported for fixed effects as provided by the *lme()* function in the 'nlme' package: the function computes p-values after estimating the degrees of freedom as  $n-p$ , where  $n$  is the sample size and  $p$  is the number of parameters in the model.



#### 5.2.4 Results of Random Forest Models

Random forest models were run to identify the variables exerting the greatest 'relative influence' on turbidity across all four sites and at each site individually. In addition, the random forest results informed the selection of variables for hypothesis testing with mixed effects models (discussed in following section). The predictors considered by each model included user counts, vessel counts, rainfall, and spring discharge, as well as the sampling site, date, and time (full list of variables in **Table 5.3**). Each model yielded an acceptable fit to out-of-sample data during cross-validation ( $NSE > 0.50$ ), suggesting reliability for drawing inferences (**Table 5.4**).

Overall, the analysis sought to identify recreational factors influencing turbidity while controlling for the spatial and temporal variability associated with the sampling sites, dates, and times. These categorical variables were therefore included in the random forest models although they were not of primary interest as predictors of turbidity. Because sampling site, date, and time ranked highly in each model, they were specified as candidate 'random effects' in the mixed effects models (following section).

The top-five numerical predictors in each random forest model are marked in **Table 5.4**. Among the five models, the hourly cumulative vessel count (*vessTOT.cumu*) most often ranked highest. The hourly cumulative counts of users (*user.cumu*) and people wading/swimming (*swim.cumu*) were also highly ranked across models. These results provide a preliminary indication that both the cumulative number of vessels per hour and the cumulative number of users in the water per hour each day exerted a relatively strong influence on turbidity concentrations.

Spring discharge (*flow.cfs*) was ranked as the most influential predictor of turbidity by the WW3 model (continuous sonde data). Otherwise, the random forest models detected zero influence on turbidity from rainfall and spring discharge. These results should not be interpreted as evidence that rainfall and spring discharge did not physically influence turbidity. Instead, the results may be an artifact of the temporal resolution of these data. The daily resolution of the rainfall and discharge data means that their (numerical) variability would easily be captured by the categorical sampling date variable (*date*).

The motorized vessel counts (*dockMP.hour* and *dockMP.cumu*) did not rank in the top-five most influential predictors across models. This result should not be interpreted as evidence that motorized vessels did not influence turbidity. Instead, the result likely reflects the low variance in the motorized vessel data, relative to the variance present in other predictors.



**Table 5.4 – Summary of Random Forest Model Results**

Dataset		Continuous Sonde and Camera Count Data					Grab-Sample and Field Count Data
Response variable		Turbidity (log <sub>10</sub> , FNU)					Turbidity (log <sub>10</sub> , NTU)
Site		WW1	WW2	WW3	WW4	All sites	All sites
<b>Observations</b>	<i>n</i>	384	480	433	362	1659	144
<b>Error Statistics</b>	<i>test NSE</i>	0.801	0.933	0.966	0.539	0.562	0.609
	<i>test RMSE</i>	0.435	0.297	0.273	0.295	0.746	
<b>Predictor</b>	rain.in.d0						
	rain.in.d1						
	rain.in.d2						
	rain.in.d3						
	rain.in.tot						
	flow.cfs			<b>X</b>			
	vessTOT.hour			x			
	vessTOT.cumu	<b>X</b>	<b>X</b>		<b>X</b>		<b>X</b>
	user.hour	x			x		
	user.cumu	x	x	x	x		x
	dockHP.hour				x		
	dockHP.cumu		x	x		x	
	dockMP.hour						
	dockMP.cumu						
	dockTOT.hour						
	dockTOT.cumu		x				x
swim.hour				x	<b>X</b>	x	
swim.cumu		x	x		x	x	

Note: The top-five predictors from each model are marked; a bold **X** indicates the top-ranked predictor. (The models for WW1 and all sites based on the continuous sonde data identified only three numerical variables with non-zero influence.) Error statistics on out-of-sample ('test') data indicate that the models provide a reliable basis for inference.

### 5.2.5 Results of Linear Mixed Effects Models

Based on the random forest model results, linear mixed effects models were specified to test whether various user and vessel counts had statistically significant effects on turbidity, after controlling for spatial and temporal variability arising from replicate sampling.

Each selected predictor was correlated with each other predictor (shown in **Appendix G**). Including correlated predictors (i.e. co-variates) in the same model would make coefficient estimation and hypothesis testing unreliable, because the regression procedure would be unable to accurately isolate the effect of each correlated variable on the response variable (turbidity). To avoid this problem, a separate mixed-effects model (and hypothesis test) was developed for each selected predictor.

AIC was applied to select the variables for inclusion as random intercepts for each LMEM; random slopes were not included. For the LMEM of the grab-sample dataset (all sites), random intercepts were specified by *site*, *date*, and *time*. For the continuous sonde dataset (all sites), random intercepts were specified by *site* and *date* (inclusion of random intercepts for *time* did not improve



the AIC score). Likewise, for each of the 4 site-specific models (continuous sonde dataset), random intercepts were specified by *date*.

Each mixed-effects model achieved a high NSE value ( $NSE \geq 0.85$ ), and visual checks of each model's Pearson residuals did not show evidence of residual structure or autocorrelation. Results of the hypothesis tests are summarized in **Table 5.5**. Each of the statistically significant coefficient estimates associated with user and vessel counts were positive, indicating a significantly positive relationship with turbidity.

The following results are from analysis of the continuous sonde dataset. The mixed effects model for all sites identified the hourly cumulative counts of docked human-powered vessels and people wading/swimming as highly significant predictors of turbidity ( $p < 0.0001$ ). Results from the site-specific mixed effects models generally agreed with these results:

- At WW1, the hourly cumulative counts of vessels (all types) and users were identified as significant predictors of turbidity ( $p=0.0002$  and  $p=0.0003$ , respectively).
- At WW2, the hourly cumulative counts of vessels (all types), docked vessels (all types), users, docked human-powered vessels, and people wading/swimming were identified as significant predictors of turbidity ( $p < 0.0001$ ).
- At WW3, spring discharge and the hourly cumulative counts of users, docked human-powered vessels, and people wading/swimming were identified as significant predictors of turbidity ( $p < 0.0001$ ). The coefficient estimated for spring discharge (*flow.cfs*) was negative, indicating a negative relationship between discharge and turbidity.
- At WW4, the cumulative hourly counts of vessels (all types), users, and docked human-powered vessels were identified as significant predictors of turbidity ( $p < 0.0001$ ). Also, the hourly counts of people wading/swimming ( $p=0.0025$ ) and users ( $p < 0.0001$ ) were identified as significant predictors of turbidity.

Several predictors identified as highly influential by a random forest model were not identified as statistically significant by the LMEMs, which included the number of people wading/swimming in the all-sites model ( $p=0.582$ ), the hourly user count at WW1 ( $p=0.058$ ), and the hourly count of vessels at WW3 ( $p=0.31$ ).

The mixed effects model for the grab-sample dataset identified the hourly cumulative counts for vessels (all types), users, docked vessels (all types), and people wading/swimming as significant predictors of turbidity ( $p < 0.0001$ ), which essentially corroborated the results from the continuous sonde dataset analysis. The hourly count of people wading/swimming was not identified as a significant predictor ( $p=0.31$ ).



**Table 5.5 – Summary of Hypothesis Test Results from Linear Mixed Effects Models**

Dataset		Continuous Sonde and Camera Count Data					Grab-Sample and Field Count Data
Response variable		Turbidity (log <sub>10</sub> , FNU)					Turbidity (log <sub>10</sub> , NTU)
Site		WW1	WW2	WW3	WW4	All sites	All sites
Predictor	flow.cfs			<i>&lt;0.01</i>			
	vessTOT.hour			0.31			
	vessTOT.cumu	<0.01	<0.01		<0.01		<0.01
	user.hour	0.06			<0.01		
	user.cumu	<0.01	<0.01	<0.01	<0.01		<0.01
	dockHP.hour				<0.01		
	dockHP.cumu		<0.01	<0.01		<0.0001	
	dockMP.hour						
	dockMP.cumu						
	dockTOT.hour						
	dockTOT.cumu		<0.01				<0.01
	swim.hour					0.58	0.31
swim.cumu		<0.01	<0.01			<0.01	

Note: Each p-value represents the result from a model testing the significance of a single predictor (fixed effect) on the turbidity response, after controlling for spatial and temporal variability (random effects). Values in bold indicate statistical significance ( $\alpha=0.05$ ). All significant coefficient estimates are positive, except for *flow.cfs* (indicated by italics).

### 5.3. Summary of Statistical Analysis to Assess Recreational Impacts on Water Quality

The statistical analysis results provided empirical evidence that both the cumulative number of vessels and users per hour contributed to turbidity along the spring run during the study period (July 2018 through June 2019). Hypothesis tests using linear mixed effects models corroborated the initial results from the random forest models. The fact that the models largely favored cumulative user and vessel counts over hourly counts suggests that recreation has an additive and cumulative effect on turbidity, and thus water clarity and quality. In summation, the results suggest that there are statistically significant relationships between the number of users/vessels and turbidity, and also between in-water recreational activities, such as docking, wading, and swimming and turbidity in the Weeki Wachee River. These results also suggest that a simple reduction in the number of users/vessels alone may not reduce the effects on turbidity and water clarity/quality and the in-water activities will need to be considered before making important management decisions on recreational use.



## 6.0 MANAGEMENT OPTIONS

This study found links between recreational activities and ecological degradation and collected a large, varied dataset which will be useful for guiding management decisions or directing future focused studies. The data, analyses, and observations from this study have informed a preliminary list of possible management options that have potential to reduce the observed impacts from recreation.

Key observations include:

- Point bars started to be denuded of herbaceous vegetation between 2008 and 2011, indicating user impacts commenced before censusing data was collected starting in 2012.
- By 2016, many points bars had become severely denuded of vegetation, and some were accreting sandy sediments presumably from upstream erosion of the denuded bars. Stress and erosion of the opposite streambanks from the accreting point bars became substantial at some locations during our study in 2019.
- The period from 2012 to 2016 saw a linear increase in users, with a moderate decline to current levels thereafter. There has been no apparent trend in point bar recovery during the reduced use. In fact, point bars have continued to denude. A total of 20,000 square feet of shoreline vegetation habitat has been lost.
- Denudation appears to be initiated by vessel docking dislodging organic soils and vegetation on the point bars. This sets up a cascading series of events by facilitating more foot traffic at the impacted areas, expanding the denudation. Once a sandy beach is exposed, it contributes sand to the run that would otherwise not leave the bar. Organic soil releases are estimated at about 30 cy/bar based on the comparative and cumulative assessments, which sums up to approximately 1,000 cubic yards (approximately 60 dump trucks) from 33 impacted point bars.
- Rope swings appear to generate additional vessel docking and wading, which may accelerate impacts. Further, trees with rope swings and those used for climbing and jumping have been observed to fall more rapidly than if not used for these purposes.
- Effects of trampling of vegetation and the underlying soil matrix were documented and were shown to cause immediate and mid-term effects on recovery.
- Points bars release substantial turbidity from organic soil releases into the run when they are initially being denuded, but less once the vegetation and organic soils have been rather fully depleted of organic soils. If this study was conducted during a time prior to the point bars being denuded, then the effects on turbidity from recreational use would have likely been more pronounced. Thus, the turbidity increases that occurred during this study in direct association with increased vessels and users would likely be much more substantial if the river's point bars were in better ecological condition.
- A clear breakpoint between the number of users/vessels was not found that would be useful for setting a carrying capacity simply on the number of users/vessels. However,





statistical analyses provided empirical evidence that cumulative number of vessels/users and in-water activities such as docking, wading, and swimming contributed significantly to turbidity along the river, which suggests that recreation has negative effects on water quality. A potential threshold may be drawn from the results for management purposes if in-water and on-bar recreational activities are taken into consideration since these activities are influencing turbidity values.

- The sandy point bars at the Weeki Wachee River are a human activity artifact and are unnatural perturbations for Florida spring runs in general and represent a state change for the river that commenced sometime between 2008 and 2011.
- It appears that limits on the number of users launching from the State Park may have reduced the number of vessels on the river. Partying on upstream point bars appeared to decline once the disposables ban was enforced. However, even though partying may have declined, the in-water and on-bar activities may still be causing impacts.
- Downstream access points from Rogers Park and other sites contribute up to 50% of users for the lower point bars, but less for upstream point bars. This suggests that impacts are due to users from these areas as well as from launches at the State Park.
- About 80% of users dock and recreate on the point bars. These users are more likely to trample vegetation and compact organic soils on point bars and therefore have a greater ecological impact than non-disembarking users in terms of greater reductions in vegetation and changes in bar morphology.

The primary reasons a single carrying capacity value based on vessels (or users) alone could not be recommended is because 1) the number of users/vessels alone did not cause the ecological and water quality impacts and in-water and on-bar activities appear to have substantial acute and cumulative impacts; 2) long-term user/vessel count data were not available from downstream access points such as Rogers Park, vendors, and private residences to assess a “total” user/vessel count to assess potential breakpoints; and 3) the threshold for unacceptable impacts occurred prior to the period of available vessel/user data. In addition to these reasons, the stressors were sustained at impactful levels during the duration of the field study without adequate recovery times between high use periods (so even if low impact variability did occur during this study it wasn’t sufficiently recovered before the next impactful episode occurred). The water quality data did not indicate a significant threshold break (just that increased users increase impacts), and the most transformative impacts are generated by a subset of users engaged in particular activities (docking, swimming/wading, rope swinging). Therefore, a simple reduction in the number of users/vessels alone may not reduce the effects on water clarity/quality and ecological condition. To reduce impacts to water quality and ecological condition, a multi-tiered management decision matrix may be needed to define the number of users/vessels launching from both the State Park and from downstream areas (i.e. Rogers Park, vendors, and private residences) along with a decision on whether and at what level in-water and on-bar activities will need to be restricted.



It is evident from the results of this study that managing the kinds of activities that can occur on the river and limiting where certain activities can occur may be at least if not more important as capping the total number of daily users. This approach has been implemented on other spring runs in Florida and elsewhere. Successful approaches range from 'soft' or indirect controls to explicit regulation with strong enforcement activity.

An example of indirect control occurs at the Juniper Run in the Ocala National Forest. The run is swift and narrow, which may limit swimming and bank excursions, and docking/exiting vessels is discouraged. The number of users is not explicitly capped, but similar to the Weeki Wachee State park, the sole kayak vendor restricts rentals to occur from 8:00 AM to 11:45 AM. They often sell out, so the number of vessels they have available is another informal cap on daily use. No one is allowed to self-launch a kayak 4 hours before sunset. The timeframe restrictions induce informal limits on daily use. Activities are also indirectly controlled by a total ban on disposables, which is enforced by cooler inspections at the launch. The intrinsic characteristics of the run prevent beaching and the ban on disposables dampens a desire to disembark and party in the run. The kayak vendor encourages boaters to stay in their vessels for safety. Despite high use during the day, the run has very good biophysical integrity because users have multiple incentives to remain in their boats. It is one of the most pristine spring runs in Florida.

To alleviate impacts from recreation, some types of management could be implemented sooner than others. The first category of management options are tasks that can be conducted without regulatory actions or changing permitted recreational activities.

- Additional recreation guidance signage can be added throughout the river.
- Educational outreach can be enhanced, and videos and posters can be produced to inform the public about ecological impacts of recreational activities.
- The existing impacted point bars can be revegetated with sawgrass and other native plantings to stabilize soils and restore lost structure and function. This would involve restrictions of recreation to allow establishment of vegetation and soils.
- Rope swings can continue to be removed when observed.
- Vendors can provide ropes, bungies, or ties with rented boats so that visitors can tie off in shallow open water areas away from the bar to reduce direct impacts to soils and vegetation when docking boats.
- Reinforcement of susceptible banks or trees can be considered to reduce erosion, sedimentation and tree falls.

The next category of management options involves considering changes to operations, regulations, and enforcement of recreational guidelines.

- The regulations and enforcement of State Park Rules could be extended down to Rogers Park and other downstream access locations to avoid moving issues



downstream (especially the 'no disposables' rule, as this appears to have been effective at the State Park).

- Access to landing points on point bars could be completely restricted (except for private property), as it is in some other spring runs throughout the state (i.e. disallow docking or exiting vessels).
- Access to landing points for docking and exiting vessels could be limited to designated areas. Some such areas could be enhanced to increase their resiliency to such activities.
- Beach re-nourishment practices that contribute sediment yield in the river could be limited.
- Evaluation of regulations for type of boats allowed on the river (size of boat, size of motor) can be considered.
- After recreational activities such as docking and exiting vessels have been addressed, then additional restrictions on the number of vessels can be further evaluated.

The final category of management options includes collaboration by multiple agencies to work together to accomplish the recommendations, potential additional studies, or plans that could provide more information and additional management options. These can provide a feedback system to inform an adaptive management strategy.

- The experimental trampling plots should be left in place and a follow up assessment should be planned for one year after trampling (May 2020) to assess recovery of vegetation and organic soil accretion.
- Additional studies on tree falls, snag sufficiency, and streambank undercutting can be considered.
- Additional studies on sufficiency of wetland buffer clearing ordinances can be considered to evaluate if existing ordinances provide enough buffered areas to prevent erosion and tree falls.
- Hernando County and other agencies with jurisdiction could consider developing a management plan for the river, with enforcement.
- Restoration efforts can be tracked for ecological sustainability and improvement over time.
- Creation of a multi-agency working group to convene and work together to review the results from the study and proposed management options. The working group could pursue a path to implement the most appropriate recommendations that would align along jurisdictions. The working group could also evaluate and recommend the most effective methods for enforcing the selected management options.



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**Addendum 10—Weeki Wachee Springs State Park Master Plan**



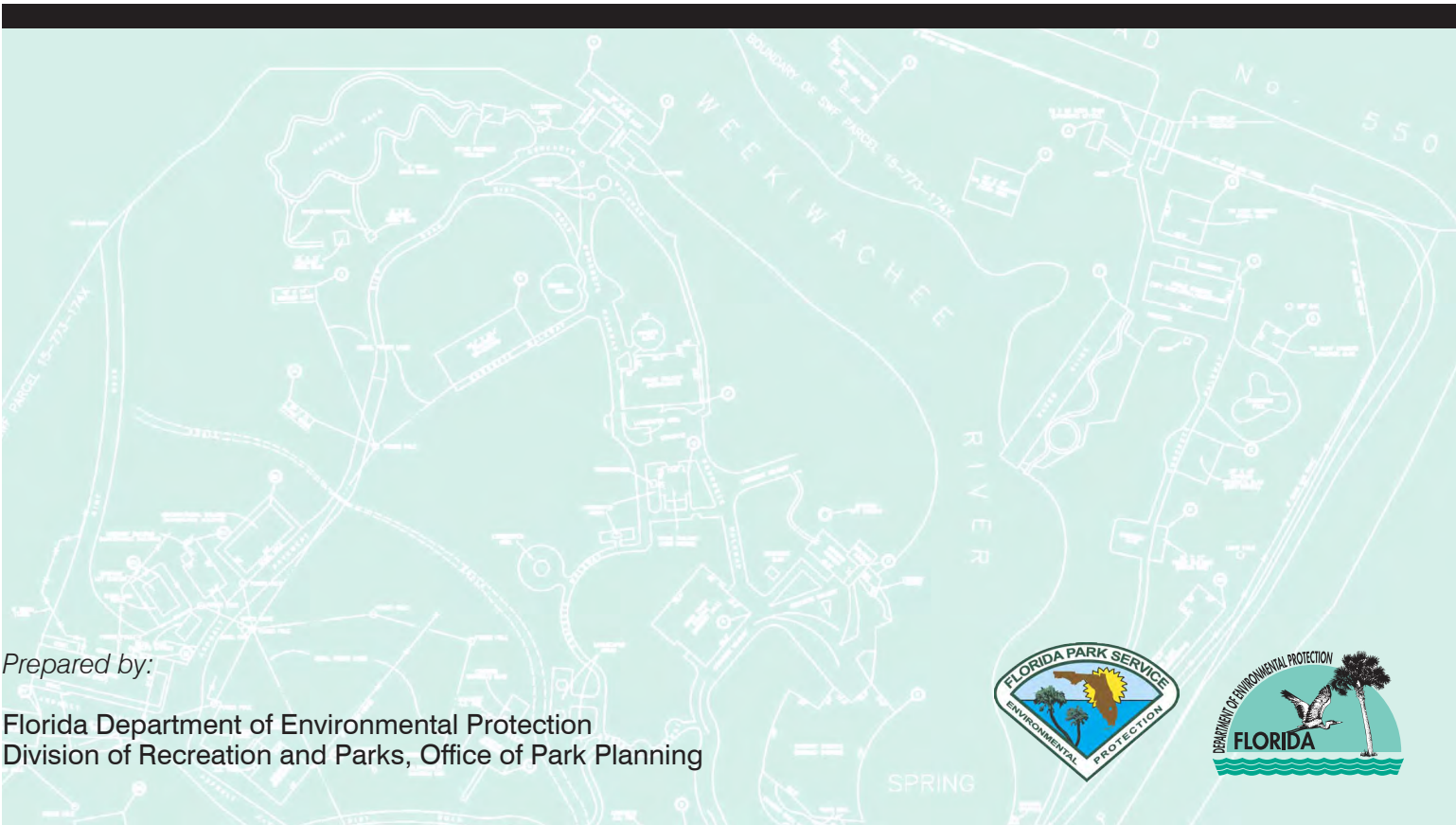




# Weeki Wachee Springs State Park

*2013 Conceptual Master Plan - Historic Attraction and Buccaneer Bay*

**November 2013**



Prepared by:

Florida Department of Environmental Protection  
Division of Recreation and Parks, Office of Park Planning





# Weeki Wachee Springs State Park

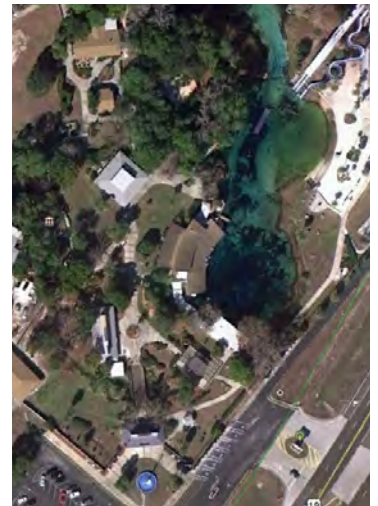
## 2013 Conceptual Master Plan - Historic Attraction and Buccaneer Bay

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## Introduction

The Unit Management Plan (UMP) serves as the basic statement of policy and direction for the management of the park as a unit of Florida's state park system. The Weeki Wachee Springs State Park Master Plan defines a common vision for the park's future. It bridges the gap between the development concepts identified in the park's UMP and the site-specific designs created later in the development process. The plan presents a design framework, conceptual site plan and an implementation strategy. The combination of narrative text and graphic maps and drawings help the public visualize the recommendations for the park in a realistic setting.

The master plan will aid decision-making about future park improvements. The master plan lays out a potential work plan for the Division of Recreation and Parks (DRP). It summarizes the park's current needs and assets and targets particular projects. By clearly identifying capital projects, the master plan can provide the rationale and framework to raise funds for park needs and specific park projects. It also establishes a basis for fiscal planning that will support scheduled development.

## Background

The property that comprises the park was purchased by the Southwest Florida Water Management District (SWFWMD) in 2008 and leased the property to the DRP that same year. Parklands were purchased as part of the Weekiwachee Preserve project, which consists of approximately 16,000 acres along the coastal



*The boat tour gives visitors an opportunity to experience the river*

region of Hernando and Pasco counties. The sovereign submerged lands within the park, including the Weeki Wachee headsprings and the upper segment of the Weeki Wachee River, were leased to the DRP by the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida in 2010.

The park takes its name from Weeki Wachee Spring, a first-magnitude spring and the headwaters of the beautiful spring-fed Weeki Wachee River. The park preserves a rich mosaic of habitats. This includes several miles of river frontage and Twin Dees Spring, a second-magnitude spring. The park contains a significant portion of scrub. Scrub is the primary habitat for numerous imperiled species and is increasingly rare in Florida. In addition to its natural attributes, the park provides for the perpetual preservation of a historic roadside attraction that developed during the early days of Florida's tourism industry.

The park currently offers a wide range of resource-based recreation activities including swimming, picnicking, canoeing, kayaking, and nature observation. Visitors come from all over the world



*Visitors enjoy the swimming area at Weeki Wachee Springs State Park*

to experience the “Old Florida” represented by the historic attraction. The park prominently features performances by the world-famous Weeki Wachee mermaids. The famous underwater theater currently hosts three mermaid shows per day, weather permitting. Additional activities within the historic attraction include a wildlife show offered three times daily and a river boat cruise on the Weeki Wachee River. Boat rides are offered continuously throughout the day, from 10 am until 4:30 p.m. Special programs, such as Mermaid Camps, Junior Lifeguard Camp and the Mermaid Tea Party, are offered through the Friends of Weeki Wachee Springs State Park.

Buccaneer Bay, the park’s swimming area, is a 1980s - era water park. Buccaneer Bay includes water slides, a lazy river float ride and a kiddie pool. The swimming area is open all year round.

The water slides, lazy river and kiddie pool operate seasonally from late March through September. Buccaneer Bay is very popular with local residents and visitors, particularly in the summer. Paddling on the river is available through the park’s canoe/kayak concession. Park visitors may also launch personal watercraft from the park’s canoe and kayak launch, located just downstream from the attraction.

### THE UNIT MANAGEMENT PLAN

#### **Vision/Goals**

The current UMP for the park was approved in 2011. The park’s UMP recognizes the opportunity to preserve a unique example of Florida’s early tourism industry, and protect one of Florida’s first magnitude springs. The UMP identifies recreational activities and interpretative programs

## SPOTLIGHT

### **Weeki Wachee’s Mermaid Culture**



*The famous mermaids of Weeki Wachee*

The Mermaids of Weeki Wachee Springs made their debut in the underwater theater on October 13, 1947. There they performed synchronized ballet moves underwater while breathing through air hoses hidden in the scenery. It did not take long for the attraction to receive worldwide acclaim. Movies, like 1948’s “Mr. Peabody and the Mermaid,” were filmed at the spring and many famous visitors came to see the mermaids, including Esther Williams and Elvis.

Like the sirens of ancient lore who lured sailors, the girls would stand by the road in their bathing suits to beckon drivers into the parking lot. Once they had an audience, they jumped into the spring to perform.

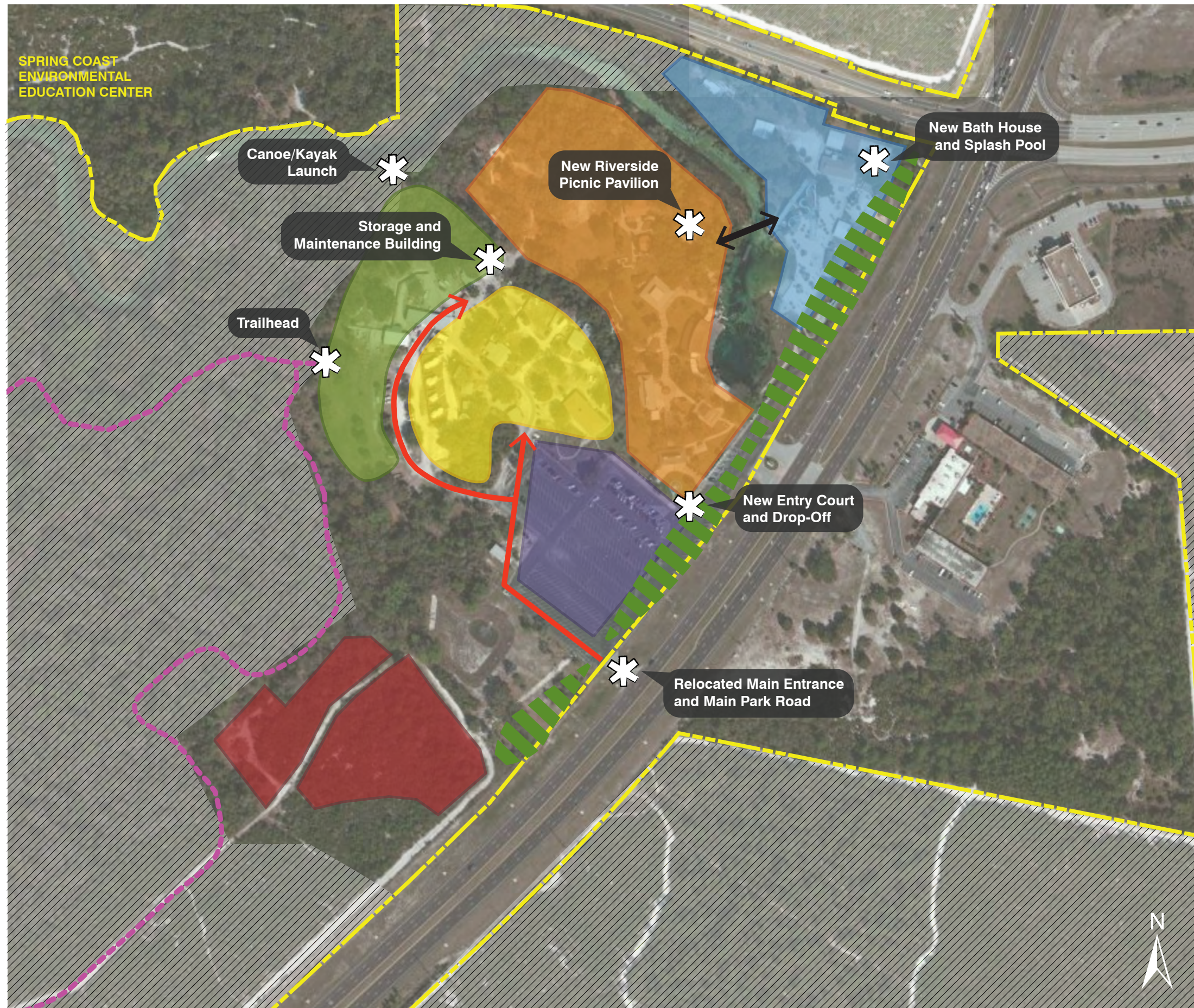
The glamorous mermaids took etiquette and ballet lessons, performing as many as eight shows a day to sold out crowds. During the attractions heyday, half a million people a year came to see the Weeki Wachee mermaids. Thirty-five mermaids took turns swimming in the shows. They captivated crowds by playing football and having picnics underwater. They wore one-piece suits and were treated like royalty wherever they went in Florida. In 1997, many former mermaids returned to Weeki Wachee Springs. Today, the Mermaids of Yesteryear shows, play to standing-room only crowds. The former mermaids may have moved on in life, but the enchantment of the Weeki Wachee Spring calls them back time and again.



*Mermaids by the villa, circa 1960*

**Once a mermaid, always a mermaid.**






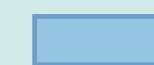

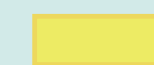
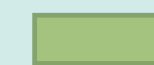
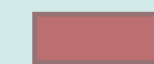



*- Former Weeki Wachee mermaids’ motto*



## Weeki Wachee Springs State Park

# CONCEPTUAL LAND USE PLAN

### LEGEND

-  Park Boundary
-  Proposed Hiking Trail
-  Proposed Park Road
-  Protected Area
-  Former Attraction Redevelopment
-  Buccaneer Bay Redevelopment
-  Parking Area (Landscape and Stormwater Improvements)
-  Recreational Use Area
-  Canoe/Kayak Launch Area
-  Support Area
-  Pedestrian Bridge
-  Proposed Facilities
-  New 30-50 ft. Landscape Buffer



**BACK OF MAP**





*The Mermaid Theater is a unique offering of Weeki Wachee Springs State Park*

appropriate to the park's natural and cultural resources.

The UMP recommends gradual redevelopment of the former attraction in order to improve resource protection, provide greater enjoyment of the river and spring and improve interpretation of the famous mermaids and mermaid performances.

In the Historic Attraction Area, the focus is to preserve the park's pre-1970 era elements, enhance spring overlook opportunities, develop an interpretive center and improve visitor circulation. The UMP recommends rehabilitation of the park's landscaping and implementation of landscape best management practices.

In Buccaneer Bay, the long-term vision is to rehabilitate the swimming area with a new bathhouse, concession building and improved splash pool. The park will also enhance picnicking opportunities, incorporate stormwater improvements and reduce the overall amount of impervious surface. Universal accessibility is a management priority throughout the attraction. The UMP identifies the need to redesign the existing parking lot to improve safety and circulation, add landscaping and stormwater improvements. Outside of the former attraction area, the UMP includes primitive campsites, hiking trails, and new park support facilities.

## **CONCEPTUAL MASTER PLAN DEVELOPMENT**

The UMP recommends a master plan focused on the park's attraction areas adjacent to the intersection of US Highway 19 and State Road 50. The master plan process began in earnest in March of 2013. Several key meetings and site visits were held with DRP staff as well as members of the park's Citizen Support Organization (CSO), and the SWFWMD. These interactive meetings included sessions on visioning, field review, design, and project prioritization.

The planning team reviewed historical information on the park and various agency plans affecting the area. The further research on the archaeological resources of the site to inform development of the master plan. OPP staff developed the draft master plan for review by DRP staff and the CSO in July of 2013.

Developing a single park vision identifies clear direction and helps ensure the best possible outcome during master plan implementation. The broad consensus achieved through the master planning process promotes continued involvement and support for the park.

### ***Regional Context and Connectivity***

The park is within the City of Weeki Wachee Springs, in Hernando County, approximately 45 miles north of Tampa and 60 miles west of Orlando. Rural and low-density suburban developments characterize the region between Tampa and Weeki Wachee Springs. The area is served by the Orlando and Tampa International Airports as well as the Brooksville-Tampa Bay Regional Airport. Hernando County is part of the Withlacoochee planning region, that includes a group of rural counties in transition.

This region has experienced tremendous population and housing growth, and the economic base is primarily dependent on service and retail opportunities (Withlacoochee RPC 2012). Hernando County is also becoming an important corporate and industrial community.

The area is also known as the "Nature Coast."

The Nature Coast extends from the eastern portion of Wakulla County to New Port Richey in Pasco County. The Nature Coast encompasses several small to mid-sized urban areas, including Brooksville, Crystal River, Homosassa Springs, Dade City, San Antonio, Tarpon Springs, Port Richey and New Port Richey. The region's abundance of natural and cultural resources, and outdoor recreation opportunities is the foundation for a wide range of ecotourism activities.

The City of Brooksville, the County Seat of Hernando County, is located 12 miles east of the park. This historic community, established in 1856, brings back the old town southern spirit of the 1800s with antebellum homes, antique shops and scenic brick lined streets. Fort DeSoto, a military fort established about 1840 to give protection to settlers from Indians, was located at the northeastern edge of present day Brooksville on Croom Road about one-half mile east of U.S. Highway 41.

Crystal River, located, about 30 minutes north of the park is known around the world as one of the best places to observe the imperiled Florida manatee. The town supports many opportunities for boating, diving, swimming as fishing.

Tarpon Springs is known as the "sponge capital of the world," having a long history of sponge diving and commercial fishing. Tarpon Springs revitalized the historic downtown. Art galleries, antiques stores and specialty shops are all housed in buildings dating from the late 1800s.

New Port Richey is a residential community with a revitalized historic downtown and Main Street. The Pithlachascotee River runs through the heart of the city. The city is recognized for its cultural heritage and unique riverfront landscape.

### **Surrounding Natural Areas and Recreational Opportunities**

A wide range of natural areas and recreational opportunities surround the park, creating a network of diverse activities for visitors of all interests and abilities.



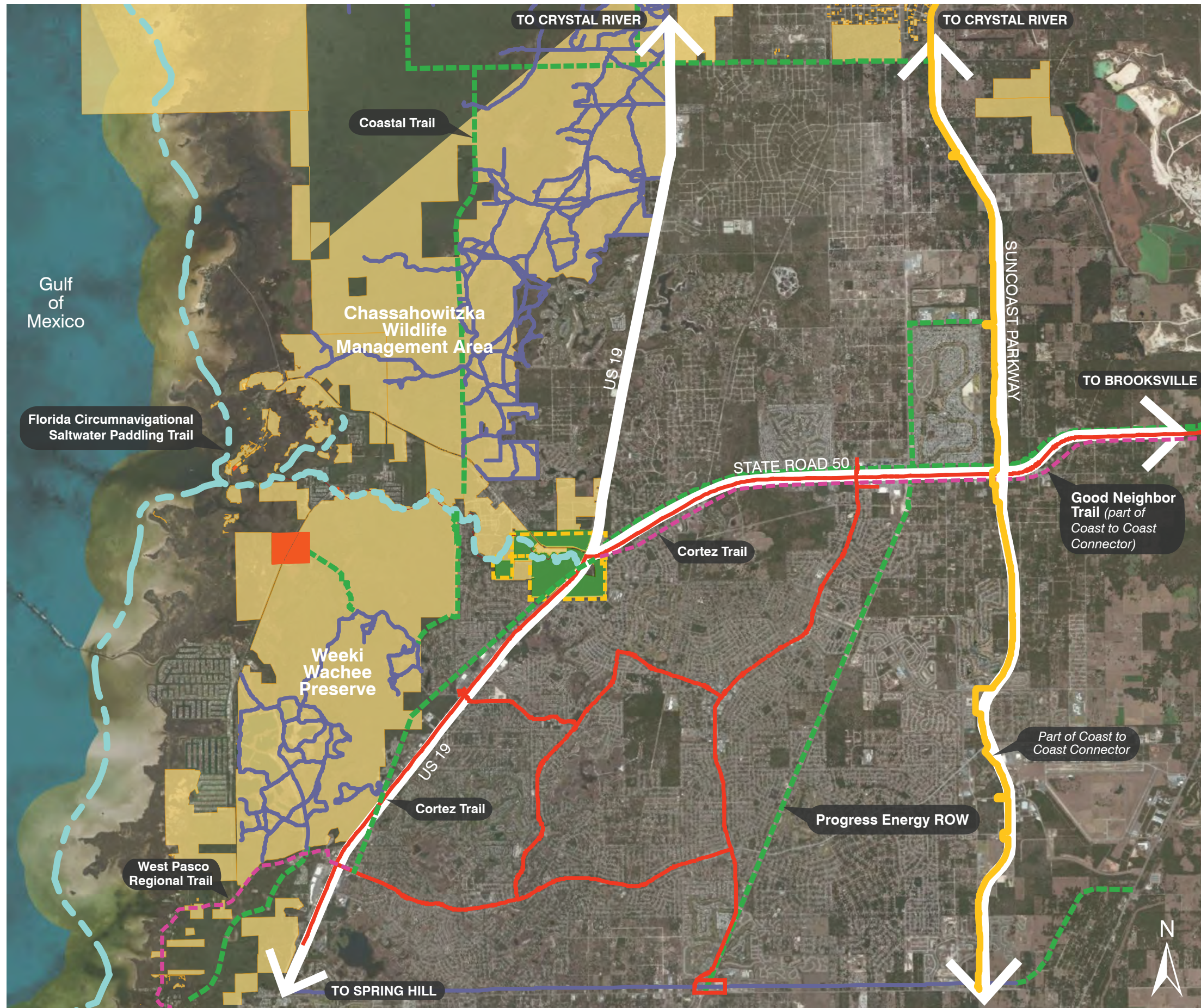
*Manatees gather near the Weeki Wachee headspring*

The Chassahowitzka River runs through the nearly 34,000-acre Florida Fish and Wildlife Conservation Commission (FWC) Chassahowitzka Wildlife Management Area (WMA) and 31,000-acre Chassahowitzka National Wildlife Refuge (NWR). Both managed areas are located northwest of Weeki Wachee Springs, along the Gulf Coast, and comprised of scrub, forested uplands, saltwater bays, brackish tidal creeks, and freshwater marshes. The NWR, is accessible only by boat, and was established primarily to protect waterfowl habitat. The WMA, accessible from land, allows hunting, fishing, picnicking and hiking. The FWC also manages a small recreational area on the Weeki Wachee River. It features a wildlife viewing platform, and nature trails through scrub habitat. The 11,206 acre Weekiwachee Preserve owned by the SWFWMD protects a diversity of habitats and a significant population of the imperiled Florida black bear. The preserve offers bike trails, boating, paddling, fishing, hiking, and nature study.

Paddlers and boaters are able to navigate the

# Weeki Wachee Springs State Park

## REGIONAL CONNECTIVITY MAP



### LEGEND

#### Site Features

- Weeki Wachee Springs State Park
- Other Conservation Land
- County Parks
- Weeki Wachee City Limits
- Primary Road
- Existing Bus Routes
- Existing Trails
- Proposed Trails
- Suncoast Trail
- Paddling Trail
- Florida Greenways & Trails System Land Trail Opportunity



Florida Department of Environmental Protection  
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**BACK OF MAP**

Weeki Wachee River until it reaches the Gulf. Two popular Hernando County parks are located along the Weeki Wachee River. Bayport Park, a seven-acre park located on the Gulf at the mouth of the Weeki Wachee River, offers a boat ramp, a canoe launch, a fishing pier and picnic areas. Rogers Park, a three-acre park on the Weeki Wachee River, offers a boat ramp, canoe launch, swimming area, picnic areas and a playground. One mile south of Rogers Park, the adjoining parks, Jenkins Creek and Linda Pedersen offer 140 acres of natural areas with springs, coastal marshes, uplands and waterways leading to the Gulf of Mexico. Recreational facilities offered at these two parks include a small boat launch, fishing pier, observation tower, boardwalk, swimming area, and picnic facilities.

Camping is widely available throughout Hernando County and near Weeki Wachee Springs. Primitive camping and tent-only campgrounds are available in the Withlacoochee State Forest, at the Silver Lake, Cypress Glen, and Crooked River campgrounds. Sixteen separate campgrounds throughout Hernando County can accommodate recreational vehicles and motor coaches.

Hernando County contains over 107,000 acres

of publicly accessible natural areas that are well-suited for hiking. Cypress Lake Preserve and Lake Townsend Regional Park offer hiking trails through densely wooded areas bounded by the Withlacoochee State Forest and the Withlacoochee River. The Florida National Scenic Trail extends through Cypress Lake Preserve. The Preserve has long term plans for additional hiking trails and trailhead facilities, as well as a paddling launch on the Withlacoochee River.

Weeki Wachee Springs State Park is not the only “Old Florida” roadside attraction in the region. Other former roadside attractions are preserved within Ellie Schiller Homosassa Springs Wildlife State Park, Rainbow Springs State Park, and Silver Springs State Park.

Ellie Schiller Homosassa Springs Wildlife State Park, located 25 miles to the north, showcases native Florida wildlife. The park was originally centered on “Nature’s Giant Fish Bowl,” a floating observation platform, and further developed as a zoo-like park on the headspring of the Homosassa River. Several wildlife encounter programs are offered daily, and visitors can view wildlife from a floating observation platform, boardwalk and pontoon boat rides. The park also serves as a



*Kayaking along the Weeki Wachee River*

wildlife rehabilitation center.

Rainbow Springs State Park, 50 miles to the northeast, is Florida's fourth largest spring. Rainbow Springs was a popular privately-owned springs attraction from the 1930s through the 1970s. Archaeological evidence indicates that humans have used the spring for nearly 10,000 years. The park currently offers swimming, snorkeling, picnicking and paddling in the headspring area. A walking trail leads visitors through the former gardens. Tubing (seasonal) and camping are also offered from a separate portion of the park located downstream from the former attraction.

### **Regional Transportation Network**

The park is located at the intersection of US Highway 19 and State Road 50. Improvements are planned for both roads including the addition of sidewalks and bike lanes. These projects are intended to increase the transportation efficiency and safety of the County's most congested traffic corridors and intersections.

Hernando County proposes extensive expansion of its multi-use trail system, and improvements to the bicycle lane and sidewalk network associated with new roadway construction or expansions of existing roadways. These multi-modal transportation improvements will be funded and implemented between 2015 and 2035



*Scuba divers prepare to explore the Weeki Wachee headspring*

(West Central Florida MPO Chairs Coordinating Committee 2010).

An existing paved multi-use trail extends five miles east from the intersection of US 19 and SR 50 along SR 50 to Mariner Blvd and the Suncoast Trail. This multi-use trail is planned to extend further east along SR 50 and then run north along US 98. The planned extension of this trail will facilitate bicycle and pedestrian access to Weeki Wachee Springs State Park from the City of Brooksville. Community connector and collector routes in the vicinity will provide spur connections to this trail from additional towns and neighborhoods. Another paved multi-use trail is planned along a north-south powerline easement, which will also intersect with SR 50, the Suncoast Trail and the planned trail along County Line Road.

The Coast-to-Coast Connector is a proposed multi-use trail corridor that will span the 275-mile distance between St. Petersburg and Titusville. From St. Petersburg, the Connector will extend north through Clearwater, Pasco and Hernando counties and proceed east to the Atlantic Coast. Several of the state's major trails, including the Fred Marquis Pinellas Trail, the Suncoast Trail and the West Orange Trail, will serve as portions of the Coast-to-Coast Connector.

A local public bus route currently connects Weeki Wachee Springs to the City of Brooksville along US 19 and SR 50. Buses along this route, known as the purple line, arrive at each of the nearly 80 identified stops every 1.25 hours. There are two park and ride locations along this main route. Plans are in progress to increase the connectivity between small towns and neighborhoods in the Weeki Wachee, Spring Hill, and Brooksville area. This will increase the frequency of bus arrivals at each stop and facilitate ease of access between sites in the area for pedestrians and cyclists. These local transit routes would also connect with future express bus service into the Tampa Bay region, providing multiple opportunities for travel to the park.



*The Weeki Wachee River, with a view towards the swimming area and headspring*

### **Planning, Zoning and Regulatory Issues**

The city limits of Weeki Wachee Springs encompass the state park. Land use and zoning matters are handled by the City's elected officials and their agents. The allowable land uses are identified in the City's comprehensive plan and further delineated in the zoning code. The specific comprehensive plan requirements and zoning regulations covering Weeki Wachee State Park are as follows:

#### **Comprehensive Plan**

The Comprehensive Plan for the City of Weeki Wachee was found to be in compliance (with State of Florida requirements) in February 1992 based on a Stipulated Settlement Agreement (SSA) with the state. According to the records from the Florida Department of Economic Opportunity, there have been no amendments to the plan other than those outlined in the SSA.

#### ***Future Land Use Element***

The Future Land Use Map indicates that several different future land use categories are designated within the park property. The Future Land Use Element provides information on the purpose of these categories and allowable uses within them. They are as follows:

#### ***Within the historic attraction area:***

- Tourist - The Tourist land use category is reserved for the Weeki Wachee attraction and is supportive of commercial land uses.
- Within the state park boundary (and adjacent to the Tourist future land use):
- Residential, 5 du/per acre - Allows residential uses and requires 15-foot setback from wetlands and water bodies.
- Residential, 3 du/per acre - Allows residential uses and requires 15-foot setback from wetlands and water bodies.
- Community Commercial - Located on arterial roads, maximum of 75 acres
- Regional Commercial - Minimum of 80 acres, not to exceed 10,000 square feet per acre; internal access.
- Commercial Infill - Limited and managed to minimize incompatible land use and improve traffic circulation. Requires esthetic quality through landscaping, setbacks, buffers, screening and limited signage. Will not extend to a greater depth than 600 feet west of U.S. 19 right-of-way.
- Natural Preservation Districts - Reserved for conservation of natural systems including research, recreation, and open space. Included in this category are the following Future Land



One of Weeki Wachee's first animal shows featured Birds of Prey

Use Map categories: Nature Preserve A, Nature Preserve B, Riverine Protection Area.

*Note: All commercial development (regardless of future land use category) requires a site plan prior to approval.*

### Conservation Element

Several other policies in the Conservation Element of the comprehensive plan are relevant to the master plan area, including the following:

- Development adjacent to nature preserve areas or lakes requires a 15-foot buffer.
- The City shall require conservation of and use of native plant species in the developed landscapes.
- A protected species survey is required on parcels greater than five acres in size submitted for development approval.
- To protect the Riverine Protection and Nature Preserve areas along the river from encroachment of incompatible land uses, a minimum 150-foot natural buffer from the water's edge is the river is required. The tourist area is exempt from this requirement.
- Support the continuation of the attraction

(structures, etc.) and permit flexibility in the types of events and exhibits by allowing a range of permitted uses in the zoning ordinance.

### Zoning

#### Zoning Categories

All the zoning districts within the park boundary are planned development projects which require a site plan or plat to accompany the request for development. There are several different zoning districts shown on the zoning map. They are as follows:

#### Within the Master Plan area:

- Recreational Planned Development Project (REC. P.D.P.) - Allows a number of recreational uses ranging from golf courses to go-cart tracks, amusements, gun and archery ranges, as well as parks and other outdoor uses of a recreational nature specifically approved by the governing body.

#### Within the state park boundary:

- Residential Planned Development Project (RES. P.D.P.) - Allows residential uses at a density consistent with the zoning code and comprehensive plan.
- General Highway Commercial Planned Development Project (G.H.C. P.D.P.) - Allows Commercial uses consistent with zoning code and comprehensive plan.
- Natural Protection District (N.P.D.) - There is no section in the zoning code that clearly states what uses are allowed in this category. This zoning district refers to the future land use map



A vintage bumper sticker advertising Weeki Wachee Springs



categories, as applicable, Nature Preserve A, Nature Preserve B and Riverine Protection Area.

- Riverine Protection District (R.P.D.) – There is no section in the zoning code that clearly states what uses are allowed in this category.

### *Other Zoning Code Requirements*

All zoning districts are Planned Development Projects that require a site plan or master development plan to be submitted for the City's review and approval prior to commencing development..

All Planned Development Projects require the approval of a preliminary Plat (Plan) and a final Plat (Plan). Detailed requirements regarding process and content of the submittals are listed in the zoning code. Environmental control standards are noted in Article II, Section 5. The City contracts with land use planners to review development and site plans on an as needed basis.

### Permitting

Zoning permits are required prior to construction or alteration of any structure. There are exceptions. No permit is required for reoccurring maintenance work or installation of improvements with an approved preliminary development plat, or for an approved plan development project.

The City is responsible for issuing permits within the city limits. PDCS, LLC, a consulting firm specializing in building department services, assists the City with building inspections and fire code inspections. The firm is also authorized to issue permits for minor alterations or structures, such as building a storage shed or adding a porch, as well as certain renovations that do not alter the footprint of a structure.

### Water and Wastewater

The Park is currently served by Hernando County's central wastewater system. The Park is currently served by an on-site well that supplies water to the park.



*Fall color reflected on the waters of the Weeki Wachee River*

### SITE ANALYSIS

DRP staff conducted several site visits to review the natural and cultural resources on the site. The locations and use of existing facilities and how visitors and staff move through the park was also noted. This brought understanding of the park's operation, main activity areas, and the current circulation patterns. The analysis of the park's current condition and operation indicated a need for specific improvements. Documentation of the current visitor experience, determines the look and feel promoted by the plan.

### ***Natural Resources***

Weeki Wachee Spring is a first magnitude spring that discharges an average of 112 million gallons a day. The spring feeds the crystal clear Weeki Wachee River that flows west towards the Gulf. The Weeki Wachee Spring and upper segments of the Weeki Wachee River are considered "impaired by nutrients" (FDEP, 2009). These waterbodies have elevated concentrations of nitrate indicated by algal smothering of the flora and fauna. This listing required the development of a Total Maximum Daily Load (TMDL) for nitrogen. The TMDL sets the level of nutrient loading needed to meet applicable water quality standards. (FDEP DRAFT TMDL 2013).

The Weeki Wachee Spring consists of a conical pool that is 165 feet by 210 feet wide (Scott 2004). The pool slopes gently down 10 feet to the start of the main vent. Divers have been able to map and explore over 6700 feet of subterranean passages. (Karst Underwater Research, Inc. 2008).

The spring and river are habitat for a number of imperiled species, including the West Indian manatee, American alligator, striped mullet, bluegill, mangrove snapper, peninsular cooter and Florida red-bellied turtle.

Park lands affected by this master plan are primarily developed. Key features within the master plan area include:

- The river floodplain contains remnant portions of hydric hammock. It is heavily impacted by fill, previous development and invasive exotic plant species.
- A drainage swale traverses the west side of the attraction area. It currently directs runoff from the heavily developed areas of the park. It is unclear if this ornamental feature was created for stormwater management
- Two areas of steep slopes, the Buccaneer Bay picnic area and adjacent to the headspring. These areas create challenges for accessibility.
- Numerous large trees are found throughout the historic attraction.
- A portion of the Buccaneer Bay picnic area



*An egret finds a resting spot in the Weeki Wachee River*

is a remnant bluff that overlooks the river and headspring. This area may have once been scrub but is now characterized by an established canopy of sand live oak and cabbage palm.

## **Cultural Resources**

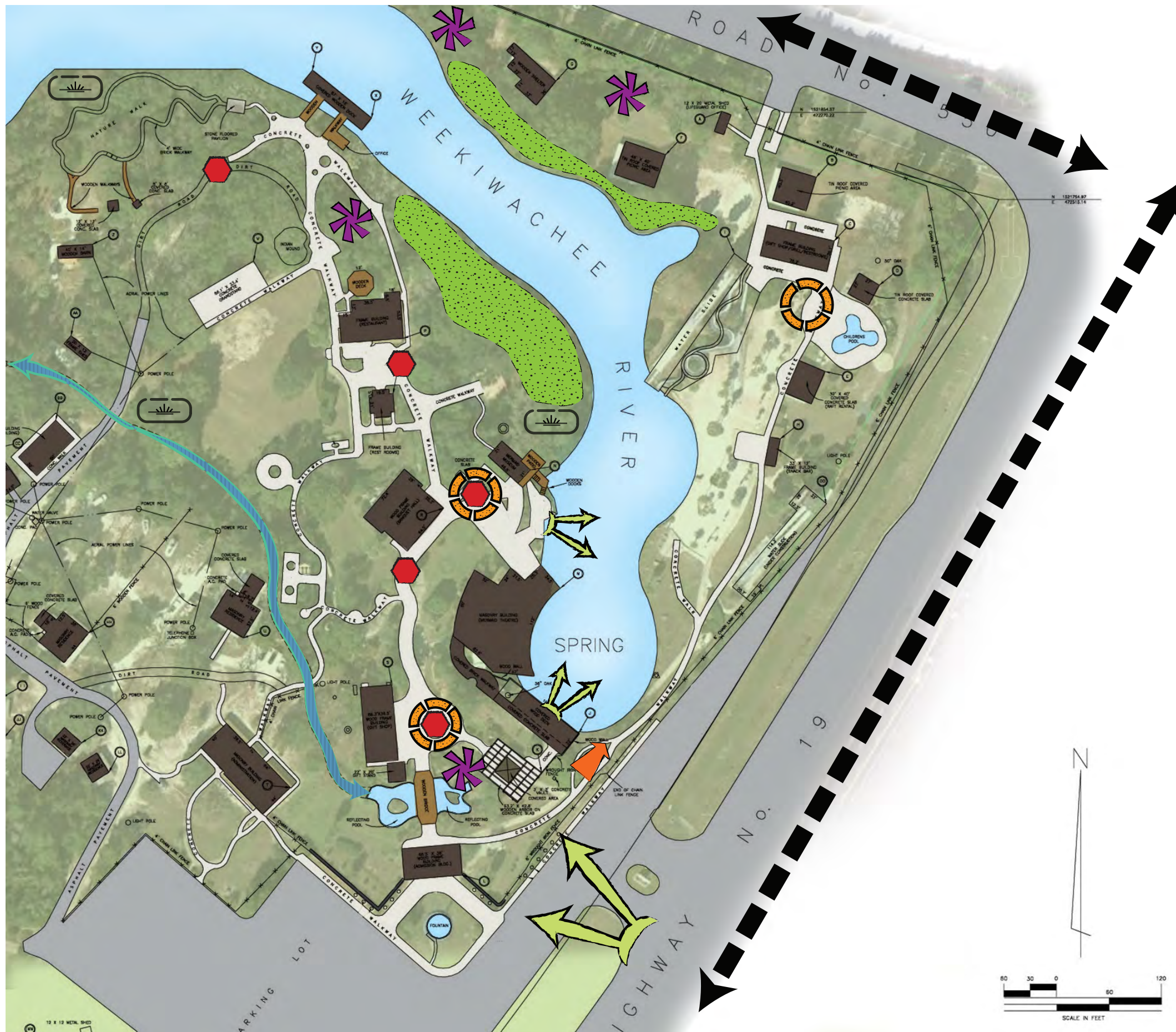
Since its founding in 1947, Weeki Wachee played an important role in Florida's tourist industry. The opening of Walt Disney World in 1971 led indirectly to the decline of Florida's famous roadside attractions. Today, several elements of the attraction area are considered historic and eligible for listing in the National Register of Historic Places. The Mermaid Theater (built in 1959) is significant for its original clamshell roof. The building is located prominently on the spring. The Adagio Statue (constructed c. 1965) and the Mermaid Wall (constructed c. 1963) are considered historic because of their distinctive design and association with the Weeki Wachee attraction. The Star Garden is a historic remnant of the attraction's landscape. Props from mermaid performances were displayed and provided photo opportunities for visitors.

There are several archaeological sites in the area of the park covered by the master plan. Weekiwachee mound, is the most prominent of the sites in the park. This sand burial mound is located about 180 meters north of the spring, near the grandstand, and is currently roped off and marked by signage. Analysis of pottery from the mound indicated construction during the Safety Harbor period (AD 900–1650), the terminal pre-contact and initial contact cultural period. The presence of Spanish glass beads at the site indicates contact with the Spanish during the early 16th century (c. 1525 AD -1550 AD).

Implementation of the park's master plan will be dependent on close consultation with the Division of Historic Resources in order to limit potential disturbance to significant cultural resources.

## **Historic Park Character**

The historic attraction area preserves significant elements from the heyday of roadside attractions













# Weeki Wachee Springs State Park

## SITE ANALYSIS

### LEGEND

#### Site Features

-  Potential Archaeological Artifact Area
-  Circulation/Activity Node
-  Difficult Wayfinding
-  Scenic View
-  Significant Slope
-  Pedestrian Circulation
-  Primary Road
-  Drainage Swale
-  Wet Area
-  Vegetated Buffer



Florida Department of Environmental Protection  
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**BACK OF MAP**



*The historic mermaid wall greets visitors upon their arrival to the park*

and automobile tourism in Florida. The signature architecture evident in key features at the park include the mermaid wall and Adagio sculpture as well as the mermaid theater (which will be restored with its original clamshell roof). The original attraction was quite small, focused directly on the entrance, mermaid theater, gift shop and swimming area. Over time, the original attraction expanded to add new features and services to increase visitation. As a result, the current compilation of buildings and use areas differ in style and character from the original attraction.

### **Current Park Facilities and Visitor Services**

Numerous buildings provide locations for various activities at the park. The site analysis included an assessment of current facility locations and uses. This portion of the analysis determined the need for additional services or facilities. This analysis also considered if facilities might be more functional if they were relocated or renovated.

Existing facilities in the master plan area include the following:

- **Attraction area:** admission building, mermaid theater, gift shop, snack bar/ice cream shop, restaurant, banquet hall, grandstand (stadium), playground, rest room, boat dock, riverside theater and mermaid photo spot. The grandstand serves as the anchor for a large open event area where concerts and other special events are held.

- **Buccaneer Bay:** water slides, beverage bar, concession building with rest rooms and snack bar, picnic shelters, floating dock, sunning beach, kiddie pool, volleyball court, tiki bar and lifeguard office.

## **CONCEPTUAL MASTER PLAN OVERVIEW**

The conceptual master plan drawing includes the historic attraction area, Buccaneer Bay, and the parking area. The drawing is an illustrative depiction of the overall vision for the attraction area.

The conceptual master plan highlights the special features of one of Florida's historic roadside attractions, provides quality recreational experiences and preserves and interprets sensitive resources. The master plan focuses on the following principles throughout:

- Enhancing the park's natural and cultural resources
- Preserving historic elements and special features
- Inspiring a sense of discovery and delight
- Creating a tangible sense of place
- Providing a showcase for best management practices

The master plan seeks to accomplish these principles by incorporating the following features:

SPOTLIGHT

**Florida’s Roadside Attractions**

Beginning in the late 19th century, tourists traveled to Florida to see lush gardens, to peer through glass bottom boats and to interact with the exotic environment. These early attractions provided a unique experience for visitors. Most focused on using the state’s natural resources to generate profit and many were located near major highways, such as US 1, and US 41.

Promoters employed the myths and legends of Florida, such as the Fountain of Youth, to lure patrons. Attractions featuring water, such as springs, often competed with each other by featuring new gimmicks to showcase the clarity of the waters and the uniqueness of the features at a particular spring.

In 1947, champion swimmer Newton Perry opened Weeki Wachee. Perry constructed an Underwater Theater where tourists could sit and view the wildlife in the springs. To further differentiate Weeki Wachee from other roadside attractions, Perry trained women to perform stunts and ballet underwater, with the help of an unique underwater tubing system used for breathing. Perry advertised these women as the mermaids of Weeki Wachee.

The roadside tourist trade remained healthy into the 1960s, but the industry was showing signs of change. The Florida Turnpike, combined with new interstate highway segments opening in the mid 1960s, changed traffic patterns in the state. Most U.S. and state highways that had been the primary travel arteries became alternate routes for travel, leaving many roadside attractions isolated. A few of these roadside attractions survived and several, in addition to Weeki Wachee, are part of the Florida State Park system, such as Wakulla Springs, Silver Springs, Homosassa Springs and Rainbow Springs.



- Gathering places for visitors
- Clear and safe pathways and circulation patterns
- Efficient use of facilities and resources
- Opportunities for spaces with multiple and flexible uses
- Areas for play and picnicking
- Opportunities to view, preserve and interpret natural and cultural resources, including the attraction’s history and culture
- Landscape and stormwater practices that enhance and protect water quality

**HISTORIC ATTRACTION AREA**

Throughout the park, the goal is to create an atmosphere of discovery from the moment the visitor passes through the park entrance. The plan preserves and highlights the historic elements of the former attraction and improves walkway alignments to enhance wayfinding.

A central promenade creates open sight lines that will draw visitors through the park to choose their destinations and activities. Buildings frame views

but not block travel. Overlooks can be created at several locations to provide greater visual access to the head spring and river.

The mermaid theater once again becomes the dominant architectural element in the park. The existing banquet hall is removed and in its place is a large central fountain. This area will feature ample seating and gathering space to accommodate the large crowds that gather near the theater prior to mermaid performances.

A new interpretive center can serve multiple purposes. It will include space for interpretive programming and exhibits as well as special events. One portion of the exterior of becomes a stage area for performances. Its location also capitalizes on the potential of the Star Garden, one of the park’s unique historic elements. The Star Garden will create a special approach to the new interpretive center. The renovated garden will once again contain props from vintage mermaid performances and provide photo opportunities for visitors.



Weeki Wachee Springs State Park: **CONCEPTUAL MASTER PLAN**



**BACK OF MAP**





*Props from mermaid performances were displayed in the Star Garden*

The gift shop will remain in its current location, near the park entrance. This location provides visitors with a convenient opportunity to purchase gifts and other items during their visit. A new separate exit is proposed adjacent to the entry building in order to better facilitate large crowds leaving the park after special events or on exceptionally busy days.

The attraction area also features a redesigned playground area adjacent to a new picnic pavilion and a new rest room facility. The restaurant remains in its current location but will be a renovated facility with improved outdoor seating.

Beyond the restaurant, visitors will enter an area focused on interpretation of the park's natural and cultural resources. Relocating the primary circulation away from the Weekiwachee mound site will improve conservation efforts and provide greater opportunity for interpretation of the park's

archaeological sites. The central promenade terminates at the boat dock, and visitors may then choose to, take a boat ride, or attend a wildlife show. The historic attraction area is ultimately connected to Buccaneer Bay via a pedestrian bridge, creating a complete loop through the attraction.

## **BUCCANEER BAY**

Buccaneer Bay is a former water park that is popular with local residents and visitors, especially families. The master plan envisions an enhanced swimming area complete with new amenities. This includes a new splash pool designed for kids ages 2-12. This exciting water feature will have a variety of age appropriate play areas for splashing and swimming. Additional amenities include a new bathhouse and concession building. The current picnic area is to be renovated. New picnic shelters will accommodate use by both small and large groups and provide greater enjoyment of the spring and river.

As with the attraction area circulation patterns and overall accessibility need improvement. New walkways will promote way finding and provide greater connectivity to amenities within Buccaneer Bay and between Buccaneer Bay and the historic attraction.

Landscape improvements will be particularly important and should be designed to direct the



*Themed splash pool at a private resort*



Bioretention area at the Tampa Aquarium Photo: Ekistics Design Studio

circulation of users and compliment stormwater treatment. The final site design will reduce the overall amount of impervious surface and provide enhanced stormwater management.

## PARKING AREA

Visitors begin and end their experience in the parking lot and entrance areas. The conceptual master plan creates an enhanced entry experience that emphasizes safety and circulation, integrated stormwater management and extensive landscape improvements. A new entrance to the park is created on US 19 and a large roundabout will facilitate vehicle entry. A landscaped boulevard centered on the historic Adagio sculpture will create a dramatic sense of arrival. The parking design facilitates improved access to the canoe and kayak launch and improved safety for cyclists and pedestrians. The new plan also provides areas for a bus drop off, and parking for buses and recreational vehicles.

Enhanced stormwater treatment will be required to mitigate the negative impacts of stormwater runoff from the parking lot, as well as other impervious surfaces within the park. Pervious paving will be utilized to the greatest extent possible. In addition extensive landscape areas will provide much needed shade and reduce the overall amount of impervious surface created within the parking area.

Through careful design and planning these landscape areas can also be integrated as part of the stormwater management system. These

bioretention areas can be ecologically diverse, and aesthetically pleasing. When combined with interpretive signs and materials, they are educationally rich environments where visitors can learn about the many benefits and values of stormwater management. The goal is to create a parking area with dynamic landscape features that provide a number of conservation benefits.

## INTERPRETATION AND VISITOR SERVICES

The master plan process identified a need for enhanced visitor services and improved interpretive experiences. Visitors should be able to create their own experience by encountering multiple opportunities to learn about the park's resources, to meet a mermaid, or participate in recreational activities.

The park's natural and cultural resources provide myriad opportunities for interpretation. The Weeki Wachee River provides the backdrop for boat rides downstream of the headwaters, to experience some of the park's natural areas. Both the boat tour and mermaid shows can highlight the river and its wildlife and the head spring.

It is important that the park's interpretive programming be dynamic in order to create generations of park visitors. The park's Statement for Interpretation developed in March of 2009



Recent animal shows feature species native to the area

## SPOTLIGHT

### Beauty and Benefits of Florida's Springs

Florida's springs are a unique and beautiful resource. The historically clear waters provide valuable habitat and recreational opportunities. Springs are an important component of the State's tourism economy. Springs also provide a "window" into a valuable resource – the ground water in the Floridan Aquifer. Our drinking water comes from the same aquifer that supplies water to our springs. The quality and quantity of water in springs indicates the quality and quantity of the State's drinking water.

Springs, where groundwater comes to the surface, are major sources of stream flow in a number of rivers such as the Weeki Wachee, the Rainbow, the Wakulla, and the Suwanee. Nineteen counties have first magnitude springs, ranging from well-known springs such as Weeki Wachee Springs, Rainbow Springs, and Silver Springs, to lesser known springs, often on private land and known only by a few.

### Threats to Springs

Spring water is very high quality and lacks contaminants. It can be used directly for public water supplies or for irrigation. However, when pollutants are introduced on the land surface, they will travel into the aquifer and later appear in spring flow. The closer to the spring that nutrients are introduced, the more rapidly the impact on the spring can occur. Dissolved nutrients provide for rapid growth of algae and aquatic plants that obscure the spring bottoms and clog the surfaces. This diminishes the spring's ability to support wildlife and provide economic value.



identifies specific themes that should be covered by interpretive programming, including natural springs systems, Florida tourism history, mermaid culture, and unique underwater technologies. The statement also outlines various ways to deliver interpretive programming.

The amount of potential activities will require a variety of locations and methods of delivery. In addition to a dedicated interpretive center, opportunities for expanding the programming offered at the mermaid theater itself are to be explored. This could include programming focused on water quality and springs protection, to be offered regularly and as alternative programming when inclement weather forces cancellation of mermaid shows for safety reasons.

As new facilities and circulation routes are

developed, the detailed site plans should include outdoor locations suitable for interpretive programming such as mermaid encounters, interpretive signage or other exhibits. In addition, throughout the park, small areas appropriate for mobile interpretive activities or mobile concessions should be sited, creating an ongoing sense of discovery and excitement as visitors move through the park from one destination to another.

The plan provides several locations for food service. The future vision for these services will be consistent with the overall theme and character outlined in this master plan and implemented jointly by the DRP and visitor service providers operating within the park. Some flexibility and mobility in the location and specific services offered is also key to providing exceptional services and adapting to changing conditions and visitor preferences.



*The Mermaid Theater and Mermaid Villa in 1960*

## **PARK CHARACTER**

A well designed space has a distinct character or “sense of place” that is anchored in the landscape, history and culture of a particular area. It is the result of the relationship between people, the landscape, and the built environment. It can be created with a careful approach to site layout and design.

### ***Design Theme: Water***

The park would not exist without the Weeki Wachee Spring and River. The various activities, resources and important interpretive messages at the park can all be tied to water. This includes the famous mermaids, swimming, the importance of water quality, and the wildlife. For this reason “water” is an excellent central design theme. Water also creates patterns that can be repeated throughout the park. Incorporating this theme into the design of facilities, signage, and walkways unifies all the disparate site elements. Visitors will have a visual reminder that they have entered a special place tied to the springs and river, through the sights that they experience throughout the park.

### ***Architecture***

Future park facilities will be designed to link to the park’s central theme and be complementary to the historic mermaid theater, with its restored dramatic white clamshell roof. Constructed during the 1960s the mermaid theater was considered

an engineering marvel. The building illustrates the clean lines and connection to the landscape typical of mid-century modern architecture. The design of future park facilities should be inspired by this important architectural period. White, blue, concrete, glass, and steel are all colors and materials that should be found throughout the architecture of the park. The architectural possibilities are numerous but most importantly the buildings should address the environmental qualities of the site. Features such as large windows to provide views and generous overhangs to provide shelter from thunderstorms are examples of architectural elements that should be considered.

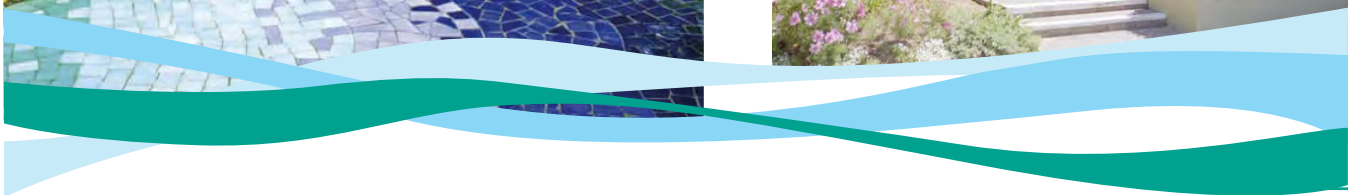
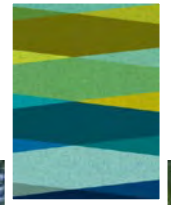
### ***Landscape***

Interesting visual details, textures and even fragrances also establish park character. A redesigned landscape will improve the aesthetic appeal of the entire area and retain some of “roadside attraction” character of the park. Visitors to the park will experience the colorful “tropical” ambiance common in Florida’s mid-20th century tourist attractions. Diverse plantings enhance the aesthetic qualities of the landscape. The ever-changing forms, colors, and textures of the wildflowers, grasses and other native plants create dynamic landscape patterns and visual interest in all seasons. Landscape plantings should be composed of native plants found within the park in aesthetically appealing groupings, and may include non-native species that are not considered invasive. Plant species should be selected in order to minimize the use of water, fertilizer and pesticides in order to protect water quality. The landscape itself will serve to interpret environmentally sensitive landscape management techniques for the park’s visitor’s. Additionally landscape structures such as signs, fencing, and hardscape materials should incorporate products and patterns that evoke the primary design theme..

## DESIGN THEME: WATER

*If there is magic on this planet, it is contained in water. - Loren Eiseley*

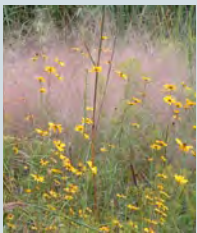
- Focus on Springs and River
- Unites Mermaids and natural features of the park through the common theme of water
- Incorporate Mermaids as magical feature directly related to the Springs/water
- Shades of blue and white used throughout the park
- Curvilinear shapes/lines throughout park
- Mid-Century Modern Architecture with clean lines throughout the park
- Opportunity to interpret and educate on water supply, quality, the water cycle and its role in people's lives



## Landscape Best Management Practices (BMPs)

Landscaping and lawn care affect springs in several ways. Maintaining lawns and landscaping typically involves large amounts of water, which can ultimately reduce spring flows. Fertilizers and other chemicals used in managing lawns and landscaping are a source of pollution and contribute nitrates to the aquifer. Invasive species may be introduced that result in rapid growth of the vegetation, choking springs and spring runs. Sediment resulting from erosion can choke springs, damage aquatic vegetation and destroy fish-spawning beds. Landscape BMPs to protect water quality are easily implemented and have proven to be effective in reducing the off-site transport of sediment, nutrients, and pesticides. The BMPs presented here provide general guidelines for lawn and landscape maintenance practices to protect Florida springs. More detailed information, in terms of specific techniques and practices, can be found in the references section.

Florida-friendly best management practices (BMPs) address the protection of water resources where pesticides, nutrients, and sediments enter the surface water and ground water as a result of nonpoint source pollution. BMP goals are to promote the efficient use of water and reduce non point source pollution through (1) the use of appropriate site design and plant selection; (2) the use of appropriate rates of irrigation and fertilizer application; and (3) the use of integrated pest management (IPM) to minimize pests with chemicals, only when appropriate. The application of these BMPs in the proposed redevelopment and management of the Weeki Wachee Springs State Park landscape will contribute significantly to the protection of this unique and beautiful spring system.

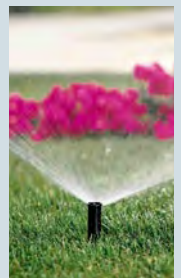


### Site Design and Plant Selection

- Group plants with similar cultural requirements, particularly irrigation demand.
- Limit high maintenance plantings to high visual impact zones.
- Limit sod areas to high traffic/activity zones.
- Low maintenance, naturalistic plantings should be used in peripheral areas and zones with lower visitation.
- Select plants that are well adapted to the soil and microclimate of the site.
- Select native and/or well-adapted non-native plants that will achieve the overall goals of the landscape project and incorporate areas of natural vegetation into the landscape design to the greatest degree possible.
- Avoid planting invasive species as listed by the Florida Exotic Pest Plant Council.
- Bioretention areas, including berms, swales, and rain gardens, should be incorporated into the landscape design.
- A maintenance-free zone, a minimum of 10 feet in width, should be established between lawn and landscaped areas and shoreline vegetation where the application of fertilizers and pesticides is prohibited.

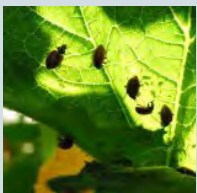
### Irrigation

- Irrigation systems should be designed and calibrated to meet a site's peak water requirements.
- Prevent irrigation runoff, do not exceed the ability of the soil to absorb and retain the water applied during any one application.
- Irrigation systems should be designed to serve turf and non-turf areas separately.
- Micro-irrigation should be used where feasible. Drip or micro-spray irrigation systems apply water directly to the roots of plants and lose minimal water to evaporation or wind drift.
- Apply irrigation only when plants show signs of stress. Apply just enough irrigation to support healthy plant growth and water deeply to encourage deep root systems.
- Install rain shut-off devices on all automatic irrigation systems as required by Florida law.



### Fertilizer

- Avoid regularly scheduled fertilizer applications; develop a plan where fertilizer formulations and application rates are based on the needs of plants.
- If plant nutrient deficiencies arise, soil testing should be conducted to determine which nutrients should be applied.
- Follow UF/IFAS recommendations for ideal rates, application timings, and formulas.
- Designate a fertilizer free zone, a minimum of 10 feet in width, between landscaped areas and riparian zones.
- Do not apply fertilizer if heavy rain is expected.



### Integrated Pest Management (IPM)

- Encourage healthy plant growth by irrigating and fertilizing only when necessary.
- Monitor for pests and diseases on a regular basis to detect problems early before significant damage occurs.
- Use natural or low-toxicity products that are least harmful to people, pets, and wildlife.
- Spot treat only the affected areas of plants or lawn. Never use blanket treatments or broad-spectrum insecticides and always encourage and promote beneficial insects.

<b>PHASING AND COST ESTIMATES</b>			
<b>Conceptual Master Plan - Development Program</b>		<b>Proposed Units</b>	<b>Total Cost</b>
<b>PHASE ONE</b>	<b>Historic Attraction</b>		
	Partial Sidewalk Improvements	1	\$350,000
	Large Pavilion	1	\$85,000
	New Food Service Building	1	\$700,000
	Partial Landscaping Improvements	1	\$100,000
	Wayfinding and Interpretive Kiosks	1	\$50,000
	<b>Parking Lot Improvements</b>	1	\$2,000,000
	<b>Buccaneer Bay</b>		
	New Bathhouse and Concession Building	1	\$1,500,000
	New Splash Pool	1	\$500,000
	Picnic Pavilions	1 large	\$85,000
		3 medium	\$120,000
<b>Phase One Estimated Total Cost</b>			<b>\$5,485,000</b>
<b>PHASE TWO</b>	<b>Historic Attraction</b>		
	Interpretive Center	1	\$1,500,000
	Central Fountain	1	\$250,000
	New Restroom	2	\$250,000
	Spring Overlooks and Special Event Pavilion	1	\$500,000
	New Playground	1	\$75,000
	Completed Sidewalk Improvements	1	\$300,000
	Completed Landscaping Improvements	1	\$100,000
<b>Phase Two Estimated Total Cost</b>			<b>\$2,975,000</b>
<b>PHASE THREE</b>	<b>Historic Attraction</b>		
	Pedestrian Bridge	1	\$200,000
<b>Phase Three Estimated Total Cost</b>			<b>\$200,000</b>
<b>Estimated Total Project Cost</b>			<b>\$8,665,000</b>

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