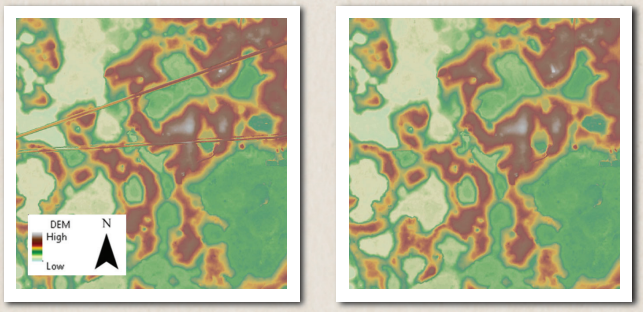
Scenario 1
Green Swamp Railroad Berms

Logging Industry

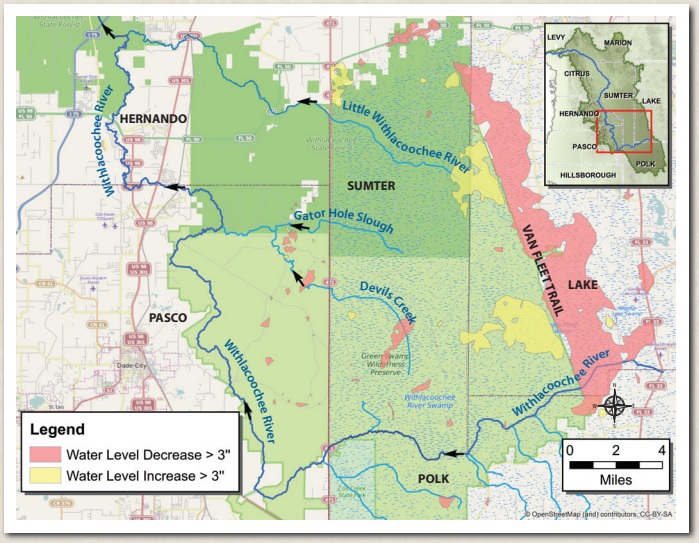
- From the 1920s through the 1950s, large-scale logging operations were active throughout much of Florida, including the headwaters of the Withlacoochee River in the Green Swamp.

Scenario Description

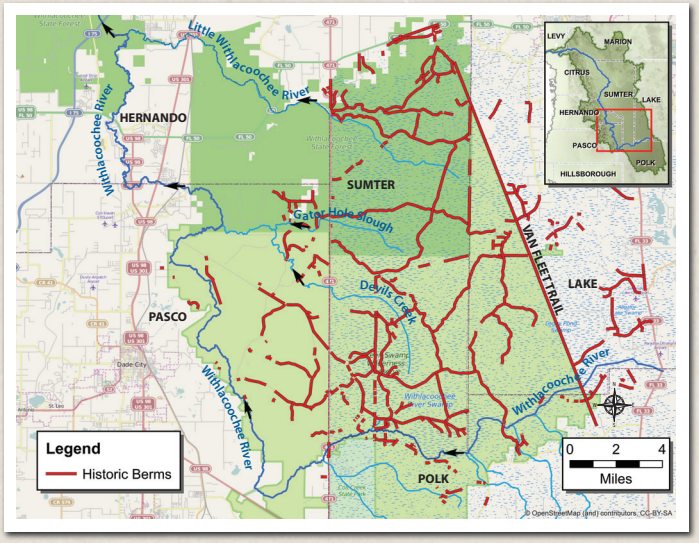
- Railroad berms and drainage ditches in the Green Swamp were built decades ago to support logging and other industries.
- This scenario evaluated the removal of 200 miles of berms and nearly 300 culverts to simulate natural flow conditions within the Green Swamp.



Existing Topography with Berms Present (left side)
Simulated Topography with Berms Removed (right side)



Peak Water Level Changes from Simulated Berm Removal (100-year Design Storm Event)



Historic Berms in the Green Swamp that were Removed for this Scenario

Preliminary Results

- Changes in water levels were observed at some locations within the Green Swamp.
- During the 2004 hurricane season, 10 percent more flow would have been released from the Green Swamp.
- There were no measurable changes to water levels downstream of the Green Swamp.

Conclusions

- Water levels in the Green Swamp are a reflection of regional rainfall and aquifer levels.
- The model results indicate that removing the berms would temporarily increase water flow from the Green Swamp.
- During low-water periods, there would be no change to flows leaving the Green Swamp.

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Scenario 2
Green Swamp Bridge Piling Log Jams

Remnant Bridge Pilings

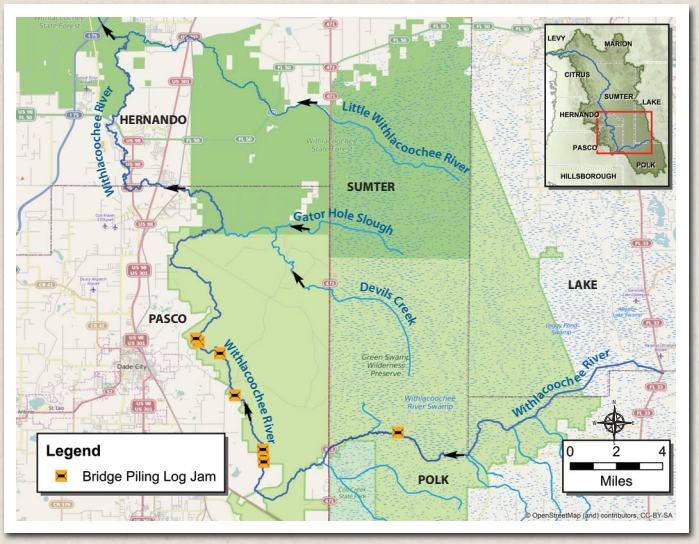
- During the early-to-mid 1900s, extensive logging activities in the Green Swamp necessitated the construction of railroad bridges that crossed the river's main channel.
- Although the railroad tracks themselves have since been removed, many of the bridge pilings remain as a reminder of these historical activities.

Scenario Description

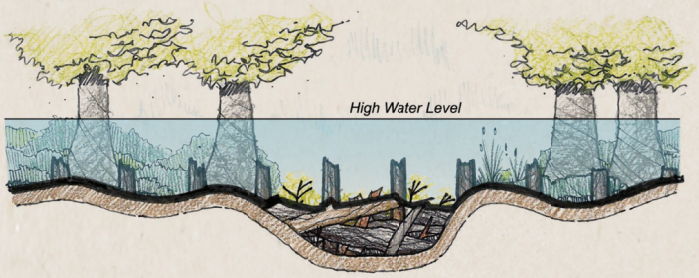
- Bridge pilings in the Green Swamp have collected debris and artificially created significant log jams at eight locations along the Withlacoochee River.
- These bridge piling log jams were removed in the model to evaluate what effect they have on water levels and flow along the Withlacoochee River.

Preliminary Results

- Water level decreases were observed immediately upstream of the removed log jams.
- These differences did not translate to other locations along the river or within the Green Swamp.
- When water levels in the Green Swamp are high enough for flows downstream, the area obstructed by the log jams is minimal compared to the overall flow area of the adjacent swamp.



Location of Major Bridge Piling Log Jams along the Withlacoochee River in the Green Swamp



Typical Extent of Flow Area in the Green Swamp as Compared to Obstructed Area

Conclusions

- The model results suggest that minor changes to water levels and flow exist at the log jam locations as a result of the flow obstructions.
- These are localized changes and do not significantly affect river levels or flows upstream or downstream.

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Comparison of Low Water (left side) and High Water (right side) at the same Bridge Piling Log Jam in the Green Swamp near Dade City

Scenario 3
Green Swamp and SR 471

SR 471

- SR 471 extends through the middle of the Green Swamp, from US 98 in Polk County to US 301 in Sumter County.
- Major bridge crossings are located at both the Withlacoochee and Little Withlacoochee rivers along with large box culvert crossings at Devils Creek and Gator Hole Slough.
- In addition to these major crossings, there are more than 50 additional culvert crossings where the raised highway bisects natural wetlands and sloughs.

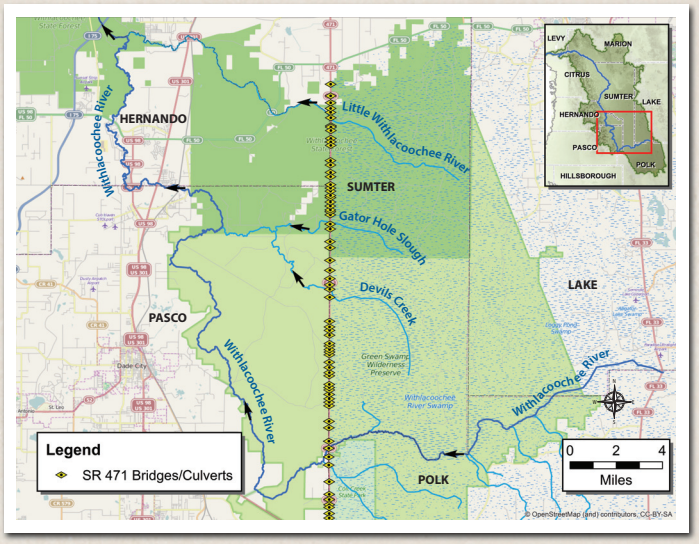
SR 471 Bridge at the Withlacoochee River

Scenario Description

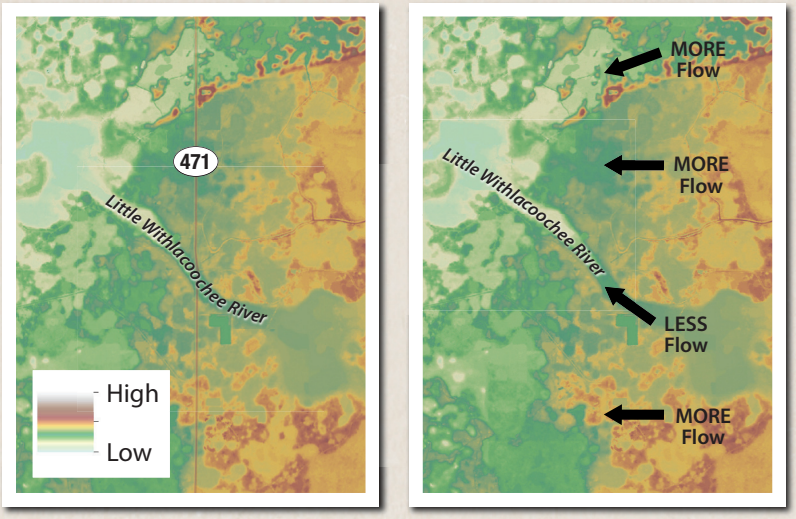
- SR 471 was constructed several feet higher than the natural elevations of the adjacent land.
- This scenario evaluated the removal of nearly 20 miles of SR 471 in the Green Swamp to determine its impact on regional water levels and flow.

Preliminary Results

- Model results indicate minor differences in water levels throughout the Green Swamp as a result of removing SR 471.
- Less flow was observed at the major stream crossings during the peak of simulated storm events.
- Flow increases were observed in non-channelized areas.
- Overall, there were no changes to water levels or flow in the Withlacoochee River downstream of the Green Swamp.



Location of Major Streams and Culvert Crossings under SR 471 in the Green Swamp



Existing Topography with SR 471 (left side)
Simulated Topography with SR 471 Removed (right side)

Conclusions

- The results suggest that while the footprint of SR 471 has very little impact on water levels in the Green Swamp, its presence has a local effect on the magnitude of flows at specific locations.
- This effect is diminished further downstream as model results show no overall change in flow volume leaving the Green Swamp.
- Model results indicate the existing bridge and culvert locations are able to convey the necessary capacity of water downstream.

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Scenario 4
Hillsborough River Overflow at US 98

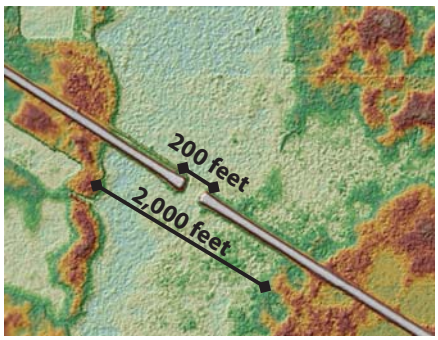
Hillsborough River Overflow

- The vast majority of surface water leaving the Green Swamp flows to the Withlacoochee River because of the area's natural topography.
- The Hillsborough River originates in a wide-forested swamp, just northeast of US 98, where the Withlacoochee turns sharply northward.
- When water levels in the Withlacoochee River rise above the natural elevations of this flat region, flow occurs from the Green Swamp to the Hillsborough River under the US 98 bridge.

Aerial View of the US 98 Bridge Crossing on the Hillsborough River

Scenario Description

- It has been suggested that during high-water conditions, historical flooding along the Withlacoochee River may be the result of a constrictive bridge opening at US 98 and sediment that may have deposited there over time.
- The graphic (right) shows how the footprint of the bridge compresses the 2,000-foot-wide natural flow path into a 200-foot-wide opening at the bridge.
- This scenario evaluated the role of the US 98 bridge opening to pass flow from the Green Swamp to the Hillsborough River and its impact on water levels along the Withlacoochee River.



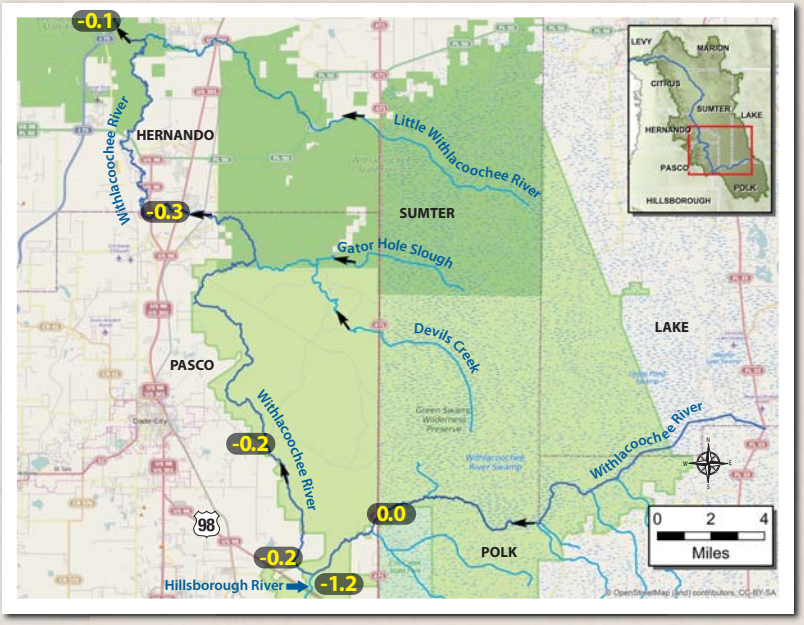
Existing Topography of the Hillsborough River at the US 98 Bridge

Preliminary Results

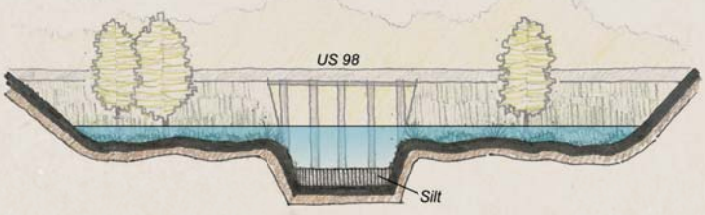
- During the 2004 hurricane season, less than two percent more flow would have diverted to the Hillsborough River.
- Negligible changes to water levels and flow were observed downstream along the Withlacoochee River.

Conclusions

- Removing the footprint of the US 98 bridge increases the potential for greater flow to the Hillsborough River by increasing the area of flow that is currently restricted to the bridge opening.
- Model results show only slightly higher flows since water levels at US 98 are lower in the model as a result of this wider flow path.
- Substantially greater flows would require higher water levels in the floodplain swamps of the Withlacoochee River, where the Hillsborough River originates.
- Results also suggest that the US 98 bridge at the Hillsborough River does not significantly affect water levels and flows along the Withlacoochee River, which appear to be driven by hydrologic conditions and the natural topography of the region.



Peak Water Level Changes (inches) from Simulated US 98 Bridge Removal (2004 Hurricanes)



Comparison of the Current US 98 Bridge Opening to the Natural Flow Path (black line)

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Scenario 5
Bridge Crossings near Trilby and Lacoochee

History of Flooding

- Near the border of Hernando and Pasco counties, the Withlacoochee River passes through the communities of Trilby and Lacoochee as it exits the Green Swamp.
- There is a history of flooding in this area, documented as far back as 1933 and occurring most recently in 2004.

Trilby

SR 575 Bridge

Scenario Description

- Within a three-mile stretch, SR 575, US 301, US 98, and a railroad trestle cross the main channel of the Withlacoochee River.
- It has been suggested that these crossings have constricted the natural flows exiting the Green Swamp impacting flood levels in the area.
- This scenario evaluated the impact that these four bridge crossings have on water levels and flows along the Withlacoochee River.

US 301 Bridge over the Withlacoochee River

Preliminary Results

- There were no changes to river flows upstream within the Green Swamp or downstream along the Withlacoochee River after simulating the removal of these crossings.
- Water levels that rose more than 10 feet during the 2004 Hurricanes would have decreased by one inch or less as a result of removing the footprint of the bridge crossings.

Conclusions

- The model suggests that the existence of the bridge crossings near Trilby and Lacoochee are not a major factor contributing to flooding in the region.
- The Withlacoochee River's natural transition from the expansive wetlands of the Green Swamp into a narrow, high-banked channel in this area is the main reason for the extreme water-level fluctuations.

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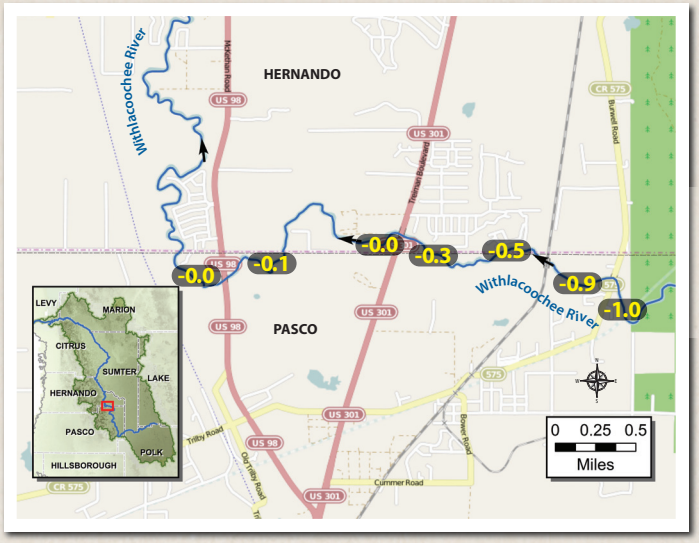
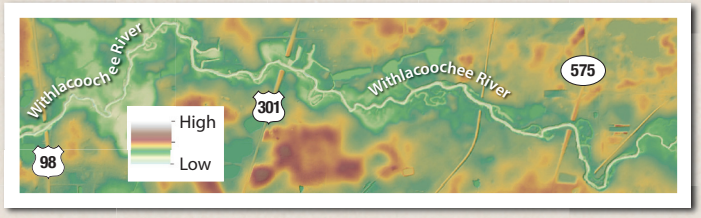


Peak Water Level Changes (inches) from Simulated Bridge Removal (2004 Hurricanes)



Existing Topography with Bridges and Roadway Berms Present

Simulated Topography with Bridges and Roadway Berms Removed

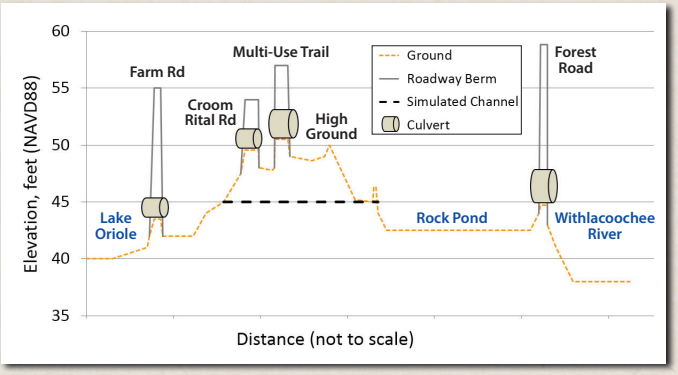
Scenario 6
Lake Oriole

Lake Oriole

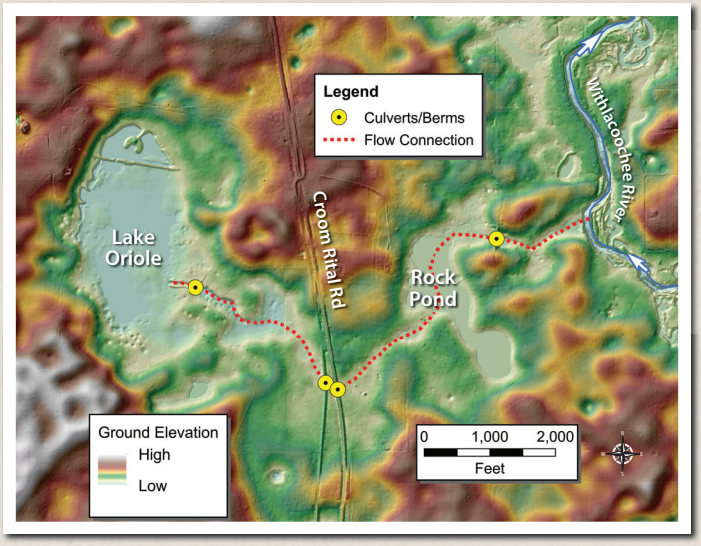
- Lake Oriole is located in Hernando County, north of SR 50 and east of I-75, approximately one mile west of the Withlacoochee River.
- The lake is typically isolated, although during times of high water, a flow connection exists between the lake and the Withlacoochee River.

Scenario Description

- Over the past century, several roadway berms and culverts were constructed between the lake and the river.
- This scenario evaluates the existing flow connection and how changes to the land between the lake and the river would impact opportunities for additional inflow from the Withlacoochee River to Lake Oriole.



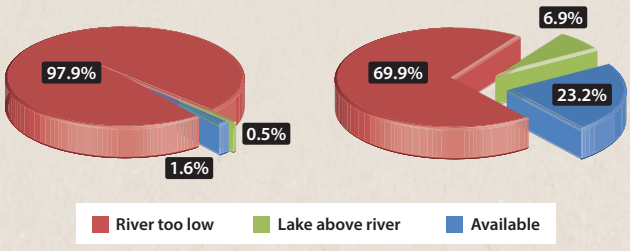
Profile of Ground and Culvert Elevations between Lake Oriole and the Withlacoochee River



Topographic Map showing the Flow Connection between Lake Oriole and the Withlacoochee River

Preliminary Results

- Water levels in Lake Oriole rise and fall in response to rainfall and changing groundwater levels.
- Over the past 75 years, the Withlacoochee River was above elevation 50 feet (NAVD88) and able to flow towards Lake Oriole less than two percent of the time.
- If a channel was constructed through the high ground and the existing culverts were lowered, the Withlacoochee River would be available to flow into Lake Oriole approximately 23 percent of the time.



Historic Availability of River Inflow to Lake Oriole (left side) and Simulated Availability of River Inflow (right side)

Conclusions

- The results of this scenario indicate that natural inflows from the Withlacoochee River to Lake Oriole are rare.
- Water levels in Lake Oriole are a reflection of aquifer levels that rise and fall from changing rainfall conditions.
- Simulating a lower connection resulted in additional days that water would be available to flow from the river to the lake.
- It is anticipated that once river levels cease contributing flow, lake levels would quickly return to regional groundwater levels and not result in sustained water level increases.

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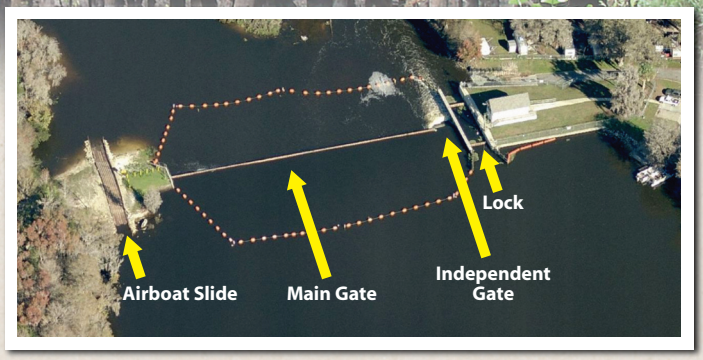
Scenario 7
Wysong-Coogler Water Conservation Structure

Wysong Structure

- The Wysong-Coogler water conservation structure is located within the Withlacoochee River approximately two miles downstream (north) of the Outlet River confluence from Lake Panasoffkee.
- The structure consists of two inflatable gates; a 230-foot-wide main gate and a 19-foot-wide independent gate. A lock system allows boaters to pass through the structure and an airboat slide provides an alternative means for passage.



Aerial View of the Wysong Structure

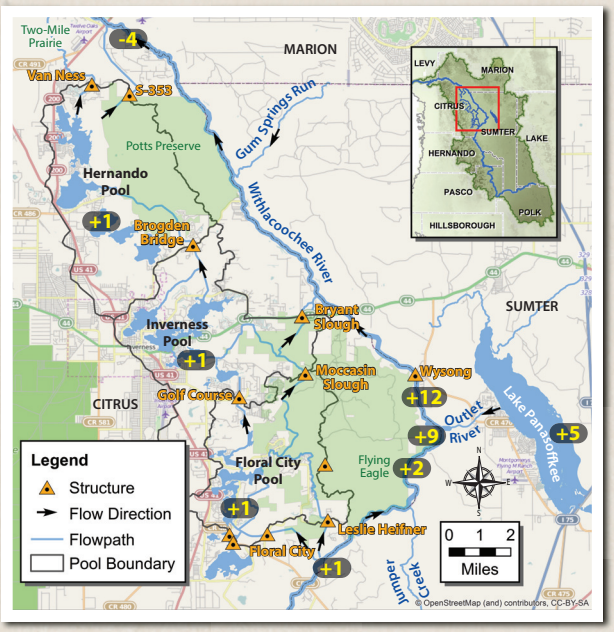
Scenario Description

- The Wysong structure is operated to maintain a target upstream water level while ensuring adequate outflow from Lake Panasoffkee and required flows down the Withlacoochee River.
- The ability of the structure to maintain upstream water levels is limited because of changing rainfall patterns and river flows.
- To evaluate this scenario, the operational range of the structure and the target water level just upstream were both increased by one foot in the model.

Wysong Structure with Main Gate Fully Inflated (Raised)

Preliminary Results

- The greatest differences in water levels were observed directly upstream of the Wysong structure, within the Outlet River and in Lake Panasoffkee.
- Raising the Wysong structure decreased average flows leaving Lake Panasoffkee.
- A water level increase of 12 inches at the Wysong structure translated into a one-inch increase farther upstream along the Withlacoochee River and throughout Tsala Apopka.



Peak Water Level Changes (inches) for the Mean Annual Event.

Conclusions

- The operation of the Wysong structure is limited by water levels and flow in both the Withlacoochee River and the Outlet River.
- Results indicate that increasing the operational range of the Wysong structure an additional foot would cause minimal changes to water levels in the Tsala Apopka Chain-of-Lakes.
- Water-level increases immediately upstream of the Wysong structure are significantly diminished a few miles upstream along the Withlacoochee River.

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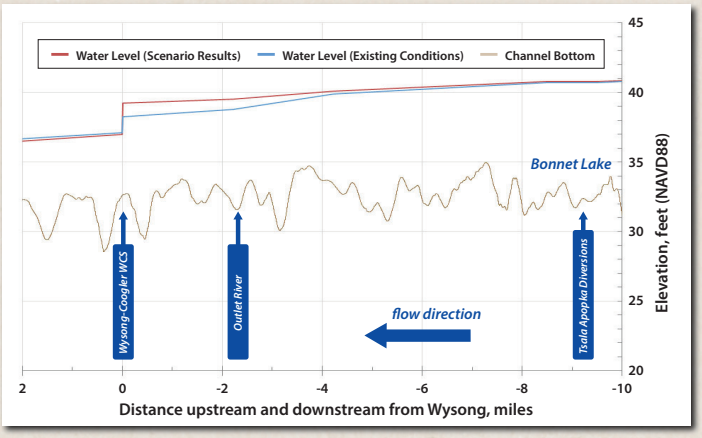


Scenario 8
Flood Storage

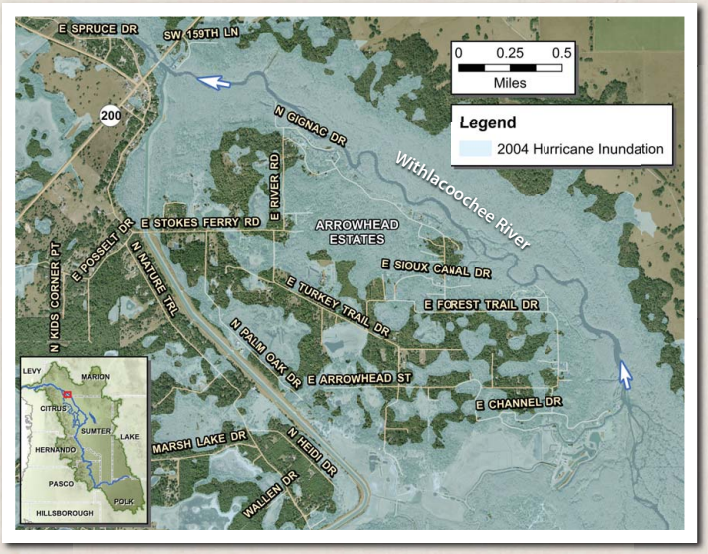
History of Flooding

- Along the border of Citrus and Marion counties, in the vicinity of State Road 200, the Withlacoochee River transitions from a wide, shallow river near Tsala Apopka into a narrow, high-banked channel once again.
- There is a history of flooding in this area both upstream and downstream of the State Road 200 bridge.

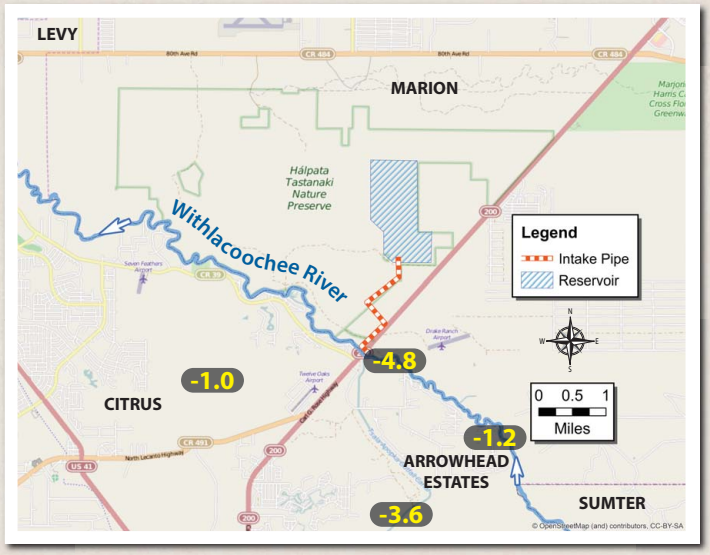

Withlacoochee River at SR 200

Scenario Description

- As part of the Withlacoochee Regional Water Supply Authority's (WRWSA) 2014 Regional Water Supply Plan, locations for potential future water supply are identified.
- A location in Halpata Tastanaki Preserve was proposed, where excess water from the river could be diverted, stored and used as a drinking water source.
- Using the conceptual design and withdrawal rates as specified in the WRWSA 2014 Regional Water Supply Plan, this model scenario simulates whether withdrawals from the river will have the additional benefit of lowering peak flood levels in this region.



Areas flooded by the 2004 Hurricanes near Arrowhead Estates.



Peak Water Level Changes (inches) with Simulated Pumping to Reservoir during the 2004 Hurricanes.

Preliminary Results

- During the 2004 Hurricanes, Withlacoochee River water levels rose nearly 10 feet and peak flow rates were more than 5,000 cubic feet per second (cfs) at the SR 200 bridge.
- Assuming an unlimited reservoir size, the maximum pumping rate, per the 2014 Regional Water Supply Plan, was 265 cfs during the 2004 Hurricanes.
- This would have lowered water levels by five inches at SR 200 and one inch near Arrowhead Estates.

Conclusions

- The simulated reduction in flood levels would require a reservoir capable of storing 29,000 acre-feet of water, similar to the entire Hernando Pool.
- In addition, the pumps would need to be capable of diverting a flow equivalent to one-third the discharge of the Rainbow River.
- Results indicate that if the reservoir and pump requirements could be met, minimal flood relief would be achieved for properties along the Withlacoochee River in this area.

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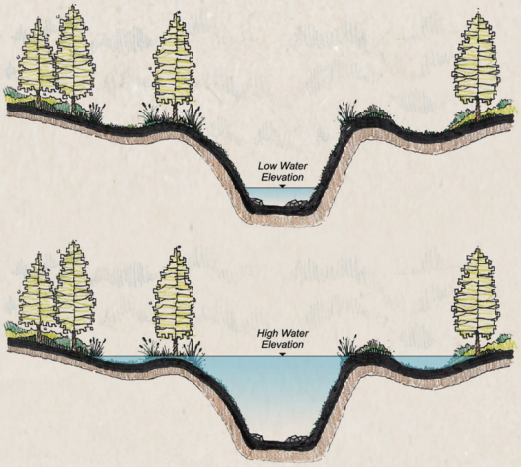
Scenario 9
Withlacoochee River High Initial Water Levels

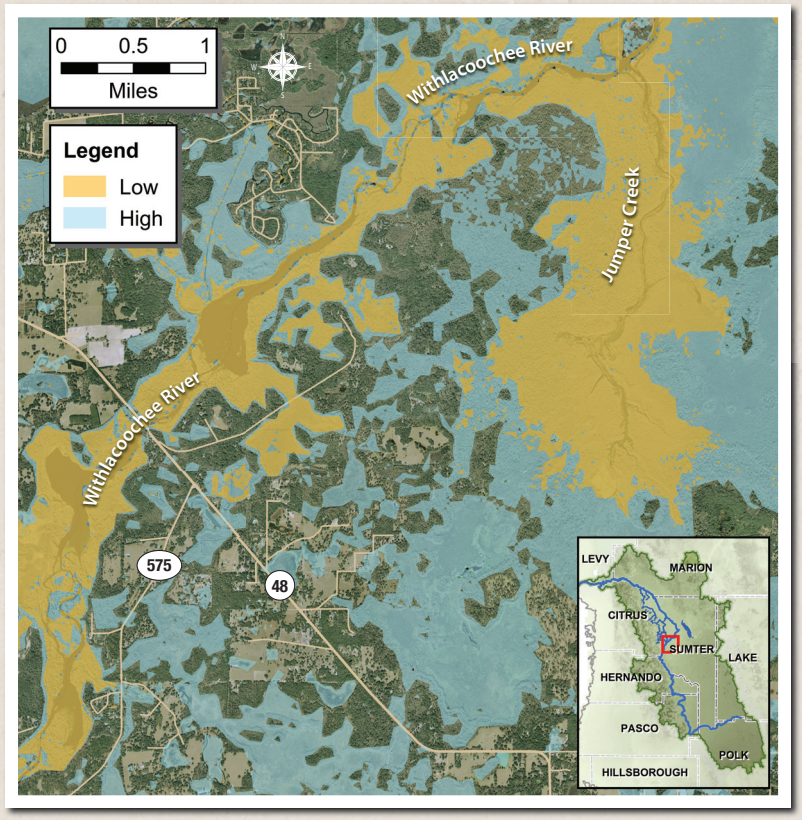
Extreme Fluctuations

- The Withlacoochee River has historically experienced extreme high and low conditions due to natural fluctuations in rainfall and groundwater levels.
- The areas earliest inhabitants named the river "We-thalko-chee," meaning "little-big-water."



Comparison of Low and High Initial Water Levels That Were Simulated for Each of the Design Storms

Comparison of Low-Water (left side) and High-Water (right side) Levels Just Downstream of I-75 Bridge



Comparison of Areas Inundated by Low and High Initial Water Levels

Scenario Description

- The initial, or starting, water levels within the Withlacoochee River watershed have a significant impact on how high river levels and flows will increase following a rainfall event.
- Each design storm event was originally simulated with low to normal initial water levels.
- To match historic flood conditions and to provide an additional basis of comparison for each of the scenarios, the design storms were simulated with higher initial water levels.

Storm Event Simulation	DESIGN EVENTS			
	Mean Annual	10-Year	25-Year	100-Year
Rainfall Amount	6.9 inches	10.8 inches	12.3 inches	16.3 inches

Rainfall Amounts Simulated Over the Entire Watershed

Preliminary Results

- Water levels along the Withlacoochee River rose several feet higher and peaked several days later when simulated with high initial water levels.
- Results of the design storms with high initial water levels more closely matched published gage data along the river.

Conclusions

- Historical flood events along the Withlacoochee River are the result of significant rainfall on an already saturated watershed, rather than a single event with low initial water levels.
- Simulating the design storm events with both low and high initial conditions resulted in a wide range of water levels and flows along the Withlacoochee River and throughout the watershed.
- The results provide an additional basis of comparison for many of the other scenarios simulated by the model.

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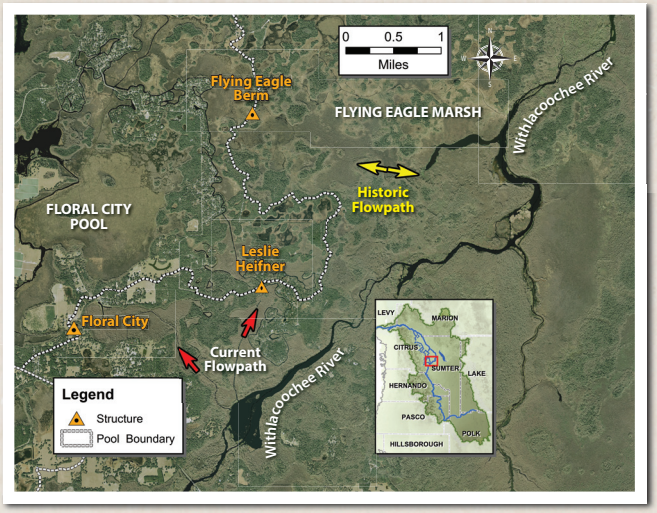
Scenario 10
Tsala Apopka Flying Eagle Berm

Historic vs. Existing Connection

- The Flying Eagle Marsh historically connected the Withlacoochee River with the Tsala Apopka Chain-of-Lakes during high water times.
- The Flying Eagle Berm was constructed in the late 1950s, altering the natural flow connection through the Flying Eagle Marsh.
- Today, inflow from the river occurs several miles upstream of the Flying Eagle Marsh through the Orange State and Leslie Heifner canals.

Scenario Description

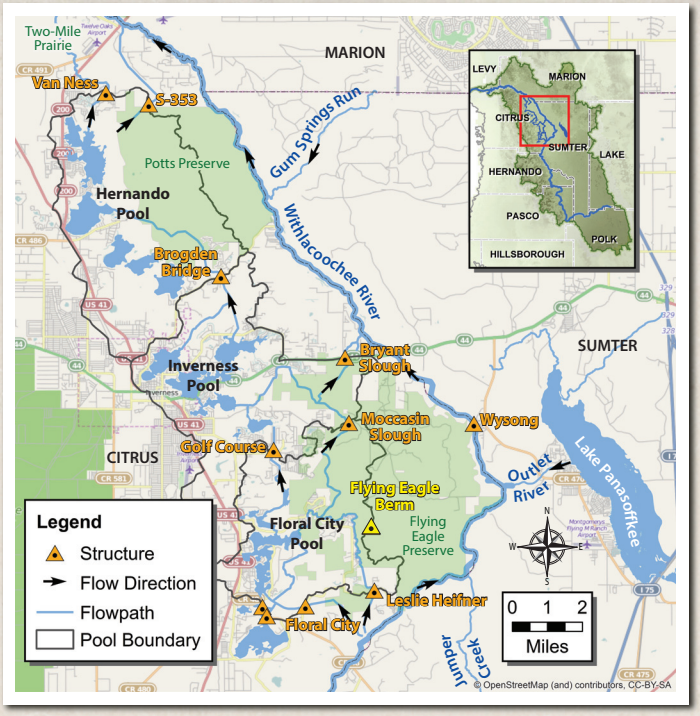
- It has been suggested that restoring the historic flow through the Flying Eagle Marsh will help maintain higher water levels in Tsala Apopka.
- This scenario evaluated the regional impact of removing the Flying Eagle Berm, which includes nearly two miles of filled road segments between several islands in the Flying Eagle Marsh.
- An analysis also was conducted to determine the historical availability of additional river water to enter the Floral City Pool if the berm were removed.



Comparison of Current and Historical Flowpaths between the Withlacoochee River and the Tsala Apopka Chain-of-Lakes

Conclusions

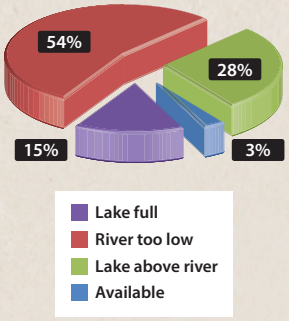
- The results of this scenario suggest that the Flying Eagle Berm serves to conserve water in the Floral City Pool under normal conditions, while providing some level of flood protection during high-water events.
- Results also indicate that the existing canals are more effective at filling the Tsala Apopka Chain-of-Lakes and very few opportunities exist to bring additional river water through the Flying Eagle Marsh.



Flying Eagle and Tsala Apopka Area Map

Preliminary Results

- Overall lower-water levels were observed in Tsala Apopka with the berm removed, as water flowing in through the existing canals flowed back out across the Flying Eagle Marsh.
- During flood events, water levels peaked higher throughout the Tsala Apopka Chain-of-Lakes, as unregulated flow entered through the Flying Eagle Marsh.



Availability of River Water to enter Tsala Apopka through the Flying Eagle Marsh

- Over the past 31 years, desired river water would have been available to flow into the lake three percent of the time (11 days per year on average).
- Water would have flowed back to the river from the lake 52 percent of the time if the Flying Eagle Berm were not in place.

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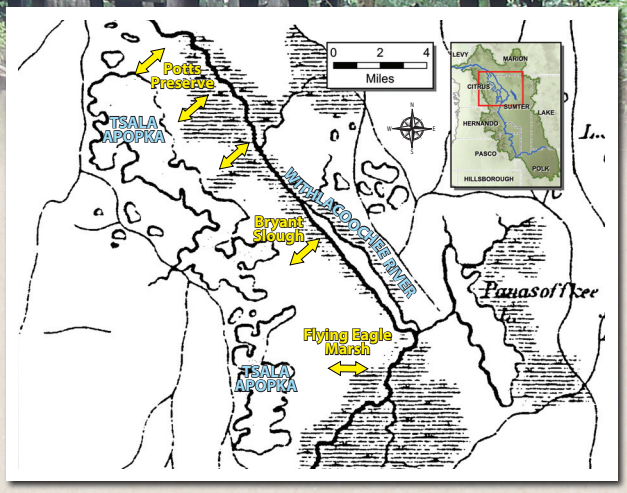
Scenario 11
Tsala Apopka Pre-Settlement Conditions



Pre-Settlement Conditions

- In pre-settlement times, water naturally flowed back and forth between the Tsala Apopka Chain-of-Lakes and the Withlacoochee River through extensive marshlands and forested wetlands that would flood and dry out with changing hydrologic conditions.

Scenario Description

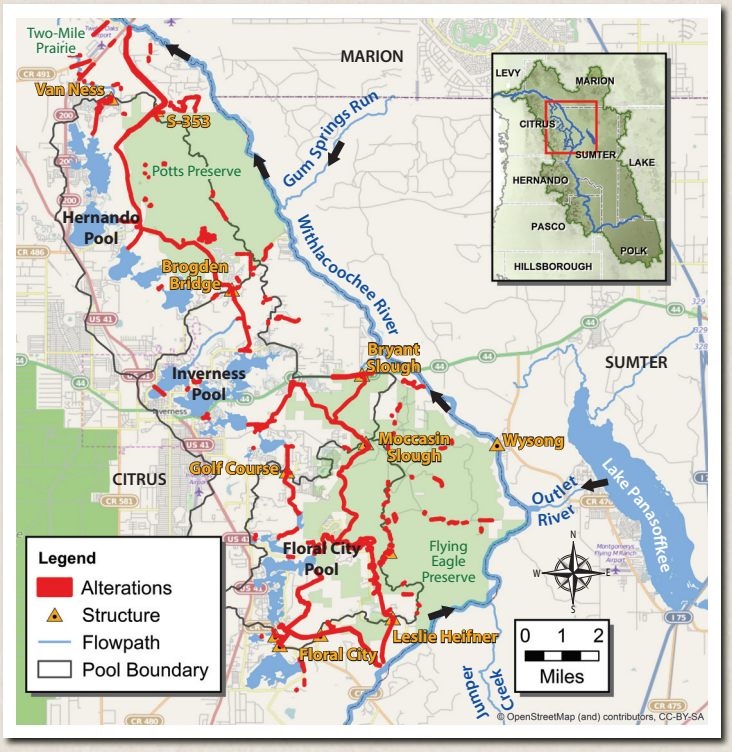
- Since the late 1800s, constructed alterations have transformed this region's natural function into one that benefited navigation, industry and private needs.
- This scenario evaluated how these alterations have changed water levels and flow by simulating pre-settlement conditions throughout the Tsala Apopka Chain-of-Lakes.

Orange State Canal

S-353 Structure

Preliminary Results

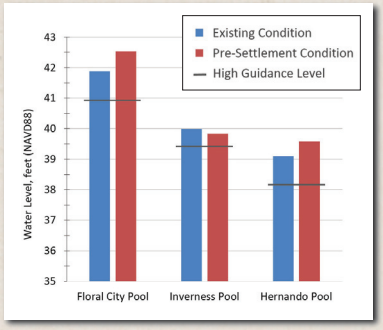
- Water levels were typically lower under pre-settlement conditions but peaked higher due to unregulated flow from the Withlacoochee River.
- During flood events, the natural connection between the Inverness and Hernando pools would allow them to merge into a single pool.
- Without the canals, river levels would be required to rise higher before inflow could occur across the natural marshlands to the Tsala Apopka Chain-of-Lakes.



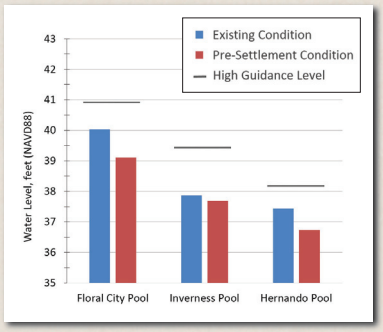
Alterations that were Removed to Simulate Pre-Settlement Conditions

Conclusions

- Model results suggest that without the existing canals, structures and berms, the Tsala Apopka Chain-of-Lakes would not fill as quickly under normal river conditions.
- Water levels in Tsala Apopka, which are currently maintained by the berms and structures, would naturally drain back to the river.
- Under high water conditions, the lakes would receive significant, uncontrolled inflows from the river, causing their levels to peak higher.



Peak Differences during High Water (2004 Hurricanes)



Peak Differences during Low Water (Mean Annual Event)

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Scenario 12
Tsala Apopka and the Orange State Canal

River Inflows

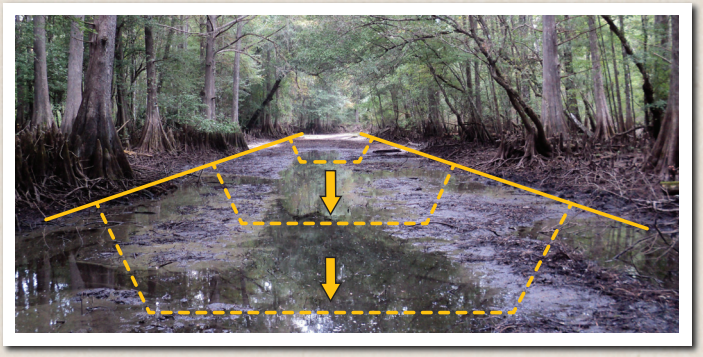
- In pre-settlement times, water naturally flowed back and forth between the Tsala Apopka Chain-of-Lakes and the Withlacoochee River through extensive marshlands that would flood and dry out with changing hydrologic conditions.
- Today, the Leslie Heifner and Orange State canals directly connect the river to the lakes, allowing for more frequent inflow to the lakes at lower elevations than the natural marsh.

Orange State Canal

Leslie Heifner Canal

Scenario Description

- The Leslie Heifner canal is the preferred path to move water into the lakes because of its lower channel bottom and control structure elevations.
- This scenario evaluated how lowering the Orange State canal and Floral City structure to match the Leslie Heifner canal and structure would impact flows from the Withlacoochee River and water levels within the Tsala Apopka Chain-of-Lakes.



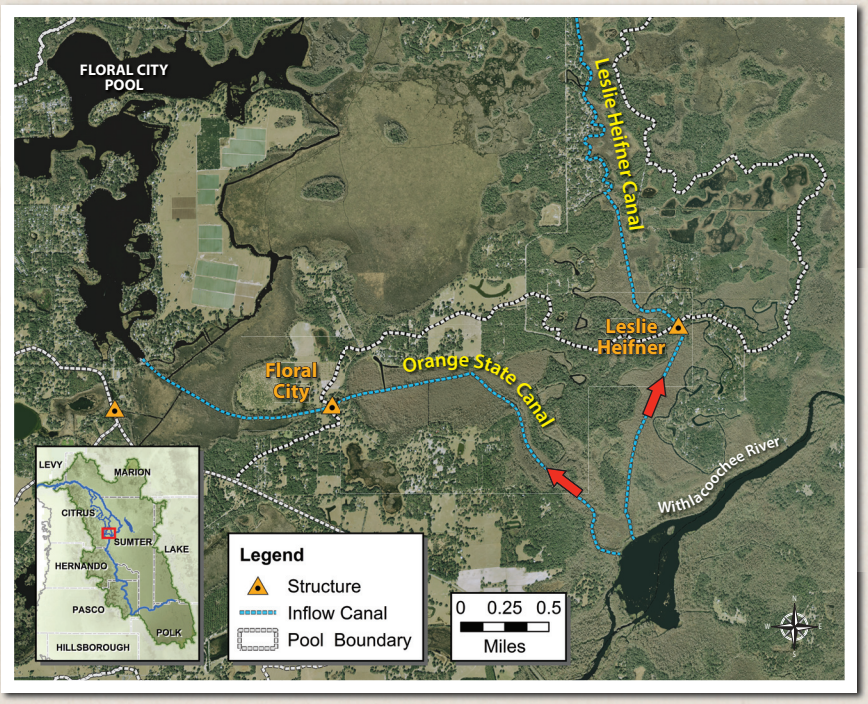
Simulated Lowering of the Orange State Canal

Preliminary Results

- Average inflows from the river to the Floral City Pool increased through the Orange State canal.
- Overall inflows through the Leslie Heifner canal were reduced when the Orange State canal and Floral City structure were lowered.
- Over a 40-day period when river water was available, water levels in the Tsala Apopka Chain-of-Lakes rose by one to two inches.

Conclusions

- The effectiveness of dredging the Orange State Canal and lowering the Floral City structure is cut in half from decreased flows through Leslie Heifner.
- In the past 60 years, the Withlacoochee River was available to flow into Tsala Apopka through the Orange State canal 28 percent of the time and through the Leslie Heifner canal 31 percent of the time.



Historical Availability of River Inflow

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Scenario 13
Tsala Apopka Structure Sizes

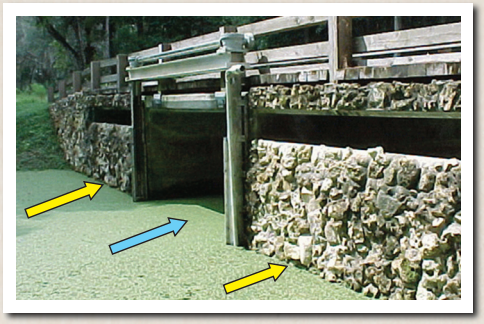
Tsala Apopka Chain-of-Lakes: Inflows and Outflows

- Water enters the Tsala Apopka Chain-of-Lakes from direct rainfall, runoff from adjacent higher ground, and diversions from the Withlacoochee River that are split between each pool.
- Outflows include evapotranspiration of water back to the atmosphere, natural leakage downward into the underlying Floridan aquifer system, and diversions back to the Withlacoochee River or to Two-Mile Prairie.

Scenario Description

- The most significant flow constriction in Tsala Apopka is the movement of water between the Floral City Pool and the Inverness Pool.
- To evaluate this scenario, structure openings were increased in the model for the Golf Course and Moccasin Slough structures.

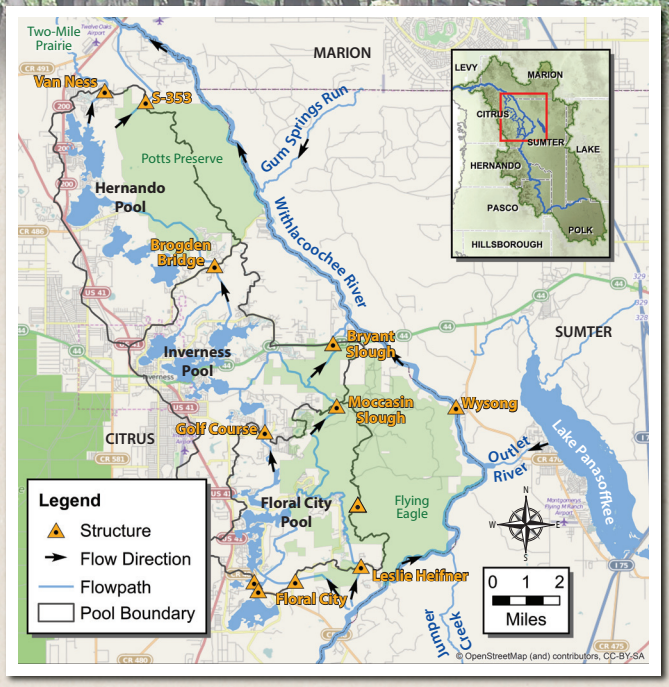
Golf Course Structure with Simulated Lower Gate Opening



Moccasin Slough Structure with Simulated Wider Gate Opening

Conclusions

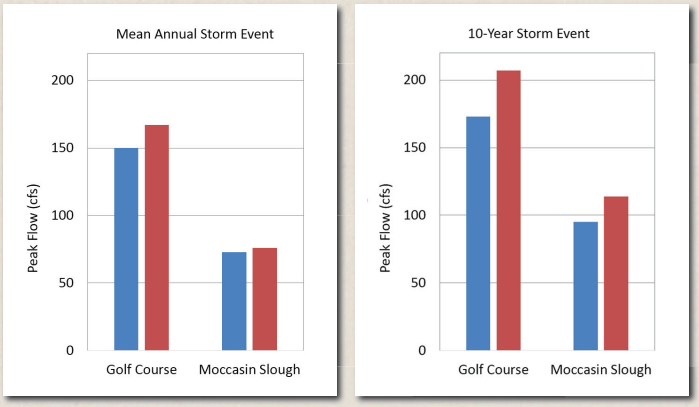
- Flow between the Floral City Pool and Inverness Pool was historically limited to the natural elevations of Moccasin Slough.
- Several decades ago the Golf Course Canal was built through high ground to enhance this movement of water.
- Model results indicate that modifying the structures increased flows into the Inverness Pool; however, that increase is limited by the conveyance potential of the Golf Course Canal and Moccasin Slough.



Flowpaths, Structures and Pools within the Tsala Apopka Chain-of-Lakes

Preliminary Results

- Overall, the total volume of water in Tsala Apopka increased by approximately one percent during the mean annual storm event.
- This resulted in Floral City Pool water levels that were 1.4 inches lower and Inverness and Hernando Pool water levels that were 1.5 and 1.2 inches higher, respectively.
- Even after modifying the structures, the Inverness Pool filled slower than the Floral City and Inverness pools.
- Increased flows were observed through the Golf Course and Moccasin Slough structures as a result of larger openings.



Comparison of Peak Flows From Existing and Modified Structure Openings

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Scenario 14
Tsala Apopka Structure Operations

Water Control Structures

- More than a dozen water control structures exist throughout the Tsala Apopka Chain-of-Lakes.
- The majority of these structures were constructed in the 1950s and 1960s and were originally operated by the Tsala Apopka Basin Recreation and Water Conservation Control Authority.

Brogden Bridge Structure

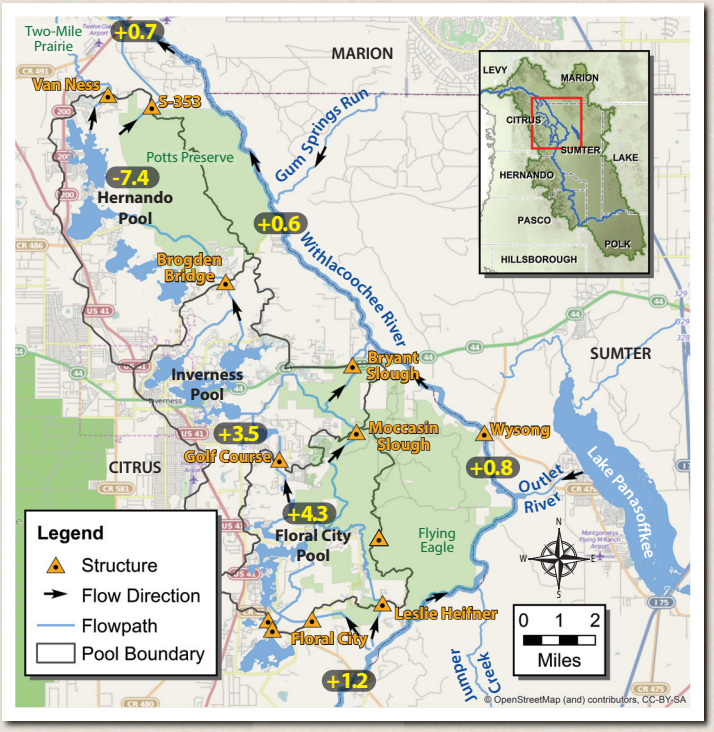
- By the early 1970s, the Southwest Florida Water Management District (District) assumed management responsibility of many of the existing Tsala Apopka structures.

Scenario Description

- Throughout history, these structures have been managed in an attempt to balance two competing activities — recreation and flood protection.
- Concerns regarding both high and low water levels in the Tsala Apopka Chain-of-Lakes have persisted for many decades.
- This scenario compared the current District guideline of sharing river inflow equally with all three pools to the previous guideline of filling each upstream pool first.

Low Water in Inverness Pool

High Water in Hernando Pool



Average Water Level Changes (inches) from Filling Upstream Pools First During the Mean Annual Event

Preliminary Results

- Filling the upstream pools first resulted in a 25 percent decrease in flow volume entering the Tsala Apopka Chain-of-Lakes during the mean annual storm event and an 11 percent decrease during the 10-year storm event.
- Withlacoochee River flows at the Wysong structure increased by approximately three percent during the mean annual storm event, because of less flow diversion into Tsala Apopka.
- On average, higher water levels were observed in the Floral City and Inverness pools while lower water levels were observed in the Hernando Pool as a result of filling the upstream pools first.

Conclusions

- Operating the Tsala Apopka structures to fill upstream pools first would raise water levels in the Floral City and Inverness pools for the events simulated.
- Water levels in the Hernando Pool would remain lower; however, with little or no opportunity to receive river inflows.
- Model results indicate that the current guideline of sharing river inflows between all three pools increases the overall volume of water entering the Tsala Apopka Chain-of-Lakes from the Withlacoochee River.

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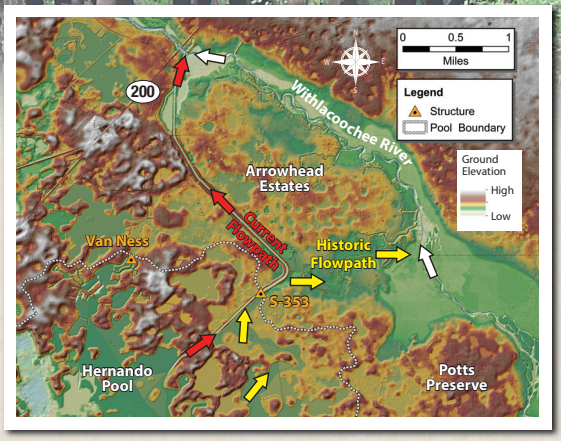
Scenario 15
Tsala Apopka Outflows and Arrowhead Estates

Tsala Apopka Outflow

- Historically, high water in the Hernando Pool flowed to the Withlacoochee River through low marshlands just north of present-day Potts Preserve.
- Major flooding in 1960 led to the modification of this natural outflow and the creation of the S-353 structure and C-331 canal, which were completed by the U.S. Army Corps of Engineers in 1968.
- Berms were also constructed to channel flood waters from the Hernando Pool to the Withlacoochee River just upstream of SR 200.



Historic and Current Outflow From the Hernando Pool to the Withlacoochee River

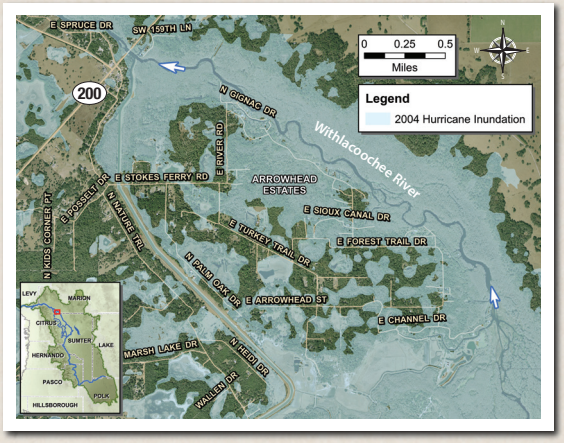
Scenario Description

- The Arrowhead Estates community has a long history of flooding during high-water events, including the 2004 Hurricanes.
- This has led to concerns regarding how the release of water from the Tsala Apopka Chain-of-Lakes may affect flood levels in Arrowhead Estates.
- To address these concerns, this scenario evaluated the effects of not releasing water through S-353 during high-water events.

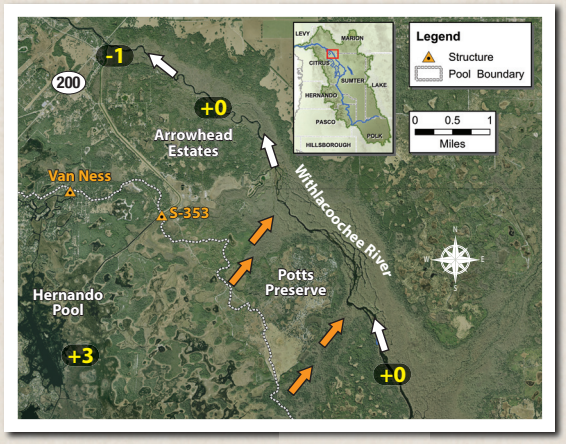
High Water in the Hernando Pool Prompted Outflow Through the S-353 Structure in 2014 and 2015

Preliminary Results

- Model results showed that during the 2004 Hurricanes, water levels in the Hernando Pool would have risen three inches higher as a result of keeping the S-353 structure closed.
- This resulted in greater flows through the natural wetlands of Potts Preserve back to the Withlacoochee River, which is upstream of Arrowhead Estates.
- No changes to water levels were observed in Arrowhead Estates as a result of closing S-353 during the 2004 Hurricanes.
- Keeping the S-353 structure closed in 2004 would have lowered flows on the Withlacoochee River at SR 200 by three percent during the 35 days the structure was open.
- For the larger simulated storm events, water levels at Arrowhead Estates would peak slightly higher if the S-353 structure remained closed.



Areas Flooded by the 2004 Hurricanes Near Arrowhead Estates



Peak Water Level Changes (inches) With S-353 Structure Closed During the 2004 Hurricanes

Conclusions

- Model results suggest that keeping the S-353 structure closed during a high-water event will not reduce flood levels in Arrowhead Estates.
- Past flooding near Arrowhead Estates is the result of high-water conditions along the Withlacoochee River rather than releases from the Hernando Pool through the S-353 structure, which are minimal compared to river flows.

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Scenario 16
Green Swamp Rock Formations

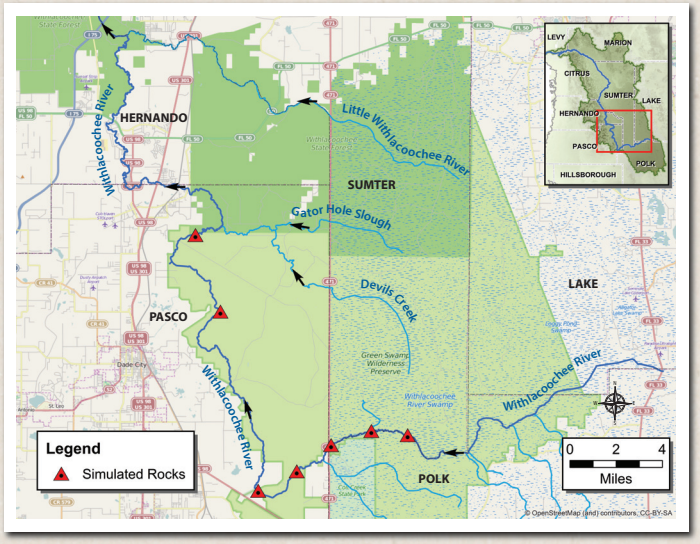
Rock Outcroppings

- The interaction of groundwater and surface water is evident by numerous limestone outcroppings that exist at or near land surface in the vicinity of the Green Swamp.

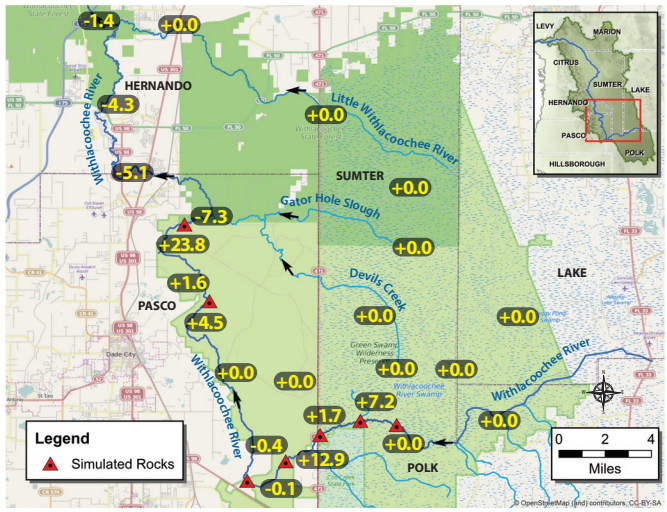
Scenario Description

- Concerns relating to low-water levels in the Green Swamp have emerged from claims that critical rock outcroppings within the Withlacoochee River were removed decades ago.
- To evaluate this scenario, the existing river channel was adjusted in the model to simulate the addition of rocks at seven locations where rocks were reported to have been removed or altered in some way.

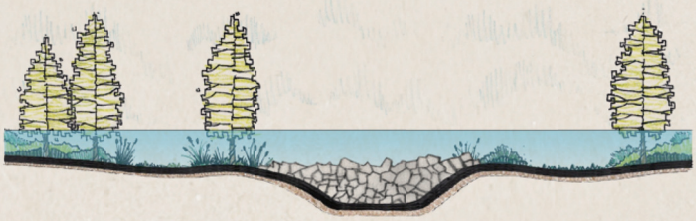
Example of Rocks Added to the Main Channel of the Withlacoochee in the Green Swamp



Locations of Simulated Rocks



Average Water Level Changes (inches) for the Mean Annual Storm Event



Comparison of River Channel With and Without the Addition of Rocks

Preliminary Results

- Water level increases were observed immediately upstream of the simulated rocks for the smallest simulated storm.
- These differences were confined to the channel and did not translate far upstream.
- No changes were observed throughout the Green Swamp.
- Water level decreases were observed downstream of the simulated rocks.

Conclusions

- The model results indicate that adding rocks to the main channel of the Withlacoochee River would have little effect on regional water levels within the Green Swamp.
- The graphic (left) demonstrates how the obstructed flow area created by the rocks is relatively small compared to the overall flow area in the swamplands adjacent to the main channel.

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Scenario 17
Rocks near Jumper Creek

Description

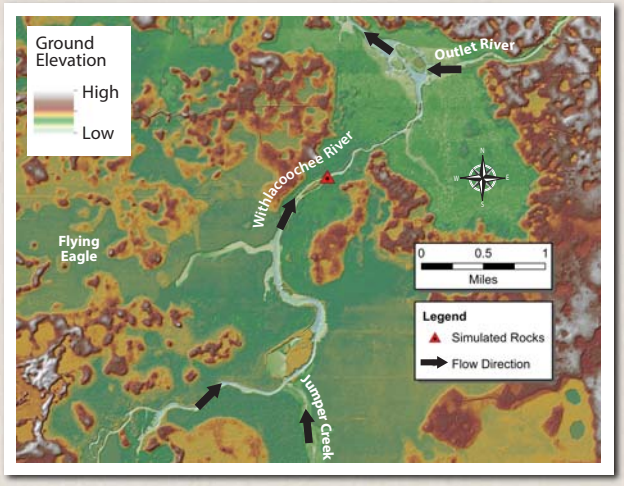
- The Withlacoochee River forms the border of Citrus and Sumter counties as it passes the Tsala Apopka Chain-of-Lakes to the west and several tributaries to the east including the Outlet River from Lake Panasoffkee and Jumper Creek.
- This portion of the river is characterized by a relatively shallow channel, hundreds of feet wide, with a floodplain that extends more than a mile wide in some areas.

Typical View Along the Withlacoochee River Near Tsala Apopka and Lake Panasoffkee

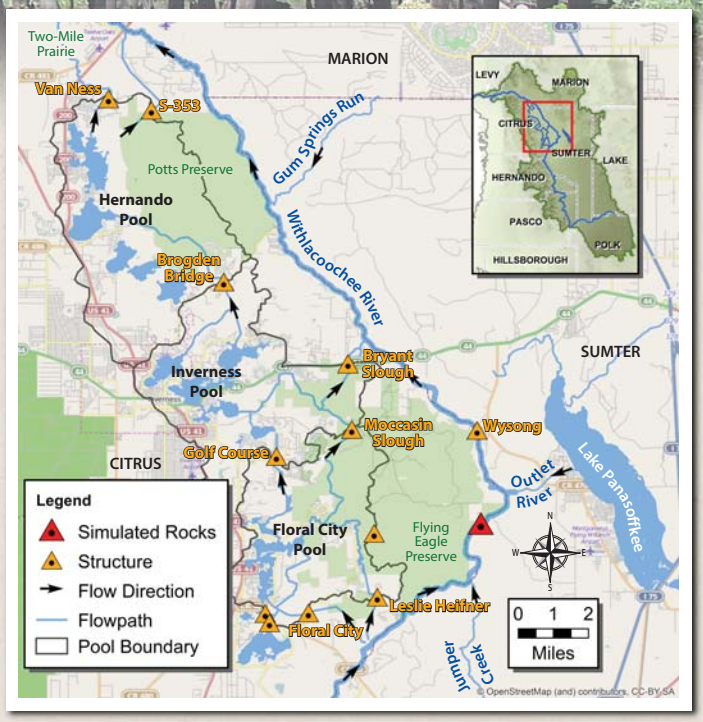
Scenario Description

- Two miles downstream of Jumper Creek, the floodplain of the Withlacoochee River narrows to approximately one-quarter mile wide with a 180-foot-wide main channel as it passes between high ground on either side.
- It has been suggested that rocks at this location were removed potentially lowering water levels upstream.
- This scenario evaluated the effects of adding rocks to the main channel of the Withlacoochee River at this location.

Withlacoochee River Near the Location of the Simulated Rocks (2007)



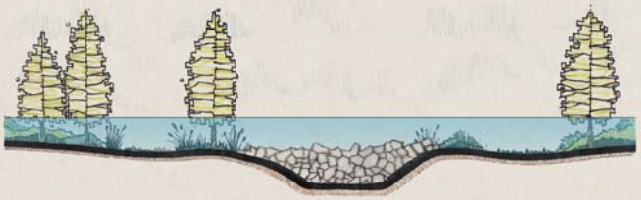
Topography of the Withlacoochee River Between Jumper Creek and the Outlet River



Location of Simulated Rocks Between Jumper Creek and the Outlet River

Preliminary Results

- The simulated storm event with the greatest difference in water levels, as a result of adding rocks to the main channel, was the mean annual event with low initial water conditions.
- Water levels increased by less than one inch on the Withlacoochee River at Jumper Creek and less than one-quarter inch in the Floral City Pool during this event.
- Under high-water conditions there are almost no changes to water levels or flow.



Conclusions

- Model results indicate that adding rocks to the main channel of the Withlacoochee River near Jumper Creek would cause minimal changes to water levels and river flows.
- The area of flow obstructed by the rocks is relatively small (180-feet-wide), as compared to several feet of water flowing over the entire 1,500-foot (quarter-mile) width of the river and adjacent wetlands.

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Scenario 18 and 19
Flows to the Lower Withlacoochee

Alterations

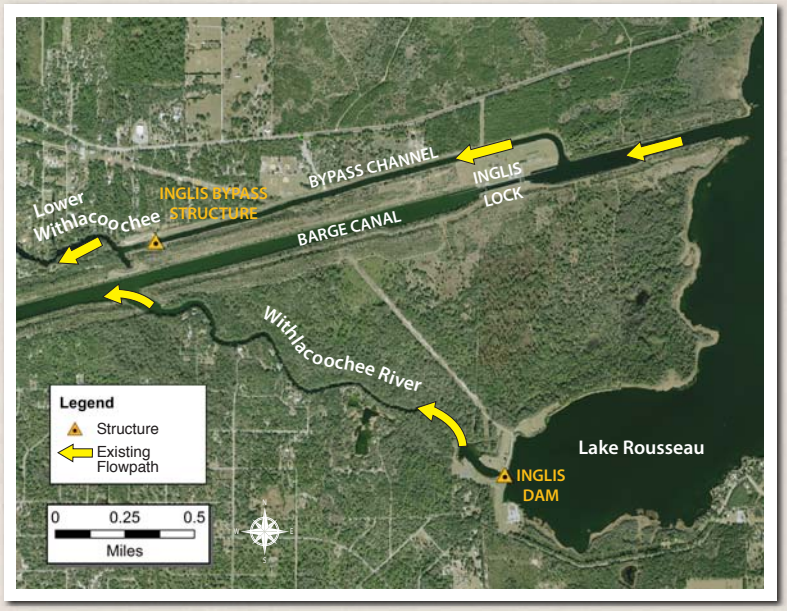
- In 1909, Lake Rousseau was formed by the construction of a spillway and lock structure to support navigation and commerce.
- In the 1960s, the Cross Florida Barge Canal severed the Lower Withlacoochee River, requiring the construction of a bypass channel and an additional structure to ensure downstream flows.
- Today, the Inglis Bypass structure, which is located at the end of the Bypass Channel, passes normal flows downstream to the Lower Withlacoochee River while the Inglis Dam conveys excess flows to the Barge Canal.

Original Spillway and Lock Structure

Inglis Bypass Structure

Scenario Description

- The flow capacity of the Inglis Bypass structure is limited by water levels that decrease along the Bypass Channel's 8,000 foot length.
- These scenarios evaluated alternatives to provide additional flow to the Lower Withlacoochee through the existing Inglis Bypass structure.
- Scenario 18 simulated a wider Bypass Channel while Scenario 19 simulated a modified flow path from Lake Rousseau through the Barge Canal.



Preliminary Results

- When Lake Rousseau is at its target water level of 26.4 feet (NAVD88) the Inglis Bypass structure allows approximately 1,400 cubic feet per second (cfs) of water downstream to the Lower Withlacoochee River.
- Water levels immediately upstream of the Inglis Bypass structure are typically four inches lower than water levels in Lake Rousseau.
- Doubling the width of the Bypass Channel in Scenario 18 increased water levels on the upstream side of the Inglis Bypass structure by two inches and increased flows through the structure by five percent.
- Using the Barge Canal to convey water to the upstream side of the Inglis Bypass structure in Scenario 19 eliminated the water level difference between the lake and the structure and increased flows through the structure by nine percent.

	Water Level Difference (inches)	Flow to Lower Withlacoochee (cfs)	Flow Increase
Existing Conditions	4.2	1,400	–
Scenario 18 (Bypass Channel widening)	2.2	1,466	5 percent
Scenario 19 (Barge Canal connection)	0.0	1,532	9 percent

Comparison of Water Level and Flow Differences for Scenarios 18 and 19

Conclusions

- Model results suggest that modifying the existing flow path by increasing water levels at the Inglis Bypass structure would increase flows to the Lower Withlacoochee River under certain conditions.
- These increases would occur when Lake Rousseau is at its target water level, the Withlacoochee River is experiencing above average flow, and the current configuration of the Bypass Channel is unable to pass additional flow downstream.
- No increases in flows to the Lower Withlacoochee would be expected under normal or low flow conditions with the simulated modifications.

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