Upper Myakka Lake Weir Restoration Feasibility Study

Myakka River Management Coordinating Council Public Meeting,
September 18, 2020

Presenters

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Project Sponsors

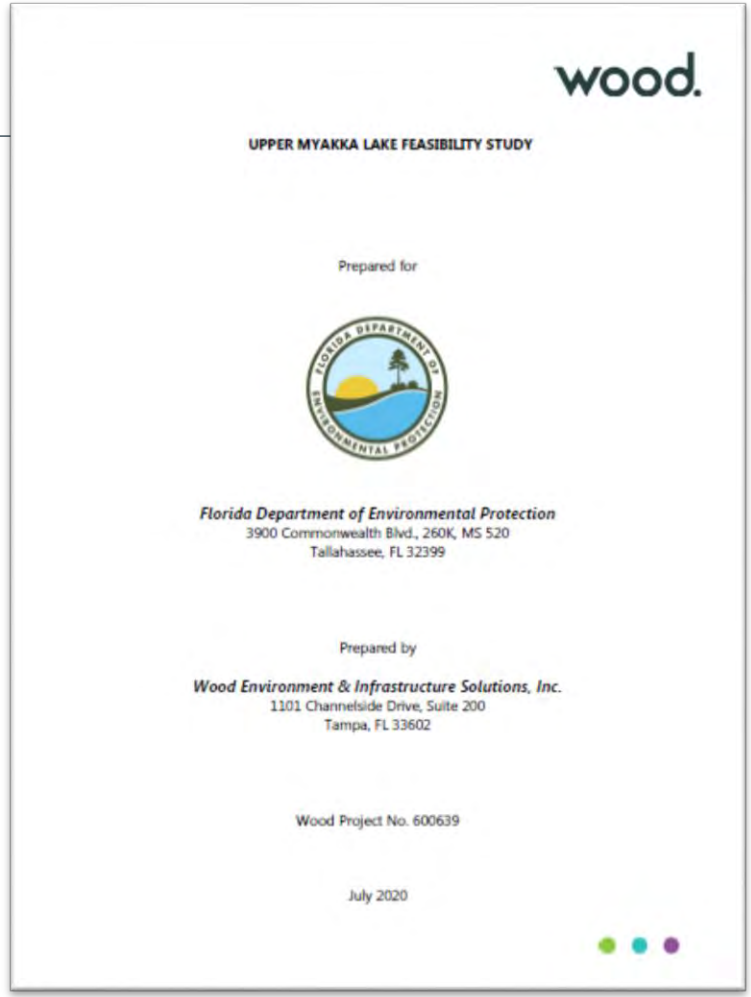
Florida Department of Environmental Protection – FDEP

Southwest Florida Water Management District – SWFWMD

Cooperative funding partner (CFI matching funds)

Study Components

- Project Objective
- Background Information
- Data Collection and Analysis
- Modeling
- Alternatives Analysis
- Summary & Conclusions



wood.

UPPER MYAKKA LAKE FEASIBILITY STUDY

Prepared for

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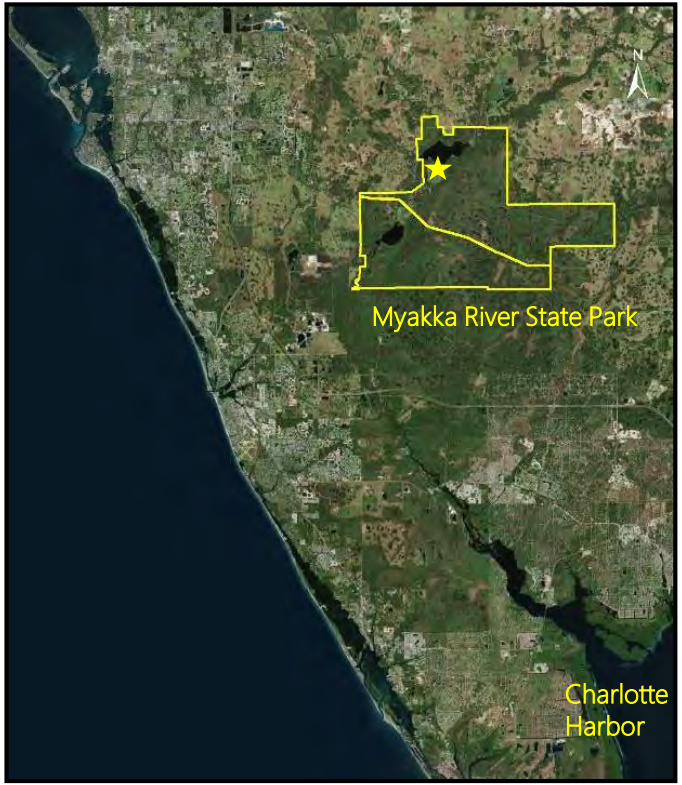
Project Objective

- Feasibility study to explore three alternatives, with the objectives of restoring natural systems and improving water quality in the Myakka River
  - Alt 1: Removing the low water control structure
  - Alt 2: Amending the low water control structure
  - Alt 3: Rebuilding the low water control structure

Background Information

- Location
- Project Site
- Weir & Bypass
- Current Conditions

Location


N
Myakka River State Park
Charlotte
Harbor


Upper Myakka Lake

Project Site

- Low-water control structure located at lake outlet
- Constructed to hold water back during the dry season

Weir

- 1937 plans show proposed hydrologic modifications
- Constructed in 1938/39
- Lack of drawdown caused unintended consequences

Bypass

- 1974 bypass built to improve negative effects of the weir
- Only marginally successful

1974 construction

Late 1970s drawdown after bypass construction, with pumping

Current Conditions

- Weir degraded
- Rusted culverts
- May 2016 “blow-out”

No Action Alternative

- Bypass would continue to erode
  - Loss of park property
  - Increased sedimentation downstream
- Structure will continue to degrade and reduce intended function
- Rusted culverts and dilapidating dam present unsafe condition to humans and wildlife
- Unusable viewing deck
- Addressing issues here is part of MRSP's Unit Management Plan

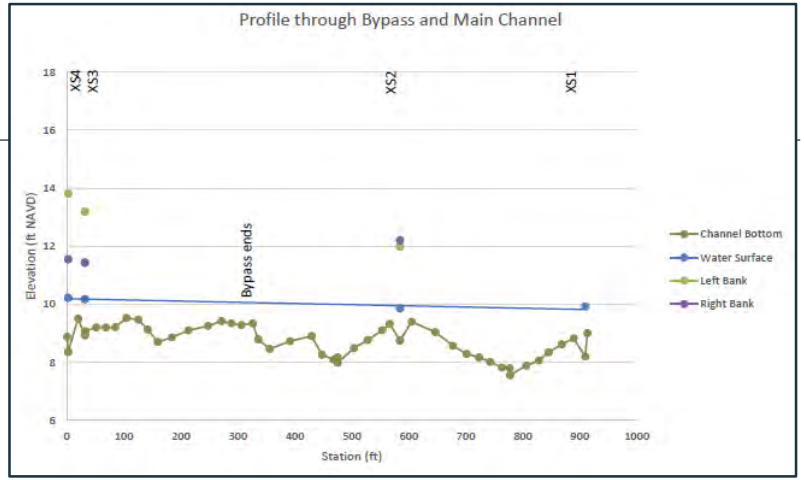
→ No action is <u>not</u> a viable alternative

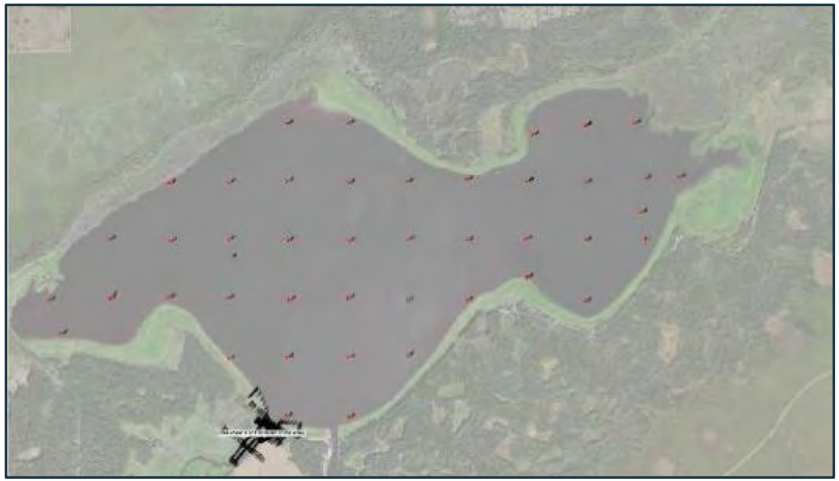
Data Collection

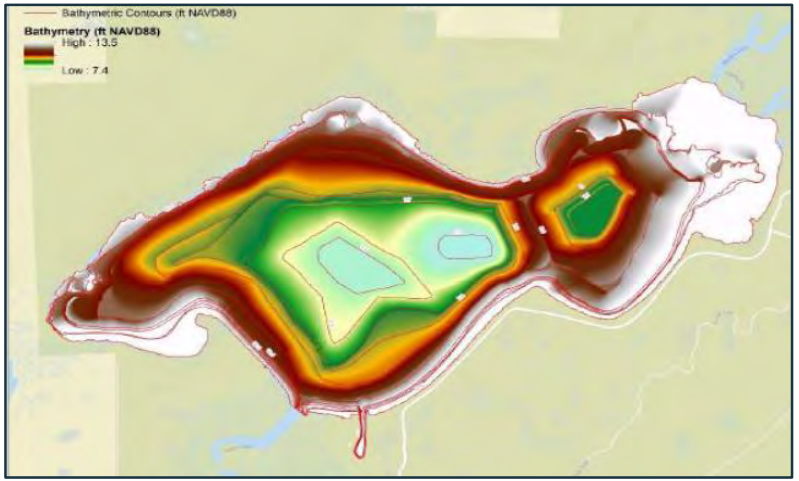
- Survey
- Water Levels
- Sediment
- Water Quality
- Vegetation & Wildlife

Survey

- Lake/river survey
  - Bathymetry
  - Sediment thickness
  - Profile and cross sections
- Bridges

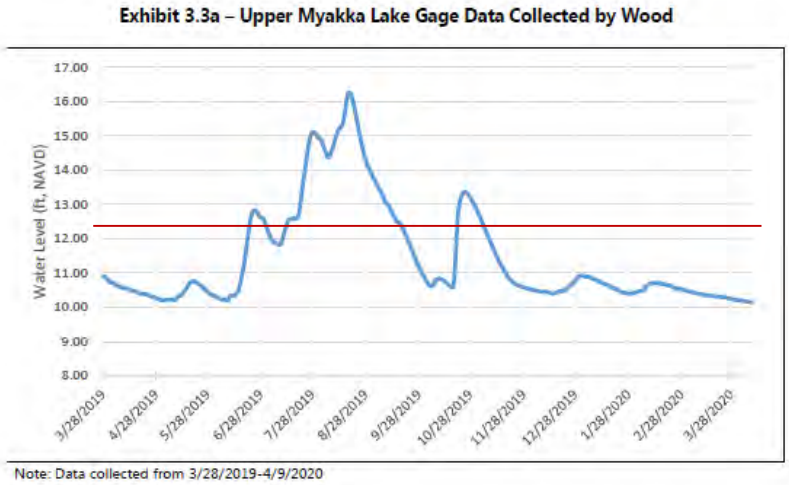






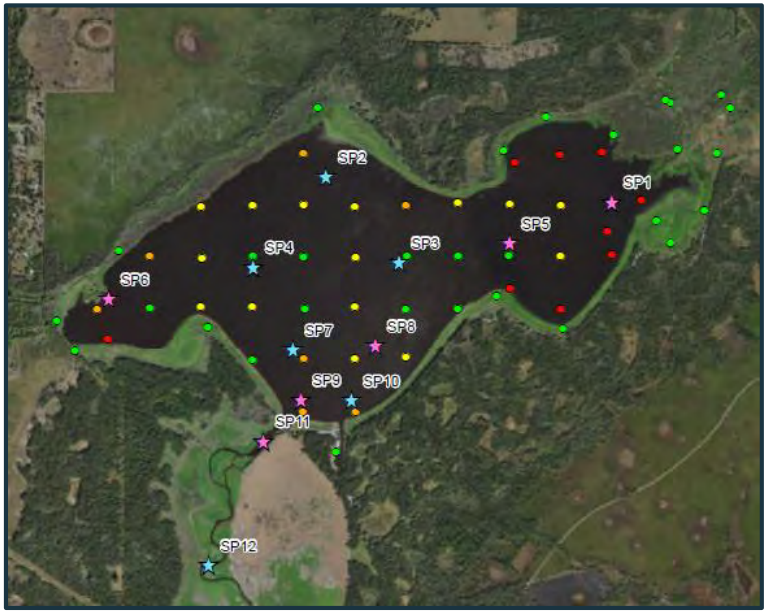
Water Levels

- Reviewed available hydrologic data
- Installed continuously-recording logger in Lake
- Monitored lake levels for one year



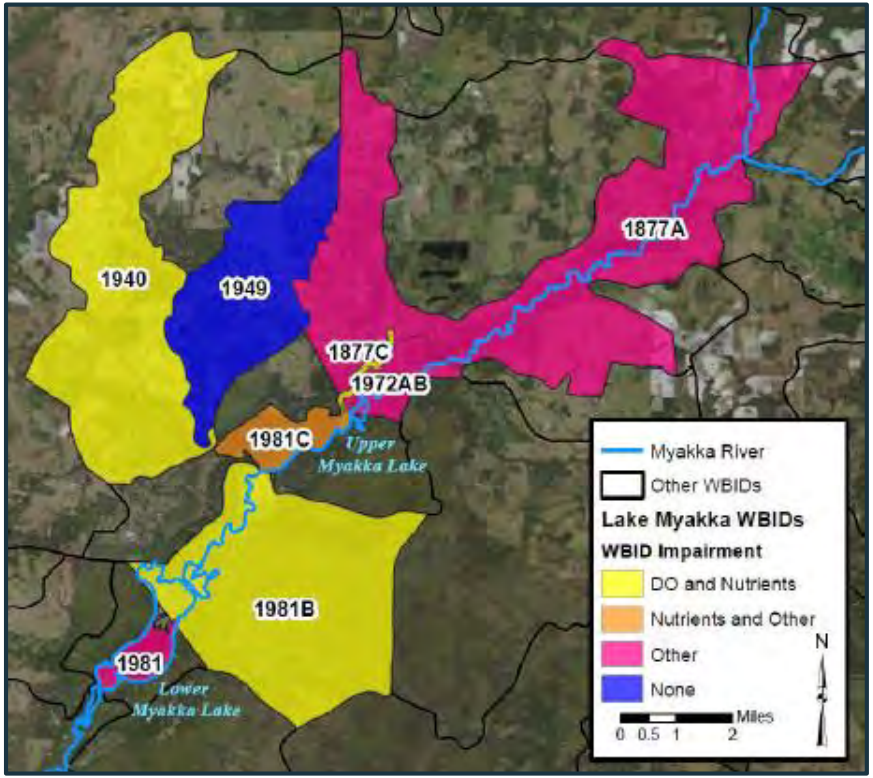
Sediment

- Sediment cores collected at 12 locations
  - 10 in the lake
  - 2 in the river
- Sediment Characteristics
  - Mostly sandy sediments
  - Higher levels of nutrients, metals, and TOC in lake sediments (but lower than typical urban lakes)
- Phosphorus Fractionation
  - Low bio-available phosphorus (BAP)
  - Low opportunity for nutrient release or resuspension (not likely to impact downstream waters)



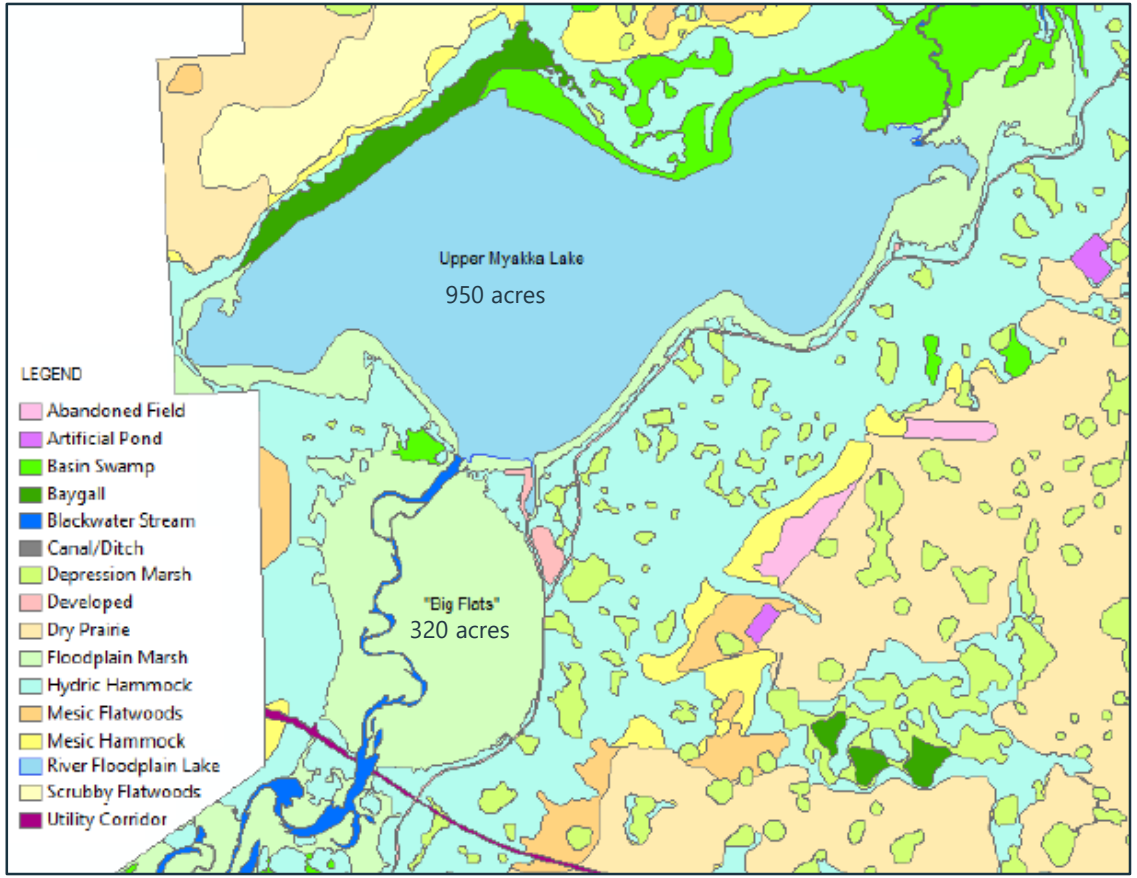
Water Quality

- Identified existing water quality impairments
- UML is impaired for nutrients, but concentrations have been decreasing in recent years



Vegetation & Wildlife

- Ecological Communities
- Invasive Plants and Fish
- Manatee stranding



Modeling

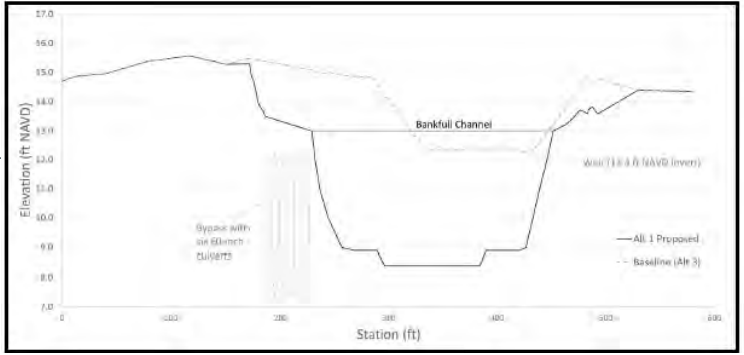
- Three Alternatives
- Event Modeling
- Continuous Modeling

Alternatives

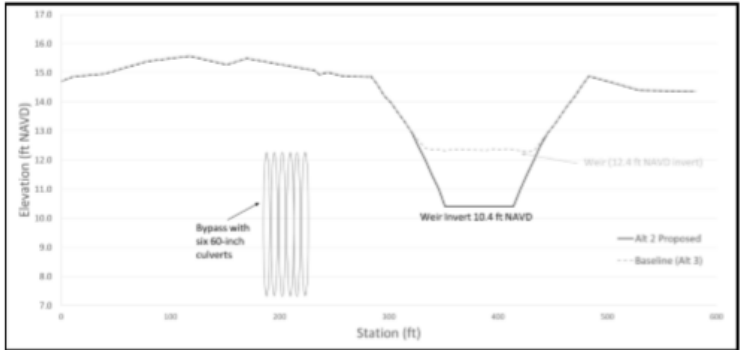
- Three alternatives:
  - Alt 1: Removing the low water control structure and re-wilding the UML outfall
  - Alt 2: Amending the low water control structure to lower the weir invert by 2 ft to elevation 10.41 ft NAVD88
  - Alt 3: Rebuilding the low water control structure to its historical state prior to the recent failures, including the bypass and pipes

Alternatives

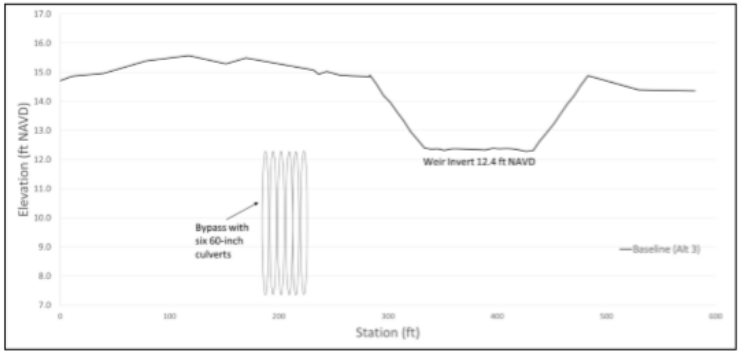
Alt. 1 - Removal



Alt. 2 - Modification

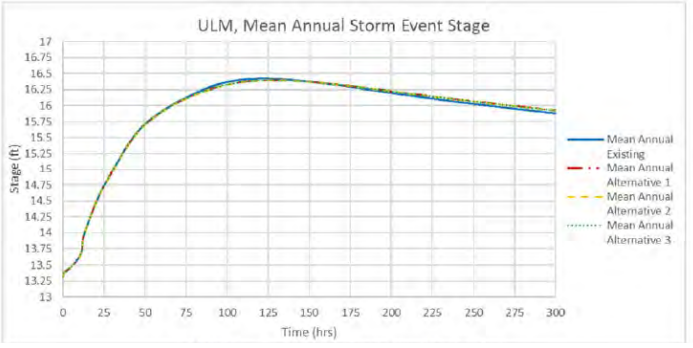


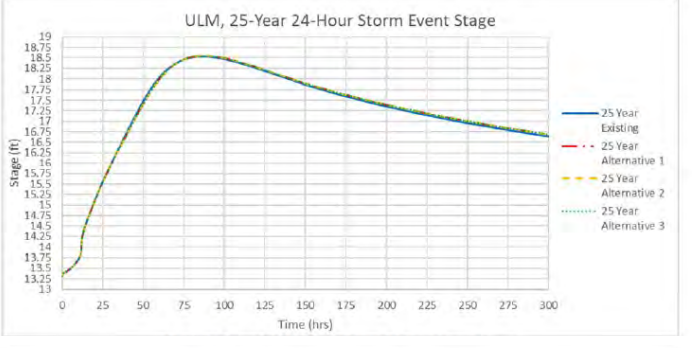
Alt. 3 - Rebuild

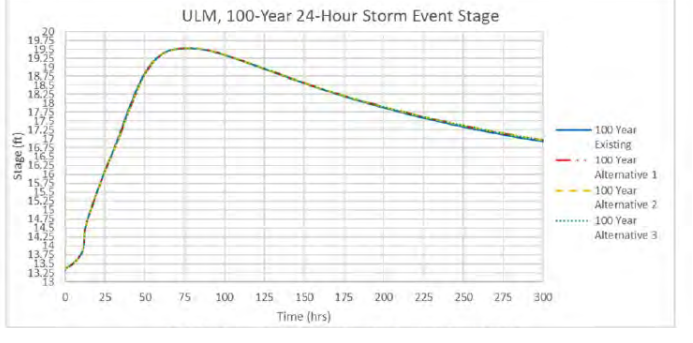


Event Modeling

- Objective: to assess flooding impacts
- Myakka River Watershed Initiative (MRWI) model
- Used ICPR4 Software to model
  - 2.33-year (mean annual) 24-hour
  - 25-year 24 hour
  - 100-year 24 hour
- No adverse impacts for any of the three alternatives





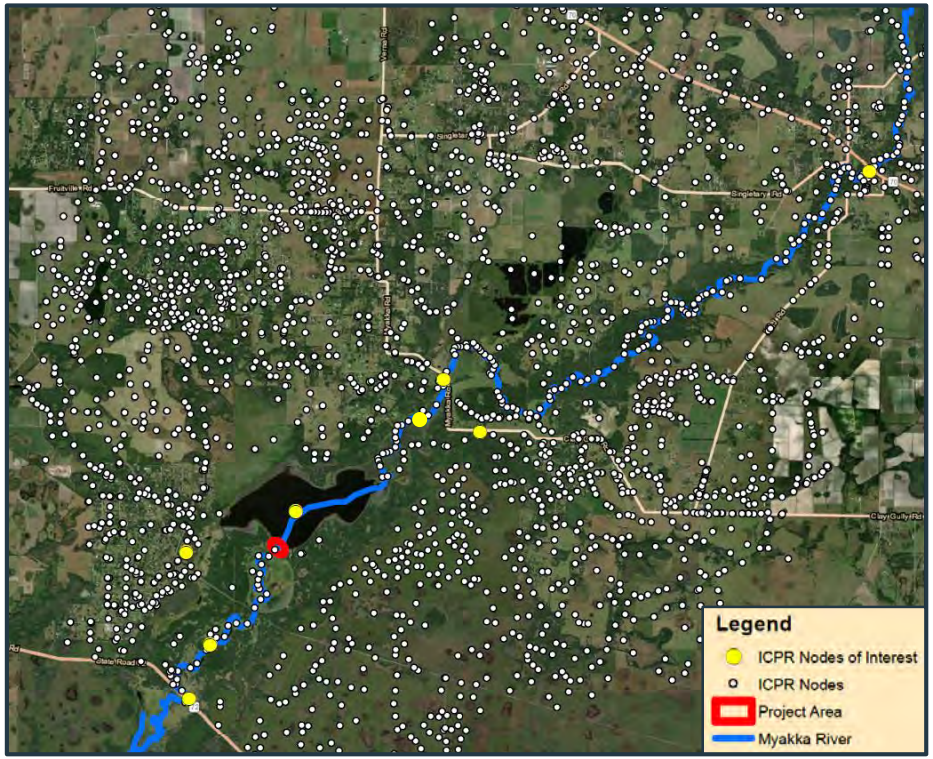


Event Modeling

- No adverse off-site impacts

Differences in Peak Flood Elevations from Alt 3/Baseline Conditions (ft)

Location	Alt 1 (Removal)			Alt 2 (Modification)		
	Mean Annual	25-Yr, 24-Hr	100-Yr, 24-Hr.	Mean Annual	25-Yr, 24-Hr.	100-Yr, 24-Hr
State Road 70 Bridge	0.0	0.0	0.0	0.0	0.0	0.0
Myakka Road Bridge	0.0	0.0	0.0	0.0	0.0	0.0
Clay Gully Road Bridge	0.0	0.0	0.0	0.0	0.0	0.0
Hidden River	0.0	0.0	0.0	0.0	0.0	0.0
Upper Lake Myakka	0.0	0.0	0.0	0.0	0.0	0.0
Vanderpipe Slough	0.0	0.0	0.0	0.0	0.0	0.0
Myakka State Park Road Bridge	0.0	0.0	0.0	0.0	0.0	0.0
State Road 72 Bridge	0.0	0.0	0.0	0.0	0.0	0.0

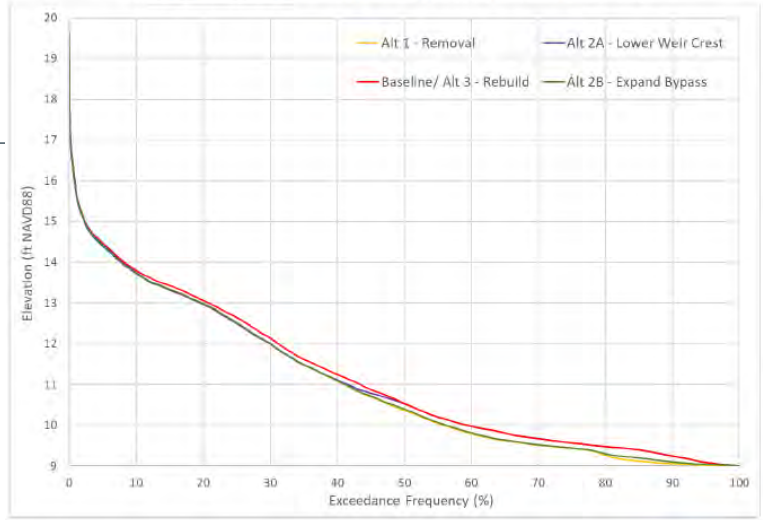


ICPR Model Nodes of Interest (locations listed in table). No increases at nodes.

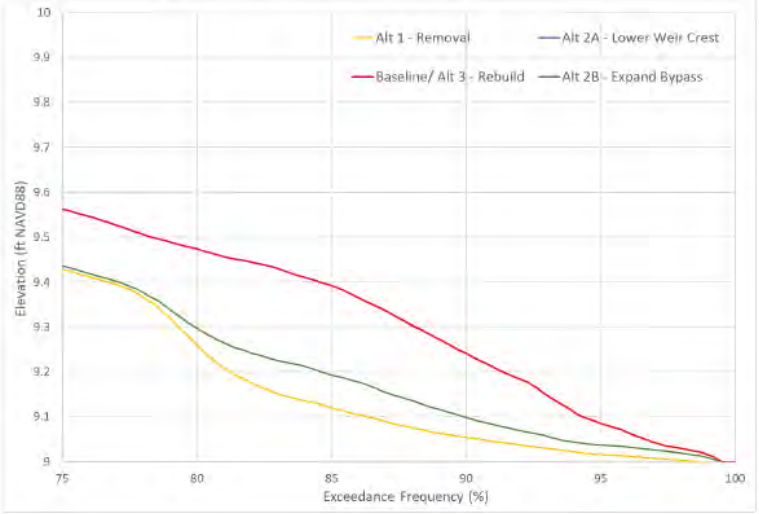
Continuous Modeling

- Objective: to further assess restoration and management benefits between alternatives
- Used MIKE SHE integrated surface and groundwater model to simulate 16 years
- Alt. 1 removal showed greatest benefits:
  - Seasonal low water level in UML would reduce by 0.3 ft from the baseline condition
  - ~70 acres of additional land would be exposed during seasonal low water level conditions

Water Level Exceedance Frequency



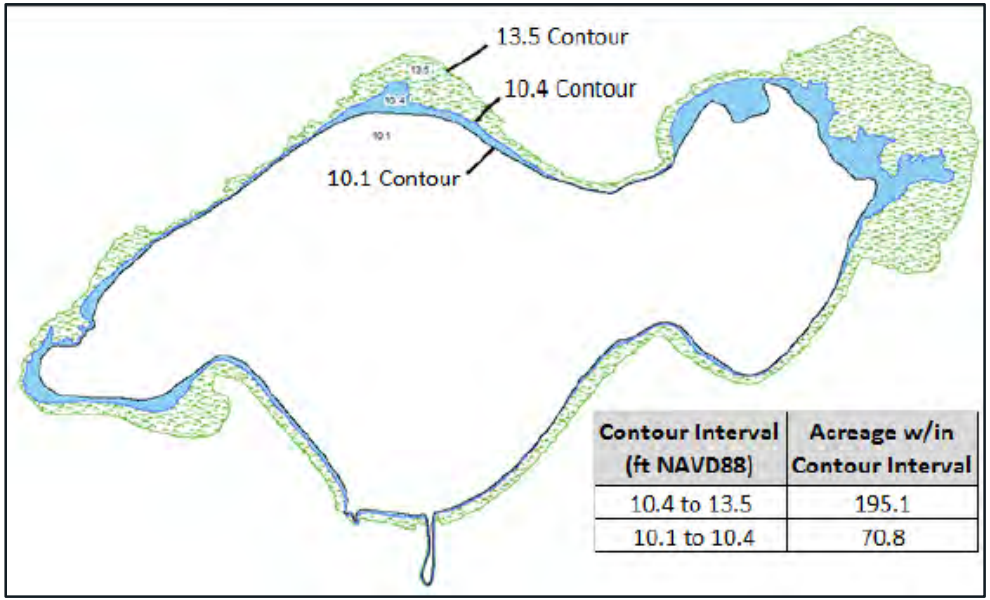
75-100% Exceedance Frequency WL



Continuous Modeling

- The additional exposed land restores wetlands
- Additional wetland habitat improves water quality
- Aids management activities
  - Breach has created real-life preview

Additional Exposed Lakebed Acreage Resulting from 0.3 ft Lowering of Seasonal Low Water in UML



Contour Interval (ft NAVD88)	Acreage w/in Contour Interval
10.4 to 13.5	195.1
10.1 to 10.4	70.8

Lake Dynamics

- Lake will not drain if remove weir
- Downstream controlling shoal crest at 9.4 ft NAVD
- Acts as natural control structure for the lake (typical in-line lake transition for Florida)
- Controlling shoal crest seldom right at lake boundary – typically formed and sustained some distance downstream

Downstream Controlling Shoal Crest Exposed During Dry Season
(Image Source: Google Earth, 4/2006)

Alternatives Analysis

- Parameters Assessed
- Feasibility and Comparison

Parameters Assessed

- Water Quantity
- Natural Systems
- Sediment
- Water Quality
- Environmental Considerations
- Fish and Wildlife Passage
- Recreation
- Permitting
- Costs

Parameter	Alternative 1 - Removal	Alternative 2 - Modification	Alternative 3 - Rebuild
Water Quantity	Restores more natural flow regime. No adverse offsite flooding impacts.	Detains water during dry season; no wet season flow impacts. No adverse offsite flooding impacts.	Detains water during dry season; no wet season flow impacts. No adverse offsite flooding impacts.
Natural Systems	Restores ~70 acres of floodplain marsh	Inundates historically floodplain marsh areas.	Inundates historically floodplain marsh areas.
Sediment	Reduces accumulation of organic material. Restores sediment transport regime.	Artificially increases sedimentation in the lake by holding back water.	Artificially increased sedimentation in lake by holding back water.
Water Quality	Restored wetlands improve nutrient load removal and algal suppression.	Artificially increases residence time/nutrient retention within the lake. Possibly converts lake from a sink to source of nutrients downstream.	Artificially increases residence time/nutrient retention within the lake. Possibly converts lake from a sink to source of nutrients downstream.
Environmental Considerations	Greater drawdown aids weed control programs, habitat restoration, and fire program. Reduces biomass of exotic species.	Detaining water during dry season hinders park maintenance activities (weed control and burning).	Detaining water during dry season hinders park maintenance activities (weed control and burning)
Fish/Wildlife Passage	Removes barrier/hazard to the upstream migration of manatees and fish.	Reduces barrier/hazard to manatee and fish passage.	Maintains barrier/hazard to manatee and fish passage.
Recreation	May change wildlife viewing opportunities. Removes barrier/hazard to paddlers. Lower dry reason levels may reduce tour boat operating days.	Reduces barrier/hazard to paddlers.	Maintains barrier/hazard to paddlers.
Permitting	Federal (USACE) – Nationwide Permit 27 (habitat restoration) State/Local (SWFWMD) – Individual Permit	Federal (USACE) - may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities). May require a Standard Permit. State (SWFWMD) - Individual Permit.	Federal (USACE) – may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities). May require a Standard Permit. State (SWFWMD) – Individual Permit.
Cost Estimate	Total Estimate: $637,916 (O&M not required). Potential funding available from FWS and FWC (restoration project).	Total Estimate: $1,070,888 (O&M required)	Total Estimate: $1,078,944 (O&M required)

Ranking

Ranking Factor	Alternative 1 - Removal	Alternative 2 - Modification	Alternative 3 - Rebuild
Adverse offsite impacts (flooding)	0	0	0
Restores/improves wetland habitat	1	0	0
Restores sediment balance	1	0	-1
Improves water quality	1	0	0
Improves fire and nuisance species activities	1	0	0
Improves fish/wildlife passage	1	1	0
Improves recreation	0	1	0
Reduces maintenance costs	1	0	0
Regulatory requirement/ease of permitting			
Local/State	0	0	1
Federal	1	0	1
Total	**7**	**2**	**1**

Summary of Removal Benefits

- Restoration of flows and timing
- Restore natural systems
- Aid management activities (fire and exotic programs)
- Improve fish and manatee passage

Next Steps

- Final design/permitting in late 2020-21
- 2021-22 implementation (construction/restoration)

Questions?

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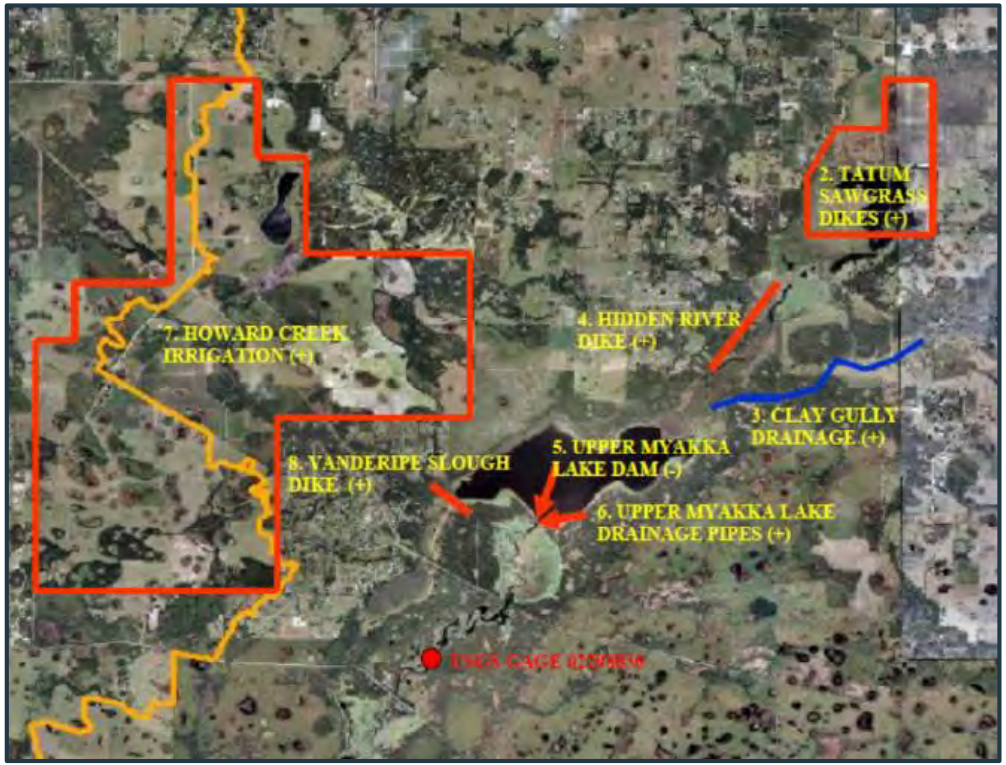
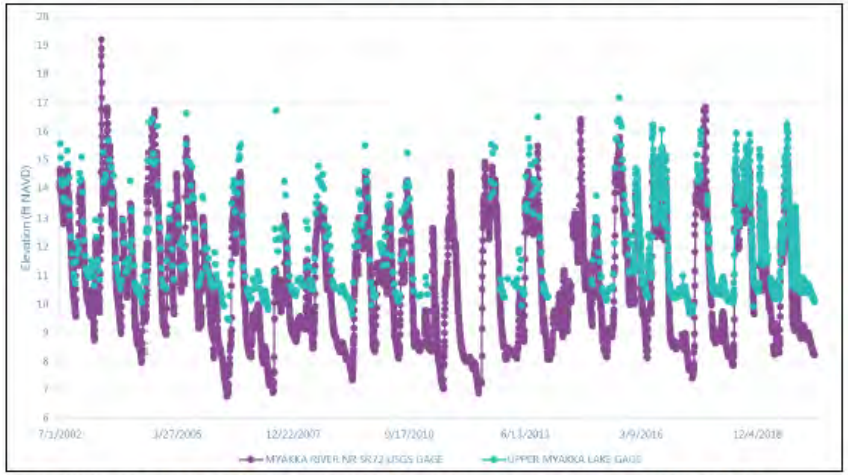
Additional Information: Hydrologic Alterations in Myakka Area

- Tatum Sawgrass Dikes (1974)
- Clay Gulley Drainage (1900)
- Hidden River Dike (1958)
- Upper Myakka Lake Weir (1938)
- Upper Myakka Lake Bypass (1974)
- Howard Creek Irrigation (1990)
- Vanderipe Slough Dike (1940)



Additional Information - Hydrology

Exhibit 3.3b – Upper Myakka Lake Gage vs USGS Gage



Note: USGS gage monitors the Myakka River near SR72. Data shown for period from July 2002 to April 2020.

Period of Record	n	Min Stage (ft NAVD)	Max Stage (ft NAVD)	Avg Stage (ft NAVD)	Seasonal High – P15 (ft NAVD)	Median Stage - P50 (ft NAVD)	Seasonal Low - P85 (ft NAVD)	Avg. No. of Readings per Year
1/1/2003 to 12/31/2019	1813	9.5	17.2	11.9	14.1	11.1	10.4	107

Additional Information - Sediment

Table 3.5 – Summary of Sediment Physical Characterization Results

Location	# of Samples	Passing 200 Sieve (%)	Percent Moisture (%)	Dry Weight (%)	Volatile Solids (%)	Bulk Density (g/cc)
Lake	10	2.6	45	60.5	3.73	0.94
		(1-5.6)	(26-97)	(44-74.9)	(1.5-6.3)	(0.6-1.2)
River	2	2.9	43	77.4	1.35	1.4
		(2.6-3.2)	(25-61)	(74.3-80.3)	(1.35-1.35)	(1.3-1.5)

Note: Singular value is the mean value of the data, and values within parentheses are the range.

Table 3.6 – Summary of Sediment Chemical Characterization Results

Location	# of Samples	Aluminum (mg/kg)	Calcium (mg/kg)	Iron (mg/kg)	Ammonia (N) (mg/kg)	Nitrate + Nitrite (mg/kg)	Total Kjeldahl Nitrogen (mg/kg)	Total Phoshorus (mg/kg)	Total Sulfur (%)	Total Organic Carbon (mg/kg dry)
Lake	10	3,765 (240-24,000)	2,942 (300-19,000)	3,770 (180-26,000)	3.75 (0.84-20.74)	22.51 (6.2-150)	2,944 (540-13,000)	149.1 (30-250)	0.23 (0.03-0.49)	18,603 (7,660-33,400)
River	2	845 (590-1,100)	755 (730-780)	550 (500-600)	8.42 (0.84-16)	9.5 (7-12)	440 (200-680)	82 (37-127)	0.40 (0.02-0.06)	4,570 (3,030-6,110)

Note: Singular value is the mean value of the data, and values within parentheses are the range.

Table 3.7 – Summary of Operational Sediment P Fractions Based on Sequential P-Extraction Procedures (Modified from: Meis et al. 2012)

P fraction	P from in fraction	Driver of BAP release from sediments	Likelihood of BAP release to water column	Mean P Fractionation Within the Lake* (mg/kg)	P Fractionation Within the River (mg/kg)
Labile P	Directly bioavailable; loosely bound or adsorbed P	Desorption; diffusion; steep concentration gradients	High	9.5 (1.9-18)	9.8
Reductant soluble P	P bound to Fe-hydroxides and Mn-compounds	Anoxia	High	9.2 (4.2-17.3)	12.2
Metal-oxide adsorbed P	P adsorbed to metal oxides (mainly FE, Al); P exchangeable against OH-	High pH (e.g., from high levels of photosynthetic activity in water column)	Medium to High	35.3 (10.2-62.8)	30.7
Organic P	Allochthonous organic material; detritus	Bacterial mineralization (temperature dependent)	Medium to High	19.6 (8.2-31.2)	11.9
Apatite Bound P	P bound to carbonates and apatite P	Low pH	Medium	9.6** (3.0-23.6)	9.7
Residual P	Refractory compounds		Low	11.2** (10-15)	7.5**
Total BAP	Labile P + Reductant soluble P + Metal oxide adsorbed P + Organic P	See individual drivers above	Medium to High	73.74 (27-127.9)	64.60

*Mean (Range)
**Compound was analyzed but not detected, value is represented by the minimum detection level (MDL)

Additional Information – Water Quality

Table 3.11 – Upper Lake Myakka NNC Assessment

Year	AGM CHLAC (ug/L)	CHLAC NNC (ug/L)	AGM TN (mg/L)	TN NNC (mg/L)	AGM TP (mg/L)	TP NNC (mg/L)
2009	46.2	20	1.48	1.27	0.39	0.05
2010	29.3	20	1.13	1.27	0.35	0.05
2011	30.2	20	1.43	1.27	0.31	0.05
2012	24.0	20	1.84	1.27	0.34	0.05
2013	21.6	20	1.35	1.27	0.26	0.05
2014	19.2	20	1.24	2.23	0.34	0.49
2015	13.2	20	1.36	2.23	0.40	0.49
2016	17.3	20	1.21	2.23	0.35	0.49
2017	--	--	--	--	--	--
2018	43.9	20	1.88	1.27	0.46	0.05
2019	18.4	20	1.33	2.23	0.43	0.49

AGM = annual geometric mean; CHLAC = chlorophyll-a; NNC = numeric nutrient criteria; TN = total nitrogen; TP = total phosphorus.
Red shading indicates NNC exceedance.