# Florida Department of Environmental Protection

## Upper Myakka Lake Feasibility Study

**Wood Project #600639**
**Date: July 2020**

# UPPER MYAKKA LAKE FEASIBILITY STUDY

Prepared for

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## 1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by the Florida Department of Environmental Protection (FDEP) to conduct a feasibility study on Upper Myakka Lake (UML) located within the Myakka River State Park (MRSP) in Sarasota County, Florida (Figure 1a). The Southwest Florida Water Management District (SWFWMD or District) is a cooperative funding partner for this project. Two water control structures (WCS) exist on the southern rim of the lake: a concrete weir constructed in 1941 and a bypass constructed in 1974. The feasibility study explores the following three alternatives, with the objectives of restoring natural systems and improving water quality in the Myakka River before the water enters Charlotte Harbor:

1) Removing the low water control structure (weir and bypass);
2) Amending the low water control structure; or
3) Re-building the low water control structure to the way it was prior to the recent failure.

This report is organized as follows: **Section 1** – **Introduction**, which provides a project overview and project objectives; **Section 2 – Background Information**, which describes the Myakka River, the hydrologic modifications made within the river, and studies documenting the effects of water control structures on rivers; **Section 3 – Data Collection and Analysis**, which summarizes data reviewed, collected, and analyzed for this study organized by topic; **Section 4 – Modeling**, which summarizes the event and continuous modeling conducted for the project; **Section 5 – Alternatives Analysis**, which compares the different alternatives; **Section 6 – Summary and Recommendations**; and **Section 7 – References**.

### 1.1. Project Objectives

The water control structures on the UML have been identified for study and potential restoration. Part of the District's Myakka River Watershed Initiative (MRWI) modeling of the river examined options to modify the UML weir to replicate a more historic hydrology (Singhofen & Associates, Inc., 2013). This feasibility study expands the MRWI effort by considering recent hydrologic impacts to the bypass area and benefits for water quality and natural systems that could result from reducing dry season levels closer to pre-alteration conditions.

As stated in the Cooperative Funding application to the SWFWMD, this study focuses on the 850-acre floodplain lake, the surrounding marsh, and the downstream floodplain marsh, known as Big Flats (**Figure 2**). This area within the Myakka River Watershed is a central ecological feature of MRSP and acts as a holding basin much of the year. Project objectives include restoring natural systems and improving water quality in the Myakka River before the water enters Charlotte Harbor, a SWFWMD Surface Water Improvement and Management (SWIM) priority water body. Returning the system to a more natural hydrological regime (i.e. pre-1939) by reducing dry season inundation would provide positive benefits for invasive aquatic plant control, improve adjacent marsh habitat, and transition ecotones towards the upland edge. The timing and distribution of freshwater would move closer to the historic natural pattern. Spring dry period conditions should improve marshes associated with UML, which would benefit from the increased opportunity for ecological/prescribed fire events, reduction in vegetative mass in the floodplain, and a return to a sandier lake bottom over time through reduction in muck accumulation from decaying aquatic plants. Reduction in dry season levels is needed as a first step in restoring wetlands closely hydrologically connected to the project area. Structural removal or modification would also remove a physical barrier to the Florida Manatee in the Upper Lake.

Modifying or removing the water control structures would also aid ongoing multi-agency aquatic weed control programs, aquatic habitat restoration efforts, and Florida Park Service (FPS) fire program. A more natural hydroperiod is expected to aid the return to a normal fire interval and a reduction in invasive grass bio-mass leading to healthier marshes and increased water quality treatment capacities.

## 2.0 BACKGROUND INFORMATION

### 2.1. Myakka River System

The Myakka River is a 66-mile long blackwater stream with a total drainage area of 580 square miles (Boning, 2007). It flows southwest from its headwaters in Myakka Head, through Flatford Swamp where seven tributaries converge to make a fifth order stream, through the 37,197.68-acre MRSP, and then southeast towards its terminus into Charlotte Harbor (**Figure 1b**). The river is an important wildlife corridor for the region, and its floodplain marsh within the MRSP is critical habitat of resident and migratory birds. The Myakka River within Sarasota County is an Outstanding Florida Waterway and was designated by the Florida Legislature as a Wild and Scenic River in 1985.

The river corridor is punctuated by four major floodplain depressions: Flatford Swamp, Tatum Sawgrass, Upper Myakka Lake (UML), and Lower Myakka Lake (LML) (**Figure 1b**), and variably consists of valleys occupied by a single meandering open channel, multiple shallow or anabranching channels, or no well-defined open channels. The two in-line lakes are located within MRSP. Their primary water source is river flow, with local rainfall providing additional input from runoff and seepage from surrounding uplands. Their water depth varies from approximately two to six feet, depending on rainfall (FDEP, 2019).

Valleys consisting of meandering stream channels punctuated with in-line lakes and wetland depressions that sporadically subsume the channel are common in peninsular Florida and are referred to as 'deranged drainage networks' (Kiefer et al. 2015). The Myakka River is a quintessential case of this valley type and its geodiversity is rather pronounced. This complexity results from a combination of the region's historic marine geology and active fluvial forces and alluvial materials interacting with vegetation under the modern climate. In other words, much of the genesis of the Myakka River ecosystem comes from processes sustained by modern fluvial forces occurring during the last few millennia, but these forces have lacked sufficient magnitude to overwhelm the geologic features along some portions of the valley that were created by more ancient geologic and climactic conditions.

The large in-line waterbodies are predominantly relics of the region's ancient marine history and include some solution depressions in limerock and karst features. The modern watershed provides significant seasonal, inter-annual, and multi-decadal variability of water and sediment loads that in aggregate maintain the valley form between the geologic depressions. Modern factors are most dominant in areas where alluvial features like meandering stream channels and lacustrine deltas occur in the valley. Valley slope and watershed area interact with vegetation to add to the system's geodiversity because these variables govern alluvial channel form (Kiefer et al. 2015). The steepest valleys have enough energy to develop a single dominant meandering open channel with excellent continuity of sediment transport, while intermediate slopes provide less transport continuity and smaller fluvial forces resulting in multiple shallow channels together (anabranching). Very gradual slopes are too weak to scour and maintain unvegetated alluvial channels. The transitions between the in-line depressions and meandering stream channels add even more fluvial forms to the system. Dams, weirs, and diversions have transformed these transitions along the Myakka valley, including the subject lake of this study.

Florida native species are highly adapted to the tremendous variability caused by this suite of hydrobiogeomorphic interactions. The system is rather dynamic, so attempting to restore a pre-development form may be less compelling than seeking to allow natural processes greater reign in the name of ecosystem restoration. This is important because much of the biodiversity of the river corridor rests on its geodiversity and flow pulses at both ends of the range of natural variability (flood and drought).

Some of the dynamic processes have been altered by a combination of deliberate hydraulic modification and unplanned inter-aquifer transfers that have hydrologically homogenized the river's water level fluctuations during dry periods by not allowing the low water levels to get as low. The perception is these changes have had unintended consequences on the biophysical diversity of the system in the MRSP; including degrading water quality, reducing fire frequencies in pyrogenic communities, increasing organic sedimentation, and reducing the hydraulic habitat variability that native species are adapted to. These factors have promoted an increased dominance of nuisance exotic species at the expense of Florida native species in the State Park.

Chief among these are perhaps two water control structures (WCS) present on the Myakka River (**Figure 1b**). The upstream WCS is located on the south side of the approximate 850-acre UML and consists of an historic weir and bypass. The downstream WCS, referred to as Downs' Dam, is a privately constructed dam located approximately 3.5 miles downstream of the approximate 350-acre LML. The UML WCS, which has impacted the lake and its associated wetlands by limiting dry-season drawdowns, as well as limiting wildlife passage to species such as the Florida manatee, is the focus of this feasibility study.

## 2.2. Hydrologic Alterations in the Myakka River

Numerous drainage modifications within the Myakka watershed have been instituted for the conversion of lands to agricultural uses, to control flooding, and for transportation needs. The Myakka River State Park Unit Management Plan (FDEP, 2019) provides an excellent summary of the hydrologic alterations made from Flatford Swamp to Lower Myakka Lake, as transcribed below.

*Hydroperiod and the timing of water delivery are fundamental factors that determine natural community structure. Alterations of the natural hydrologic regime have had a negative impact on natural communities within the park and in adjacent conservation lands. Several FDEP plans (FDNR 1986; FDEP 1999; FDEP 2004), the Myakka Wild and Scenic River Management Plan (FDEP, 2011), the SWFWMD Comprehensive Watershed Management Plan (2004), the Charlotte Harbor National Estuary Program Comprehensive Conservation and Management Plan (CHNEP, 2013), and other studies (Bukata et al., 2015) have identified specific hydrologic alterations in the Myakka watershed for study and potential restoration.*

*Starting from the northern part of the watershed, the historic alterations of the natural hydrologic regime that most impact the park include: dry season inputs into Flatford Swamp; the diversion dikes of the Tatum Sawgrass Marsh; the County Road 780 bridge and causeway; the Clay Gully diversion; the dikes at Hidden River; the inputs from Howard Creek; the dike separating Upper Myakka Lake from Vanderipe Slough; the concrete weir where the Myakka River exits the Upper Myakka Lake; the State Road 72 bridge, causeway, and drainage ditches; the railroad grade; ditching and the dike on Deer Prairie Slough; and Downs' Dam on the Myakka River near the southern boundary of the park* (**Exhibit 2.1**).

These alterations are described in more detail below. Additional hydrologic alterations occur downstream of the area of interest and are provided in **Table 2.1** below for information purposes.

**Exhibit 2.1 - Hydrologic Alterations in the Project Vicinity (Suau, 2005)**

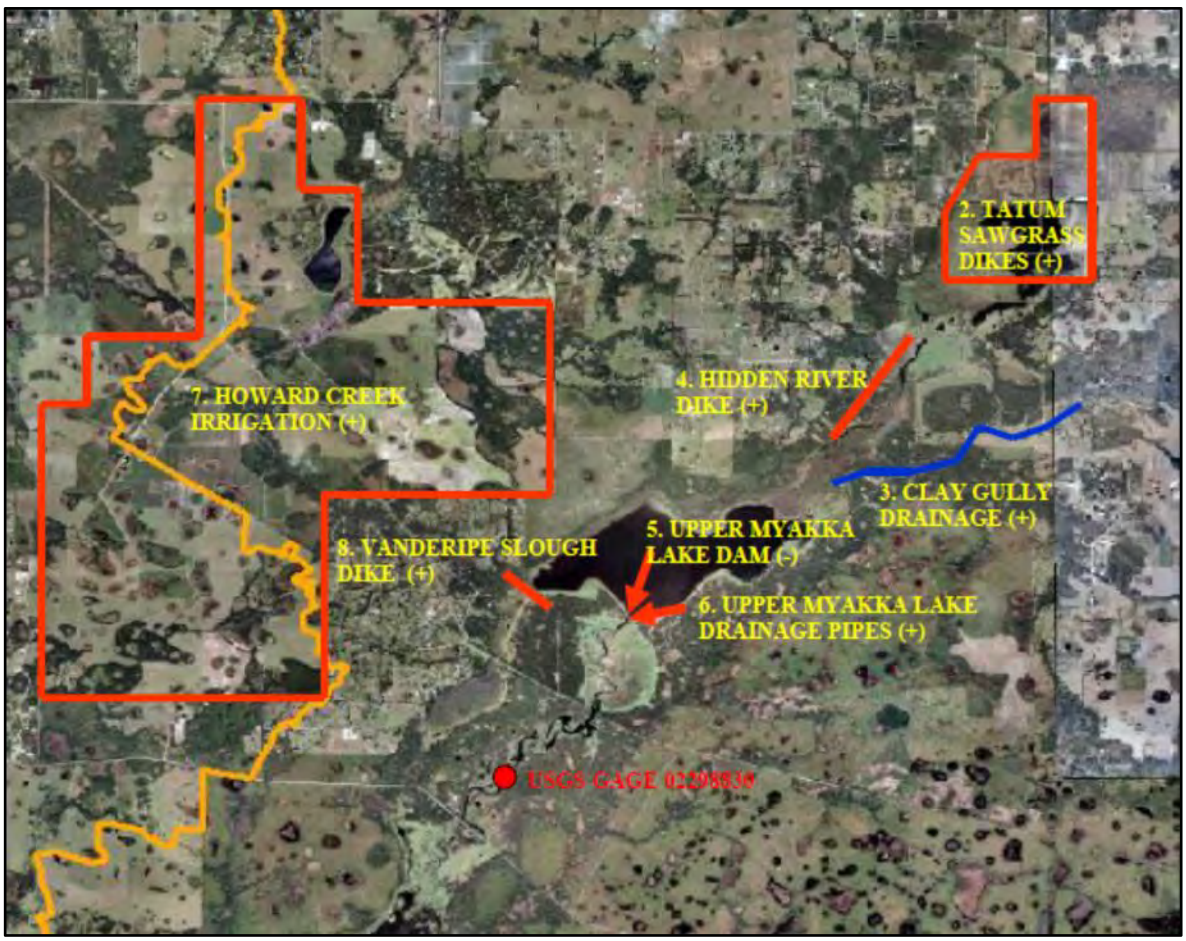


**Table 2.1 - Summary of Hydrologic Alterations in the Myakka River (Suau, 2005)**

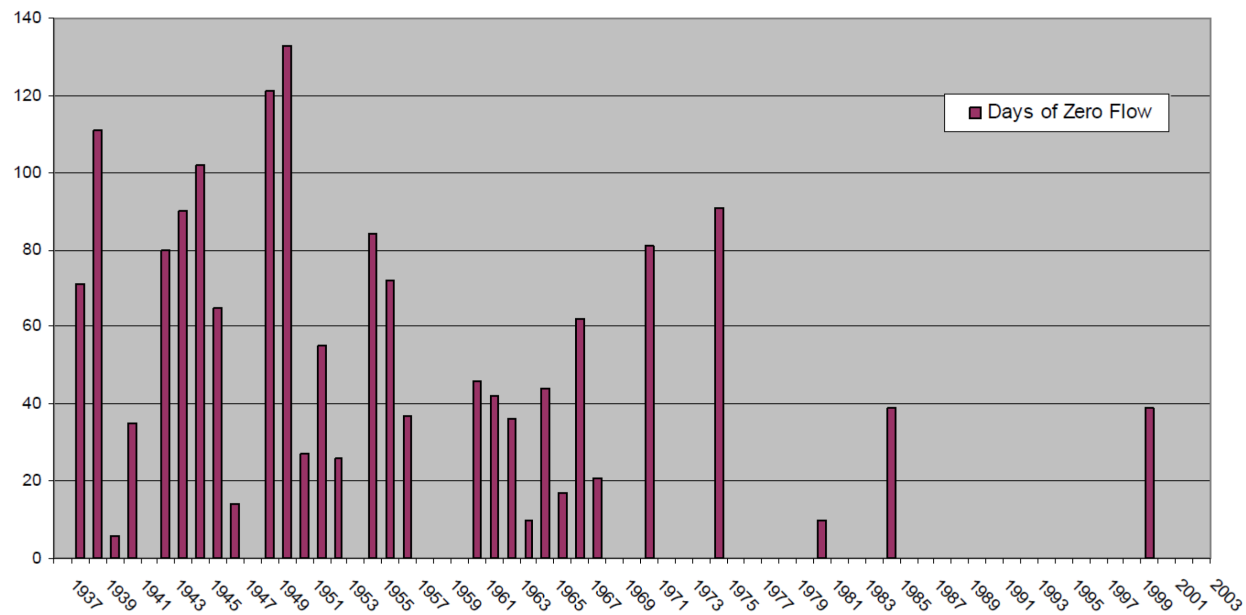
| Hydrologic Alteration | Type of Alteration | Date of Alteration | Control Elevation (msl) | Flow Regime Impact | Water Budget Impact |
|---|---|---|---|---|---|
| 1. Flatford Swamp | Irrigation | 1980 | N/A | Low flow | + |
| 2. Tatum Sawgrass | Dike | 1974 | 19 | Low flow | + |
| 3. Clay Gulley | Drain & Diversion | 1900 | N/A | All flow | + |
| 4. Hidden River | Dike | 1958 | 21.66 | All flow | + |
| 5. Upper Lake Dam | Dam | 1936/1941 | 13.65 | Low to moderate flow | - |
| 6. Upper Lake Pipes | Drain | 1974 | 9.8 | Low to moderate flow | + |
| 7. Vanderipe Slough | Dike | 1940 | 14.5 | Low to moderate flow | + |
| 8. Howard's Creek | Irrigation | 1990 | N/A | Low flow | + |
| 9. Downs Dam | Dam | 1930's | 6.6/10.6 | All flow | - |
| 10. Cow Pen Slough | Diversion | 1920's, 50's & 60's | 16.2 | All flow | - |
| 11. Blackburn Canal | Diversion | 1959 | N/A | All flow | - |
| 12. Deer Prairie | Dam | 1950 | 3.31 | Low flow | - |
| 13. Big Slough Canal | Drainage | 1930's & 1960's | N/A | All flow | + |

Positive and negative refer to water balance additions and subtractions. They do not represent value judgements of beneficial or adverse effects.

*Changes to land use starting in the late 1970s have led to increased water inflows to Flatford Swamp, and while relatively distant, produce negative impacts downstream into the park. In reports prepared for the SWFWMD (Coastal Environmental, 1998; Jones Edmunds, 2012), researchers assigned the cause of a large tree mortality event in the Upper Myakka River Basin and Flatford Swamp to hydrological stress. This stress was identified as being from an increase in seasonal highwater levels and longer seasonal hydroperiods. The primary contributor was subsurface seepage generated from agricultural irrigation which caused an excess base flow to the swamp. In 1998, the zone of potentially abnormal mortality and stress (area with dead trees) in the Upper Myakka River Watershed (100-year floodplain from State Road 64 downstream to State Road 72) covered approximately 3,740 acres, or about 25 percent. Additional and more recent work by SWFWMD and researchers (Bukata et al. 2015) found that Flatford Swamp is responding to changing soil biogeochemical conditions and processes due to changes in hydrology and water quality of nearby agricultural runoff derived from groundwater for irrigation. Significantly high soil total phosphorus content and potential sulfide toxicity in Flatford Swamp were suggested as contributing factors that* *led to observed degradation in vegetation community structure and dieback of Nyssa sylvatica var. biflora (Bukata et al. 2015).*

*An Assessment of Tree Conditions in Myakka River State Park (Ford and Brooks, 2000) reported that the increased flows in the Upper Myakka Watershed were causing stress and mortality in trees within the park, most notably upstream of the weir at the outflow of the Upper Myakka Lake. Beyond the tree morality issue, the increased input of water during the dry season has drastically reduced the number "no flow" periods and changed the water chemistry through the addition of mineralized groundwater (**Exhibit 2.2**).[1] These changes have had impacts to natural communities well beyond the river banks and slough systems.*

**Exhibit 2.2 - Days of Zero Flow at Myakka River near Sarasota (Suau, 2005)**




*Tatum Sawgrass Marsh was modified by 1974 via a series of dikes to divert water away from the marsh to create agricultural lands and control flooding, resulting in reduced storage capacity of the marsh and increased potential of downstream flooding. As a result of the dike system, flood-peak discharges and flood heights having recurrence intervals of up to 25 years are increased, and approximately 1,200 additional acres along the Myakka River may be flooded during two-year flood conditions. In addition, a 19 percent increase in flood-peak discharge at the County Road 780 Bridge may occur, and a 0.8-foot increase in flood height can result (Hammett et al. 1978). Prior to these modifications, Tatum Sawgrass was an extremely important holding basin during periods of heavy rainfall, with the capacity to store an equivalent of 1.8 inches of rainfall (which is four times that of the Upper and Lower Myakka Lakes combined).*

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[1] This pattern is particularly counter to the climate conditions given that rainfall patterns were greatest during the Atlantic Multidecadal Oscillation from the 1930's to the 1960's, and lowest from the 1970's through 2000's.

*The raised berm (causeway) for the approach road and associated bridge at County Road 780 over the Myakka River constrict flow south of the Tatum Sawgrass area especially during peak flow events. Duever and McCollom (1990) note the large width of river floodplain and potential for flow reduction at these points could lead to adverse impacts to natural communities. They also suggest changes are likely minor and localized. There is a potential for future study to determine what hydrologic effects this structure has and what, if any, modifications could be made to enhance hydrologic functions. Sarasota County recently finished the replacement of the old dilapidated bridge.*

*Clay Gully was originally a slough system that was ditched to increase drainage around 1900 (Suau 2005). A more formal diversion was constructed in 1949 after Robert Angas recommended a larger diversion in his 1945 Engineering Report to the Florida Forest and Park Service to divert more flow. The resulting project diverts much of the normal flow of the river through Clay Gully and into Upper Myakka Lake at its northeast corner. Based on measurements made during a USGS study, 35 percent of the flow goes directly into the lake, bypassing Tatum Sawgrass Marsh (Hammett et al. 1978). This has hastened vegetation changes in the bypassed section of the river, which now stays dry almost half of the year between its juncture with Clay Gully and the point where it enters the Upper Myakka Lake (FDNR, 1986).*

*The dikes at the Hidden River community were originally installed in 1958 to exclude water from the Myakka River to create pasture for cattle. The result of the dikes is increased water input in the Upper Myakka River Watershed via the Myakka River that would have historically flowed into adjacent marsh and bottomlands communities. In 1966, it was platted for a residential community (Suau 2005). The proximity and history of flood issues in the Hidden River community make potential return to the natural hydrologic regime unlikely within that portion of the watershed.*

*Beginning in the 1950s, land clearing activities in the Howard Creek area for agriculture, and later increases in irrigation have had a net result of increased water input to Upper Myakka Lake. Treated reclaimed wastewater has been used to irrigate several thousand acres of agricultural operations starting in the 1990s (Suau 2005) and continues to the present. Howard Creek discharges into the western tip of Upper Myakka Lake at the western park boundary close to Vanderipe Slough.*

*A 1,000-foot earthen dike separating Upper Myakka Lake from Vanderipe Slough was constructed by the Civilian Conservation Corps (CCC) and completed around 1940. The structure's purpose was to prevent water from the lake from entering the slough (Historic Property Associates, 1989). Due to concerns that excess water from the Upper Myakka Lake was damaging adjacent pasturelands, it was suggested by Robert Angas (1945) that the dike be extended, which was completed in the late 1950s. Resulting impacts from dikes included redirected flow of Howard Creek from Vanderipe Slough into the Upper Myakka Lake.*

*In 1937-38, the CCC constructed a weir at the main outflow to the Upper Myakka Lake (Historic Property Associates 1989). Flippo and Joyner (1968) reported that in spring 1941 a low concrete weir replaced the previous CCC structure that had been partially washed out. These alternations to the natural hydrology were conducted to retain water in the Upper Myakka Lake to enhance sport fishing and recreational boating. While certain features may have been enhanced, there were also unintended consequences to plant and animal communities.*

*The Upper Myakka Lake Weir was bypassed by culverts in November 1974. Six 60- inch culverts were installed just southeast of the dam with the primary purpose of controlling invasive exotic plants in the lake by periodic drawdown (Suau 2005). Since 1979, the culverts have generally been kept open, restricting little to no water flow. In the past, the culvert openings were restricted to slow the flow through the bypass during the dry season, which was perceived to extend the period of operation of the concession airboats. In May of 2016 there was a wash out associated with bypass culverts leaving a 10-foot opening on the east side.*

*As with County Road 780, State Road 72 and its associated bridges were impeding natural hydrologic flow. Beginning in late 2006 and continuing through April 2010, four bridges were replaced or improved to increase the openings, including those over Vanderipe Slough, Myakka River, and Deer Prairie Slough. Some efforts were made to improve hydrologic functions, including sheet flow, flood conveyance as well as enhanced stormwater treatment and wildlife crossings. There may be opportunities to improve these functions in the future.*

*While relatively minor, it is worth mentioning that some remnants from an earthen dam at the south end of the Lower Myakka Lake still exist. Water movement at this point may be near pre-alteration conditions, but some bottleneck effect may be present from the remaining earthen structure on either side. No research has been done on the existing condition and effects of the earthen dam on hydrology. Flippo and Joyner (1968) only mention in passing that the lower lake was dry in 1945 before the structure was in place and "dry in 1950, after the earthen dam at its outlet had washed out."*

*Downstream of the Lower Myakka Lake, a dam referred to as Downs' Dam exists. It was constructed in the 1930's. It has a 5 x 4 foot high notch which controls the water level. The water level varies from 10.6 msl in the dry season to 6.6 msl in the wet season. During the dry season, water is impounded in the Lower Myakka Lake due to the operation of the dam. At the dry season elevation of 10.6, approximately 1000 acre-feet are stored in the Lower Myakka Lake. The dam is expected to have minimal effect on high flows and affect low and normal flows during the dry season (Suau 2005). Note that a breach has formed along the east side of the dam.*

### **2.2.1.** Historic Conditions at the UML Weir and Bypass

According to an FDEP memorandum, the original low-water weir was built in 1938-1939 associated with a Civilian Conservation Corps (CCC) project to reportedly hold back water for recreation purposes (i.e. boating) in the low water season. While little hard data exist on the seasonal fluctuations, vegetative community, and special features that existed prior to modifications, a 1916 survey indicates a dynamic high water and low water period during which several sections of the river and floodplain marsh went dry (**Appendix A**).

In 1974 a set of bypass culverts were installed immediately east of the weir that were specifically intended to help mitigate some negative effects of the weir (**Exhibits 2.3** and **2.4**). The bypass culverts were intended to allow for periodic draw down of the UML for aquatic plant control, expose the lake bottom to reduce muck, improve native fish habitat, and move toward a more historic flow pattern. However, draw-downs were not fully achieved even with the extensive use of diesel pumps in the late 1970s. During this time period, increased agricultural inputs and modifications in the Tatum Sawgrass Marsh above the park increased dry season water inputs into the UML making draw down unlikely.

**Exhibit 2.3 - UML Weir and Bypass**


**Exhibit 2.4 - Construction of Bypass in 1974 (Suau, 2005)**

### 2.2.2. Current Conditions at the UML Weir and Bypass

According to an FDEP memorandum, the UML weir has degraded over the last few decades, with numerous four- to six-inch gaps in the weir structure that are expected to continue to degrade and reduce the original intended function of the structure. The bypass culverts have rusted out, and in May 2016 the park concession installed boards against the dilapidated culverts in an attempt to slow the flow and manipulate water levels in the UML. The blocking of the bypass culverts with boards did little to hold back water, and approximately one week later a heavy rain event caused a serious wash out on the east side of the bypass, which opened up a ten-foot space in what was formerly berm and is now the river (**Exhibit 2.5**). This required the closure of the platform/fishing deck located over the culverts. Additionally, the trail to the observation platform over the bypass is to remain closed until the bank can be stabilized.

**Exhibit 2.5 - Bypass Wash Out**


There have been unintended benefits from the decline in function of these water control structures, such as a somewhat quicker dry-down after the rainy season and a more natural dry season. This led to the first significant prescribed burn of the floodplain conducted in well over a decade, with 227 acres in the eastern area of Big Flats burned just south of the UML. These efforts were planned to compliment Florida Fish and Wildlife Conservation Commission (FWC) Aquatic Habitat Restoration and Enhancement (AHRES) program aerial herbicide application efforts to combat paragrass monocultured areas of the marsh. However, increased dry season hydroperiod from the WCS remains a severe limit on resource management efforts in the river area.

### 2.3. Effects of Water Control Structures on River Systems

Many of the riverine water control structures in the United States are low-head dams utilized for recreation, farm ponds, flood control, irrigation, or water supply, and it is important to consider unintended and adverse effects of dam removal as well as the benefits (Schuman, 1995). However, very few, if any, studies of dam removal from other regions apply to the UML because they were not conducted in deranged drainage systems with similar climate, sediment loads, hydrology, or ecology. Further, they instead evaluated projects aimed at eliminating artificial lakes to restore alluvial stream valleys. That is not the case here, where the system to be maintained or improved is a shallow natural riverine lake.

Despite these limitations, the scientific literature cautions dam removal designers to consider the likelihood of post-project release of impounded sediments and secondary downstream adjustments to the temporary and permanent changes in sediment yield and fluvial forces that may have been suppressed by the dam. Within years to decades, riparian vegetation will colonize and stabilize the newly exposed terraces and banks. Management may likely be necessary to facilitate recruitment of desirable species. All responses will likely be relative to the size of the dam and the degree of difference between ecological and hydrologic conditions upstream and downstream of the dam. The natural progression of river "re-wilding" will likely be acceptable downstream of the Myakka River dam, as the state park contains a substantial portion of the downstream reach. However, if important structures are located along the banks downstream, careful management will be required to control bank failures and other geomorphological changes.

The responses downstream of the former dam will depend greatly on the quantity and quality of released impounded sediments and the degree of the pre-removal stream's incision, armoring, and disconnection from floodplains. Released sediments will temporarily increase turbidity and limit light penetration, potentially increasing nutrients or smothering benthic organisms. However, sediment deposition and redistribution can aggrade incised channels, reconnect lateral floodplains, improve fish spawning habitat, and provide new surfaces for riparian colonization and restoration.

A study of low-head dam removals conducted by ICF Consulting for AASHTO in 2005 stated many of the same system responses but highlighted the importance of studying the change in hydrologic gradient prior to dam removal and its effects on surface water/groundwater interactions. This is anticipated to be comparatively inconsequential for the Myakka system's low-gradient valley. However, exposing previously submerged land and increasing flow downstream may result in subtle changes to groundwater recharge rates, groundwater levels, and water levels in existing wetlands. Vegetation along any stretch of the river will shift toward the post-removal hydrologic regime.

Another study (Gangloff, 2013) highlighted adverse ecological impacts of dam removal from case studies. However, such affects were characteristically associated with the significant trapping capacity of high sediment and pollutant loads in creeks impounded in Wisconsin, North Carolina, and Alabama and the subsequent under-managed release of those legacy materials downstream.

The material characteristics, gradients, and loads of the dammed streams in this study were more severe than what could reasonably be expected for the UML WCS and Myakka River downstream. However, the data collection here aims to conduct due diligence regarding the potential for mobilizing excess sediments.

It appears that removal or lowering of the low-head dam on the Myakka river is a rather unique case that could have a variety of effects. The beneficial effects include relief of stressed trees upstream of the dam, creation of wetlands and restoration of riparian environments upstream and downstream of the dam, supporting re-establishment of aquatic species and increased species diversity. Potentially negative impacts include recruitment of invasive or undesirable species on newly-exposed soils, potential temporary release of legacy nutrients in downstream reaches, and loss of open water area and depth in the UML potentially limiting recreational uses. These potential impacts will be assessed in the feasibility analysis, as they may affect the ability of the project to be approved by relevant permitting agencies. Aside from recreational losses, adverse effects can be avoided or mitigated using controlled dam removal, vegetation management, and stream restoration design.

## 3.0 DATA COLLECTION AND ANALYSIS

An extensive amount of data has been collected within the Myakka River Watershed over the last few decades. Information relevant to the feasibility of removing or modifying the UML WCS were compiled and reviewed to determine what additional data should be collected to complete the feasibility study, as described in the sections below which include the following topics: survey, water levels, sediment, water quality, vegetation, and wildlife. A series of general maps were prepared and reviewed for the project area, including recent and historic aerials (**Figures 2a-f**), USGS topographic quads (**Figures 3a-b**), NRCS-mapped soils (**Figure 4**), and SWFWMD land use (**Figure 5**).

### 3.1. Survey

#### 3.1.1. Existing Data

SWFWMD provided Wood with existing survey data collected for various task assignments conducted throughout the Myakka River watershed. Survey data collected within the vicinity of UML are provided in **Figure 6a**, and survey data collected throughout the watershed are provided in **Figure 6b**. Data include cross-sections within the Myakka River channel and various tributaries, transects along the UML edge, line work for the Myakka River and various tributaries, and data at some of the bridges. Available bridge data are shown in more detail in **Appendix A**. These data collection efforts were to support various modeling and Minimum Flows and Levels studies.

Some survey data exist for the existing structures associated with the UML. Singhofen & Associates, Inc. (2013) examined options to modify the UML weir to replicate a more historic hydrology. The report provides some detail of the existing weir and bypass, which is provided in **Appendix A**. Angus (1945) studied the effects of the UML outlet structure on areas around the lake, including Vanderipe Slough, a secondary outlet on the UML prior to the construction of a dike. The report provides some detail of elevations along the constructed dike, as well as a profile along the slough, which are also provided in **Appendix A**.

A US Army Corps of Engineers Survey conducted in 1916 as a response to a request to dredge the entire Myakka River for cattle and agricultural interests (which was denied due to lack of economic viability) provides information regarding seasonal fluctuations, vegetative communities, and special features that existed in the UML prior to human induced changes to the land (**Appendix A**). The survey covers the Myakka River from its mouth to Rocky Ford. It notes that the difference in elevation between the Upper and Lower Lakes to be 22 feet under normal conditions. It shows broken lines downstream of the UML, indicating a dry stream bed and notes that pools between dry stretches have varying depths of from 0.5 foot to 1.5 feet. It maps the area just below the UML as marsh and swamp and references extreme high water from the flood of 1912. The current shape of the lake differs from what is shown on the 1916 map.

Based on our literature review, no detailed bathymetric data have been collected in the UML. A 2013 map prepared for the FWC did note an average lake depth of 1.6 feet.

### 3.1.2. Data Collected by Wood

Wood conducted a survey in spring 2019, which included the following elements:

- Measured and mapped bathymetry (top of sediment) on a 1,000-ft grid across the open water area of the lake.
- Probed the sediment at each grid point to measure and map soft sediment/muck thickness.
- Located and mapped the existing weir structure and bypass area at the lake outfall, including one cross-section immediately upstream of the structure and three cross-sections downstream of the structure.
- Surveyed a longitudinal profile through the bypass channel and extending approximately 600 feet downstream of the bypass channel.
- Collected additional bridge information necessary for the model at Myakka River State Park Road, SR72, CR 780, and Clay Gully Road.

The general survey point locations are provided in **Figure 7**; **Exhibit 3.1** presents the bathymetric surface that was created for UML from the survey points collected within the lake; **Appendix A** provides detailed survey results including elevations, sediment thickness, cross-sections, and a longitudinal profile; and general survey results are summarized below.

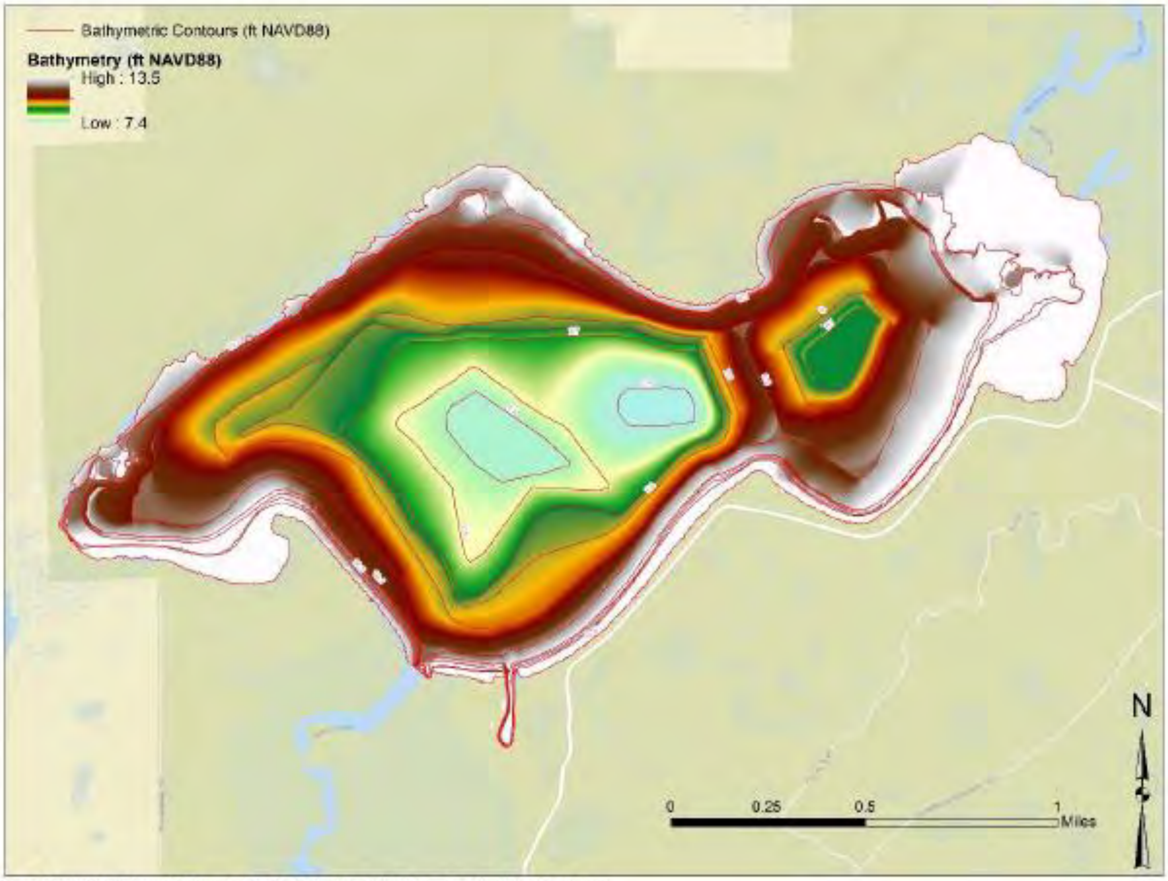
Submerged lake bottom elevations ranged from 7.4 ft NAVD at the center/deepest part to 9.5 ft NAVD near the water's edge. Soft sediment thickness ranged from 0 to 1.4 ft; the thickest soft sediment was found in the northeast portion of the lake (**Figure 9**). At the lake outlet, just upstream of the weir, the deepest elevation was 8.4 ft NAVD and the prevailing elevation was 9.7 ft NAVD. The concrete weir structure has a total length of approximately 200 ft, with a 60-ft long section with an invert of 12.41 ft NAVD. Bed elevations within the approximate 40-ft wide bypass channel ranged from 8.4 to 9.5 with an average of 8.5 ft NAVD, while bed elevations within the river channel downstream of the bypass approximately 600 ft downstream to where the river branches ranged from 7.6 to 9.4 ft NAVD, with an average of 8.5 ft. Various ecotones were identified along cross-sections surveyed within the vicinity of the structure, the elevations of which are summarized in **Table 3.1** below.

**Table 3.1 – Notable Elevations**

| Ecotone Break | Average Elevation (ft NAVD ) |
|---|---|
| Water Stain Line | 17.13 |
| Hydric Hammock Waterward Edge | 13.55 |
| Top of Bank | 12.53 |
| Paragrass Waterward Edge | 12.28 |
| Pluchea Waterward Edge | 11.45 |

*Data derived from XS1 through XS4 collected within the vicinity of the UML WCS.*

**Exhibit 3.1 - Bathymetric Surface Created by Wood**




## 3.2. Water Levels

### 3.2.1. Existing Data

Wood obtained data from hydrologic monitoring stations applicable to this project, including USGS long-term station 02298608 Myakka River at Myakka City located 12.5 miles upstream of the UML WCS; USGS long-term station 02298830 Myakka River near Sarasota located approximately 3.5 miles downstream of the WCS; and SWFWMD station 25941 located on the lake itself (**Figure 8, Table 3.2**). SWFWMD only measured lake water levels on an approximate biweekly basis between October 2003 and August 2004; however, the MRSP has taken manual readings at the gage on a regular basis from 2002 to present, though these had not all been previously digitized. Flow was measured by the USGS for a relatively short period of time just below the UML (1946-1951). Stage and flow hydrographs were developed for these sites, and stage and flow duration curves were developed for the long-term USGS stations (**Appendix C**).

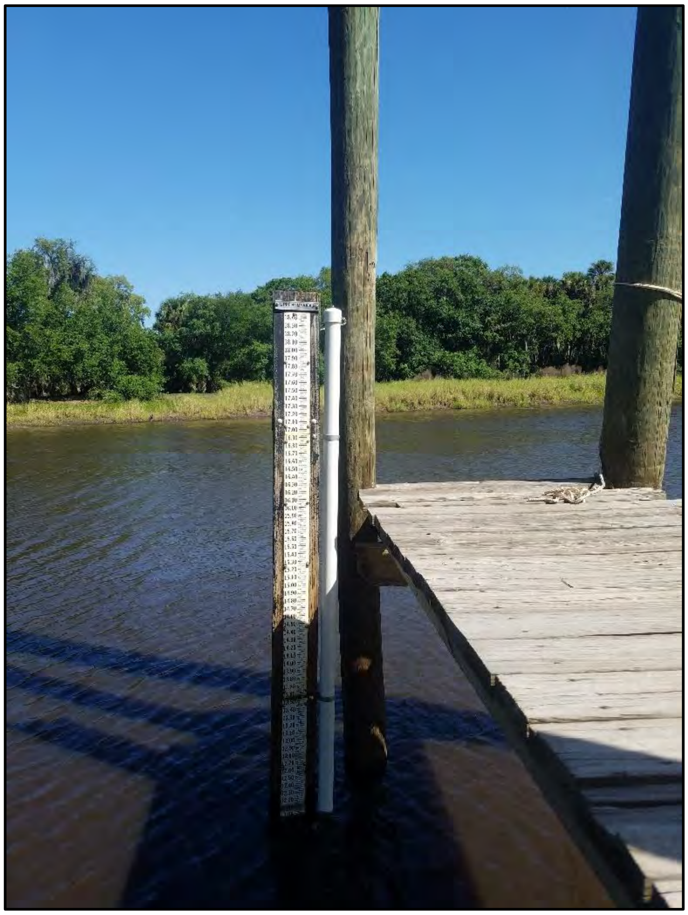
**Table 3.2 - Hydrologic Data Period of Record Obtained**

| Parameter | Agency | Site ID | Site Name | Drainage Area | Start Date | End Date | N |
|---|---|---|---|---|---|---|---|
| Discharge (cfs) | USGS | 2298608 | Myakka River near Myakka City | 125 sq. mi | 2/5/1963 | 4/3/2019 | 16,800 |
| Gage Height (ft) | USGS | 2298608 | Myakka River near Myakka City | 125 sq. mi | 10/1/1977 | 4/3/2019 | 15,033 |
| Stream Water Level (ft NAVD88) | USGS | 2298608 | Myakka River near Myakka City | 125 sq. mi | 10/1/2007 | 4/3/2019 | 4,302 |
| Gage Height (ft) | State Park | NA | Upper Myakka Lake | 219 sq. mi | 7/3/2002 | 3/5/2019 | 1,433 |
| Water Elevation (ft NAVD88) | SWFWMD | 25941 | Upper Myakka Lake | 219 sq. mi | 10/6/2003 | 8/30/2004 | 90 |
| Discharge (cfs) | USGS | 2298805 | Myakka River below Upper Myakka Lake | 219 sq. mi | 1/1/1946 | 6/30/1951 | 2,007 |
| Discharge (cfs) | USGS | 2298830 | Myakka River near Sarasota | 229 sq. mi | 9/1/1936 | 3/30/2019 | 30,580 |
| Gage Height (ft) | USGS | 2298830 | Myakka River near Sarasota | 229 sq. mi | 10/1/1936 | 3/30/2019 | 29,914 |
| Stream Water Level (ft NAVD88) | USGS | 2298830 | Myakka River near Sarasota | 229 sq. mi | 4/4/2016 | 3/30/2019 | 1,423 |

### 3.2.2. Data Collected by Wood

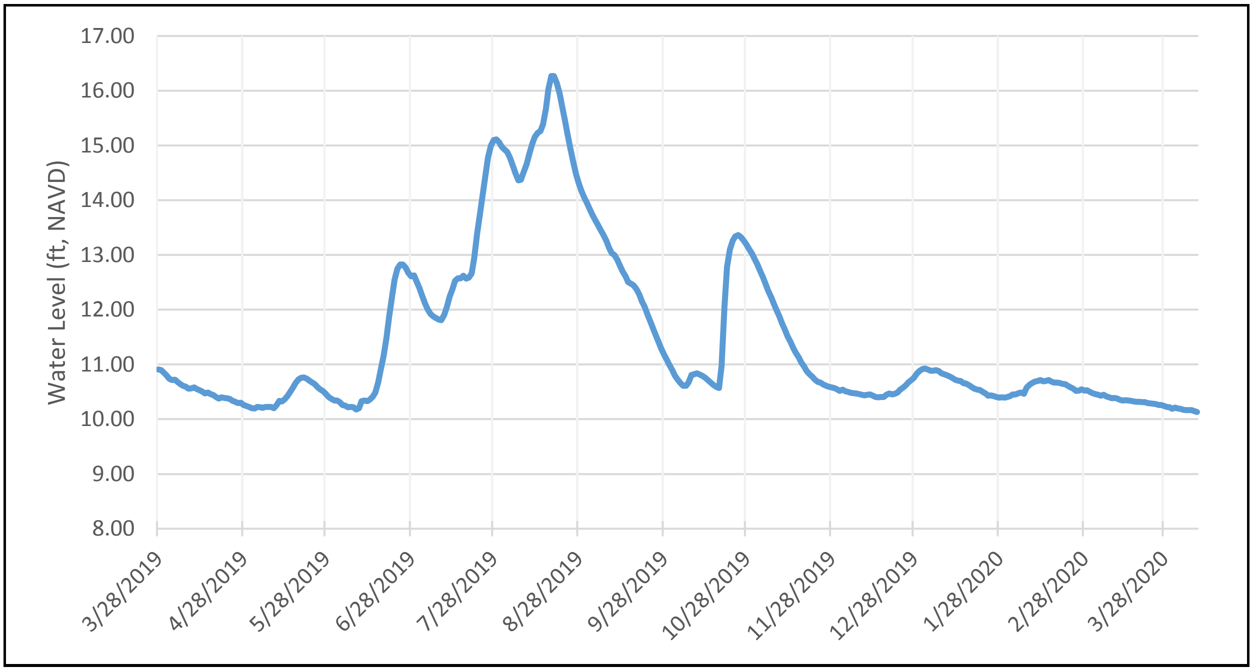
Wood collected additional lake water level data over the course of the data collection period. A continuously-recording pressure transducer (logger) was deployed by Wood staff on March 28, 2019. The logger was installed within a PVC pipe that Wood staff attached to the existing lake gage station (with permission from the MRSP). The logger was set to record lake levels hourly. A photograph of the monitoring station is provided below in **Exhibit 3.2**. Note that the existing staff gage elevations are represented in ft NGVD29, but for modeling purposes the data were converted to ft NAVD88.

**Exhibit 3.2 - Upper Myakka Lake Logger Installation (3/28/2019)**



Wood downloaded the logger and recorded manual gage readings on a quarterly basis between March 2019 and April 2020. Data were post-processed and recorded water levels were converted to ft NAVD88 (**Exhibit 3.3a**). The newly collected water level data, along with previously obtained water level data, were used to summarize the range of water levels within UML. Over the full period of record (2003-2019), lake stage ranged from 9.5 to 17.2 ft NAVD88, with an average stage of 11.9 ft NAVD88 (**Table 3.3**). The observed seasonal low water level (associated with the $85^{th}$ percent exceedance value) was 10.4 ft NAVD88, while the observed seasonal high water level (associated with the $15^{th}$ percent exceedance value) was 14.1 ft NAVD88. As previously mentioned, a breach occurred on the eastern side of the bypass channel in 2016. To determine if the breach has had an effect on overall water levels, the same summary statistics described above were determine for the pre-2016 POR and the post-2016 POR (**Table 3.3**). The seasonal low water level pre-breach is 0.1 ft higher than the seasonal low water level calculated post-breach. Note that the frequency at which readings were taken increased dramatically from 2016, with readings now being take daily versus monthly or weekly.

**Exhibit 3.3a – Upper Myakka Lake Gage Data Collected by Wood**



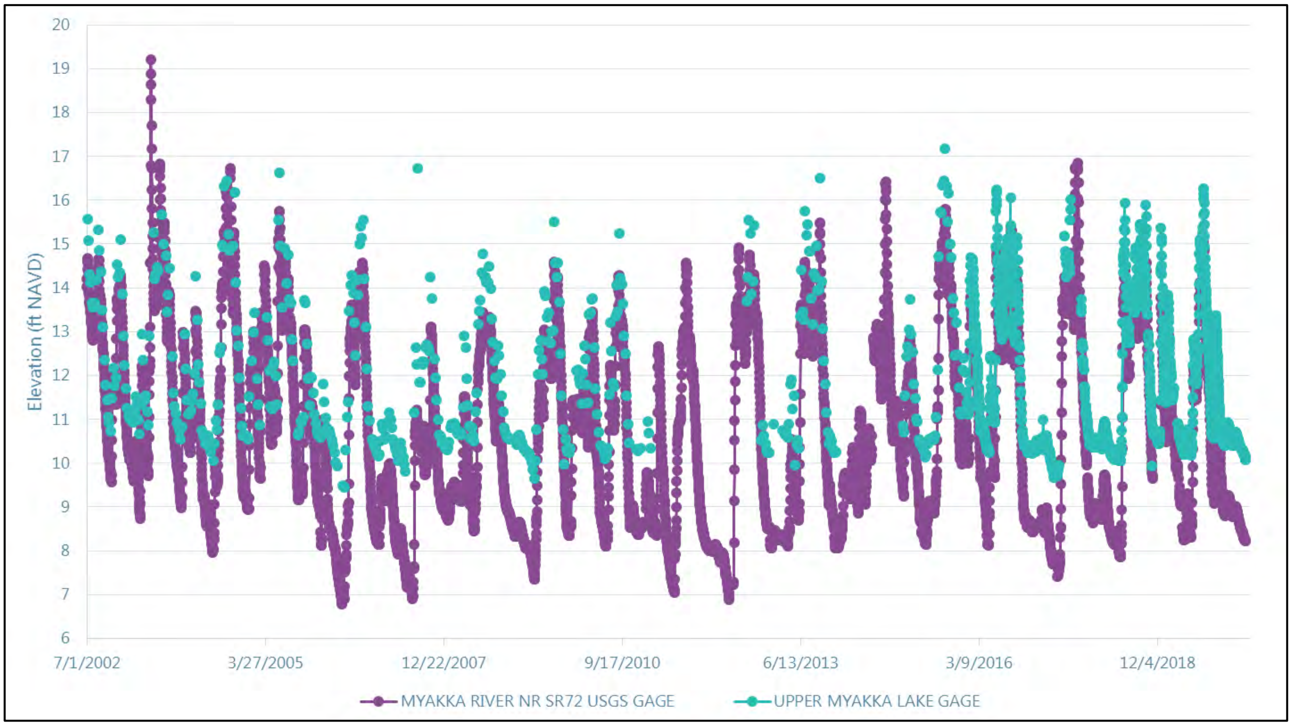

Note: Data collected from 3/28/2019-4/9/2020

**Table 3.3 - Summary of Lake Gage Data**

| 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 |
| 1/1/2003 to 12/31/2015 (pre-breach) | 480 | 9.5 | 17.2 | 12.0 | 14.1 | 11.5 | 10.5 | 37 |
| 1/1/2016 to 12/31/2019 (post-breach) | 1198 | 9.7 | 16.3 | 11.9 | 14.2 | 11.1 | 10.4 | 300 |

Lake water levels were also compared to river water levels recorded downstream at the long-term USGS gaging location Myakka River near Sarasota during their overlapping period of record (7/2002 through 4/2020) (**Exhibit 3.3b**). The two hydrographs follow a very similar pattern, but the downstream gage's water level is approximately 1.2 ft lower on average than the lake level.

**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.

## 3.3. Sediment

### 3.3.1. Existing Data

No hard data were found regarding lake bottom sediments during the literature review. A 1983 interview conducted by a MRSP park ranger with a long-time local resident indicated that the lake was drier and had a sandy bottom prior to the installation of the WCS. He stated, "I've waded through the lake many times. 'Till they put the dam in there the lake never did get over pocket deep. They dammed all the water up and run it up and pushed it back to Howard Creek. I've crossed that lake with a car. And it didn't drown it out. Used to be the lake was all sand. Now you go out there and bog down" (Suau, 2005).

The interviewee above also stated that water hyacinths were brought in from South America in the early 1900s to be sold for flowers. Excessive growths of exotic water hyacinth and hydrilla in the MRSP are attributed to the fast growth rates of the plants coupled with stabilized water levels, and they can increase sedimentation rates in the lake (SWFWMD, 2004). These species can decrease dissolved oxygen levels, reduce light penetration, limit the exchange of gases, and reduce water circulation. Reduced oxygen levels slow decomposition rates, thus contributing to sediment accrual.

### 3.3.2. Data Collected by Wood

Wood collected sediment samples on July 29th and 30th, 2019. Sediment samples were collected with a piston core sampler to characterize the sediment in the top 30 cm of the profile. Sediment sampling locations were selected based on preliminary sediment thickness data collected during the lake bathymetric survey. These preliminary data were screened to select stations that would capture a gradient of low to high organic composition and potential associated nutrient accumulation. Sediment cores were collected from ten locations from within the lake and two from within the river, for a total of twelve sample locations, as shown in **Figure 9**.

During core collection and extraction, sediment color and qualitative characteristics were described and recorded, and in-situ water quality vertical profiles were collected in the water column at each location. **Table 3.4** provides the range of water quality data collected across the vertical profiles. The data provided represents the top, middle, and bottom portions of the water column. The turbidity measurements were collected at a depth of 0.3 meters from the surface. Soft sediment thickness at the sampling locations within the lake ranged from 0.1 feet to 0.75 feet, while soft sediment thickness at the sampling locations within the river was limited to an estimated thickness of 0.1 feet.

**Table 3.4 – Summary of In-Situ Water Quality Parameters**

| Location | Total Depth (ft) | Secchi Depth (ft) | Water Temperature (°C) | Dissolved Oxygen (mg/L) | Dissolved Oxygen Saturation (%) | Salinity (ppt) | Conductivity (us/cm) | pH | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|---|
| Lake | 6-7.25 | 1.5-3 | 27.78-31.79 | 0.22-4.32 | 2.0-59.0 | 0.11-0.15 | 239-315 | 5.90-6.03 | 1.31-3.92 |
| River | 5.5-6.25 | 2.25-2.25 | 30.49-30.8 | 1.87-3.58 | 24.6-48.3 | 0.14-0.14 | 300-307 | 6.01-6.12 | 2.72-4.31 |

### 3.3.3. Physical and Chemical Sediment Characterization

Following collection, cores were extruded from the piston corer to a depth of 30 cm and stored in darkness at <4 °C during transport to a NELAC certified laboratory for analysis. The lab analyzed the following parameters: % passing 200 sieve, %Dry Weight, Bulk Density, Volatile Solids, Total Nitrogen, Total Kjeldahl Nitrogen, Ammonia-Nitrogen, Total Organic Carbon, Iron, Calcium, Aluminum, and Total Sulfur. Laboratory analytical reports and results for sediment characterization are provided in **Appendix B**. **Tables 3.5** and **3.6** below summarize the chemical and physical parameters tested on the sediment samples. Based on the field observations of the samples and the results of the % passing 200 test, all sediment samples were dominated by particles greater in size than 200 microns, which would indicate that samples were mostly dominated by sand and not fine materials such as clays or silts. With the low percentages of fines within the samples, it is unlikely for there to be much mobilization of the substrate from the lake to the river.

**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 | 2,942 | 3,770 | 3.75 | 22.51 | 2,944 | 149.1 | 0.23 | 18,603 |
| | | (240-24,000) | (300-19,000) | (180-26,000) | (0.84-20.74) | (6.2-150) | (540-13,000) | (30-250) | (0.03-0.49) | (7,660-33,400) |
| River | 2 | 845 | 755 | 550 | 8.42 | 9.5 | 440 | 82 | 0.40 | 4,570 |
| | | (590-1,100) | (730-780) | (500-600) | (0.84-16) | (7-12) | (200-680) | (37-127) | (0.02-0.06) | (3,030-6,110) |

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

As seen in the tables above, the lake sediments had higher levels of nutrients, metals, and total organic carbon than the river, but still lower than typical urban lakes. This is expected due to the lake being lentic (standing) and more depositional in nature.

### 3.3.4. Sediment Phosphorus Fractionation

In addition to the analyses described above, Biological Available Phosphorus (BAP) fractionation analyses that included total phosphorus and soluble reactive phosphorus were performed on a subset of six (6) of the samples. Five of the fractionation samples were collected within the lake and one was collected within the river (**Figure 9**). Sequential phosphorus extraction procedures used to calculate the mass of potentially bioavailable P in the upper 30 cm of sediments were modified by Meis et al. (2012) and based on methods developed earlier by Hupfer et al. (1995) and Psenner et al. (1988). Operational sediment phosphorus availability is defined from most available to most strongly bound in order of labile, reductant-soluble, metal-oxide, organic, and apatite and residual.

The P fractionation extraction sequence includes the following steps:

(1) Extraction with 1 M $NH_4Cl$ to determine loosely adsorbed and porewater P ('labile P')

(2) Extraction with 0.11 M $NaHCO_3$/0.11 M $Na_2S_2O_4$ to determine P mainly bound to Fe-hydroxides or manganese (Mn) compounds ('reductant-soluble P')

(3a) Extraction in 1 M NaOH to mobilize P which is mainly exchangeable against hydroxide ions determined as SRP ('metal-oxide adsorbed P')

(3b) Organic bound P in the same fraction quantified by subtracting NaOH-SRP from NaOH-TSP[2] ('organic P')

(4) Extraction with 0.5 M HCl to determine P bound to carbonates and apatite P ('apatite bound P')

(5) Digestion with 30% (v/v) H2SO4 and 8% K2S2O4 followed by TSP quantification to determine refractory P ('residual P')

Results of the analyses are provided in **Appendix B**, while an overview of the operational sediment P fractions quantified using this procedure, the driving factors that cause them to release BAP to the water column, and the likelihood of BAP releases are provided in **Table 3.7**. Although there is a possibility of phosphorus release from the sediment based on the anoxic conditions and pH levels found within the lake and river, the opportunity for release is relatively low and are relatively similar between the two environments. For all portions of the phosphorus fractionation, the sample collected within the river fell within the range of what was found within the lake, and both sediments had overall low BAP and total P concentrations. BAP values for two of the five samples collected within the lake were below what was found within the river, however the mean BAP was lower within the river than in the lake.

**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 |

[2] TSP = total soluble phosphorus

| 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) |
|---|---|---|---|---|---|
| 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)

Based upon the physical characterization of the sediment, it is unlikely that a mass mobilization of the substrate will occur if the WCS is removed. Although there is a slight possibility of release of nutrients from the sediments, the levels found were relatively low and similar within the lake and river.

## 3.4. Water Quality

### 3.4.1. Existing Data

Water quality data are collected at various locations along the Myakka River (**Figure 8**); but for congruence with hydrologic data, only stations in Upper Myakka Lake and near the USGS stations near Myakka City and Sarasota were assessed for data availability. Within the lake, Lakewatch and USGS collect the most data, spanning a combined period of 1984 to 2019 (**Table 3.8**). Upstream and downstream of the lake, Manatee County, USGS, and SWFWMD stations have recorded data spanning the period from 1962 to 2019 (**Table 3.9**). It should be noted that only nutrient parameters used to assess impairments and Total Daily Maximum Loads (TMDLs) are listed in

**Tables 3.8** and **3.9**; however, more parameters (such as TSS, conductivity, temperature) are available.

**Table 3.8 - Water Quality Data POR within Upper Myakka Lake**

| Parameter | Agency | Site ID | Start Date | End Date | N | Avg. Value |
|---|---|---|---|---|---|---|
| TN (mg/L) | Lakewatch | Upper Myakka-Sarasota | 8/7/2001 | 12/6/2018 | 192 | 1.41 |
| TP (mg/L) | Lakewatch | Upper Myakka-Sarasota | 8/7/2001 | 12/6/2018 | 195 | 0.39 |
| Chl-a Uncorrected (ug/L) | Lakewatch | Upper Myakka-Sarasota | 8/7/2001 | 11/9/2018 | 192 | 28.4 |
| TN (mg/L) | FDEP | LAKE MYAKKA (UPPER) @ MIDDLE | 3/14/2018 | 8/6/2019 | 9 | 1.67 |
| TP (mg/L) | FDEP | LAKE MYAKKA (UPPER) @ MIDDLE | 3/14/2018 | 8/6/2019 | 9 | 0.48 |
| Chl-a Corrected (ug/L) | FDEP | LAKE MYAKKA (UPPER) @ MIDDLE | 3/14/2018 | 8/6/2019 | 8 | 39.7 |
| TN (mg/L) | USGS | 2298800 | 10/2/1984 | 12/6/1991 | 72 | 4.13 |
| TP (mg/L) | USGS | 2298800 | 10/2/1984 | 12/6/1991 | 72 | 0.71 |

**Table 3.9 - Water Quality Data POR for Myakka River near Myakka City and Sarasota**

| Parameter | Agency | Site ID | Start Date | End Date | N | Location |
|---|---|---|---|---|---|---|
| TN (mg/L) | SWFWMD | 26046 | 10/8/1998 | 3/6/2019 | 230 | Near Sarasota |
| TP (mg/L) | SWFWMD | 26046 | 10/8/1998 | 3/6/2019 | 230 | Near Sarasota |
| Chl-a Corrected (ug/L) | SWFWMD | 26046 | 10/8/1998 | 1/3/2018 | 211 | Near Sarasota |
| TN (mg/L) | USGS | 02298830 | 6/11/1970 | 9/29/1999 | 138 | Near Sarasota |
| TP (mg/L) | USGS | 02298830 | 10/2/1962 | 9/29/1999 | 147 | Near Sarasota |
| TN (mg/L) | Manatee County | MR2 | 6/3/1997 | 12/5/2017 | 216 | Near Myakka City |
| TP (mg/L) | Manatee County | MR2 | 6/3/1997 | 12/5/2017 | 227 | Near Myakka City |
| Chl-a Corrected (ug/L) | Manatee County | MR2 | 6/3/1997 | 6/15/1998 | 8 | Near Myakka City |
| TKN (mg/L) | SWFWMD | 25585 | 11/2/1999 | 1/4/2010 | 7 | Near Myakka City |
| NOX (mg/L) | SWFWMD | 25585 | 10/8/1998 | 11/4/2015 | 179 | Near Myakka City |
| TP (mg/L) | SWFWMD | 25585 | 10/8/1998 | 11/4/2015 | 179 | Near Myakka City |
| Chl-a Corrected (ug/L) | SWFWMD | 25585 | 10/8/1998 | 11/4/2015 | 178 | Near Myakka City |

### 3.4.2. Water Body Impairments

According to FDEP's Impaired Waters Rule (IWR; F.A.C. Ch 62-303), various waterbody impairments exist within the UML and its surrounding WBIDs (**Table 3.10, Exhibit 3.4**). The UML is impaired for mercury in fish tissues and for total phosphorus concentrations (TP). The Myakka River WBID just upstream of the north end of the lake is impaired for dissolved oxygen (DO, percent saturation), fecal coliforms, mercury in fish tissues and macrophytes. Clay Gulley, a tributary just upstream of the north end of the lake, is impaired for fecal coliforms and mercury in fish tissues. Howard Creek, a tributary just upstream of the southwest end of the lake, is impaired for DO (percent saturation), fecal coliforms, mercury in fish tissues, iron, and TP. The Myakka River directly downstream of the UML outlet WCS, WBID 1981B is impaired for DO (percent saturation), mercury in fish tissue, and algal mats. Nutrients and lower velocities are known to contribute to algal mats, and algal decomposition likely contributes to biological oxygen demand (BOD), thereby reducing DO. Although these impairments have been identified, the FDEP has not issued any TMDLs within the project area. The EPA issued a draft TMDL for DO and nutrients for WBID 1981B in 2013.

**Table 3.10 – Summary of Myakka River Waterbody Impairments by WBID**

| WBID | Name | FDEP Verified Impairments | EPA Verified Impairments |
|---|---|---|---|
| 1972B | Clay Gulley East | Mercury (fish tissue) | None |
| 1972 A | Clay Gulley West* | Fecal Coliforms, Mercury (fish tissue) | None |
| 1877C | Myakka River North Fork* | DO (% Sat), Fecal Coliforms, Mercury (fish tissue), Nutrients (macrophytes) | None |
| 1877A | Myakka River, Upper Segment | Fecal Coliforms, Mercury (fish tissue) | None |
| 1940 | Howard Creek* | DO (% Sat), Fecal Coliforms, Mercury (fish tissue), Iron, TP | None |
| 1949 | Howard Creek Northeast Branch | None | None |
| 1981C | Upper Myakka Lake | Mercury (fish tissue), TP | None |
| 1981B | Myakka River** | DO (% Sat), Mercury (fish tissue), Nutrients (algal mats) | BOD, TN, TP |
| 1981 | Myakka Lake (lower segment) | Mercury (fish tissue) | None |

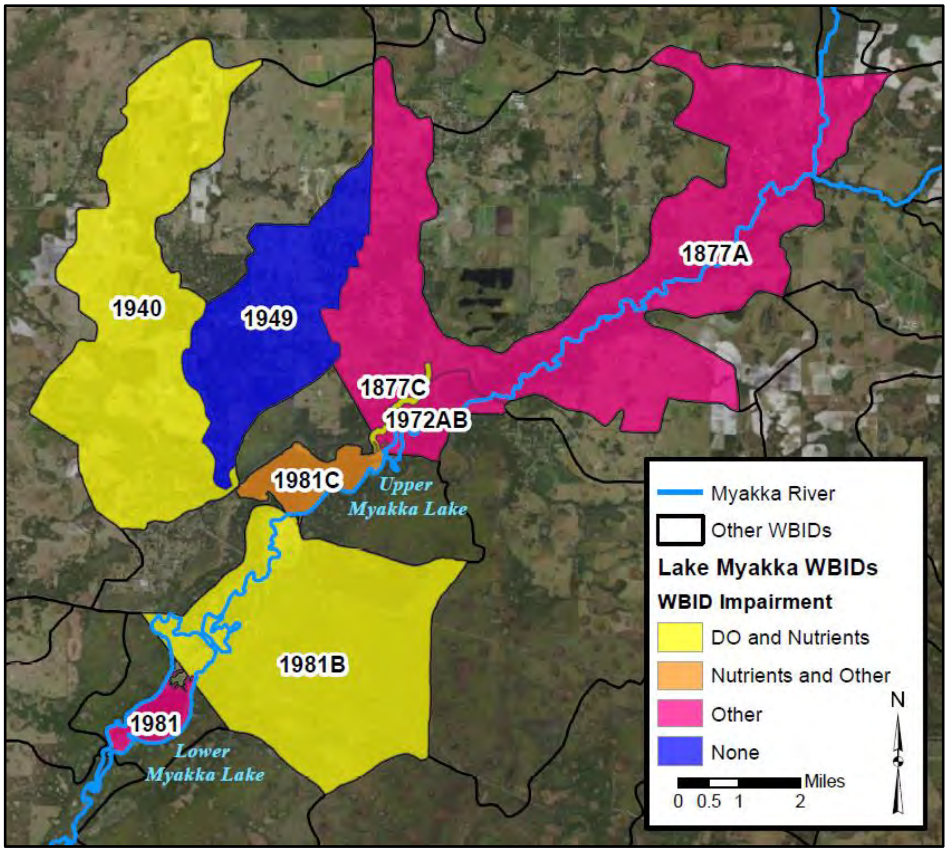
* WBID immediately upstream of Upper Myakka Lake
** WBID immediately downstream of Upper Myakka Lake

Streams in the West Central region of Florida (including most of the Alafia, Myakka, and Peace River watersheds) are subject to numeric nutrient criteria (NNC) thresholds of 1.65 mg/L TN and 0.49 mg/L TP, with floral evidentiary thresholds for chlorophyll-a (Chl-a) based on assessments of algal communities, linear vegetation surveys, and other ecological variables. The riverine WBIDs of the Myakka River are all subject to the West Central stream NNC, and the annual geometric mean (AGM) concentrations of TN and TP are not to exceed the NNC thresholds. If the annual geometric mean concentrations exceed the NNC more than once in a three-year period, the WBID is considered impaired.

Lakes in Florida follow a separate set of NNC thresholds per 62-302.531(2)(b)1., F.A.C. Upper Lake Myakka is a colored lake, with a long-term geometric mean color of 124 PCU. For colored lakes, the NNC for chlorophyll-a corrected for pheophytins is 20 ug/L. If the chlorophyll-a annual geometric mean exceeds NNC, the TN and TP NNC for that year are 1.27 mg/L and 0.05 mg/L, respectively. If the annual geometric mean of Chl-a is less than 20 ug/L, the TN and TP NNC for that year are 2.23 mg/L and 0.49 mg/L, respectively. If the annual geometric mean concentration exceeds NNC more than once in a three-year period, the WBID is considered impaired.

Using available data from the FDEP's most recent IWR Database (Run 58) for the Upper Lake Myakka WBID (1981C), a brief NNC assessment was performed. TP, TN and Chl-a concentrations exceeded NNC from 2009 until 2013. TN and Chl-a appeared to decrease since 2009. The more recent period of 2014-2019, except for 2018, all nutrient parameters met the NNC thresholds. Overall, Chl-a displays sustained decreases, with the concentration in 2019 less than half the concentration in 2009, even though TN and TP have fluctuated at relatively similar concentrations throughout the period of record. Results of NNC comparisons are shown in **Table 3.11**.

**Exhibit 3.4 – Upper Myakka Lake and Surrounding WBIDs**




Note: Map only shows impairment status of WBIDs in Table 3.10.

**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.

A similar NNC assessment was performed on the downstream Myakka River WBID 1981B, which is listed as impaired for DO, mercury, and algal mats. Using available data for the WBID from the IWR Run 58 database, the annual geometric mean concentrations were calculated and compared to the West Central region stream nutrient thresholds of 1.65 mg/L TN and 0.49 mg/L TP (**Exhibits 3.5-3.7**). Both TN and TP concentrations have met NNC thresholds all but three years from 1980 to 2019. TN and TP concentrations also appear to have been decreasing in recent years. While Chl-a does not have a concentration-based NNC, the AGM concentrations were below 20 ug/L for most years with available data. It does appear that while TN and TP concentrations have been decreasing, Chl-a concentrations have been increasing from the early 2000s to 2019, suggesting that factors other than nutrients (such as changes in hydrology, algal and/or macrophyte community abundance) may be influencing increases in algal growth and Chl-a production.

**Exhibit 3.5 – Annual Geometric Mean TN in WBID 1981B Compared to NNC**

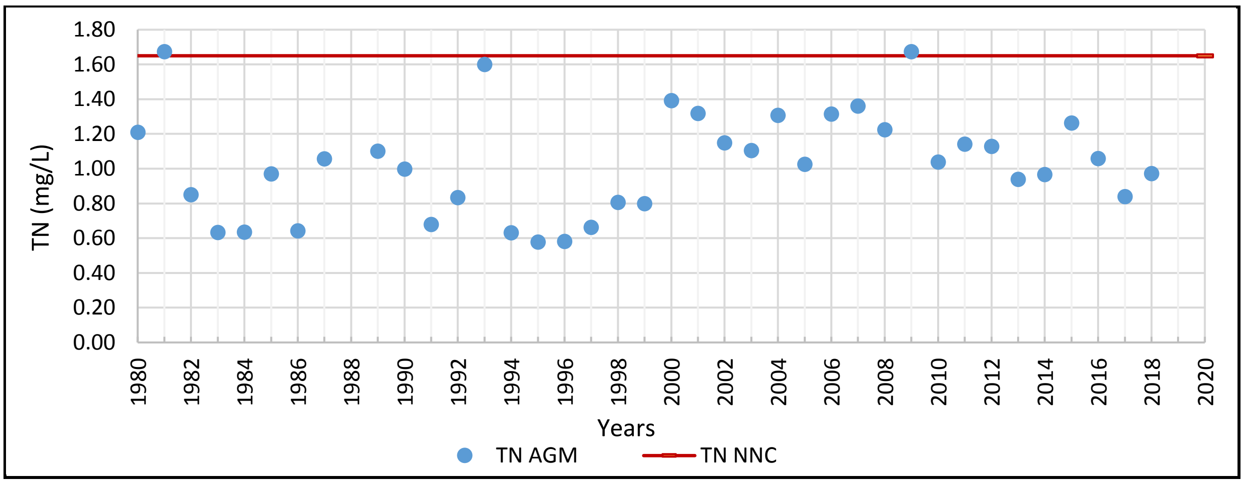



**Exhibit 3.6 – Annual Geometric Mean TP in WBID 1981B Compared to NNC**

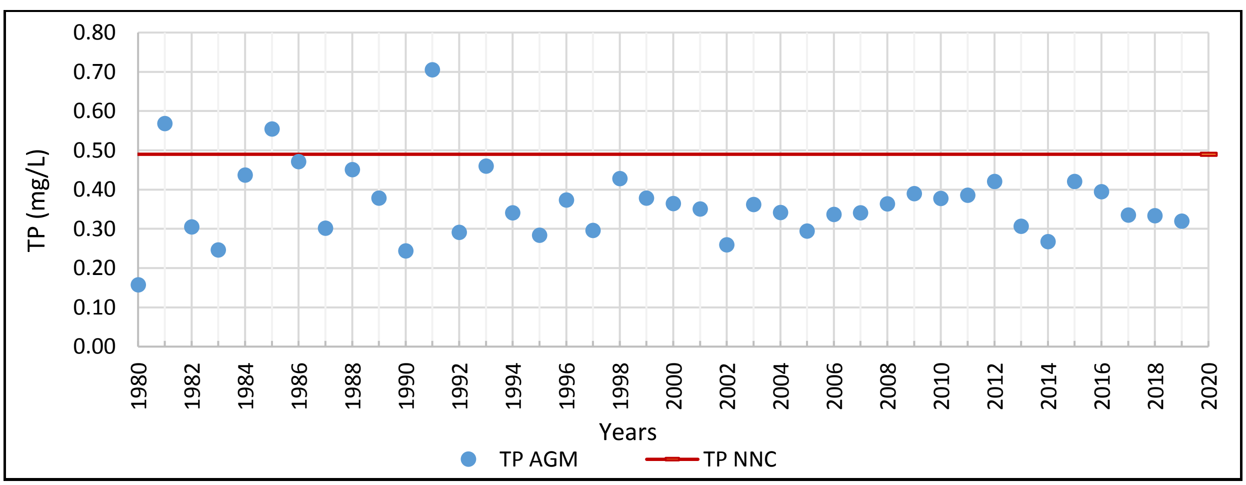
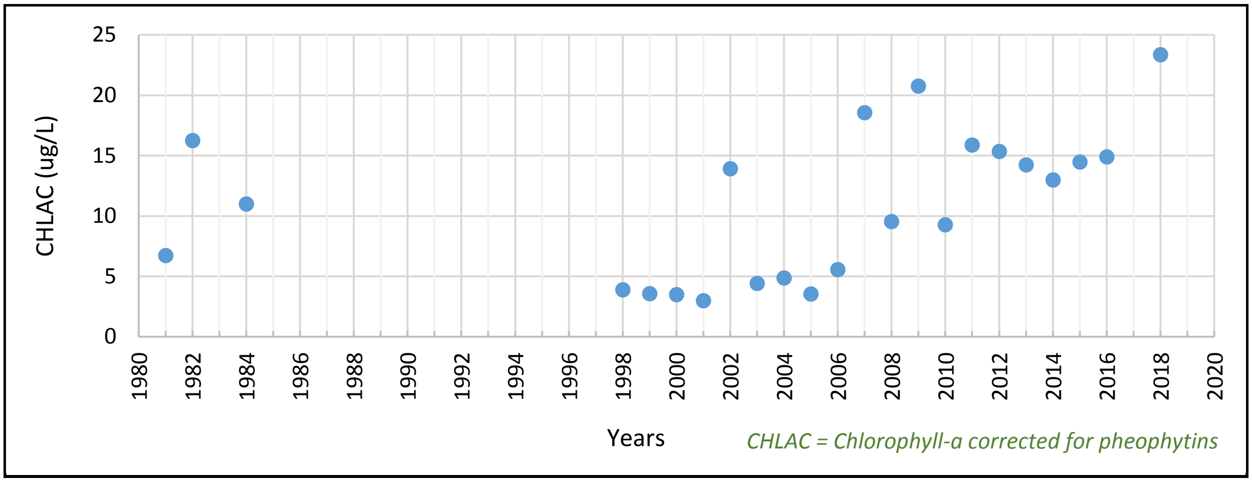


**Exhibit 3.7 – Annual Geometric Mean Chl-a (Corrected) in WBID 1981B**




### 3.4.3. Preliminary Water Quality Assessment

Spearman Rho correlation analysis was performed to assess relationships between water quality and hydrologic parameters in Upper Myakka Lake and the downstream river WBID. The correlation analysis was performed using data from stations with the most continuous periods of record: Lakewatch Upper Myakka-Sarasota station in the Lake WBID 1981C and the USGS/SWFWMD Myakka River near Sarasota station in the downstream river WBID 1981B (**Tables 3.12-3.13**). In the lake, Chl-a was positively, significantly correlated to TN, but negatively, significantly correlated to TP, suggesting that the lake is nitrogen-limited. Chl-a was negatively, significantly correlated to lake level, suggesting higher Chl-a concentrations during times of lower lake levels. This may be attributed to the effects of increased resuspension of sediments prompting algal productivity. Based on previous Wood studies, managed lakes often show similar correlations between higher water levels and lower Chl-a concentrations, however, where flow data are available, Chl-a tends to decrease with increased flow. In managed lake systems with weirs or release thresholds, higher flows occur with higher water levels, and lower water levels are associated with low or no flow.

**Table 3.12 – Correlation Results for Available Parameters in WBID 1981C**

| | TN | TP | Chl-a (unc.) |
|---|---|---|---|
| TP | 0.152 | | |
| | 0.2 | | |
| Chl-a (unc.) | 0.449 | -0.321 | |
| | **0** | **0.006** | |
| Gage Height | -0.065 | 0.635 | -0.71 |
| | 0.722 | **0** | **0** |

Note: Chl-a unc. = Chlorophyll-a uncorrected. The corrected parameter did not have sufficient POR for analysis. Analysis performed on all available data from August 2001 to August 2019.
Top value in cell is Spearman Rho correlation coefficient, and bottom value is p-value. Bold p-values are significant at alpha=0.05. Green shading indicates positive correlation, and red shading indicates negative correlation.

**Table 3.13 – Correlation Results for Available Parameters in WBID 1981B**

| | DO | Chl-a | TN | TP | Flow |
|---|---|---|---|---|---|
| **Chl-a** | 0.131 | | | | |
| | 0.099 | | | | |
| **TN** | -0.078 | 0.215 | | | |
| | 0.194 | **0.006** | | | |
| **TP** | -0.641 | -0.011 | 0.05 | | |
| | **0** | 0.894 | 0.391 | | |
| **Flow** | -0.617 | -0.32 | -0.158 | 0.343 | |
| | **0** | **0** | **0.007** | **0** | |
| **Gage Height** | -0.659 | -0.349 | -0.117 | 0.386 | 0.927 |
| | **0** | **0** | **0.045** | **0** | **0** |

Note: Analysis performed on all available data from May 1967 to March 2019.
Top value in cell is Spearman Rho correlation coefficient, and bottom value is p-value. Bold p-values are significant at alpha=0.05. Green shading indicates positive correlation, and red shading indicates negative correlation.

Correlation results with downstream river data showed that Chl-a is positively, significantly correlated to TN, but not correlated to TP, again suggesting a nitrogen-limited system. Flow and water level were negatively, significantly correlated to DO, Chl-a and TN, suggesting these parameters decrease with increasing flow and level. Water level was positively significantly correlated to TP and flow.

## 3.5. Vegetation

### 3.5.1. Existing Data

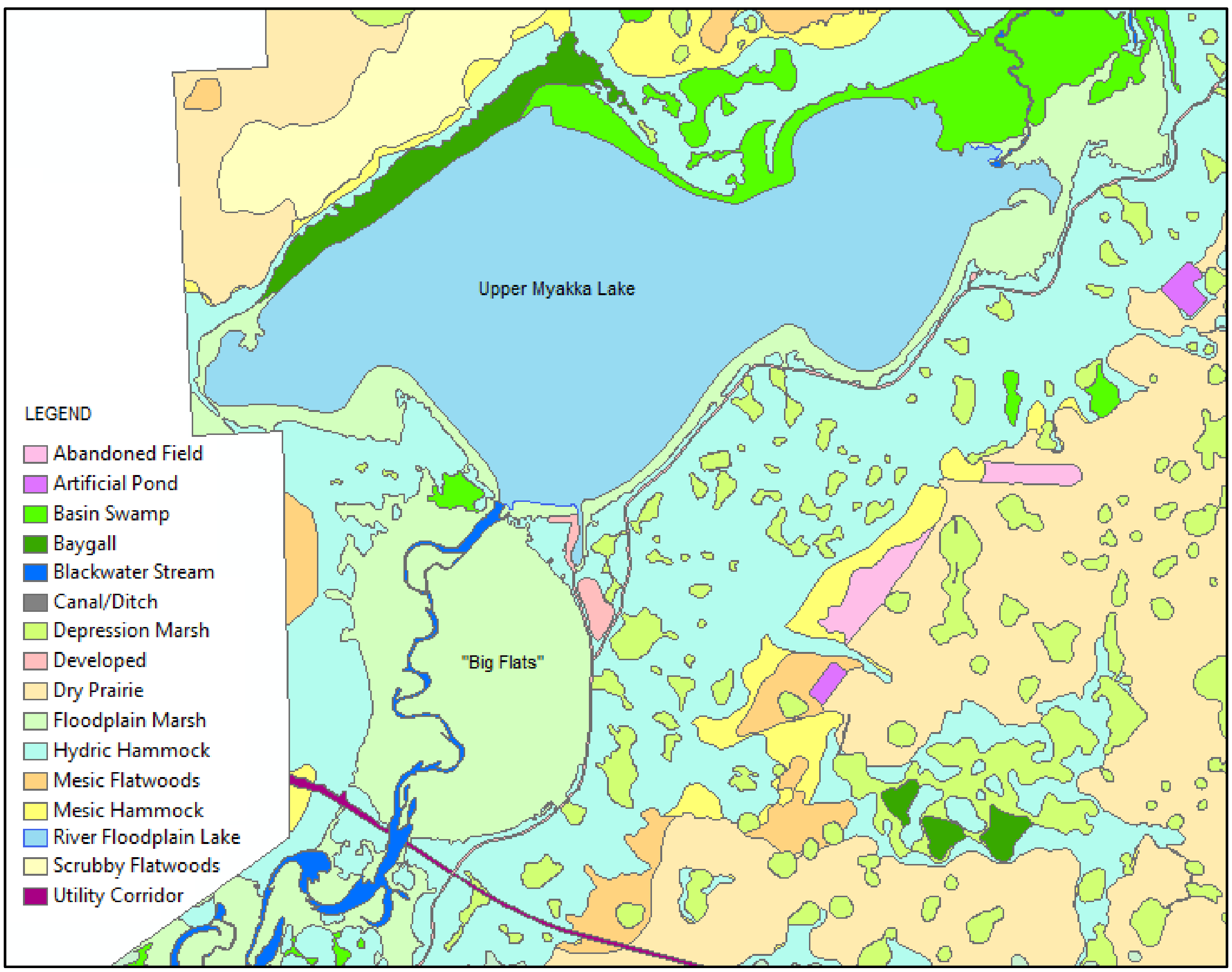
According to the MRSP Unit Management Plan (FDEP, 2019), the vegetation within the lakes has fluctuated greatly over the last 70 years. During the period between 2001 and 2010, little native aquatic vegetation occurred. In the spring of 2010, yellow waterlily (*Nymphaea mexicana*) was present and continues to persist along with a few other aquatic plants. In the past, nuisance exotic plants such as hydrilla (*Hydrilla verticillata*) and water hyacinth (*Eichhornia crassipes*) have invaded both lakes, but historically SWFWMD, and more recently FWC has been actively controlling these aquatic exotics. Although there were several years when vegetation in the Upper Myakka Lake was sparse, currently found are smartweed (*Polygonum setaceum*), softstem bulrush and yellow waterlily. Two non-native invasive grasses, Paragrass and West Indian marshgrass, line the edge of lake. Common reed (*Phragmites australis*), although considered native, has grown into large bands around 3 sides of the Upper Myakka Lake. Agricultural activities, spray irrigation fields and an effluent treatment system along Howard Creek are possible contributors to the poor water quality of the lakes (Lowrey et al. 1989). The upper and lower lakes serve as two of the many detention areas within the Myakka River watershed that are nutrient-enriched and exhibit seasonally low dissolved oxygen levels.

Ecological community data were also collected for the Upper Myakka River MFL study (SWFWMD, 2005). Vegetative transect locations are shown in **Figure 6A** and detailed transect survey cross-sections are provided in **Appendix A**.

### 3.5.2. Ecological Communities Assessment

The ecological communities within the vicinity of UML are provided in **Exhibit 3.8**. UML is surrounded by various wetland communities, including floodplain marsh, basin swamp, baygall, and hydric hammock. The floodplain marsh along the lake shore comprises approximately 172 acres, while the floodplain marsh immediately downstream of UML referred to as "Big Flats" comprises approximately 320 acres. The various communities which comprise the lake and river floodplain, including the hydric hammock, are seasonally inundated during the wet season when lake and river levels are high.

**Exhibit 3.8 - Myakka River State Park Ecological Communities within the Vicinity of UML (FDEP, 2019)**



## 3.6. Wildlife

### 3.6.1. Existing Data

The river is an important wildlife corridor for the region, and its floodplain marsh within the MRSP is critical habitat of resident and migratory birds. According to an FDEP memorandum, during periods of sufficient water level (approximately 3.5 feet as measured from the SR 72 USGS gage) manatees have been sighted in the Myakka River including both the LML and UML. There have been approximately one hundred manatee observations since 2012 within MRSP with the vast majority within the general UML/Big Flats project area. During periods of lower water levels, the UML weir and Downs' Dam have proven to be an obstacle to wildlife traversing the river. In January 2014, a juvenile manatee stranding occurred at Downs' Dam and was successfully rescued by FWC and FPS staff.

According to the MRSP Unit Management Plan (2019), invasive exotic fish including blue tilapia (*Oreochromis aureus*), brown hoplo (*Hoplosternum littorale*), sailfin suckermouth catfish (*Pterygoplichthys* spp.) and walking catfish (*Clarias batrachus*) are well established in the lakes. In 2012, an exotic snail, the island apple snail was found in the Upper Myakka Lake. It is now residing in both the Upper and Lower Myakka Lakes.

### 3.6.2. Wildlife Data Analysis

No additional wildlife data were collected for this plan. The existing wildlife data were used to assess the feasibility of the three alternatives.

## 4.0 MODELING

Event and continuous modeling were conducted to compare the alternatives assessed for this feasibility study. Event modeling was conducted to identify any adverse offsite impacts (flooding) during the 2.33-year, 25-year, and 100-year 24-hour design storms among the various alternatives; and continuous modeling was conducted to assess differences across the full hydrologic regime (which includes both wet and dry periods) among the various alternatives. The alternatives assessed are listed below:

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

The full event modeling and continuous modeling reports/memos submitted in prior deliverables are provided in **Appendices E** and **F**, respectively. This section of the report summarizes the pertinent findings of those reports.

### 4.1. Event Modeling Summary and Conclusions

Single event simulations using the ICPR4 software were conducted for the 2.33-year 24-hour (mean annual), 25-year 24-hour, and 100-year 24-hour design storms. Based upon the model results, no significant offsite impacts are shown in the model analysis for any of the three alternatives/proposed conditions. Note that the proposed conditions modeled include the Tatum Sawgrass Marsh restoration. Although not yet constructed, this restoration was included in the model to review a big picture restoration in this vicinity.

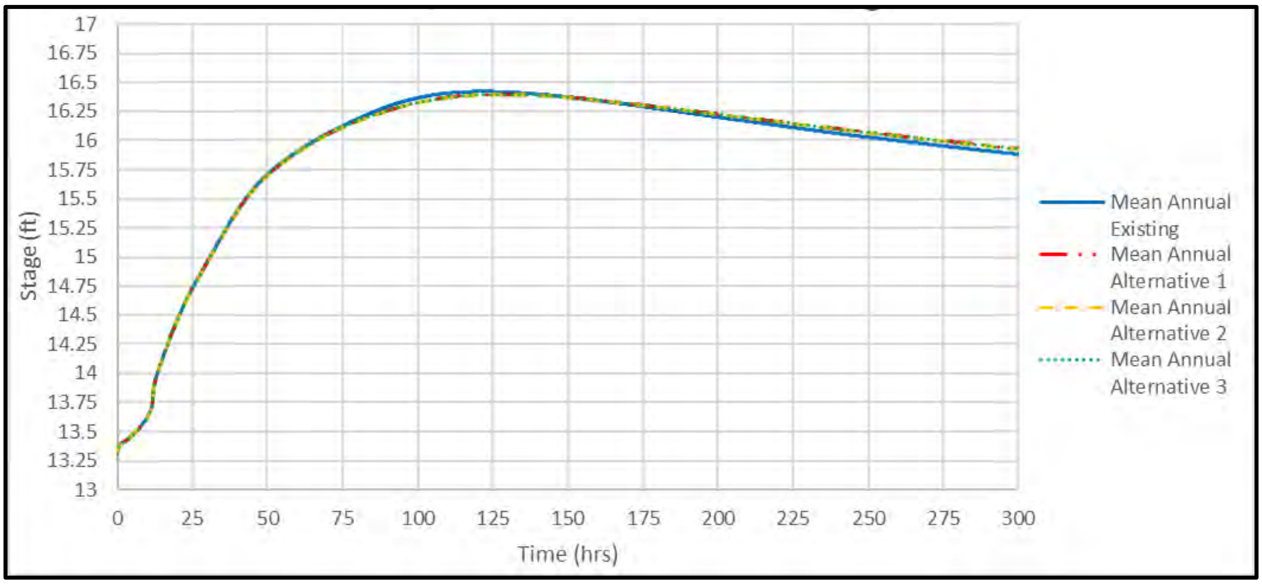
**Table 4.1** shows that compared to the baseline condition (Alternative 3 - Rebuild), there are no differences in peak flood elevations in either **Alternative 1** (Removal) or **Alternative 2** (Modification) during any of the design storms modeled. The stages for UML are presented in **Exhibits 4.1, 4.2** and **4.3** and show negligible changes in stage for UML as a result of the alternatives for any of the analyzed storm events. **Exhibits 4.4, 4.5** and **4.6** show the flow rates for the mean annual, 25-year 24-hour, and 100-year 24-hour storm events, comparing all proposed alternatives to the exiting conditions model. Overall, the flow rates of the three proposed alternative models are similar to the flow rates in the existing model, with **Alternative 1** and **Alternative 2** showing slightly higher peak flow rates.

Therefore, the results of the flood stage modelling do not drive which alternative should be selected, as all alternatives show good correlation with existing conditions in the three analyzed storm events.

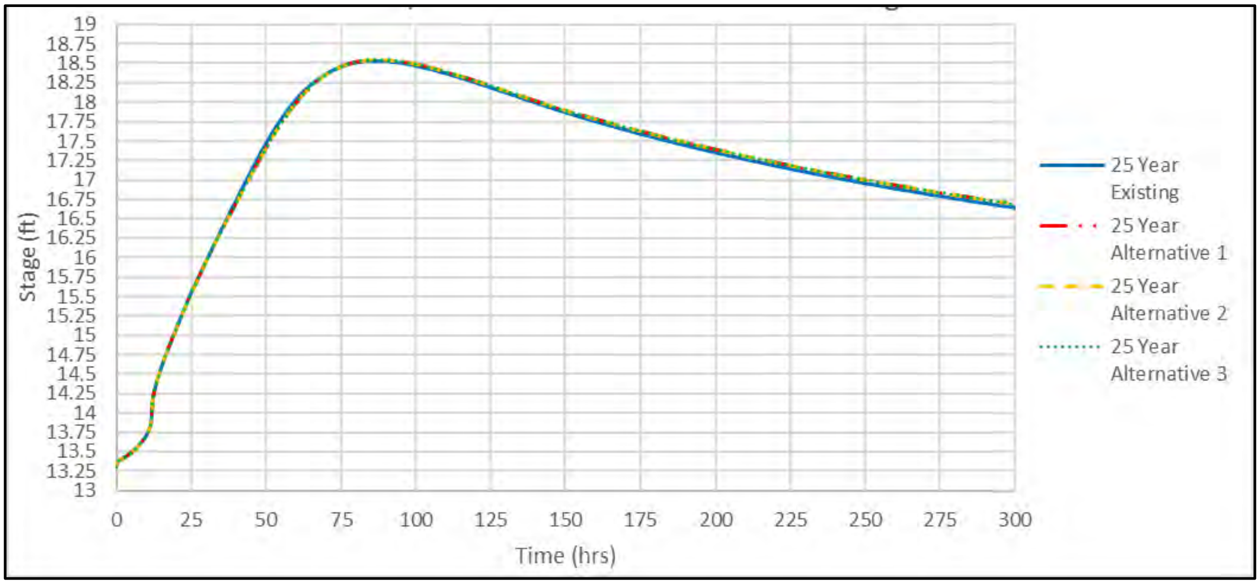
**Table 4.1 - Summary of Differences in Peak Flood Elevations from Baseline Condition (Alternative 3 – Rebuild) in Feet**

| Reference Nodes | 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 |
| UM_A02170_N | State Road 70 Bridge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A00410_N | Myakka Road Bridge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A00362_N | Clay Gully Road Bridge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A00300_N | Upper Lake Myakka | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A05118_N | Vanderipe Slough | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A00090_N | Myakka State Park Road Bridge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| UM_A00000_N | State Road 72 Bridge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**Exhibit 4.1 - UML Stage, Mean Annual Storm Event**



## Exhibit 4.2 - UML Stage, 25-year 24-hour Storm Event




## Exhibit 4.3 - UML Stage, 100-year 24-hour Storm Event

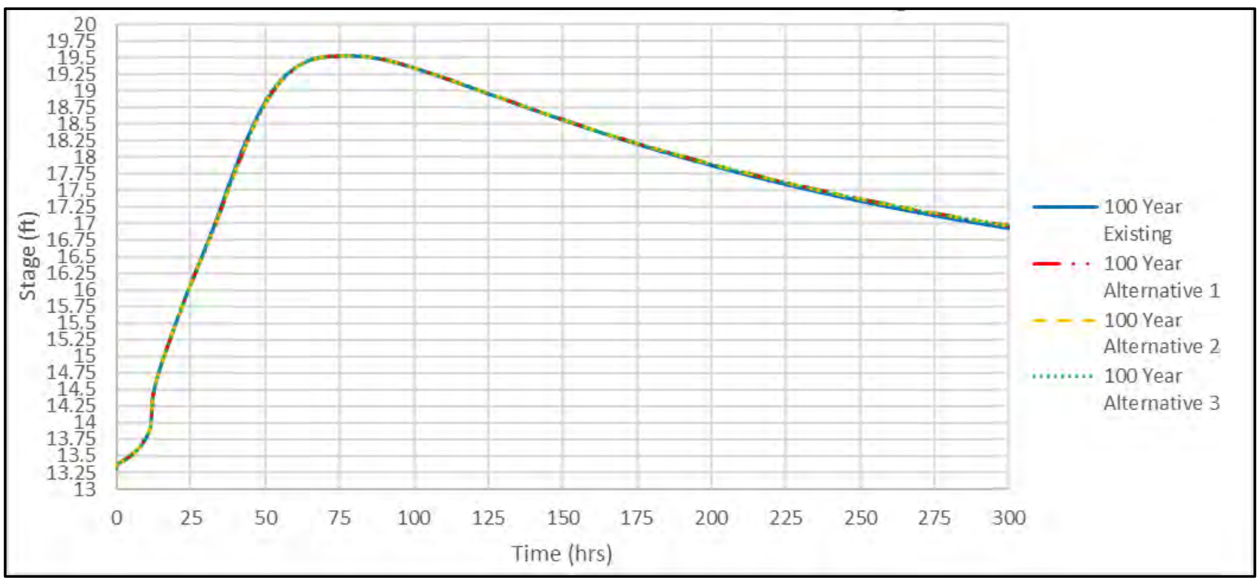


**Exhibit 4.4 - UML Downstream Channel Flow, Mean Annual Storm Event**

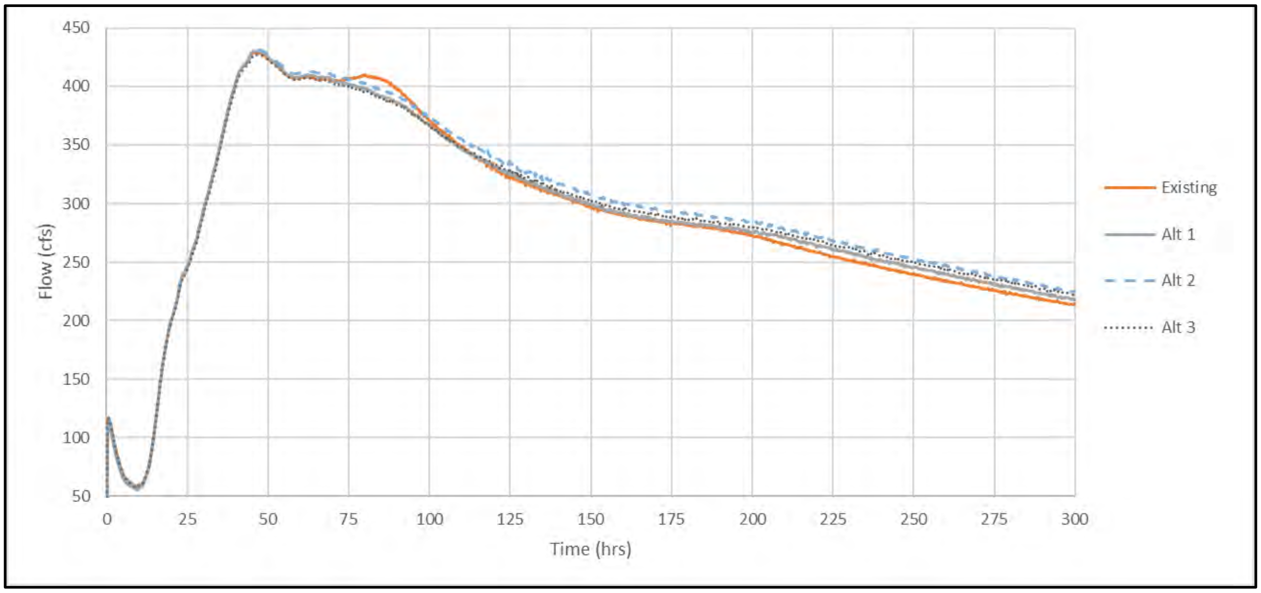



**Exhibit 4.5 - UML Downstream Channel Flow, 25-year 24-hour Storm Event**

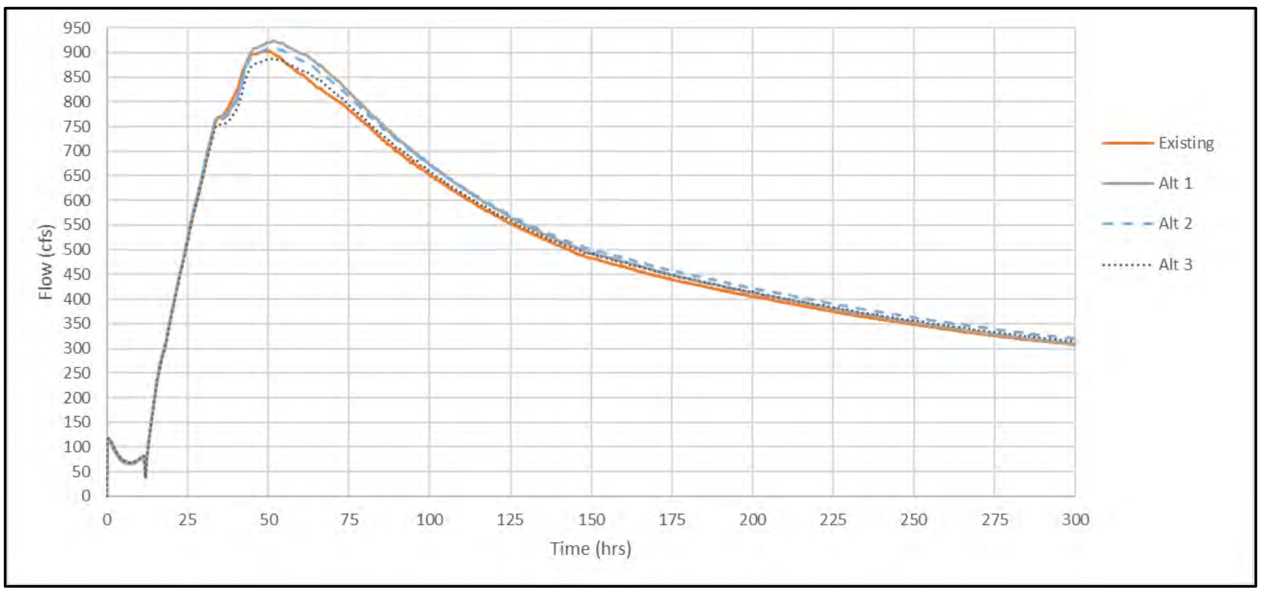
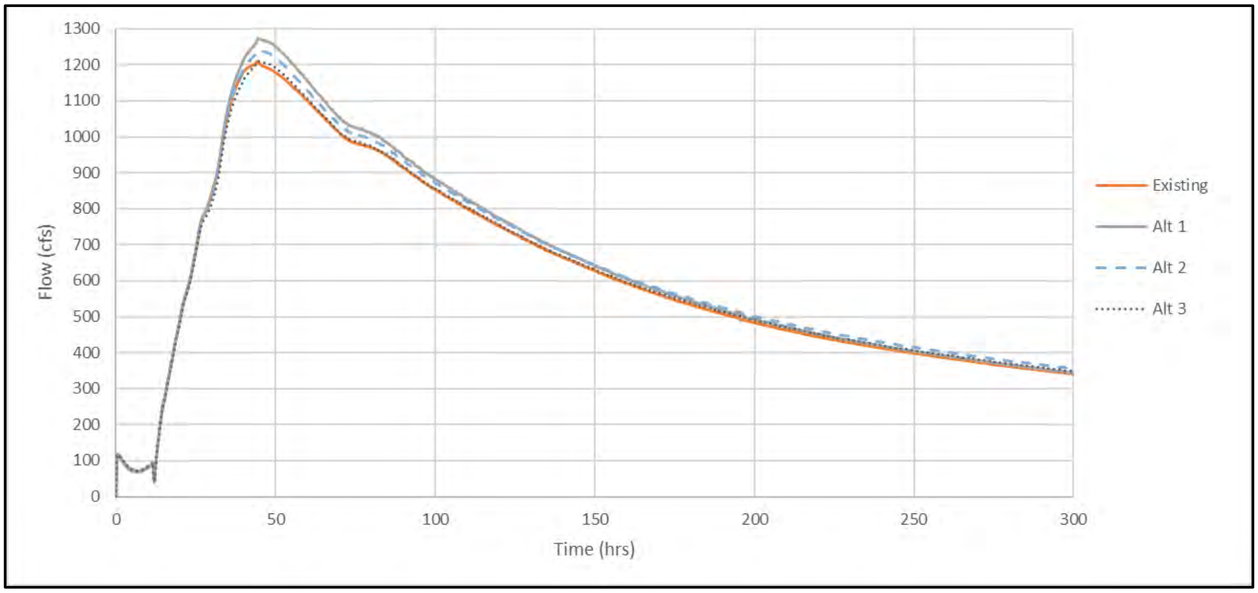


**Exhibit 4.6 - UML Downstream Channel Flow, 100-year 24-hour Storm Event**




### 4.2. Continuous Modeling Summary and Conclusions

Continuous modeling of daily flow and water levels over a simulation period of 16 years was conducted to assess seasonal conditions, including low and high water levels. The UML WCS is a low-water weir built to hold back water in the low water season, and it is submerged during the wet season. Therefore, to evaluate the impacts of the three alternatives on the overall UML water levels, a detailed integrated surface and groundwater MIKE SHE model was setup. The UML integrated model (derived from the MRWI model, with adjustments) was recalibrated and verified against long-term observed lake level data.

Three alternatives including WCS removal and re-wilding (**Alternative 1**), reducing weir height (**Alternative 2A**), and rebuilding the existing structures (**Alternative 3**) were simulated, and their potential impacts on the lake water levels were estimated. Additionally, a sensitivity analysis was performed to assess differences in results when widening the bypass (**Alternative 2B**) versus lowering the weir. The model results showed that the three options had minor impact on overall lake levels, with weir removal (**Alternative 1**) allowing for the lowest overall lake levels (**Exhibit 4.7**). Exceedance frequency analysis conducted to evaluate shifts in the water level patterns indicated that if the WCS is removed, the seasonal high would reduce by 0.1 ft, while the seasonal low water level would reduce by 0.3 feet compared to the baseline condition. This decrease in seasonal low water level results in approximately 70 acres of additional land exposed during seasonal low water level conditions, an area which could shift from open water habitat to wetland habitat (**Exhibit 4.8**).

**Exhibit 4.7 - UML Water Level Exceedance Frequency Curve for Proposed Alternatives**

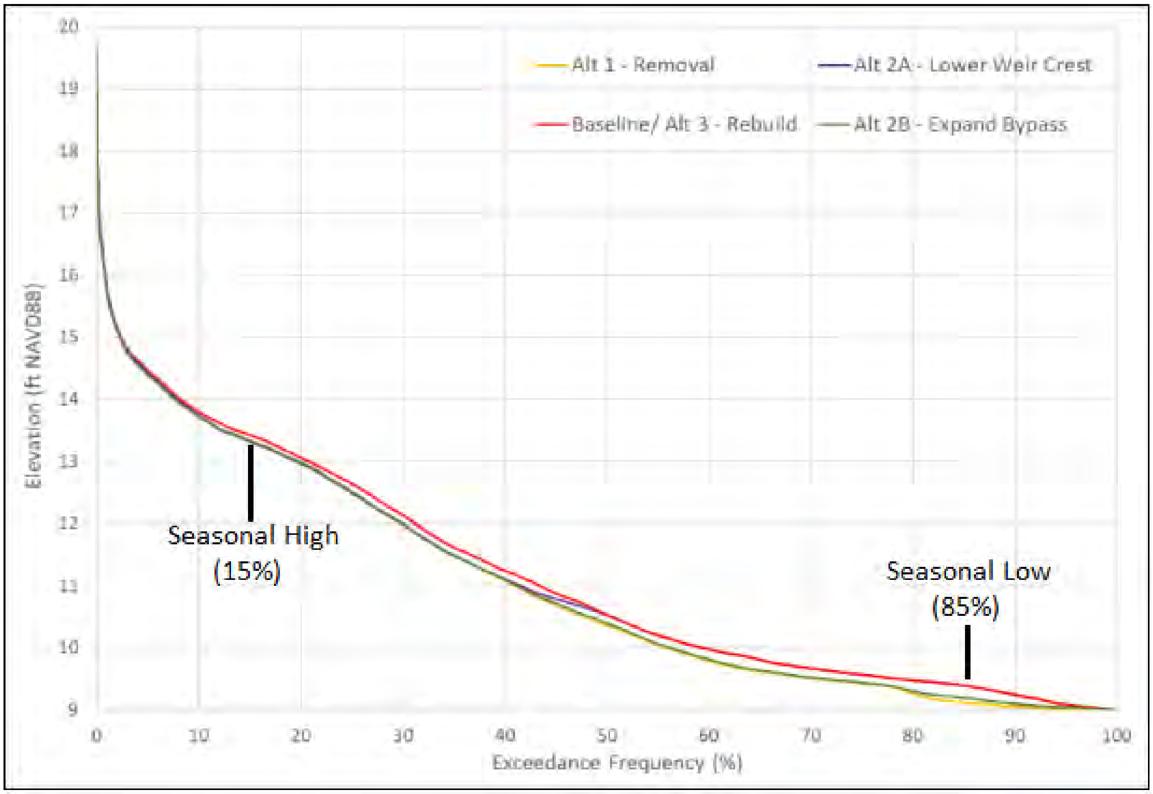
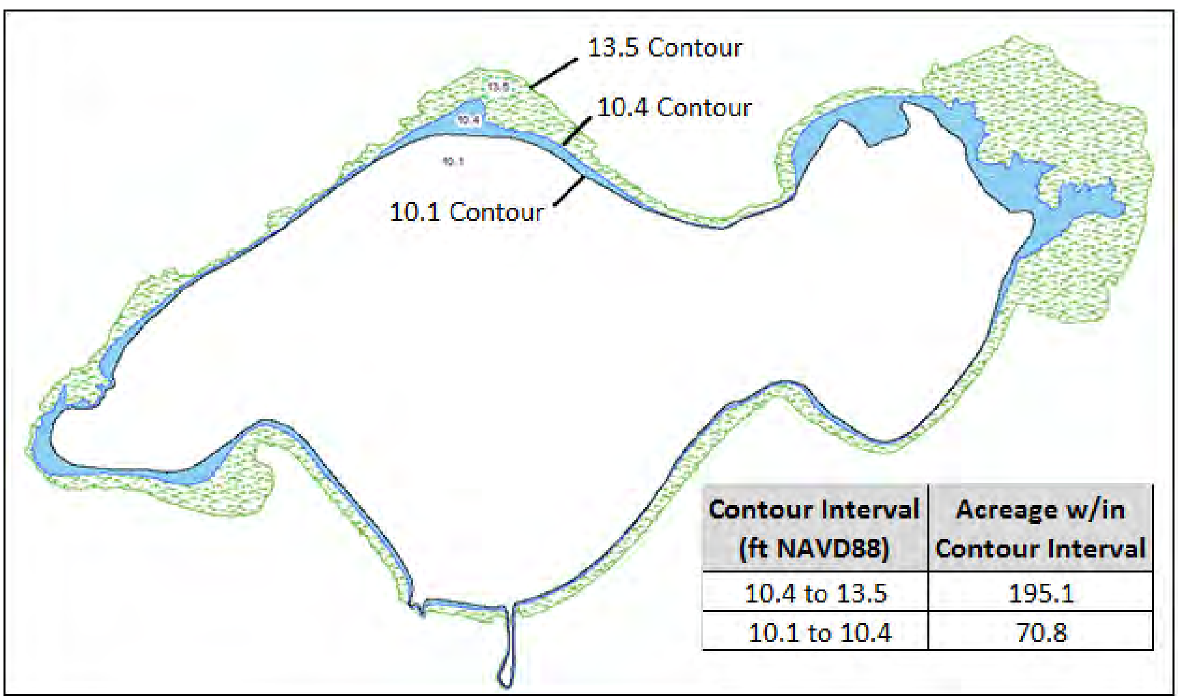


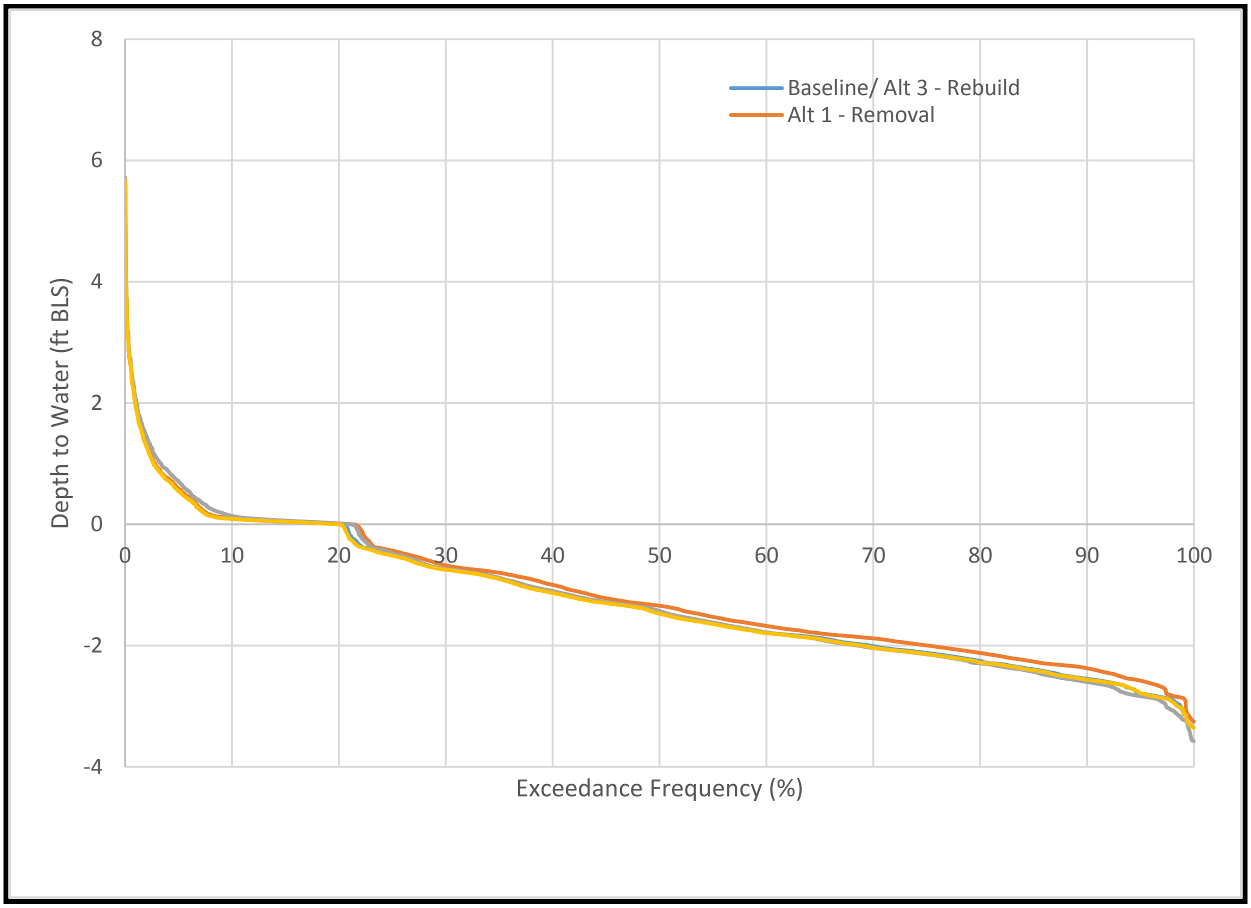

**Exhibit 4.8 – Additional Exposed Lakebed Acreage Resulting from 0.3 ft Lowering of Seasonal Low Water in UML**




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

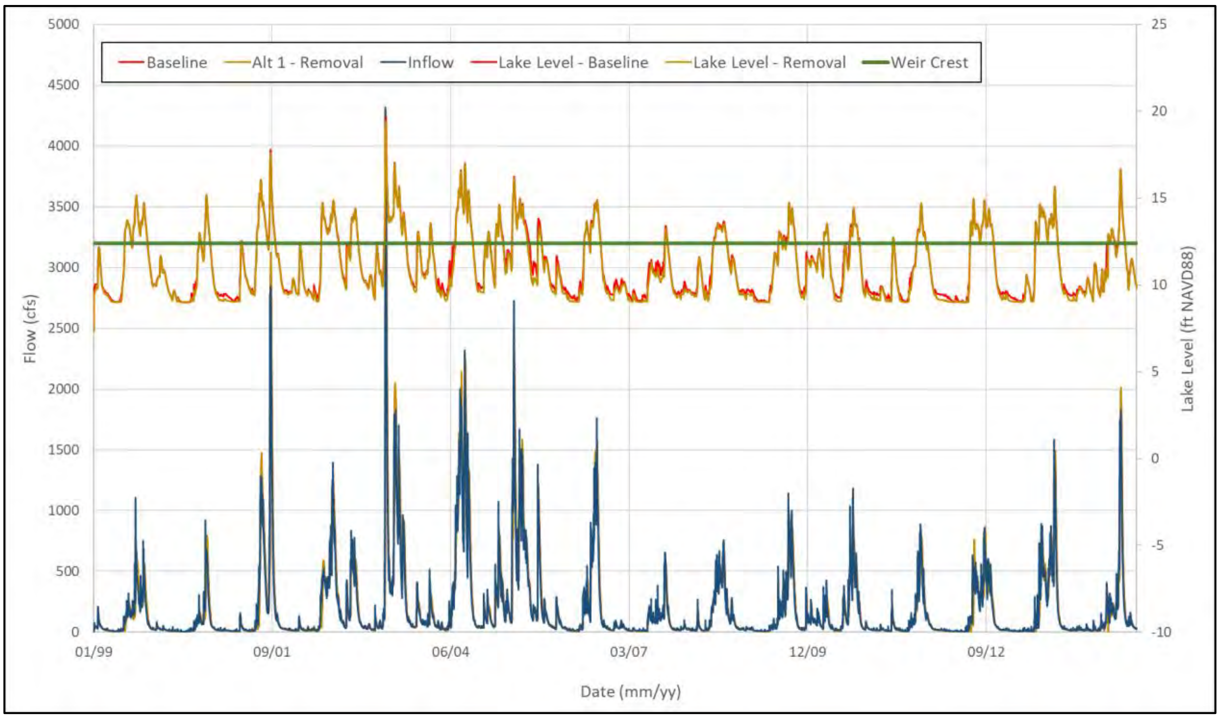
Water levels downstream of the lake, within the floodplain marsh area referred to as "Big Flats," were also assessed. **Exhibit 4.9** shows the exceedance frequencies of each alternative. The removal/re-wilding option (**Alternative 1**) shows a slightly higher exceedance frequency for water levels corresponding to a depth to water above zero (which means the water table is above ground). This translates to five additional days per year that the floodplain marsh is inundated compared to the baseline/rebuild condition. The seasonal low water level is 0.1 ft higher in the removal/re-wilding option than in the baseline/rebuild option, while seasonal high water levels show no difference. This does not represent a functional shift because the baseline SLW is 2.4 ft below the ground surface. The median water level is also slightly higher (0.1 ft) in the removal/re-wilding option than in the baseline/rebuild option.

**Exhibit 4.9 - Downstream Wetlands (Big Flats) Depth to Water Exceedance Frequency Curve for Proposed Alternatives**




Another important aspect that was evaluated as part of this investigation was the impact of the removal option on flows downstream of the WCS. **Exhibit 4.10** shows the time-series plots for the simulated period of record, including both lake level stages and flows. The removal of weir does not appear to have a significant impact on the downstream flow regime. Comparing the inflow to the outflow made it clear that under the baseline conditions, the overall flow capacity (with bypass culverts under low flow and additional overflow capacity from the weir during high flows) is sufficient to match the expected lake inflows. Removal of weir intuitively created additional conveyance capacity at lower stages; however, since the inflows are not expected to change, the additional capacity does not seem to result in increases in downstream flows. Additionally, there is an existing downstream shoal feature that has an approximate crest elevation of 9.4 feet NAVD88 (about one foot higher than the lowest elevation of the removal profile). This controlling shoal crest affects lake outflow as well as lake levels, especially during low flow conditions where water stages up behind the controlling shoal crest, ultimately controlling how low the lake level can go.

**Exhibit 4.10 – Simulated Downstream Flow and Corresponding Inflow and Lake Level Time-Series**



## 5.0 ALTERNATIVES ANALYSIS

This section provides a feasibility study and comparison of three Upper Myakka Lake (UML) water control structure (WCS) project alternatives; 1) Weir and Bypass Removal and Natural System Restoration (Removal), 2) Structure Modernization (Modification), and 3) Structure Reconstruction (Rebuild). These alternatives were assessed with regards to water quantity, natural systems, sediment, water quality, environmental considerations, fish/wildlife passage, recreation, permitting, and construction cost estimates.

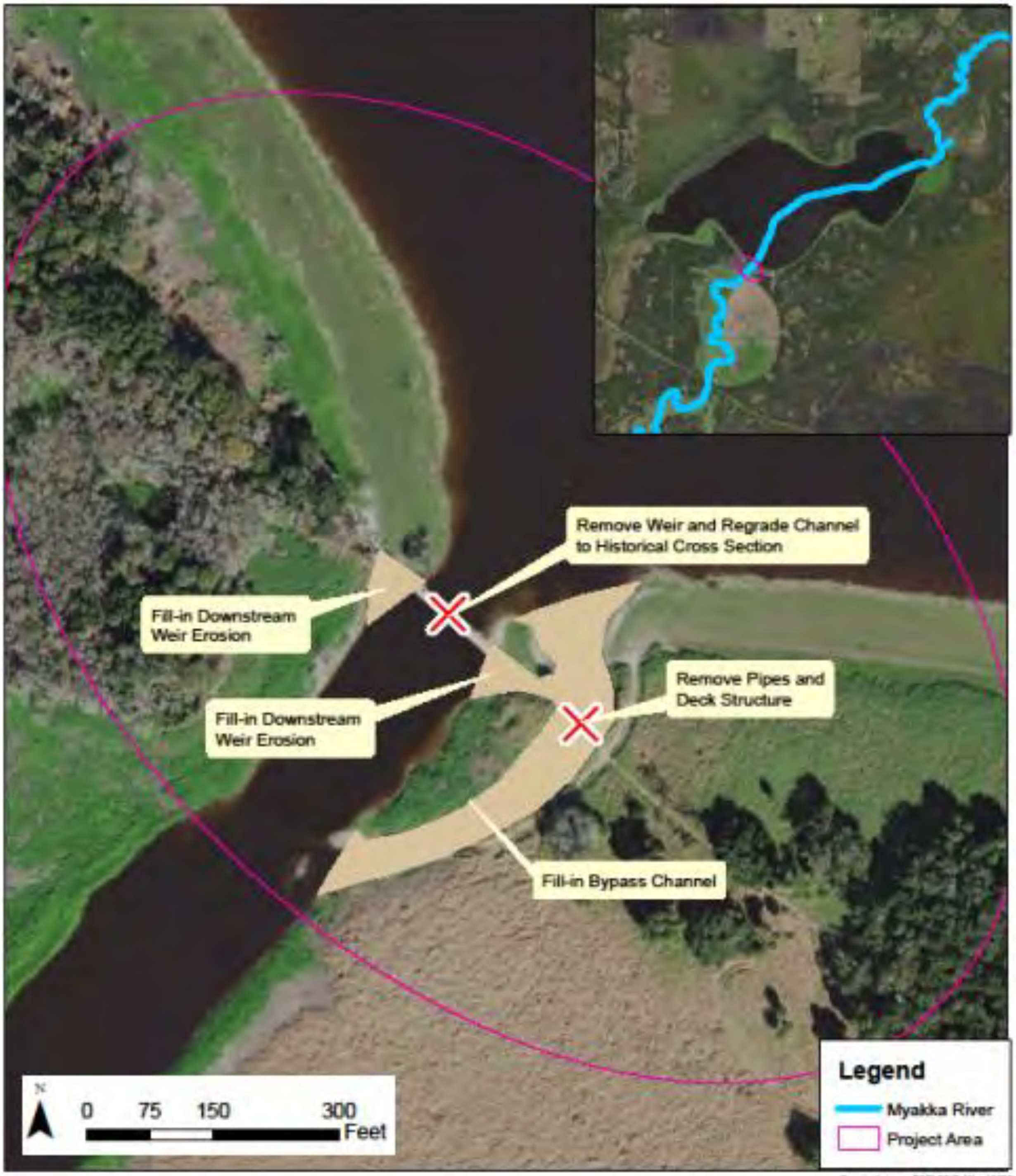
### 5.1. Alternative 1 – Weir and Bypass Removal and Natural System Restoration

**Alternative 1** involves removing the deteriorating weir and bypass structures, filling the artificial bypass channel and weir-induced erosion areas, and grading the lake outlet channel to more closely resemble the pre-altered natural channel cross section outfall from UML. This alternative restores the transition between the UML and Myakka River to be more like the pre-altered, uneroded condition. It uses the applied sciences of soil bioengineering and natural channel design to create a naturally appearing conveyance with a stable pattern and dimension at this altered lacustrine-riverine transition.

The proposed morphology includes a 220-ft wide bankfull channel subsuming a streambed with a thalweg at 8.4 ft NAVD and an inner berm at 8.9 ft NAVD. The adjacent floodplain remains at existing grade. The design grades were derived from interpretation of a suite of historical maps, original engineering documents, special purpose survey, and aerial interpretation – and were further vetted by hydrologic and hydraulic modeling. A basic concept plan for Alternative 1 is shown in **Exhibit 5.1**. Refinements could include invoking a more complex cross-section to better fit existing grades and minimize earthwork. For example, leaving greater relief at the current island position and reducing fill placed in the bypass channel. Such value-added considerations are subject to proper engineering study of local erosive forces.

Of note the proposed morphology of the lake outlet is but an integrated part of an overall longer transition from the lakebed to the riverbed. The controlling crest, absent the weir, is located at a persistent shoal approximately 940 ft downstream of the weir at elevation 9.4 ft NAVD (**Exhibit 5.2**). Transitions from Florida's in-line lakes and wetlands characteristically consist of a heel rising from the depression like a ramp toward the downstream controlling shoal crest (Kiefer et al. 2015), which is the proposed condition. The controlling shoal crest is seldom positioned right at the lake boundary and is typically formed and sustained some distance downstream.

**Exhibit 5.1a - Alternative 1 Conceptual Plan**




Source: Imagery ESRI 2017; Wood 2020

**Exhibit 5.1b - Alternative 1 Conceptual Cross-Section (facing downstream)**

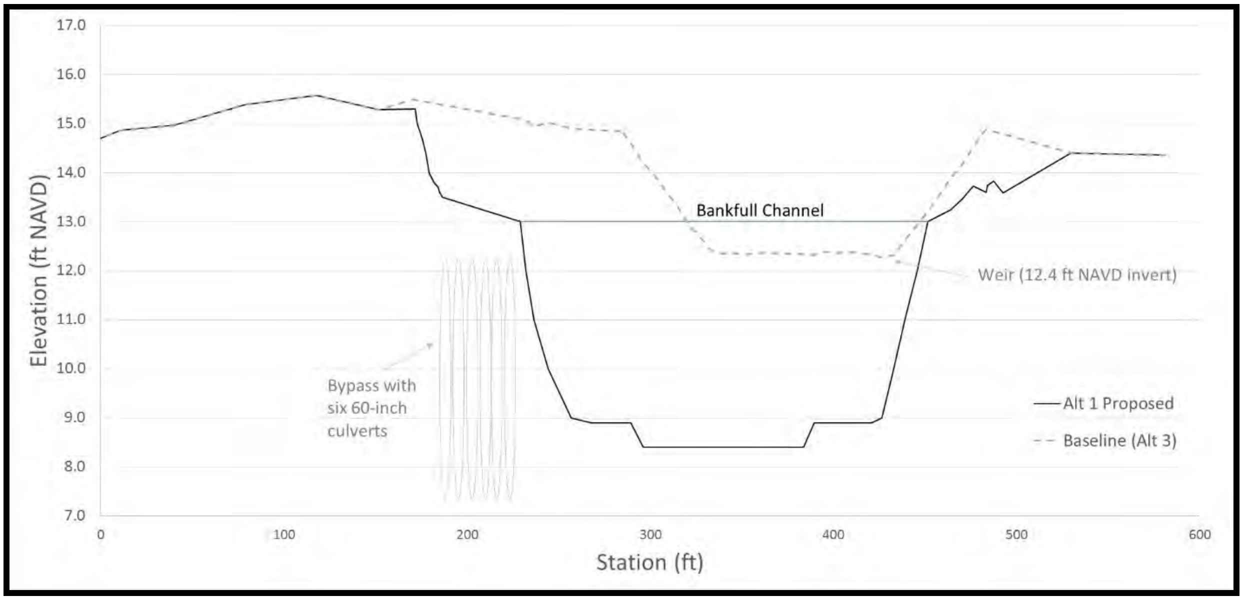



**Exhibit 5.2 - Downstream Controlling Shoal Crest Exposed During Dry Season (Image Source: Google Earth, 4/2006)**

### **5.1.1.** Water Quantity

In accordance with the previously issued report "Upper Lake Myakka Restoration Hydrologic & Hydraulic Report" dated February 2020 and provided in **Appendix E**, ICPR version 4 software was used to model storm events in the project area and surrounding watershed. The 2.33-year 24-hour, 25-year 24-hour, and 100-year 24-hour storm events were simulated. Compared to the baseline conditions ICPR model, Alternative 1 did not show any adverse impacts to offsite property during any storm event modeled as a result of the proposed modifications. Furthermore, the **Alternative 1** modifications had only negligible effects to onsite property during the modeled storm events. The 2.33-year 24-hour, 25-year 24-hour, and 100-year 24-hour storm events showed no increases to onsite maximum stages over baseline conditions as a result of the proposed modifications. Continuous modeling showed no effects on downstream flows.

### **5.1.2.** Natural Systems

Continuous modeling of daily flow and water levels over a simulation period of 16 years using MIKE SHE, shows that removing the WCS and restoring the lake outlet to a more natural condition will allow the lake to achieve a greater drawdown during the dry season, more akin to the pre-WCS conditions. Modeling indicates that the seasonal low water (SLW) level in the lake will decrease by 0.3 ft. This provides a more natural range of hydrologic variation versus the artificially impounded condition, which restores approximately 70 acres of floodplain marsh along the lake edge that are currently open water habitat due to the WCS. Because of a dry season impoundment effect upstream, the WCS slightly suppressed SLW levels immediately downstream of the structure in the Big Flats marsh. Thus, its removal slightly increases the SLW within the Big Flats floodplain by 0.1 ft from the baseline condition. This does not represent a functional shift because the baseline SLW is 2.4 ft below the ground surface.

Modeling indicates that the seasonal high water (SHW) level in the lake will decrease by 0.1 ft, resulting in approximately 18 acres of upper hydric hammock wetlands experiencing slightly drier conditions during portions of the wet season. This is not expected to shift the most-limiting root zone anoxic conditions or cause related shifts in the biological community or species composition of these hammocks, which are more sensitive to the effects of large flood pulses that establish water levels significantly greater than SHW (Deuver, 2013), and that are practically unaffected by the presence or absence of the WCS. SHW immediately downstream of the WCS does not change from the baseline condition, as the WCS is routinely overwhelmed by normal wet season flow as to have little discernable effects on downstream wet season water levels.

In summary, the WCS most adversely affects the system's dry season hydrology and associated biological integrity, while wet season hydrology is not adversely affected because of the low head of the WCS.

### **5.1.3.** Sediment

The removal option is expected to result in a greater drawdown in UML, which will expose additional areas of the littoral zone during the dry season thereby reducing the accumulation of organic materials. Sediment analysis along with field observations suggest that there is not a substantial amount of fine organic sediment being held back by the WCS; however, temporary sediment control measures may be necessary to prevent a sediment plug from releasing downstream upon removal of the structure. If sediment transport occurs, then it will be a redistribution of some sands with a temporary shear of fine materials just downstream of the WCS in a localized area. Far-reaching sediment transport is not expected based on the data collected from the lake and river. One key control suppressing the potential for downstream migration of lacustrine sediments into the river is the persistent controlling shoal crest at the head of the river within the Big Flats area. This controlling shoal crest occurs at elevation 9.4 feet while the lakebed sediments in the vicinity of the WCS range from 8.4 to 9.7 feet. This indicates low potential for sediment wedge migration beyond the proposed constructed submerged outlet channel which is to be excavated at lower elevations than the natural downstream controlling shoal crest.

Analysis of lake and river sediments showed that sediments in UML and the river downstream had low values of nutrients and similar magnitudes of bioavailable phosphorus (BAP) based on the fractionation analysis. Based on these results, changes in water levels or flow resulting from the restoration of the outlet to natural conditions will have minimal effects on nutrient flux from lake sediments. Additionally, the sediment analysis showed a small percentage of fines in the lake and river sediments, suggesting that the minimal flow and level changes modeled for **Alternative 1** would not substantially change sediment resuspension or transport of nutrient-laden sediments.

The sediment transport regime is expected to be restored in **Alternative 1** as a lake outlet more akin to pre-altered conditions will be put in place allowing the water to flow over a natural sill rather than be held back by a WCS. Stabilization of the banks by native vegetation will prevent additional erosion and subsequent sediment inputs into downstream waters.

#### **5.1.4.** Water Quality

Nutrients or contaminants entrained in the water column are primarily introduced to UML from runoff, through flow from upstream waters, and groundwater seepage (likely minimal). Contributions from upstream waters will not change as a result of restoring the UML outlet to natural conditions. With the modeled minimal changes in lake levels (0.3 ft decrease in SLW and 0.1 decrease in SHW levels), removal is not likely to affect the overall treatment capacity or residence time in the lake due to its large size. However, water quality is expected to nominally improve with the restoration of approximately 70 acres of wetlands around the lake edge that would result from the WCS removal. A new shallow vegetated zone with enough light penetration for submerged aquatic vegetation (SAV) to grow may also be created from the WCS removal. Reconnecting wetlands and introducing emergent aquatic vegetation (EAV) and SAV are often recommended as a water quality BMP for nutrient impaired lakes because the additional vegetation provides nutrient uptake, surface area for microbially mediated denitrification and other nitrogen-reducing mechanisms, and storage and can also contribute more color to the lake. UML already has high color (long-term average of 120 PCU), but in some previous Wood lake studies (Wood, 2019), increase in color has been correlated to lower Chl-a concentrations due to the mitigating effects of color on algal production. If nuisance EAV and SAV are not harvested regularly, the stored nutrients could be reintroduced into the lake system upon decomposition.

MRSP staff have expressed interest in maintaining vegetation around the lake and have expressed that a lower water level would provide better access for maintenance activities; therefore, management of biomass to prevent reintroduction of nutrients is not expected to be an issue.

### 5.1.5. Environmental Considerations

MRSP staff have indicated that a greater drawdown in UML resulting from the removal option would aid ongoing multi-agency aquatic weed control programs, aquatic habitat restoration efforts, and FPS fire program. A more natural hydroperiod is expected to aid the return to a normal fire interval and a reduction in invasive grass biomass, such as paragrass, leading to healthier marshes. MRSP staff have already noticed some unintended benefits since the WCS was breached in 2016, including a somewhat quicker dry-down after the rainy season and a more natural dry season. This led to the first significant burn of the floodplain conducted in well over a decade during February 2017, with 227 acres in the eastern area of Big Flats burned just south of UML.

A greater drawdown of the lake is also expected to reduce the biomass of exotic aquatic species such as water hyacinth, both in terms of reduced expansion and increased ability to manage them. Excessive growths of these species in the MRSP are attributed to the fast growth rates of the plants coupled with stabilized water levels, and they can increase sedimentation rates in the lake (SWFWMD, 2004). These species can decrease dissolved oxygen levels by reducing light penetration, limiting the exchange of gases, and reducing water circulation. Reduced oxygen levels slow decomposition rates, thus contributing to sediment accrual. News articles from the early 1970s, prior to the installation of the bypass channel, indicated how degraded UML had become due to the oxygen depletion these species were causing as a result of the weir not allowing for a natural drawdown period (Hardee, 1973; Herald-Tribune, 1974).

Invasive exotic fish including blue tilapia, brown hoplo, sailfin suckermouth catfish, and walking catfish are also well established in the lake (FDEP, 2019). Park staff have indicated that native floating leaf plants, which used to cover 20-30% of the lake, are negatively impacted by invasive fish; and that native floating leaf plants increase in the lake following invasive fish die-offs (from cold weather events). A greater drawdown may improve the ability to manage these species. Further, park staff indicated that an exposed lake bottom resulting in less muck and a sandy bottom is thought to improve habitat for native species.

### 5.1.6. Fish and Wildlife Passage

The WCS poses a physical barrier and hazard for the passage of fish and wildlife. Restoring the outlet to an elevation of 8.4 ft NAVD from the current weir elevation of 12.4 ft NAVD allows the river's natural shoals and riffles downstream to set seasonal passage depths for aquatic fauna in the manner to which they are adapted, including the Florida manatee. During periods of sufficient water level manatees have been sighted within the UML/Big Flats project area, with approximately 100 sightings since 2012 (FDEP, 2019). During periods of lower water levels, the UML WCS and the downstream WCS (Downs' Dam) have proven to be an obstacle to wildlife traversing the river. In January 2014, a juvenile manatee stranding occurred at Downs' Dam and was successfully rescued by FWC and FPS staff.

Removal of the UML WCS is supported by the FWC, U.S. Fish and Wildlife Service (FWS), and the Southeast Aquatic Resources Partnership (SARP) since it restores/improves connectivity within an important river corridor. FWS has indicated that they would potentially provide funding for the demolition of the weir if funding is available, and SARP has identified the UML WCS on their Southeast Aquatic Barrier Prioritization Tool (https://connectivity.sarpdata.com/priority/dams).

### **5.1.7.** Recreation

There are various recreational opportunities associated with the UML WCS, including a tour boat run by a third-party Park concession, paddling, and wildlife viewing. The greater drawdown associated with the removal option may reduce the number of days the existing tour boat concession can operate. In the past, the culvert openings were restricted to slow the flow through the bypass during the dry season, which was perceived to extend the period of operation of the concession tour boats but may not have had much of an effect as water was seen flowing around it and ultimately led to the breach. MRSP staff have indicated that the tour boat has become stuck in the soft sediment in the western portion of the lake during very windy days.

The removal of the WCS will remove a physical barrier and hazard for paddlers going into and out of the lake, which is a recreational benefit. Wildlife viewing, however, may change with the removal option. American alligators currently congregate on the downstream side of the WCS during the dry season because the area immediately downstream of the weir is deeper, fisherman have been known to leave their extra catch behind, and fish are forced through the bypass during shallow water conditions providing an easy meal for alligators waiting at the outlet. The removal of the WCS may change this particular opportunity for wildlife viewing. Bird watching, however, may improve as ducks and wading birds are most prevalent when the water is lower, both above and below the weir. The viewing platform, which is currently not operational due to the breach, will be removed in this alternative. It should be noted, however, wildlife viewing areas can be considered and included as part of the final design.

### **5.1.8.** Permitting

#### ***Federal Permitting***

Based on a pre-application meeting with the US Army Corps of Engineers (USACE) on April 1, 2020, **Alternative 1** (Removal) clearly falls within Nationwide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities) because it is a hydrologic restoration project. The USACE has a goal of issuing Nationwide Permits within 60 days. The USACE noted that the current Nationwide Permits are due to expire in March 2022 and will go through a re-verification process. If the project is already under construction once the permit expires, the permittee will have one additional year to complete the major earthwork.

Other components of the USACE review process include:

- National Environmental Policy Act (NEPA) – the feasibility study can be turned in for NEPA documentation since it discusses various alternatives.

- National Historic Preservation Act (NHPA) – consult with State Historic Preservation Offices (SHPO). The weir is a historic structure, originally built by the Civilian Conservation Corps (CCC) in the late 1930's. FDEP has initiated talks with SHPO regarding this project. "Mitigation" in the form of historical documentation of the dam, structural/architectural photos and drawings, and a historical report may be required.
- Endangered Species Act (ESA) – consult with Fish and Wildlife Service (FWS). The Florida manatee has been observed within the project area.

Tribal Historic Preservation Officer (THPO) – consult regarding tribal issues. The MRSP has conducted a Phase I archeological review and has not identified any sites within the footprint of the project area. They have five staff who can conduct archeological monitoring during earthwork.

***State Permitting***

Based on a pre-application meeting with SWFWMD on April 23, 2020, SWFWMD recommends an Individual Environmental Resource Permit (ERP) for **Alternative 1**. SWERP General ERP under Rule 62-330.485, F.A.C. and SWERP General ERP under Rule 62-330.631, F.A.C. were also discussed, but the Individual ERP appears to be the simplest option. Portions of the proposed improvements, if considered separately, may qualify as Exempt activities (i.e. stabilizing the shoreline). This alternative should be exempt from permitting requirements under Rule 62D-15, F.A.C. (Myakka River Wild and Scenic River Rule) because it is a restoration project, and SWFWMD will coordinate with the FDEP South District Office (SDO) as this is not a delegated authority.

<u>The following must be provided as part of the permitting process, as per the pre-application meeting minutes provided by SWFWMD</u>:

- Limits of jurisdictional wetlands and surface waters, with areas that will change with the proposed opening quantified
- A hydrologic model showing how downstream wetlands and wetlands upstream of the weir around the lake will function
- Determination of seasonal high water and normal pool elevations within affected wetlands
- Demonstration that no adverse peak increases for the 2.33-year, 25-year, and 100-year storm event
- As per Rule 62-330.031(2), demonstration of a net improvement for UML discharges to Myakka River since WBID 1981C (Upper Myakka Lake) is impaired for nutrients and WBID 1981B (Myakka River) is impaired for dissolved oxygen (considered nutrient related). Applicant must demonstrate that the removal option will not exacerbate the existing low dissolved oxygen levels of Myakka River.
- An application for an individual permit to construct or alter a dam requires that a notice of receipt of the application must be published in a newspaper within the affected area.

- Soil erosion and sediment control measures during construction must be provided, along with a Turbidity Monitoring Plan (including sampling locations and methods).

It was recommended that a follow-up pre-application meeting be scheduled prior to submitting the application.

### 5.1.9. Cost Estimate

A preliminary cost estimate was developed for **Alternative 1** which includes projected design, permitting, and construction costs. **Table 5.1** presents the cost of each item based on the conceptual plan; **Appendix F** presents the detailed costs of each item as well as the associated assumptions. The final cost estimate may change based on the final design. Additionally, these costs assume a 2020 date of construction. If construction is delayed, inflation and other changes to construction industry rates could affect the total cost of the project. The unit price sources include FDOT historical averages, RSMeans Online, and local quotes for present day unit costs. Specific unit price information is shown in the detailed opinion of probable cost estimate. Due to the nature of the proposed Alternative 1 work, this estimate does not include any operation and maintenance costs.

**Table 5.1 - Alternative 1 Preliminary Cost Estimate**

| Item Number | Description | Quantity | Units | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $75,642.16 | $75,642 |
| 2 | Mobilization and Demobilization | 1 | LS | $45,843.74 | $45,844 |
| 3 | Pollution Control | 1 | LS | $8,064.98 | $8,065 |
| 4 | Clearing and Grubbing | 1 | LS | $3,260.48 | $3,260 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $115,148.60 | $115,149 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Earthfill | 1 | LS | $80,645.37 | $80,645 |
| 9 | Vegetative Measures | 1 | LS | $13,524.69 | $13,525 |
| | | | | **Subtotal** | **$579,923** |
| | | | | **Total Estimate (Plus 10% Contingency)** | **$637,916** |

The following are noteworthy considerations and alternative design strategies that could be implemented during the final design phase of the project, and may have significant effects on the total cost of the project:

1. A split channel system could be implemented by not filling in the bypass and grading the bypass channel to have a higher invert than the main outfall channel. This may lower construction costs as the required earthwork volume would be reduced. However, additional protection along the bypass may be required to prevent future erosion in the bypass channel.

2. Only an upstream portion of the bypass channel could be filled to save on fill costs during construction, and the downstream portion of the bypass channel could be left to create a backwater/habitat area.
3. Some of the construction debris, such as the rubble from the coquina walls, could be subgraded and/or used to cap and armor the fill in the bypass channel to reduce hauling and disposal costs, and reduce fill costs in the bypass channel. The rubble would have to be milled to an appropriate size gradation to make the stabilization efficient and effective, and to allow proper compaction in and around the reused rubble. The additional cost of milling will have to be weighed against the associated savings.
4. Since this alternative is a restoration project, FWS and FWC AHRES have indicated that they would potentially provide funding for the demolition of the weir if funding is available. They have indicated that they will not fund the other alternatives, as those are considered maintenance and not restoration.

### 5.2. Alternative 2 – Structure Modernization (Modification)

**Alternative 2** involves modifying the weir structure by lowering the invert by two feet (from 12.41 ft NAVD to 10.41 ft NAVD). Additionally, new bypass structure pipes would be installed to baseline conditions (including inverts and dimensions) and the berm surrounding the pipes would be reconstructed. The goal of this alternative is to promote a more natural hydroperiod and increase UML's drawdown during the dry season. A conceptual plan for **Alternative 2** is shown in **Exhibit 5.3**.

**Exhibit 5.3a - Alternative 2 Conceptual Plan**

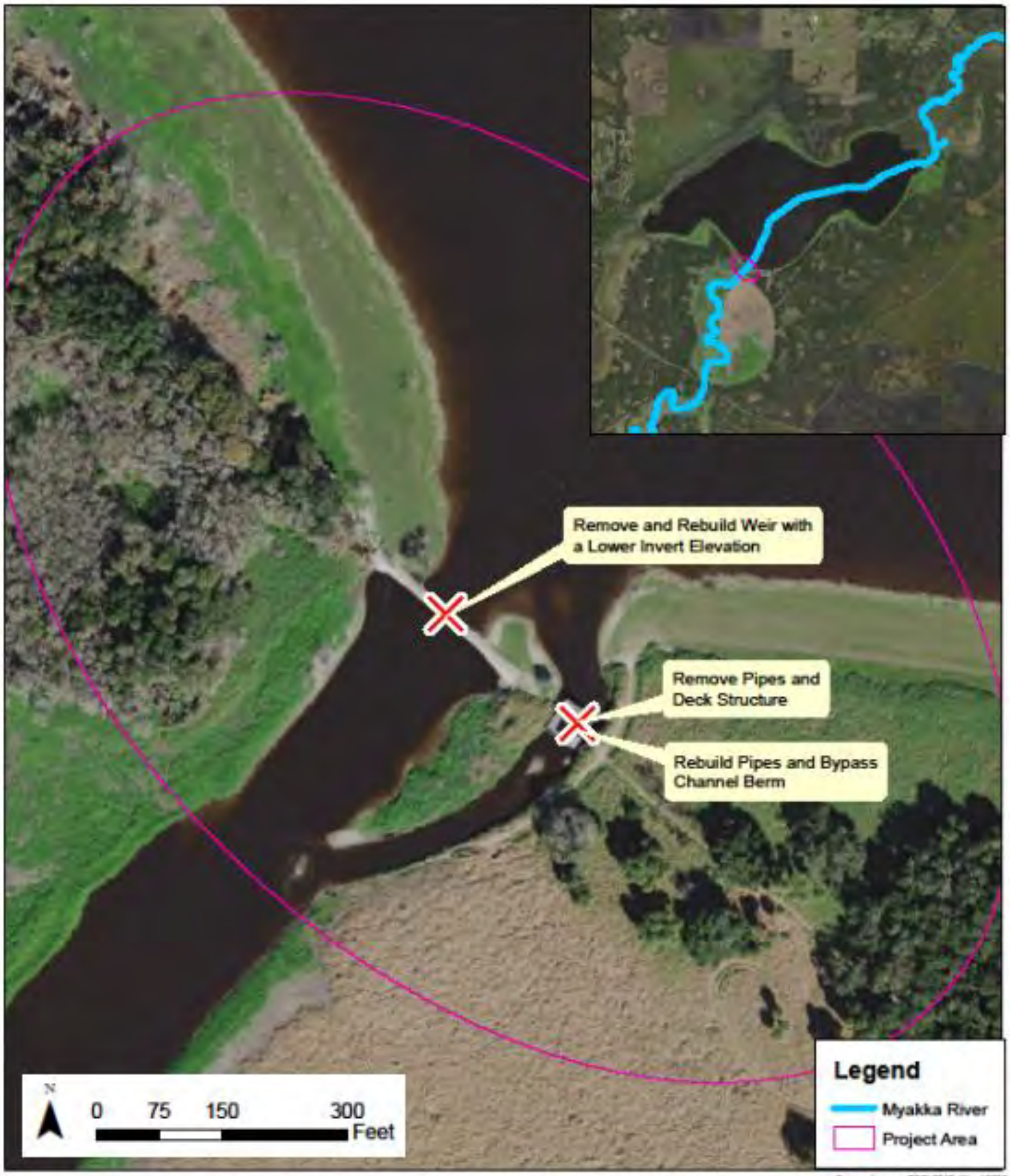
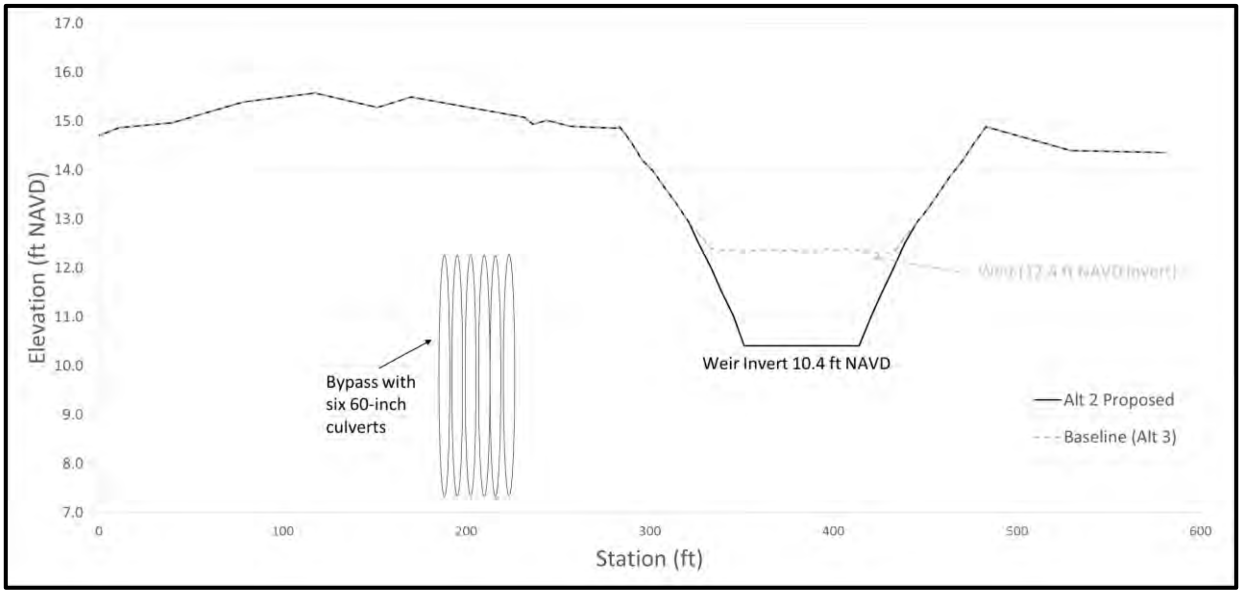


**Exhibit 5.3b - Alternative 2 Conceptual Cross-Section (facing downstream)**




### 5.2.1. <u>Water Quantity</u>

As shown in the event modeling report provided in **Appendix E**, **Alternative 2** did not show any adverse impacts to offsite property as a result of the proposed modifications when compared to historical existing conditions for the modeled storm events. Likewise, the **Alternative 2** modifications had negligible effects to onsite property during the modeled storm events. The models simulated the 2.33-year 24-hour, 25-year 24-hour and 100-year 24-hour storm events. These storm events showed no increases to onsite maximum stages over baseline conditions as a result of the proposed modifications.

### 5.2.2. <u>Natural Systems</u>

Continuous modeling shows that lowering the weir invert by 2 ft does not change the SLW level in the lake; therefore, this option is not expected to increase or restore wetlands within the lake. Modeling indicates that the SHW water level in the lake will decrease by 0.1 ft from the baseline condition, resulting in approximately 18 acres of upper hydric hammock wetlands experiencing slightly drier conditions during portions of the wet season, similar to the effects of **Alternative 1**. Immediately downstream of UML, within the Big Flats floodplain marsh system, neither SLW nor SHW level is expected to change as compared to the baseline condition, indicating no net change in natural systems with this option.

### 5.2.3. <u>Sediment</u>

Modeling indicates that the reduced weir will detain water during the dry season at levels akin to the original WCS, and the SLW level in the lake is not expected to change from the baseline condition. This means there will be no additional areas of lake bottom exposed to reduce soft sediment accumulation or facilitate colonization of wetland vegetation. **Alternative 2** is not expected to have noticeable effects on nutrient flux from lake sediments, sediment resuspension, or transport of nutrient-laden sediments. Stabilization of the bank within the bypass channel that will occur from modifying will prevent additional sediment inputs into downstream waters.

### 5.2.4. Water Quality

As in **Alternative 1**, contributions from upstream waters or groundwater will not change as a result of modifying the UML outlet. With the modeled minimal changes in lake levels (0.1 increase in SHW), modification is not likely to affect the overall treatment capacity or residence time in the lake due to its large size. Because the SLW level in the lake does not change with this option from the baseline condition, there is no expected wetland marsh creation, less potential for SAV growth, and less access for maintenance and harvesting of nutrient-rich biomass. With a WCS still controlling storage and release of water, there is still potential for some level of stagnation and conditions that could support algal growth and dissolved oxygen sags. The overall water quality benefits of **Alternative 2** would be less than those of **Alternative 1**.

### 5.2.5. Environmental Considerations

Modifying/lowering the weir structure by 2 ft does not allow a natural drawdown and thus does not create the environmental benefits of **Alternative 1**.

### 5.2.6. Fish and Wildlife Passage

The modification of the UML WCS would help improve a physical barrier and hazard for the passage of fish and wildlife, however it would not remove the barrier. Lowering the weir to an elevation of 10.4 ft NAVD from the current weir elevation of 12.4 ft NAVD establishes the unnatural structure, rather than the natural river morphology, as the limiting factor on fish and manatee passage.

### 5.2.7. Recreation

There are various recreational opportunities associated with the UML WCS, including a tour boat run by a third-party, paddling, and wildlife viewing. Lowering the weir is not expected to impact the tour boat concession, as it is not expected to lower the seasonal low water level in the lake. Lowering the weir would help improve a physical barrier for paddlers going into and out of the lake by providing an additional two feet of vertical depth. Since the WCS will still be there, albeit at a lower level, wildlife viewing is not expected to change.

### 5.2.8. Permitting

***Federal Permitting***

Based on a pre-application meeting with the USACE on April 1, 2020, **Alternative 2** (Modification) may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities); however, it may not qualify for a Nationwide Permit and may require a Standard Permit.

**Alternative 2**, which involves lowering the weir, may qualify for a Nationwide 27 if some restoration benefit can be shown; however, continuous modeling did not show additional wetland benefits. The USACE has a goal of issuing Nationwide Permits within 60 days, while Standard Permits have a longer timeframe of 120 days and also require a Public Notice of 21 days. The USACE noted that the current Nationwide Permits are due to expire in March 2022 and will go through a re-verification process. If the project is already under construction once the permit expires, the permittee will have one additional year to complete the major earthwork.

<u>Other components of the USACE review process include</u>:

- National Environmental Policy Act (NEPA) – the feasibility study can be turned in for NEPA documentation since it discusses various alternatives.
- National Historic Preservation Act (NHPA) – consult with State Historic Preservation Offices (SHPO). The weir is a historic structure, originally built by the Civilian Conservation Corps (CCC) in the late 1930's. FDEP has initiated talks with SHPO regarding this project. "Mitigation" in the form of historical documentation of the dam, structural/architectural photos and drawings, and a historical report may be required.
- Endangered Species Act (ESA) – consult with Fish and Wildlife Service (FWS). The Florida manatee has been observed within the project area.
- Tribal Historic Preservation Officer (THPO) – consult regarding tribal issues. The MRSP has conducted a Phase I archeological review and has not identified any sites within the footprint of the project area. They have five staff who can conduct archeological monitoring during earthwork.

### *State Permitting*

Based on a pre-application meeting with SWFWMD on April 23, 2020, SWFWMD recommends an Individual Environmental Resource Permit (ERP) for **Alternative 2**. SWERP General ERP under Rule 62-330.485, F.A.C. and SWERP General ERP under Rule 62-330.631, F.A.C. were also discussed, but the Individual ERP appears to be the simplest option. Portions of the proposed improvements, if considered separately, may qualify as Exempt activities (i.e. replacing culverts in-kind or stabilizing the shoreline). This alternative should be exempt from permitting requirements under Rule 62D-15, F.A.C. (Myakka River Wild and Scenic River Rule) because it is a rebuild, and SWFWMD will coordinate with the FDEP SDO as this is not a delegated authority.

<u>The following must be provided as part of the permitting process, as per the pre-application meeting minutes provided by SWFWMD</u>:

- Limits of jurisdictional wetlands and surface waters, with areas that will change with the proposed opening quantified
- A hydrologic model showing how downstream wetlands and wetlands upstream of the weir around the lake will function

- Determination of seasonal high water and normal pool elevations within affected wetlands
- Demonstration that no adverse peak increases for the 2.33-year, 25-year, and 100-year storm event
- As per Rule 62-330.031(2), demonstration of a net improvement for UML discharges to Myakka River since WBID 1981C (Upper Myakka Lake) is impaired for nutrients and WBID 1981B (Myakka River) is impaired for dissolved oxygen (considered nutrient related). Applicant must demonstrate that the lowering option will not exacerbate the existing low dissolved oxygen levels of Myakka River.
- An application for an individual permit to construct or alter a dam requires that a notice of receipt of the application must be published in a newspaper within the affected area.
- Soil erosion and sediment control measures during construction must be provided, along with a Turbidity Monitoring Plan (including sampling locations and methods).

It was recommended that a follow-up pre-application meeting be scheduled prior to submitting the application.

#### **5.2.9.** Cost Estimate

A preliminary cost estimate was created for **Alternative 2**, which includes projected design, permitting, construction, and operation and maintenance costs. **Table 5.2** presents the cost of each item based on the conceptual plan; **Appendix F** presents the detailed costs of each item as well as the associated assumptions. The final cost estimate may change based on the final design. Additionally, these costs assume a 2020 date of construction. If construction is delayed, inflation and other changes to construction industry rates could affect the total cost of the project. The unit price sources include FDOT historical averages, RSMeans Online, and local quotes at present day unit costs. Specific unit price information is shown in the detailed opinion of probable cost estimate.

**Table 5.2 - Alternative 2 Preliminary Cost Estimate**

| Item Number | Description | Quantity | Units | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $135,678.43 | $135,678 |
| 2 | Mobilization and Demobilization | 1 | LS | $76,168.74 | $76,169 |
| 3 | Pollution Control | 1 | LS | $8,303.68 | $8,304 |
| 4 | Clearing and Grubbing | 1 | LS | $1,656.60 | $1,657 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $95,534.60 | $95,535 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Weir Structure | 1 | LS | $271,796.25 | $271,796 |
| 9 | Pipe Structure | 1 | LS | $83,103.12 | $83,103 |
| 10 | Vegetative Measures | 1 | LS | $10,265.06 | $10,265 |
| 11 | Long-term Monitoring and Maintenance | 1 | LS | $53,234.91 | $53,235 |
| | | | | **Subtotal** | **$973,535** |
| | | | | **Total Estimate (Plus 10% Contingency)** | **$1,070,888** |

The following are noteworthy considerations and alternative design strategies that could be implemented during the final design phase of the project, and may have significant effects on the total cost of the project:

1. It is possible that the weir structure may only require minor surface repairs rather than removing and rebuilding the entire structure. Preliminary observations from Wood indicate that the age of the dam and the damage to the concrete cap may have led to erosion and damage to the dam core. Further testing is needed to fully assess the stability of the dam core. However, if testing indicates it is appropriate, portions of the weir structure may be salvageable, and the design may be able to incorporate minor repairs to the weir structure as opposed to a complete rebuild of the weir structure at the new invert elevation.
2. Instead of replacing the weir structure with materials and quantities similar to the original dam construction plans, as is currently included in the cost estimate, a new design could be implemented that incorporates materials such as articulating concrete block, Flexamat, or sheet piling, which could change the projected aesthetics and cost of the alternative.
3. The six 60-inch bypass structure pipes could be replaced with open box culverts or a precast bridge. In some of these scenarios, fill above the bypass structure would not be required, but such structures vary in cost and are often selected over pipes for aesthetics or longevity rather than cost savings.

## 5.3. Alternative 3 – Structure Reconstruction (Rebuild)

**Alternative 3** consists of rebuilding the weir and bypass structures to their undilapidated conditions, including the same weir invert elevation, the same pipe inverts, and the same pipe sizes. This alternative re-establishes the conditions observed at the UML discharge location from approximately 1974 to 2016. A conceptual plan for Alternative 3 is shown in **Exhibit 5.4(a-b)**.

**Exhibit 5.4a - Alternative 3 Conceptual Plan**

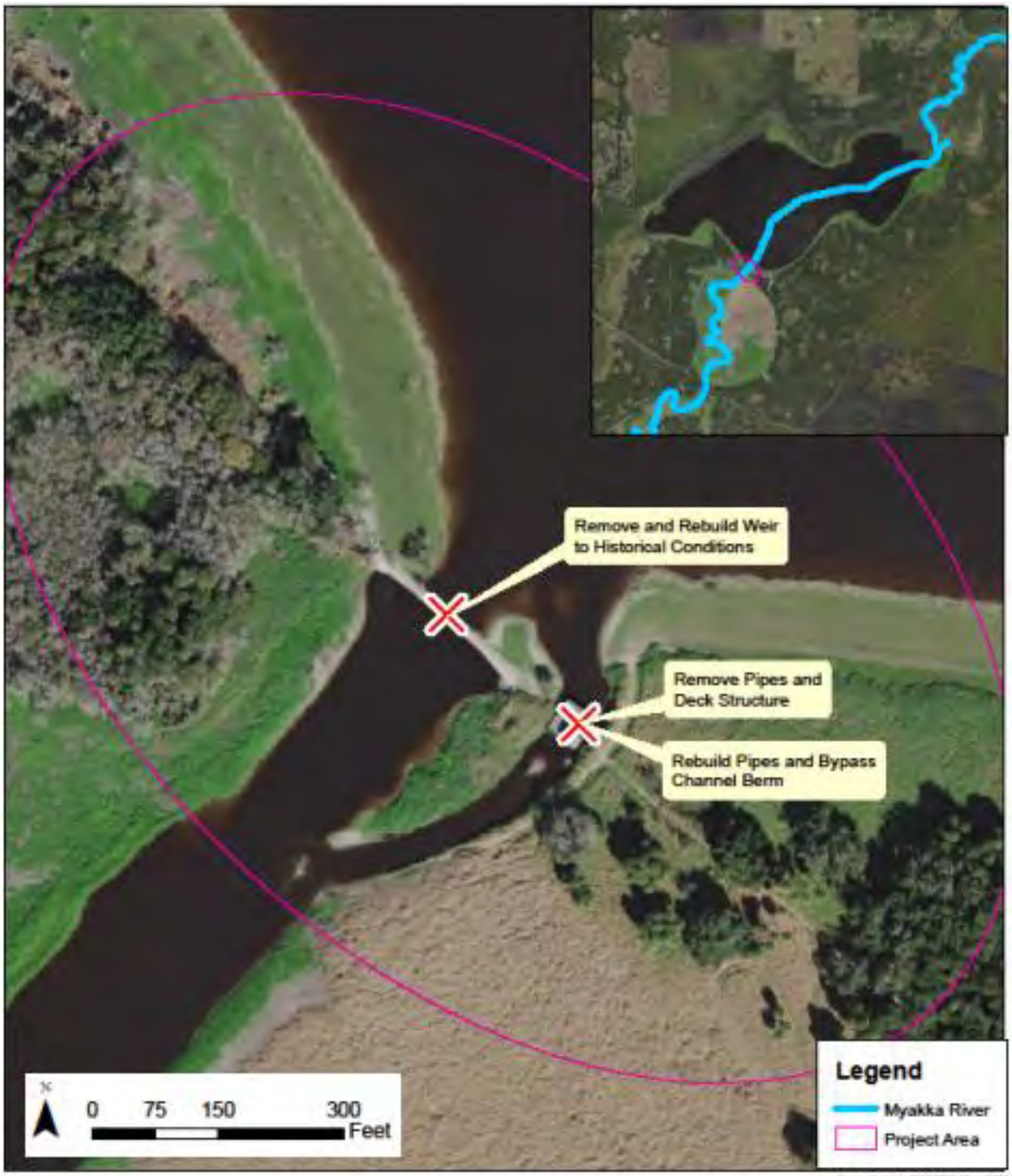
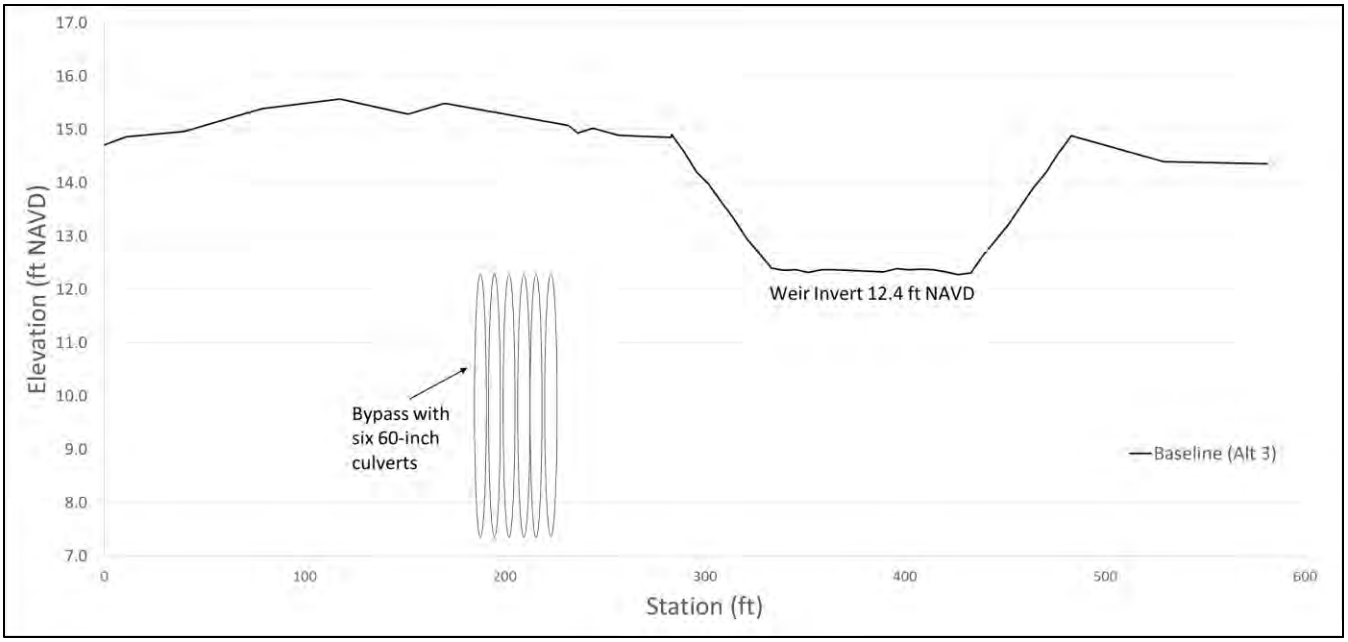


**Exhibit 5.3b - Alternative 3 Conceptual Cross-Section (facing downstream)**




## 5.3.1. Water Quantity

As presented in the event modeling report provided in **Appendix E**, **Alternative 3** represents the baseline condition. As such, the results did not show any adverse impacts to offsite property as a result of the proposed modifications when compared to baseline conditions for the modeled storm events, which included the 2.33-year 24-hour, 25-year 24-hour, and 100-year 24-hour storm events. Thus **Alternative 3** modifications had negligible effects to onsite property and showed no increases to offsite maximum stages over baseline conditions as a result of the proposed modifications for all modeled storm events. No additional drawdown of UML occurs under **Alternative 3**, which would continue the baseline detention of UML.

## 5.3.2. Natural Systems

No net change is expected in regard to natural systems with the rebuild option.

## 5.3.3. Sediment

No net change is expected in regard to sediment with the rebuild option, though the stabilization of the bank within the bypass that will occur from rebuilding will prevent additional sediment inputs into downstream waters. As detailed in previous sections, it does not appear that the lake sediments differ greatly from river sediments, so the benefits from settling of fine particles and storage of nutrients in sediments do not appear to be substantial.

#### 5.3.4. Water Quality

While there are some water quality benefits associated with controlled in-line lakes, such as settling of particles, weirs acting as sumps, and nutrient storage in sediments or biomass, it appears that in UML these benefits are not as substantial as the benefits that could be obtained by restoring the system to a more natural condition. Because the WCS creates a greater pool of stagnant water conditions that tend to support algae growth and nuisance floating vegetation mats associated with DO sags, **Alternative 3** has the greatest potential to contribute to ongoing water quality impairments. Further, residence time and associated nutrient retention within the lake may extend beyond expected natural conditions to a point of saturation, thus converting the lake from being a sink to potentially a source of nutrient loading downstream.

#### 5.3.5. Environmental Considerations

No net change is expected in regard to environmental considerations.

#### 5.3.6. Fish and Wildlife Passage

No net change is expected in regard to fish/wildlife passage.

#### 5.3.7. Recreation

No net change is expected in regard to recreation.

#### 5.3.8. Permitting

***Federal Permitting***

Based on a pre-application meeting with the USACE on April 1, 2020, **Alternative 3** (Rebuild) may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities); however, it may not qualify for a Nationwide Permit and may require a Standard Permit. The USACE has a goal of issuing Nationwide Permits within 60 days, while Standard Permits have a longer timeframe of 120 days and also require a Public Notice of 21 days. The USACE noted that the current Nationwide Permits are due to expire in March 2022 and will go through a re-verification process. If the project is already under construction once the permit expires, the permittee will have one additional year to complete the major earthwork.

Other components of the USACE review process include:

- National Environmental Policy Act (NEPA) – the feasibility study can be turned in for NEPA documentation since it discusses various alternatives.
- National Historic Preservation Act (NHPA) – consult with State Historic Preservation Offices (SHPO). The weir is a historic structure, originally built by the Civilian Conservation Corps (CCC) in the late 1930's. FDEP has initiated talks with SHPO regarding this project.

“Mitigation” in the form of historical documentation of the dam, structural/architectural photos and drawings, and a historical report may be required.

- Endangered Species Act (ESA) – consult with Fish and Wildlife Service (FWS). The Florida manatee has been observed within the project area.
- Tribal Historic Preservation Officer (THPO) – consult regarding tribal issues. The MRSP has conducted a Phase I archeological review and has not identified any sites within the footprint of the project area. They have five staff who can conduct archeological monitoring during earthwork.

***State Permitting***

Based on a pre-application meeting with SWFWMD on April 23, 2020, SWFWMD recommends an Individual Environmental Resource Permit (ERP) for **Alternative 3**. SWERP General ERP under Rule 62-330.485, F.A.C. and SWERP General ERP under Rule 62-330.631, F.A.C. were also discussed, but the Individual ERP appears to be the simplest option. Portions of the proposed improvements, if considered separately, may qualify as Exempt activities (i.e. replacing culverts in-kind or stabilizing the shoreline). This alternative should be exempt from permitting requirements under Rule 62D-15, F.A.C. (Myakka River Wild and Scenic River Rule) because it is a rebuild, and SWFWMD will coordinate with the FDEP SDO as this is not a delegated authority.

<u>The following must be provided as part of the permitting process, as per the pre-application meeting minutes provided by SWFWMD</u>:

- Limits of jurisdictional wetlands and surface waters, with areas that will change with the proposed opening quantified
- A hydrologic model showing how downstream wetlands and wetlands upstream of the weir around the lake will function
- Determination of seasonal high water and normal pool elevations within affected wetlands
- Soil erosion and sediment control measures during construction must be provided, along with a Turbidity Monitoring Plan (including sampling locations and methods).

It was recommended that a follow-up pre-application meeting be scheduled prior to submitting the application.

**5.3.9.** <u>Cost Estimate</u>

A preliminary cost estimate was developed for **Alternative 3**, which includes projected design, permitting, construction, and operation and maintenance costs. **Table 5.3** presents the cost of each item based on the conceptual plan; **Appendix F** presents the detailed costs of each item as well as the associated assumptions. The actual cost estimate may change based on the final design. Additionally, these costs assume a 2020 date of construction. If construction is delayed, inflation and other changes to construction industry rates could affect the total cost of the project.

The unit price sources include FDOT historical averages, RSMeans Online, and local quotes at present day unit prices. Specific unit price information is shown in the detailed opinion of probable cost estimate. The proposed **Alternative 3** work is generally the same as the **Alternative 2** work, however it requires more material for rebuilding the weir structure as the invert of the structure in **Alternative 3** is 2 feet higher than in **Alternative 2**. Therefore, the estimates for **Alternative 2** and **Alternative 3** are very similar.

**Table 5.3 - Alternative 3 Preliminary Cost Estimate**

| Item Number | Description | Quantity | Units | Unit Price | Amount |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $136,633.65 | $136,634 |
| 2 | Mobilization and Demobilization | 1 | LS | $76,747.67 | $76,748 |
| 3 | Pollution Control | 1 | LS | $8,303.68 | $8,304 |
| 4 | Clearing and Grubbing | 1 | LS | $1,656.60 | $1,657 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $95,534.60 | $95,535 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Weir Structure | 1 | LS | $276,830.37 | $276,830 |
| 9 | Pipe Structure | 1 | LS | $83,103.12 | $83,103 |
| 10 | Vegetative Measures | 1 | LS | $10,265.06 | $10,265 |
| 11 | Long-term Monitoring and Maintenance | 1 | LS | $53,990.02 | $53,990 |
| | | | | **Subtotal** | **$980,858** |
| | | | | **Total Estimate (Plus 10% Contingency)** | **$1,078,944** |

The following are noteworthy considerations and alternative design strategies that could be implemented during the final design phase of the project, and may have significant effects on the total cost of the project:

1. It is possible that the weir structure may only require minor surface repairs rather than removing and rebuilding the entire structure. Preliminary observations from Wood indicate that the age of the dam and the damage to the concrete cap may have led to erosion and damage to the dam core. Further testing is needed to fully assess the stability of the dam core. However, if testing indicates it is appropriate, portions of the weir structure may be salvageable, and the design may be able to incorporate minor repairs to the weir structure as opposed to a complete rebuild of the weir structure.
2. Instead of replacing the weir structure with materials and quantities similar to the original dam construction plans, as is currently included in the cost estimate, a new design could be implemented that incorporates materials such as articulating concrete block, Flexamat, or sheet piling, which could change the aesthetics and projected cost of the alternative.

3. The six 60-inch bypass structure pipes could be replaced with open box culverts or a precast bridge. In some of these scenarios, fill above the bypass structure would not be required, but such structures vary in cost and are often selected over pipes for aesthetics or longevity rather than cost savings.

### 5.4. No Action Alternative

The No Action Alternative would involve doing nothing to address the issues at the WCS. If the WCS was not removed, modified, or rebuilt, the left/east bank of the bypass channel would continue to erode, increasing sedimentation downstream and resulting in loss of property to the park. The weir has degraded over the last few decades, with numerous gaps in the structure that are expected to continue to degrade and reduce the original intended function of the structure. The bypass culverts have rusted out leaving a series of jagged metal hoops projecting above the streambed presenting an unsafe condition to humans and wildlife. Erosion has pervaded around the remnant bypass structures and is progressing further into the banks of the bypass. As a result, the viewing deck over the bypass structures has been closed out of concern for public safety and is unusable at this time. Lastly, addressing the issues at the WCS is part of the MRSP's Unit Management Plan (FDEP, 2019). For these reasons, the No Action Alternative is not a viable option.

### 5.5. Summary of Alternatives Analysis

**Table 5.4** provides a side-by-side comparison of the three alternatives with regards to the nine components analyzed. **Table 5.5** ranks the three alternatives based on a ranking system of 1 for positive benefit, 0 for neutral benefit, or -1 for negative benefit. **Alternative 1** (Removal) ranks first with a total of 7 points.

## Table 5.4 - Alternatives Comparison

| Parameter | Alternative 1 - Removal | Alternative 2 - Modification | Alternative 3 - Rebuild |
|---|---|---|---|
| Water Quantity | Restores a more natural lacustrine and riverine flow regime. No adverse offsite impacts in regard to flooding. | Detains water during the dry season; does not impact wet season flows. No adverse offsite impacts in regard to flooding. | Detains water during the dry season; does not impact wet season flows. No adverse offsite impacts in regard to flooding. |
| Natural Systems | Restores ~70 acres of floodplain marsh wetlands within the lake by lowering seasonal low water level in lake by 0.3 ft. Lowers seasonal high water level in lake by 0.1 ft, resulting in 18 acres of hydric hammock experiencing drier conditions. Increases seasonal low water table by 0.1 ft in Big Flats. | Detains water during the dry season, inundating areas that historically would have been floodplain marsh. Lowers seasonal high water level in lake by 0.1 ft, resulting in 18 acres of hydric hammock experiencing drier conditions. | Detains water during the dry season, inundating areas that historically would have been floodplain marsh. |
| Sediment | Reduces accumulation of organic material. Restores sediment transport regime. | Artificially increases sedimentation in the lake by holding back water. | Artificially increases sedimentation in the lake by holding back water. |
| Water Quality | Improves water quality through:<br>- reduced lake volumes associated with dry season algal blooms and DO depletion<br>- creation of additional areas of EAV and SAV which will provide nutrient uptake and storage and contribute additional color | Artificially increases residence time and associated nutrient retention within the lake, which may extend beyond expected natural conditions to a point of saturation, thus converting the lake from being a sink to potentially a source of nutrient loading downstream. | Artificially increases residence time and associated nutrient retention within the lake, which may extend beyond expected natural conditions to a point of saturation, thus converting the lake from being a sink to potentially a source of nutrient loading downstream. |
| Environmental Considerations | Greater drawdown aids weed control programs, habitat restoration, and fire program. Reduces biomass of exotic species. | Detains water during the dry season hinders park maintenance activities such as weed control and burning. | Detains water during the dry season hinders park maintenance activities such as 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 | Lower dry season lake levels may reduce number of days tour boat can operate. Removal of dam may change opportunities for wildlife viewing. Removes barrier/hazard to paddlers. | Reduces barrier/hazard to paddlers. | Maintains barrier/hazard to paddlers. |
| Permitting | Federal (USACE) - clearly falls under Nationwide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities); goal of issuing within 60 days.<br>State/Local (SWFWMD) - Individual Permit. Must show net improvement in WQ; no adverse impacts. Should be exempt from Myakka River Wild and Scenic River Rule (62D-15). | Federal (USACE) - may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities); however, project may not qualify for a Nationwide Permit and may require a Standard Permit. Nationwide Permits have a goal of being issued within 60 days. Standard Permits have a longer timeframe of 120 days and also require a Public Notice of 21 days.<br>State (SWFWMD) - Individual Permit. Must show net improvement in WQ; no adverse impacts. Should be exempt from Myakka River Wild and Scenic River Rule (62D-15). | Federal (USACE) - may fall within Nationwide Permit 3 (Maintenance), 25 (Structural Discharges), or 42 (Recreational Facilities); however, project may not qualify for a Nationwide Permit and may require a Standard Permit. Nationwide Permits have a goal of being issued within 60 days. Standard Permits have a longer timeframe of 120 days and also require a Public Notice of 21 days.<br>State (SWFWMD) - Individual Permit. Should be exempt from Myakka River Wild and Scenic River Rule (62D-15). |
| Cost Estimate | Total Estimate: $637,916 (O&M not required). Potential funding available from FWS and FWC since this is a restoration project. | Total Estimate: $1,070,888 (O&M required) | Total Estimate: $1,078,944 (O&M required) |

**Table 5.5 - Project 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 |
| Reduces soft sediment accrual | 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** |

## 6.0 SUMMARY AND CONCLUSIONS

Prompted in part by the recent degradation of the weir and bypass structures at the outlet of Upper Myakka Lake within the Myakka River State Park, these water control structures have been identified for study and potential restoration. The overall objectives of the project included restoring natural systems and improving water quality in UML and downstream waters. This feasibility study was conducted to identify three conceptual design alternatives and assess their impacts on the hydrology, ecology, water quality, and human uses of the UML and Myakka River system.

The 66-mile long blackwater Myakka River is a complex drainage network that includes natural in-line lakes and marshes, areas with multiple channels (anabranches), and areas with no well-defined open channels. Numerous hydraulic alterations to the Myakka River system that impact UML have occurred over the past 90 years including irrigation, dikes, and diversions in Flatford Swamp, Tatum Sawgrass marsh, Clay Gulley, Hidden River, Howard Creek, and Vanderipe Slough and the construction of dams, weirs, and diversion structures in Upper and Lower Myakka Lake. The current structures at the UML outlet include a degrading weir with large gaps in the structure and the remnants of heavily corroded bypass culverts surrounded by 10 ft of washed out space that used to be the embankment surrounding the culverts.

Existing survey, hydraulic, sediment, water quality, vegetation, and wildlife data were compiled and summarized. New data were also collected where necessary, including topographic survey, lake water levels, and sediment samples for physical and chemical characterization.

Three conceptual design alternatives were developed to address the issues at the UML outlet:

- **Alternative 1**: Removing the low water control structure (weir and bypass) and re-wilding the UML outfall (restoring it to more natural state).
- **Alternative 2:** Amending the low water control structure (lowering weir by 2 ft).
- **Alternative 3**: Rebuilding the low water control structure (weir and bypass) to their historic state (prior to recent failures).

Hydraulic and hydrologic (ICPR4) modeling and integrated surface water and groundwater (MIKE-SHE) were conducted to compare the offsite impacts and changes in seasonal water levels for each alternative. Flood event modeling (ICPR4) showed no adverse flood impacts onsite or offsite for any of the design alternatives.

Continuous hydrology modeling (MIKE-SHE) showed that the removal and re-wilding alternative (Alt 1) lowers seasonal low lake levels, resulting in a step toward a more natural range of variation for water levels in the UML. This is desirable because the range of natural water level variation has been suppressed by numerous hydromodifications in the basin that act in concert to artificially raise seasonal low water levels. Removing the water control structures exposes more of the lakebed during the dry season, resulting in 70 additional acres of exposed flats and wetlands. This increase provides value to FDEP initiatives to manage invasive plant species, enhance the suppressed fire ecology of the floodplain marsh, creates valuable bird habitat, and puts more water in contact with cleansing wetlands during wet season rises. Neither of the other two alternatives provide range-of-variability water level benefits.

Each alternative was assessed systematically for impacts to water quantity, natural systems, sediment, water quality, fish and wildlife passage, recreation, and permitting implications. Water quantity changes are the master variable. The river and various structure alternatives at the lake outlet have ample conveyance capacity relative to the inflows to the lake, so none of the alternatives change the downstream flow regime in any adverse way. It remains essentially controlled by the upstream delivery. However, the structures can influence dry season water levels in the lake upstream of the control. No tangible downstream water level changes occur because the flow regime remains so similar among the alternatives.

Weir removal and re-wilding (**Alternative 1**) received the highest ranking among the suite of functional attributes and is the preferred alternative because it facilitates restoration and improvement of wetland habitat, reduction of soft sediment accrual, improvements in water quality, improvements in fire and nuisance species activities, improvements in fish/wildlife passage, reduction of maintenance costs, and reasonable permitting. These benefits are highly compatible with regional objectives for protecting and enhancing the Myakka River, such as those outlined by CHNEP (2013). **Alternative 1** is also the low-cost alternative. Not only is it intrinsically the low cost option, it also potentially qualifies for co-funding opportunities with the FWS and FWC that the other two more expensive and less beneficial alternatives do not. Wood recommends implementing **Alternative 1** as the best investment.

## 7.0 REFERENCES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# FIGURES


**Notes:**

1- Project No.: 600639

2- Data Source - ESRI 2019

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2018
Revised: 4/9/2019
Checked By: KN

**Explanation of Features**

N

0 250,000 ft

1" = 10,000'

wood.

Wood Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Ste #200
Tampa, FL 33602
CA-5392
(813) 636-1500

**Figure 1A**
**Location Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 1_Project Location.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - ESRI 2019

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2018
Revised: 4/9/2019
Checked By: KN

**Explanation of Features**

N

Major Basins

Myakka River

0 250,000 ft

1" = 30,000'

wood.

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**Figure 1B**
**Location Map (Regional)**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 1b_Project Location.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - Aerial ESRI 2018

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

wood.

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**Figure 2a**
**Current Aerial Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2a_Current Aerial.mxd

**Notes:**

1- Project No.: 600639

2- Data Source - UF 1948

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/10/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

wood.

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**Figure 2b**
**Historic Aerial 1948**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2b_1940s Aerial.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - UF 1957

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

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**Figure 2c**
**Historic Aerial 1957**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2c_1950s Aerial.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - UF 1969

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

wood.

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**Figure 2d**
**Historic Aerial 1969**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2d_1960s Aerial.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - UF 1974

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

wood.

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**Figure 2e**
**Historic Aerial 1974**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2e_1970s Aerial.mxd


**Notes:**

1- Project No.: 600639

2- Data Source - UF 1993

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,000'

wood.

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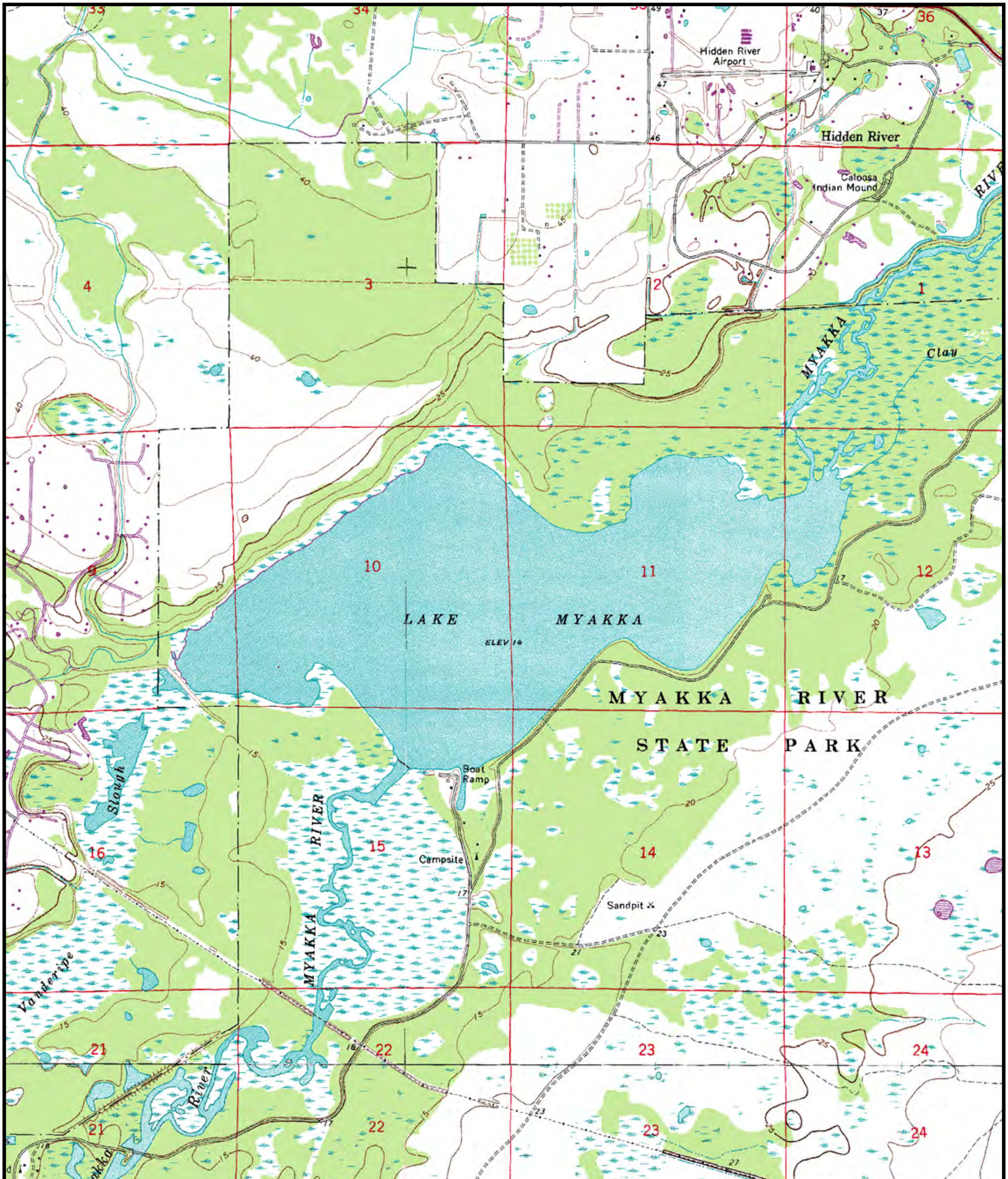
**Figure 2f**
**Historic Aerial 1993**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 2f_1990s Aerial.mxd




**Notes:**

1- Project No.: 600639

2- Data Source - USGS

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/11/2019
Checked By: KN

**Explanation of Features**

N

0 2,000 ft

1" = 2,500'

wood.

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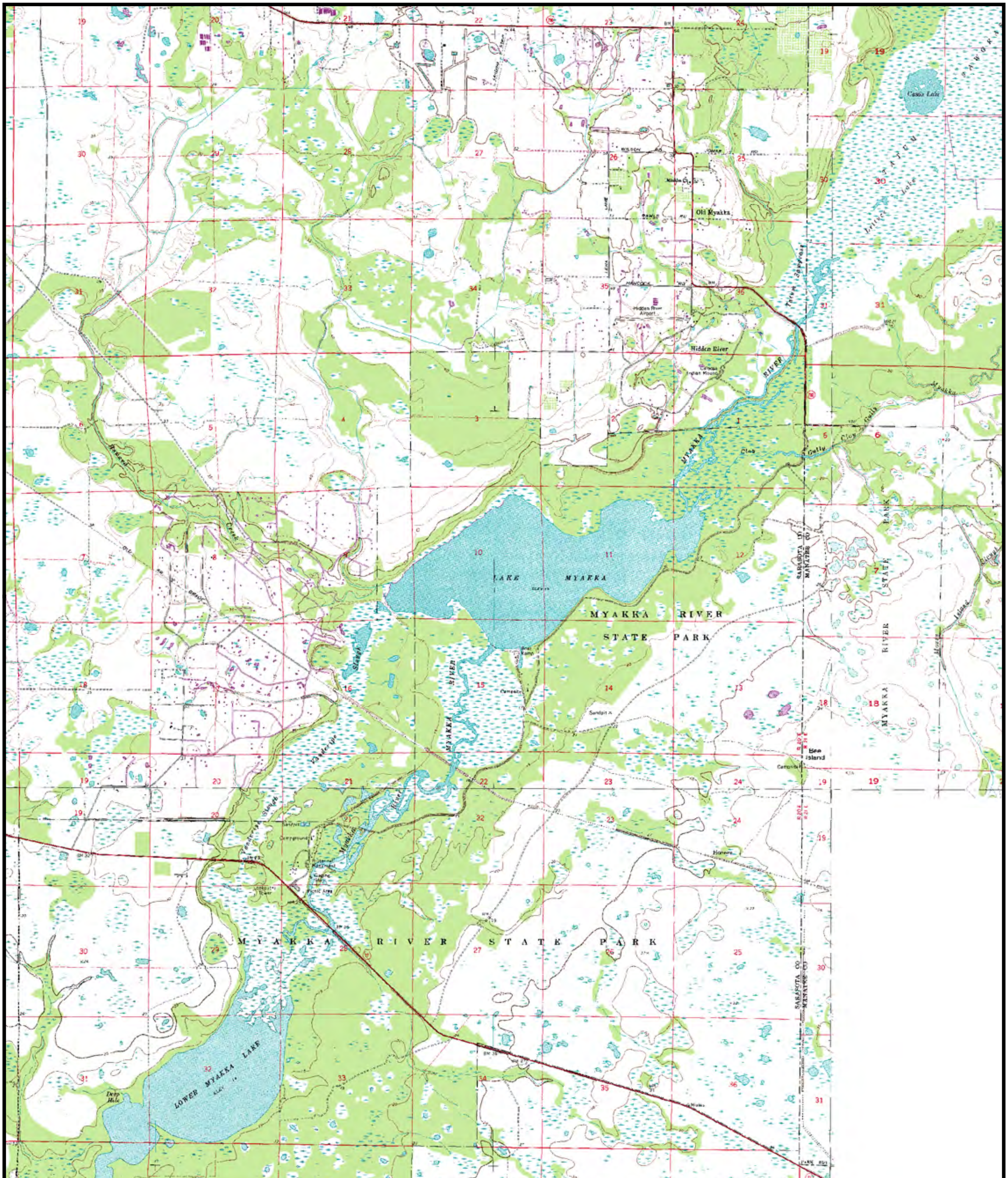
**Figure 3**
**USGS Topography (Lake Area)**
**Upper Myakka Lake Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 3a_USGS Topography (Lake Area).mxd




**Notes:**

1- Project No.: 600639

2- Data Source - USGS

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/11/2019
Checked By: KN

**Explanation of Features**

N

0 1

1" = 1 Mile

wood.

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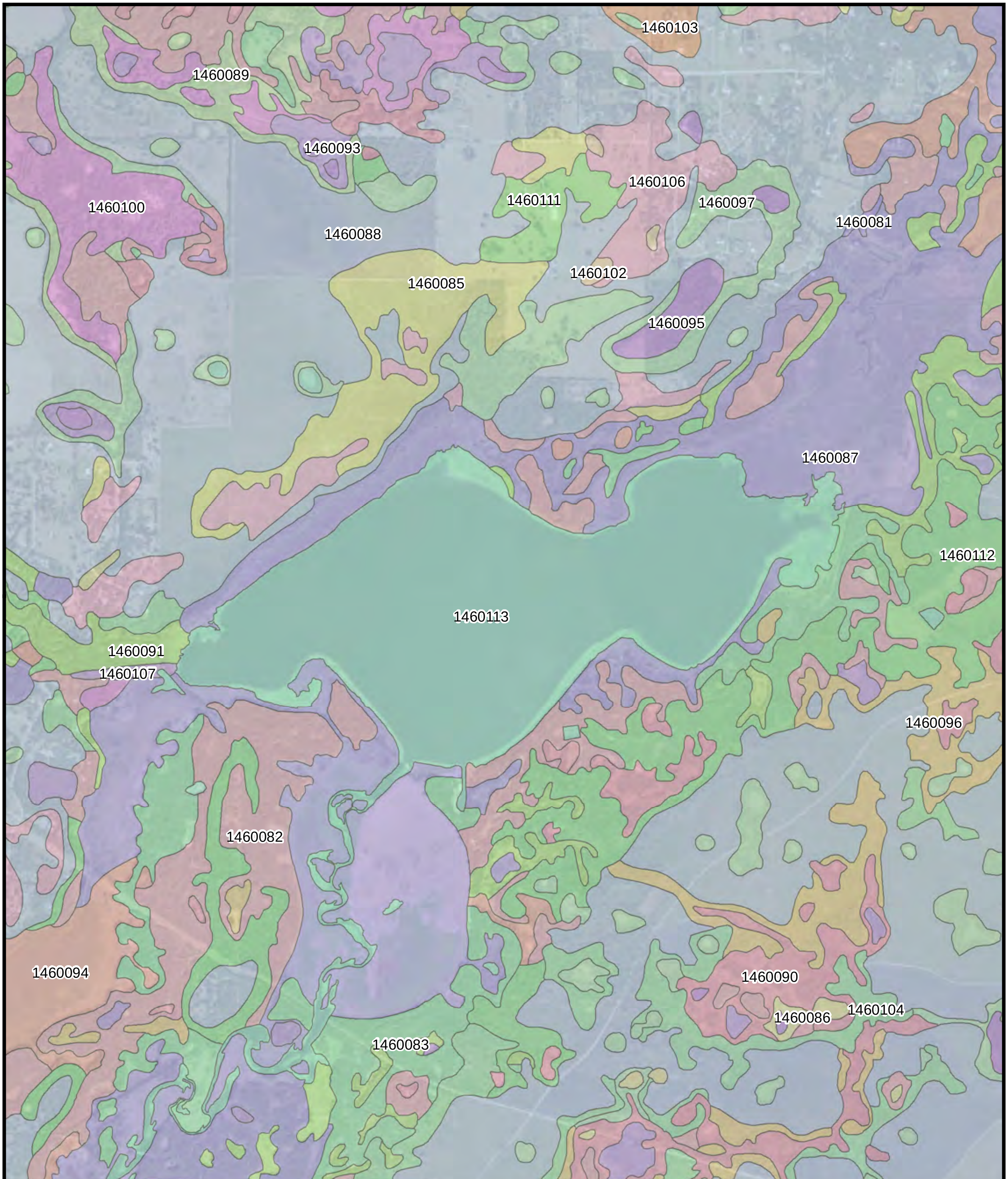
**Figure 3**
**USGS Topography (Watershed)**
**Upper Myakka Lake Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 3b_USGS Topography (Watershed).mxd




**Notes:**

1- Project No.: 600639

2- Data Source - NRCS 2017

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:3/29/2019
Checked By: KN

## Explanation of Features

N

- 1460081; BOCA AND HALLANDALE SOILS
- 1460082; BRADENTON FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460083; BRADENTON FINE SAND, FREQUENTLY FLOODED
- 1460085; CASSIA FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460086; DELRAY FINE SAND, DEPRESSIONAL
- 1460087; DELRAY AND ASTOR SOILS, FREQUENTLY
- 1460088; EAUGALLIE AND MYAKKA FINE SANDS
- 1460089; FELDA FINE SAND
- 1460090; FELDA FINE SAND, FREQUENTLY PONDED, 0 TO 1 PERCENT SLOPES
- 1460091; FELDA AND POMPANO FINE SANDS, FREQUENTLY FLOODED
- 1460093; FLORIDANA AND GATOR SOILS, DEPRESSIONAL
- 1460094; FLORIDANA AND GATOR SOILS, FREQUENTLY FLOODED
- 1460095; GATOR MUCK
- 1460096; FT. GREEN FINE SAND
- 1460097; HOLOPAW FINE SAND, FREQUENTLY PONDED, 0 TO 1 PERCENT SLOPES
- 1460100; MANATEE LOAMY FINE SAND, FREQUENTLY PONDED, 0 TO 1 PERCENT SLOPES
- 1460102; ORSINO FINE SAND
- 1460103; ONA FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460104; PINEDA FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460106; POMELLO FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460107; POMPANO FINE SAND, FREQUENTLY PONDED, 0 TO 1 PERCENT SLOPES
- 1460111; TAVARES FINE SAND, 0 TO 5 PERCENT SLOPES
- 1460112; WABASSO FINE SAND, 0 TO 2 PERCENT SLOPES
- 1460113; WATER

0 2,000 ft

1" = 2,500'

wood.

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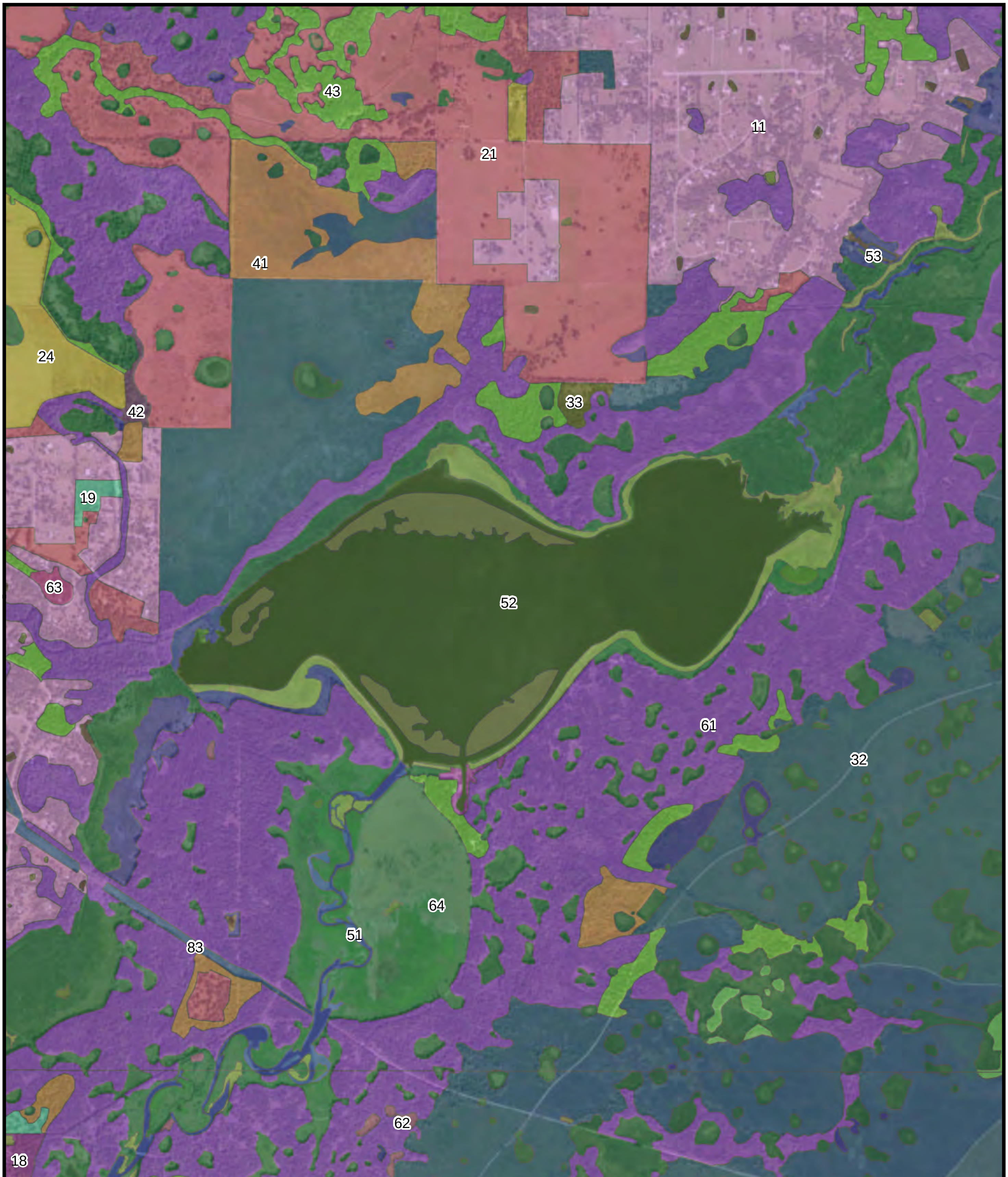
**Figure 4**
**NRCS Soils Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 4_Soils.mxd




**Notes:**

1- Project No.: 600639

2- Data Source - SWFWMD 2011

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/9/2019
Checked By: KN

## Explanation of Features

N

- 11; RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS
- 18; RECREATIONAL
- 19; OPEN LAND
- 21; CROPLAND AND PASTURELAND
- 24; NURSERIES AND VINEYARDS
- 32; SHRUB AND BRUSHLAND
- 33; MIXED RANGELAND
- 41; PINE FLATWOODS
- 42; UPLAND HARDWOOD FORESTS - PART 1
- 43; HARDWOOD CONIFER MIXED
- 51; STREAMS AND WATERWAYS
- 52; LAKES
- 53; RESERVOIRS
- 61; STREAM AND LAKE SWAMPS (BOTTOMLAND)
- 61; BAY SWAMPS
- 62; CYPRESS
- 63; WETLAND FORESTED MIXED
- 64; FRESHWATER MARSHES
- 64; EMERGENT AQUATIC VEGETATION
- 64; WET PRAIRIES
- 83; UTILITIES

0 2,000 ft

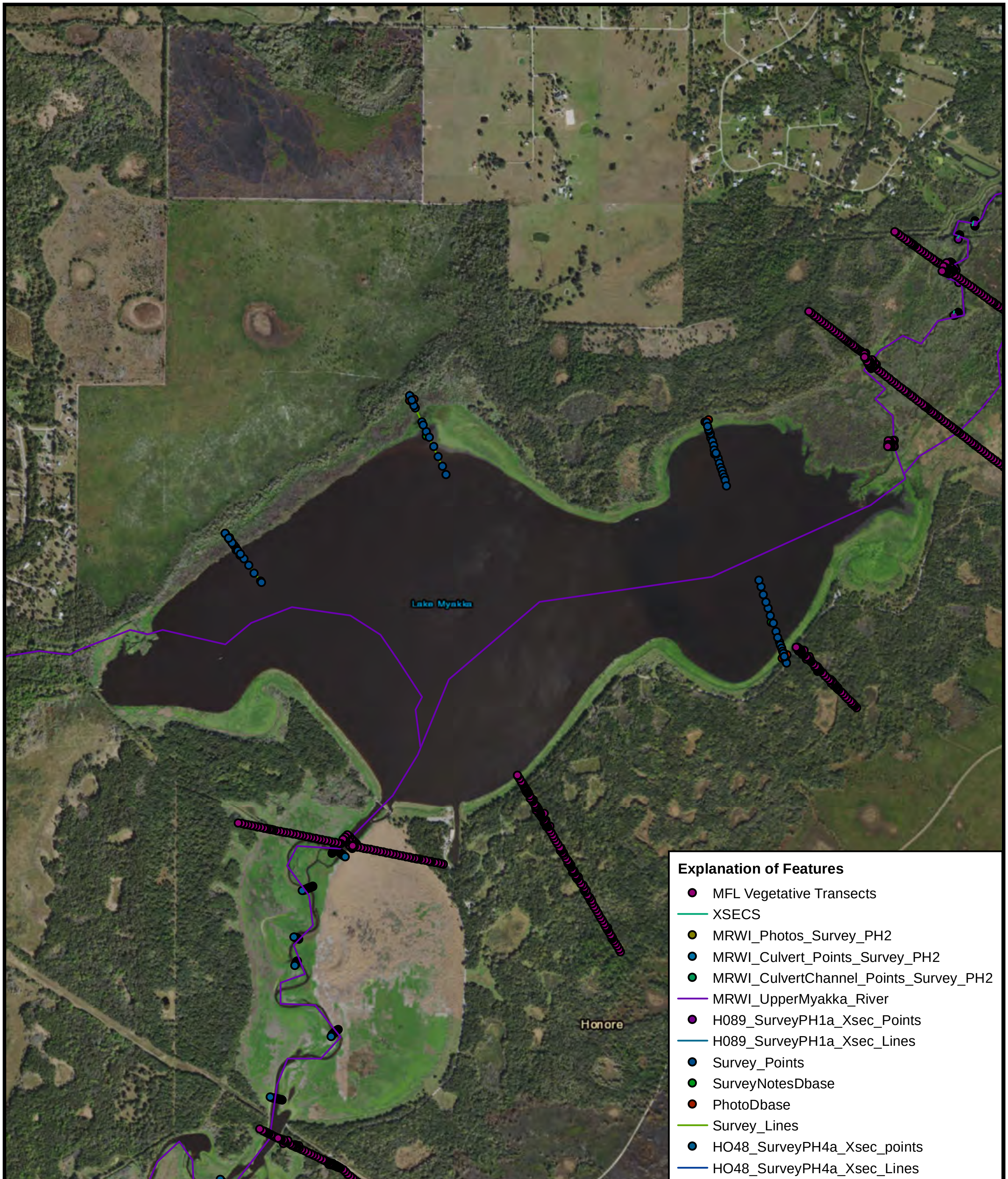
1" = 2,500'

wood.

Wood Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Ste #200
Tampa, FL 33602
CA-5392
(813) 636-1500

**Figure 5**
**Land Use Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 5_LandUse.mxd




**Notes:**

1- Project No.: 600639

2- Data Source - Aerial ESRI 2018

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/3/2019
Checked By: KN

N

0 ft 2,000

1" = 2,500'

wood.

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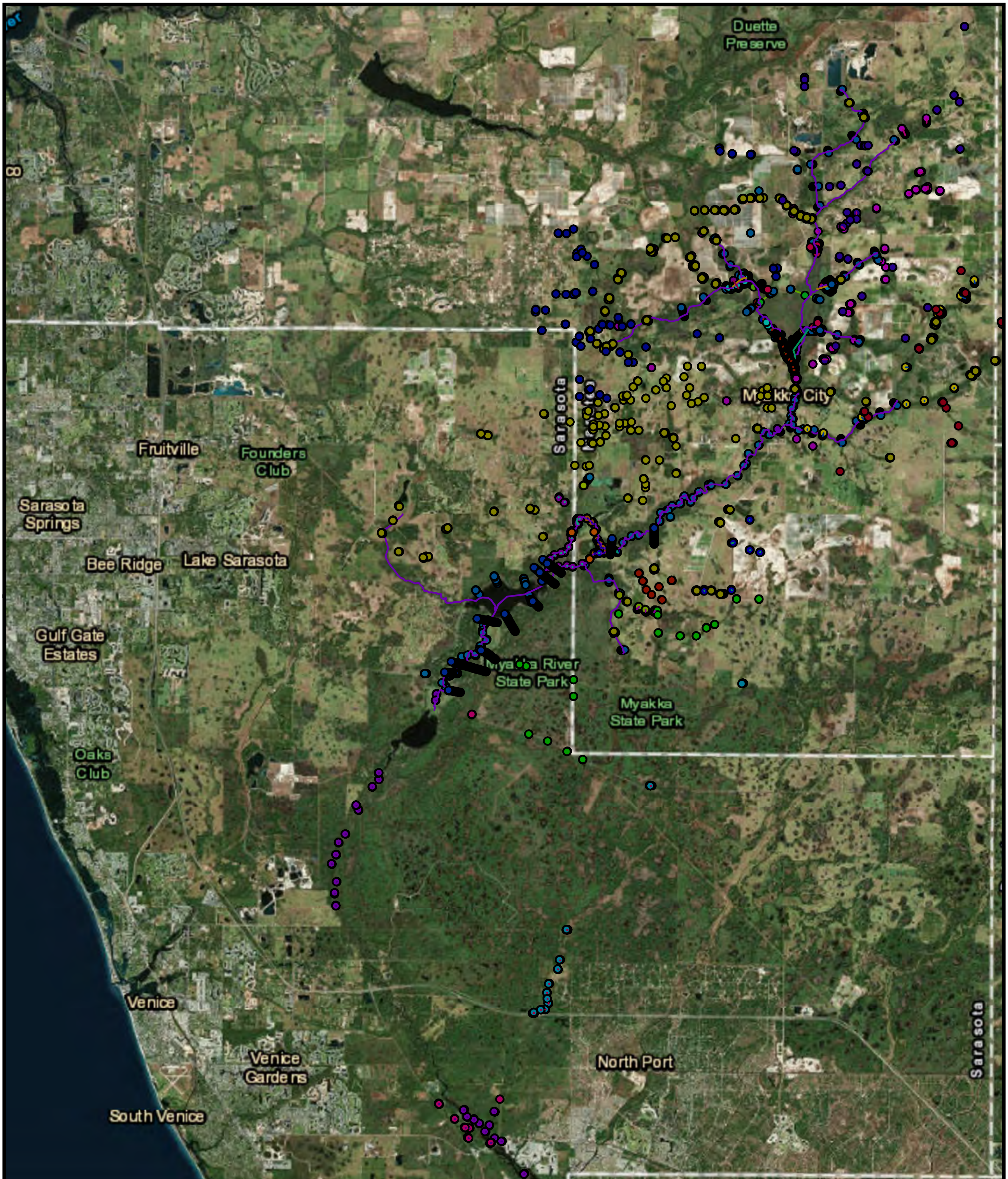
Tampa, FL 33602
CA-5392
(813) 636-1500

# Figure 6a
# Existing Survey Map (Lake Area)
# Upper Myakka Lake Feasibility Study
# Sarasota County, FL

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 6a_Existing Survey (Lake Area).mxd




**Notes:**
1- Project No.: 600639
2- Data Source - Aerial ESRI 2018
3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/9/2019
Checked By: KN

**Explanation of Features**

N

0 20,000 ft

1 in = 20,000 ft

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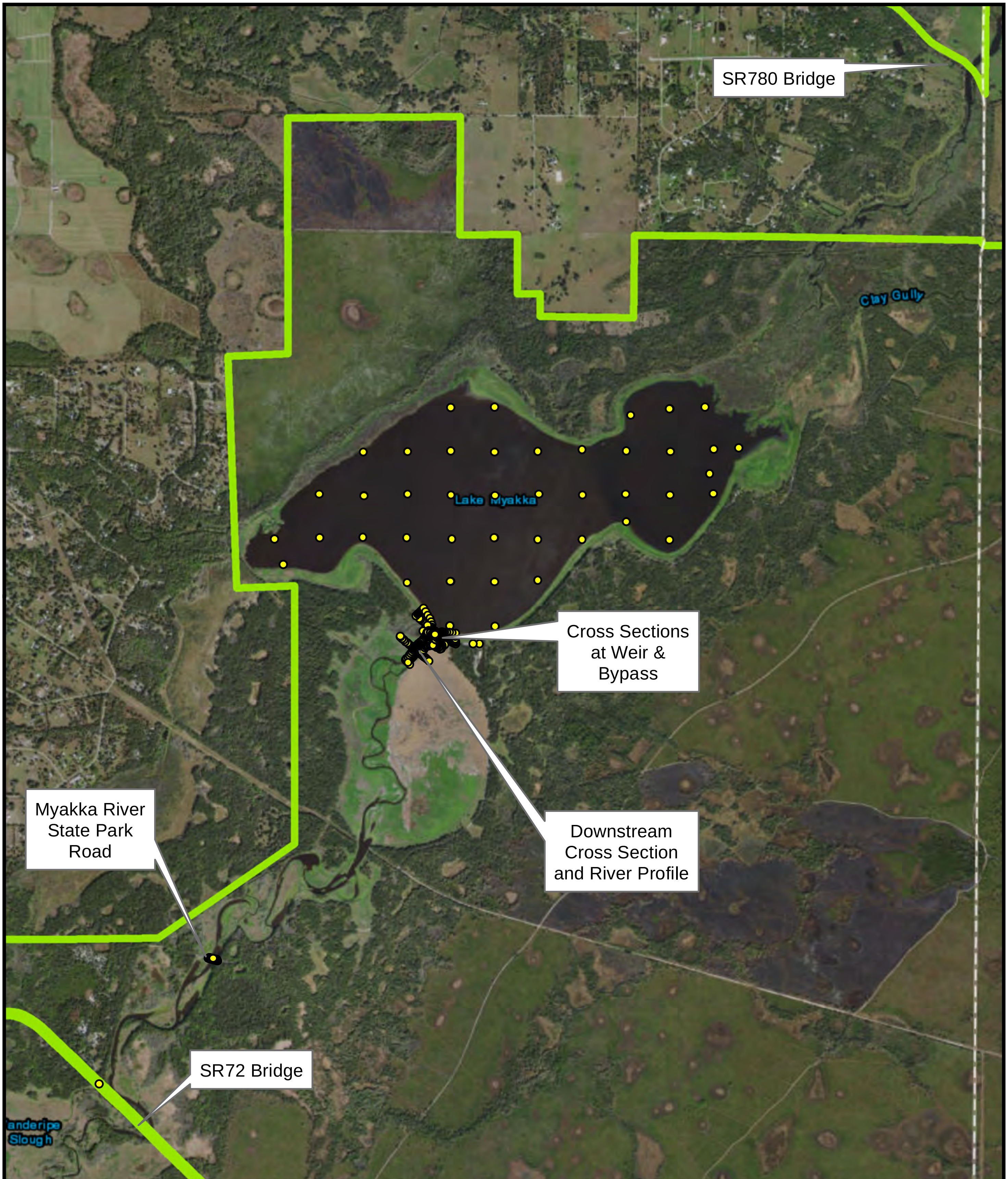
Tampa, FL 33602
CA-5392
(813) 636-1500

**Figure 6b**
**Existing Survey Map (Watershed)**
**Upper Myakka Lake Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Data_Collection_Plan\Figure 6b_Existing Survey (Watershed).mxd




**Notes:**

1- Project No.: 600639

2- Data Source - Aerial ESRI 2018
Survey data collected in 2019 by Wood in datum NAVD89

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:6/18/2020
Checked By: KN

**Explanation of Features**

N

Wood Survey

State Park Boundary

0 2,000 ft

1" = 3000'

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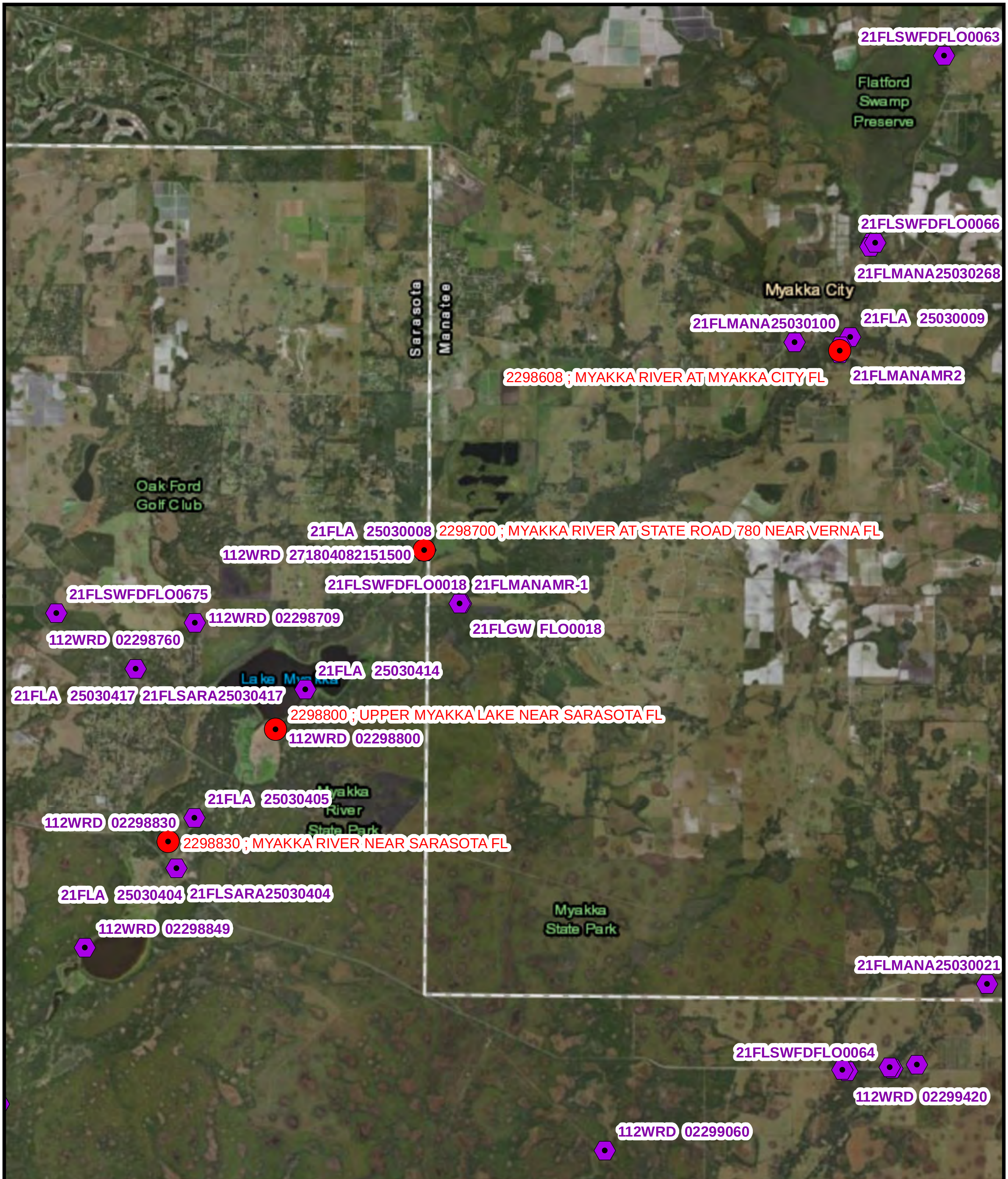
CA-5392
(813) 636-1500

**Figure 7**
**Wood Survey**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Report\Draft_Report\Figure 7_Wood Survey.mxd




**Notes:**

1- Project No.: 600639

2- Data Source - Aerial ESRI 2018
USGS 2019

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 3/28/2019
Revised:4/9/2019
Checked By: KN

**Explanation of Features**

N

USGS Hydrography Sites

STORET Water Quality

0 10,000 ft

1 in = 10,000 ft

wood.

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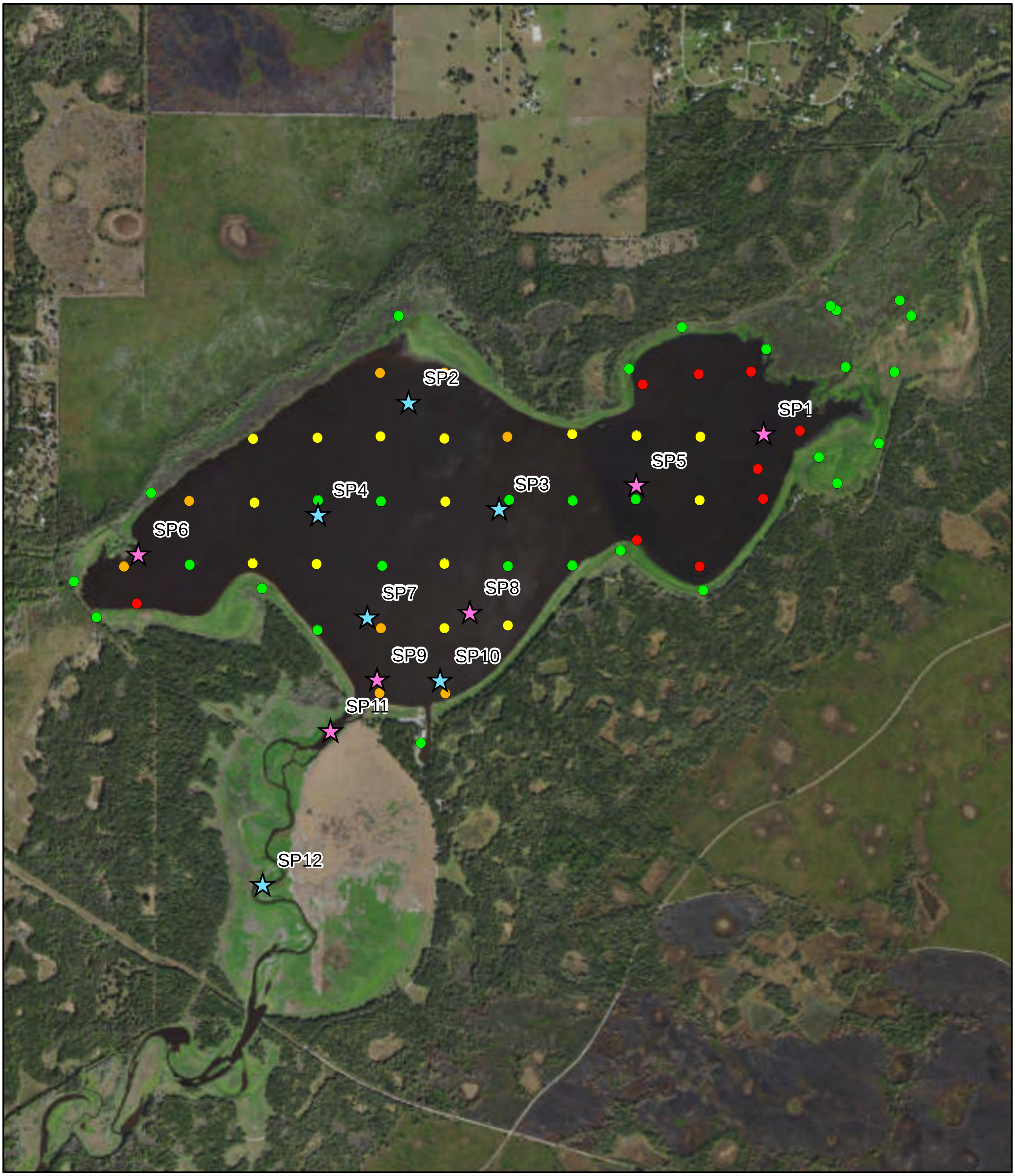
Tampa, FL 33602
CA-5392
(813) 636-1500

**Figure 8**
**Monitoring Stations Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: C:\Users\nina.berithova\Desktop\Figure 8_Monitoring Stations.mxd




**Notes:**
1- Project No.: 600639
2- Data Source - Aerial ESRI 2018
3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 6/18/2020
Revised:6/18/2020
Checked By: KN

N

**Explanation of Features**

**Sediment Thickness (ft)**
- 0.0 - 0.1
- 0.2 - 0.3
- 0.4 - 0.6
- 0.7 - 1.4

Sampling Location

P-Fractionation Sampling Location

0 2,000 ft
1" = 2,500'

wood.


Wood Environment & Infrastructure Solutions, Inc.
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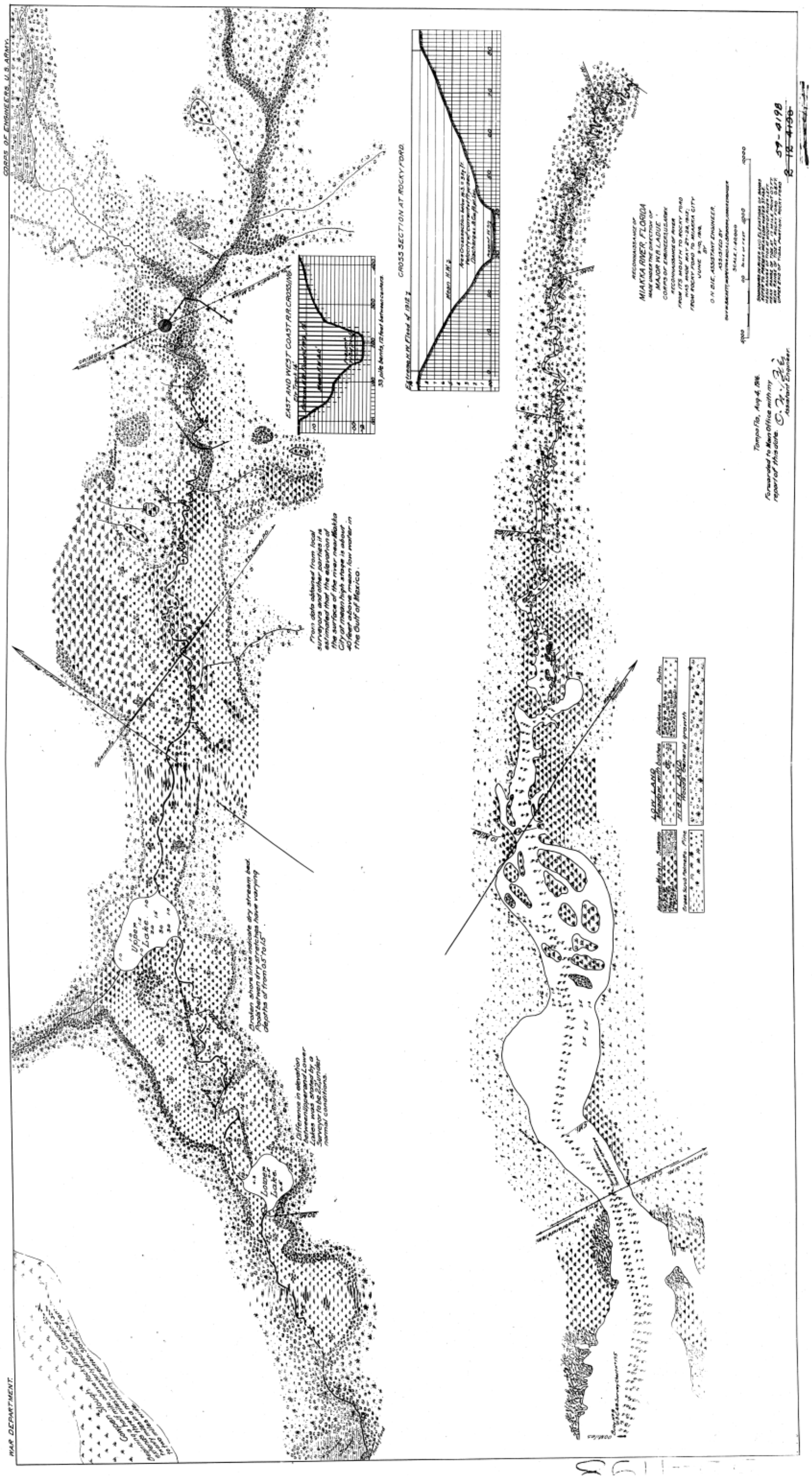
Tampa, FL 33602
CA-5392
(813) 636-1500


**Figure 9**
**Sediment Sampling Locations**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

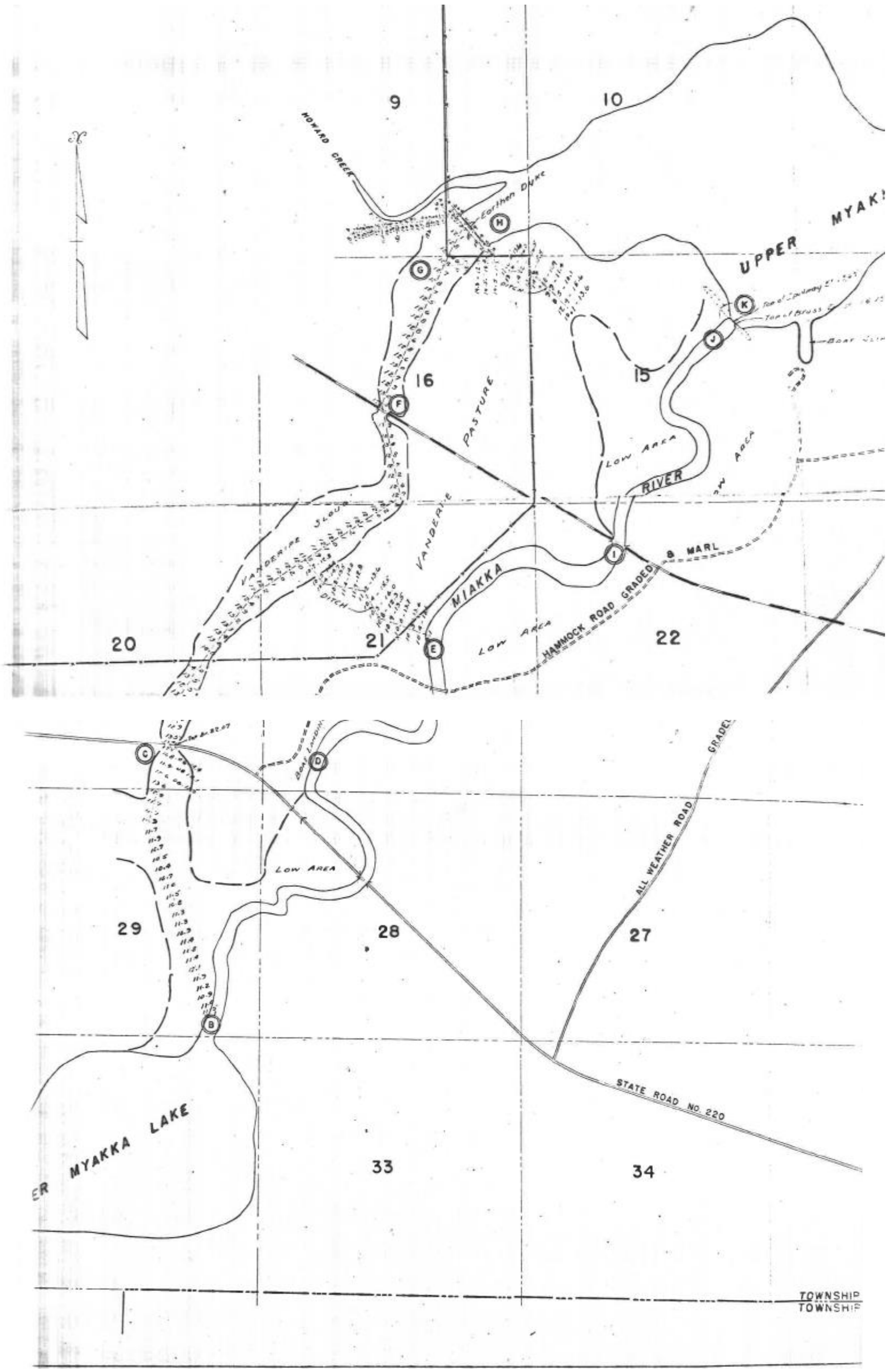
Path: C:\Users\taylor.faist\Desktop\Sampling_points.mxd

# APPENDIX A

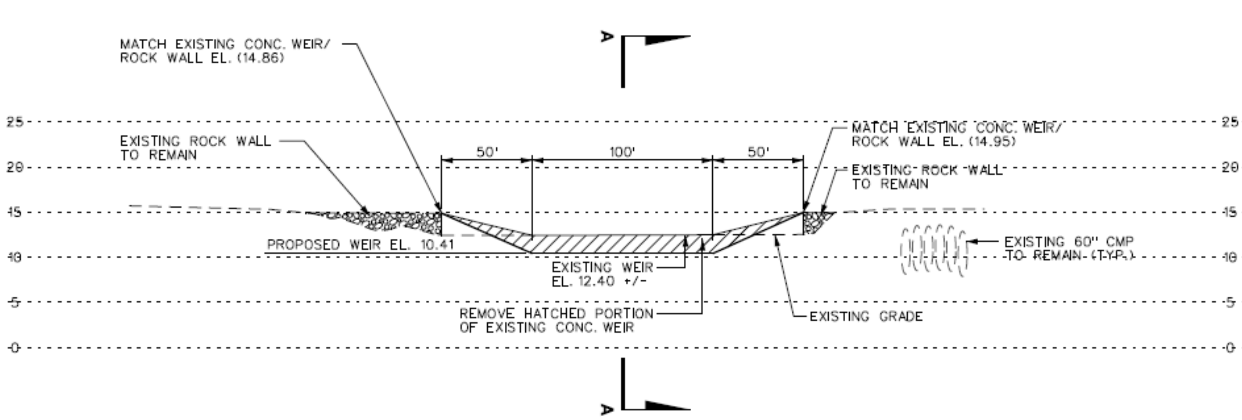
Survey Data



*Source: US Army Corps of Engineers, 1916*

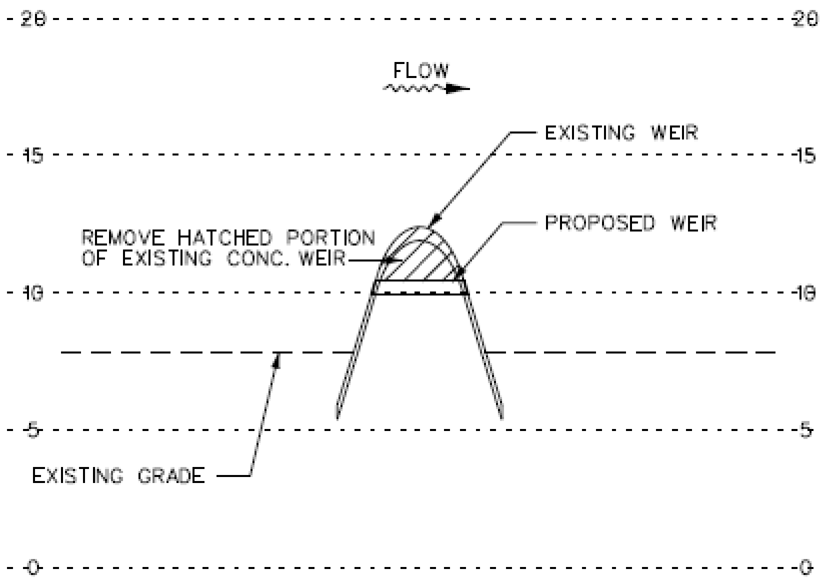



*Source: Angus, 1945*




**UPPER MYAKKA LAKE WEIR**
**OPTION 1**

HSCALE: 1" = 100'
VSCALE: 1" = 20'




**SECTION A:A**

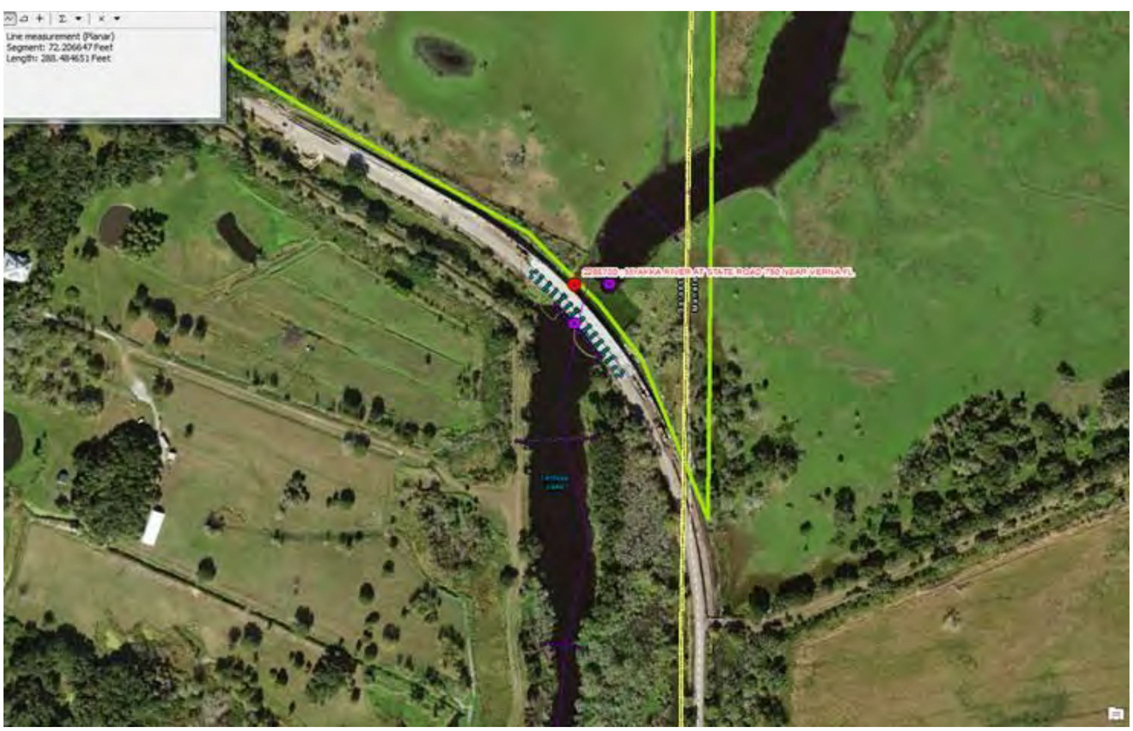
HSCALE: 1" = 20'
VSCALE: 1" - 10'

*Source: Singhofen & Associates, Inc. 2013*

**Clay Gully Road**

*Source: SWFWMD Geodatabase sent March 2019*

**County Road 780**




*Source: SWFWMD Geodatabase sent March 2019*

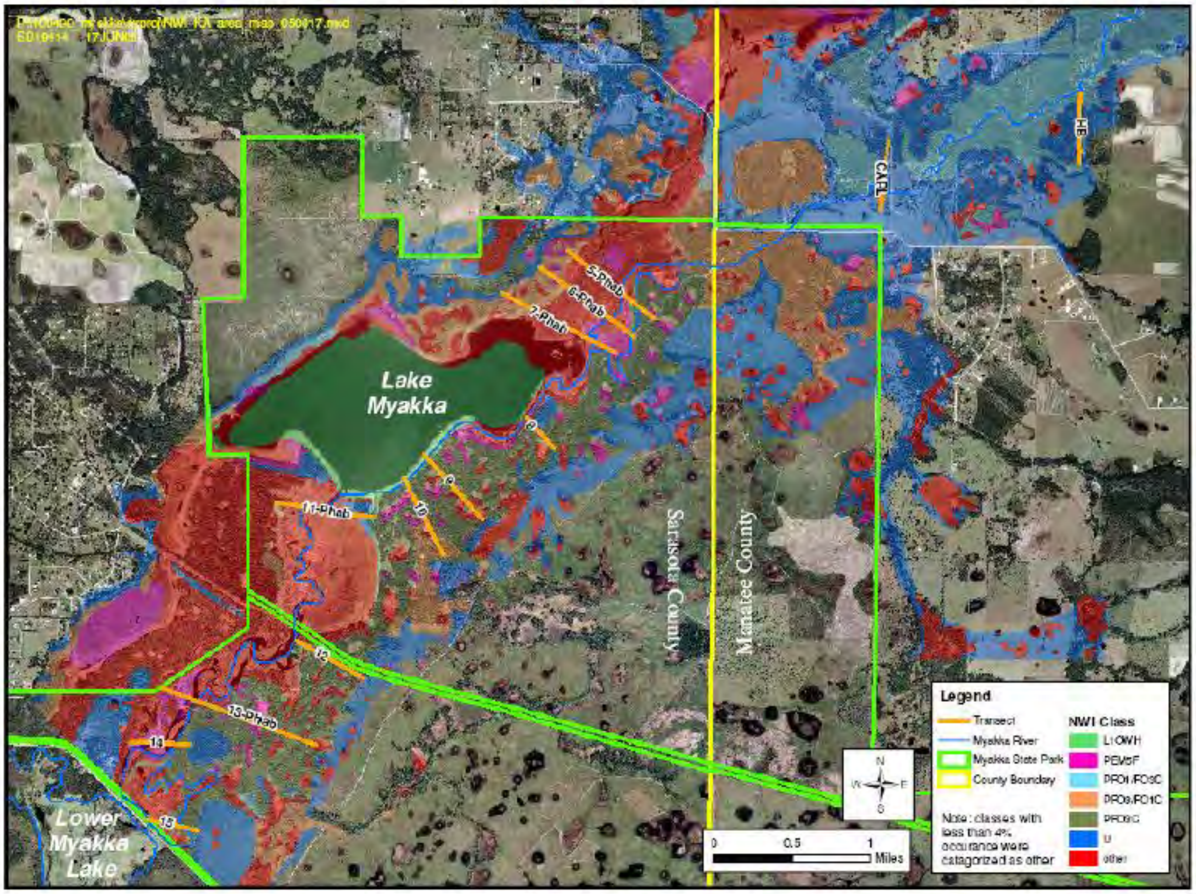
**Myakka River State Park Road**

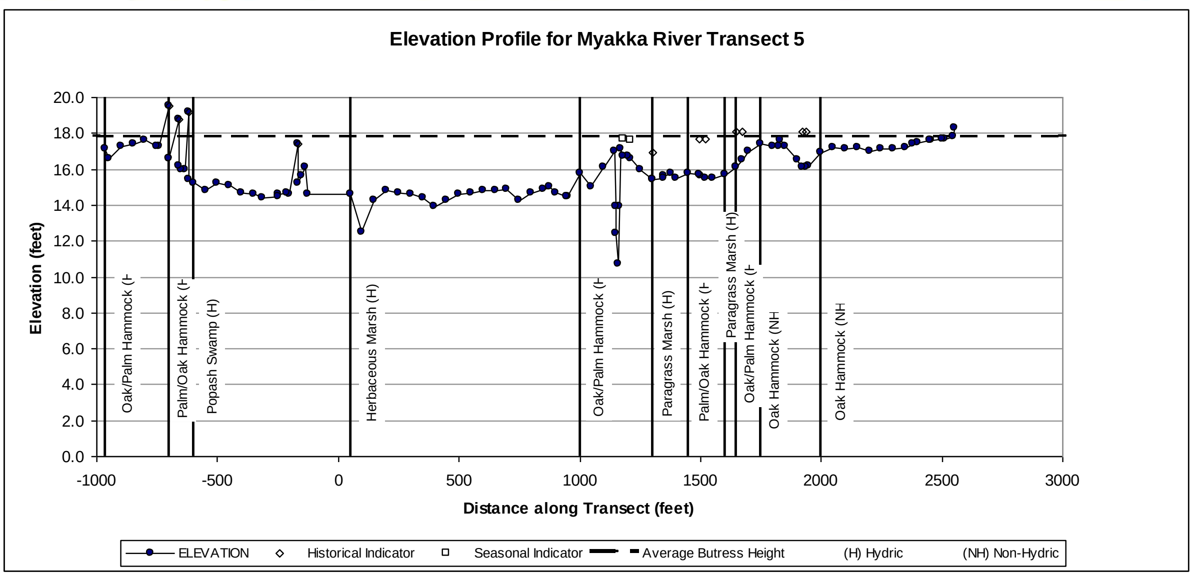

*Source: SWFWMD Geodatabase sent March 2019*

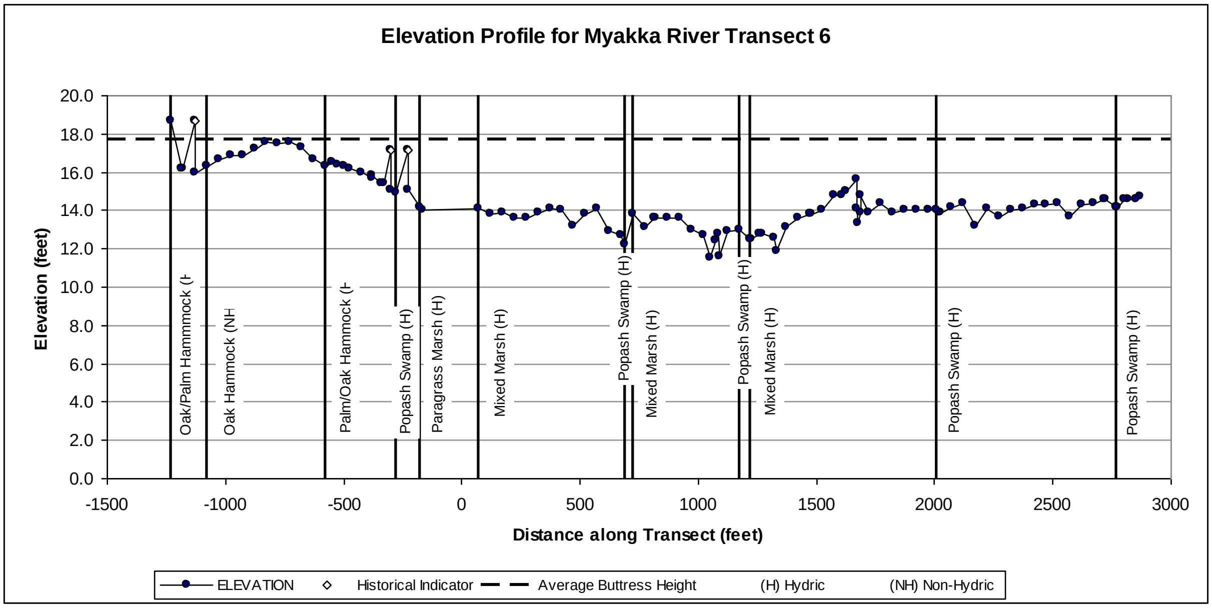
**State Road 72**


*Source: SWFWMD Geodatabase sent March 2019*

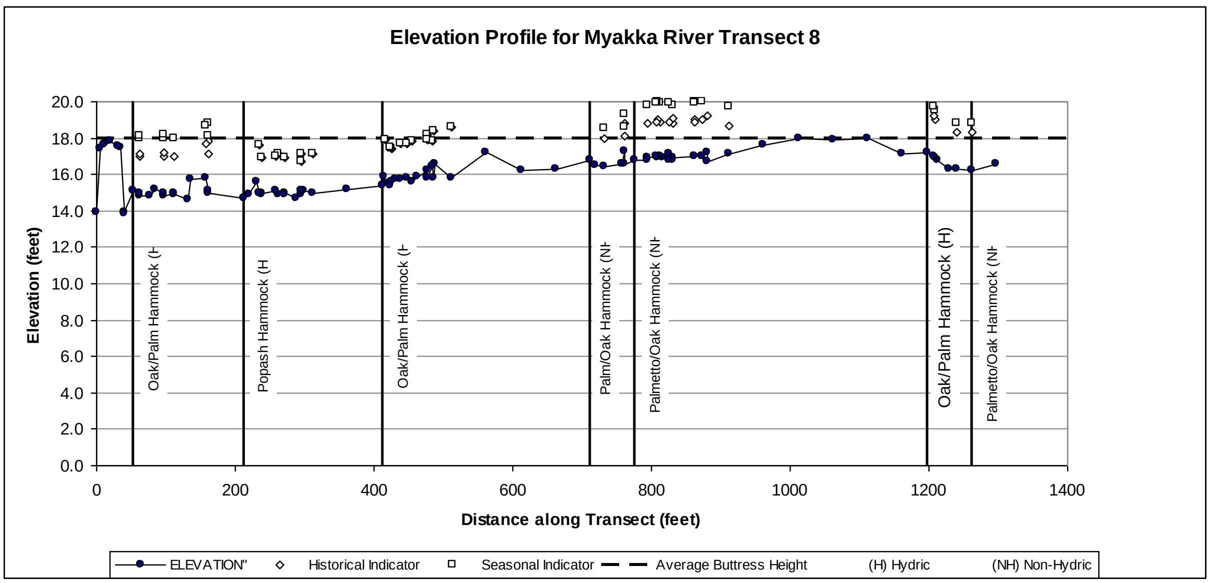
## SWFWMD MFL Transect Locations and Vegetation Cover



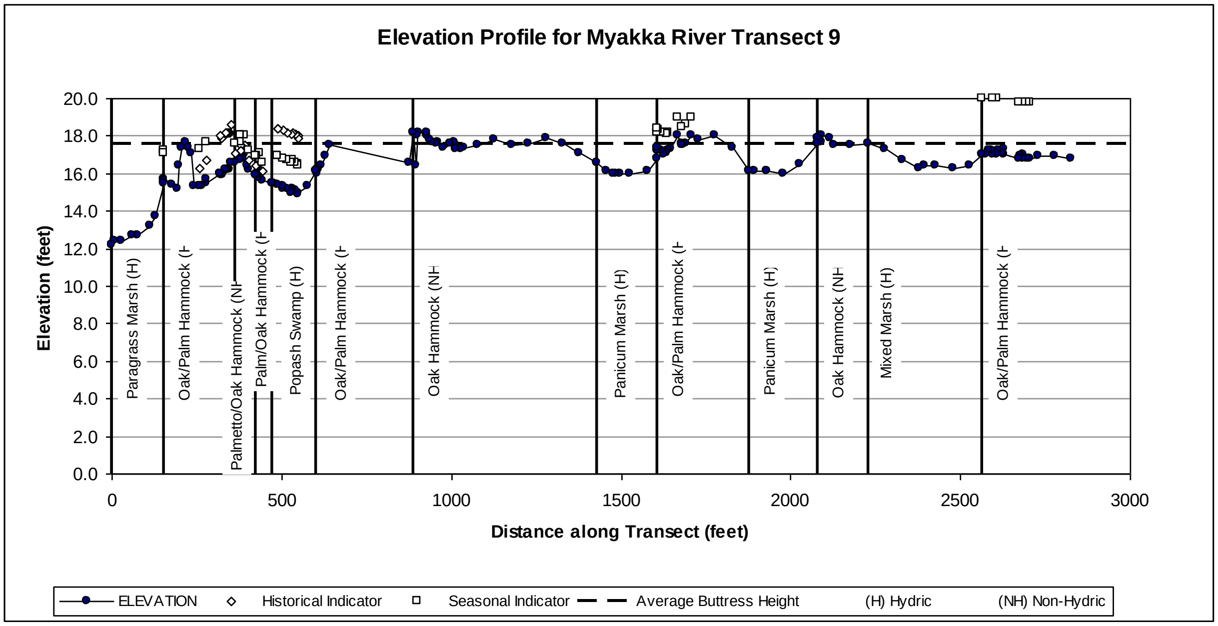





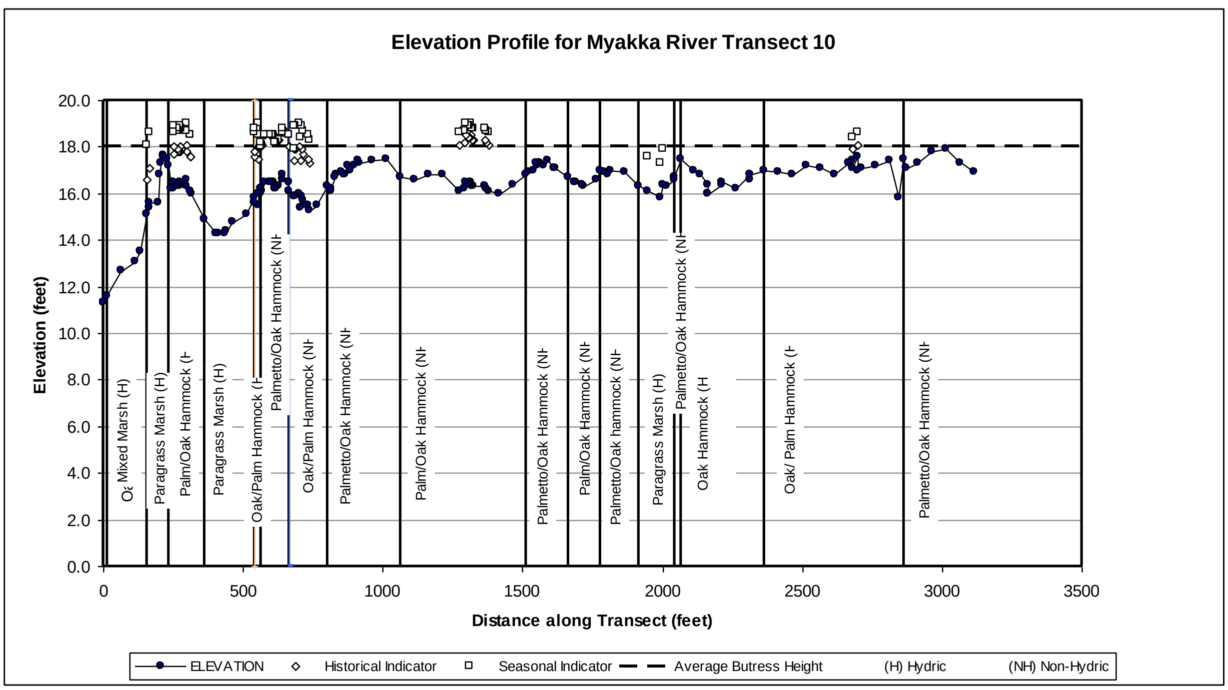
Elevation Profile for Myakka River Transect 6
Elevation (feet)
Distance along Transect (feet)
Oak/Palm Hammmock (H
Oak Hammock (NH
Palm/Oak Hammock (H
Popash Swamp (H)
Paragrass Marsh (H)
Mixed Marsh (H)
Popash Swamp (H)
Mixed Marsh (H)
Popash Swamp (H)
Mixed Marsh (H)
Popash Swamp (H)
Popash Swamp (H)
ELEVATION
Historical Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

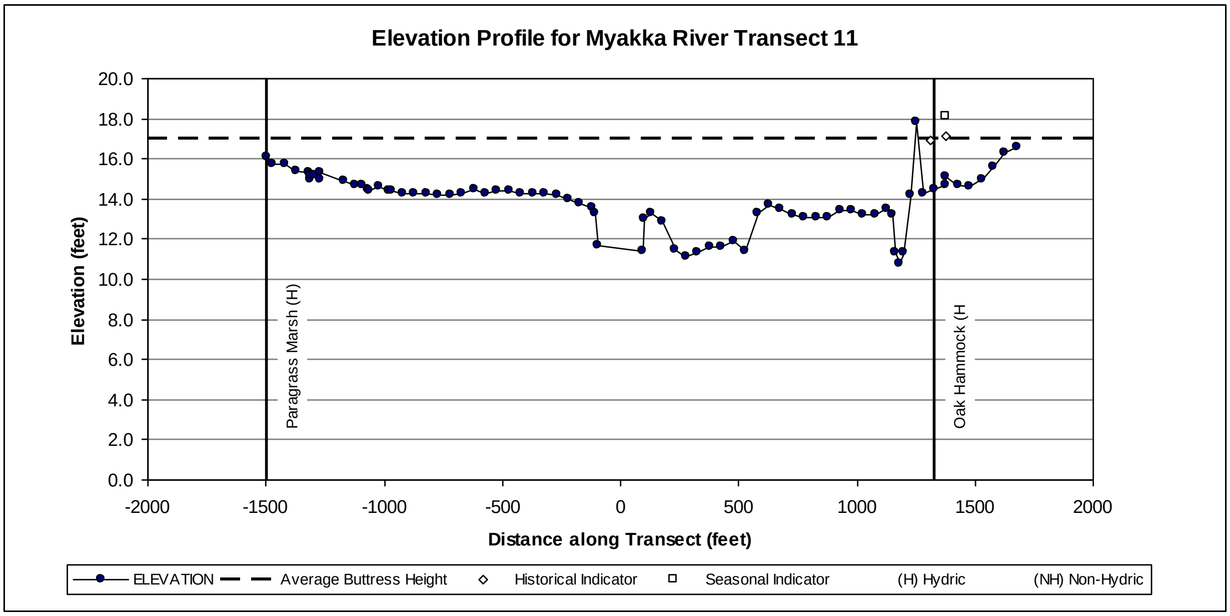
Elevation Profile for Myakka River Transect 8
Elevation (feet)
Distance along Transect (feet)
Oak/Palm Hammock (H
Popash Hammock (H
Oak/Palm Hammock (H
Palm/Oak Hammock (NH
Palmetto/Oak Hammock (NH
Oak/Palm Hammock (H)
Palmetto/Oak Hammock (NH
ELEVATION"
Historical Indicator
Seasonal Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

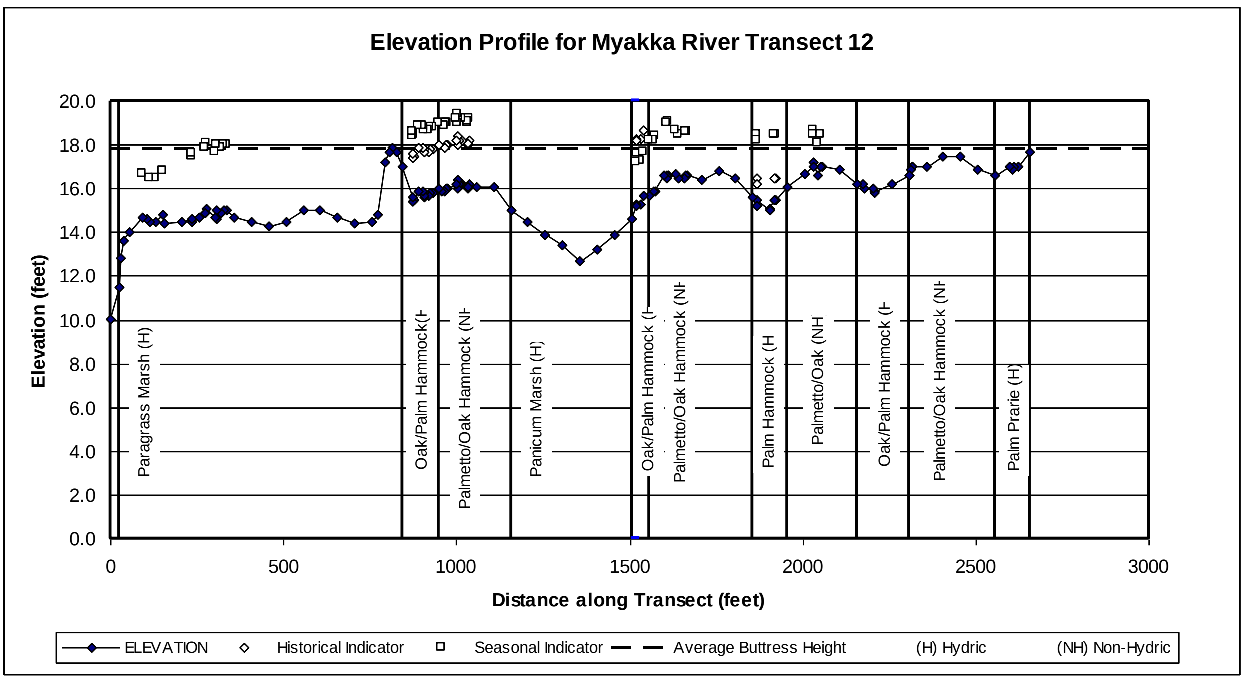


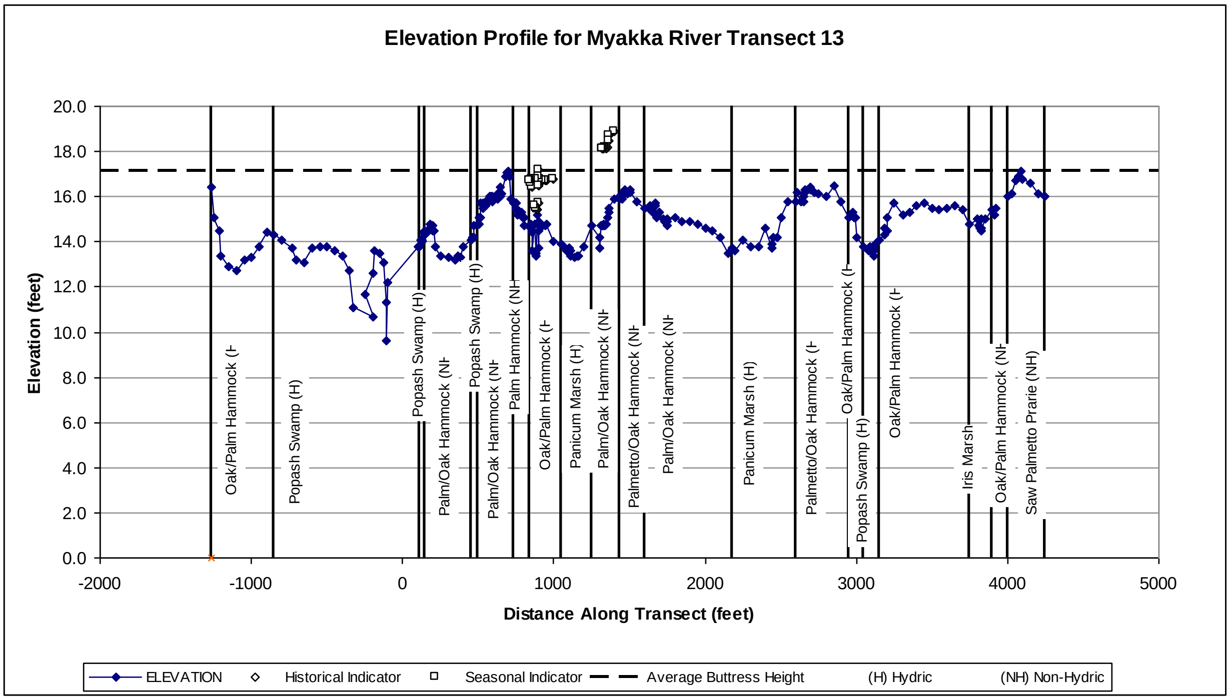
Elevation Profile for Myakka River Transect 9
Elevation (feet)
Distance along Transect (feet)
Paragrass Marsh (H)
Oak/Palm Hammock (H
Palmetto/Oak Hammock (NH
Palm/Oak Hammock (H
Popash Swamp (H)
Oak/Palm Hammock (H
Oak Hammock (NH
Panicum Marsh (H)
Oak/Palm Hammock (H
Panicum Marsh (H)
Oak Hammock (NH
Mixed Marsh (H)
Oak/Palm Hammock (H
ELEVATION
Historical Indicator
Seasonal Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

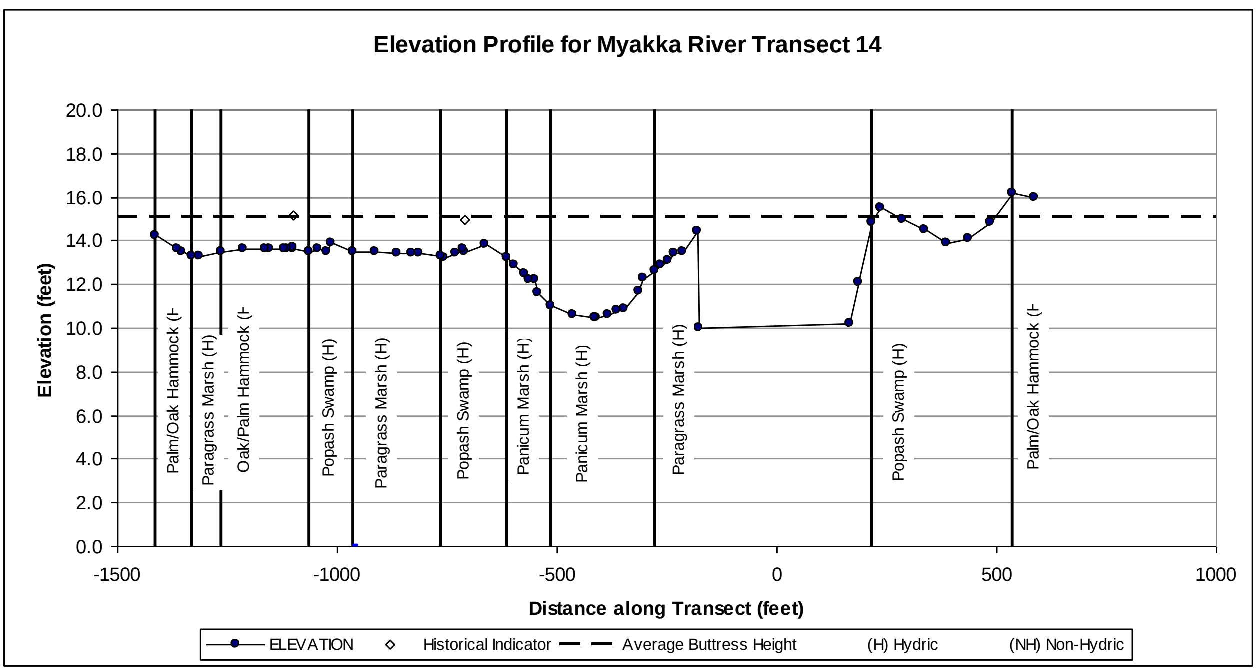



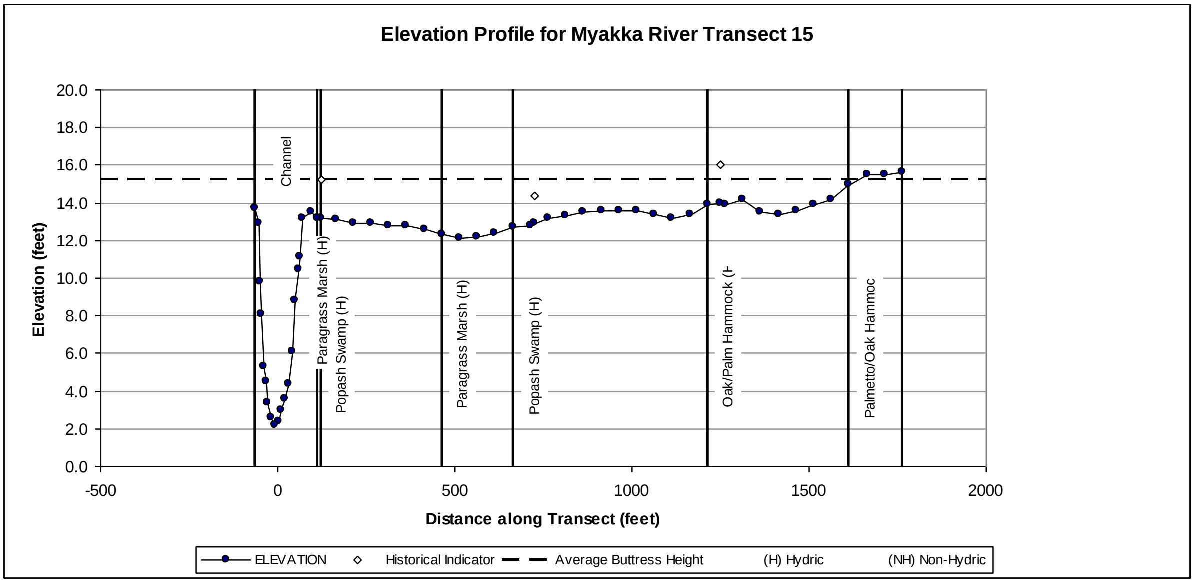
Elevation Profile for Myakka River Transect 10
Elevation (feet)
Distance along Transect (feet)
Mixed Marsh (H)
Paragrass Marsh (H)
Palm/Oak Hammock (H
Paragrass Marsh (H)
Oak/Palm Hammock (H
Palmetto/Oak Hammock (NH
Oak/Palm Hammock (NH
Palmetto/Oak Hammock (NH
Palm/Oak Hammock (NH
Palmetto/Oak Hammock (NH
Palm/Oak Hammock (NH
Palmetto/Oak hammock (NH
Paragrass Marsh (H)
Palmetto/Oak Hammock (NH
Oak Hammock (H
Oak/ Palm Hammock (H
Palmetto/Oak Hammock (NH
ELEVATION
Historical Indicator
Seasonal Indicator
Average Butress Height
(H) Hydric
(NH) Non-Hydric

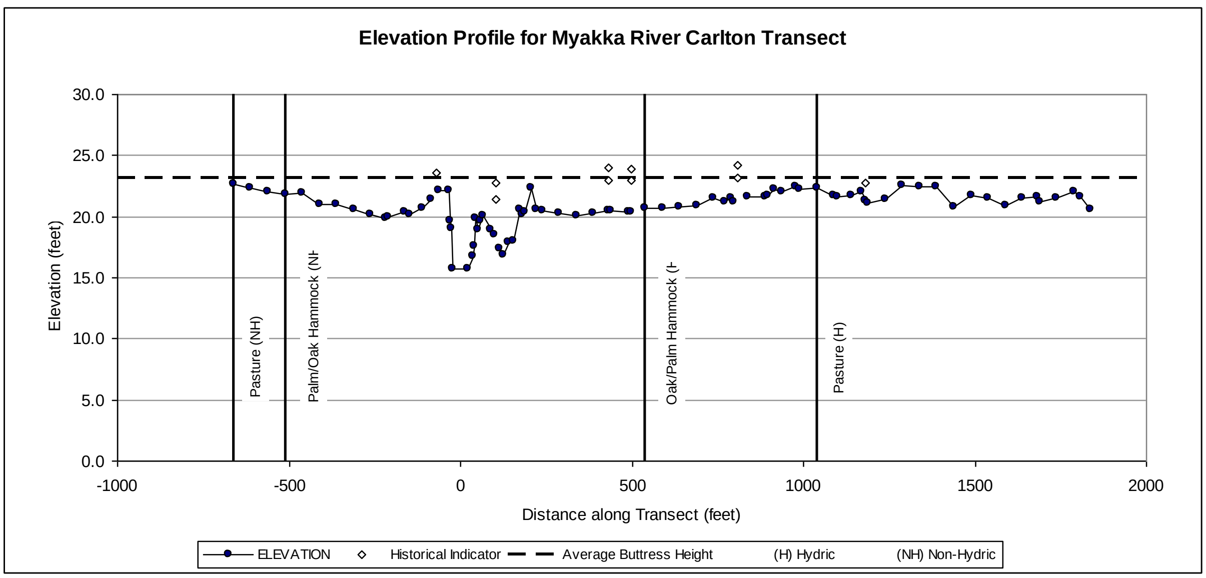

Elevation Profile for Myakka River Transect 11
Elevation (feet)
Distance along Transect (feet)
Paragrass Marsh (H)
Oak Hammock (H
ELEVATION
Average Buttress Height
Historical Indicator
Seasonal Indicator
(H) Hydric
(NH) Non-Hydric

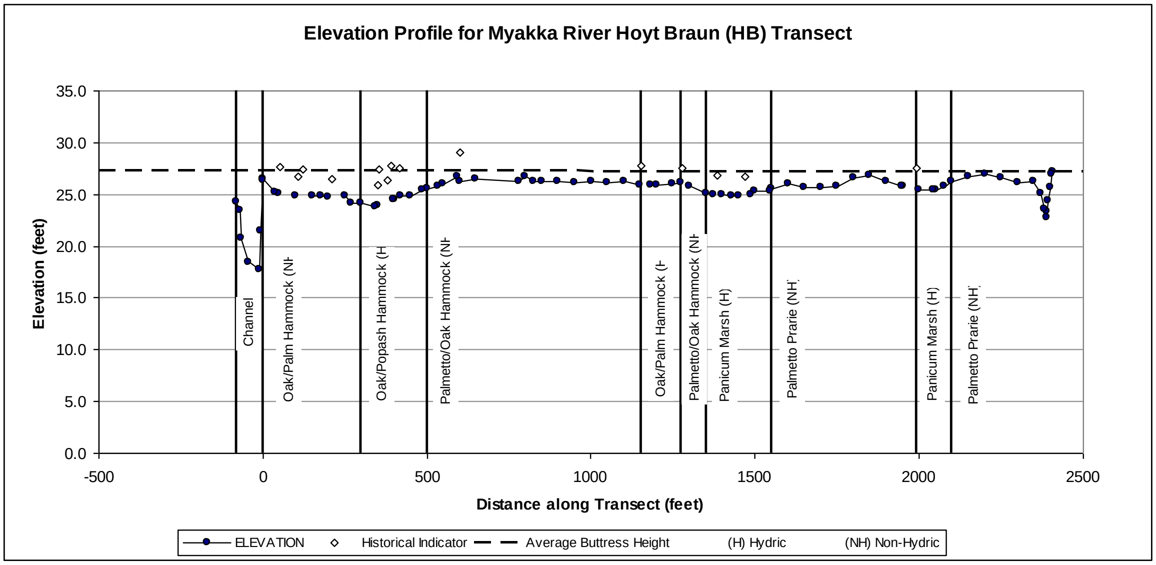

Elevation Profile for Myakka River Transect 12
Elevation (feet)
Distance along Transect (feet)
Paragrass Marsh (H)
Oak/Palm Hammock(H
Palmetto/Oak Hammock (NH
Panicum Marsh (H)
Oak/Palm Hammock (H
Palmetto/Oak Hammock (NH
Palm Hammock (H
Palmetto/Oak (NH
Oak/Palm Hammock (H
Palmetto/Oak Hammock (NH
Palm Prarie (H)
ELEVATION
Historical Indicator
Seasonal Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric


Elevation Profile for Myakka River Transect 13
Elevation (feet)
Distance Along Transect (feet)
Oak/Palm Hammock (H
Popash Swamp (H)
Popash Swamp (H)
Palm/Oak Hammock (NH
Popash Swamp (H)
Palm/Oak Hammock (NH
Palm Hammock (NH
Oak/Palm Hammock (H
Panicum Marsh (H)
Palm/Oak Hammock (NH
Palmetto/Oak Hammock (NH
Palm/Oak Hammock (NH
Panicum Marsh (H)
Palmetto/Oak Hammock (H
Oak/Palm Hammock (H
Popash Swamp (H)
Oak/Palm Hammock (H
Iris Marsh
Oak/Palm Hammock (NH
Saw Palmetto Prarie (NH)
ELEVATION
Historical Indicator
Seasonal Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

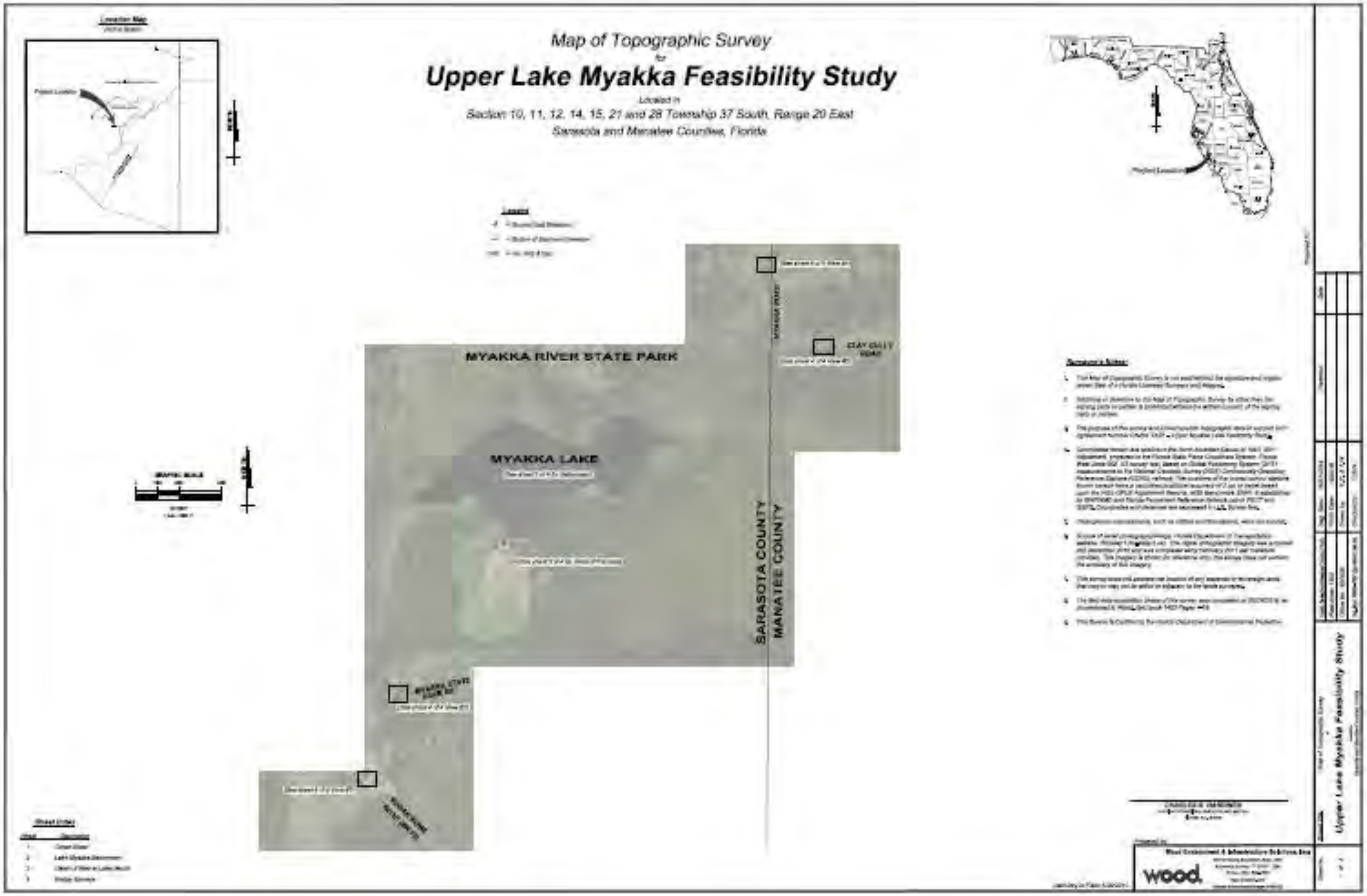

Elevation Profile for Myakka River Transect 14
Elevation (feet)
Distance along Transect (feet)
Palm/Oak Hammock (H
Paragrass Marsh (H)
Oak/Palm Hammock (H
Popash Swamp (H)
Paragrass Marsh (H)
Popash Swamp (H)
Panicum Marsh (H)
Panicum Marsh (H)
Paragrass Marsh (H)
Popash Swamp (H)
Palm/Oak Hammock (H
ELEVATION
Historical Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric


Elevation Profile for Myakka River Transect 15
Elevation (feet)
Distance along Transect (feet)
Channel
Paragrass Marsh (H)
Popash Swamp (H)
Paragrass Marsh (H)
Popash Swamp (H)
Oak/Palm Hammock (H
Palmetto/Oak Hammoc
ELEVATION
Historical Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric


Elevation Profile for Myakka River Carlton Transect
Elevation (feet)
Distance along Transect (feet)
Pasture (NH)
Palm/Oak Hammock (NH
Oak/Palm Hammock (H
Pasture (H)
ELEVATION
Historical Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

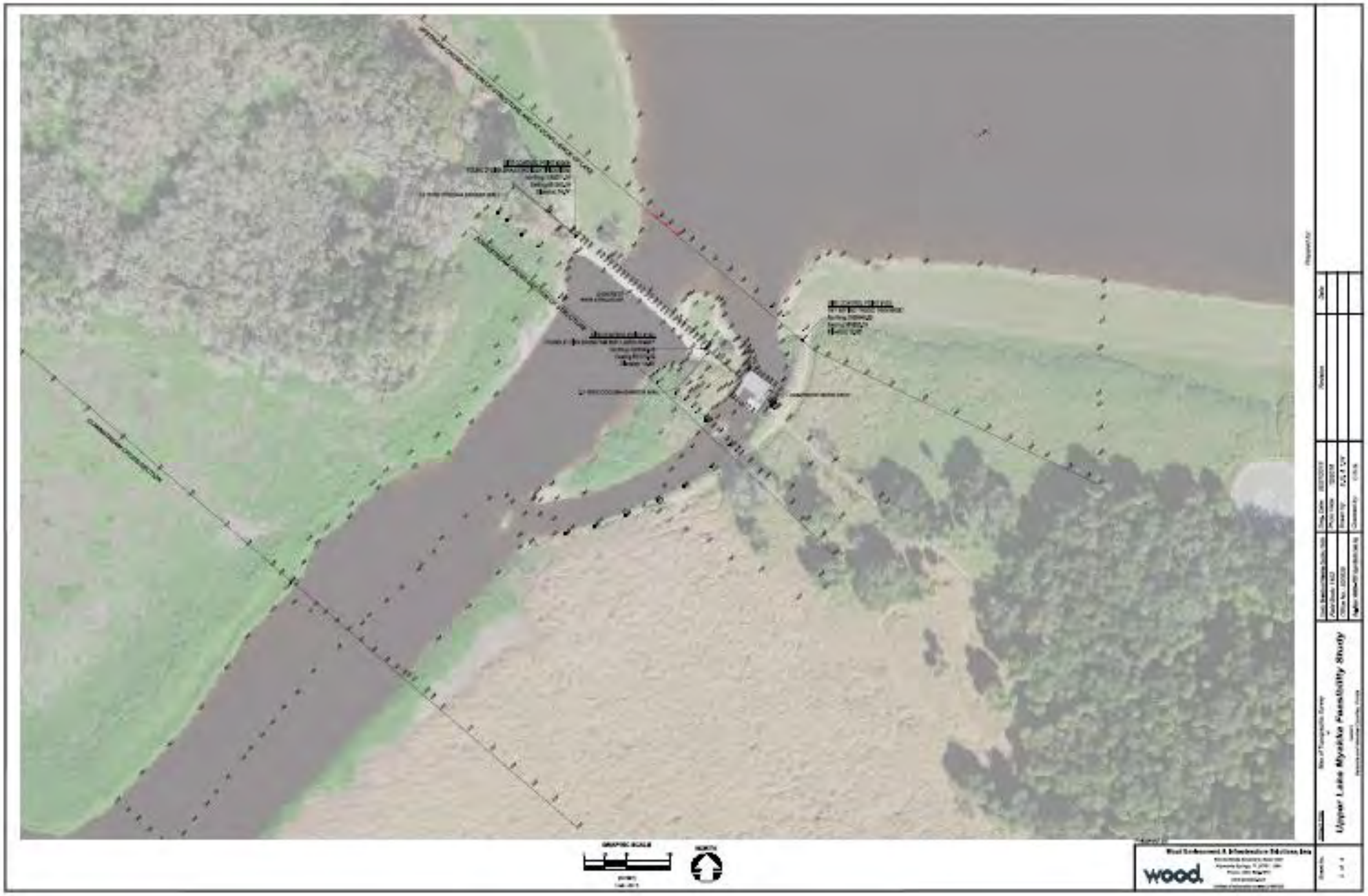


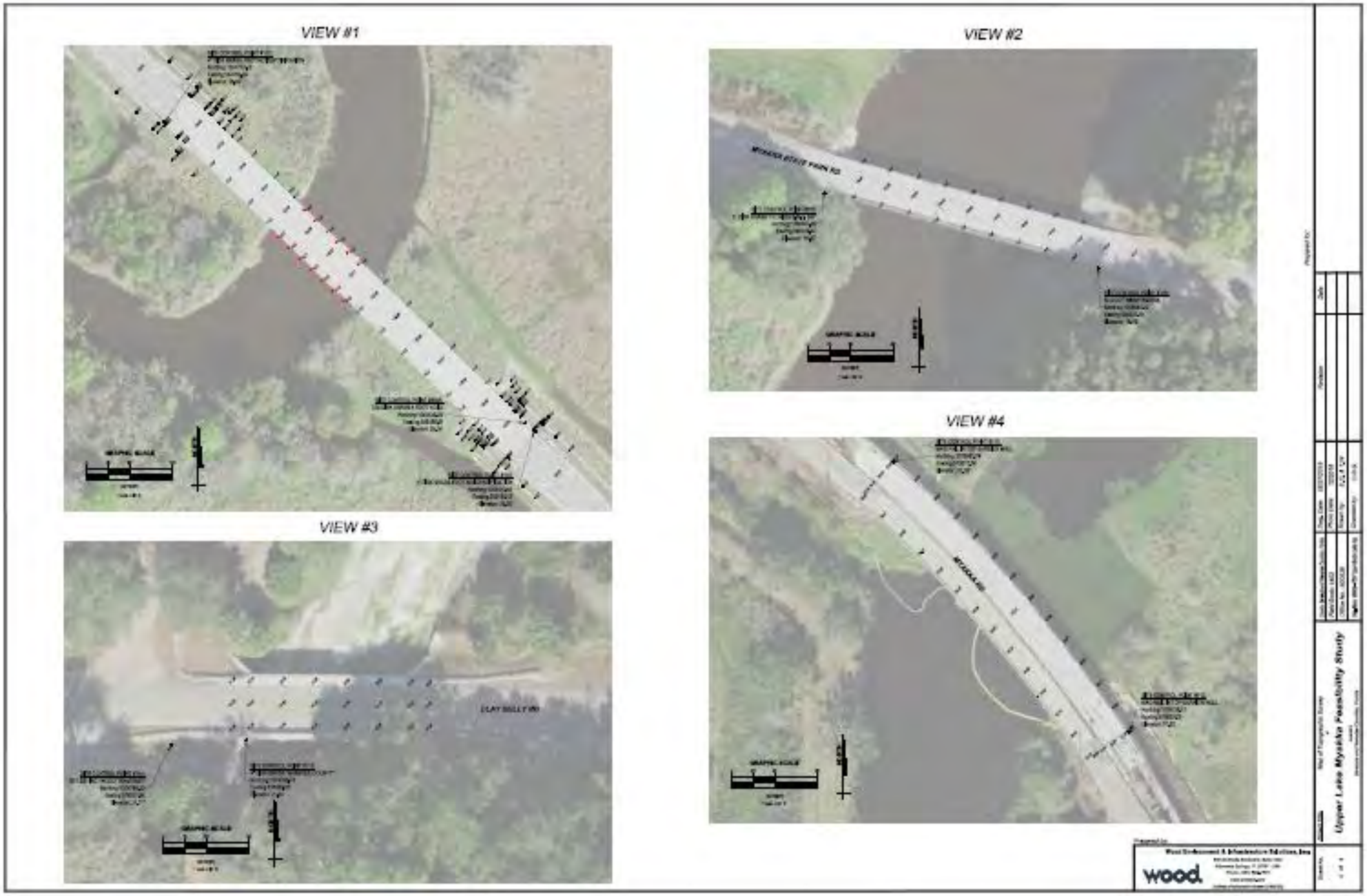
Elevation Profile for Myakka River Hoyt Braun (HB) Transect
Elevation (feet)
Distance along Transect (feet)
Channel
Oak/Palm Hammock (NH)
Oak/Popash Hammock (H)
Palmetto/Oak Hammock (NH)
Oak/Palm Hammock (H)
Palmetto/Oak Hammock (NH)
Panicum Marsh (H)
Palmetto Prarie (NH)
Panicum Marsh (H)
Palmetto Prarie (NH)
ELEVATION
Historical Indicator
Average Buttress Height
(H) Hydric
(NH) Non-Hydric

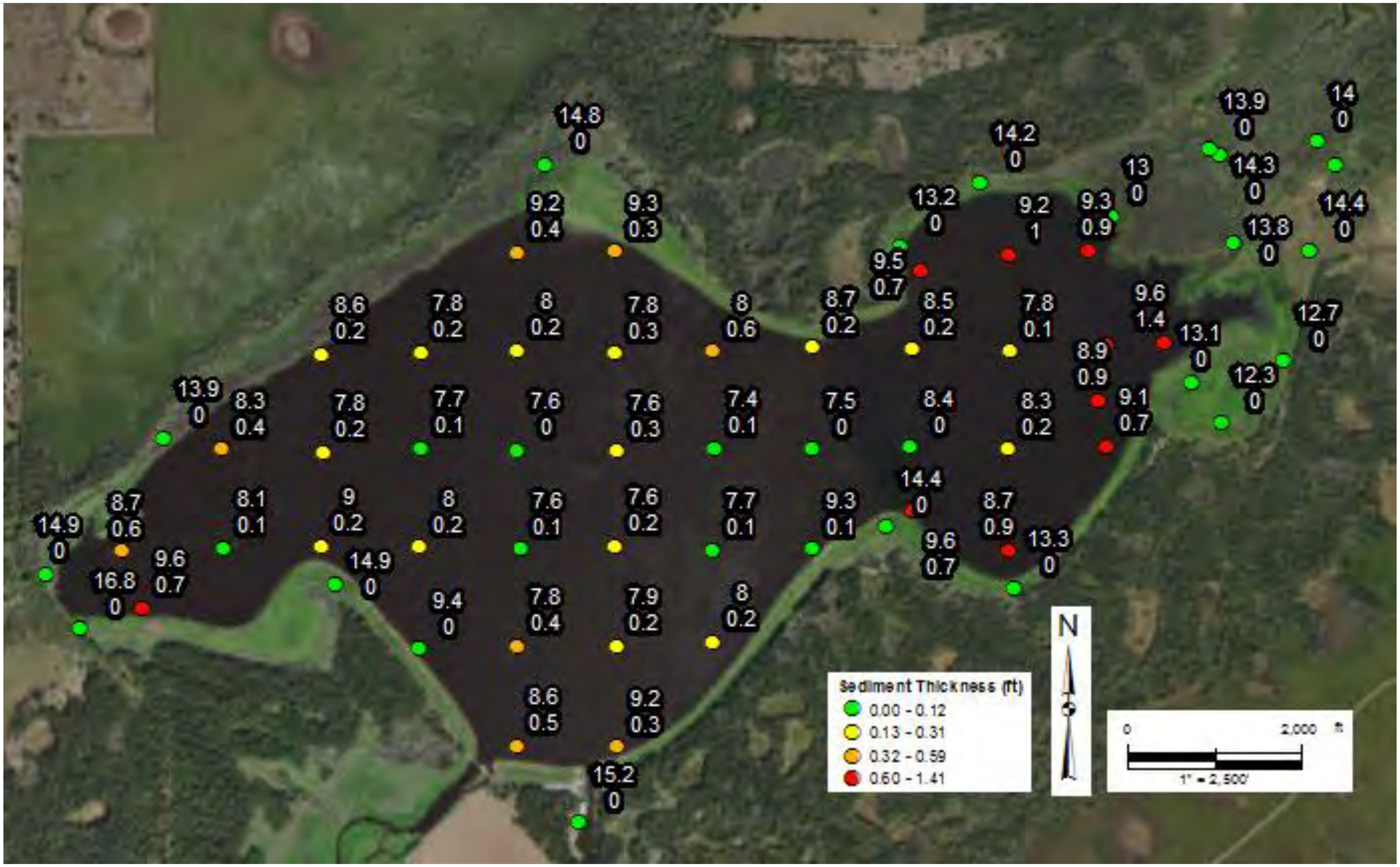


Map of Topographic Survey
for
Upper Lake Myakka Feasibility Study
Located in
Section 10, 11, 12, 14, 15, 21 and 28 Township 37 South, Range 20 East
Sarasota and Manatee Counties, Florida
MYAKKA RIVER STATE PARK
MYAKKA LAKE
SARASOTA COUNTY
MANATEE COUNTY
Upper Lake Myakka Feasibility Study
wood.


Upper Lake Myakka Feasibility Study
wood.

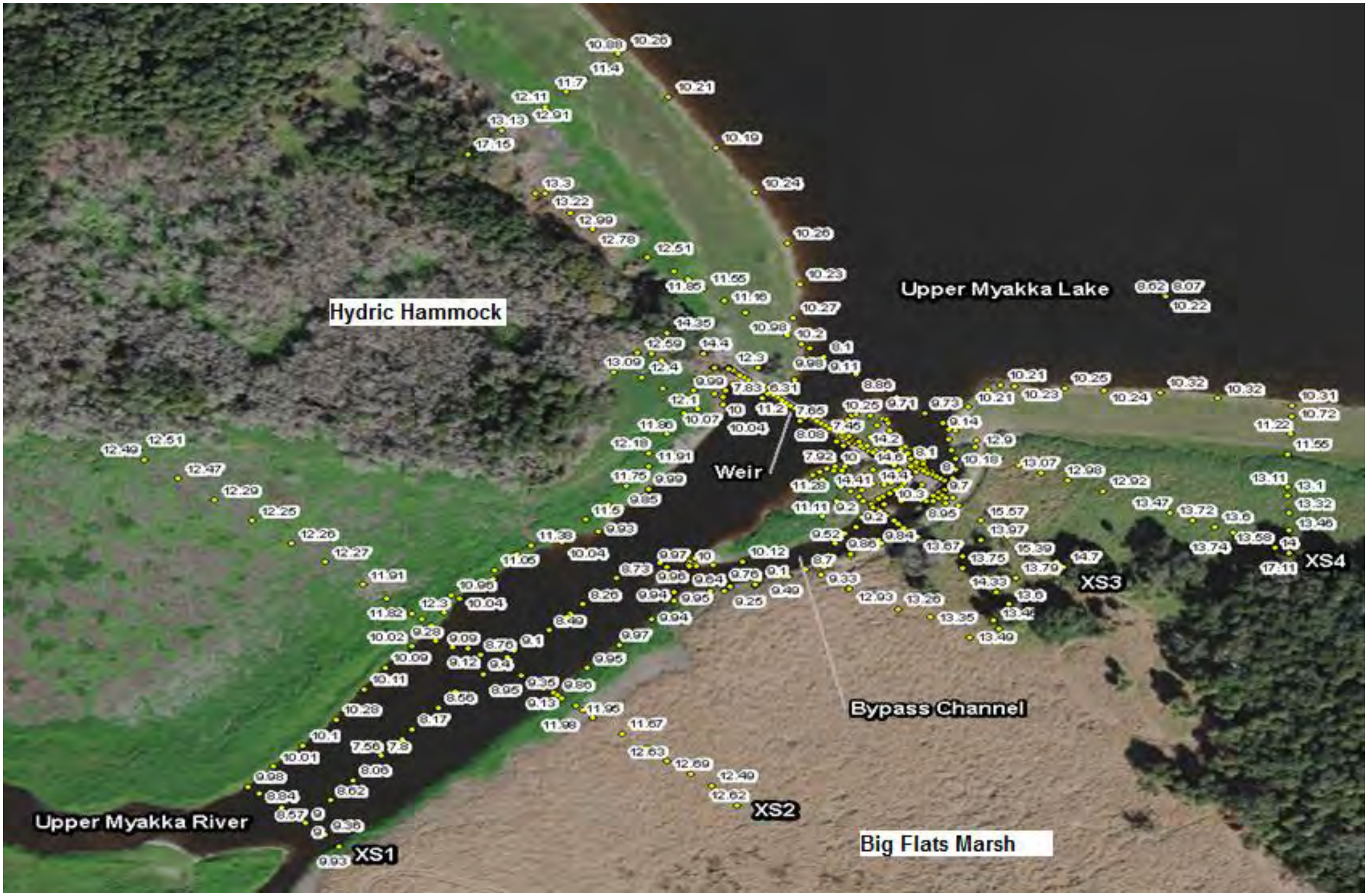



VIEW #1
VIEW #2
VIEW #3
VIEW #4
wood.
Upper Lake Myakka Feasibility Study

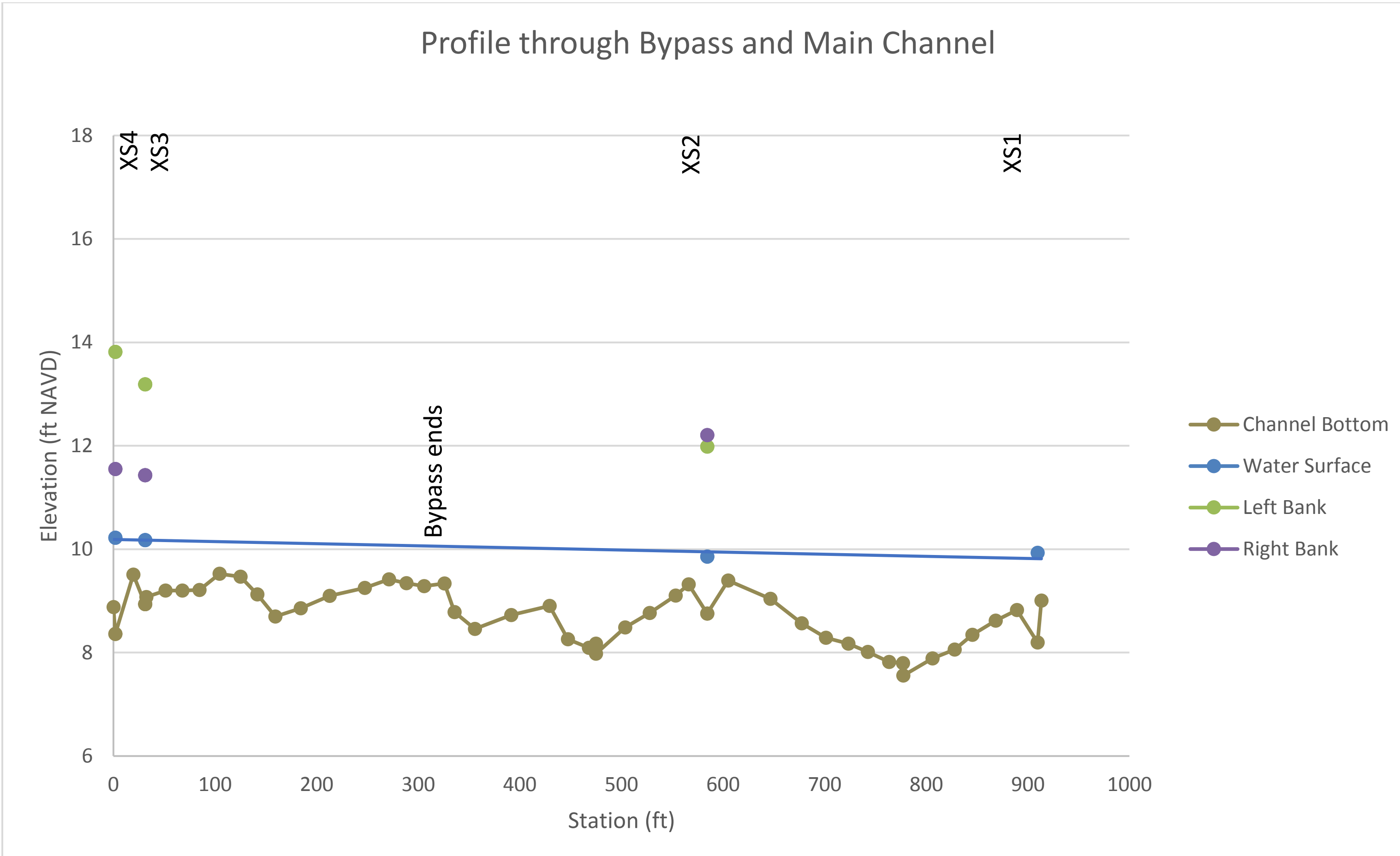



**Lake Bed Elevations and Soft Sediment Thickness Survey Results**

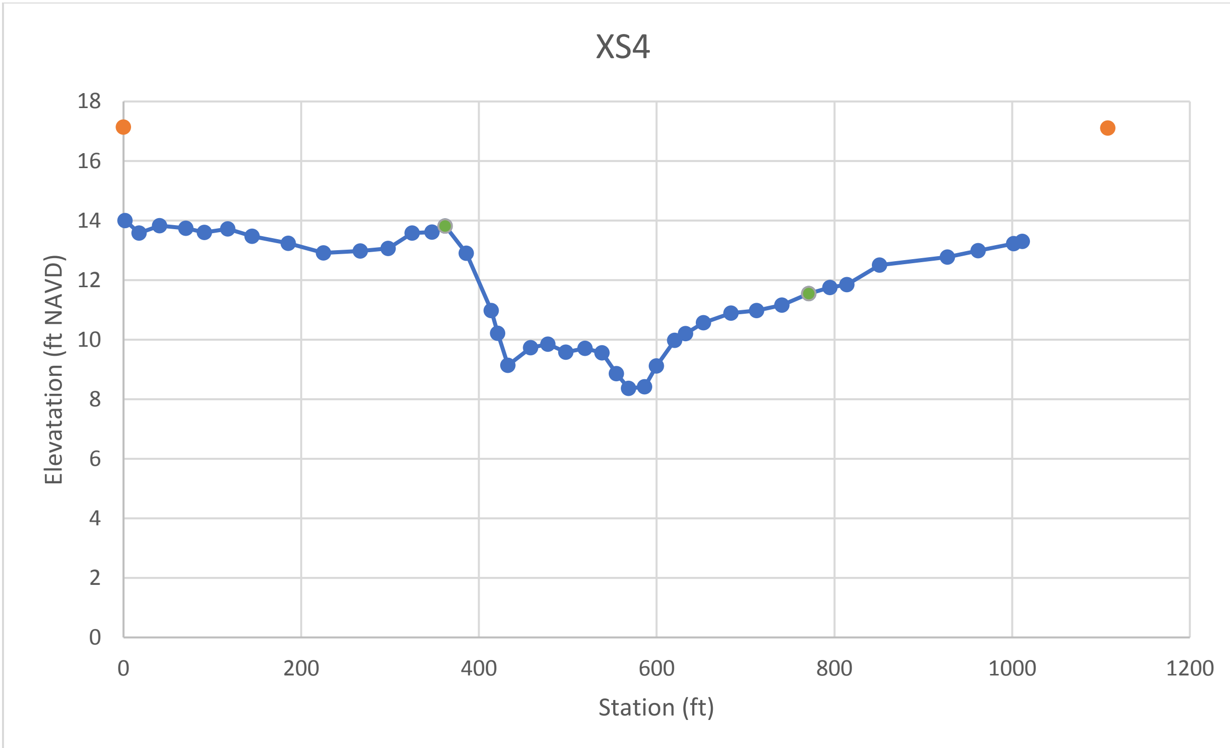
Top value = lake bed elevation in ft NAVD
Bottom value = soft sediment thickness in ft




**Weir and Bypass Survey Results**

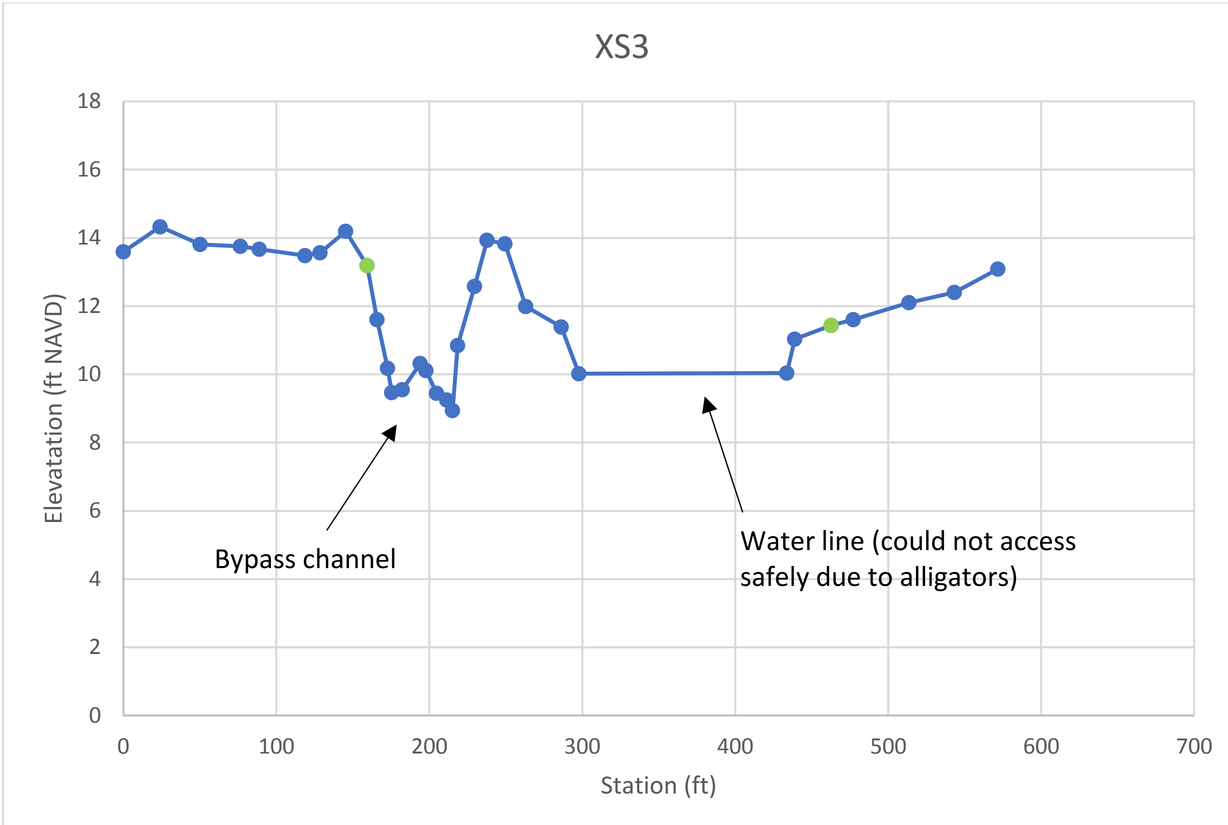


Profile through Bypass and Main Channel
XS4
XS3
XS2
XS1
Bypass ends
Elevation (ft NAVD)
Station (ft)
18
16
14
12
10
8
6
0
100
200
300
400
500
600
700
800
900
1000
Channel Bottom
Water Surface
Left Bank
Right Bank

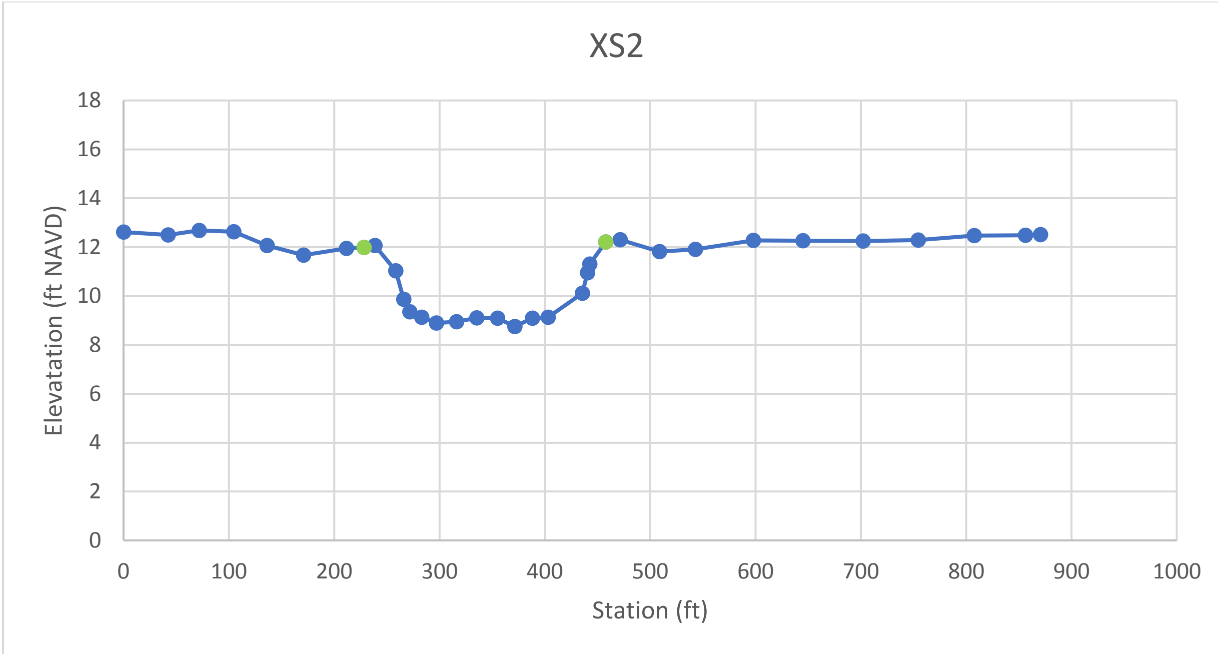



**Orange dots = water stain lines on trees**

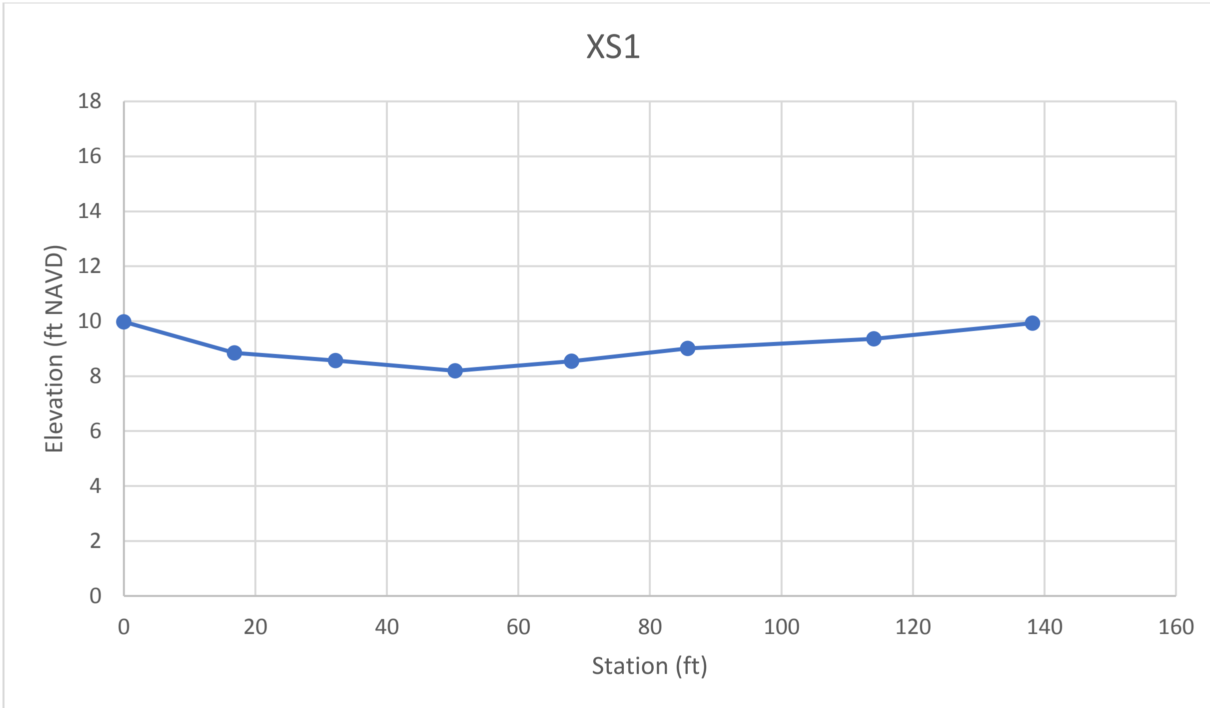
**Green dots = top of bank**




**Green dots = top of bank**

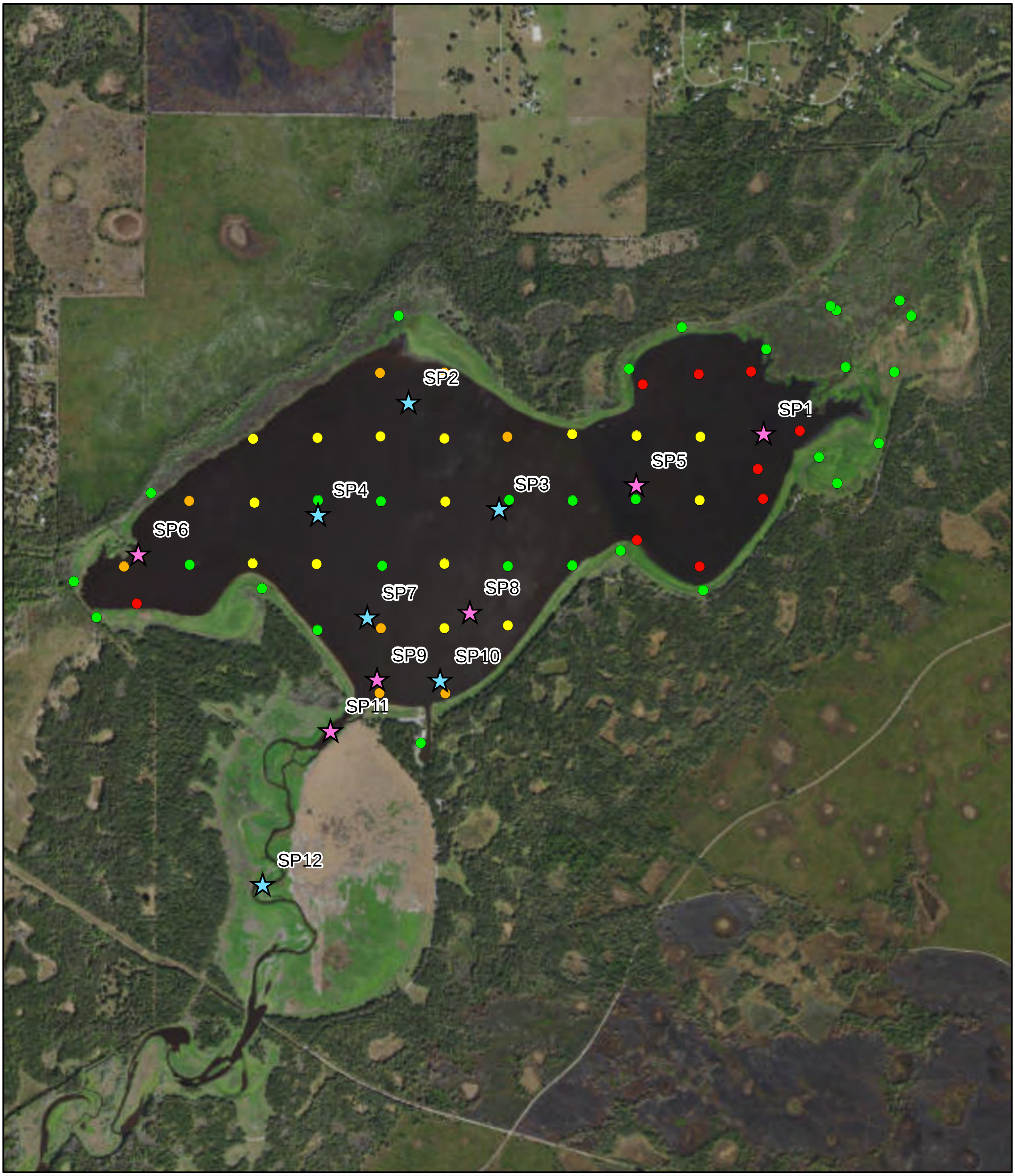



**Green dots = top of bank**


XS1
Elevation (ft NAVD)
18
16
14
12
10
8
6
4
2
0
0
20
40
60
80
100
120
140
160
Station (ft)

# APPENDIX B

Sediment Sampling Results




**Notes:**
1- Project No.: 600639
2- Data Source - Aerial ESRI 2018
3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 7/23/2019
Revised:7/23/2019
Checked By: KN

N

**Explanation of Features**

**Sediment Thickness (ft)**
- 0.000 - 0.124
- 0.125 - 0.315
- 0.316 - 0.599
- 0.600 - 1.414

**Sampling Location**

**P-Fractionation Sampling Location**

0 2,000 ft
1" = 2,500'

wood.

Wood Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Ste #200
Tampa, FL 33602
CA-5392
(813) 636-1500

**Sampling Locations Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Drawings_CAD_GIS\GIS\MXD\Sampling_points.mxd

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Fax: (813)630-4327

August 14, 2019

Mary Szafraniec
Wood PLC
1101 Channelside Dr
Suite 200
Tampa, FL  33602

RE: Workorder: T1913290 Upper Myakka Lake

Dear Mary Szafraniec:

Enclosed are the analytical results for sample(s) received by the laboratory on Wednesday, July 31, 2019. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report. The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody and results pertain only to these samples.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Heidi Parker - Project Manager
HParker@AELLab.com

Enclosures



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## SAMPLE SUMMARY

Workorder: T1913290 Upper Myakka Lake

| Lab ID | Sample ID | Matrix | Date Collected | Date Received |
|---|---|---|---|---|
| T1913290001 | SP1 0-27cm | Soil | 7/29/2019 09:43 | 7/31/2019 15:00 |
| T1913290002 | SP2 0-17.5cm | Soil | 7/29/2019 12:42 | 7/31/2019 15:00 |
| T1913290003 | SP3 0-10cm | Soil | 7/30/2019 09:28 | 7/31/2019 15:00 |
| T1913290004 | SP4 0-14cm | Soil | 7/29/2019 16:17 | 7/31/2019 15:00 |
| T1913290005 | SP5 0-30cm | Soil | 7/29/2019 11:37 | 7/31/2019 15:00 |
| T1913290006 | SP6 0-28cm | Soil | 7/29/2019 14:05 | 7/31/2019 15:00 |
| T1913290007 | SP7 0-11cm | Soil | 7/30/2019 10:43 | 7/31/2019 15:00 |
| T1913290008 | SP8 0-22.5cm | Soil | 7/30/2019 08:53 | 7/31/2019 15:00 |
| T1913290009 | SP9 0-14.5cm | Soil | 7/30/2019 11:45 | 7/31/2019 15:00 |
| T1913290010 | SP10 0-19cm | Soil | 7/30/2019 08:22 | 7/31/2019 15:00 |
| T1913290011 | SP11 0-29cm | Soil | 7/30/2019 12:40 | 7/31/2019 15:00 |
| T1913290012 | SP12 0-21cm | Soil | 7/30/2019 13:37 | 7/31/2019 15:00 |

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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

| | | | | | |
|---|---|---|---|---|---|
| Lab ID: | **T1913290001** | Date Received: | 07/31/19 15:00 | Matrix: | Soil |
| Sample ID: | **SP1 0-27cm** | Date Collected: | 07/29/19 09:43 | | |

Results for sample T1913290001 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1200** | | **mg/Kg** | **1** | 110 | 29 | 8/6/2019 16:43 | T |
| Calcium | **1200** | | **mg/Kg** | **1** | 55 | 15 | 8/6/2019 16:43 | T |
| Iron | **1200** | | **mg/Kg** | **1** | 18 | 9.1 | 8/6/2019 16:43 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **8.0** | **J4** | **mg/Kg** | **1** | 4.28 | 1.07 | 8/6/2019 11:43 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **6500** | | **mg/Kg** | **2** | 150 | 57 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **7.9** | **U,J4** | **mg/Kg** | **2** | 17 | 7.9 | 8/7/2019 15:40 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **42** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290002** Date Received: 07/31/19 15:00 Matrix: Soil
Sample ID: **SP2 0-17.5cm** Date Collected: 07/29/19 12:42

Results for sample T1913290002 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1900** | | **mg/Kg** | **1** | 120 | 30 | 8/6/2019 16:46 | T |
| Calcium | **1900** | | **mg/Kg** | **1** | 58 | 16 | 8/6/2019 16:46 | T |
| Iron | **820** | | **mg/Kg** | **1** | 19 | 9.7 | 8/6/2019 16:46 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.94** | **U** | **mg/Kg** | **1** | 3.78 | 0.94 | 8/6/2019 11:45 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **1500** | | **mg/Kg** | **1** | 72 | 27 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **7.0** | **U** | **mg/Kg** | **2** | 15 | 7.0 | 8/7/2019 15:42 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **34** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |

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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

| | | | | | |
|---|---|---|---|---|---|
| Lab ID: | **T1913290003** | Date Received: | 07/31/19 15:00 | Matrix: | Soil |
| Sample ID: | **SP3 0-10cm** | Date Collected: | 07/30/19 09:28 | | |

Results for sample T1913290003 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1800** | | **mg/Kg** | **1** | 130 | 33 | 8/6/2019 16:50 | T |
| Calcium | **1600** | | **mg/Kg** | **1** | 64 | 17 | 8/6/2019 16:50 | T |
| Iron | **2000** | | **mg/Kg** | **1** | 21 | 11 | 8/6/2019 16:50 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **1.17** | **U** | **mg/Kg** | **1** | 4.69 | 1.17 | 8/6/2019 11:46 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **2000** | | **mg/Kg** | **1** | 89 | 33 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **8.6** | **U** | **mg/Kg** | **2** | 19 | 8.6 | 8/7/2019 15:43 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **47** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290004** Date Received: 07/31/19 15:00 Matrix: Soil
Sample ID: **SP4 0-14cm** Date Collected: 07/29/19 16:17
Results for sample T1913290004 are reported on a dry weight basis.
Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **24000** | | **mg/Kg** | **1** | 1100 | 290 | 8/6/2019 16:54 | T |
| Calcium | **19000** | | **mg/Kg** | **1** | 550 | 150 | 8/6/2019 16:54 | T |
| Iron | **26000** | | **mg/Kg** | **1** | 180 | 92 | 8/6/2019 16:54 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **20.74** | **U** | **mg/Kg** | **1** | 83.12 | 20.74 | 8/6/2019 11:47 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **13000** | | **mg/Kg** | **1** | 1500 | 580 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **150** | **U** | **mg/Kg** | **2** | 330 | 150 | 8/7/2019 15:44 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **97** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290005** Date Received: 07/31/19 15:00 Matrix: Soil
Sample ID: **SP5 0-30cm** Date Collected: 07/29/19 11:37
Results for sample T1913290005 are reported on a dry weight basis.
Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **240** | | **mg/Kg** | **1** | 42 | 11 | 8/6/2019 16:57 | T |
| Calcium | **300** | | **mg/Kg** | **1** | 21 | 5.6 | 8/6/2019 16:57 | T |
| Iron | **180** | | **mg/Kg** | **1** | 7.0 | 3.5 | 8/6/2019 16:57 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.84** | **U** | **mg/Kg** | **1** | 3.36 | 0.84 | 8/6/2019 11:48 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **660** | | **mg/Kg** | **1** | 65 | 24 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **6.2** | **U** | **mg/Kg** | **2** | 13 | 6.2 | 8/7/2019 15:45 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **26** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |

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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290006** Date Received: 07/31/19 15:00 Matrix: Soil

Sample ID: **SP6 0-28cm** Date Collected: 07/29/19 14:05

Results for sample T1913290006 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1100** | | **mg/Kg** | **1** | 69 | 18 | 8/6/2019 17:01 | T |
| Calcium | **930** | | **mg/Kg** | **1** | 34 | 9.2 | 8/6/2019 17:01 | T |
| Iron | **1000** | | **mg/Kg** | **1** | 11 | 5.7 | 8/6/2019 17:01 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.96** | **U** | **mg/Kg** | **1** | 3.85 | 0.96 | 8/6/2019 11:48 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **1200** | | **mg/Kg** | **1** | 75 | 28 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **7.6** | **I** | **mg/Kg** | **2** | 15 | 7.1 | 8/7/2019 15:45 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **35** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |

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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290007** Date Received: 07/31/19 15:00 Matrix: Soil
Sample ID: **SP7 0-11cm** Date Collected: 07/30/19 10:43

Results for sample T1913290007 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **2600** | | **mg/Kg** | **1** | 220 | 59 | 8/6/2019 17:05 | T |
| Calcium | **2000** | | **mg/Kg** | **1** | 110 | 30 | 8/6/2019 17:05 | T |
| Iron | **2700** | | **mg/Kg** | **1** | 37 | 19 | 8/6/2019 17:05 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **2.05** | **U** | **mg/Kg** | **1** | 8.21 | 2.05 | 8/6/2019 11:49 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **2300** | | **mg/Kg** | **1** | 160 | 60 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **15** | **U** | **mg/Kg** | **2** | 33 | 15 | 8/7/2019 15:46 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **70** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290008** Date Received: 07/31/19 15:00 Matrix: Soil
Sample ID: **SP8 0-22.5cm** Date Collected: 07/30/19 08:53

Results for sample T1913290008 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **510** | | **mg/Kg** | **1** | 48 | 13 | 8/6/2019 17:24 | T |
| Calcium | **440** | | **mg/Kg** | **1** | 24 | 6.4 | 8/6/2019 17:24 | T |
| Iron | **1000** | | **mg/Kg** | **1** | 8.0 | 4.0 | 8/6/2019 17:24 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.88** | **U** | **mg/Kg** | **1** | 3.52 | 0.88 | 8/6/2019 11:50 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **540** | | **mg/Kg** | **1** | 67 | 25 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **6.5** | **U** | **mg/Kg** | **2** | 14 | 6.5 | 8/7/2019 15:47 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **29** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290009** Date Received: 07/31/19 15:00 Matrix: Soil

Sample ID: **SP9 0-14.5cm** Date Collected: 07/30/19 11:45

Results for sample T1913290009 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **3100** | | **mg/Kg** | **1** | 62 | 16 | 8/6/2019 17:27 | T |
| Calcium | **1200** | | **mg/Kg** | **1** | 31 | 8.2 | 8/6/2019 17:27 | T |
| Iron | **1800** | | **mg/Kg** | **1** | 10 | 5.1 | 8/6/2019 17:27 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.95** | **U** | **mg/Kg** | **1** | 3.80 | 0.95 | 8/6/2019 11:51 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **800** | | **mg/Kg** | **1** | 74 | 28 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **9.1** | **I** | **mg/Kg** | **2** | 15 | 7.0 | 8/7/2019 15:48 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **34** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290010** Date Received: 07/31/19 15:00 Matrix: Soil

Sample ID: **SP10 0-19cm** Date Collected: 07/30/19 08:22

Results for sample T1913290010 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1200** | | **mg/Kg** | **1** | 110 | 30 | 8/6/2019 17:31 | T |
| Calcium | **850** | | **mg/Kg** | **1** | 57 | 15 | 8/6/2019 17:31 | T |
| Iron | **1000** | | **mg/Kg** | **1** | 19 | 9.6 | 8/6/2019 17:31 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.98** | **U** | **mg/Kg** | **1** | 3.92 | 0.98 | 8/6/2019 11:51 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **940** | | **mg/Kg** | **1** | 76 | 29 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **7.2** | **U** | **mg/Kg** | **2** | 16 | 7.2 | 8/7/2019 15:48 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **36** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |



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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290011** Date Received: 07/31/19 15:00 Matrix: Soil

Sample ID: **SP11 0-29cm** Date Collected: 07/30/19 12:40

Results for sample T1913290011 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **590** | | **mg/Kg** | **1** | 31 | 8.2 | 8/6/2019 17:35 | T |
| Calcium | **730** | | **mg/Kg** | **1** | 16 | 4.2 | 8/6/2019 17:35 | T |
| Iron | **500** | | **mg/Kg** | **1** | 5.2 | 2.6 | 8/6/2019 17:35 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **0.84** | **U,J4** | **mg/Kg** | **1** | 3.35 | 0.84 | 8/6/2019 11:57 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **680** | | **mg/Kg** | **1** | 63 | 24 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **7.0** | **I** | **mg/Kg** | **2** | 13 | 6.2 | 8/7/2019 15:54 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **25** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |

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# ANALYTICAL RESULTS

Workorder: T1913290 Upper Myakka Lake

Lab ID: **T1913290012** Date Received: 07/31/19 15:00 Matrix: Soil

Sample ID: **SP12 0-21cm** Date Collected: 07/30/19 13:37

Results for sample T1913290012 are reported on a dry weight basis.

Sample Description: Location:

| Parameters | Results | Qual | Units | DF | Adjusted PQL | Adjusted MDL | Analyzed | Lab |
|---|---|---|---|---|---|---|---|---|
| **METALS** | | | | | | | | |
| Analysis Desc: SW846 6010B Analysis,Soils | Preparation Method: SW-846 3050B<br>Analytical Method: SW-846 6010 | | | | | | | |
| Aluminum | **1100** | | **mg/Kg** | **1** | 110 | 30 | 8/6/2019 17:39 | T |
| Calcium | **780** | | **mg/Kg** | **1** | 57 | 15 | 8/6/2019 17:39 | T |
| Iron | **600** | | **mg/Kg** | **1** | 19 | 9.5 | 8/6/2019 17:39 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Ammonia,E350.1,Soil | Analytical Method: EPA 350.1 | | | | | | | |
| Ammonia (N) | **16** | | **mg/Kg** | **1** | 6.36 | 1.59 | 8/6/2019 11:59 | T |
| Analysis Desc: TKN,E351.2,Solids | Preparation Method: Copper Sulfate Digestion Solid<br>Analytical Method: EPA 351.2 | | | | | | | |
| Total Kjeldahl Nitrogen | **200** | | **mg/Kg** | **1** | 120 | 45 | 8/7/2019 10:58 | T |
| Analysis Desc: Nitrate+Nitrite,SM4500NO3F,S | Analytical Method: SM 4500NO3-F | | | | | | | |
| Nitrate + Nitrite | **12** | **U** | **mg/Kg** | **2** | 25 | 12 | 8/7/2019 15:54 | T |
| **WET CHEMISTRY** | | | | | | | | |
| Analysis Desc: Percent Solids,SM2540G,Soil | Analytical Method: SM 2540G | | | | | | | |
| Percent Moisture | **61** | | **%** | **1** | 0.0010 | 0.0010 | 8/1/2019 14:00 | T |

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# ANALYTICAL RESULTS QUALIFIERS

Workorder: T1913290 Upper Myakka Lake

**PARAMETER QUALIFIERS**

| | |
|---|---|
| U | The compound was analyzed for but not detected. |
| I | The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit. |
| J4 | Estimated Result |

**LAB QUALIFIERS**

| | |
|---|---|
| T | DOH Certification #E84589(AEL-T)(FL NELAC Certification) |

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# QUALITY CONTROL DATA

Workorder: T1913290 Upper Myakka Lake

QC Batch: DGMt/3713 Analysis Method: SW-846 6010
QC Batch Method: SW-846 3050B Prepared: 08/01/2019 11:00
Associated Lab Samples: T1913290001

METHOD BLANK: 3175313

| Parameter | Units | Blank Result | Reporting Limit | Qualifiers |
|---|---|---|---|---|
| METALS | | | | |
| Aluminum | mg/Kg | 3.9 | 3.9 | U |
| Calcium | mg/Kg | 2.0 | 2.0 | U |
| Iron | mg/Kg | 1.2 | 1.2 | U |

LABORATORY CONTROL SAMPLE: 3175314

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| METALS | | | | | | |
| Aluminum | mg/Kg | 630 | 530 | 84 | 80-120 | |
| Calcium | mg/Kg | 630 | 540 | 85 | 80-120 | |
| Iron | mg/Kg | 630 | 530 | 84 | 80-120 | |

QC Batch: DGMt/3734 Analysis Method: SW-846 6010
QC Batch Method: SW-846 3050B Prepared: 08/06/2019 11:00
Associated Lab Samples: T1913290002, T1913290003, T1913290004, T1913290005, T1913290006, T1913290007, T1913290008,

METHOD BLANK: 3179031

| Parameter | Units | Blank Result | Reporting Limit | Qualifiers |
|---|---|---|---|---|
| METALS | | | | |
| Aluminum | mg/Kg | 3.9 | 3.9 | U |
| Calcium | mg/Kg | 2.0 | 2.0 | U |
| Iron | mg/Kg | 1.2 | 1.2 | U |

LABORATORY CONTROL SAMPLE: 3179032

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| METALS | | | | | | |
| Aluminum | mg/Kg | 630 | 620 | 99 | 80-120 | |



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# QUALITY CONTROL DATA

Workorder: T1913290 Upper Myakka Lake

LABORATORY CONTROL SAMPLE: 3179032

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| Calcium | mg/Kg | 630 | 610 | 97 | 80-120 | |
| Iron | mg/Kg | 630 | 600 | 95 | 80-120 | |

QC Batch: WCAt/12696 Analysis Method: SM 4500NO3-F

QC Batch Method: SM 4500NO3-F Prepared:

Associated Lab Samples: T1913290001, T1913290002, T1913290003, T1913290004, T1913290005, T1913290006, T1913290007,

METHOD BLANK: 3179145

| Parameter | Units | Blank Result | Reporting Limit | Qualifiers |
|---|---|---|---|---|
| WET CHEMISTRY | | | | |
| Nitrate + Nitrite | mg/Kg | 0.92 | 0.92 | U |

LABORATORY CONTROL SAMPLE: 3179146

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| WET CHEMISTRY | | | | | | |
| Nitrate + Nitrite | mg/Kg | 1 | 1.0 | 103 | 90-110 | |

QC Batch: WCAt/12697 Analysis Method: EPA 350.1

QC Batch Method: EPA 350.1 Prepared:

Associated Lab Samples: T1913290001, T1913290002, T1913290003, T1913290004, T1913290005, T1913290006, T1913290007,

METHOD BLANK: 3179157

| Parameter | Units | Blank Result | Reporting Limit | Qualifiers |
|---|---|---|---|---|
| WET CHEMISTRY | | | | |
| Ammonia (N) | mg/Kg | 0.25 | 0.25 | U |

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# QUALITY CONTROL DATA

Workorder: T1913290 Upper Myakka Lake

LABORATORY CONTROL SAMPLE: 3179158

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| WET CHEMISTRY | | | | | | |
| Ammonia (N) | mg/Kg | 5 | 5.3 | 106 | 90-110 | |

QC Batch: WCAt/12705 Analysis Method: EPA 351.2

QC Batch Method: Copper Sulfate Digestion Solid Prepared: 08/06/2019 17:00

Associated Lab Samples: T1913290001, T1913290002, T1913290003, T1913290004, T1913290005, T1913290006, T1913290007,

METHOD BLANK: 3180543

| Parameter | Units | Blank Result | Reporting Limit | Qualifiers |
|---|---|---|---|---|
| WET CHEMISTRY | | | | |
| Total Kjeldahl Nitrogen | mg/Kg | 19 | 19 | U |

LABORATORY CONTROL SAMPLE: 3180545

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| WET CHEMISTRY | | | | | | |
| Total Kjeldahl Nitrogen | mg/Kg | 250 | 270 | 108 | 90-110 | |

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## QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1913290 Upper Myakka Lake

| Lab ID | Sample ID | Prep Method | Prep Batch | Analysis Method | Analysis Batch |
|---|---|---|---|---|---|
| T1913290001 | SP1 0-27cm | | | SM 2540G | WCAt/12630 |
| T1913290002 | SP2 0-17.5cm | | | SM 2540G | WCAt/12630 |
| T1913290003 | SP3 0-10cm | | | SM 2540G | WCAt/12630 |
| T1913290004 | SP4 0-14cm | | | SM 2540G | WCAt/12630 |
| T1913290005 | SP5 0-30cm | | | SM 2540G | WCAt/12630 |
| T1913290006 | SP6 0-28cm | | | SM 2540G | WCAt/12630 |
| T1913290007 | SP7 0-11cm | | | SM 2540G | WCAt/12630 |
| T1913290008 | SP8 0-22.5cm | | | SM 2540G | WCAt/12630 |
| T1913290009 | SP9 0-14.5cm | | | SM 2540G | WCAt/12630 |
| T1913290010 | SP10 0-19cm | | | SM 2540G | WCAt/12630 |
| T1913290011 | SP11 0-29cm | | | SM 2540G | WCAt/12630 |
| T1913290012 | SP12 0-21cm | | | SM 2540G | WCAt/12630 |
| T1913290001 | SP1 0-27cm | SW-846 3050B | DGMt/3713 | SW-846 6010 | ICPt/2596 |
| T1913290002 | SP2 0-17.5cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290003 | SP3 0-10cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290004 | SP4 0-14cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290005 | SP5 0-30cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290006 | SP6 0-28cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290007 | SP7 0-11cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290008 | SP8 0-22.5cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290009 | SP9 0-14.5cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290010 | SP10 0-19cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290011 | SP11 0-29cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290012 | SP12 0-21cm | SW-846 3050B | DGMt/3734 | SW-846 6010 | ICPt/2596 |
| T1913290001 | SP1 0-27cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290002 | SP2 0-17.5cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290003 | SP3 0-10cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290004 | SP4 0-14cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290005 | SP5 0-30cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290006 | SP6 0-28cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290007 | SP7 0-11cm | | | SM 4500NO3-F | WCAt/12696 |

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## QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1913290 Upper Myakka Lake

| Lab ID | Sample ID | Prep Method | Prep Batch | Analysis Method | Analysis Batch |
|---|---|---|---|---|---|
| T1913290008 | SP8 0-22.5cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290009 | SP9 0-14.5cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290010 | SP10 0-19cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290011 | SP11 0-29cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290012 | SP12 0-21cm | | | SM 4500NO3-F | WCAt/12696 |
| T1913290001 | SP1 0-27cm | | | EPA 350.1 | WCAt/12697 |
| T1913290002 | SP2 0-17.5cm | | | EPA 350.1 | WCAt/12697 |
| T1913290003 | SP3 0-10cm | | | EPA 350.1 | WCAt/12697 |
| T1913290004 | SP4 0-14cm | | | EPA 350.1 | WCAt/12697 |
| T1913290005 | SP5 0-30cm | | | EPA 350.1 | WCAt/12697 |
| T1913290006 | SP6 0-28cm | | | EPA 350.1 | WCAt/12697 |
| T1913290007 | SP7 0-11cm | | | EPA 350.1 | WCAt/12697 |
| T1913290008 | SP8 0-22.5cm | | | EPA 350.1 | WCAt/12697 |
| T1913290009 | SP9 0-14.5cm | | | EPA 350.1 | WCAt/12697 |
| T1913290010 | SP10 0-19cm | | | EPA 350.1 | WCAt/12697 |
| T1913290011 | SP11 0-29cm | | | EPA 350.1 | WCAt/12697 |
| T1913290012 | SP12 0-21cm | | | EPA 350.1 | WCAt/12697 |
| T1913290001 | SP1 0-27cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290002 | SP2 0-17.5cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290003 | SP3 0-10cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290004 | SP4 0-14cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290005 | SP5 0-30cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290006 | SP6 0-28cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290007 | SP7 0-11cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290008 | SP8 0-22.5cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290009 | SP9 0-14.5cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290010 | SP10 0-19cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |
| T1913290011 | SP11 0-29cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |

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## QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1913290 Upper Myakka Lake

| Lab ID | Sample ID | Prep Method | Prep Batch | Analysis Method | Analysis Batch |
|---|---|---|---|---|---|
| T1913290012 | SP12 0-21cm | Copper Sulfate Digestion Solid | WCAt/12705 | EPA 351.2 | WCAt/12717 |

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* T 1 9 1 3 2 9 0 *

Page 1 of 2

Client Name: Wood PLC
Address: 1101 Channelside Dr, Tampa, FL 33803
Phone: 813-455-9780
FAX:
Contact: Kristen Nowak
Sampled By: Erik Oij
Turn Around Time: ☒ STANDARD ☐ RUSH
AEL Profile #:

Project Name: Upper Myakka Lake
Project Number: 600639 X 002B
PO Number: T015762
FDEP Facility No:
FDEP Facility Address:
Special Instructions:
☐ ADaPT ☐ EQuIS ☐ Other

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | BOTTLE SIZE & TYPE | glass | glass |
| | | | | | | ANALYSIS REQUIRED | Metals | Nutrients |
| SAMPLE ID | SAMPLE DESCRIPTION | Grab Comp | SAMPLING DATE | SAMPLING TIME | MATRIX | NO. COUNT | | |
| | | | | | | Preservation | I | I |
| | | | | | | Field-Filtered? | no | no |

| SAMPLE ID | SAMPLE DESCRIPTION | Grab Comp | DATE | TIME | MATRIX | NO. COUNT | Metals | Nutrients | LABORATORY I.D. NUMBER |
|---|---|---|---|---|---|---|---|---|---|
| SP1 | S81 ~~0-30cm~~ 0-27cm | grab | 7/29/19 | 9:43 | SO | 2 | 1 | 1 | 001 |
| SP2 | SP2 ~~0-30cm~~ 0-17.5cm | grab | 7/29/19 | 12:42 | SO | 2 | 1 | 1 | 002 |
| SP3 | SP3 ~~0-30cm~~ 0-10cm | grab | 7/30/19 | 0928 | SO | 2 | 1 | 1 | 003 |
| SP4 | SP4 ~~0-30cm~~ 0-14cm | grab | 7/29/19 | 16:17 | SO | 2 | 1 | 1 | 004 |
| SP5 | SP5 ~~0-30cm~~ 0-30cm | grab | 7/29/19 | 11:37 | SO | 2 | 1 | 1 | 005 |
| SP6 | SP6 ~~0-30cm~~ 0-28cm | grab | 7/29/19 | 14:05 | SO | 2 | 1 | 1 | 006 |
| SP7 | SP7 ~~0-30cm~~ 0-11cm | grab | 7/30/19 | 1043 | SO | 2 | 1 | 1 | 007 |
| SP8 | SP8 ~~0-30cm~~ 0-22.5cm | grab | 7/30/19 | 0853 | SO | 2 | 1 | 1 | 008 |
| SP9 | SP9 ~~0-30cm~~ 0-14.5cm | grab | 7/30/19 | 1145 | SO | 2 | 1 | 1 | 009 |
| SP10 | SP10 0-30cm 0-19cm | grab | 7/30/19 | 0822 | SO | 2 | 1 | 1 | 010 |

Matrix Code: WW = wastewater SW = surface water GW = ground water DW = drinking water O = oil A = air SO = soil SL = sludge
Preservation Code: I = Ice H=(HCl) S = (H2SO4) N = (HNO3) T = (Sodium Thiosulfate)

Received on Ice ☒ Yes ☐ No ☒ Temp taken from sample ☐ Temp from blank ☒ Where required, pH checked
Temp. when received (observed) 3.1 °C Temp. when received (corrected) 3.1 °C

DCN: AD-051 Form last revised 06/19/2017
Device used for measuring Temp by unique identifier (circle IR temp gun used) J: 9A G: LT-1 LT-2 T: 10A A: 3A M: 3A S: 1V F: 1A

| | Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|---|
| 1 | | | | [signature] | 7-31-19 | 1925 |
| 2 | | | | [signature] | 7-31-19 | 1500 |
| 3 | | | | | | |
| 4 | | | | | | |

**FOR DRINKING WATER USE:**
(When PWS information not otherwise supplied) PWS ID:
Contact Person: Phone:
Supplier of Water:
Site-Address:

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☐ **Jacksonville:** 6681 Southpoint Pkwy. • Jacksonville, FL 32216 • 904.363.9350 • Fax 904.363.9354
☐ **Tallahassee:** 2639 North Monroe St., Suite D, Tallahassee, FL 32303 • 850.219.6274 • Fax 850.219.6275
☐ **Gainesville:** 4965 SW 41st Blvd. • Gainesville, FL 32608 • 352.377.2349 • Fax 352.395.6639
☐ **Miramar:** 10200 USA Today Way, Miramar, FL 33025 • 954.889.2288 • Fax 954.889.2281
☒ **Tampa:** 9610 Princess Palm Ave. • Tampa, FL 33619 • 813.630.9616 • Fax 813.630.4327

T1913290

Page 2 of 2

| | |
|---|---|
| Client Name: Wood PLC | Project Name: Upper Myakka |
| Address: 1101 Channelside Dr, Tampa, FL 33603 | Project Number: 600 634 x 002B |
| | PO Number: T015762 |
| Phone: 813-455-9780 | FDEP Facility No: |
| FAX: | FDEP Facility Address: |
| Contact: Kristen Nowh | Special Instructions: |
| Sampled By: Erik Oij | |
| Turn Around Time: ☒ STANDARD ☐ RUSH | |
| AEL Profile #: | ☐ ADaPT ☐ EQuIS ☐ Other |

| SAMPLE ID | SAMPLE DESCRIPTION | Grab / Comp | SAMPLING DATE | SAMPLING TIME | MATRIX | NO. COUNT | metals (glass) | nutrients (glass) | LABORATORY I.D. NUMBER |
|---|---|---|---|---|---|---|---|---|---|
| Bottle size & type | | | | | | | glass | glass | |
| Preservation | | | | | | | 1 | 1 | |
| Field-Filtered? | | | | | | | no | no | |
| SB11 | SB11 ~~0-30cm~~ 0-29cm | grab | 7/30/19 | 1240 | SO | 2 | 1 | 1 | 011 |
| SB12 | SB12 ~~0-30cm~~ 0-26cm | grab | 7/30/19 | 1337 | SO | 2 | 1 | 1 | 012 |

**Matrix Code:** **WW** = wastewater **SW** = surface water **GW** = ground water **DW** = drinking water **O** = oil **A** = air **SO** = soil **SL** = sludge

**Preservation Code:** I = ice H=(HCl) S = (H2SO4) N = (HNO3) T = (Sodium Thiosulfate)

Received on ice ☒ Yes ☐ No ☒ Temp taken from sample ☐ Temp from blank ☒ Where required, pH checked

Temp. when received (observed) 3.1 °C Temp. when received (corrected) 3.1 °C

Device used for measuring Temp by unique identifier (circle IR temp gun used) J: 9A G: LT-1 LT-2 T: 10A A: 3A M: 3A S: 1V F: 1A

DCN: AD-051 Form last revised 06/19/2017

| | Relinquished by: | Date | Time | Received by: | Date | Time |
|---|---|---|---|---|---|---|
| 1 | | | | [signature] | 7-31-19 | 1125 |
| 2 | | | | | 7/31/19 | 1500 |
| 3 | | | | | | |
| 4 | | | | | | |

**FOR DRINKING WATER USE:**
(When PWS Information not otherwise supplied) PWS ID:
Contact Person: Phone:
Supplier of Water:
Site-Address:

6681 Southpoint Parkway
Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

**Project No.:** T1913290

**Client Name:** Wood PLC

**ProjectID:** Upper Myakka Lake

**I. Receipt**

No Exceptions were encountered.

**II. Holding Times**

Preparation: All holding times were met.

Analysis: All holding times were met.

**III. Method**

Analysis: SW-846 6010

Preparation: SW-846 3050B

**IV. Preparation**

Sample preparation proceeded normally.

**V. Analysis**

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Duplicates: All acceptance criteria were met.

D. Spikes: The Matrix Spike Duplicate (MSD) of Al, Ba, Ni, Pb, and Zn for T1913422001 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS), Matrix Spike (MS), and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential low bias in this matrix for these analytes. No further corrective action was required.

E. Serial Diluion: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

6681 Southpoint Parkway
Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

**Project No.:** T1913290

**Client Name:** Wood PLC

**ProjectID:** Upper Myakka Lake

**I. Receipt**

No Exceptions were encountered.

**II. Holding Times**

Preparation: All holding times were met.

Analysis: All holding times were met.

**III. Method**

Analysis: SM 4500NO3-F

Preparation: None

**IV. Preparation**

Sample preparation proceeded normally.

**V. Analysis**

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Duplicates: All acceptance criteria were met.

D. Spikes: The matrix spike recovery of NOx for T1913290001 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS) and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential high bias in this matrix. The effected sample is qualified to indicate matrix interference.

E. Serial Diluion: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

6681 Southpoint Parkway
Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

**Project No.:** T1913290

**Client Name:** Wood PLC

**ProjectID:** Upper Myakka Lake

## I. Receipt

No Exceptions were encountered.

## II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

## III. Method

Analysis: EPA 350.1

Preparation: None

## IV. Preparation

Sample preparation proceeded normally.

## V. Analysis

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Duplicates: All acceptance criteria were met.

D. Spikes: The matrix spike recovery of NH3 for T1913290001 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS)and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential low bias in this matrix. The effected sample is qualified to indicate matrix interference.

The matrix spike recovery of T1913290011 for [SAMPLE] was outside control criteria. Recoveries in the Laboratory Control Sample (LCS) and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential low bias in this matrix. The effected sample is qualified to indicate matrix interference.

E. Serial Diluion: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

Advanced Environmental Laboratories, Inc.

6681 Southpoint Parkway
Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

**Project No.:** T1913290

**Client Name:** Wood PLC

**ProjectID:** Upper Myakka Lake

## I. Receipt

No Exceptions were encountered.

## II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

## III. Method

Analysis: EPA 351.2

Preparation: Copper Sulfate Digestion Solid

## IV. Preparation

Sample preparation proceeded normally.

## V. Analysis

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Duplicates: All acceptance criteria were met.

D. Spikes: The matrix spike recovery of TKN for G1906197001 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS) and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential low bias in this matrix. The effected sample is qualified to indicate matrix interference.

The matrix spike recovery of TKN for T1913515002 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS) and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential high bias in this matrix. The effected sample is qualified to indicate matrix interference.

E. Serial Diluion: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

Environmental

September 11, 2019

Wood PLC
Attention: Kristen Nowak
1101 Channelside Drive, Suite 200
Tampa, FL 33602

PO #: C012608931
Project Name: Upper Myakka Lake Feasibility Study
Project No.: 600639-002B
Batch ID: 358418

Dear Kristen Nowak:

DB Environmental received 5 samples on July 30, 2019 @ 10:00 and 7 samples on July 31, 2019 @ 09:30 for the analyses presented in the following report.

Analyses are performed with method required calibration and QA/QC samples whenever applicable. Method performance, which is based on the calibration and QA/QC samples, establishes the validity and certainty of the reported sample results. These results are calculated on a dry-weight basis, unless otherwise noted. These results relate only to the samples as received. The report shall not be reproduced except in full, without the written approval of the laboratory.

This report contains a total of 11 pages:

| | | | | | |
|---|---|---|---|---|---|
| cover letter | 1 | case narrative | 1 | report | 5 |
| QC summary | 1 | COC | 2 | analytical results | Ø |
| correspondence | Ø | invoice | 1 | | |

Please note that any unused portion of the samples will be disposed of 30 days following issuance of report, unless you have requested otherwise.

If you have any questions regarding the analytical results, please feel free to call me at 321-639-4896.

Sincerely,

Nancy Chan

Nancy Chan
Project Manager

Enclosure

THIS DOCUMENT MEETS NELAC STANDARDS
NELAP Certification #E 83330

**CASE NARRATIVE**

September 11, 2019

Wood PLC
Attention: Kristen Nowak
1101 Channelside Drive, Suite 200
Tampa, FL 33602

PO #: C012608931
Project Name: Upper Myakka Lake Feasibility Study
Project No.: 600639-002B
Batch ID: 358418

---

**Lab Log#s: 358423-358429**

The ice in the cooler had melted. The receiving temperature was 16.6 degrees Celcius.

Nancy Chan
Project Manager

**DB Environmental, Inc.**, 365 Gus Hipp Blvd., Rockledge, FL 32955 - (321) 639-4896
NELAP/FDOH# E 83330

**Date:** September 11, 2019

## REPORT OF ANALYSIS

**Client:** Wood PLC
Attention: Kristen Nowak
1101 Channelside Drive, Suite 200
Tampa, FL 33602

**Date and Time Received:** 7/30/2019 @ 10:00 and 7/31/2019 @ 09:30

**PO #:** C012608931
**Project Name :** Upper Myakka Lake Feasibility Study
**Project No. :** 600639-002B
**Matrix:** Sediment

| SAMPLE ID | LAB LOG NUMBER | DATE SAMPLED | TIME SAMPLED | PARAMETER | METHOD NUMBER | RESULTS | UNITS | METHOD DETECTION LIMIT | DATE/TIME OF ANALYSIS | QUALIFIER CODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SP-1 | 358418 | 7/29/2019 | 9:43 | % Dry Weight | ASA 21-2 | 58.44 | % | 0.01 | 8/6/2019 | |
| SP-5 | 358419 | 7/29/2019 | 11:37 | % Dry Weight | ASA 21-2 | 74.86 | % | 0.01 | 8/6/2019 | |
| SP-2 | 358420 | 7/29/2019 | 12:42 | % Dry Weight | ASA 21-2 | 59.44 | % | 0.01 | 8/6/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | % Dry Weight | ASA 21-2 | 63.52 | % | 0.01 | 8/6/2019 | |
| SP-4 | 358422 | 7/29/2019 | 14:48 | % Dry Weight | ASA 21-2 | 59.21 | % | 0.01 | 8/6/2019 | |
| SP-10 | 358423 | 7/30/2019 | 8:22 | % Dry Weight | ASA 21-2 | 60.70 | % | 0.01 | 8/6/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | % Dry Weight | ASA 21-2 | 70.72 | % | 0.01 | 8/6/2019 | |
| SP-3 | 358425 | 7/30/2019 | 9:28 | % Dry Weight | ASA 21-2 | 48.43 | % | 0.01 | 8/6/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | % Dry Weight | ASA 21-2 | 44.00 | % | 0.01 | 8/6/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | % Dry Weight | ASA 21-2 | 65.71 | % | 0.01 | 8/6/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | % Dry Weight | ASA 21-2 | 74.27 | % | 0.01 | 8/6/2019 | |
| SP-12 | 358429 | 7/30/2019 | 13:37 | % Dry Weight | ASA 21-2 | 80.28 | % | 0.01 | 8/6/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Bulk Density | ASA 13 | 0.90 | g/cc | 0.001 | 8/6/2019 | |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Bulk Density | ASA 13 | 1.1 | g/cc | 0.001 | 8/6/2019 | |
| SP-2 | 358420 | 7/29/2019 | 12:42 | Bulk Density | ASA 13 | 0.90 | g/cc | 0.001 | 8/6/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Bulk Density | ASA 13 | 1.0 | g/cc | 0.001 | 8/6/2019 | |
| SP-4 | 358422 | 7/29/2019 | 14:48 | Bulk Density | ASA 13 | 0.92 | g/cc | 0.001 | 8/6/2019 | |
| SP-10 | 358423 | 7/30/2019 | 8:22 | Bulk Density | ASA 13 | 0.96 | g/cc | 0.001 | 8/6/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Bulk Density | ASA 13 | 1.2 | g/cc | 0.001 | 8/6/2019 | |
| SP-3 | 358425 | 7/30/2019 | 9:28 | Bulk Density | ASA 13 | 0.70 | g/cc | 0.001 | 8/6/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | Bulk Density | ASA 13 | 0.60 | g/cc | 0.001 | 8/6/2019 | |

| SAMPLE ID | LAB LOG NUMBER | DATE SAMPLED | TIME SAMPLED | PARAMETER | METHOD NUMBER | RESULTS | UNITS | METHOD DETECTION LIMIT | DATE/TIME OF ANALYSIS | QUALIFIER CODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SP-9 | 358427 | 7/30/2019 | 11:45 | Bulk Density | ASA 13 | 1.1 | g/cc | 0.001 | 8/6/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Bulk Density | ASA 13 | 1.3 | g/cc | 0.001 | 8/6/2019 | |
| SP-12 | 358429 | 7/30/2019 | 13:37 | Bulk Density | ASA 13 | 1.5 | g/cc | 0.001 | 8/6/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Volatile Solids | EPA/COE 3-59 | 4.49 | % | 1.35 | 8/16/2019 | A I |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Volatile Solids | EPA/COE 3-59 | 1.50 | % | 1.35 | 8/16/2019 | I |
| SP-2 | 358420 | 7/29/2019 | 12:42 | Volatile Solids | EPA/COE 3-59 | 6.31 | % | 1.35 | 8/16/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Volatile Solids | EPA/COE 3-59 | 3.59 | % | 1.35 | 8/16/2019 | I |
| SP-4 | 358422 | 7/29/2019 | 14:48 | Volatile Solids | EPA/COE 3-59 | 3.11 | % | 1.35 | 8/16/2019 | I |
| SP-10 | 358423 | 7/30/2019 | 8:22 | Volatile Solids | EPA/COE 3-59 | 3.89 | % | 1.35 | 8/16/2019 | A I |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Volatile Solids | EPA/COE 3-59 | 1.90 | % | 1.35 | 8/16/2019 | I |
| SP-3 | 358425 | 7/30/2019 | 9:28 | Volatile Solids | EPA/COE 3-59 | 5.53 | % | 1.35 | 8/16/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | Volatile Solids | EPA/COE 3-59 | 4.88 | % | 1.35 | 8/16/2019 | I |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Volatile Solids | EPA/COE 3-59 | 2.10 | % | 1.35 | 8/16/2019 | I |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Volatile Solids | EPA/COE 3-59 | <1.35 | % | 1.35 | 8/16/2019 | U |
| SP-12 | 358429 | 7/30/2019 | 13:37 | Volatile Solids | EPA/COE 3-59 | <1.35 | % | 1.35 | 8/16/2019 | U |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Total Phosphorus | DBE SOP TP | 124 | mg/kg dry | 10 | 8/16/2019 | |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Total Phosphorus | DBE SOP TP | 30 | mg/kg dry | 10 | 8/16/2019 | I |
| SP-2 | 358420 | 7/29/2019 | 12:42 | Total Phosphorus | DBE SOP TP | 199 | mg/kg dry | 10 | 8/16/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Total Phosphorus | DBE SOP TP | 133 | mg/kg dry | 10 | 8/16/2019 | |
| SP-4 | 358422 | 7/29/2019 | 14:48 | Total Phosphorus | DBE SOP TP | 174 | mg/kg dry | 10 | 8/16/2019 | |
| SP-10 | 358423 | 7/30/2019 | 8:22 | Total Phosphorus | DBE SOP TP | 129 | mg/kg dry | 10 | 8/16/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Total Phosphorus | DBE SOP TP | 69 | mg/kg dry | 10 | 8/16/2019 | |
| SP-3 | 358425 | 7/30/2019 | 9:28 | Total Phosphorus | DBE SOP TP | 250 | mg/kg dry | 10 | 8/16/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | Total Phosphorus | DBE SOP TP | 206 | mg/kg dry | 10 | 8/16/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Total Phosphorus | DBE SOP TP | 177 | mg/kg dry | 10 | 8/16/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Total Phosphorus | DBE SOP TP | 127 | mg/kg dry | 10 | 8/16/2019 | A |
| SP-12 | 358429 | 7/30/2019 | 13:37 | Total Phosphorus | DBE SOP TP | 37 | mg/kg dry | 10 | 8/16/2019 | I |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Porewater SRP | DBE SOP OPO4 | 0.86 | mg/kg dry | 0.005 | 7/31/2019 12:35 | A |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Porewater SRP | DBE SOP OPO4 | 0.39 | mg/kg dry | 0.002 | 7/31/2019 12:35 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Porewater SRP | DBE SOP OPO4 | 0.90 | mg/kg dry | 0.004 | 7/31/2019 12:35 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Porewater SRP | DBE SOP OPO4 | 0.55 | mg/kg dry | 0.002 | 7/31/2019 12:35 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Porewater SRP | DBE SOP OPO4 | 0.22 | mg/kg dry | 0.002 | 7/31/2019 12:35 | A |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Porewater SRP | DBE SOP OPO4 | 0.48 | mg/kg dry | 0.002 | 7/31/2019 12:35 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 2.31 | mg/kg dry | 0.018 | 8/7/2019 | A |

| SAMPLE ID | LAB LOG NUMBER | DATE SAMPLED | TIME SAMPLED | PARAMETER | METHOD NUMBER | RESULTS | UNITS | METHOD DETECTION LIMIT | DATE/TIME OF ANALYSIS | QUALIFIER CODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SP-5 | 358419 | 7/29/2019 | 11:37 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 0.953 | mg/kg dry | 0.009 | 8/7/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 1.65 | mg/kg dry | 0.015 | 8/7/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 1.35 | mg/kg dry | 0.049 | 8/23/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 0.526 | mg/kg dry | 0.006 | 8/7/2019 | A |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Porewater $NH_3$-N | SM 4500-NH3 (18th ed.) | 2.84 | mg/kg dry | 0.040 | 8/7/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | $NH_4Cl$ TSP* | DBE SOP TP | 8.9 | mg/kg dry | 1.0 | 8/29/2019 | A |
| SP-5 | 358419 | 7/29/2019 | 11:37 | $NH_4Cl$ TSP* | DBE SOP TP | 1.9 | mg/kg dry | 1.0 | 8/29/2019 | I |
| SP-6 | 358421 | 7/29/2019 | 14:05 | $NH_4Cl$ TSP* | DBE SOP TP | 10.5 | mg/kg dry | 1.0 | 8/29/2019 | A |
| SP-8 | 358424 | 7/30/2019 | 8:53 | $NH_4Cl$ TSP* | DBE SOP TP | 8.4 | mg/kg dry | 1.0 | 8/29/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | $NH_4Cl$ TSP* | DBE SOP TP | 18.0 | mg/kg dry | 1.0 | 8/29/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | $NH_4Cl$ TSP* | DBE SOP TP | 9.8 | mg/kg dry | 1.0 | 8/29/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 7.4 | mg/kg dry | 3.0 | 8/28/2019 | A I |
| SP-5 | 358419 | 7/29/2019 | 11:37 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 4.2 | mg/kg dry | 3.0 | 8/28/2019 | I |
| SP-6 | 358421 | 7/29/2019 | 14:05 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 9.9 | mg/kg dry | 3.0 | 8/28/2019 | A I |
| SP-8 | 358424 | 7/30/2019 | 8:53 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 7.3 | mg/kg dry | 3.0 | 8/28/2019 | I |
| SP-9 | 358427 | 7/30/2019 | 11:45 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 17.3 | mg/kg dry | 3.0 | 8/28/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | $NaHCO_3/Na_2S_2O_4$ TSP** | DBE SOP TP | 12.2 | mg/kg dry | 3.0 | 8/28/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | NaOH SRP*** | DBE SOP OPO4 | 29.1 | mg/kg dry | 2.0 | 8/7/2019 11:34 | A |
| SP-5 | 358419 | 7/29/2019 | 11:37 | NaOH SRP*** | DBE SOP OPO4 | 10.2 | mg/kg dry | 2.0 | 8/7/2019 11:34 | A |
| SP-6 | 358421 | 7/29/2019 | 14:05 | NaOH SRP*** | DBE SOP OPO4 | 52.4 | mg/kg dry | 2.0 | 8/7/2019 11:34 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | NaOH SRP*** | DBE SOP OPO4 | 22.2 | mg/kg dry | 2.0 | 8/7/2019 11:34 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | NaOH SRP*** | DBE SOP OPO4 | 62.8 | mg/kg dry | 2.0 | 8/7/2019 11:34 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | NaOH SRP*** | DBE SOP OPO4 | 30.7 | mg/kg dry | 2.0 | 8/7/2019 11:34 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | NaOH TSP | DBE SOP TP | 60.3 | mg/kg dry | 3.2 | 8/28/2019 | A |
| SP-5 | 358419 | 7/29/2019 | 11:37 | NaOH TSP | DBE SOP TP | 20.9 | mg/kg dry | 3.2 | 8/28/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | NaOH TSP | DBE SOP TP | 70.7 | mg/kg dry | 3.1 | 8/28/2019 | A |
| SP-8 | 358424 | 7/30/2019 | 8:53 | NaOH TSP | DBE SOP TP | 30.4 | mg/kg dry | 3.1 | 8/28/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | NaOH TSP | DBE SOP TP | 92.6 | mg/kg dry | 3.2 | 8/28/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | NaOH TSP | DBE SOP TP | 42.6 | mg/kg dry | 3.1 | 8/28/2019 | |
| SP-1 | 358418 | 7/29/2019 | 9:43 | NaOH TSP minus NaOH SRP† | Calculation | 31.2 | mg/kg dry | 3.2 | n/a | A |
| SP-5 | 358419 | 7/29/2019 | 11:37 | NaOH TSP minus NaOH SRP† | Calculation | 10.7 | mg/kg dry | 3.2 | n/a | A I |
| SP-6 | 358421 | 7/29/2019 | 14:05 | NaOH TSP minus NaOH SRP† | Calculation | 18.3 | mg/kg dry | 3.1 | n/a | A |
| SP-8 | 358424 | 7/30/2019 | 8:53 | NaOH TSP minus NaOH SRP† | Calculation | 8.2 | mg/kg dry | 3.1 | n/a | I |
| SP-9 | 358427 | 7/30/2019 | 11:45 | NaOH TSP minus NaOH SRP† | Calculation | 29.8 | mg/kg dry | 3.2 | n/a | |

| SAMPLE ID | LAB LOG NUMBER | DATE SAMPLED | TIME SAMPLED | PARAMETER | METHOD NUMBER | RESULTS | UNITS | METHOD DETECTION LIMIT | DATE/TIME OF ANALYSIS | QUALIFIER CODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SP-11 | 358428 | 7/30/2019 | 12:40 | NaOH TSP minus NaOH SRP† | Calculation | 11.9 | mg/kg dry | 3.1 | n/a | I |
| SP-1 | 358418 | 7/29/2019 | 9:43 | HCl TSP†† | DBE SOP TP | 3.3 | mg/kg dry | 3.0 | 8/28/2019 | A I |
| SP-5 | 358419 | 7/29/2019 | 11:37 | HCl TSP†† | DBE SOP TP | <3.0 | mg/kg dry | 3.0 | 8/28/2019 | U |
| SP-6 | 358421 | 7/29/2019 | 14:05 | HCl TSP†† | DBE SOP TP | 23.6 | mg/kg dry | 3.0 | 8/28/2019 | A |
| SP-8 | 358424 | 7/30/2019 | 8:53 | HCl TSP†† | DBE SOP TP | 4.8 | mg/kg dry | 2.9 | 8/28/2019 | I |
| SP-9 | 358427 | 7/30/2019 | 11:45 | HCl TSP†† | DBE SOP TP | 13.2 | mg/kg dry | 3.0 | 8/28/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | HCl TSP†† | DBE SOP TP | 9.7 | mg/kg dry | 3.0 | 8/28/2019 | I |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Residual P | DBE SOP TP | 12 | mg/kg dry | 10 | 8/29/2019 | A I |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Residual P | DBE SOP TP | <10 | mg/kg dry | 10 | 8/29/2019 | U |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Residual P | DBE SOP TP | <10 | mg/kg dry | 10 | 8/29/2019 | U |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Residual P | DBE SOP TP | <10 | mg/kg dry | 10 | 8/29/2019 | U |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Residual P | DBE SOP TP | <10 | mg/kg dry | 10 | 8/29/2019 | U |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Residual P | DBE SOP TP | <15 | mg/kg dry | 15 | 8/29/2019 | U |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 25800 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 8770 | mg/kg dry | 3030 | 8/20/2019 | A I |
| SP-2 | 358420 | 7/29/2019 | 12:42 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 25900 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 20800 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-4 | 358422 | 7/29/2019 | 14:48 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 19800 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-10 | 358423 | 7/30/2019 | 8:22 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 16200 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 7660 | mg/kg dry | 3030 | 8/20/2019 | I |
| SP-3 | 358425 | 7/30/2019 | 9:28 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 33400 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 16700 | mg/kg dry | 3030 | 8/20/2019 | |
| SP-9 | 358427 | 7/30/2019 | 11:45 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 11000 | mg/kg dry | 3030 | 8/20/2019 | I |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | 6110 | mg/kg dry | 3030 | 8/20/2019 | I |
| SP-12 | 358429 | 7/30/2019 | 13:37 | Total Organic Carbon | DBE SOP MVP/COE 3-73 | <3030 | mg/kg dry | 3030 | 8/20/2019 | U |
| SP-1 | 358418 | 7/29/2019 | 9:43 | Total Sulfur¥ | ASTM E1915-11 | 0.27 | % | 0.01 | 8/16/2019 | |
| SP-5 | 358419 | 7/29/2019 | 11:37 | Total Sulfur¥ | ASTM E1915-11 | 0.03 | % | 0.01 | 8/16/2019 | I |
| SP-2 | 358420 | 7/29/2019 | 12:42 | Total Sulfur¥ | ASTM E1915-11 | 0.15 | % | 0.01 | 8/16/2019 | |
| SP-6 | 358421 | 7/29/2019 | 14:05 | Total Sulfur¥ | ASTM E1915-11 | 0.16 | % | 0.01 | 8/16/2019 | |
| SP-4 | 358422 | 7/29/2019 | 14:48 | Total Sulfur¥ | ASTM E1915-11 | 0.26 | % | 0.01 | 8/16/2019 | |
| SP-10 | 358423 | 7/30/2019 | 8:22 | Total Sulfur¥ | ASTM E1915-11 | 0.18 | % | 0.01 | 8/16/2019 | |
| SP-8 | 358424 | 7/30/2019 | 8:53 | Total Sulfur¥ | ASTM E1915-11 | 0.22 | % | 0.01 | 8/16/2019 | |
| SP-3 | 358425 | 7/30/2019 | 9:28 | Total Sulfur¥ | ASTM E1915-11 | 0.49 | % | 0.01 | 8/16/2019 | |
| SP-7 | 358426 | 7/30/2019 | 10:43 | Total Sulfur¥ | ASTM E1915-11 | 0.35 | % | 0.01 | 8/16/2019 | |

| SAMPLE ID | LAB LOG NUMBER | DATE SAMPLED | TIME SAMPLED | PARAMETER | METHOD NUMBER | RESULTS | UNITS | METHOD DETECTION LIMIT | DATE/TIME OF ANALYSIS | QUALIFIER CODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SP-9 | 358427 | 7/30/2019 | 11:45 | Total Sulfur¥ | ASTM E1915-11 | 0.14 | % | 0.01 | 8/16/2019 | |
| SP-11 | 358428 | 7/30/2019 | 12:40 | Total Sulfur¥ | ASTM E1915-11 | 0.06 | % | 0.01 | 8/16/2019 | |
| SP-12 | 358429 | 7/30/2019 | 13:37 | Total Sulfur¥ | ASTM E1915-11 | 0.02 | % | 0.01 | 8/16/2019 | I |

**Key to Qualifier Code**

A Result based on the mean of two or more determinations; average of lab dup and/or extraction dup results.

I Result is between method detection limit and practical quantitation limit.

U Indicates that the compound was analyzed for but not detected.

Project Manager: Nancy

Nancy Chan
Project Manager

¥ Subcontract to SVL Analytical (EPA Code: ID00019)

**Reference**

Meis, S., Spears, B.M., Maberly, S.C., O'Malley, M.B., Perkins, R.G. 2012. Sediment amendment with Phoslock® in Clatto Reservoir (Dundee, UK): Investigating changes in sediment elemental composition and phosphorus fractionation. *J. Environ. Manag*.; 93, 185-193.

*$NH_4Cl$ TSP = Labile P

**$NaHCO_3/Na_2S_2O_4$ TSP = Reductant-Soluble P

***NaOH SRP = Metal-Oxide Adsorbed P

†NaOH TSP minus NaOH SRP = Organic P

††HCl TSP = Apatite Bound P

**QC SUMMARY**
**Wood PLC**
**PO # : C012608931**
**Project Name: Upper Myakka Lake Feasibiliy Study**
**Project No. : 600639-002B**
**(358418-358429)**

| PARAMETER | LAB DUPLICATES | % RSD | SPIKES | % RECOVERY | BLANKS |
|---|---|---|---|---|---|
| **Volatile Solids** | 358418 | 18.8 | | | <1.35 % |
| | 358423 | 32.6 | | | <1.35 % |
| **Total Phosphorus/Residual P** | 358419 | ND | 358424 | 100 | <10 mg/kg dry |
| | 358428 | 12.1 | 358429 | 118 | <10 mg/kg dry |
| **Porewater SRP** | 358427 | 1.9 | 358419 | 95 | <0.001 mg/kg dry |
| **Porewater NH3-N** | 358427 | 0.5 | 358427 | 121 | <0.006 mg/kg dry |
| **$NH_4Cl$ TSP** | 358421 | 4.3 | 358424 | 116 | <1.0 mg/kg dry |
| **$NaHCO_3/Na_2S_2O_4$ TSP** | 358421 | 11.5 | 358424 | 101 | <3.0 mg/kg dry |
| **NaOH SRP** | 358419 | 11.5 | 358421 | 102 | <2.0 mg/kg dry |
| **NaOH TSP** | 358421 | 1.7 | 358424 | 109 | <3.1 mg/kg dry |
| **HCl TSP** | 358421 | 4.9 | 358424 | 96 | <3.0 mg/kg dry |
| **Total Organic Carbon** | 358419 | 0.2 | 358427 | 109 | <3030 mg/kg dry |
| **Total Sulfur** | 358418 | 1.7 | | | <0.01 % |

ND- Not determined; not calculated because one of both results were below detection limit.

**DB Environmental, Inc.**
365 Gus Hipp Blvd. Rockledge, FL 32955
Ph: (321) 639-4896 Fax: (321) 631-3169
e-mail: info@dbenv.com Lab Certification #: E83330



# CHAIN OF CUSTODY

Revision 8.0, Effective 8/31/2018

| Client: Wood PLC | Address: 1101 Channelside Dr | City: Tampa | State: FL | Zip: 33602 | Phone: 8134559780 | Fax: |
|---|---|---|---|---|---|---|
| Contact Person: Kristen Nowak | Contact Info: 9542886588 | Invoice #: C012608931 | | Requested Analysis | | |

Project: Upper Myakka Lake

(7/31/19 NC)

Collected By: Erik Oij

| pH Checked (for Lab Use Only) | Lab Log #: | Date | Time | Comp/ Grab | Matrix Code | Field- Filter Y/N | Preservative: Thermal (4°C, <0°C, or n/a) | Preservative: pH Code | Sample ID: | Sample Description | Pore water extraction/Meis P Fractionation | % Dry Weight | Total Phosporous | Bulk density | Volatile Solids | Total Organic Carbon | Total Sulfer | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ~~358425~~ 358423 | 7/30/19 | 0822 | Comp | Se | N | | | SP-10 | SP-10 0-19cm | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358424 | 7/20/19 | 0853 | Comp | Se | N | | | SP-8 | SP-8 0-22.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358425 | 7/20/19 | 928 | Comp | Se | N | | | SP-3 | SP-3 0-10 cm | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358426 | 7/30/19 | 1043 | Comp | Se | N | | | SP-7 | SP-7 0-11cm | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358427 | 7/30/19 | 1145 | Comp | Se | N | | | SP-9 | SP-9 0-14.5cm | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358428 | 7/30/19 | 1240 | Comp | Se | N | | | SP-11 | SP-11 0-29cm | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358429 | 7/30/19 | 1337 | Comp | Se | N | | | SP-12 | SP-12 0-21cm | | 1 | 1 | 1 | 1 | 1 | 1 | | |

**Custody Transfer:**

| Relinquished by: Signature | Date/Time | Received by: Signature | Date/Time |
|---|---|---|---|
| 1 | | 1 | 7/31/2019 0930 |
| 2 | | 2 | |
| 3 | | 3 | |
| 4 | | 4 | |

**Matrix ID**
F-Fish, FL-Floc, G-Gas, I-Invertebrate, L-Leachate, PE- Periphyton, PT-Plant/Veg, SD-Sludge, SE-Sediment, SO-Soil
DI- DI Water, DW-Drinking Water, GW-Ground Water, IW- Incubation Water, PW-Porewater, RW-Rain Water, SW-Surface Water, WW-Waste Water, O-Other ______

**pH Code**
H: HCl to pH <2
N: $HNO_3$ to pH <2
S1: $H_2SO_4$ to pH <2
S2: $H_2SO_4$ to pH 2-3
OH1: ZnAc+NaOH to pH >9
OH2: NaOH to pH >12
O: Other ______

**Sample Receiving - For Lab Use Only**
Method of Shipping/Delivery:
Received on ice or similar Yes___ No X n/a___
Receiving Temperature (°C) - *if applicable:* 16.6 °C
Thermometer #: 64 Initials: NC
pH checked in accordance with Preservation Codes
Yes___ No___ n/a X Initials: NC
First Lab Log # (Batch ID): ~~358425~~ 358423

Comments:

(7/31/19 NC)

**DB Environmental, Inc.**

365 Gus Hipp Blvd. Rockledge, FL 32955

Ph: (321) 639-4896 Fax: (321) 631-3169

e-mail: info@dbenv.com

Lab Certification #: E83330

# CHAIN OF CUSTODY

Revision 8.0, Effective 8/31/2018

| | | | | | | |
|---|---|---|---|---|---|---|
| Client: Wood PLC | Address: 1101 Channelside Dr | City: Tampa | State: FL | Zip: 33602 | Phone: 8134559780 | Fax: |
| Contact Person: Kristen Nowak | Contact Info: 9542886588 | Invoice #: C012608931 | | Requested Analysis | | |
| Project: Upper Myakka Lake | | Collected By: Erik Oij | | | | |

| pH Checked (for Lab Use Only) | Lab Log #: | Date | Time | Comp/ Grab | Matrix Code | Field- Filter Y/N | Preservative: Thermal (4°C, <0°C, or n/a) | Preservative: pH Code | Sample ID: | Sample Description | Pore water extraction/Meis P Fractionation | % Dry Weight | Total Phosporous | Bulk density | Volatile Solids | Total Organic Carbon | Total Sulfer | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 358418 | 7/29 | 943 | Comp | SE | N | | | SP-1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358419 | 7/29 | 1137 | Comp | SE | N | | | SP-5 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358420 | 7/29 | 1242 | Comp | SE | N | | | SP-2 | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358421 | 7/29 | 1405 | Comp | SE | N | | | SP-6 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 358422 | 7/29 | 1448 | Comp | SE | N | | | SP-9 | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | SH | | | | | | | | | | | | | | | | | |

**Custody Transfer:**

| Relinquished by: Signature | Date/Time | Received by: Signature | Date/Time |
|---|---|---|---|
| 1 | | 1 Nancy [signature] | 7/30/19 1000 |
| 2 | | 2 | |
| 3 | | 3 | |
| 4 | | 4 | |

**Matrix ID**

F-Fish, FL-Floc, G-Gas, I-Invertebrate, L-Leachate, PE- Periphyton, PT-Plant/Veg, SD-Sludge, SE-Sediment, SO-Soil, DI- DI Water, DW-Drinking Water, GW-Ground Water, IW- Incubation Water, PW-Porewater, RW-Rain Water, SW-Surface Water, WW-Waste Water, O-Other ______

**pH Code**

H: HCl to pH <2
N: $HNO_3$ to pH <2
S1: $H_2SO_4$ to pH <2
S2: $H_2SO_4$ to pH 2-3
OH1: ZnAc+NaOH to pH >9
OH2: NaOH to pH >12
O: Other ______

**Sample Receiving - For Lab Use Only**

Method of Shipping/Delivery:

Received on ice or similar Yes X No____ n/a____

Receiving Temperature (°C) - *if applicable:* 0.9 °C

Thermometer #: 64 Initials: NC

pH checked in accordance with Preservation Codes Yes____ No____ n/a X Initials: NC

First Lab Log # (Batch ID): 358418

Comments:

*bill to:*

Wood PLC

Attention: Jackie Shields

2000 E. Edgewood Drive, Suite 215

Lakeland, FL 33803

lakeland.ap@woodplc.com

**Invoice Date:** 11 Sep 2019

**Invoice Number:** 6936

**Amount Due:** **$4,003.50**

| Sample Received | Description | Qty | Unit Price | Amount |
|---|---|---|---|---|
| 30 Jul 2019 | Grinding (Processing) | 12 | $15.00 | $180.00 |
| 31 Jul 2019 | % Dry Weight | 12 | $9.00 | $108.00 |
| Batch ID: 358418 | Bulk Density | 12 | $12.50 | $150.00 |
| | Volatile Solids | 12 | $13.75 | $165.00 |
| | Total Phosphorus | 12 | $19.25 | $231.00 |
| | Porewater Extraction | 6 | $18.00 | $108.00 |
| | Porewater SRP | 6 | $18.25 | $109.50 |
| | Porewater $NH_3$-N | 6 | $26.50 | $159.00 |
| | NH4Cl TSP* | 6 | $45.00 | $270.00 |
| | NaHCO3/Na2S2O4 TSP** | 6 | $123.00 | $738.00 |
| | NaOH SRP*** | 6 | $48.25 | $289.50 |
| | NaOH TSP | 6 | $44.50 | $267.00 |
| | NaOH TSP minus NaOH SRP† | 6 | $0.00 | $0.00 |
| | HCI TSP†† | 6 | $39.50 | $237.00 |
| | Residual TP | 6 | $43.25 | $259.50 |
| | Total Organic Carbon | 12 | $34.50 | $414.00 |
| | Total Sulfur¥ | 12 | $26.50 | $318.00 |
| | | | **Subtotal:** | $4,003.50 |
| | | | | |
| | | | **Total:** | **$4,003.50** |

Project Manager: Kristen Nowak

Wood PO# : C012608931

Wood Project Name: Upper Myakka Lake Feasibilty Study

Wood Project No. : 600369-002B

*NH4CI TSP = Labile P

**NaHCO3/Na2S2O4 TSP = Reductant-Soluble P

***NaOH SRP = Metal-Oxide Adsorbed P

†NaOH TSP minus NaOH SRP = Organic P

††HCI TSP = Apatite Bound P

¥Subcontract to SVL Analytical (EPA Code: ID00019)

**THANK YOU FOR YOUR BUSINESS!**

If you have any questions concerning this invoice call, Suzie Larson

## SOIL TESTING REPORT

Project: Upper Myakka Lake Feasibility Study

Client: Wood -Tampa

Project Number: 600639.002B
Date Tested: August 9, 2019
Date Reported: August 28, 2019

Wood Environment & Infrastructure Solutions, Inc. performed soil testing on the soil samples delivered to our Jacksonville laboratory on August 2, 2019. The samples were tested in general accordance with ASTM standards. The results are outlined below.

| Boring No | Sample No. | Depth (cm) | Percent Moisture (ASTM D2216) | Percent Organic (ASTM D2974) | Percent Passing #200 (ASTM D1140) |
|---|---|---|---|---|---|
| SP-1 | 1 | 0-27 | - | - | 2.1% |
| SP-2 | 1 | 0-17.5 | - | - | 2.3% |
| SP-3 | 1 | 0-10 | - | - | 2.6% |
| SP-4 | 1 | 0-13 | - | - | 2.2% |
| SP-5 | 1 | 0-30 | - | - | 1.0% |
| SP-6 | 1 | 0-28 | - | - | 1.9% |
| SP-7 | 1 | 0-11 | - | - | 2.8% |
| SP-8 | 1 | 0-22.5 | - | - | 2.4% |
| SP-9 | 1 | 0-14.5 | - | - | 5.6% |
| SP-10 | 1 | 0-19 | - | - | 3.1% |
| SP-11 | 1 | 0-29 | - | - | 3.2% |
| SP-12 | 1 | 0-21 | - | - | 2.6% |

*"-" Test not performed.*

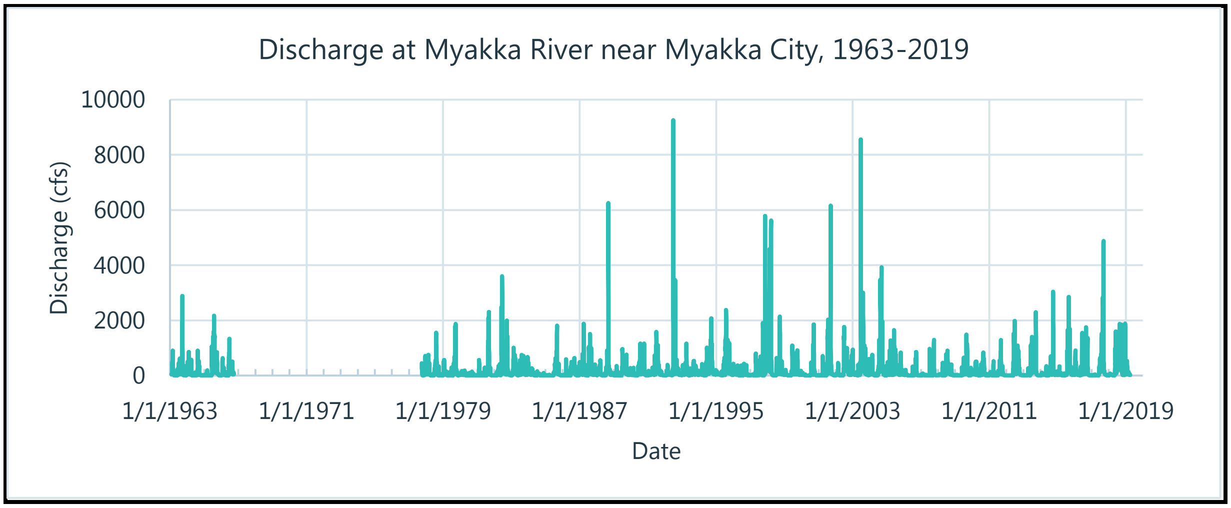
Reviewed By

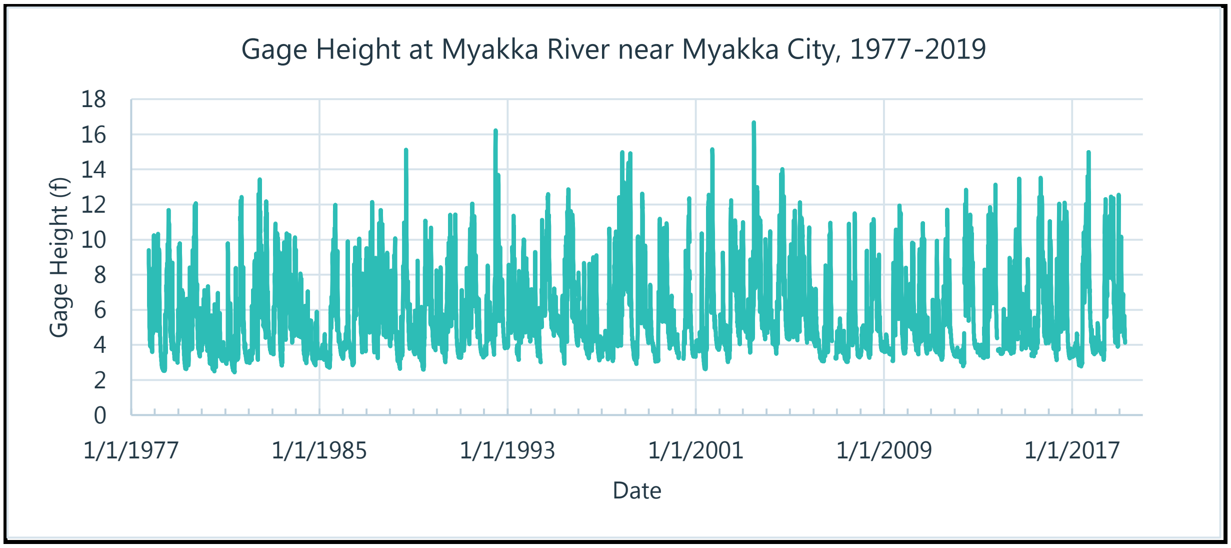
Christopher R. Martin, Jr.

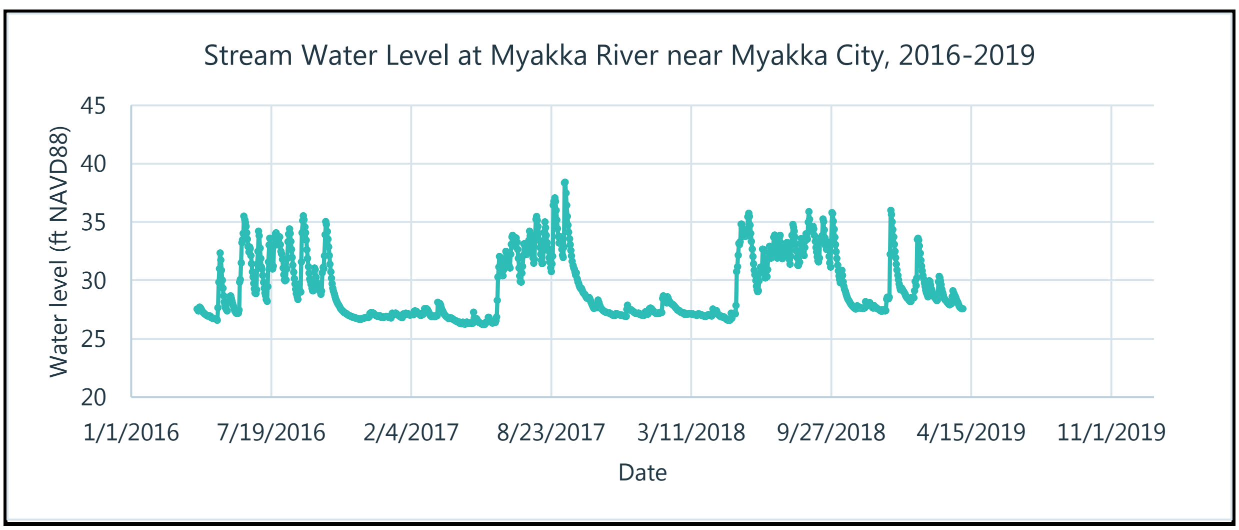
8/28/19

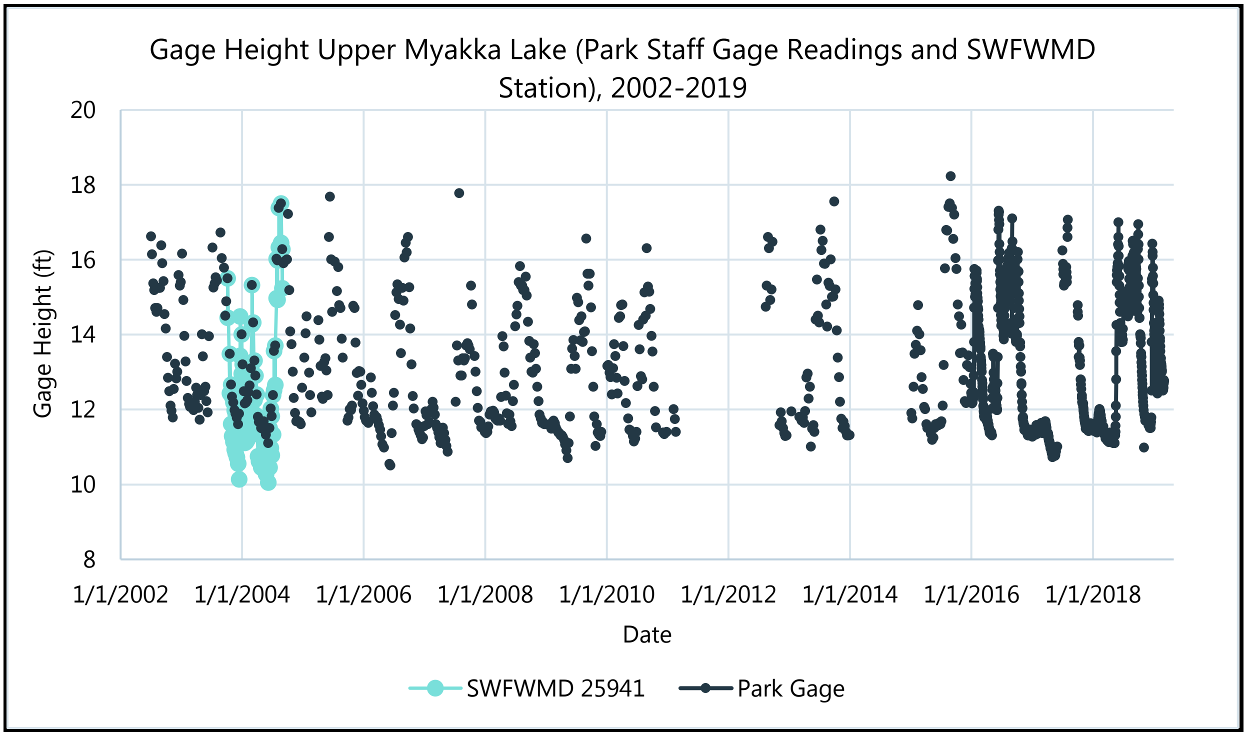
# APPENDIX C

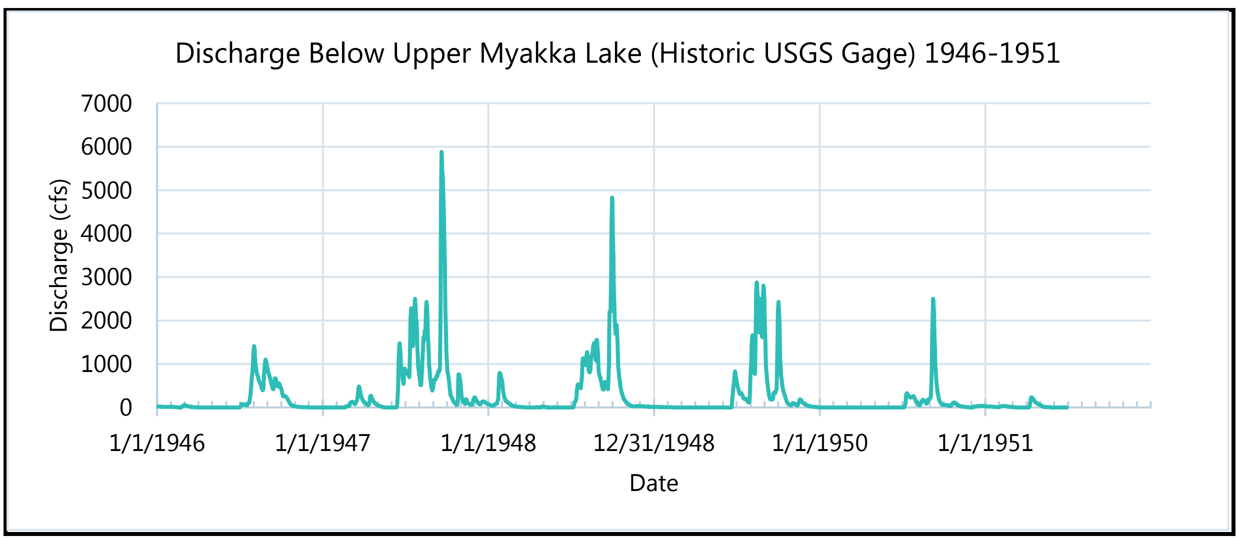
Hydrologic Data

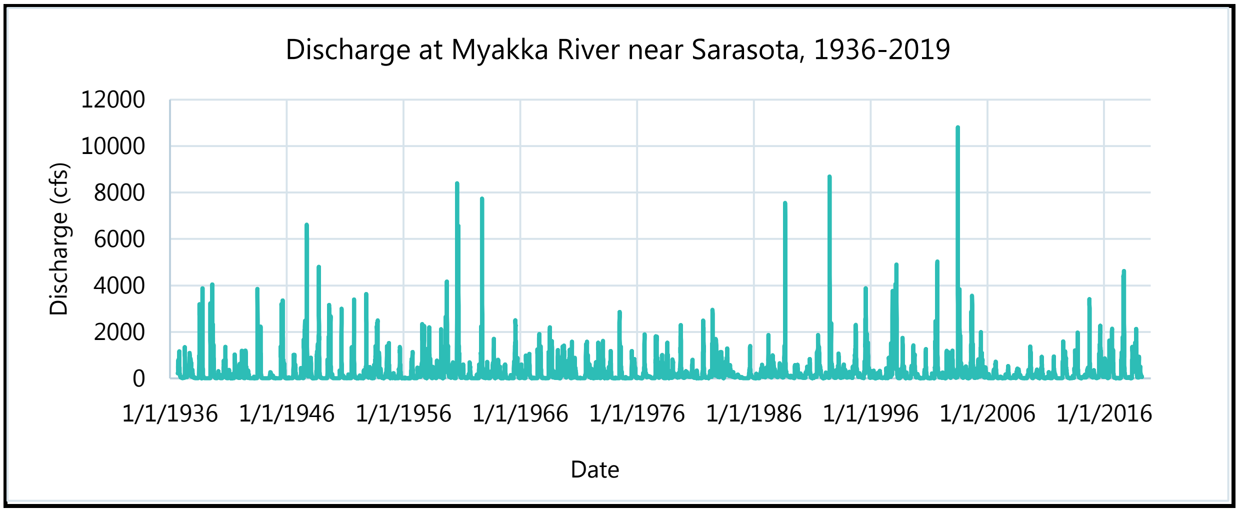

Discharge at Myakka River near Myakka City, 1963-2019
Discharge (cfs)
10000
8000
6000
4000
2000
0
1/1/1963
1/1/1971
1/1/1979
1/1/1987
1/1/1995
1/1/2003
1/1/2011
1/1/2019
Date


Gage Height at Myakka River near Myakka City, 1977-2019
Gage Height (f)
18
16
14
12
10
8
6
4
2
0
1/1/1977
1/1/1985
1/1/1993
1/1/2001
1/1/2009
1/1/2017
Date

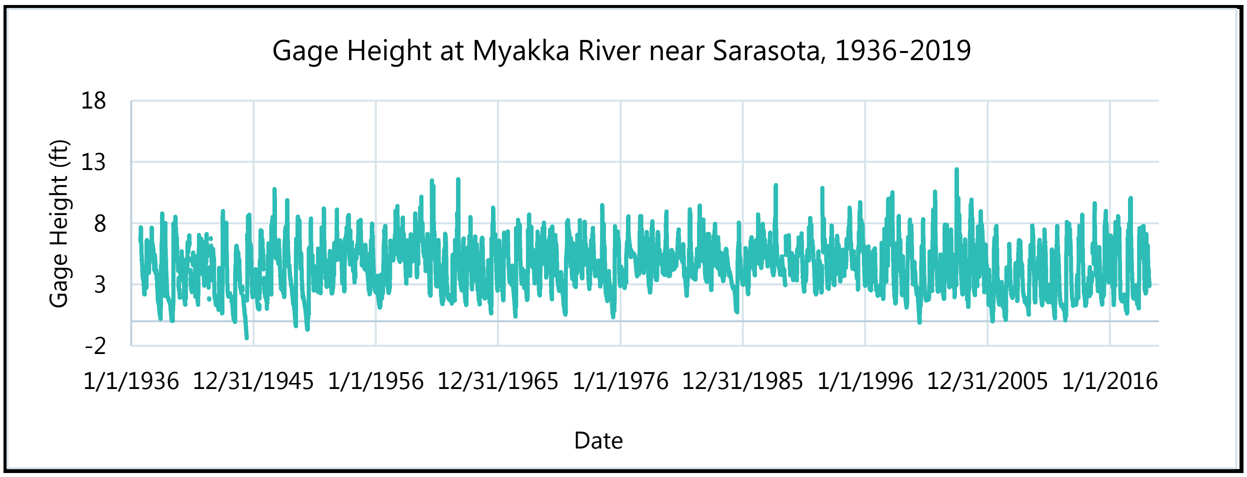

Stream Water Level at Myakka River near Myakka City, 2016-2019
Water level (ft NAVD88)
45
40
35
30
25
20
1/1/2016
7/19/2016
2/4/2017
8/23/2017
3/11/2018
9/27/2018
4/15/2019
11/1/2019
Date


Gage Height Upper Myakka Lake (Park Staff Gage Readings and SWFWMD Station), 2002-2019
Gage Height (ft)
20
18
16
14
12
10
8
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
Date
SWFWMD 25941
Park Gage

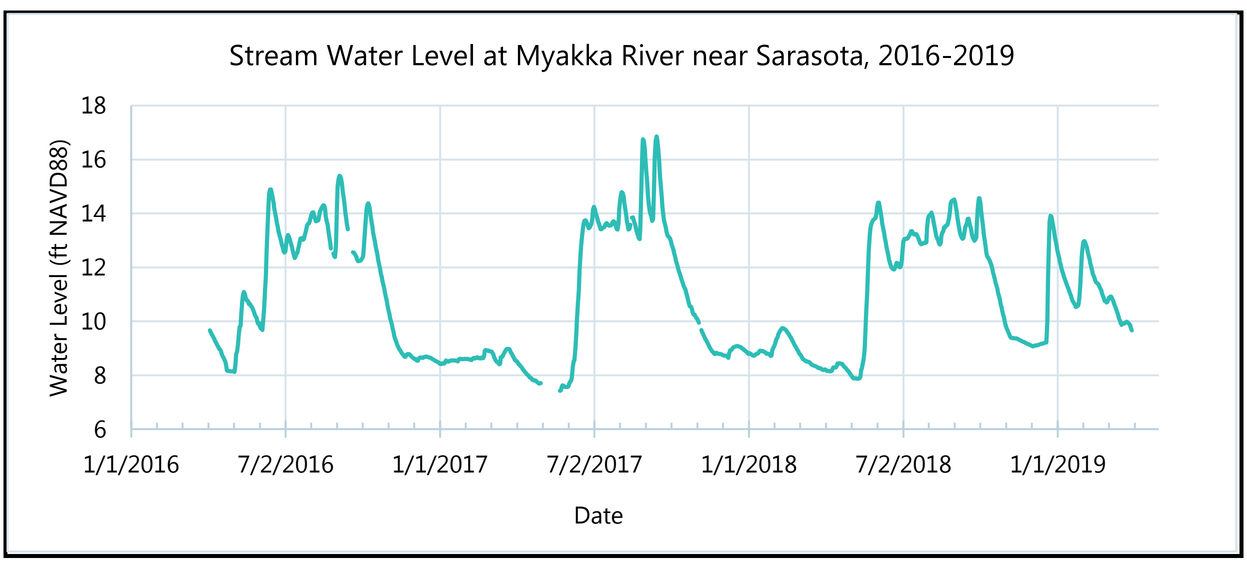

Discharge Below Upper Myakka Lake (Historic USGS Gage) 1946-1951
Discharge (cfs)
7000
6000
5000
4000
3000
2000
1000
0
1/1/1946
1/1/1947
1/1/1948
12/31/1948
1/1/1950
1/1/1951
Date



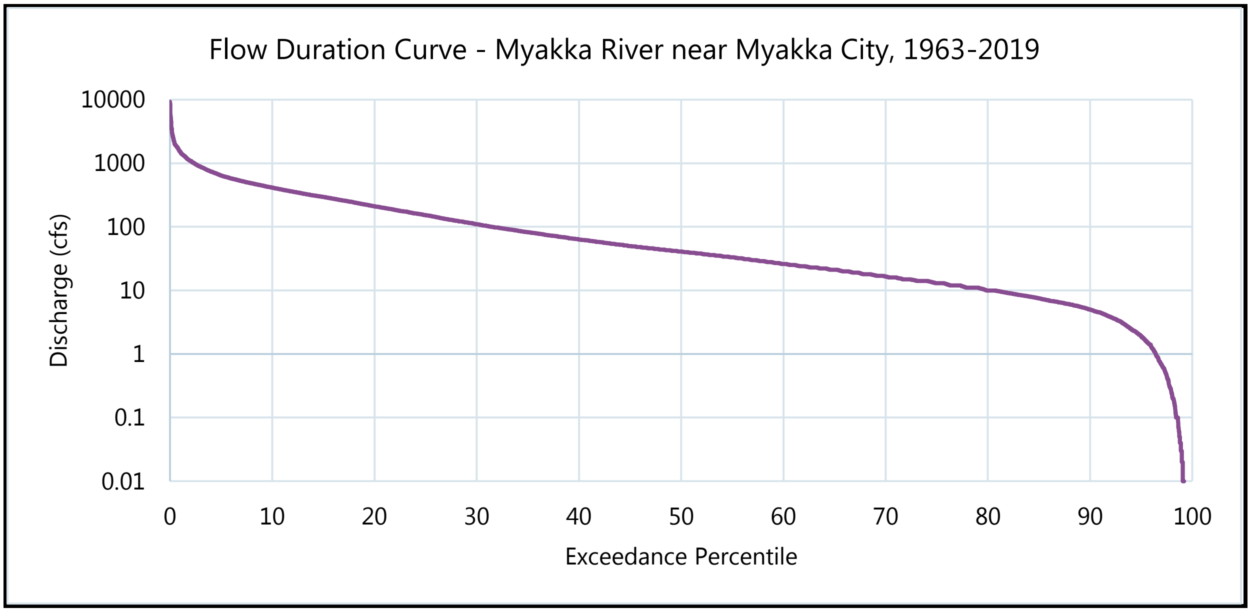
Discharge at Myakka River near Sarasota, 1936-2019
Discharge (cfs)
12000
10000
8000
6000
4000
2000
0
1/1/1936
1/1/1946
1/1/1956
1/1/1966
1/1/1976
1/1/1986
1/1/1996
1/1/2006
1/1/2016
Date

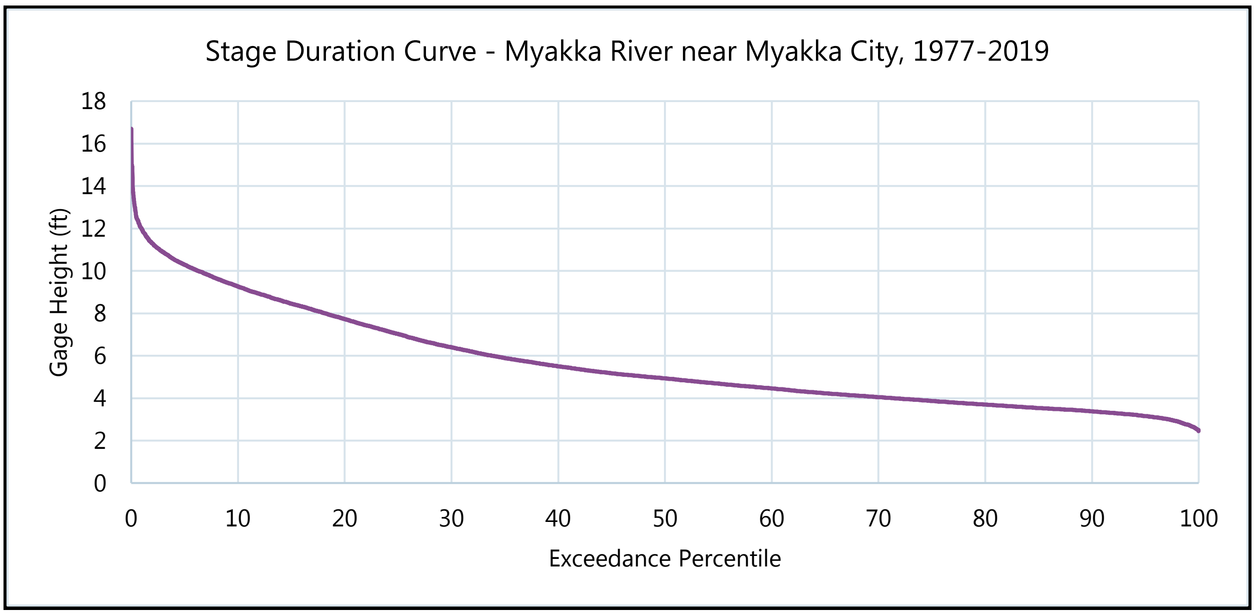



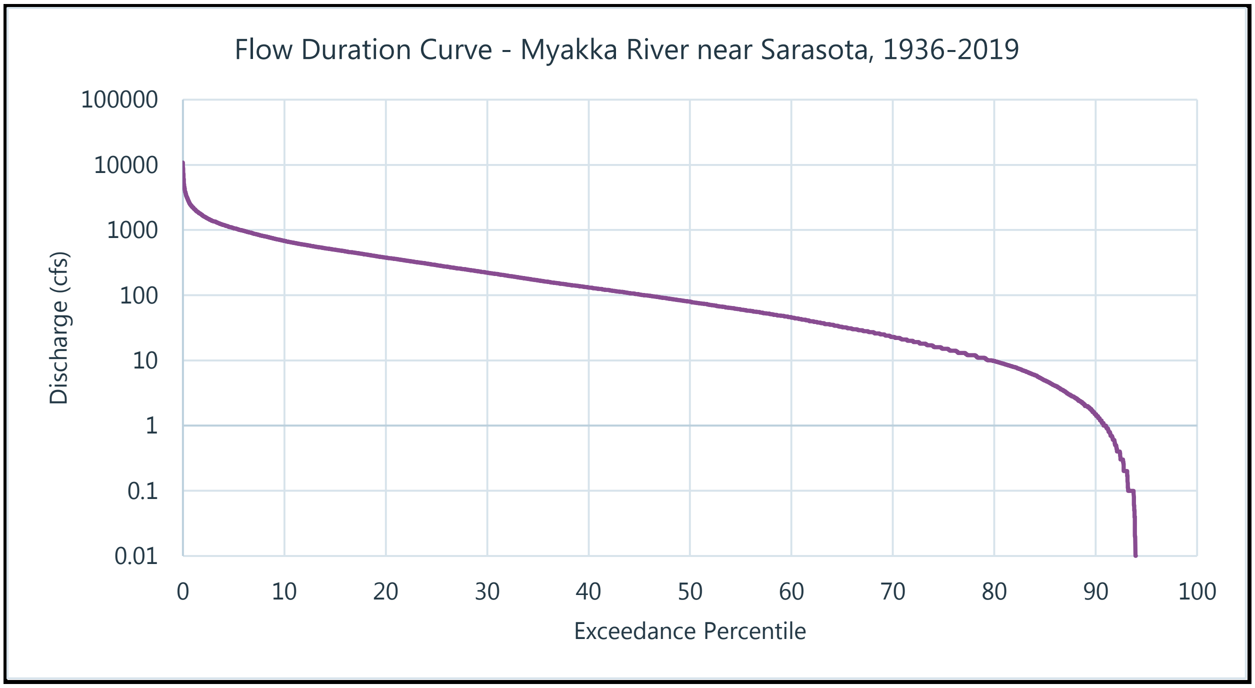
Gage Height at Myakka River near Sarasota, 1936-2019
Gage Height (ft)
18
13
8
3
-2
1/1/1936
12/31/1945
1/1/1956
12/31/1965
1/1/1976
12/31/1985
1/1/1996
12/31/2005
1/1/2016
Date

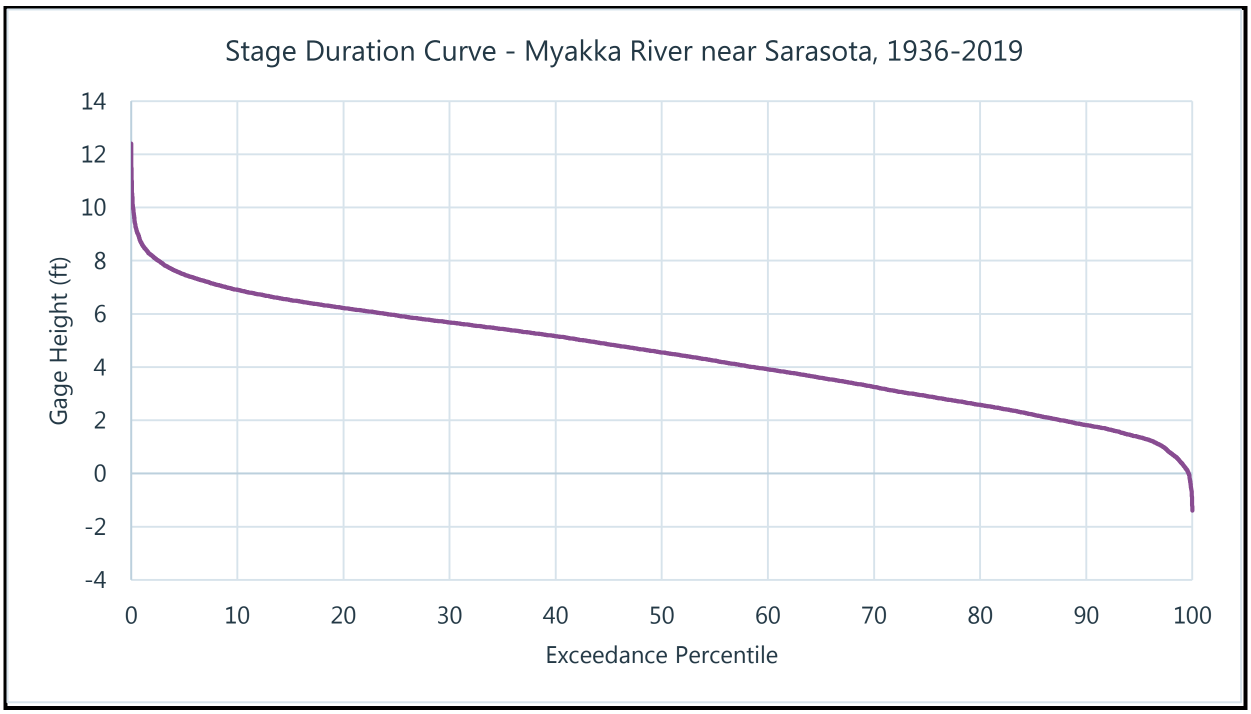



Stream Water Level at Myakka River near Sarasota, 2016-2019
Water Level (ft NAVD88)
18
16
14
12
10
8
6
1/1/2016
7/2/2016
1/1/2017
7/2/2017
1/1/2018
7/2/2018
1/1/2019
Date


Flow Duration Curve - Myakka River near Myakka City, 1963-2019
Discharge (cfs)
10000
1000
100
10
1
0.1
0.01
0
10
20
30
40
50
60
70
80
90
100
Exceedance Percentile


Stage Duration Curve - Myakka River near Myakka City, 1977-2019
Gage Height (ft)
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
Exceedance Percentile


Flow Duration Curve - Myakka River near Sarasota, 1936-2019
100000
10000
1000
100
10
1
0.1
0.01
Discharge (cfs)
0
10
20
30
40
50
60
70
80
90
100
Exceedance Percentile


Stage Duration Curve - Myakka River near Sarasota, 1936-2019
14
12
10
8
6
4
2
0
-2
-4
Gage Height (ft)
0
10
20
30
40
50
60
70
80
90
100
Exceedance Percentile

**Stage Duration Curve Summary**

| Station | Parameter | 15th Percentile | Median | 85th Percentile |
|---|---|---|---|---|
| Myakka River near Myakka City | Discharge (cfs) | 3550 | 1960 | 1640 |
| Myakka River near Myakka City | Gage Height (ft) | 13.9 | 12.5 | 12.1 |
| Myakka River near Sarasota | Discharge (cfs) | 4460 | 2890 | 2350 |
| Myakka River near Sarasota | Gage Height (ft) | 10.06 | 9.14 | 8.75 |

# APPENDIX D

Event Modeling Report

# Upper Lake Myakka Restoration

# Hydrologic & Hydraulic Report

**Prepared for:**


**Florida Department of Environmental Protection**

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**Prepared by:**


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**February 2020**

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# List of Acronyms

| | |
|---|---|
| AOM | Area of Modification |
| CCC | Civilian Conservation Corps |
| CMP | Corrugated Metal Pipe |
| DCIA | Directly Connected Impervious Area |
| FDEP | Florida Department of Environmental Protection |
| FEMA | Federal Emergency Management Agency |
| ft | Feet |
| ICPR | Interconnected Channel and Pond Routing |
| LiDAR | Light Detection and Ranging |
| LML | Lower Myakka Lake |
| MRSP | Myakka River State Park |
| MRWI | Myakka River Watershed Initiative |
| NAVD88 | North American Vertical Datum of 1988 |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| NRCS | Natural Resources Conservation Service |
| SWFWMD | Southwest Florida Water Management District |
| SR72 | State Road 72 |
| $t_c$ | Time of Concentration |
| ULM | Upper Lake Myakka |
| USGS | United States Geological Survey |
| WCS | Water Control Structure |
| Wood | Wood Environment & Infrastructure Solutions, Inc. |

# 1.0 Project Introduction

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by the Florida Department of Environmental Protection (FDEP) to conduct a feasibility study on Upper Lake Myakka (ULM) located within the Myakka River State Park (MRSP) in Sarasota County, Florida (**Figure 1**). The Southwest Florida Water Management District (SWFWMD) is a cooperative funding partner for this project. Two water control structures (WCS) exist on the southern rim of the lake: a concrete weir constructed in 1941 and a bypass constructed in 1974. The feasibility study explores the following three alternatives, with the objectives of restoring natural systems and improving water quality in the Myakka River before the water enters Charlotte Harbor:

1) Removing the low water control structure (weir and bypass);
2) Amending the low water control structure; or
3) Re-building the low water control structure to the way it was prior to the recent failure.

This Hydrologic and Hydraulic Report was prepared for Task 3A of the overall feasibility study. This task is focused on the event-based modelling using the existing SWFWMD Myakka River Watershed Initiative (MRWI) Interconnected Channel and Pond Routing (ICPR) version 4 model. The MRWI model was used as the baseline/existing conditions and was updated by incorporating hydraulic and bathymetric survey data from field efforts collected by Wood. The calibration of the updated model was verified against the initial MRWI model to ensure appropriateness of the baseline ICPRv4 model. This report summarizes the efforts used in the model updates, as well as discusses and analyses the results of the above listed three alternative analyses.

## 1.1 Project Location

MRSP is located within Sarasota County, approximately nine miles east of Interstate 75 (**Figure 1**). A 12 mile stretch of the Myakka River is located within the park boundaries and travels through the western portion of the park. Upper Lake Myakka is located approximately 2.5 miles northeast and upstream of State Road 72 (SR72) in the northernmost area of MRSP. Please refer to **Figure 2** for a location map depicting the project area relative to ULM.

## 1.2 Project Background

Following construction of the lake's main outfall weir in the spring of 1941, several property owners expressed flooding concerns including backwater effects in Howard Creek and Vanderipe Slough (Suau, 2005). Over time, the six pipes that made up the bypass structure deteriorated to the point of no longer being functional. Additionally, the area around the bypass structure was breached and the ULM discharge now flows freely around the bypass structure. The weir structure has also degraded over the last few decades and has multiple six-inch gaps along the invert of the weir.

### 1.2.1 Myakka River System

The Myakka River is a 66-mile long blackwater stream with a total drainage area of 580 square miles (Boning, 2007). It flows southwest from its headwaters in Myakka Head, through Flatford Swamp where seven tributaries converge to make a fifth order stream, through the 37,199-acre MRSP, and then southeast towards its terminus into Charlotte Harbor (**Figure 1**). The river corridor is punctuated by four major floodplain depressions: Flatford Swamp, Tatum Sawgrass, ULM, and Lower Myakka Lake (LML), and variably consists of valleys occupied by a single meandering open channel, anabranching channels, or no well-defined open channels. The two in-line lakes are located within MRSP. Their primary water source is rainfall with additional input from runoff and seepage from surrounding uplands; and their water depth varies from approximately 2 to 6 feet (ft), depending on rainfall (FDEP, 2018).

There are two WCS present on the Myakka River in the MRSP. The upstream WCS is located on the south side of the approximate 850-acre ULM and consists of an historic weir and bypass channel with six pipes. The downstream WCS, referred to as Downs' Dam, is a privately constructed dam located approximately 3.5 miles downstream of the approximate 350-acre LML. The ULM WCS, which has impacted the lake and its associated wetlands by limiting dry-season drawdowns, as well as limiting wildlife passage to species such as the Florida manatee, is the focus of this feasibility study.

### 1.2.2 Hydrologic Alterations in the Myakka River

Numerous drainage modifications within the Myakka watershed have been instituted for the conversion of lands to agricultural uses, to control flooding, and for transportation needs. The *Myakka River State Park Unit Management Plan* (FDEP, 2018) provides an excellent summary of the hydrologic alterations made from Flatford Swamp to Lower Myakka Lake, as transcribed below.

Starting from the northern part of the watershed, the historic alterations of the natural hydrologic regime that most impact the park include: dry season inputs into Flatford Swamp; the diversion dikes of the Tatum Sawgrass Marsh; the County Road 780 bridge and causeway; the Clay Gully diversion; the dikes at Hidden River; the inputs from Howard Creek; the dike separating Upper Myakka Lake from Vanderipe Slough; the concrete weir where the Myakka River exits Upper Lake Myakka; the State Road 72 bridge, causeway, and drainage ditches; the railroad grade; ditching and the dike on Deer Prairie Slough; and Down's Dam on the Myakka River near the southern boundary of the park (**Exhibit 1**). These alterations are described in more detail below. Additional hydrologic alterations occur downstream of the area of interest and are provided in **Table 1** below for information purposes.

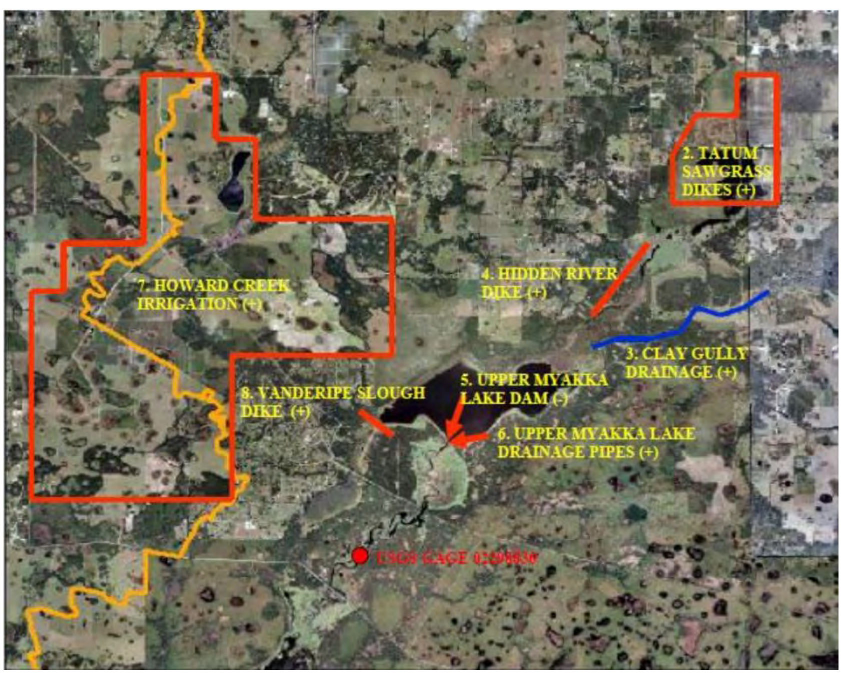


**Exhibit 1. Hydrologic Alterations in the Project Vicinity (Suau, 2005)**

**Table 1. Summary of Hydrologic Alternations in the Myakka River**

| Hydrologic Alteration | Type of Alteration | Date of Alteration | Control Elevation | Flow Regime Impact | Water Budget Impact |
|---|---|---|---|---|---|
| 1. Flatford Swamp | Irrigation | 1980 | NA | Low flow | + |
| 2. Tatum Swamp | Dike | 1974 | 19 | Low flow | + |
| 3. Clay Gulley | Drain & Diversion | 1900 | NA | All flow | + |
| 4. Hidden River | Dike | 1958 | 21.66 | All flow | + |
| 5. Upper Lake Dam | Dam | 1936/1941 | 13.65 | Low to moderate flow | - |
| 6. Upper Lake Pipes | Drain | 1974 | 9.8 | Low to moderate flow | + |
| 7. Vanderipe Slough | Dike | 1940 | 14.5 | Low to moderate flow | + |
| 8. Howard's Creek | Irrigation | 1990 | NA | Low flow | + |
| 9. Downs Dam | Dam | 1930's | 6.6/10.6 | Low flow | - |
| 10. Cow Pen Slough | Diversion | 1920s, 50's & 60s | 16.2 | All flow | - |
| 11. Blackburn Canal | Diversion | 1959 | NA | All flow | - |
| 12. Deer Prairie | Dam | 1950 | 3.31 | Low flow | - |
| 13. Big Slough Canal | Drainage | 1930s &1960s | NA | All flow | + |

Changes to land use starting in the late 1970s have led to increased water inflows to Flatford Swamp, and while relatively distant, produce negative impacts downstream into the park. In a report prepared for the SWFWMD, *Tree Mortality Assessment of the Upper Myakka River Watershed* (Coastal Environmental, 1998), researchers assigned the cause of a large tree mortality event in the Upper Myakka River Basin and Flatford Swamp to hydrological stress. This stress was identified as being from an increase in seasonal highwater levels and longer seasonal hydroperiods. The primary contributor was subsurface seepage generated from agricultural irrigation which caused an excess base flow to the swamp. In 1998, the zone of potentially abnormal mortality and stress (area with dead trees) in the Upper Myakka River Watershed (100-year floodplain from State Road 64 downstream to State Road 72) covered approximately 3,740 acres, or about 25 percent (FDEP, 2018). An Assessment of Tree Conditions in Myakka River State Park (Ford and Brooks, 2000) reported that the increased flows in the Upper Myakka Watershed were causing stress and mortality in trees within the park, most notably upstream of the weir at the outflow of the Upper Lake Myakka. Beyond the tree morality issue, the increased input of water during the dry season has drastically reduced the number of "no flow" periods and changed the water chemistry through the addition of mineralized groundwater (**Exhibit 2**). These changes have had impacts to natural communities well beyond the riverbanks and slough systems.

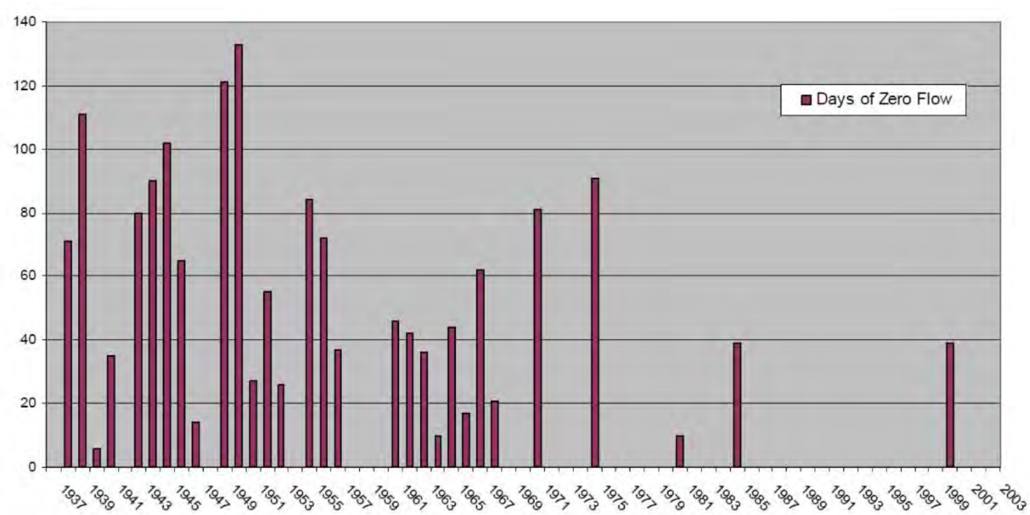


**Exhibit 2. Days of Zero Flow at Myakka River near Sarasota (Suau, 2005)**

Tatum Sawgrass Marsh was modified in 1974 via a series of dikes to divert water away from the marsh to create agricultural lands and control flooding. Tatum Sawgrass is extremely important as a holding basin during periods of heavy rainfall. The 2,500-acre marsh (Conservation Foundation, 2018) has the capacity to store an equivalent of 1.8 inches of rainfall, which is four times that of the Upper and Lower Myakka Lakes combined (FDEP, 2018). The results of the Tatum Sawgrass diking have reduced the storage capacity of the marsh during low flow events and increased the potential of downstream flooding by diverting water away from the marsh. As a result of the dike system, flood-peak discharges and flood heights having recurrence intervals of up to 25 years are increased, and approximately 1,200 additional acres along the Myakka River may be flooded during two-year flood conditions. In addition, a 19 percent increase in flood peak discharge at the County Road 780 Bridge may occur, and a 0.8-foot increase in flood height can result (Hammett *et al*. 1978).

The raised berm (causeway) for the approach road and associated bridge at County Road 780 over the Myakka River constrict flow south of the Tatum Sawgrass area especially during peak flow events. Duever and McCollom (1990) note the large width of river floodplain and potential for flow reduction at these points could lead to adverse impacts to natural communities. They also suggest changes are likely minor and localized. There is a potential for future study to determine what hydrologic effects this structure has and what, if any, modifications could be made to enhance hydrologic functions. Sarasota County recently finished the replacement of the old dilapidated bridge.

Clay Gully was originally a slough system that was ditched to increase drainage around 1900 (Suau, 2005). A more formal diversion was constructed in 1949 after it was recommended by Robert Angas in his 1945 Engineering Report to Florida Forest and Park Service. The resulting project diverts much of the normal flow of the river through Clay Gully and into Upper Myakka Lake at its northeast corner. Based on measurements made during a United States Geologic Survey (USGS) study, 35 percent of the flow goes directly into the lake, bypassing Tatum Sawgrass Marsh (Hammett *et al*. 1978). This has hastened vegetation changes in the bypassed section of the river, which now stays dry almost half of the year between its juncture with Clay Gully and the point where it enters Upper Lake Myakka (FDNR, 1986).

The dikes at the Hidden River community were originally installed in 1958 to exclude water from the Myakka River to create pasture for cattle. The result of the dikes is increased water input in the Upper Myakka River Watershed via the Myakka River that would have historically flowed into adjacent marsh and bottomlands communities. In 1966, it was platted for a residential community (Suau, 2005). The proximity and history of flood issues in the Hidden River community make potential return to the natural hydrologic regime unlikely.

Beginning in the 1950s, land clearing activities in the Howard Creek area for agriculture, and later increases in irrigation have had a net result of increased water input to Upper Myakka Lake. Treated reclaimed wastewater has been used to irrigate several thousand acres of agricultural operations starting in the 1990s (Suau, 2005) and continues to the present. Howard Creek discharges into the western tip of Upper Myakka Lake at the western park boundary close to Vanderipe Slough.

A 1,000-foot earthen dike separating Upper Myakka Lake from Vanderipe Slough was constructed by the Civilian Conservation Corps (CCC) and completed around 1940. The structure's purpose was to prevent water from the lake from entering the slough (Historic Property Associates, 1989). Due to concerns that excess water from the Upper Myakka Lake was damaging adjacent pasturelands, it was suggested by Robert Angas (1945) that the dike be extended, which was completed in the late 1950s. Resulting impacts from dikes included redirected flow of Howard Creek from Vanderipe Slough into the Upper Myakka Lake.

In 1937-38, the CCC constructed a weir at the main outflow to the Upper Myakka Lake (Historic Property Associates, 1989). Flippo and Joyner (1968) reported that in spring 1941 a low concrete weir replaced the previous CCC structure that had been partially washed out. These alternations to the natural hydrology were conducted to retain water in the Upper Myakka Lake to enhance sport fishing and recreational boating. While certain features may have been enhanced, there were also unintended consequences to plant and animal communities.

The Upper Myakka Lake Weir was bypassed by culverts in November 1974. Six 60-inch culverts were installed just southeast of the dam with the primary purpose of controlling invasive exotic plants in the lake by periodic drawdown (Suau, 2005). Since 1979, the culverts have generally been kept open, restricting little to no water flow. In the past, the culvert openings were restricted to slow the flow through the bypass during the dry season, which was perceived to extend the period of operation of the concession airboats. In May of 2016 there was a washout associated with the bypass culverts leaving a 10-foot opening on the east side, thus making the pipes ineffective.

As with County Road 780, State Road 72 and its associated bridges impede natural hydrologic flow. Beginning in late 2006 and continuing through April 2010, four bridges were replaced or improved, including those over Vanderipe Slough, Myakka River, and Deer Prairie Slough. Some efforts were made to improve hydrologic functions, including sheet flow, flood conveyance as well as enhanced stormwater treatment and wildlife crossings. There may be opportunities to improve these functions in the future.

While relatively minor, it is worth mentioning that some remnants from an earthen dam at the south end of the Lower Myakka Lake still exist. Water movement at this point may be near prealteration conditions, but some bottleneck effect may be present from the remaining earthen structure on either side. No research has been done on the existing condition and effects of the earthen dam on hydrology. Flippo and Joyner (1968) only mention in passing that the lower lake was dry in 1945 before the structure was in place and "dry in 1950, after the earthen dam at its outlet had washed out."

### 1.2.3 Historic Conditions at the ULM Weir and Bypass

According to an FDEP memorandum, the original low-water weir at the discharge of Upper Lake Myakka was built in 1938-1939 associated with a CCC project to reportedly hold back water for recreation purposes (i.e. boating) in the low water season. In 1974, a set of bypass culverts were installed immediately east of the weir that were specifically intended to help mitigate some negative effects of the weir (**Exhibits 3 and 4**). The bypass culverts were intended to allow for periodic draw down of the ULM for aquatic plant control, expose the lake bottom to reduce muck, improve native fish habitat, and move toward a more historic flow pattern. However, drawdowns were not fully achieved even with the extensive use of diesel pumps in the late 1970s. During this time period, increased agricultural inputs and modifications in the Tatum Sawgrass above the park increased dry season water inputs into the ULM making draw down unlikely.


**Exhibit 3. ULM Weir and Bypass (1974)**

**Exhibit 4. Construction of Bypass in 1974 (Suau, 2005)**

### 1.2.4 Current Conditions at the ULM Weir and Bypass

According to an FDEP memorandum, the ULM weir has degraded over the last few decades, with numerous four- to six-inch gaps in the weir structure, which are lower than the weir invert of 12.41 ft, that are expected to continue to degrade and reduce the original intended function of the structure. The bypass culverts have rusted out, and in May 2016 the park concession installed boards against the dilapidated culverts in an attempt to slow the flow and manipulate water levels in the ULM. The blocking of the bypass culverts with boards did little to hold back water, and approximately one week later a heavy rain event caused a serious wash out on the east side of the bypass, which make the pipes non-functional and opened up a ten-foot space in what was formerly berm and is now the river. This required the closure of the platform/fishing deck located over the culverts. Additionally, the trail to the observation platform over the bypass is to remain closed until the bank can be stabilized.

## 1.3 Objectives

The water control structures on the ULM have been identified for study and potential restoration. Part of the District's recently completed MRWI modeling of the river examined options to modify the ULM weir to replicate a more historic hydrology (Singhofen & Associates, Inc. 2013). This current project feasibility study expands the MRWI effort by considering the recent hydrologic impacts to the bypass area, adverse impacts to the event storms and benefits for water quality and natural systems that could result from reducing dry season levels to a more pre-alteration condition.

This large project area within the Myakka River Watershed is a central ecological feature of MRSP and acts as a holding basin much of the year. Project objectives include restoring natural systems and improving water quality in the Myakka River before the water enters Charlotte Harbor, a SWIM priority water body.

Modifying or removing the water control structure and bypass was analyzed to determine if the effect would have any adverse impacts to flood stages in the surrounding areas. This Hydrologic and Hydraulic Report analyzes the existing/baseline model as well as the three alternatives mentioned in Section 3.0 and provides a comparison of each alternative to determine the effects and benefits offered from each. The 2.33-year 24-hour, 25-year 24-hour, and 100-year 24-hour storm events were modelled for each of the four prepared models. This report presents the model setup and preparation, as well as the analysis and summary of these findings.

# 2.0 Site Characterization

## 2.1 Site Description

The project area lies within the Myakka River State Park, at the ULM discharge. The below sections provide a description of the site characteristics.

## 2.2 Land Use/Cover

As indicated in **Figure 5**, land uses within the project area consist of lakes, freshwater marshes, and streams/waterways. East of the ULM is primarily stream/lake swamps and shrub/brushland with smaller regions of freshwater marshes scattered throughout. To the north is a matrix of shrub/brushland, residential low-density areas, hardwood conifer mixed areas, and cropland/pastureland. The areas to the south of the lake are mainly freshwater marshes and stream/lake swamps while the area to the west contains low density residential areas and stream/lake swamps.

## 2.3 Topography

The project area is located within the Myakka River Watershed in Sarasota County, Florida which is a part of the Gulf Coastal Plain Province. The highest elevation within the Myakka River Watershed is 140.9 feet (ft) above mean sea level with the lowest elevation being 8.1 ft near Charlotte Harbor (Singhofen & Associates, Inc. 2013). **Figure 4** depicts the Clay Gully and Myakka River systems upstream of the ULM, as well as the Vanderipe Slough and Myakka River System downstream of the ULM, which provides an additional overflow for the ULM. The Vanderipe Slough reconnects with the Myakka River system south of SR72.

**Figure 9** displays elevation data of the project area and surrounding area which was taken using light detection and ranging (LiDAR) surveying (FGDL, 2019). The areas adjacent to the project area are generally higher, sloping down towards the river and to the south. This LiDAR data was built into the model and used to generate some channel and weir cross sections as well as model the 2D areas of the ICPR model, which include the ULM and Vanderipe Slough.

Additionally, Wood obtained bathymetric data of Upper Lake Myakka and the adjacent project area which was then analysed and incorporated into the model. The bathymetry was created using the "Topo to Raster" geoprocessing tool which utilizes layers as variables in the creation of a hydrologically correct raster surface. The tool uses the input layers elevation data to create a new raster surface based on interpolations of all collected topographic data. The new interpolated bathymetric raster surface was then checked for accuracy by overlaying the field survey spot elevations and calculating the mean variation and standard deviation between the two datasets. The final bathymetric raster has a standard deviation of 0.09 ft, which was deemed an acceptable margin of error.

## 2.4 Soils

The primary soil type found within and directly surrounding the project area is Bradenton Fine Sand with certain areas being designated as frequently flooded (**Figure 6**). Bradenton Fine Sand is characterized as a moderately permeable, deep, and poorly drained soil commonly found on flood plains and low ridges that form within loamy marine sediments. In the areas adjacent to the project area, Eugallie and Myakka Fine Sands are the most dominant soil type followed by Holopaw Fine Sand (depressional). Myakka Fine Sands have been designated as Florida's state soil and are characterized as poorly drained, moderately permeable, and very deep while being commonly found in mesic flatwoods throughout the Florida Peninsula (NRCS, 2012). Eugallie Fine Sand is similar in composition being poorly drained, slowly permeable, and very deep while being found in depressional areas in flatwoods throughout southern Florida (NRCS, 2013). This soil type is formed in loamy marine sediments.

**Figure 7** displays the various hydrologic soil groups within and adjacent to the project area, with the A/D group being the most prominent followed by C/D. The dual hydrologic soil group labels represent the soil in a well-drained scenario versus the second letter representing the soil in a poorly drained/natural soil condition. Group A soils are characterized by a low rate of runoff and high infiltration, primarily being deep and well-drained sands. Group A/D soils are found within the project area as well as along the path of the Myakka River and in the surrounding areas. Group C is primarily soils with a low infiltration rate and typically include fine textured soils. Group C/D soils are found primarily to the east of the Myakka River path in space that is characterized as stream/lake swamps.

The soils in the project area and surrounding area is dominated by hydric soils (**Figure 8**). Hydric soils are defined as soils which are either permanently or temporarily saturated, thus creating anaerobic conditions similar to wetlands. Non-Hydric soils become more dominant with increasing distance from the Myakka River.

## 2.5 Hydrologic and Hydraulic Study Area

The Tatum Sawgrass design project existing model, which was a revised version of the original MRWI ICPRv4 model was used as the baseline for the existing conditions model. The original MRWI model was trimmed at the SR72 bridge, and only the items upstream of the SR72 bridge are included in this analysis. Due to long model run times, a rating curve was implemented at the SR72 bridge to represent model boundary conditions downstream of the bridge. The hydrologic and hydraulic study area is indicated on **Exhibit 5** and is inclusive of the following sub-watershed areas:

- Upper Myakka
- Howard Creek
- Mossy Island
- East Myakka
- West Myakka
- Coker-Ogleby
- Owen Creek
- North Myakka

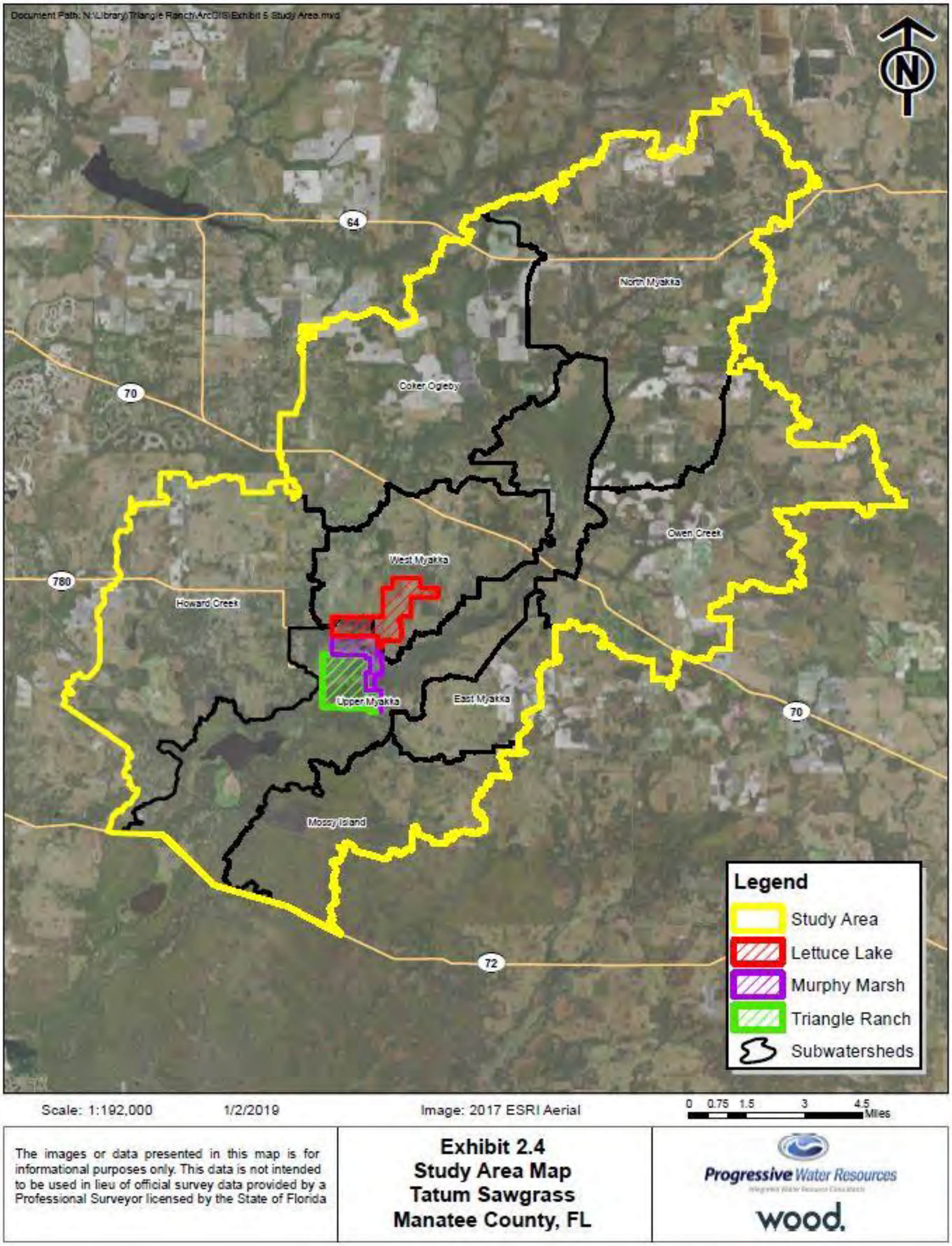


**Exhibit 5. Hydrologic and Hydraulic Study Area**

# 3.0 Proposed Restoration Activities

The proposed restoration activities include analysis of the following three alternatives:

- Alternative 1: Removing the low water control structure and re-wilding the ULM outfall (**Figure 14**);
- Alternative 2: Amending the low water control structure to lower the weir invert by 2 feet to elevation 10.41 ft NAVD88 (**Figure 15**);
- Alternative 3: Re-building the low water control structure to its historical state prior to the recent failures, including the bypass and pipes (**Figure 16**).

The following Section 4.0 presents the analysis of each alternative as compared to the existing conditions model.

# 4.0 Hydrologic and Hydraulic Analyses

## 4.1 Existing Conditions ICPR Model Setup - Single Event Flood Simulation

The hydrodynamic model prepared for, and available from the SWFWMD for their MRWI was updated and utilized to establish the existing, baseline conditions for the study area during the Tatum Sawgrass design project. Specifically, Streamline Technologies' ICPR Version 4 software was employed. Due to extensive model run times and the relative size of the model, the model was truncated to exclude portions of the Myakka River Watershed that are located downstream of State Road 72. Connections to the downstream nodes, considered as boundary conditions, are discussed in more detail in Subsection 4.1.6.
The Tatum Sawgrass existing model was then used as the starting baseline model for this project.

### 4.1.1 Upper Myakka ICPR4 Model QA and Updates

The following was reviewed and the existing baseline model was updated as needed:

- Wood 2019 survey data (spanning from the Tatum Sawgrass area to the SR72 bridge) was compared to culvert and bridge locations in the model to verify model accuracy. Only the SR72 bridge appeared to have incorrect elevations in the cross section. The SR72 bridge weir link (UM_A00000_W) invert and control elevation were updated. The weir link cross section (092111150214MD) was also updated to match the Wood 2019 survey data. National Geodetic Vertical Datum of 1929 (NGVD29) elevations on the bridge construction plans were converted to North American Vertical Datum of 1988 (NAVD88) elevations (-1.073 ft for comparison).
- The Wood 2019 bathymetry data for Upper Lake Myakka was processed in GIS and compared to the stage/storage information for node UM_A00300_N in the model. The node was updated with the new stage/storage data representative of the ULM bathymetry.
- The HEC-RAS data used to develop the SR72 bridge rating curves was compared to the bridge construction plans and as-builts, as well as the Wood 2019 survey data. The dimensions used in the HEC-RAS model match the information in the plans and survey data and no updates to the rating curve were required.

### 4.1.2 Rainfall

Consistent with SWFWMD Environmental Resource Permit requirements, the following design storm events were considered:

- Mean Annual Storm (43% probability of occurrence, once in any given year)
- 25-Year 24-Hour Frequency Storm (4% probability of occurrence, once in any given year)
- 100-Year 24-Hour Frequency Storm (1% probability of occurrence, once in any given year)

The rainfall amounts were determined using the SWFWMD Environmental Permit Resource Information Manual Figures D-2, D-5 and D-7 (SWFWMD, 2009). The rainfall storm events, consistent with the previously identified frequency are provided in **Table 2**.

**Table 2. Design Storm Events**

| Frequency (years) | Duration (hours) | Total Rainfall (inches) |
|---|---|---|
| 2.33 | 24 | 4.5 |
| 25 | 24 | 8.0 |
| 100 | 24 | 10.0 |

Source: Environmental Resource Permit Applicant's Handbook Volume II, Part D

### 4.1.3 Sub-basin Area

As previously mentioned, the existing model for the Tatum Sawgrass project was used as the starting baseline model for this project. During the Tatum Sawgrass design project, the truncated SWFWMD model was updated to reflect adjustments of sub-basin boundaries and field survey information within the Tatum Sawgrass study area. **Exhibit 6** delineates the area in which sub-basins were modified for the revised existing conditions model. **Table 3** provides the balance of acreage between the existing conditions and revised existing conditions models within the Area of Modification (AOM).

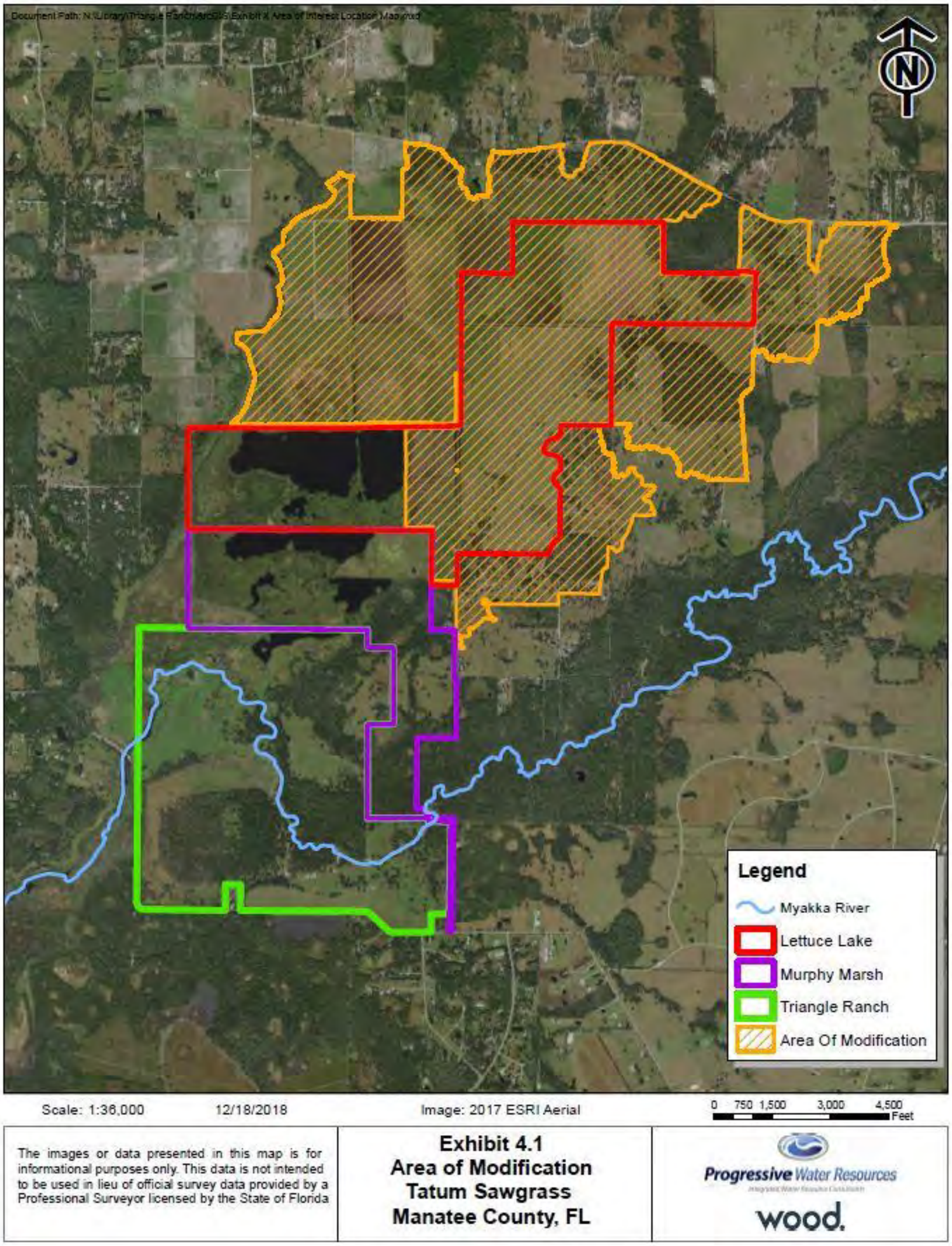


**Exhibit 6. Tatum Sawgrass Subbasin Area of Modification**

**Table 3. Acreage Balance for Area of Modification**

| Sub-basin | Existing Condition Area (acres) | Revised Existing Conditions Area (acres) |
|---|---|---|
| WM_A15050_S | 609.7 | - |
| WM_A15050A_S | - | 285.9 |
| WM_A15050B_S | - | 323.8 |
| WM_B09000_S | 459.9 | - |
| WM_B09000A_S | - | 333.8 |
| WM_B09000B_S | - | 126.1 |
| WM_B09130_S | 191.9 | - |
| WM_B09130A_S | - | 151.6 |
| WM_B09130B_S | - | 36.0 |
| WM_B09130C_S | - | 4.3 |
| WM_B09131_S | 30.0 | 30.0 |
| WM_B09140_S | 110.1 | - |
| WM_B09140A_S | - | 66.3 |
| WM_B09140B_S | - | 0.6 |
| WM_B09140C_S | - | 3.8 |
| WM_B09140D_S | - | 39.4 |
| WM_B09141_S | 28.4 | - |
| WM_B09141A_S | - | 27.2 |
| WM_B09141B_S | - | 1.2 |
| WM_B09150_S | 221.8 | - |
| WM_B09150A_S | - | 214.0 |
| WM_B09150B_S | - | 1.3 |
| WM_B09150C_S | - | 0.6 |
| WM_B09150D_S | - | 4.8 |
| WM_B09150E_S | - | 1.2 |
| WM_B10020_S | 51.2 | - |
| WM_B10020A_S | - | 39.5 |
| WM_B10020B_S | - | 7.4 |
| WM_B10020C_S | - | 6.1 |
| WM_B10020D_S | - | 4.9 |
| WM_B10020E_S | - | 3.1 |
| WM_B10022_S | 33.3 | 33.3 |
| WM_B10023_S | 87.0 | 87.0 |
| WM_B10024_S | 66.3 | - |
| WM_B10024A_S | - | 37.2 |
| WM_B10024B_S | - | 5.2 |
| WM_B10030_S | 98.2 | 98.2 |
| WM_B10040_S | 142.1 | - |
| WM_B10040A_S | - | 80.9 |
| WM_B10040B_S | - | 12.9 |
| WM_B10040C_S | - | 10.2 |
| WM_B10040D_S | - | 10.0 |
| WM_B10040E_S | - | 30.1 |
| WM_B10040F_S | - | 0.5 |
| WM_B10040G_S | - | 2.3 |
| WM_B10040H_S | - | 0.3 |
| WM_B10040I_S | - | 8.8 |

**Table 3. Acreage Balance for Area of Modification (Cont.)**

| Sub-basin | Existing Condition Area (acres) | Revised Existing Conditions Area (acres) |
|---|---|---|
| WM_B10041_S | 15.4 | 15.4 |
| WM_B10043_S | 12.2 | 12.2 |
| WM_B10044_S | 38.5 | 38.5 |
| WM_B10050_S | 162.0 | 162.0 |
| WM_D14030_S | 220.7 | - |
| WM_D14030A_S | - | 165.4 |
| WM_D14030B_S | - | 24.6 |
| WM_D14030C_S | - | 30.6 |
| **Total** | **2578.7** | **2578.5** |

### 4.1.4 Green-Ampt Methodology

The Green-Ampt methodology was utilized in the MRWI model to determine basin runoff. This methodology includes provisions for surface ponding, soil moisture redistribution, evapotranspiration and both stationary and time-variable water tables (Streamline Technologies, Inc., 2016). ICPR4 utilizes the soils information and land use data in the map layers, and intersects the two datasets to calculate surface runoff. Inputs into the Green-Ampt calculations include but are not limited to the soil zone, saturated hydraulic conductivity, soil pore size, depth to water table, percent impervious area, and the percent directly connected impervious area (DCIA). The model is then able to utilize this information to determine surface runoff from each union of land use type and soil type within the dataset.

### 4.1.5 Time of Concentration

The time of concentration ($t_c$) is the time it takes for runoff to travel from the hydraulically most distant part of the sub-basin to the determined sub-basin outlet or other point of reference. The $t_c$ is calculated based on the slope of the ground, travel distance within the sub-basin, and type of ground cover, using the Natural Resources Conservation Service (NRCS) TR-55 method, "Urban Hydrology for Small Watersheds". $T_c$ calculations are input for the 1D portions of the model. The sub-basin shape and area are factors for Tc determination, as they can dictate the length of flow. The $t_c$ calculations utilized in the model were unchanged from the original MRWI model, as the basin delineations were maintained for the area of interest.

### 4.1.6 Boundary Conditions

Long term USGS monitoring station 02298830 (State Road 72) was reviewed to establish downstream boundary conditions associated with the Myakka River. Initial elevations and estimated wet season water levels were reviewed to establish downstream boundary conditions to areas landward of the Myakka River Corridor.

Daily stages for the period of record (1939 to present) were averaged for USGS station 02298830 to reflect an average annual signature for the Myakka River at the downstream boundary condition. The result is shown in **Exhibit 7**. Based upon this analysis, the average annual wet season water elevation is fairly consistent at 13.2 ft NAVD88. Therefore, elevation 13.2 ft NAVD88 was utilized as the downstream boundary condition elevation for the Myakka River corridor. **Table 4** presents the boundary condition elevations determined for nodes downstream of State Road 72 landward of the Myakka River corridor.

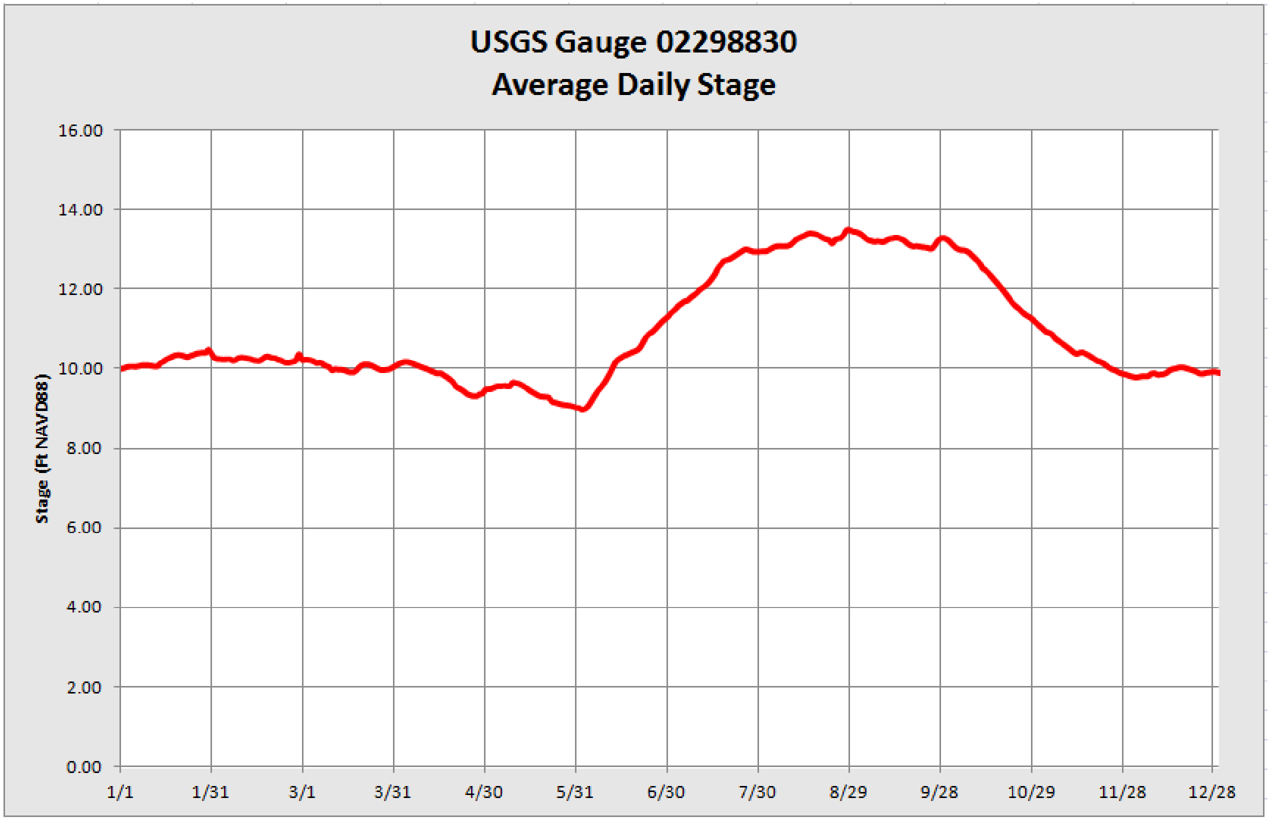


**Exhibit 7. Myakka River Stage for USGS Station 02298830**

**Table 4. Downstream Boundary Conditions**

| Link Name | From Node | To Node | Initial Stage | Type |
|---|---|---|---|---|
| 185404B | 185404 | 185406 | 25.96 | Pipe |
| 185404C | 185404 | 185406 | 25.96 | Pipe |
| R185404 | 185404 | 185406 | 25.96 | Weir |
| UM_A00002_W | UM_A00002_N | LM_A01805_N | 13.20 | Weir |
| UM_A00032_W | UM_A00032_N | LM_A01802_N | 13.20 | Weir |
| UM_A00000_B | UM_A00000_N | LM_A01830_N | 13.20 | Rating Curve |
| UM_A00000_W | UM_A00000_N | LM_A01830_N | 13.20 | Weir |
| UM_A00071_P | UM_A00071_I | LM_A01707_I | 15.29 | Pipe |
| UM_A00073_P | UM_A00073_I | LM_A01709_I | 17.01 | Pipe |
| UM_A00074_P | UM_A00074_I | LE_A00680_I | 20.09 | Pipe |
| UM_A00075_P | UM_A00075_I | LM_A05102_N | 24.49 | Pipe |
| UM_A00076_P | UM_A00076_N | LM_A05101_N | 26.17 | Pipe |
| UM_A00076_W1 | UM_A00076_N | LM_A05101_N | 26.17 | Weir |
| MI_E04000_P1 | MI_E04000_N | LE_A01004_N | 27.73 | Pipe |
| MI_E04000_W1 | MI_E04000_N | LE_A01004_N | 27.73 | Weir |
| MI_E03000_P1 | MI_E03000_N | LE_A01014_N | 29.02 | Pipe |
| MI_E03000_W2 | MI_E03000_N | LE_A01014_N | 29.02 | Weir |
| MI_E02000_P1 | LE_A01001_N | MI_E02000_N | 30.65 | Pipe |
| MI_E02000_W5 | MI_E02000_N | LE_A01001_N | 30.65 | Weir |
| MI_E01000_P2 | MI_E01000_N | DP_B01032_N | 30.84 | Pipe |
| MI_E01000_W1 | MI_E01000_N | DP_B01032_N | 30.84 | Weir |
| MI_E01000_P1 | MI_E01000_N | DP_B00502_I | 26.57 | Pipe |

### 4.1.7 Existing Water Control Structure Details

The existing ULM weir discharge structure is approximately 100 ft long at elevation 12.41 ft (NAVD88). The cross section for the structure is shown in **Exhibit 8**. The historical bypass structure, which is deteriorated in its current conditions, consists of six 60-inch corrugated metal pipe (CMP) culverts. Details for the six pipes are shown in **Table 5**.

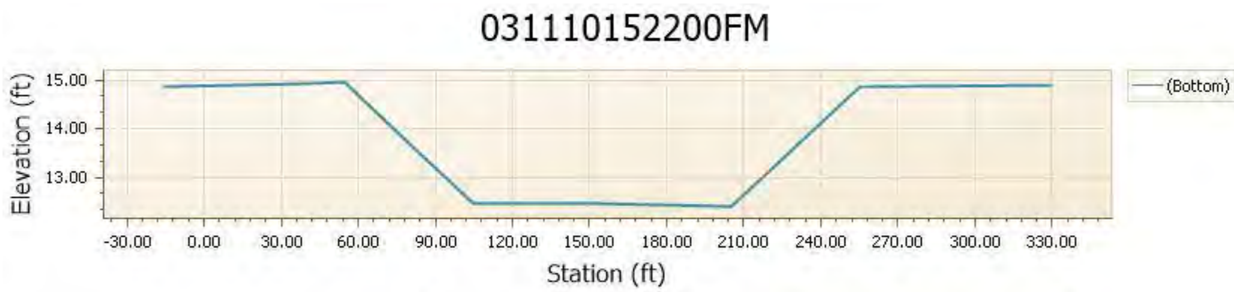


**Exhibit 8. Existing ULM Water Control Structure Weir Cross Section**

**Table 5. Historical ULM Bypass Water Control Structure Pipe Invert Elevations**

| Culvert | Upstream Invert Elevation (ft NAVD88) | Downstream Invert Elevation (ft NAVD88) |
|---|---|---|
| UM_A00300_P1 | 7.62 | 8.70 |
| UM_A00300_P2 | 7.87 | 9.15 |
| UM_A00300_P3 | 7.80 | 9.07 |
| UM_A00300_P4 | 8.02 | 9.17 |
| UM_A00300_P5 | 7.91 | 8.98 |
| UM_A00300_P6 | 7.35 | 8.41 |

### 4.1.8 Model Results

Peak flood elevations estimated by the model for existing baseline conditions are summarized at strategic locations in **Table 6**.

**Table 6. Existing/Baseline Conditions Peak Flood Elevations (NAVD88)**

| Reference Nodes | Location | Mean Annual (ft NAVD88) | 10-Yr., 24-Hr. (ft NAVD88) | 25-Yr., 24-Hr. (ft NAVD88) | 100-Yr., 24-Hr. (ft NAVD88) |
|---|---|---|---|---|---|
| UM_A02170_N | State Road 70 Bridge | 33.72 | 36.66 | 37.61 | 39.14 |
| UM_A00410_N | Myakka Road Bridge | 17.08 | 19.07 | 19.78 | 20.84 |
| UM_A00362_N | Clay Gully Road Bridge | 18.61 | 20.05 | 20.38 | 20.99 |
| UM_A00300_N | Upper Lake Myakka | 16.42 | 17.95 | 18.53 | 19.52 |
| UM_A05118_N | Vanderipe Slough | 16.20 | 17.69 | 18.25 | 19.22 |
| UM_A00090_N | Myakka State Park Road Bridge | 15.92 | 17.37 | 17.92 | 18.84 |
| UM_A00000_N | State Road 72 Bridge | 15.82 | 17.22 | 17.75 | 18.65 |

As indicated in **Table 6**, flood stage elevations consistently decrease from SR70 to Upper Lake Myakka for all flood events simulated. The elevations within the Myakka River downstream of the ULM weir structure are slightly lower than the elevations in the adjacent Vanderipe Slough, which discharges the lake at higher flood stages than the river. Upstream in the Tatum Sawgrass area, the existing dikes are generally effective at restricting backflow and interaction with the Myakka River floodplain system for the Mean Annual Storm. As the magnitude of the flood increases, the ability of the dikes to restrict backflow diminishes in the historic Tatum Sawgrass area, allowing more interaction with the Myakka River floodplain in larger storm events.

The updated existing model flood stages in the ULM and SR72 bridge locations were compared to the Tatum Sawgrass project existing model stages. The stages between the two models had negligible differences. Therefore, the existing conditions/baseline model correlates well with previous flood elevation estimates for the study area.

## 4.2 Proposed Conditions ICPR Model Setup - Single Event Flood Simulation

The existing conditions/baseline model was updated to incorporate the proposed restoration activities discussed in Section 3 and presented on **Figure 14** (Alternative 1), **Figure 15** (Alternative 2) and **Figure 16** (Alternative 3). In addition, each proposed alternative model includes the upstream Tatum Sawgrass restoration from a separate project feasibility analysis that was prepared by Progressive Water Resources, Inc. and Wood. The Tatum Sawgrass area restoration includes proposed items such as berm modifications, pump modifications and pipe modifications. **Exhibit 9** below depicts the proposed restoration plan in the Tatum Sawgrass area, which is included in the proposed alternative models in this analysis. This restoration has not been constructed as of the preparation of this report (February 2020), however FDEP requested the analysis with the Upper Myakka Lake water control structure modifications include the restoration to the Tatum Sawgrass area in order to review a big picture restoration in this vicinity.

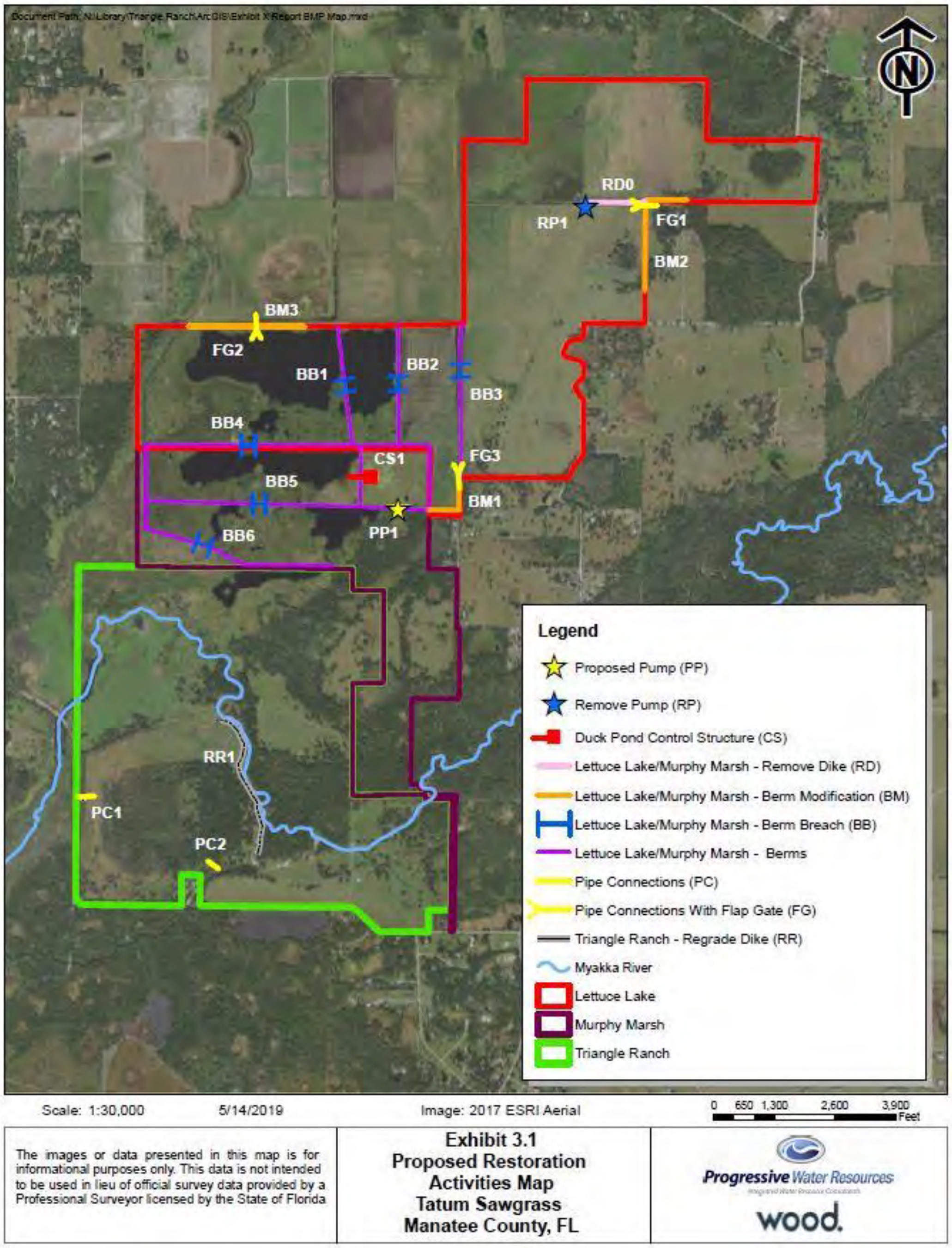


**Exhibit 9. Tatum Sawgrass Proposed Restoration**

### 4.2.1 Proposed Conditions Alternative 1 Analysis

The Alterative 1 analysis includes removal of the weir and bypass at the ULM discharge location, including removal of the existing 6 pipes and the bypass, in order to provide a more natural outfall of the ULM through the Myakka River. The cross section for this option was developed by review of historic data of the river in this vicinity, and review of historic water level information. The cross section is shown in **Exhibit 10**. See below for the detailed analysis of results associated with this alternative.

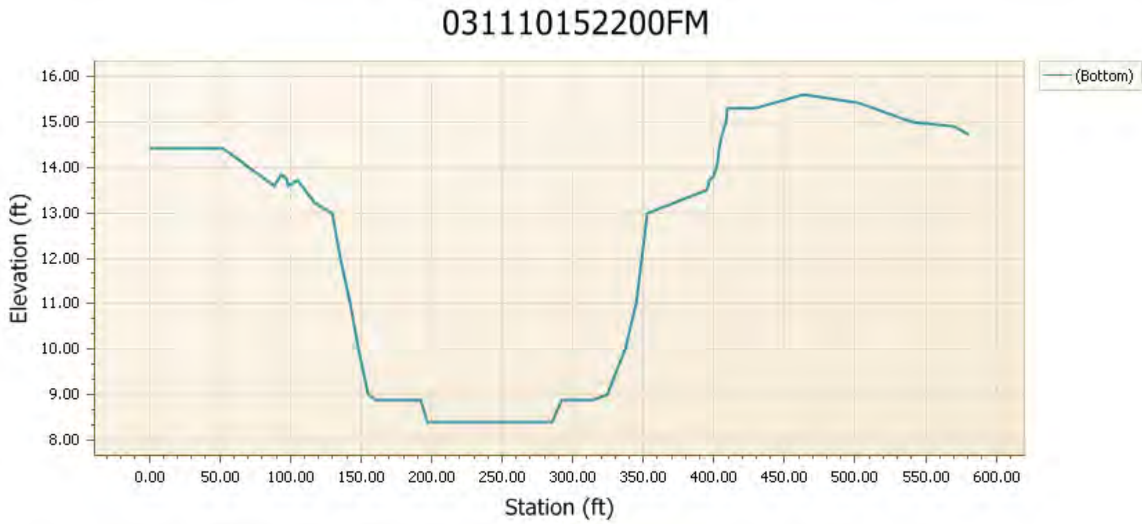


**Exhibit 10. Proposed ULM Weir Removal Cross Section**

**Table 7. Alt 1 Conditions Peak Flood Elevations**

| Reference Nodes | Location | Mean Annual (ft NAVD88) | 10-Yr., 24-Hr. (ft NAVD88) | 25-Yr., 24-Hr. (ft. NAVD88) | 100-Yr., 24-Hr. (ft NAVD88) |
|---|---|---|---|---|---|
| UM_A02170_N | State Road 70 Bridge | 33.72 | 36.66 | 37.61 | 39.14 |
| UM_A00410_N | Myakka Road Bridge | 17.04 | 19.12 | 19.84 | 20.85 |
| UM_A00362_N | Clay Gully Road Bridge | 18.58 | 20.02 | 20.39 | 21.00 |
| UM_A00300_N | Upper Lake Myakka | 16.39 | 17.97 | 18.54 | 19.52 |
| UM_A05118_N | Vanderipe Slough | 16.18 | 17.70 | 18.26 | 19.22 |
| UM_A00090_N | Myakka State Park Road Bridge | 15.90 | 17.39 | 17.93 | 18.84 |
| UM_A00000_N | State Road 72 Bridge | 15.80 | 17.24 | 17.76 | 18.65 |

The proposed conditions flood model results indicate that the proposed restoration activities in Alternative 1, which consists of removing the weir and bypass channel with pipes and re-wilding the Upper Myakka Lake outfall, do not show adverse effects in offsite flood stages in the event storm modelling. The results for each design flood event are discussed in the following sections.

#### 4.2.1.1 Alt 1 Mean Annual Design Storm

**Figure 19** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 1 during the mean annual storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.1.2 Alt 1 25-yr, 24-hr Design Storm

**Figure 17** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 1 during the 25-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.1.3 Alt 1 100-yr, 24-hr Design Storm

**Figure 18** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 1 during the 100-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

### 4.2.2 Proposed Conditions Alternative 2 Analysis

The Alternative 2 analysis includes amending the Upper Myakka Lake water control structure by lowering the weir invert by 2 feet, to an elevation of 10.41 ft NAVD88. The cross section of the weir was maintained, and the existing 6 pipes remained in a functioning condition at existing inverts. See below for the detailed analysis of results associated with this alternative.

**Table 8. Alt 2 Conditions Peak Flood Elevations**

| Reference Nodes | Location | Mean Annual (ft NAVD88) | 10-Yr., 24-Hr. (ft NAVD88) | 25-Yr., 24-Hr. (ft NAVD88) | 100-Yr., 24-Hr. (ft NAVD88) |
|---|---|---|---|---|---|
| UM_A02170_N | State Road 70 Bridge | 33.72 | 36.66 | 37.61 | 39.14 |
| UM_A00410_N | Myakka Road Bridge | 17.04 | 19.12 | 19.84 | 20.85 |
| UM_A00362_N | Clay Gully Road Bridge | 18.58 | 20.02 | 20.39 | 21.00 |
| UM_A00300_N | Upper Lake Myakka | 16.39 | 17.97 | 18.54 | 19.52 |
| UM_A05118_N | Vanderipe Slough | 16.18 | 17.70 | 18.26 | 19.22 |
| UM_A00090_N | Myakka State Park Road Bridge | 15.90 | 17.39 | 17.93 | 18.84 |
| UM_A00000_N | State Road 72 Bridge | 15.80 | 17.24 | 17.76 | 18.65 |

The proposed conditions flood model results indicate that the proposed restoration activities in Alternative 2, which consists of lowering the ULM weir structure by 2 feet to an elevation of 10.41 ft NAVD88, do not show adverse effects in offsite flood stages in the event storm modelling. The results for each design flood event are discussed in the following sections.

#### 4.2.2.1 Alt 2 Mean Annual Design Storm

**Figure 22** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 2 during the mean annual storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.2.2 Alt 2 25-year, 24-hour Design Storm

**Figure 20** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 2 during the 25-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.2.3 Alt 2 100-year, 24-hour Design Storm

**Figure 21** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 2 during the 100-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

### 4.2.3 Proposed Conditions Alternative 3 Analysis

The Alternative 3 analysis includes rebuilding the Upper Myakka Lake water control structure and bypass including repairing the six existing pipes, which have recently degraded. The alternative includes repairing the weir structure with the original design cross section of approximately 100 feet wide at an elevation of 12.41 ft NAVD88 which is shown in **Exhibit 8** The pipes were replaced at their original sizes and elevations, as shown in **Table 5**. See below for the detailed analysis of results associated with this alternative.

**Table 9. Alt 3 Conditions Peak Flood Elevations**

| Reference Nodes | Location | Mean Annual (ft NAVD88) | 10-Yr., 24-Hr. (ft NAVD88) | 25-Yr., 24-Hr. (ft NAVD88) | 100-Yr., 24-Hr. (ft NAVD88) |
|---|---|---|---|---|---|
| UM_A02170_N | State Road 70 Bridge | 33.72 | 36.66 | 37.61 | 39.14 |
| UM_A00410_N | Myakka Road Bridge | 17.04 | 19.12 | 19.84 | 20.85 |
| UM_A00362_N | Clay Gully Road Bridge | 18.58 | 20.02 | 20.39 | 21.00 |
| UM_A00300_N | Upper Lake Myakka | 16.39 | 17.97 | 18.54 | 19.52 |
| UM_A05118_N | Vanderipe Slough | 16.18 | 17.70 | 18.26 | 19.22 |
| UM_A00090_N | Myakka State Park Road Bridge | 15.90 | 17.39 | 17.93 | 18.84 |
| UM_A00000_N | State Road 72 Bridge | 15.80 | 17.24 | 17.76 | 18.65 |

The proposed conditions flood model results indicate that the proposed restoration activities in Alternative 3, which consists of rebuilding the historic ULM weir structure and bypass channel with the six pipes to the same size and invert elevations, do not show adverse effects in offsite flood stages in the event storm modelling. The results for each design flood event are discussed in the following sections.

#### 4.2.3.1 Alt 3 Mean Annual Design Storm

**Figure 25** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 3 during the mean annual storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.3.2 Alt 3 25-year, 24-hour Design Storm

**Figure 23** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 3 during the 25-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

#### 4.2.3.3 Alt 3 100-year, 24-hour Design Storm

**Figure 24** contrasts the changes in flood stages at each node between the existing/baseline conditions and the proposed conditions for Alt 3 during the 100-year 24-hour storm event. Nodes identified in red, green, and white indicate that flood stages increase, decrease, or have no change, respectively, as a result of the proposed restoration activities. Nodes identified in purple indicate that the increase or decrease noted is a result of the Tatum Sawgrass Restoration project and was previously quantified as the same stage increase or decrease as is resulting in this Upper Lake Myakka model. As indicated, there are no increases of flood stages greater than 0.1 ft as a result of the proposed model updates.

# 5.0 Summary

## 5.1 ICPR4 Design Storm Simulations

Single event simulations using the ICPR4 software were conducted for the mean annual, 25-year 24-hour, and 100-year 24-hour design storms. Results were then compared for the existing and proposed conditions for each alternative. For the largest event considered, corresponding to the 100-year 24-hour design storm, any off-site increases in flood stages resulting from the proposed restoration would be below 0.05 ft. The majority of the offsite increases are a result of the intentional restoration in the upstream Tatum Sawgrass area. Based upon the model results, the maximum increase for any of the modelled storm events in each of the three alternatives as a result of the Upper Lake Myakka weir modification is 0.02 feet and occurs at the ULM weir discharge location. No significant offsite impacts are shown in the model analysis for any of the three alternatives.

The stages for Upper Lake Myakka are presented in **Exhibits 12, 13 and 14** and show negligible changes in stage for ULM as a result of the alternatives for any of the analyzed storm events. **Exhibits 15, 16 and 17** show the flow rates for the mean annual, 25-year 24-hour, and 100-year 24-hour storm events, comparing all proposed alternatives to the exiting conditions model. Overall, the flow rates of the three proposed alternative models are similar to the flow rates in the existing model, with Alternative 1 and Alternative 2 showing slightly higher peak flow rates.

Therefore, the results of the flood stage modelling do not drive which alternative the client should move forward with, as all alternatives show good correlation with existing conditions in the three analyzed storm events.

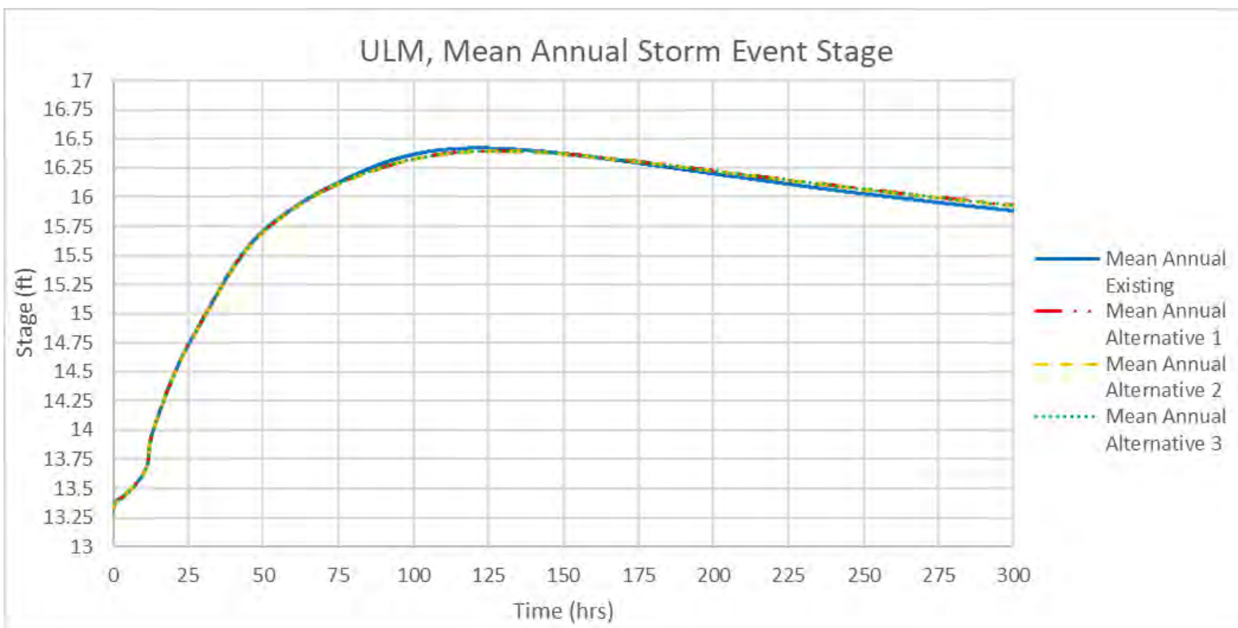


**Exhibit 12. ULM Stage, Mean Annual Storm Event**

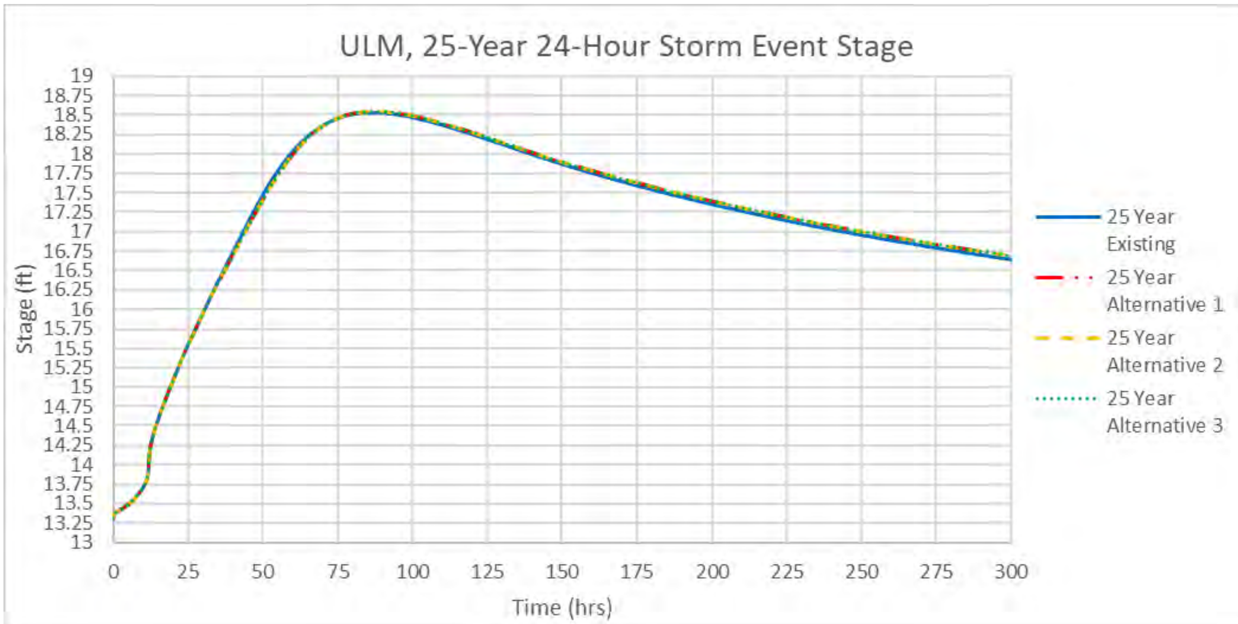


**Exhibit 13. ULM Stage, 25-year 24-hour Storm Event**

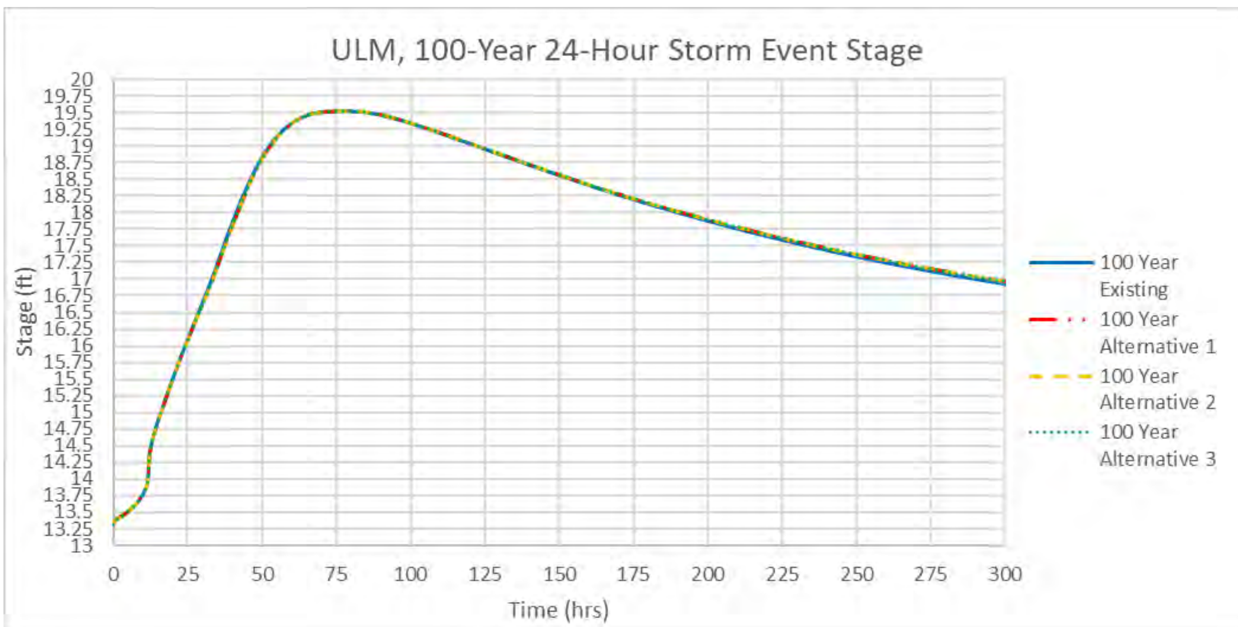


**Exhibit 14. ULM Stage, 100-year 24-hour Storm Event**

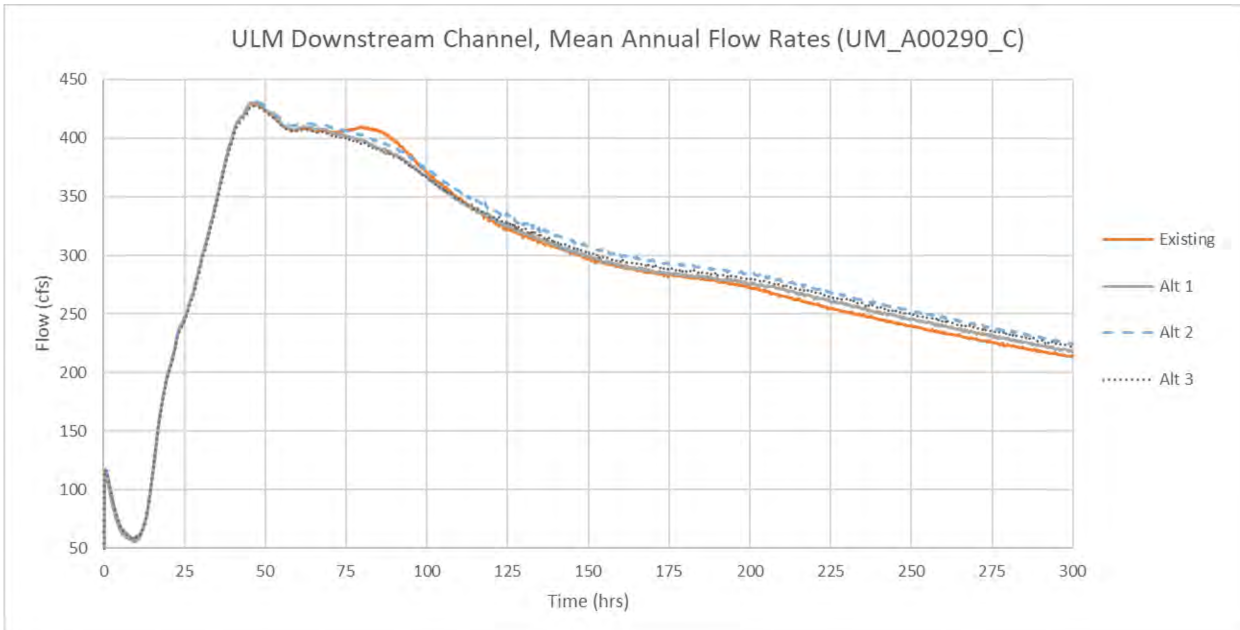


**Exhibit 15. ULM Downstream Channel Flow, Mean Annual Storm Event**

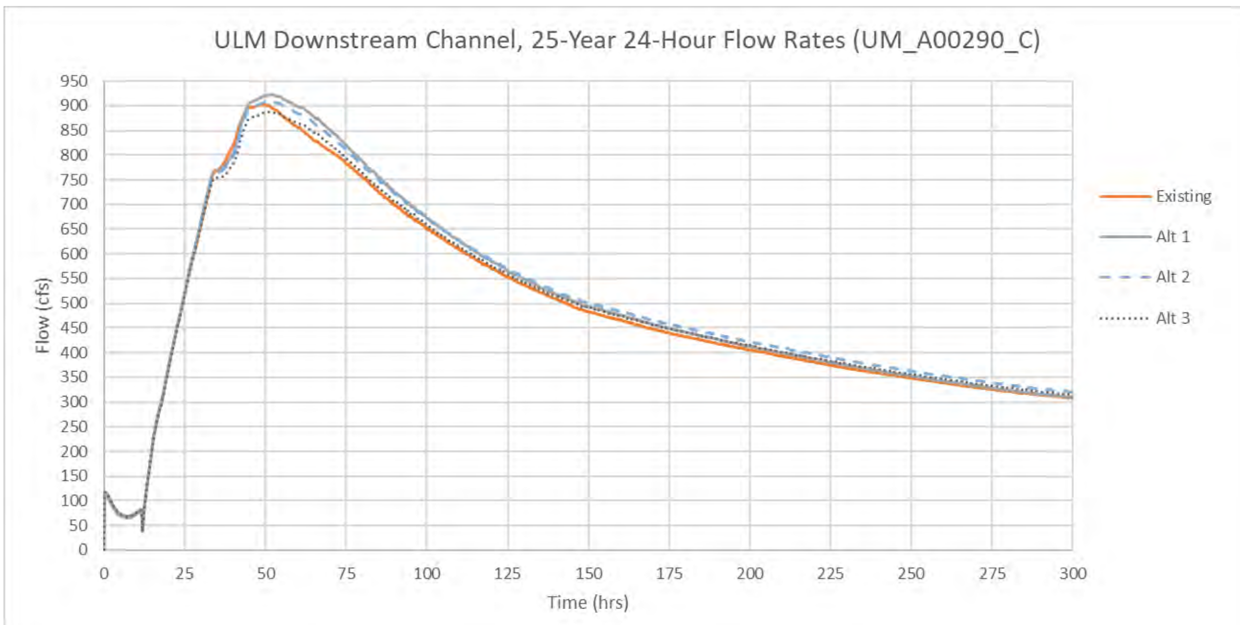


**Exhibit 16. ULM Downstream Channel Flow, 25-year 24-hour Storm Event**

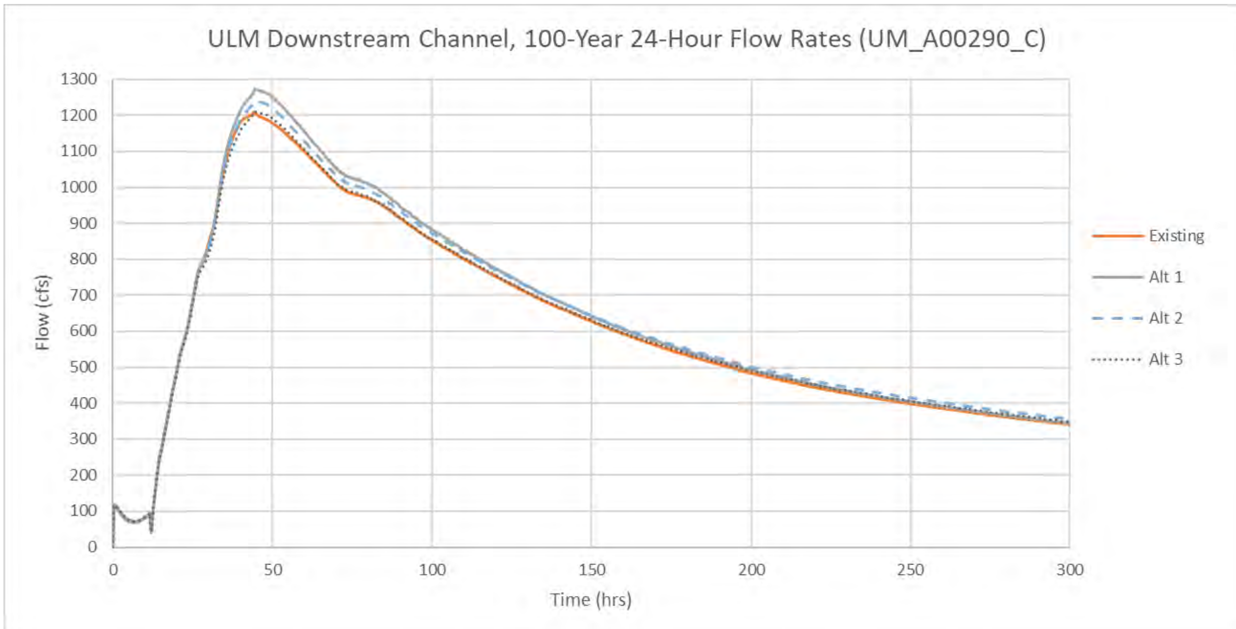


**Exhibit 17. ULM Downstream Channel Flow, 100-year 24-hour Storm Event**

## 6.0 References

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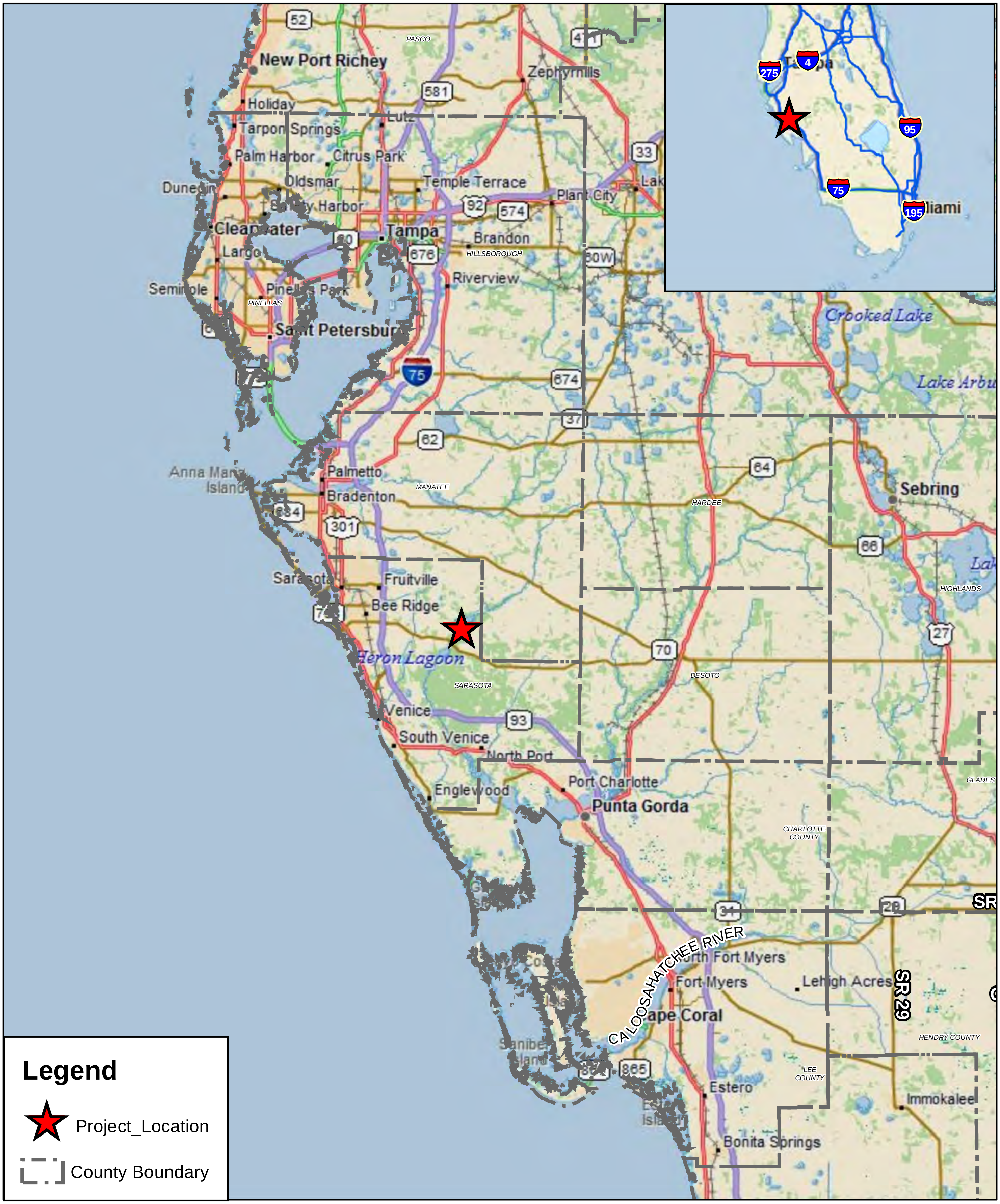
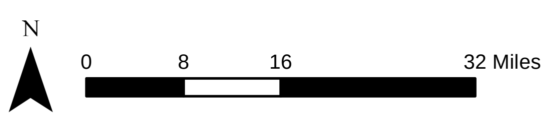
# Figures




Source: NRCS 2014; DeLorme 2018; Wood 2018

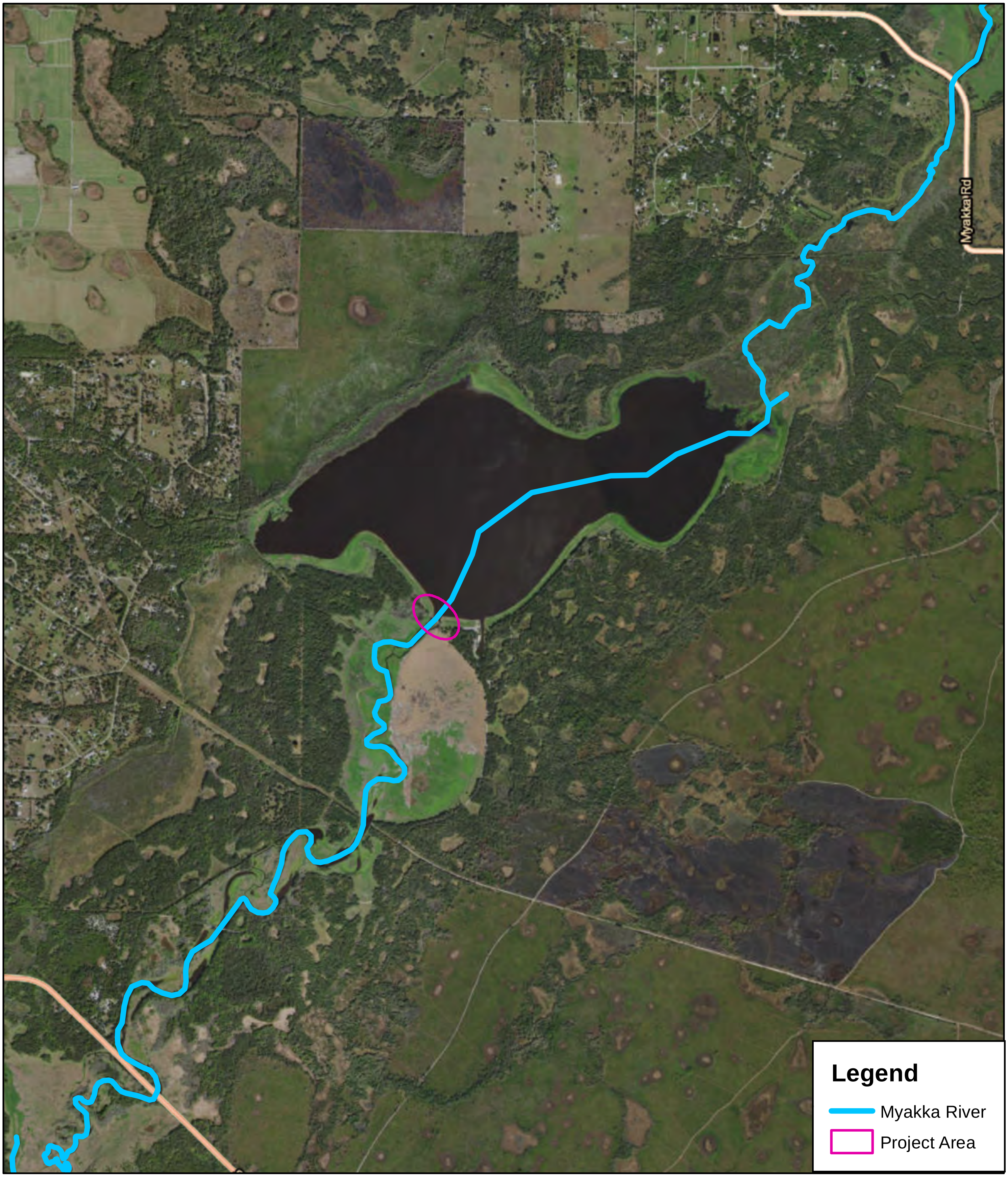



# Upper Lake Myakka Restoration

## Location Map

| Drawn | Date | *Gainesville Florida Project No. 6063-39-003A* | wood. | Figure 1 |
|---|---|---|---|---|
| RJL | 2/18/2020 | | | |
| Checked | Date | | | |
| TGD | 2/18/2020 | | | |

Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Figure 1 Location and Vicinity Map.mxd mary.szoka Date Saved: 2/18/2020 3:02:05 PM




Source: Imagery, NRCS 2016; ESRI 2017; Wood 2018

N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

**Project Area Map**

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 2 |
|---|---|---|---|---|
| MES | 2/18/2020 | | | |
| Checked | Date | | | |
| | 2/18/2020 | | | |

Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Figure 2 Project Area Map.mxd mary.szoka Date Saved: 2/18/2020 11:40:28 AM

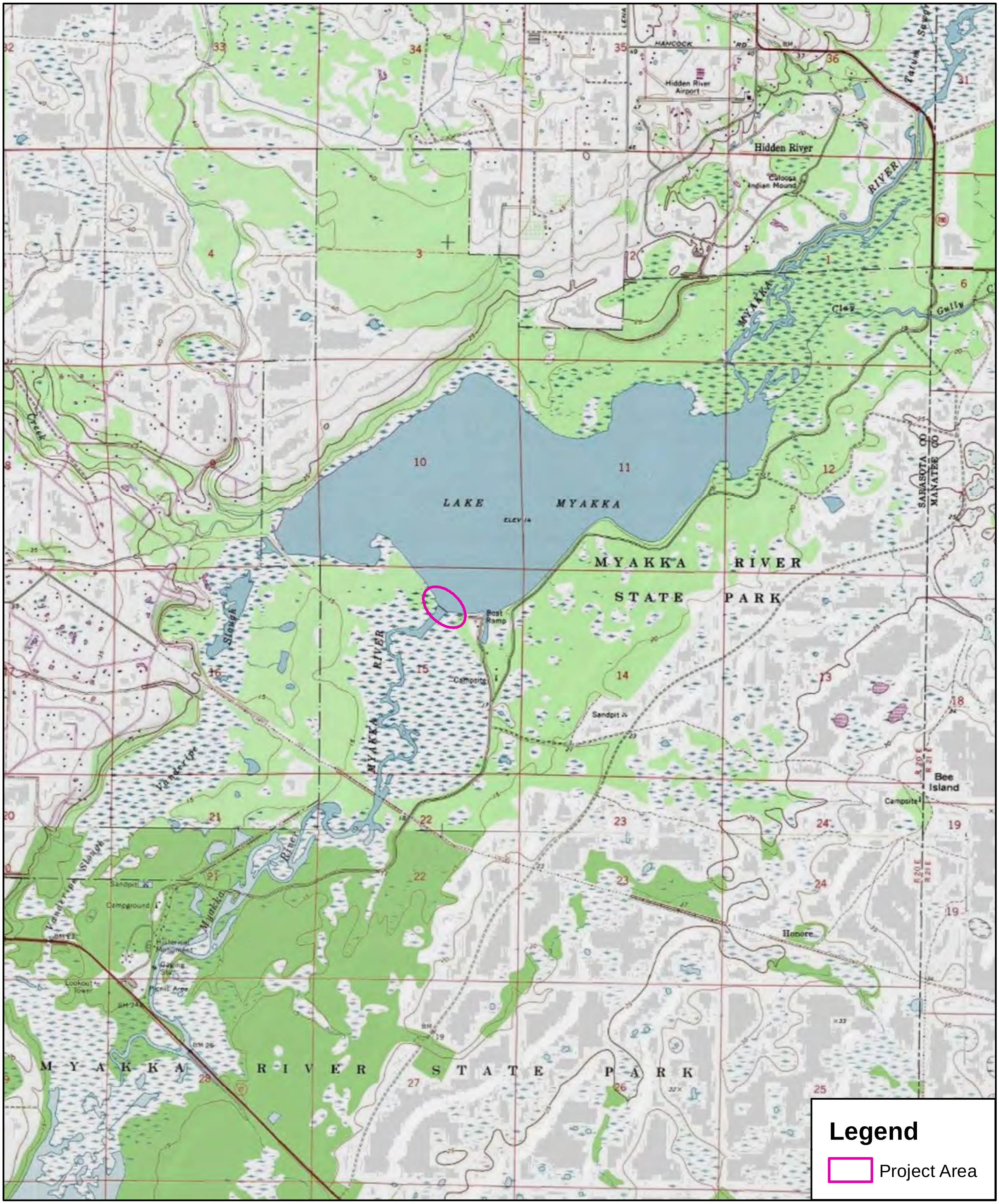

Source: University of Florida Map & Digital Image Library 1948, Wood 2020

**Upper Lake Myakka Restoration**

**Historic Aerial Map (1948)**

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 3 |
|---|---|---|---|---|
| MES | 2/19/2020 | | | |
| Checked | Date | | | |
| | 2/19/2020 | | | |

Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Figure 3 Historic Aerial Map 1948.mxd mary.szoka Date Saved: 2/19/2020 8:35:30 AM




Source: USGS 2013; Wood 2020

N

0 1,250 2,500 5,000 Feet

# Upper Lake Myakka Restoration

## USGS Topographic Map

| Drawn | Date | Gainesville Florida Project No. 6063-39-003A | wood. | Figure 4 |
|---|---|---|---|---|
| MES | 2/18/2020 | | | |
| Checked | Date | | | |
| | 2/18/2020 | | | |

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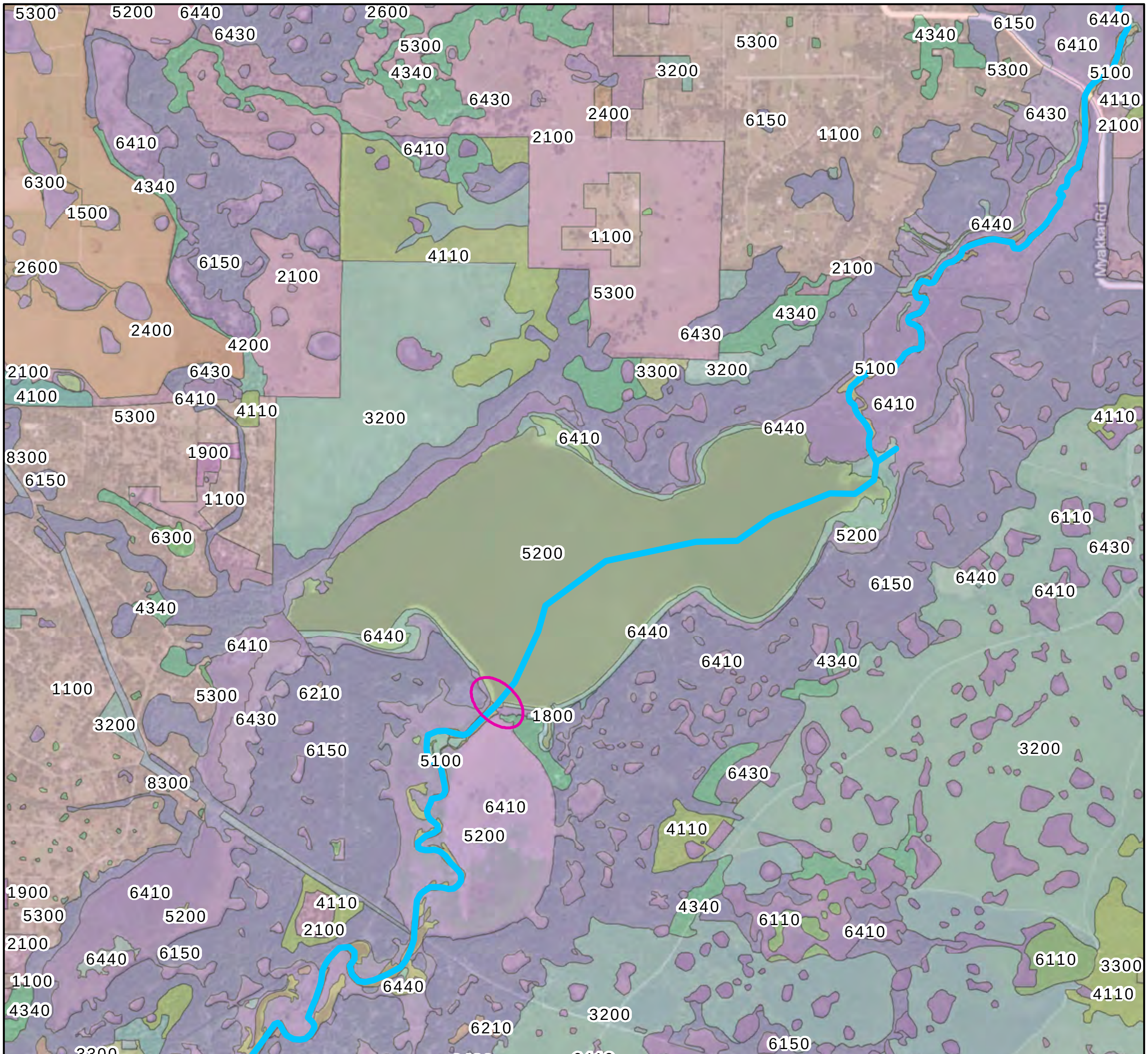



**Legend**

- Myakka River
- Project Area
- 1100, RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS
- 1500, INDUSTRIAL
- 1800, RECREATIONAL
- 1900, OPEN LAND
- 2100, CROPLAND AND PASTURELAND
- 2400, NURSERIES AND VINEYARDS
- 2600, OTHER OPEN LANDS <RURAL>
- 3200, SHRUB AND BRUSHLAND
- 3300, MIXED RANGELAND
- 4100, UPLAND CONIFEROUS FOREST
- 4110, PINE FLATWOODS
- 4200, UPLAND HARDWOOD FORESTS - PART 1
- 4340, HARDWOOD CONIFER MIXED
- 5100, STREAMS AND WATERWAYS
- 5200, LAKES
- 5300, RESERVOIRS
- 6110, BAY SWAMPS
- 6150, STREAM AND LAKE SWAMPS (BOTTOMLAND)
- 6210, CYPRESS
- 6300, WETLAND FORESTED MIXED
- 6410, FRESHWATER MARSHES
- 6430, WET PRAIRIES
- 6440, EMERGENT AQUATIC VEGETATION
- 8300, UTILITIES

Source: SWFWMD 2010, ESRI 2018, Wood 2020

N

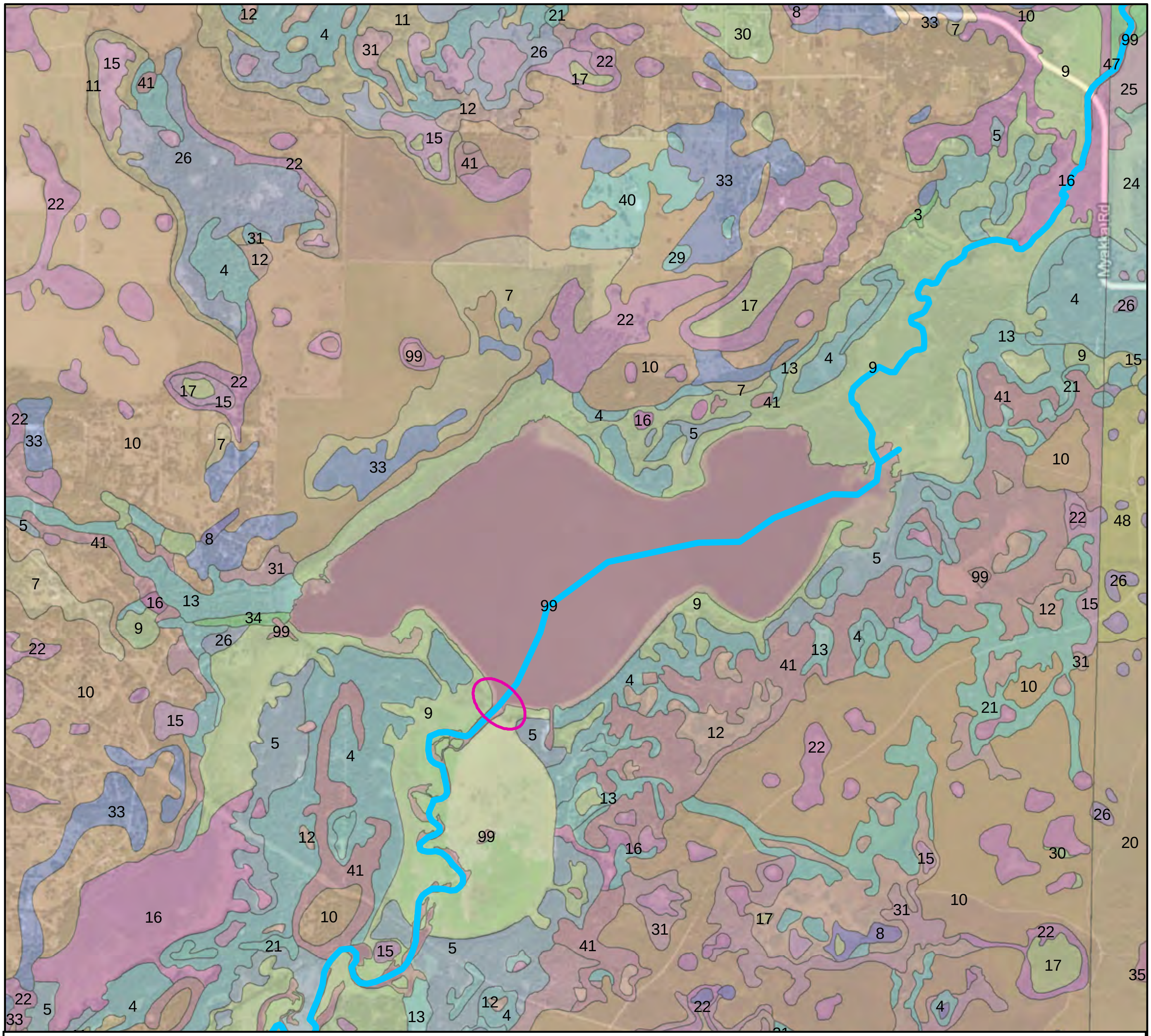
0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

**Current Land Use/Ecological Communities**

| Drawn | Date | | | |
|---|---|---|---|---|
| MES | 2/18/2020 | *Gainesville Florida Project No. 6006-39-003A* | wood. | **Figure 5** |
| Checked | Date | | | |
| | 2/18/2020 | | | |

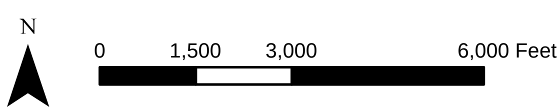
Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Figure 5 Current Land Use Ecological Communities.mxd mary.szoka Date Saved: 2/18/2020 10:22:30 AM



**Legend**

- Myakka River
- Project Area
- 10:EAUGALLIE AND MYAKKA FINE SANDS
- 11:FELDA FINE SAND
- 12:FELDA FINE SAND, DEPRESSIONAL
- 13:FELDA AND POMPANO FINE SANDS, FREQUENTLY FLOODED
- 15:DELRAY MUCKY LOAMY FINE SAND
- 15:FLORIDANA AND GATOR SOILS, DEPRESSIONAL
- 16:DELRAY COMPLEX
- 16:FLORIDANA AND GATOR SOILS, FREQUENTLY FLOODED
- 17:GATOR MUCK
- 20:EAUGALLIE FINE SAND
- 21:FT. GREEN FINE SAND
- 22:HOLOPAW FINE SAND, DEPRESSIONAL
- 24:FELDA-WABASSO ASSOCIATION, FREQUENTLY FLOODED
- 25:FLORIDANA FINE SAND
- 26:FLORIDANA-IMMOKALEE-OKEELANTA ASSOCIATION
- 26:MANATEE LOAMY FINE SAND, DEPRESSIONAL
- 29:ORSINO FINE SAND
- 30:ONA FINE SAND
- 31:PINEDA FINE SAND
- 33:POMELLO FINE SAND
- 34:POMPANO FINE SAND, DEPRESSIONAL
- 35:ONA FINE SAND, ORSTEIN SUBSTRATUM
- 38:PALMETTO SAND
- 3:BOCA AND HALLANDALE SOILS
- 40:TAVARES FINE SAND
- 41:WABASSO FINE SAND
- 47:TOMOKA MUCK
- 48:WABASSO FINE SAND
- 4:BRADENTON FINE SAND
- 5:BRADENTON FINE SAND, FREQUENTLY FLOODED
- 7:CASSIA FINE SAND
- 8:DELRAY FINE SAND, DEPRESSIONAL
- 99:WATER
- 9:DELRAY AND ASTOR SOILS, FREQUENTLY FLOODED

Source: Imagery, NRCS 2012; ESRI 2017; Wood 2020

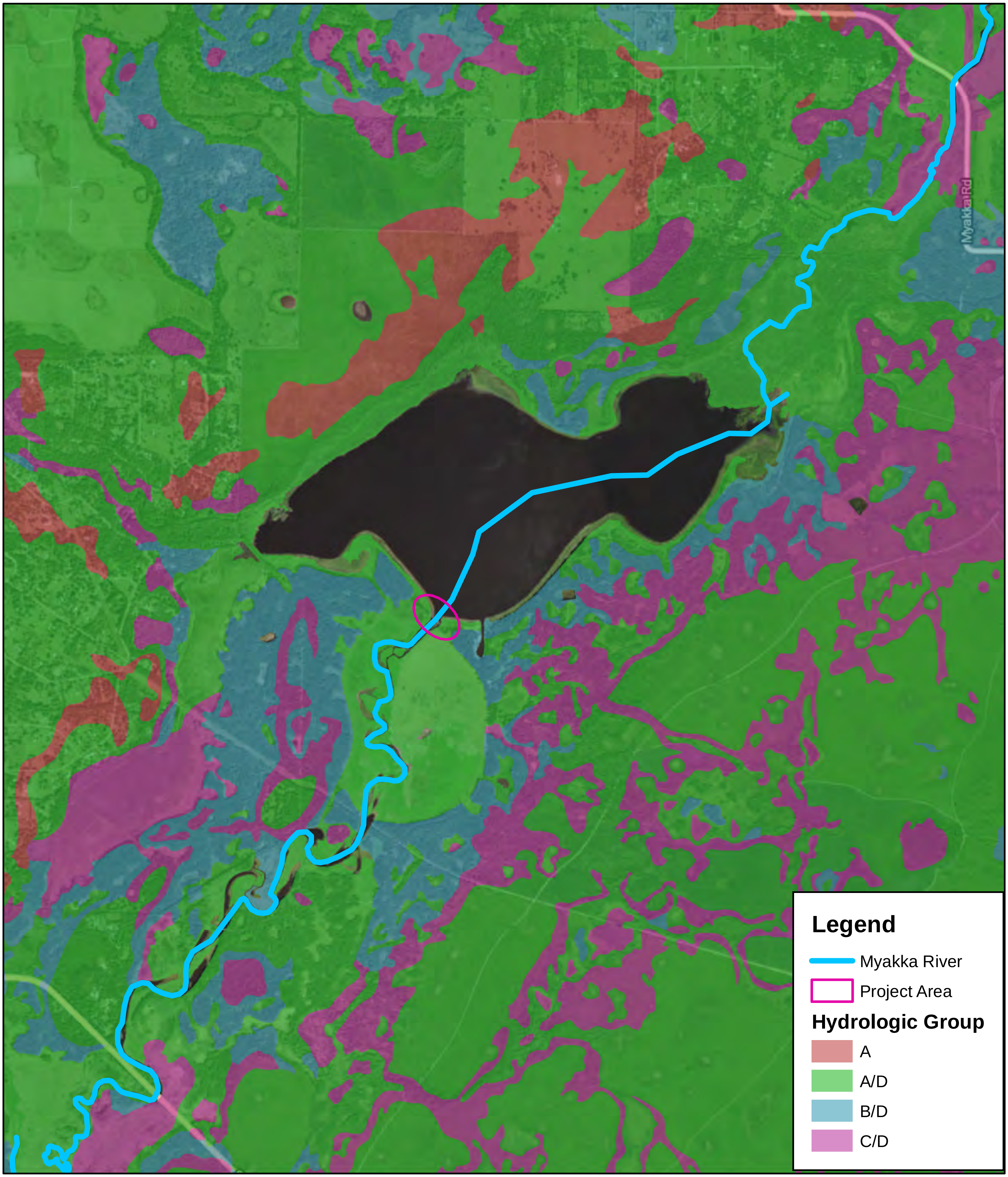



# Upper Lake Myakka Restoration

## Soils Map

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | Figure 6 |
|---|---|---|---|
| MES | 2/19/2020 | | |
| Checked | Date | | |
| | 2/19/2020 | | |

Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Figure 6 Soils Map.mxd mary.szoka Date Saved: 2/19/2020 8:44:28 AM




Source: Imagery, NRCS 2012; ESRI 2017; Wood 2020

N

0 1,500 3,000 6,000 Feet

| Upper Lake Myakka Restoration | | | | |
|---|---|---|---|---|
| Hydrologic Soil Group Map | | | | |
| Drawn | Date | *Gainesville Florida Project No. 6006-39-003A* | wood. | Figure 7 |
| MES | 2/19/2020 | | | |
| Checked | Date | | | |
| | 2/19/2020 | | | |

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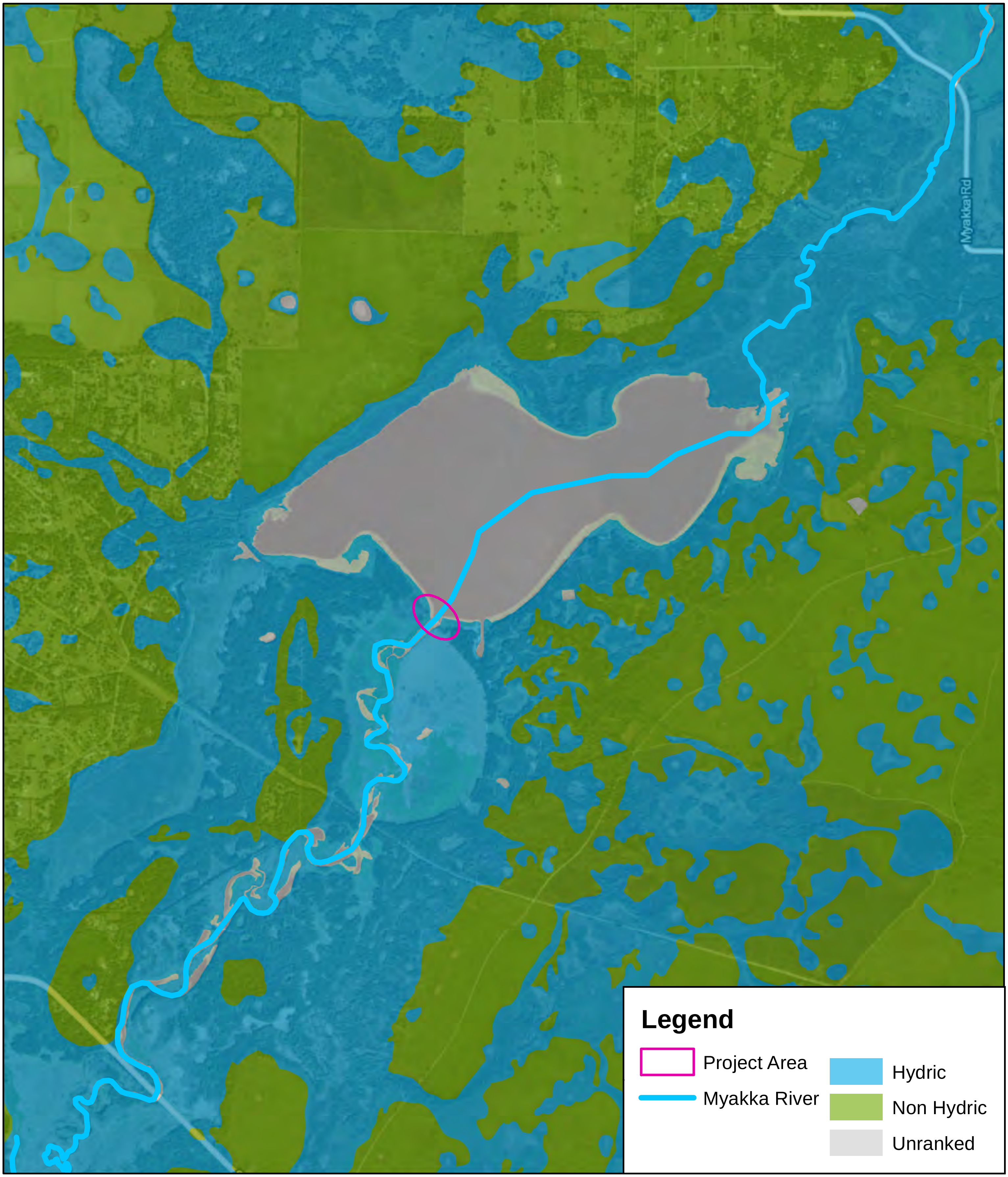


Source: Imagery, NRCS 2012; ESRI 2017; Wood 2020

N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

**NRCS Hydric Soils Map**

| Drawn | Date | *Gainesville Florida Project No. 6006-39-003A* | wood. | **Figure 8** |
|---|---|---|---|---|
| MES | 2/19/2020 | | | |
| Checked | Date | | | |
| | 2/19/2020 | | | |

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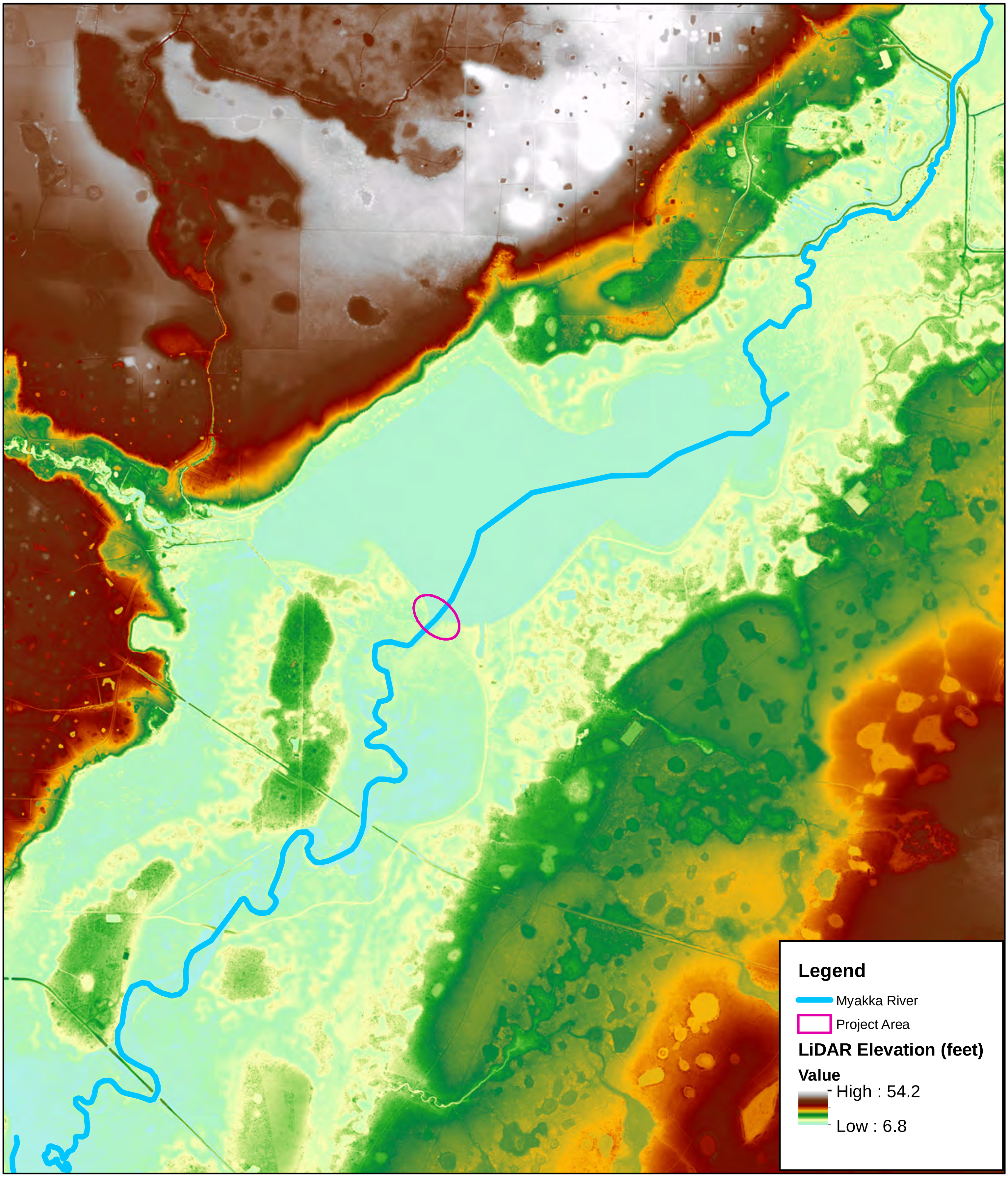



Source: Imagery, Progressive Water Resources; ESRI 2017; Wood 2020

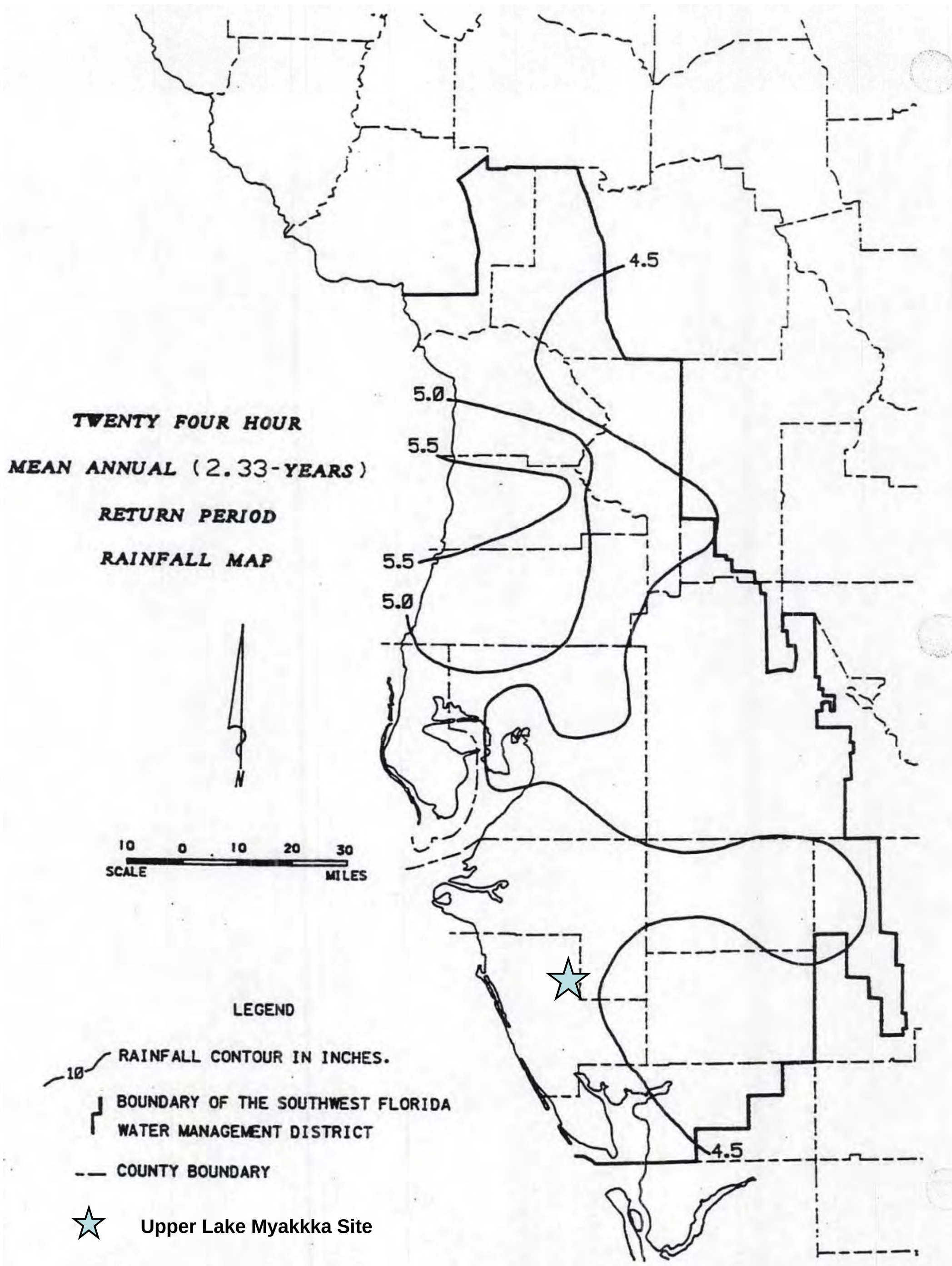
N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

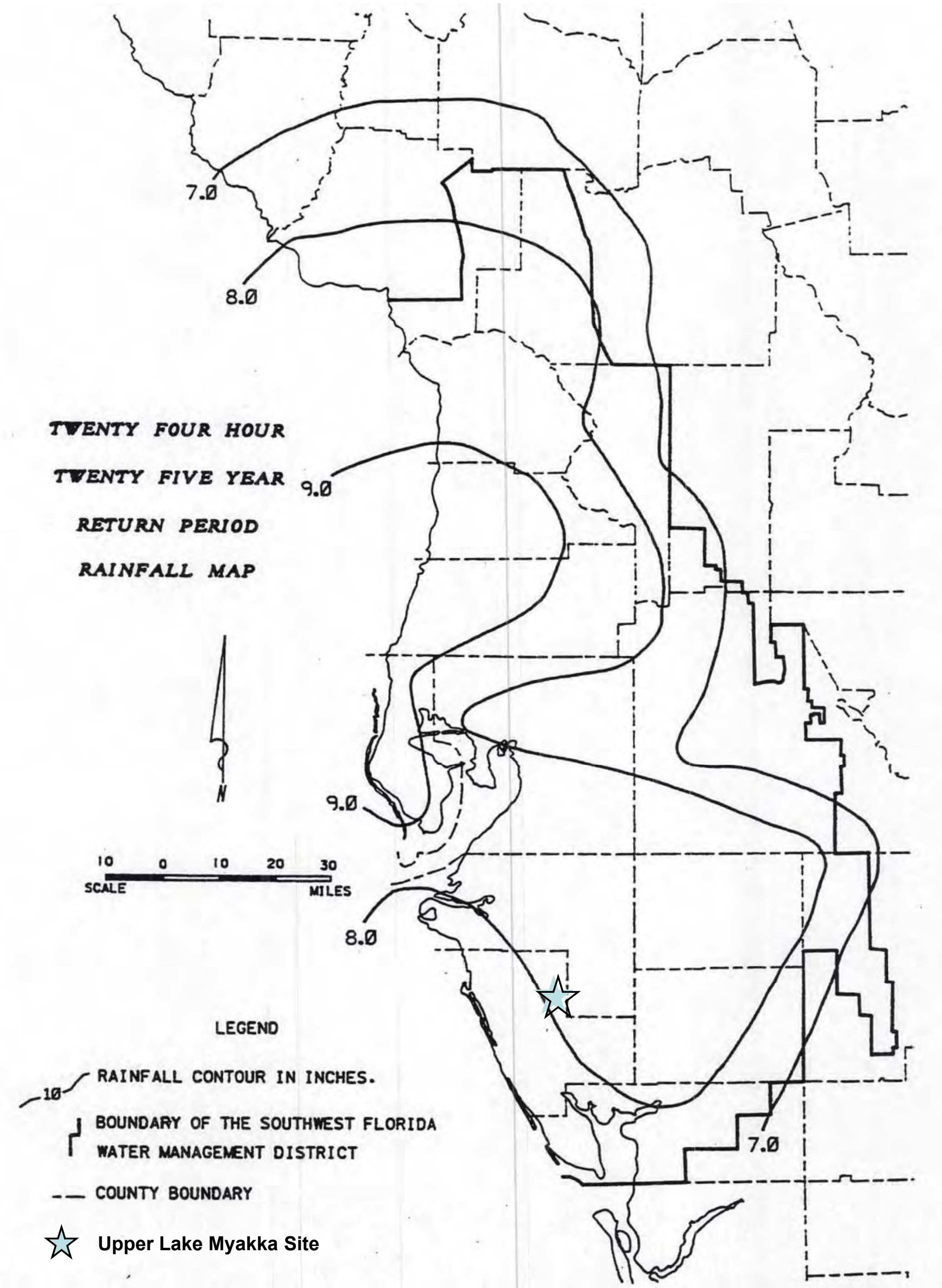
**LiDAR Topography Map**

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 9 |
|---|---|---|---|---|
| MES | 2/27/2020 | | | |
| Checked | Date | | | |
| | 2/27/2020 | | | |



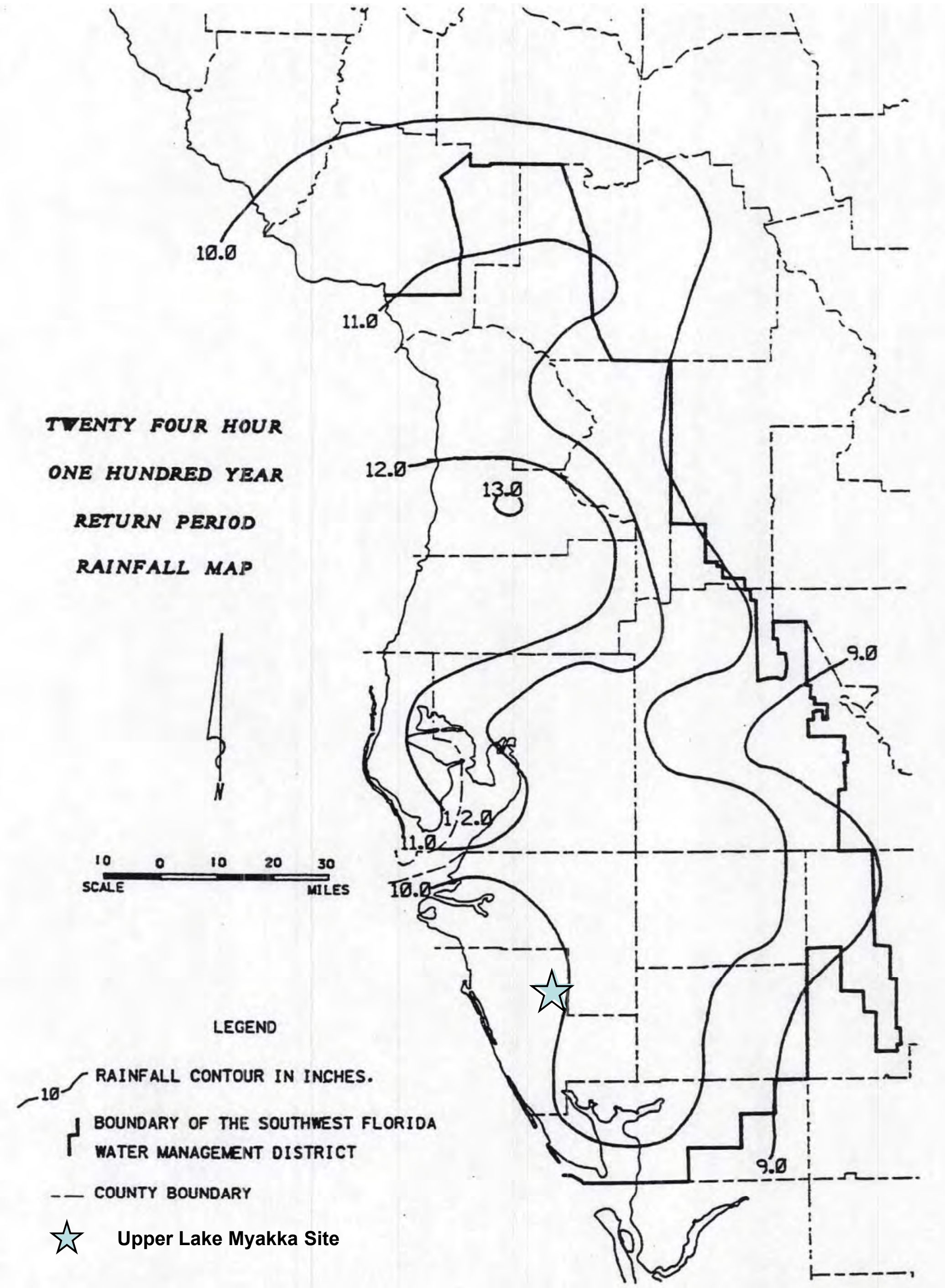

Source: SWFWMD.

| Upper Lake Myakka Restoration | wood. | Mean Annual Return Period Rainfall Map<br>606339003A<br>Figure 10 |
|---|---|---|



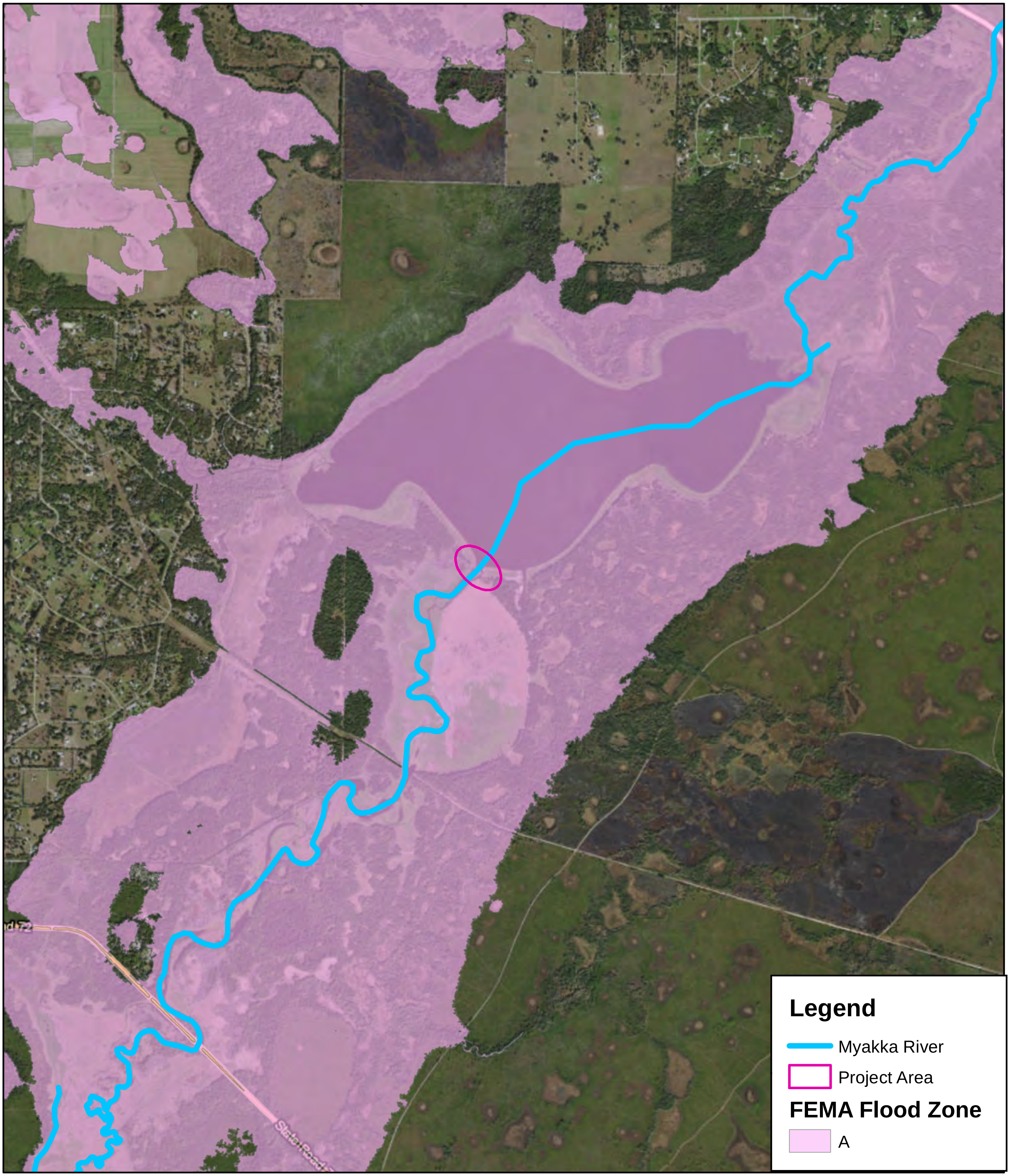

Source: SWFWMD.

| | | |
|---|---|---|
| **Upper Lake Myakka Restoration** | wood. | 24 Hour 25 Year Return Period Rainfall Map<br>606339003A<br>Figure 11 |




Source: SWFWMD.

| | | |
|---|---|---|
| **Upper Lake Myakka Restoration** | wood. | 24 Hour 100 Year Return Period Rainfall Map<br>606339003A<br>Figure 12 |




Source: Imagery, FEMA 2017; ESRI 2017; Wood 2020

N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

**FEMA Flood Zone Map**

| Drawn | Date | *Gainesville Florida Project No. 6006-39-003A* | wood. | **Figure 13** |
|---|---|---|---|---|
| MES | 2/19/2020 | | | |
| Checked | Date | | | |
| | 2/19/2020 | | | |

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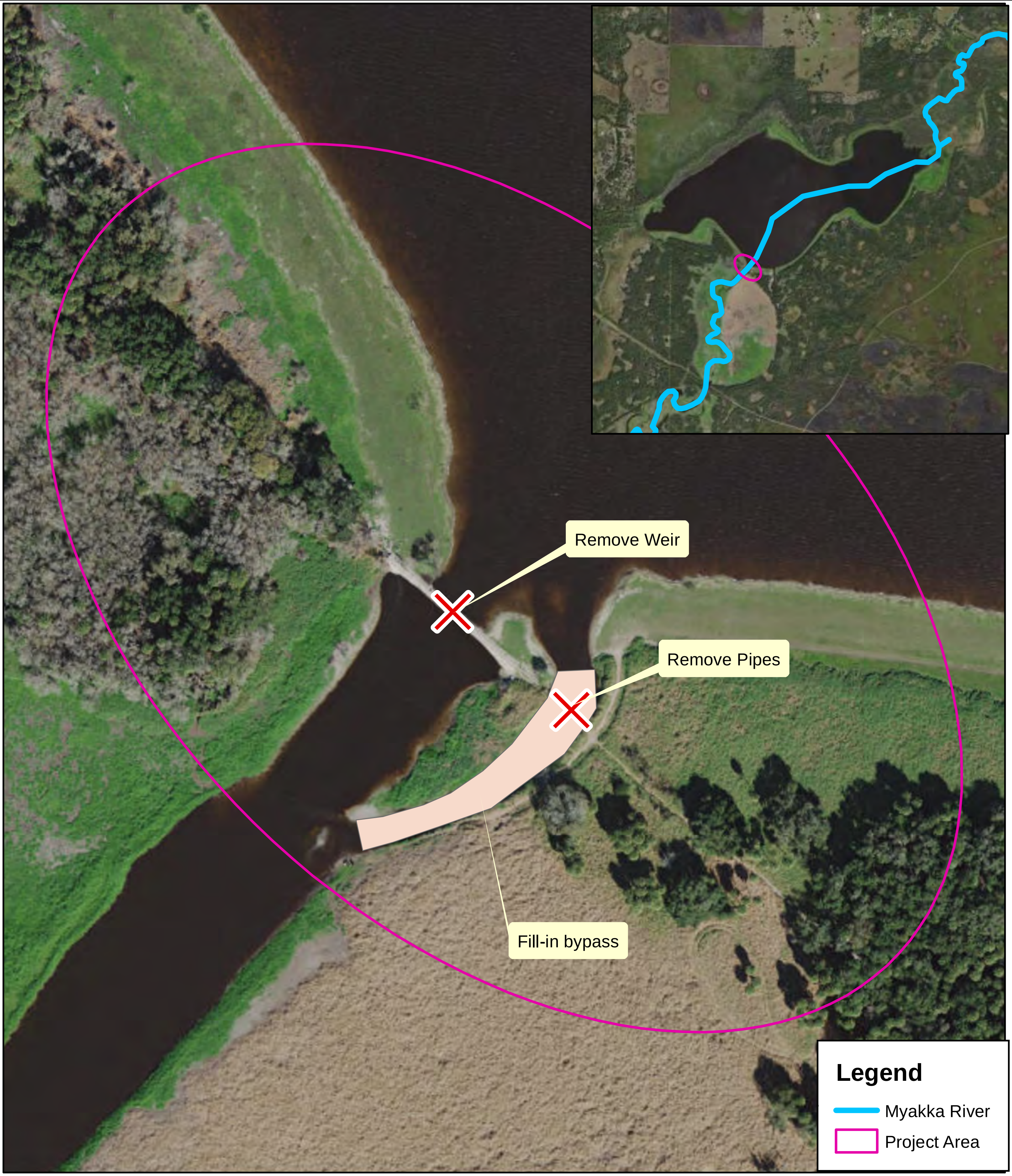


Source: Imagery, NRCS 2016; ESRI 2017; Wood 2018

N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

**Alt 1 Modifications**

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 14 |
|---|---|---|---|---|
| MES | 2/27/2020 | | | |
| Checked | Date | | | |
| | 2/27/2020 | | | |

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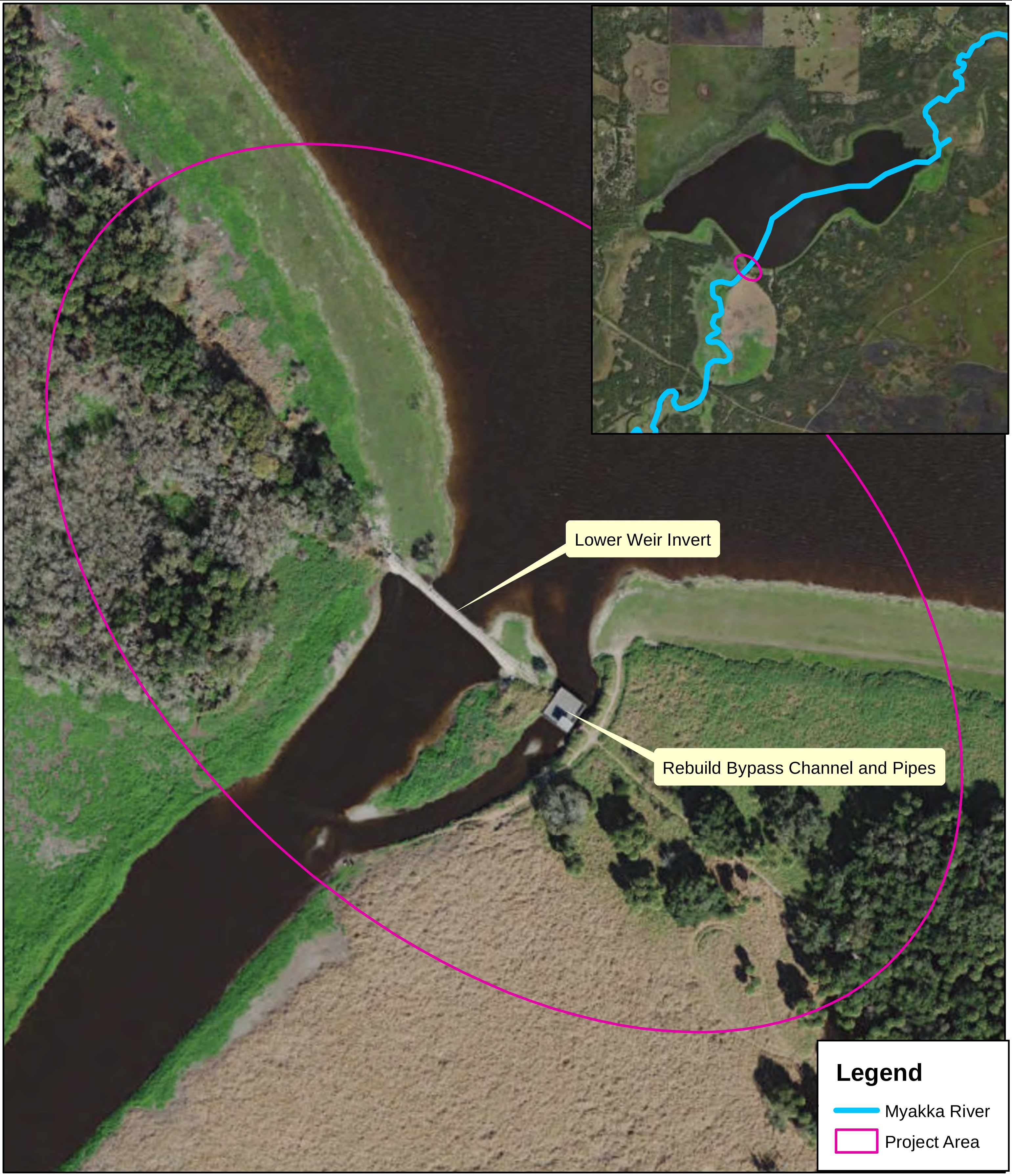



Source: Imagery, NRCS 2016; ESRI 2017; Wood 2018

N

0 1,500 3,000 6,000 Feet

**Upper Lake Myakka Restoration**

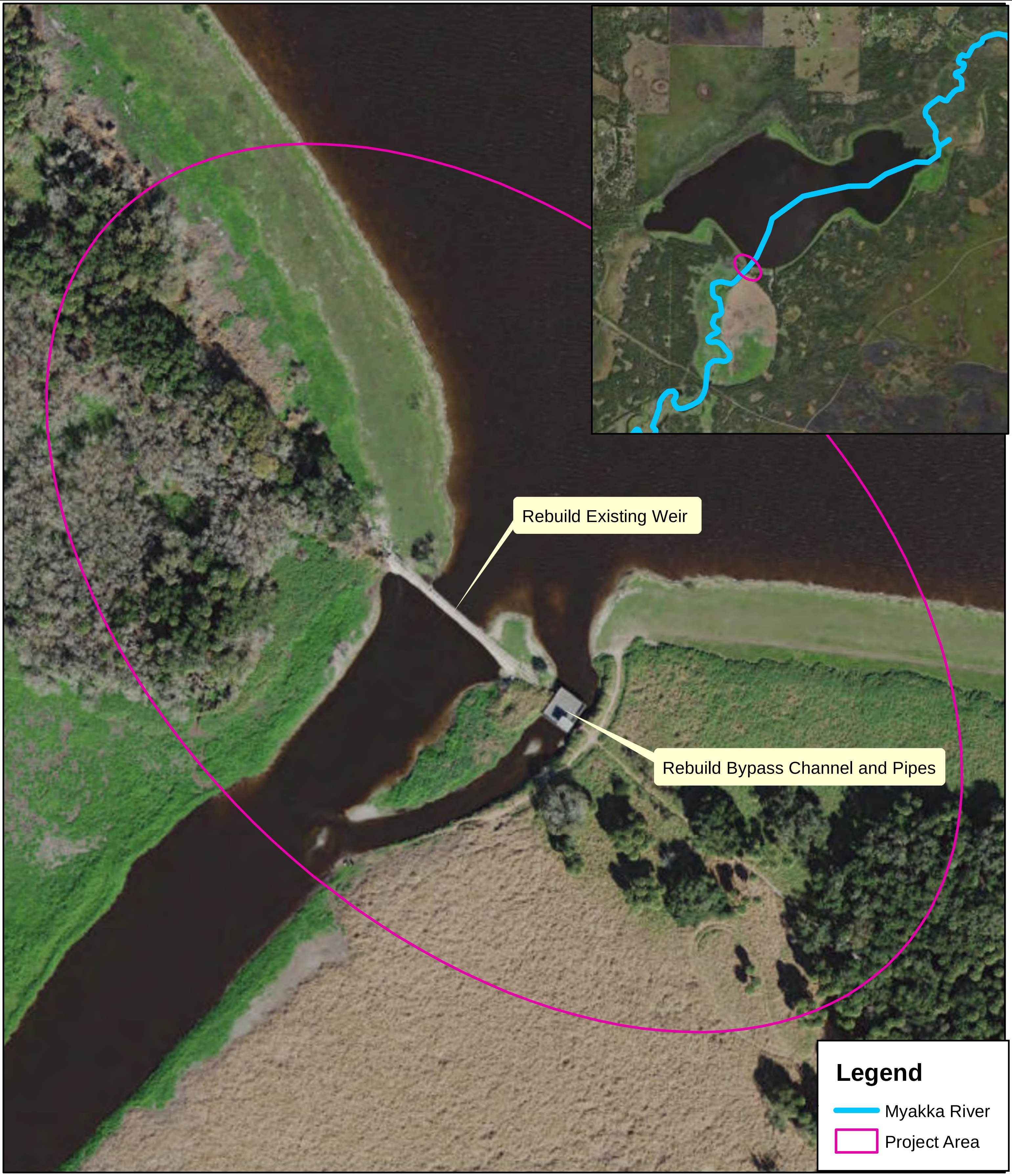
**Alt 2 Modifications**

| Drawn | Date | *Gainesville Florida* |
|---|---|---|
| MES | 2/27/2020 | *Project No.* |
| Checked | Date | *6006-39-003A* |
| | 2/27/2020 | |

wood.

**Figure 15**

Path: P:\EAT\2019\PROJECT\Wood Tampa\Upper Myakka\DISCIPLINES\GIS\MXD\Alt 2.mxd mary.szoka Date Saved: 2/27/2020 11:18:47 AM




Source: Imagery, NRCS 2016; ESRI 2017; Wood 2018

N

0 1,500 3,000 6,000 Feet

## Upper Lake Myakka Restoration

## Alt 3 Modifications

| Drawn | Date | *Gainesville Florida* | wood. | Figure 16 |
|---|---|---|---|---|
| MES | 2/27/2020 | *Project No.* | | |
| Checked | Date | *6006-39-003A* | | |
| | 2/27/2020 | | | |

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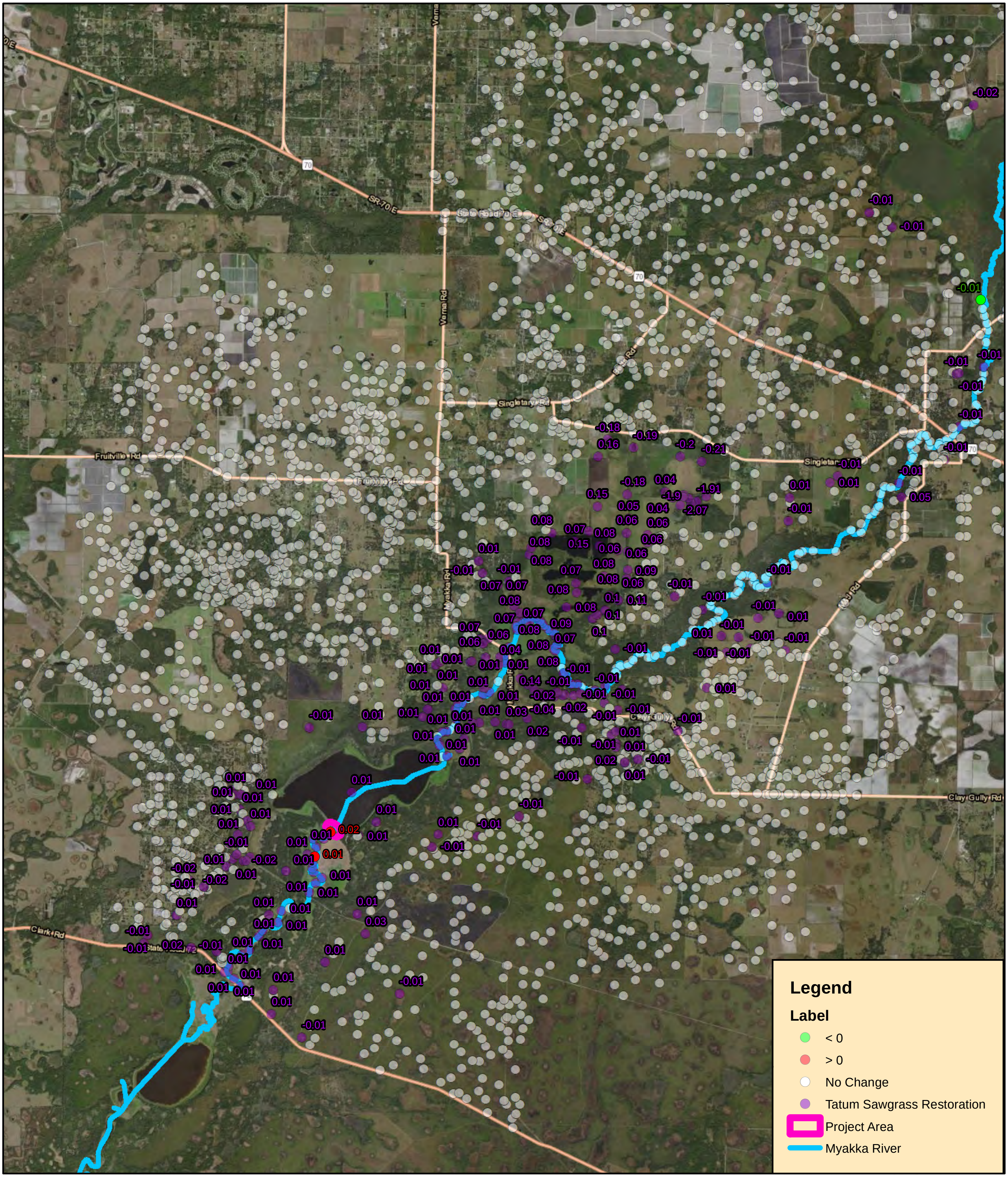



Source: Imagery; ESRI 2017; Wood 2020

N

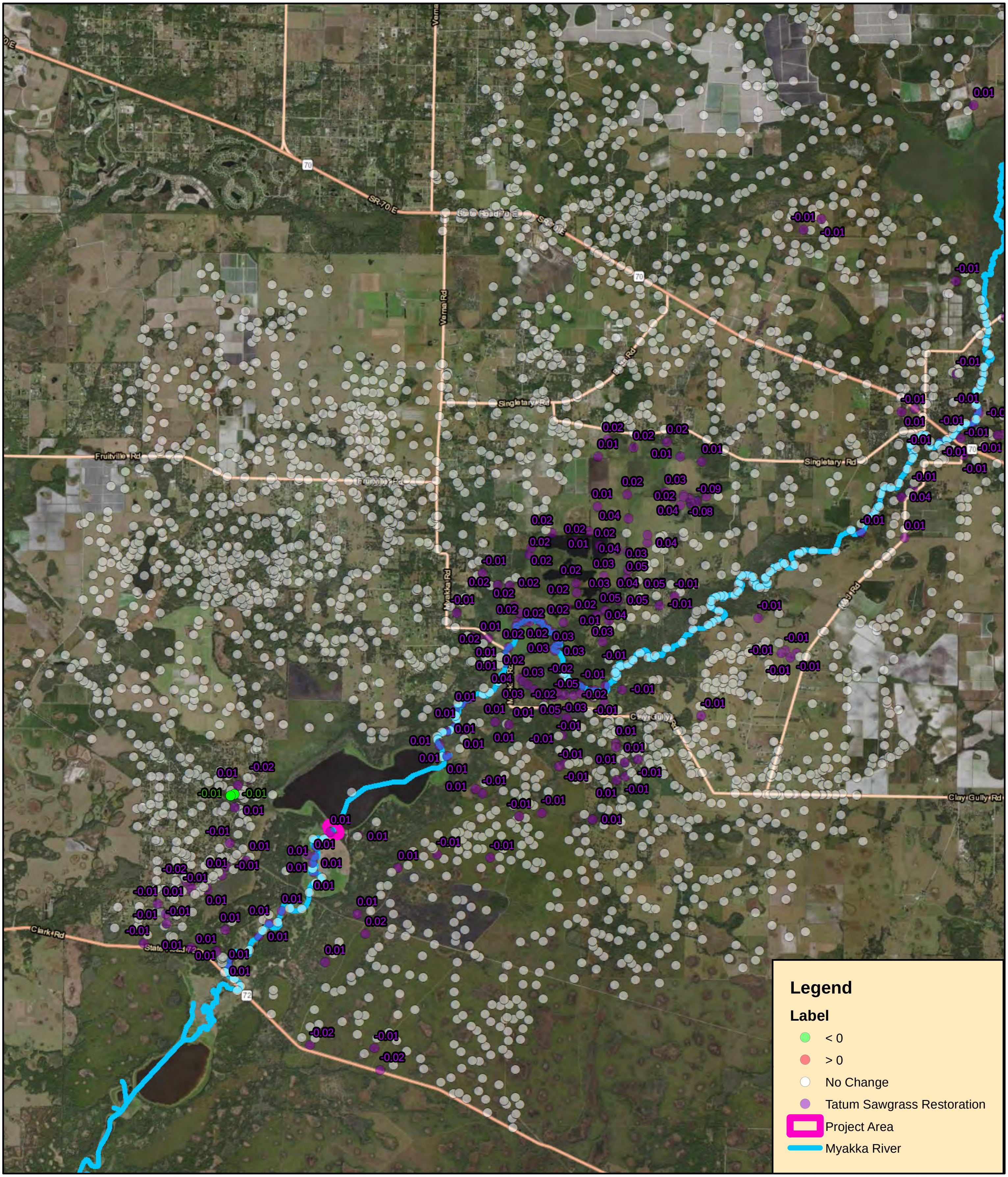
0 4,500 9,000 18,000 Feet

# Upper Myakka Restoration

## 25 YEAR MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 1

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 17 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 17 Atl 1 Node Max 25yrl storm event.mxd dustin.atwater Date Saved: 2/28/2020 4:34:06 PM




Source: Imagery; ESRI 2017; Wood 2020

N

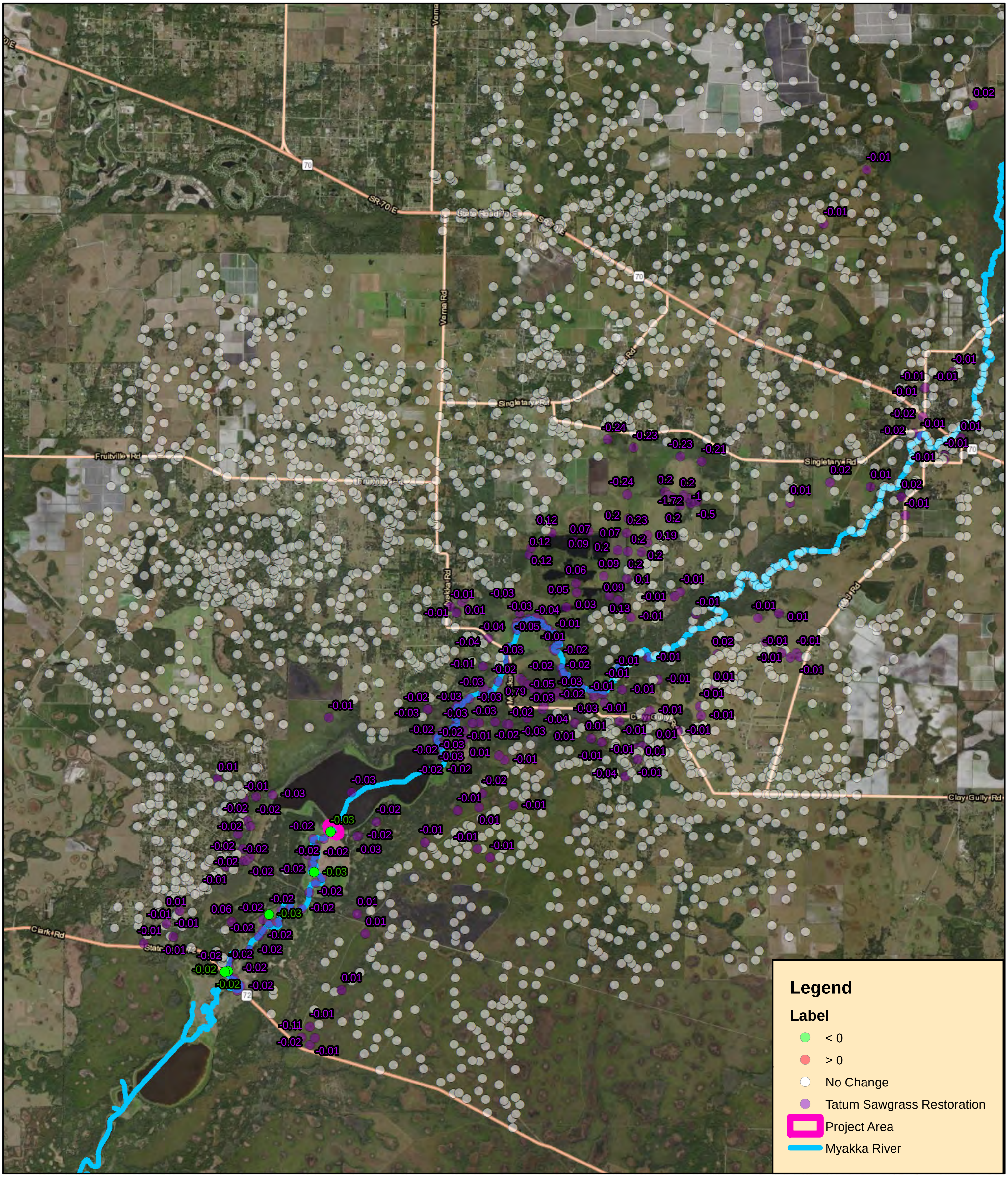
0 4,500 9,000 18,000 Feet

# Upper Myakka Restoration

## 100 YEAR MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 1

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 18 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 18 Atl 1 Node Max 100yr storm event.mxd dustin.atwater Date Saved: 2/28/2020 4:11:35 PM




Source: Imagery; ESRI 2017; Wood 2020

N

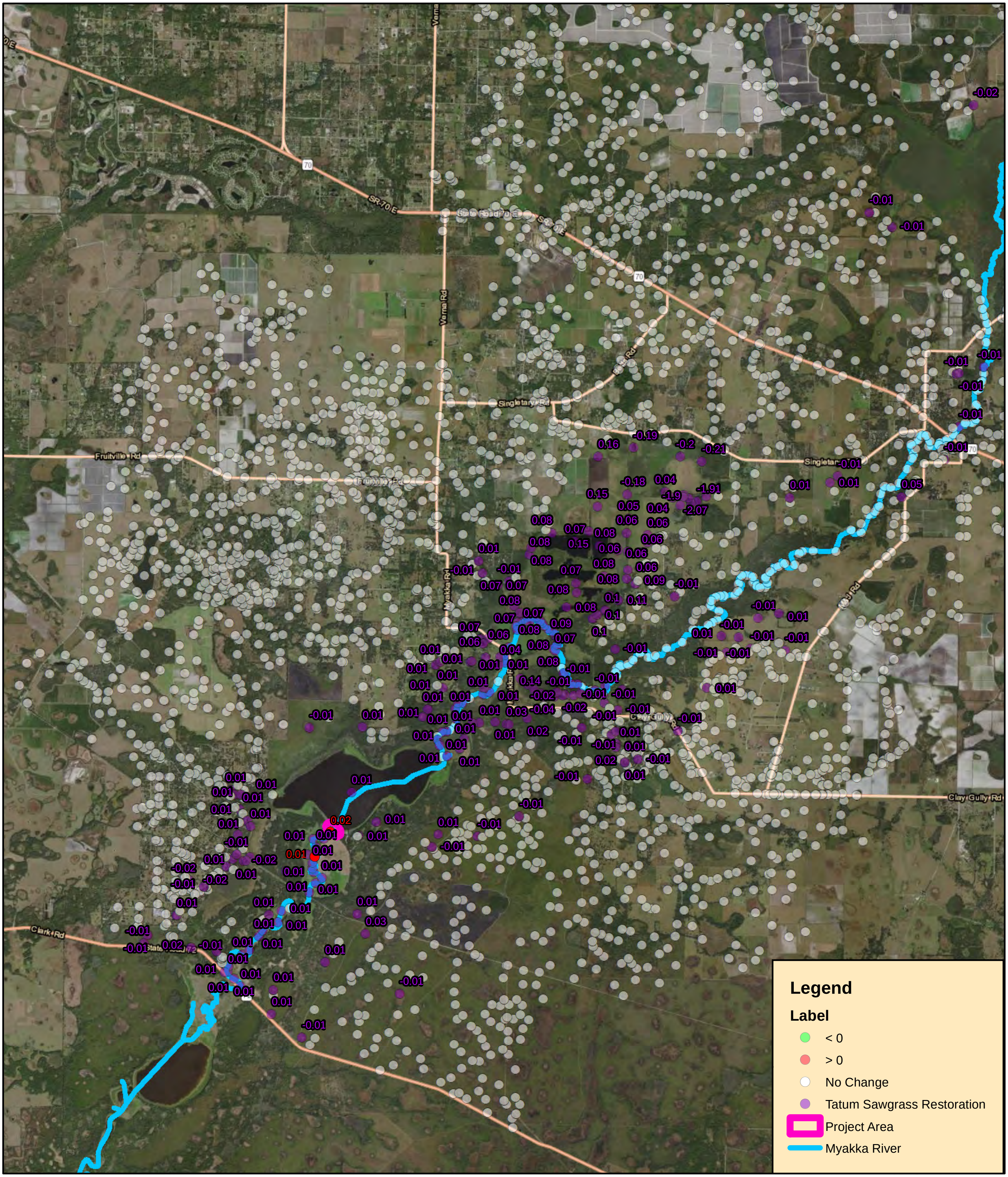
0 4,500 9,000 18,000 Feet

# Upper Myakka Restoration

## MEAN ANNUAL MAX STAGE COMPARISON
## BASELINE VS MOD ALTERNATIVE 1

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 19 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 19 Atl 1 Node Max mean annual storm event.mxd dustin.atwater Date Saved: 2/28/2020 4:47:30 PM




Source: Imagery; ESRI 2017; Wood 2020

N

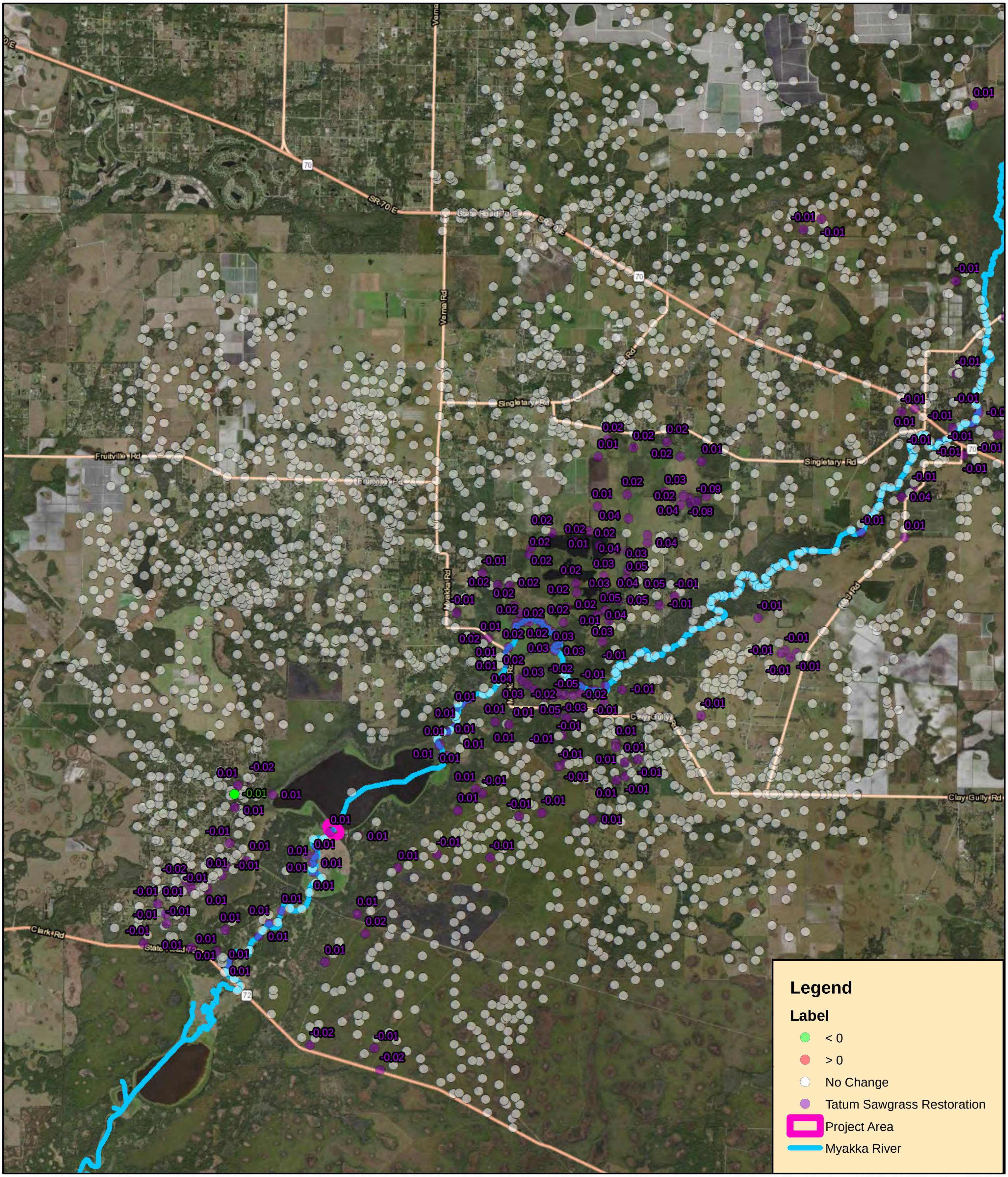
0 4,500 9,000 18,000 Feet

## Upper Myakka Restoration

**25 YEAR MAX STAGE COMPARISON
BASELINE VS MOD ALTERNATIVE 2**

| Drawn | Date | | | |
|---|---|---|---|---|
| DLA | 2/28/2020 | *Gainesville Florida* | wood. | **Figure 20** |
| Checked | Date | *Project No.* | | |
| TGD | 2/28/2020 | *6006-39-003A* | | |

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 20 Atl 2 Node Max 25yr storm event.mxd dustin.atwater Date Saved: 2/28/2020 4:37:58 PM




Source: Imagery; ESRI 2017; Wood 2020

N

0 4,500 9,000 18,000 Feet

# Upper Myakka Restoration

## 100 YEAR MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 2

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | | Figure 21 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |

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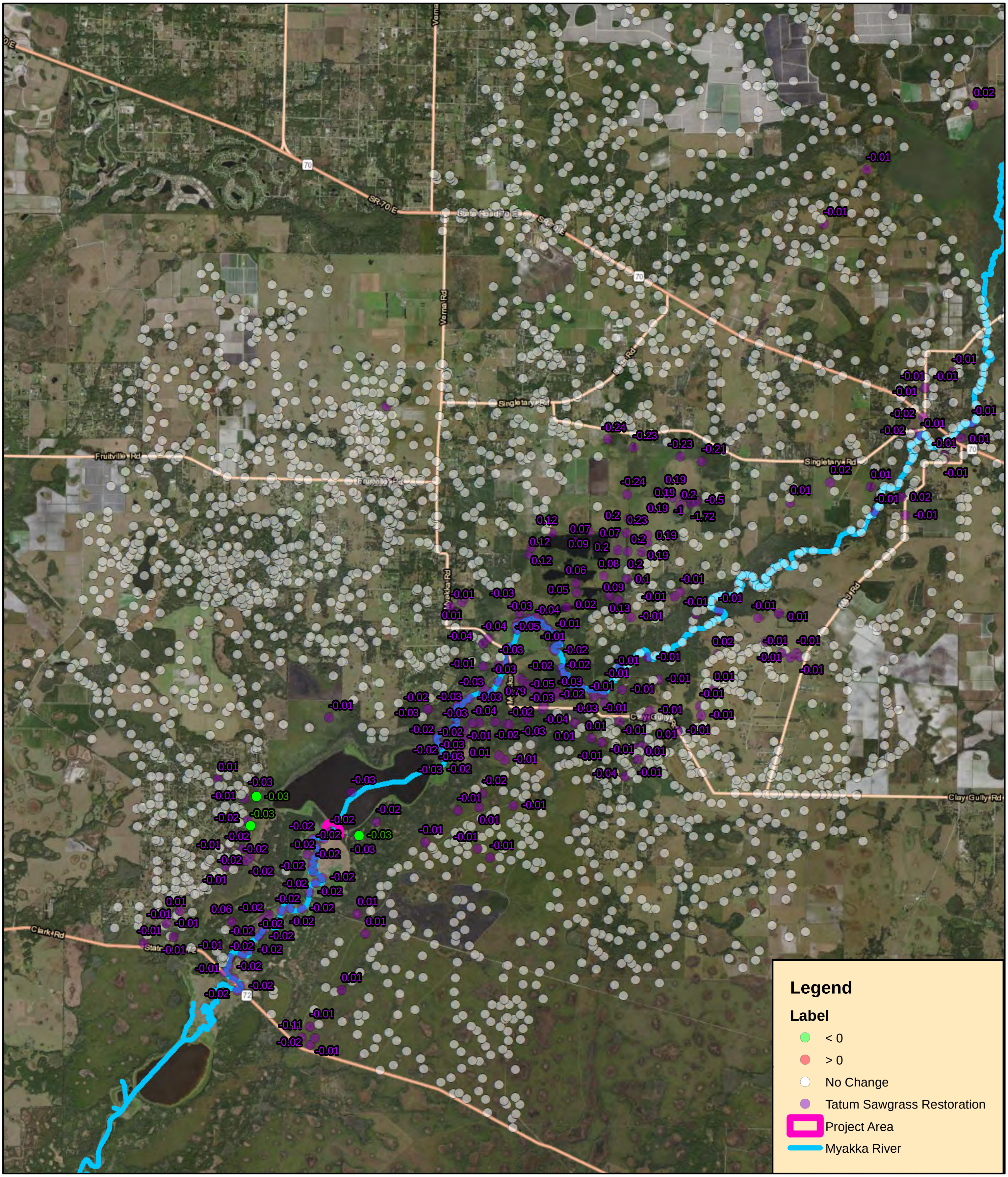



Source: Imagery; ESRI 2017; Wood 2020

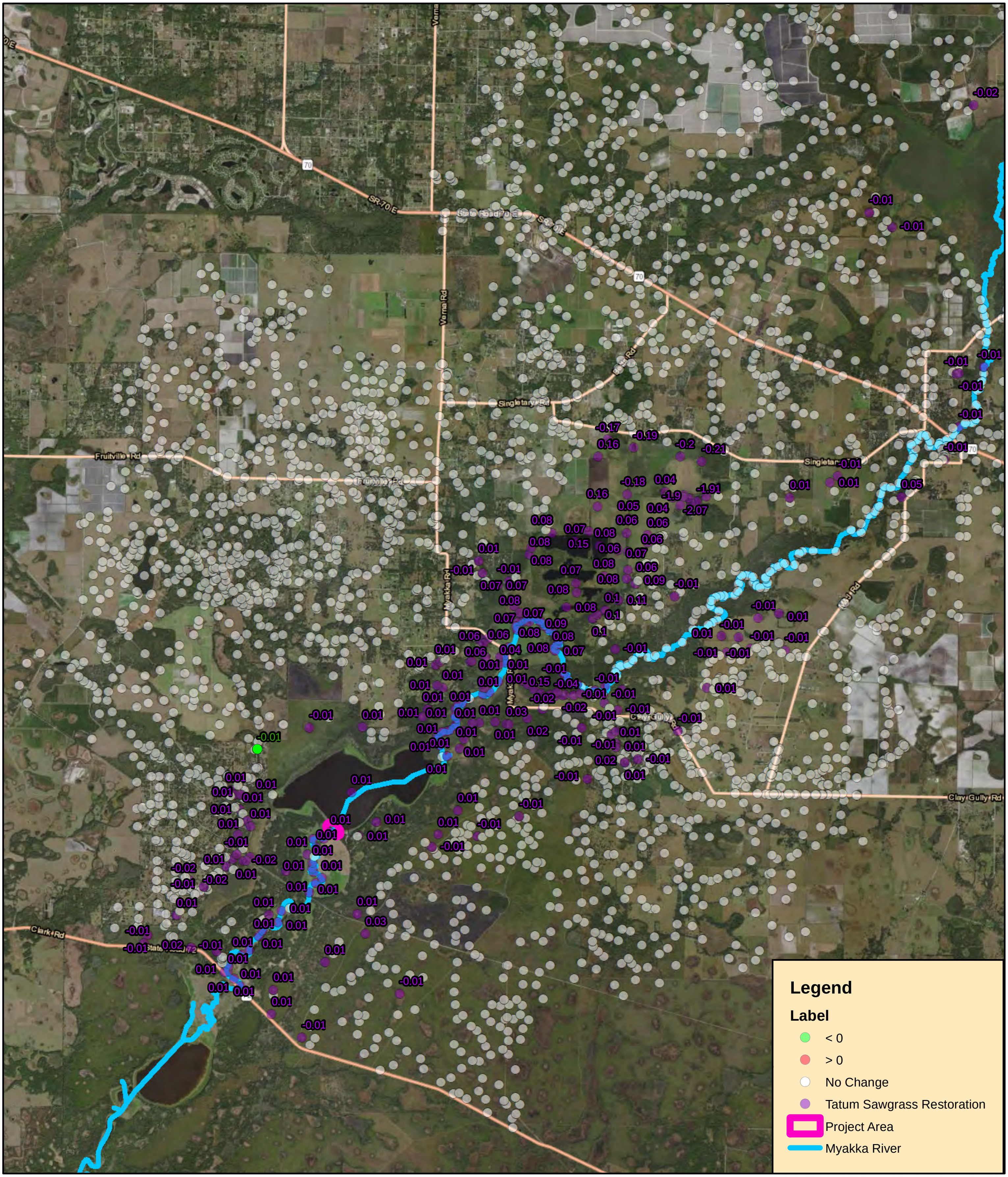
N

0 4,500 9,000 18,000 Feet

## Upper Myakka Restoration

### MEAN ANNUAL MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 2

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 22 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |




Source: Imagery; ESRI 2017; Wood 2020

N

0 4,500 9,000 18,000 Feet

## Upper Myakka Restoration

### 25 YEAR MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 3

| Drawn | Date | Gainesville Florida | | Figure 23 |
|---|---|---|---|---|
| DLA | 3/2/2020 | *Project No.* | wood. | |
| Checked | Date | *6006-39-003A* | | |
| TGD | 3/2/2020 | | | |

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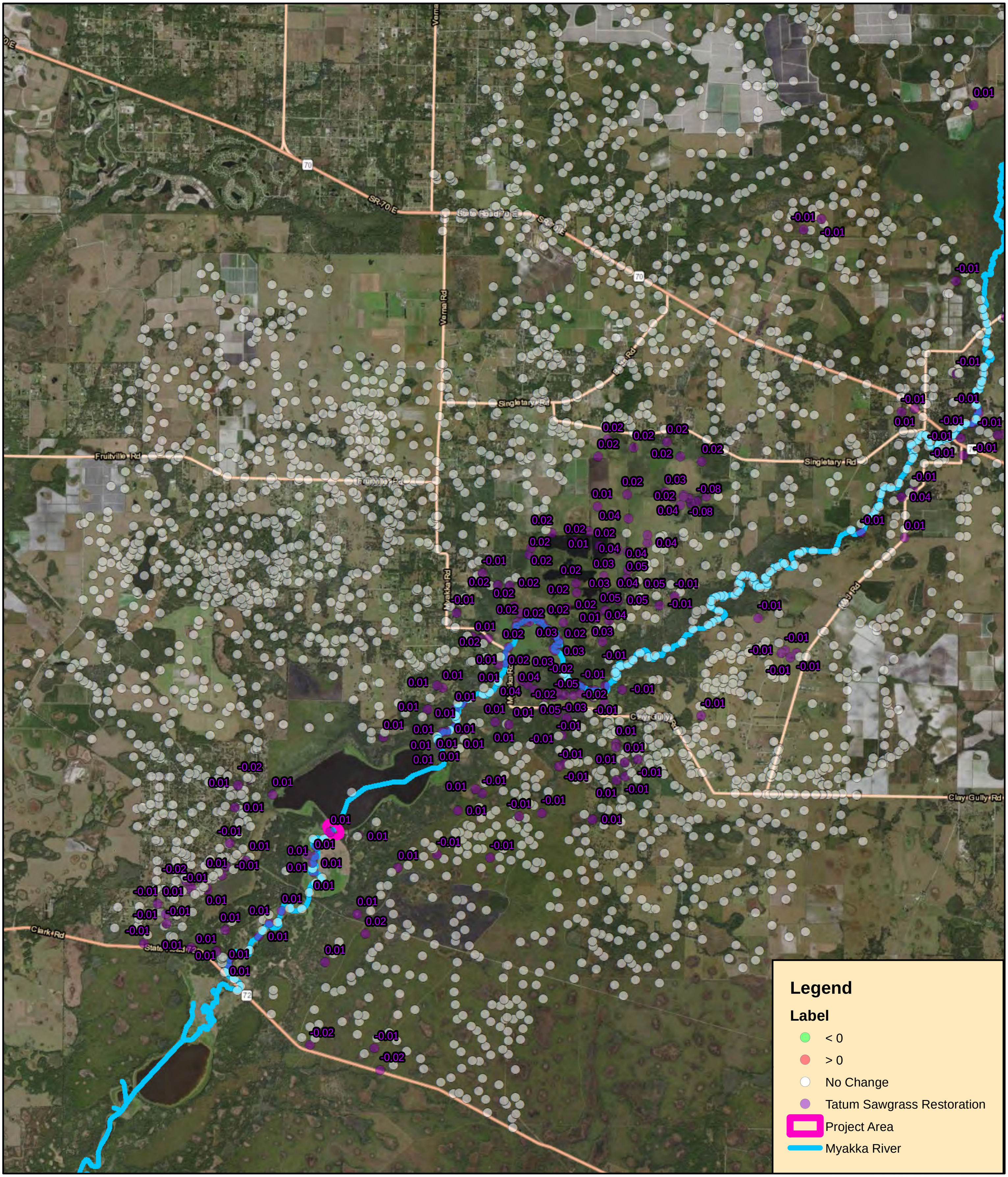



Source: Imagery; ESRI 2017; Wood 2020

N

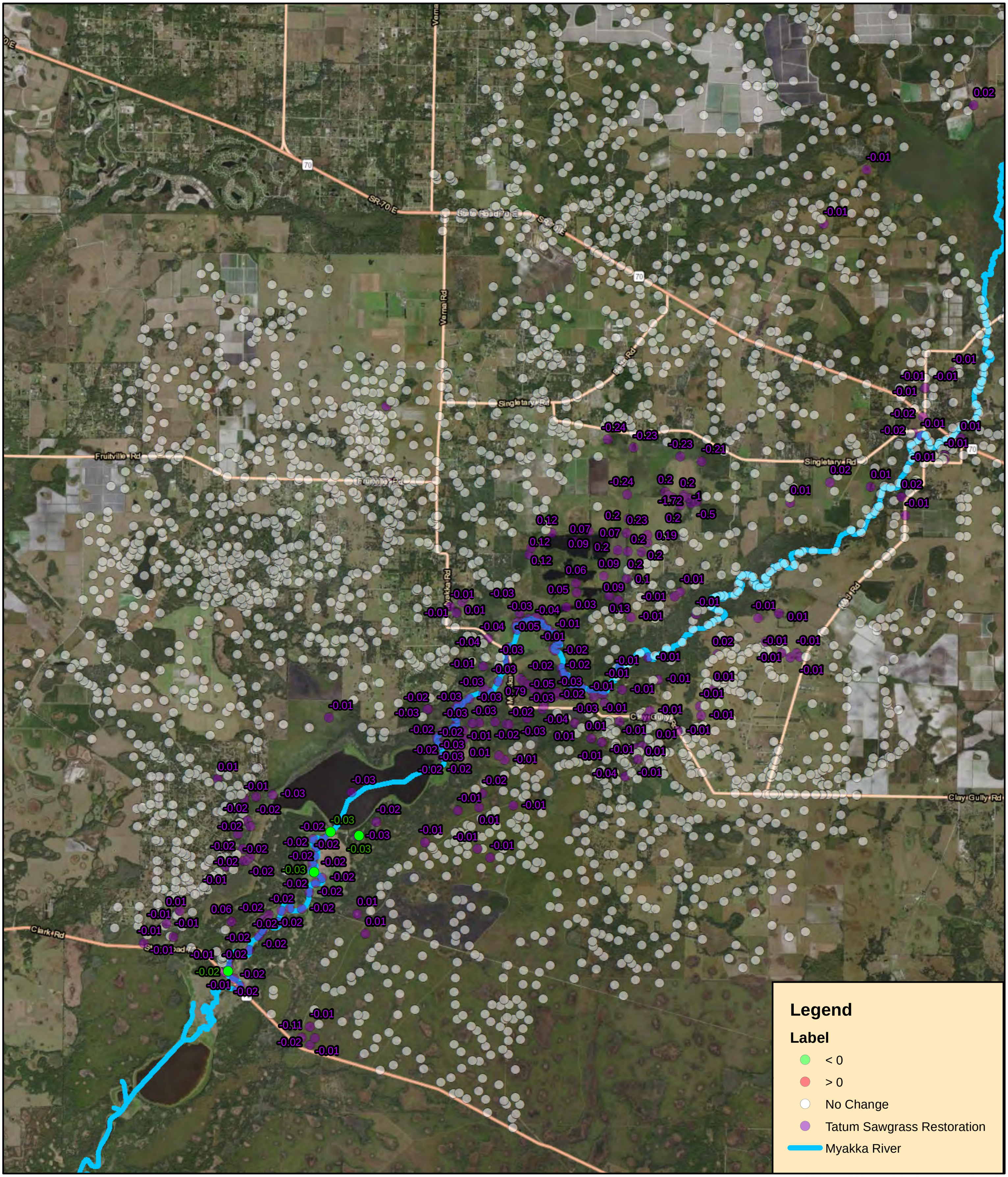
0 4,500 9,000 18,000 Feet

# Upper Myakka Restoration

## 100 YEAR MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 3

| Drawn | Date | Gainesville Florida Project No. 6006-39-003A | wood. | Figure 24 |
|---|---|---|---|---|
| DLA | 2/28/2020 | | | |
| Checked | Date | | | |
| TGD | 2/28/2020 | | | |

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 24 Atl 3 Node Max 100yr storm event.mxd dustin.atwater Date Saved: 2/28/2020 4:30:40 PM




Source: Imagery; ESRI 2017; Wood 2020

N

0 4,500 9,000 18,000 Feet

## Upper Myakka Restoration

### MEAN ANNUAL MAX STAGE COMPARISON BASELINE VS MOD ALTERNATIVE 3

| Drawn | Date | | |
|---|---|---|---|
| DLA | 2/28/2020 | Gainesville Florida Project No. 6006-39-003A | Figure 25 |
| Checked | Date | | |
| TGD | 2/28/2020 | | |

wood.

Path: C:\ARCHYDRO_MODELS\Tatum\Figure 25 Atl 3 Node Max mean annual storm event.mxd dustin.atwater Date Saved: 2/28/2020 5:02:59 PM

# APPENDIX E

Continuous Modeling Report

Wood Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Suite 200
Tampa, FL 33602
T: 813-289-0750
**www.woodplc.com**

# Memorandum

**To:** Theresa Carron
Florida Department of Environmental Protection

**From:** Nirjhar Shah, PhD, PE, and Kristen Nowak, PWS
Wood Environment & Infrastructure Solutions, Inc.

**Date:** February 27, 2020 (Revised June 8, 2020)

**Re.** Upper Myakka Lake Long Term Continuous Modeling for Evaluation of Options

Wood Project No. 600639

## 1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, Inc. (Wood) was contracted by the Florida Department of Environmental Protection (FDEP) to conduct a feasibility study on Upper Myakka Lake (UML) located within the Myakka River State Park (MRSP) in Sarasota County, Florida (**Figure 1**). The Southwest Florida Water Management District (SWFWMD) is a cooperative funding partner for this project. Two water control structures (WCS) exist on the southern rim of the lake: a concrete weir constructed in 1941 and a bypass constructed in 1974. The feasibility study explores the following three alternatives, with the objectives of restoring natural systems and improving water quality in the Myakka River before the water enters Charlotte Harbor:

1) Removing the low water control structure (weir and bypass),
2) Amending the low water control structure; or
3) Re-building the low water control structure to the way it was prior to the recent failure.

This technical memorandum describes the long-term continuous modeling effort that was conducted to evaluate the expected impacts of the implementation of various alternatives on the lake water levels and potential changes in the wetland acreages around the lake.

## 2.0 MODEL SELECTION AND PARAMETERIZATION

As part of the Myakka River Watershed Initiative (MRWI), Interflow Engineering LLC (Interflow) developed a long-term integrated water budget model representing general hydrologic and hydraulic conditions within the Upper Myakka River watershed (Interflow Engineering 2008). **Figure 2** shows the extent of the water budget model that spans from north of the Tatum Sawgrass area to SR-72. In 2017 Interflow updated this model by extending the simulated period of record (May 1994 through December 2014) and adding three proposed water management scenarios in the Flatford Swamp area (Interflow 2017). For the current study, Southwest Florida Water Management District (District) recommended use of this latest model as the starting point for the current study. Unless specified otherwise, the MRWI water budget model will refer to the latest version of the model (updated in 2017).

The MRWI water budget model was developed using DHI Water and Environment Inc. (DHI) integrated surface and groundwater modeling code MIKE SHE and MIKE 11. The model domain was set up with a grid size of 125 m X 125 m (~410 X 410 feet) resulting in about 39,200 cells. Before use of the MRWI water budget model for the study, a thorough QA/QC was performed on model setup, input dataset, and simulated results. Below is a list of elements that were reviewed and adjusted as-needed. The resultant model will be referred to as the Upper Myakka Lake (UML) model.

### 2.1 Rainfall

The MRWI water budget model used a combination of rain-gage data and NEXRAD derived rainfall data for simulating different periods of record. For the current study, Wood updated the entire rainfall dataset to solely use NEXRAD-based rainfall. NEXRAD-derived rainfall was compared against the observed rainfall at available rain gages (3 locations) and appropriate adjustment/correction factors were computed and applied to the NEXRAD-based rainfall time-series.

### 2.2 Potentiometric Surface Dataset

The MRWI water budget model uses observed potentiometric surface data from the District as model groundwater boundary condition. During Wood's review it was noted that from January 2005 onwards the specified values in the model were shifted by almost six months resulting in the observed values from May being incorrectly specified as September values. Wood corrected this shift and applied the corrected time-series to the UML model.

### 2.3 Lake Bathymetry and Channel Cross-Section Data

As part of the current study, Wood conducted a survey to collect Lake bathymetry and cross-section data in the vicinity of the outfall weir and bypass channel as well as representative cross-sections downstream of the lake along the Myakka River. Wood replaced the existing lake bathymetry and cross-section data in the MRWI model with the dataset that was collected as part of the current study. **Figure 3** shows the lake bathymetry derived from the survey data.

### 2.4 Simulation of Bypass Channel

The MRWI model simulated the existing weir and the bypass channel as single hydraulic system connecting the UML to the Myakka River downstream. To allow for accurate evaluation of different restoration alternatives, the hydraulic system in the MRWI model was split to represent two independent connections between the lake and the Myakka River, one via the weir and the second via the bypass channel/pipes.

### 2.5 Other Modeling Inputs

Other modeling inputs such as subsurface hydrogeology, irrigation dataset (which Wood verified as part of initial QA/QC process), land-use, and soils were left unchanged from the MRWI model.

### 2.6 Baseline Model Setup

The MRWI model provided by the District had three proposed water management scenarios built in. These scenarios involved adding diversions to the Myakka River in the Flatford Swamp area. For the current study, the diversions were removed from the model setup before it was used for conducting the UML alternative simulations.

## 3.0 <u>MODEL SIMULATIONS</u>

Subsequent to adjustments, the UML model was set-up for calibration and verification runs, as well as simulations of the three UML restoration alternatives.

### 3.1 Model Calibration and Verification

The MRWI water budget model used a staggered calibration process where the calibration was conducted for a period of record from 1999 through 2014 while the verification run was set-up from 1994 to 1999. For the current study the UML model was set-up with a calibration period of 1/1/1999 through 12/31/2006 and verification period from 1/1/2007 through 1/1/2015. The initial conditions in the model were specified based on the simulated values from the MRWI model for 1/1/1999. All model parameters adjustments were conducted for a period of record from 1/1/1999 through 1/1/2007. The verification run was made by using the same modeling set-up as the calibration run without any parametric changes. **Figure 4** shows the results of the calibration and varication runs as compared to observed lake levels, which fall within an acceptable range. The results for the other calibration points in the new UML model were similar to those of the MRWI model run.

The calibrated and verified UML model was used as the baseline conditions model to compare all the alternative scenario results.

### 3.2 Alternative 1 Model Simulation – Removal Option

The **Alternative 1** model simulation involved removing the weir and filling in the bypass channel, which is also referred to as the "rewilding" option. For this alternative any control at the lake would be removed and the river would flow freely allowing water levels in the UML to fluctuate more naturally. To simulate **Alternative 1**, the hydraulic setup of the baseline UML model was modified by removing the weir and the bypass connection between the lake and the downstream Myakka River. **Figure 5** shows the details of **Alternative 1**.

### 3.3 Alternative 2 Model Simulation – Amend Option

The **Alternative 2** model simulation was aimed at amending the existing outflow configuration to allow more water to flow through at lower lake water levels. The scenarios that were evaluated for this alternative involved:

- Lowering the current weir by 2 feet (**Alternative 2A**), and
- Widening the bypass channel and adding more pipes (**Alternative 2B**)

The baseline UML model was adjusted to set-up these two alternatives. **Alternative 2A** was set-up by lowering the crest elevation of the Upper Myakka Lake from 12.41 feet NAVD88 to 10.41 feet NAVD88. All other connections were kept the same. For **Alternative 2B** the weir crest was kept fixed at 12.41 feet NAVD88; however, the number of pipes set-up in the bypass channel was doubled (as a sensitivity case) from six to twelve. **Figure 6** show the details of **Alternative 2**.

### 3.4 Alternative 3 Model Simulations – Rebuild Option (Baseline)

**Alternative 3** included rebuilding the weir so that the invert of the weir met the original design elevation of 12.41 feet NAVD88. Under this scenario, the bypass channel that is currently eroded would be rehabilitated, and the six pipes that were originally installed but are currently rusted out would be put back to allow flow out of the lake. Conceptually, this alternative is identical to the baseline model that was simulated, hence no additional model runs were made for this alternative. The results of the baseline model can be interpreted to represent the Alternative 3 model results.

## 4.0 MODEL RESULTS AND DISCUSSION

**Figure 7** shows the comparison of the simulated lake level time-series for the entire simulated period of record (i.e. 1/1/1999 through 1/1/2015). From **Figure 7** no significant shift is apparent in the lake water levels. However, if zoomed in to a selected time frame such as 2007 (see **Figure 8**), the differences start becoming more apparent. As could be expected, the lake levels are lowest for **Alternative 1** (removal of weir, orange line) followed by **Alternative 2B**. **Alternative 2A** follows the baseline simulated values until the water level reaches 10.41 feet (simulated discharge elevation of the modified lake weir), beyond which the baseline steadily rises while the **Alternative 2A** water level increase is very gradual.

To provide an overall view to the changes in water level frequencies associated with a certain alternative, the simulated period of record water level data were computed, sorted, and plotted for displaying exceedance frequencies in **Figure 9**. Similar to the water level time-series, results indicate no significant shift in water level patterns. However, if zoomed into specific intervals, the even subtle differences become more apparent. **Figure 10** shows the exceedance frequency graph for the first 2.5% (extremely high water levels). From the **Figure 10** it can be seen that the removal option produces the lowest water level conditions; however, the differences in the water levels are less than 0.1 ft between the alternatives, indicating no impact on the extreme high lake level conditions.

**Figure 11** shows the exceedance frequency graph between 10% and 50% exceedance frequency. The seasonal high water level is generally attributed at the 15$^{th}$ percentile water level value from a long-term time-series. From **Figure 11** the 15% exceedance value for the baseline/rebuild scenario is about 13.4 feet NAVD88 while for the lowest value (removal scenario) is about 13.3 feet NAVD88, indicating about 0.1 feet drop in seasonal high water level. This difference in water level produced about 18 acres of exposed land during seasonal high conditions.

**Figure 12** shows the exceedance frequency graph between 75% and 100%, and the differences between different alternatives are more obvious on the lower end of the water level. The 85$^{th}$ percentile water level, considered as a good indicator of seasonal low water level, is approximately 9.1 feet NAVD88 for **Alternative 1** (removal) while the baseline scenario (rebuild) seasonal low water level is about 9.4 feet NAVD88, indicating that removing the structures results in about a 0.3 foot drop in the seasonal low. Note that the seasonal low water level based on observed lake level readings collected at a gage with an approximate 17-year period of record is actually 10.4 feet NAVD88, which is approximately one foot higher than the modeled seasonal low. The model verification process did show that during low water conditions the model results are slightly lower than the observed conditions (**Figure 4**). The intent of the modeling exercise is to determine the differences in water levels, if any, among the various alternatives. The 0.3 foot drop observed between seasonal low in the rebuild versus the removal option can be applied to the observed lake conditions to help determine the effect of WCS removal on overall lake conditions. Based on the bathymetric data, a 0.3 foot drop in water level results in about 70 acres of land exposed during seasonal low water level conditions (**Figure 13**). These 70 acres could potentially shift from open water habitat to wetland habitat.

Although the results indicate the impact of the three alternatives on the lake water levels is fairly minimal in scale, the area that can be potentially shifted from open water habitat to wetland habitat is greatest under the removal option. The construction of the bypass channel and the installation of pipes is most likely what caused the most impact on the lake water levels. Any additional efforts (proposed alternatives) seem to have little overall impact on the general water level dynamics of the lake.

Another important aspect that was evaluated as part of this investigation was the impact of the proposed restoration alternatives on the downstream flows and phreatic surface. For the purpose of this review, extreme cases of baseline scenario (Alternative 3 rebuild) and **Alternative 1** (removal) were compared. Simulated flow time-series from a location just downstream of the confluence point of the bypass channel with the primary channel were plotted for both scenarios (**Alternative 1** and Baseline). **Figure 14** shows the time-series plots for the simulated period of record. From the graphs it is evident that downstream flow characteristics remain relatively unchanged under both scenarios. **Figure 15 (a)** and **(b)** show some specific instances where expected minor differences in flow were noted between baseline and removal scenario. However, the removal of weir did not seem to have a significant impact on the downstream flow regime. To investigate further, the simulated inflow values were added to the respective graphs. This made it clear that under the baseline conditions, the overall flow capacity (with bypass culverts under low flow and additional overflow capacity from the weir during high flows) is sufficient to match the expected lake inflows. Removal of weir intuitively created additional conveyance capacity at lower stages; however, since the inflows are not expected to change, the additional capacity does not seem to result in increases in downstream flows. Additionally, there is an existing downstream shoal feature that has an approximate crest elevation of 9.4 feet NAVD88 (about one foot higher than the lowest elevation of the removal profile). This shoal was found to impact lake outflow as well as lake levels, especially during low flow conditions where water was found to stage up behind the shoal, ultimately controlling how low the lake level can go.

For review of the phreatic surface changes, simulated depth to the water level time-series from the model grid cells for the entire model domain was compiled, and 15$^{th}$ and 85$^{th}$ percentile values (indicative of seasonal high and seasonal low water level, respectively) were computed. Differences between the baseline seasonal high/low values and the removal seasonal high/low values were computed and mapped. **Figure 16** shows the spatial distribution of the significant differences in the values. From **Figure 16** it can be noted that during the removal scenario, the seasonal high values for phreatic surface just downstream of the UML weir showed a measurable increase, while the phreatic surface associated with the lake level indicated a slight decrease in the seasonal low phreatic surface elevation (as expected). The changes in the phreatic surface elevations are not expected to cause any adverse impacts on areas upstream or downstream of the UML weir.

Water levels downstream of the lake, within the floodplain marsh area referred to as "Big Flats," were also assessed. **Figure 17** shows the exceedance frequencies of each alternative. The removal/re-wilding option (Alternative 1) shows a slightly higher exceedance frequency for water levels corresponding to a depth to water above zero (which means the water table is above ground). This translates to five additional days per year that the floodplain marsh is inundated compared to the baseline/rebuild condition. The seasonal low water level is 0.1 ft higher in the removal/re-wilding option than in the baseline/rebuild option, while seasonal high water levels show no difference. This does not represent a functional shift because the baseline SLW is 2.4 ft below the ground surface. The median water level is also slightly higher (0.1 ft) in the removal/re-wilding option than in the baseline/rebuild option.

## 5.0 CONCLUSIONS

A detailed integrated surface and groundwater model was setup to evaluate impacts of three alternatives on the overall Upper Myakka Lake water levels. The UML integrated model derived from adjusting the MRWI model was recalibrated and verified against long-term observed lake level data.

Three alternatives ranging from weir removal to rebuilding it were simulated and the potential impacts on the lake water levels were estimated. Based on the model results it was noted that the three options had minor impact on overall lake levels, with weir removal allowing for the lowest lake levels overall. The exceedance frequency analysis conducted to evaluate shifts in the water level patterns indicated that if the weir is removed the seasonal high would reduce by 0.1 ft while the seasonal low water level would reduce by 0.3 feet from the baseline condition. From a restoration standpoint, it seems that the removal option provides the most benefit without causing any significant adverse impacts. The removal alternative results in approximately 70 acres of additional land exposed during seasonal low water level conditions, an area which could potentially shift from open water habitat to wetland habitat.

## 6.0 REFERENCES

Interflow Engineering. 2008. Myakka River Watershed Initiative, Water Budget Model Development and Calibration – Final Report, prepared for Southwest Florida Water Management District, December 5, 2008.

Interflow Engineering. 2017. Most Impacted Area (MIA) Recharge SWIMAL Recovery at Flatford Swamp – Update of Upper Myakka Water Budget Model. Technical Memorandum prepared for Southwest Florida Water Management District.


**Notes:**

1- Project No.: 600639

2- Data Source - ESRI 2019

3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 02/27/2020
Revised: 2/27/2020
Checked By: NS

wood.

Wood Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Ste #200
Tampa, FL 33602
CA-5392
(813) 636-1500

**Figure 1**
**Location Map**
**Upper Myakka Lake**
**Feasibility Study**
**Sarasota County, FL**

Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Technical\7_Modeling\Figures\Figure 1_Project Location.mxd


**Notes:**
1- Project No.: 600639
2- Data Source - ESRI 2019
3- This map is intended to be used for planning purposes only. It is not a survey.

Date: 2/28/2020
Revised: 2/27/2020
Checked By: NS

**Explanation of Features**

MRWI Water Budget Model Extent
Myakka River

N

0 2 4 8 Miles

wood.

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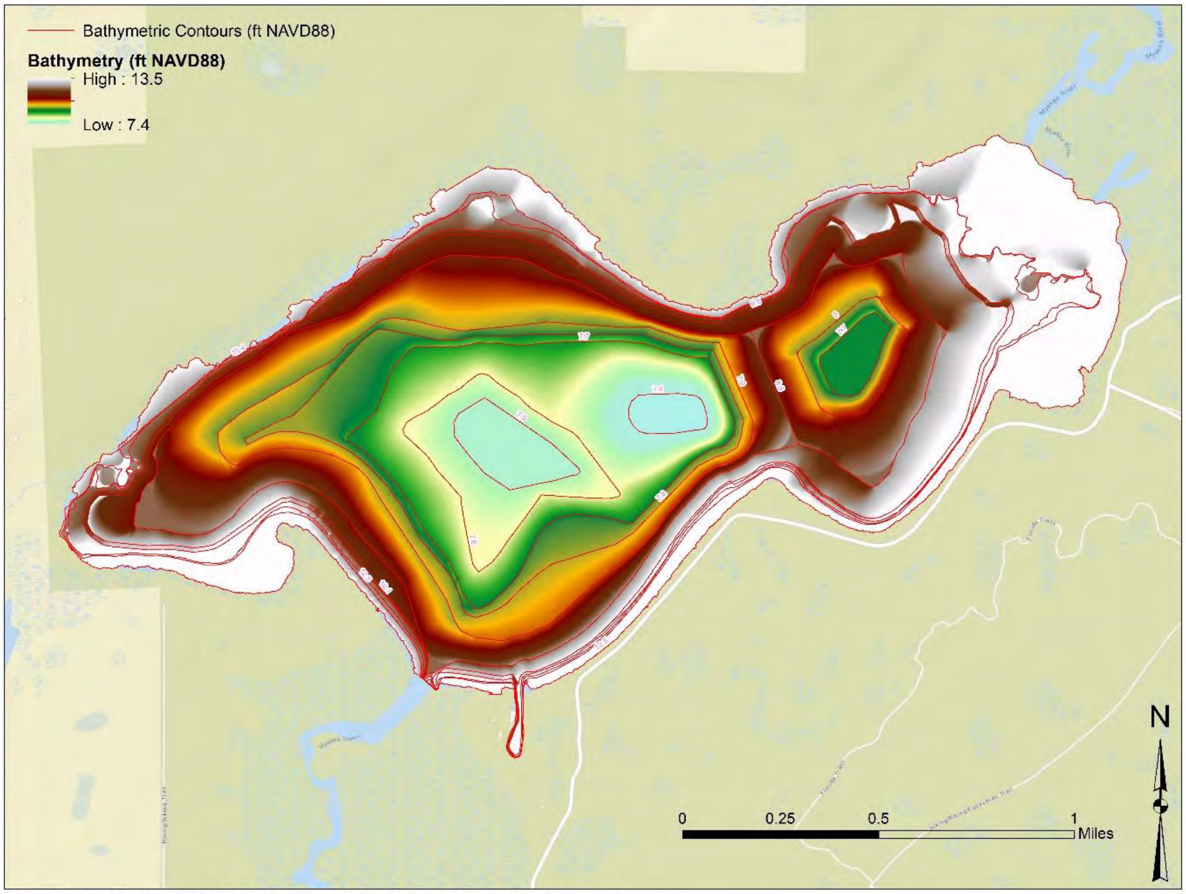
(813) 636-1500

**Figure 2**
**MRWI Water Budget Model Extent**
**Upper Myakka Lake Feasibility Study**
**Sarasota County, FL**

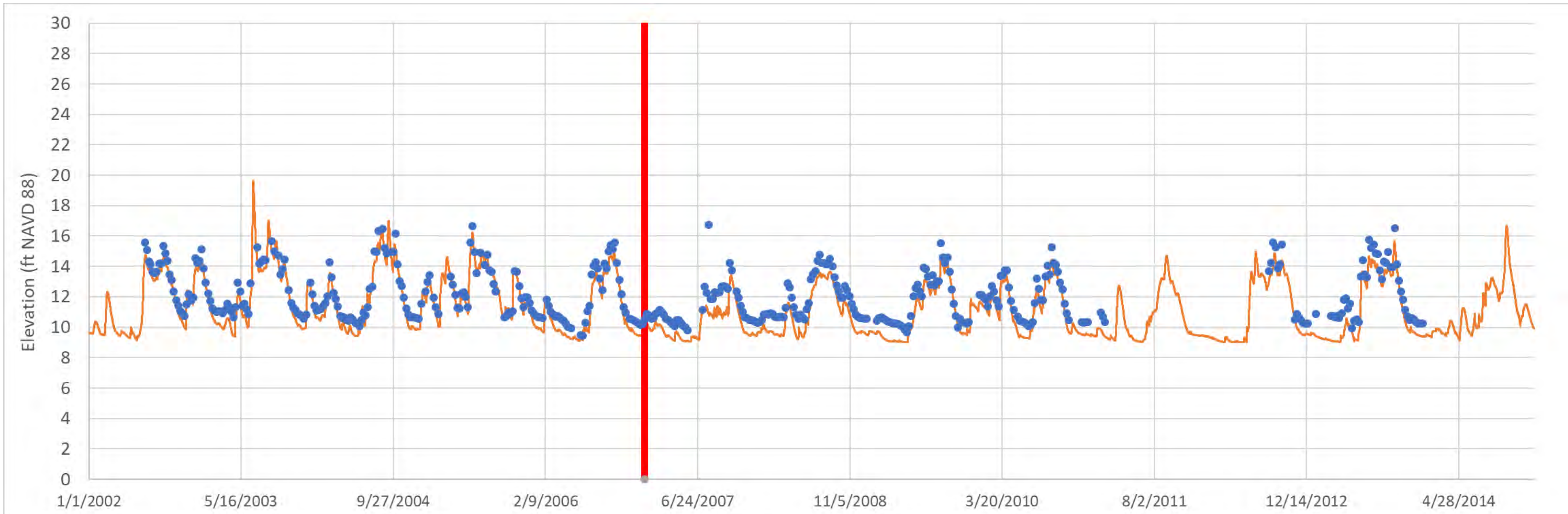
Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Technical\7_Modeling\Figures\Figure2_MRWI_Basin.mxd

**Figure 3 - Upper Myakka Lake Bathymetry – Derived from Wood Survey**




Document Path: Z:\WATER\PROJECTS\600639 FDEP Upper Myakka Lake Feasibility Study\Technical\7_Modeling\Figures\Figure 3_UpperMyakkaLake_Bathymetry.mxd

**Figure 4 - UML Model Calibration and Verification Result**




Orange line = model results
Blue dots = observed lake level data
Red line = distinguishes calibration period (left) versus verification period (right)

## Figure 5 - Alternative 1 – Weir Removal Option

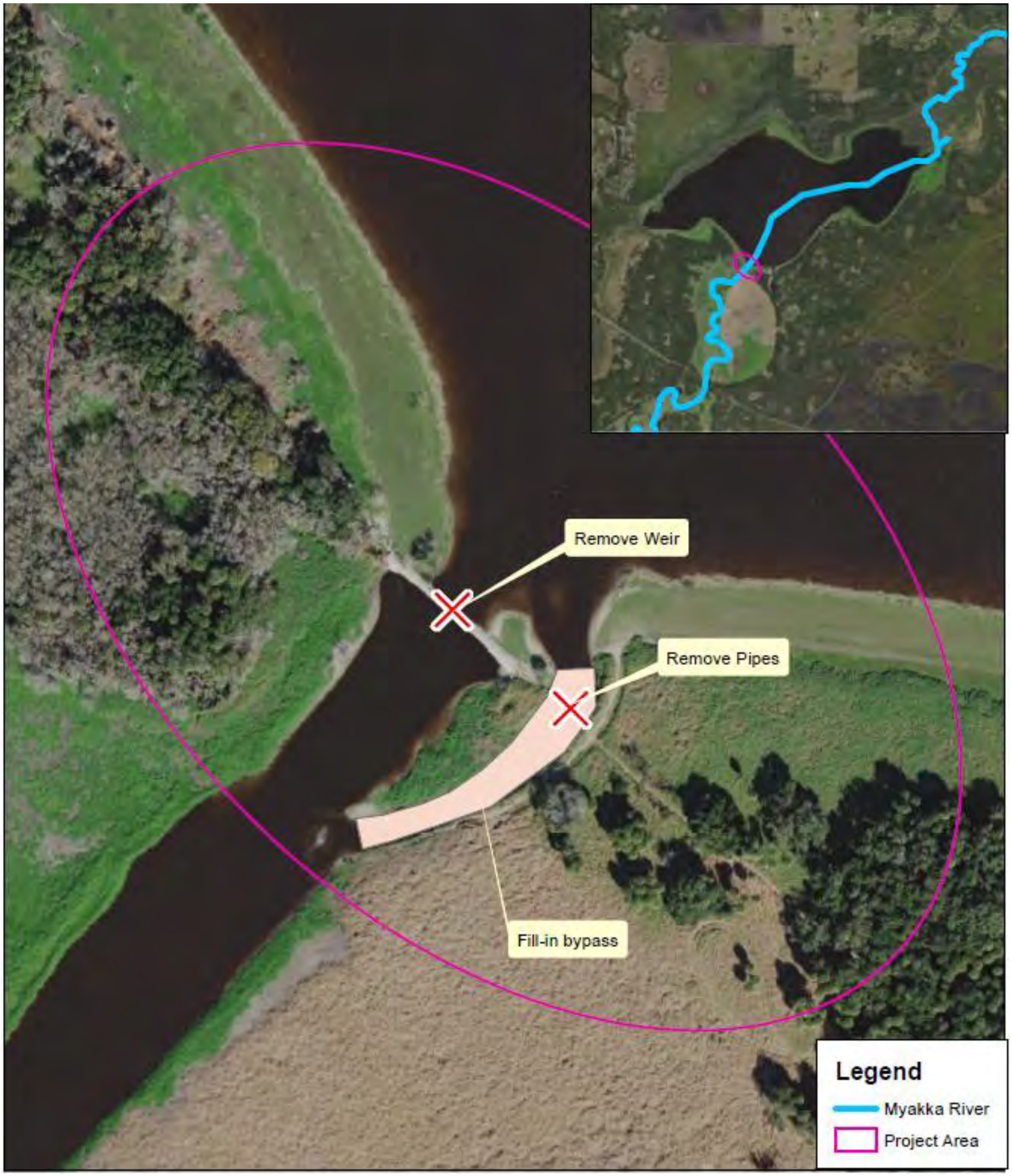


**Figure 6 - Alternative 2 – Amend Option**

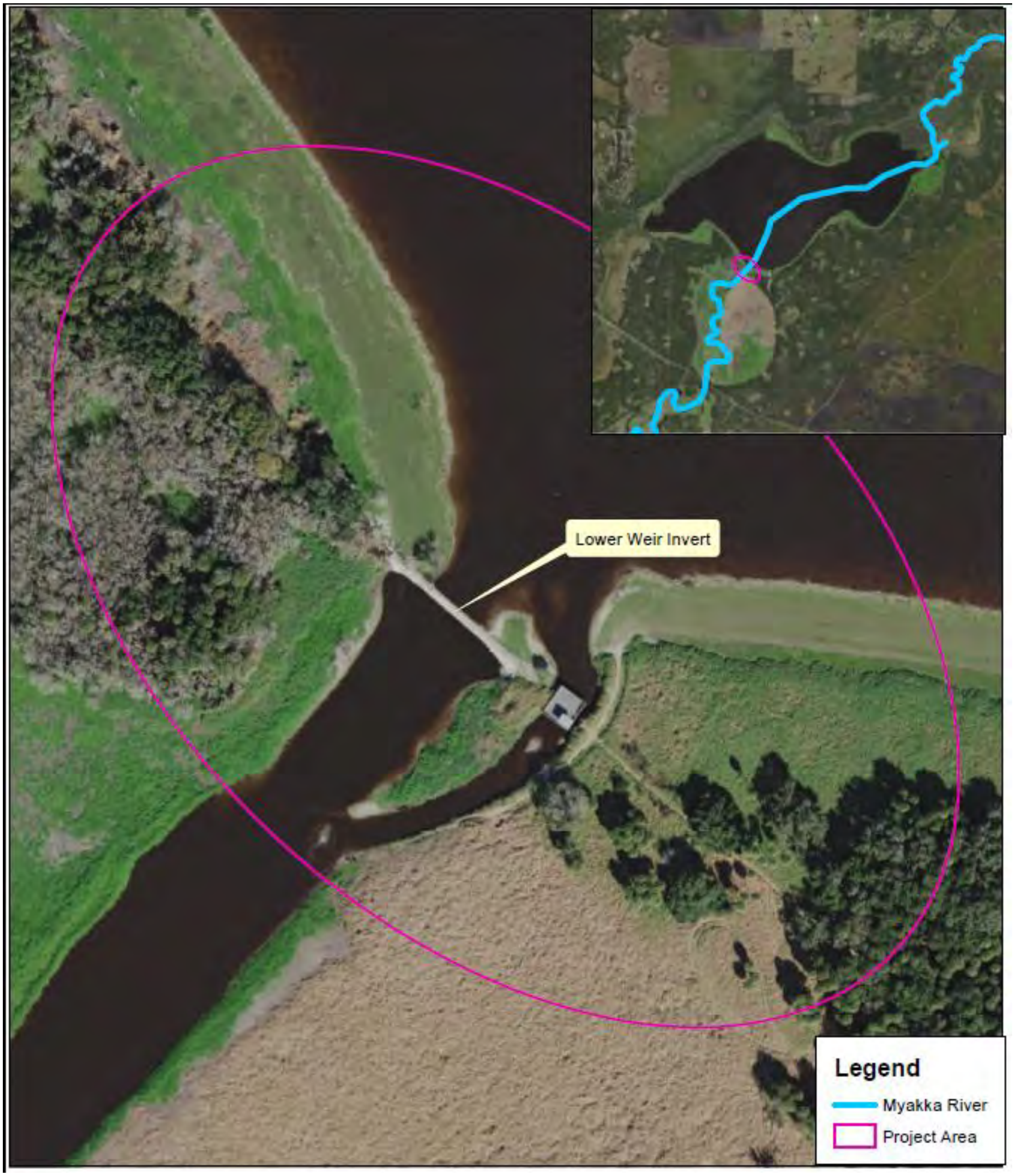


**Figure 7 - Simulated Upper Myakka Lake Water Level for Proposed Alternatives**

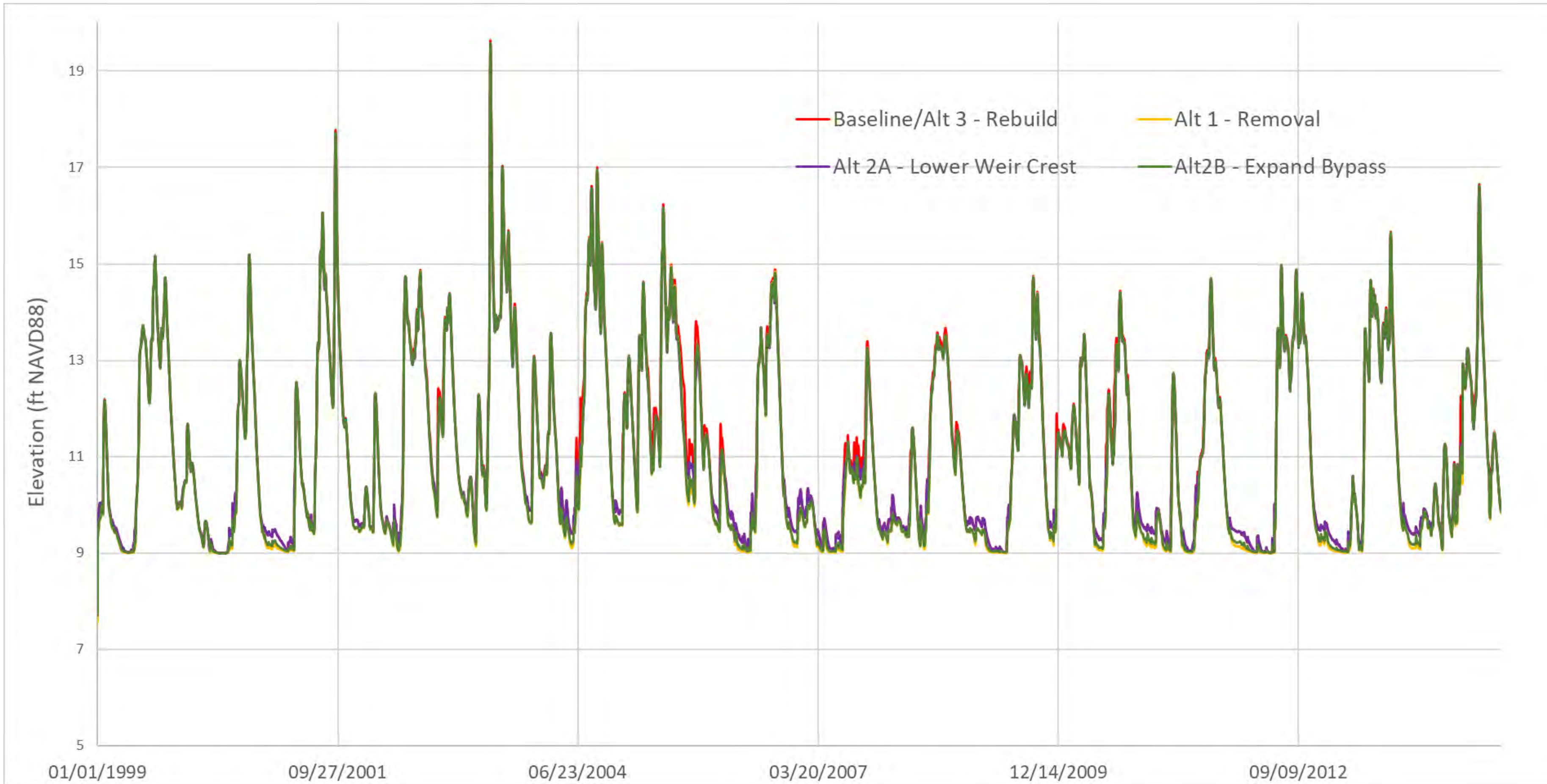


**Figure 8 - Simulated Water Level Time-Series for 2007 for Proposed Alternatives**

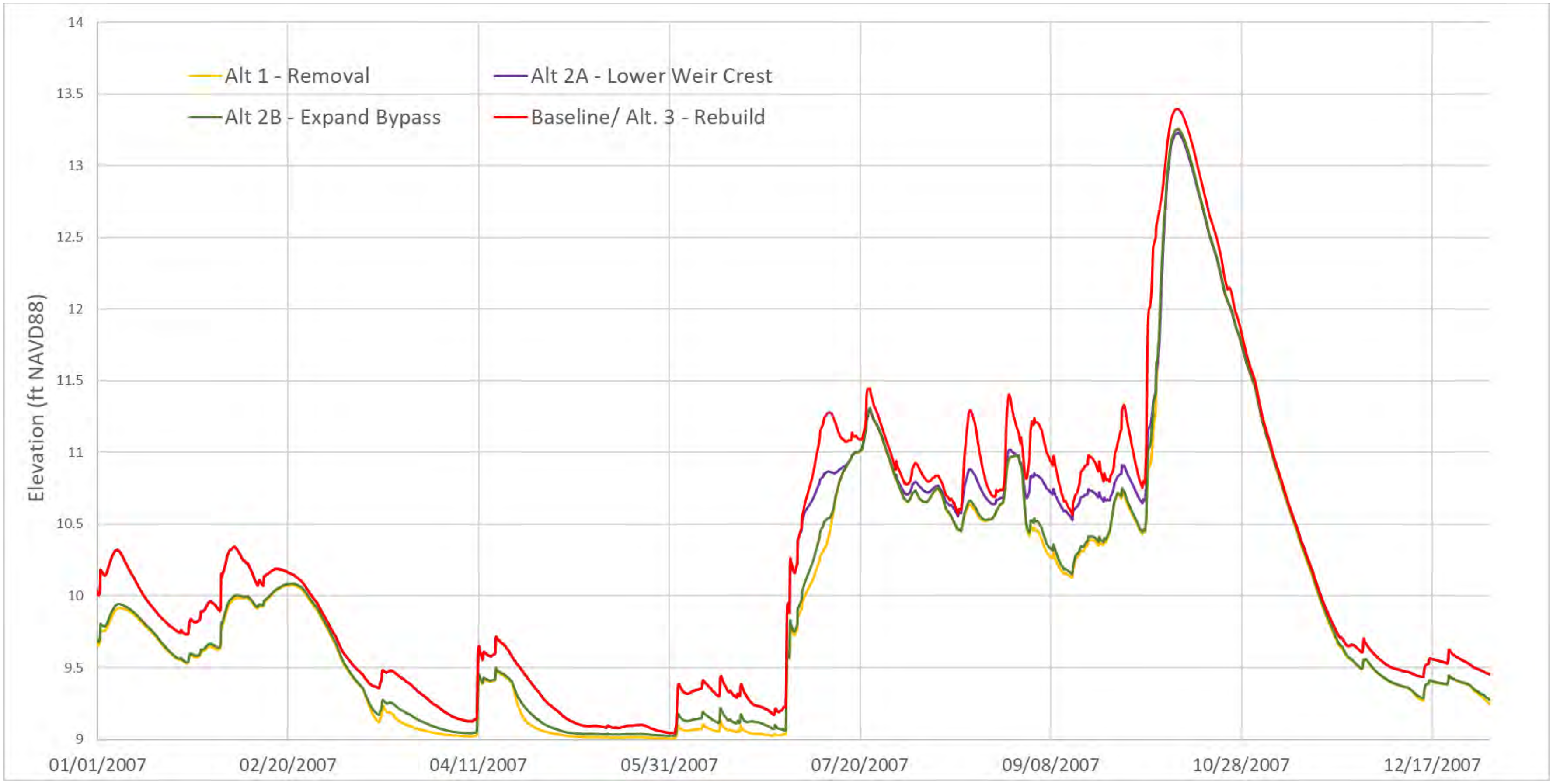


**Figure 9 - Water Level Exceedance Frequency Curve for Proposed Alternatives**

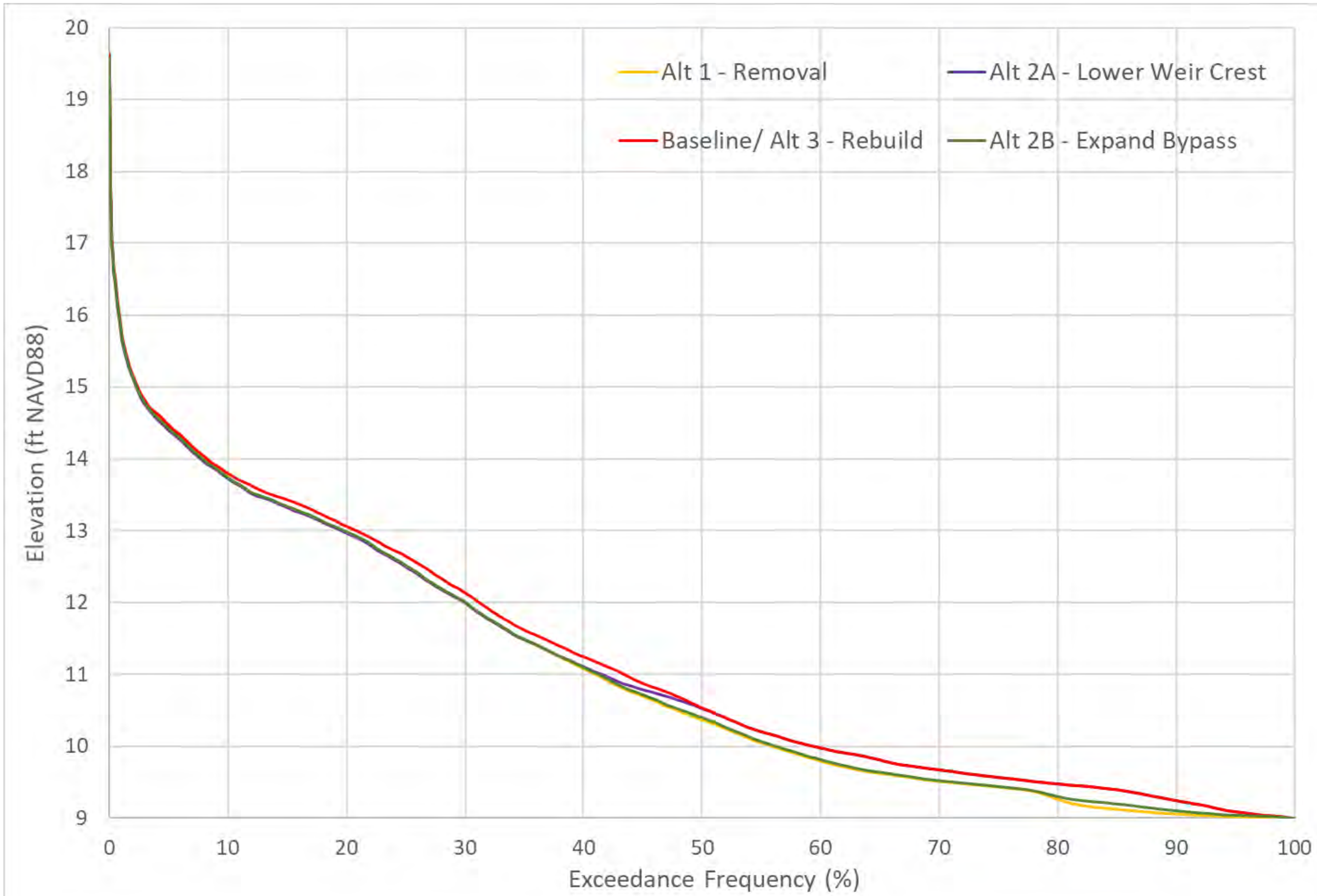


**Figure 10 - 0-2.5% Exceedance Frequency Water Levels**

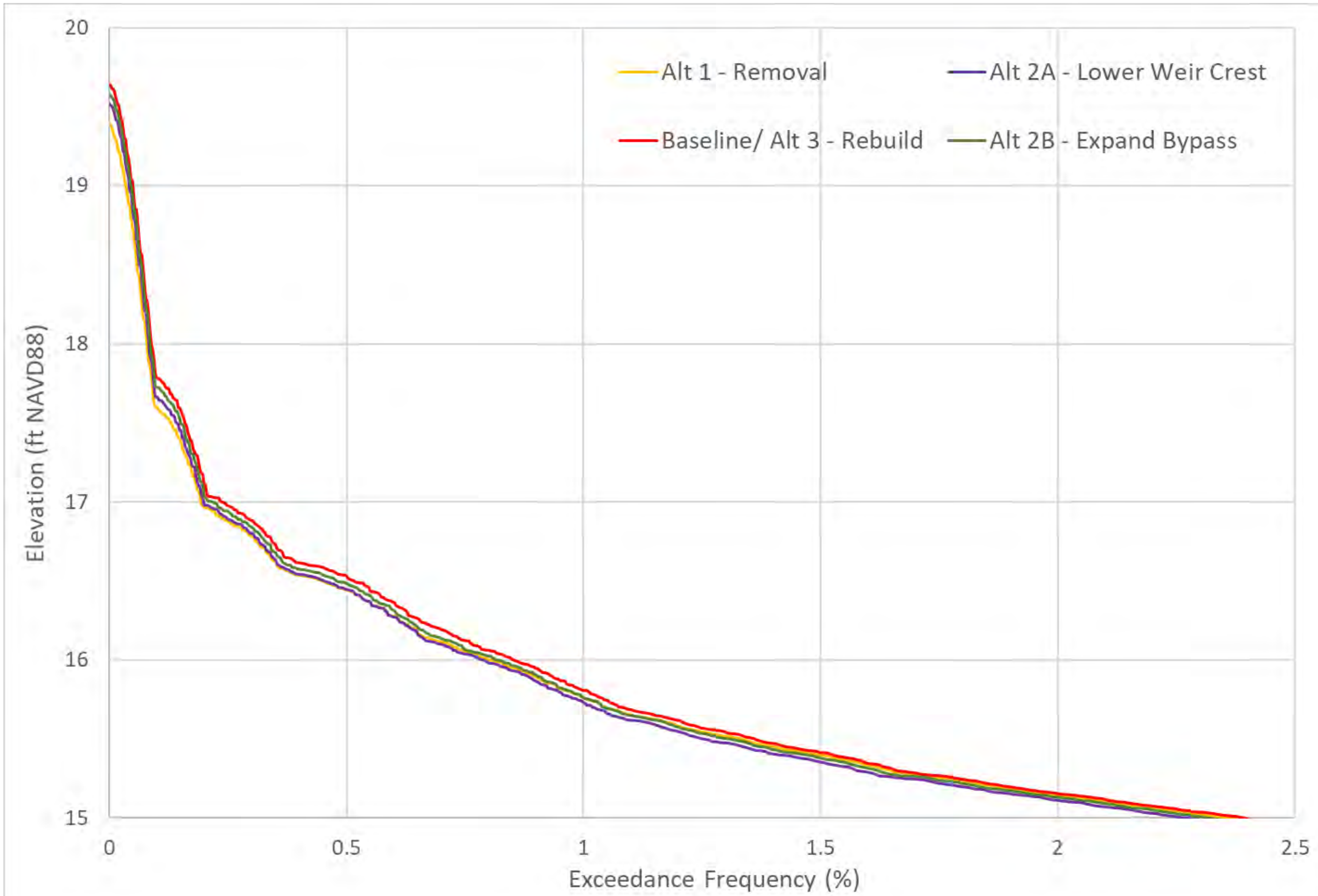


**Figure 11 - 10%-50% Exceedance Frequency Water Levels**

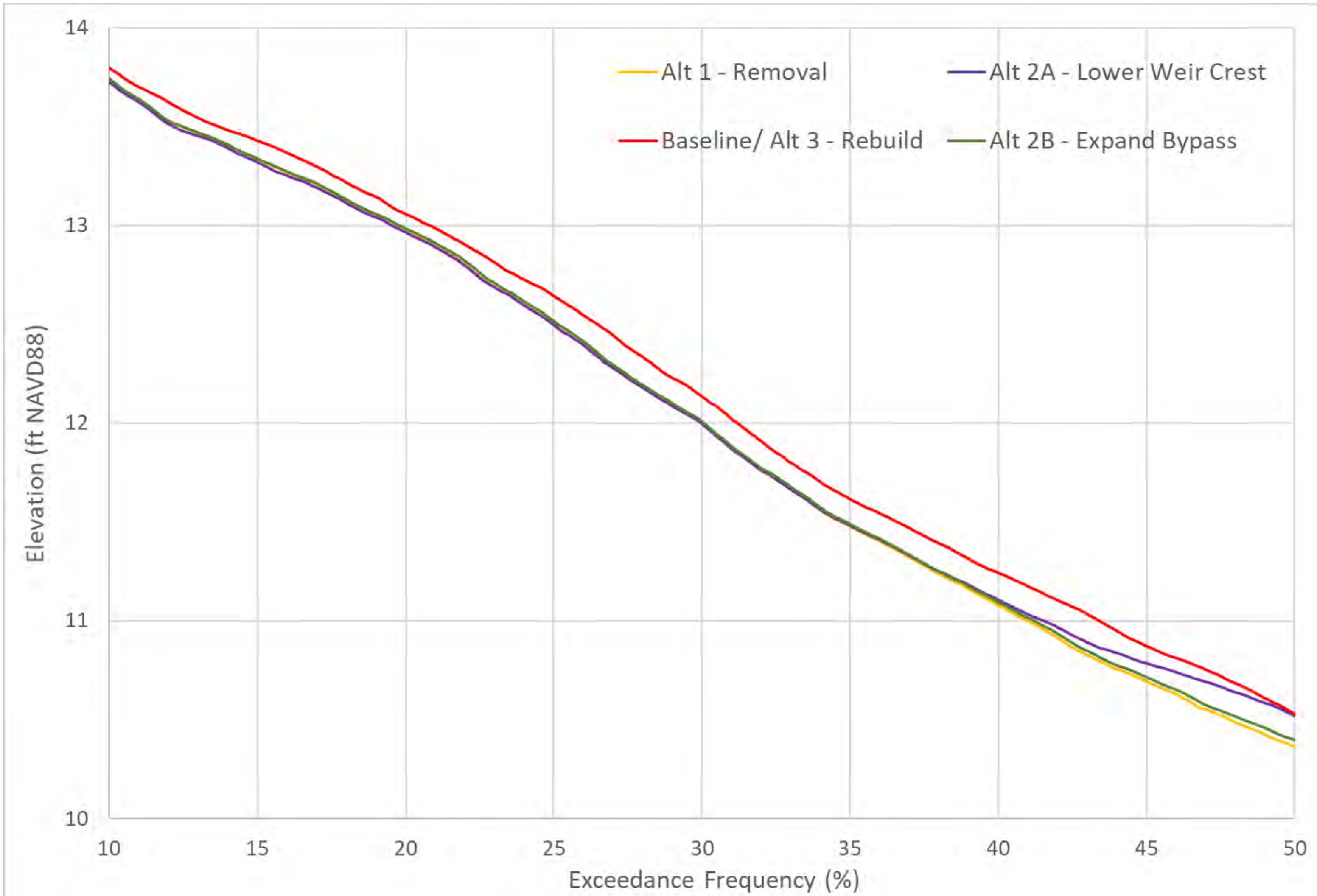


**Figure 12 - 75%-100% Exceedance Frequency Water Levels**

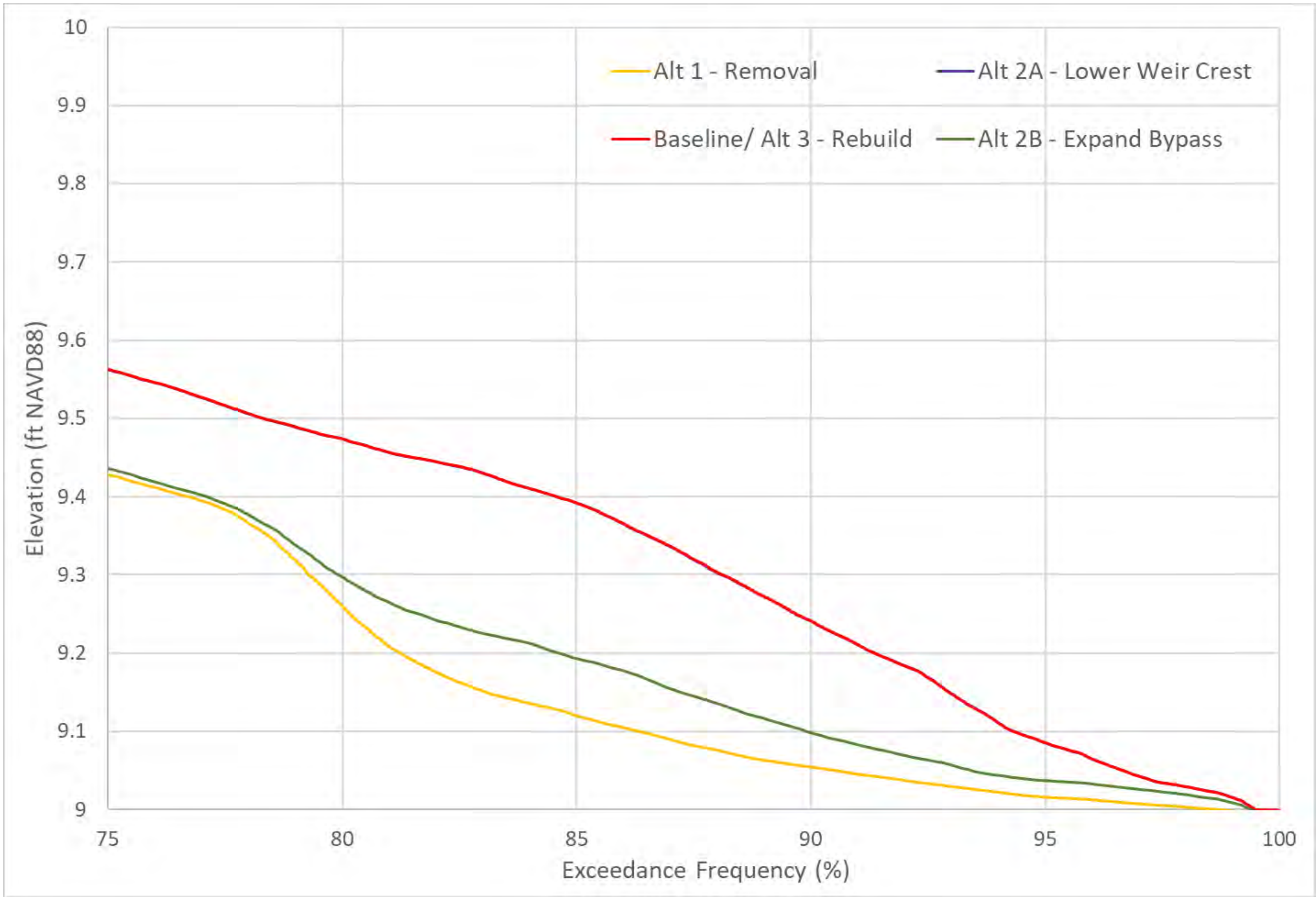
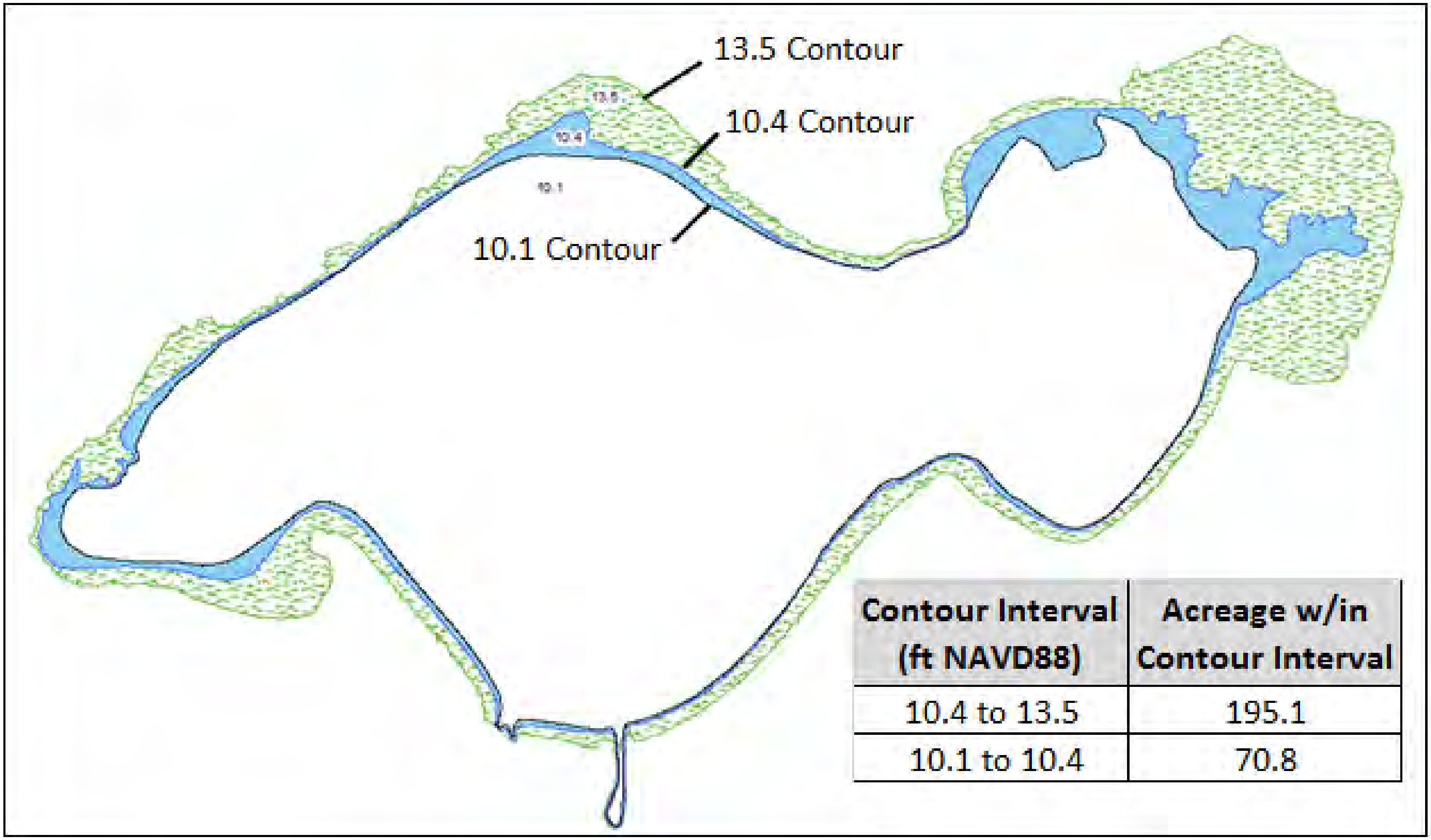


**Figure 13 - Additional Acreage Resulting from 0.3 ft Lowering of Seasonal Low Water in UML**




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

**Figure 14 - Simulated Downstream Flow and Corresponding Inflow and Lake Level Time-Series**

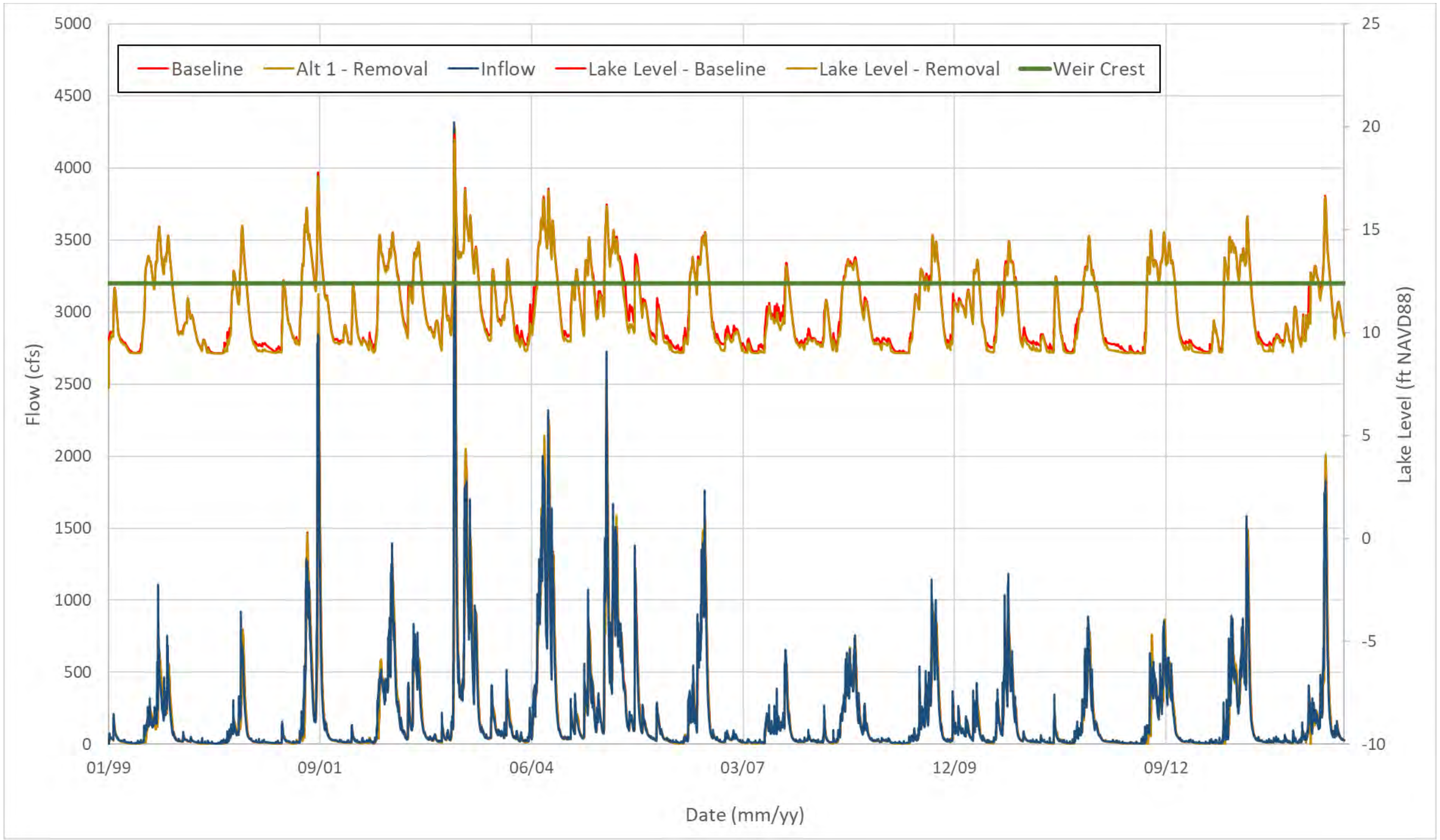


**Figure 15 (a) - Simulated Downstream Flow and Corresponding Inflow and Lake Level Time-Series for Selected Period of Record**

**(Lake Level Above Weir Crest)**

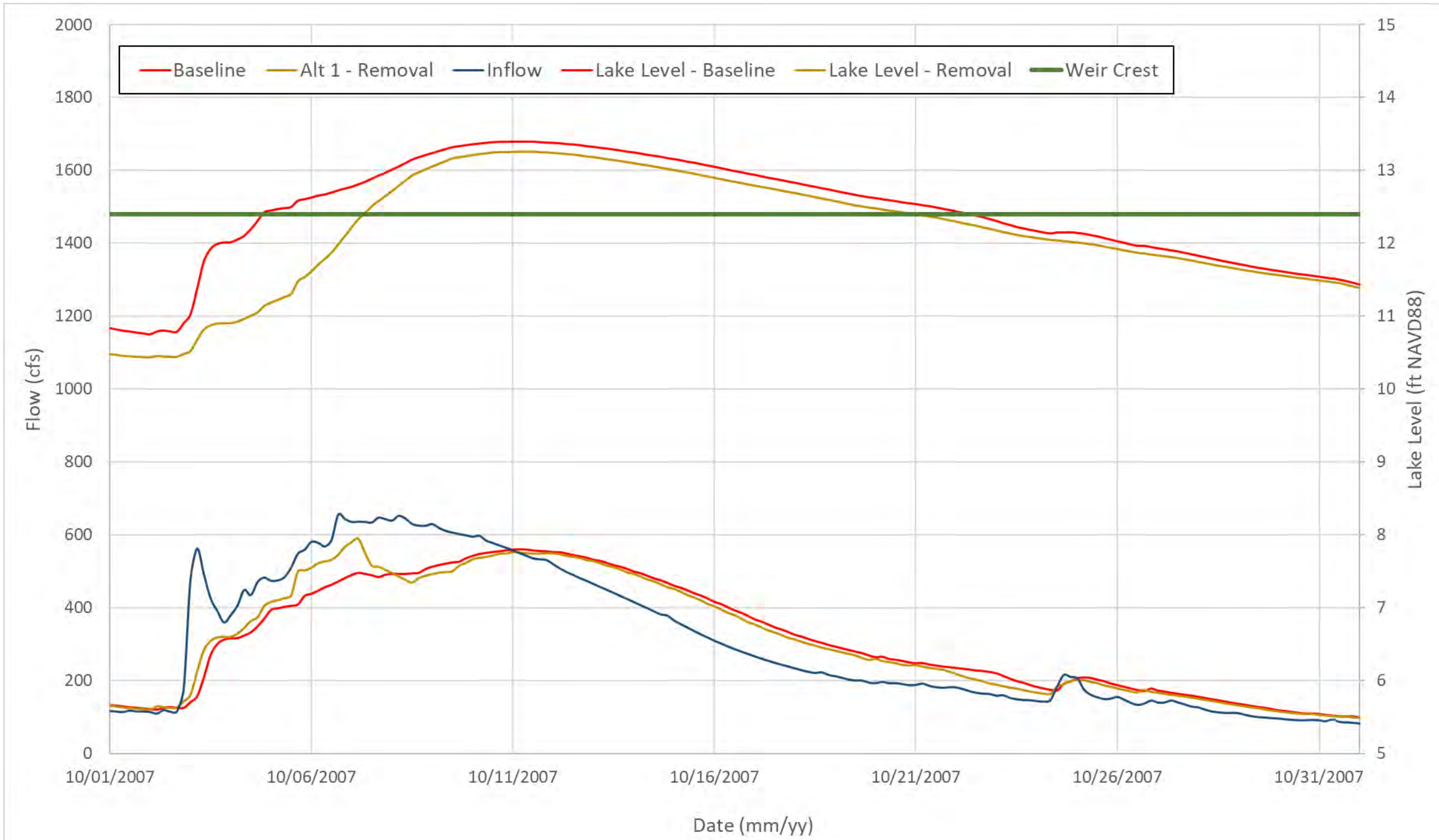
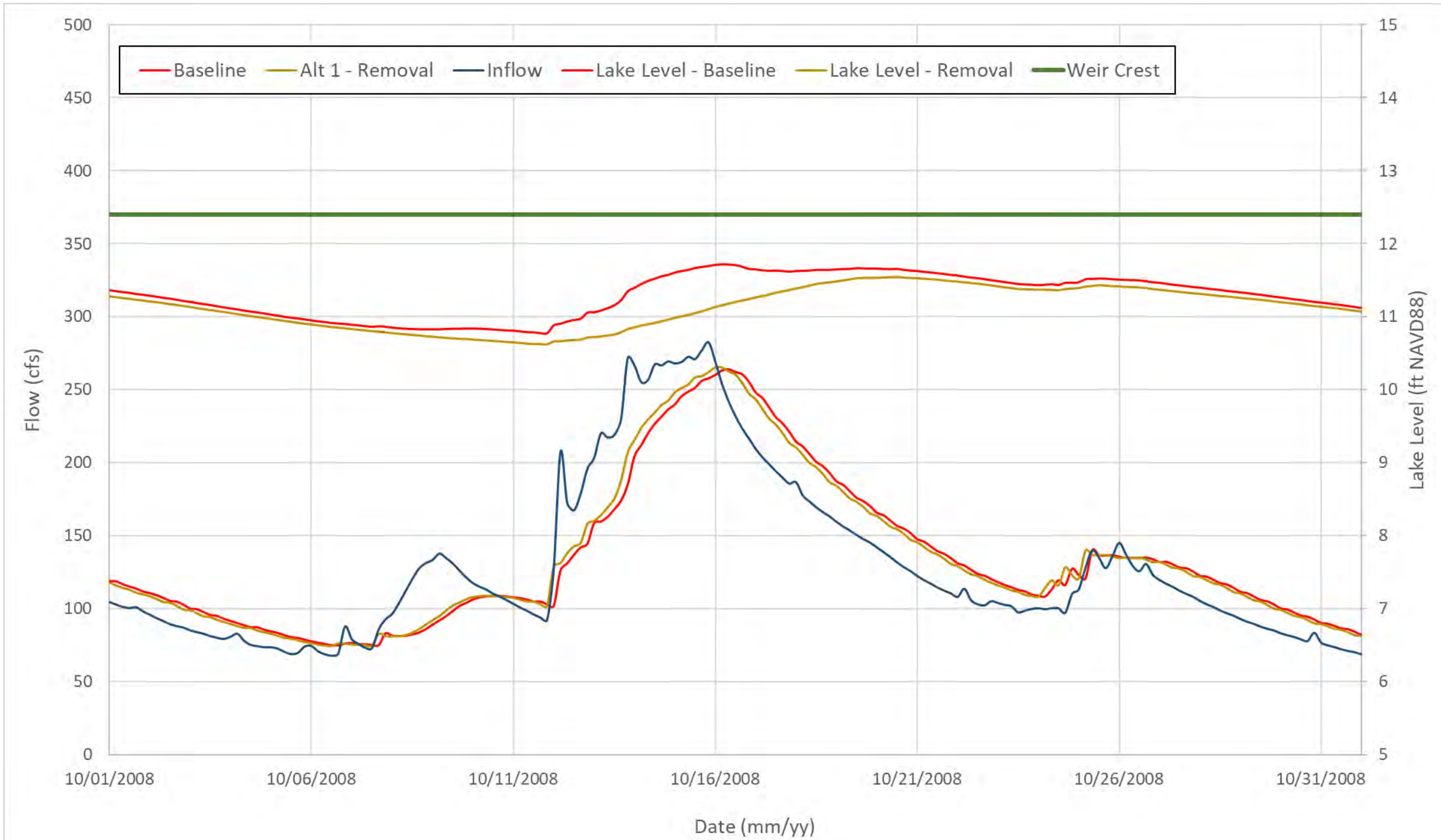


**Figure 15 (b) - Simulated Downstream Flow and Corresponding Inflow and Lake Level Time-Series for Selected Period of Record**

**(Lake Level Below Weir Crest)**



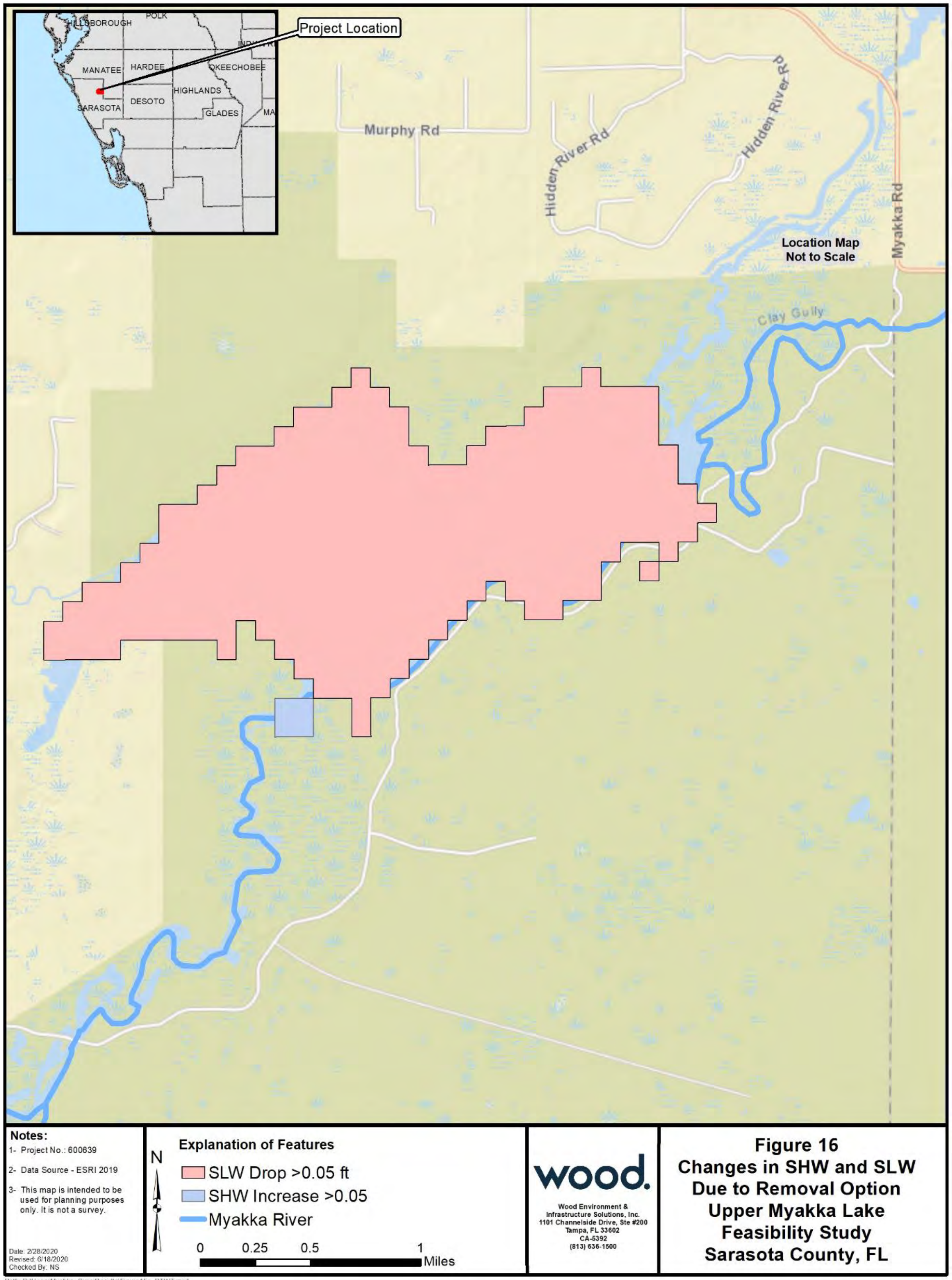
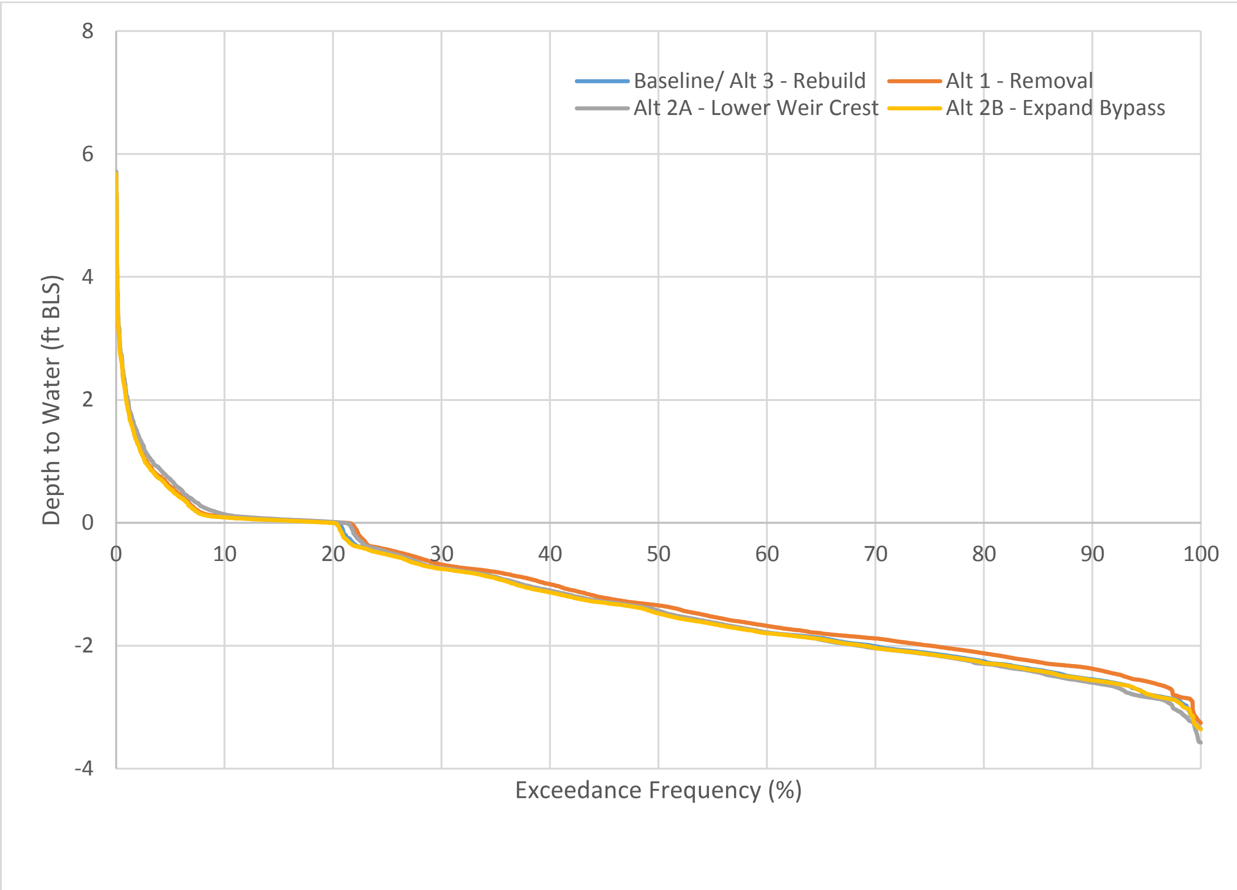



**Figure 16**
**Changes in SHW and SLW Due to Removal Option**
**Upper Myakka Lake Feasibility Study**
**Sarasota County, FL**

Path: D:\UpperMyakka_Sims\Results\Figure15a_DTWT.mxd

**Figure 17 - Downstream Wetlands (Big Flats) Depth to Water Exceedance Frequency Curve for Proposed Alternatives**



# APPENDIX F

Cost Estimates

**ENGINEER'S OPINION OF PROBABLE COST**
**UPPER MYAKKA LAKE RESTORATION PROJECT, SARASOTA COUNTY, FLORIDA**
**ALTERNATIVE 1 - REMOVAL OF WATER CONTROL STRUCTURES AND EARTHFILL**

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNITS | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $49,124.61 | $49,125 |
| 2 | Mobilization and Demobilization | 1 | LS | $44,658.74 | $44,659 |
| 3 | Pollution Control | 1 | LS | $8,064.98 | $8,065 |
| 4 | Clearing and Grubbing | 1 | LS | $3,260.48 | $3,260 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $115,148.60 | $115,149 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Earthfill | 1 | LS | $68,795.41 | $68,795 |
| 9 | Vegetative Measures | 1 | LS | $13,524.69 | $13,525 |
| **SUBTOTAL** | | | | | **$540,371** |
| **TOTAL ESTIMATE (PLUS 10% CONTINGENCY)** | | | | | **$594,408** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 1 Final Design & Permitting | | |

**1. Quantity**

| | | | |
|---|---|---|---|
| A. Final Design and Permitting | | 1 | LS |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Final Design and Permitting | $49,124.61 | per LS |
| | | | Source: Standard industry rate |

**3. Total Item Cost**

| | | |
|---|---|---|
| | Final Design and Permitting | $49,124.61 |
| | **Total Cost** | **$49,124.61** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 2 Mobilization and Demobilization | | |

**1. Quantity**

A. Mobilization and Demobilization — $44,658.74

(Hauling construction equipment and supplies to/from site) — Source: 10% of the project

**2. Total Item Cost**

1 Job x $44,658.74 per Job = $44,658.74

**Total Cost** **$44,658.74**

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 3 Pollution Control | | |

**1. Quantity**

| | | |
|---|---|---|
| A. Floating Turbidity Barrier | 420 | LF |
| B. Soil Tracking Prevention Device | 1 | EA |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Furnish and Install Floating Turbidity Barrier | $10.85 | per LF<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 11<br>Floating Turbidity Barrier |
| | Floating Turbidity Barrier Maintenance | $1.09 | per LF<br>Source: RSMeans - 2019<br>L# 312514161100 Stabilization measures for erosion and sediment control<br>allow 10% per month for maintenance |
| | Soil Tracking Prevention Device | $2,802.28 | per EA<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 15<br>Soil Tracking Prevention Device |
| | NPDES Fee | $250.00 | per EA<br>Source: FDEP NPDES Fee Schedule<br>Small Construction (< 5 acres)<br>http://www.dep.state.fl.us/water/stormwater/npdes/fees.htm |

**3. Total Item Cost**

| | | | |
|---|---|---|---|
| Floating Turbidity Barrier | 420 LF x | $10.85 per LF = | $4,557.00 |
| Floating Turbidity Barrier Maintenance | 420 LF x | $1.09 per LF = | $455.70 |
| Soil Tracking Prevention Device | 1 EA x | $2,802.28 per EA = | $2,802.28 |
| NPDES Fee | 1 EA x | $250.00 per EA = | $250.00 |
| | | **Total Cost =** | **$8,064.98** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 4 Clearing and Grubbing | | |

**1. Quantity**

A. Clear and Grub Area

Estimated area from CAD: 21,650 SF — 0.50 AC

**2. Bid Estimate**

A. Unit Cost

Brush Mowing — $655.32 per Acre

Source: RSMeans - 2020
L# 311313101040 Brush mowing, tractor w/ rotary mower, no removal
Medium density

Topsoil Stripping and Stockpiling — $5,904.80 per Acre

Source: RSMeans - 2020
L# 311413231550 Topsoil stripping and stockpiling
By dozer, 6" deep, 200' haul, ($0.61/SY converted to Acres)
($2952.40/AC multiplied by 2 to account for double moving of soil)

**3. Total Item Cost**

| | | | | | | |
|---|---|---|---|---|---|---|
| Brush Mowing | 0.50 AC | x | $655 | per AC | = | $325.70 |
| Topsoil Stripping | 0.50 AC | x | $5,905 | per AC | = | $2,934.78 |
| | | | | | Total Cost | **$3,260.48** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 5 Construction Surveys | | |

**1. Quantity**

A. Construction Surveys

| | | | |
|---|---|---|---|
| Survey Stake Out and Construction Layout | | | |
| | Crew | 40 | hours |
| | Tech | 24 | hours |
| | PLS | 16 | hours |
| | Hotel | 1 | LS |
| | Per diem | 1 | LS |
| As-built and Record Drawings | | | |
| | Crew | 40 | hours |
| | Tech | 24 | hours |
| | PLS | 16 | hours |
| | Hotel | 1 | LS |
| | Per diem | 1 | LS |

**2. Bid Estimate**

A. Unit Cost

| | | | |
|---|---|---|---|
| Survey Stake Out and Construction Layout | | | |
| | Crew | $140.00 | per hour |
| | Tech | $80.00 | per hour |
| | Professional Land Surveyor | $155.00 | per hour |
| | | | Source: Standard industry rates |
| As-built and Record Drawings | | | |
| | Crew | $140.00 | per hour |
| | Tech | $80.00 | per hour |
| | Professional Land Surveyor | $155.00 | per hour |
| | | | Source: Standard industry rates |
| Hotel | | $450.00 | per LS |
| | | | Source: Standard industry rates |
| Per Diem | | $400.00 | per LS |
| | | | Source: Standard industry rates |

**3. Total Item Cost**

| | | |
|---|---|---|
| Survey Stake Out and Construction Layout | | |
| | Crew | $5,600.00 |
| | Tech | $1,920.00 |
| | Professional Land Surveyor | $2,480.00 |
| | Hotel | $450.00 |
| | Per diem | $400.00 |
| As-built and Record Drawings | | |
| | Crew | $5,600.00 |
| | Tech | $1,920.00 |
| | Professional Land Surveyor | $2,480.00 |
| | Hotel | $450.00 |
| | Per diem | $400.00 |
| | **Total Cost** | **$21,700.00** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 6 Dewatering | | |

**1. Quantity**

A. Dam Area Earthfill Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Dam Area Earthfill | | 100 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 700 | SF |
| Downstream Sheet Pile Cofferdam for Dam Area Earthfill | | 150 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 1050 | SF |
| Sheet Pile Removal | | 8 | hours |

B. Bypass Channel Earthfill Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Bypass Channel Earthfill | | 170 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 1190 | SF |
| Downstream Sheet Pile Cofferdam for Bypass Channel Earthfill | | 140 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 980 | SF |
| Sheet Pile Removal | | 8 | hours |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Dewatering Pump (6") | $1,112.95 | per day<br>Source: RSMeans - 2020<br>L# 312319201100 Dewatering Systems<br>Pumping 8 hrs, attended 2 hrs/day, 20 LF suction hose,<br>100 LF discharge hose, 6" centrifugal pump |
| Temporary Sheet Pile Installation | $23.35 | SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0455133 2<br>Sheet Piling Steel, Temporary-Critical |
| Equipment Operator, Medium Equip. | $84.85 | per hour<br>Source: RSMeans 2020<br>Cost per labor hour for equipment operator, medium equipment<br>Includes O&P |

**3. Total Item Cost**

| | | | | | |
|---|---|---|---|---|---|
| Dam Area Dewatering | 10 | days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 1,750 | SF x | $23.35 | per SF = | $40,862.50 |
| Sheet Pile Removal | 8 | HR x | $84.85 | per HR = | $678.80 |
| | | Dam Area Dewatering Total Cost | | | $52,670.80 |
| Bypass Channel Dewatering | 10 | days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 2,170 | SF x | $23.35 | per SF = | $50,669.50 |
| Sheet Pile Removal | 8 | HR x | $84.85 | per HR = | $678.80 |
| | | Bypass Channel Dewatering Total Cost | | | $62,477.80 |
| | | | | **Total Cost** | **$115,148.60** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 7 Structure Removal | | |

**1. Quantity**

| | | | | | |
|---|---|---|---|---|---|
| A. Existing Weir Structure (and coquina walls) | Estimated area from CAD: | | | 2,917 | SF |
| | Volume estimate: | | | 391 | CY |
| | Weight estimate: | | | 469 | TN |
| B. Existing Remnant Pipes | Only pipe ribs remaining (assume material equal to one full pipe) | | | | |
| | Length (FT) | Width (FT) | | | |
| | | 43 | 5 | 215 | SF |
| | Volume estimate: | | | 31 | CY |
| | Weight estimate: | | | 3 | TN |
| | Source: 118 lbs/ft - Contech Galvanized, 10 Gage, 3"x1" Corrugated Steel Pipe | | | | |
| C. Deck Structure | Length (FT) | Width (FT) | | | |
| | | 40 | 36 | 1,440 | SF |
| | Volume estimate: | | | 53 | CY |
| | Weight estimate: | | | 29 | TN |
| | Source: 40 lbs/cf - engineeringtoolbox.com | | | | |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Structure Removal | $30.28 | per SF |
| | | | Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31) |
| | | | Item: 0110 3 |
| | | | Removal of existing structures/bridges |
| | Hauling (to County landfill) | $11.84 | per CY |
| | | | Source: RSMeans - 2020 |
| | | | L# 312323209104 Hauling |
| | | | 18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 45 mph, cycle 50 miles |
| | Structure Disposal | $54.00 | per Ton |
| | | | Source: Sarasota County Lanfill Disposal Rates/Tipping Fees 2020 |

**3. Total Item Cost**

| | |
|---|---|
| Structure Removal | $138,440.16 |
| Hauling (to County landfill) | $37,662.69 |
| Structure Disposal | $39,990.38 |
| **Total Cost** | **$216,093.22** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 8 Earthfill | | |

**1. Quantity**

A. Earthwork

| | | | |
|---|---|---|---|
| Fill for Dam Area | | 1962 | CY |
| Fill for Bypass Channel | | 394 | CY |
| | Total Compacted CY Needed: | 2356 | CY |
| | Total Truck Fill Volume: | 3927 | CY |
| Grading for Proposed Channel Cross Section | | 117 | CY |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Imported Fill Material | $5.55 | per CY<br>Source: Hi-Hat Fill Dirt - 2020<br>11270 SR72 Sarasota, FL<br>Fill dirt: $5.55/CY, not delivered |
| Imported Fill Hauling | $7.11 | per CY<br>Source: RSMeans - 2020<br>L# 312323209080 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 40 mph, cycle 20 miles |
| Spreading Fill/Grading | $3.03 | per CY<br>Source: RSMeans - 2020<br>L# 312323144400 Backfill, structural, dozer, from stockpile, no compaction<br>200 hp, 300' haul, sand and gravel |
| Compaction | $1.74 | per CY<br>Source: RSMeans - 2020<br>L# 312323240300 Compaction, structural, common fill, 8" lifts<br>Sheepsfoot or wobbly wheel roller |

**3. Total Item Cost**

| | |
|---|---|
| Imported Fill | $49,711.60 |
| Spreading Fill/Grading | $12,251.41 |
| Compaction | $6,832.40 |
| **Total Cost** | **$68,795.41** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 4/1/2020 |
| Check by: | T. Davies | Date: | 4/2/2020 |
| Bid Item: | 9 Vegetative Measures | | |

**1. Quantity**

| | | |
|---|---|---|
| A. Seeding and Mulching | 17,100 SF | 0.39 AC |
| B. Sod | 21,650 SF | 2,406 SY |
| C. Water Truck | | 60 HR |

**2. Bid Estimate**

A. Unit Cost

Seeding/Fertilizer — $4,452.80 per AC
Source: RSMeans - 2020
L# 329219131000 Hydro seeding for large areas, including seed and fertilizer
$0.92/SY converted to per acre

Mulching — $2,817.03 per AC
Source: RSMeans - 2020
L# 329113160350 Soil Preparation
Hay, 1" deep, power mulcher, large ($64.67/1000 SF converted to acres)

Sod — $2.67 per SY
Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)
Item 0570 1 2
Performance Turf, Sod

Water Truck Operator — $70.80 per hour
Source: RSMeans 2020
Cost per labor hour for equipment operator, medium equipment
Includes O&P
hourly operating cost of $70.80 (over 4 weeks, 15 hrs per week)

**3. Total Item Cost**

| | | | | |
|---|---|---|---|---|
| Seeding/Fertilizer | 0.39 AC | x | $4,452.80 per acre | $1,748.00 |
| Mulch | 0.39 AC | x | $2,817.03 per acre | $1,105.86 |
| Sod | 2,406 SY | x | $2.67 per SY | $6,422.83 |
| Water Truck | 60 HR | x | $70.80 per HR | $4,248.00 |
| | | | **Total Cost** | **$13,524.69** |

**ENGINEER'S OPINION OF PROBABLE COST**
**UPPER MYAKKA LAKE RESTORATION PROJECT, SARASOTA COUNTY, FLORIDA**
**ALTERNATIVE 2 - WEIR MODIFICATION AND PIPE REBUILD**

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNITS | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $93,037.04 | $93,037 |
| 2 | Mobilization and Demobilization | 1 | LS | $75,488.22 | $75,488 |
| 3 | Pollution Control | 1 | LS | $8,303.68 | $8,304 |
| 4 | Clearing and Grubbing | 1 | LS | $1,656.60 | $1,657 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $95,534.60 | $95,535 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Weir Structure | 1 | LS | $268,568.47 | $268,568 |
| 9 | Pipe Structure | 1 | LS | $80,413.31 | $80,413 |
| 10 | Vegetative Measures | 1 | LS | $10,265.06 | $10,265 |
| 11 | Long-term Monitoring and Maintenance | 1 | LS | $52,347.27 | $52,347 |
| **SUBTOTAL** | | | | | **$923,407** |
| **TOTAL CONSTRUCTION ESTIMATE (PLUS 10% CONTINGENCY)** | | | | | **$1,015,748** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 1 Final Design and Permitting | | |

**1. Quantity**

| | | | |
|---|---|---|---|
| A. Geotechnical Investigation | Weir Footer/Subbase | 1 | LS |
| B. Final Design and Permitting | | 1 | LS |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Geotechnical Investigation | $10,000.00 | per LS<br>Source: Standard industry rate |
| | Final Design and Permitting | $83,037.04 | per LS<br>Source: Standard industry rate |

**3. Total Item Cost**

| | | |
|---|---|---|
| | Geotechnical Investigation | $10,000.00 |
| | Final Design and Permitting | $83,037.04 |
| | **Total Cost** | **$93,037.04** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 2 Mobilization and Demobilization | | |

**1. Quantity**

A. Mobilization and Demobilization — $75,488.22

(Hauling construction equipment and supplies to/from site) — Source: 10% of the project

**2. Total Item Cost**

1 Job x $75,488.22 per Job = $75,488.22

**Total Cost** **$75,488.22**

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 3 Pollution Control | | |

**1. Quantity**

| | | |
|---|---|---|
| A. Floating Turbidity Barrier | 440 | LF |
| B. Soil Tracking Prevention Device | 1 | EA |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Furnish and Install Floating Turbidity Barrier | $10.85 | per LF<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 11<br>Floating Turbidity Barrier |
| | Floating Turbidity Barrier Maintenance | $1.09 | per LF<br>Source: RSMeans - 2019<br>L# 312514161100 Stabilization measures for erosion and sediment control<br>allow 10% per month for maintenance |
| | Soil Tracking Prevention Device | $2,802.28 | per EA<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 15<br>Soil Tracking Prevention Device |
| | NPDES Fee | $250.00 | per EA<br>Source: FDEP NPDES Fee Schedule<br>Small Construction (< 5 acres)<br>http://www.dep.state.fl.us/water/stormwater/npdes/fees.htm |

**3. Total Item Cost**

| | | | |
|---|---|---|---|
| Floating Turbidity Barrier | 440 LF x | $10.85 per LF = | $4,774.00 |
| Floating Turbidity Barrier Maintenance | 440 LF x | $1.09 per LF = | $477.40 |
| Soil Tracking Prevention Device | 1 EA x | $2,802.28 per EA = | $2,802.28 |
| NPDES Fee | 1 EA x | $250.00 per EA = | $250.00 |
| | | **Total Cost =** | **$8,303.68** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 4 Clearing and Grubbing | | |

**1. Quantity**

A. Clear and Grub Area

Estimated area from CAD: 11,000 SF — 0.25 AC

**2. Bid Estimate**

A. Unit Cost

Brush Mowing — $655.32 per Acre

Source: RSMeans - 2020
L# 311313101040 Brush mowing, tractor w/ rotary mower, no removal
Medium density

Topsoil Stripping and Stockpiling — $5,904.80 per Acre

Source: RSMeans - 2020
L# 311413231550 Topsoil stripping and stockpiling
By dozer, 6" deep, 200' haul, ($0.61/SY converted to Acres)
($2952.40/AC multiplied by 2 to account for double moving of soil)

**3. Total Item Cost**

| | | | | | | |
|---|---|---|---|---|---|---|
| Brush Mowing | 0.25 AC | x | $655 | per AC | = | $165.48 |
| Topsoil Stripping | 0.25 AC | x | $5,905 | per AC | = | $1,491.11 |
| | | | | Total Cost | | **$1,656.60** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 5 Construction Surveys | | |

**1. Quantity**

A. Construction Surveys — Survey Stake Out and Construction Layout

| | | |
|---|---|---|
| Crew | 40 | hours |
| Tech | 24 | hours |
| PLS | 16 | hours |
| Hotel | 1 | LS |
| Per diem | 1 | LS |

As-built and Record Drawings

| | | |
|---|---|---|
| Crew | 40 | hours |
| Tech | 24 | hours |
| PLS | 16 | hours |
| Hotel | 1 | LS |
| Per diem | 1 | LS |

**2. Bid Estimate**

A. Unit Cost — Survey Stake Out and Construction Layout

| | | |
|---|---|---|
| Crew | $140.00 | per hour |
| Tech | $80.00 | per hour |
| Professional Land Surveyor | $155.00 | per hour |
| | | Source: Standard industry rates |

As-built and Record Drawings

| | | |
|---|---|---|
| Crew | $140.00 | per hour |
| Tech | $80.00 | per hour |
| Professional Land Surveyor | $155.00 | per hour |
| | | Source: Standard industry rates |
| Hotel | $450.00 | per LS |
| | | Source: Standard industry rates |
| Per Diem | $400.00 | per LS |
| | | Source: Standard industry rates |

**3. Total Item Cost**

Survey Stake Out and Construction Layout

| | |
|---|---|
| Crew | $5,600.00 |
| Tech | $1,920.00 |
| Professional Land Surveyor | $2,480.00 |
| Hotel | $450.00 |
| Per diem | $400.00 |

As-built and Record Drawings

| | |
|---|---|
| Crew | $5,600.00 |
| Tech | $1,920.00 |
| Professional Land Surveyor | $2,480.00 |
| Hotel | $450.00 |
| Per diem | $400.00 |
| **Total Cost** | **$21,700.00** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 6 Dewatering | | |

**1. Quantity**

A. Weir Structure Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Weir Structure | | 110 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 770 | SF |
| Downstream Sheet Pile Cofferdam for Weir Structure | | 180 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 1260 | SF |
| Sheet Pile Removal | | 8 | hours |

B. Pipes Sturcture Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Pipe Structure | | 80 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 560 | SF |
| Downstream Sheet Pile Cofferdam for Pipe Structure | | 70 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 490 | SF |
| Sheet Pile Removal | | 8 | hours |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Dewatering Pump (6") | $1,112.95 | per day<br>Source: RSMeans - 2020<br>L# 312319201100 Dewatering Systems<br>Pumping 8 hrs, attended 2 hrs/day, 20 LF suction hose,<br>100 LF discharge hose, 6" centrifugal pump |
| Temporary Sheet Pile Installation | $23.35 | SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0455133 2<br>Sheet Piling Steel, Temporary-Critical |
| Equipment Operator, Medium Equip. | $84.85 | per hour<br>Source: RSMeans 2020<br>Cost per labor hour for equipment operator, medium equipment<br>Includes O&P |

**3. Total Item Cost**

| | | | | |
|---|---|---|---|---|
| Weir Structure Dewatering | 10 days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 2,030 SF x | $23.35 | per SF = | $47,400.50 |
| Sheet Pile Removal | 8 HR x | $84.85 | per HR = | $678.80 |
| | | Weir Structure Total Cost | | $59,208.80 |
| Pipe Structure Dewatering | 10 days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 1,050 SF x | $23.35 | per SF = | $24,517.50 |
| Sheet Pile Removal | 8 HR x | $84.85 | per HR = | $678.80 |
| | | Pipe Structure Total Cost | | $36,325.80 |
| | | | **Total Cost** | **$95,534.60** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 7 Structure Removal | | |

**1. Quantity**

A. Existing Weir Structure (and coquina walls)

| | | |
|---|---|---|
| Estimated area from CAD: | 2,917 | SF |
| Volume estimate: | 391 | CY |
| Weight estimate: | 469 | TN |

B. Existing Remnant Pipes

Only pipe ribs remaining (assume material equal to one full pipe)

| Length (FT) | Width (FT) | | |
|---|---|---|---|
| 43 | 5 | 215 | SF |

| | | |
|---|---|---|
| Volume estimate: | 31 | CY |
| Weight estimate: | 3 | TN |

Source: 118 lbs/ft - Contech Galvanized, 10 Gage, 3"x1" Corrugated Steel Pipe

C. Deck Structure

| Length (FT) | Width (FT) | | |
|---|---|---|---|
| 40 | 36 | 1,440 | SF |

| | | |
|---|---|---|
| Volume estimate: | 53 | CY |
| Weight estimate: | 29 | TN |

Source: 40 lbs/cf - engineeringtoolbox.com

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Structure Removal | $30.28 | per SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item: 0110 3<br>Removal of existing structures/bridges |
| Hauling (to County landfill) | $11.84 | per CY<br>Source: RSMeans - 2020<br>L# 312323209104 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 45 mph, cycle 50 miles |
| Structure Disposal | $54.00 | per Ton<br>Source: Sarasota County Lanfill Disposal Rates/Tipping Fees 2020 |

**3. Total Item Cost**

| | |
|---|---|
| Structure Removal | $138,440.16 |
| Hauling (to County landfill) | $37,662.69 |
| Structure Disposal | $39,990.38 |
| **Total Cost** | **$216,093.22** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 8 Weir Structure | | |

**1. Quantity**

A. Materials

| | | |
|---|---|---|
| Concrete | 249 | CY |
| Steel Reinforcement<br>Source: engineeringtoolbox.com, 5/8" rebar = 1.04 lbs/ft | 7939 | LB |
| Sheet Pile Footer | 2025 | SF |
| Stone | 31 | CY |

B. Earthwork

| | | |
|---|---|---|
| Fill (for earthfill within weir structure)) | 114 | CY |
| (for soil losses due to structure removal and stabilized layer) | 54 | CY |
| Total Compacted CY Needed: | 168 | CY |
| Total Truck Fill Volume: | 280 | CY |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Concrete | $686.13 | per CY<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0400 1 11<br>Concrete Class I, Retaining Walls |
| Steel Reinforcement | $1.29 | per LB<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0415 1 3<br>Reinf Steel- Retaining Wall |
| Imported Fill Material | $5.55 | per CY<br>Source: Hi-Hat Fill Dirt - 2020<br>11270 SR72 Sarasota, FL<br>Fill dirt: $5.55/CY, not delivered |
| Imported Fill Hauling | $7.11 | per CY<br>Source: RSMeans - 2020<br>L# 312323209080 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 40 mph, cycle 20 miles |
| Spreading Fill | $3.03 | per CY<br>Source: RSMeans - 2020<br>L# 312323144400 Backfill, structural, dozer, from stockpile, no compaction<br>200 hp, 300' haul, sand and gravel |
| Compaction | $1.74 | per CY<br>Source: RSMeans - 2020<br>L# 312323240300 Compaction, structural, common fill, 8" lifts<br>Sheepsfoot or wobbly wheel roller |
| Sheet Pile Installation | $39.10 | SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0455133 3<br>Sheet Piling Steel, F&I Permanent |
| Hauling of Stone | $3.39 | per CY<br>Source: RSMeans - 2020<br>L# 312323209018 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 15 mph, cycle 2 miles |
| Stone | $103.65 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>Riprap 6-12" - Small Boulders: $1803.56/Truck (including tax), 17.4 CY/Truck |

**3. Total Item Cost**

| | |
|---|---|
| Concrete | $170,897.19 |
| Steel Reinforcement | $10,240.86 |
| Imported Fill | $3,546.75 |
| Spreading Fill | $848.87 |
| Compaction | $487.47 |
| Sheet Pile | $79,177.50 |
| Hauling of Stone | $106.72 |
| Stone | $3,263.11 |
| **Total Cost** | **$268,568.47** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 9 Pipe Structure | | |

**1. Quantity**

A. Pipes

Install Six 60" Corrugated Aluminum Pipes — Proposed Length with Side Slopes: 76 ft — 456 LF

Assume 12 ft top width for access, 4:1 side slopes, 3 ft of cover over pipes, 3 ft spacing between pipes

B. Earthwork

Fill Around Pipes — Estimated CY of fill assuming 8 ft fill height, 12 ft top width, and 4:1 side slopes

V(fill) = 587 CY

V = V(fill) - V(pipe) — V = V(fill) - (PI*(Rpipe^2)*Lpipe) + V(pipe protruding above side slope

| | Radius | Length |
|---|---|---|
| 60" CAP | 2.5 | 456 |

| | | |
|---|---|---|
| Total Compacted CY Needed | 262 | CY |
| Total Truck Fill Volume | 437 | CY |
| Truck Volume to be Compacted Between and Directly Over Pipes | 406 | CY |
| Riprap (upstream and downstream) | 92 | CY |
| Bedding Stone (pipes) | 63 | CY |
| Bedding Stone (riprap) | 23 | CY |
| Geotextile (pipe bedding stone) | 380 | SY |
| Geotextile (riprap bedding stone) | 139 | SY |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| 60" CAP | $124.00 | LF<br>Source: Contech - 2019<br>60" CAP |
| Imported Fill Material | $5.55 | per CY<br>Source: Hi-Hat Fill Dirt - 2020<br>11270 SR72 Sarasota, FL<br>Fill dirt: $5.55/CY, not delivered |
| Imported Fill Hauling | $7.11 | per CY<br>Source: RSMeans - 2020<br>L# 312323209080 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 40 mph, cycle 20 miles |
| Spreading Fill | $3.03 | per CY<br>Source: RSMeans - 2020<br>L# 312323144400 Backfill, structural, dozer, from stockpile, no compaction<br>200 hp, 300' haul, sand and gravel |
| Compaction of Berm | $1.74 | per CY<br>Source: RSMeans - 2020<br>L# 312323240300 Compaction, structural, common fill, 8" lifts<br>Sheepsfoot or wobbly wheel roller |
| Compaction Between Pipes | $2.32 | per CY<br>Source: RSMeans - 2020<br>L# 312323240600 Compaction, structural, common fill, 8" lifts<br>Vibratory plate |
| Hauling of Riprap and Stone | $3.39 | per CY<br>Source: RSMeans - 2020<br>L# 312323209018 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 15 mph, cycle 2 miles |
| RipRap | $103.65 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>Riprap 6-12" - Small Boulders: $1803.56/Truck (including tax), 17.4 CY/Truck |
| Bedding Stone (FDOT No. 57) | $55.53 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>#57 Limestone Gravel: $966.19/Truck (including tax), 17.4 CY/Truck |
| Geotextile Fabric (Mirafi 140N) | $1.48 | per SY<br>RH Moore & Associates, Inc - 2019<br>Mirafi 140N Nonwoven Geotextile - 15' x 360' ($444/600 SY)<br>Assume bare material cost x 2 for delivered cost |
| Geotextile Fabric Installation | $64.25 | per hr<br>Source: RSMeans - 2020<br>2 Laborers (includes O&P) |

**3. Total Item Cost**

| | |
|---|---|
| Pipe Material | $56,544.00 |
| Imported Fill | $5,535.09 |
| Spreading Fill | $1,324.75 |
| Compaction | $996.18 |
| Hauling of Riprap and Stone | $606.43 |
| RipRap | $9,582.13 |
| Bedding Stone | $4,800.10 |
| Geotextile Fabric Material | $767.63 |
| Geotextile Fabric Installation | $257.00 |
| **Total Cost** | **$80,413.31** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 10 Vegetative Measures | | |

**1. Quantity**

| | | |
|---|---|---|
| A. Seeding and Mulching | 16,500 SF | 0.38 AC |
| B. Sod | 11,000 SF | 1,222 SY |
| C. Water Truck | | 60 HR |

**2. Bid Estimate**

A. Unit Cost

Seeding/Fertilizer — $4,452.80 per AC
Source: RSMeans - 2020
L# 329219131000 Hydro seeding for large areas, including seed and fertilizer
$0.92/SY converted to per acre

Mulching — $2,817.03 per AC
Source: RSMeans - 2020
L# 329113160350 Soil Preparation
Hay, 1" deep, power mulcher, large ($64.67/1000 SF converted to acres)

Sod — $2.67 per SY
Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)
Item 0570 1 2
Performance Turf, Sod

Water Truck Operator — $70.80 per hour
Source: RSMeans 2020
Cost per labor hour for equipment operator, medium equipment
Includes O&P
hourly operating cost of $70.80 (over 4 weeks, 15 hrs per week)

**3. Total Item Cost**

| | | | | |
|---|---|---|---|---|
| Seeding/Fertilizer | 0.38 AC | x | $4,452.80 per acre | $1,686.67 |
| Mulch | 0.38 AC | x | $2,817.03 per acre | $1,067.06 |
| Sod | 1,222 SY | x | $2.67 per SY | $3,263.33 |
| Water Truck | 60 HR | x | $70.80 per HR | $4,248.00 |
| | | | **Total Cost** | **$10,265.06** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 11 Long-term Monitoring and Maintenance | | |

**1. Quantity**

| | | | |
|---|---|---|---|
| A. Long-term Monitoring and Maintenance | Inspection and Maintenance for Weir Structure and Pipe Structure for 30-year Period | 1 | LS |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Long-term Monitoring and Maintenance | $52,347.27 | per LS |

Source: 15 percent of construction cost for water control structures

**3. Total Item Cost**

| | | |
|---|---|---|
| | Long-term Monitoring and Maintenance | $52,347.27 |
| | **Total Cost** | **$52,347.27** |

**ENGINEER'S OPINION OF PROBABLE COST**
**UPPER MYAKKA LAKE RESTORATION PROJECT, SARASOTA COUNTY, FLORIDA**
**ALTERNATIVE 3 - REBUILD TO HISTORICAL CONDITIONS**

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNITS | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1 | Final Design and Permitting | 1 | LS | $93,673.86 | $93,674 |
| 2 | Mobilization and Demobilization | 1 | LS | $76,067.14 | $76,067 |
| 3 | Pollution Control | 1 | LS | $8,303.68 | $8,304 |
| 4 | Clearing and Grubbing | 1 | LS | $1,656.60 | $1,657 |
| 5 | Construction Surveys | 1 | LS | $21,700.00 | $21,700 |
| 6 | Dewatering | 1 | LS | $95,534.60 | $95,535 |
| 7 | Structure Removal | 1 | LS | $216,093.22 | $216,093 |
| 8 | Weir Structure | 1 | LS | $273,602.59 | $273,603 |
| 9 | Pipe Structure | 1 | LS | $80,413.31 | $80,413 |
| 10 | Vegetative Measures | 1 | LS | $10,265.06 | $10,265 |
| 11 | Long-term Monitoring and Maintenance | 1 | LS | $53,102.39 | $53,102 |
| **SUBTOTAL** | | | | | **$930,412** |
| **TOTAL CONSTRUCTION ESTIMATE (PLUS 10% CONTINGENCY)** | | | | | **$1,023,454** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 1 Final Design and Permitting | | |

**1. Quantity**

| | | | |
|---|---|---|---|
| A. Geotechnical Investigation | Weir Footer/Subbase | 1 | LS |
| B. Final Design and Permitting | | 1 | LS |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Geotechnical Investigation | $10,000.00 | per LS<br>Source: Standard industry rate |
| | Final Design and Permitting | $83,673.86 | per LS<br>Source: Standard industry rate |

**3. Total Item Cost**

| | | |
|---|---|---|
| | Geotechnical Investigation | $10,000.00 |
| | Final Design and Permitting | $83,673.86 |
| | **Total Cost** | **$93,673.86** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 2 Mobilization and Demobilization | | |

**1. Quantity**

A. Mobilization and Demobilization — $76,067.14

(Hauling construction equipment and supplies to/from site) — Source: 10% of the project

**2. Total Item Cost**

1 Job x $76,067.14 per Job = $76,067.14

**Total Cost** **$76,067.14**

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 3 Pollution Control | | |

**1. Quantity**

A. Floating Turbidity Barrier — 440 LF

B. Soil Tracking Prevention Device — 1 EA

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Furnish and Install Floating Turbidity Barrier | $10.85 | per LF<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 11<br>Floating Turbidity Barrier |
| Floating Turbidity Barrier Maintenance | $1.09 | per LF<br>Source: RSMeans - 2019<br>L# 312514161100 Stabilization measures for erosion and sediment control<br>allow 10% per month for maintenance |
| Soil Tracking Prevention Device | $2,802.28 | per EA<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0104 15<br>Soil Tracking Prevention Device |
| NPDES Fee | $250.00 | per EA<br>Source: FDEP NPDES Fee Schedule<br>Small Construction (< 5 acres)<br>http://www.dep.state.fl.us/water/stormwater/npdes/fees.htm |

**3. Total Item Cost**

| | | | |
|---|---|---|---|
| Floating Turbidity Barrier | 440 LF x | $10.85 per LF = | $4,774.00 |
| Floating Turbidity Barrier Maintenance | 440 LF x | $1.09 per LF = | $477.40 |
| Soil Tracking Prevention Device | 1 EA x | $2,802.28 per EA = | $2,802.28 |
| NPDES Fee | 1 EA x | $250.00 per EA = | $250.00 |
| | | **Total Cost =** | **$8,303.68** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 4 Clearing and Grubbing | | |

**1. Quantity**

A. Clear and Grub Area

Estimated area from CAD: 11,000 SF 0.25 AC

**2. Bid Estimate**

A. Unit Cost

Brush Mowing $655.32 per Acre

Source: RSMeans - 2020
L# 311313101040 Brush mowing, tractor w/ rotary mower, no removal
Medium density

Topsoil Stripping and Stockpiling $5,904.80 per Acre

Source: RSMeans - 2020
L# 311413231550 Topsoil stripping and stockpiling
By dozer, 6" deep, 200' haul, ($0.61/SY converted to Acres)
($2952.40/AC multiplied by 2 to account for double moving of soil)

**3. Total Item Cost**

| | | | | | | |
|---|---|---|---|---|---|---|
| Brush Mowing | 0.25 AC | x | $655 | per AC | = | $165.48 |
| Topsoil Stripping | 0.25 AC | x | $5,905 | per AC | = | $1,491.11 |
| | | | | Total Cost | | **$1,656.60** |

Bid Item Quantities and Cost

| | |
|---|---|
| Project: | Upper Myakka Lake Restoration Project |
| Prepared by: | G. Gatson — Date: 3/11/2020 |
| Check by: | T. Davies — Date: 3/13/2020 |
| Bid Item: | 5 Construction Surveys |

**1. Quantity**

A. Construction Surveys

| | | | |
|---|---|---|---|
| Survey Stake Out and Construction Layout | | | |
| | Crew | 40 | hours |
| | Tech | 24 | hours |
| | PLS | 16 | hours |
| | Hotel | 1 | LS |
| | Per diem | 1 | LS |
| As-built and Record Drawings | | | |
| | Crew | 40 | hours |
| | Tech | 24 | hours |
| | PLS | 16 | hours |
| | Hotel | 1 | LS |
| | Per diem | 1 | LS |

**2. Bid Estimate**

A. Unit Cost

| | | | |
|---|---|---|---|
| Survey Stake Out and Construction Layout | | | |
| | Crew | $140.00 | per hour |
| | Tech | $80.00 | per hour |
| | Professional Land Surveyor | $155.00 | per hour |
| | | | Source: Standard industry rates |
| As-built and Record Drawings | | | |
| | Crew | $140.00 | per hour |
| | Tech | $80.00 | per hour |
| | Professional Land Surveyor | $155.00 | per hour |
| | | | Source: Standard industry rates |
| Hotel | | $450.00 | per LS |
| | | | Source: Standard industry rates |
| Per Diem | | $400.00 | per LS |
| | | | Source: Standard industry rates |

**3. Total Item Cost**

| | | |
|---|---|---|
| Survey Stake Out and Construction Layout | | |
| | Crew | $5,600.00 |
| | Tech | $1,920.00 |
| | Professional Land Surveyor | $2,480.00 |
| | Hotel | $450.00 |
| | Per diem | $400.00 |
| As-built and Record Drawings | | |
| | Crew | $5,600.00 |
| | Tech | $1,920.00 |
| | Professional Land Surveyor | $2,480.00 |
| | Hotel | $450.00 |
| | Per diem | $400.00 |
| | **Total Cost** | **$21,700.00** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 6 Dewatering | | |

**1. Quantity**

A. Weir Structure Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Weir Structure | | 110 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 770 | SF |
| Downstream Sheet Pile Cofferdam for Weir Structure | | 180 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 1260 | SF |
| Sheet Pile Removal | | 8 | hours |

B. Pipes Sturcture Dewatering

| | | | |
|---|---|---|---|
| Dewatering Pump (6") | seepage and intial volume | 10 | days |
| Upstream Sheet Pile Cofferdam for Pipe Structure | | 80 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 560 | SF |
| Downstream Sheet Pile Cofferdam for Pipe Structure | | 70 | LF |
| | In ground | 4 | FT |
| | Above ground | 3 | FT |
| | Area | 490 | SF |
| Sheet Pile Removal | | 8 | hours |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Dewatering Pump (6") | $1,112.95 | per day<br>Source: RSMeans - 2020<br>L# 312319201100 Dewatering Systems<br>Pumping 8 hrs, attended 2 hrs/day, 20 LF suction hose,<br>100 LF discharge hose, 6" centrifugal pump |
| | Temporary Sheet Pile Installation | $23.35 | SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0455133 2<br>Sheet Piling Steel, Temporary-Critical |
| | Equipment Operator, Medium Equip. | $84.85 | per hour<br>Source: RSMeans 2020<br>Cost per labor hour for equipment operator, medium equipment<br>Includes O&P |

**3. Total Item Cost**

| | | | | | |
|---|---|---|---|---|---|
| Weir Structure Dewatering | 10 | days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 2,030 | SF x | $23.35 | per SF = | $47,400.50 |
| Sheet Pile Removal | 8 | HR x | $84.85 | per HR = | $678.80 |
| | | | Weir Structure Total Cost | | $59,208.80 |
| Pipe Structure Dewatering | 10 | days x | $1,112.95 | per day = | $11,129.50 |
| Temp. Sheet Pile Installation | 1,050 | SF x | $23.35 | per SF = | $24,517.50 |
| Sheet Pile Removal | 8 | HR x | $84.85 | per HR = | $678.80 |
| | | | Pipe Structure Total Cost | | $36,325.80 |
| | | | **Total Cost** | | **$95,534.60** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 7 Structure Removal | | |

**1. Quantity**

A. Existing Weir Structure (and coquina walls)

| | | |
|---|---|---|
| Estimated area from CAD: | 2,917 | SF |
| Volume estimate: | 391 | CY |
| Weight estimate: | 469 | TN |

B. Existing Remnant Pipes

Only pipe ribs remaining (assume material equal to one full pipe)

| Length (FT) | Width (FT) | | |
|---|---|---|---|
| 43 | 5 | 215 | SF |
| Volume estimate: | | 31 | CY |
| Weight estimate: | | 3 | TN |

Source: 118 lbs/ft - Contech Galvanized, 10 Gage, 3"x1" Corrugated Steel Pipe

C. Deck Structure

| Length (FT) | Width (FT) | | |
|---|---|---|---|
| 40 | 36 | 1,440 | SF |
| Volume estimate: | | 53 | CY |
| Weight estimate: | | 29 | TN |

Source: 40 lbs/cf - engineeringtoolbox.com

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Structure Removal | $30.28 | per SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item: 0110 3<br>Removal of existing structures/bridges |
| Hauling (to County landfill) | $11.84 | per CY<br>Source: RSMeans - 2020<br>L# 312323209104 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 45 mph, cycle 50 miles |
| Structure Disposal | $54.00 | per Ton<br>Source: Sarasota County Lanfill Disposal Rates/Tipping Fees 2020 |

**3. Total Item Cost**

| | |
|---|---|
| Structure Removal | $138,440.16 |
| Hauling (to County landfill) | $37,662.69 |
| Structure Disposal | $39,990.38 |
| **Total Cost** | **$216,093.22** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 8 Weir Structure | | |

**1. Quantity**

A. Materials

| | | |
|---|---|---|
| Concrete | 249 | CY |
| Steel Reinforcement<br>Source: engineeringtoolbox.com, 5/8" rebar = 1.04 lbs/ft | 7939 | LB |
| Sheet Pile Footer | 2025 | SF |
| Stone | 54 | CY |

B. Earthwork

| | | |
|---|---|---|
| Fill (for earthfill within weir structure)) | 205 | CY |
| (for soil losses due to structure removal and stabilized layer) | 54 | CY |
| Total Compacted CY Needed: | 260 | CY |
| Total Truck Fill Volume: | 433 | CY |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| Concrete | $686.13 | per CY<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0400 1 11<br>Concrete Class I, Retaining Walls |
| Steel Reinforcement | $1.29 | per LB<br>Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)<br>Item 0415 1 3<br>Reinf Steel- Retaining Wall |
| Imported Fill Material | $5.55 | per CY<br>Source: Hi-Hat Fill Dirt - 2020<br>11270 SR72 Sarasota, FL<br>Fill dirt: $5.55/CY, not delivered |
| Imported Fill Hauling | $7.11 | per CY<br>Source: RSMeans - 2020<br>L# 312323209080 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 40 mph, cycle 20 miles |
| Spreading Fill | $3.03 | per CY<br>Source: RSMeans - 2020<br>L# 312323144400 Backfill, structural, dozer, from stockpile, no compaction<br>200 hp, 300' haul, sand and gravel |
| Compaction | $1.74 | per CY<br>Source: RSMeans - 2020<br>L# 312323240300 Compaction, structural, common fill, 8" lifts<br>Sheepsfoot or wobbly wheel roller |
| Sheet Pile Installation | $39.10 | SF<br>Source: FDOT 12 Month Statewide Average (2019/02/01 to 2020/01/31)<br>Item 0455133 3<br>Sheet Piling Steel, F&I Permanent |
| Hauling of Stone | $3.39 | per CY<br>Source: RSMeans - 2020<br>L# 312323209018 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 15 mph, cycle 2 miles |
| Stone | $103.65 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>Riprap 6-12" - Small Boulders: $1803.56/Truck (including tax), 17.4 CY/Truck |

**3. Total Item Cost**

| | |
|---|---|
| Concrete | $170,897.19 |
| Steel Reinforcement | $10,240.86 |
| Imported Fill | $5,475.45 |
| Spreading Fill | $1,310.48 |
| Compaction | $752.55 |
| Sheet Pile | $79,177.50 |
| Hauling of Stone | $182.05 |
| Stone | $5,566.50 |
| **Total Cost** | **$273,602.59** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 9 Pipe Structure | | |

**1. Quantity**

A. Pipes

Install Six 60" Corrugated Aluminum Pipes — Proposed Length with Side Slopes: 76 ft — 456 LF

Assume 12 ft top width for access, 4:1 side slopes, 3 ft of cover over pipes, 3 ft spacing between pipes

B. Earthwork

Fill Around Pipes — Estimated CY of fill assuming 8 ft fill height, 12 ft top width, and 4:1 side slopes

V(fill) = 587 CY

V = V(fill) - V(pipe) — V = V(fill) - (PI*(Rpipe^2)*Lpipe) + V(pipe protruding above side slope

| | Radius | Length |
|---|---|---|
| 60" CAP | 2.5 | 456 |

| | | |
|---|---|---|
| Total Compacted CY Needed | 262 | CY |
| Total Truck Fill Volume | 437 | CY |
| Truck Volume to be Compacted Between and Directly Over Pipes | 406 | CY |
| Riprap (upstream and downstream) | 92 | CY |
| Bedding Stone (pipes) | 63 | CY |
| Bedding Stone (riprap) | 23 | CY |
| Geotextile (pipe bedding stone) | 380 | SY |
| Geotextile (riprap bedding stone) | 139 | SY |

**2. Bid Estimate**

A. Unit Cost

| | | |
|---|---|---|
| 60" CAP | $124.00 | LF<br>Source: Contech - 2019<br>60" CAP |
| Imported Fill Material | $5.55 | per CY<br>Source: Hi-Hat Fill Dirt - 2020<br>11270 SR72 Sarasota, FL<br>Fill dirt: $5.55/CY, not delivered |
| Imported Fill Hauling | $7.11 | per CY<br>Source: RSMeans - 2020<br>L# 312323209080 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 40 mph, cycle 20 miles |
| Spreading Fill | $3.03 | per CY<br>Source: RSMeans - 2020<br>L# 312323144400 Backfill, structural, dozer, from stockpile, no compaction<br>200 hp, 300' haul, sand and gravel |
| Compaction of Berm | $1.74 | per CY<br>Source: RSMeans - 2020<br>L# 312323240300 Compaction, structural, common fill, 8" lifts<br>Sheepsfoot or wobbly wheel roller |
| Compaction Between Pipes | $2.32 | per CY<br>Source: RSMeans - 2020<br>L# 312323240600 Compaction, structural, common fill, 8" lifts<br>Vibratory plate |
| Hauling of Riprap and Stone | $3.39 | per CY<br>Source: RSMeans - 2020<br>L# 312323209018 Hauling<br>18 C.Y. truck, 8 wheels, 15 min wait\ld\unld, 15 mph, cycle 2 miles |
| RipRap | $103.65 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>Riprap 6-12" - Small Boulders: $1803.56/Truck (including tax), 17.4 CY/Truck |
| Bedding Stone (FDOT No. 57) | $55.53 | per CY<br>Source: gravelshop.com delivery to 34241 Sarasota, FL<br>#57 Limestone Gravel: $966.19/Truck (including tax), 17.4 CY/Truck |
| Geotextile Fabric (Mirafi 140N) | $1.48 | per SY<br>RH Moore & Associates, Inc - 2019<br>Mirafi 140N Nonwoven Geotextile - 15' x 360' ($444/600 SY)<br>Assume bare material cost x 2 for delivered cost |
| Geotextile Fabric Installation | $64.25 | per hr<br>Source: RSMeans - 2020<br>2 Laborers (includes O&P) |

**3. Total Item Cost**

| | |
|---|---|
| Pipe Material | $56,544.00 |
| Imported Fill | $5,535.09 |
| Spreading Fill | $1,324.75 |
| Compaction | $996.18 |
| Hauling of Riprap and Stone | $606.43 |
| RipRap | $9,582.13 |
| Bedding Stone | $4,800.10 |
| Geotextile Fabric Material | $767.63 |
| Geotextile Fabric Installation | $257.00 |
| **Total Cost** | **$80,413.31** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 10 Vegetative Measures | | |

**1. Quantity**

| | | |
|---|---|---|
| A. Seeding and Mulching | 16,500 SF | 0.38 AC |
| B. Sod | 11,000 SF | 1,222 SY |
| C. Water Truck | | 60 HR |

**2. Bid Estimate**

A. Unit Cost

Seeding/Fertilizer — $4,452.80 per AC
Source: RSMeans - 2020
L# 329219131000 Hydro seeding for large areas, including seed and fertilizer
$0.92/SY converted to per acre

Mulching — $2,817.03 per AC
Source: RSMeans - 2020
L# 329113160350 Soil Preparation
Hay, 1" deep, power mulcher, large ($64.67/1000 SF converted to acres)

Sod — $2.67 per SY
Source: FDOT 6 Month Statewide Average (2019/08/01 to 2020/01/31)
Item 0570 1 2
Performance Turf, Sod

Water Truck Operator — $70.80 per hour
Source: RSMeans 2020
Cost per labor hour for equipment operator, medium equipment
Includes O&P
hourly operating cost of $70.80 (over 4 weeks, 15 hrs per week)

**3. Total Item Cost**

| | | | | |
|---|---|---|---|---|
| Seeding/Fertilizer | 0.38 AC | x | $4,452.80 per acre | $1,686.67 |
| Mulch | 0.38 AC | x | $2,817.03 per acre | $1,067.06 |
| Sod | 1,222 SY | x | $2.67 per SY | $3,263.33 |
| Water Truck | 60 HR | x | $70.80 per HR | $4,248.00 |
| | | | **Total Cost** | **$10,265.06** |

Bid Item Quantities and Cost

| | | | |
|---|---|---|---|
| Project: | Upper Myakka Lake Restoration Project | | |
| Prepared by: | G. Gatson | Date: | 3/11/2020 |
| Check by: | T. Davies | Date: | 3/13/2020 |
| Bid Item: | 11 Long-term Monitoring and Maintenance | | |

**1. Quantity**

| | | | |
|---|---|---|---|
| A. Long-term Monitoring and Maintenance | Inspection and Maintenance for Weir Structure and Pipe Structure for 30-year Period | 1 | LS |

**2. Bid Estimate**

| | | | |
|---|---|---|---|
| A. Unit Cost | Long-term Monitoring and Maintenance | $53,102.39 | per LS |
| | | | Source: 15 percent of construction cost for water control structures |

**3. Total Item Cost**

| | | |
|---|---|---|
| Long-term Monitoring and Maintenance | $53,102.39 |
| **Total Cost** | **$53,102.39** |

## ALTERNATIVE 1 COSTING ASSUMPTIONS

The following assumptions were used to develop the **Alternative 1** preliminary cost estimate. Item costs can be heavily influenced by these assumptions which are based on the current best available information. During the final design, additional data will be gathered that may influence the final costing. The assumptions have been organized by item number:

1. **Alternative 1** final design and permitting estimate assumes an industry standard of 15% of the total construction costs.
2. The project site is easily accessible from SR72, therefore, typical mobilization costs of 10% of the overall construction estimate were utilized with no additional markups included in this estimate.
3. Placing floating turbidity barriers upstream and downstream of the work area eliminates the need for silt fencing along the banks, since uplands within and adjacent to the project area drain back into the work area and are captured by the turbidity barrier.
4. Any trees in the clearing and grubbing areas are small and can be easily removed.
5. The construction stakeout and as-builts costing is preliminary and will depend on final design drawings.
6. The contractor would complete the entire removal and construction for the weir area in sequence to the removal and construction of the bypass area. Both areas would not be under construction concurrently. Both upstream and downstream of each work area will require temporary sheet pile for dewatering for the duration of construction.
7. The entire dam structure and two coquina walls will be completely removed. Quantities for the weir structure volume were assumed based on historical available data and site visits. While there is no cross section view in the original dam construction plans to provide for a detailed estimate, additional information was gathered during a March 25, 2020 site visit from Wood. Only the pipe ribs are remaining in the bypass structure, so the assumed total material remaining for each pipe was approximately one-sixth of the original length of pipe installed. It is assumed that the deck structure over the pipes will be removed and properly disposed of. All construction debris will need to be hauled to the County landfill.
8. Fill would be imported from a nearby location (Hi-Hat Fill Dirt). Fill estimates are based on the difference in elevation between the average low point of the existing grade minus stripping loss of 6" and the average proposed elevation required, multiplied by the square footage of the area. The cut/fill analysis was split into multiple earthwork polygons to obtain a more accurate estimate. The cut and fill analysis assumes the entire bypass channel will be filled. Final design may ultimately entail a partial fill of the bypass channel.
9. Sod will be used around the work area for all disturbed areas, and seed and mulch will be used for disturbed areas along the haul route from the parking area to the work area.
10. There are no anticipated long term operation and maintenance costs associated with **Alternative 1**. However, the contractor and/or FDEP will need to ensure vegetation growth of any areas seeded/sodded as part of construction. This may include a period of watering for the seed and sod.

## ALTERNATIVE 2 COSTING ASSUMPTIONS

The following assumptions were used to develop the **Alternative 2** preliminary cost estimate. Item costs can be heavily influenced by these assumptions which are based on the current best available information. During the final design, additional data will be gathered that may influence the final costing. The assumptions have been organized by item number:

1. Assumes a geotechnical investigation will be performed prior to rebuilding the weir structure. Final design will require structural design plans for a new weir structure. In addition to the geotechnical investigation, **Alternative 2** final design and permitting estimate assumes an industry standard of 15% of the total construction costs.
2. The project site is easily accessible from SR72, therefore, typical mobilization costs of 10% of the overall construction estimate were utilized with no additional markups included in this estimate.
3. Placing floating turbidity barriers upstream and downstream of the work area eliminates the need for silt fencing along the banks, since uplands within and adjacent to the project area drain back into the work area and are captured by the turbidity barrier.
4. Any trees in the clearing and grubbing areas are small and can be easily removed.
5. The construction stakeout and as-builts costing is preliminary and will depend on final design drawings.
6. The contractor would complete the entire removal and construction for the weir area in sequence to the removal and construction of the bypass area. Both areas would not be under construction concurrently. Both upstream and downstream of each work area will require temporary sheet pile for dewatering for the duration of construction.
7. The entire dam structure and two coquina walls would be completely removed. Quantities for the weir structure volume were assumed based on historical available data and site visits. While there is no cross section view in the original dam construction plans to provide for a detailed estimate, additional information was gathered during a March 25, 2020 site visit from Wood. Only the pipe ribs are remaining in the bypass structure, so the assumed total material remaining for each pipe was approximately one-sixth of the original length of pipe installed. It is assumed that the deck structure over the pipes will be removed and properly disposed of. All construction debris will need to be hauled to the County landfill.
8. Fill would be imported from a nearby location (Hi-Hat Fill Dirt). Fill is needed due to soil loss from the weir structure removal and topsoil stripping, for stabilizing the subgrade, and for the earthfill required within the new weir structure. The new weir structure will require poured reinforced FDOT Class 1 concrete. Material quantities are approximated from plan view and elevation views of original dam construction plans, as well as a March 25, 2020 site visit from Wood and adjusted to be 2 ft lower than the original weir invert elevation.
9. Fill would be imported from a nearby location (Hi-Hat Fill Dirt). Assumes complete deck structure removal for proper compaction around and over pipes. Assumes a 4 to 1 slope on either end of the new pipes with riprap stabilization and a top berm width of 12 ft for access to the weir structure. A total fill height of 8 ft (bottom of side slope to top of bank) was assumed for 3 ft of cover over the pipes. Bedding stone and geotextile fabric will be installed under all pipes and riprap. This estimate does not include the cost to rebuild the deck structure.
10. Sod will be used around the work area for all disturbed areas, and seed and mulch will be used for disturbed areas along the haul route from the parking area to the work area.
11. Assumes 30-year period for monitoring and maintenance costs, which include annual inspections of the water control structures, periodic vegetation removal, and structure repair work.

## ALTERNATIVE 3 COSTING ASSUMPTIONS

The following assumptions were used to develop the **Alternative 3** preliminary cost estimate. Item costs can be heavily influenced by these assumptions which are based on the current best available information. During the final design, additional data will be gathered that may influence the final costing. The assumptions have been organized by item number:

1. Assumes a geotechnical investigation will be performed prior to rebuilding the weir structure. Final Design will require structural design plans for the new weir structure. In addition to the geotechnical investigation, **Alternative 3** final design and permitting estimate assumes an industry standard of 15% of the total construction costs.
2. The project site is easily accessible from SR72, therefore, typical mobilization costs of 10% of the overall construction estimate were utilized with no additional markups included in this estimate.
3. Placing floating turbidity barriers upstream and downstream of the work area eliminates the need for silt fencing along the banks, since uplands within and adjacent to the project area drain back into the work area and are captured by the turbidity barrier.
4. Any trees in the clearing and grubbing areas are small and can be easily removed.
5. The construction stakeout and as-builts costing is preliminary and will depend on final design drawings.
6. The contractor would complete the entire removal and construction for the weir area in sequence to the removal and construction of the bypass area. Both areas would not be under construction concurrently. Both upstream and downstream of each work area will require temporary sheet pile for dewatering for the duration of construction.
7. The entire dam structure and two coquina walls would be completely removed. Quantities for the weir structure volume were assumed based on historical available data and site visits. While there is no cross section view in the original dam construction plans to provide for a detailed estimate, additional information was gathered during a March 25, 2020 site visit from Wood. Only the pipe ribs are remaining in the bypass structure, so the assumed total material remaining for each pipe was approximately one-sixth of the original length of pipe installed. It is assumed that the deck structure over the pipes will be removed and properly disposed of. All construction debris will need to be hauled to the County landfill.
8. Fill would be imported from a nearby location (Hi-Hat Fill Dirt). Fill is needed due to soil loss from the weir structure removal and topsoil stripping, for stabilizing the subgrade, and for the earthfill required within the new weir structure. The new weir structure will require poured reinforced FDOT Class 1 concrete. Material quantities are approximated from plan view and elevation views of original dam construction plans, as well as a March 25, 2020 site visit from Wood.
9. Fill would be imported from a nearby location (Hi-Hat Fill Dirt). Assumes complete deck structure removal for proper compaction around and over pipes. Assumes a 4 to 1 slope on either end of the new pipes with riprap stabilization and a top berm width of 12 ft for access to the weir structure. A total fill height of 8 ft (bottom of side slope to top of bank) was assumed for 3 ft of cover over the pipes. Bedding stone and geotextile fabric will be installed under all pipes and riprap. This estimate does not include the cost to rebuild the deck structure.
10. Sod will be used around the work area for all disturbed areas, and seed and mulch will be used for disturbed areas along the haul route from the parking area to the work area.
11. Assumes 30-year period for monitoring and maintenance costs which will include annual inspections of the water control structures, periodic vegetation removal, and structure repair work.

Wood

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