Lake Okeechobee Water Management: A Historical Fight for Control

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I. INTRODUCTION

Lake Okeechobee is the largest body of water in Florida, yet is the cornerstone of one of Florida's largest environmental concerns; Water Management. By definition, water management is the "activity of planning, developing, distributing and optimum use of water", but more specifically, it is the cause of over $2 billion dollars spent by the state of Florida to ensure Everglades Restoration. Recent threats to Florida's natural ecosystem has caused finger pointing, seeking to determine who is responsible for damage and clean-up, yet the problem is much deeper than only what appears at the surface. This issue historically stems from our desire for control over Lake Okeechobee and the Everglades, which leads back 180 years ago.

II. HISTORY

A. 1800's

The 1800's marked a time for change within our nation's control over territory and power. The second Seminole war in 1835 marked the first contact between the United States army and the Everglades wetlands during the Battle of Okeechobee. During this battle between the young Zachary Taylor and Seminole Indian Chief Holata Micco, it was recorded that the native sawgrass stood five feet high and the mud and water sunk three feet in depth (Battle of Lake Okeechobee, April 2018). This meant that Taylor and his troops were at a disadvantage in battle because of the inability to use their horses. So, the opinion of wanting to control the Everglades to make it "usable" land was first established in 1835 as a need for an advantage in battle. Then in 1837, eight years before Florida became a State, Congress under 8th President of the United States Martin Van Buren directed the Secretary of War Joel Roberts Poinsett to

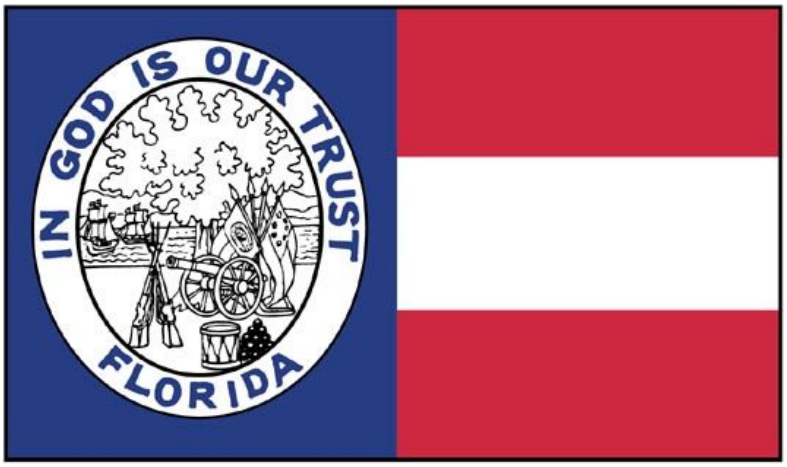
prepare a report “in relation to the practicability and probable expense of draining the Everglades of Florida” (Williams, C. A, 2017). In 1850, Congress now under 12th President of the United States Zachary Taylor proposed the *Swamp and Overflowed Lands Act*, which gave states title to any wetlands they could “reclaim”, which lead to the beginning of control over the Florida Everglades. (History & Culture, 2018)

Artist Guy LaBree's depiction of the Battle of Okeechobee (R. Fell, January 2018).

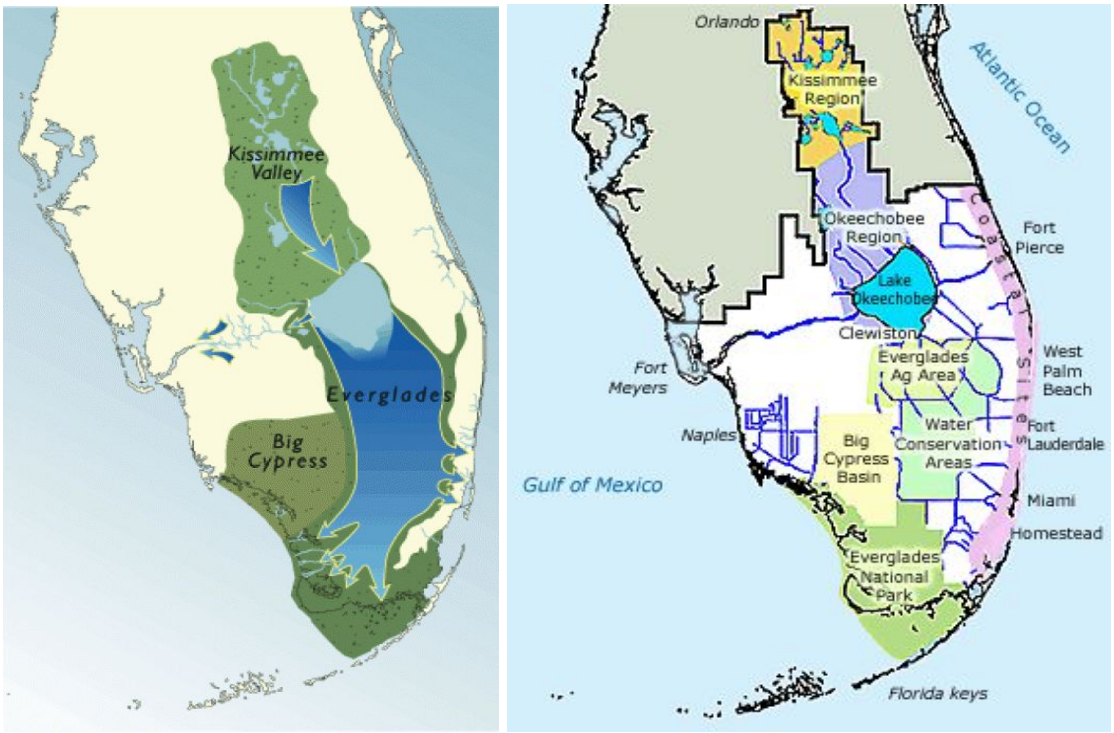
1. ***STATEHOOD***

After 26 years of Florida statehood, the physical plans beginning Lake Okeechobee water management started in 1881. State officials lead by 17th Governor of Florida William D. Bloxham proposed that for water going South out Lake Okeechobee to instead be redistributed into man-made channels going East and West. However, these channels made a more significant

difference to the geography of Florida than just serving as a connection to the East and West coasts of Florida; they allowed for the south area of Lake Okeechobee to be drained of water, which is the area we know today as the Everglades. The Everglades originally occupied 4000 square miles of South Florida and served as a slow-moving body of water, moving from North Florida's Kissimmee River, down through Lake Okeechobee and filtered south through the sawgrass marsh lands of Biscayne Bay, the Ten Thousand Islands, and Florida Bay before overflowing into the sea (History & Culture, 2018). However, the Everglades were historically seen as a "big useless swamp" and the new state leaders of Florida sought to turn the newly drained land into "productive and profitable farmland" (Williams, C. A, 2017). A tugboat, a dredge, and the use of dynamite were employed for the channel job in 1881 where a pathway upriver to Fort Myers from the Caloosahatchee River through the marshlands of the Everglades was made to connect a path to Lake Okeechobee. This created the Caloosahatchee River channel going West which was completed in 1883 (Williams, C. A, 2017). However, one channel established for the entire draining of the Everglades was not enough to make a significant difference.



The first Florida state flag created in 1861. Florida became the twenty-seventh state in the United States on March 3, 1845 (Museum of Florida History, 2018).

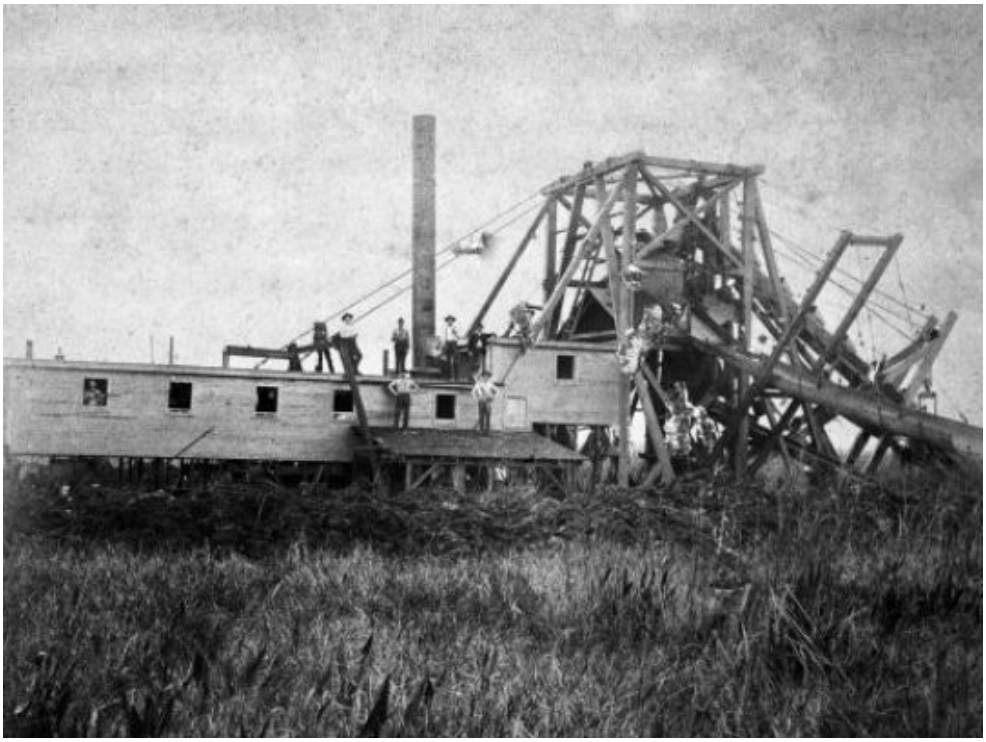


Maps of Florida outlining the area of the Everglades and areas within the waterbody. (Curing Florida's algae crisis will take time, money, science, 2017)

B. <u>1900'S</u>

From the late 1800s and through the early 1900s, business interests along with government partnerships once again planned to drain the Everglades so that the land could be developed. The desire to farm crops and cattle in this area became the main reason for the draining of the Everglades because the concept of these newly drained, nutrient rich lands meant greater opportunities for economic growth. In 1904 USDA engineer James Wright calculated that eight channels designed to hold a maximum daily rainfall of 4 inches would be sufficient to drain 1,850,000 acre-feet of water, which would open up enough land to start these agricultural

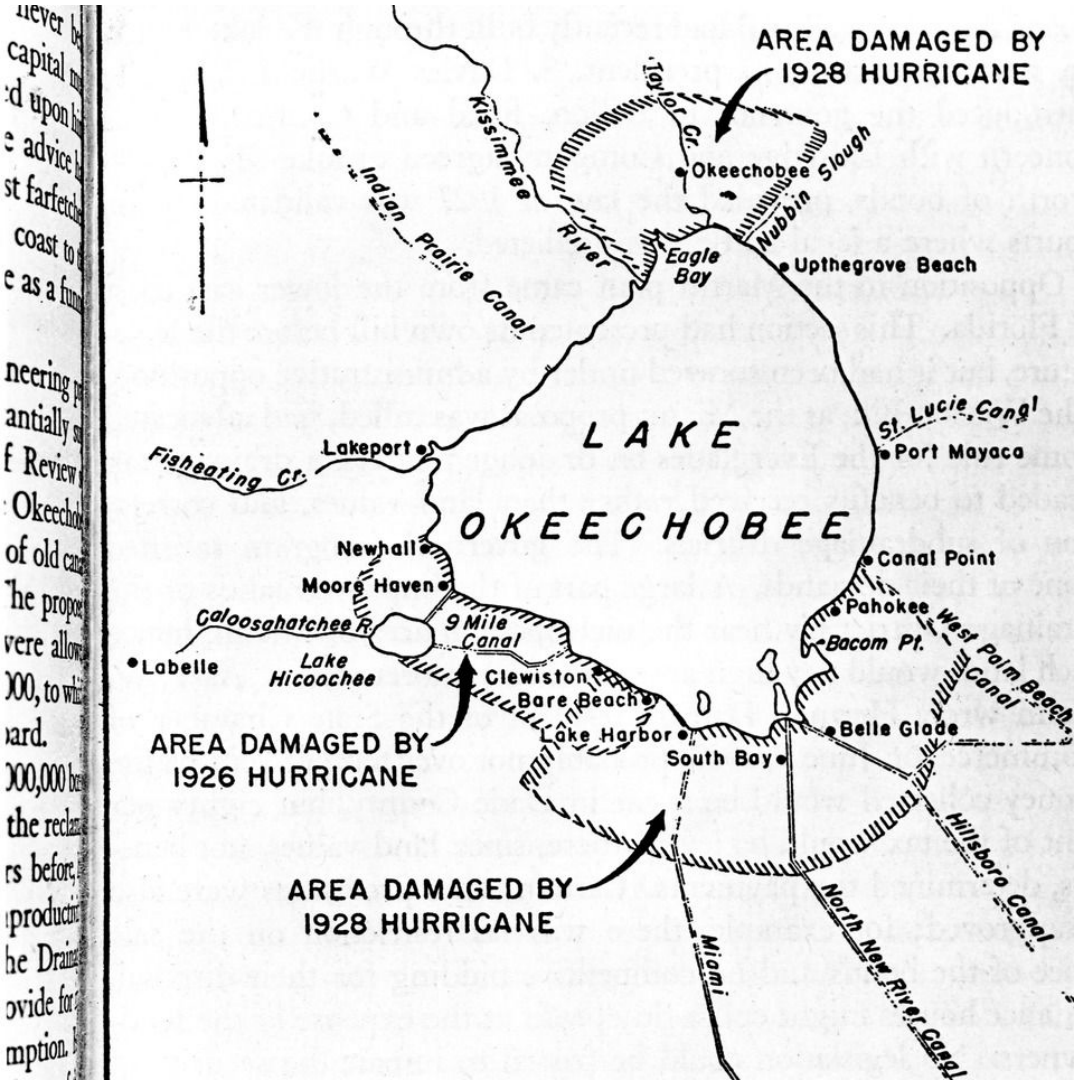
endeavors (Williams, C. A, 2017). So in 1910, Congress under 27th President of the United States William Howard Taft passed the *River and Harbors Act*, which was created to deepen the Caloosahatchee River channel. However, in 1914 Wright was accused for not being competent as an engineer which dismissed the attempts to continue draining and the economy that once supported this effort had failed. It was recorded that people who had invested and lost their life savings to live in the Everglades reclamation tried to make the land livable themselves by burning off the sawgrass, but this caused the top layer of peat to burn as well so the soil became dusty and infertile (Williams, C. A, 2017).



The dredge that was used to create the Caloosahatchee River channel. (Cynthia A. Williams, July 2016)

1. DRAINING

Yet by 1920, the creation of the St. Lucie Canal going East was completed, natural levee areas around the lake were constructed, and the intended draining of the Everglades finally began. The first embankments were constructed in 1915 by local interest with materials used from the available sand and muck (JACKSONVILLE DISTRICT, 2018). Within 5 years, this adjustment in the Lake Okeechobee water management caused around 2,000 people to relocated into the areas of Moore Haven, Belle Glade, as well as Clewiston (the main agricultural locations). These startup communities were created to house agricultural workers who were hired to live near and work in the fields where experiments in soil improvement had finally made harvesting sugarcane and vegetables a possibility (Williams, C. A, 2017).



Map of hurricane damage around Lake Okeechobee. (Eliot Kleinberg, August 2016)

2. <u>NATURAL DISASTERS</u>

Natural levees held no match for the Hurricanes of 1926 and 1928. Being only 18 to 24 inches above the level of the lake, the natural levees were flooded over by the 1926 Category 4 "Miami Hurricane" who claimed ⅓ of the residents (around 2000 residents) in Moore Haven, and the Category 5 "Okeechobee Hurricane" in 1928 who's flooding collapsed the levee and

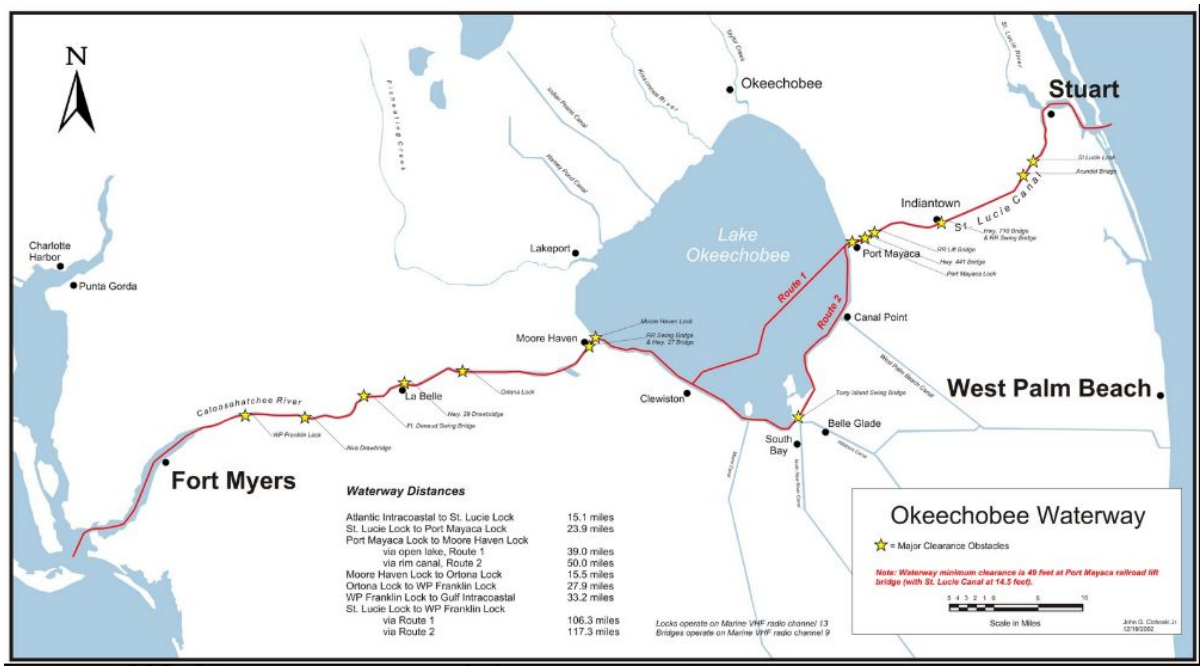
many bodies were recorded as “unrecoverable” in the re-emerged swamp (Williams, C. A, 2017).

Flood in Belle Glade after the 1928 Okeechobee Hurricane. (Eliot Kleinberg, August 2016)

3. FLOOD CONTROL

The need for flood control became the priority in Everglades reclamation after the tragic deaths in the late 1920’s. So by 1929, under 31st President Herbert Hoover, the Okeechobee Flood Control District was formed and the Army Corps of Engineers (USACE) took ownership over this embankment task. The Army Corps of Engineers constructed new levees from Port Myakka to Moore Haven in the south, and from the Kissimmee River to Navin Slough in the north which took place between 1932 and 1938 (Williams, C. A, 2017). From the new levee, the Army Corps then dug a 155-mile cross-state channel in 1937 named the “Okeechobee

Waterway", which completed the connected from the Gulf of Mexico through the Caloosahatchee River channel, into Lake Okeechobee, through the St. Lucie Canal, and then out into the Atlantic Ocean (Williams, C. A, 2017). This channel would serve as the solution of establishing conduits for the discharge of excess water from the lake for over the next 80 years.

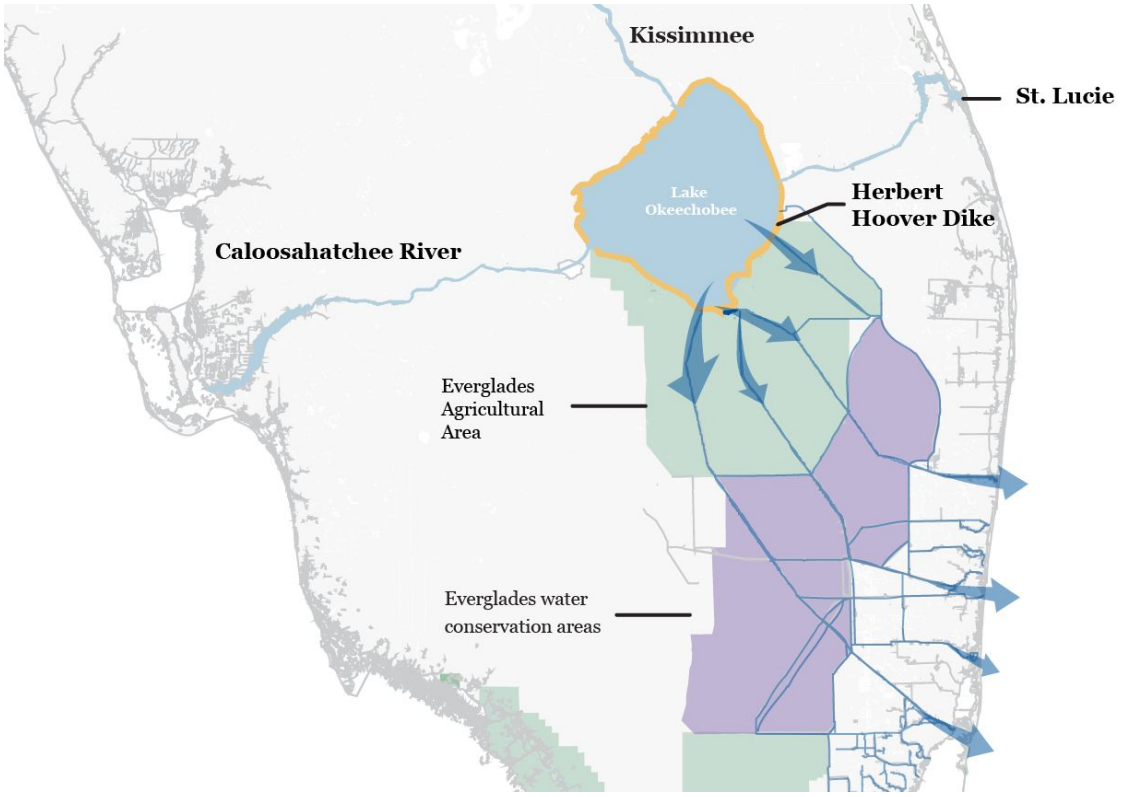


Map of the Okeechobee Waterway (Williams, C. A, 2017)

4. PLEE FOR PROTECTION

Major hurricanes in 1947 and 1948 caused Lake Okeechobee to once again overflow its banks, which prompted a more aggressive need for additional flood and storm damage reduction work. Flooding in central and south Florida was so extensive in regards to the amount of lost livestock and agriculture that these residents plead to the US government to approve a larger flood-protection project. As a result, Congress under 33rd President of the United States Harry S. Truman passed the *Flood Control Act* of 1948, which documented plans for the first phase of the

Central and South Florida (C&SF) Project. This was a comprehensive plan to provide flood protection and water control in the affected central and south Florida regions. The following year, the Army Corps of Engineers were authorized to groundbreak this project by constructing an earthen berm that rose 35 feet high and completely encircled the 730 square mile area of Lake Okeechobee. The new structure consisted of 143 miles of levee, hurricane gates and other water control structures that provided maximum protection during severe hurricanes. (Williams, C. A, 2017) This project was officially completed in 1960 and the structure was named "Herbert Hoover Dike" in honor of President Hoover, which it is still referred as today.



Map of the Herbert Hoover Dike and direction of water flow through channels (A Draining Problem, 2018)

III. PRESENT DAY

A. FAULTY DESIGN

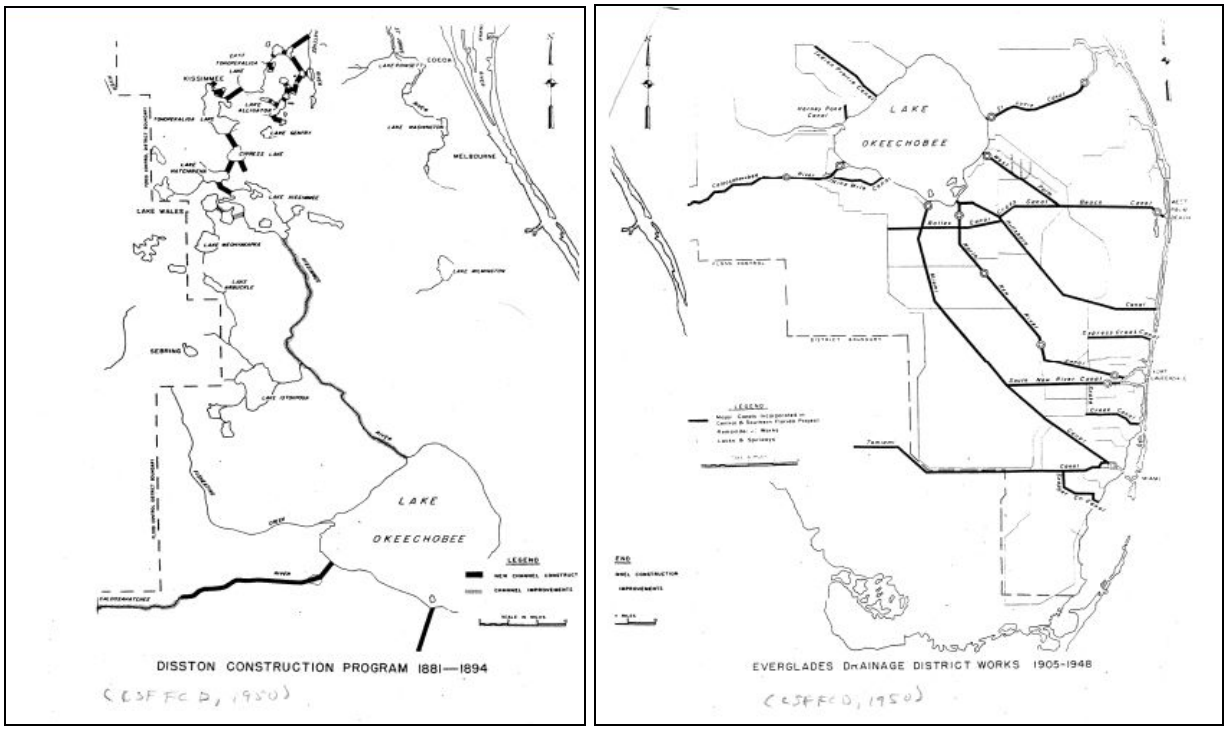
The turn of the century presented its own "sludge" of problems. The Okeechobee Waterway became the main channel for Lake Okeechobee's water overflow that went East and West into coastal areas like Fort Myers, the Florida Bay, and St. Lucie before entering out to sea. However, these South Florida coastal areas ended up on the downside of a "toilet flush" from the buildup of pollutants in Lake Okeechobee. These 80 years of man-made water control did not account for the increased levels of pollutants that would be collected and contained inside the Herbert Hoover Dike from the influx of the Florida population. Simply, the design and construction of the Dike were meant to redistribute the water flow, but was not designed to filter it. That is where the Everglades plays an important part in the natural environment; though it was disregarded in the past, the Everglades essentially acts as a kidney by filtering water through its 1.5-million-acre wetlands preserve (Eliot Kleinberg, August 2016). Removing the Everglades from Lake Okeechobee by installing the Herbert Hoover Dike removed this filtration process, and what was left inside Lake Okeechobee was 60 years of toxic buildup.

A cartoon emphasising the pollutants coming from Lake Okeechobee (Eliot Kleinberg, August 2016)

B. <u>ARMY CORPS OF ENGINEERS</u>

The entity responsible for the structural integrity and reinforcement of the Herbert Hoover Dike is the Army Corps of Engineers. Since their original intervention into this project in 1929, any current and future construction that concerns the Dike has been left in their hands. However, evidence of any damage to the Dike was not foreseen until the 1980's when damage from sinkholes, erosion, and piping, began to cause "seepages". According to Jacob Davis, a USACE civilian engineer in charge of Dike repairs, the leaks were caused by water under constant pressure pushing against the dike, loosening the soil, and gradually seeping through

(Willie Drye, March 2006). As water levels rise, more pressure is exerted on the dike, and the additional seepage could cause the dike to fail. As the water moves, it finds larger openings and follows the paths of least resistance through coarse materials such gravel or clay and sand. (Willie Drye, March 2006) Seepage is nothing new to water management practices around the world, but containing a body of water that is twice the square mileage of New York City such as that of Lake Okeechobee, this kind of seepage causes alarm.

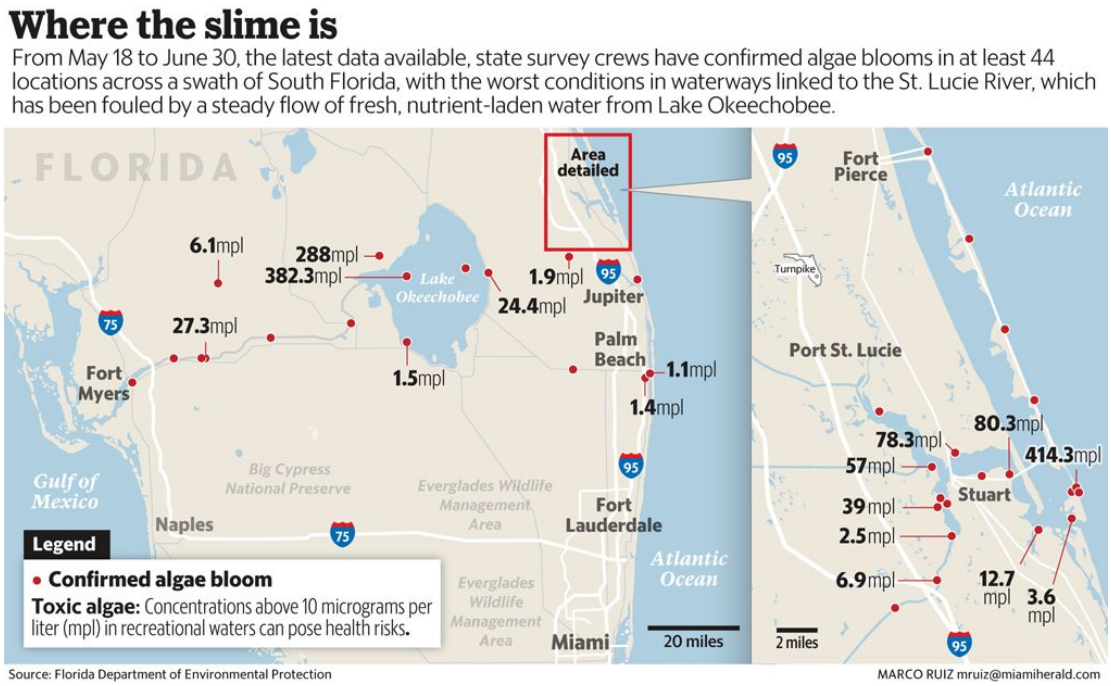


Left: Disston Construction Program 1881-1894, Right: Everglades Drainage District Works 1905-1948 (Vearil, J. 2008)

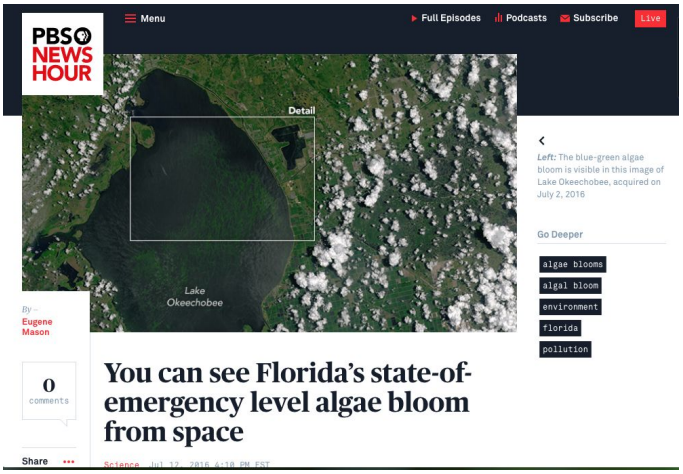
C. <u>BLUE-GREEN ALGAE</u>

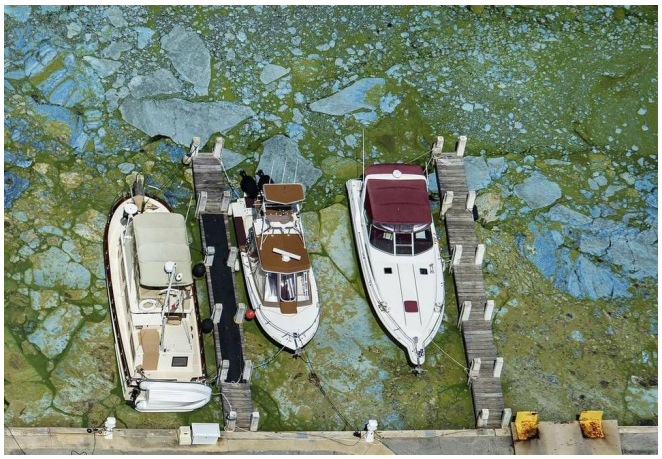
Over the decades of confining water inside Lake Okeechobee, the natural filtration properties of the Everglades had been almost completely cut off. Lake Okeechobee water, before

man-intervention in 1929, had naturally gone south through the Everglades, but was now completely redirected to go East and West. What was happening to the quality of this water became a disturbing actuality. Large amounts of nitrogen and phosphorus were being pumped into Lake Okeechobee from agricultural and residential runoff. These chemicals present in the runoff became the elemental foundation for a toxic phenomena; blue green algae blooms. Blue-green algae (cyanobacteria) is structurally similar to bacteria, but uses sunlight to grow and is known to multiply quickly in lakes with high nutrient levels. (St. Johns River Water Management District, 2016). However, ingesting water contaminated with toxic cyanobacteria can cause nausea, vomiting, and even acute liver failure according to Florida's Fish and Wildlife Conservation Commission (Wright, P. 2016). Blooms of blue-green algae in Lake Okeechobee have been recorded eight times since the early 2000's, but the bloom that occurred during the summer of 2016 was so impactful that it forced Florida into a State of Emergency. It was recorded that from this particular bloom, Florida was left with an estimated $880 million in damage control alone (Parker, L. July 2017). Fish began to die off, residents were becoming ill, and coastal tourism came to a halt in the middle of the peak summer season. Not only did these blooms hurt the economy and reputation of Florida's coastal communities, but in some areas along the St. Lucie Canal, it irreversibly destroyed estuaries and wildlife habitat.



Map locating areas of Florida affected by the 2016 blue-green algal blooms (Parker, L. July 2017)





Left: Close up picture of blue-green algae, Right: PBS News report, Lake Okeechobee algae blooms near St.Lucie Canal, Bottom: Boats docked at Central Marine in Stuart, FL in 2016 (Spencer, T. July 2016)

D. <u>BIG SUGAR</u>

The unregulated use of fertilizers containing nutrients that are run-off into Lake Okeechobee are no doubt correlated to the toxic blue-green algae blooms. While agricultural runoff isn't the only cause, many fingers point to the Sugar Industry, a $677 million dollar Florida industry (Fleshler, D. July 2016) A study from 1992 found that sugarcane fields and

sugar mills accounted for almost 28 percent of Lake Okeechobee's phosphorus. (Dewey, E. (2017) Yet cane fields of U.S. Sugar and Florida Crystals around the southern rim of the lake account for only a small percentage of its phosphorus today. In 2016, 5.8 percent of phosphorus found in lake Okeechobee came from areas where sugar fields are located (Fleshler, D. July 2016). And in 2015, the South Florida Water Management District recorded 37 percent of phosphorus as originating from land to the north that drains into the Kissimmee River (Staletovich, J. 2017). These lands contain vegetable farms, dairy farms, cattle ranches, citrus groves, and neighborhoods that span as far north as the Orlando suburbs, where fertilizer, wastewater and other sources of nutrient wash into the Kissimmee River, which then flows into Lake Okeechobee.

Sign of Florida Crystals, a major sugarcane producer in South Florida (Parker, L. July 2017)

E. FUNDING AND POLITICS

In 2008, U.S. Sugar sold 42 square miles of land south of Lake Okeechobee to the State of Florida for $197 million (Staletovich, J. 2017). In the 2014 Florida election, 74.1 percent of voters approved Amendment 1, or the *Water and Land Conservation* amendment to our state constitution. (Florida Election Results, 2014). The Water and Land Conservation amendment was created to generate an annual $750 million through taxpayer dollars to purchase more land south of Lake Okeechobee for water storage, which was a deal that also supported reducing the need for discharges into the ocean. However, according to David Guest from Earthjustice, the Senate and House under 45th Governor of Florida Rick Scott proposed that in 2014 they planned to use most of the money allocated for this amendment to be used instead for salaries and other non-environmental projects (Guest D. June 2015). Thought ¾'s of the Florida population, or 4,230,858 of the people, voted yes to pass Amendment 1,, The Water and Land Conservation amendment has not been taken seriously at the state level (Florida Election Results, 2014).

Ballot Measures

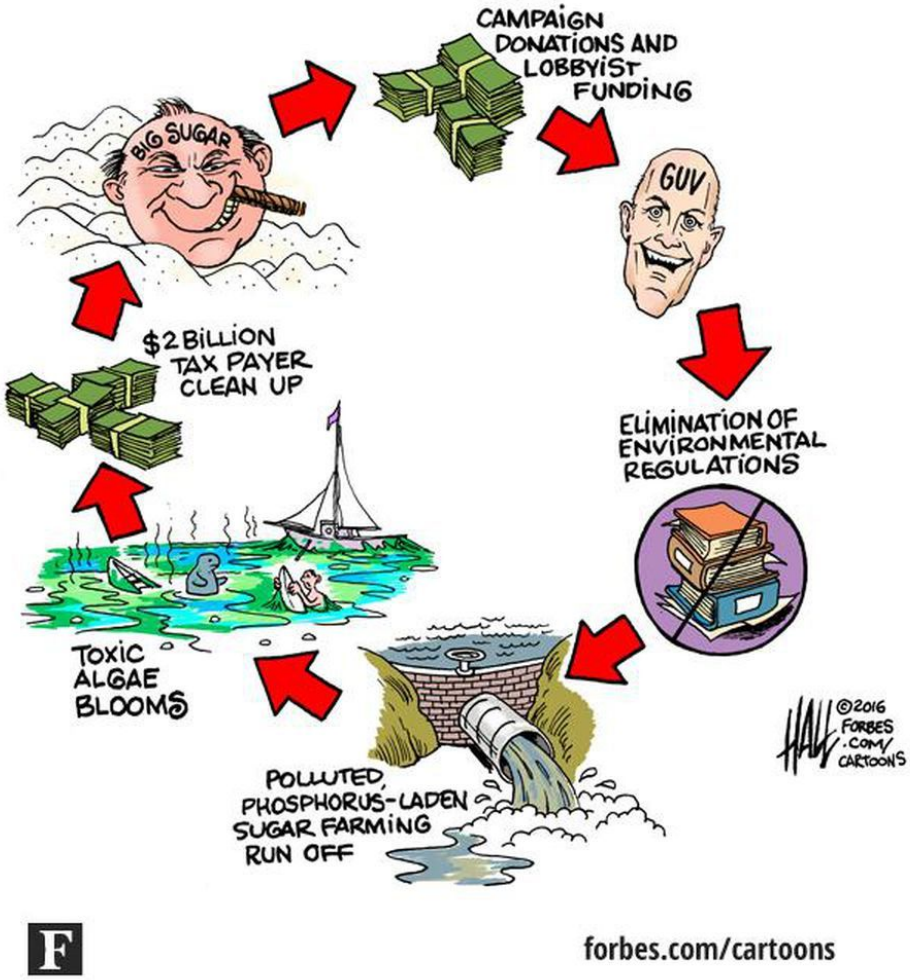
Amendment 1

Amend Constitution to dedicate funds to acquire and restore Florida conservation and recreation lands?

ANSWER	VOTES	PCT.
✔ Yes	4,230,858	**74.9%**
No	1,414,079	**25.1**

100% reporting

Data from the 2014 Florida Election, New York Times (Florida Election Results, 2014).

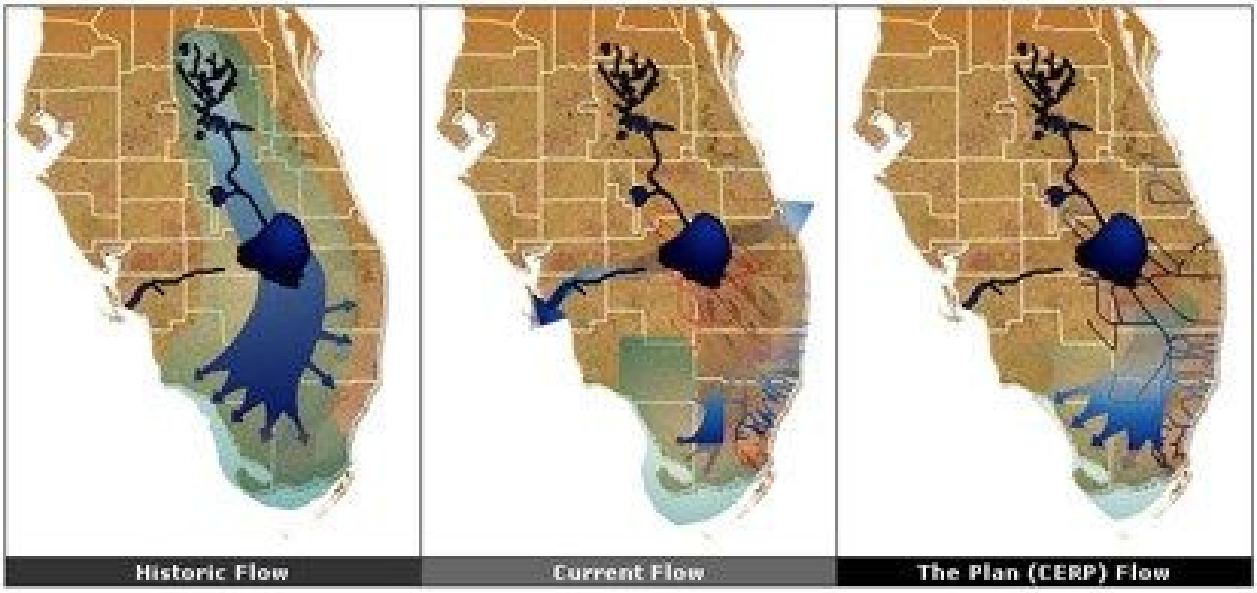


Cartoon depicting political cycle of environmental regulations in Florida from Forbes.com (Cartoon Of The Day, 2016)

F. <u>THE BIG PICTURE</u>

The bottom line is this: the more we try to control nature, the more of a responsibility we take on. Lake Okeechobee is our main source of fresh water to surrounding communities and to the millions of residents of central and south Florida. Lake Okeechobee also provides irrigation

for the state's 1.5 billion dollar agricultural industry and is abundant in fertile soil and favorable climate year-round, which is ideal for growing sugarcane, winter crops, citrus, and rice (Lake Okeechobee, April 2018). The Everglades National Park is a pristine natural ecosystem hosting thousands of trees plants birds fish and wildlife species such as hardwood hammocks, pineland, cypress swamps, mangrove and coastal prairies, and a variety of marine life which the balance of coexistence is vital to Everglades biodiversity (State of the Everglades, 2018). These species rely on the Everglades as their habitat for survival, yet their existence is threatened by high levels of pollutants and toxins found in our water. We know who is responsible for this mess; we are as a human species. However, we can only move forward if we are all moving together. Many environmental groups support the idea of returning control back to nature is the best solution, which would redirect the water flow back down south into the Everglades as it did before man intervened. This idea was actually proposed on December 11, 2000, with former Florida Governor Jeb Bush and President Bill Clinton signing the Comprehensive Everglades Restoration Plan (CERP), also known as “the largest ecosystem restoration project in the history of the planet” (Comprehensive Everglades Restoration Plan, 2000). This $7.8 billion dollar bill with a 35+ year timeline had these allocations to be used strictly on Everglades restoration efforts (Grunwald, M. December 2010). However, allowing today’s polluted water of Lake Okeechobee to flow directly into the Everglades would do more harm than good, for obvious reasons. That’s why an alternative plan for filtration of the lake’s water before disbursement is essential for the survival of the Everglades ecosystem.



Map showing the past, present, and future Everglades flow following the CERP plan (Comprehensive Everglades Restoration Plan, 2000).

Groups like the Everglades Foundation protect and restore America's Everglades through science, advocacy, and education (State of the Everglades, 2018).

IV. SOLUTIONS FOR THE FUTURE

A. ARMY CORPS OF ENGINEERS

Though the progress on the Herbert Hoover Dike has had its obstacles, the Army Corps of Engineers have been consistent with executing their plans to maintain this 1929 structure to date. Since 2001, the U.S. Army Corps of Engineers has invested more than $870 million as part of rehabilitation efforts to reduce the risk of failure of the Dike, and have sought out repair evaluation with state and independent experts (Herbert Hoover Dike Rehabilitation Reach 1, 2017). The governing system that is in place for the Dike's water management today consists of 5 gated outlets, 5 gated inlets, 33 primary and secondary culverts, 9 navigation locks, and 9 pump stations. (JACKSONVILLE DISTRICT, 2018) This show that there is a specific method for how and where the water will flow through Lake Okeechobee in order for this man-controlled water management practice to work. However, the one structural concern is that Lake Okeechobee has never had overflow capacity, meaning if another storm came through South Florida, it would further stress the already crumbling state of the Dike.

Map of the water management system used in the Herbert Hoover Dike (USACE: Lake Okeechobee and the Herbert Hoover Dike, August 2010)

Because the Dike's condition is so fragile, the likelihood of flood and residential displacement is high. In order to provide the optimal protection of the populations living in this area, the Army Corps of Engineers have created a plan for restoration of the Herbert Hoover Dike. This plan is titled as Rehabilitation Reach 1, which includes the construction of 35 miles of seepage barrier along the south and west sides of the dike (Herbert Hoover Dike Rehabilitation

Reach 1, 2017). This would eliminate the concern for seepage and breeches in the Dike's integrity from erosion of the original structure. Plans for the future include extending the cutoff wall that goes west through Lake Harbor, Clewiston, Moore Haven and Lakeport. The Army Corps of Engineers estimated that the cost for all of the remaining work through 2025 will exceed $800 million, bringing the total cost of the Herbert Hoover Dike rehabilitation effort to more than $1.7 billion. (Miller, K. 2017)

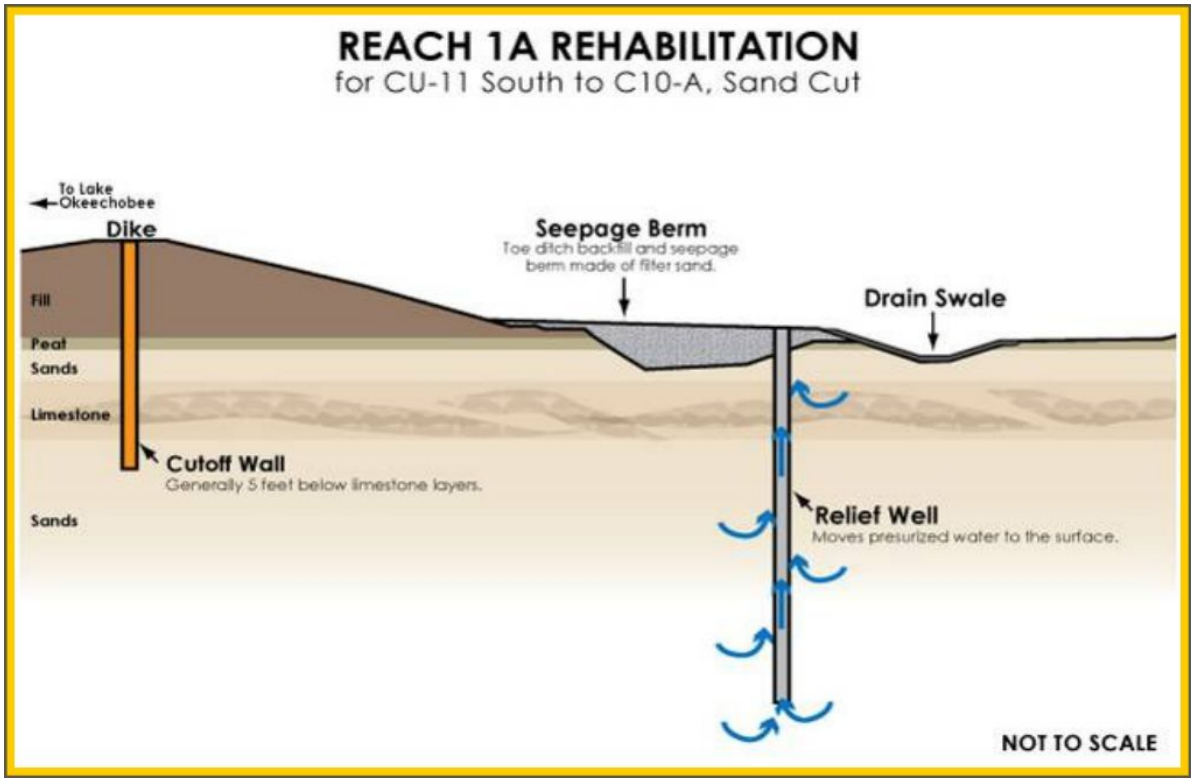
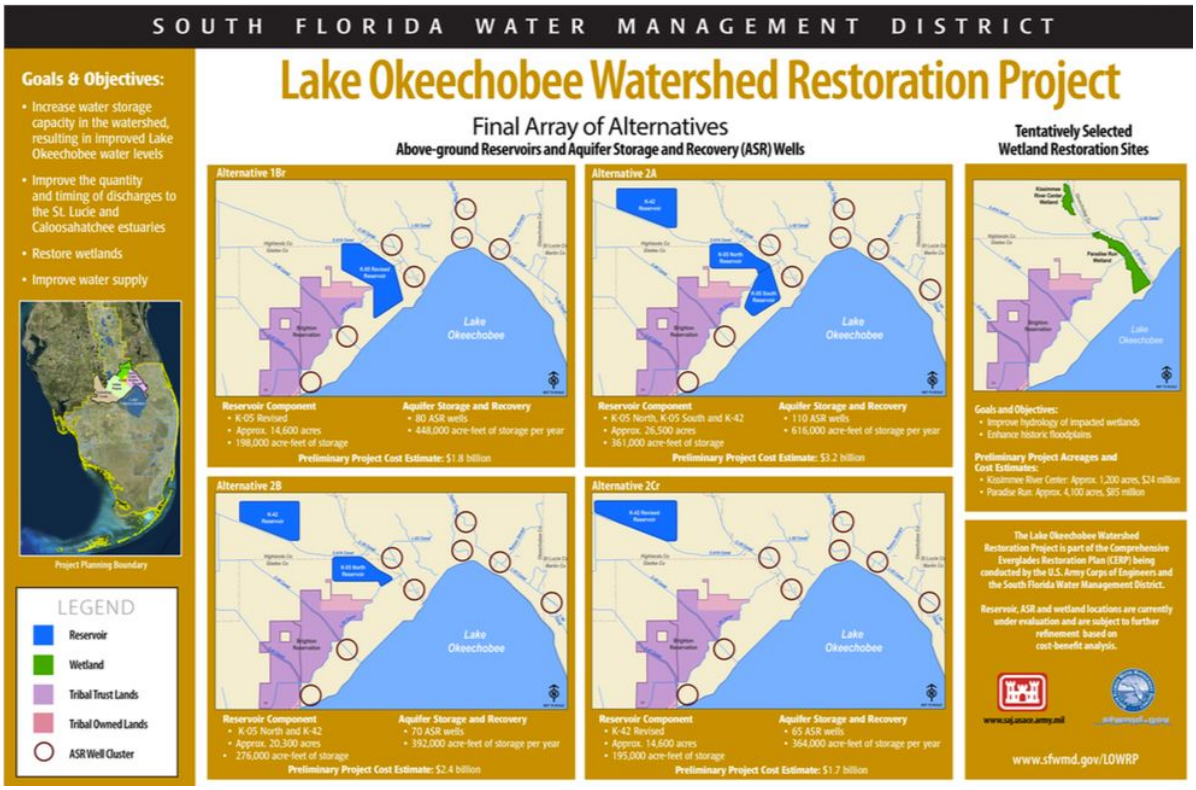


Diagram showing the USACE plan for Herbert Hoover Dike rehabilitation (Herbert Hoover Dike Rehabilitation Reach 1, 2017)

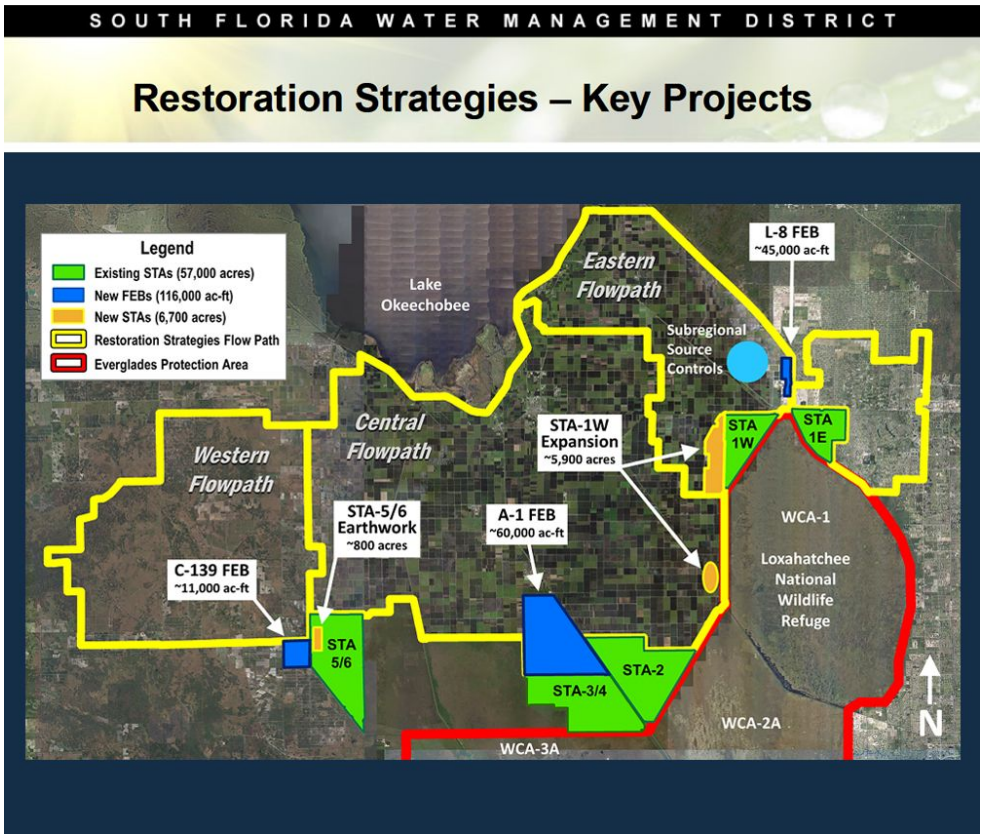
B. SOUTH FLORIDA WATER MANAGEMENT DISTRICT

There are many components to the crisis for clean water in Lake Okeechobee and the Everglades, but the main Environmental Group who is claiming responsible towards "clean-up" is the South Florida Water Management District. Under the Comprehensive Everglades Restoration Plan (CERP), the South Florida Water Management Districts' responsibilities are to identify opportunities to improve the quantity, timing, and distribution of flows into and out of Lake Okeechobee, specifically on the North and South areas. (Comprehensive Everglades Restoration Plan, 2000). In the North side of Lake Okeechobee, the Lake Okeechobee Watershed Restoration Project utilizes above ground reservoirs within the Kissimmee River to increase water storage capacity in the watershed. This project is in partnership with the U.S. Army Corps of Engineers to help improve Lake Okeechobee water levels, quantity, and timing of discharges into the Caloosahatchee and St. Lucie estuaries. On the South side of Lake Okeechobee, the Everglades Agricultural Area Storage Reservoir Project (EAA) reduces damaging discharges to the northern estuaries and instead filters and delivers clean water through Everglades restoration to achieve water quality standards. In 2017, the South Florida Water Management District constructed five operational Everglades Stormwater Treatment Areas (STAs) with an effective treatment area of 57,000 acres and is continuing 12,000 acres of STA expansions. Implementation of Best Management Practices (BMP), or improved farming methods, has also been applied to the 470,000 acres of agricultural lands south of Lake Okeechobee. To date, this project has treated more than 1.1 million acre-feet of water bound for the Everglades each year from the use of STA's (Restoration Strategies, 2018). To date this has reduced phosphorus levels by 84 percent of the 1.1 million acre feet of water before flowing out of the STA's, which has

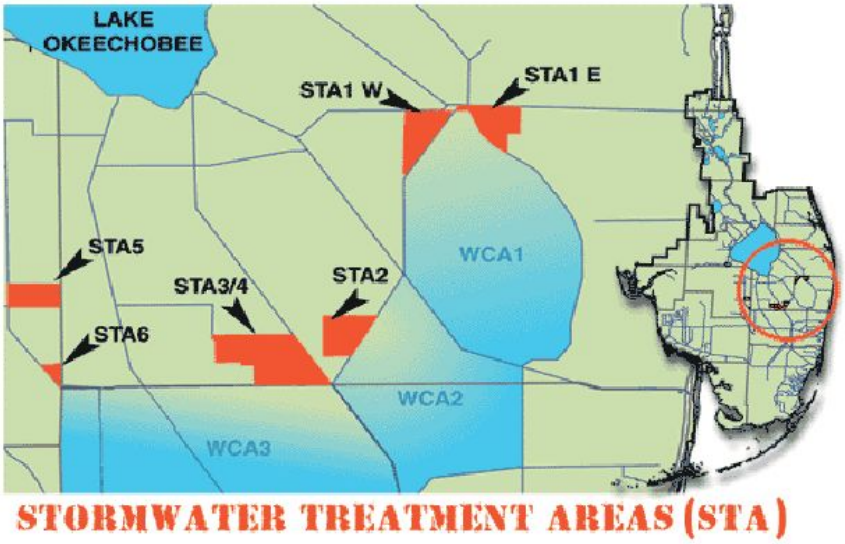
reduced twice the amount of phosphorus from the area as required by Florida's Everglades Forever Act (DOI Office of Everglades Restoration Initiatives, 2018).



North, Lake Okeechobee Watershed Restoration Project (Restoration Strategies, 2018).



South, Everglades Agricultural Area Storage Reservoir Project (Restoration Strategies, 2018).



A map showing the locations of the stormwater treatment areas in south Florida (DOI Office of Everglades Restoration Initiatives, 2018).

V. PROPOSAL

The use of stormwater treatment areas and above ground water reservoirs has made progress in the right direction towards a healthy ecosystem. Stormwater Treatment Areas, or STA's, are man-constructed wetlands designed to reduce phosphorus levels in the northern Everglades and Loxahatchee National Wildlife Refuge. These areas filter phosphorus and nitrogen from the water in Lake Okeechobee through specific conservation areas. Plants are selected and planted in the STA's strategically to absorb phosphorus in the water as they grow, eventually depositing much of the nutrient in the soils. These techniques of water filtration and storage helps to reduce harmful nutrient loads going in and coming out of Lake Okeechobee and have been the most effective means in environmental clean-up to date. However, there are two observations that I believe could be improved upon to help further the progress of restoring Lake Okeechobee and the Everglades.

A. OBSERVATION 1

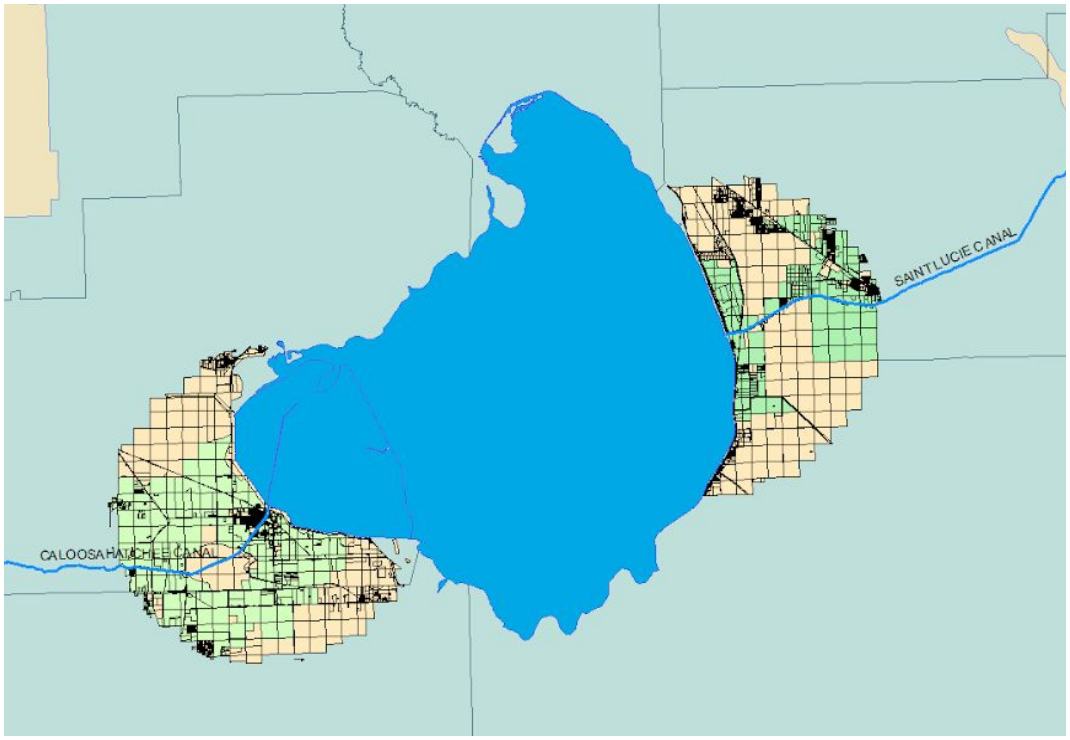
The First area of concern is that there is not enough water being filtered from Lake Okeechobee in the 5 operational Stormwater Treatment Areas for it to equal the total amount of water being discharged out of Lake Okeechobee per year. The concern is in part due to the lack of information available to determine the amount of water that is discharged out of Lake Okeechobee per year. However, according to an article from the TCPalm in 2017, from mid-September to Dec. 28, 2017, the Army Corps of Engineers sent about 192 billion gallons of Lake Okeechobee water to the St. Lucie River and Indian River Lagoon. (Treadway, T. November, 2017) We do have data that supports the proposed concern such as the maximum

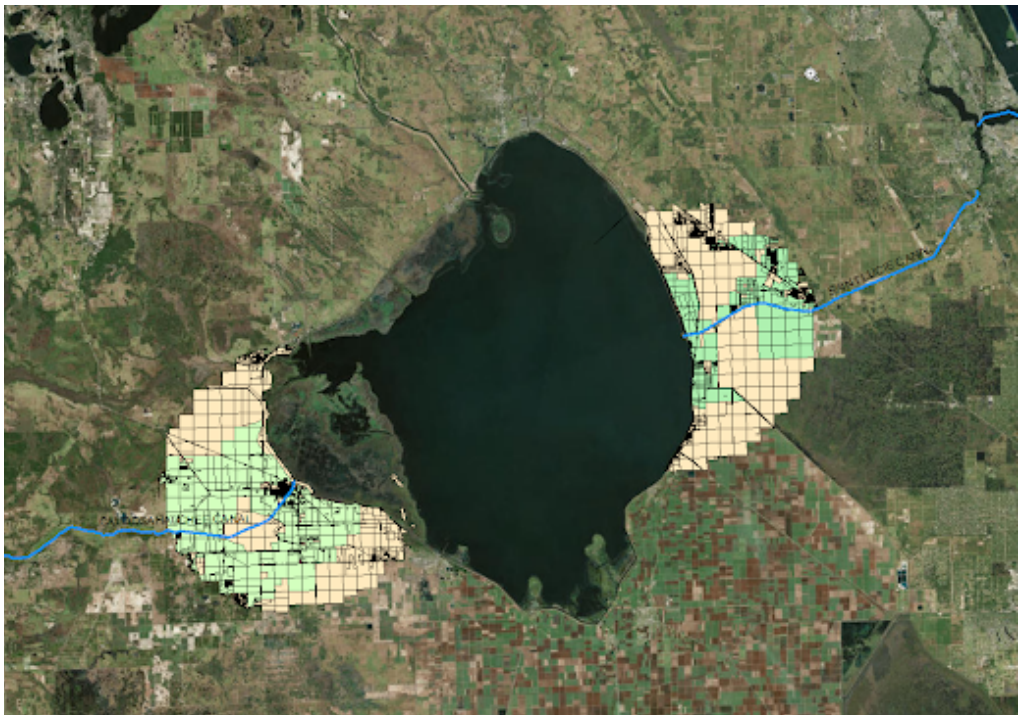
capacity of the operational STA's, which in 2017 was 240,000 acre-feet of water at one time (Restoration Strategies for Clean Water for the Everglades, 2018). And the data available that can be used to determine the amount of water directed out of Lake Okeechobee per year is also related to the amount of water directed out of the 5 STA's, which in 2017 was 1.1 million acre-feet of water (State of the Everglades. 2018). These measurements were recorded from each individual STA which put together adds up to these total volumes recorded in 2017.

B. OBSERVATION 2

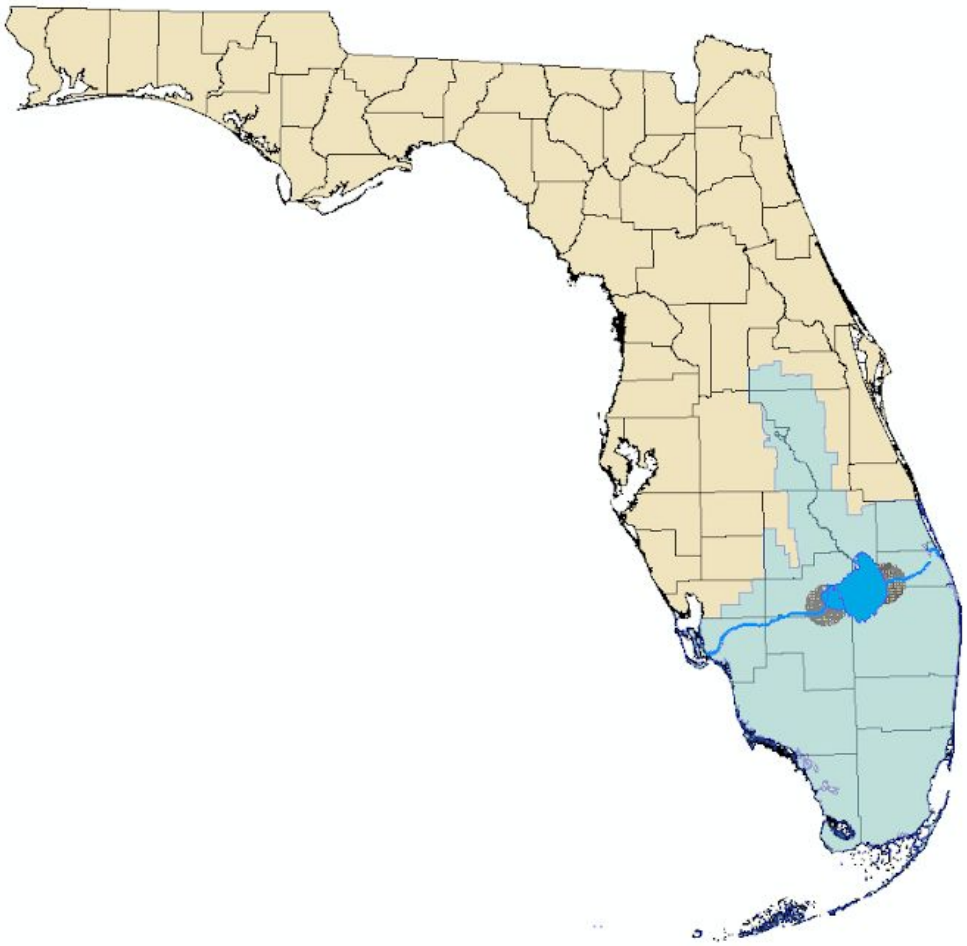
The Second issue is that not enough of the available restoration land has been utilized for Stormwater Treatment Areas. There are currently 5 operational STA's with a 6th in progress of completion which occupies and area of around 57,000 acres (Andy Reid, Irfan Uraizee and Yiran Zhu, 2016). However, this only represents a quarter of a fraction of the 470,000 acres of available land allocated for water conservation to the South Florida Water Management District, called the Everglades Agricultural Area Storage Reservoir Project (EAA) (Harmful Nutrients in the Everglades Now Reduced by 90%, 2017). Using GIS, we were able to identified potential parcels of land to purchase and convert into more STA's. The criteria we chose for selecting these parcels was by location and land type. The location we selected to create new STA's had to be located East and West along the Caloosahatchee Channel and St. Lucie canal entrances from Lake Okeechobee. The size of these two locations had to be within a 10 mile radius from the two canal entrances, and be within 5 miles of the canals themselves. The strategic selection of these new STA locations were intended to directly clean the water coming out of Lake Okeechobee going to the East and West Coastal areas of Fort Myers and St. Lucie. The land type was also a

criteria in selection in that the land in these specific locations also had to be zoned as agriculture lands to mirror the CERP plan of acquiring and restoring these lands back to their natural states.





Top: Close up image of the map we created in GIS of Lake Okeechobee to show the areas located East and West that could be converted into STA's, based on the given criteria. Beige represents parcels within the 10 mile radius of the canal entrance, and green represents the parcels that are 5 miles off of each canal within the 10 mile area. Bottom: Satellite version of the map.



Full sized version of the map we created in GIS depicting the research area. Light blue represents the South Florida Water Management Districts, which consists of the Kissimmee River, Lake Okeechobee, and the Everglades. The darker blue lines going East and West are St. Lucie Canal and Caloosahatchee Channel, respectively.

VI. DATA

A. OBSERVATION 1

1. Question 1:

Is there enough water being filtered from Lake Okeechobee in the 5 operational Stormwater Treatment Areas for it to equal the total amount of water being discharged out of Lake Okeechobee per year?

2. Hypothesis 1:

We believe that the amount of water directed out of Lake Okeechobee will be **greater** than the amount of water directed out of STA's alone, per year.

3. STEP 1:

Determine the VOLUME INTAKE of STA's per year.

a) DATA:

MAX CAPACITY OF STA's: 240,000 acre-feet at one time

VOLUME OUTPUT OF STA's 2017: 1.1 million acre-feet of water

b) FORMULA:

(MAX CAPACITY STA) / (VOLUME OUTPUT OF STA) = (VOLUME INTAKE RATE STA)

c) **EQUATION:**

(240,000) / (1,100,000) = 0.2181 or ~1/5

d) **ANALYSIS:**

South Florida Water Management District can FLOW OUT 240,000 acre feet of water within 5 active STA's in approximately 1/5th of a year, or every 2 months.

e) **RESULTS:**

The Volume Intake Rate of ~22% or ⅕ means that the STA's can produce 1.1 million acre-feet of filtered water in one year by processing 1 full capacity load every 2 to 2.5 months.

4. **STEP 2:**

Determine the VOLUME of water being directed OUT OF Lake Okeechobee each year.

a) **DATA:**

VOLUME OUTPUT OF LAKE O September-December 2017: 193 billion gallons

NUMBER OF MONTHS IN A YEAR: 12

b) **FORMULA:**

ESTIMATE VOLUME OUTPUT OF LAKE OKEECHOBEE PER YEAR:

1) (VOLUME OUTPUT OF LAKE O September-December 2017) / 2 = (AMOUNT IN 1 MONTHS)

2) (VOLUME OUTPUT OF LAKE O September-December 2017) x 12 = (AMOUNT IN 12 MONTHS)

c) <u>EQUATION:</u>

(193 billion gallons) / 2 = 96.5 billion gallons

(193 billion gallons) x 12 = 1.158 trillion gallons

d) <u>ANALYSIS:</u>

The amount of water being discharged out of Lake Okeechobee each month is around 96.5 billion gallons, and per year the discharge is 1.158 trillion gallons.

e) <u>RESULTS:</u>

The calculated volume of water being discharged from Lake Okeechobee each year is 1.158 trillion gallons, which is an estimation based on data retrieved from a TCPalm article published in 2017.

5. <u>STEP 3:</u>

Determine the PERCENTAGE of the water directed from Lake O into STA's per year.

a) <u>DATA:</u>

VOLUME OUTPUT OF LAKE O PER YEAR:= 1.158 trillion gallons

VOLUME OUTPUT OF STA's 2017: 1.1 million acre-feet of water

b) <u>FORMULA:</u>

CONVERT ACRE-FEET INTO GALLONS (1 acre foot = 325,851 gallons)

1) (VOLUME OUTPUT OF STA's 2017) x 325,851 = (VOLUME OUTPUT OF STA's 2017 IN GALLONS)
2) (VOLUME OUTPUT OF STA's 2017) / (VOLUME OUTPUT OF LAKE O PER YEAR) = (PERCENTAGE OF WATER FROM LAKE O THAT IS FILTERED THROUGH STA'S PER YEAR)

c) <u>EQUATION:</u>

(1,100,000 acre-feet) x 325,851 gallons = 3.5843604e+11 gallons (358,436,100,000)

358,436,100,000 gallons / 1,158,000,000,000 gallons = 0.3095 or ~1/3

d) <u>ANALYSIS:</u>

The percentage of water discharged from STA's on a yearly basis is around 31%, or ⅓ of the total amount of water discharged from Lake Okeechobee annually.

e) <u>RESULTS:</u>

The percentage of water being filtered and discharged out of STA's is only ⅓ of the total amount of water being discharged from Lake Okeechobee.

6. SUMMARY:

My hypothesis proved correct. The amount of water directed out of the 5 STA's alone only accounts for 30% of the annual Lake Okeechobee discharge, meaning that 70% of the water discharged is not filtered through an STA.

VOLUME INTAKE OF STA's	20% or ⅕ of total annual output PER capacity
VOLUME OUTPUT OF LAKE OKEECHOBEE PER YEAR	1.158 trillion gallons
VOLUME OUTPUT OF STA's 2017	1.1 million acre-feet of water or 358,436,100,000 gallons

B. OBSERVATION 2

1. Question 2:

Is enough of the available restoration land being utilized for Stormwater Treatment Areas?

2. Hypothesis 2:

I believe there is **not** enough of the available restoration land being utilized for Stormwater Treatment Areas.

3. STEP 1:

Determine PERCENTAGE of restoration land currently being utilized by Stormwater Treatment Areas and determine the AVERAGE SIZE of STA's.

a) DATA:

TOTAL LAND AREA: 470,000 acres

LAND USED FOR STA's: ~57,000 acres

NUMBER OF STA's: 5

b) FORMULA:

1) (LAND USED FOR STA's) / (TOTAL LAND AREA) = (PERCENTAGE OF LAND USED FOR STA's)
2) (LAND USED FOR STA's) / (NUMBER OF STA's) = (AVERAGE SIZE OF STA)

c) EQUATION:

(57,000) / (470,000) = 0.121 or 12%

(57,000) / (5) = 11,400 acres

d) ANALYSIS:

The percentage of land that is being used for STA's is around 12%. The average size of an STA is around 11,400 acres.

e) **RESULTS:**

STA's only take up 12% of the available restoration land, meaning there is 88% of the land available that is not being utilized as an STA.

4. **STEP 2:**

Determine the amount of STA's that could fit within 10 mile radius of lake entrances and within 5 miles off the canals.

a) **DATA:**

AVERAGE STA SIZE: 11,400 acres

TOTAL QUALIFIED LAND ACREAGE CALOOSAHATCHEE: 60,525.71 acres

TOTAL QUALIFIED LAND ACREAGE ST. LUCIE: 32,314.83 acres

b) **FORMULA:**

1) (TOTAL QUALIFIED LAND ACREAGE CALOOSAHATCHEE) / (AVERAGE STA SIZE) = (NUMBER OF POTENTIAL STA's NEAR CALOOSAHATCHEE)
2) (TOTAL QUALIFIED LAND ACREAGE ST. LUCIE) + (AVERAGE STA SIZE) = (NUMBER OF POTENTIAL STA's NEAR ST. LUCIE)

c) **EQUATION:**

(60,525.71 acres) / (11,400 acres) = 5.3 or ~5

(32,314.83 acres) / (11,400 acres) = 2.83 or ~ 2.5

d) ANALYSIS:

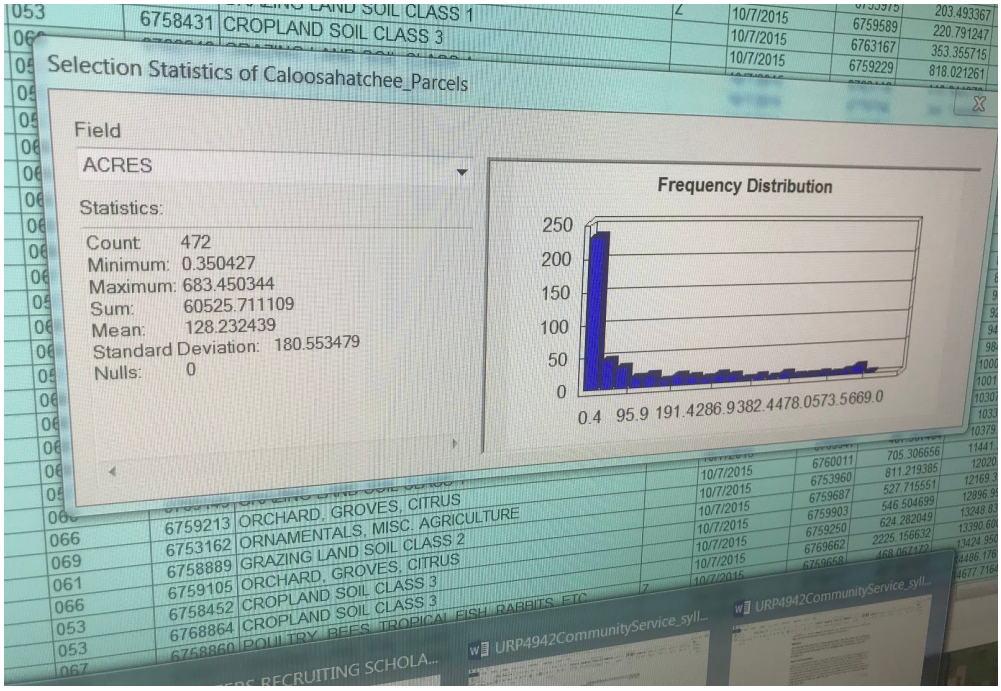
Around 5 additional STA's sites could be included near Caloosahatchee channel and as much as 2.5 additional STA's sites could be included near St. Lucie Canal.

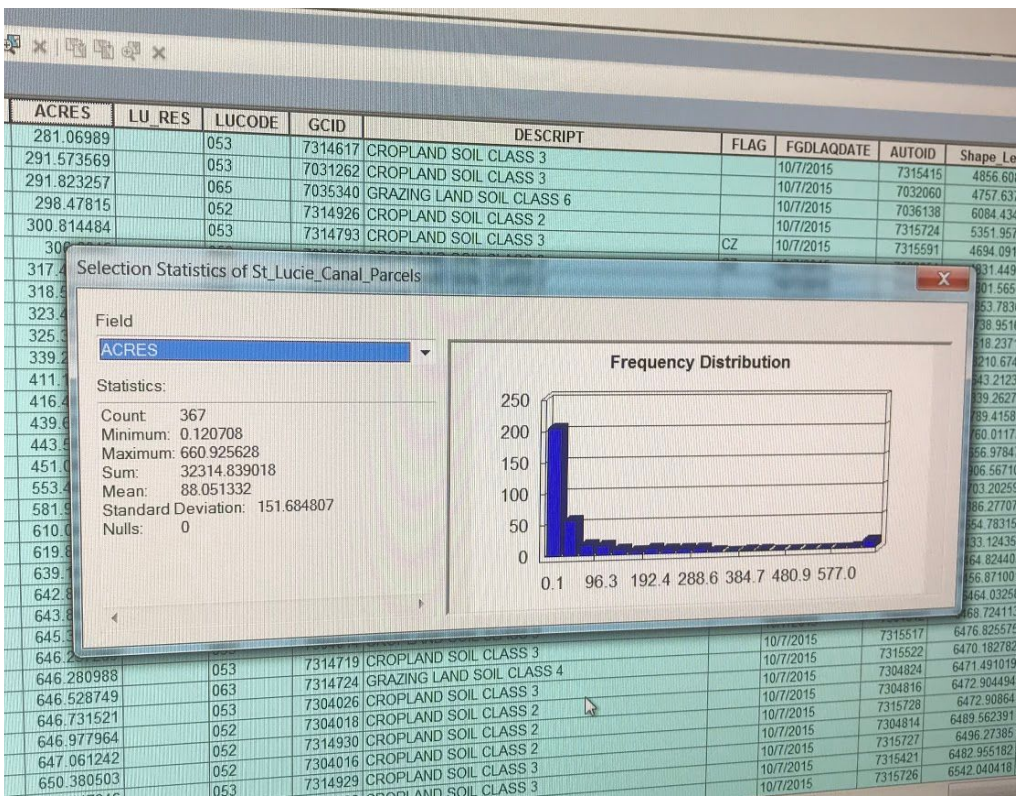
e) RESULTS:

Having an additional 7.5 STA's near the entrance points going east and west towards the coastal areas will ensure the health and quality of the water going to these highly populated areas.

5. SUMMARY:

My hypothesis proved correct. The Everglades Agricultural Area is only utilizing 12% of its 470,000 acre area for Stormwater Treatment Areas. This could be due to a number of different reasons, such as a slow acquisition of lands for STA purposes because of zoning and specific land use requirements. However, if we were to extend the area to the East and West sides of Lake Okeechobee which include the entrances to the Caloosahatchee channel and St. Lucie Canal, we would have more than twice the amount of STA's working to filter water coming from Lake Okeechobee which could reduce the unfiltered discharges by an additional 50% on top of the 30% already filtered by the current 5 STA's.





Pictures taken from the attribute table in GIS showing the analysis of land parcels in the East and West section of Lake Okeechobee.

VII. CONCLUSION

Since as far back as 1835, the desire to drain the Everglades so land could be developed in its place has been a constant. No doubt has the fight to control water in the Everglades proven to be costly, delayed, dragged out, and yet we are still not complete with our promise to the citizens of Florida to protect them and their environments from polluted waters. Giving back water management control to nature would appear to solve these problems, however the contamination that has developed in Lake Okeechobee requires extensive filtration and planning before its waters are ever to be connected back to the Everglades. The war against these toxins in our natural habitats will only continue to grow worse if something is not done. Politicians and state officials need to together work on supporting environmentally conscious policy that reflects these healthy values and morals. Agriculture companies need to put the needs of the environment over needs for the success of business. Society needs to educate themselves and demand healthier water so we can prepare for the world of tomorrow. In all, being able to review the history of Florida Water Management pertaining to Lake Okeechobee, the Everglades, and the Kissimmee River will be the key ingredient to figuring out how to clean up the mess of today for a healthier tomorrow.

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