City of Haines City

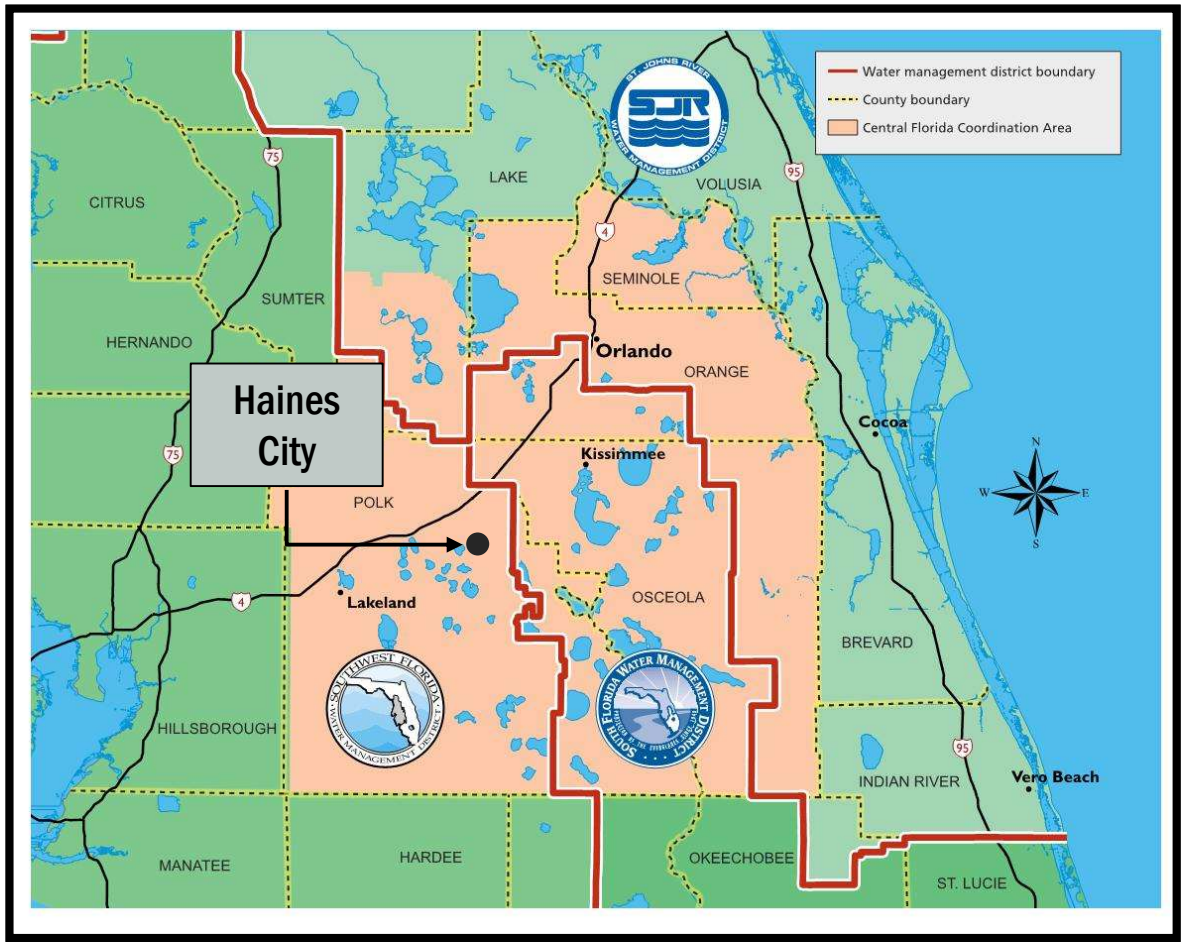
Integrated 1Water Approach to Evaluate Lake, Groundwater & Ecosystem Restoration

July 12, 2018

Agenda

1. Project Need
2. The City's Vision
3. Project Benefits
4. Previous Work
5. City's Partners and Stakeholders
6. Project Objectives
7. 1Water Approach
8. H&H Modeling
9. Lake Existing Conditions Assessment
10. Conclusions and Next Steps

Central Florida Water Initiative



- Five County Area
- Traditional Groundwater Sources Will Not Meet Estimated Demand w/o Adverse Impacts
- Most of Capacity Will Need to Come From Alternative Sources
- Promoting Multi-jurisdictional Partnerships for Regional Benefits

The City's Vision

- Environmental: Protect our natural amenities by encouraging proactive environmental initiatives intended to safeguard our natural resources.
- Infrastructure: Maintain, protect and design infrastructure that ensures a desired level of service and provides for future needs.
- Quality of Life: Create an environment that enhances the quality of life and benefits the community culturally, recreationally and economically.

Lake Eva and Lake Henry Restoration Benefits

- This project can provide a variety of benefits, including ecological restoration, water quality improvements, aquifer recharge, and stormwater harvesting.
- By helping to address water quality, water supply, natural systems, and flood protection needs.

Previous Work

Existing Reports Collected
Wahneta Canal Watershed Management Plan – PBSJ, 2005
Peace Creek Watershed Management Plan Alternatives Report – PBSJ, 2006
Peace Creek Watershed Regulatory Review – PBSJ, 2006
Peace Creek Watershed Management Plan Surface Water Resource Assessment Land Ownership Report – PBSJ, 2006
Peace Creek Watershed Management Plan Surface Water Resource Assessment – PBSJ, 2006
Peace Creek Watershed Management Plan Watershed Evaluation Report Phase I – PBSJ, 2006
City of Lake Wales Watershed Management Plan Final Report – PBSJ, 2007
Hydrogeology of Polk County – USGS, 2007
Peace Creek Watershed Management Plan Data Collection Report – PBSJ, 2008
Polk County Comprehensive Water Supply Plan - Reiss Eng., 2009
Peace Creek Level of Service Memo – Atkins, 2014
Peace Creek Winter Haven Chain of Lakes Structure Optimization Report – Atkins, 2014
Central Florida Water Initiative (CFWI) Minimum Standards for Water Resource Data Collection, Site Establishment, and Field Data Collection Protocols – CFWI, 2014
Proposed Minimum and Guidance Levels for Lake Eva (Haines City in Polk County, Florida (Draft) – SWFWMD, 2016
CFWI Environmental Measures Team – CFWI, N/A
Ground-Water Contamination Potential and Quality in Polk County, Florida – USGS, 1992

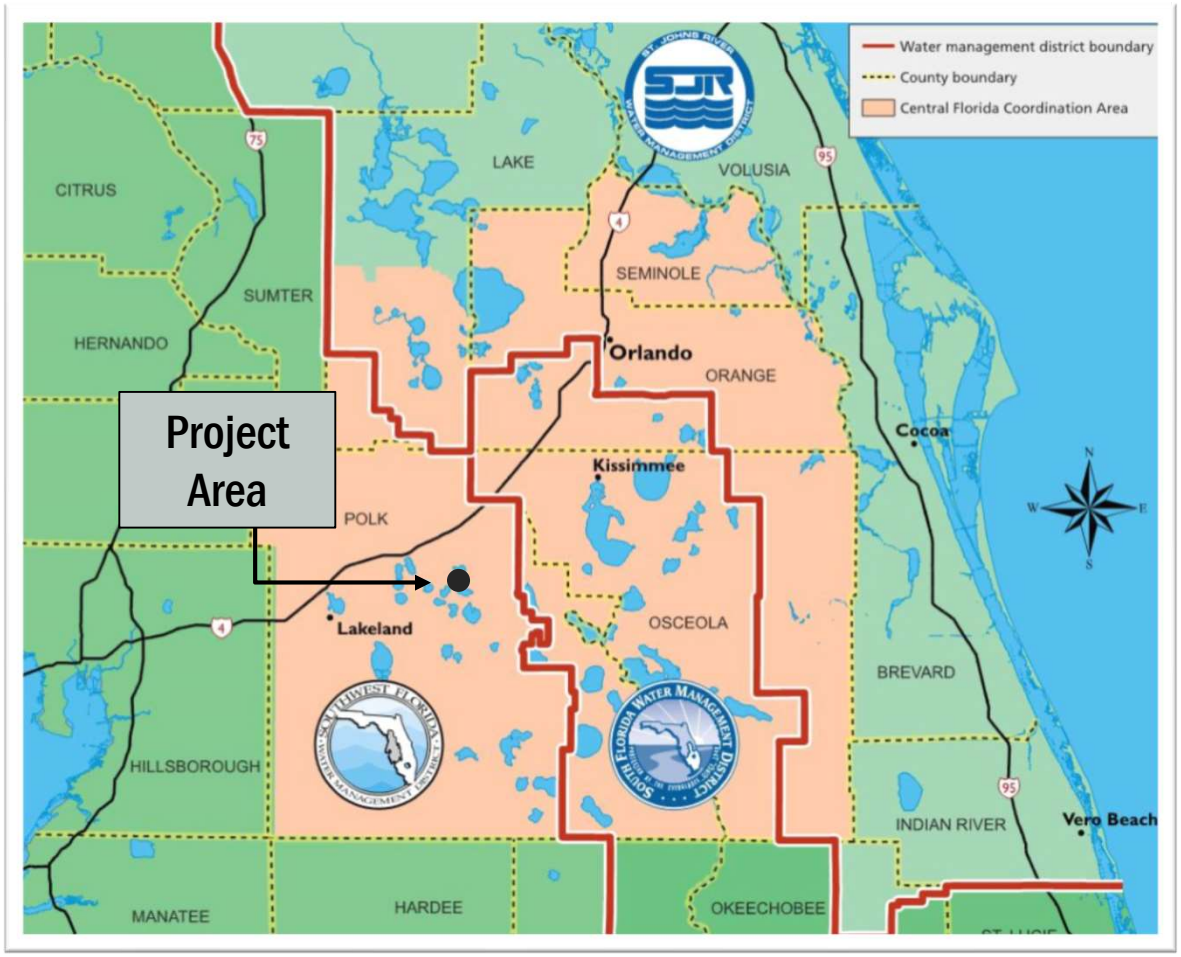
Current Data Sources include Haines City, SWFWMD, FDOT, USGS, Polk County Water Atlas, USFWS, and FGS

City's Partners and Stakeholders

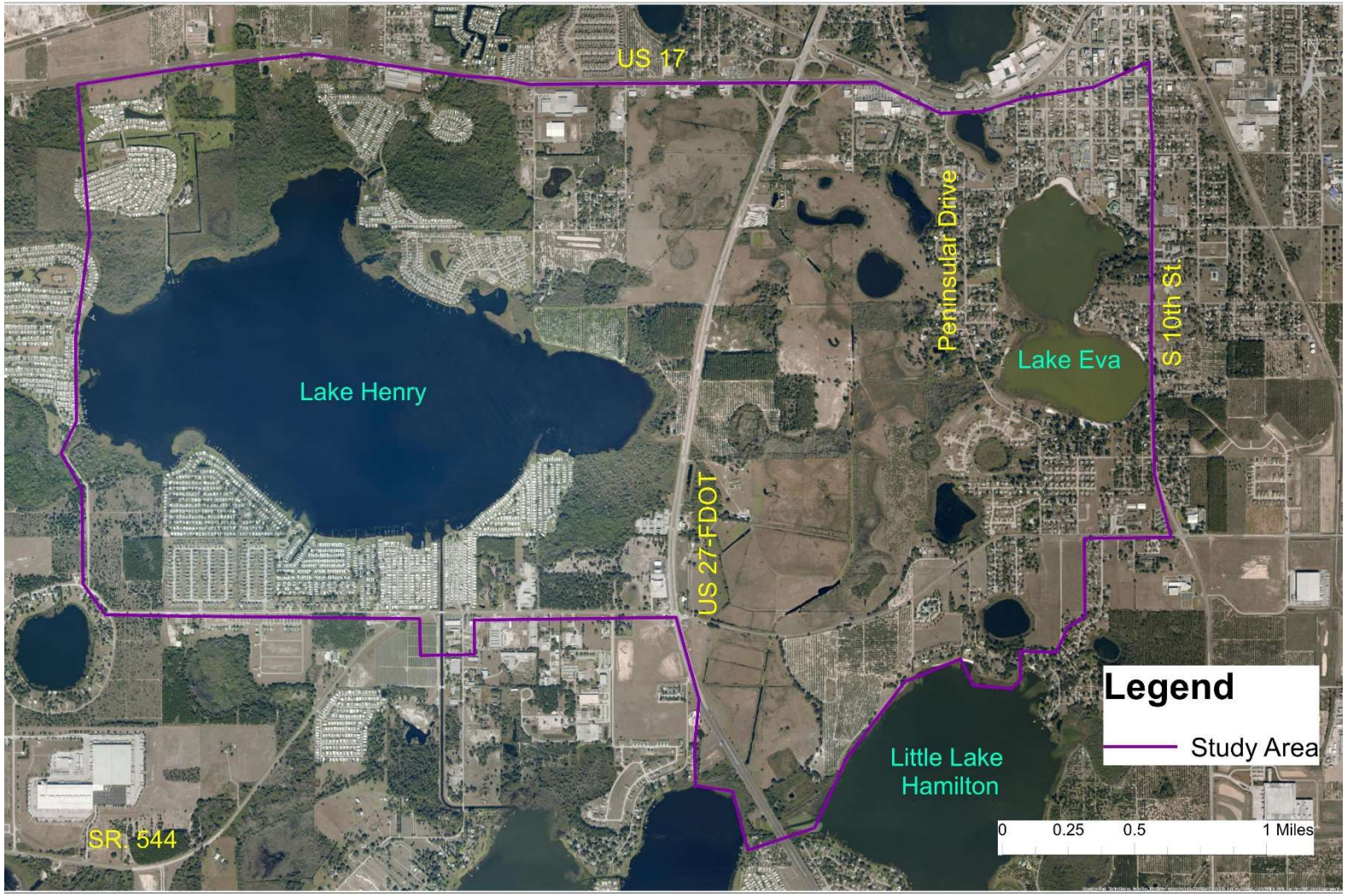
- SWFWMD
- Haines City Water Control District
- City of Winter Haven
- Polk County
- FDOT
- FDEP

We're in this together

Project Vicinity Map



Project Study Area



Project Objectives

Address Lake Eva Minimum Flow and **Level** (MFL) and SWFWMD guidance levels

Improve **water quality** in Lake Eva

Improve **flood protection** in the vicinity of Lake Henry, while protecting **water recreation** opportunities

Improve **groundwater recharge** and potentially obtain water supply credits from SWFWMD

Natural systems enhancement/improvement

ONE WATER

What is One Water and is it the Answer???

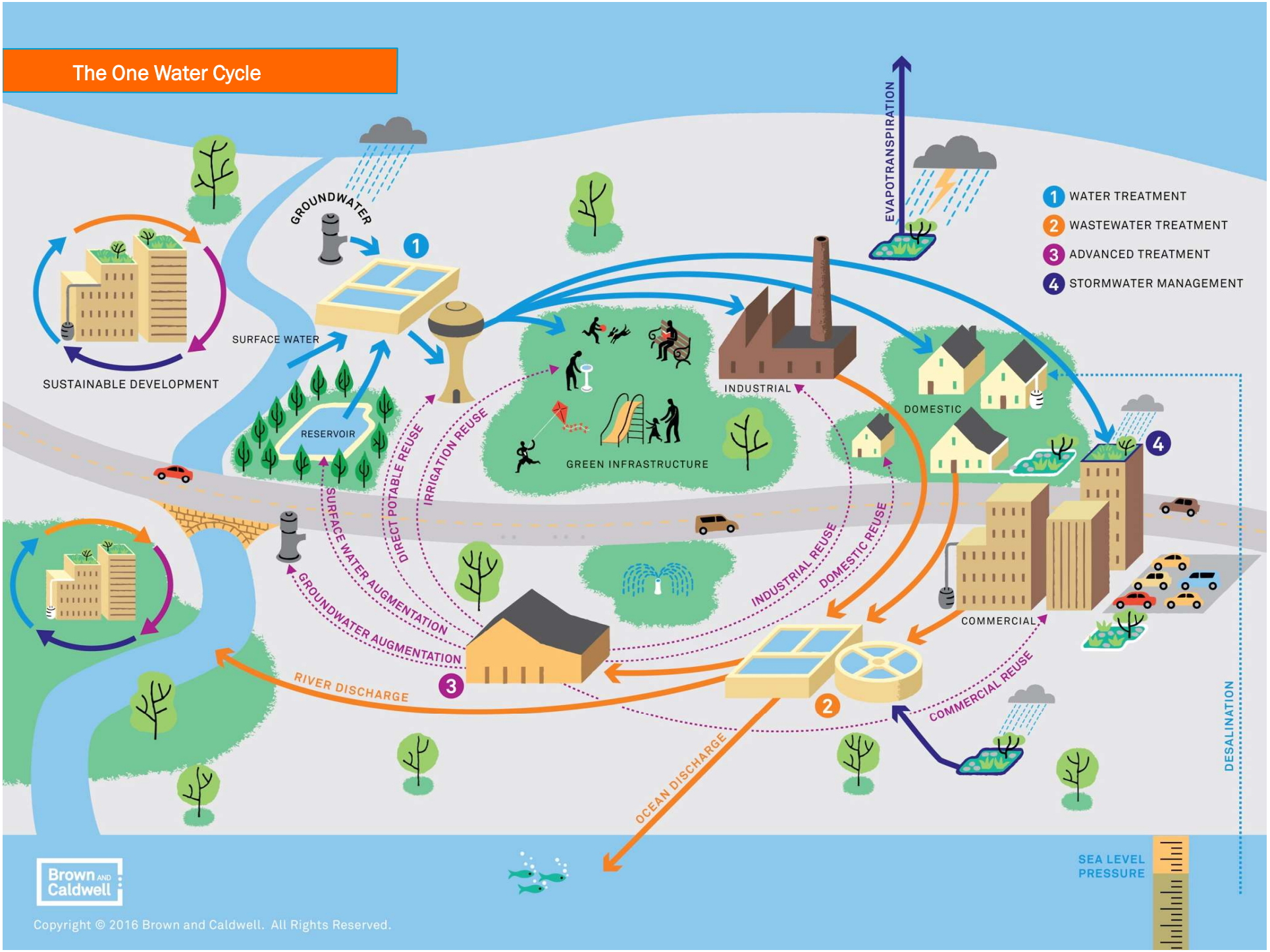
Challenges Drive New Thinking about Water

To Meet Current Challenges - One Water Shifts How We Manage Our Water Resources

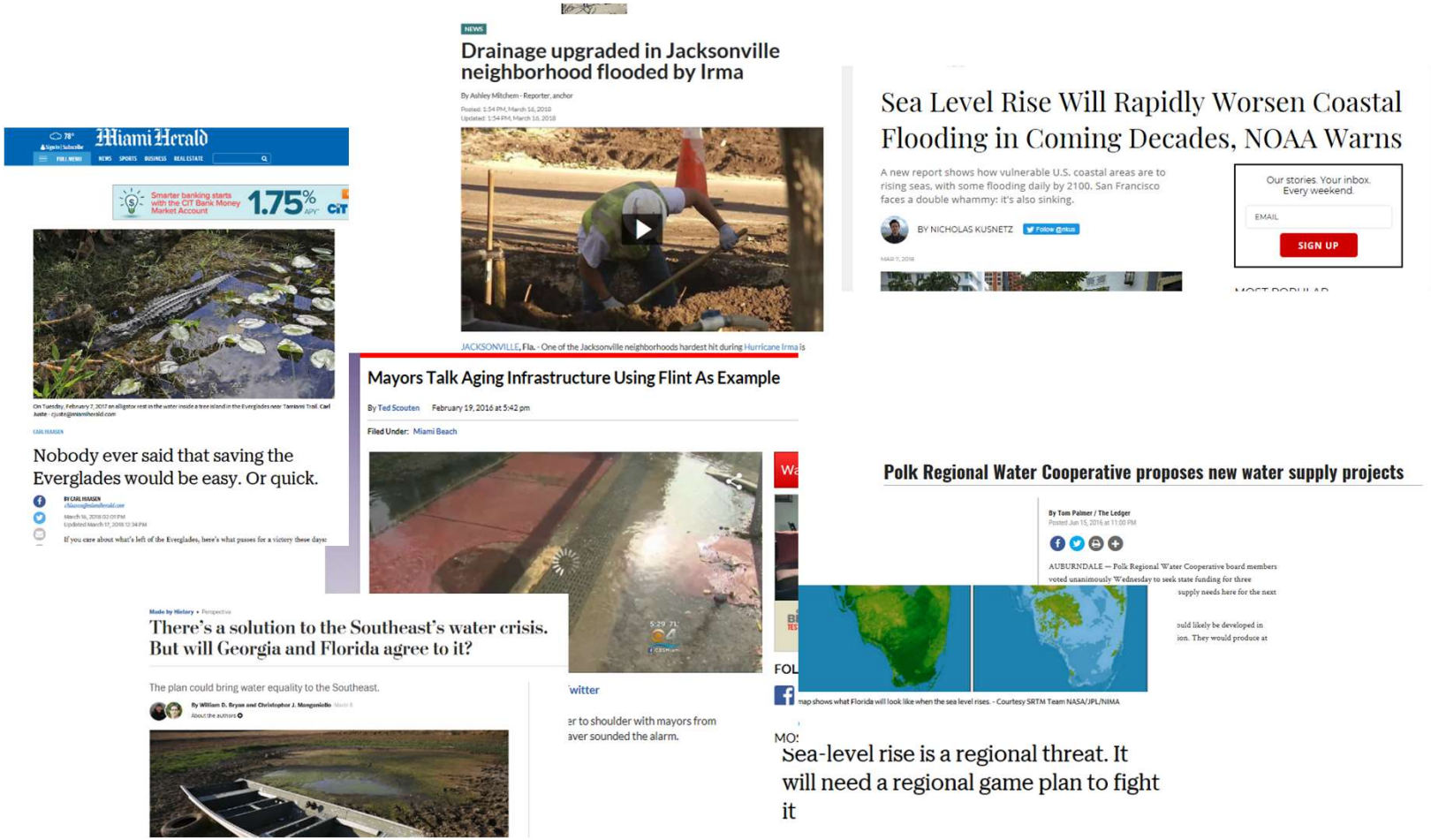
Brown AND Caldwell

One Water defined

One Water is an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs.



Florida Faces a Variety of Challenges



Integrated Approach = Technical + Business Case Evaluation + Stakeholder/Community Input

1. Series of Technical Memorandums
   a. Summary of Collected/Evaluated Existing Data (#1)
   b. Data Collection Plan (#2)
   c. Data Acquisition, Analysis, and Modeling (#3)
      i. H&H 2-D Modeling
      ii. Water Quality Analysis
      iii. Statistical Analysis
   d. Alternative Analysis and BCE Evaluation (#4)
2. Stakeholder/Community Involvement
3. Conceptual Design and Final Report

The series of key project TM's summarizing the science-based approach/input/findings and rolling up to Final Report keeps project stakeholders and the community well informed and involved throughout process to reach the most effective and publicly acceptable 1Water solution

Availability of Water for Hydrologic Restoration

1. ***Is there enough "Excess" water to meaningfully restore Lake Eva water levels?***

2. ***Is the "Excess" water available when Lake Eva needs it?***

3. ***Where is the "Excess" water coming from?***

4. ***Can the "Excess" water be re-routed the Lake Eva?***

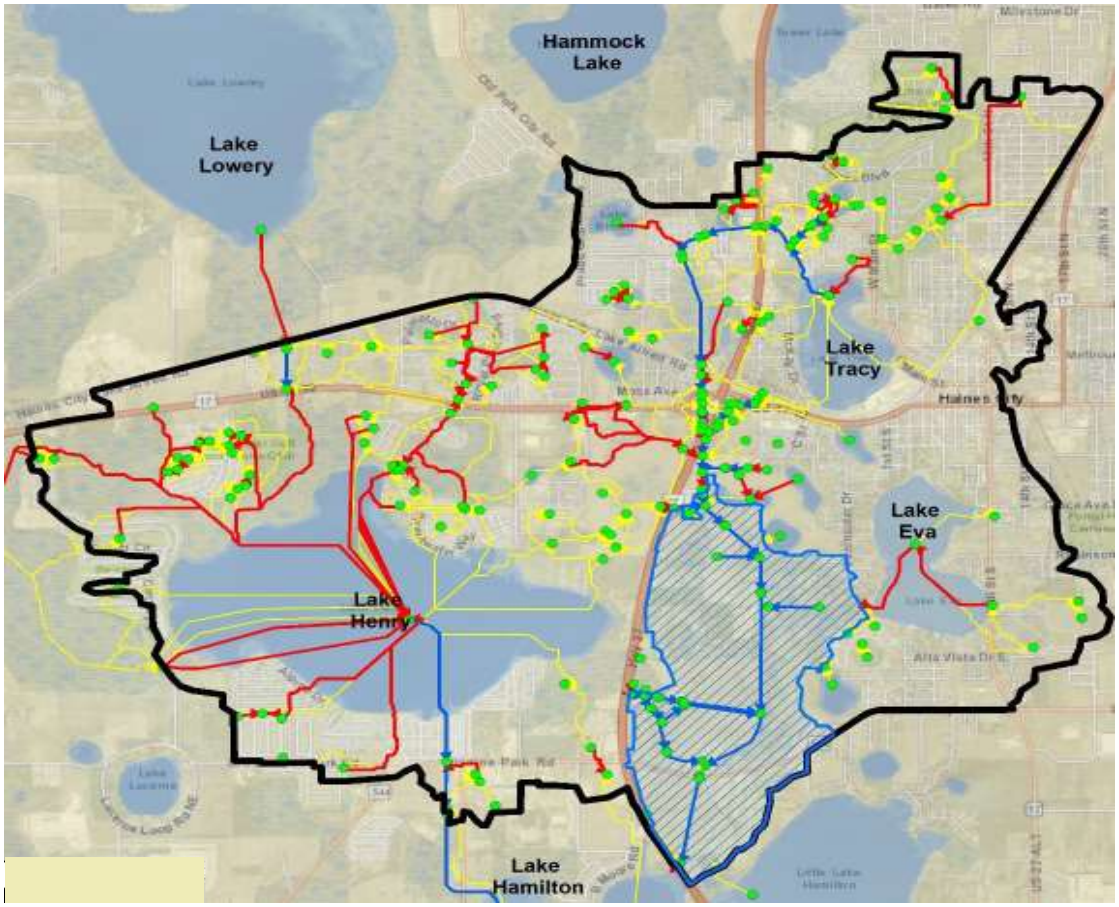
5. ***Will intercepting/re-directing "excess" water negatively impact downstream waterbodies?***

Answering these questions requires a detailed hydrologic analysis!

H&H Modeling Approach Overview

Project Hydrologic Analysis Included Development of a Surface Water/Groundwater routing model (~11 sq. mile Drainage Area)

- ***Utilized ICPR v4 Modeling Software.***
- ***Simulated ~20-year period (2002 – 2016) and Range of Design 24 hr. Storms (2, 10, 25, and 100-year events)***
- ***Included Both 1-D and 2-D Surface Water Routing***
- ***Included 2-D Groundwater Model***
- ***Calibrated/Verified using Lake Monitoring Data***



Model Inputs/Data Collection

Hydrologic Data:

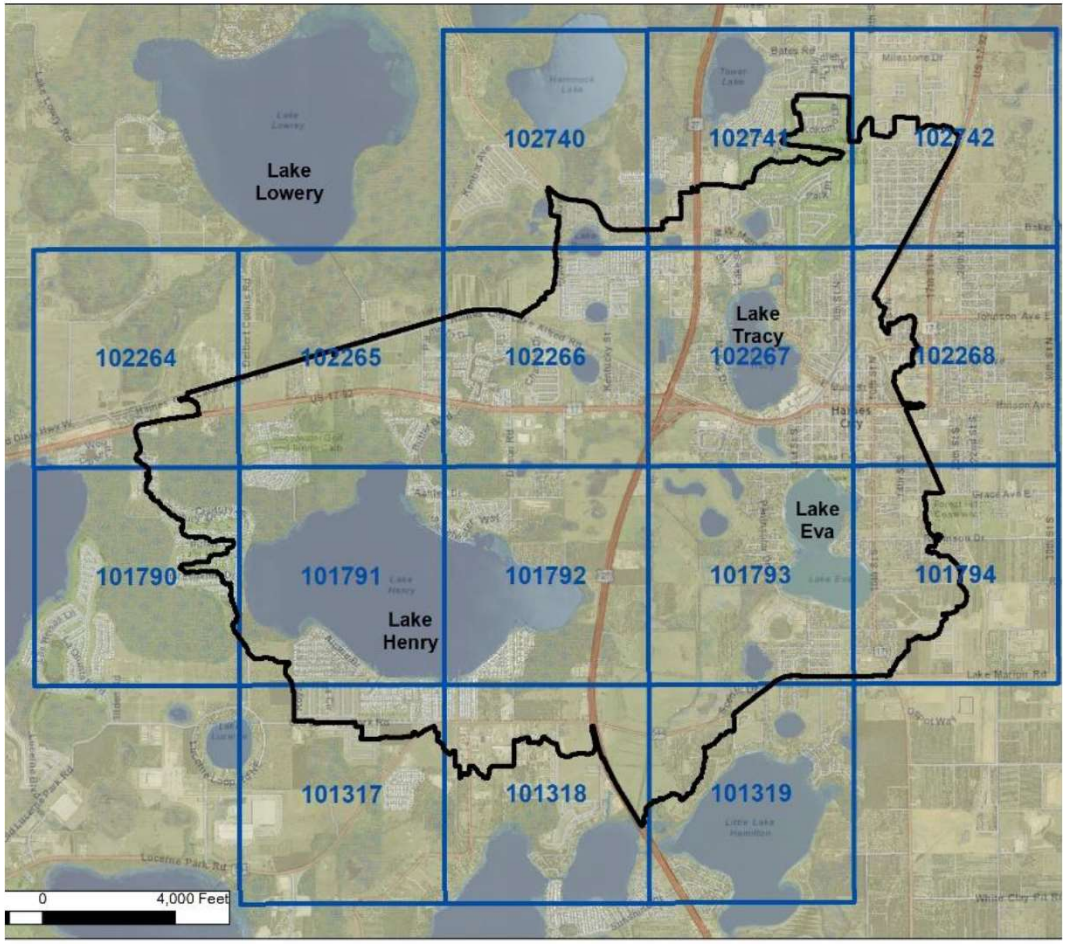
- ***Rainfall***
- ***Evapotranspiration (ET)***
- *Soils*
- *Land Cover*

Hydraulic Data:

- *Topographic*
- *Conveyance Features*
- *Water Levels*

Groundwater Data:

- *Surficial Aquifer (SA) Conductivity*
- *Intermediate Aquifer (IA) Leakance*
- *Upper Floridan Aquifer (UFA) Potentiometric Surface*
- *Lake Bathymetry*



NEXRAD Grid (15-minute Radar rainfall and Reference ET)

Model Inputs/Data Collection

Hydrologic Data:

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- ***Soils***
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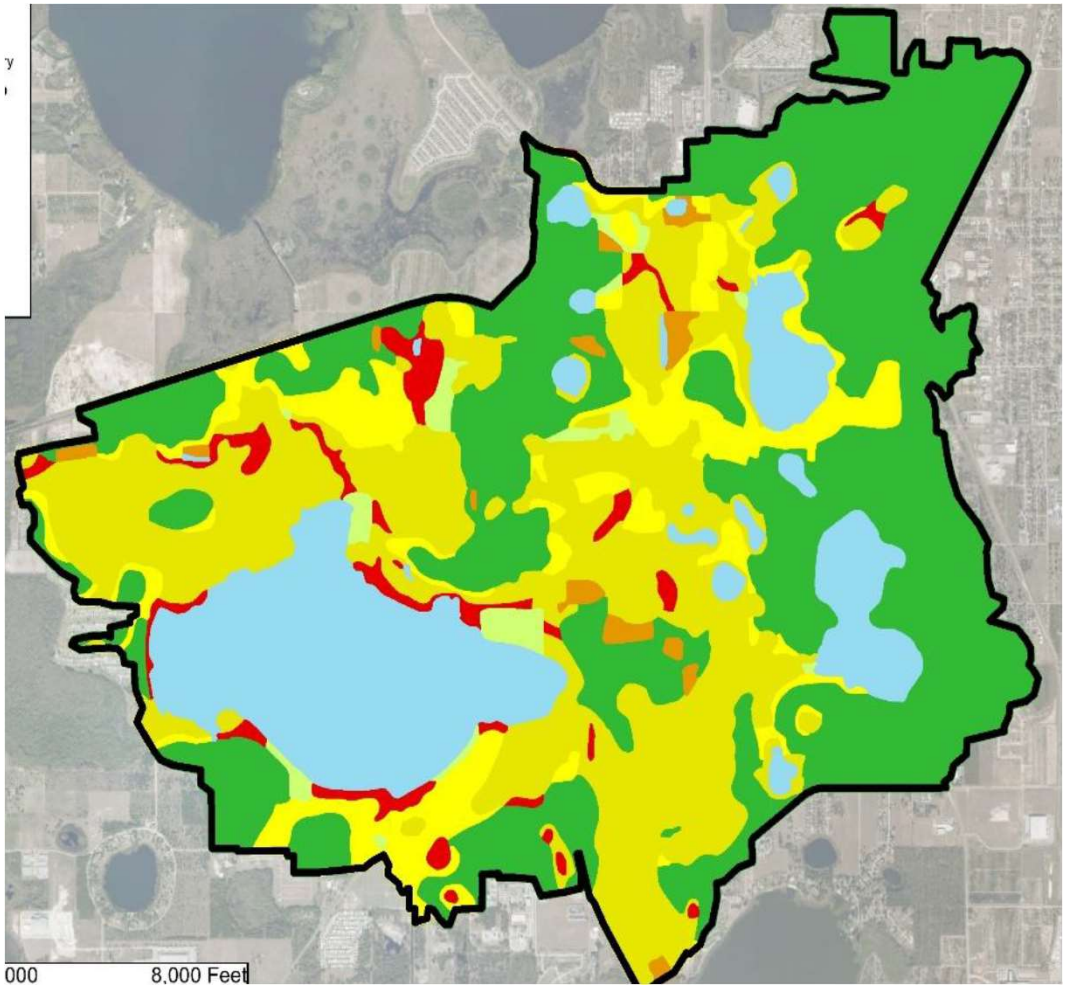

USDA Soil Coverage

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- ***Land Cover***

Hydraulic Data:

- *Topographic*
- *Conveyance Features*
- *Water Levels*

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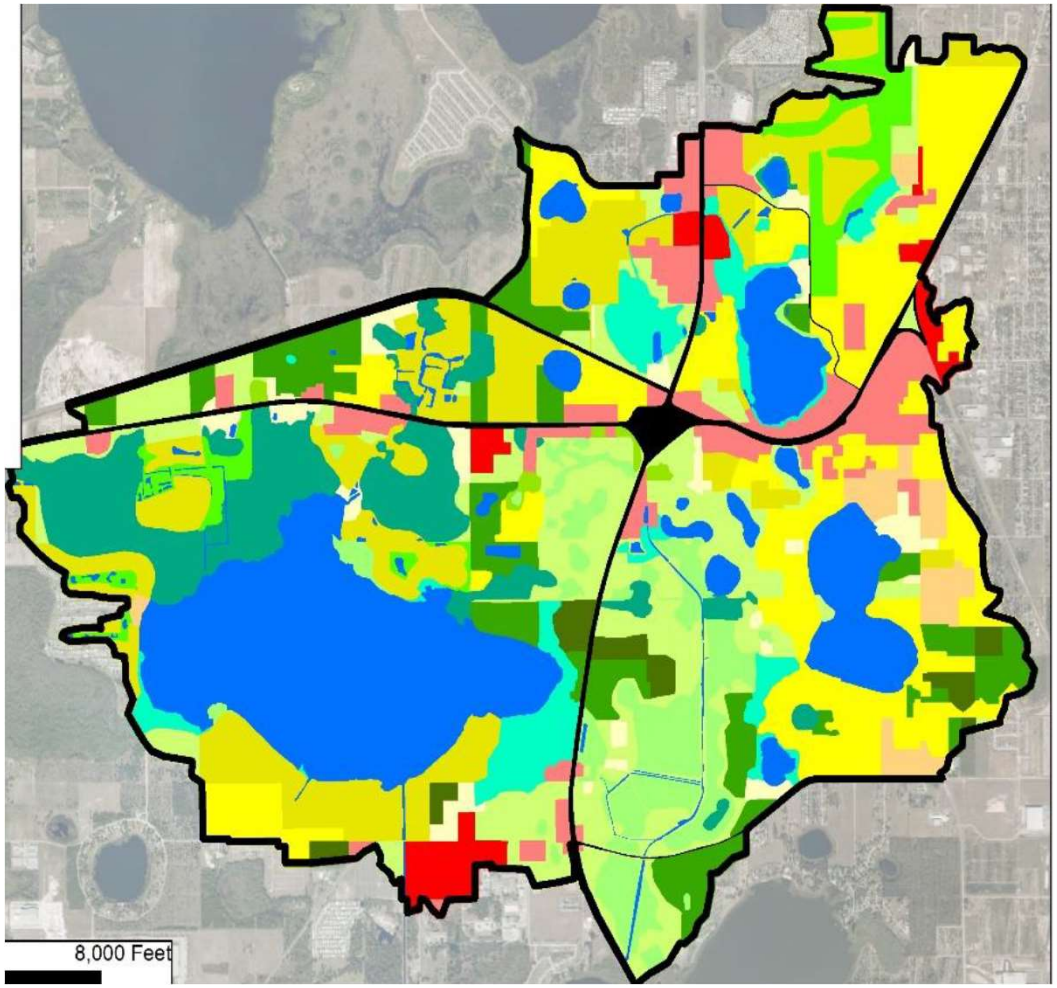

Aerial Interpreted Land Cover

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

- ***Topographic***
- *Conveyance Features*
- *Water Levels*

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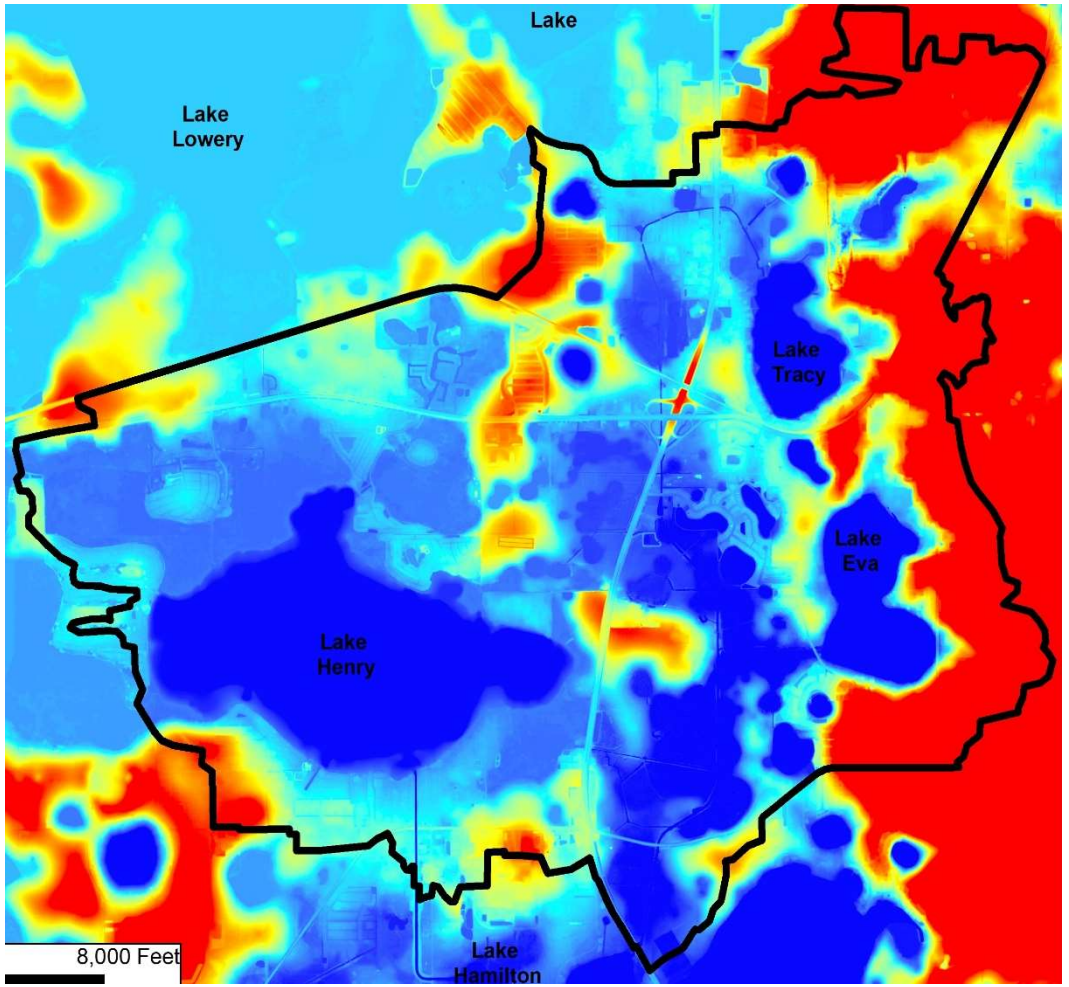

LiDAR Based Digital Elevation Model

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

- *Topographic*
- ***Conveyance Features***
- *Water Levels*

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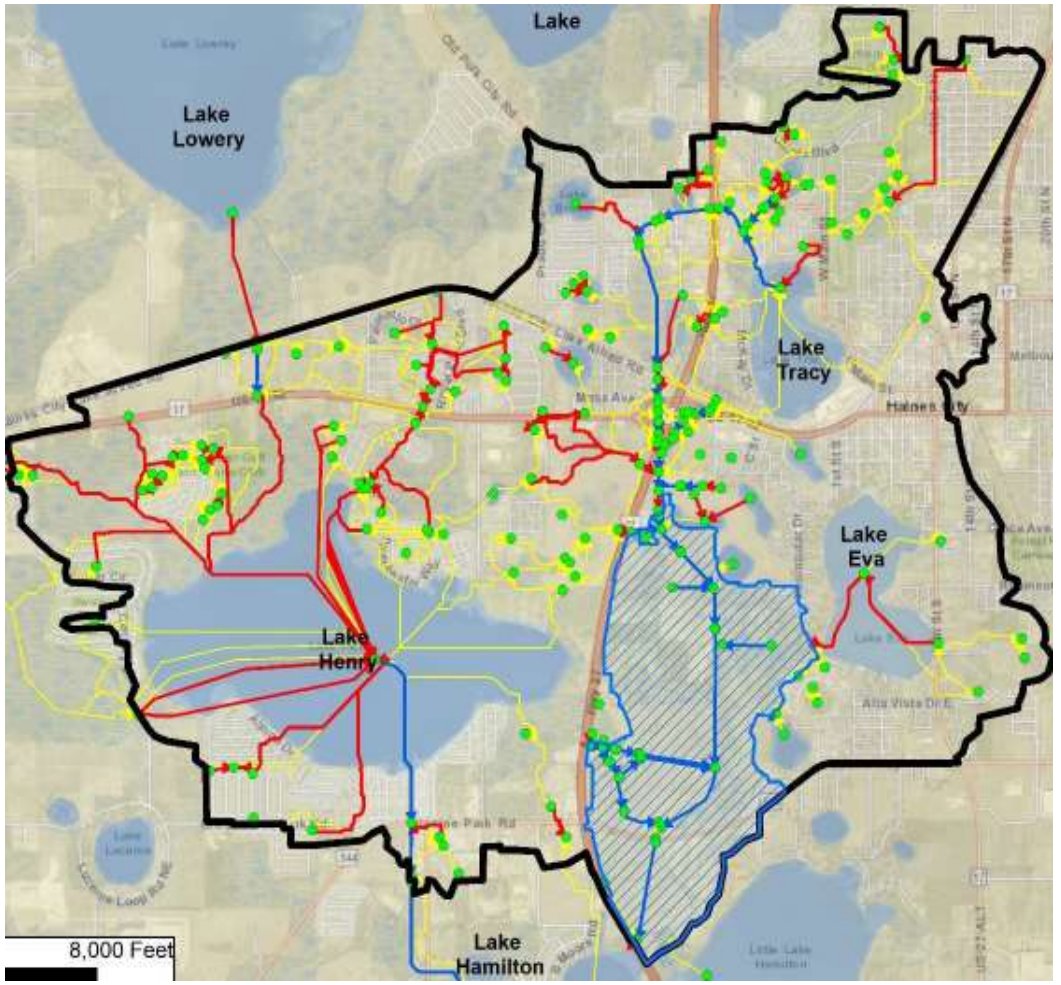

Surface Water Connections (Pipes/Channels)

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

- *Topographic*
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- ***Water Levels***

Groundwater Data:

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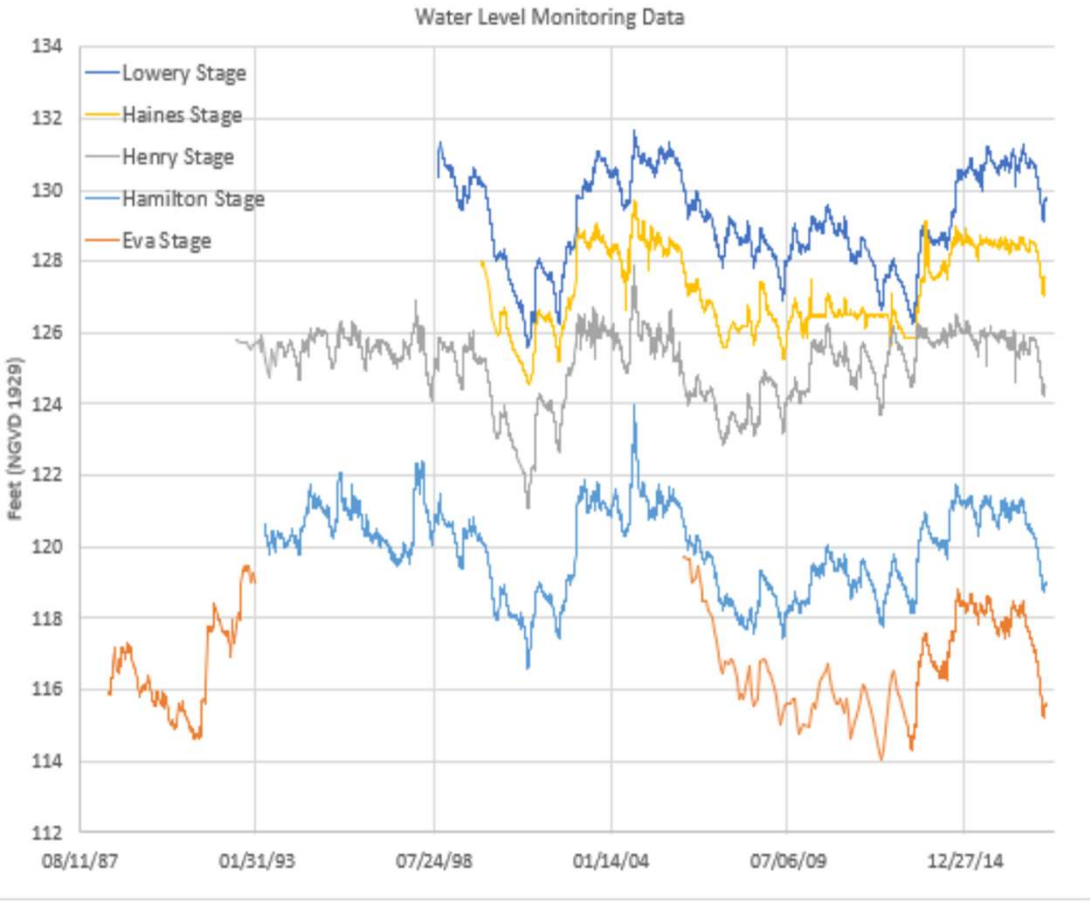

SWFWMD/USGS Lake Monitoring Data

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

- *Topographic*
- *Conveyance Features*
- *Water Levels*

Groundwater Data:

- ***Surficial Aquifer (SA) Conductivity***
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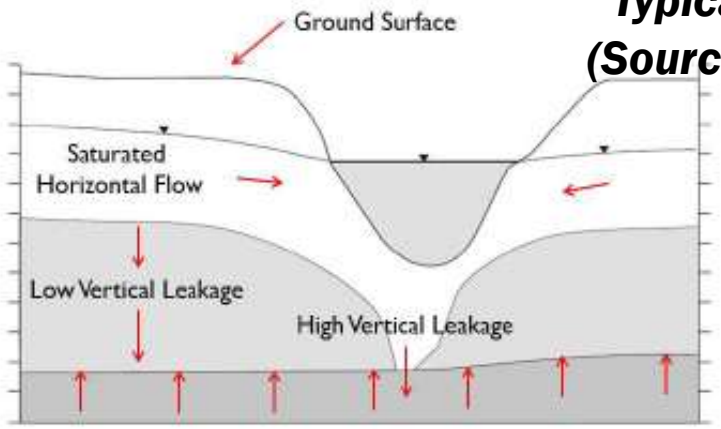
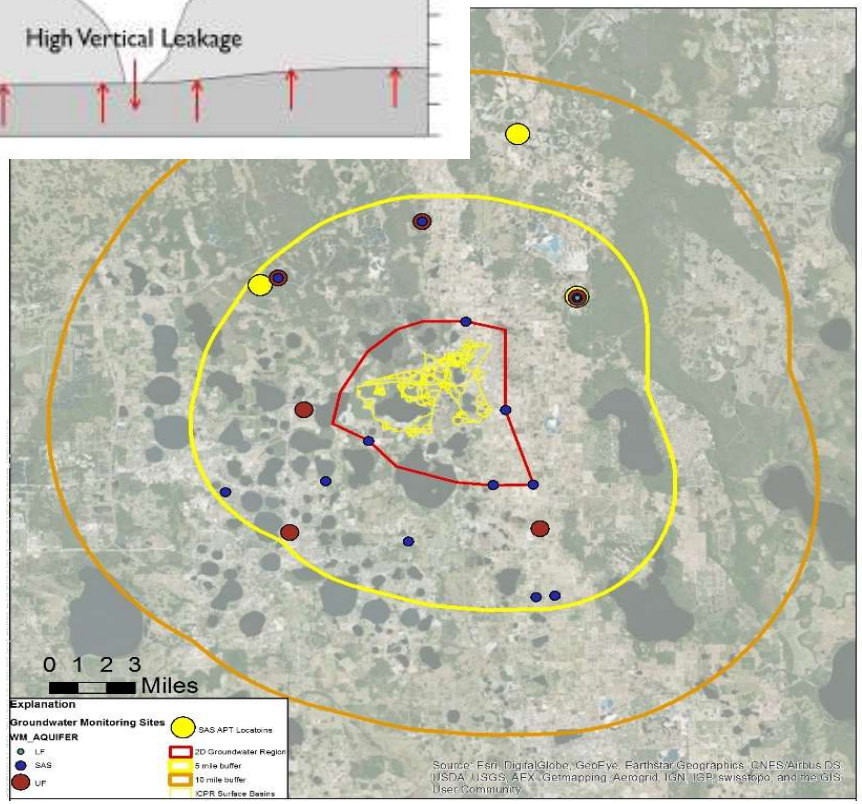
Typical GW Flow Diagram (Source: ICPR User Manual)





GW Monitoring Well Locations

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
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- *Soils*
- *Land Cover*

Hydraulic Data:

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- *Conveyance Features*
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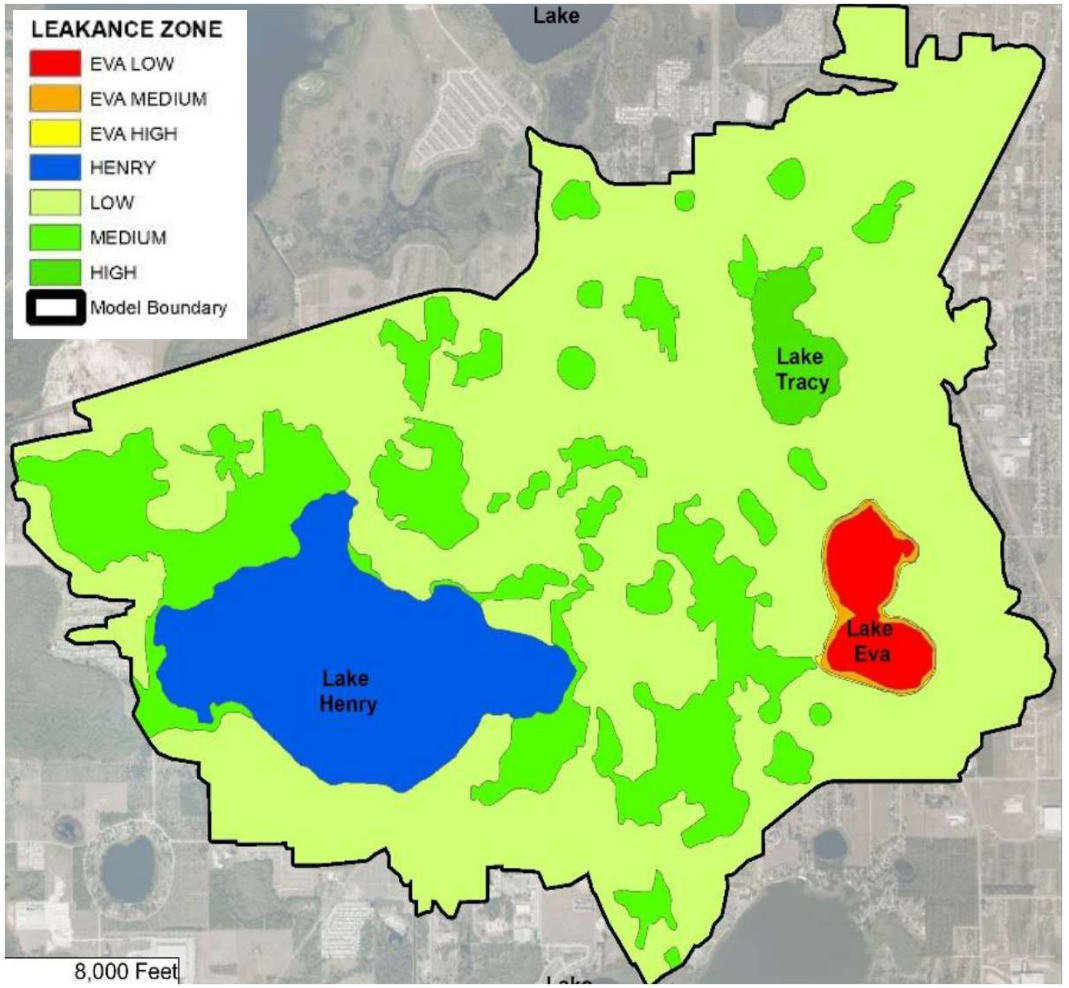


IA Leakance Coverage

Model Inputs/Data Collection

Hydrologic Data:

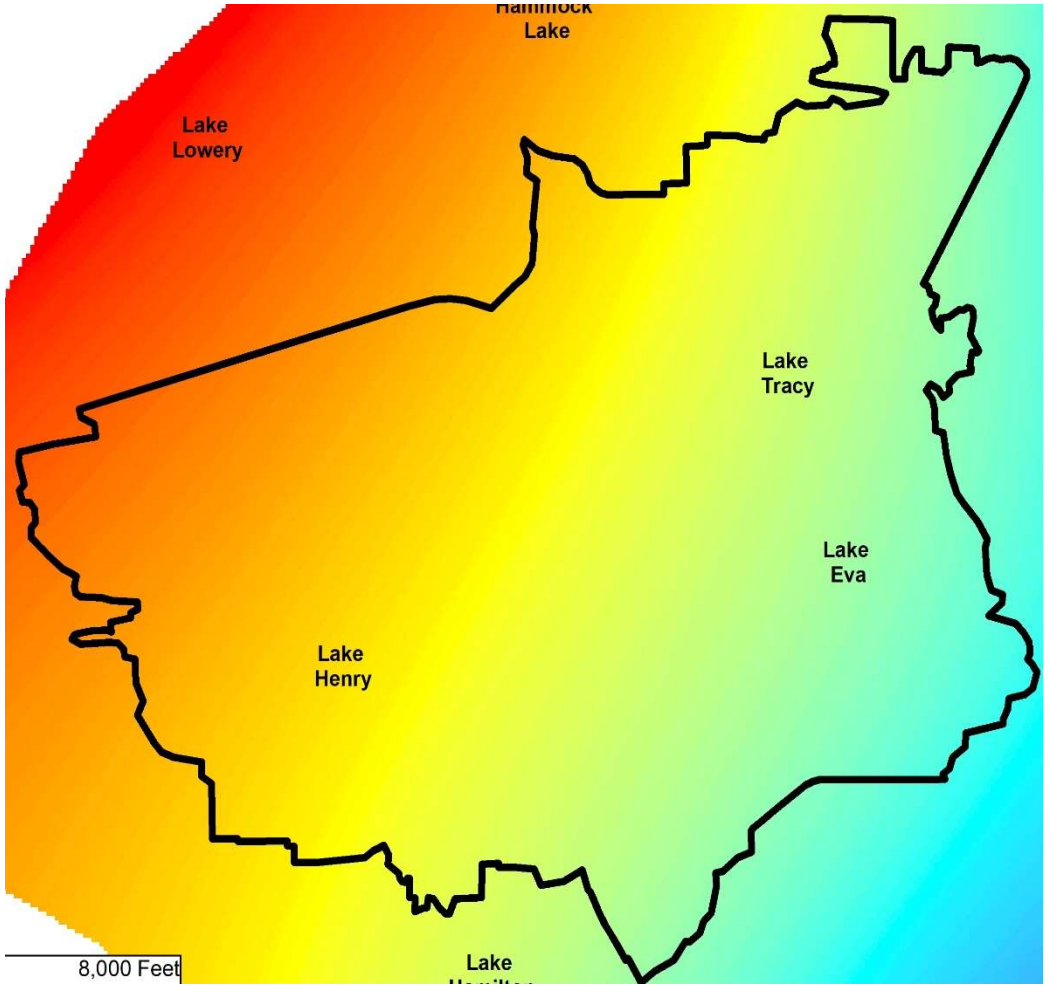
- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

- *Topographic*
- *Conveyance Features*
- *Water Levels*

Groundwater Data:

- *Surficial Aquifer (SA) Conductivity*
- *Intermediate Aquifer (IA) Leakance*
- ***Upper Floridan Aquifer (UFA) Potentiometric Surface***
- *Lake Bathymetry*



September 2007 Potentiometric Surface

Model Inputs/Data Collection

Hydrologic Data:

- *Rainfall*
- *Evapotranspiration (ET)*
- *Soils*
- *Land Cover*

Hydraulic Data:

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- *Conveyance Features*
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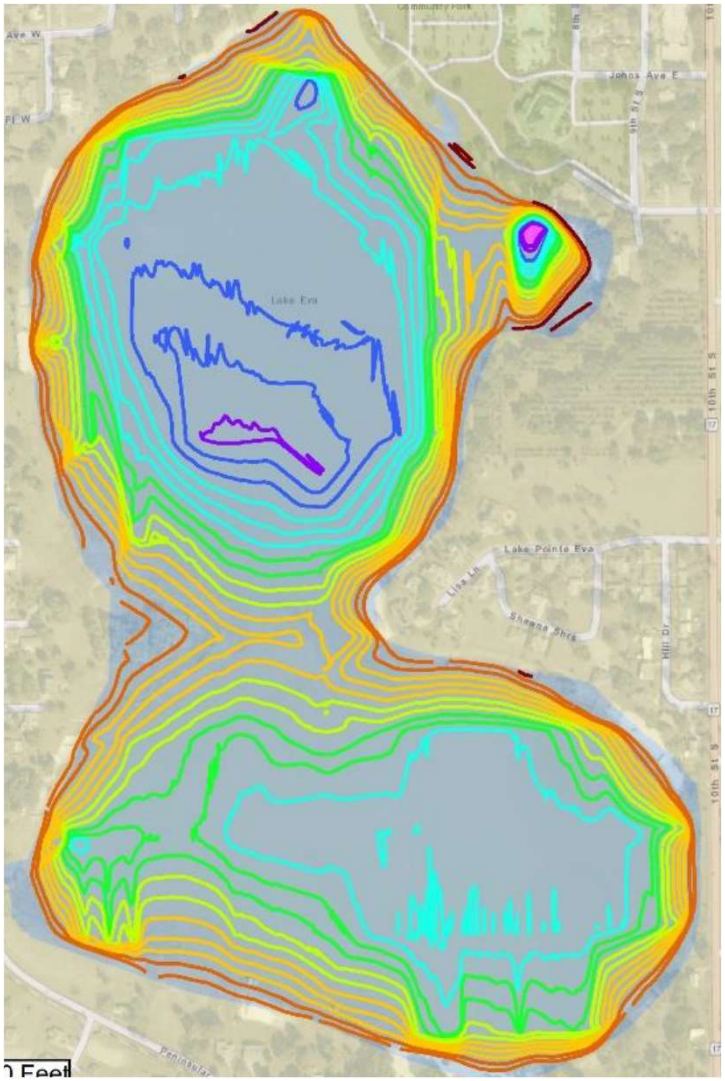
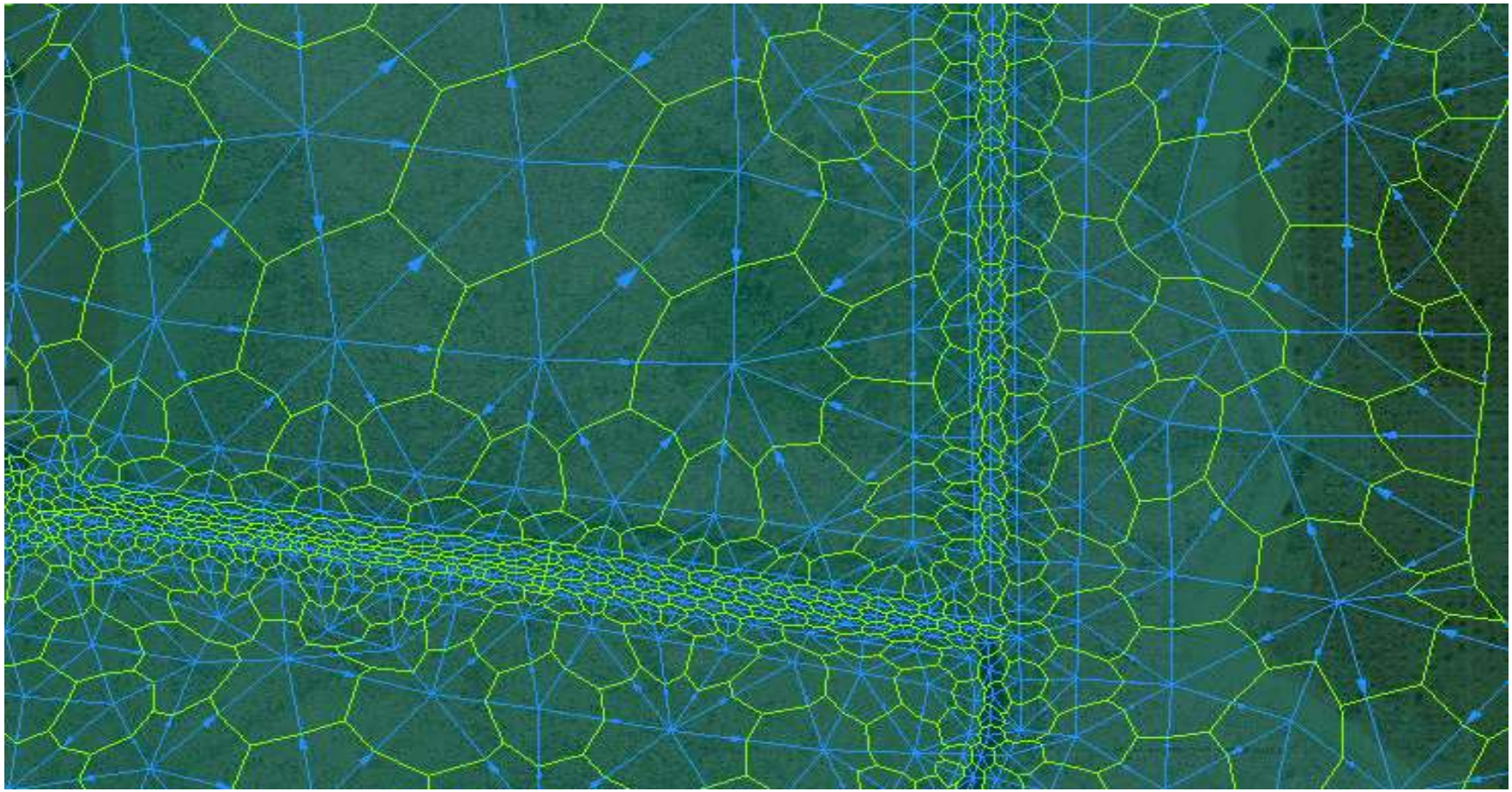
- ***Lake Bathymetry***



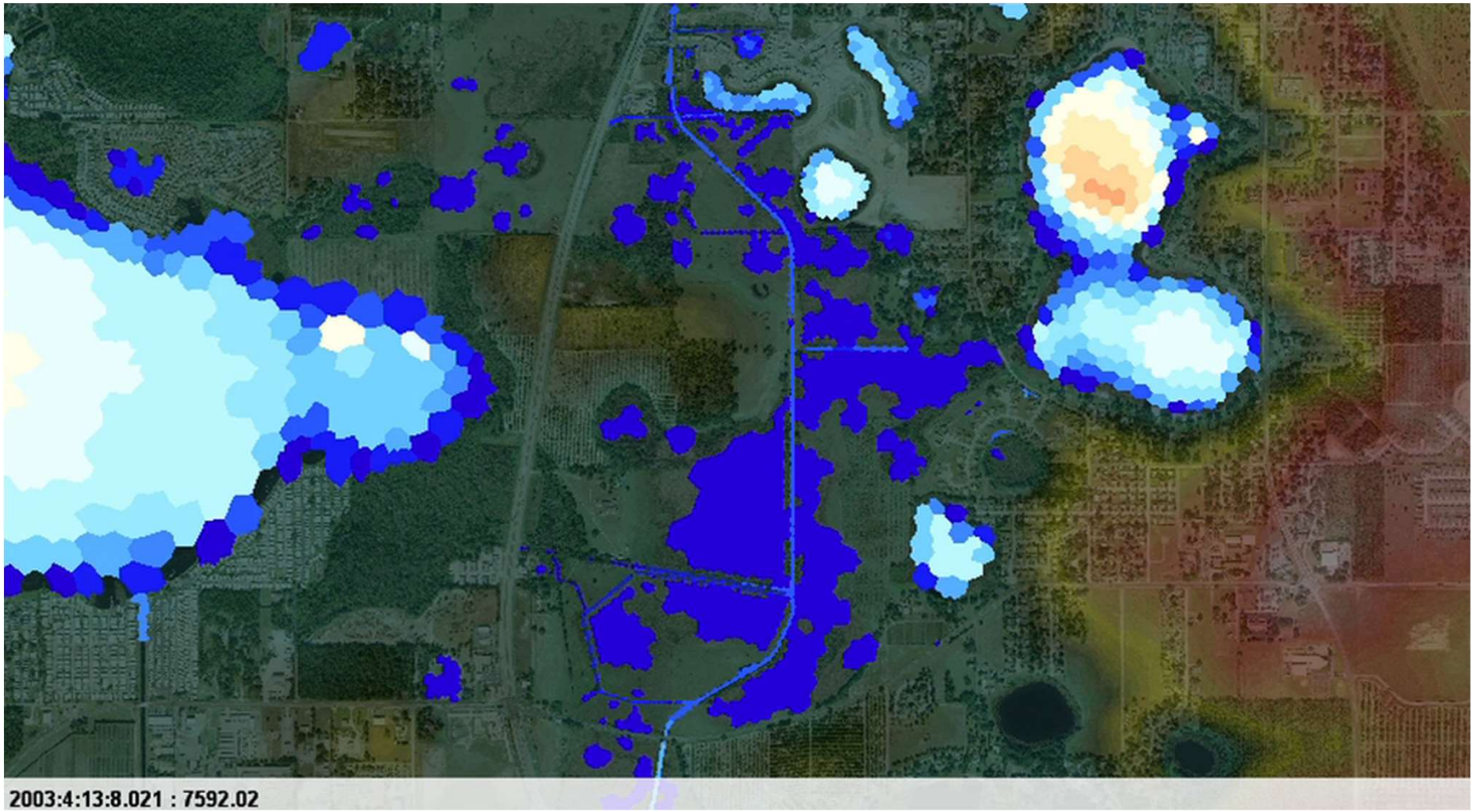
Lake Eva Bathymetric Contours

Model Setup (Honey Comb - Hydrology)

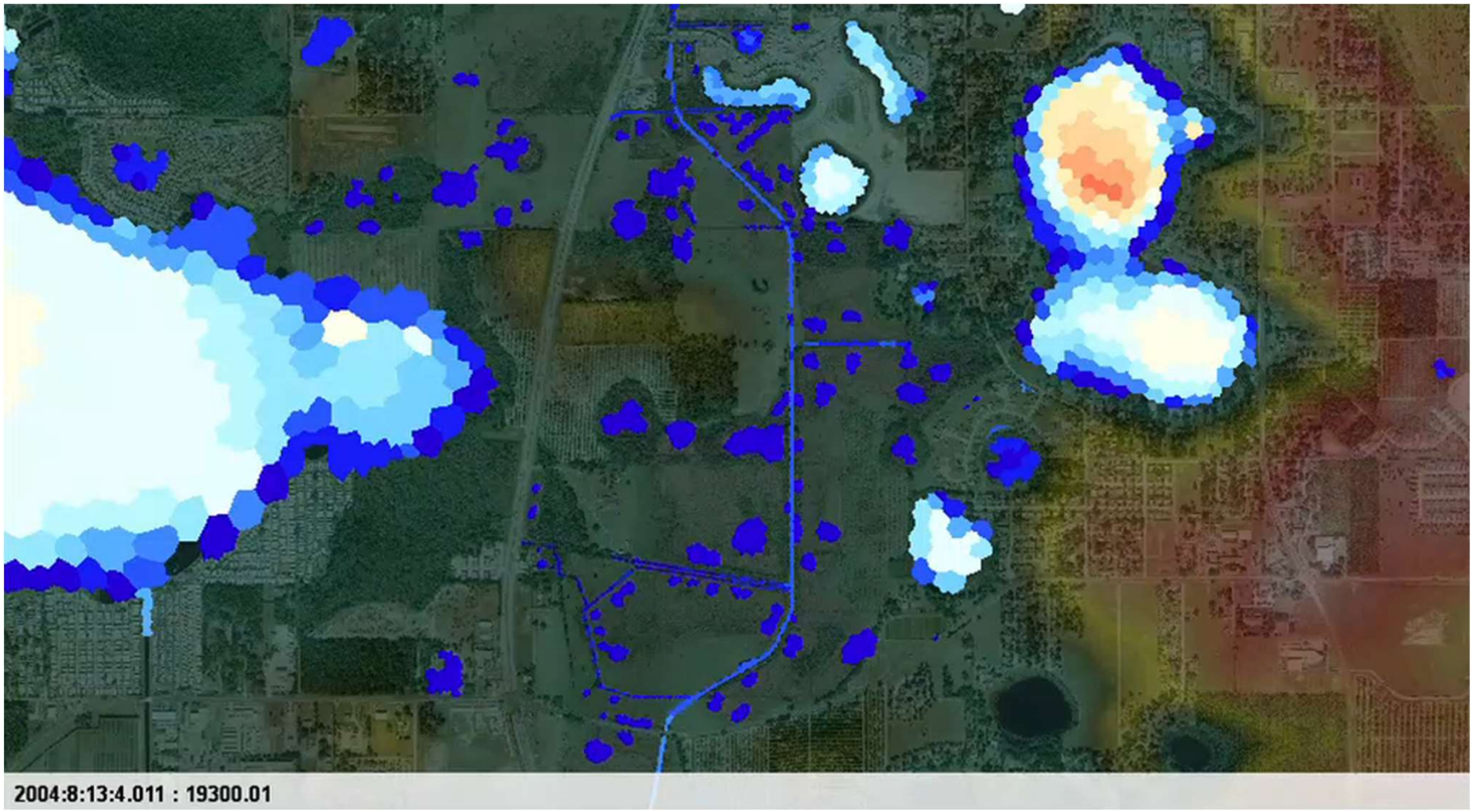
Model Setup (Triangular Mesh - Hydraulics)



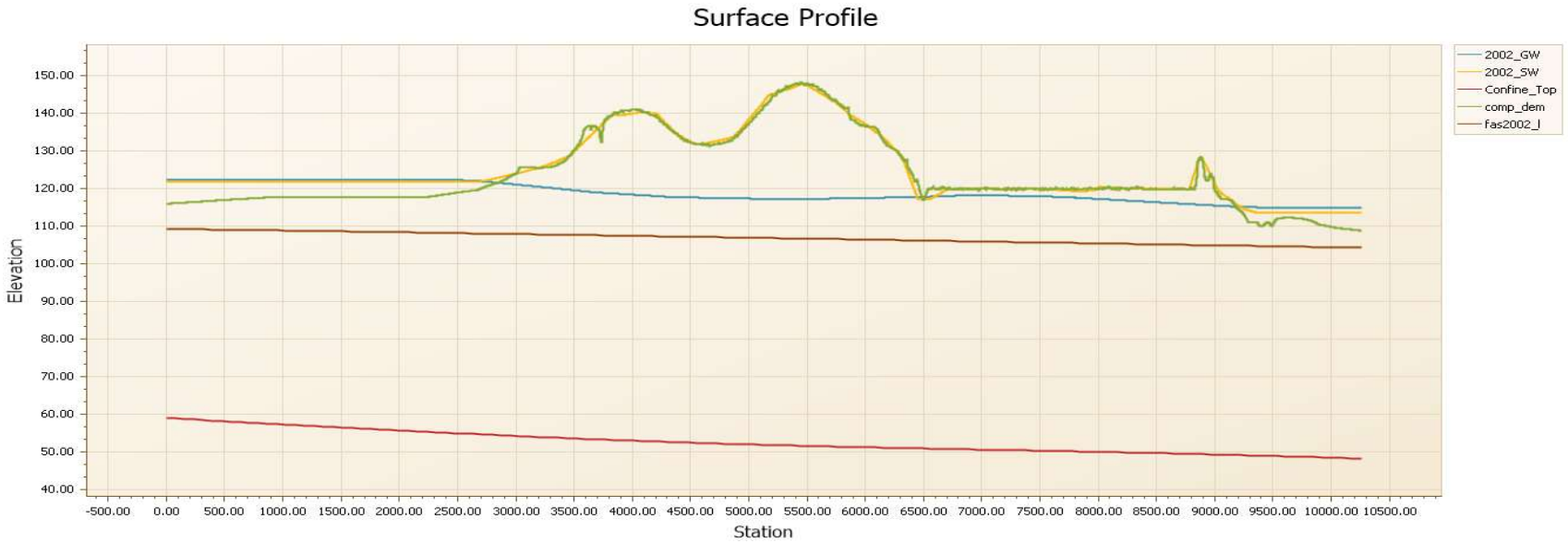
Model Outputs (Animation – Normal Wet Season)



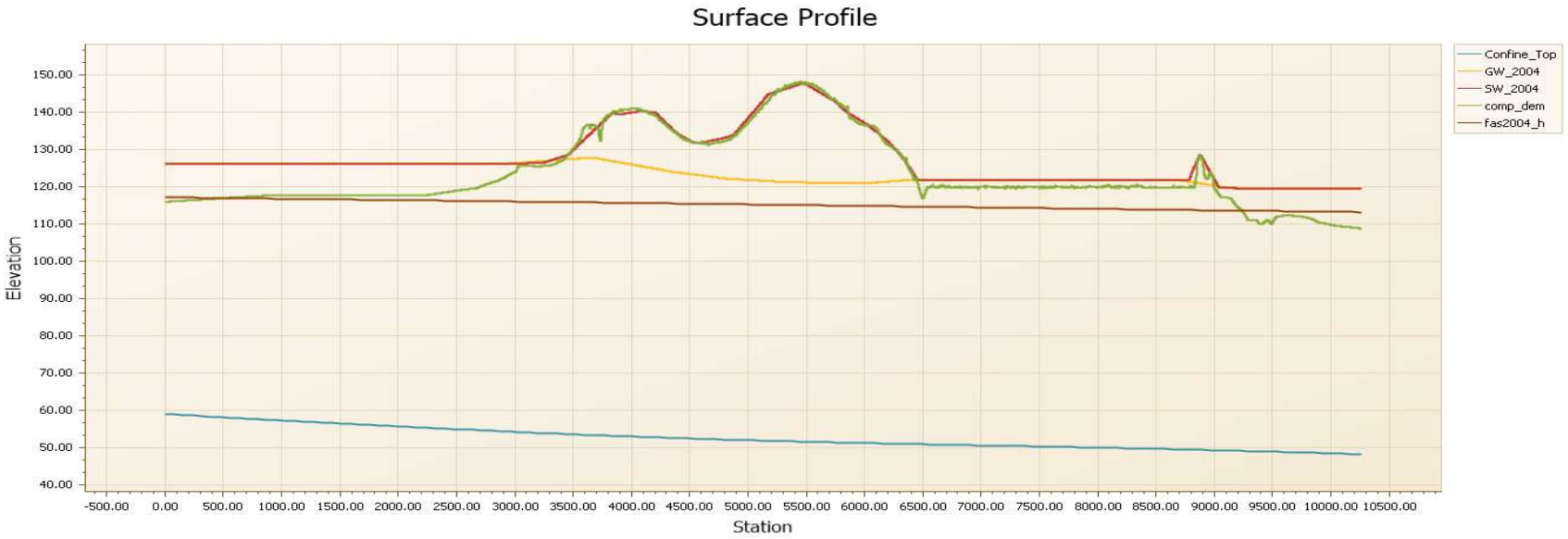
Model Outputs (Animation – 2004 Hurricanes)



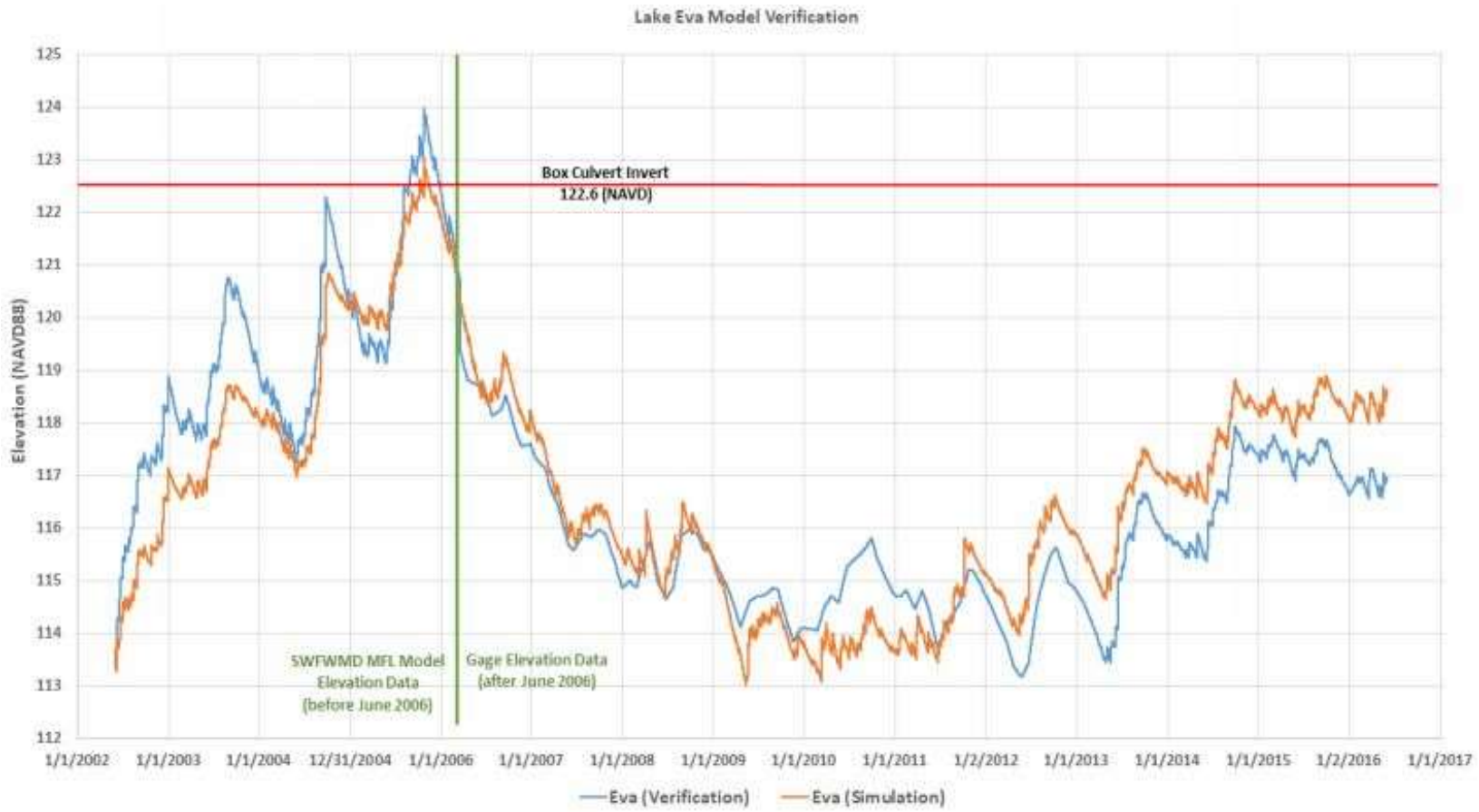
Model Outputs (Surface Profile – 2002 (Dry))



Model Outputs (Surface Profile – 2004 (Wet))



Modeling Verification

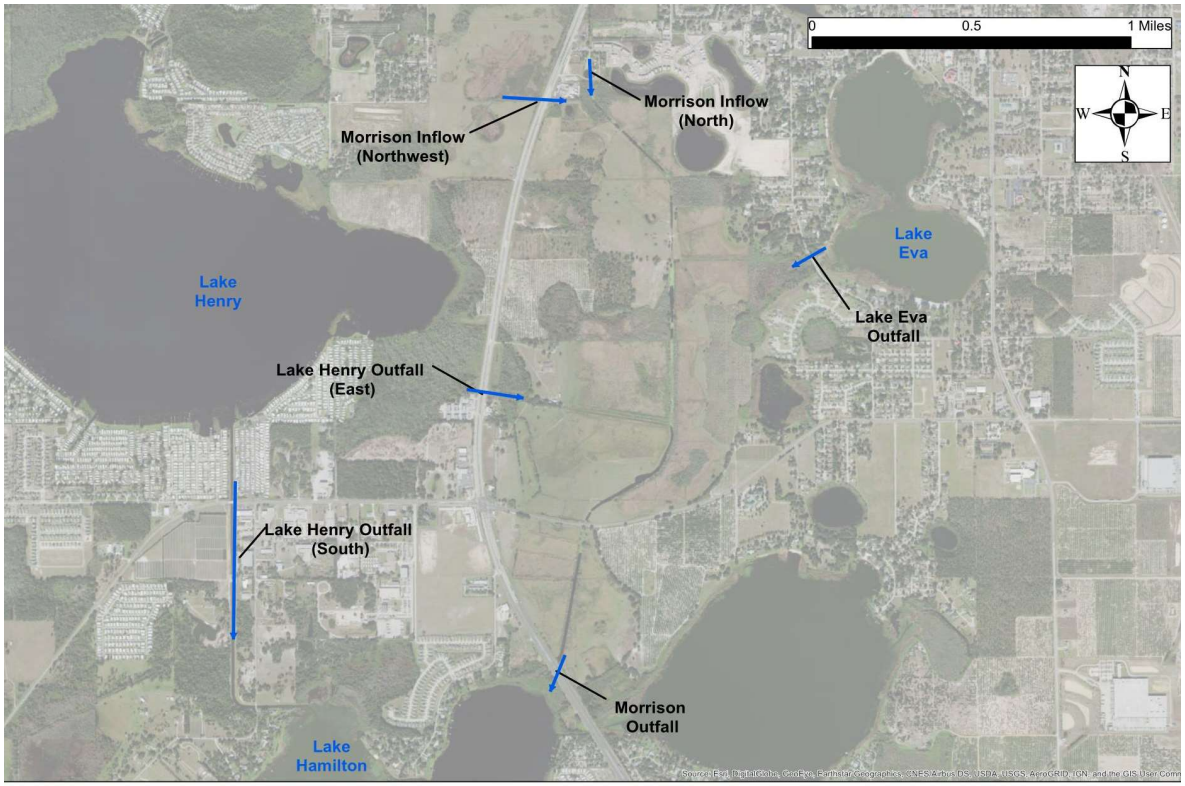


Lake Eva Model Verification Results

Modeling Verification

Lake Henry Model Verification Results

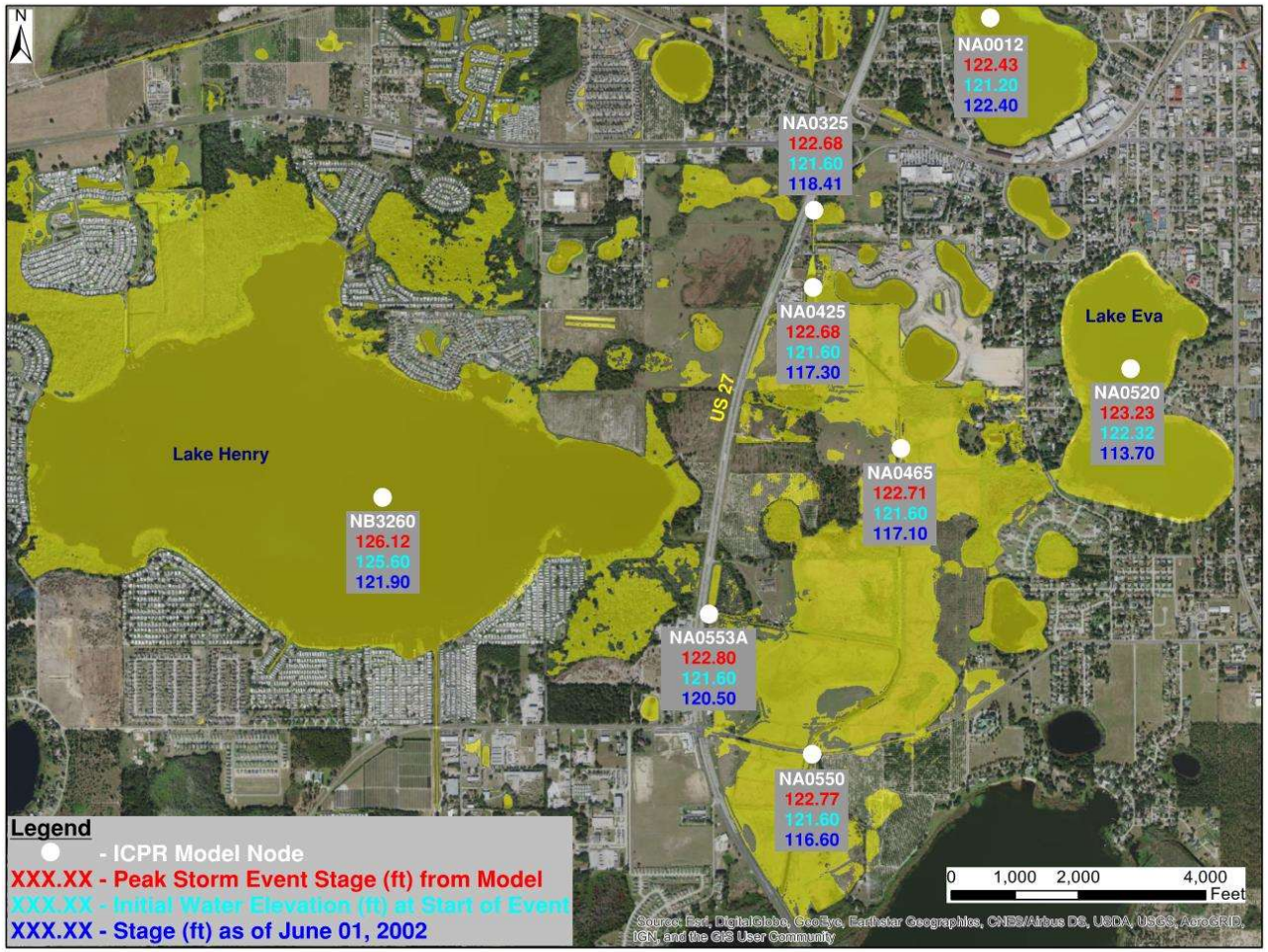
Existing Condition Model Results



Project Area Water Availability – Average Annual

Water Availability in the Lake Eva - Lake Henry Study Area Based on ICPR Modeling Results (average annual water volume from 6/1/2002 to 5/31/2016)					
Lake Eva Outfall (West to Morrison) Ac-ft/yr	Lake Henry Outfall (South to Hamilton) Ac-ft/yr	Lake Henry Outfall (East to Morrison) Ac-ft/yr	Morrison Outfall (South to Hamilton) Ac-ft/yr	Morrison Inflow (from North) Ac-ft/yr	Morrison Inflow (from Northwest) Ac-ft/yr
0	213	413	2,752	1,661	91

Existing Condition Model Results



Lake Eva and Lake Henry 100-year, 24-hour Storm Event Flood Inundation and Peak Stages

Lake Assessment Purpose

Trends

Understand

Baseline Conditions

Document

Inform Alt. Selection

Develop Tools

Comparison

Quality

Evaluate

Relationships

Improve **water quality** in Lake Eva

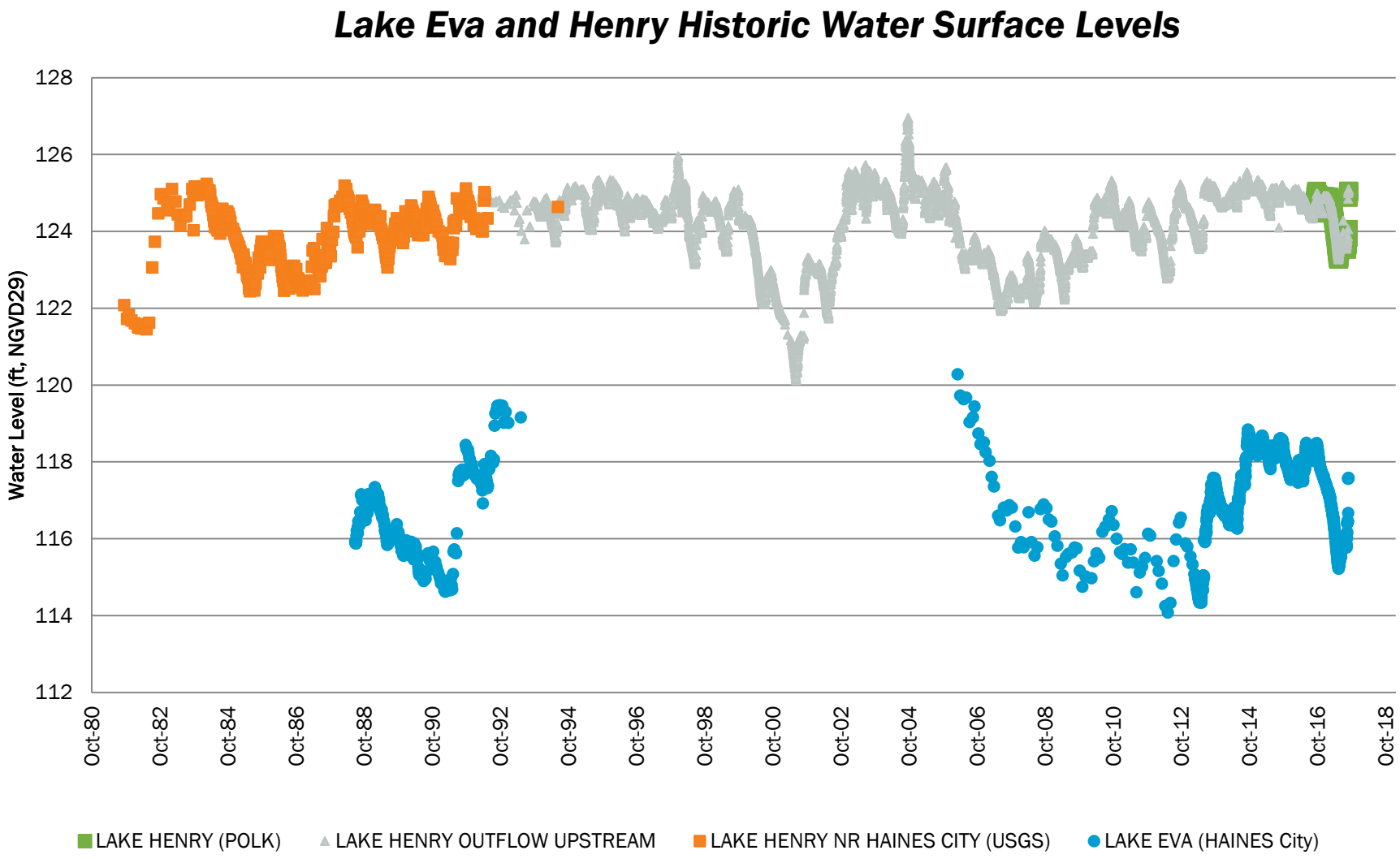
Lake Conditions Assessment Approach

Characteristics Evaluated

- Water Surface Level
- Lake Level Response to Rainfall
- Lake Stage/Volume Relationship
- Surface Water/Lake Bottom Sediment Quality
- Aquatic Vegetation
- Lake WQ Parameters Correlation
- Hydrologic and Nutrient Budgets
- Nutrient Assessment

Lake Eva Vegetation

Lake Existing Conditions Assessment



Lake Existing Conditions Assessment

Lakes' Stage, Area, and Storage

Lake	Bottom El	High El	TOB Area (acres)	Volume (acre-ft)
Henry	113.63	134	1,385	18,062
Eva	102	121	176	1,881

Lake Eva

Lake Henry Storage Volume is Approximately 10 times greater than Lake Eva's

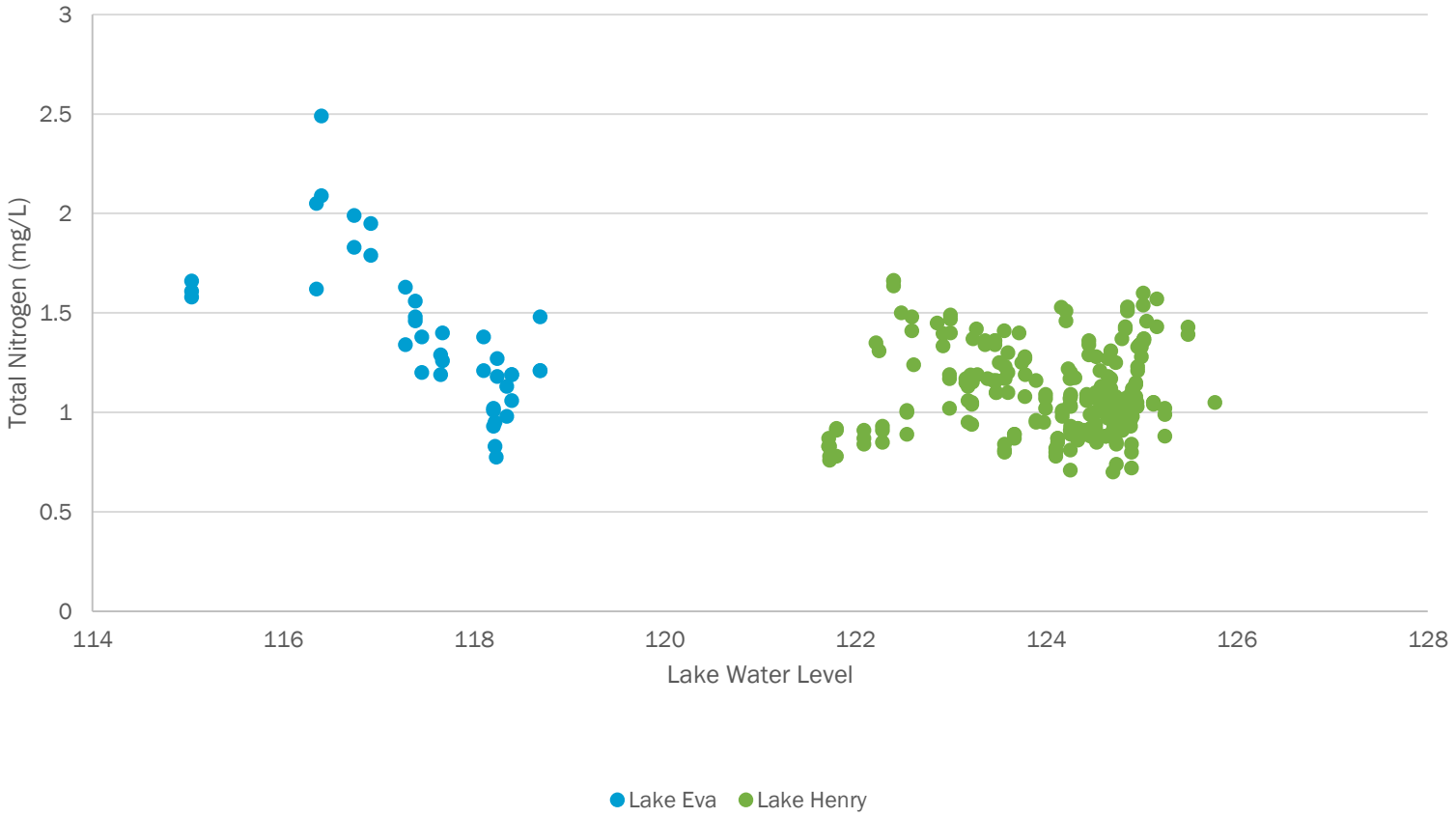
Lake Existing Conditions Assessment

Water Quality Analysis - Statistical Methods and Results

- Lake Eva time series of TN, TP, and chlorophyll-a
- Lake Henry time series of TN, TP, and chlorophyll-a
- Annual geometric mean TN and TP and avg. annual TN-TP ratio in Lake Eva and Lake Henry
- Annual geometric mean chlorophyll-a, DO, and PH in Lake Eva and Lake Henry
- Annual geometric mean Secchi disk depth, TSS, and turbidity in Lake Eva and Lake Henry
- Annual geometric mean alkalinity, color, and temperature in Lake Eva and Lake Henry
- Water quality and WQ/depth correlations

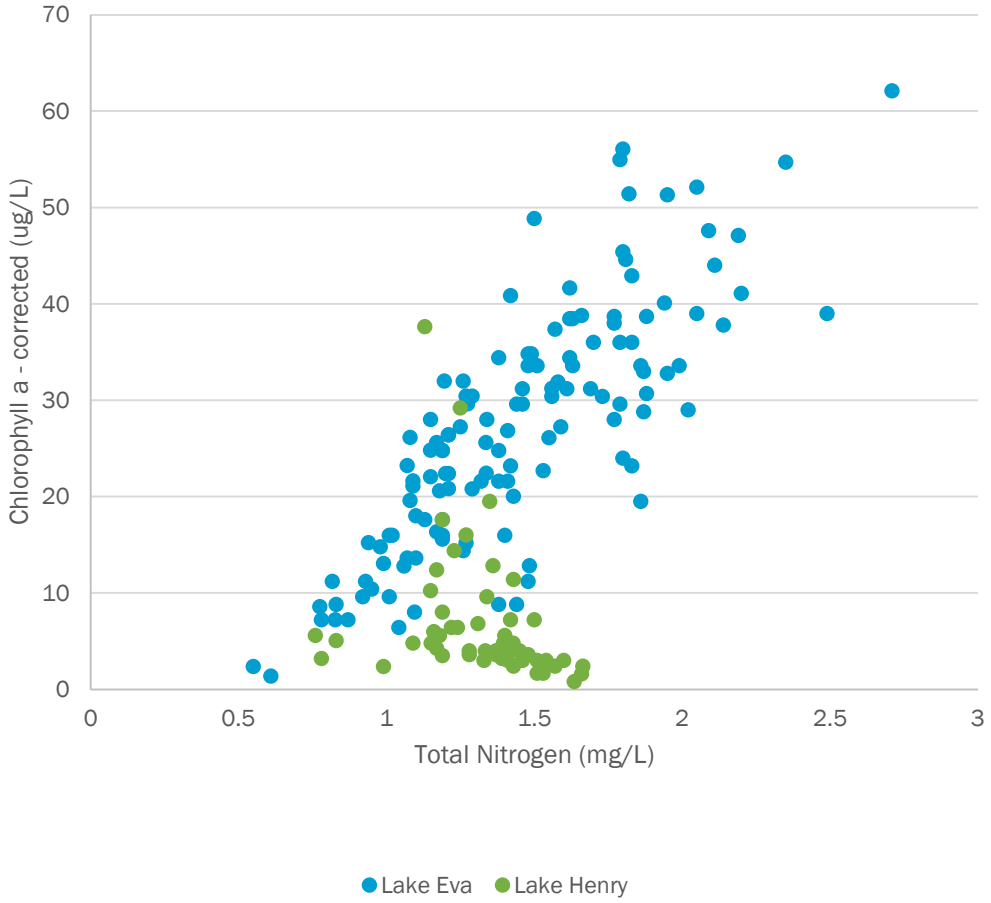
Lake Existing Conditions Assessment

Water Quality Samples (TN) by Level for Lake Eva



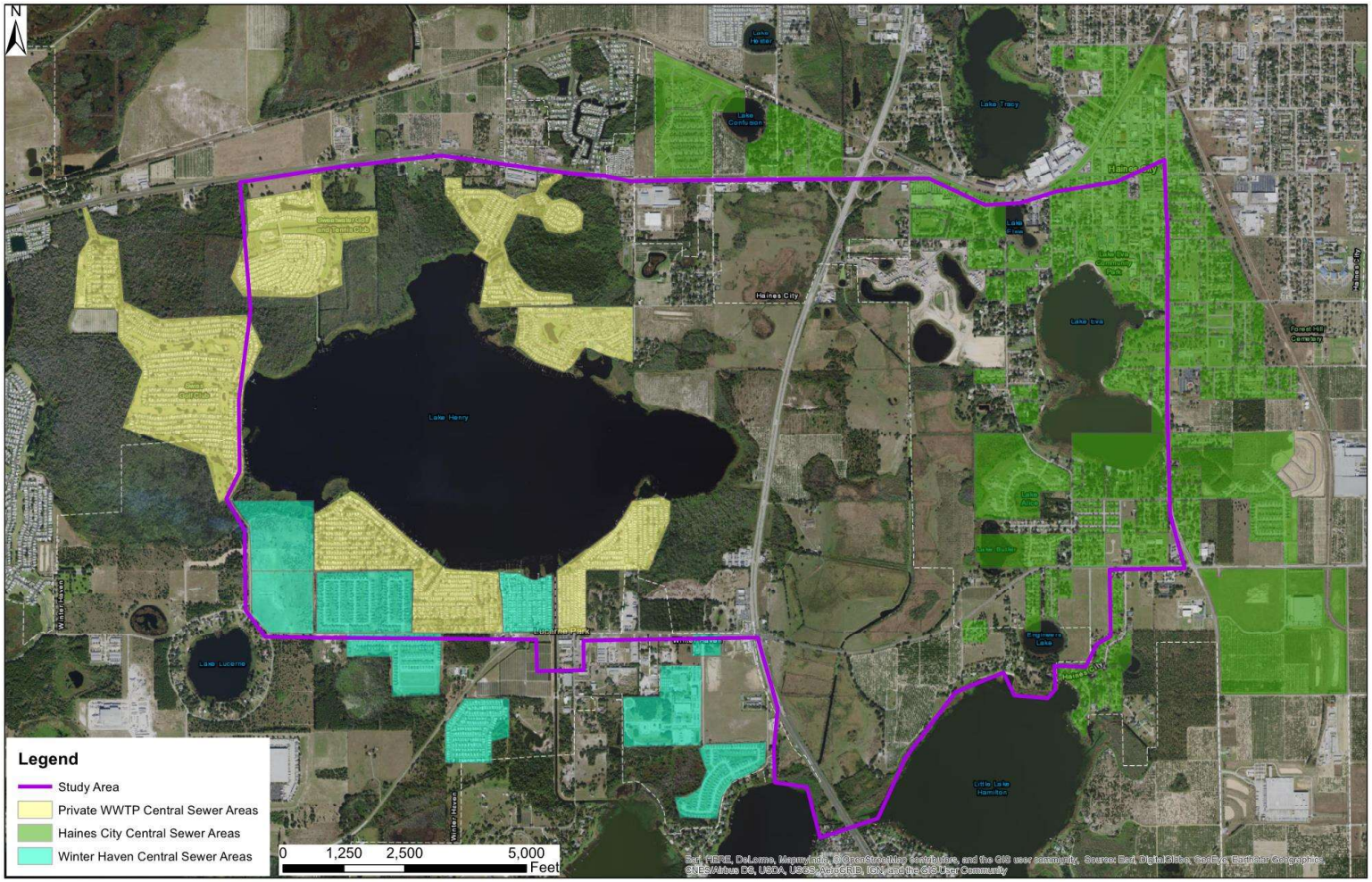
Lake Existing Conditions Assessment

Chlorophyll-a versus Total Nitrogen for Lake Eva



Lake Existing Conditions Assessment

Central Sewer Areas in Lake Eva and Lake Henry Study Area



Lake Existing Conditions Assessment

Lake Eva Sediment and Aquatic Vegetation Analysis

Saloid-bound and iron-bound phosphorus concentrations were a small portion of total P in the sediment samples. This indicates a low propensity for sediments in Lake Eva to contribute significant internal P loading to the Lake

Lake Existing Conditions Assessment

Lake Eva Hydrologic and Nutrient (TN, TP) Budgets

- Estimating Stormwater Runoff Loadings
  - Land Use GIS
  - H&H Model Results
  - Literature-based bulk deposition areal loading rates
  - Literature-based TP and TN concentrations (FDEP)
- Nutrient Budget
  - Stormwater
  - Direct Precipitation
  - Groundwater Seepage

Lake Eva Estimated External Annual Average Nutrient Loadings
1,708 kg TN and 218 kg TP

Lake Existing Conditions Assessment

Lake Eva Water Quality

Lake Trophic Condition	Carlson TSI	Secchi Disk Depth (ft)	Chlorophyll-a (µg/l)	TP (µg/l)
Oligotrophic	< 38	> 15	< 2.2	< 10
Mesotrophic	38 - 48	7.5 - 15	2.2 - 6	10 - 20
Eutrophic	49 - 61	3 – 7.4	6.1 - 22	20.1 - 50
Hypereutrophic	> 61	< 3	> 22	> 50

Based on historic total phosphorus and chlorophyll-a concentrations, and Secchi disk depth, Lake Eva water quality varies from eutrophic to hypereutrophic

Hypereutrophic Lake w/Elevated Algal Concentration

Lake Existing Conditions Assessment

Lake Eva Water Quality Existing Conditions Summary

- Lower Chlorophyll-a concentrations associated with higher lake water levels and lower TN
- Chlorophyll-a was strongly positively correlated with TN, TSS, and turbidity
- Regression Analysis showed TN is more important than TP in predicting Chlorophyll-a
- Lake Eva from 2016-2016 only met state applicable NNC during one 3-year period

Statistical Analysis indicates Lake Eva water quality improves at higher levels.

Alternative Analysis Evaluation Criteria and Priority

Selection Evaluation Criteria	Priority*	Description
Meet Regional Integrated Water Resources Needs		Follow Central Florida Water Initiative (CFWI) guidelines, use regional approach to solve multi-jurisdictional "One Water" needs
Address Lake Eva Low Water Level Concerns		Address Regulatory Requirements for Maintaining Minimum Level and Flow (MFL) in Lake Eva
Improve Lake Eva Water Quality		Achieve Lake Water Quality Improvement for Key Parameters including Total Phosphorus and Chlorophyll-a
Life-Cycle Cost		Lowest combined Capital and O&M Costs for 20-year life
Likelihood or Ease of Permitting		Regulatory Acceptability and Less Time/Lower Cost for Project Permitting
Minimize Need for Land Acquisition and Easements		Maximize the use of existing public lands and easements for project improvements and minimize the need to acquire additional private land or easements
Minimize Impacts (temporary/permanent) to residences and businesses		Construction and Operation of Proposed Improvements has minimal impact on residences and businesses
Proven Treatment/Recharge Approach		Use project elements which are effective and meet regulatory requirements
Provide Groundwater Recharge and Water Supply Credits		Infiltrate "Excess" Water into project area groundwater system with the goal of generating water supply credits
Provide Natural Systems Enhancement		Improve ecosystem form and function within the project area
Public / Stakeholder Acceptance		Consensus of acceptance by Stakeholders, Residences, and Businesses
Recreational Benefits		Maintain or improve Lake Recreational Benefits (Swimming, boating, fishing, etc.)
Reduce Lake Henry Flooding During Wet Weather Periods		Reduce extent/depth of flooding for residents adjacent to Lake Henry based on existing flood maps
Social Benefits		Provide public benefits such as increased property value, economic development, educational opportunities, aesthetics, etc.
Utilize Existing Infrastructure and Natural Conveyances		Maximize natural conveyance and maintain existing drainage system infrastructure in such a way that it's compatible with maximizing natural conveyance.

**Rank from 1 to 15, "1" is most preferred*

Collaborative Process for Criteria Prioritization

Evaluation Criteria and Priority *Input by Project Team, November 2017*		
Selection Evaluation Criteria	**Priority***	**Description**
Improve Lake Eva Water Quality	2.89	Achieve Lake Water Quality Improvement for Key Parameters including Total Phosphorus and Chlorophyll-a
Address Lake Eva Low Water Level Concerns	2.94	Address Regulatory Requirements for Maintaining Minimum Level and Flow (MFL) in Lake Eva
Meet Regional Integrated Water Resources Needs	5.1	Follow Central Florida Water Initiative (CFWI) guidelines, use regional approach to solving multi-jurisdictional "One Water" needs
Public / Stakeholder Acceptance	5.9	Consensus of acceptance by Stakeholders, Residences, and Businesses
Reduce Lake Henry Flooding During Wet Weather Periods	6.2	Reduce extent/depth of flooding for residents adjacent to Lake Henry for the 100-year, 24-hour event based on existing flood maps
Provide Groundwater Recharge and Water Supply Credits	7.5	Infiltrate "Excess" Water into project area groundwater system with the goal of generating water supply credit
Provide Natural Systems Enhancement	8.3	Improve ecosystem form and function within the project area
Minimize Impacts (temporary/permanent) to residences and businesses	8.8	Construction and Operation of Proposed Improvements has minimal impact on residences and businesses
Life-Cycle Cost	9.1	Lowest combined Capital and O&M Costs for 20-year life
Utilize Existing Infrastructure and Natural Conveyances	9.2	Maximize natural conveyance and maintain existing drainage system infrastructure is such a way that it's compatible with maximizing natural conveyance.
Likelihood or Ease of Permitting	9.4	Regulatory Acceptability and Less Time/Lower Cost for Project Permitting
Proven Treatment/Recharge Approach	9.5	Use project elements which are effective and meet regulatory requirements
Recreational Benefits	10.0	Maintain or improve Lake Recreational Benefits (Swimming, boating, fishing, etc.)
Minimize Need for Land Acquisition and Easements	10.7	Maximize the use of existing public lands and easements for project improvements and minimize the need to acquire additional private land or easements
Social Benefits	11.9	Provide public benefits such as increased property value, economic development, educational opportunities, aesthetics, etc.

** = Rank from 1 to 15, "1" is most preferred*

Conclusions

1. Flooding in the vicinity Lake Henry appears to be limited
2. Preliminary Model Results indicates there is sufficient water (avg. basis) reaching Morrison Ranch property (project area) to evaluate alternatives to meet project objectives
3. Long-term simulations are required to evaluate seasonal variability
4. No need to alter Lake Henry water inflow, elevation or water quality
5. There are options to improve stormwater water quality entering Lake Eva
6. Statistical Analysis indicates Lake Eva WQ improves at higher lake levels
7. Potential areas exist for wetland rehydration and enhancement

Next Steps

1. BCE Approach to Alternative Analysis and Ranking
   a. Brainstorm Alternatives
   b. Conduct Fatal Flaw Analysis
   c. H&H Modeling and Water Quality Analysis of Alternatives Short-list
   d. Quantify Benefits and Identify Potential Risks
   e. Develop Estimated Life-Cycle Costs
   f. Apply Weighted Evaluation Criteria to Rank Alternatives
   g. Summarize Analysis and Results in TM#4
2. Recommended Alt. Conceptual Design
3. Feasibility Report

Stakeholder/ Community Involvement and City Commission Workshops

Questions?

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