East Coast Floridan Model

Overview and Results

Lower East Coast Planning Region

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August 22, 2018
LEC Floridan Aquifer System Modeling

- Application of the East Coast Floridan Model (ECFM) in support of the 2018 Lower East Coast Water Supply Plan Update
- ECFM was used in 2016 Upper East Coast WSP Update
- ECFM was peer reviewed and comments incorporated
- Two simulations
  - 2016 Current Condition (using actual FAS withdrawals for 24 years)
  - 2040 Future Condition (using projected FAS withdrawals for 24 years)
- Key measurements: water levels, water quality, flows
Key Assumptions

- 2016 Run used actual pumped volumes
- 2040 Run used projected demands
  - Typically less than permitted volumes
  - FAS used only after SAS allocation maximized
  - Existing FAS wells used first; proposed wells used if necessary
  - Historical use patterns were considered
- ASR wells not simulated
Limitations in Simulating Demands

- Each simulation is 24 years
  - Same as calibration period
  - Wide range of climatic conditions
- Can’t simulate annual demand growth
- Simulated demands are “instant on”
- Results from the 2040 simulation are considered conservative
Regional Model Limitations

- Model Cell: 2,400 feet by 2,400 feet
- Multiple wells in a single model cell
- Model aggregates all withdrawals at center of model cell
- Tends to exaggerate water level drawdowns and water quality degradation
- Results are conservative
## LEC Floridan Aquifer System Demand Summary by County

<table>
<thead>
<tr>
<th>County</th>
<th>FAS Allocation (mgd)</th>
<th>2016 FAS Modeled (mgd)</th>
<th>2040 FAS Modeled (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm Beach</td>
<td>48.81</td>
<td>29.48</td>
<td>34.92</td>
</tr>
<tr>
<td>Broward</td>
<td>56.54</td>
<td>12.74</td>
<td>29.02</td>
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<tr>
<td>Miami-Dade</td>
<td>102.34</td>
<td>22.26</td>
<td>81.66</td>
</tr>
<tr>
<td>Monroe*</td>
<td>3.82</td>
<td>0.36</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>211.51</strong></td>
<td><strong>64.84</strong></td>
<td><strong>145.98</strong></td>
</tr>
</tbody>
</table>

* Wells for FKAA, the primary water supplier in Monroe County, are located in Miami-Dade County.
Water Level Differences

- Model run: 2040-2016
- Layer 1
- Stress period: 288
- Existing & proposed wells shown
- Change in potentiometric surface
- In feet NGVD
- Range: -10 ft to above 50 ft
  - Negative values reflect increased water levels
Water Quality Differences

- Model run: 2040-2016
- Layer 1
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: >-2,000 to >1,500
Water Level Differences

- Model run: 2040-2016
- Layer 3
- Stress period: 288
- Existing & proposed wells shown
- Change in potentiometric surface
- In feet NGVD
- Range: <-10 ft to >50 ft
Water Quality Differences

- Model run: 2040-2016
- Layer 3
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: <-2,000 to >1,500
Water Quality Differences
Miami-Dade Close Up

- Model run: 2040-2016
- Layer 3
- Stress period: 288
- Existing & proposed wells shown
- TDS in mg/L
- Range: 1,500 to 8,860
Observations

- **Water Level**
  - Stages in APPZ (Layer 3) decline in vicinity of some Upper Floridan aquifer (Layer 1) withdrawals, suggesting upward movement of water

- **Water Quality**
  - Some degradation occurs, although much of the change is <1,500 mg/L TDS over 24 years
  - Potential upward movement of APPZ water into Upper Floridan aquifer may degrade water quality

- **Regional Model**
  - May not be able to simulate response at individual wells

- **FAS** appears to be capable of meeting projected demands of all users as simulated through 2040
Next Steps

- Improve sustainability of the FAS to meet water needs:
  - Increase coordination with PWS utilities
  - Encourage conservative wellfield design and operation
    - Additional wells with greater spacing between them
    - Reduced pumping from each well to minimize upconing of poor-quality water.
    - Lower pumping rates from APPZ wells to minimize upconing of poor-quality water.
  - Work with utilities to obtain refined wellfield operational plans and communicate these refinements to the SFWMD for possible incorporation into future ECFM efforts.
  - Gather additional well construction, aquifer test, lithologic, and other data from new and existing FAS wells from utilities and other FAS users for inclusion in update of ECFM – Thank you to those who have already done so!
Next Steps (cont’d)

- Evaluate the potential for water quality changes and its effect on other regulatory programs (e.g., Underground Injection Control)

- Evaluate the issue of water quality degradation from one existing legal user to another from a regulatory perspective
Thank you
2018 Lower East Coast Water Supply Plan Update

Karin Smith, P.G., Plan Manager
Mark Elsner, P.E., Bureau Chief

Stakeholder Workshop #3
August 22, 2018
Water Supply Plan Requirements

- 20-year planning period
- Demand estimates and projections
- Resource analyses
- Issues identification
- Evaluation of water source options
- Water resource development
  - Responsibility of water management
- Water supply development
  - Responsibility of water users
- Minimum Flows and Minimum Water Levels
  - Recovery and prevention strategies
Information Sources
Planning Document Outline

Executive Summary

Chapter 1: Introduction ✓
• Plan goal and objectives, Planning Area overview, climate change & sea level rise, progress since 2013 Plan

Chapter 2: Demand Estimates and Projections
• Population and demands by water use type

Chapter 3: Demand Management: Water Conservation ✓
• Conservation effects on current & future demand

Chapter 4: Water Resource Protection ✓
• Regulatory protection, permitting, MFLs, Water Reservations, Restricted Allocation Areas, and monitoring

Indicates portions of document sent for early external review
Chapter 5: Surface Water Resources and Management

- Surface water for natural systems, surface water management in 4 sub-areas

Chapter 6: Water Resource Development Projects

- Ecosystem restoration, CERP, modeling, monitoring

Chapter 7: Water Supply Source Options

- Surface water, groundwater, reclaimed, storage, seawater for urban & agricultural needs

Chapter 8: Water Supply Development Projects

- PWS Projects to meet demands through 2040

Chapter 9: Future Direction

- Water sources, coordination, climate change
Appendices Document

A: Information for Local Governments ✔
   • Comp Plan guidance, Utility/City crosswalk, 2016 & 2040 service area maps

B: Water Demand Projections
   • Methodologies and detailed results

C: MFLs and Recovery & Prevention Strategies ✔

D: Groundwater Monitoring and Analysis
   • ECFM model results, water levels, MDL & water quality monitoring, saltwater interface maps, PWS FAS quality trends

E: Public Water Supply Utility Summaries
   • Wellfield maps, demands, permit info, projects

F: Wastewater Treatment Facilities ✔
   • Maps, profiles, reclaimed volumes and end users
Goal of Water Supply Plans

To identify sufficient water supply sources and future projects to meet existing and future reasonable-beneficial uses during 1-in-10 year drought conditions through 2040 while sustaining water resources and related natural systems.
Objectives of this Plan Update

- Identify water supplies
- Increase water conservation & alternative water source development
- Protect & enhance natural systems
- Ensure compatibility and linkage with other efforts
- Provide linkage with local governments
Regional & Local Planning Linkage

After plan update approval:

- Local governments have 18 months to amend their Comp Plan to incorporate a Water Supply Facilities Work Plan \((by \, May \, 2020)\)

- Utilities identify the projects to be developed

- Utility annual progress reports
  - Due in November
  - District on-line WaSUP database
Sea Level Rise & Climate Change

- South Florida is particularly vulnerable
- Rate of sea level rise predicted to accelerate
- SFWMD is preparing by:
  - Conducting research
  - Computer modeling
  - Analyzing vulnerabilities in the current water management system
  - Developing adaptation strategies
- Quarterly updates to Governing Board
- Coordinate with others, including Climate Change Compact
Lower East Coast Planning Area

Planning Horizon 2016-2040

- Population:
  - 2016: 6,027,190
  - 2040: 7,570,351
  - 26% increase

- Irrigated agricultural acreage:
  - 2016: 581,470
  - 2040: 550,080
  - 5% decrease

- Gross water demands:
  - 2016: 1,757 mgd
  - 2040: 2,005 mgd
  - 14% increase
Population Projections

- Palm Beach
- Broward
- Miami-Dade
- Monroe
- Hendry
History of PWS Projected Demands

![Graph showing projected PWS demands from 2005 to 2040. The graph includes three plans: 2006 LEC Plan, 2013 LEC Plan, and 2018 Draft LEC Plan. The demands increase over time, with the 2018 Draft LEC Plan showing the highest projection.]
2016 FSAID Irrigated Areas

Chapter 2, Appendix B

FSAID = Florida Statewide Agricultural Irrigation Demand
2016 FSAID Irrigated Areas

Chapter 2, Appendix B
FSAID Irrigated Acreage in the LEC

Note: Sugarcane acres unadjusted from FSAID report
# Agricultural Demand Summary

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>2016</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>Average Demand (mgd)</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>460,260</td>
<td>486.62</td>
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<tr>
<td>Fresh Market Vegetables</td>
<td>50,804</td>
<td>50.58</td>
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<tr>
<td>Citrus</td>
<td>21,223</td>
<td>22.29</td>
</tr>
<tr>
<td>Other Crops*</td>
<td>49,183</td>
<td>93.01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>581,470</strong></td>
<td><strong>652.50</strong></td>
</tr>
</tbody>
</table>

* Other crops includes sod, greenhouse/nursery, field crops, fruit (non-citrus), potatoes, pasture/hay.

mgd = million gallons per day.

Does not include aquaculture or livestock watering demands
# Total Demand Projections

<table>
<thead>
<tr>
<th>Water Use Category</th>
<th>2016 (mgd)</th>
<th>2040 (mgd)</th>
<th>Change (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Water Supply</td>
<td>864</td>
<td>1,088</td>
<td>+224</td>
</tr>
<tr>
<td>Domestic &amp; Small Supply</td>
<td>12</td>
<td>16</td>
<td>+4</td>
</tr>
<tr>
<td>Agricultural Irrigation</td>
<td>653</td>
<td>625</td>
<td>-28</td>
</tr>
<tr>
<td>Recreational/Landscape Irrigation</td>
<td>136</td>
<td>156</td>
<td>+20</td>
</tr>
<tr>
<td>Industrial/Commercial/Institutional</td>
<td>52</td>
<td>67</td>
<td>+15</td>
</tr>
<tr>
<td>Power Generation</td>
<td>40</td>
<td>53</td>
<td>+13</td>
</tr>
<tr>
<td><strong>LEC Total</strong></td>
<td><strong>1,757</strong></td>
<td><strong>2,005</strong></td>
<td><strong>+248</strong></td>
</tr>
</tbody>
</table>

*Chapter 2*

![2016 Water Sources Pie Chart](chart.png)
Demand Management: Water Conservation

Among the lowest cost solutions

- **Agriculture**
  - FDACS Best Management Practices
  - More efficient irrigation systems

- **Public Water Supply**
  - Indoor and outdoor programs
  - Conservation rate structures

- 103 mgd potential savings through conservation
  - Urban – 79 mgd
  - Agriculture – 24 mgd

*The cheapest gallon of water is the gallon we don’t use*
Population vs Demands

- LEC Demand
- LEC Population

Water Demands (mgd)

Population

- 1995
- 2000
- 2005
- 2010
- 2016
- 2020
- 2030
- 2040

0
200
400
600
800
1,000
1,200

0
1,000,000
2,000,000
3,000,000
4,000,000
5,000,000
6,000,000
7,000,000
Water Resource Protections

- Water Reservations
  - Nearshore Central Biscayne Bay

- Minimum Flows and Minimum Water Levels
  - Lake Okeechobee
  - Everglades
  - Florida Bay
  - Biscayne Aquifer
  - Lower West Coast Aquifers
  - NW Fork Loxahatchee River

- Restricted Allocation Areas
  - Lake Okeechobee & LOSA
  - L-1, L-2 & L-3 Canal System
  - LEC Everglades Waterbodies
  - NPB County/Loxahatchee
Surface Water Resources & Management

- C&S F Project
  - Flood control
  - Water supply
  - Fish & wildlife preservation
  - Water supply & preservation of ENP
  - Saltwater intrusion prevention
  - Groundwater recharge
  - Recreation and navigation

- 4 sub-regions
  - Lake Okeechobee Service Area
  - Everglades Protection Area
  - Western Basins
  - Lower East Coast Service Areas
Water Resource Development

- Implementation of CERP and other projects*
- Hydrogeologic investigations
- Groundwater monitoring and modeling
- Alternative water supply and conservation programs
- Resource protection rule activities

* MFL recovery and prevention strategies rely on CERP implementation.
South Florida Ecosystem Restoration

INTEGRATED DELIVERY SCHEDULE

NON-CERP & FOUNDATION PROJECTS
- Modified Water Deliveries to Everglades National Park
- C-111 South Dade
- C-51/Storm Water Treatment Area (STA) 1E
- Restoration Strategies
- Tamiami Trail Bridging & Roadway Modifications
- Herbert Hoover Dike (HHD) Rehabilitation
- Seminole Big Cypress Critical Project

CERP GENERATION 1 PROJECTS
- Site 1 Impoundment
- Melaleuca Annex Facility

CERP GENERATION 2 PROJECT
- Broward County Water Preserve Areas (WPA)
- C-111 Spreader Canal Western Project
- Biscayne Bay Coastal Wetlands Phase I

DECEMBER 2016 AUTHORIZATION
- Central Everglades Planning Project (CEPP)

PLANNING EFFORTS
- Loxahatchee River Watershed Restoration
- Western Everglades Restoration
- Lake Okeechobee Watershed Restoration
- Everglades Agricultural Area Storage Reservoir
Water Supply Issues

- Limited opportunity to increase surface water and surficial aquifer use
  - MFLs and Restricted Allocation Areas for Everglades & Loxahatchee River
  - LOSA Restricted Allocation Area Rule

- Effects of climate change and sea level rise

- Environmental water needs

- Freshwater sources alone are inadequate to meet water needs through 2040

- Long-term sustainability of saline sources
Water Source Options

Surface Water
- Fresh Groundwater
- Brackish Groundwater*

Reclaimed Water*
- Aquifer Storage & Recovery*

Conservation*
- Seawater*

* Alternative water source
# Water Source Uses

<table>
<thead>
<tr>
<th>Category</th>
<th>Surface Water</th>
<th>Fresh Groundwater</th>
<th>Saline Groundwater</th>
<th>Reclaimed Water</th>
<th>Storage</th>
<th>Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Supply</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Agricultural</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Recreational/Landscape</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Industrial/Commercial/Institutional</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Power Generation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Surface Water Limitations

- Minimum flows and minimum water levels
  - Lake Okeechobee
  - Everglades
  - Loxahatchee River
  - Florida Bay

- Restricted Allocation Area
  - LOSA
  - LEC Regional Water Availability
  - L1, L2, L3 Canals

- Water Reservation for Biscayne Bay

Chapter 4 and 7
Fresh Groundwater Limitations

- Minimum flows & minimum water levels
  - Biscayne aquifer
  - Lower West Coast aquifers
- Restricted Allocation Area
  - LEC Regional Water Availability
  - LWC aquifers MDL
- Threat of saltwater intrusion
  - Coastal infiltration
  - Canal conduits from ocean
  - Upconing from relict seawater

Chapter 7, Appendix D
Groundwater Monitoring

- Surficial aquifer system
  - Groundwater levels and salinities
  - Lower Tamiami MDL monitoring

- Floridan aquifer system
  - Regional water levels and salinities
  - Local wellfield operations
Saltwater Intrusion Information

- Saltwater Interface Maps
  - Palm Beach & Broward updated in 2014 by SFWMD
  - Miami-Dade updated by USGS
- Chloride graphs and induction logs
- USGS County salt water intrusion models
Floridan Aquifer System Use

- 15 treatment facilities in 2016
- PWS FAS use could double by 2040
- Total FAS use may increase by 81 mgd by 2040 to 146 mgd
East Coast Floridan Model

- New LEC Planning Tool
- 7-layer calibrated model
- Two major producing zones
- Floridan Aquifer System appears to be capable of meeting projected demands (146 mgd) for all users as simulated through 2040
Reclaimed Water

- 15% Reuse Rate
- Expansion expected

Chapter 7, Appendix F
Water Source Options

- Surface Water
- Reservoirs*
- Reclaimed Water*
- Aquifer Storage & Recovery*
- Fresh Groundwater
- Saline Groundwater*
- Conservation*
- Seawater*

* Alternative water source
Water Supply Development

- Projects proposed by utilities

- Potable
  - Majority of utilities have sufficient capacity and permit allocations to meet 2040 demands
  - 17 utilities proposed projects
  - Only 9 out of 54 utilities need projects to meet 2040 demand projections or treatment requirements

- Nonpotable
  - 8 reclaimed water supply projects
# Water Supply Project Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>Proposed Projects</th>
<th>Capacity (mgd)</th>
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<tbody>
<tr>
<td>Surface Water/Stormwater</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Surficial Aquifer System</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Floridan Aquifer System</td>
<td>17</td>
<td>63</td>
</tr>
<tr>
<td>Aquifer Storage and Recovery</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Reclaimed Water*</td>
<td>8</td>
<td>177</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38</strong></td>
<td><strong>302</strong></td>
</tr>
</tbody>
</table>

* Reclaimed water is not used as a potable water source in the LEC Planning Area, however it is an alternative water supply used to reduce reliance on traditional water sources.
Future Direction

- Continue implementation of:
  - MFL recovery and prevention strategies
  - robust water conservation programs
  - development of alternative water supplies
  - Comprehensive Everglades Restoration Plan (CERP) and other ecosystem restoration projects

- Continue to evaluate, monitor and design solutions in response to sea level rise and climate trends, participate in Climate Change Compact

- Implement long-term management measures of the Floridan aquifer system in coordination with Public Water Supply utilities

- Complete repairs to the Herbert Hoover Dike and reassess the 2008 LORS
The future water demands of the region during 1-in-10 year drought conditions can be met through the 2040 planning horizon with appropriate management, conservation, and implementation of projects in this 2018 LEC Plan Update.

Depends on completion of:

• Identified CERP components and other projects to meet environmental needs
• Water supply development projects by utilities
• Completion of repairs to the Herbert Hoover Dike and implementation of a new Lake Okeechobee Regulation Schedule
HHD/LORS Update

Herbert Hoover Dike:
- With the addition of $100 million from the State of Florida, the federal Herbert Hoover Dike Rehabilitation Project is now fully funded.
- Scheduled completion date for construction of dike repairs is 2022.

Lake Okeechobee Regulation Schedule:
- U.S. Army Corps of Engineers is accelerating revisions to the Lake Okeechobee Regulation Schedule (LORS08) to sync with the completion of dike repairs.
- U.S. Army Corps of Engineers anticipated schedule is to conduct formulation and evaluation of alternatives from January 2019 through September 2019 and finalize Record of Decision in September 2021.
- Water Supply for water users and the environment are among the many performance measures to be evaluated in the Regulation Schedule revisions.
- Future updates to the LEC Plan will reflect the outcome of the Regulation Schedule revisions.
Next Steps

- **August 2**: Overview of draft 2018 LEC plan presented at WRAC
- **August 17**: Draft plan posted for stakeholder review
- **August 22**: Stakeholder meeting #3
- **September 13**: Presentation of draft to Governing Board
- **September 21**: Deadline for stakeholder written comments
- **November 1**: Post final documents
- **November 8**: Final plan to Governing Board for approval
Questions?

- Plan information can be found at: www.sfwmd.gov/lecplan

- Written comments to: Plan Manager – Karin Smith karsmith@sfwmd.gov
Thank You

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