South Florida Water Management District

A G E N D A

Upper East Coast Floridan Aquifer Model Kick-off Meeting

Thursday, June 26, 2014
Stuart City Hall, Commission Chambers
121 SW Flagler Avenue, Stuart, FL 34994
10:00 a.m. – Noon

I.	Welcome & Introductions	Mark Elsner, Section Administrator
II.	Overview of Floridan Aquifer System	Pete Kwiatkowski, Section Administrator
III.	East Coast Floridan Model Status	Jeff Giddings, Principal Hydrogeologist
IV.	Model Application	John Mulliken, FAS Modeling Coordinator
V.	Next Steps	John Mulliken

Upper East Coast Floridan Aquifer Model Meeting for Agricultural Stakeholders
Thursday, June 26, 2014
Stuart City Hall. Commission Chambers
121 SW Flagler Avenue
Stuart, FL
10:00 am – 12:00 noon

NAME (PRINT)	ORGANIZATION	TELEPHONE	E-MAIL
MARIO LOAIZA	SOUTH MARTIN REGIONAL UTILITY	772-546-6259	Mloaiza@tji.martin.fl.us
Jim Mercurio	M.C.U	772-221-1439	JMercurio@martin.fl.us
DAVID VOISINET	MCU	772-260-6441	DVoisinet@martin.fl.us
ROBERT PLUMMER	MCU	772-221-1483	rplummer@martin.fl.us
JOSHUA C MILLER	SLWSD	772 340 0220	jmiller@SLWSD.ORG
Dean Powell	SFWMD	561-682-6787	dpowell@sfwmd.gov
Rebecca Elliott	FDACS/OAWP	561-682-6040	relliott@sfwmd.gov
Chad Brcka	SFWMD	561 682 2816	cbrcka@sfwmd.gov
Angela Montoya	SFWMD	561 682 2002	amontoy@sfwmd.gov
Digna Jurado	SFWMD	561-682-6031	ljurado@sfwmd.gov
Paul Stout	JLA Geosciences	561-704-6435	pstout@jlageosciences

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NAME (PRINT)	ORGANIZATION	TELEPHONE	E-MAIL
Valerie Schulte	FPUA	7724661600	VSchulte@fpua.com
ERIC SHEA	FPL	561 691 2993	eric.m.shea@fpl.com
Stan Lamb	FLA-LAKE	561-389 0062	lamb@fla-inc.com
Samantha Lovelady	MC Growth Mgt	772-288-5664	slove@martin.fl.us
Anne Murray	Martin Co	772 2211442	amurray@martin.fl.us
NICHOLAS ARCHIBALD	CH Engineering	772-342-5767	barchibald@ch-eng.com
SAM ANDERSON	CITY OF STUART	772-260-9613	samerson@ci.Stuart.fl.us
Ray Scott	FDACS		
Luke Polk	FL Farm Bureau	352-727-0547	luke.polk@ffbf.org
VINCE MOLLO	Seacoast Util	561-627-2900 (308)	VMOLLO@SUA.com

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NAME (PRINT)	ORGANIZATION	TELEPHONE	E-MAIL
CARL LARRABEE	SJRWMD	(386) 329.4222	clarrabee@sjrwmd.com
JILL GRIMALDI	CDM SMITH	772 360-3224	grimaldijt@cdmsmith.com

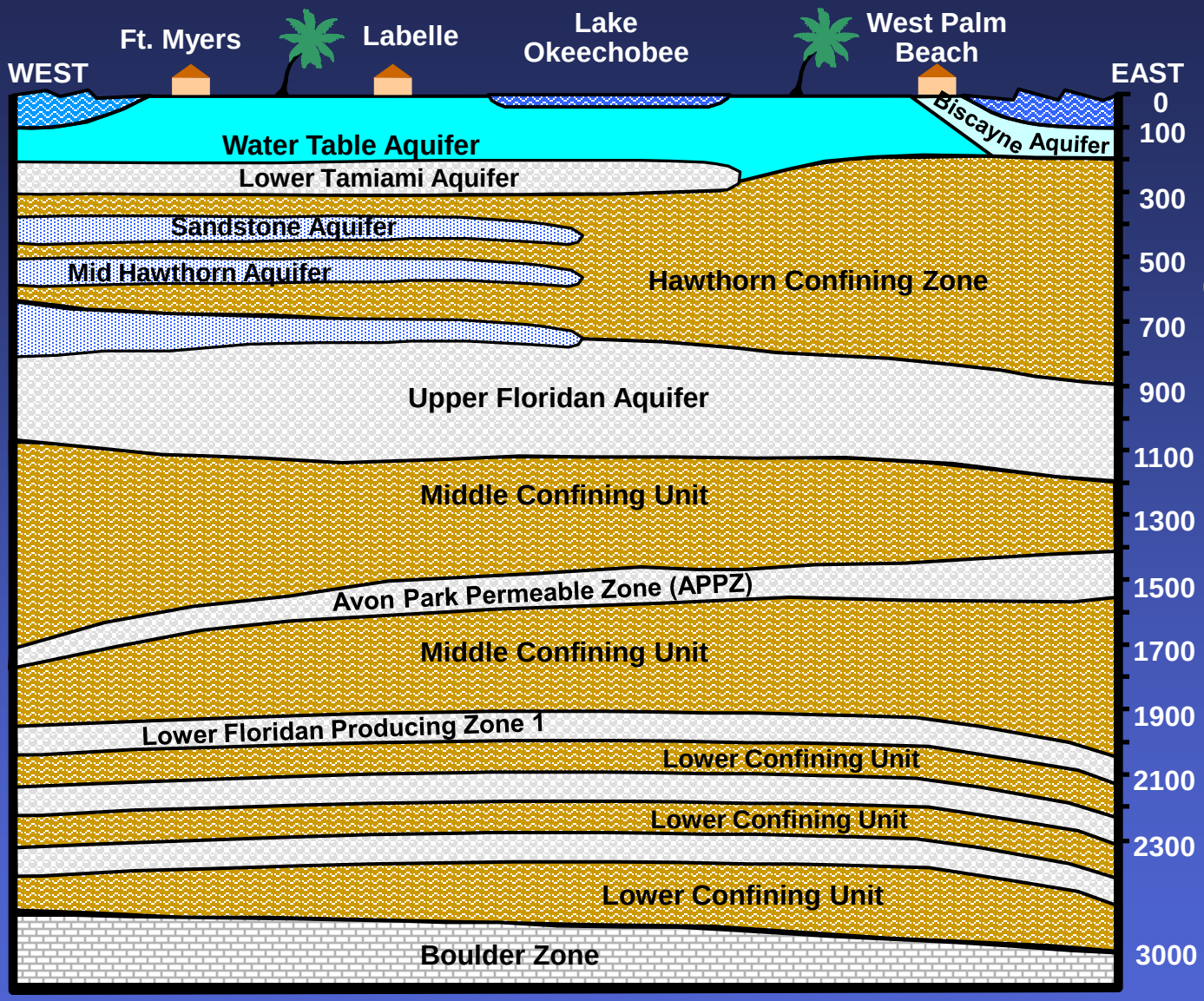
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Overview of the Floridan Aquifer System

Upper East Coast Floridan Aquifer Modeling Meeting
Stuart, Florida
June 26, 2014

Peter J. Kwiatkowski, P.G.
Section Administrator, Resource Evaluation

sfwmd.gov



Generalized Aquifer Systems of South Florida

Major Aquifers, Relative Yields, and Water Quality in South Florida

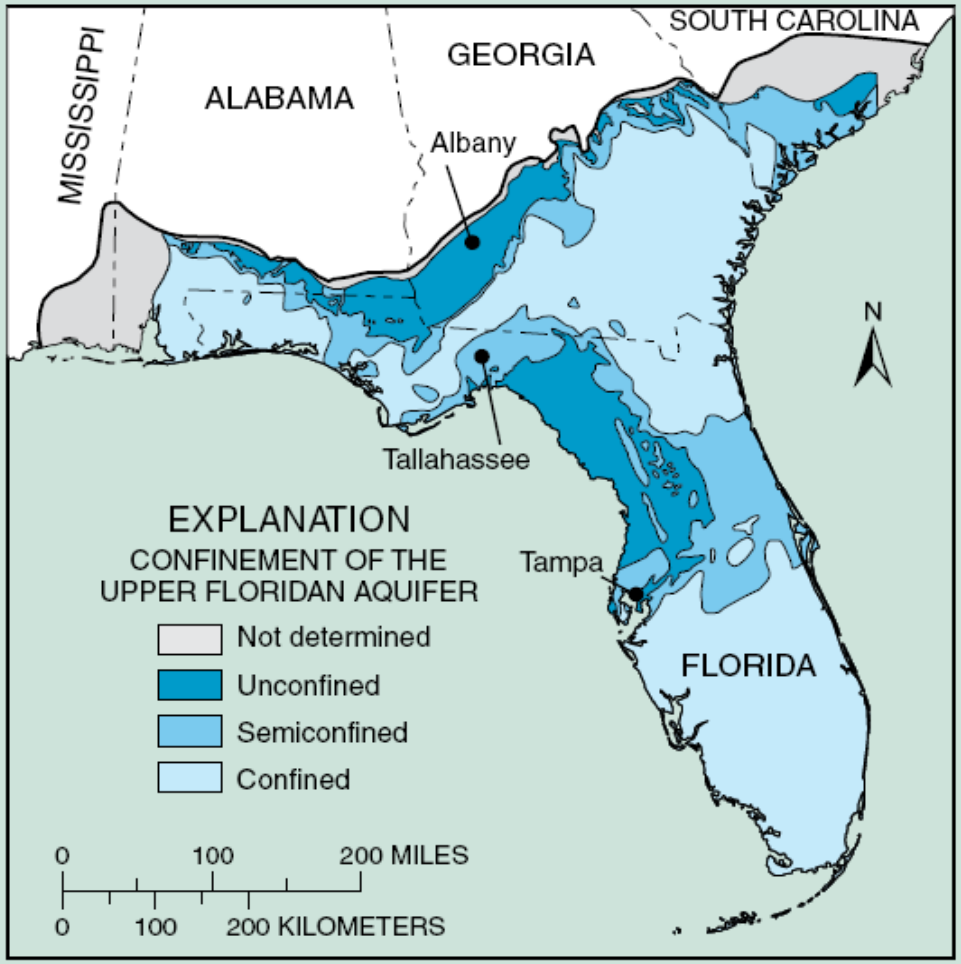
Aquifer	Yield	Water Quality
Surficial Aquifer	Low	Fresh
Upper Floridan Aquifer	Moderate	Fresh/Brackish
APPZ	Moderate	Brackish
Boulder Zone	Very High	Saline

NOTE:

APPZ = Avon Park Permeable Zone

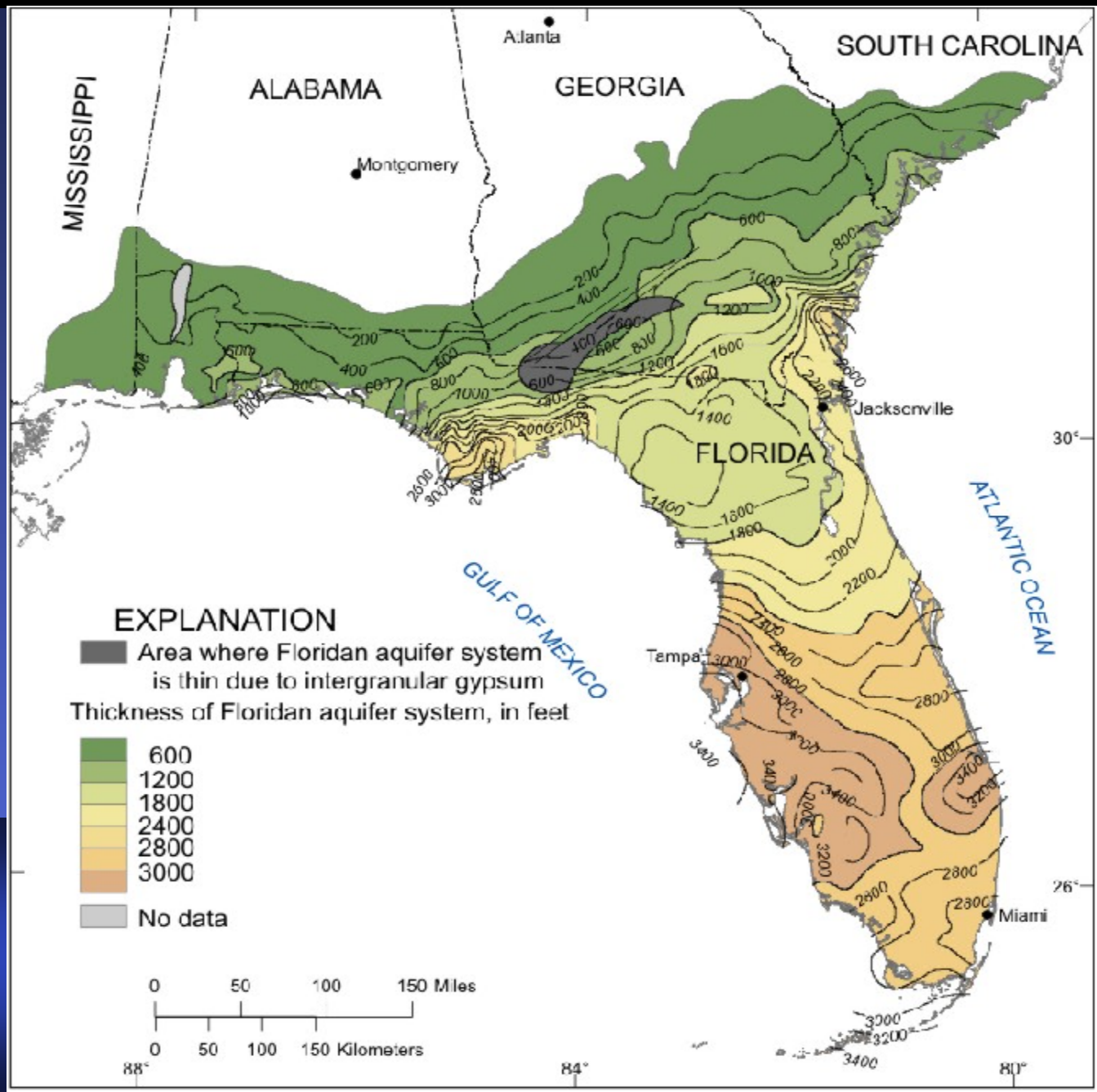
Geographic Differences of the Floridan Aquifer System (FAS)

- Recharge Area in Central Florida (Unconfined)
- Confined Aquifer in South Florida – less water released from storage, greater drawdowns

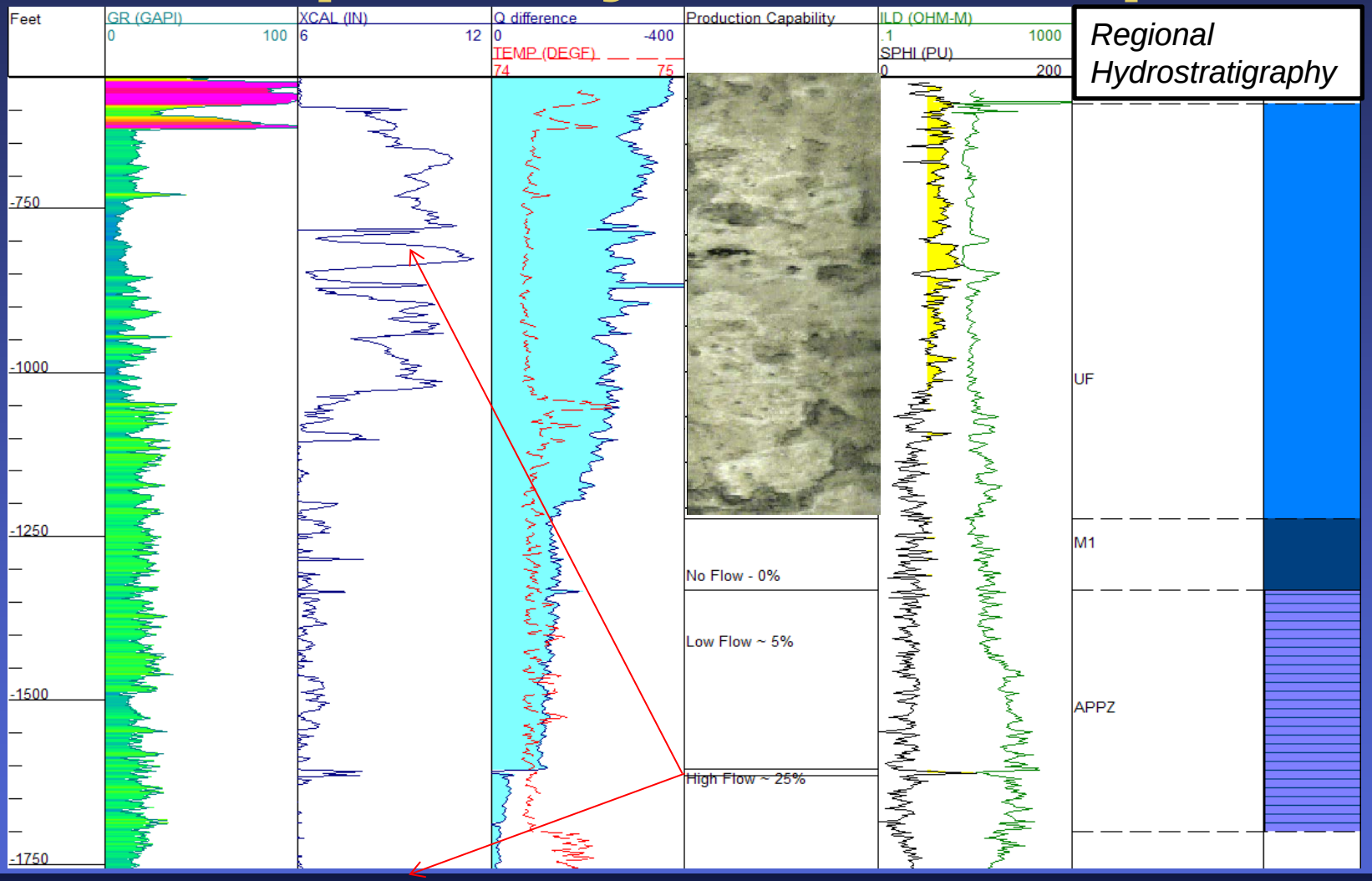


(From USGS Circular 1278)

Thickness of the Floridan Aquifer System

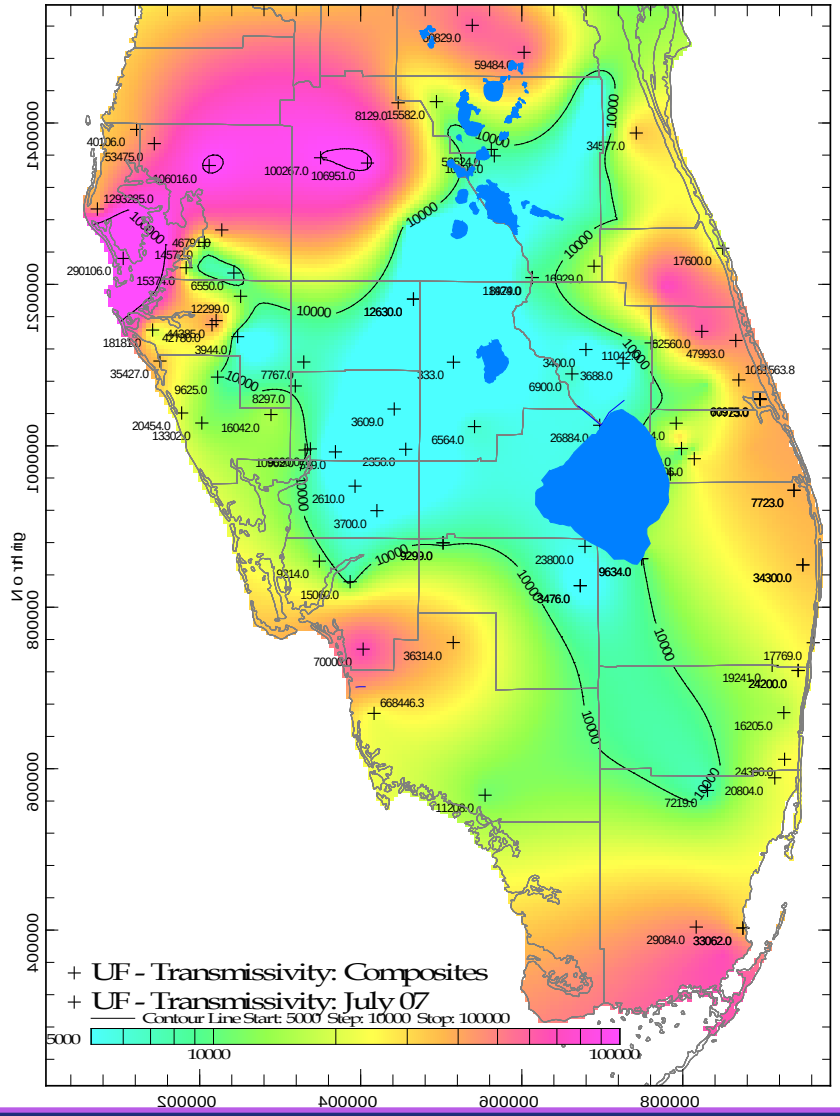


Vertical Differences of Floridan Aquifer System: Example

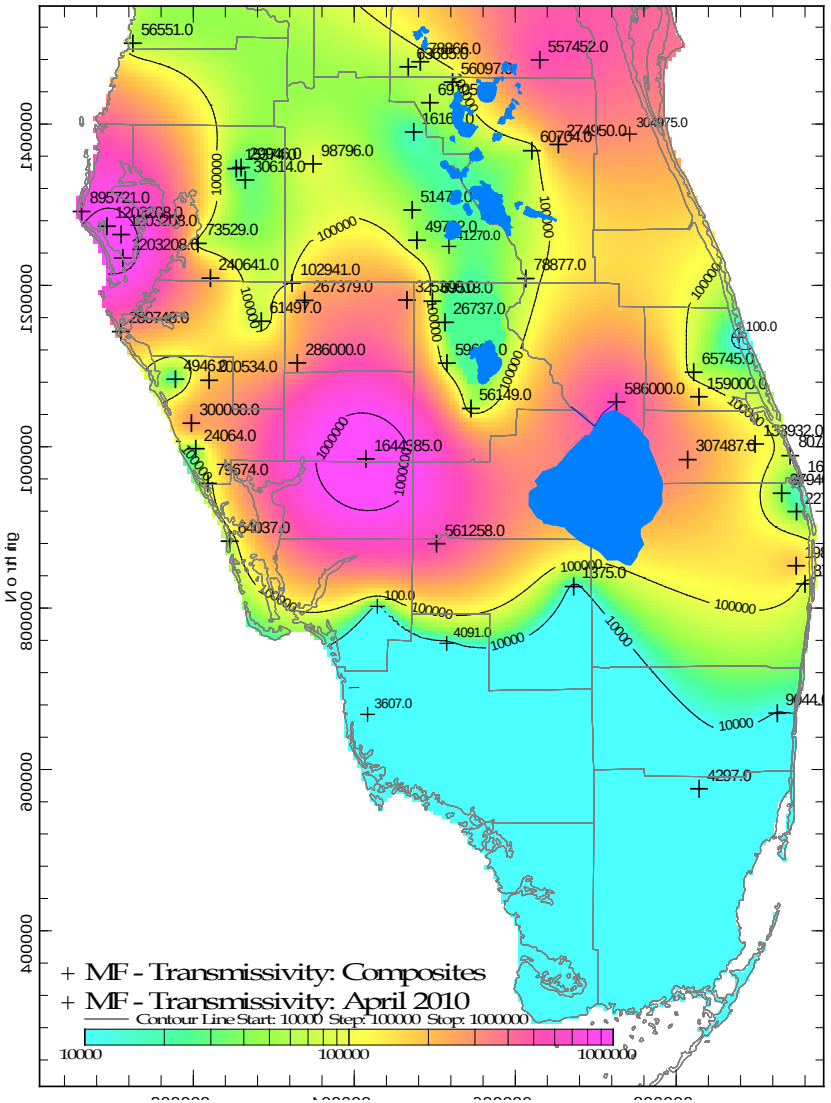


Geographic Differences in Transmissivity within the FAS

Uppermost Producing Zone

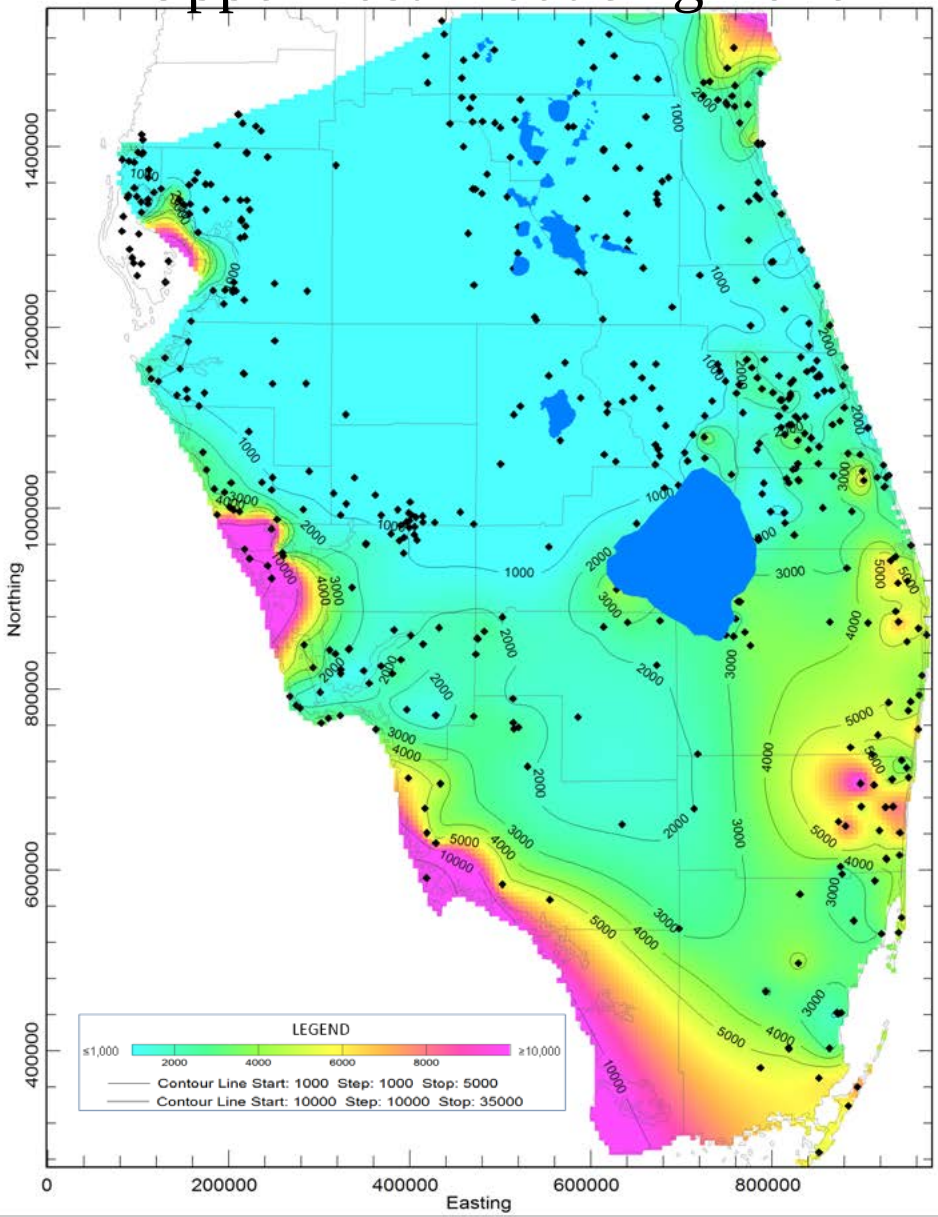


Avon Park Permeable Zone

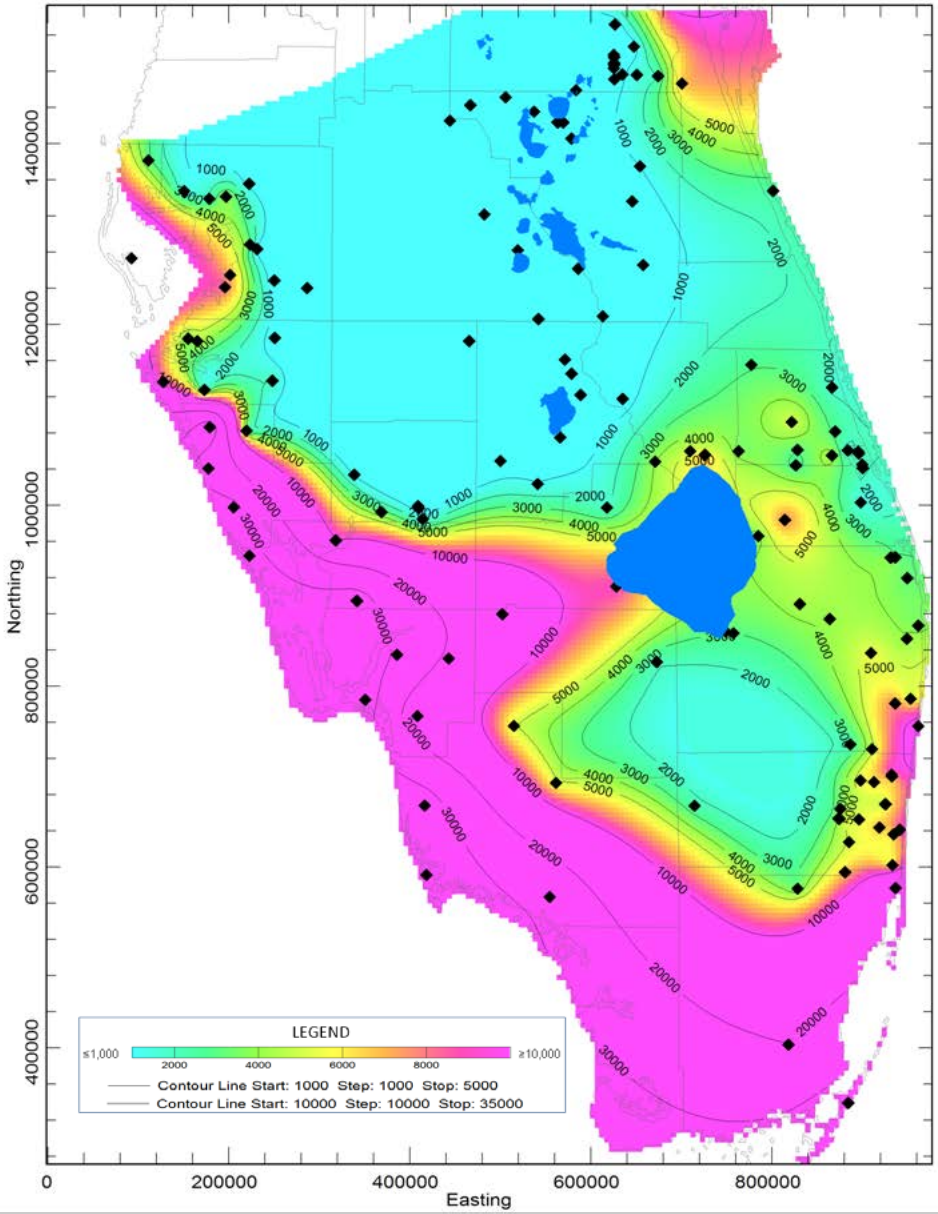


Geographic Differences in Salinity within the FAS

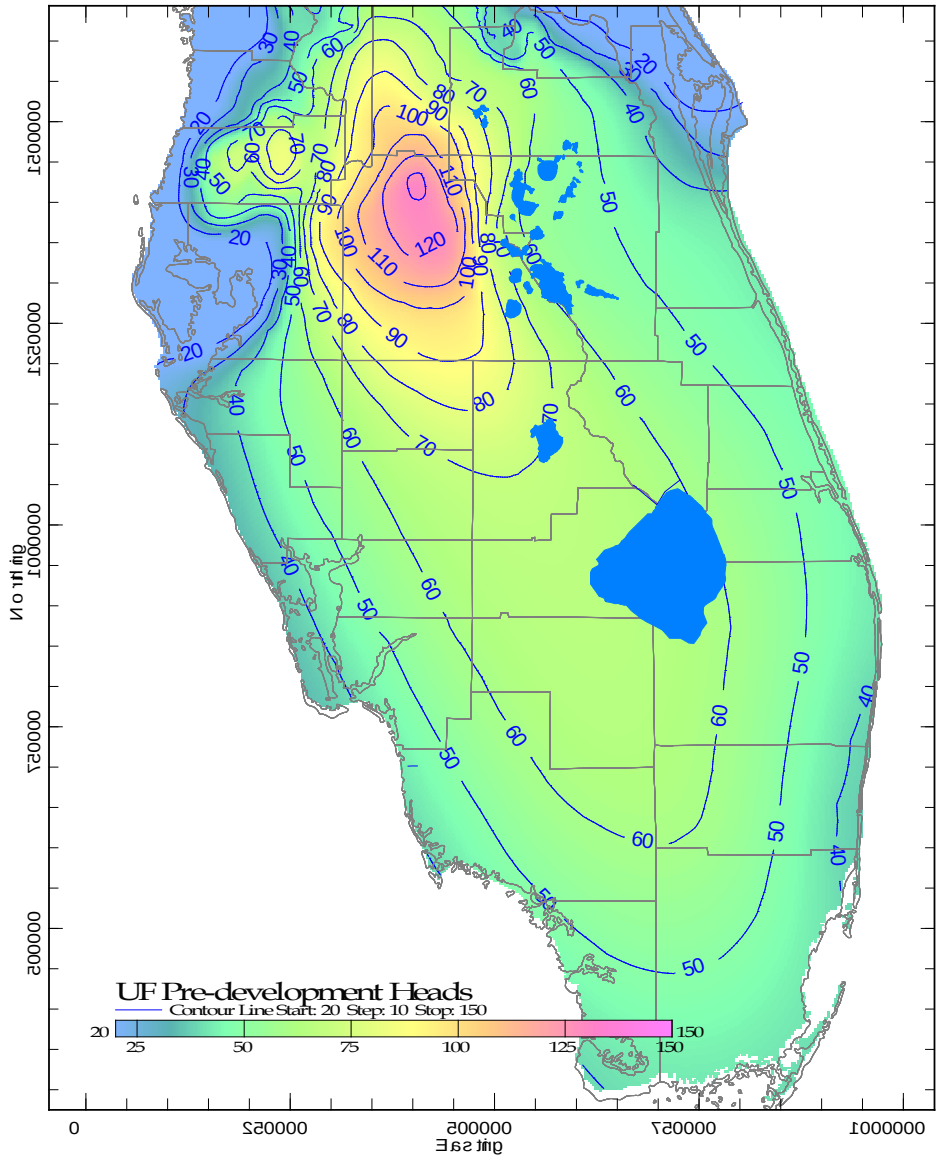
Uppermost Producing Zone

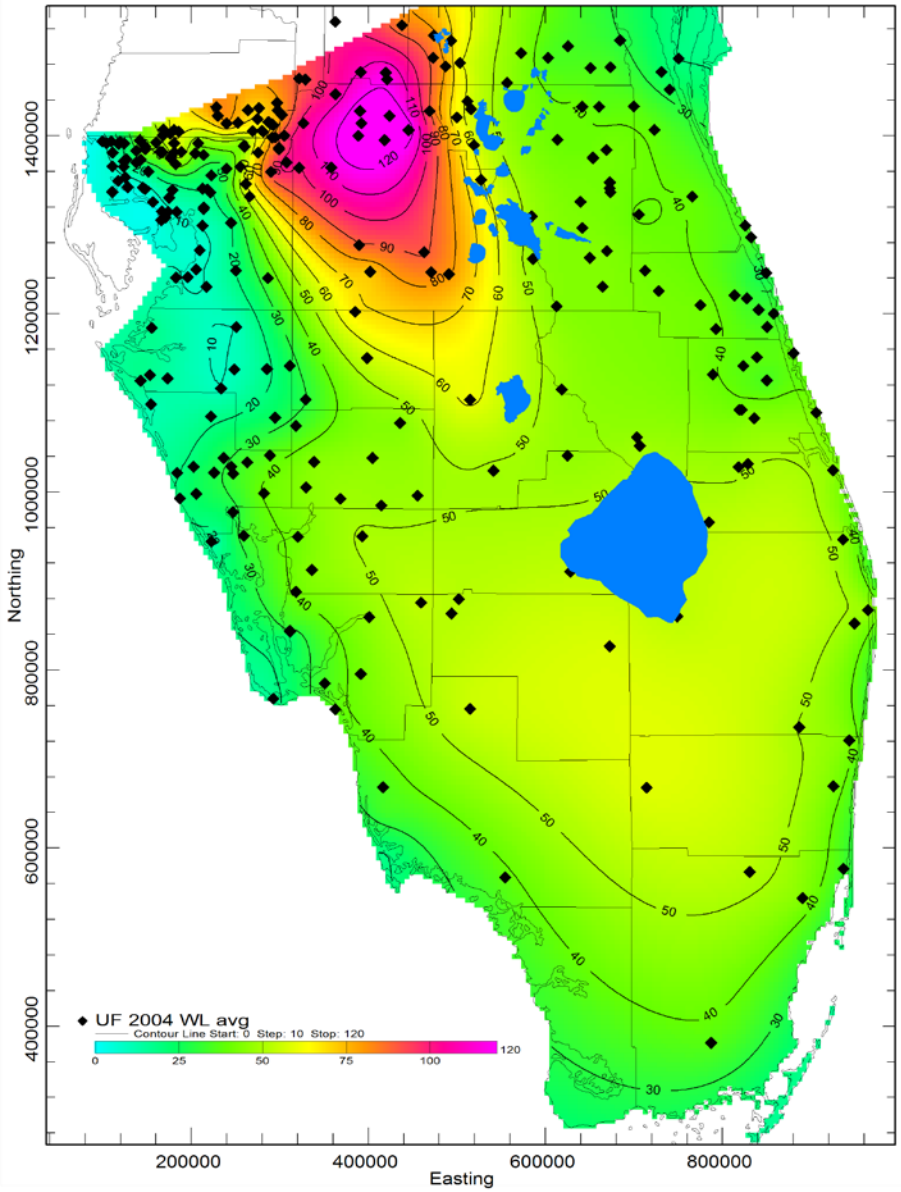


Avon Park Permeable Zone

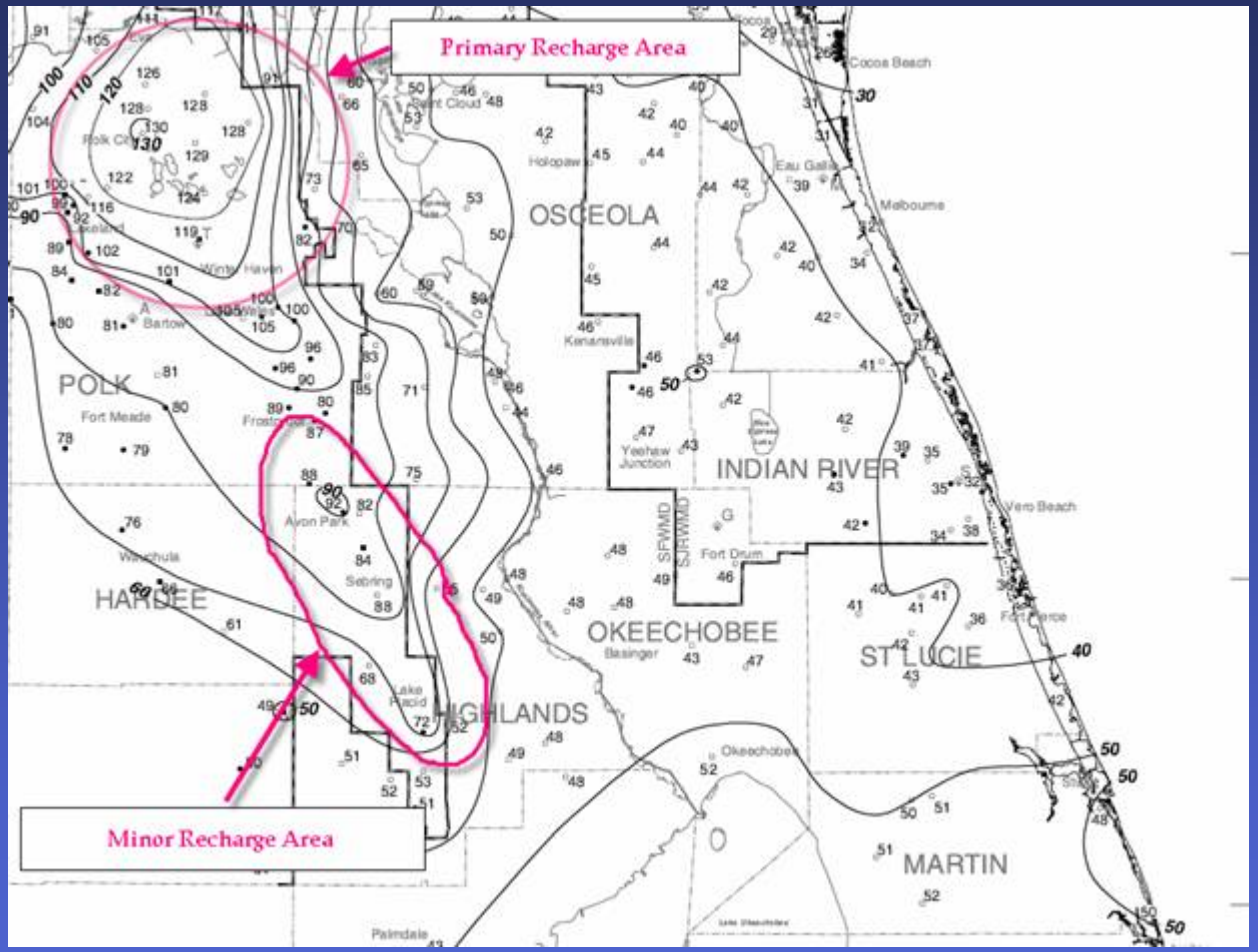


Changing Water-levels due to Long-term Withdrawals





Recharge to FAS Occurs in Polk and Highlands Counties

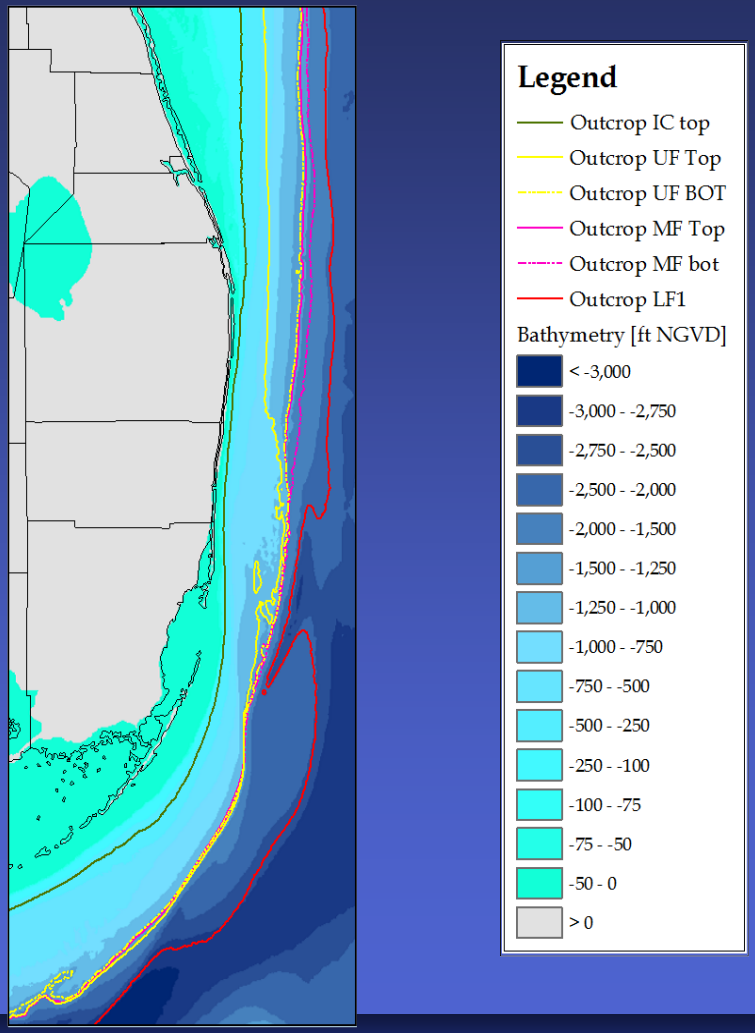


(From USGS OFR 2004-1288)

Well Flowing Under Artesian Pressure

- Several FAS zones under artesian pressure in South Florida
- Flow at land surface naturally (no pumping required)
- In general, occurs from Lake Okeechobee southward where Hawthorn Group confinement is extensive
- Boulder Zone (saltwater) does not flow naturally

Geologic Formations of the FAS extend offshore at depth



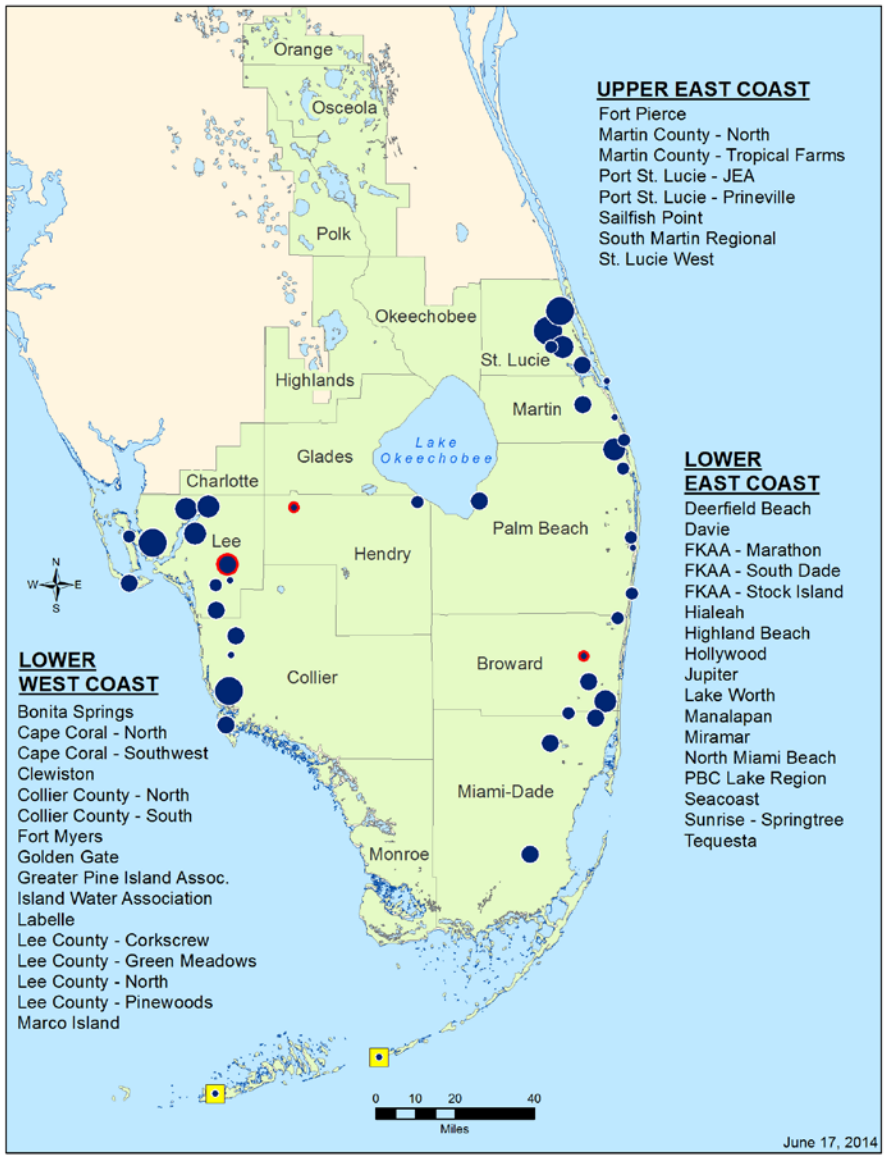
General Water Quality Characterization of the Floridan Aquifer System

- Upper Floridan Aquifer and Avon Park Permeable Zone (APPZ) are potential zones for Blending, Reverse Osmosis source water, or Aquifer Storage and Recovery (ASR)
- Brackish quality requires membrane treatment to meet drinking water standards
- Relatively stable water quality seasonally, but geographically variable
- Some pumping wells become saltier (upconing of more saline water from below or laterally along coast) over time – related to aquifer productivity, well spacing, depth to saline water, etc.

Technical Considerations of FAS

- Greater Drawdowns
  - Increased energy costs associated with lifting water via pumps
  - Increase well spacing to lessen drawdown effects (i.e., greater pipeline costs)
  - Adjacent user effects
- Potential for decline in water quality over time
  - Membrane design and periodic replacement
  - Blending with Surficial aquifer water or surface water
- Membrane Treatment
  - Estimated 115 to 125% of raw water to meet treated water demands
  - Concentrate disposal via deep injection wells

Potable Water Desalination Plants within SFWMD, 2014

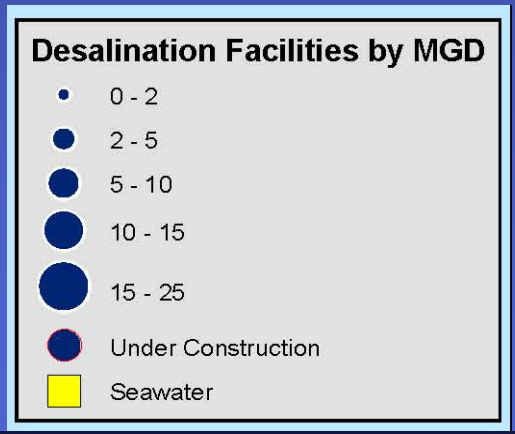


Number of Facilities:

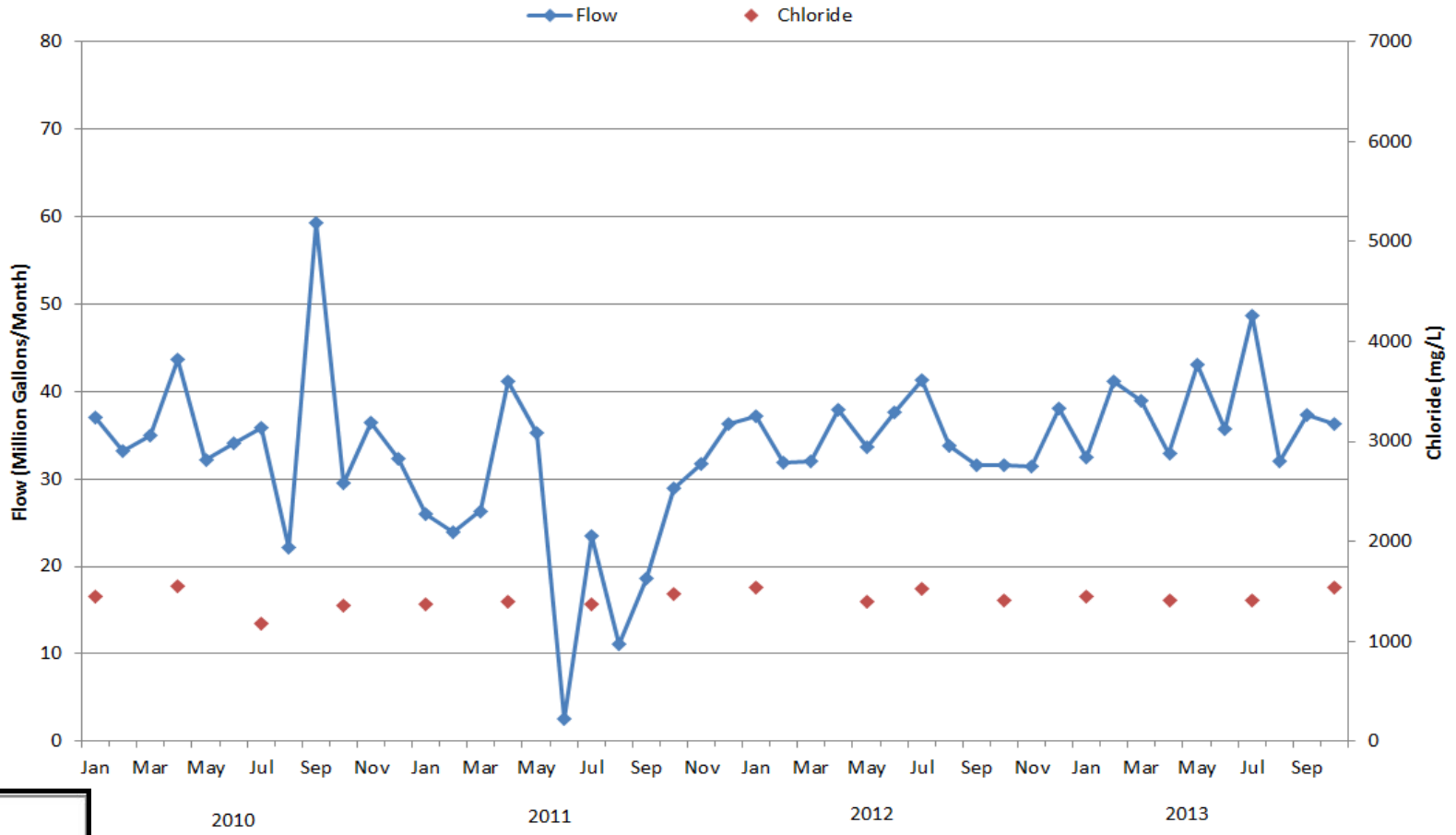
- Operating 38
- Under construction 3

Total Capacity (MGD):

- Operating 269
- Under Construction 17

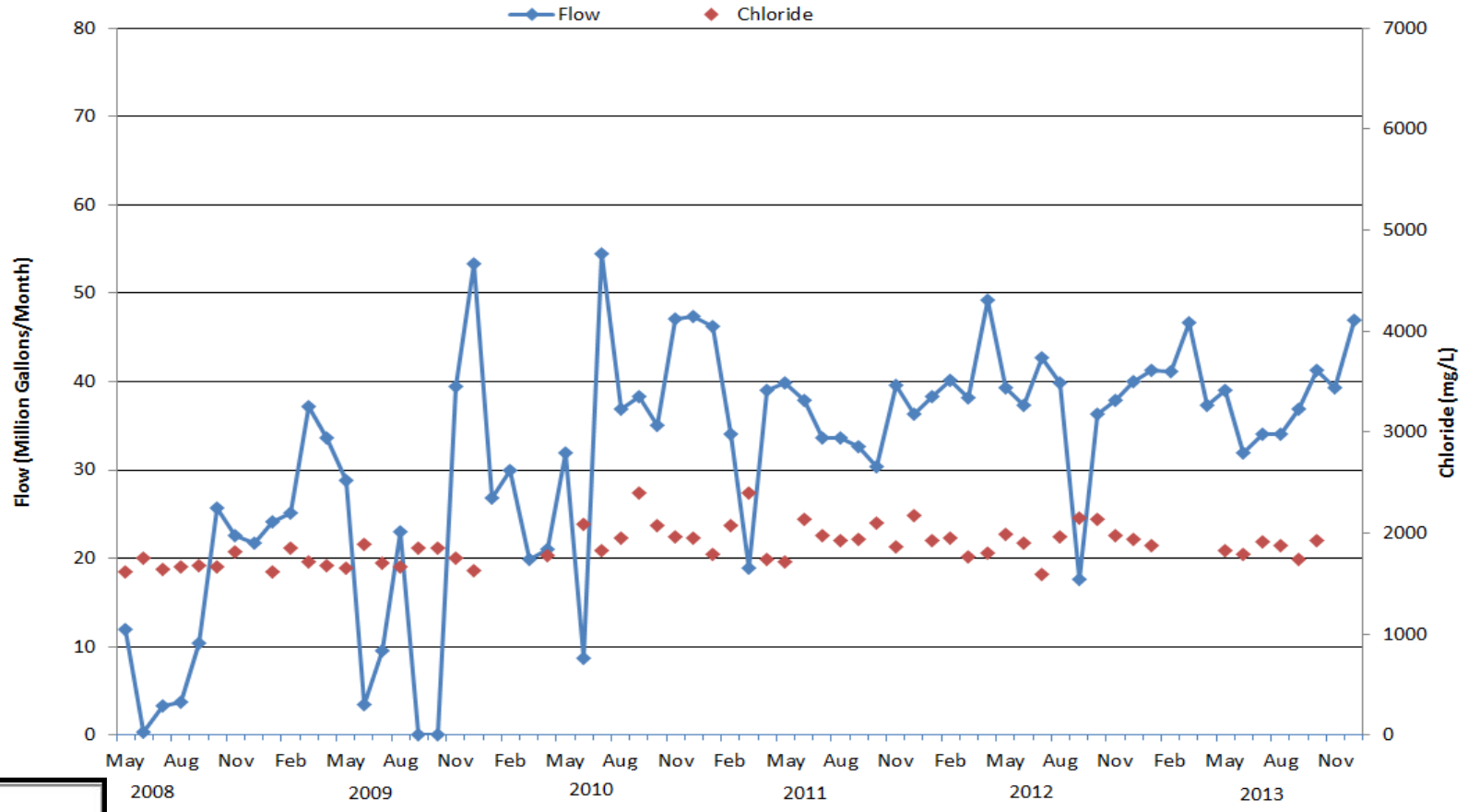


sfwmd.gov



Port St. Lucie Public Water Utility Systems
JEA Wellfield F-16
well depth= 860 ft.

sfwmd.gov

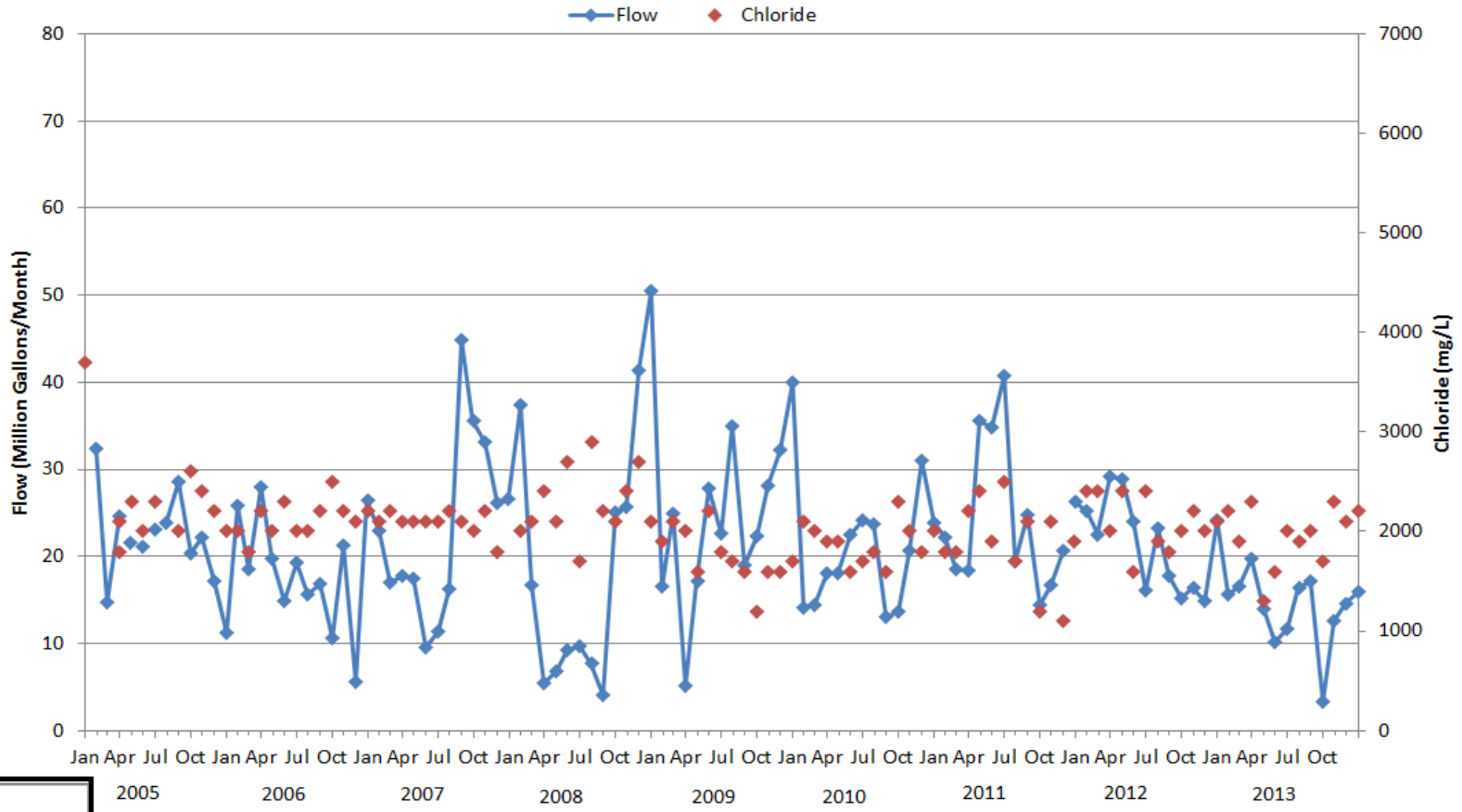


Martin County Utilities Tropical Farms

TFRO-3

well depth=1142 ft.

sfwmd.gov

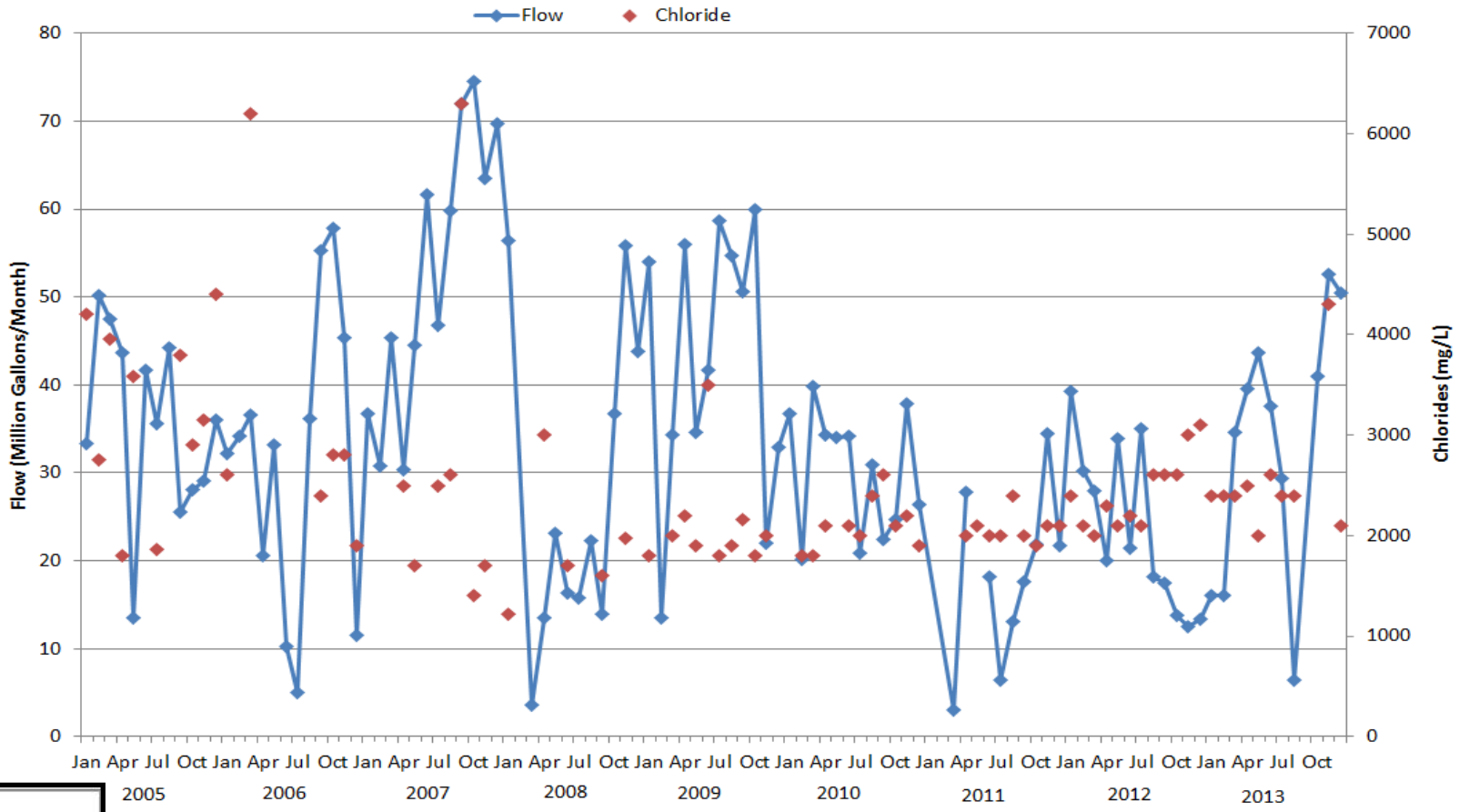


Village of Tequesta

1R

Well depth= 1000 ft.

sfwmd.gov



Town of Jupiter

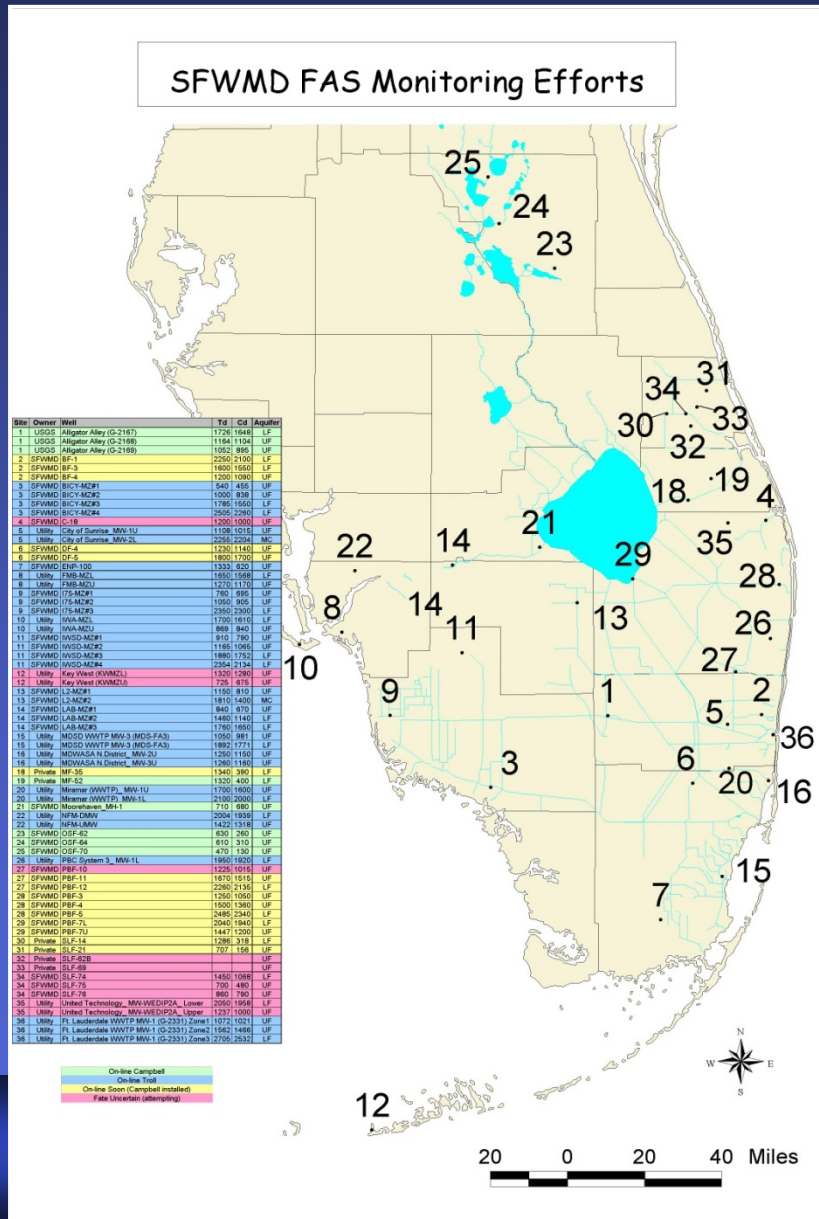
RO-7

depth= 1330 ft

sfwmd.gov

FAS Monitoring Network

- Data Loggers w/Continuous Recorders
- Provides data to support model calibration
- Most stations in Upper Floridan Aquifer
- Few stations in APPZ or deeper zones of FAS, except at deep injection well sites



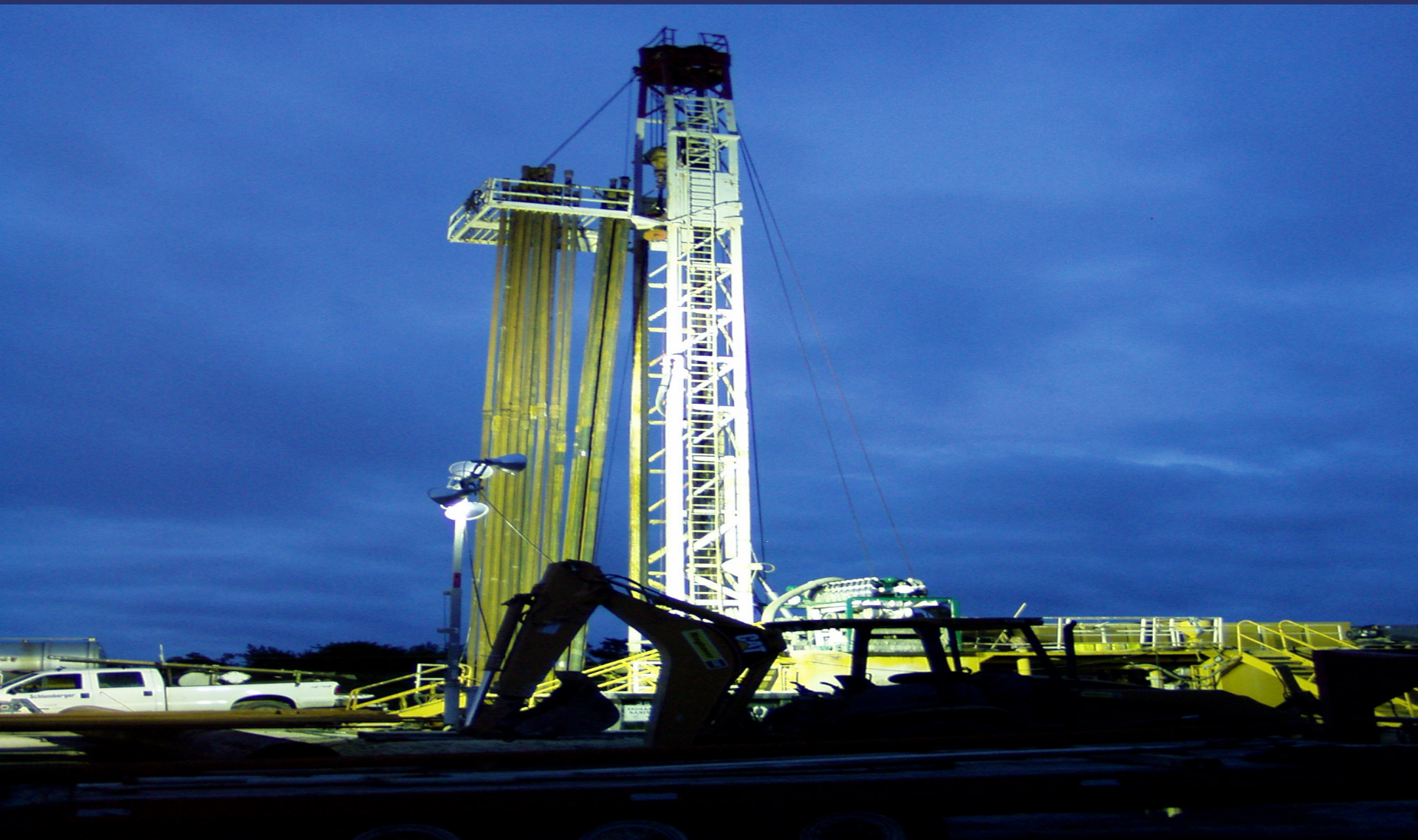
Site	Owner	Well	Td	Cd	Aquifer
1	USGS	Alligator Alley (G-2167)	1726	1648	LF
1	USGS	Alligator Alley (G-2168)	1164	1104	UF
1	USGS	Alligator Alley (G-2169)	1052	895	UF
2	SFWMD	BF-1	2250	2100	LF
2	SFWMD	BF-3	1600	1550	LF
2	SFWMD	BF-4	1200	1090	UF
3	SFWMD	BICY-MZ#1	540	455	UF
3	SFWMD	BICY-MZ#2	1000	939	UF
3	SFWMD	BICY-MZ#3	1780	1550	LF
3	SFWMD	BICY-MZ#4	2505	2280	LF
4	SFWMD	C-18	1200	1000	UF
5	Utility	City of Sunrise_MW-1U	1108	1015	UF
5	Utility	City of Sunrise_MW-2L	2255	2204	MC
6	SFWMD	DF-4	1230	1140	UF
6	SFWMD	DF-5	1800	1700	UF
7	SFWMD	ENP-100	1333	820	UF
8	Utility	FMB-MZL	1850	1568	LF
8	Utility	FMB-MZU	1270	1170	UF
9	SFWMD	I75-MZ#1	760	695	UF
9	SFWMD	I75-MZ#2	1050	905	UF
9	SFWMD	I75-MZ#3	2350	2300	LF
10	Utility	IWA-MZL	1700	1610	LF
10	Utility	IWA-MZU	869	840	UF
11	SFWMD	IWSD-MZ#1	910	790	UF
11	SFWMD	IWSD-MZ#2	1160	1065	UF
11	SFWMD	IWSD-MZ#3	1980	1752	LF
11	SFWMD	IWSD-MZ#4	2354	2134	LF
12	Utility	Key West (KWMZL)	1320	1280	UF
12	Utility	Key West (KWMZU)	725	675	UF
13	SFWMD	L2-MZ#1	1150	910	UF
13	SFWMD	L2-MZ#2	1810	1400	MC
14	SFWMD	LAB-MZ#1	840	670	UF
14	SFWMD	LAB-MZ#2	1460	1140	LF
14	SFWMD	LAB-MZ#3	1760	1650	LF
15	Utility	MDSD WWTP MW-3 (MDS-FA3)	1050	981	UF
15	Utility	MDSD WWTP MW-3 (MDS-FA3)	1892	1771	LF
16	Utility	MDWASA N District_ MW-2U	1250	1150	UF
16	Utility	MDWASA N District_ MW-3U	1280	1180	UF
18	Private	MF-35	1340	390	LF
19	Private	MF-52	1320	400	LF
20	Utility	Miramar (WWTP)_ MW-1U	1700	1600	UF
20	Utility	Miramar (WWTP)_ MW-1L	2100	2000	LF
21	SFWMD	Moorehaven_MH-1	710	680	UF
22	Utility	NFM-DMW	2004	1938	LF
22	Utility	NFM-LMW	1422	1318	LF
23	SFWMD	OSF-62	630	260	UF
24	SFWMD	OSF-64	610	310	UF
25	SFWMD	OSF-70	470	130	UF
26	Utility	PBC System 3_ MW-1L	1950	1920	LF
27	SFWMD	PBF-10	1226	1015	UF
27	SFWMD	PBF-11	1670	1515	UF
27	SFWMD	PBF-12	2260	2135	LF
28	SFWMD	PBF-3	1250	1050	UF
28	SFWMD	PBF-4	1500	1360	UF
28	SFWMD	PBF-5	2485	2340	LF
29	SFWMD	PBF-7L	2040	1940	LF
29	SFWMD	PBF-7U	1447	1200	UF
30	Private	SLF-14	1286	318	LF
31	Private	SLF-21	707	156	UF
32	Private	SLF-62B			UF
33	Private	SLF-69			UF
34	SFWMD	SLF-74	1450	1088	LF
34	SFWMD	SLF-75	700	480	UF
34	SFWMD	SLF-76	860	790	UF
35	Utility	United Technology_ MW-WEDIP2A_ Lower	2050	1958	LF
35	Utility	United Technology_ MW-WEDIP2A_ Upper	1237	1006	UF
36	Utility	Ft. Lauderdale WWTP MW-1 (G-2331) Zone1	1072	1021	UF
36	Utility	Ft. Lauderdale WWTP MW-1 (G-2331) Zone2	1562	1466	UF
36	Utility	Ft. Lauderdale WWTP MW-1 (G-2331) Zone3	2705	2632	LF

On-line Campbell
On-line Trolll
On-line Soon (Campbell installed)
Fate Uncertain (attempting)

Conclusions

- Floridan Aquifer is a Viable Alternative Water Supply Source in the UEC
- Greater Uncertainty
  - Aquifer Productivity
  - Changes in water quality over time
  - Careful planning, testing, and conservative well spacing required
- Costs will be higher than traditional sources

Questions?

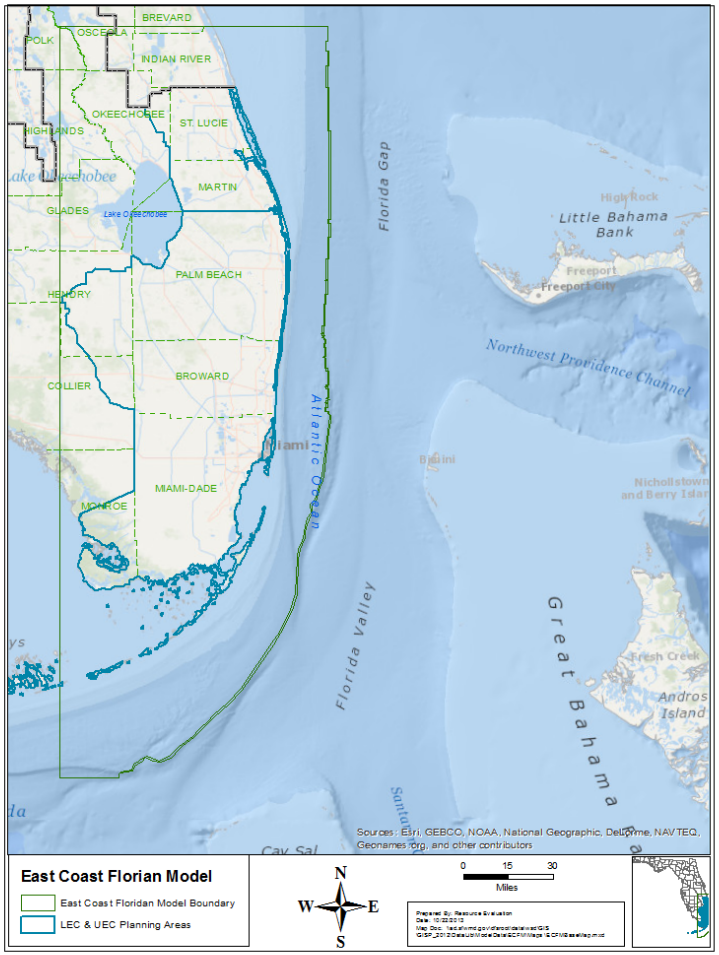


Upper East Coast Floridan Aquifer Modeling Meeting
Stuart, Florida
June 26, 2014

Jeff Giddings, Principal Scientist
Resource Evaluation, SFWMD

Presentation Outline

- Model Overview
- Model Development
- Peer Review Comments
- Model Calibration
- Pumpage Uncertainty
- Final Steps

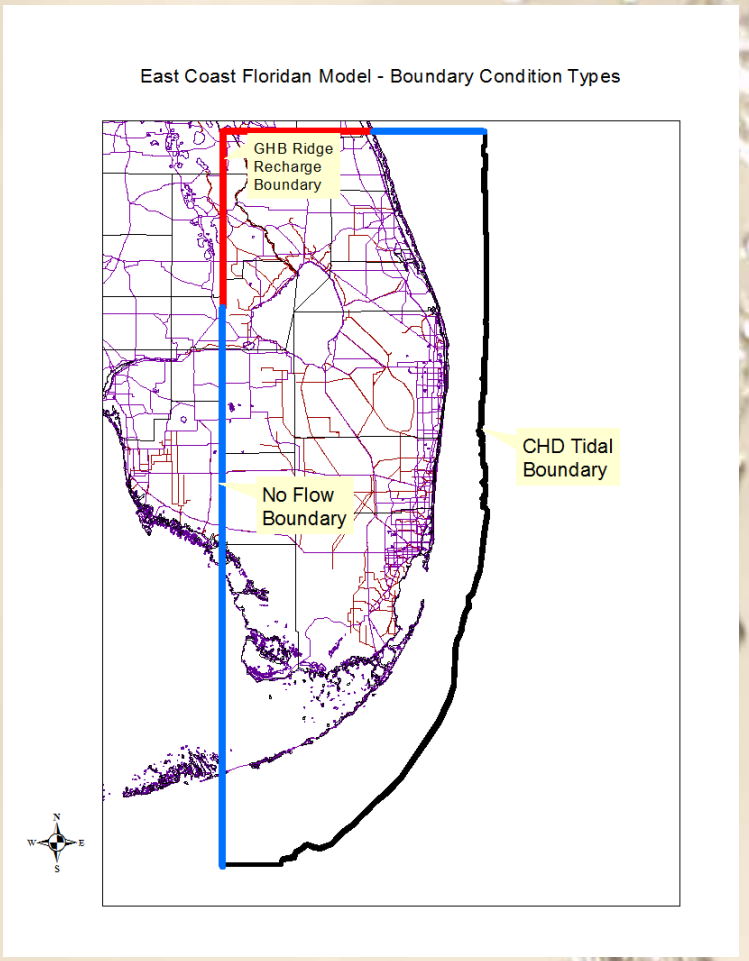


East Coast Floridan Model Implementation Team

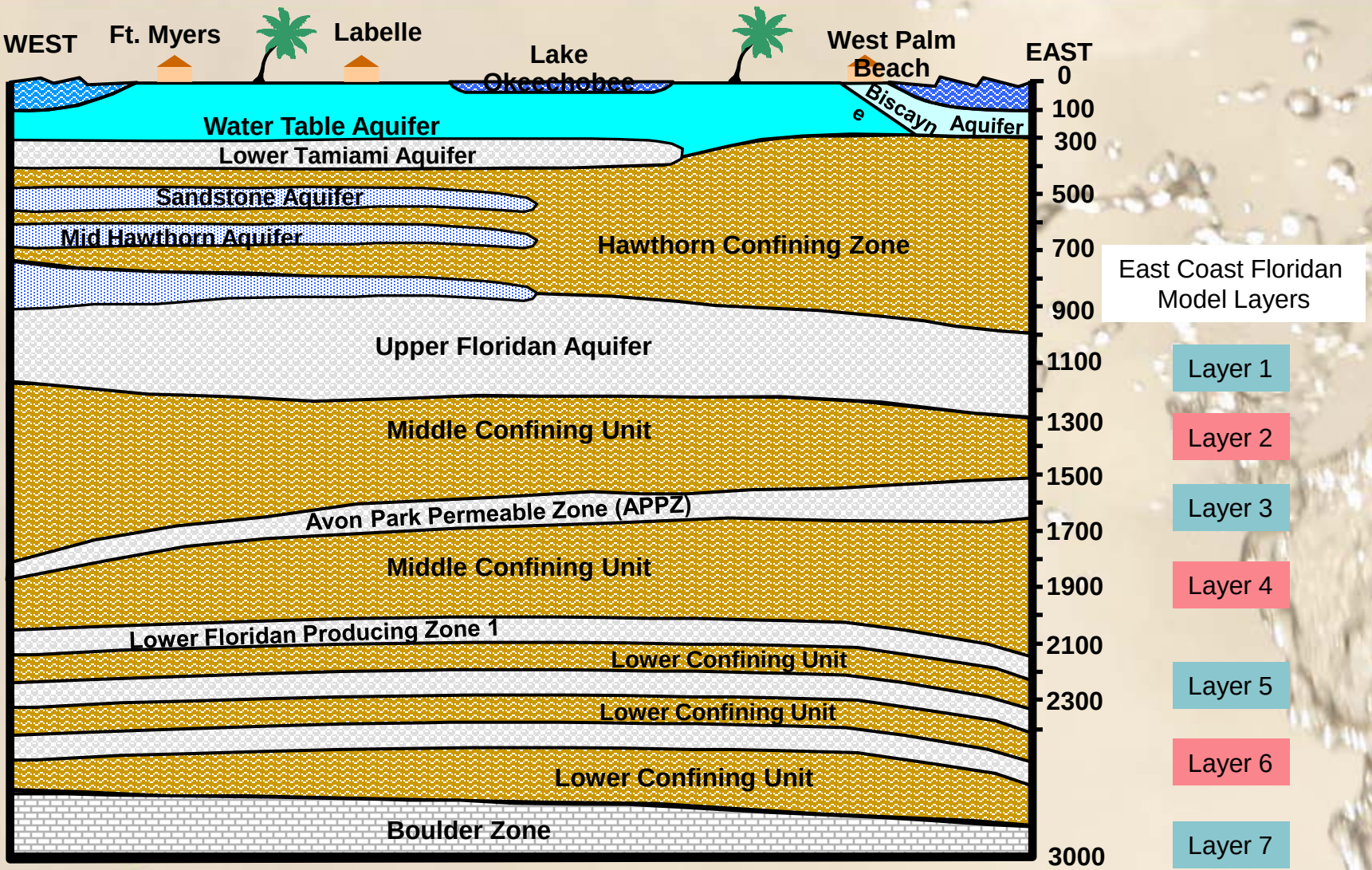
- Jeff Giddings, Principal Scientist
- Angela Montoya, Lead Engineer
- Ligia Jurado, Engineering Specialist II

Model Overview

- Cell Size: 2,400 ft X 2,400 ft
- Calibration – 1989 to 2012
- Monthly Simulation Periods
- Vertical Extent: Upper Floridan Aquifer (Layer 1) to the Boulder Zone (Layer 7)
- Water Quality included
- Boundary Conditions



East Coast Floridan Model Layers



Model Development -- A Process

1) Phase I (Lower East Coast) – 2006
2) Phase II (Lower and Upper East Coast) – October 2008
3) Independent Peer Review – June 2011
4) Strategy to implement peer review comments – Spring 2012
5) Steady-State Model Completion with Peer Review revisions – December 2013
6) Transient Model Completion with Peer Review revisions – Spring 2014

Primary Peer Review Comments

1) Develop a steady-state model and also a 20-year transient model.

2) Use automated and manual calibration techniques where appropriate.

3) Calibration of water quality to generalized categories of fresh, brackish and saline conditions.

4) Provide calibration plots including residuals and scatter diagrams

5) Calibration to inflows (volume) targets

Peer Review Comments (cont'd.)

6) Use literature values for porosity and dispersivity, if appropriate.

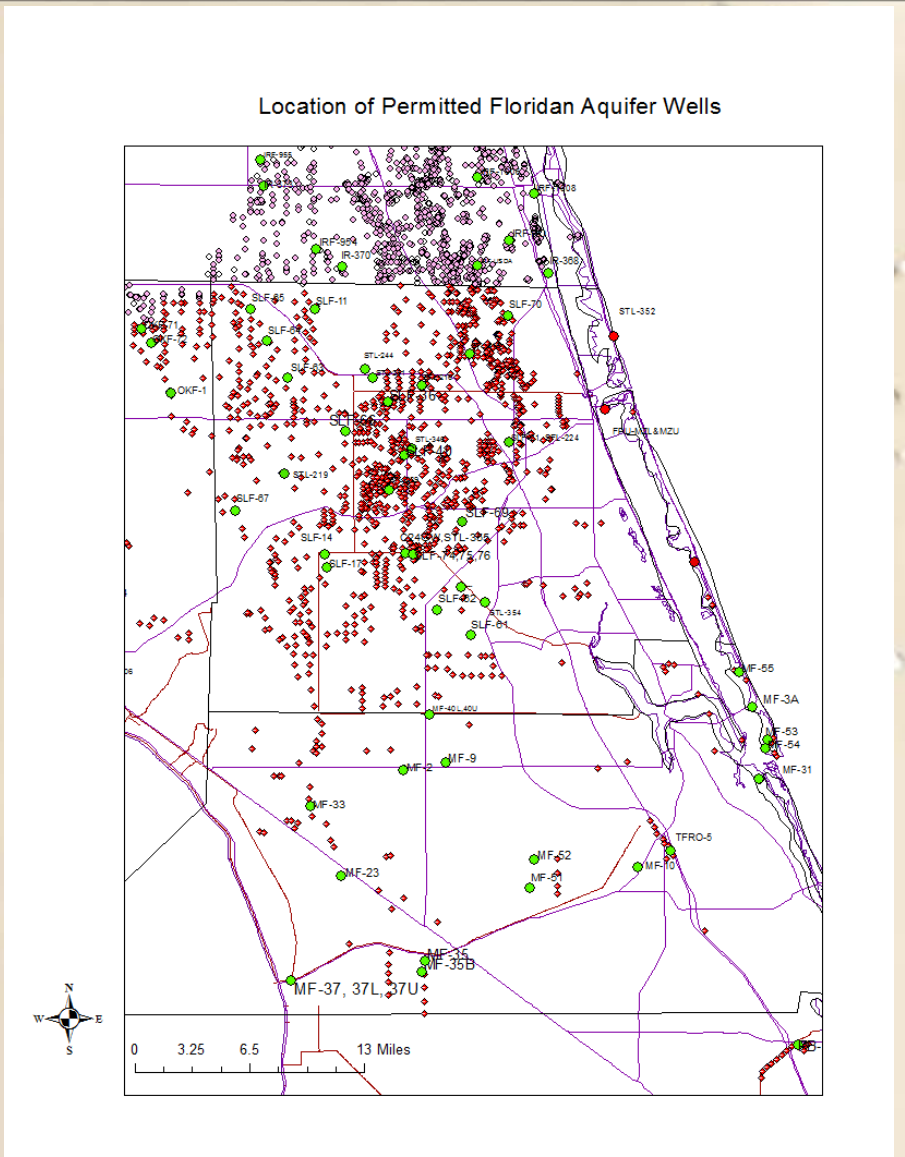
7) Include recharge areas in Polk County through grid rotation and/or model expansion.

8) Reduce model execution time.

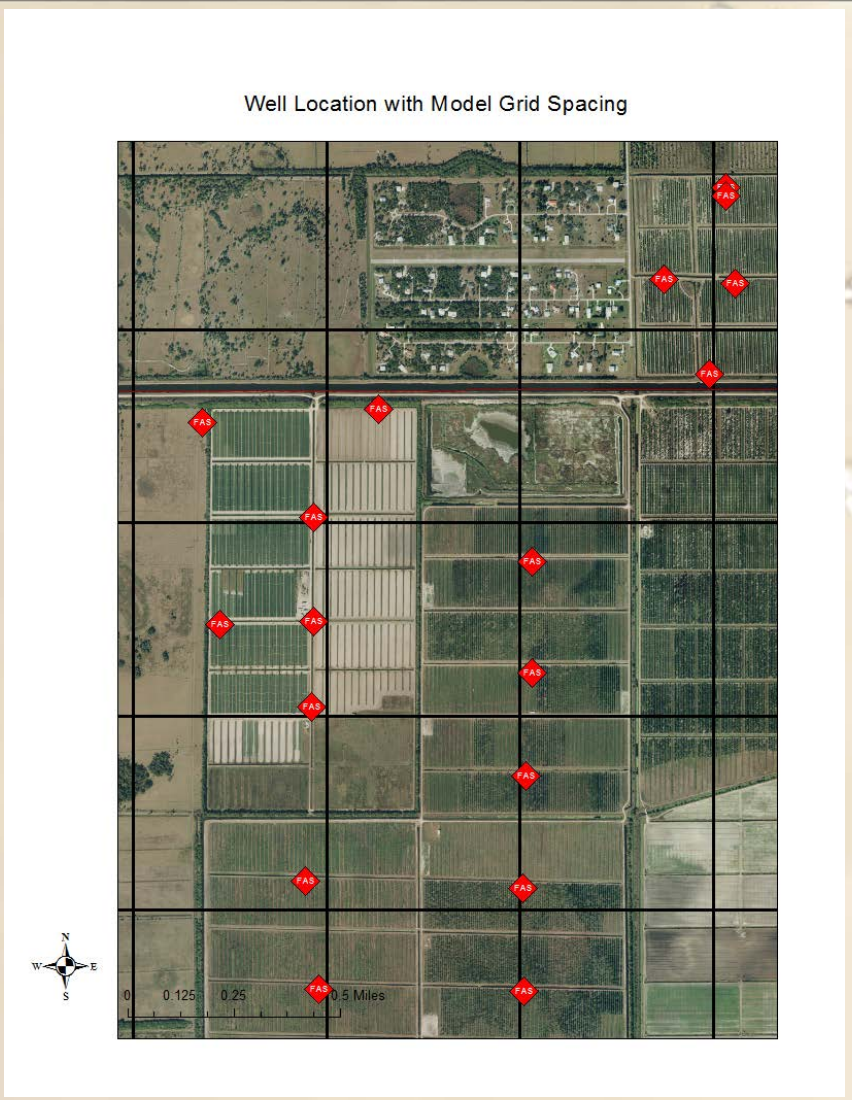
9) Work with users to collect additional data during well construction.

10) Prepare User's Manual.

Location of Floridan Aquifer System Wells

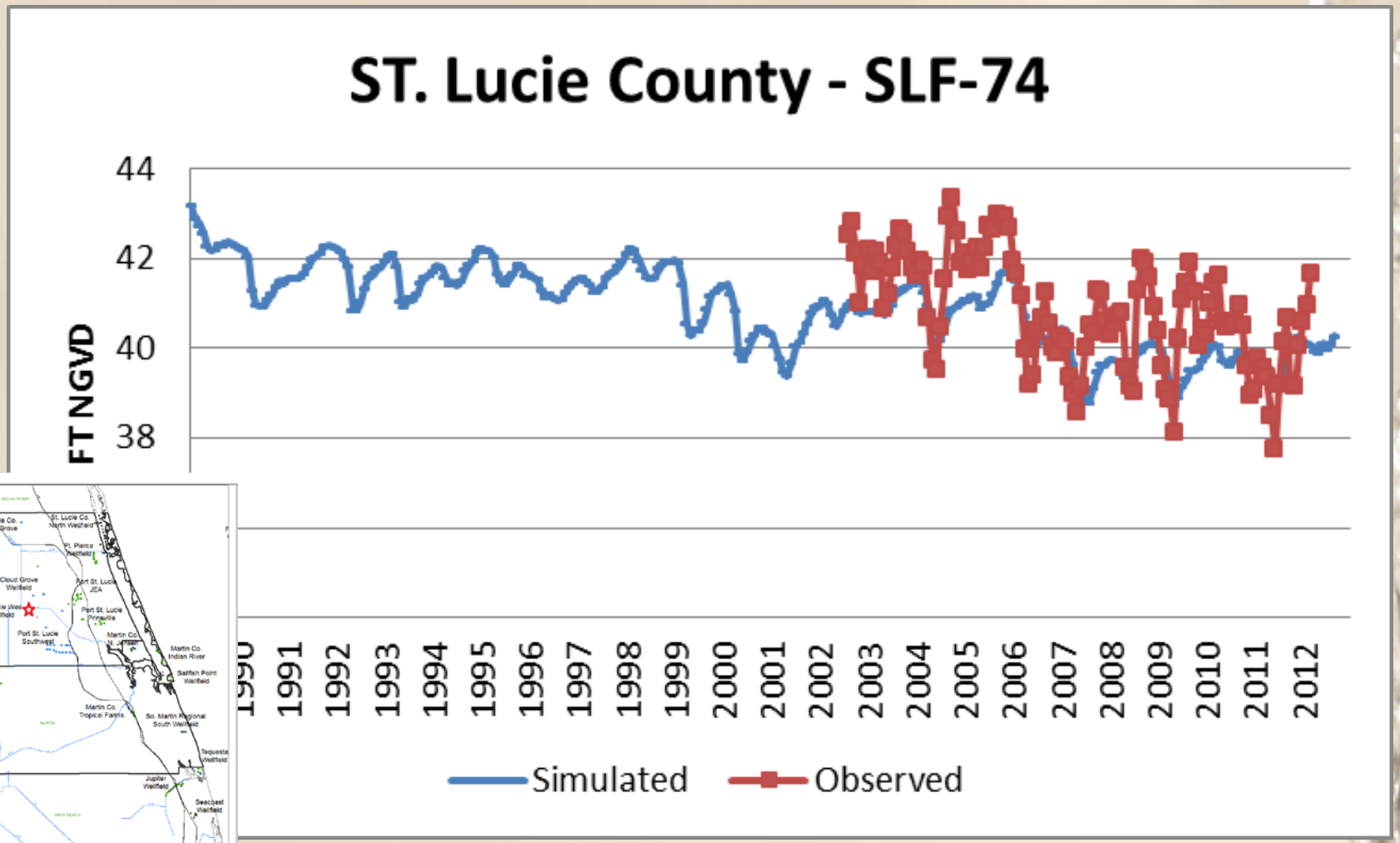


Well Spacing and Model Grid Size

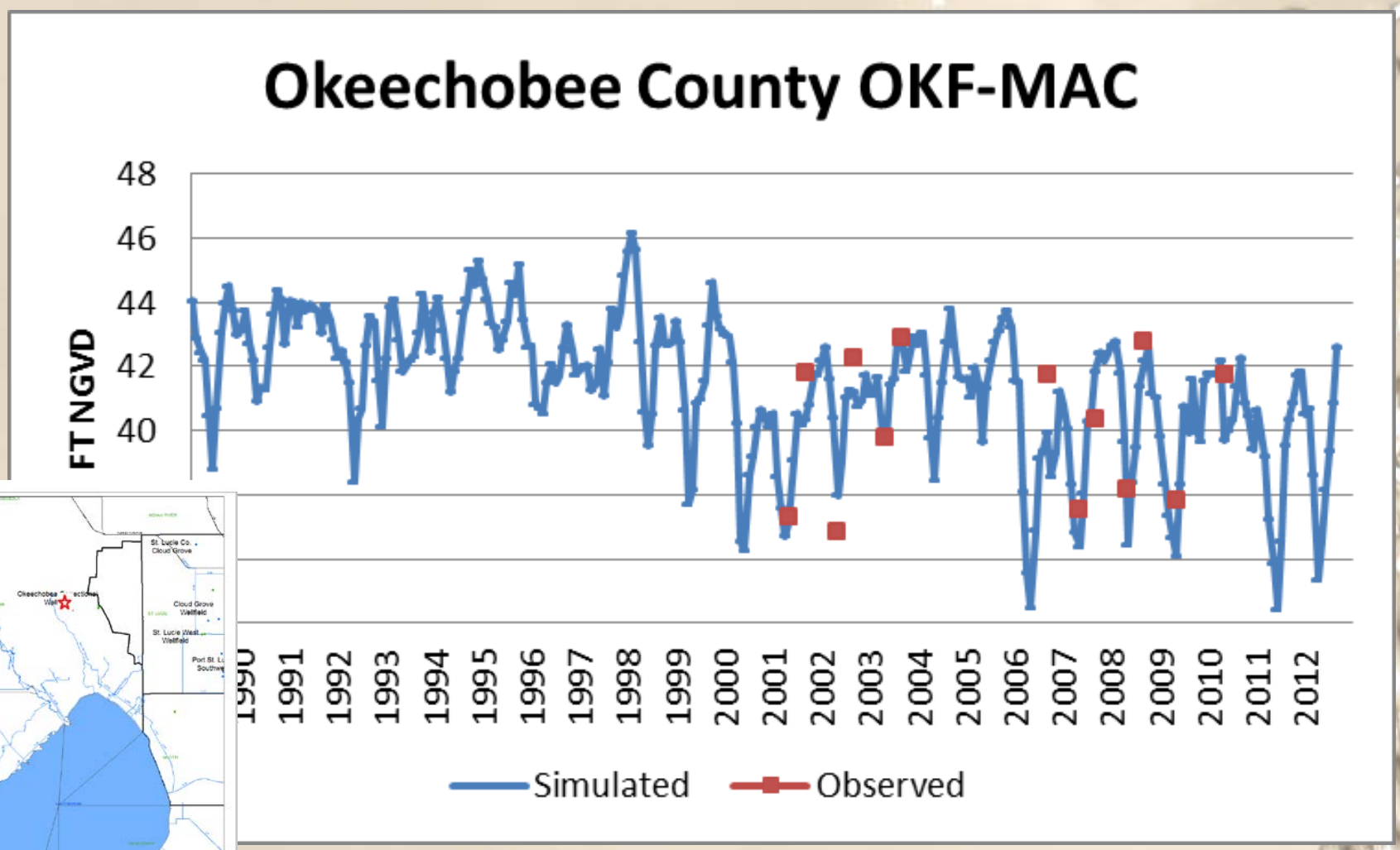


Water Level Calibration

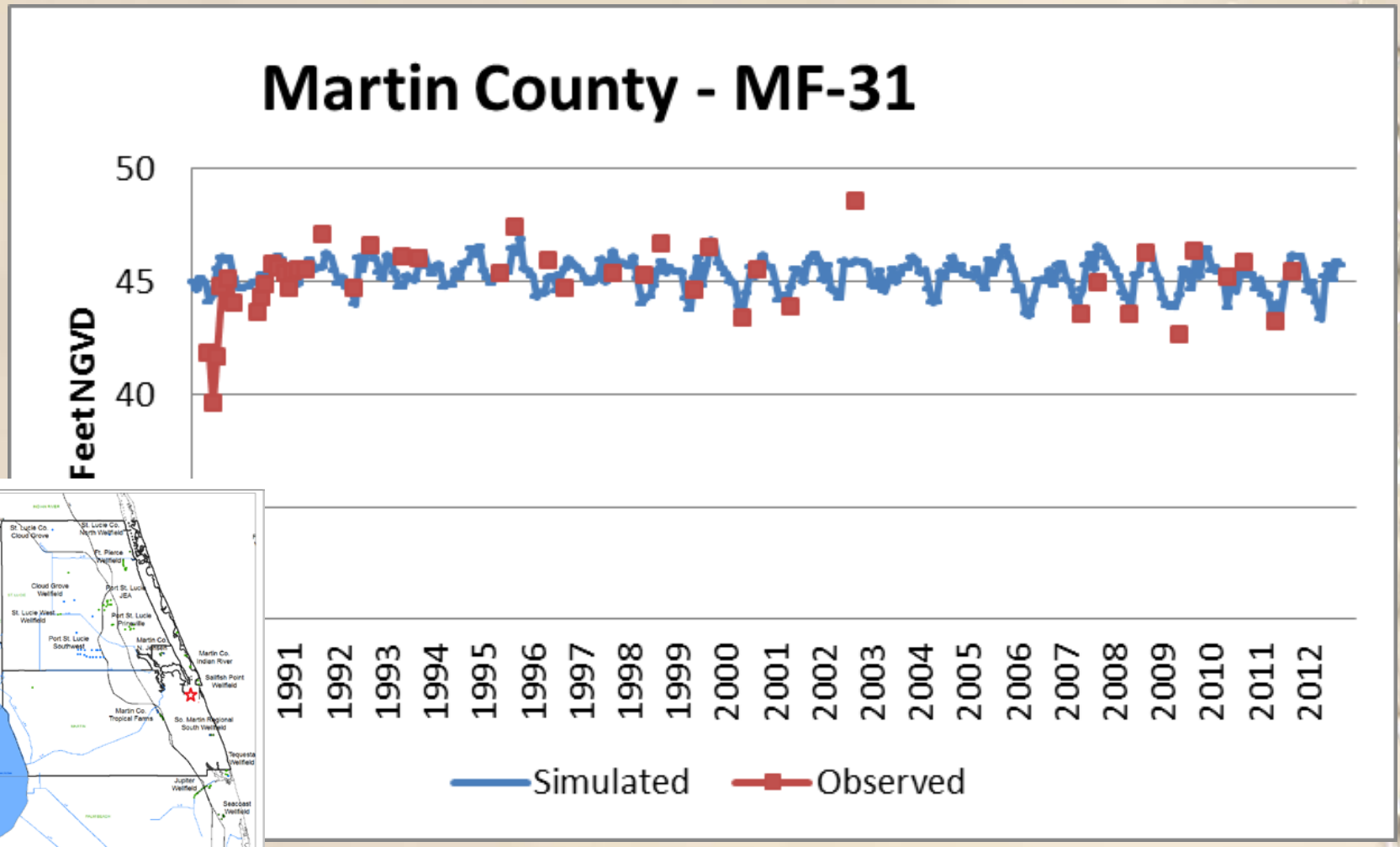
Water Level Response – St. Lucie County



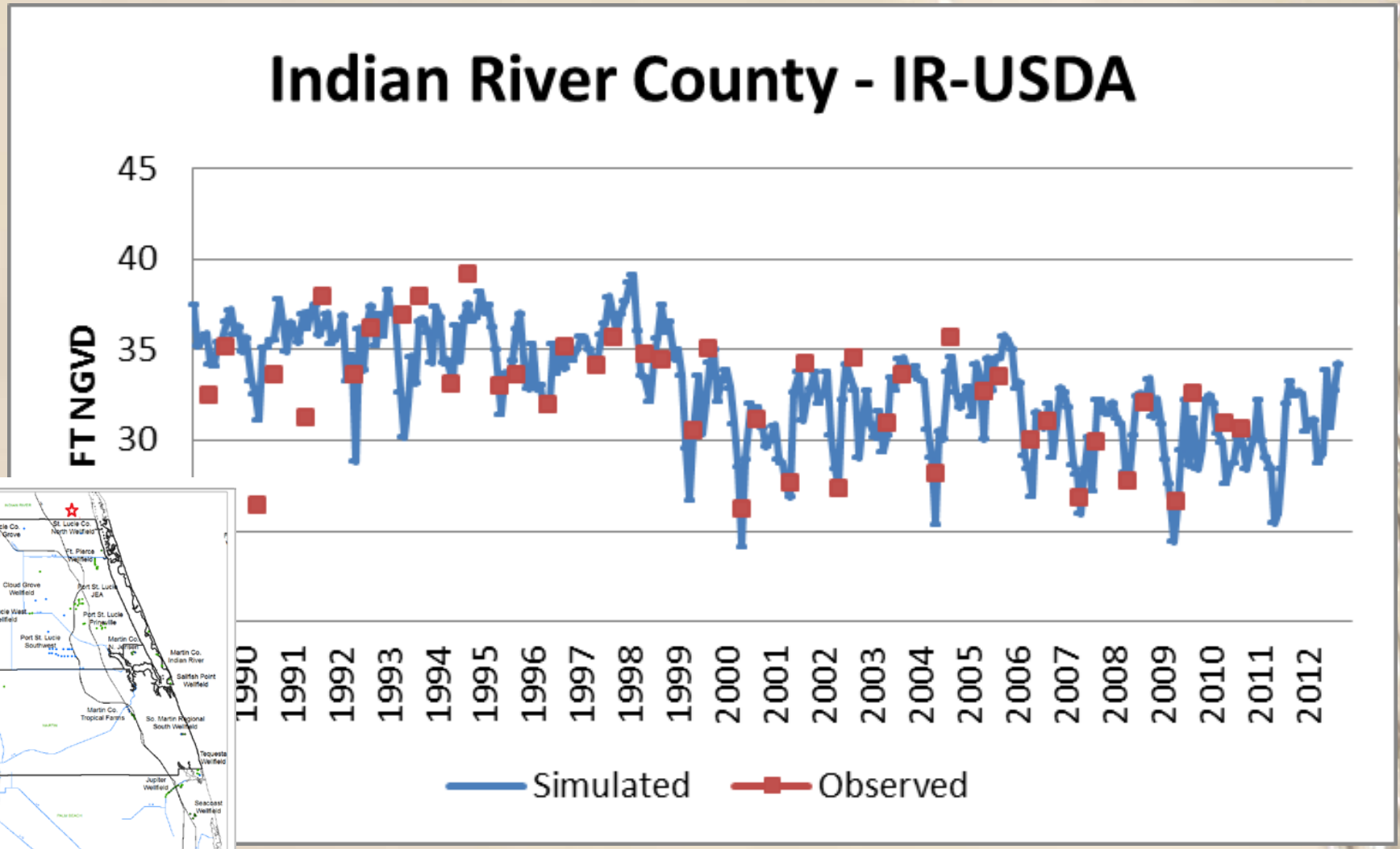
Water Level Response – Okeechobee County



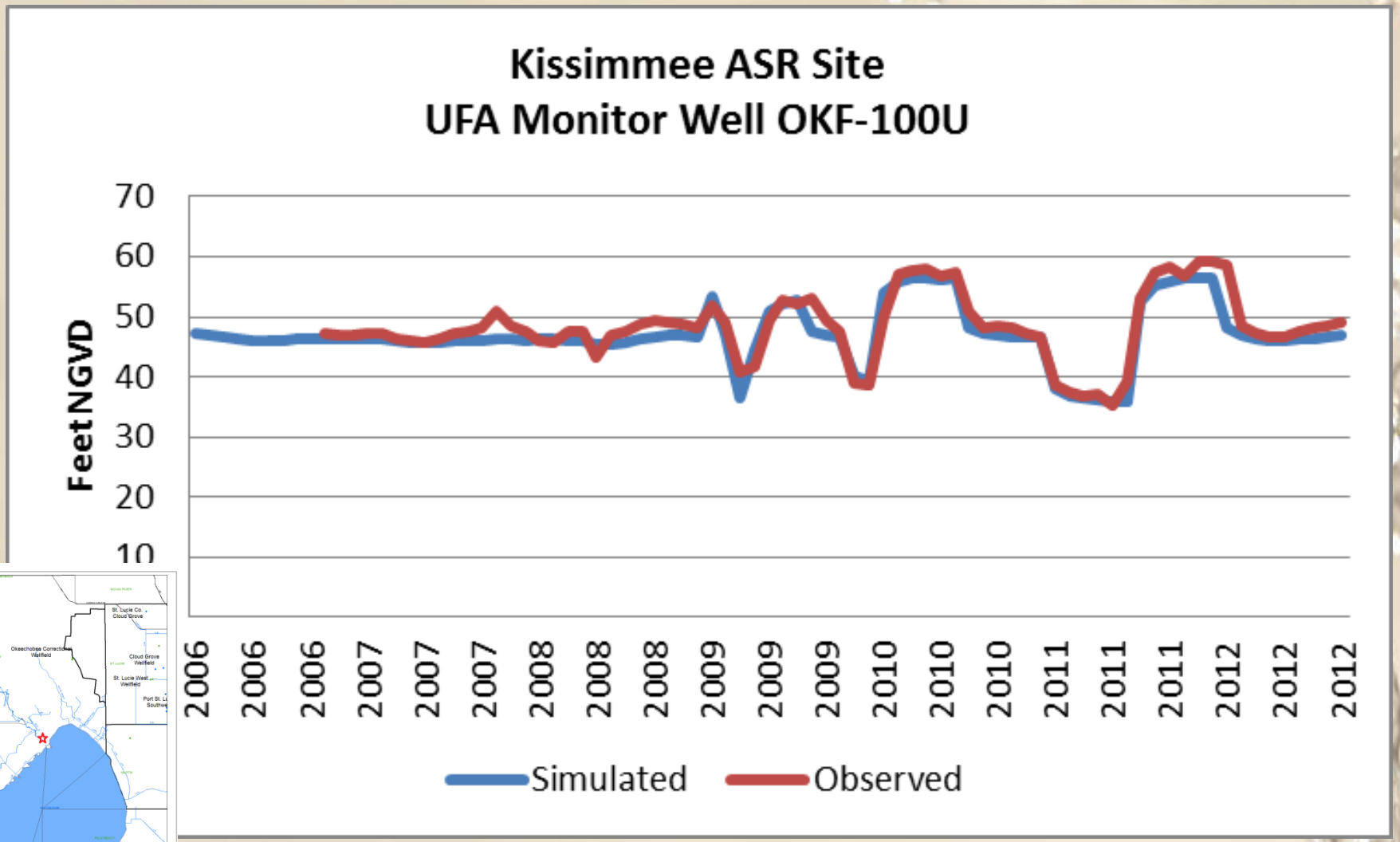
Water Level Response – Martin County



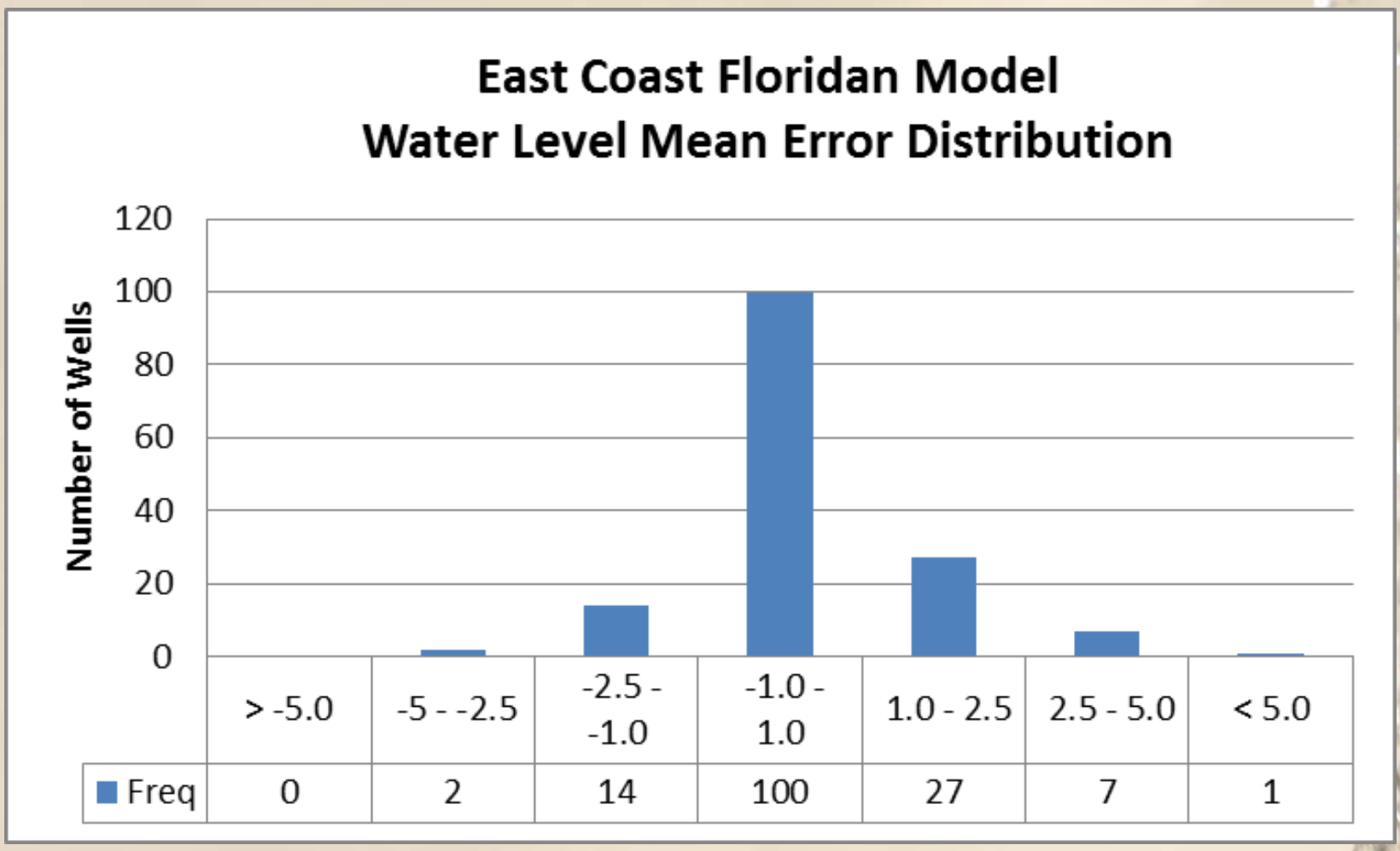
Water Level Response – Indian River County



Water Level Response – Kissimmee River Aquifer Storage and Recovery Pilot Project

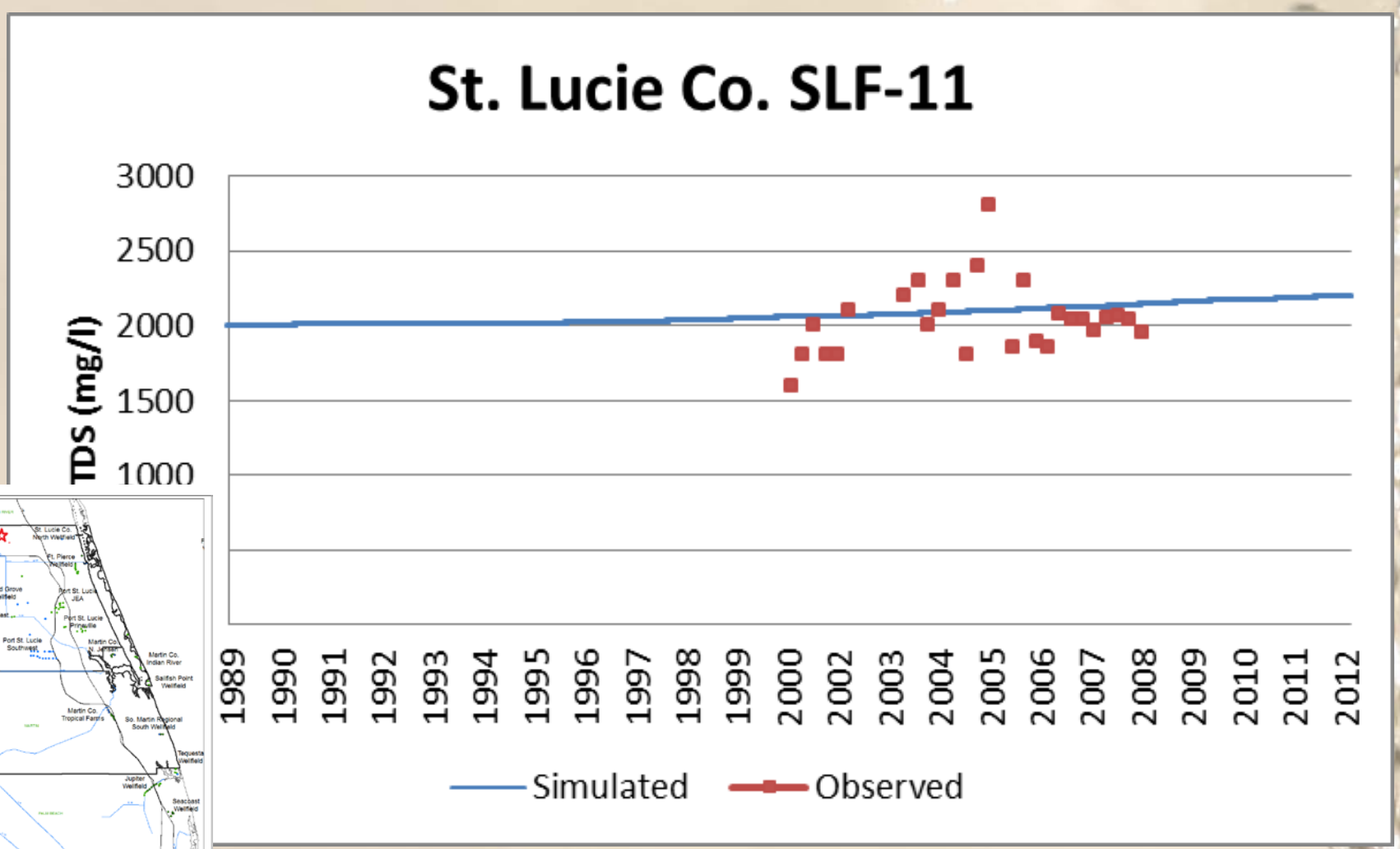


Overall Water Level Model Calibration Performance

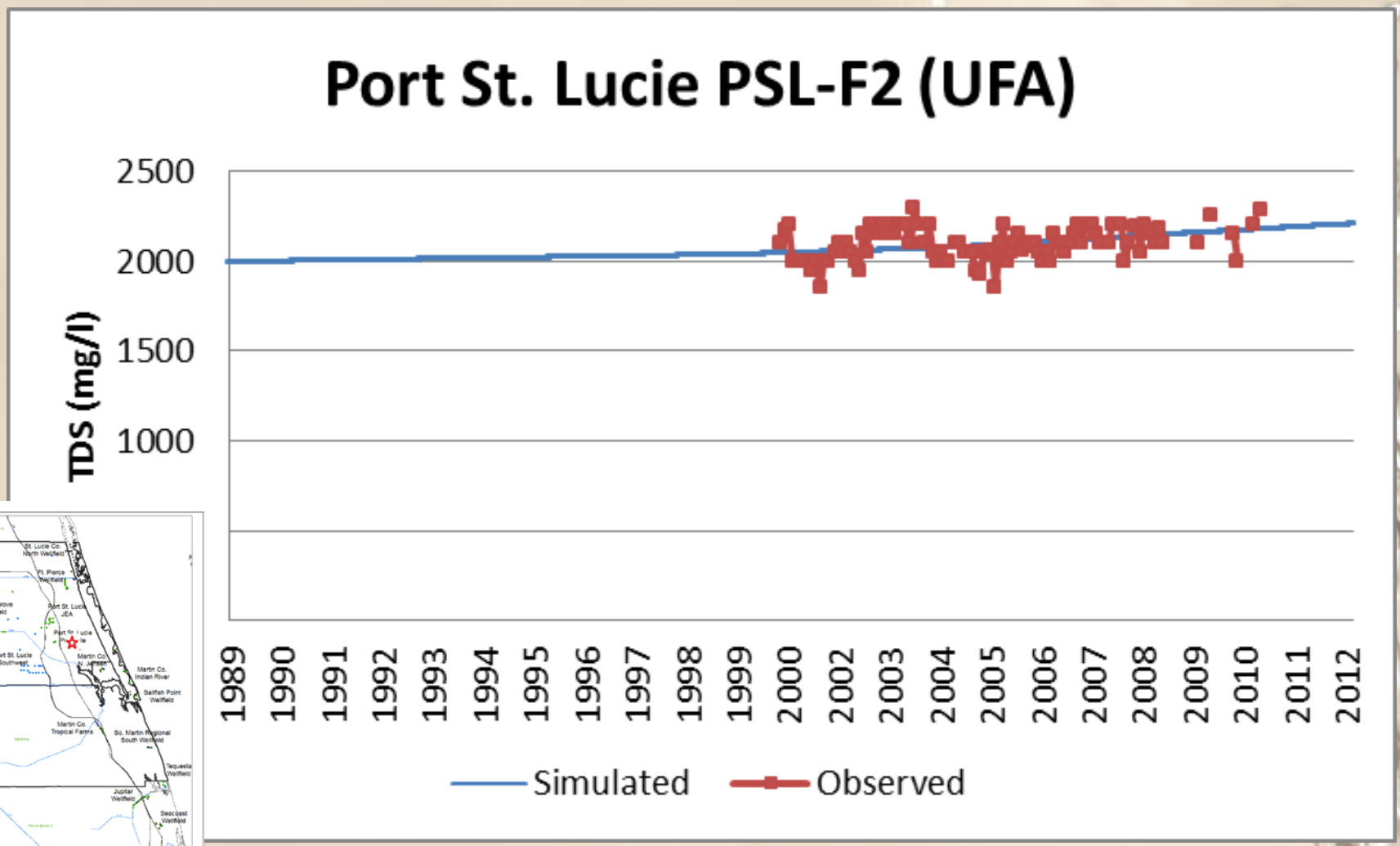


Water Quality Calibration

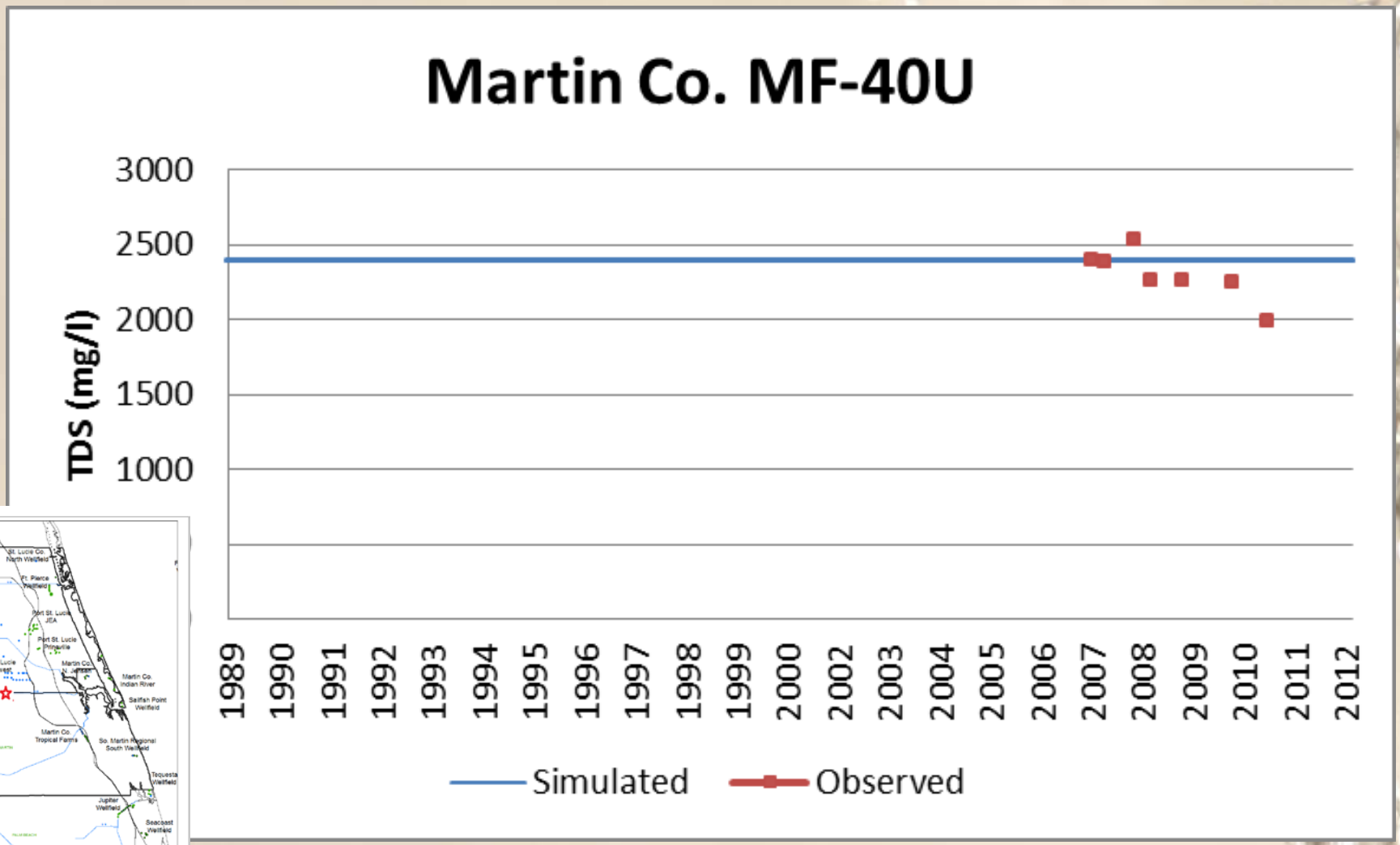
Water Quality Response – St. Lucie County



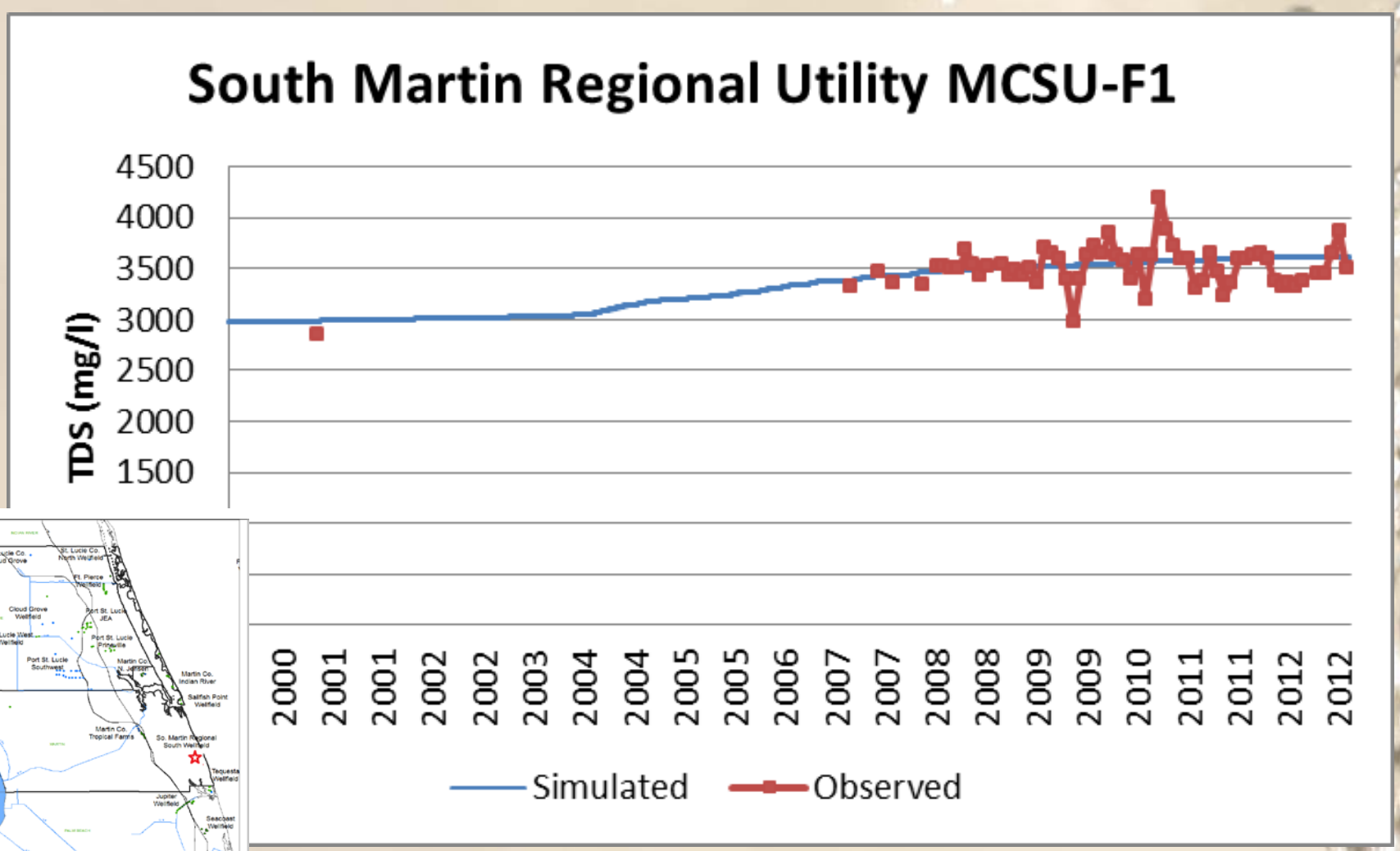
Water Quality Response – St. Lucie County



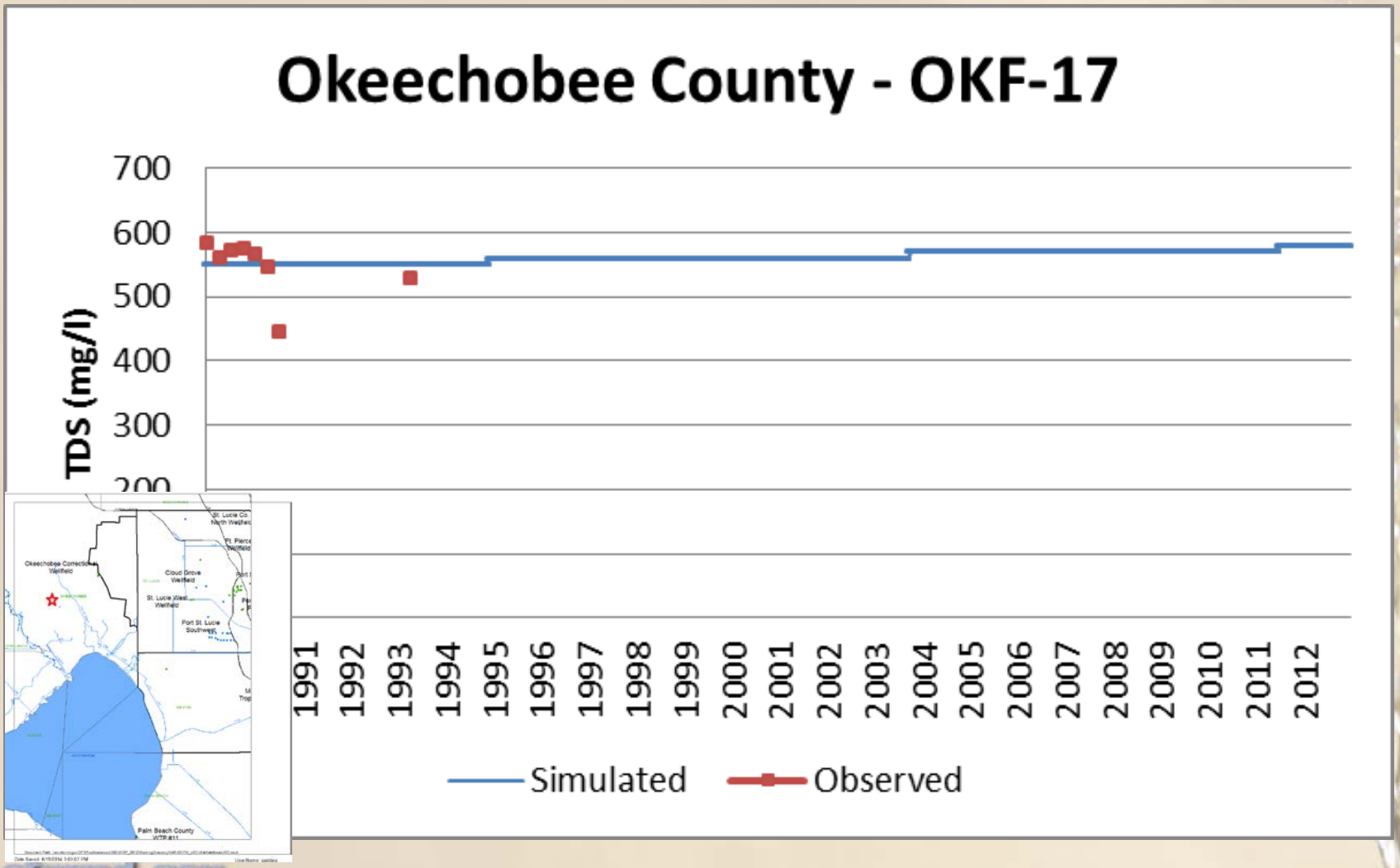
Water Quality Response – Martin County



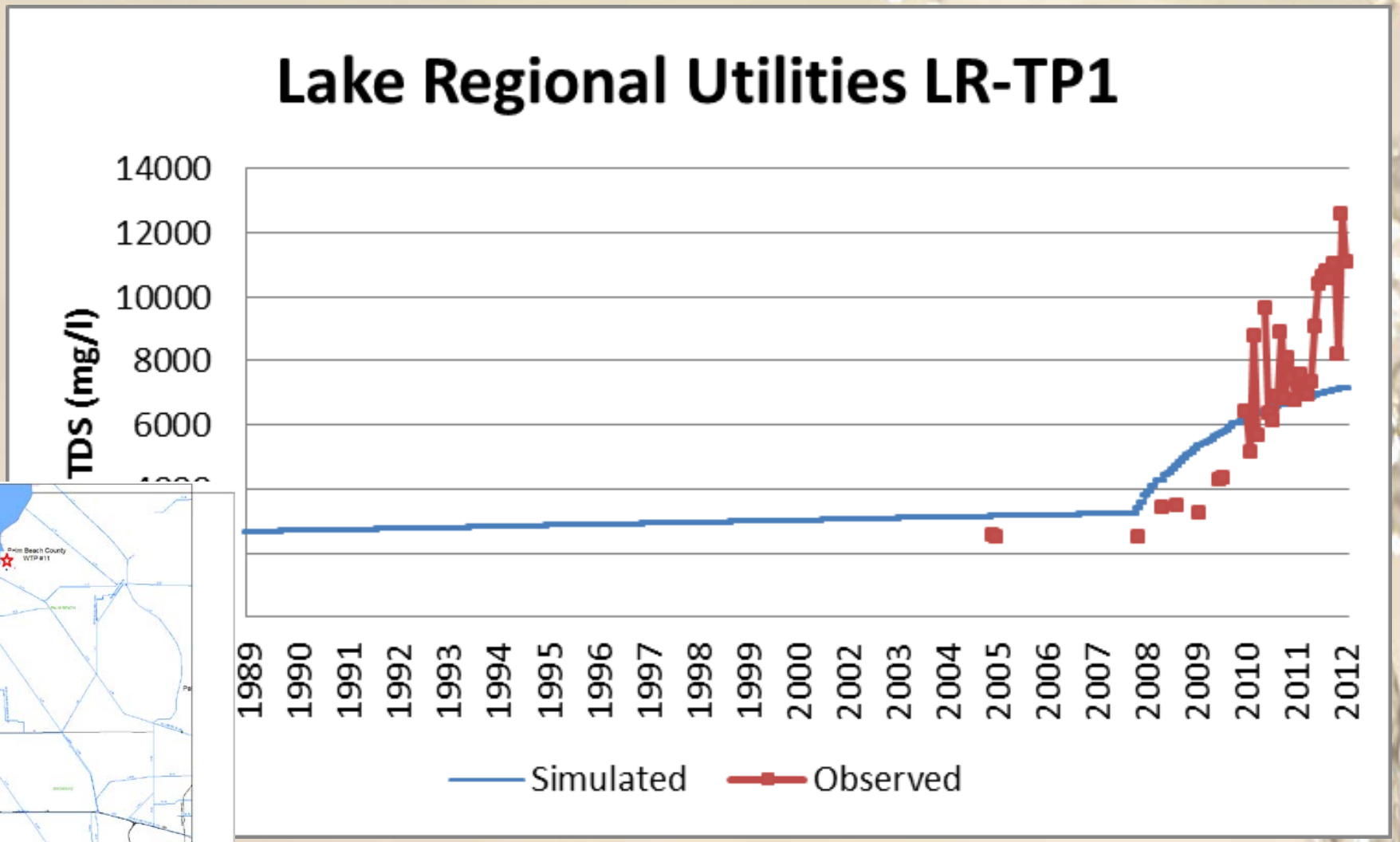
Water Quality Response – Martin County



Water Quality Response – Okeechobee County



Water Quality Response – Palm Beach County



Floridan Aquifer System Pumpage Uncertainty

- High degree of confidence in modeled Public Water Supply withdrawals – submittal of monthly pumpage is a permit requirement of both Florida Department of Environmental Protection and the District for many years.
- Moderate degree of confidence in modeled commercial and industrial uses. Demands are generally well known at time of permit issuance and are normally consistent and/or predictable.

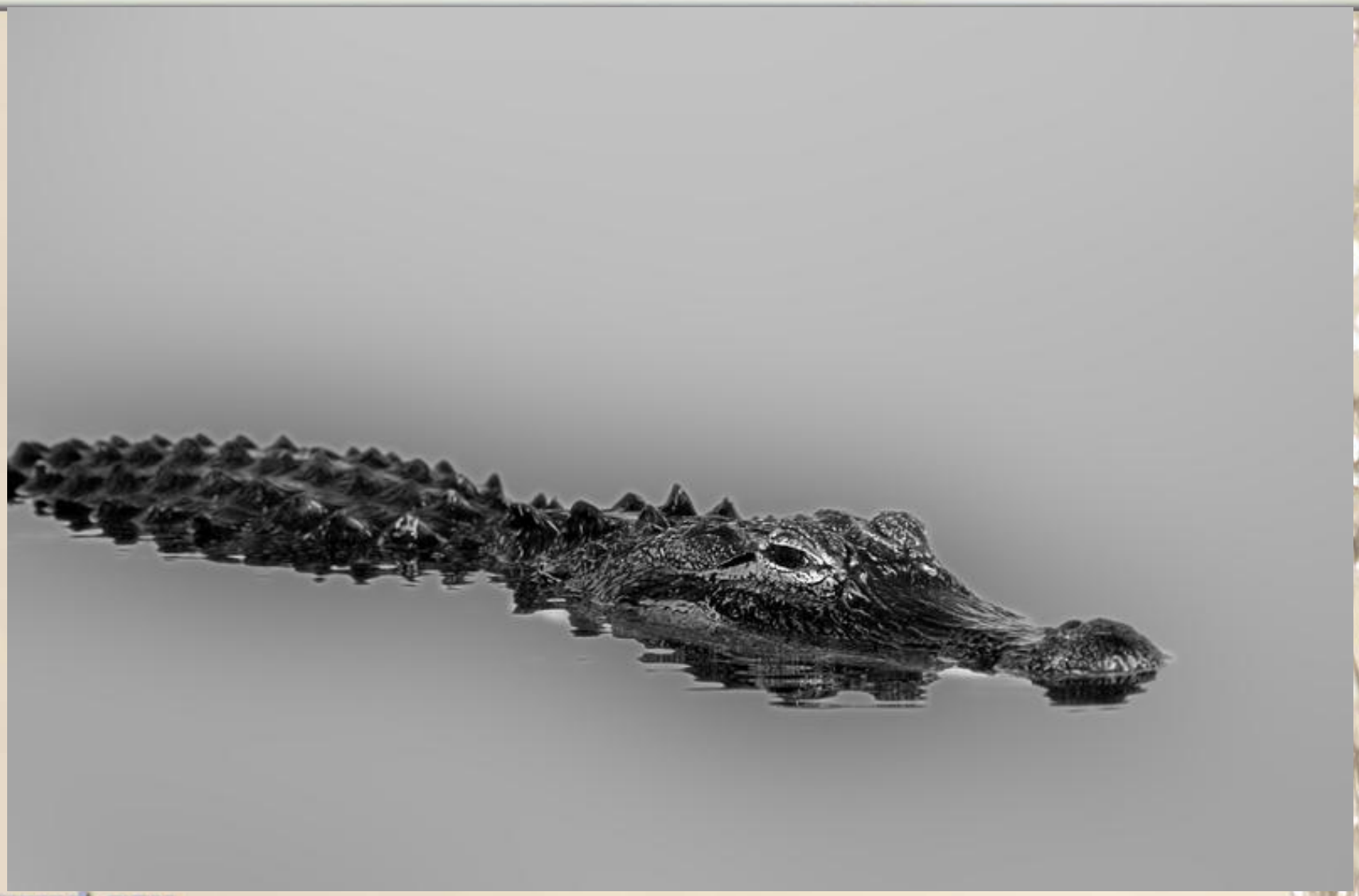
FAS Pumpage Uncertainty - Irrigation

- All irrigation monthly demands are calculated from AFSIRS using observed climatic conditions. Irrigation demands can be further modified during calibration process to reflect site specific operations.
- Moderate degree of confidence for modeled irrigation demands that utilize the Floridan Aquifer System solely and fully operational.
- Lower degree of confidence for modeled irrigation demands that utilized a combination of surface water and Floridan Aquifer System.
- Additional uncertainty introduced for citrus operations resulting from damage or disease (when, where and how much).

Final Steps to Begin Upper East Coast Simulations

- Finalize population and irrigated acreage projections for base and future conditions.
- Adjust individual Public Water Supply demands between wellfields.
- Incorporate revised demands into the model
- Standardize model graphics.
- Complete Draft Model Documentation.

Questions?



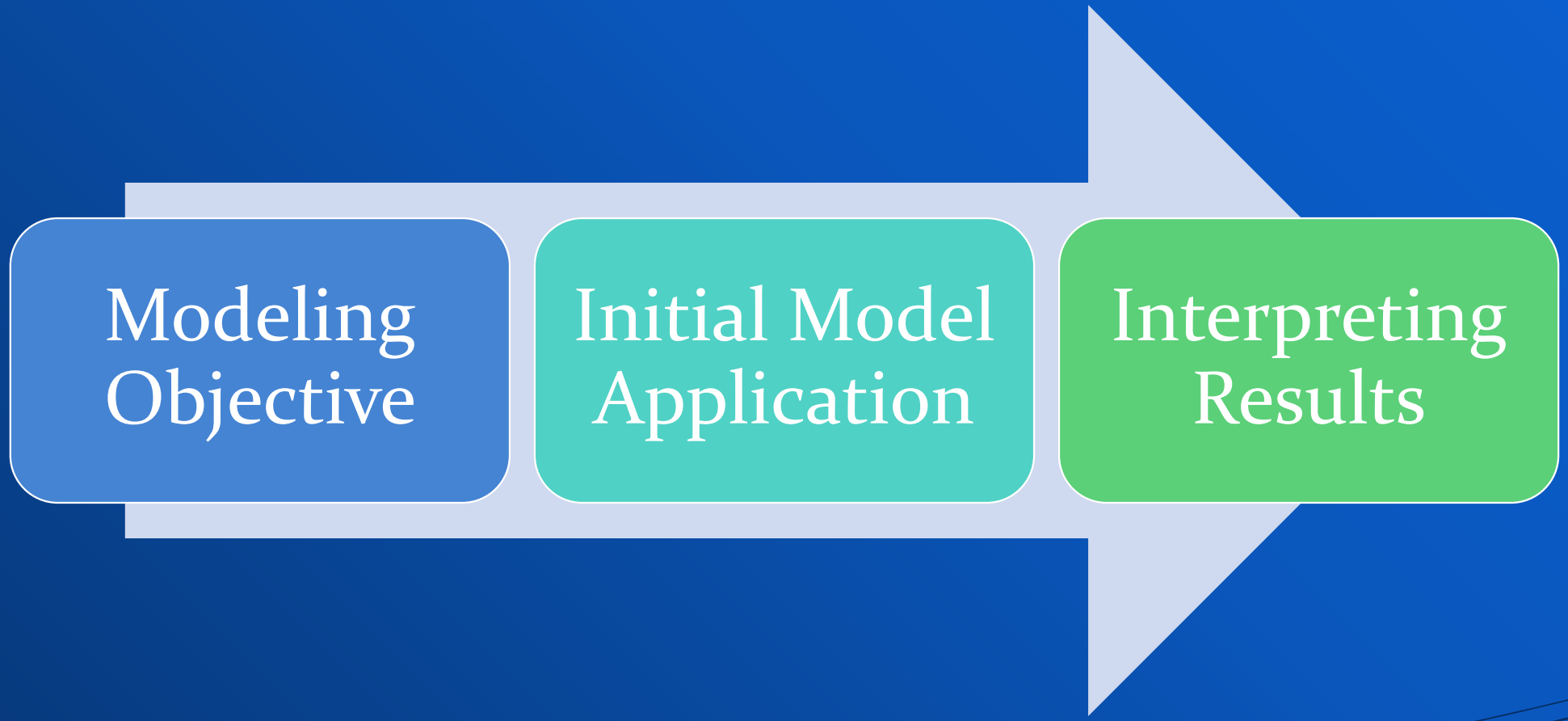
Model Application

John Mulliken
FAS Modeling Coordinator

UEC Modeling Kickoff Workshop, Stuart, FL

June 26, 2014

Getting Started



Draft FAS Modeling Objective for Upper East Coast

- *Conduct a regional-scale, planning-level evaluation of FAS as a water supply source*
- *Evaluate the potential of existing and proposed facilities to meet 2040 water demands*
- *Focus analysis on changes to water quality and water levels*
- *Consider the modeling results in UEC Plan Update process when determining if proposed FAS projects:*
  - Generally feasible
  - Have potential to meet projected demands

Draft Modeling Objective

The objective of modeling the Floridan Aquifer System (FAS) in the Upper East Coast planning region is to conduct a planning level evaluation of the potential of existing and future facilities to meet 2040 water demands from the FAS relative to 2013 facilities and demands. The analysis will focus on potential changes to water levels and water quality. The model results will be considered when determining whether proposed FAS projects are generally feasible and have the potential to meet projected needs.

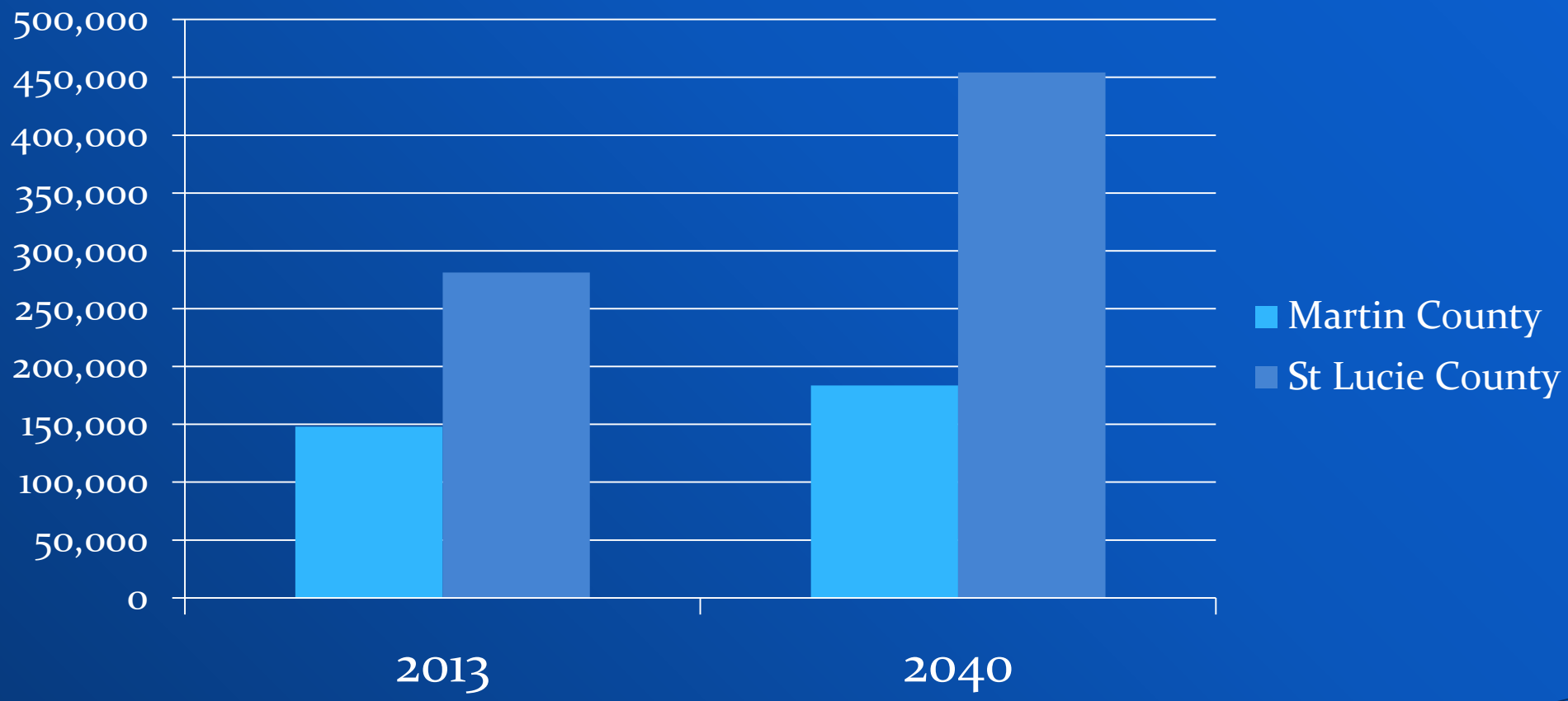
Preparing for Modeling

- *Establish base lines*
  - Current and Future Conditions
  - Planning horizon should be a minimum of 20 years
- *Proposed initial computer simulations*
  - Current Base Case – 2013
  - Future Base Case – 2040
- *Develop demand projections – all use categories*
  - Population growth, changes in agricultural acreage

Modeling Assumptions

- *Public Water Supply*
  - Distribution of population growth
  - Future Floridan use – new or expanded wellfields
  - Pumping protocols
  - Seasonal variations in water use
- *Agriculture*
  - Projected acreage by crop type
  - Seasonal variations in Floridan use
- *Other categories*
  - Changes should be consistent with population growth

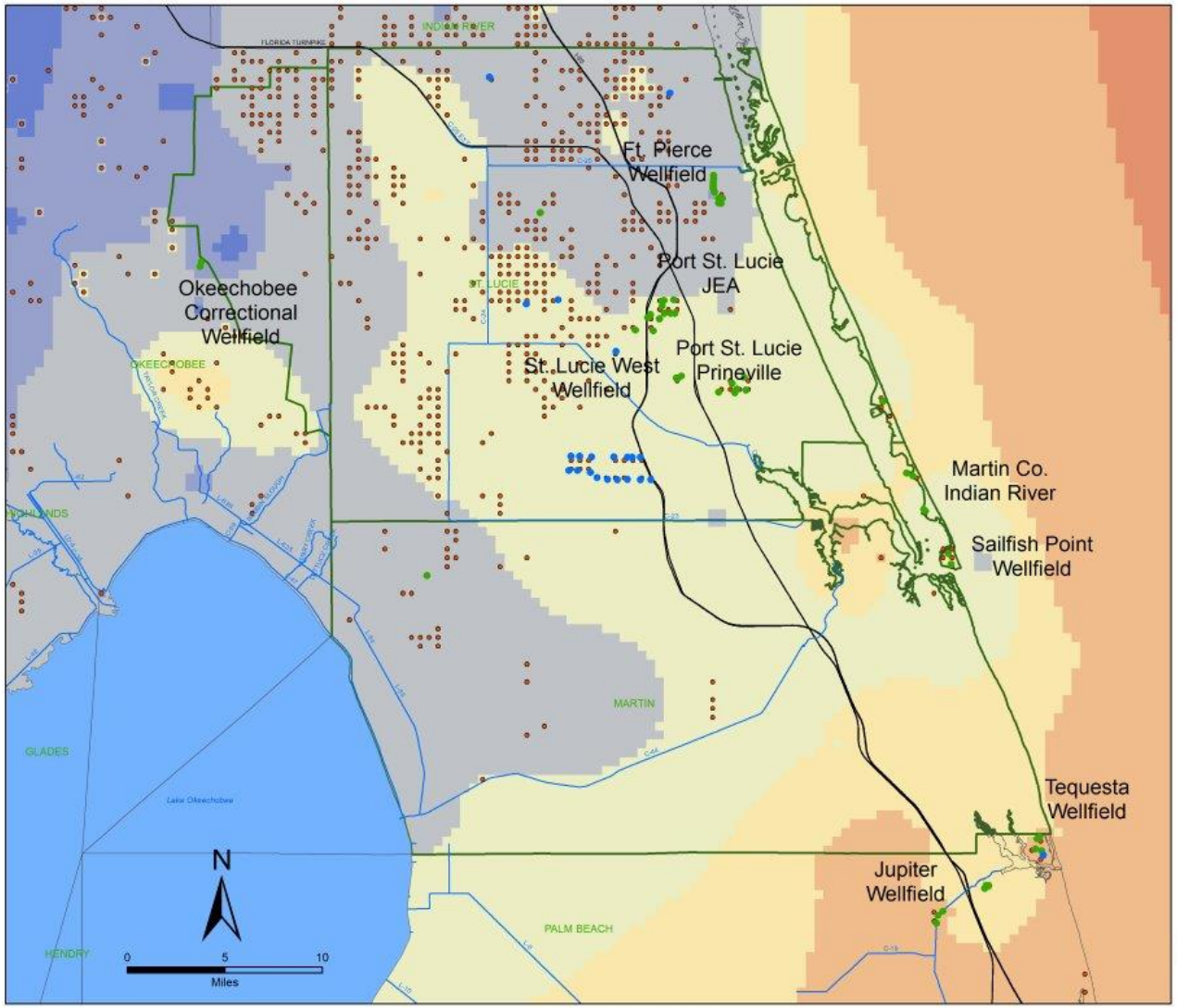
Population projections (2013-2040)



Interpreting Results

- *Relative comparisons between model runs*
  - 2013 Base Case
  - 2040 Base Case
- *Graphic representation of performance*
  - Show changes in water levels
  - Display differences in water quality (Total Dissolved Solids)
  - Illustrate variations in flow vectors (horizontal and vertical)

Conceptual Graphics – Water Quality



East Coast Floridan Model
Total Dissolved Solids
Current Base
Stress Period 8766

Layer 1 Floridan Wells

Well Status

- Existing PWS
- Proposed PWS
- Model Well locations

Total Dissolved Solids

Concentration (mg/L)

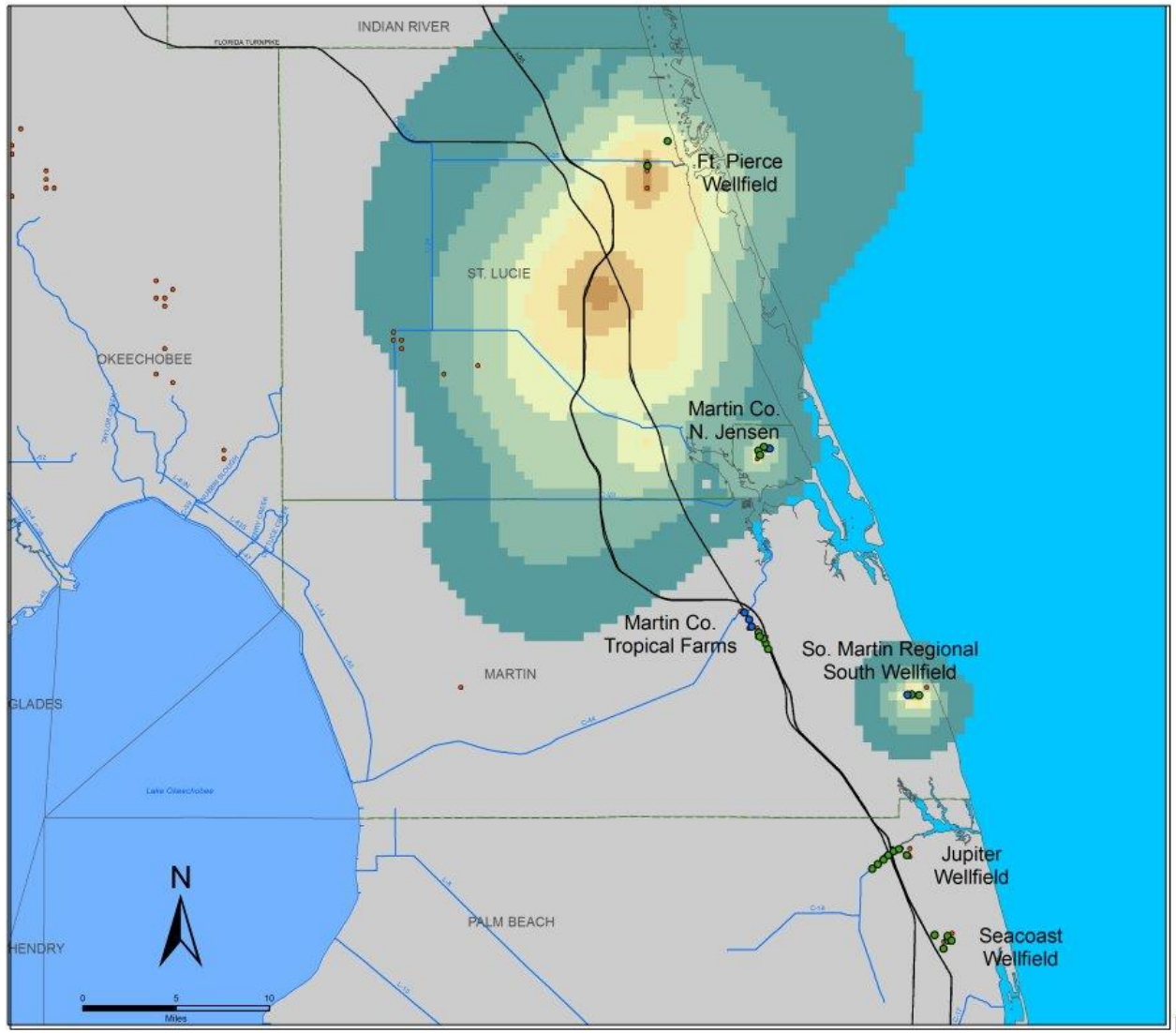
- 46 - 300
- 301 - 500
- 501 - 800
- 801 - 2,000
- 2,001 - 3,000
- 3,001 - 4,000
- 4,001 - 10,000
- 10,001 - 20,000
- 20,001 - 25,000
- 25,001 - 30,000

For Demonstration Purposes Only

User Name: krodberg
Date: 6/24/2014

Document Path: \\ad.sfwmd.gov\dfsroot\data\wsd\GIS\GISP_2012\WorkingDirectory\KAR\ECFM_UEC\TDSConceptMap.mxd

Conceptual Graphics – Water Levels



East Coast Floridan Model Head Differences

Future Base minus Current Base
Layer 3
Month 218 (2/28/2007)

East Coast Floridan Model

Layer 3 Floridan Wells

Well Status

- Existing PWS
- Proposed PWS
- Model Well Locations

Head Difference in Feet

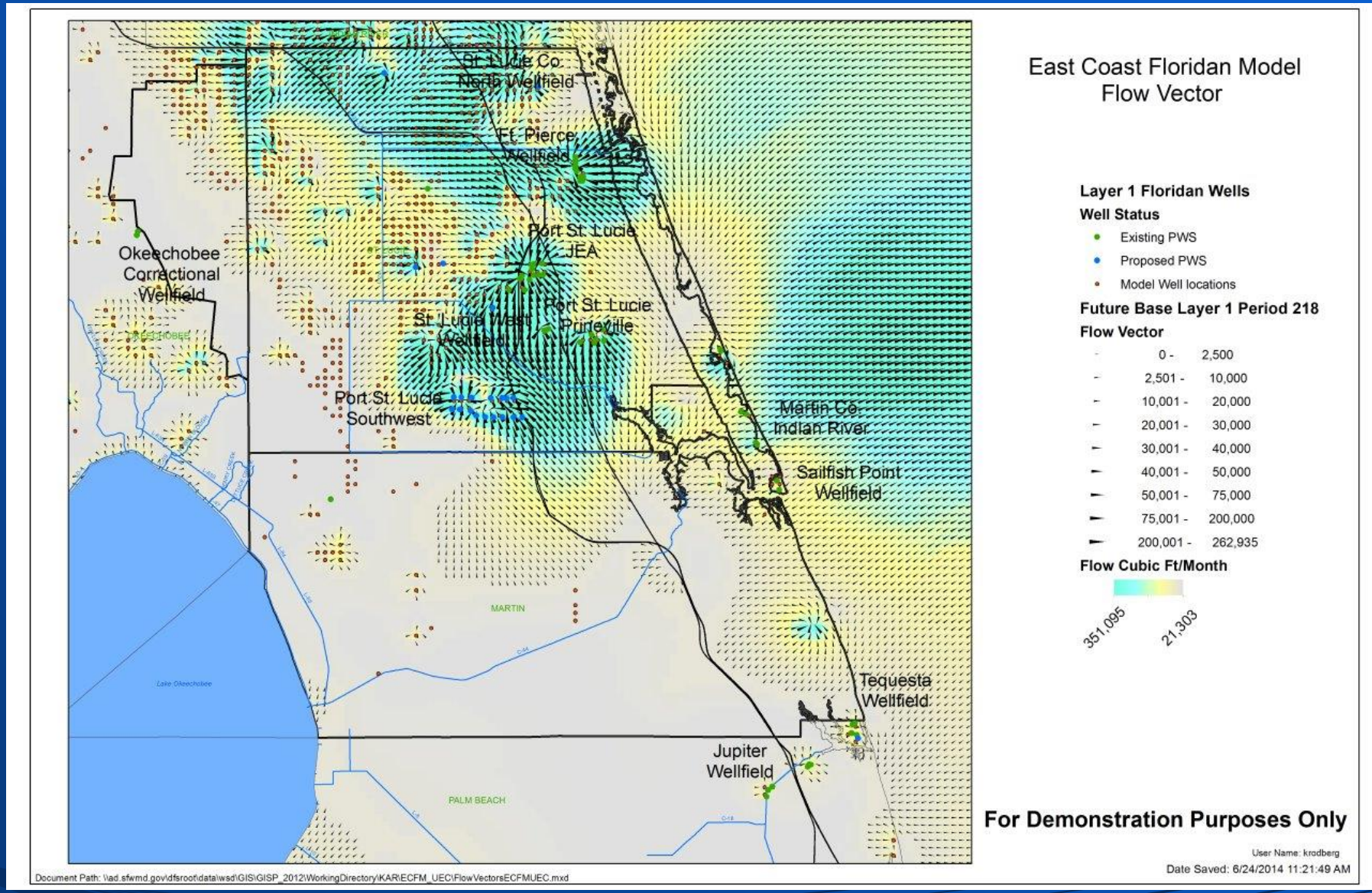
-21.4 -	-20.0
-19.9 -	-15.0
-14.9 -	-10.0
-9.9 -	-7.5
-7.4 -	-5.0
-4.9 -	-4.0
-3.9 -	-3.0
-2.9 -	-2.0
-1.9 -	-1.0

Minimal Change

For Demonstration Purposes Only

Prepared By: Kevin Rodberg
Date: 05/16/2014
Map Doc: \\ad.sfwmd.gov\dfsroot\data\wsd\GIS\GISP_2012\WorkingDirectory\KAR\ECFM_UEC\HeadDifference.mxd

Conceptual Graphics: Flow Vectors



Performance Indicators

- *Identify time periods (1989 – 2013) of interest*
  - Periods when C-23, C-24 and C-25 approached 14 feet
  - Significant rainfall deficits
  - End of simulation – cumulative impacts
- *Identify ranges of TDS or water level change that could be problematic for users*
- *Map areas of interest – wellfields, agricultural centers, commercial uses*

Please send comments by July 11, 2014 to:

John Mulliken
jmulls@sfwmd.gov

Office: 561-682-6649

Discussion

Next Steps

John Mulliken, FAS Modeling Coordinator
UEC Modeling Kickoff Workshop
June 26, 2014

Key Activities

- *Follow up on stakeholder suggestions*
- *Complete demand sets for all use categories*
- *Develop proposed assumptions for base cases*
- *Refine performance graphics*
- *Schedule Workshop #2 to finalize demands and assumptions*