ECFTX MODEL UPDATE

Thursday, August 15, 2019 1-4 PM

PEER REVIEW PANEL TELECONFERENCE

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Agenda

1. Introduction
2. Summary of work performed since December 2018
   a. Additional minor calibration in January-February 2019 to achieve meeting calibration criteria of 50 and 80% within 2.5 ft and 5 ft for CFWI area
   b. After meeting that criteria, ran the calibrated model and reduced withdrawals by 25 and 50% to examine head and flux changes to note any anomalous behavior
3. GHB Flux Issue
4. Revised Calibration and Scenario Run results
5. Schedule
6. Public Comment

CFWI HAT STATEMENT OF WORK FOR PEER REVIEW OF THE ECFTX

The principal reason for developing the ECFTX model is to provide a single model that can be used to assess the long-term availability of groundwater in support of water supply planning in the Central Florida Water Initiative (CFWI) area.

Following development and calibration, it is anticipated the model will be used to quantify changes in aquifer water levels, spring flows and river base flows in response to various planning and water management scenarios. These scenarios will involve quantifying effects of current and future withdrawals as well as understanding effects of different climatic regimes on groundwater availability.

<u>Overall appropriateness of model</u>

A. What are the model strengths
B. What are the weaknesses of the model?
C. Are there any deficiencies in the model?
D. Is the model suitable and defensible for the intended applications?

Peer Reviewer Scope of Work

Duties of Peer Review Panel:

- Conduct reviews of the conceptual model, calibration plan and products, model input datasets, sensitivity and documentation
- Evaluate the suitability of the model for water supply planning, scenario evaluation and groundwater availability predictions in the CFWI area
- Participate in meetings and workshops

Uses of ECFTX Model

Objectives of the HAT:

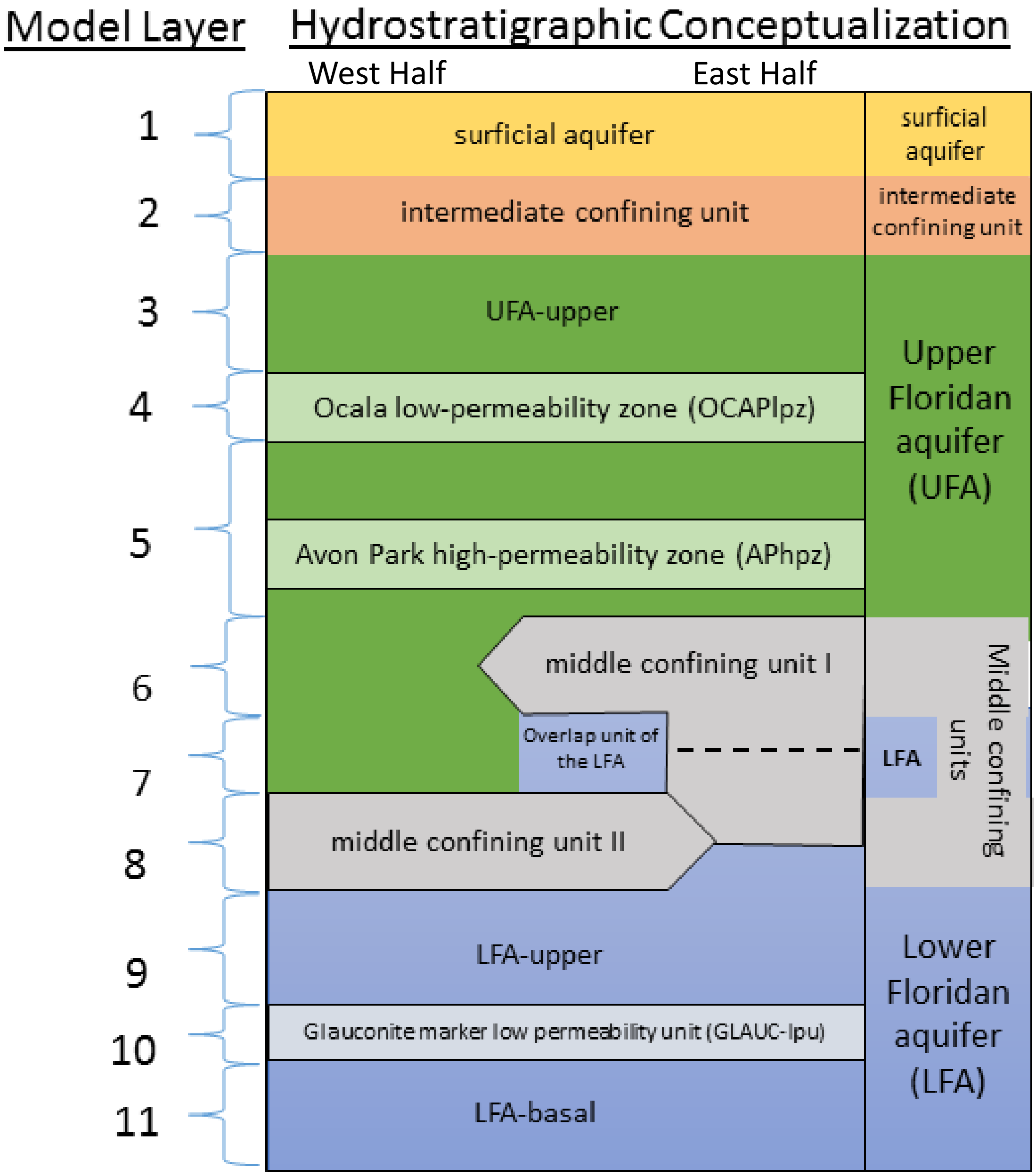
Provide the necessary modeling tools and data analysis, and work collaboratively with other CFWI teams to:

- Evaluate current and future availability of groundwater
- Assess future water supply and management strategies
- Develop processes to assess long-term effectiveness of management strategies
- Support collaborative water supply planning
- Support future regulatory actions

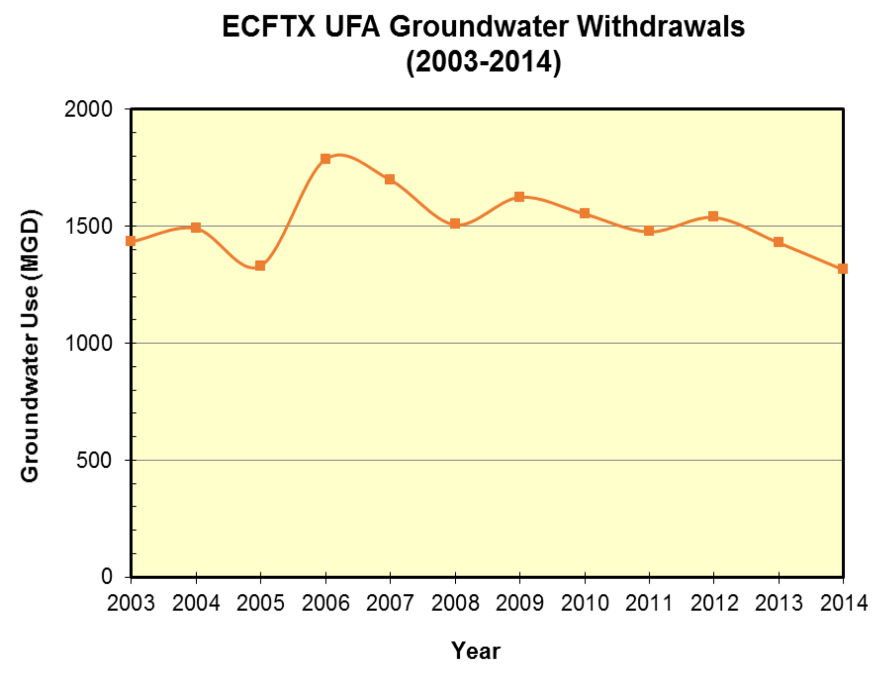
ECFTX Model Use to Support the 2020 Planning Effort

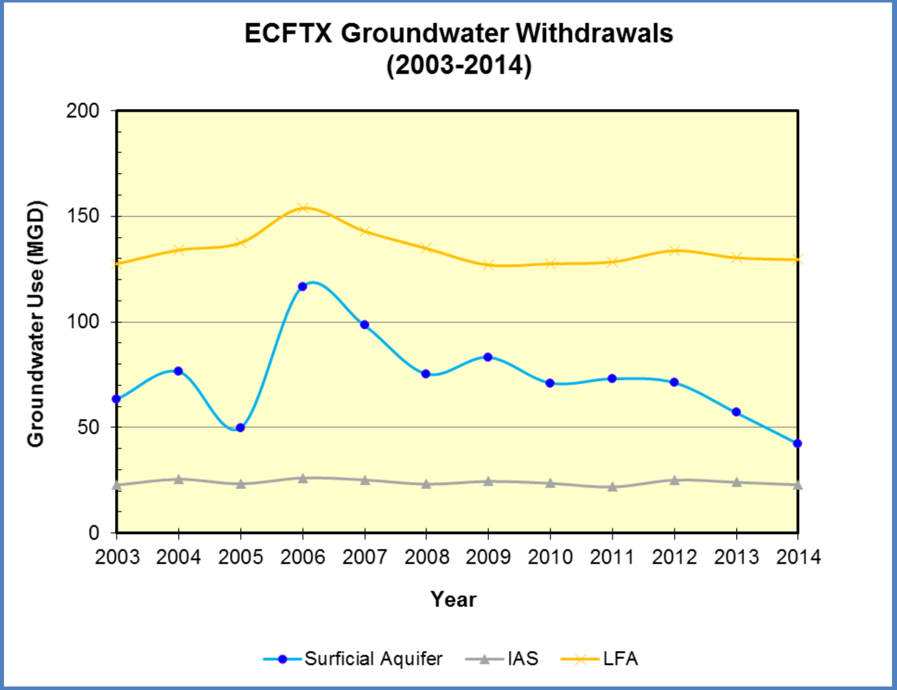
Purpose	Information Obtained/Evaluated
Assess regional effects of existing and future withdrawals	• Areas of SA and UFA (median/average) drawdowns • Flows (springs, river baseflows, lake leakage)
Evaluate MFL and wetland constraints	• Drawdown due to existing and projected withdrawals at MFLs and wetlands • UFA time series for reduced and/or projected withdrawals for calculating freeboard at MFL sites • Surficial Aquifer Levels affecting wetland sites
Quantify Groundwater Availability	• Modeled impacts to environmental criteria - MFLs, MFLs-related regulatory well water levels, non-MFL lakes/wetlands/springs, and groundwater quality

ECFTX Model Conceptualization



Groundwater withdrawal rates by aquifer in the ECFTX transient calibration



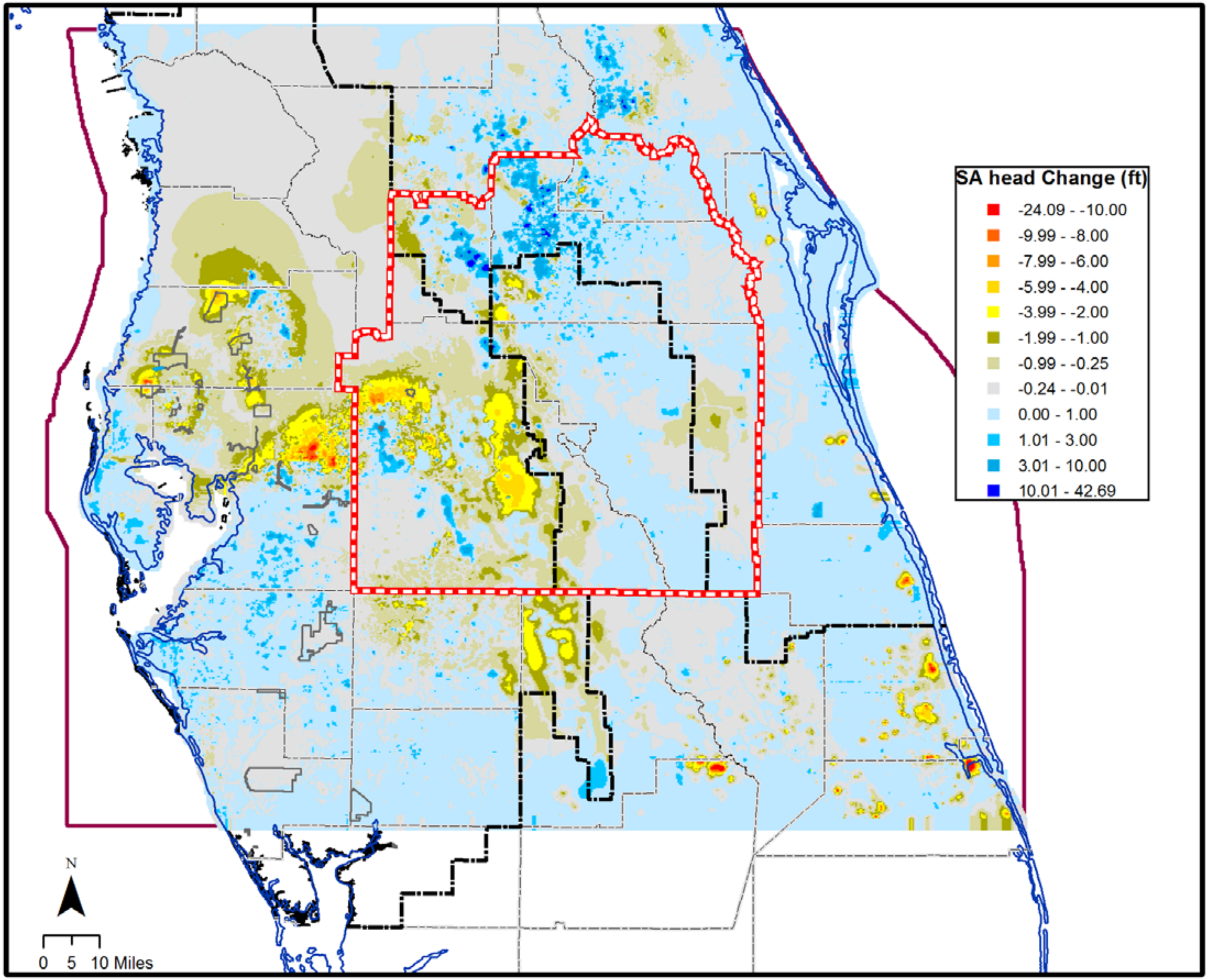


Scenario runs

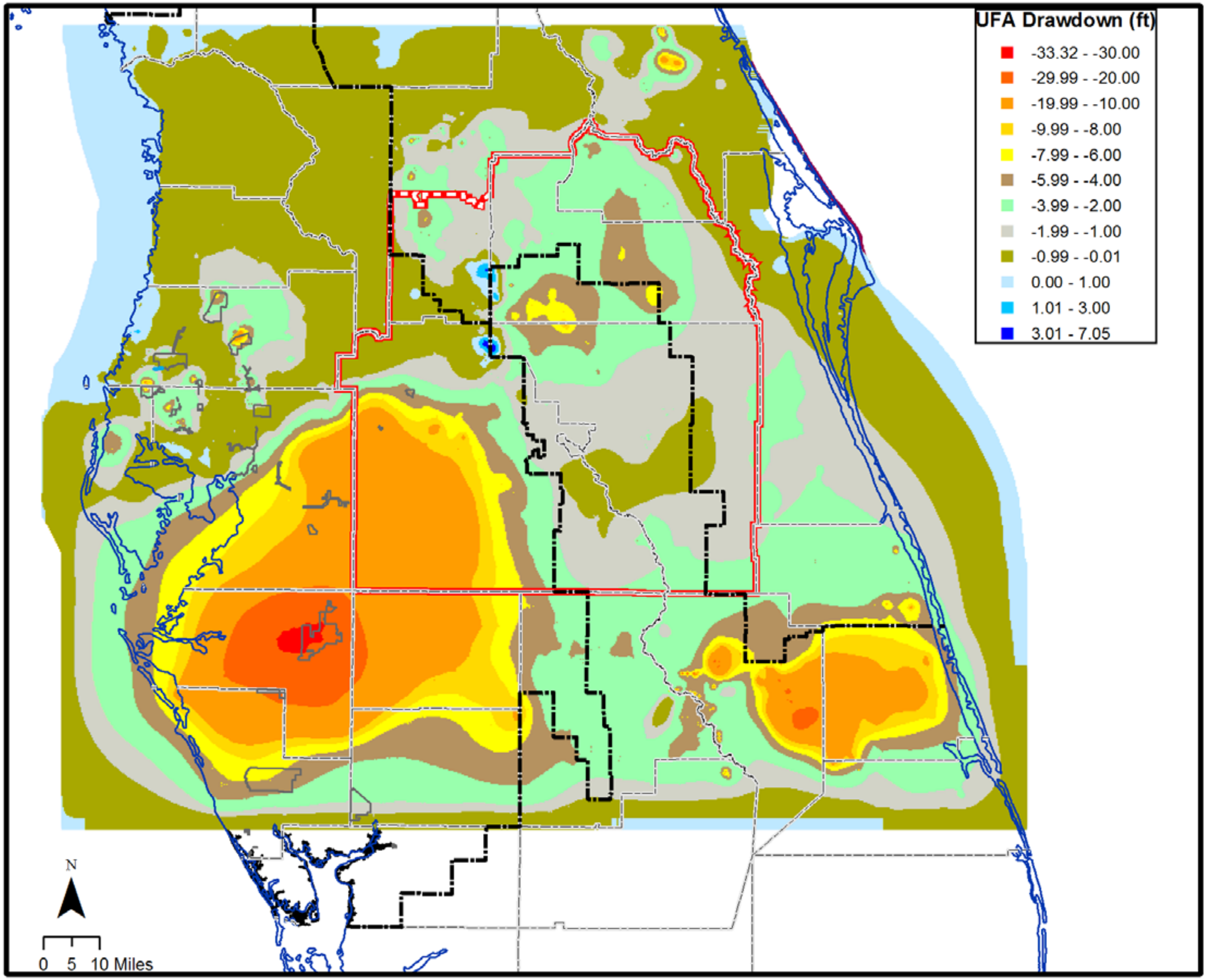
1. 25 and 50 percent reduction of groundwater use in calibration run
2. SJR 2003 and 2005 runs
3. 2014 reference condition
4. 2030 and 2040 projected water use
5. All runs utilize the 2003-2014 period – only changes are pumping and return water for each period

Predicted Water Level Change in the Surficial aquifer with 50% Reduction in Pumping x 2

Extrapolated Total Head Change in the SA (Lay 1) from Zero Pumping to Avg 2010-2014 conditions

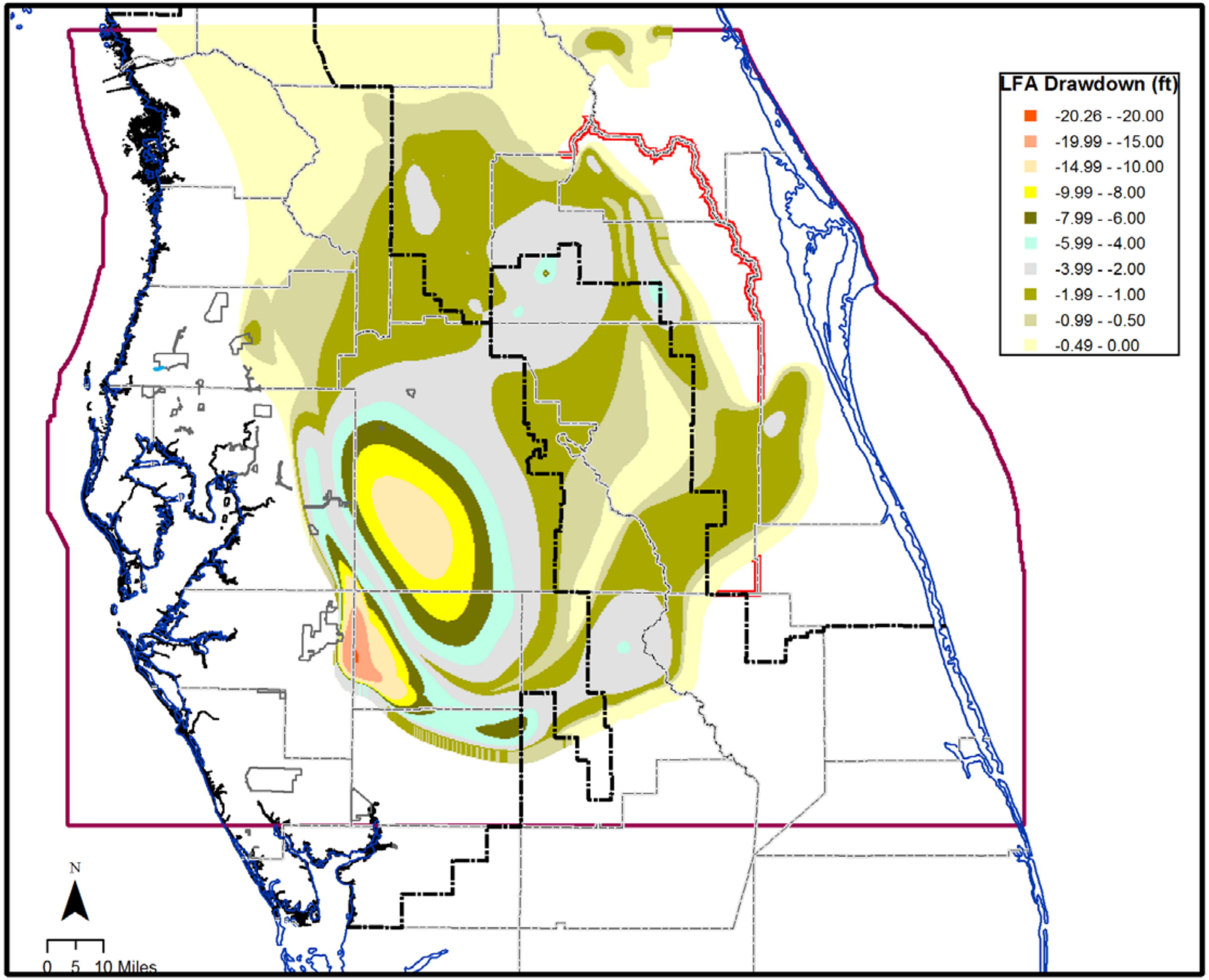


Predicted Water Level Change in the UFA with 50% Reduction in Pumping x 2



Extrapolated Total Head Change in the UFA (Suw Ls) from Zero Pumping Condition to Avg 2010-2014 conditions

Predicted Water Level Change in the LFA with 50% Reduction in Pumping x 2



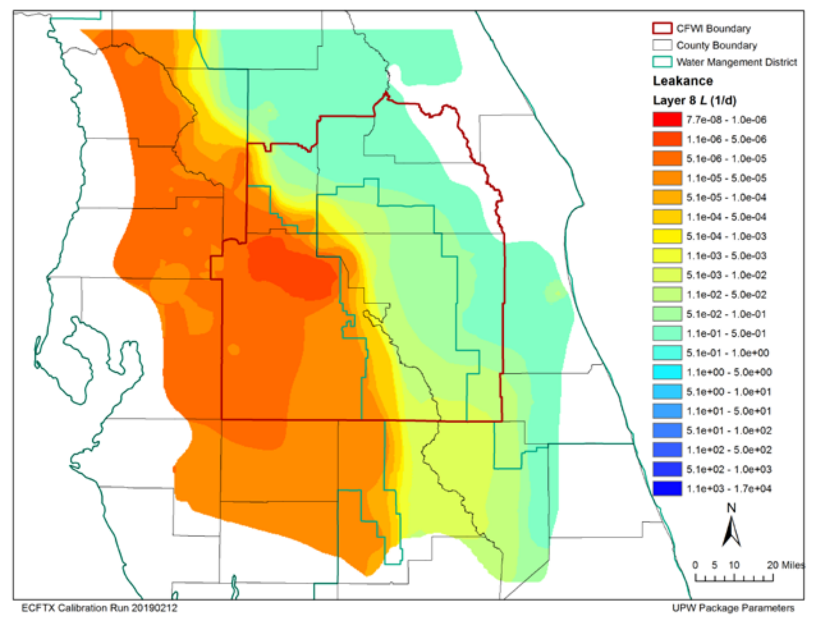
Extrapolated Total Head Change in the LFA (Layer 9) from Zero Pumping Condition to Avg 2010-2014 conditions

Predicted Springflow Change with 25% and 50% Reduction in Pumping

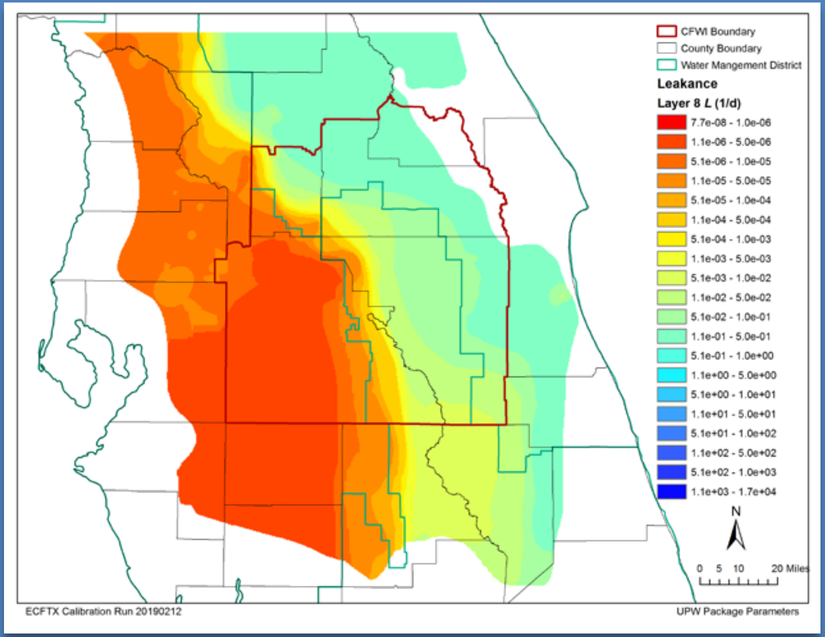
2003-2014 Period				extrpolated historical (50% x 2)	extrpolated historical (50% x 2
	Base	25%	50%	flow change (cfs)	flow change (%)
LITHIA SPRING MAJOR	**33.29**	**38.48**	**44.40**	-22.23	-40.0
BUCKHORN MAIN SPRING	12.15	13.49	15.02	-5.73	-32.0
SULPHUR SPRING (HILLSBOROUGH)	35.35	35.29	35.82	-0.93	-2.6
CRYSTAL MAIN SPRING (PASCO)	46.41	46.64	47.84	-2.86	-5.8
WEEKI WACHEE SPRING	167.24	167.29	170.54	-6.61	-3.8
CHASSAHOWITZKA SPRING MAIN	59.16	59.22	59.99	-1.66	-2.7
HOMOSASSA SPRING #1	84.37	84.37	84.74	-0.74	-0.9
GUM SPRING MAIN	66.30	65.76	67.24	-1.88	-2.8
RAINBOW SPRING #1	73.88	73.88	73.92	-0.06	-0.1
APOPKA SPRING	24.41	24.47	26.48	-4.14	-14.5
SANLANDO SPRINGS	20.05	20.63	22.02	-3.93	-16.4
STARBUCK SPRING	12.65	12.93	13.59	-1.90	-13.0
WEKIWA SPRING (ORANGE)	64.79	65.57	67.59	-5.59	-7.9
BUGG SPRING (LAKE)	9.70	10.02	10.59	-1.78	-15.5
ROCK SPRINGS (ORANGE)	52.03	52.78	54.87	-5.69	-9.9
VOLUSIA BLUE SPRING	129.69	132.51	137.76	-16.13	-11.1
ALEXANDER SPRING	99.06	99.08	99.14	-0.17	-0.2

Layer 8 Leakance

Calibration Model (UPW 20190205)

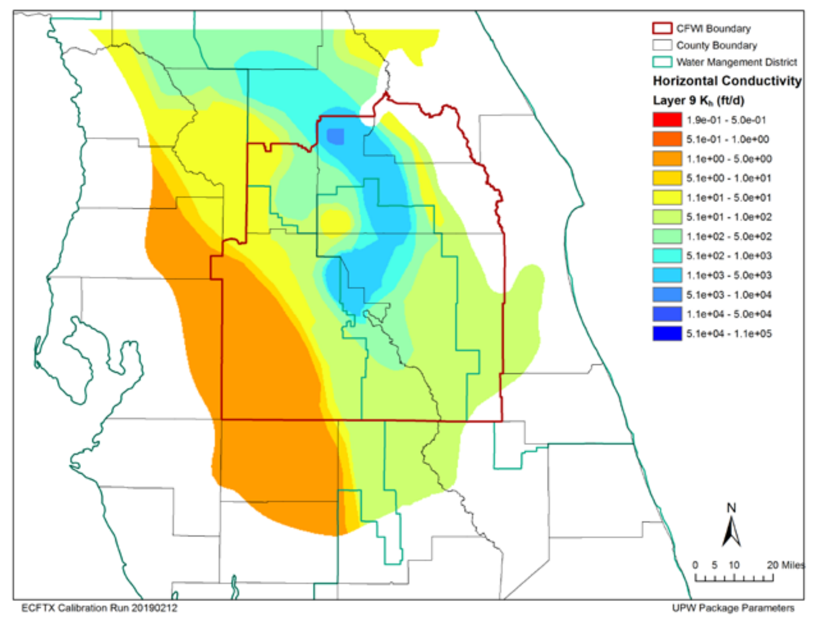


UPW 20190301

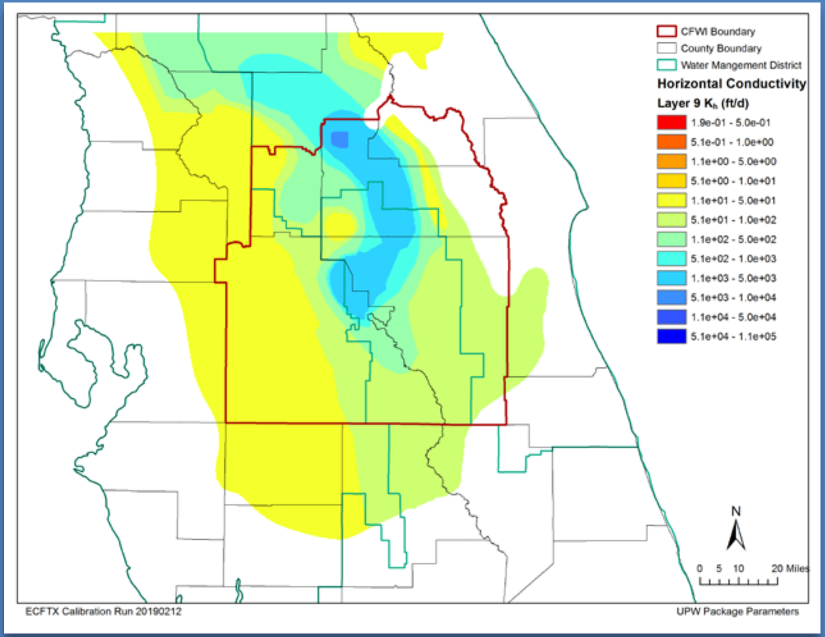


Layer 9 Horizontal Conductivity

Calibration Model (UPW 20190205)

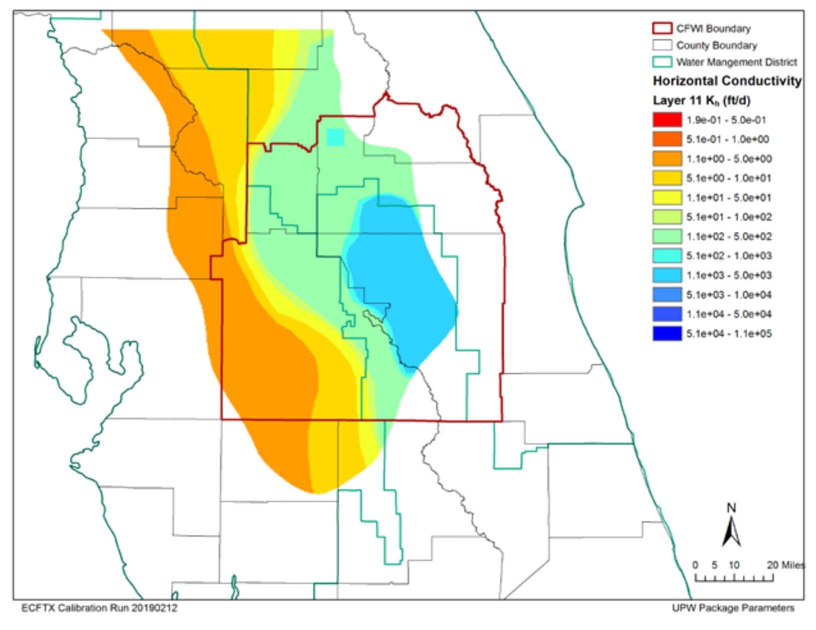


UPW 20190301

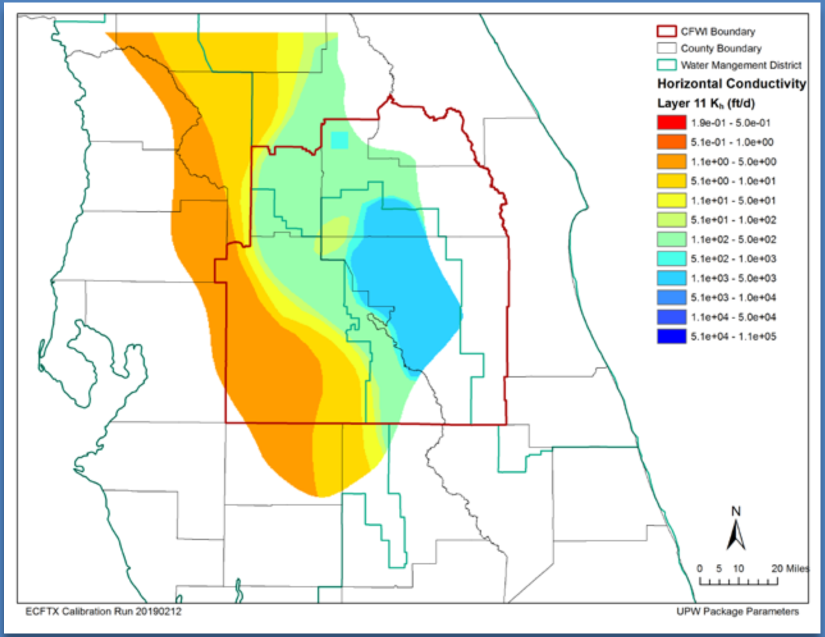


Layer 11 Horizontal Conductance

Calibration Model (UPW 20190205)

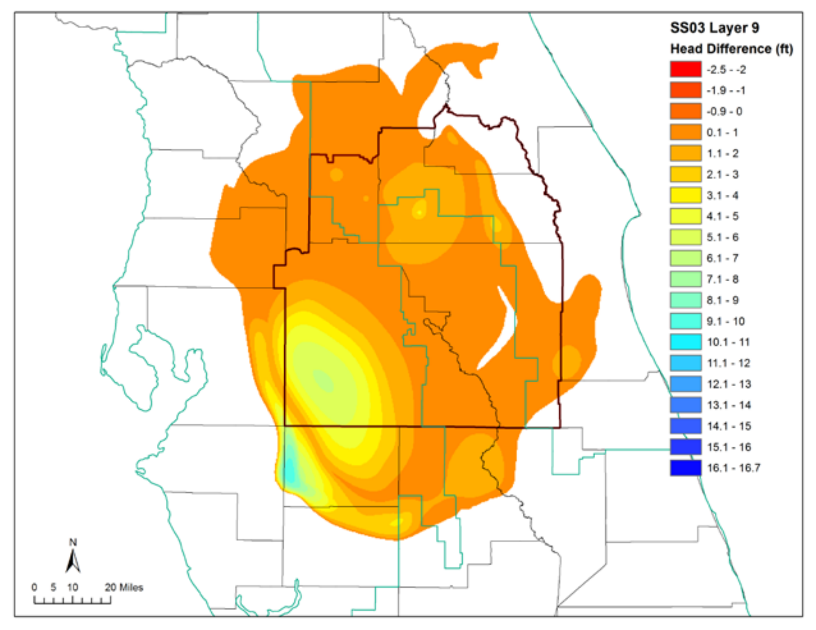


UPW 20190301

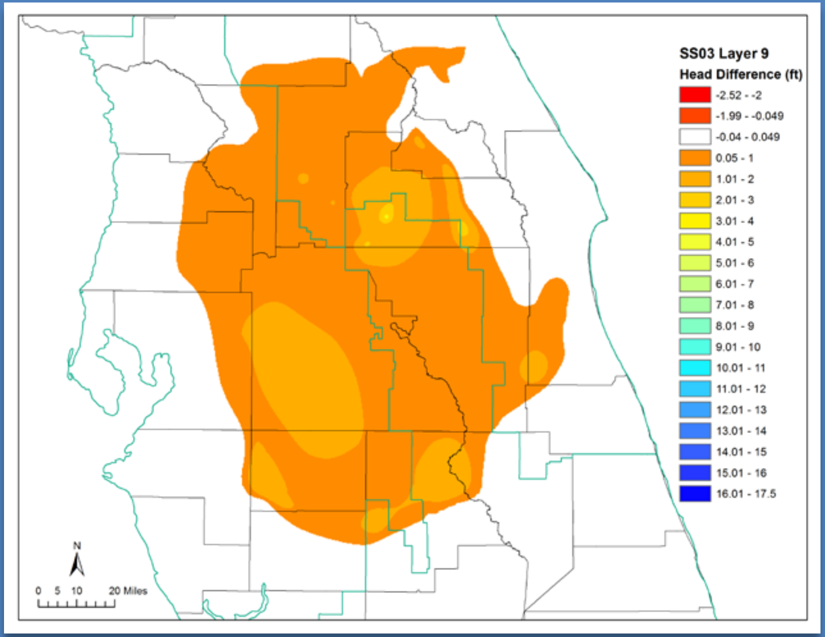


SS03 Layer 9 Head Difference (50% off – Calibration)

Calibration Model (UPW 20190205)

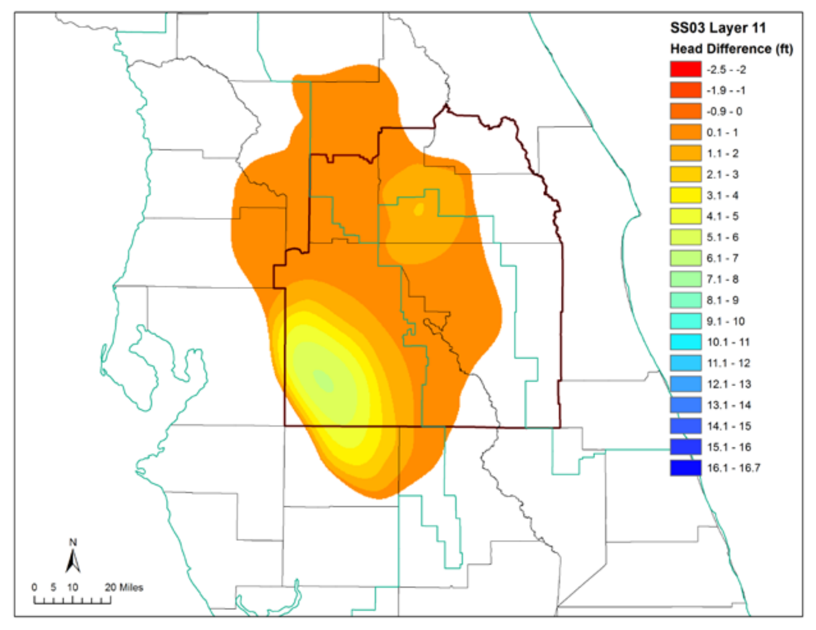


UPW 20190301

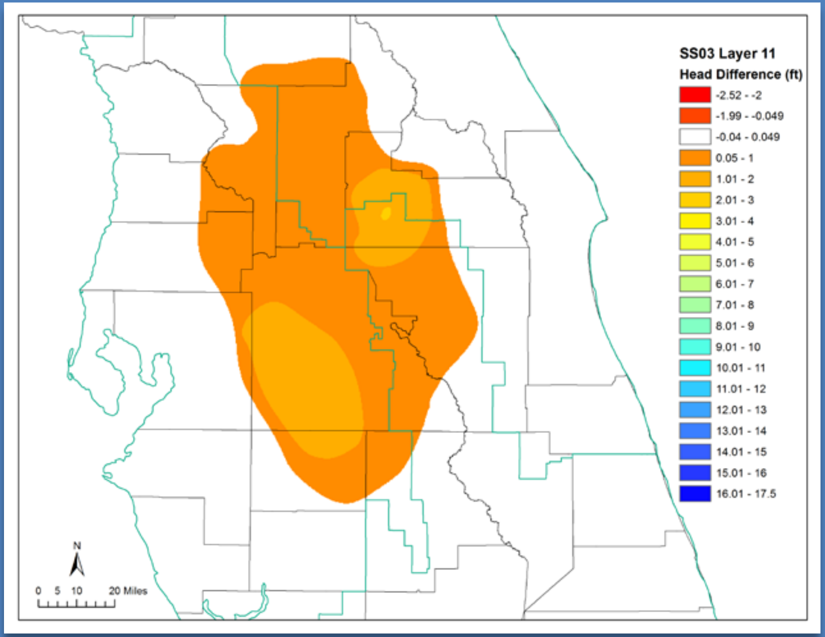


SS03 Layer 11 Head Difference (50% off – Calibration)

Calibration Model (UPW 20190205)



UPW 20190301



Calibration Model (UPW 20190205)

20190301

ECFTX	Calibration			Verification			Calibration			Verification		
	SA	UFA	LFA	SA	UFA	LFA	SA	UFA	LFA	SA	UFA	LFA
Residual Mean	-0.5	0.63	0.11	-1.05	0.08	0.19	-0.5	0.66	-0.1	-1.07	0.11	-0.12
Error Standard Dev	4.25	4.76	3.54	4.4	4.66	3.32	4.19	4.72	3.58	4.3	4.59	3.45
5% of Observation Range	8.97	7.59	2.79	8.66	6.95	2.52	8.97	7.59	2.79	8.66	6.95	2.52
Absolute Residual Mean	2.85	3.85	2.56	2.89	3.62	2.39	2.82	3.82	2.57	2.85	3.58	2.46
Error Sum of Squares	18269	21375	364	16244	15374	332	17703	21050	371	15639	14936	358
RMS Error	4.28	4.8	3.48	4.52	4.66	3.27	4.21	4.76	3.52	4.43	4.59	3.4
Minimum Residual	-31.46	-22.25	-10.19	-31.88	-21.96	-10.85	-31.47	-22.25	-10.2	-30.41	-21.96	-10.86
Maximum Residual	21.12	19.07	6.61	21.17	18.68	6.3	18.26	19.07	6.59	11.48	18.68	6.27
Numer of Observations	997	928	30	796	709	31	997	928	30	796	709	31
Percentage with MAE < 2.5 ft	67%	47%	67%	65%	47%	68%	68%	48%	67%	66%	48%	68%
Percentage with MAE < 5.0 ft	88%	75%	83%	87%	77%	84%	88%	76%	87%	87%	78%	84%
Percentage with R2 > 0.4	78%	94%	97%	80%	87%	94%	78%	93%	93%	80%	87%	94%

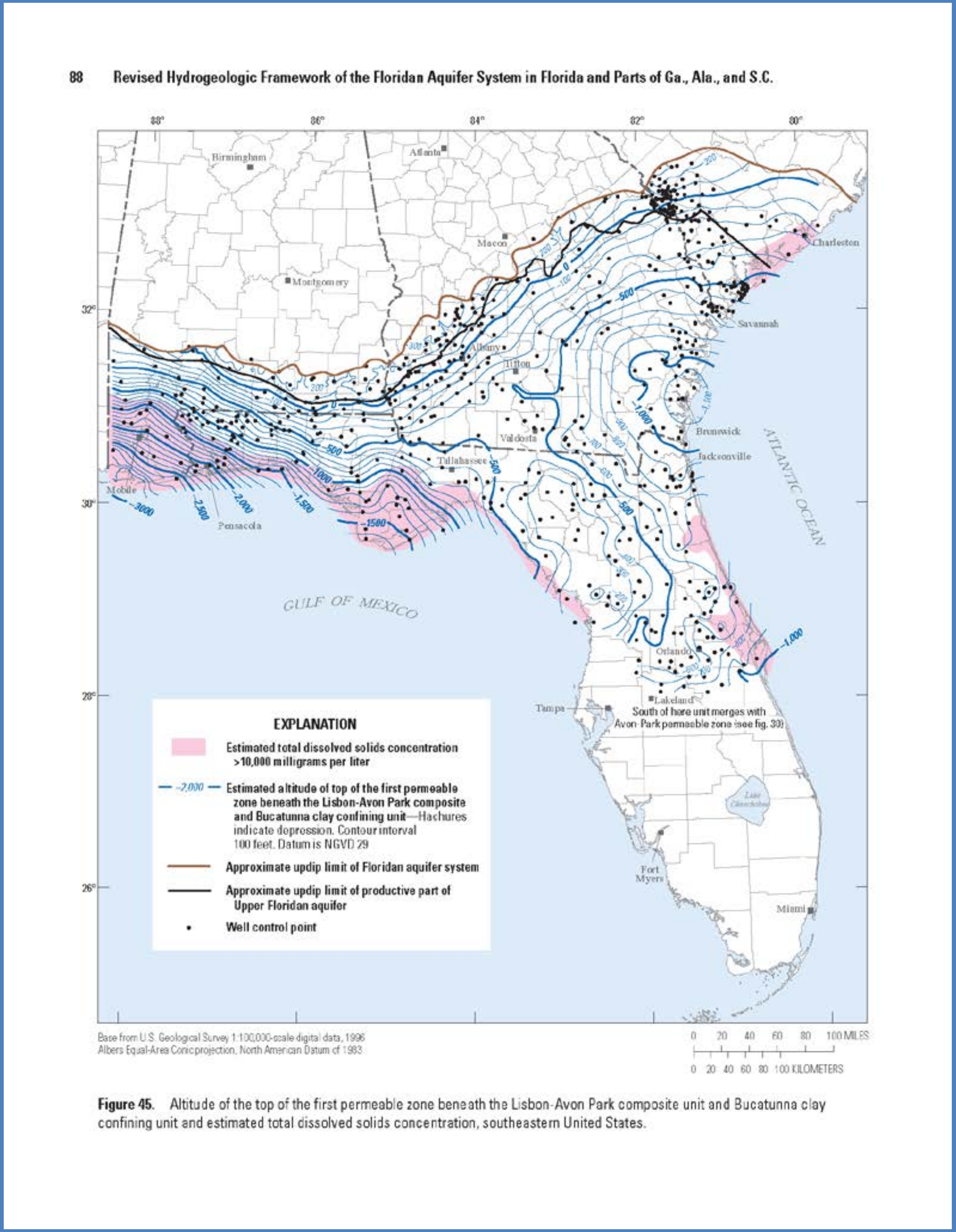
Calibration Model (UPW 20190205) 20190301

CFWI	Calibration				Verification			Calibration				Verification		
	SA	UFA	LFA		SA	UFA	LFA	SA	UFA	LFA		SA	UFA	LFA
Residual Mean	-0.78	-0.07	0.89		-0.82	-0.49	1.08	-0.71	0.15	0.63		-0.76	-0.32	0.7
Error Standard Dev	3.54	3.92	3.11		3.64	3.95	2.5	3.54	3.8	3.22		3.63	3.79	2.83
5% of Observation Range	8.6	6.2	2.62		8.56	6.02	2.38	8.6	6.2	2.62		8.56	6.02	2.38
Absolute Residual Mean	2.68	3.39	2.4		2.69	3.35	2.08	2.66	3.33	2.4		2.66	3.24	2.16
Error Sum of Squares	3626	2969	241		3049	2538	179	3607	2798	247		3021	2312	204
RMS Error	3.62	3.91	3.17		3.72	3.97	2.68	3.61	3.8	3.21		3.71	3.79	2.86
Minimum Residual	-16.74	-12.14	-6.76		-16.59	-12.32	-5.66	-16.72	-12.15	-8.49		-16.57	-12.32	-7.39
Maximum Residual	12.99	10.29	6.61		11.34	10.32	6.3	13.1	10.31	6.59		11.48	10.32	6.27
Numer of Observations	277	194	24		220	161	25	277	194	24		220	161	25
Percentage with MAE < 2.5 ft	69%	51%	67%		65%	48%	72%	70%	50%	67%		67%	50%	72%
Percentage with MAE < 5.0 ft	87%	81%	83%		85%	83%	84%	87%	82%	88%		85%	84%	84%
Percentage with R2 > 0.4	79%	97%	96%		78%	93%	100%	79%	96%	92%		78%	93%	100%

SPRING_NAM	Observation	Simulation	Error
LITHIA SPRING MAJOR	34.7	35.4	2%
BUCKHORN MAIN SPRING	12.2	12.8	4%
SULPHUR SPRING (HILLSBOROUGH)	34.7	35.6	2%
CRYSTAL MAIN SPRING (PASCO)	45.5	46.1	1%
WEEKI WACHEE SPRING	160.4	167.2	4%
CHASSAHOWITZKA SPRING MAIN	59.6	59.2	-1%
HOMOSASSA SPRING #1	83.5	84.4	1%
GUM SPRING MAIN	63.8	66.4	4%
RAINBOW SPRING #1	71.8	73.9	3%
APOPKA SPRING	24.9	24.6	-1%
SANLANDO SPRINGS	18.8	20.1	6%
STARBUCK SPRING	12.1	12.6	5%
WEKIWA SPRING (ORANGE)	61.0	64.8	6%
BUGG SPRING (LAKE)	10.6	9.6	-9%
ROCK SPRINGS (ORANGE)	54.9	52.1	-5%
VOLUSIA BLUE SPRING	143.6	132.3	-8%
ALEXANDER SPRING	100.1	99.1	-1%
WEKIVA FALLS RESORT	12.0	12.5	4%

Active Model Boundary Set at estimates of 10,000 mg/l TDS

Layers 5-7
Extent of FW zone

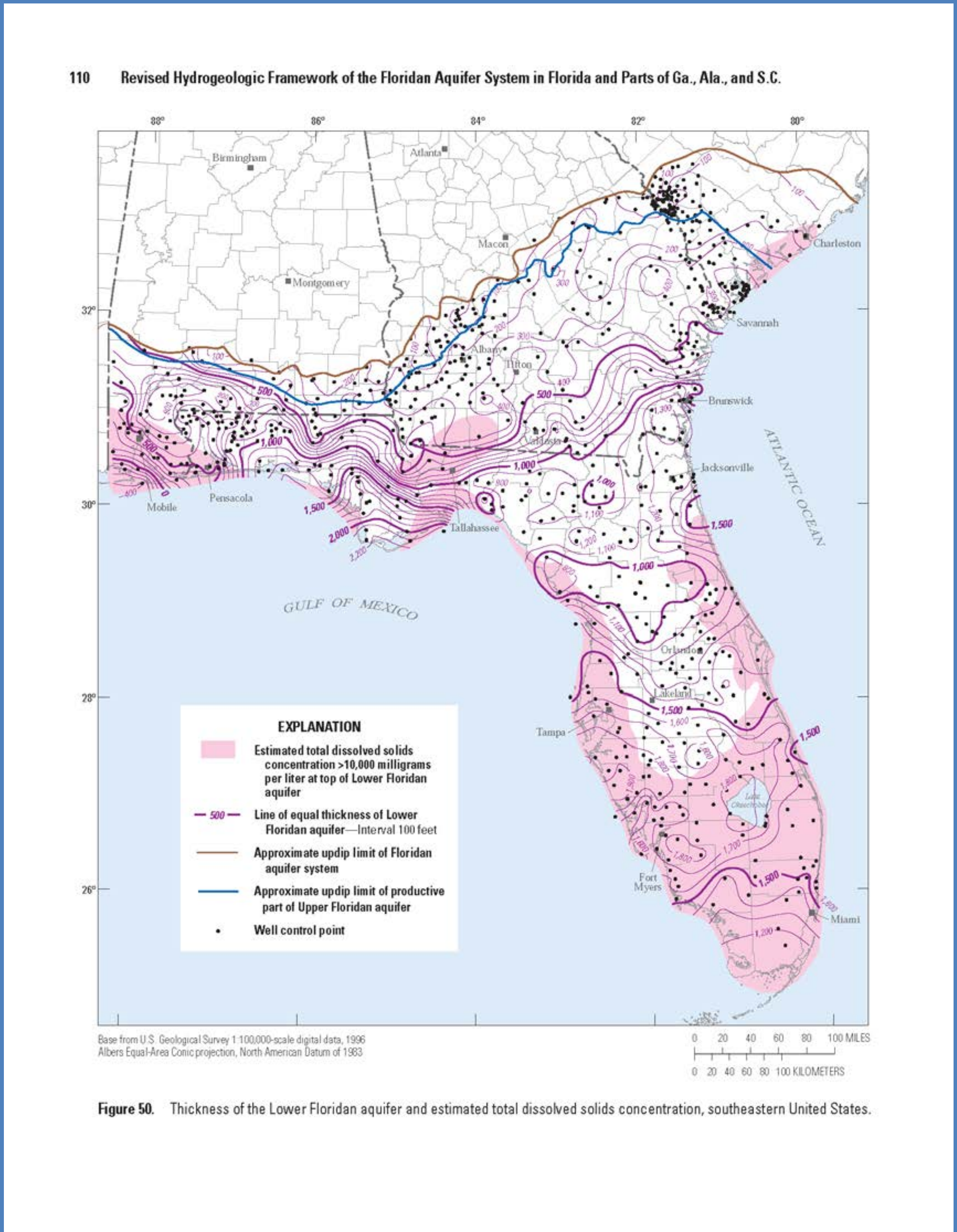


88 Revised Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Ga., Ala., and S.C.

Base from U.S. Geological Survey 1:100,000-scale digital data, 1996
Albers Equal-Area Conic projection, North American Datum of 1983

Figure 45. Altitude of the top of the first permeable zone beneath the Lisbon-Avon Park composite unit and Bucatunna clay confining unit and estimated total dissolved solids concentration, southeastern United States.

LFA – Layer 9
Extent of FW zone



110 Revised Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Ga., Ala., and S.C.

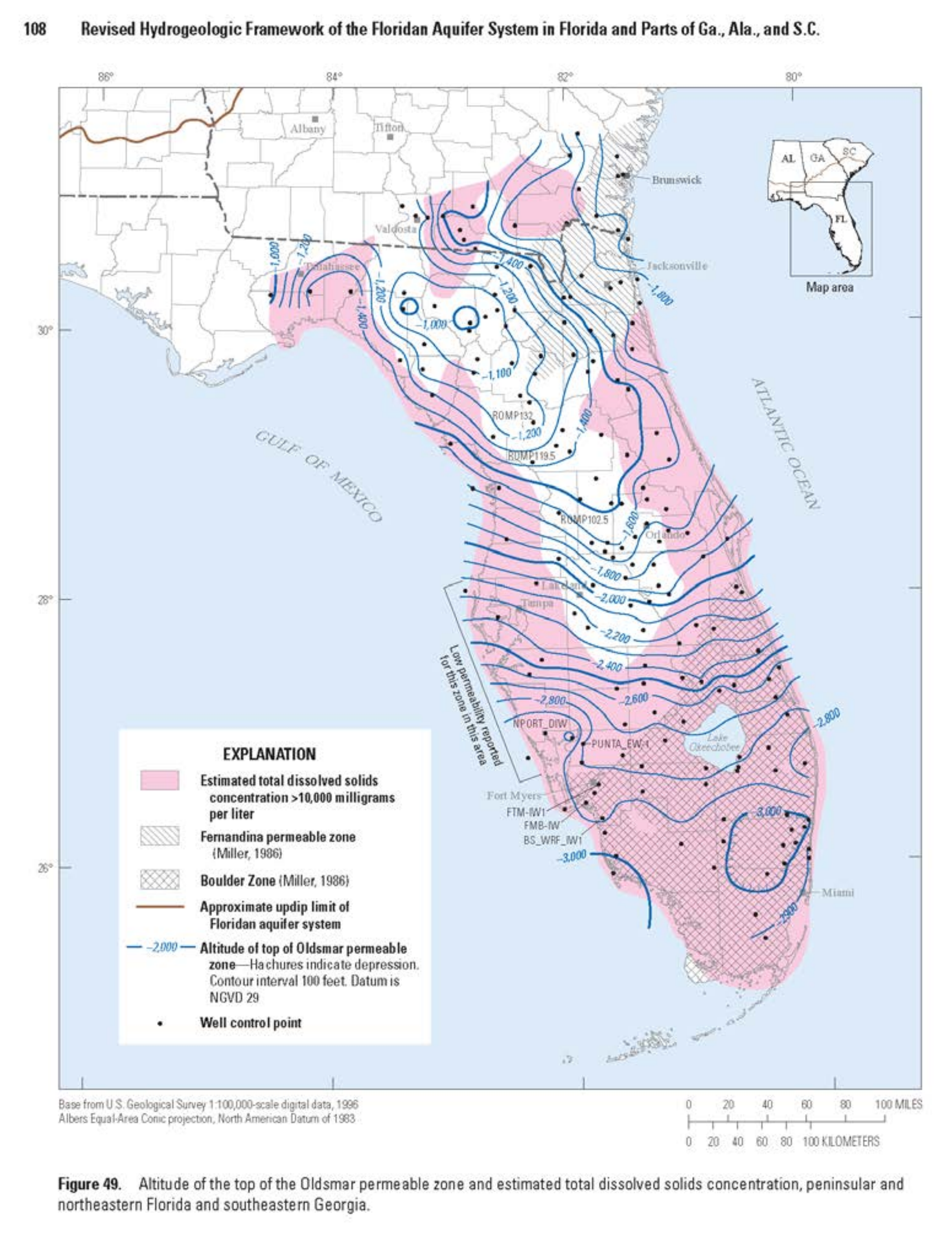
EXPLANATION

▨	Estimated total dissolved solids concentration >10,000 milligrams per liter at top of Lower Floridan aquifer
— 500 —	Line of equal thickness of Lower Floridan aquifer—Interval 100 feet
—	Approximate updip limit of Floridan aquifer system
—	Approximate updip limit of productive part of Upper Floridan aquifer
•	Well control point

Base from U.S. Geological Survey 1:100,000-scale digital data, 1996
Albers Equal-Area Conic projection, North American Datum of 1983

Figure 50. Thickness of the Lower Floridan aquifer and estimated total dissolved solids concentration, southeastern United States.

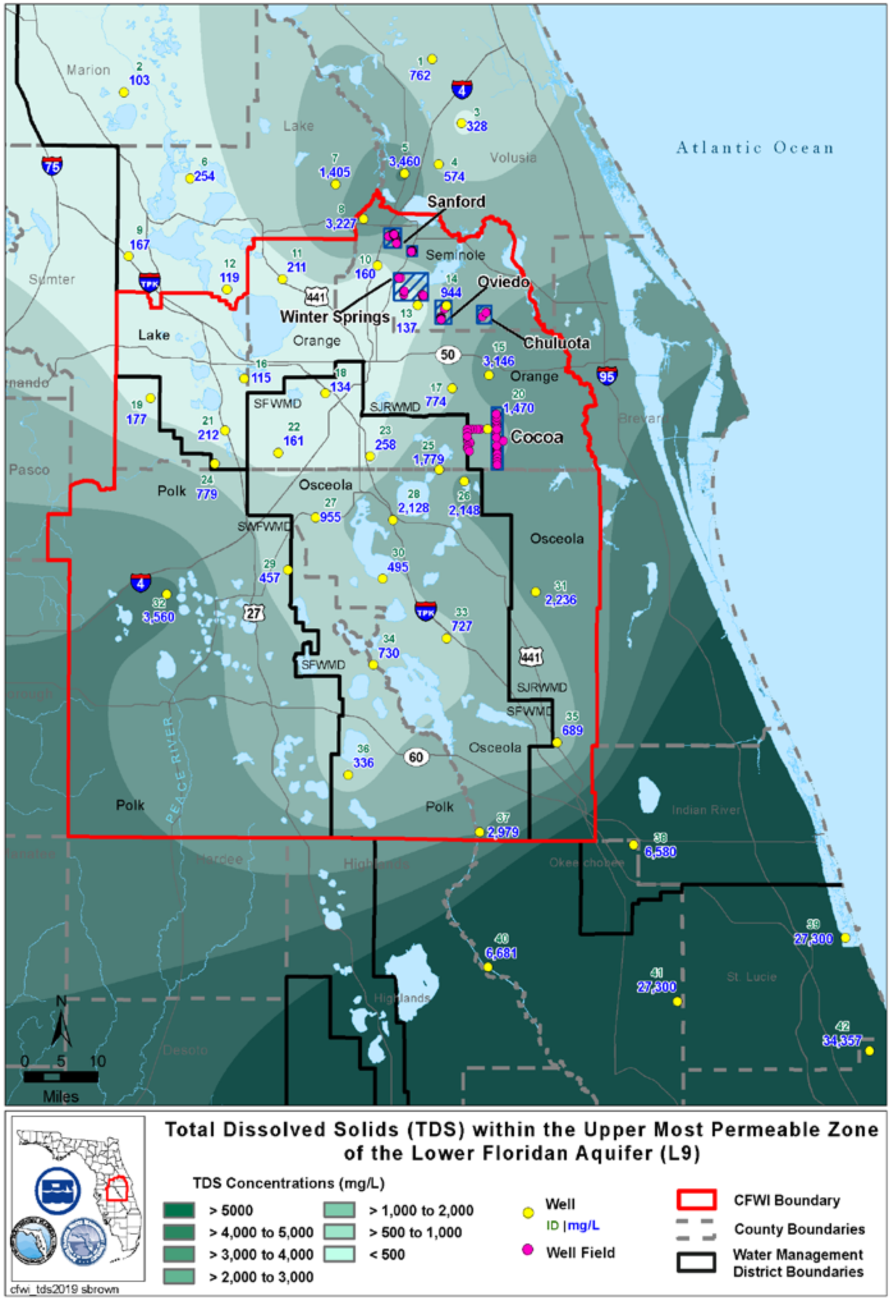
LFA – Layer 11
Extent of FW zone



108 Revised Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Ga., Ala., and S.C.

Base from U.S. Geological Survey 1:100,000-scale digital data, 1996
Albers Equal-Area Conic projection, North American Datum of 1983

Figure 49. Altitude of the top of the Oldsmar permeable zone and estimated total dissolved solids concentration, peninsular and northeastern Florida and southeastern Georgia.



Total Dissolved Solids (TDS) within the Upper Most Permeable Zone of the Lower Floridan Aquifer (L9)

TDS Concentrations (mg/L)

🟩 > 5000	🟩 > 1,000 to 2,000
🟩 > 4,000 to 5,000	🟩 > 500 to 1,000
🟩 > 3,000 to 4,000	🟩 < 500
🟩 > 2,000 to 3,000	

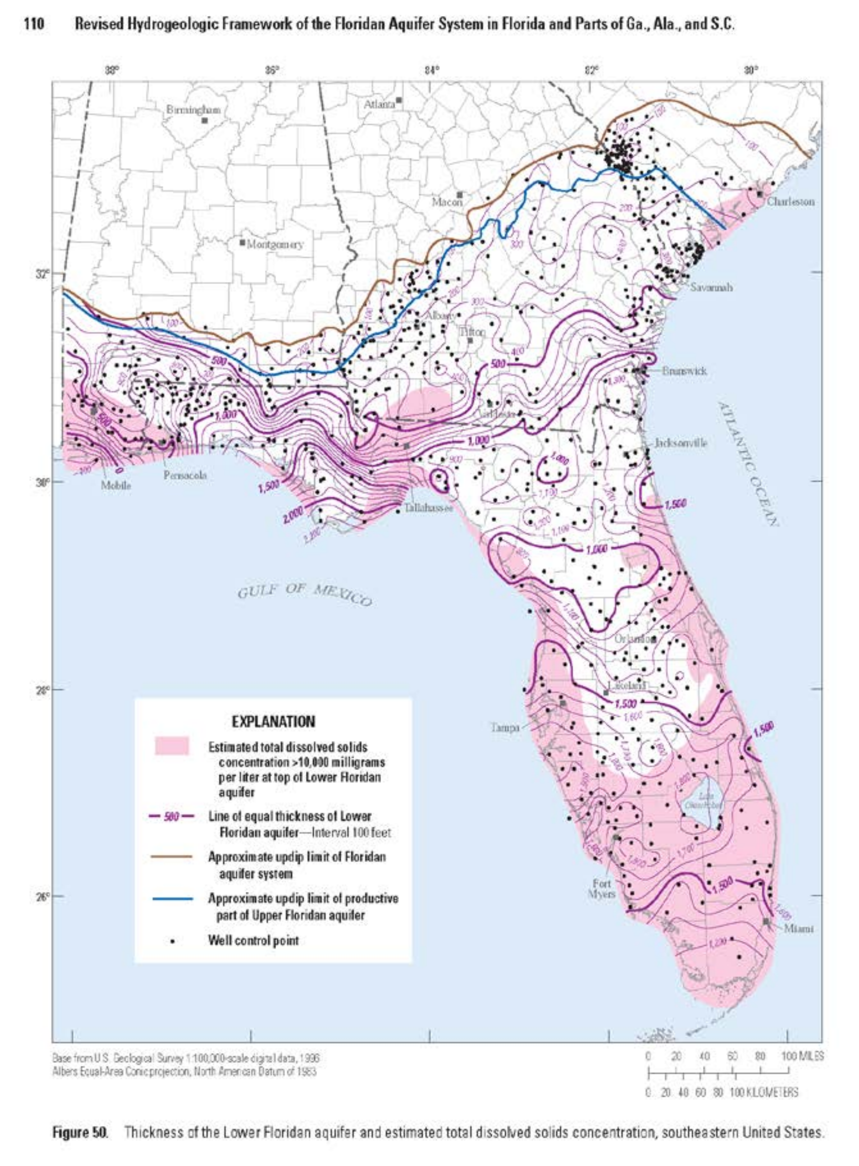
● Well
ID | mg/L

● Well Field

🟥 CFWI Boundary

County Boundaries

Water Management District Boundaries



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EXPLANATION

🟪 Estimated total dissolved solids concentration >10,000 milligrams per liter at top of Lower Floridan aquifer

— 500 — Line of equal thickness of Lower Floridan aquifer—Interval 100 feet

— Approximate updip limit of Floridan aquifer system

— Approximate updip limit of productive part of Upper Floridan aquifer

• Well control point

Base from U.S. Geological Survey 1:100,000-scale digital data, 1996
Albers Equal-Area Conic projection, North American Datum of 1983

Figure 50. Thickness of the Lower Floridan aquifer and estimated total dissolved solids concentration, southeastern United States.

GHB Issue

1. Some HAT Team members have suggested that the GH boundaries be set at no flow since they shouldn't be providing water from a boundary that is known to be brackish/saline quality.

2. ECFTX model was conceptualized with GHBs set with Equivalent Freshwater Heads in the freshwater/saltwater transition zones. The peer review panel concurred with the approach.

3. Due to the proximity of some GH boundaries to large groundwater extraction zones, could fluxes be attenuating drawdown?

4. As a conservative approach, modeling staff conducted a series of sensitivity runs to assess the impact of boundary fluxes with the goal to reduce fluxes associated with the freshwater/saltwater transition areas or other areas inconsistent with aquifer hydraulics while maintaining a reasonable calibration

5. WMD staff would like an assessment of this approach from the Peer Review Team and determine whether its reasonable to complete water use scenarios and draft report

GHB Issue – Plan of Action

Once flux issue was identified, modeling staff's plan was an attempt to improve GHBs by:

1. Minimizing GHB influx along boundaries know to be brackish/saline

2. Make GHB influxes better match the known/aquifer/confining unit properties between model layers

3. Attempt to make changes while not drastically altering the calibration which was accomplished.

Description of Test Runs

- Layer 2
  - West Side GHB Conductance * 0.1
  - Updated South side GHB Conductance Values to match SWFWMD values
  - North side GHB stage values from SWFWMD along with accompany conductance changes to Rainbow Spring in DRN package
- Layer 3
  - Fixed negative GHB Conductance Values
  - Adjusted Kh and Kv in St. Lucie County and Osceola County
  - Updated South side GHB Conductance Values to match SWFWMD values
- Layer 4
  - Updated South side GHB Conductance Values to match SWFWMD values
- Layer 5
  - South Boundary GHB Conductance in SFWMD = a max of 500,000 ft^2/day
  - Targeted East Side GHB Conductance * 0.001
  - Martin County GHB Conductance in SFWMD = a max of 10,000 ft^2/day
  - South West Boundary GHB Conductance * 0.1
  - Adjusted Kh and Kv in St. Lucie County and Osceola County
- Layer 6 West Boundary from middle to the south GHB Conductance * 0.001
- Layer 7 South and East Boundary in SFWMD GHB Conductance * 0.01
- Layer 8 South and East Boundary in SFWMD GHB Conductance * 0.01
- Layer 9 localized changes to Kh and Kv to improve calibration of wells
- Layer 10
  - Kh and Kv in South and East * 0.001
  - Kh and Kv everywhere else * 0.1
- Layer 11 Targeted South East Boundary GHB Conductance * 0.001

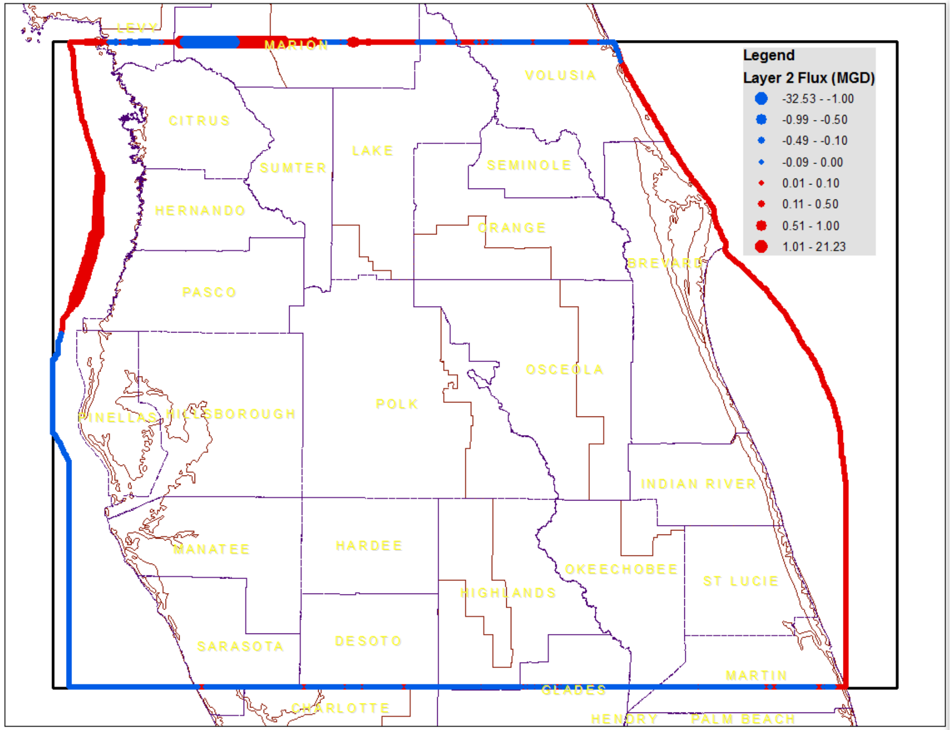
GHB Net Flux Comparison

	West Side		East Side		North Side		South Side	
	Calib	Final Calib	Calib	Final Calib	Calib	Final Calib	Calib	Final Calib
Layer 1					11	11	6	6
Layer 2	414	73			-336	165		
Layer 3	-180	-121	-37	-67	512	218	-106	-26
Layer 4	-1	54	5	9	141	72	-101	-11
Layer 5	-20	63	235	54	185	89	262	291
Layer 6	130	14			1	1	59	70
Layer 7	19	20	113	37	1	1	26	11
Layer 8			119	34			11	2
Layer 9	-1	-1	-34	-28	42	44		
Layer 10								
Layer 11	-17	-11	-302	-129	3	1		
Total	344	90	100	-91	559	603	156	342

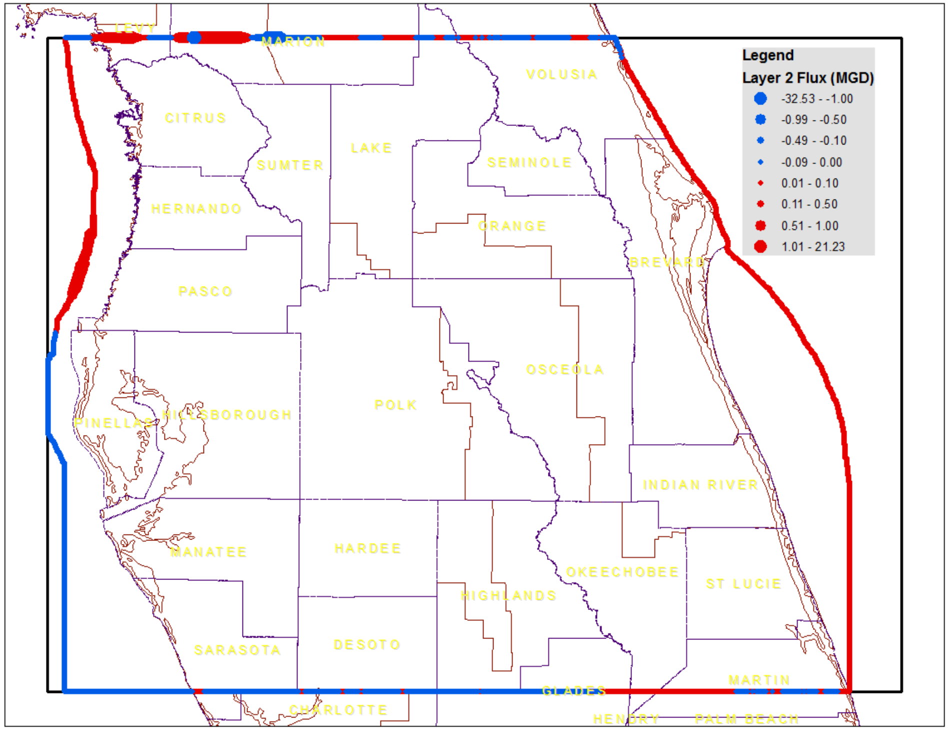
All values in mgd.

Comparison of Flux in Layer 2

Calibration

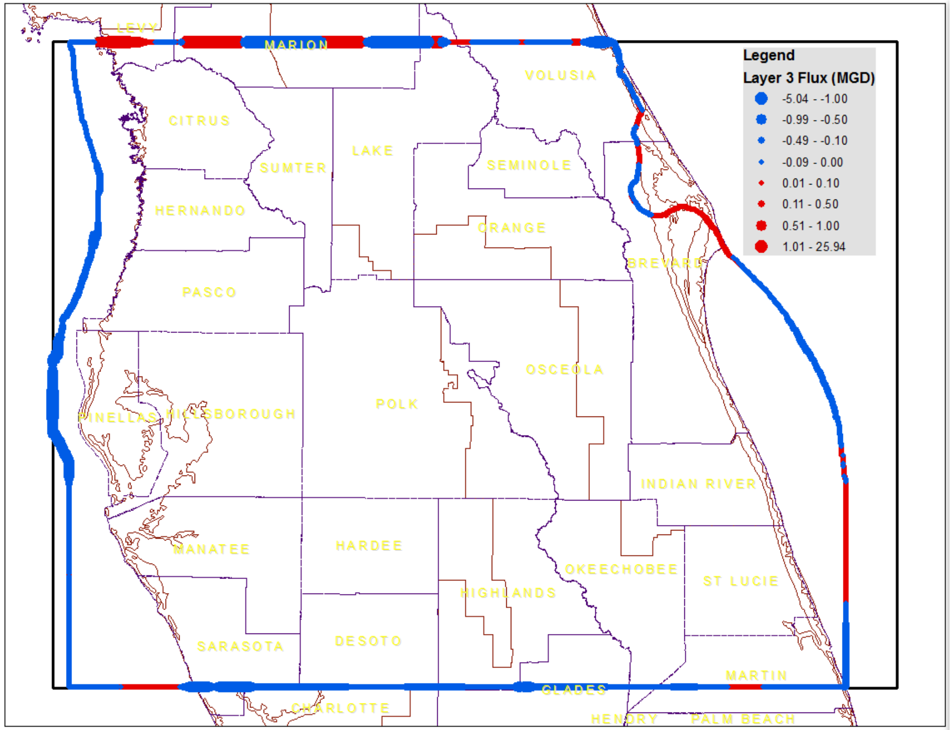


Test Run

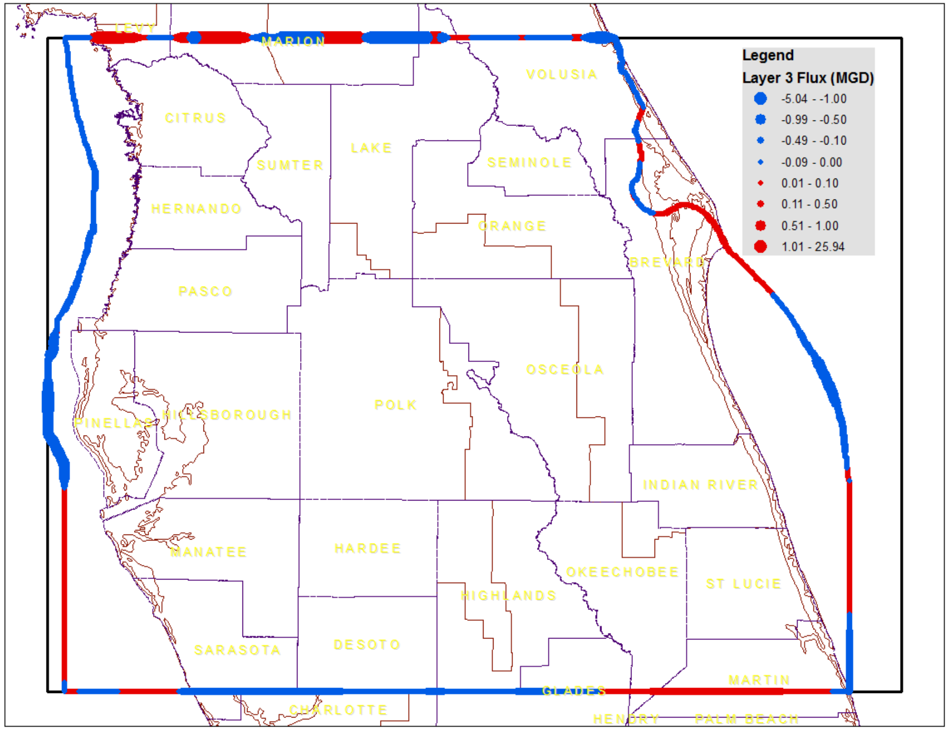


Comparison of Flux in Layer 3

Calibration

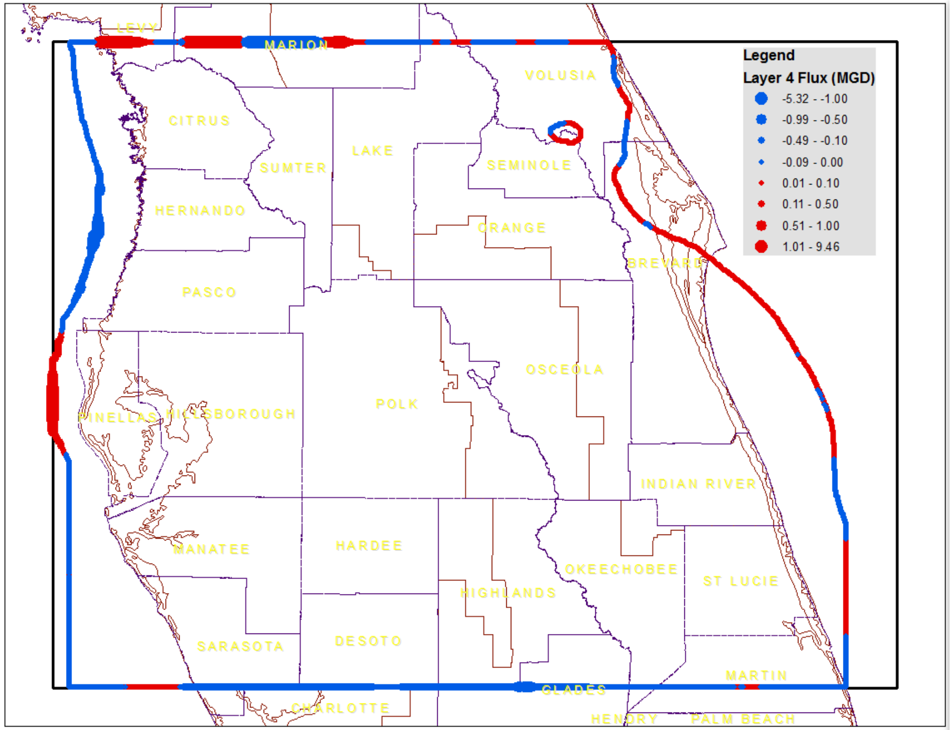


Test Run

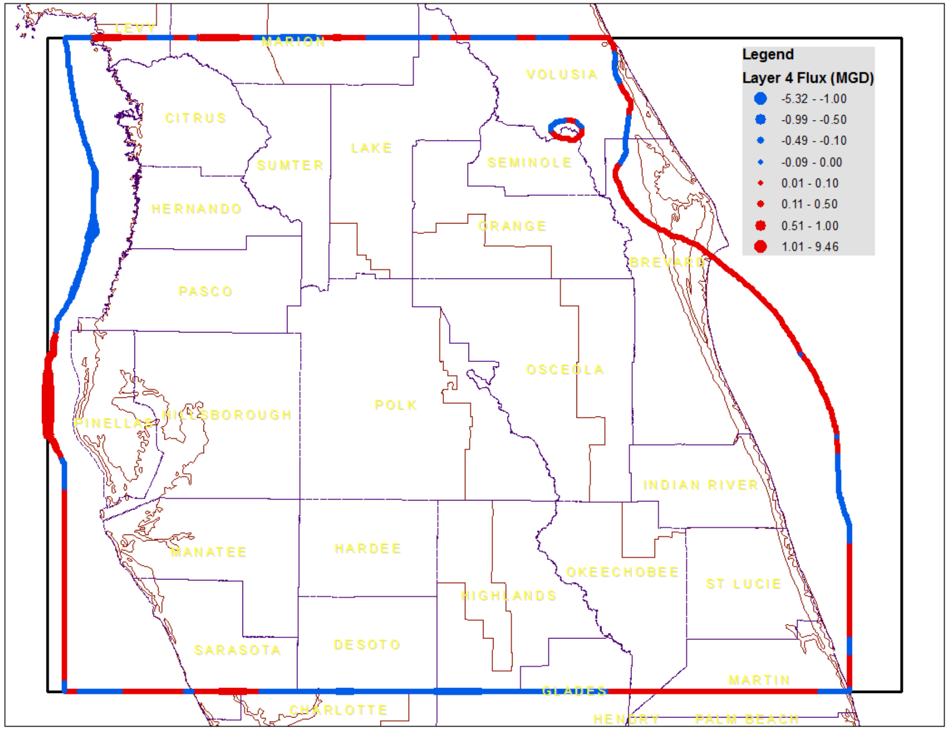


Comparison of Flux in Layer 4

Calibration

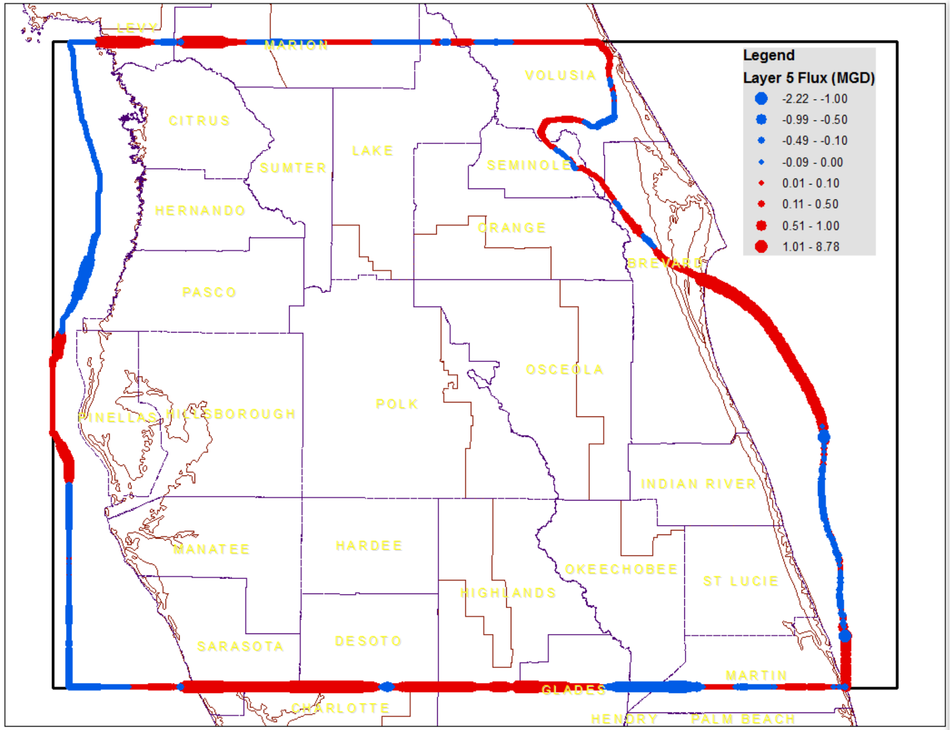


Test Run

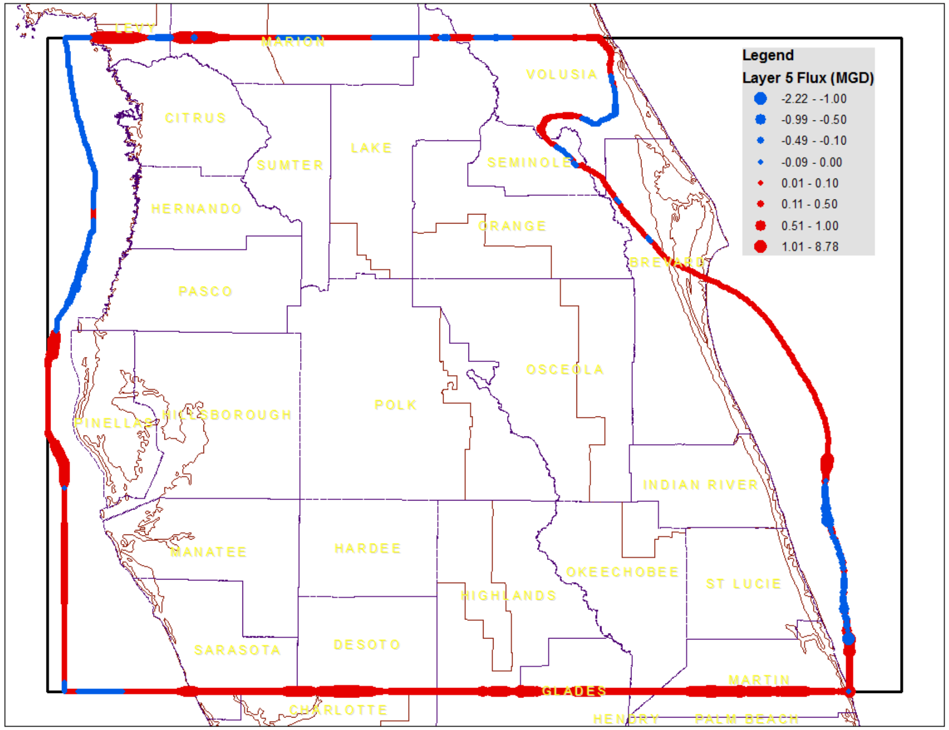


Comparison of Flux in Layer 5

Calibration

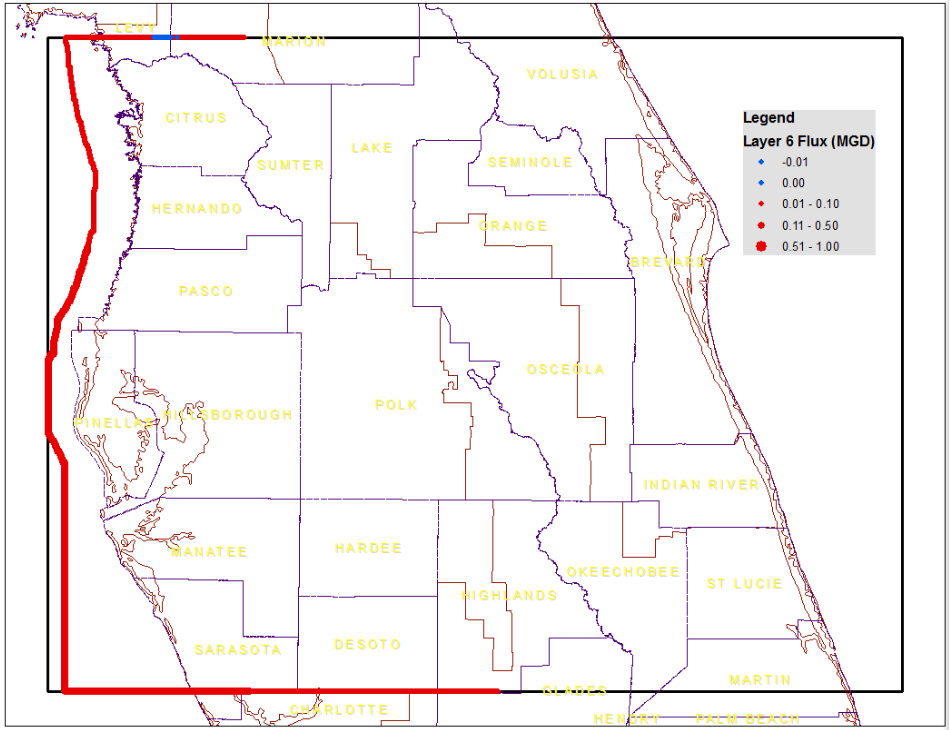


Test Run

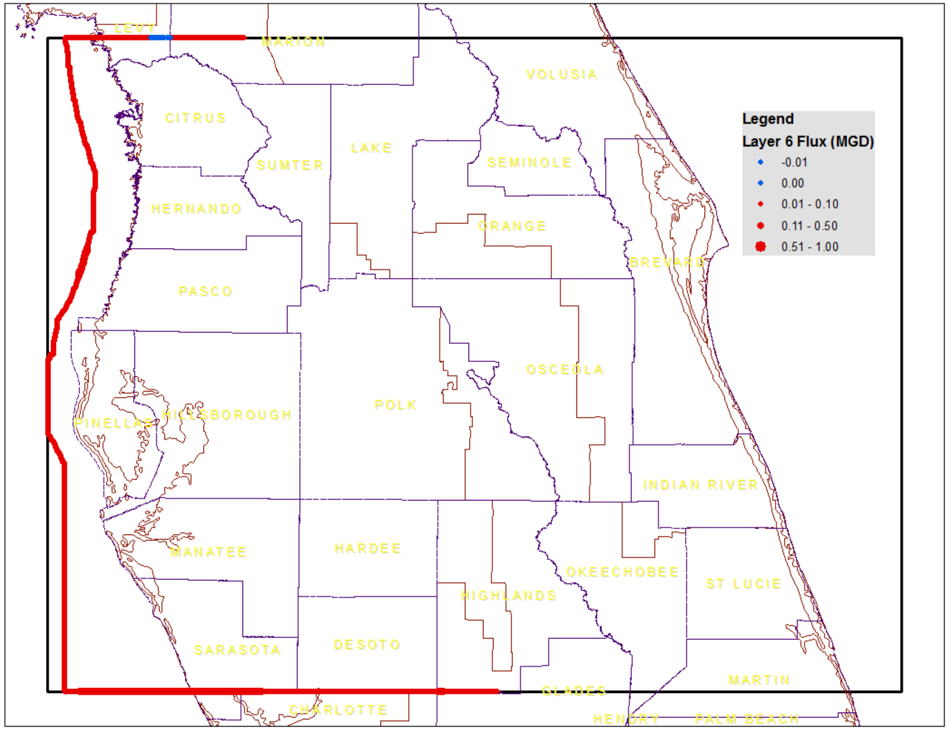


Comparison of Flux in Layer 6

Calibration

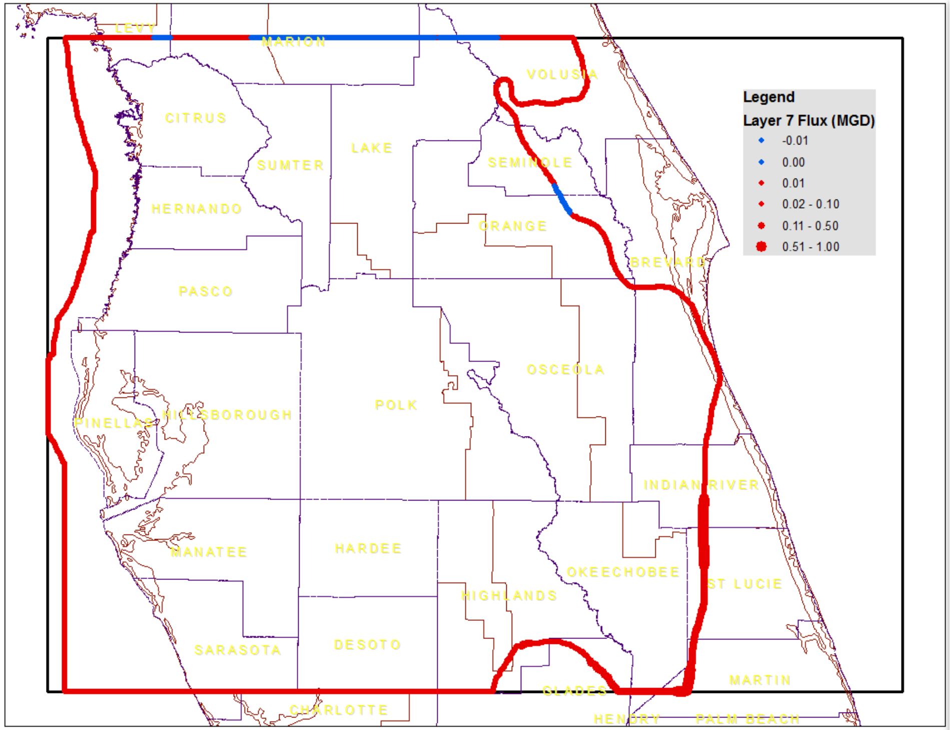


Test Run

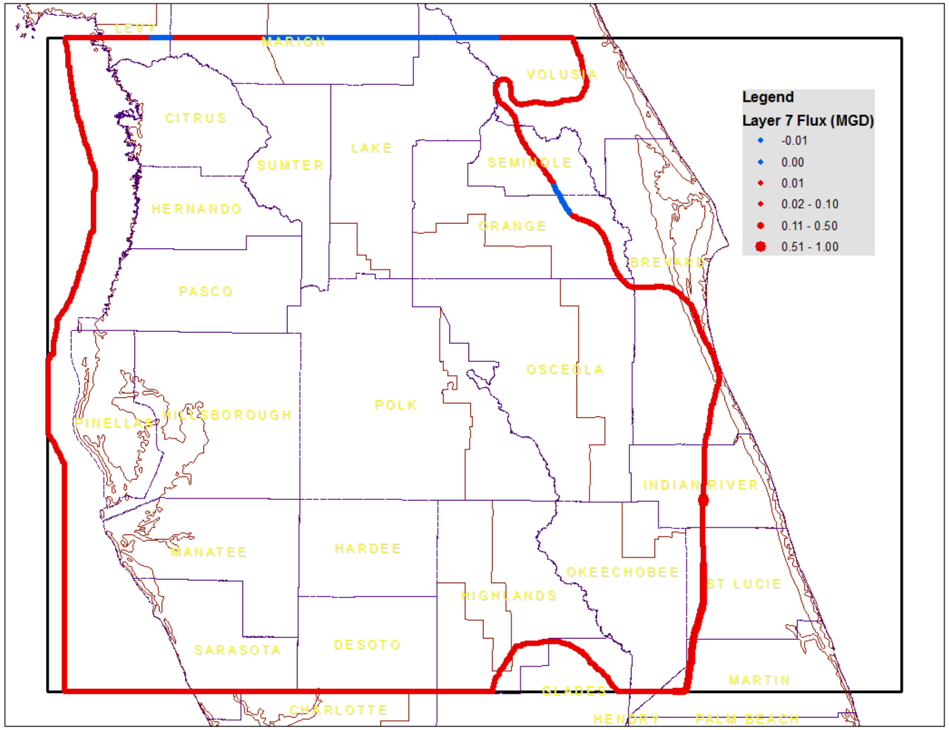


Comparison of Flux in Layer 7

Calibration

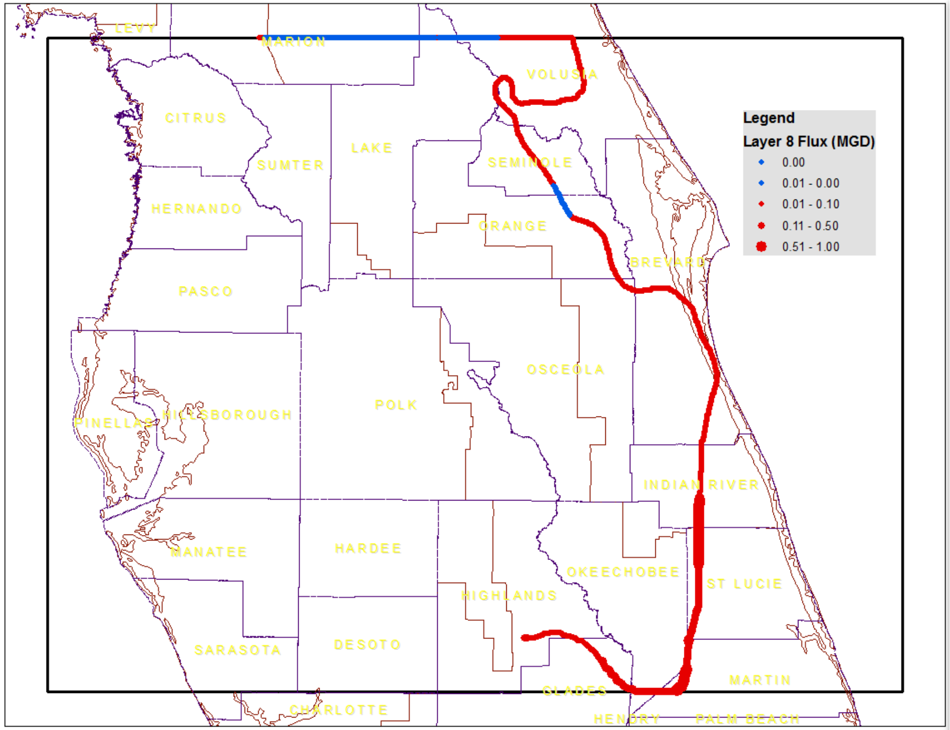


Test Run

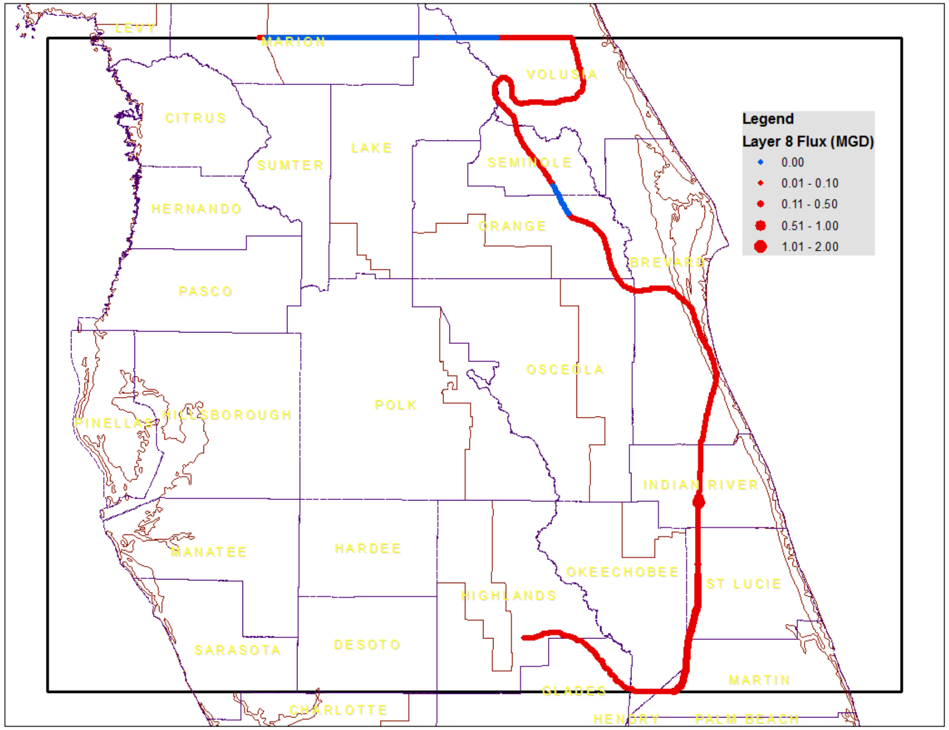


Comparison of Flux in Layer 8

Calibration

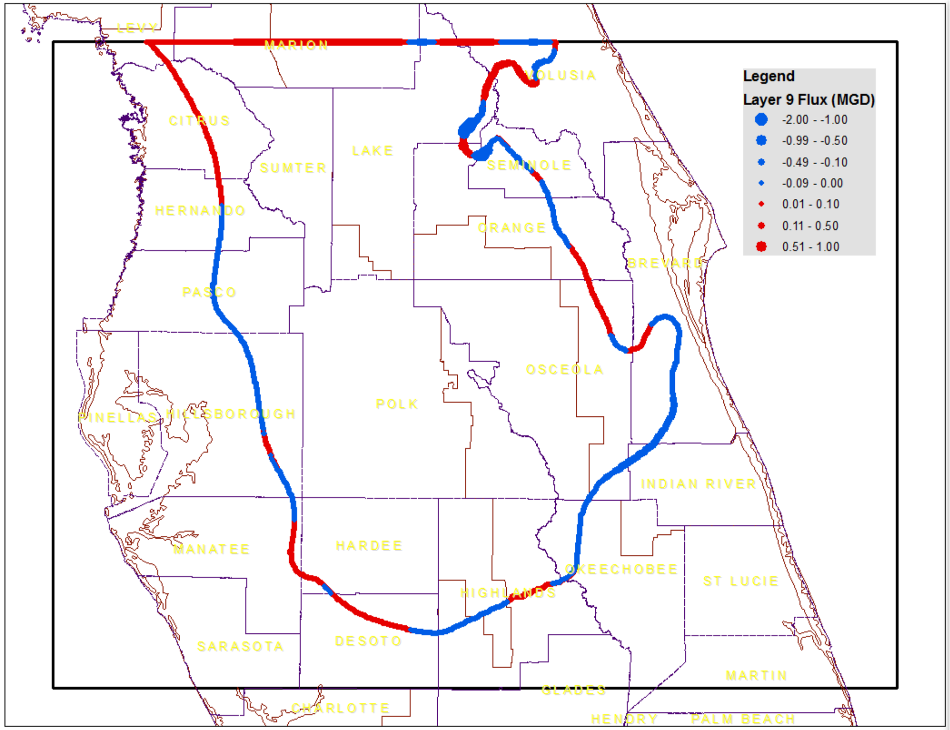


Test Run

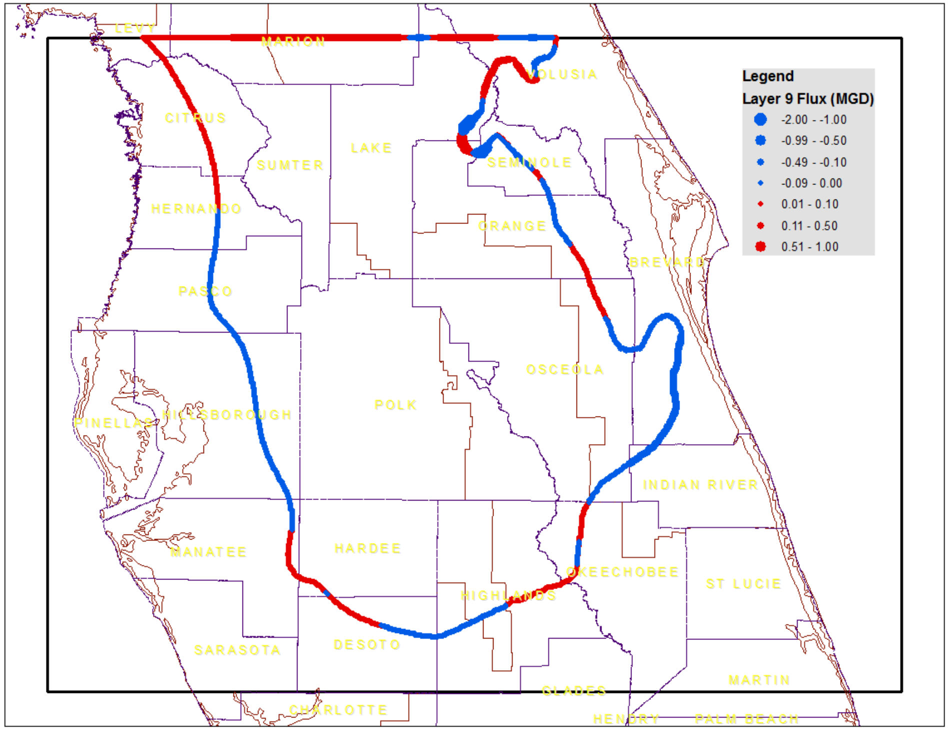


Comparison of Flux in Layer 9

Calibration

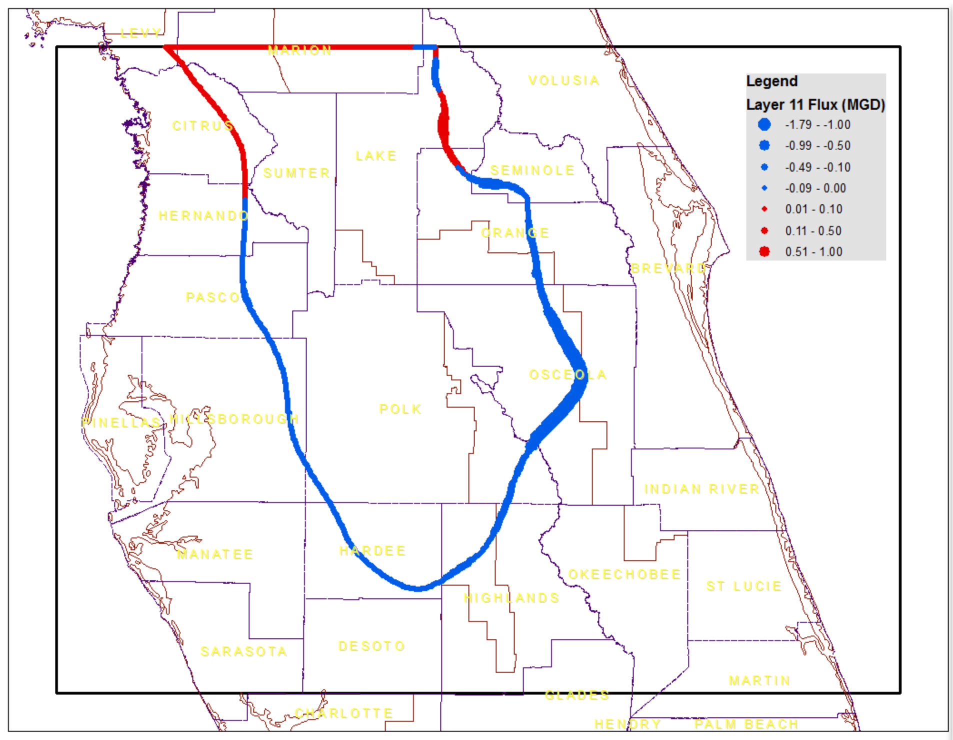


Test Run

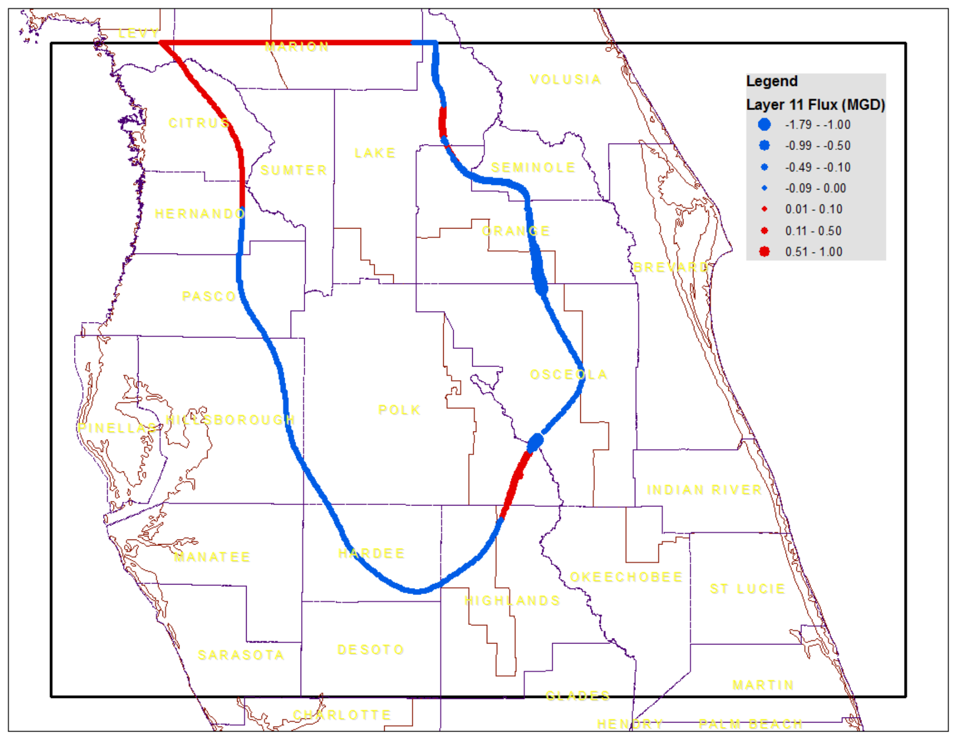


Comparison of Flux in Layer 11

Calibration



Test Run



Calibration Criteria

- Structure Flow Criteria:
  - Deviation of Volume (DV) < 15%
  - Nash-Sutcliffe Efficiency (NS) > 0.5
  - Coefficient of Determination (R^2) > 0.5
- Springflow Criteria:
  - ME within +/- 10% for Mag 1 and Mag 2 springs with continuous measurements
  - ME of within +/- 10% for total springflow
- Baseflow Criteria:
  - ME within an order of magnitude for the sum of all simulated baseflow
- Water Level Criteria:
  - Within CFWI, by Aquifer (SAS, UFA, and LFA):
    - 50% of the wells with MAE < 2.5 ft and 80% of the wells with MAE < 5 ft
  - Model Wide, by Aquifer (SAS, UFA, and LFA):
    - Average RMSE < 5 ft
    - Average Overall ME < 1 ft
    - Average MAE < 5% of the range of all observed heads within that aquifer

CFWI Well Statistics

	Calibration			Final Calibration		
	SA	UFA	LFA	SA	UFA	LFA
Residual Mean	-0.75	0.11	0.6	-0.64	0.34	1.23
Error Standard Dev	3.54	3.83	3.23	3.47	3.75	2.68
5% of Observation Range	8.6	6.2	2.62	8.6	6.2	2.62
Absolute Residual Mean	2.67	3.35	2.4	2.61	3.24	2.48
Error Sum of Squares	3616	2840	248	3442	2729	202
RMS Error	3.61	3.83	3.22	3.53	3.75	2.9
Minimum Residual	-16.8	-12.2	-8.53	-16.51	-11.93	-5.46
Maximum Residual	13.29	10.33	6.6	13.29	10.11	5.73
Number of Observations	277	194	24	277	194	24
Percentage with MAE < 2.5 ft	70%	50%	67%	71%	52%	58%
Percentage with MAE < 5.0 ft	86%	81%	88%	87%	85%	88%
Percentage with R2> 0.4	78%	96%	92%	78%	96%	92%

All values in feet except as noted.

ECFTX Well Statistics

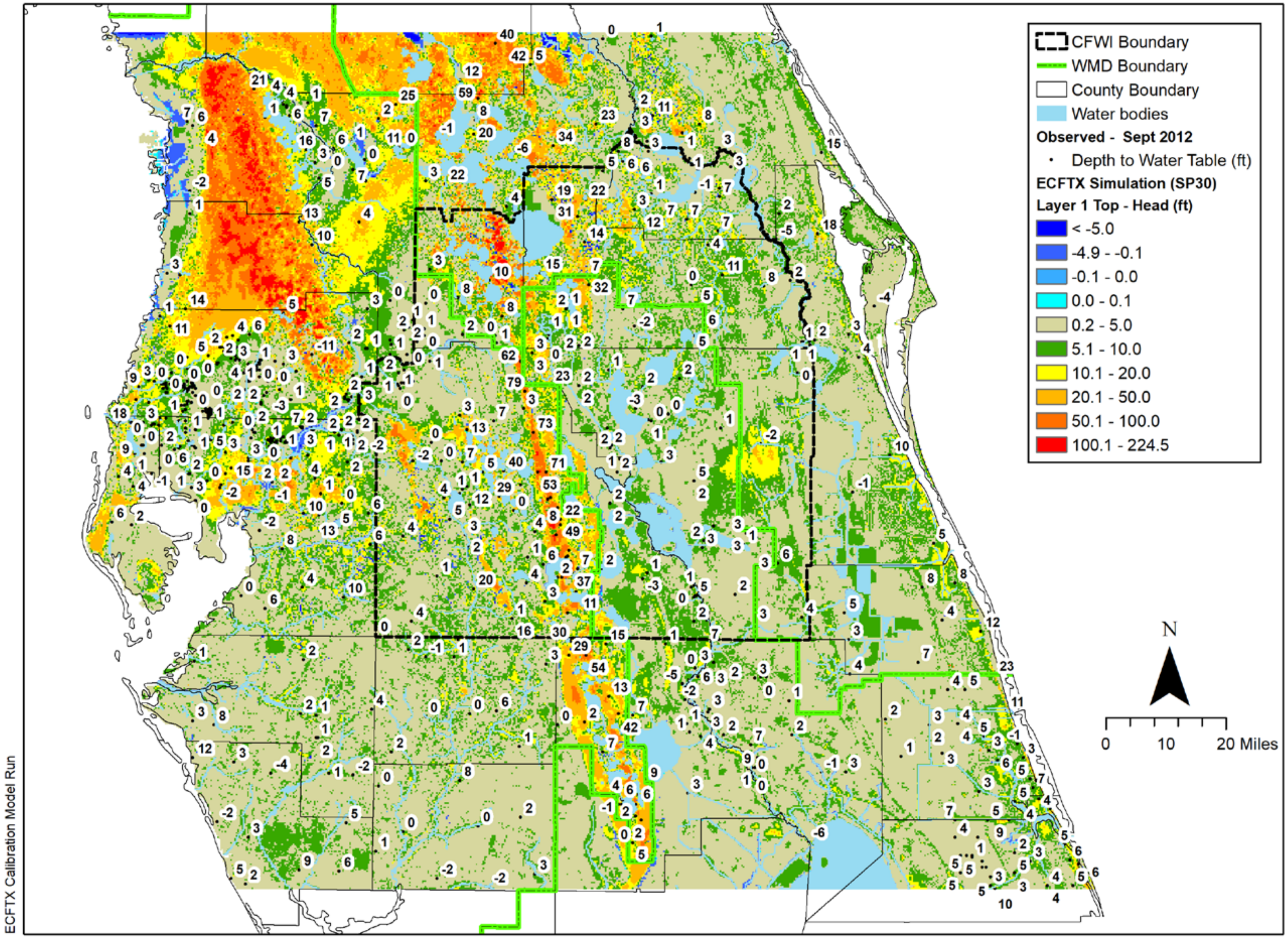
	Calibration			Final Calibration		
	SA	UFA	LFA	SA	UFA	LFA
Residual Mean	-0.5	0.65	-0.12	-0.46	0.46	0.46
Error Standard Dev	4.2	4.72	3.58	4.24	4.7	3.33
5% of Observation Range	8.97	7.59	2.79	8.97	7.59	2.79
Absolute Residual Mean	2.83	3.82	2.56	2.83	3.78	2.65
Error Sum of Squares	17794	21058	371	18156	20666	329
RMS Error	4.22	4.76	3.52	4.27	4.72	3.31
Minimum Residual	-31.5	-22.3	-10.2	-31.65	-22.1	-10.19
Maximum Residual	18.47	19.07	6.6	21.15	19.14	5.73
Number of Observations	997	928	30	997	928	30
Percentage with MAE < 2.5 ft	68%	47%	67%	68%	48%	60%
Percentage with MAE < 5.0 ft	88%	76%	87%	88%	76%	87%
Percentage with R2> 0.4	78%	93%	93%	78%	93%	93%

All values in feet except as noted.

Spring Calibration Statistics

Spring Name	Observed Flux (cfs)	Calibration		Final Calibration	
		Flux (cfs)	Error	Flux (cfs)	Error
LITHIA SPRING MAJOR	34.7	33.3	-4.2%	33.2	-4.4%
BUCKHORN MAIN SPRING	12.2	12.1	-0.7%	12.1	-0.9%
SULPHUR SPRING (HILLSBOROUGH)	34.7	35.4	2.0%	35.4	2.0%
CRYSTAL MAIN SPRING (PASCO)	45.5	46.3	1.9%	46.4	2.0%
WEEKI WACHEE SPRING	160.4	167.3	4.3%	167.3	4.4%
CHASSAHOWITZKA SPRING MAIN	59.6	59.2	-0.8%	59.3	-0.6%
HOMOSASSA SPRING #1	83.5	84.4	1.0%	84.5	1.1%
GUM SPRING MAIN	63.8	66.4	4.1%	64.8	1.5%
RAINBOW SPRING #1	71.8	73.9	2.8%	73.3	2.0%
APOPKA SPRING	24.9	24.3	-2.4%	24.8	-0.1%
SANLANDO SPRINGS	18.8	20.1	6.6%	19.9	5.4%
STARBUCK SPRING	12.1	12.7	4.8%	12.6	3.9%
WEKIWA SPRING (ORANGE)	61.0	64.9	6.3%	64.6	5.8%
BUGG SPRING (LAKE)	10.6	9.6	-9.3%	9.7	-8.2%
ROCK SPRINGS (ORANGE)	54.9	52.2	-5.0%	51.6	-6.1%
VOLUSIA BLUE SPRING	143.6	132.6	-7.7%	132.4	-7.9%
ALEXANDER SPRING	100.1	99.1	-1.0%	98.9	-1.2%

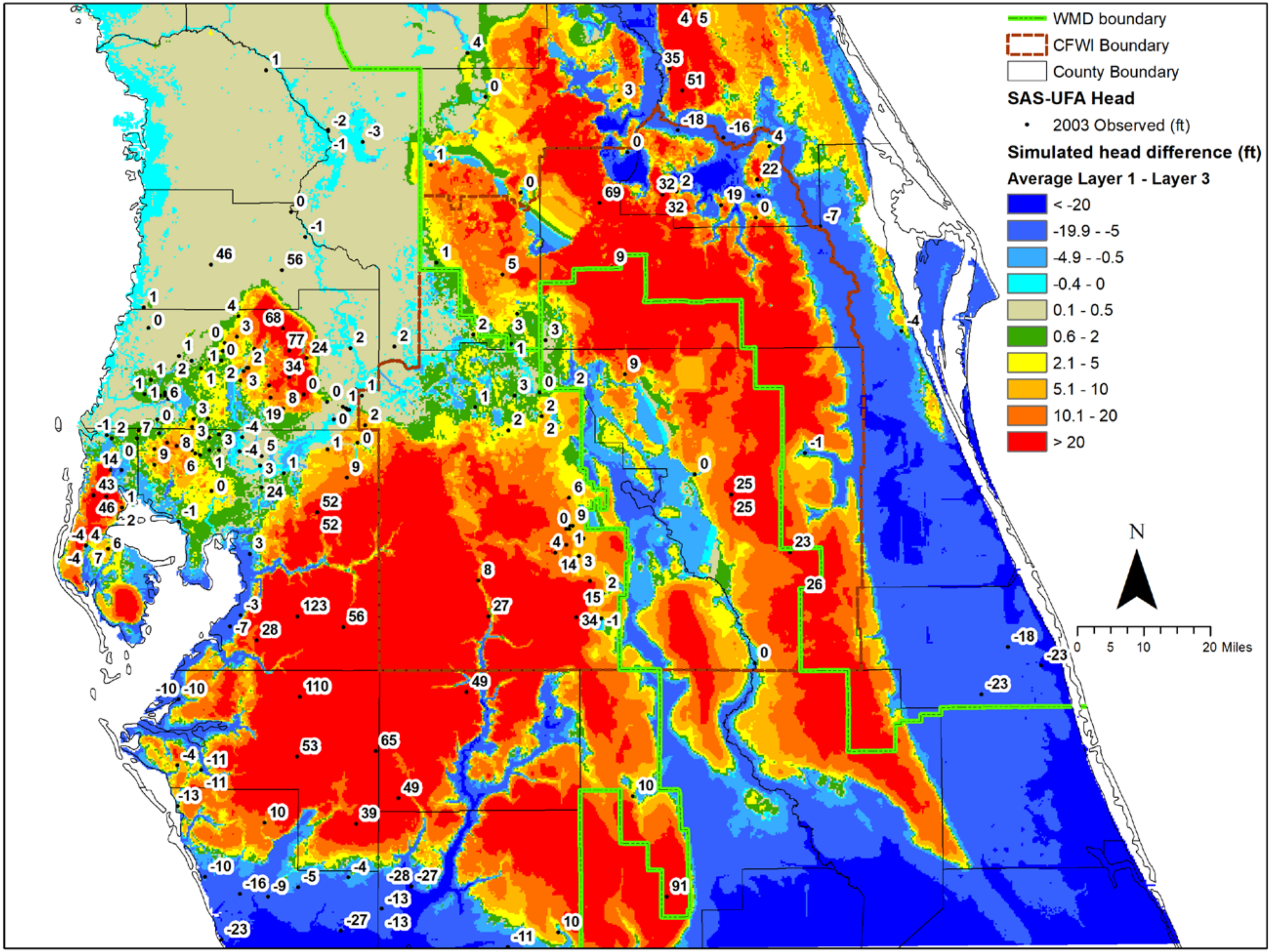
Simulated Depth to Water Table (Sept 2012)



Date: 8/12/2019

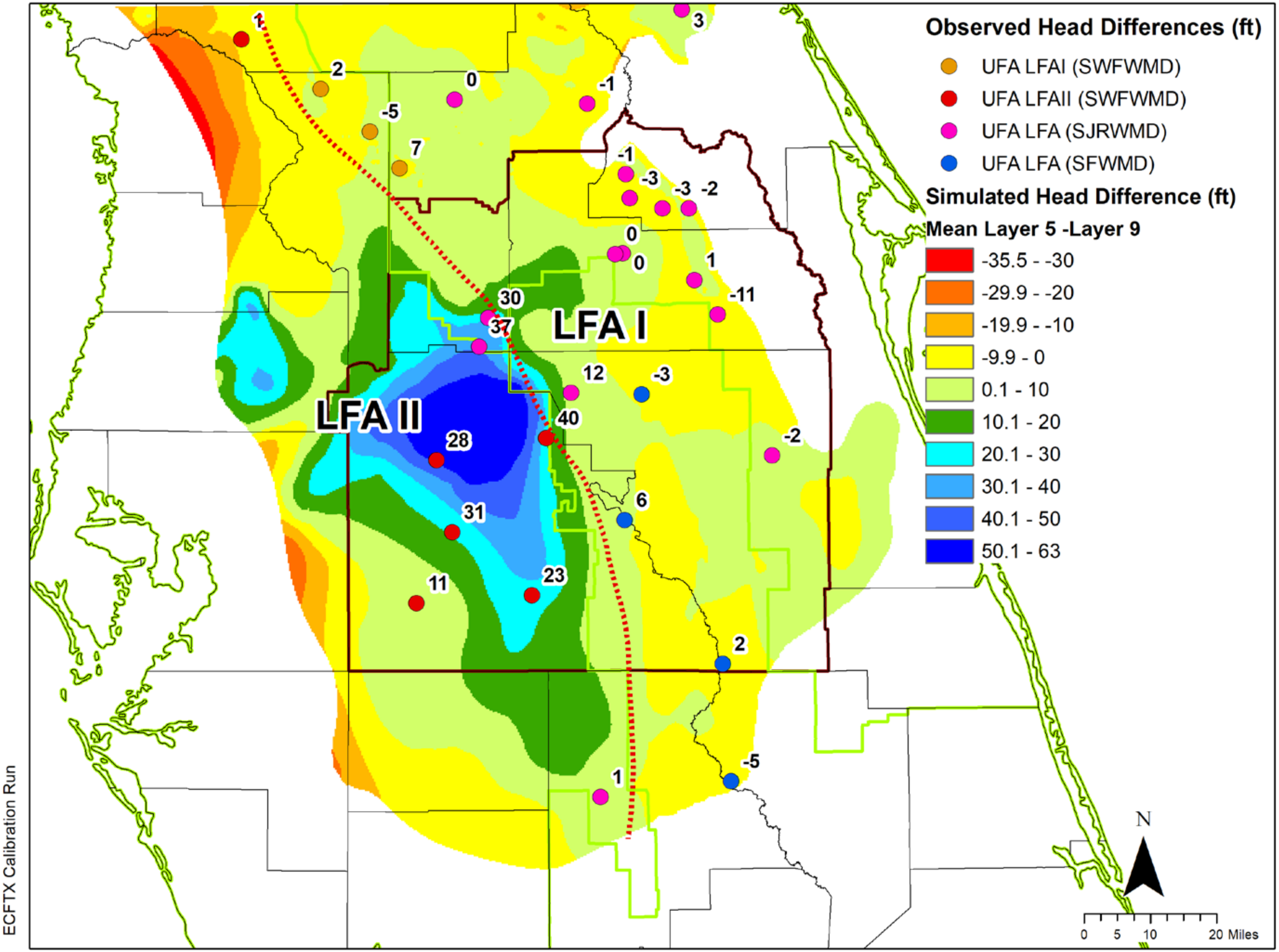
Simulated Depth to Water Table

Simulated Head Difference between SA and UFA (2003)



Date: 8/12/2019

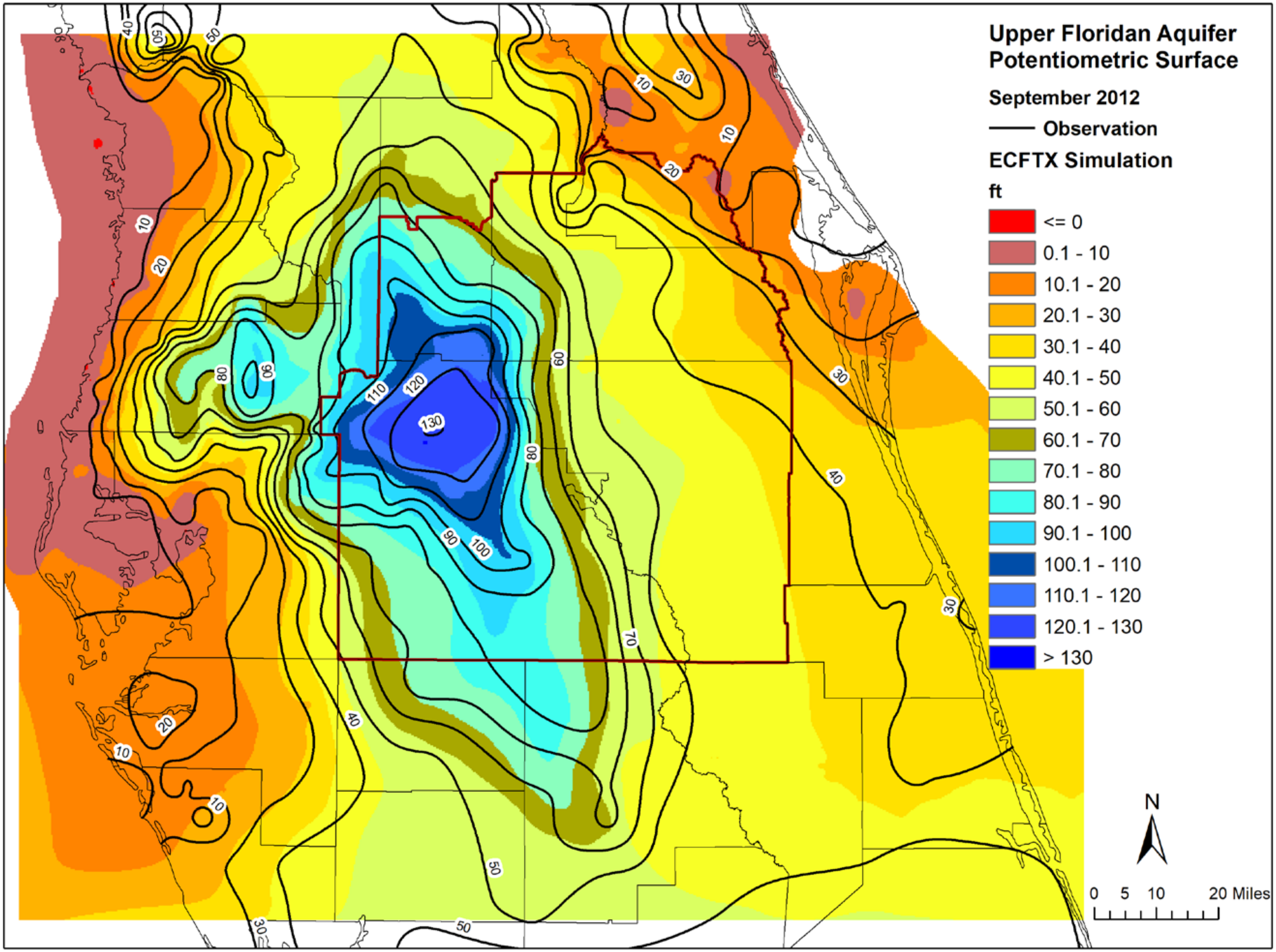
Simulated SAS - UFA Head Differences



Date: 8/12/2019

Simulated UFA-LFA Head Differences

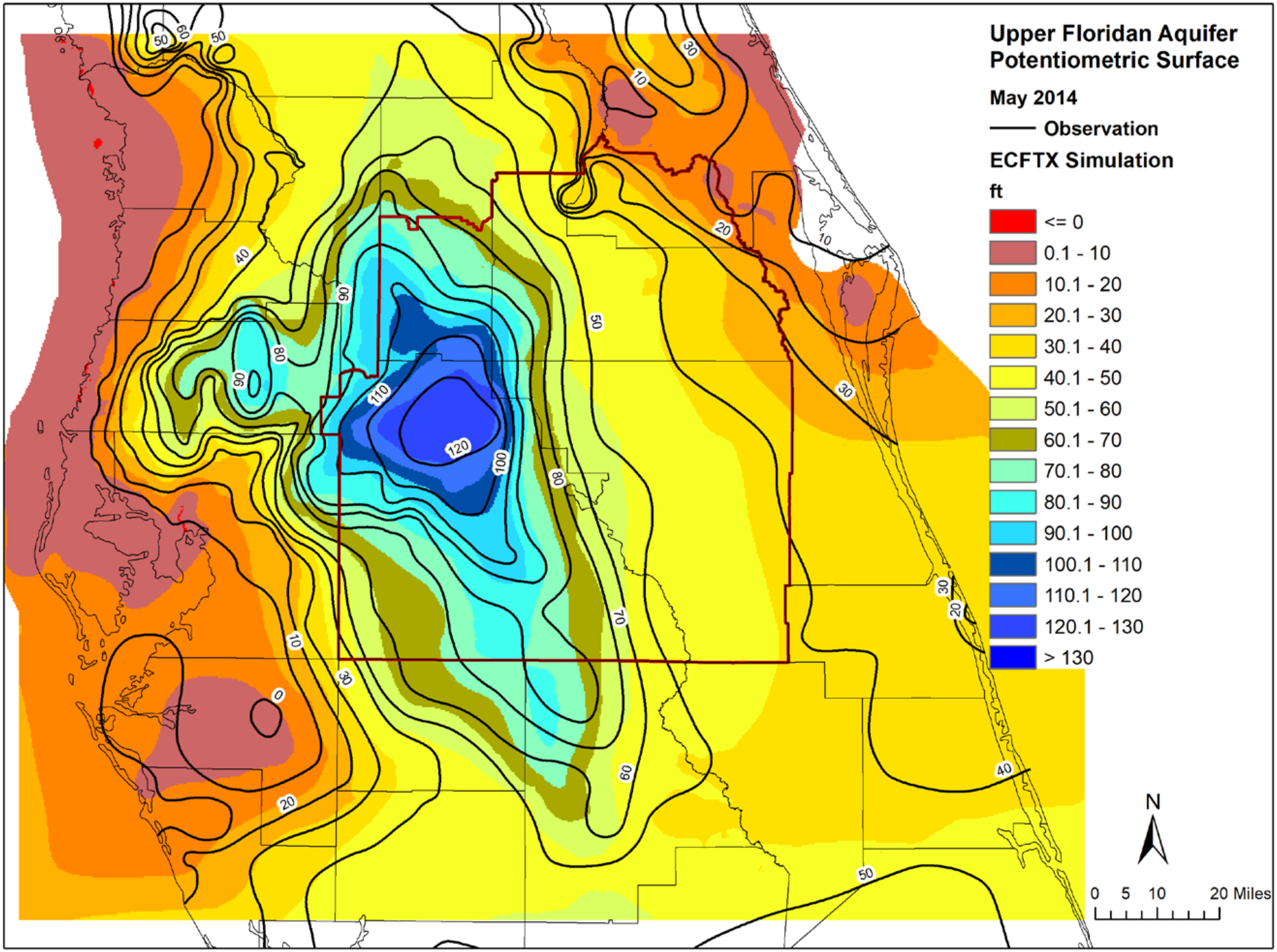
Simulated UFA Head compared to Sept 2012 USGS potentiometric surface



Date: 8/9/2019

Comparison between observed and simulated UFA potentiometric surface

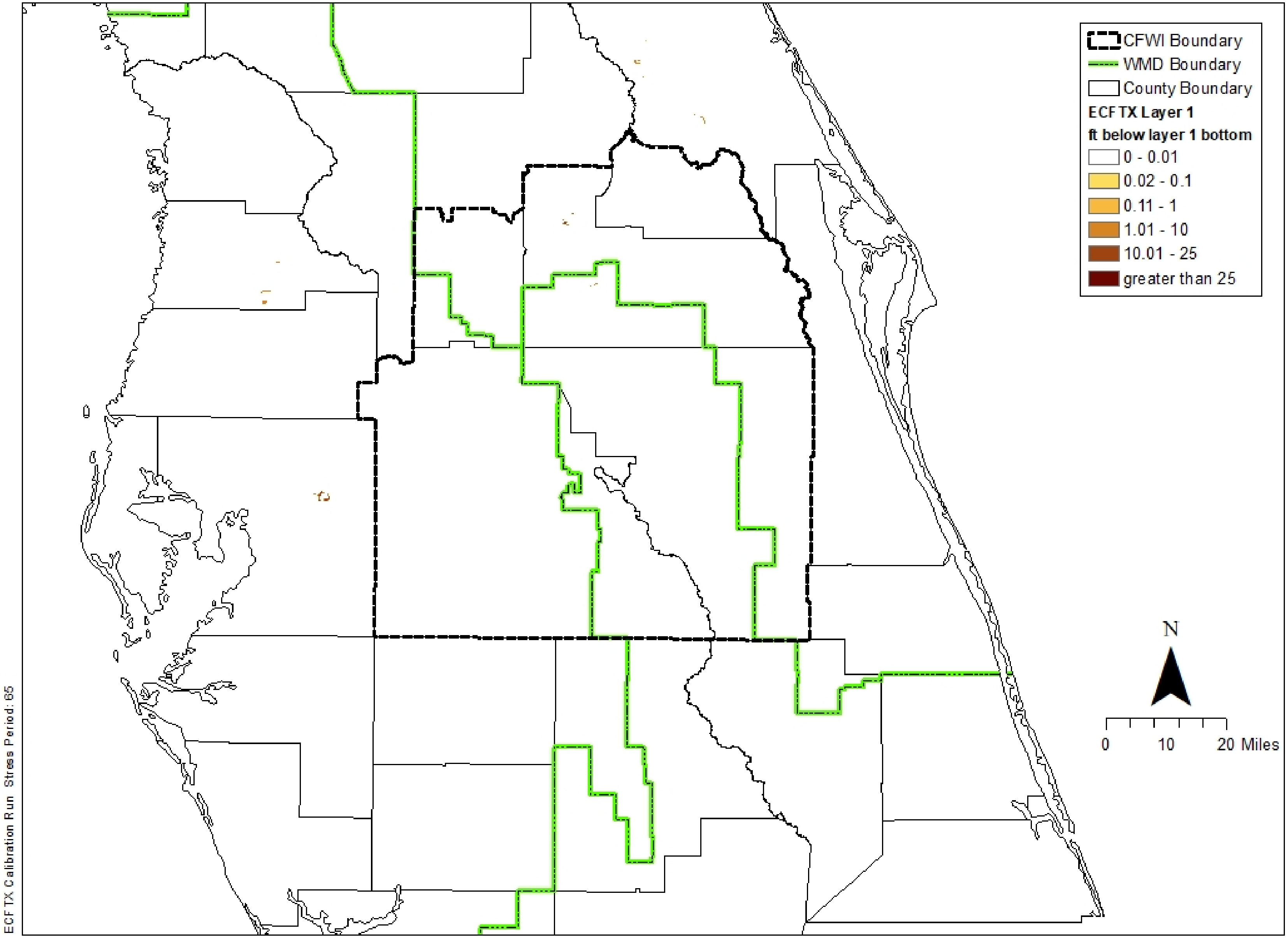
Simulated UFA Head compared to May 2014 USGS potentiometric surface



Date: 8/9/2019

Comparison between observed and simulated UFA potentiometric surface

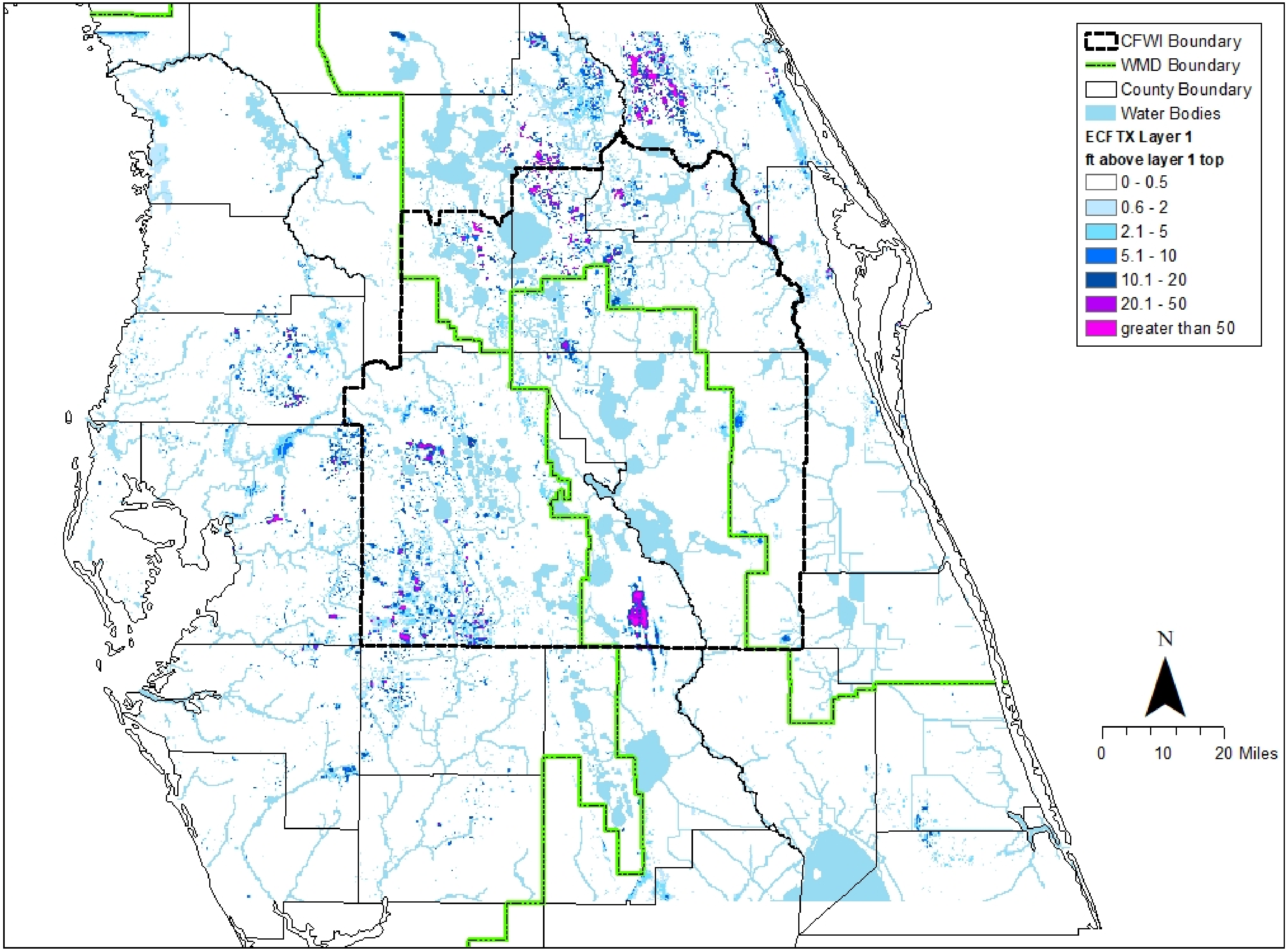
April 2009 Dry cells (worst month)



Date: 8/9/2019

Dry Cells

Sept 2004 flooded cells (worst month)

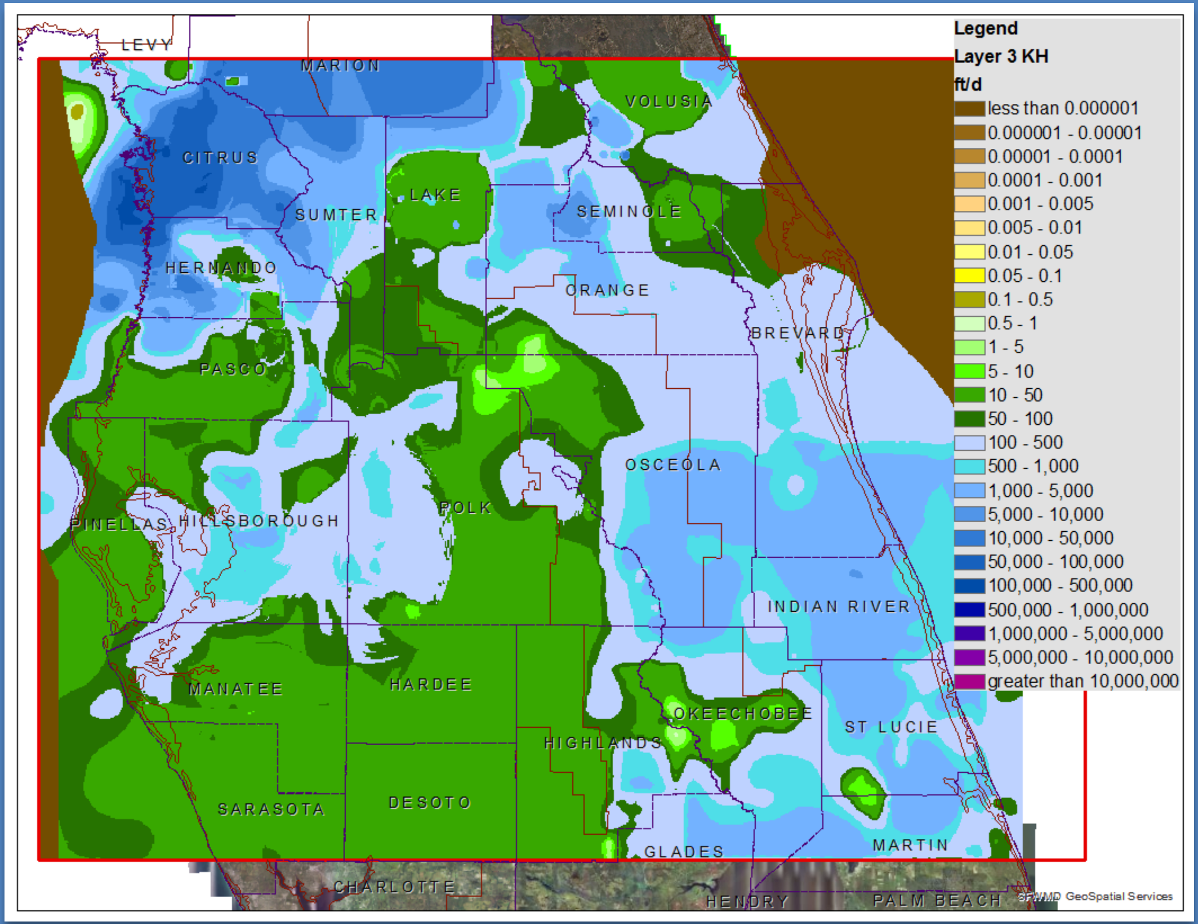


ECFTX Calibration Run Stress Period: 9

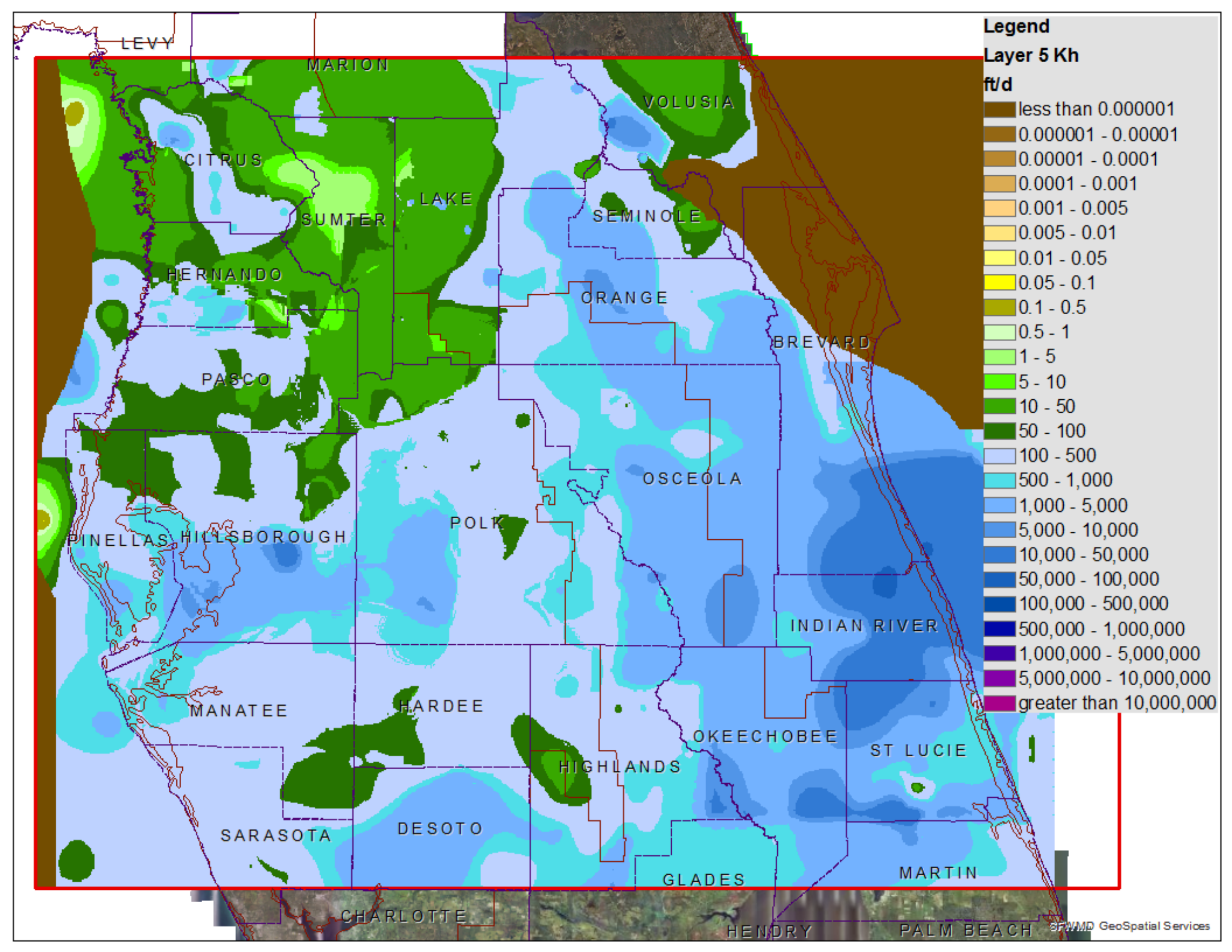
Date: 8/9/2019

Flooded Cells

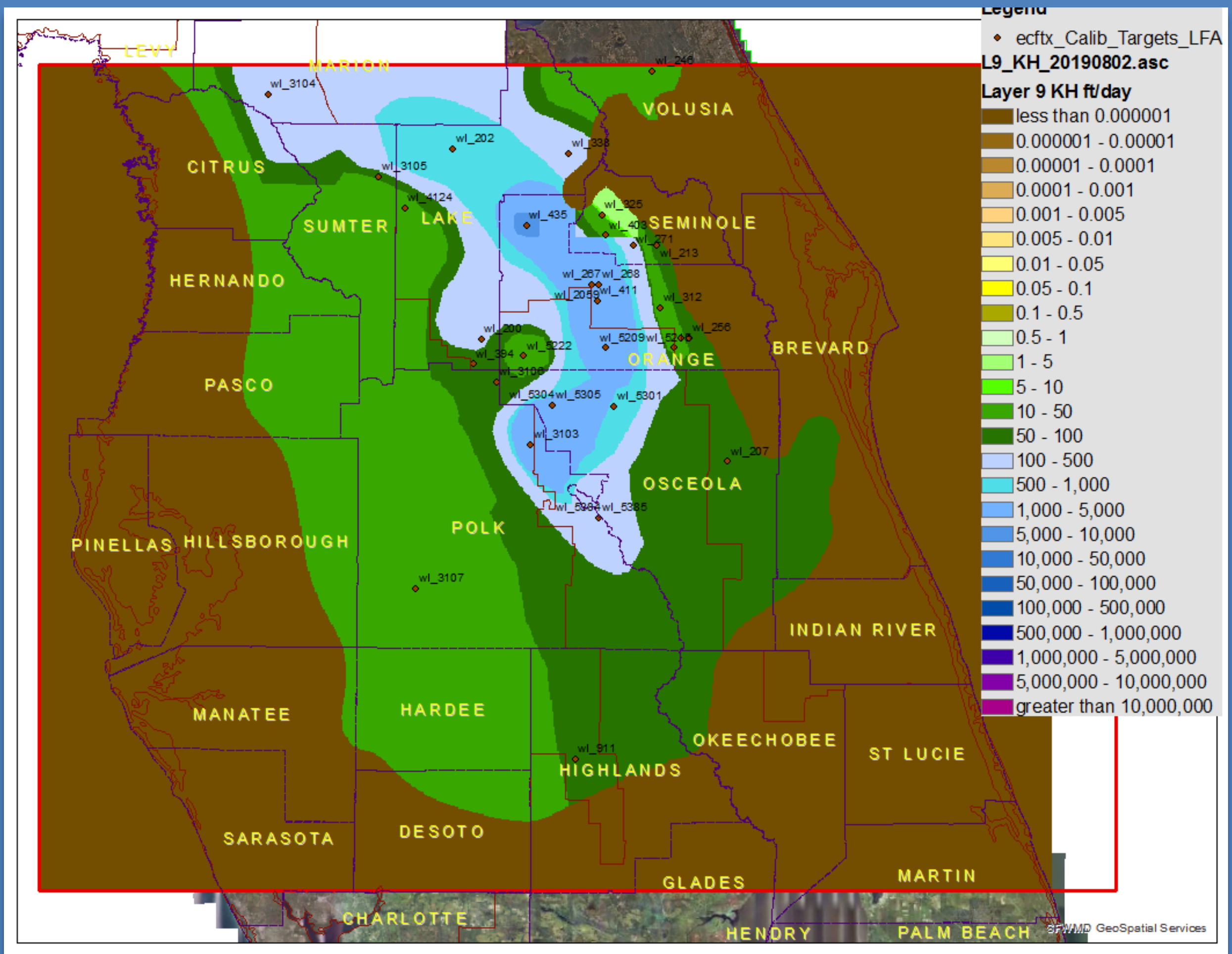
Layer 3 Hydraulic Conductivity



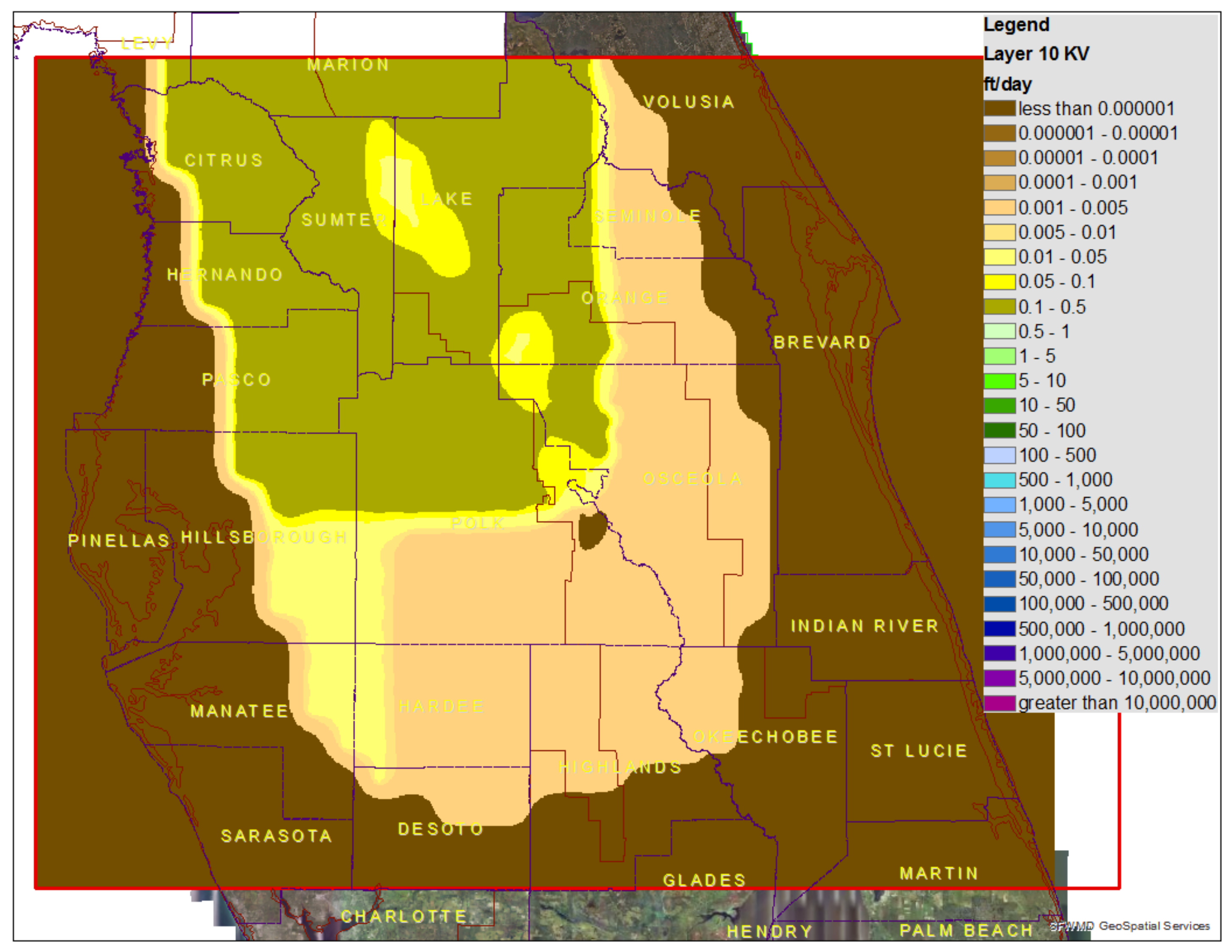
Layer 5 Hydraulic Conductivity



Layer 9 Hydraulic Conductivity

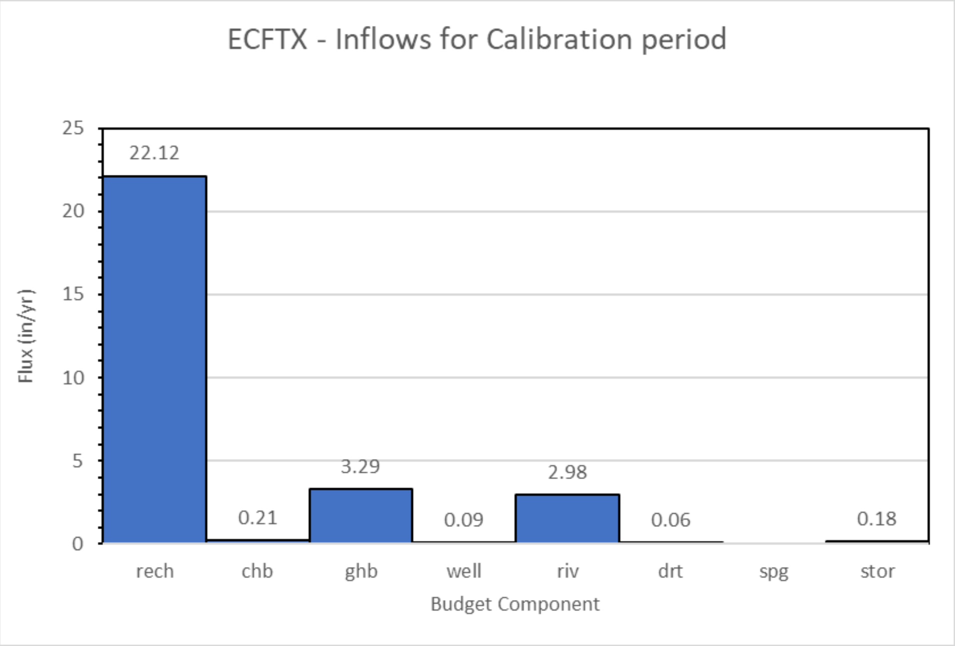


Layer 10 Hydraulic Conductivity

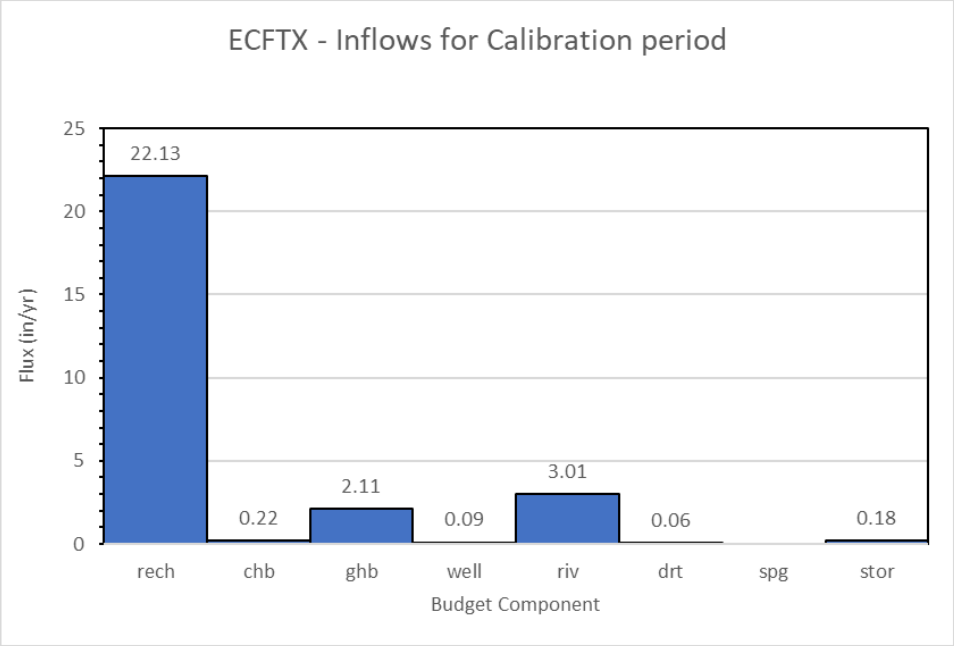


Water Budget Inflows for the previous Calibrated Model and Current Calibrated Model

Previous

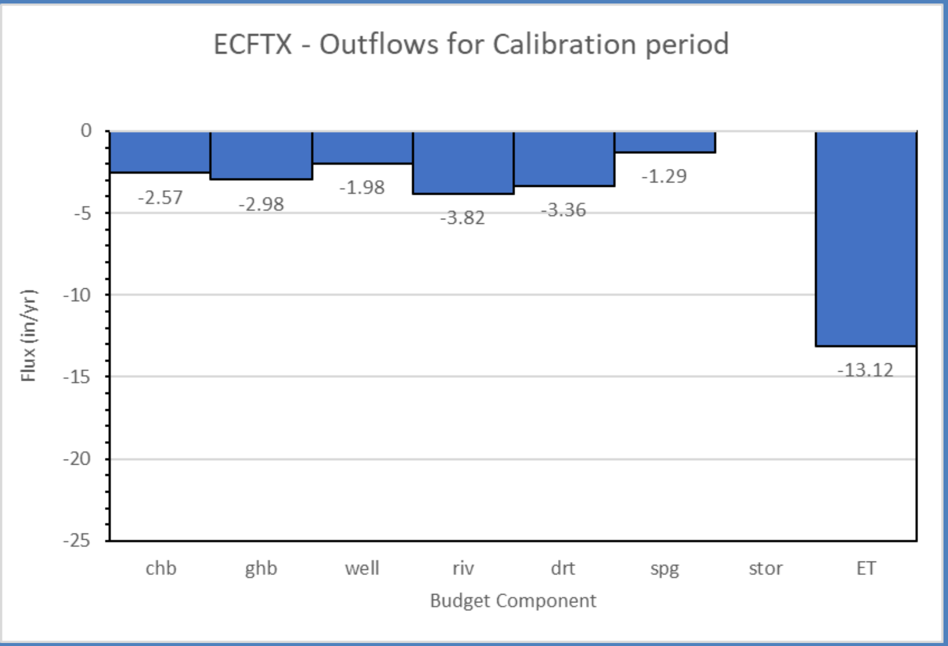


Current

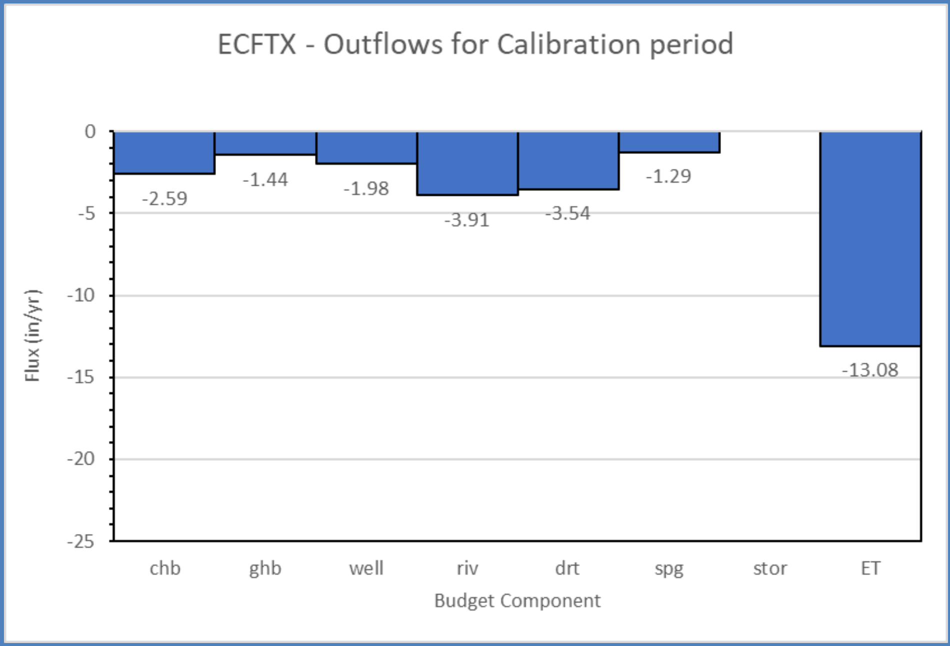


Water Budget Outflows for the previous Calibrated Model and Current Calibrated Model

Previous

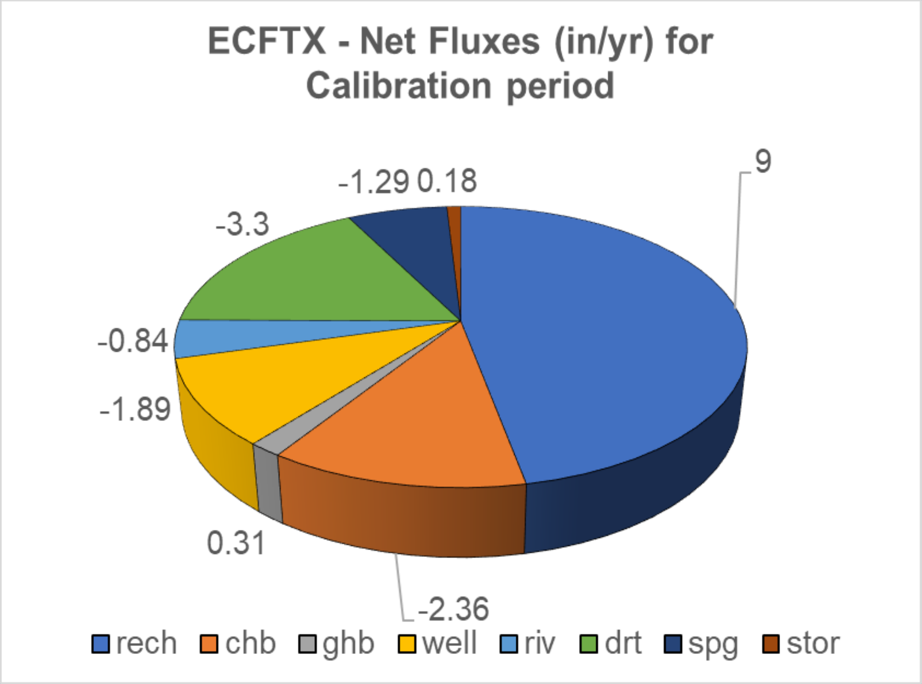


Current

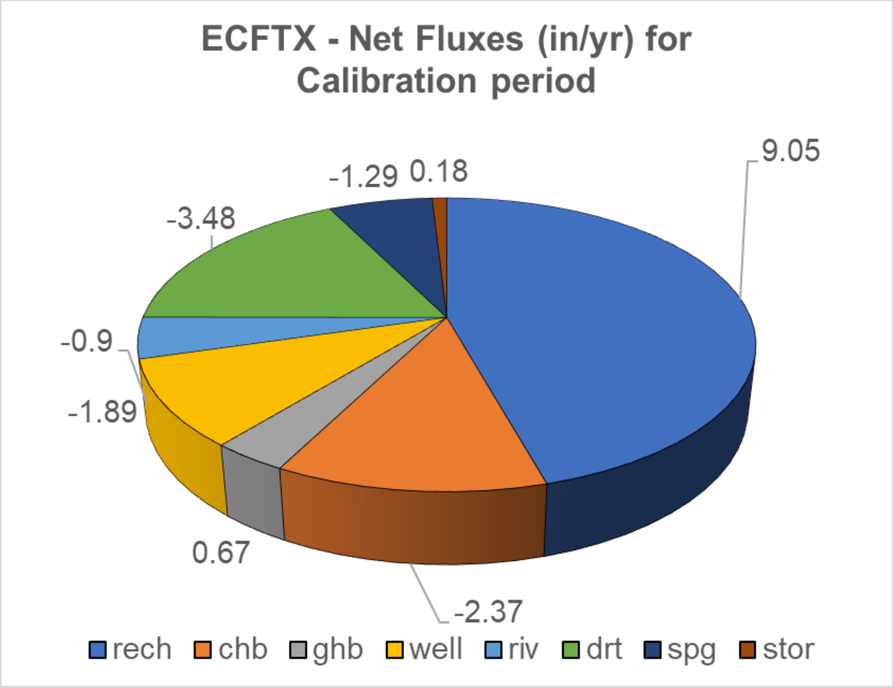


Water Budget Net flows for the previous Calibrated Model and Current Calibrated Model

Previous

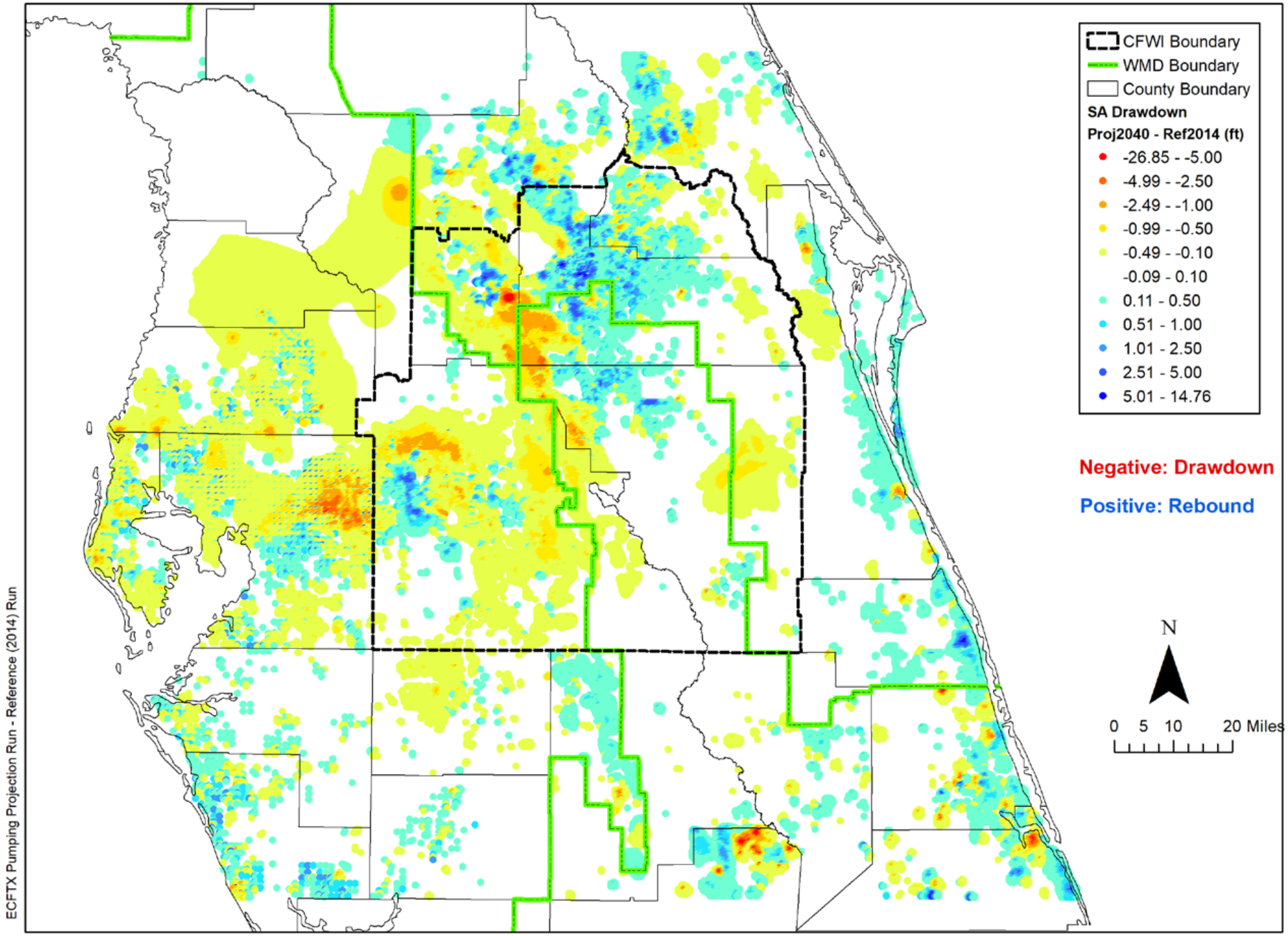


Current



Predicted Drawdown from 2014 to 2040 with Projected Pumping Increase of 458 mgd

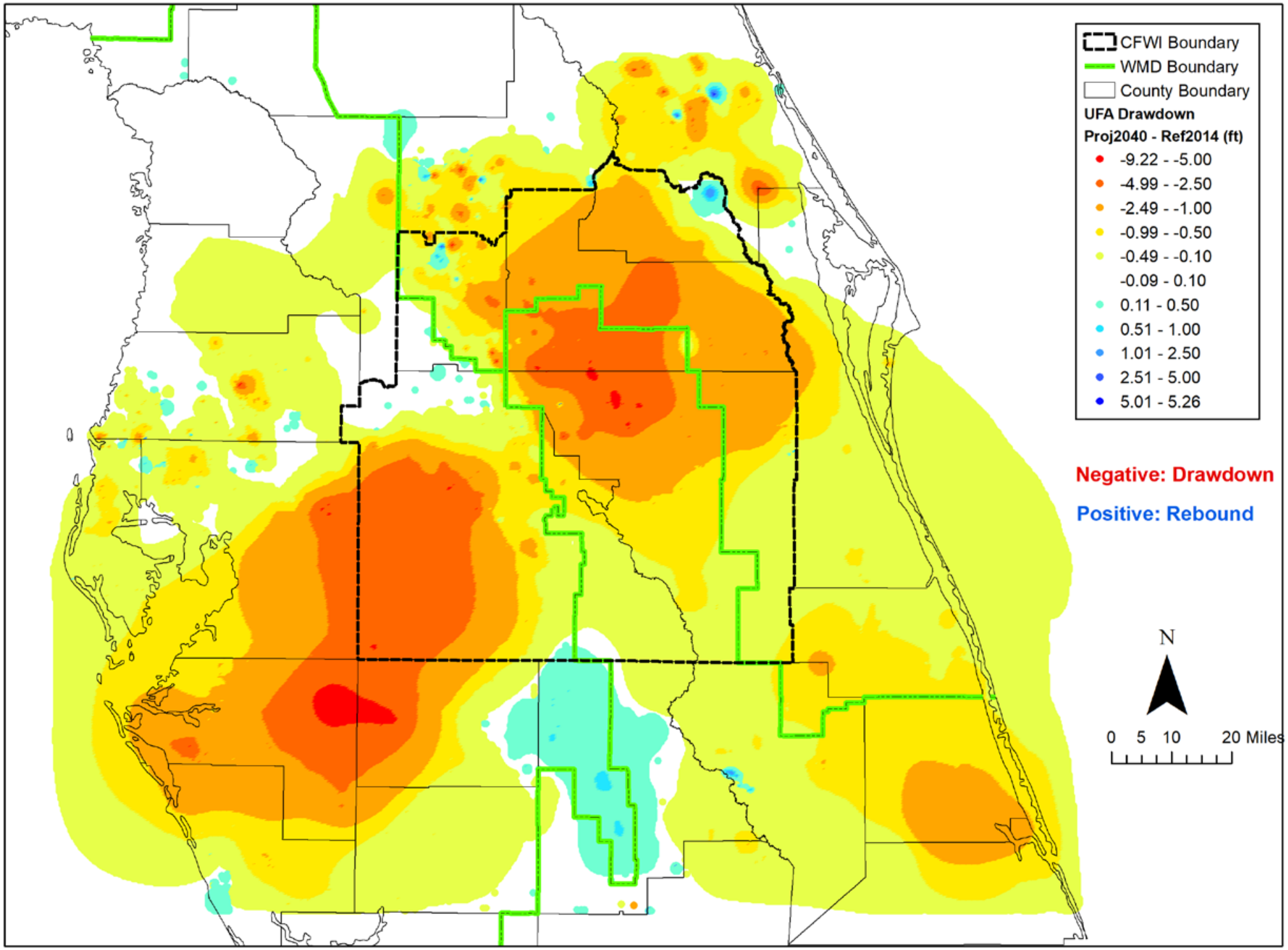
Predicted Surfical Aquifer Water Level Change from 2014 to 2040 with Projected Pumping Increase of 458 mgd



Date: 8/8/2019

Simulated Head Difference

Predicted UFA (Lay 3) Water Level Change from 2014 to 2040 with Projected Pumping Increase of 458 mgd

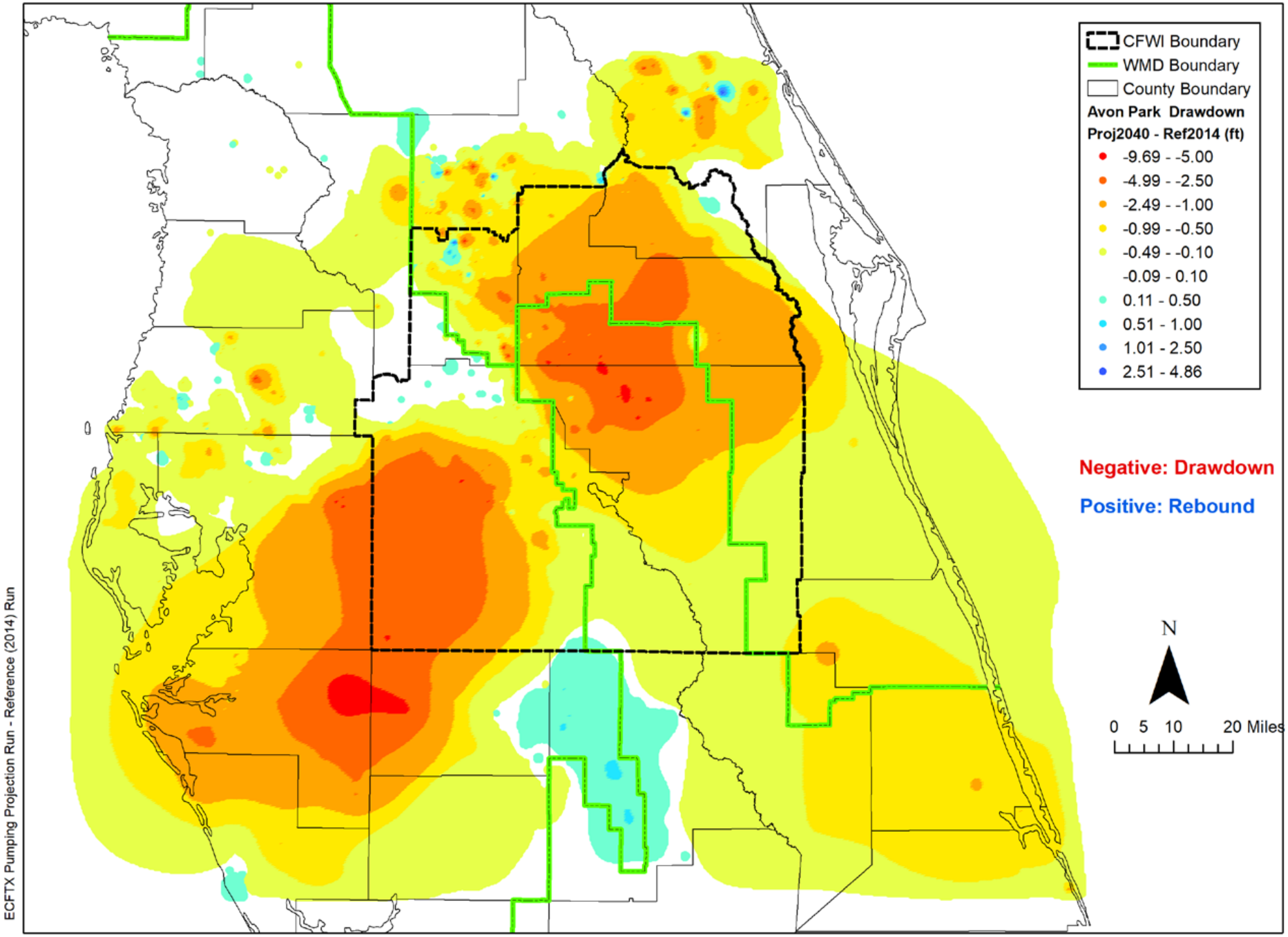


ECFTX Pumping Projection Run - Reference (2014) Run

Date: 8/8/2019

Simulated Head Difference

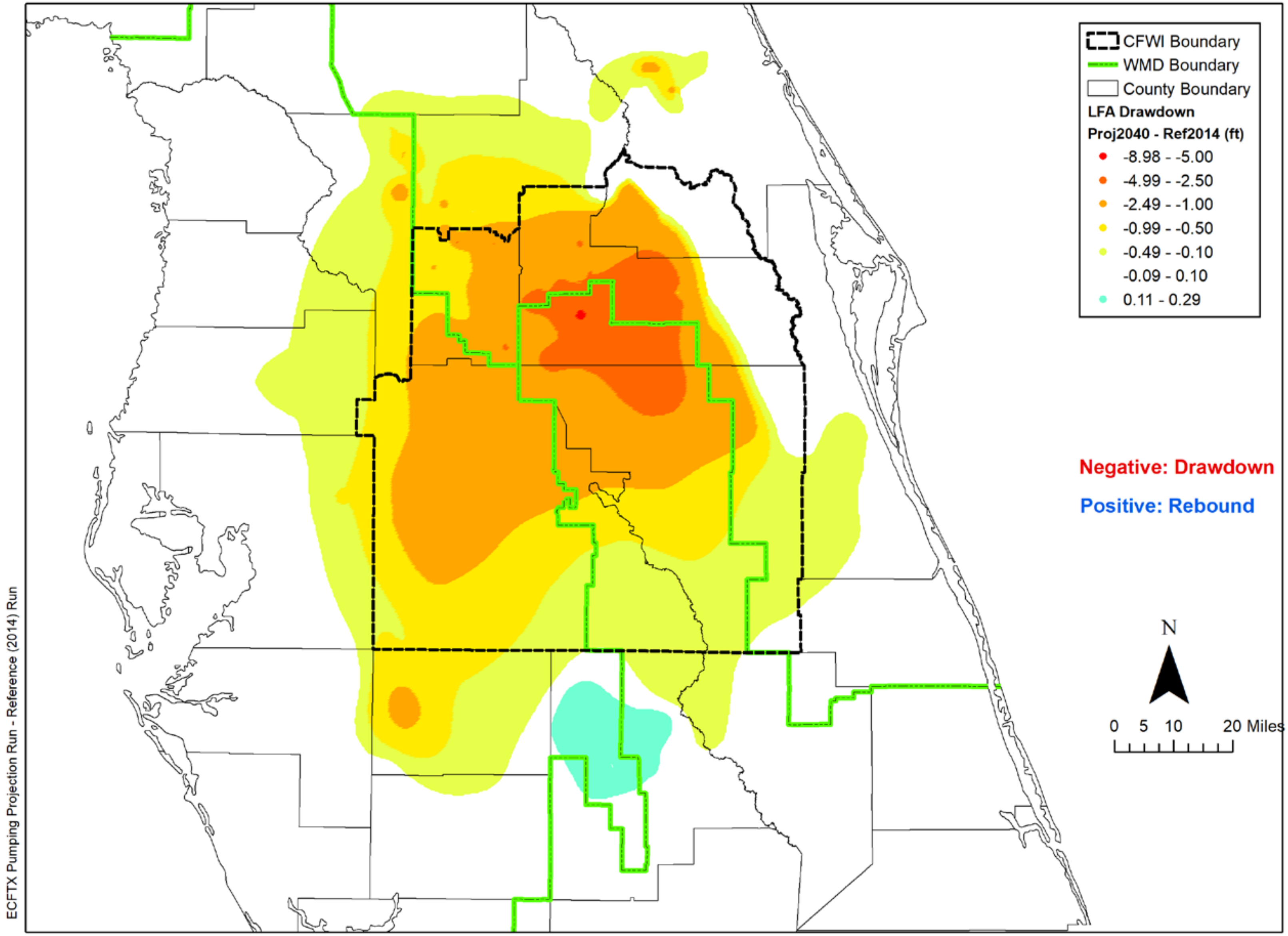
Predicted AP (Lay 5) Water Level Change from 2014 to 2040 with Projected Pumping Increase of 458 mgd



Date: 8/8/2019

Simulated Head Difference

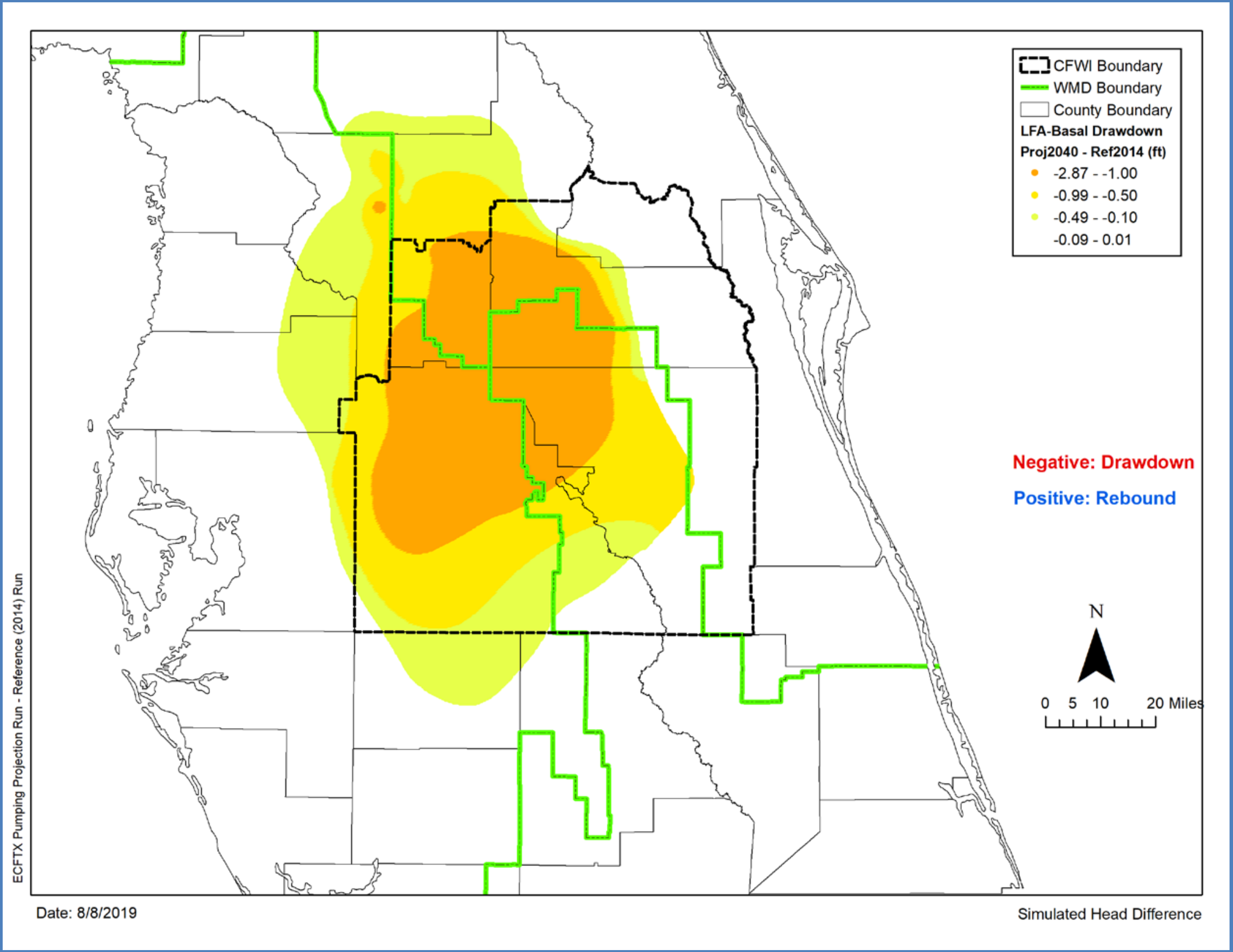
Predicted LFA (Lay 9)Water Level Change from 2014 to 2040 with Projected Pumping Increase of 458 mgd



Date: 8/8/2019

Simulated Head Difference

Predicted LFA (Lay 11) Water Level Change from 2014 to 2040 with Projected Pumping Increase of 458 mgd

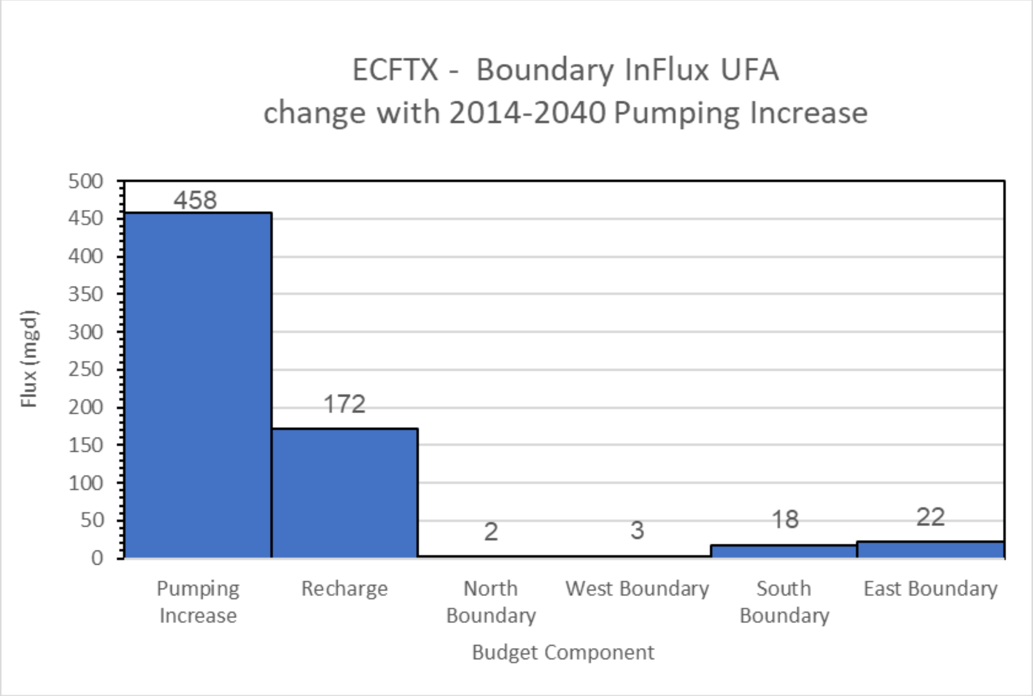


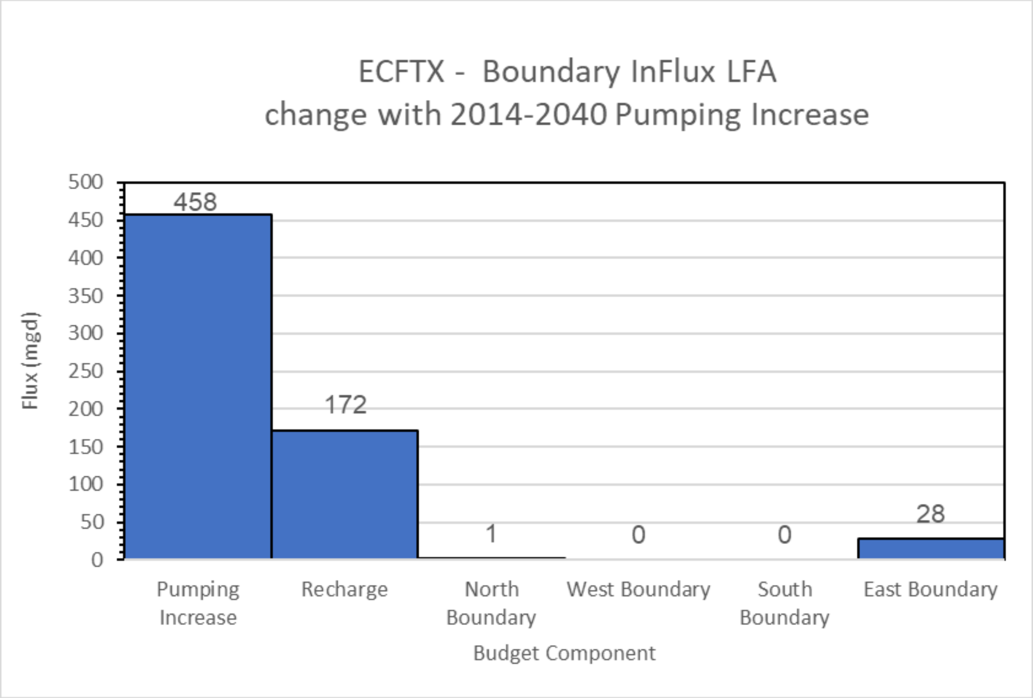
Simulated Change of Spring Flux

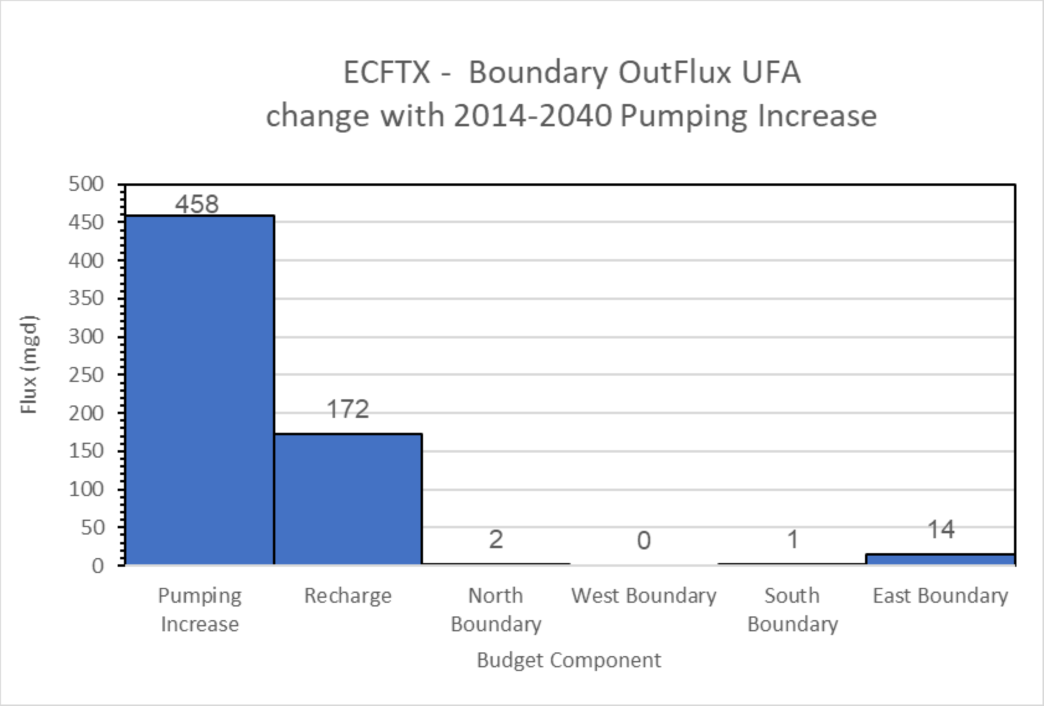
SPRING_NAM	Reference 2014	Projection 2040	Flux Change
LITHIA SPRING MAJOR	36.9	32.6	-11.6%
BUCKHORN MAIN SPRING	13.1	12.0	-8.3%
SULPHUR SPRING (HILLSBOROUGH)	35.7	35.2	-1.4%
CRYSTAL MAIN SPRING (PASCO)	47.0	46.5	-1.2%
WEEKI WACHEE SPRING	168.7	167.4	-0.8%
CHASSAHOWITZKA SPRING MAIN	59.7	59.4	-0.6%
HOMOSASSA SPRING #1	84.7	84.5	-0.2%
GUM SPRING MAIN	65.1	64.6	-0.8%
RAINBOW SPRING #1	73.3	73.3	-0.1%
APOPKA SPRING	25.0	21.9	-12.0%
SANLANDO SPRINGS	20.4	18.4	-9.7%
STARBUCK SPRING	12.8	11.9	-7.3%
WEKIWA SPRING (ORANGE)	65.3	62.6	-4.1%
BUGG SPRING (LAKE)	9.6	8.9	-7.3%
ROCK SPRINGS (ORANGE)	52.2	49.7	-4.8%
VOLUSIA BLUE SPRING	133.6	131.2	-1.8%
ALEXANDER SPRING	98.9	98.9	0.0%

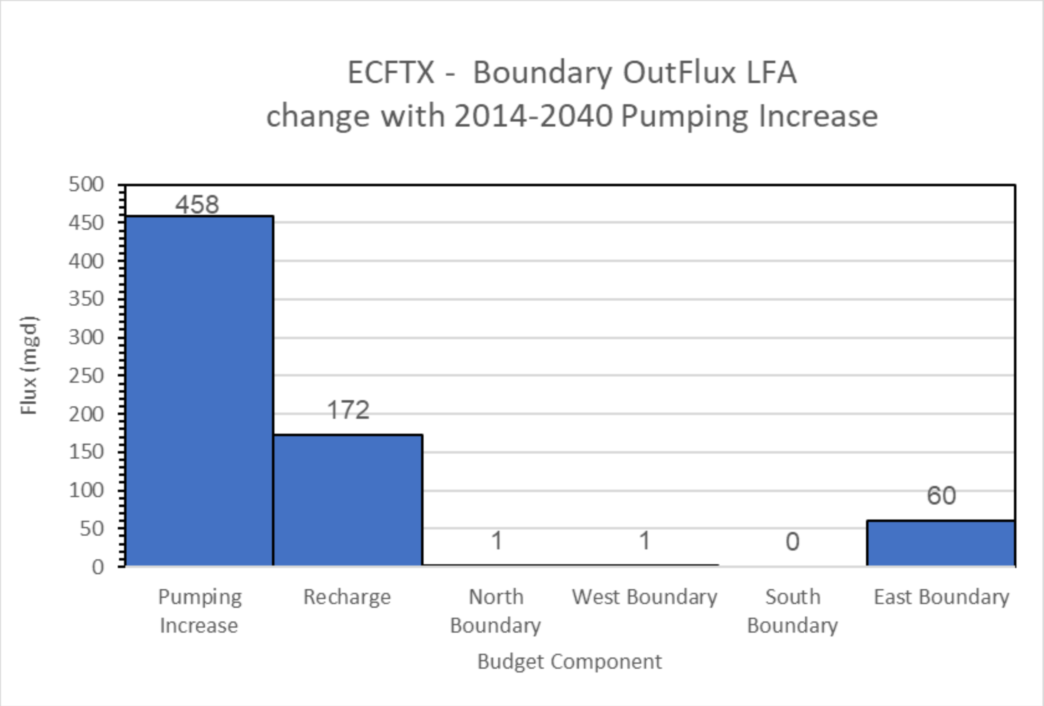
Changes in GHB flow for the 2014-2040 future scenario run (Increase of 458 mgd of GW Withdrawals) by model boundary segment (MGD)

	North			South			East			West		
Layer	**Influx**	**Outflux**	**Netflux**	**Influx**	**Outflux**	**Netflux**	**Influx**	**Outflux**	**Netflux**	**Influx**	**Outflux**	**Netflux**
1	(0)	(0)	(0)	(1)	(0)	(2)	-	-	-	-	-	-
2	1	0	1	(0)	(0)	(0)	0	0	0	0	0	0
3	1	2	3	3	1	4	1	5	6	0	0	1
4	0	0	1	0	1	1	0	0	0	0	0	0
5	0	0	1	14	0	14	19	9	28	2	0	2
6	0	(0)	0	0	0	0	-	-	-	0	0	0
7	0	0	0	0	0	0	1	0	1	0	0	0
8	0	0	0	0	-	0	1	0	1	-	0	-
9	1	0	1	-	-	-	20	13	32	0	0	0
1	-	-	-	-	-	-	-	-	-	-	0	-
11	0	0	0	-	-	-	8	47	56	0	0	1
Total	3	3	6	17	1	18	51	74	124	3	1	4


ECFTX - Boundary InFlux UFA
change with 2014-2040 Pumping Increase

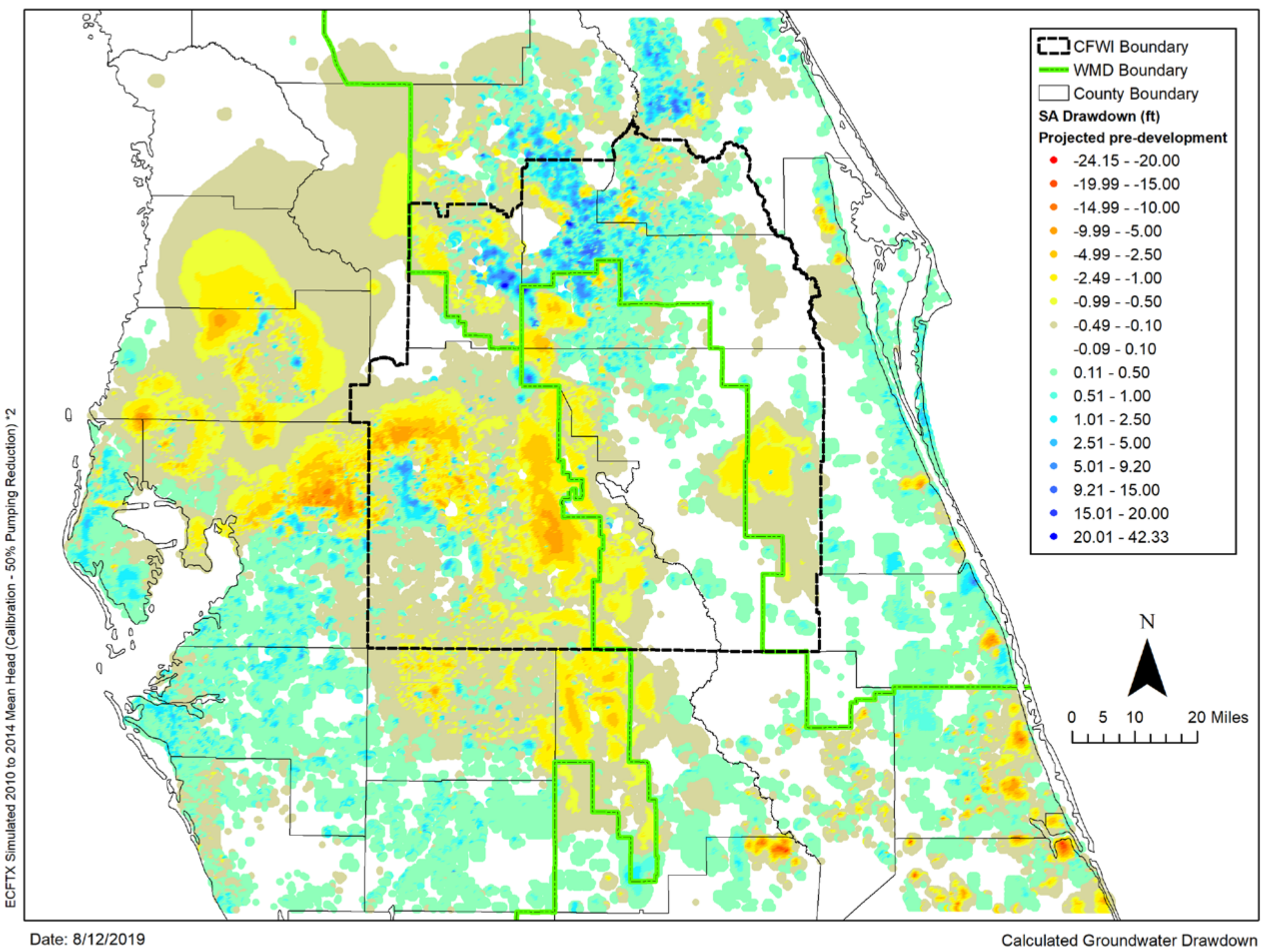

ECFTX - Boundary InFlux LFA
change with 2014-2040 Pumping Increase


ECFTX - Boundary OutFlux UFA
change with 2014-2040 Pumping Increase
500
450
400
350
300
250
200
150
100
50
0
Flux (mgd)
458
172
2
0
1
14
Pumping Increase
Recharge
North Boundary
West Boundary
South Boundary
East Boundary
Budget Component

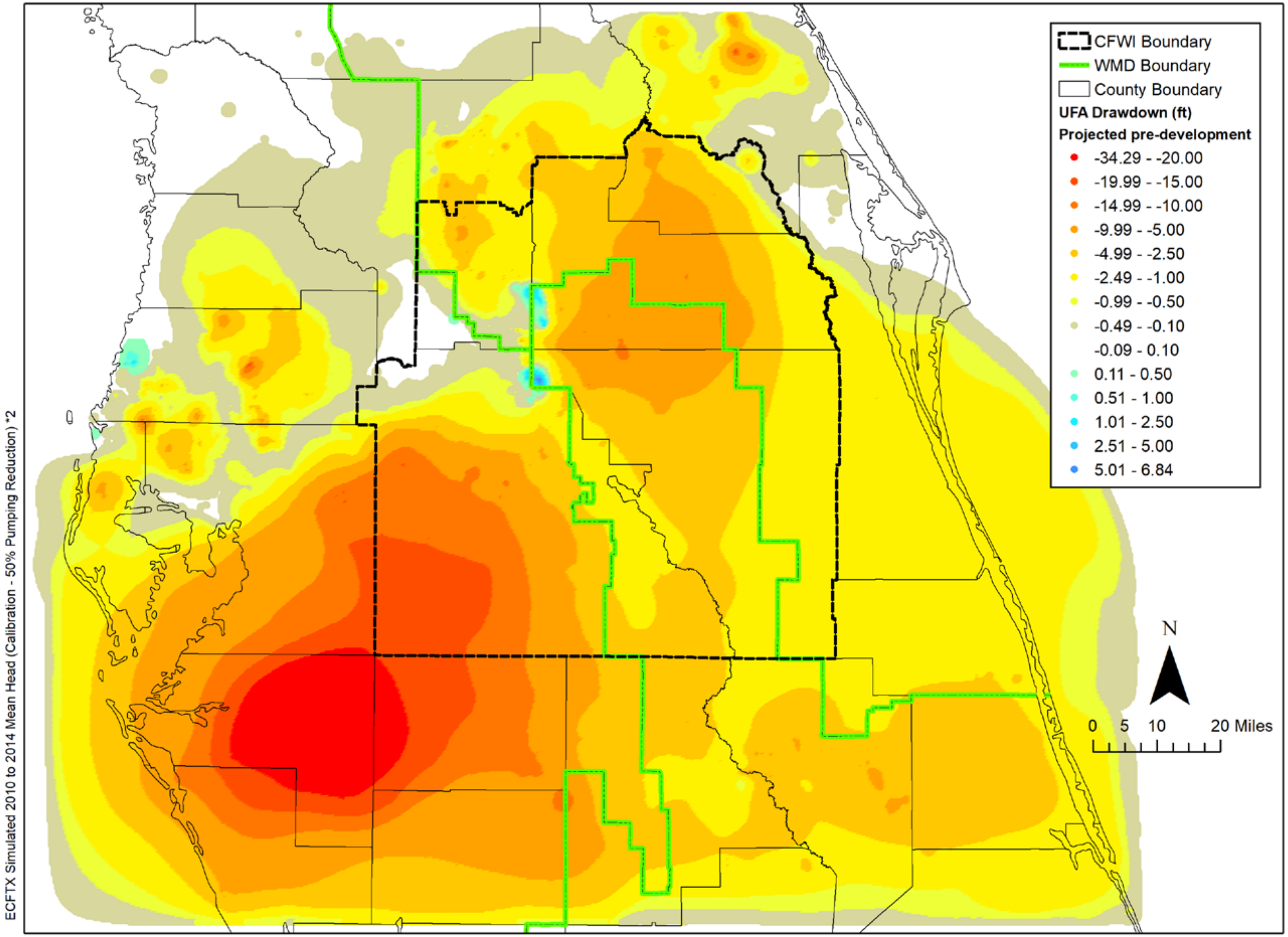

ECFTX - Boundary OutFlux LFA
change with 2014-2040 Pumping Increase
500
450
400
350
300
250
200
150
100
50
0
Flux (mgd)
458
172
1
1
0
60
Pumping Increase
Recharge
North Boundary
West Boundary
South Boundary
East Boundary
Budget Component

Revised Calibration – 50% pumping Head Changes

Predicted Water Level Change in the Surficial aquifer with 50% Reduction in Pumping x 2



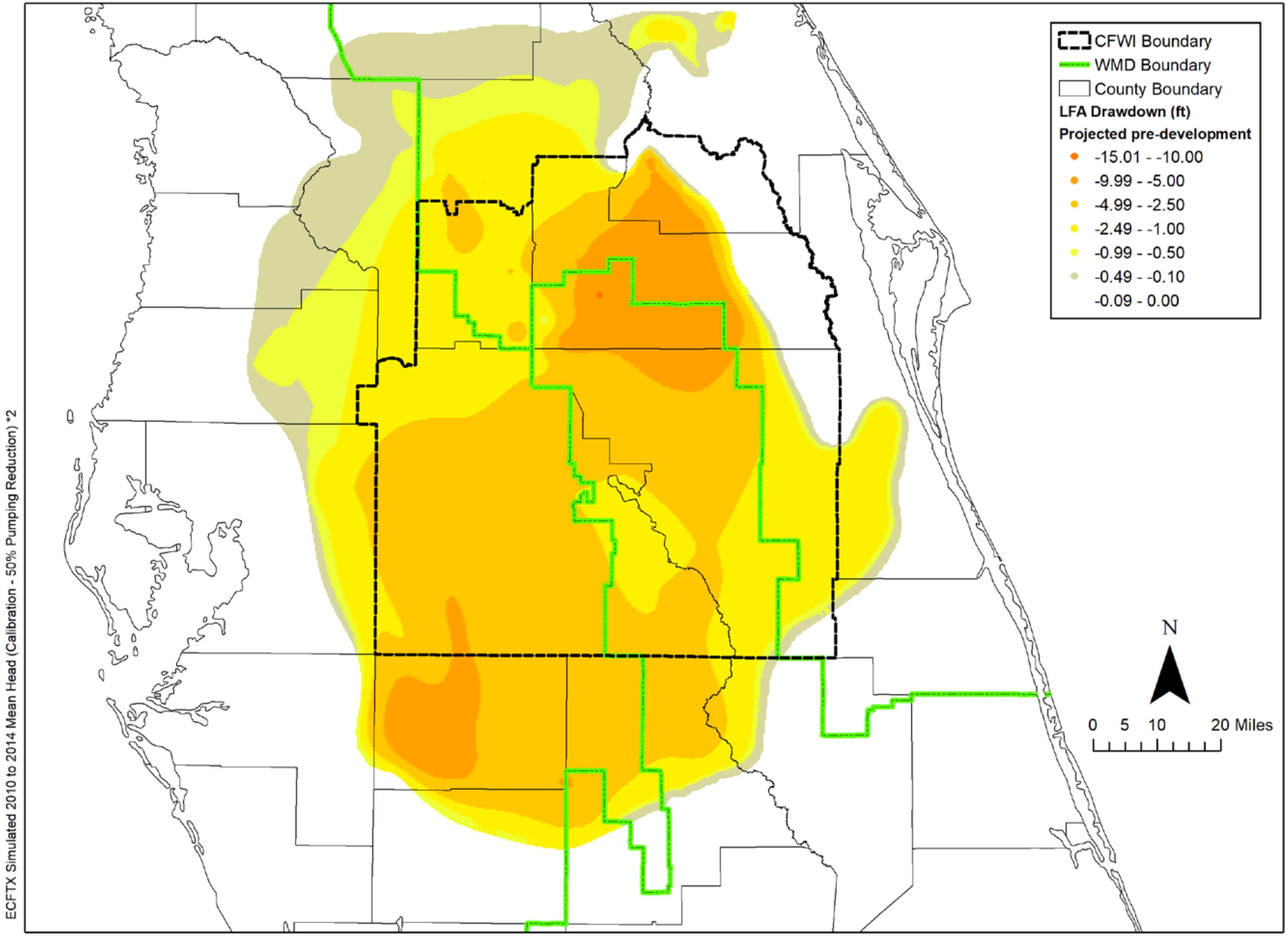
Predicted Water Level Change in the UFA with 50% Reduction in Pumping x 2



Date: 8/12/2019

Calculated Groundwater Drawdown

Predicted Water Level Change in the LFA with 50% Reduction in Pumping x 2



Date: 8/12/2019

Calculated Groundwater Drawdown

	Base	50%	2010-2014 avg (2) extrapolated historical flow change (cfs)	2010-2014 avg (2) extrapolated historical (2) flow change (%)
LITHIA SPRING MAJOR	**33.20**	**44.70**	23.00	40.9
BUCKHORN MAIN SPRING	12.10	15.10	6.00	33.1
SULPHUR SPRING (HILLSBOROUGH)	35.40	35.80	0.80	2.2
CRYSTAL MAIN SPRING (PASCO)	46.40	47.80	2.80	5.7
WEEKI WACHEE SPRING	167.30	170.60	6.60	3.8
CHASSAHOWITZKA SPRING MAIN	59.30	60.10	1.60	2.6
HOMOSASSA SPRING #1	84.50	84.90	0.80	0.9
GUM SPRING MAIN	64.80	65.70	1.80	2.7
RAINBOW SPRING #1	73.30	73.32	0.04	0.1
APOPKA SPRING	24.80	27.50	5.40	17.9
SANLANDO SPRINGS	19.90	23.00	6.20	23.8
STARBUCK SPRING	12.60	14.00	2.80	18.2
WEKIWA SPRING (ORANGE)	64.60	68.80	8.40	11.5
BUGG SPRING (LAKE)	9.70	10.70	2.00	17.1
ROCK SPRINGS (ORANGE)	51.60	55.80	8.40	14.0
VOLUSIA BLUE SPRING	132.40	140.50	16.20	10.9
ALEXANDER SPRING	98.90	99.00	0.20	0.2
Extrapolated flow change = 50% x 2				
(2): ECFTX 50% reduction run 2				

Summary

- Parameter changes were made in January-March to improve model calibration
- Concerns were raised about GHB fluxes that could possibly attenuate pumping impacts
- Staff made multiple changes to reduce GHB conductance along freshwater/saltwater transition zones and other boundaries to conform with aquifer hydraulics
- Revised calibration and scenario results
- Does the Peer Review Team agree with GHB flux changes and can the HAT move forward on the draft calibration report?

Questions/Discussion