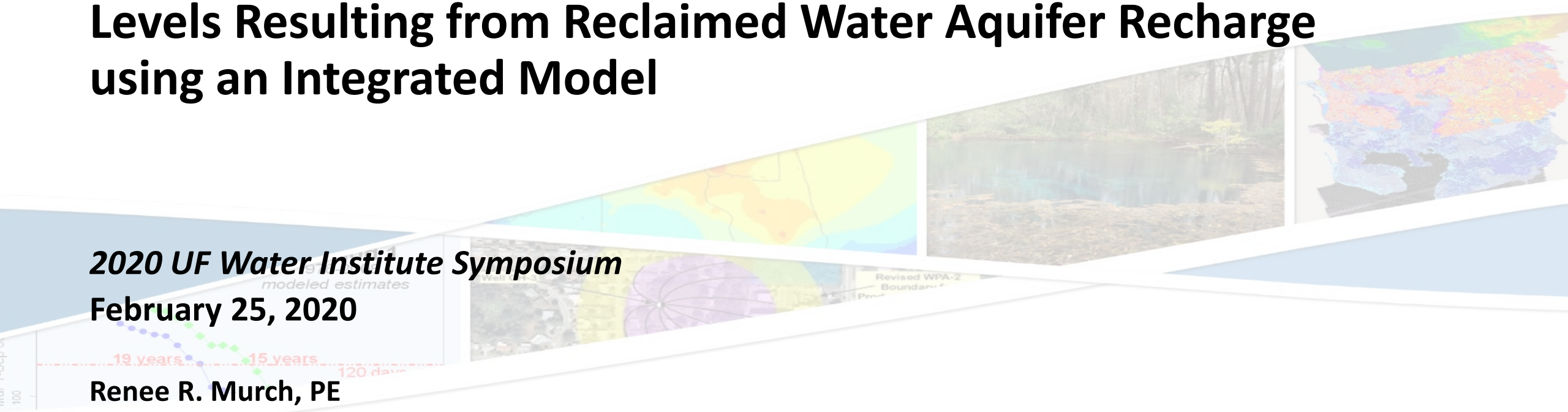
A Comprehensive Assessment of Changes to Flows and Levels Resulting from Reclaimed Water Aquifer Recharge using an Integrated Model



2020 UF Water Institute Symposium

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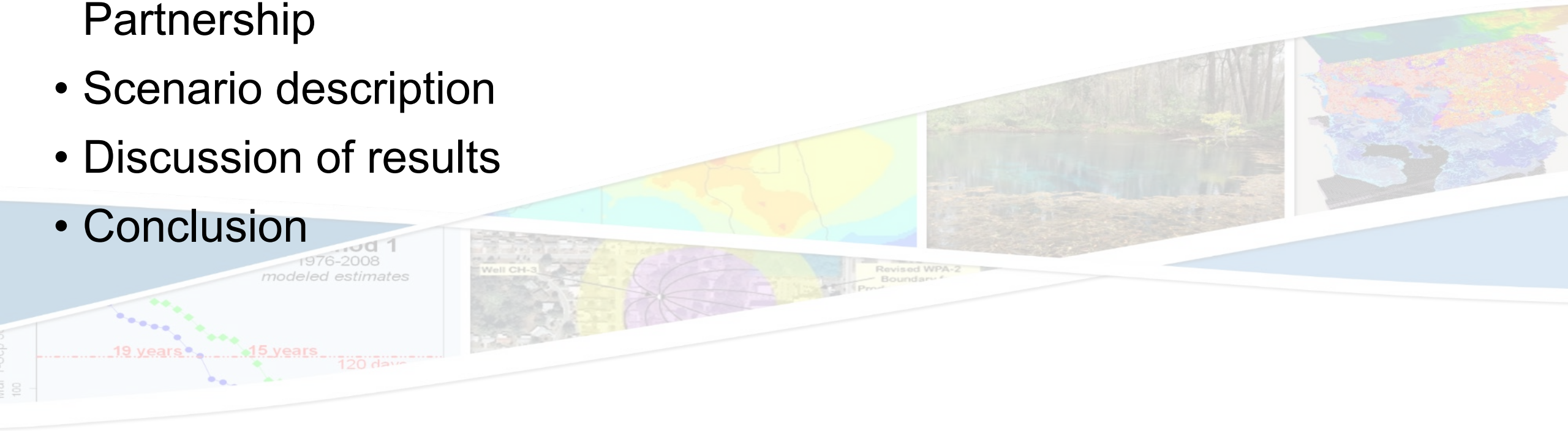
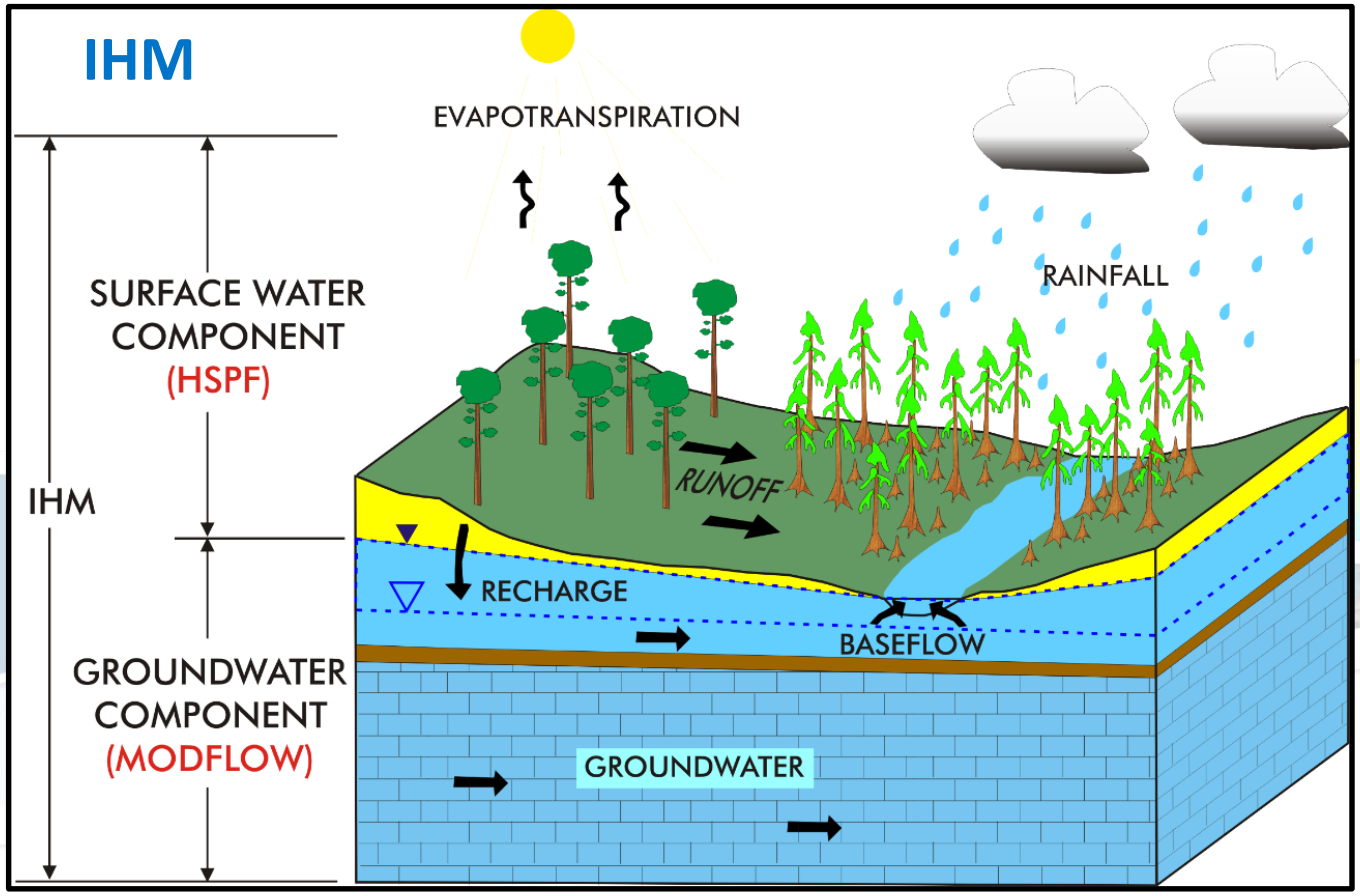
INTERA, Inc.

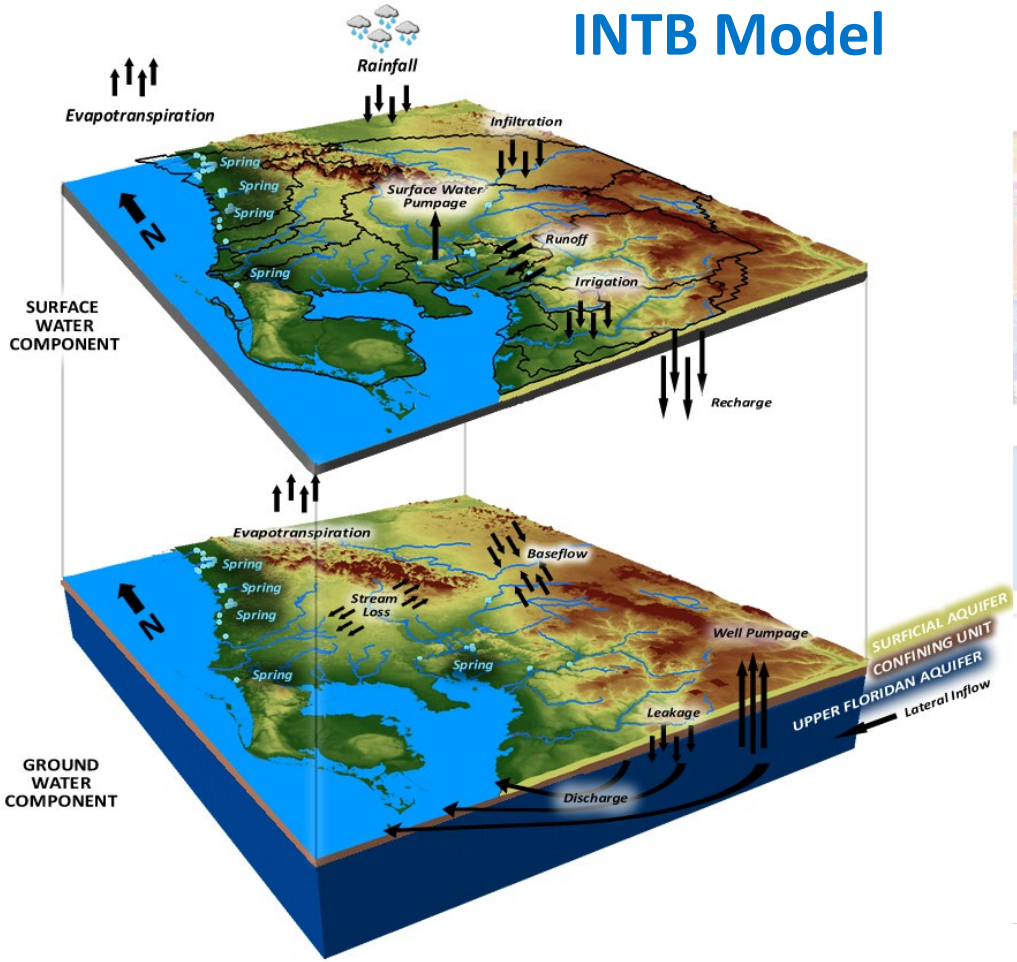
Outline

- Model background
- Case study: the Tampa Bay Integrated Water Resource Partnership
- Scenario description
- Discussion of results
- Conclusion



Integrated Hydrologic Model (IHM) and Integrated Northern Tampa Bay (INTB) Model





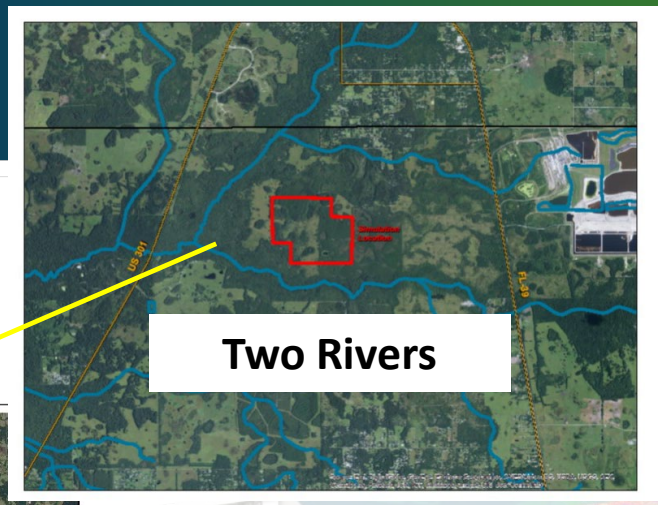
IHM Application: Tampa Bay Regional Integrated Water Resource Partnership

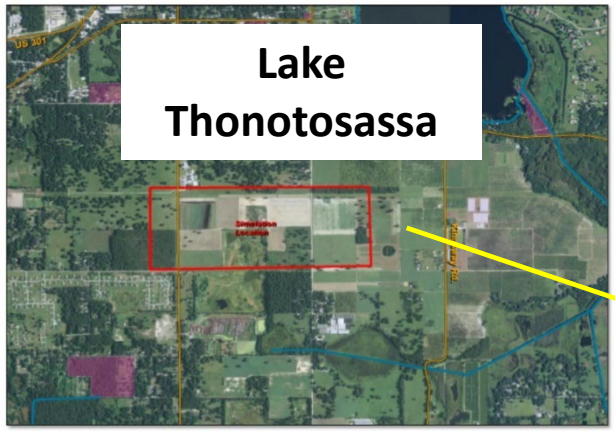
- Study partners: Hillsborough County, City of Tampa, City of Plant City and City of Temple Terrace

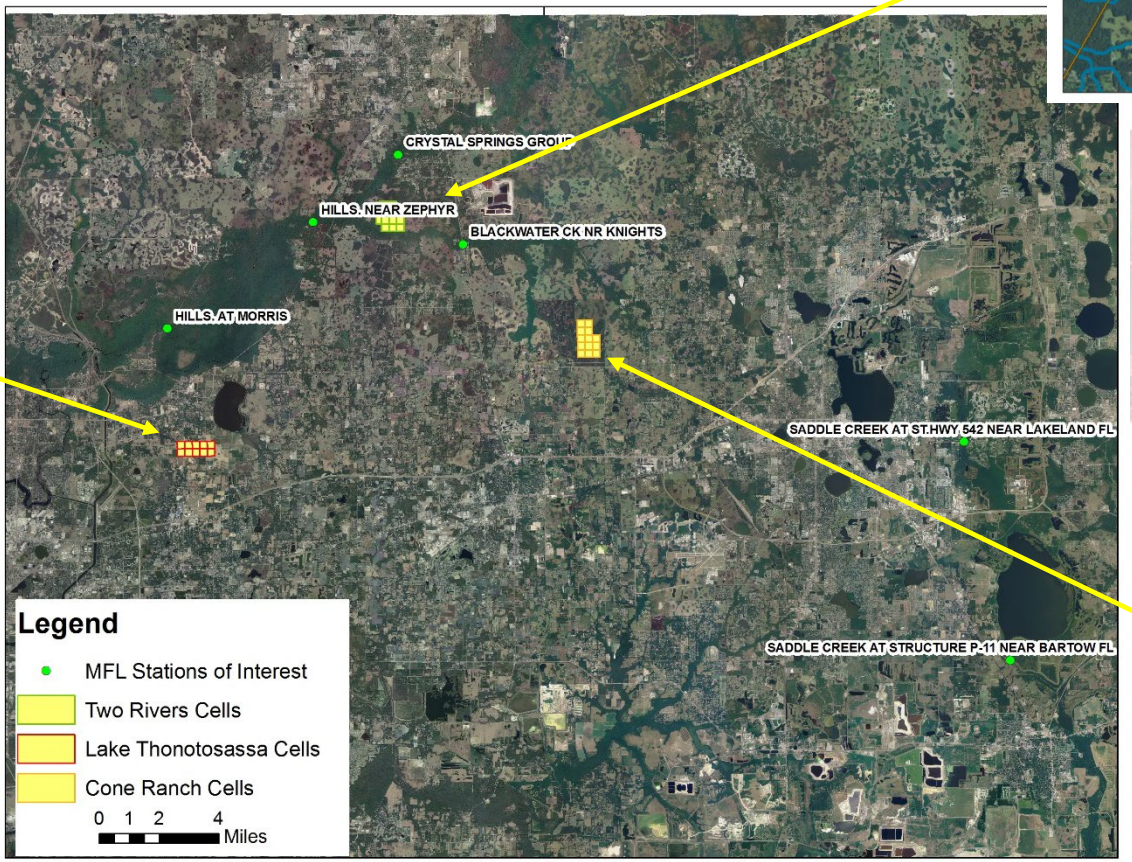
- The second phase of a regional reclaimed water feasibility study/ master plan to evaluate the water resource benefits to the region by recharging the groundwater system in the District's Water Use Caution Areas (WUCAs) in the Tampa Bay region.

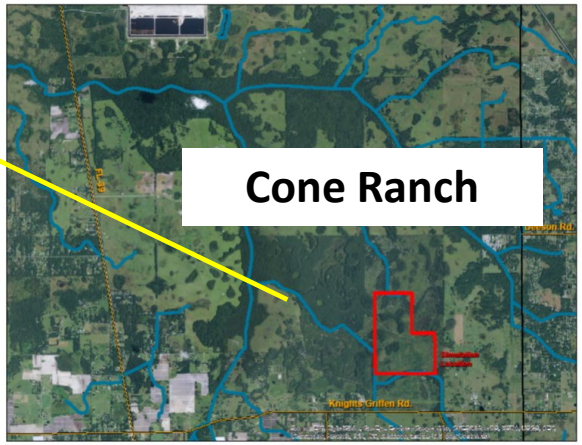
- INTB Modeling Objective: *to evaluate the technical feasibility of using excess reclaimed water to significantly increase direct and indirect recharge opportunities (recharge wells, RIBs) in eastern Hillsborough County including portions of the Dover WUCA and Northern Tampa Bay Area WUCA.*

Alternative Locations





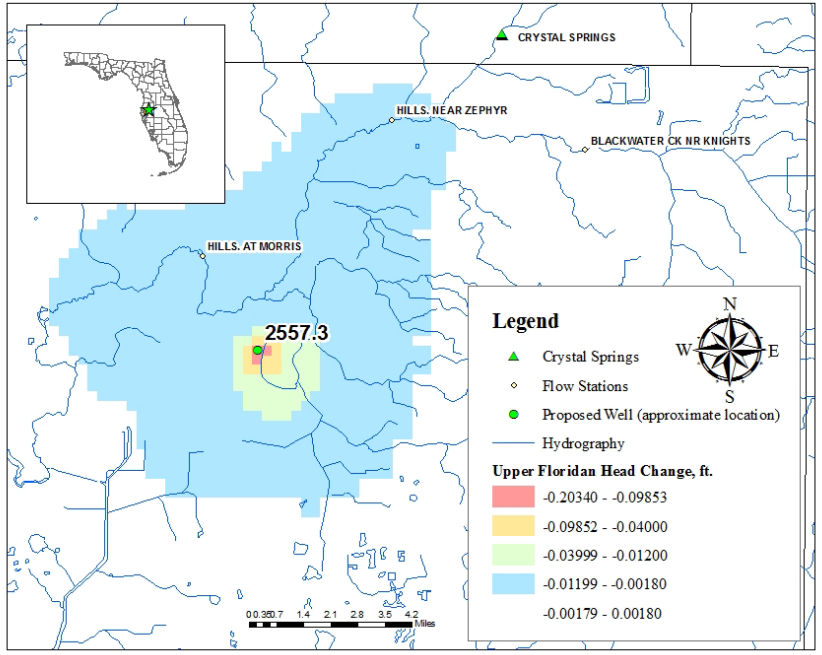


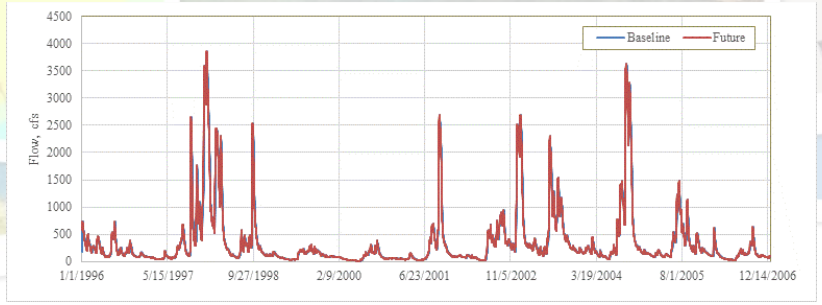


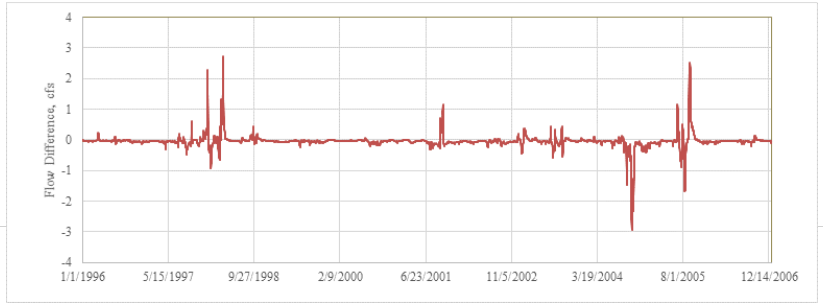
1320’ by 1320’ grid cell discretization in MODFLOW component model in this area

Typical INTB Output

- Daily time series at each gauge of interest
  - Average flows over simulation period
- Average SAS and UFA heads over simulation period
- Comparisons are made to a baseline simulation



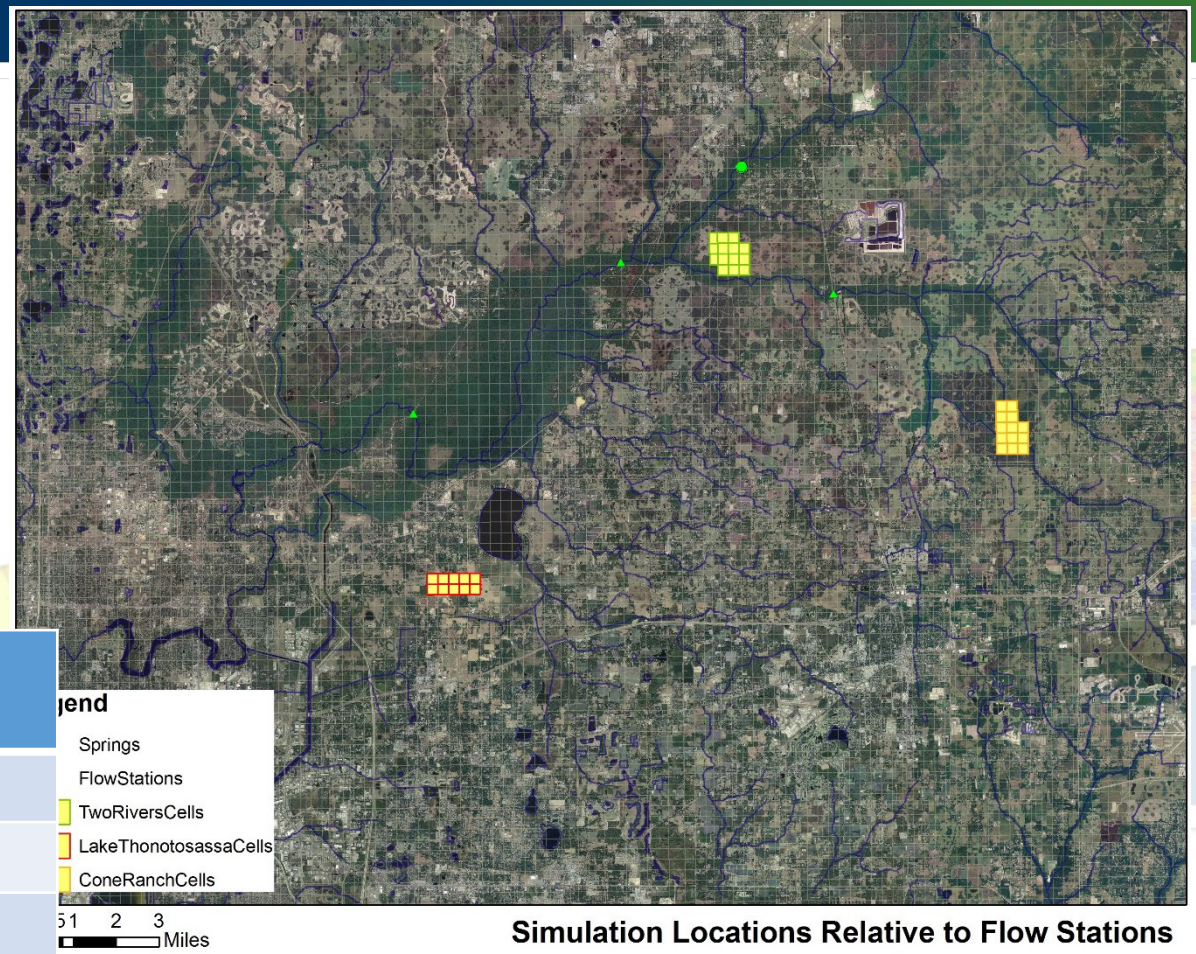




Simulation Locations

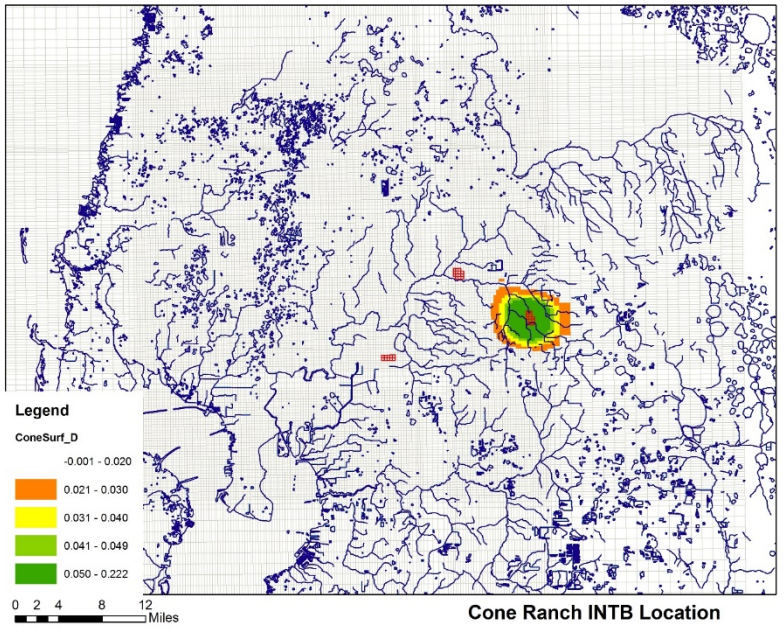
Location	# of INTB Cells
Lake Thonotosassa	10
Two Rivers	14
Cone Ranch	13

Location	Alternative	Amount per cell, mgd	Total Amount, mgd
Cone Ranch	RIB (surficial)	0.10	1.3
Two Rivers	RIB (surficial)	0.10	1.4
Lake Thonotosassa	RIB (surficial)	0.10	1.0
Cone Ranch	Injection (Floridan)	1.00	13.0
Two Rivers	Injection (Floridan)	1.00	14.0

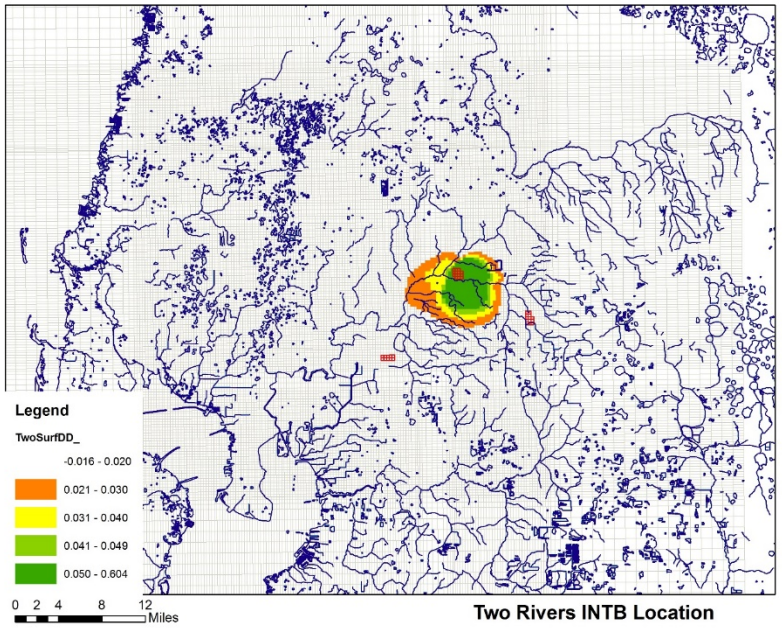


Simulation Locations Relative to Flow Stations

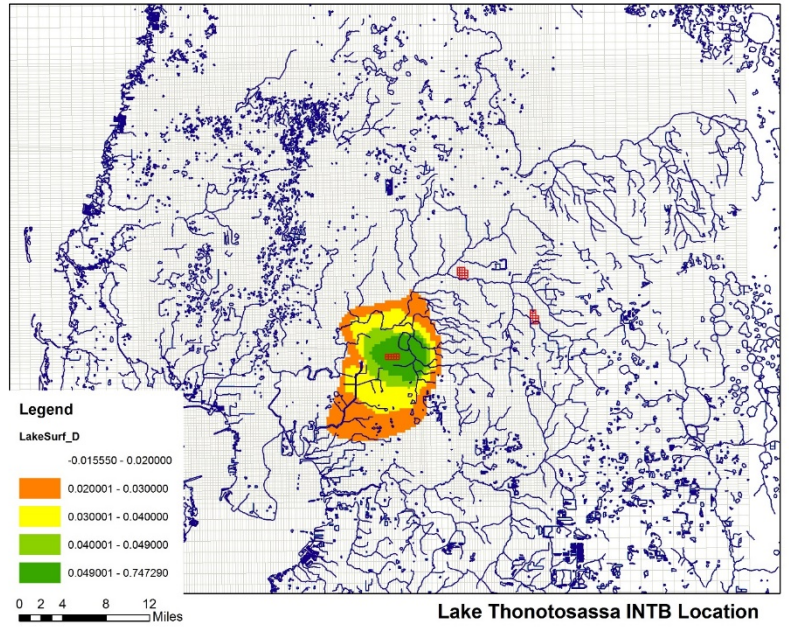
RIBs: UFA Recovery



1.3 mgd Total

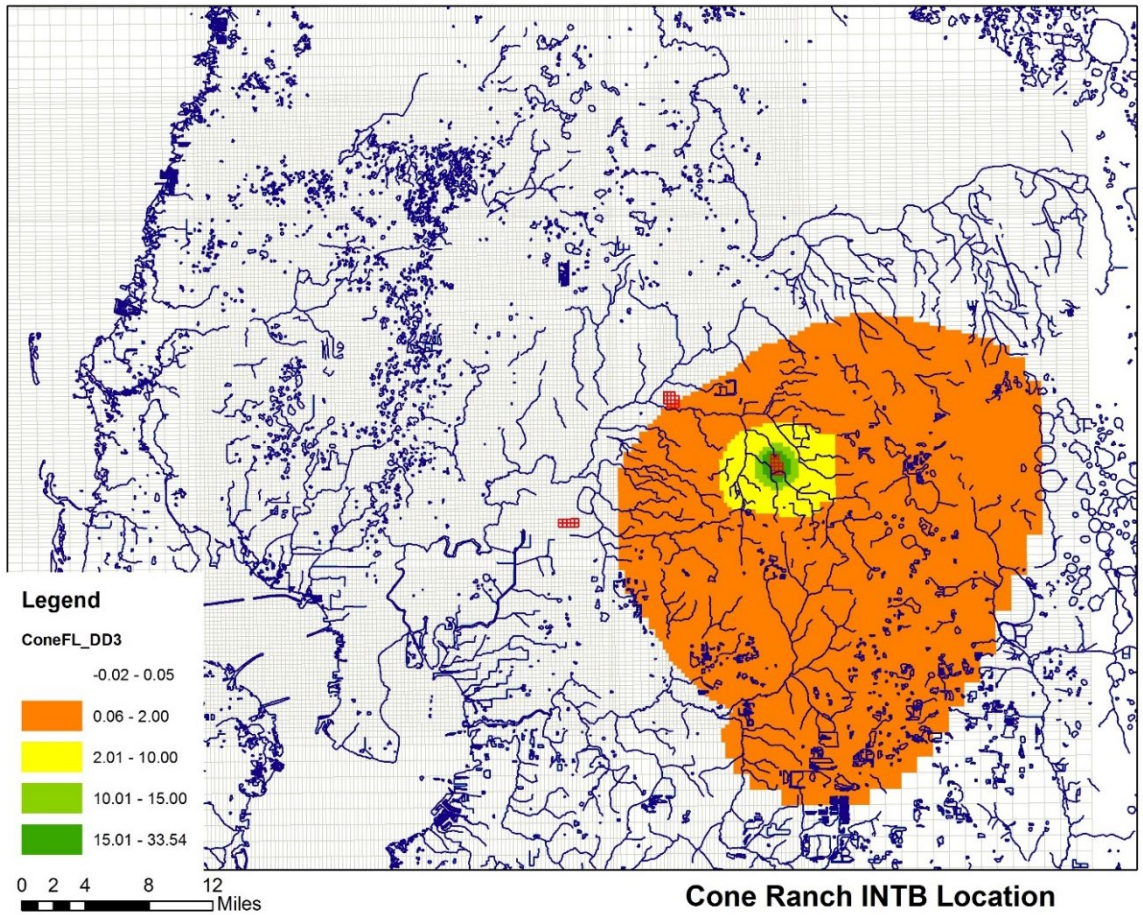


1.4 mgd Total



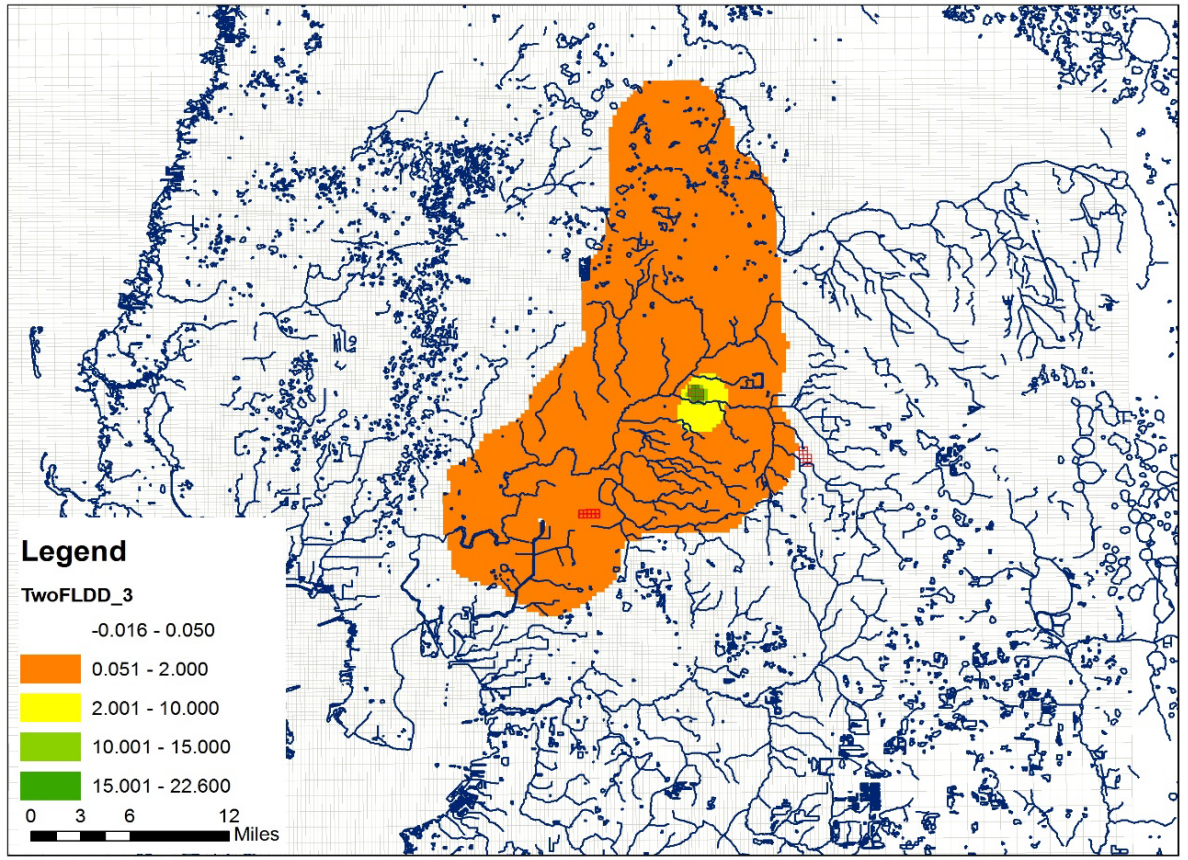
1.0 mgd Total

Injection: UFA Recovery



Cone Ranch INTB Location

13 mgd Total



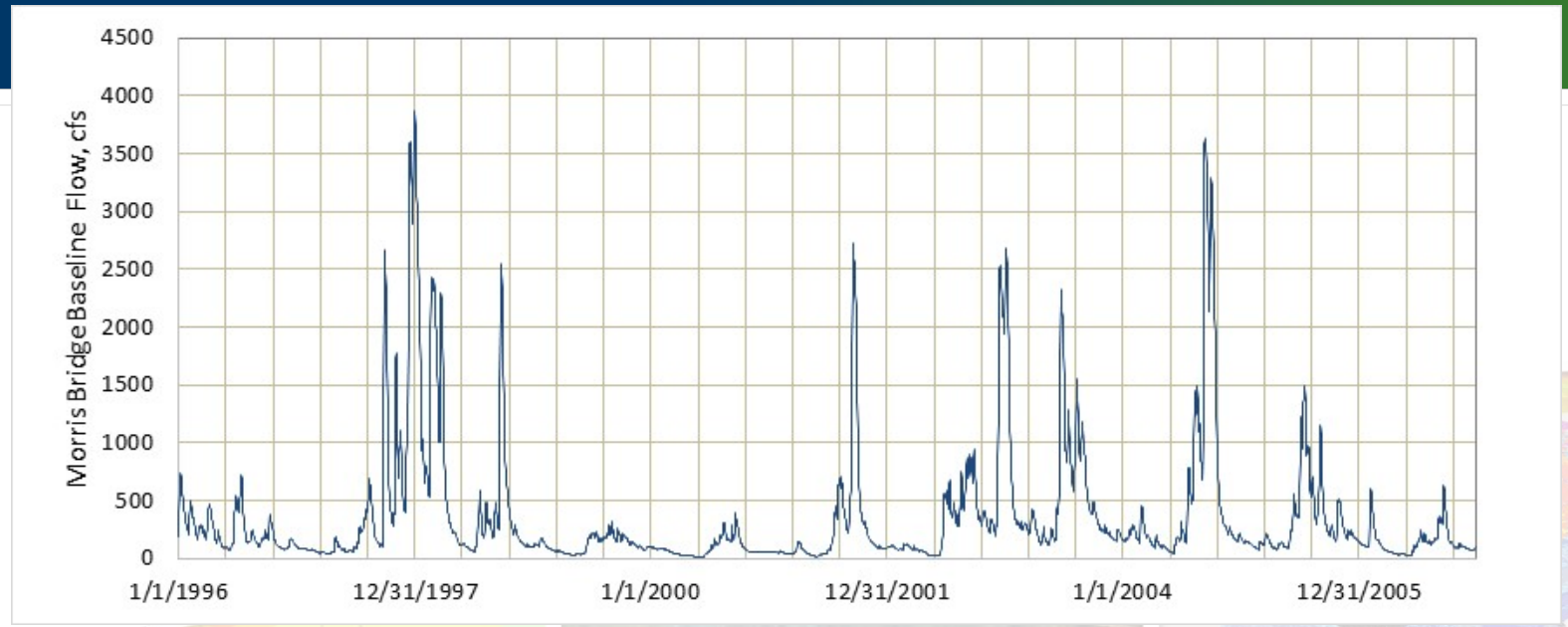
Two Rivers INTB Location

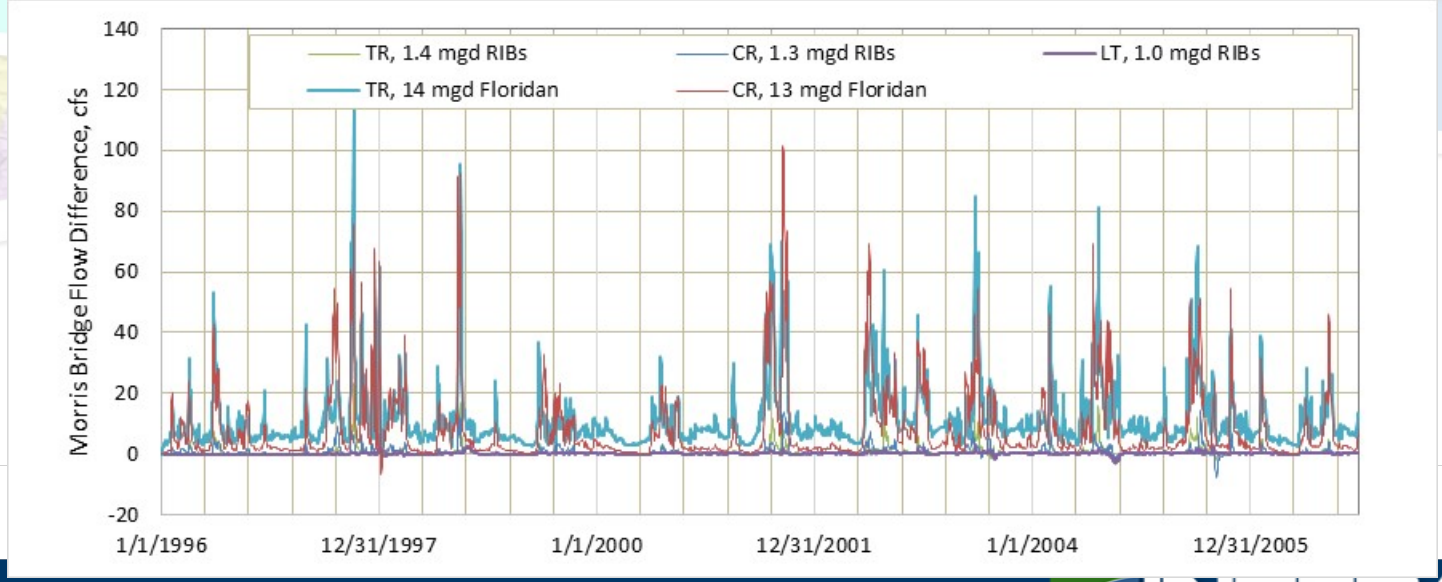
14 mgd Total

Flow Hydrographs

Hillsborough River

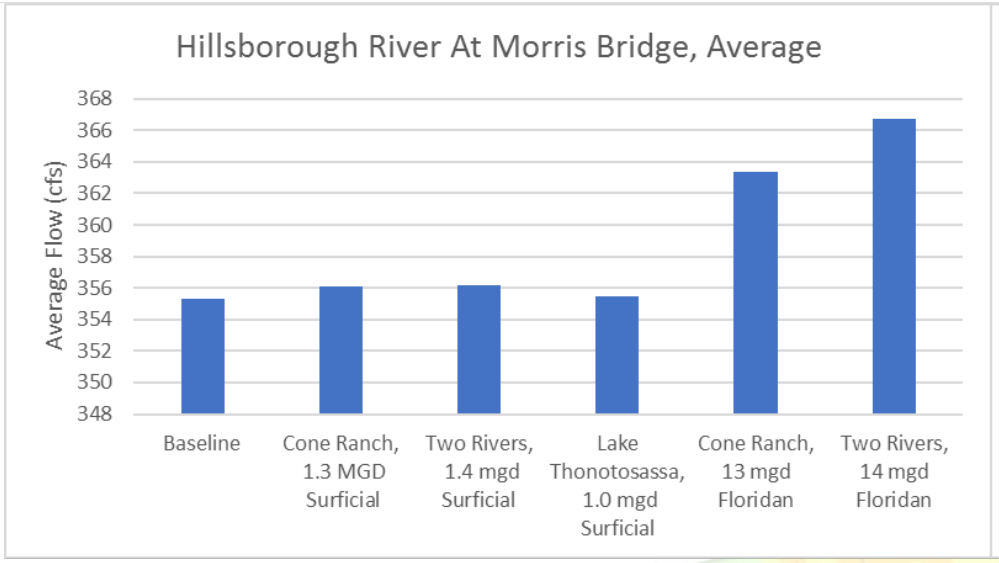
Morris Bridge

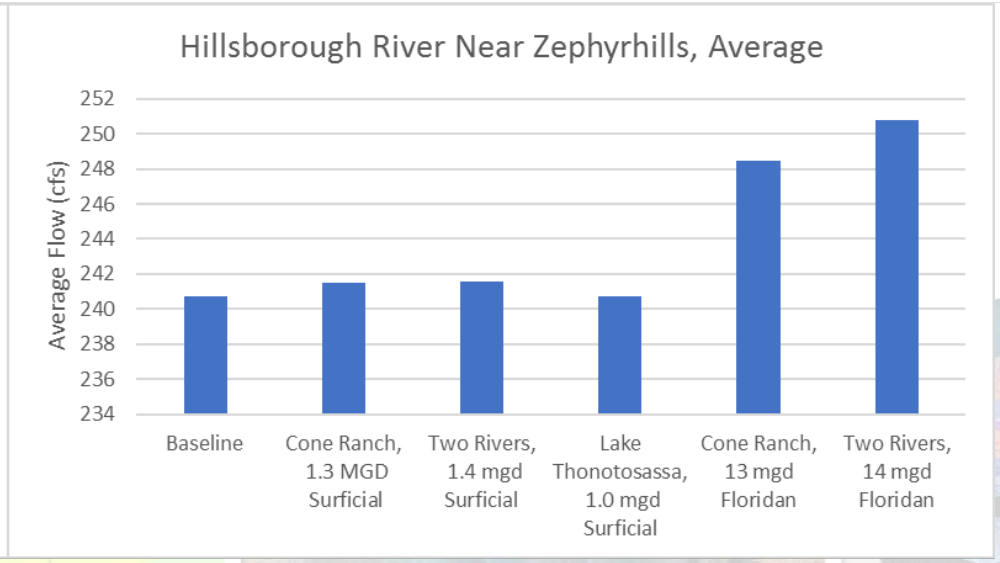


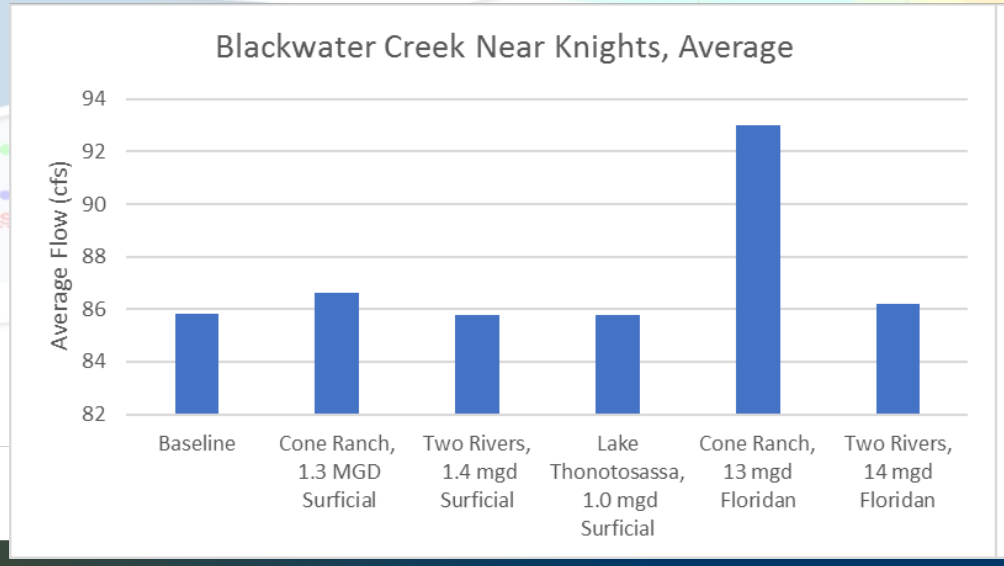


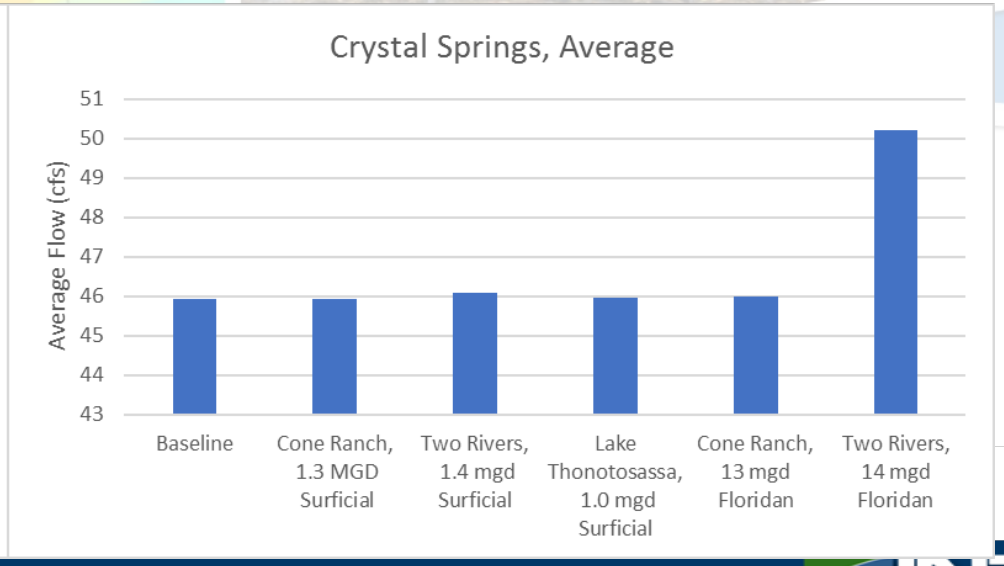
Average Flow Comparison

Floridan injection results in the highest average and 95th percentile flow increases, due to quantity and location.









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Normalized Average Flow Increases, cfs/mgd of Applied Flux

Station	Cone Ranch, 1.3 mgd Surficial	Two Rivers, 1.4 mgd Surficial	Lake Thonotosassa 1.0 mgd Surficial	Cone Ranch, 13 mgd Floridan	Two Rivers, 14 mgd Floridan
Hillsborough River At Morris Bridge	0.62	0.64	0.20	0.62	0.82
Blackwater Creek Near Knights	0.62	0.00	-0.01	0.55	0.03
Hillsborough River Near Zephyrhills	0.61	0.60	0.02	0.60	0.72
Crystal Springs	0.00	0.10	0.02	0.00	0.31

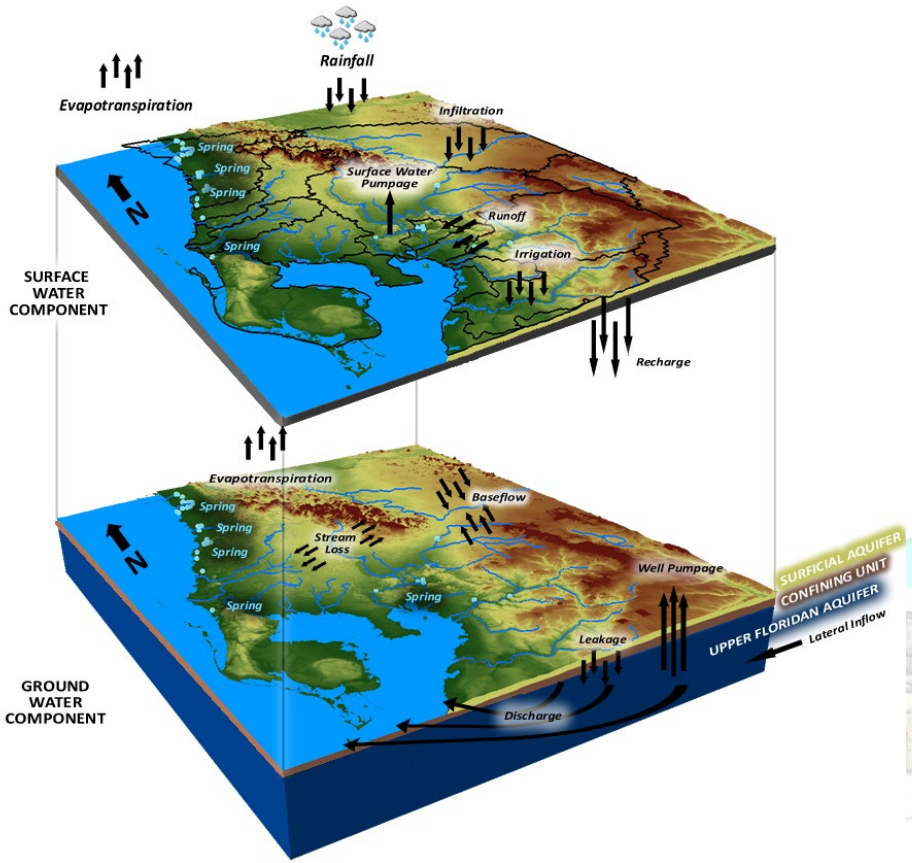
Flow Component Changes- Average Flows

Hillsborough River at Morris Bridge (units CFS)

		Cone Ranch		Two Rivers		Lake Thonotosassa		Cone Ranch		Two Rivers	
Simulation Detail	90 mgd Baseline	1.3 mgd RIBs	Difference from Baseline	1.4 mgd RIBs	Difference from Baseline	1.0 mgd RIBs	Difference from Baseline	13 mgd Floridan	Difference from Baseline	14 mgd Floridan	Difference from Baseline
Total Flow	353.3	356.1	0.8	356.2	0.9	355.5	0.2	363.3	8.1	366.7	11.4
Baseflow	102.0	102.2	0.2	102.3	0.3	102.1	0.1	103.9	2.0	107.9	5.9
Runoff	253.3	253.9	0.6	253.9	0.6	253.4	0.1	259.4	6.1	258.8	5.5
Percent of Flow Change Attributed to Baseflow		25%		32%		54%		24%		52%	
Percent of Flow Change Attributed to Runoff		75%		68%		46%		76%		48%	

Conclusion

- INTB Model provides improved accuracy, flexibility, and capability compared to standalone groundwater or surface water application
- Changes induced by RIBs and injection wells cause dynamic responses to runoff, baseflow, recharge, water-body stage, uplands ET, and water-body ET
- Integrated models capture all dynamic responses, including:
  - Total streamflow: directly simulate change to surface runoff and baseflow
  - Fraction of streamflow that is runoff and baseflow
  - Springflow and groundwater levels, including simulated water above land
- One model to assess flow and level changes provides efficiency and flexibility



Questions?

INTEGRATED HYDROLOGIC MODEL