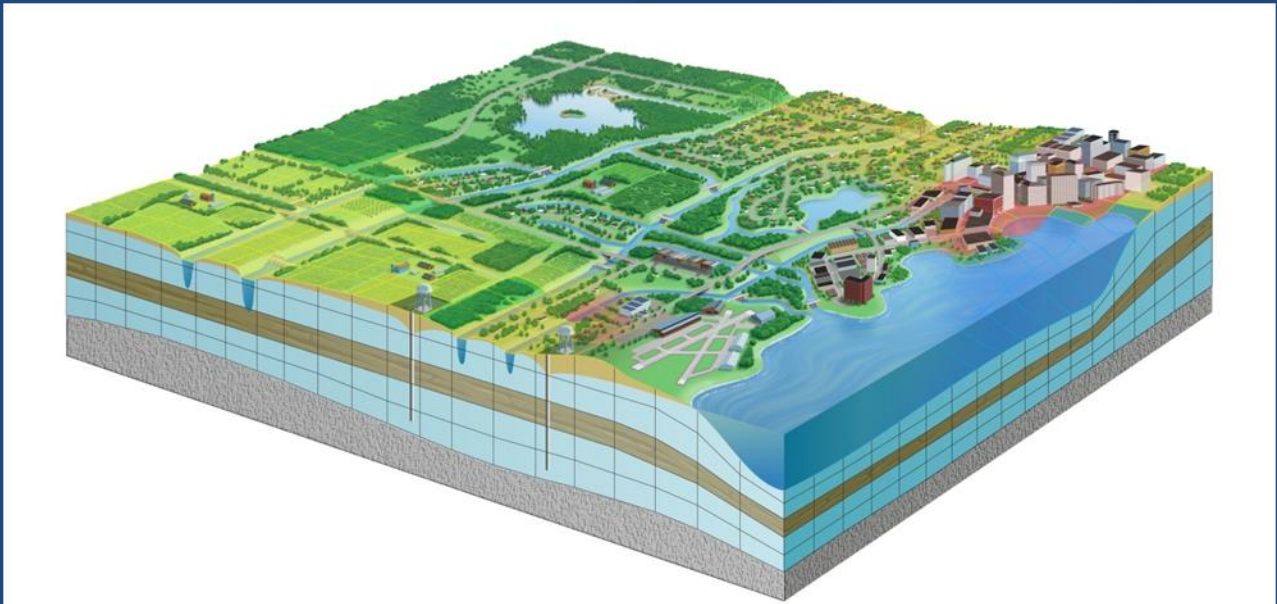
Broward Integrated Water Resources Management Master Plan Summary

Presented at the Broward County Water Resources Task Force Meeting
4/1/2011

Presentation Organization

- Background
- Objectives
- Biscayne Modeling
- Floridan Modeling
- Conclusions



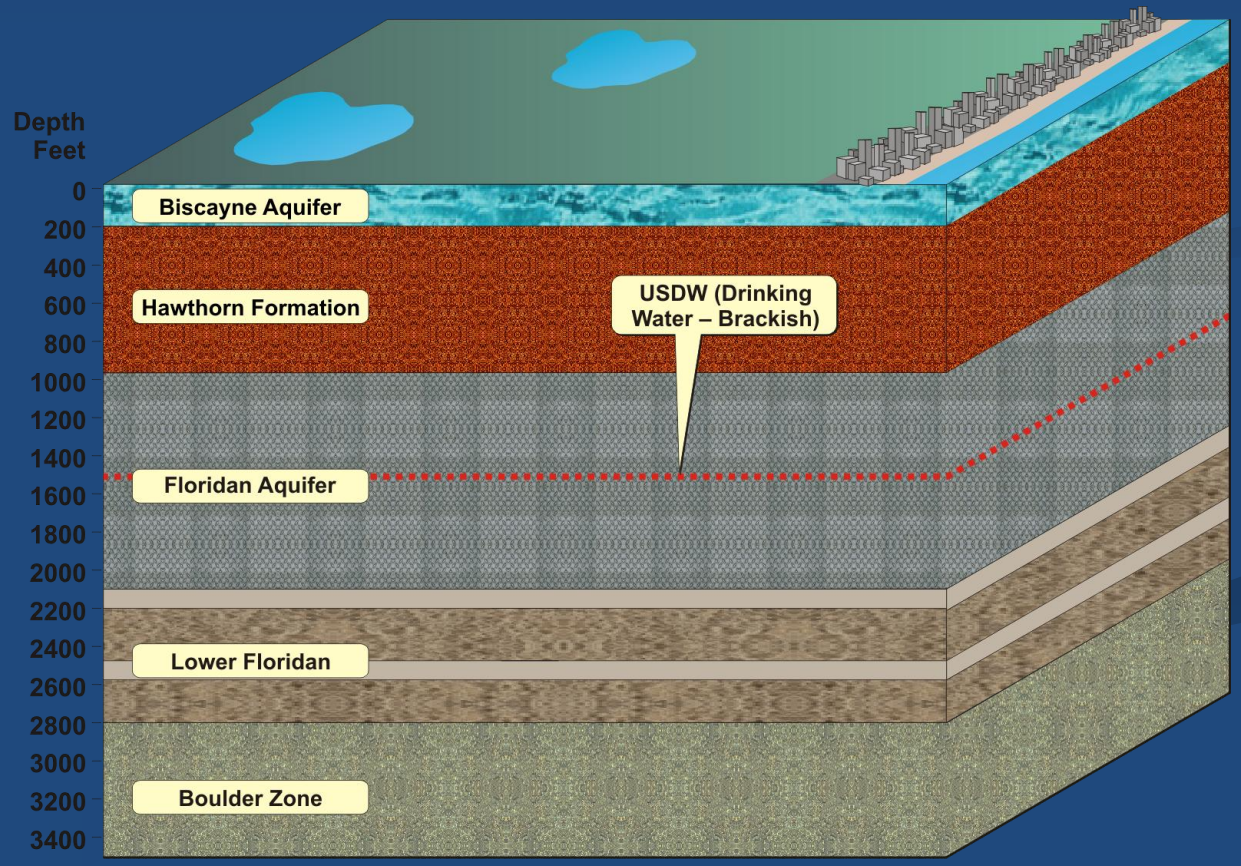
IWRMMP BACKGROUND

Unique Value of IWRMMP

- No other planning tool of this nature
  - Specific to Broward County
  - High level of resolution
  - Coupled surface/groundwater analysis
- Comprehensive Application:
  - Project compatibility
  - Project sustainability
  - Resource optimization
  - Planning level cost estimates
- Regional resource integration

Background/Need

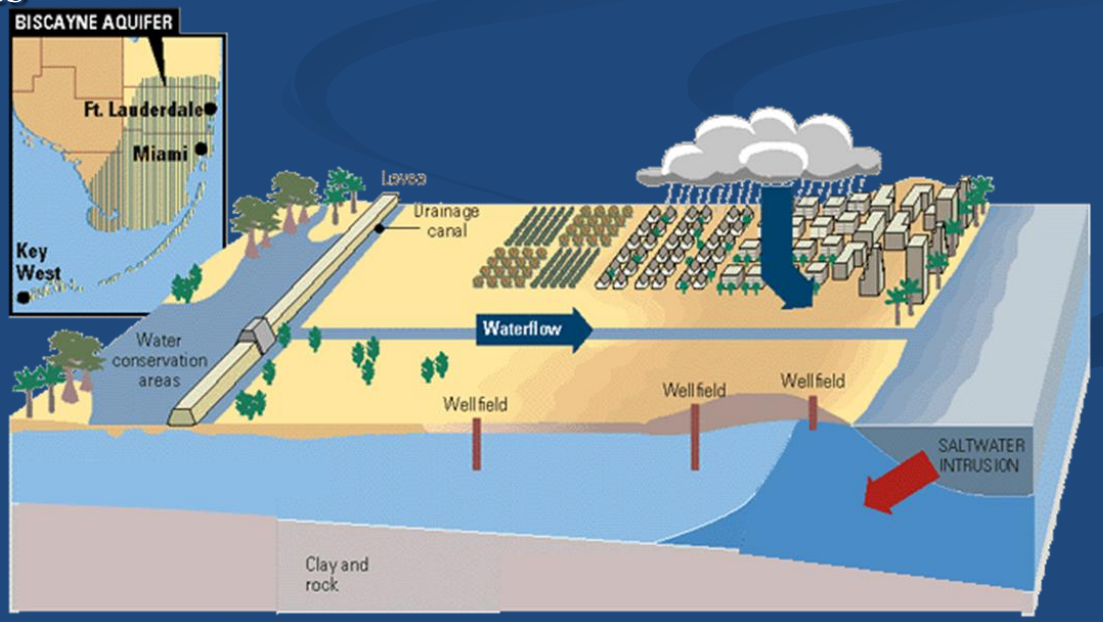
- No comprehensive assessment of planned local projects
- No previous analysis of Florida Aquifer in Broward County
- No assessment of influence of Regional projects on local water resources



IWRMMP OBJECTIVES

Objective

- Develop a plan that:
  - Meets Broward County's water supply needs and water resource goals for the period ending in 2025
  - Provides improvements in the water management and supply system that are compatible with LECWSP 2005-2006 update
  - Complies with Florida's water protection and sustainability program
  - Integrates CERP projects
  - Addresses RWA rule



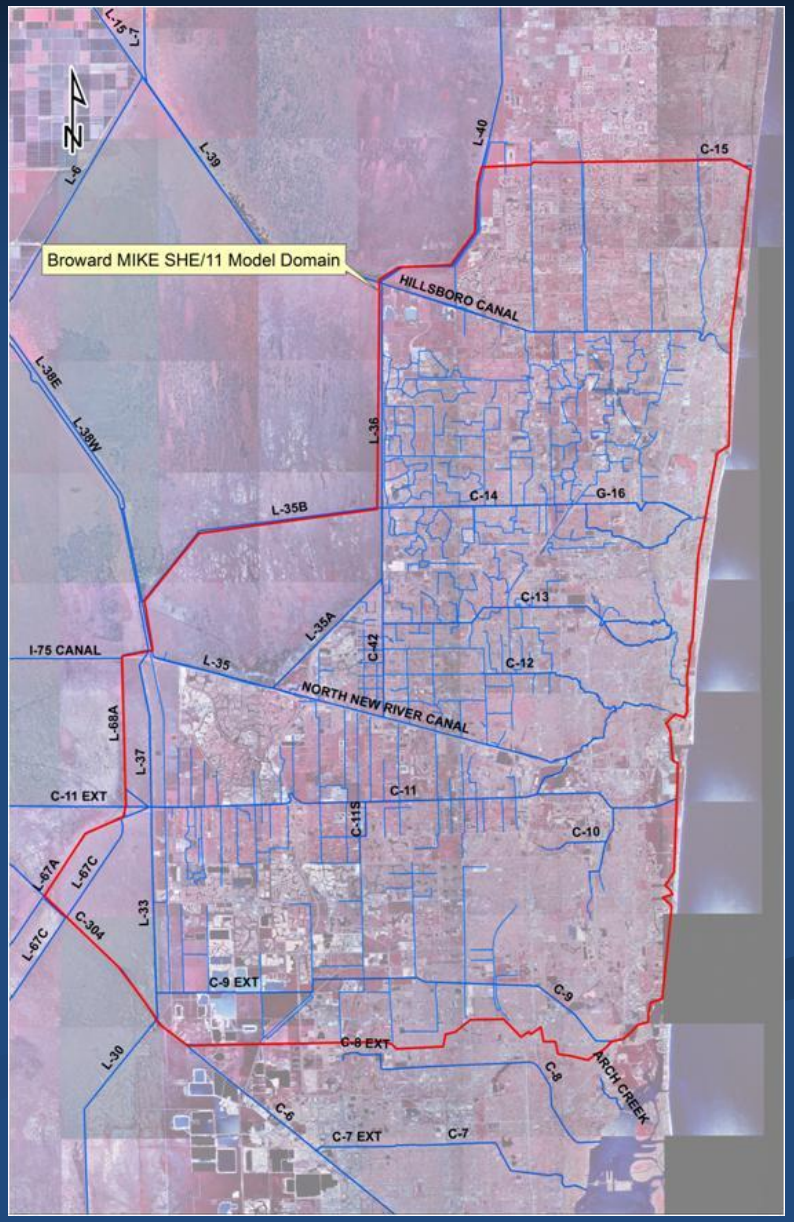
BISCAYNE AQUIFER MODELING

Introduction

- Consolidated Broward County modified into Baseline Model
- Calibrated to 1999 through 2002 data
- Determine if 2025 withdrawals from the Biscayne Aquifer (330 mgd) can be effectively offset with AWS projects
- AWS plans to be applied in the Biscayne
  - Increased reuse w/ irrigation & injection
  - Utilization of storm water via C-51 reservoir
  - Relocation of coastal wells

Model Domain

- Grid based model – 500 foot cells
- 5 layers
- 471 pumping wells
- 350 canals
- 404 water control structures
- 255 mgd baseline withdrawal

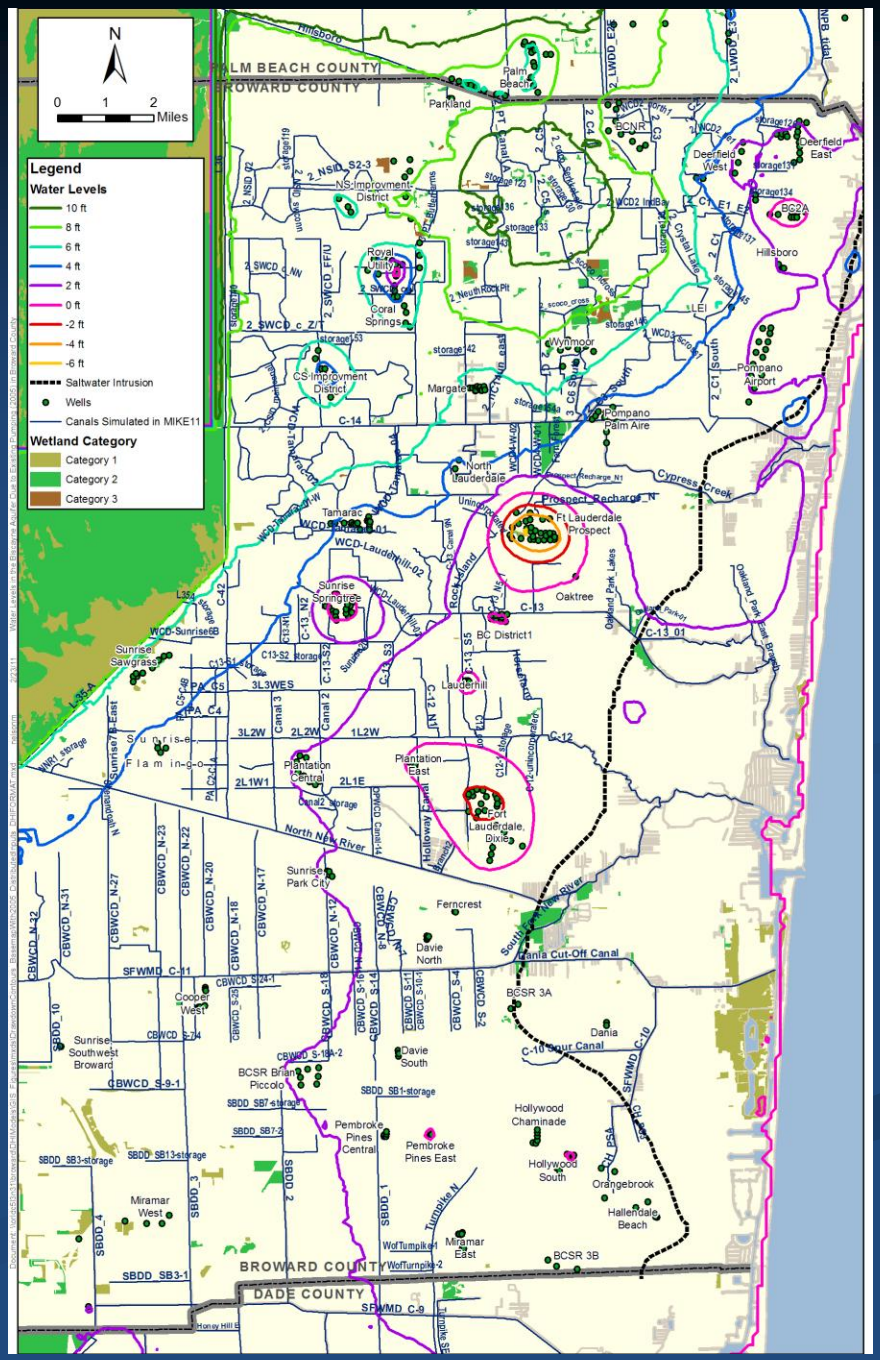


Biscayne Model Scenarios

- 2005 Base Case – 255 MGD groundwater withdrawals
- 2025 Proposed Withdrawals – 330 MGD
- 2025 + Reuse Irrigation – (18 MGD)
- 2025 + C-51 Reservoir – (~45 MGD)
- 2025 + Reuse + C-51 – (63 MGD)
- Other projects:
  - Well field relocation
  - Canal level modifications

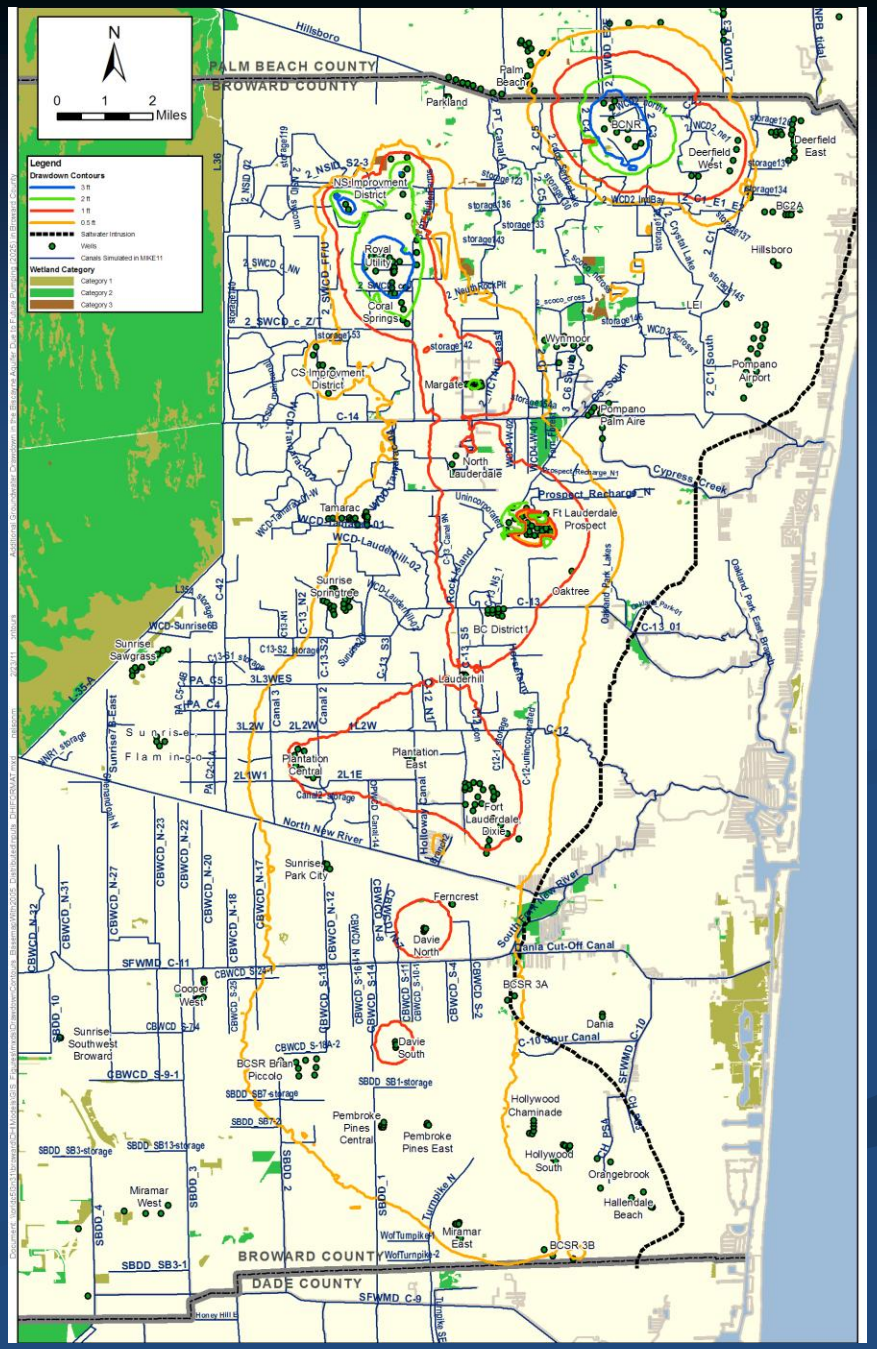
Simulation Results for Base Case (2005)

- Existing conditions
- Groundwater withdrawals ~ 255 mgd
- Conditions considered consistent with the RWA Rule



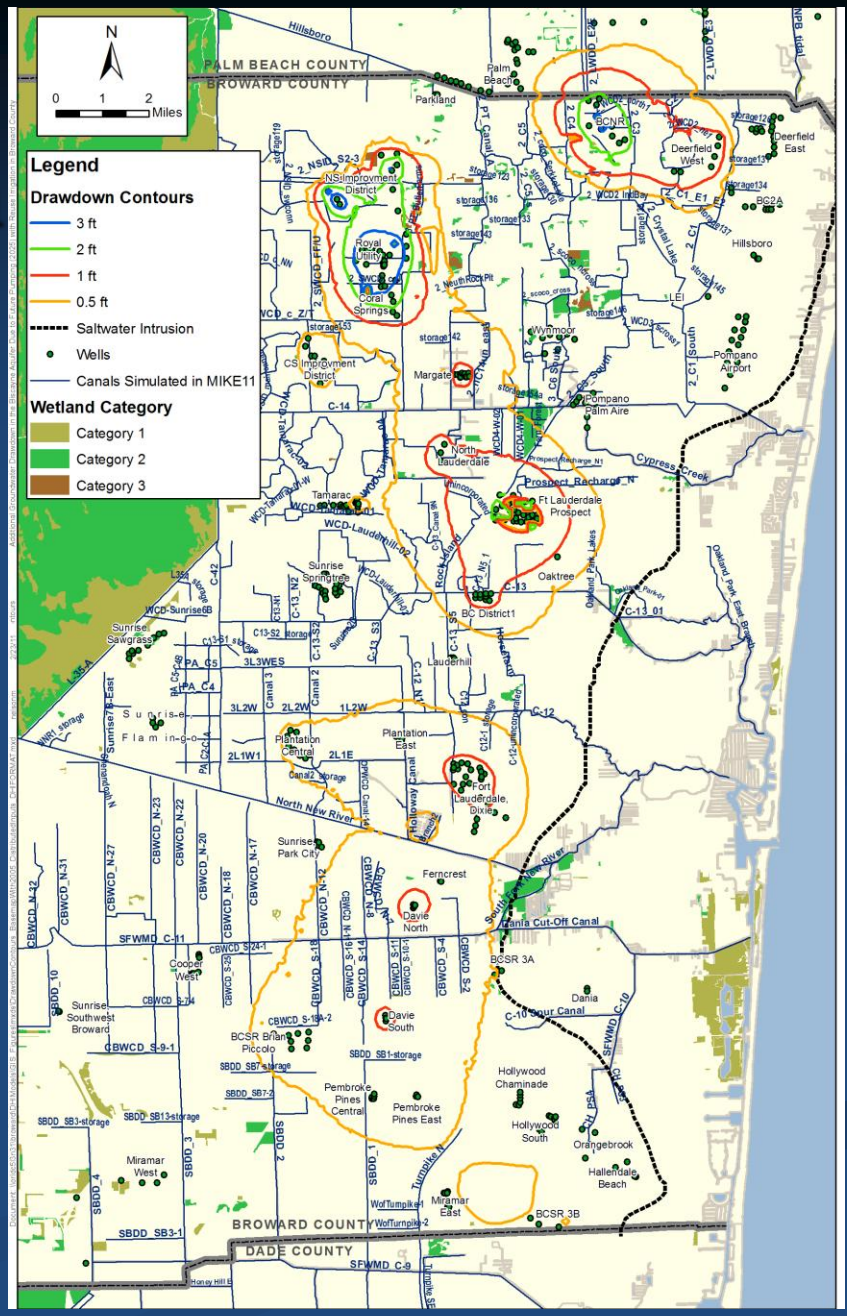
Simulation Results for 2025 - No AWS

- Groundwater withdrawals ~ 330 mgd
- Compared to 2005 groundwater level
  - 1 ft drawdown in central & southern BC
  - 2-3 ft drawdown in northern BC



Simulation Results for 2025 - Reuse Irrigation

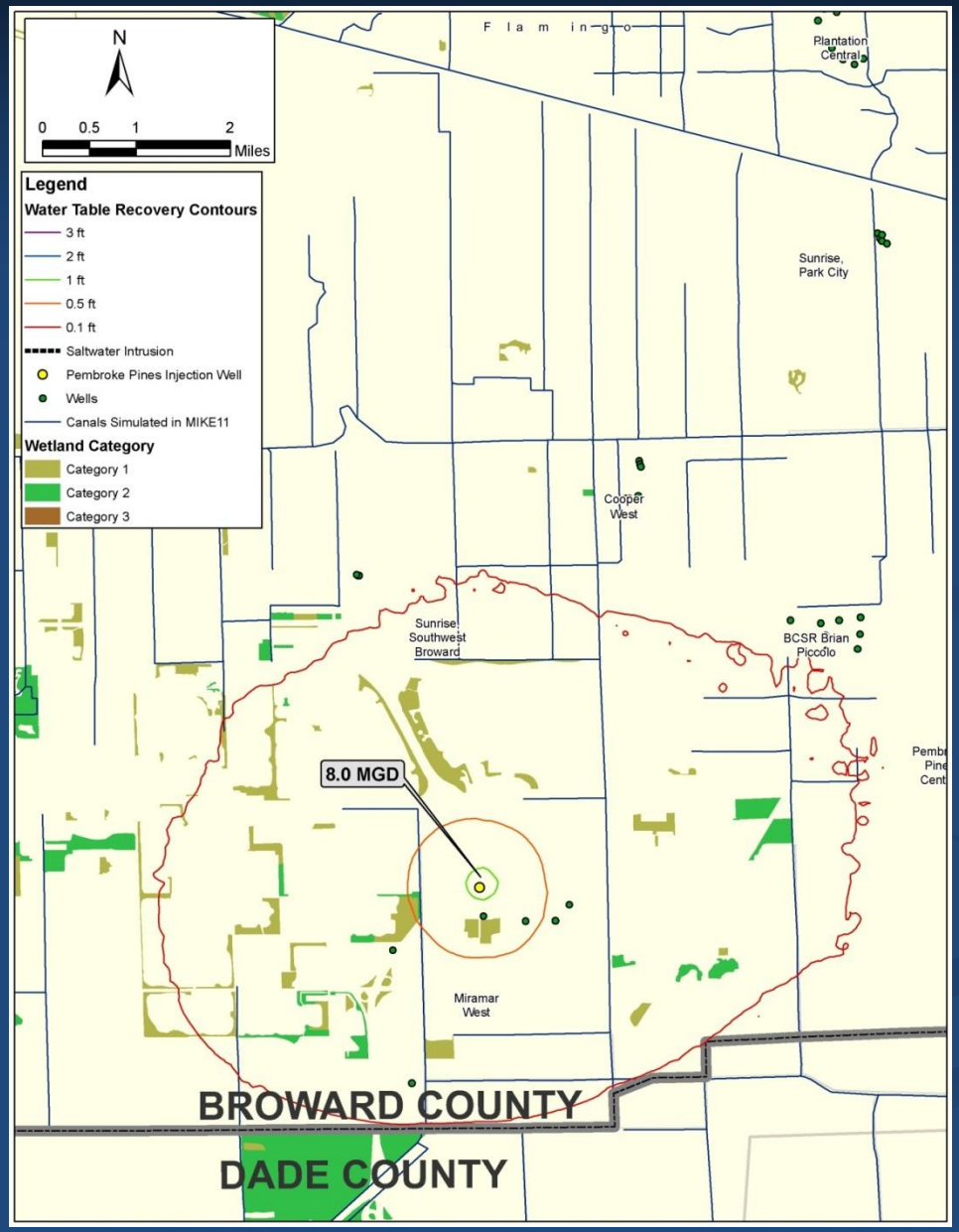
- Modeled condition in 2025
- Increase withdrawal of 75 MGD
- Application of 18 MGD reuse irrigation
  - Dania, Davie, Deerfield Beach, Hallandale, Hollywood, Pompano Beach, Sunrise, Brian Piccolo Well Field
- Isolates cones of influence



Reuse Recharge Injection

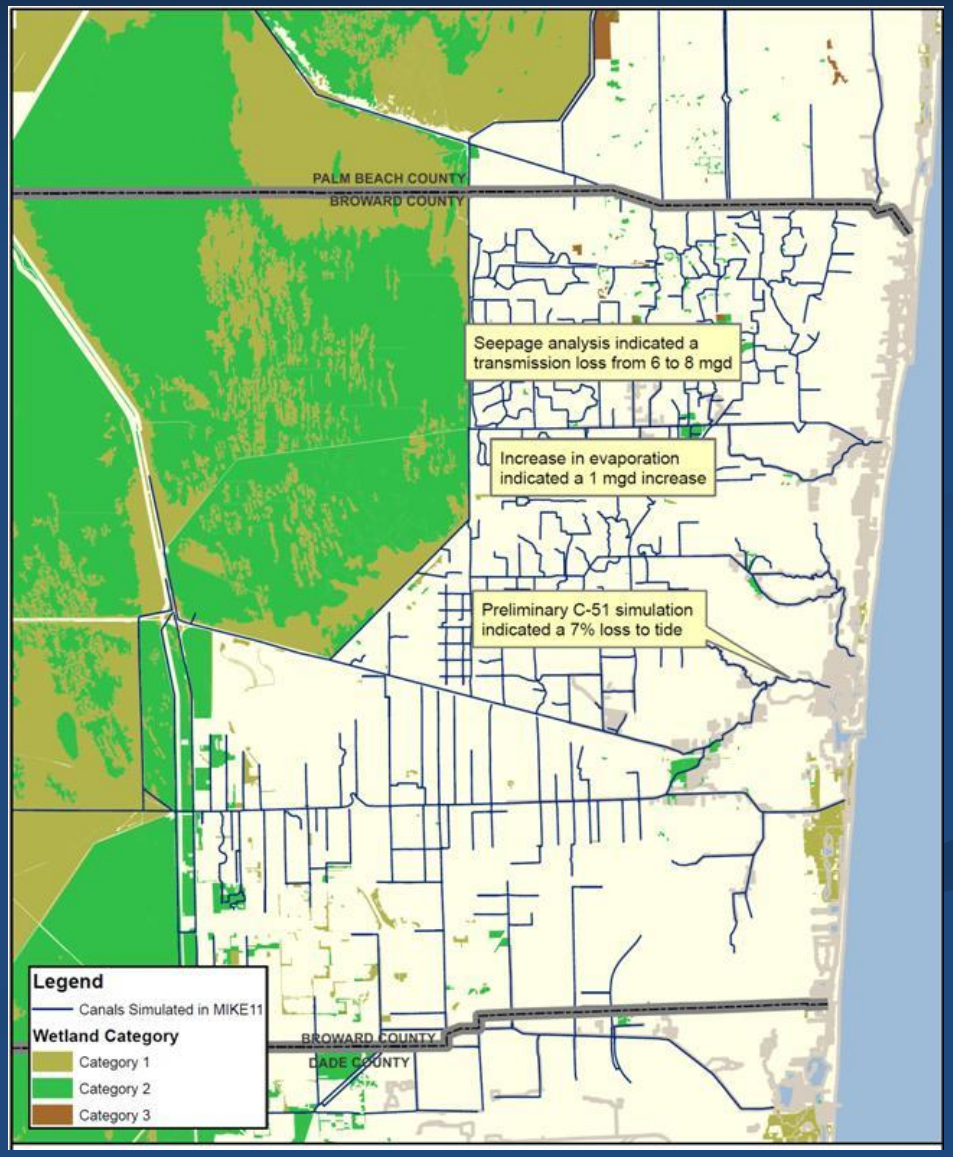
- Description:
  - Direct recharge into the Biscayne Aquifer
  - Location of Pembroke Pines
  - 8.0 MGD total volume
- Results:
  - Increased groundwater elevation by approximately 1 foot
  - Enough to switch canals from losing water to gaining, and wetlands from slightly drying out to becoming slightly wetter in Miramar vicinity

Reuse Recharge Injection



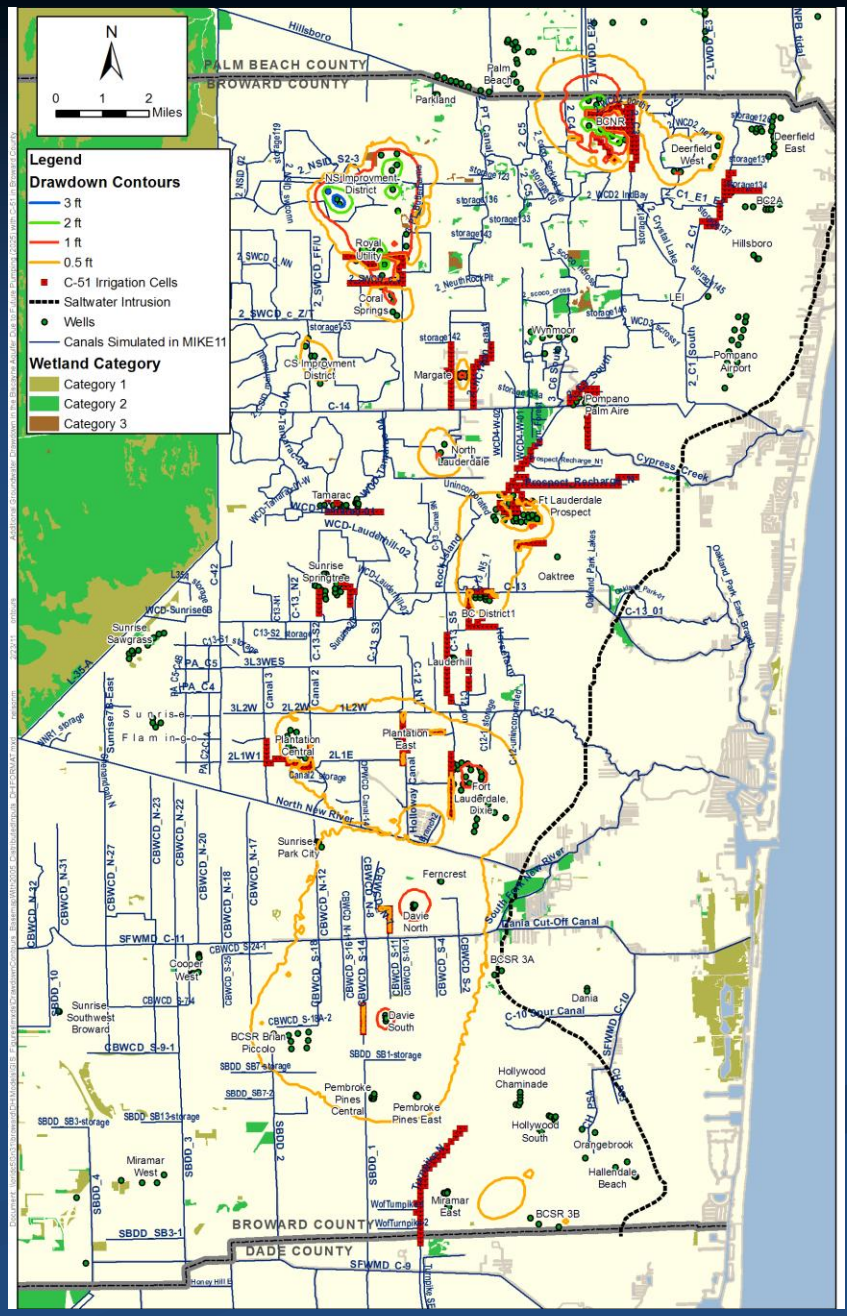
Conceptualization of Water Conveyance from the C-51 Reservoir Project

- Assumed 60 mgd of water available from reservoir
- Estimated losses
  - 10% to tide (6 mgd)
  - 14% canal seepage (8 mgd)
  - 1% evaporation from canal network (1 mgd)
- Total losses during conveyance ~ 25% (15 mgd)
- Net result: 45 mgd to provide direct recharge to wellfields



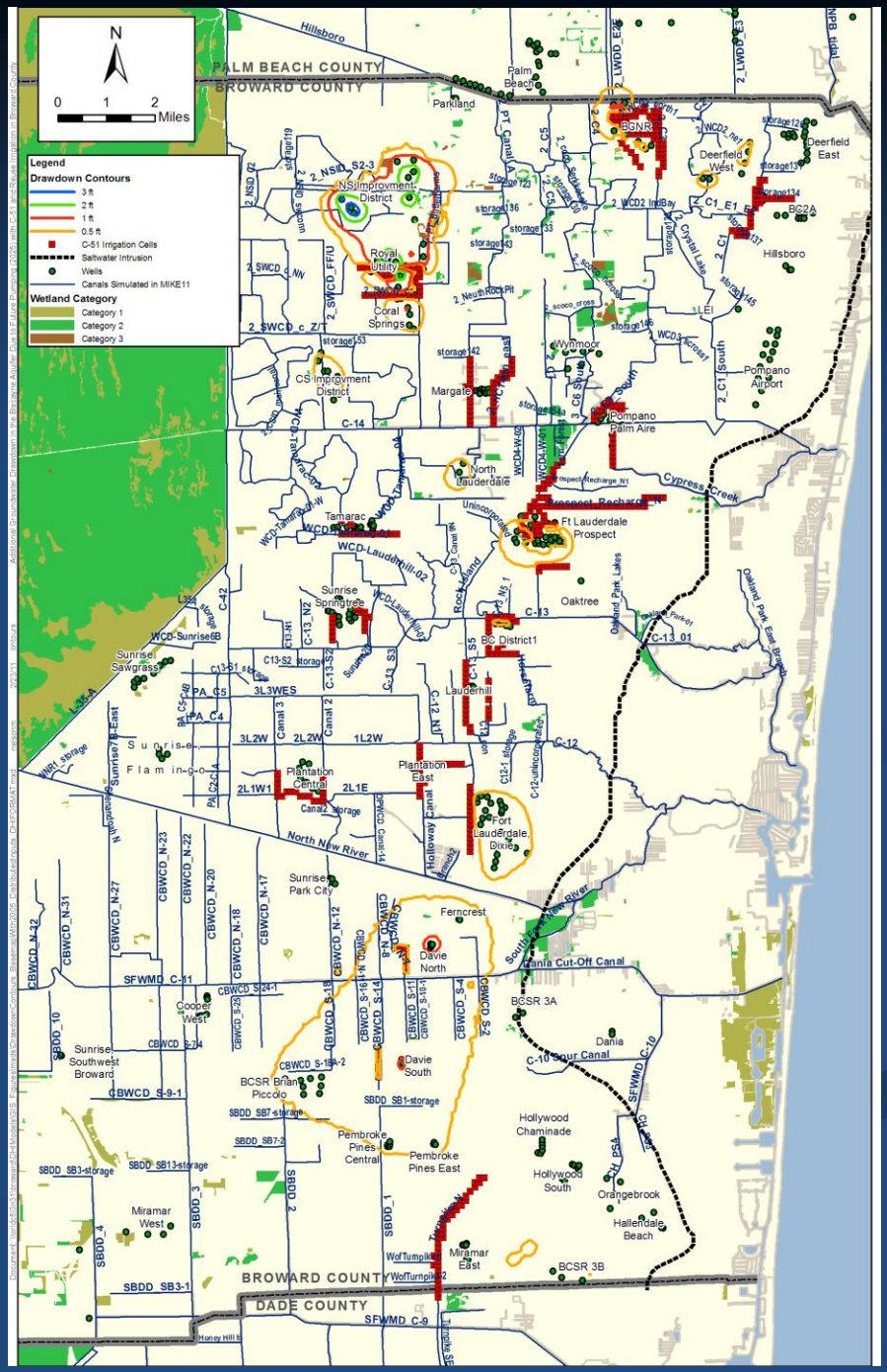
Simulation Results for 2025 w/ C-51 Project

- Proposed conditions (2025) with 45 mgd of beneficial recharge
- Drawdowns decreased from 2-3 ft to 1-2 ft in northern BC



2025 Simulation with Reuse & C-51 Projects

- Proposed conditions (2025) with 18 mgd reuse irrigation and 45 mgd C-51 project
- Provides significant drawdown recovery benefit
  - 1 ft drawdowns eliminated or confined to immediate vicinity of wells



Planning Level Costs - Reuse

	Utility/Region - Biscayne										
Parameter	Davie (Irrigation)	Davie (Recharge)	Margate	Miramar	Pembroke Pines	Plantation	Pompano Beach	Region 1 (Irrigation)	Region 1 (Recharge)[1]	Region 2	Region 3 (Recharge)[2]
Flow Rate (MGD)	1.0	3.0	1.5	2.0	8.0	3.4	2.8	12.5	2.8	9.0	7.5
Treatment Plant Cost (Million Dollars)	21.0	73.0	24.0	27.0	110.0	35.0	0.0	66.0	22.0	57.0	48.0
Level of Treatment	Tertiary	Advanced	Tertiary	Tertiary	Advanced	Tertiary	Tertiary	Tertiary	Advanced	Tertiary	Advanced
Pump Cost (Million Dollars)	1.0	1.0	1.0	1.0	6.0	1.0	0.0	6.0	1.4	5.0	4.0
Piping, Trenches, and Well Costs (Million Dollars)	1.0	1.0	2.0	3.0	1.0	4.0	5.0	10.0	10.0	5.0	7.0
Total Capital Cost (Million Dollars)	23.0	75.0	27.0	31.0	117.0	40.0	5.0	82.0	24.0	67.0	59.0
Total Equivalent Annual Capital Cost (Million Dollars)	2.2	7.1	2.5	2.9	11.0	3.8	0.5	7.7	2.3	6.3	5.6
Total Annual O&M Cost (million dollars)	0.3	1.2	0.4	0.5	2.1	0.7	0.6	1.4	0.6	1.2	1.5
Total Equivalent Annual Cost (million dollars)	2.5	8.3	2.9	3.4	13.1	4.4	1.0	9.1	2.9	7.5	7.1

- Total of:
  - $550 million in capital cost
  - $10.5 million operating costs
  - $62.2 million average annual cost

Planning Level Cost - C51

Table 3.2 Estimated Capital, O&M and Unit Costs of Proposed C-51 Reservoir in 2009 Dollars Using Conveyance Alternative 1 – LWDD, 100% of Reservoir Capacity is Used

Type of Cost	Capital Cost (million $)	Annual O&M Cost (million $)	Capital Cost In Dollars / Gal of Water Capacity	Annual O&M Cost in Dollars / 1,000 Gal. of Water	Total Cost / 1,000 Gal. of Water (a)
(1)	(2)	(3)	(4) = (2) / mgd	(5) = ((3) x 1,000) / (mgd x 365)	(6)
Cost per Water Offset (120 mgd)	$451	$1.20	$3.76	$0.03	$0.93
Cost per Raw Water Provided (160 mgd) (b)	$451	$1.20	$2.82	$0.02	$0.69
Cost per Potable Water Produced (136 mgd) (c)	$451	$1.20	$3.32	$0.02	$0.82

(a) Based on 20 year municipal bond at 6 percent annual interest.

(b) The 160 mgd was based on a recharge-to-withdrawal ratio of 0.75 that was chosen based on the findings of this study and is a weighted average that will vary depending on the utilities included and the unmet demands of these utilities.

(c) Does not include the cost of water treatment and distribution

*Based on Hazen and Sawyer Tech Memo No. 4, Phase 2A – Draft January 21, 2010

- Cost to treat 60 MGD of water for 4 months is approx. $6 million vs. $42 for equivalent amount from Floridan with a TDS of 6,000 mg/L

Conclusions

- Individually, neither the C-51 or modeled reuse projects provided the necessary offset for 75 MGD of additional Biscayne withdrawals.

- The combined implementation of the C-51 and reuse projects appear to provide the necessary offsets for a total Biscayne withdrawal of 330 mgd in accordance with RWA Rule (minor environmental impacts).

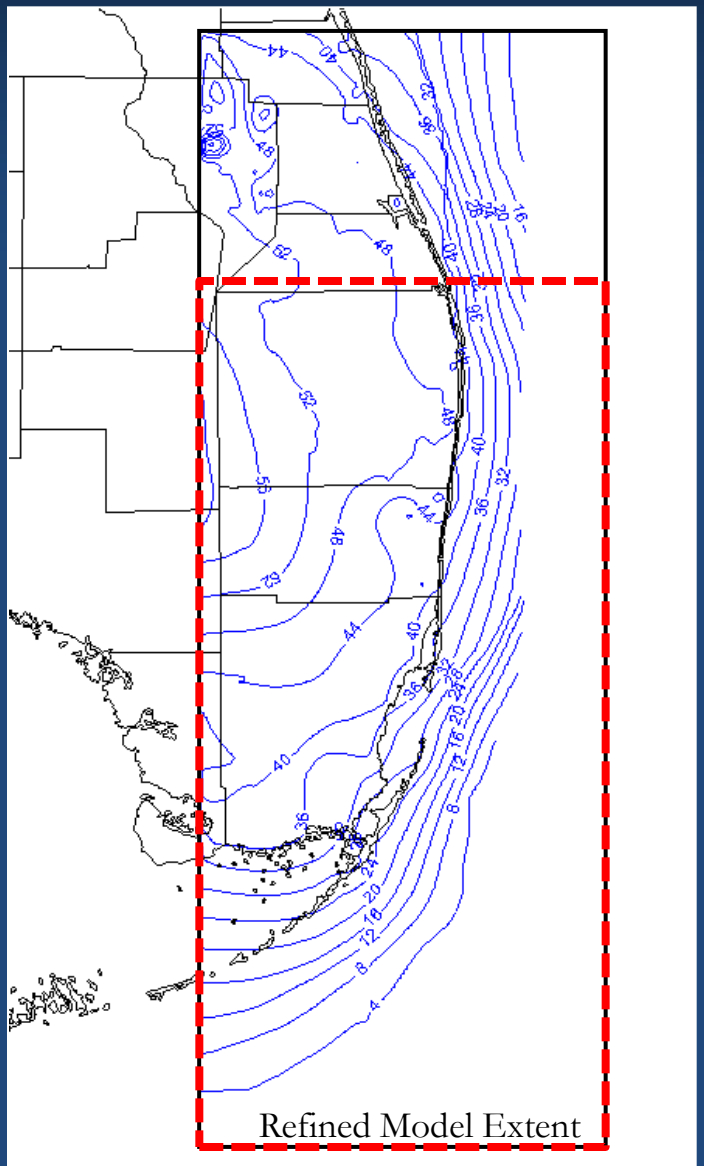
- Discrete recharge projects effective at mitigating localized impacts

FLORIDAN AQUIFER MODELING

Introduction

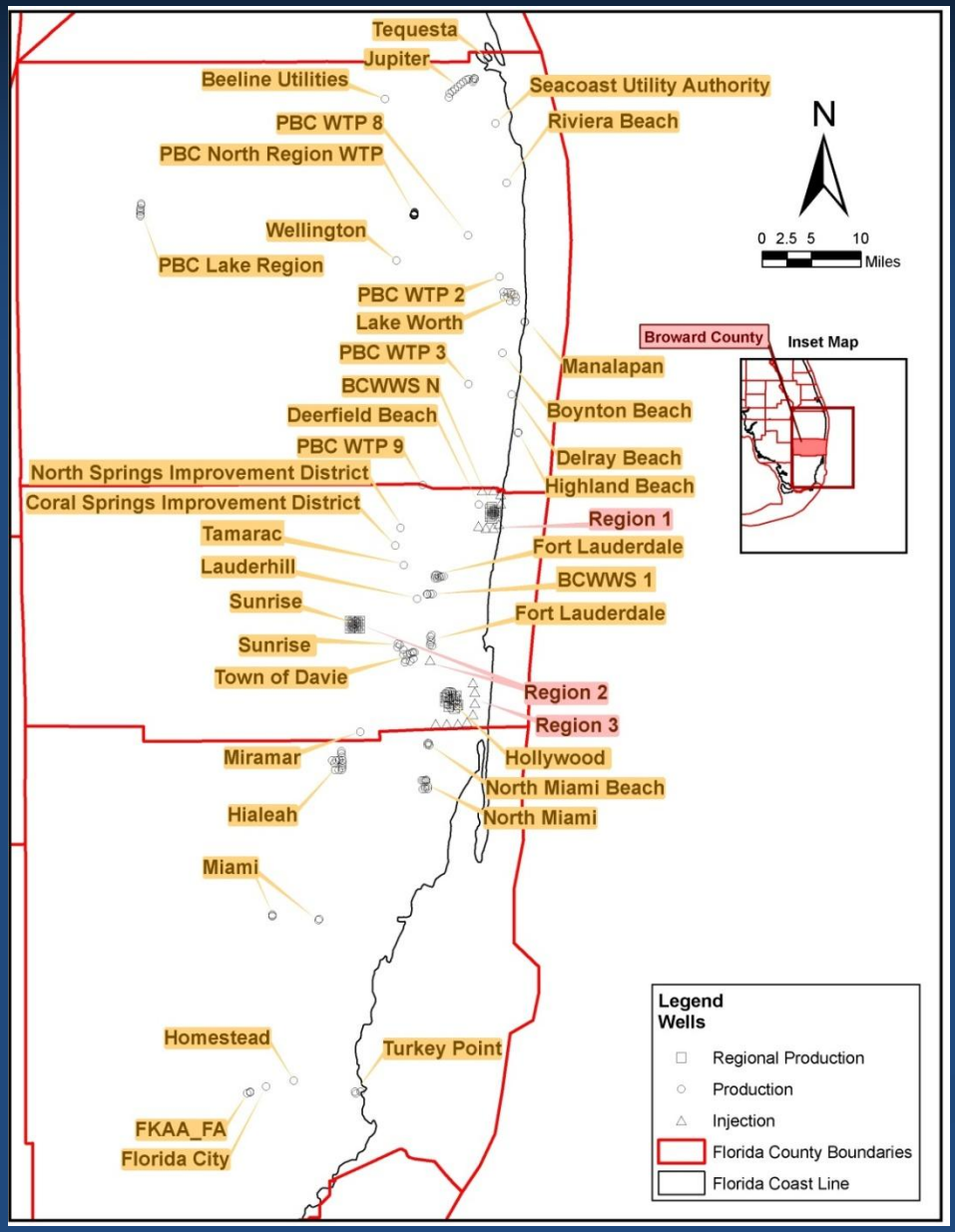
- Many AWS plans call for Floridan water
- Production rate in 2035 approximately 103 MGD
- SFWMD development of Phase II model represented first large scale attempt at modeling Floridan Aquifer
- Telescoped Broward County model provided:
  - Finer grid for higher resolution
  - Long term predictive simulations for 2035 withdrawal rates
  - Application of proposed recharge

Refinement of SFWMD Phase II Model



- Original model covered lower east coast
- New model extent based on maximum projected drawdown
- Grid refined in urban area of Broward County
- Allows evaluation of saltwater effects
- Additional layer added to UFA

Predictive Model Development



- Includes wells in tri-county region
- Includes 196 total wells
  - 56 BC Utility wells
  - 18 Region wells (3 well fields)
  - 17 Injection wells (3 facilities)
  - Analysis through 2035

Predictive Model Development

- Refinement of Broward County production rates
- Based on utility estimates, local WSPs, and BC WRTF project concepts
- 80 MGD in 2025
- 103 MGD in 2035
- Integration of proposed recharge projects
  - 52.75 MGD from 2025 through 2035

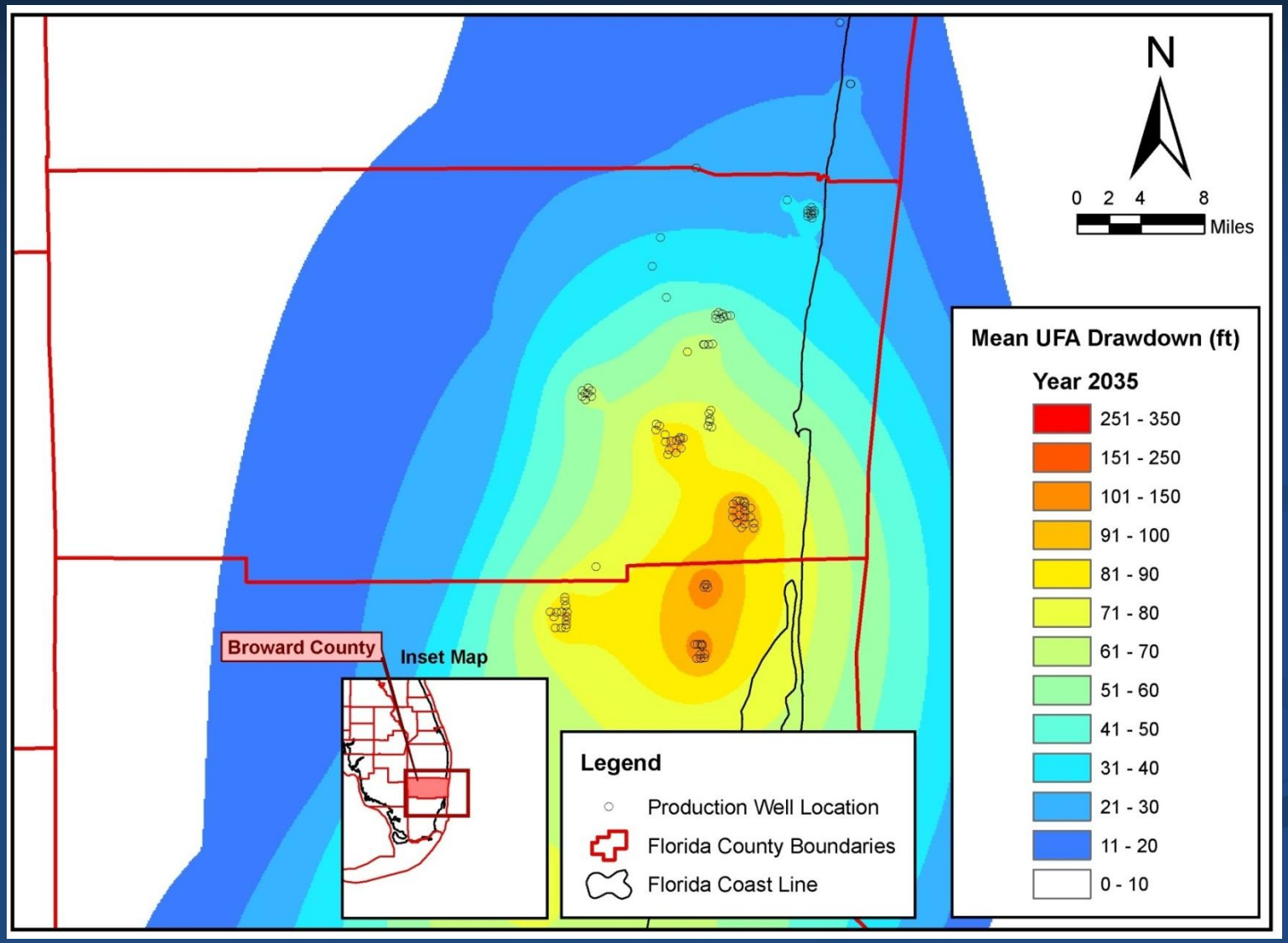
Predictive Model Development

- Four unique simulations developed
- Two simulations with individual utility well fields
  - One without recharge
  - One with recharge
- Two simulations with three regional well fields
  - One without recharge
  - One with recharge

Predictive Simulation Results

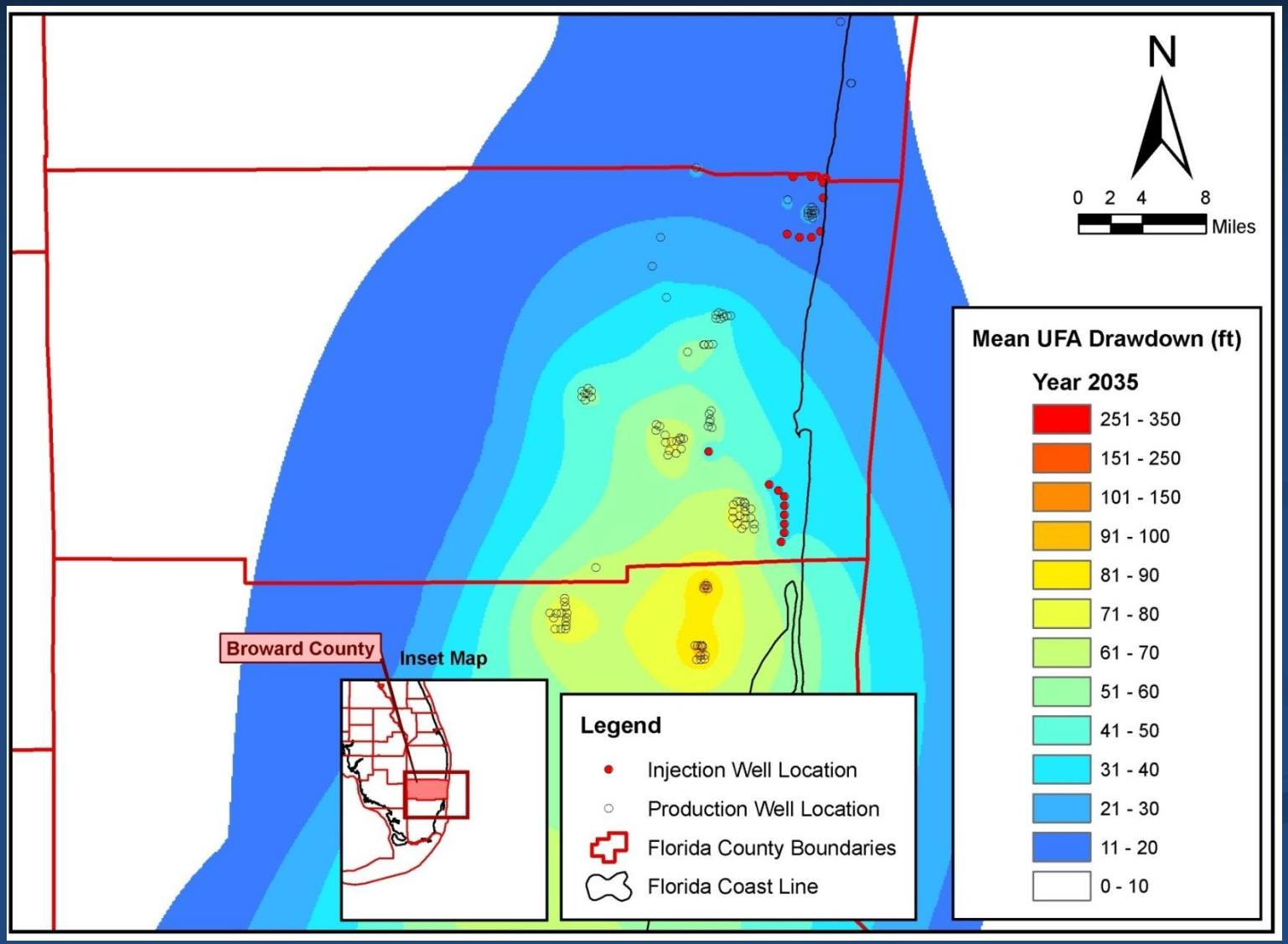
- Simulation set 1: pumping at individual utility well fields
  - With and without injection
  - Pumping at individual well fields until 2025
  - Additional demand allocated to regional well fields from 2025-2035

Predictive Simulation Results



- Simulated 2035 **Drawdown Without Injection**

Predictive Simulation Results

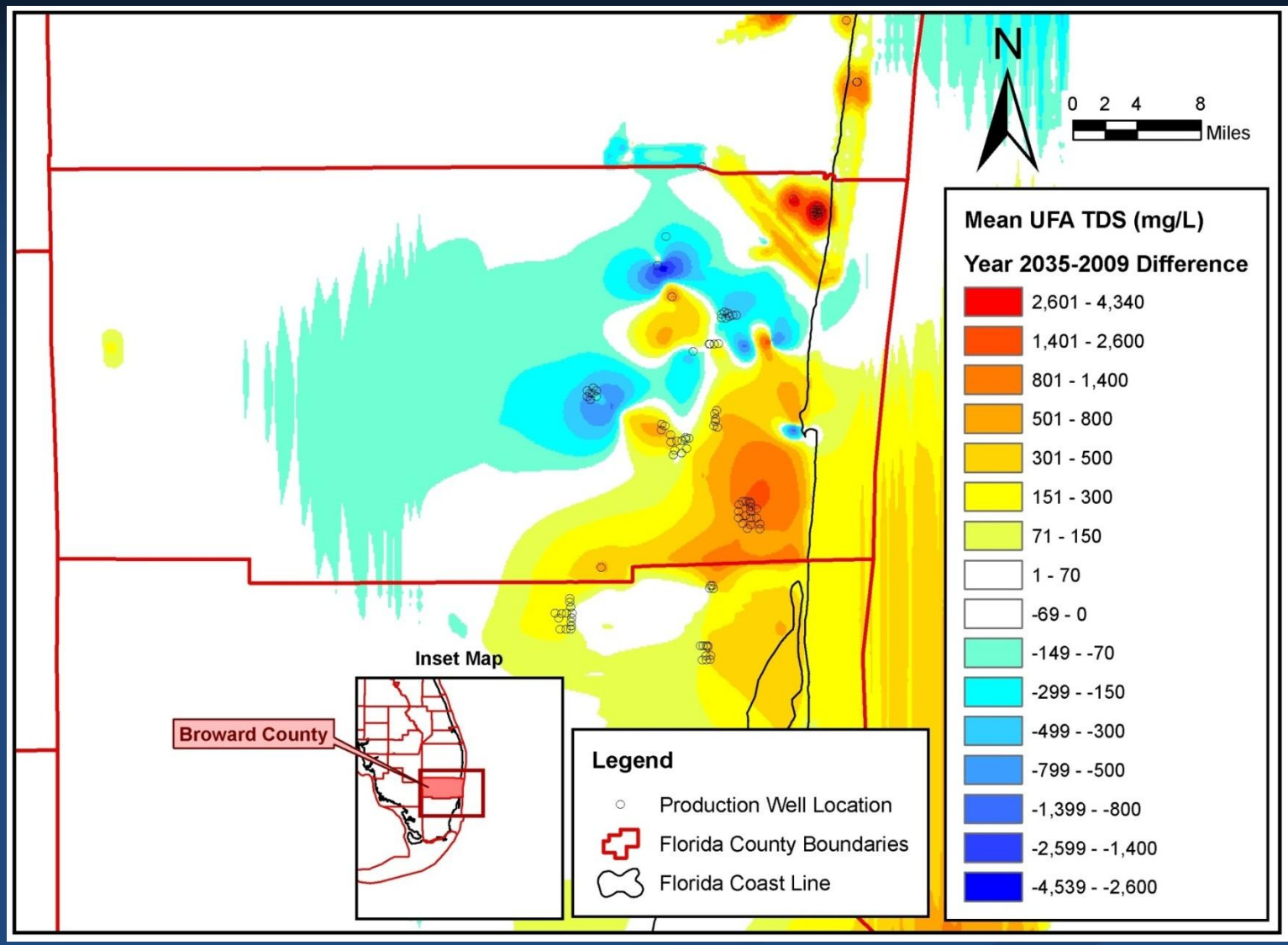


- Simulated 2035 **Drawdown With Injection**

Predictive Simulation Results

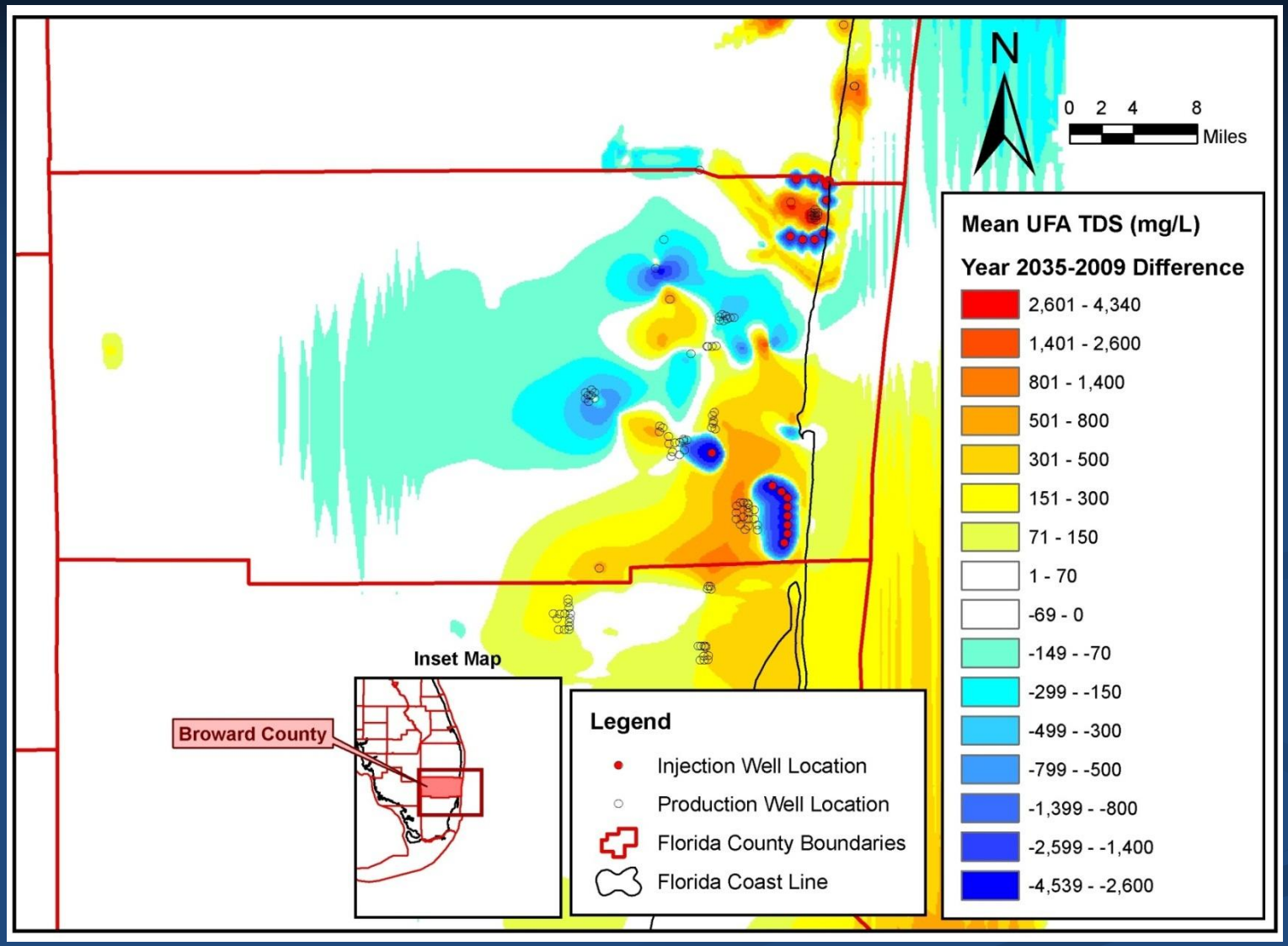
- Key benefits of injection:
- 2035 drawdown improvements relative to no injection:
  - 14 feet at BCWWS N
  - 29 feet at Hollywood
  - 20 feet at Davie

Predictive Simulation Results



- Simulated 2035 **Concentration Change Without Injection**

Predictive Simulation Results



- Simulated 2035 **Concentration Change With Injection**

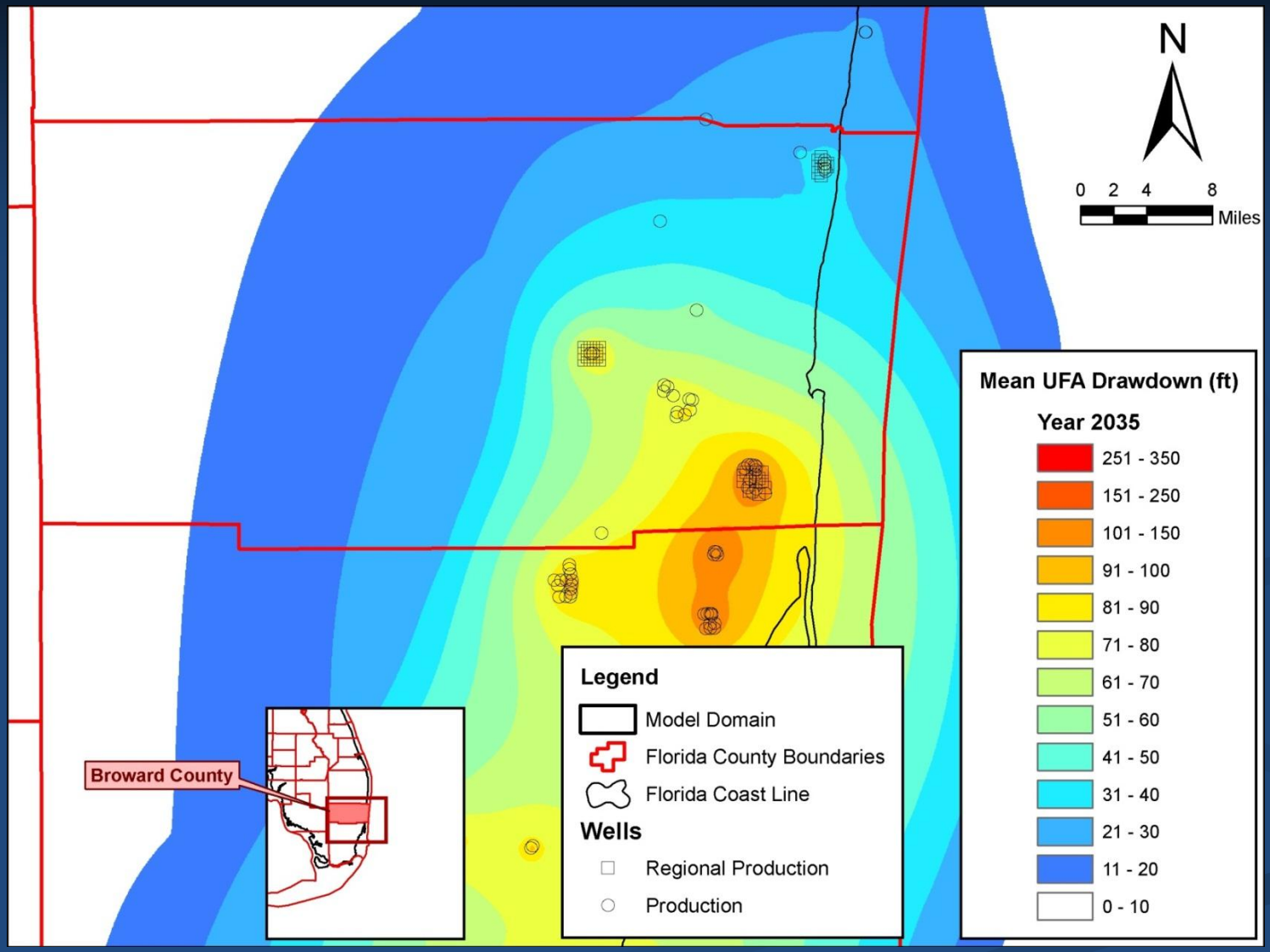
Predictive Simulation Results

- Key benefits of injection:
  - 2035 concentration decreases relative to no injection:
  - 2,200 mg/L at BCWWS N (↓ 25%)
  - 530 mg/L at Hollywood (↓ 9%)
  - 270 mg/L at Davie (↓ 5%)

Predictive Simulation Results

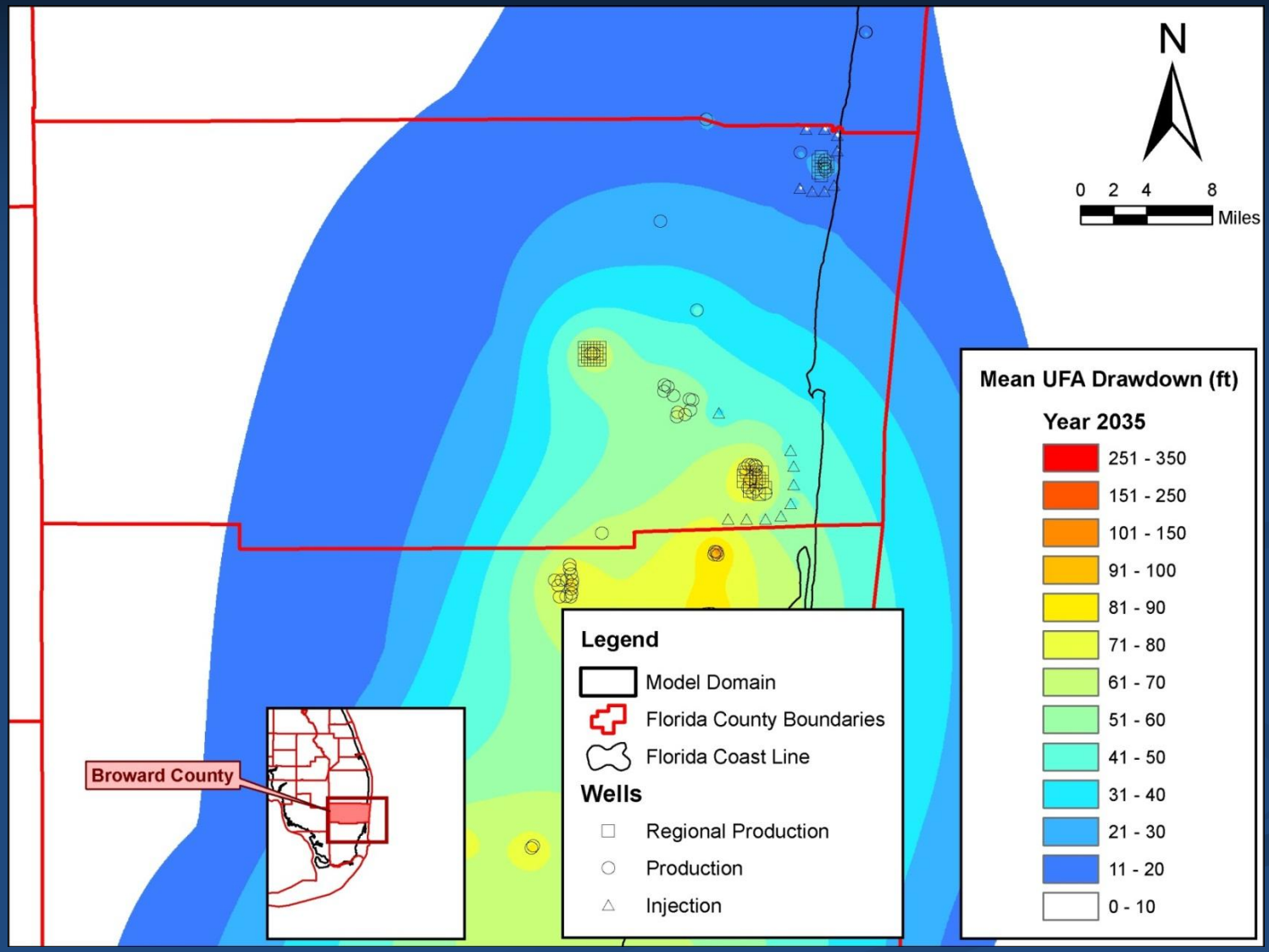
- Simulation set 2: pumping at regional well fields
- With and without injection
- Pumping at individual well fields up to 2013
- Additional pumping at regional well fields from 2013
  - WWS – Region #1
  - Sunrise – Region #2
  - Hollywood – Region #3

Predictive Simulation – Regional Projects



- Simulated 2035 **Drawdown Without Injection**

Predictive Simulation – Regional Projects



- Simulated 2035 **Drawdown With Injection**

Predictive Simulation Results

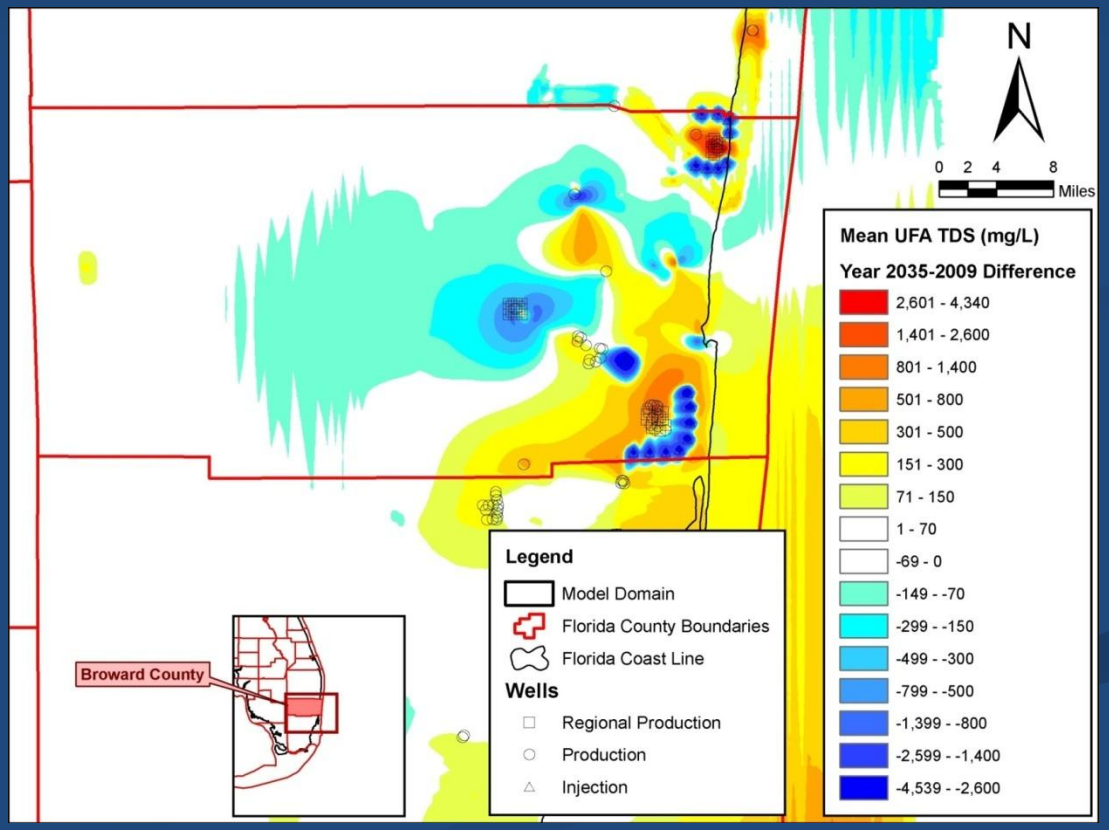
- Key changes between individual vs. regional:

- 2035 drawdown changes in regional relative to individual:

Decrease (location (feet))	Increase (location (feet))
BCWWS 1 (19)	BCWWS N (4)
Fort Lauderdale (15)	Hollywood (10)
Lauderhill (22)	Sunrise (21)
Davie (12)	Miramar (1)

Key Benefits of Injection

- 2035 concentration decreases relative to no injection (bigger number the better):
  - 2,400 mg/L at BCWWS N (↓ 25%)
  - 360 mg/L at Hollywood (↓ 6%)
  - 110 mg/L at Davie (↓ 2%)



Predictive Simulation Results

- Key changes between individual versus regional:

- 2035 concentration changes in regional relative to individual:

Decrease (location (mg/L))	Increase (location (mg/L))
Deerfield Beach (250)	BCWWS N (1020)
Sunrise (250)	Hollywood (305)
	Lauderhill (280)

Floridan Projects Cost Analysis

- $717 million likely capital cost for individual utility scenario without injection
- $572 million likely capital cost for regional wellfield scenario without injection
- $487 million likely capital cost for Floridan recharge facilities
- 15% higher TDS concentration at BCWWS N regional wellfield

Floridan Conclusions

- Saltwater intrusion a problem at simulated rates (150-1210 mg/L [3-26%] increase in chlorides)
- Significant drawdown (23-110 feet)
- Large capital costs associated with construction of appropriate treatment facilities
- Injection of reuse water improved model results by reducing heads and chloride concentrations

Floridan Summary

- 103 MGD demand from Floridan

	Local Utility Representation					
	Without Injection		With Injection		Difference	
Utility	Head (ft)	Conc (mg/L)	Head (ft)	Conc (mg/L)	Head (ft)	Conc (mg/L)
BCWWS 2A	40	8820	26	6650	-14	-2170
Hollywood	100	5820	71	5290	-29	-530
Davie	92	5470	72	5200	-20	-270

	Region Representation					
	Without Injection		With Injection		Difference	
Utility	Head (ft)	Conc (mg/L)	Head (ft)	Conc (mg/L)	Head (ft)	Conc (mg/L)
BCWWS 2A	43	9660	29	7250	-14	-2410
Hollywood	110	5950	81	5590	-29	-360
Davie	80	5480	60	5370	-20	-110

GENERAL IWRMMP CONCLUSIONS

Biscayne / Florida Cost Comparison

	Cost- Millions of Dollars		
	Total Capital	Total Annual O&M	Total Equivalent Annual
Biscayne- Reuse	550 (1)	11	62
Biscayne- C51	425 (2)	1	22
Biscayne- Facilities (3)	28-108	3-12	6-22
Floridan- Local	717	75-76 (4)	142-144 (4)
Floridan- Regional	572	55-57 (4)	1109-111 (4)
Floridan- Recharge (5)	487	11	57

(1) Region 3 advanced treatment of 31.25 MGD for injection into Biscayne & Floridan Aquifers accounts for $223 million

(2) Dependent on final routing path utilized

(3) Costs range from Anion to RO treatment facilities

(4) Range for injection and non-injection scenarios

(5) Both Region 1 and Region 2 recharge facilities are assumed to service both Biscayne and Floridan recharge operations

Conclusions

- Biscayne appears to support 75 MGD additional demand with combination of AWS projects
- However, cost implication of large-scale recharge projects substantially influences economics relative to Floridan
- Slight impacts along saltwater intrusion line and at wetlands require additional mitigation
- Conservation can reduce demands and lessen potential impacts of the 2025 withdrawal scenario

Conclusions

- Summary
  - Producing 103 MGD from Floridan cannot be sustained without water quality impacts
  - Injection of 52.75 MGD proved beneficial but does not fully mitigate the trend of increasing chlorides
  - Efforts to reduce overall demands on the Floridan would improve the longer-term quality of this resource
  - Biscayne results demonstrate AWS offsets to be a viable strategy for reducing future demands on the Floridan Aquifer.

Next Steps

- Additional analysis of C-51 routing alternatives and assessment of project benefits
- Refined study of potential AWS projects focused on the Biscayne
- Further analysis of the Floridan water supply projects and recharge scenarios to include alternative withdrawal and injection points
- Collection of additional Floridan data to further refine model
- Make use of additional model improvements resulting from SFWMD peer review

QUESTIONS?

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