# District Concept for Deep Injection Wells in the Northern Everglades

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Governing Board Meeting October 12, 2017



# Discussion

- Meaningful stakeholder input has been discussed at WRAC and project team meetings
- South Florida Water Management District (District) <u>draft</u> concept
- Analyses to protect estuaries with Deep Injection Wells (DIW)
- Draft implementation timeline and cost
  - ✓ Needs further development



Deep Injection Well at the Okeechobee Utility Authority, since 2009

# District Concept for Deep Injection Wells to Reduce Estuary Discharges

- ➤ June 2007: DIW Feasibility Study
- February 2008: SFWMD/FDEP/FDACS Lake Okeechobee Watershed Construction - Project Phase II Technical Plan
- 2013 CERP ASR Regional Study model analysis of DIWs with ASR wells
- May 2017: USACE remove DIW from Lake Okeechobee Watershed Restoration Project
- ➤ June 1, 2017: Discussion at WRAC
- June 6, 2017: Governing Board directed staff to evaluate feasibility of a DIW program
- October 12, 2017: Staff to present to Governing Board



# District Concept for Deep Injection Wells to Reduce Estuary Discharges

- DIW could work in combination with reservoirs, ASR wells, and STAs
- Long term tool to help meet estuary restoration goals
- Would be used when discharges to tide become necessary



Deep Injection Well at Delray Beach South Central Facility

# District Concept for Deep Injection Wells in the Northern Everglades Benefit Analysis

Cal Neidrauer, P.E. - Chief Engineer - Hydrology and Hydraulics Bureau

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# **Initial Analysis of DIW Concept**

- Analyses performed to evaluate current and future improvements when implementing DIWs
- 50 wells at 15 million gallons per day each assumed for demonstration purposes
  - 1. "Recent Historical" scenario evaluated recent discharge events assuming only existing infrastructure
  - "Future" scenario explored synergy of DIWs and other planned restoration efforts (i.e., Central Everglades Planning Project, Lake Okeechobee Watershed Project, C-43 Reservoir, C-44 Reservoir/STA, other anticipated projects)
- In these analyses, DIWs only operated as an alternative discharge point in place of making damaging flood control discharges to the northern estuaries (i.e., no impact to available water for restoration, or water supply. Only reduction is to flow already lost to tide)

## **Initial Analysis of Recent Historical Conditions with 50 DIWs**

#### Annual Volume of Lake Discharge to St. Lucie Estuary

■ Observed (No Deep Injection Wells) ■ With 50 Deep Injection Wells (15 MGD Each)



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### **Initial Analysis of Recent Historical Conditions with 50 DIWs**

#### Annual Volume of Lake Discharge to Caloosahatchee Estuary

■ Observed (No Deep Injection Wells) ■ With 50 Deep Injection Wells (15 MGD Each)



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## **Initial Analysis of Recent Historical Conditions with 50 DIWs**

#### Annual Volume of Lake Discharge to Caloosahatchee Estuary



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# Initial Analysis of Future Conditions with 50 Deep Injection Wells

- Including the Central Everglades Planning Project, Lake Okeechobee Watershed Restoration Project, C-43 Reservoir, C-44 Reservoir/STA and other anticipated projects
- Simulation of Future conditions indicate DIWs could further reduce impacts to estuaries after CERP and is not in conflict with other restoration projects
  - Even with all CERP components, northern estuary discharges are not fully eliminated; so DIW would still have opportunity to improve performance
- Restoration flows south are <u>unaffected</u> by DIW operations

#### Analysis of Future Conditions with 50 DIWs using RSM-BN Simulation Results (1965-2005 rainfall conditions)

Simulation	Average Annual Lake O Regulatory Discharge (kac-ft)	% Estuary Regulatory Flow Reduction (relative to ECB)	Number of Months Lake O Causes a Damaging Event	% Estuary "Months with Impact" Reduction (relative to ECB)
	St Lucie Estuary		St Lucie Estuary	
Existing Condition Baseline (ECB) (For Comparison)	165		31	
Future with Restoration Projects (CEPP, LOWRP, C43, IRL, etc)	96	<b>42%</b>	14	55%
Future with Restoration Projects + 50 Deep Injection Wells	54	67%	8	74%
	Caloosahatchee Estuary		Caloosahatchee Estuary	
Existing Condition Baseline (ECB) (For Comparison)	416		38	
Future with Restoration Projects (CEPP, LOWRP, C43, IRL, etc)	161	61%	13	66%
Future with Restoration Projects + 50 Deep Injection Wells	97	77%	8	79%

# District Concept for Deep Injection Wells in the Northern Everglades Initial Implementation and Cost

Bob Verrastro, Lead Hydrogeologist - Water Supply Bureau

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# Deep Injection Wells are nothing new...

# Over 200 active DIWs in Florida

- Almost all south of Orlando
- Most inject into the Boulder zone in the Floridan aquifer
- Stormwater not wastewater



# **Initial Site Prioritization Considerations**

- Sites identified in previous studies
- District lands only
- Benefits could include nutrient load reductions to Lake Okeechobee
- Co-located with ASR wells, STAs and Reservoirs
- Favorable hydrogeologic conditions
- Existing wells on site
- Multi-well expandability
- Proximity to field services (Operations and Maintenance)



## Deep Injection Well Facilities Initial Conceptual Plan

- Construction could be phased
- Process starts with exploratory well at recommended locations
- Site configuration dependent on exploratory well results
- Needs further development

YEARS 1 and 2 Site investigations, design evaluations, and program development

Year 3 through Year 10 Construct 50+ DIWs

## Estuary Protection in a Cost Effective Way

- Capital Costs: \$6 million per Facility
  - Well: \$3.5 million
  - Surface Facilities (piping, pump, monitor well, etc.): \$2.5 million
- Operations & Maintenance Cost: \$140,000 \$185,000 per facility per year
  - Based on usage and facility design
  - Assumes facility operates 4 months
  - Electrical cost (primary driver)
  - In-house or subcontracted
- Total Cost for 50 Facilities
  - Permitting, Design, and Capital Costs: \$330 million
  - Annual Operations & Maintenance Cost: ~ \$7.7 million \$10.2 million (at full implementation)

# **Summary of Stakeholder Comments**

- Uncertainty of hydrogeologic conditions
- Migration of water away from wells
- Scale of implementation
- Concerns for fracturing
- Energy intensive
- Diversion of funds from ongoing restoration efforts
- Removing fresh water from the regional water budget

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# **Potential Next Steps Subject to Board Input**

Initial analyses showed positive results to reduce damaging discharges to northern estuaries. However, further investigation is needed:

- Refinement of total number of DIWs
- Regional mapping of the Boulder Zone
- Analysis of overlying confining sequence
- Development of a well testing program
- Site configurations
- Design evaluations
- DIW program development
- Refinement of initial cost estimates

# Discussion

