



Reviving  
*THE river OF grass*

# Aquifer Storage and Recovery Update

*Larry Gerry, Chief Scientist  
Federal and State Policy Division*

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# Presentation Overview

RESTORATION PLANNING

- Background
- Notable ASR System results
- ASR in CERP
  - Issue Team (1999)
  - Regional Study
  - CERP Pilot studies
- River of Grass Phase II Considerations

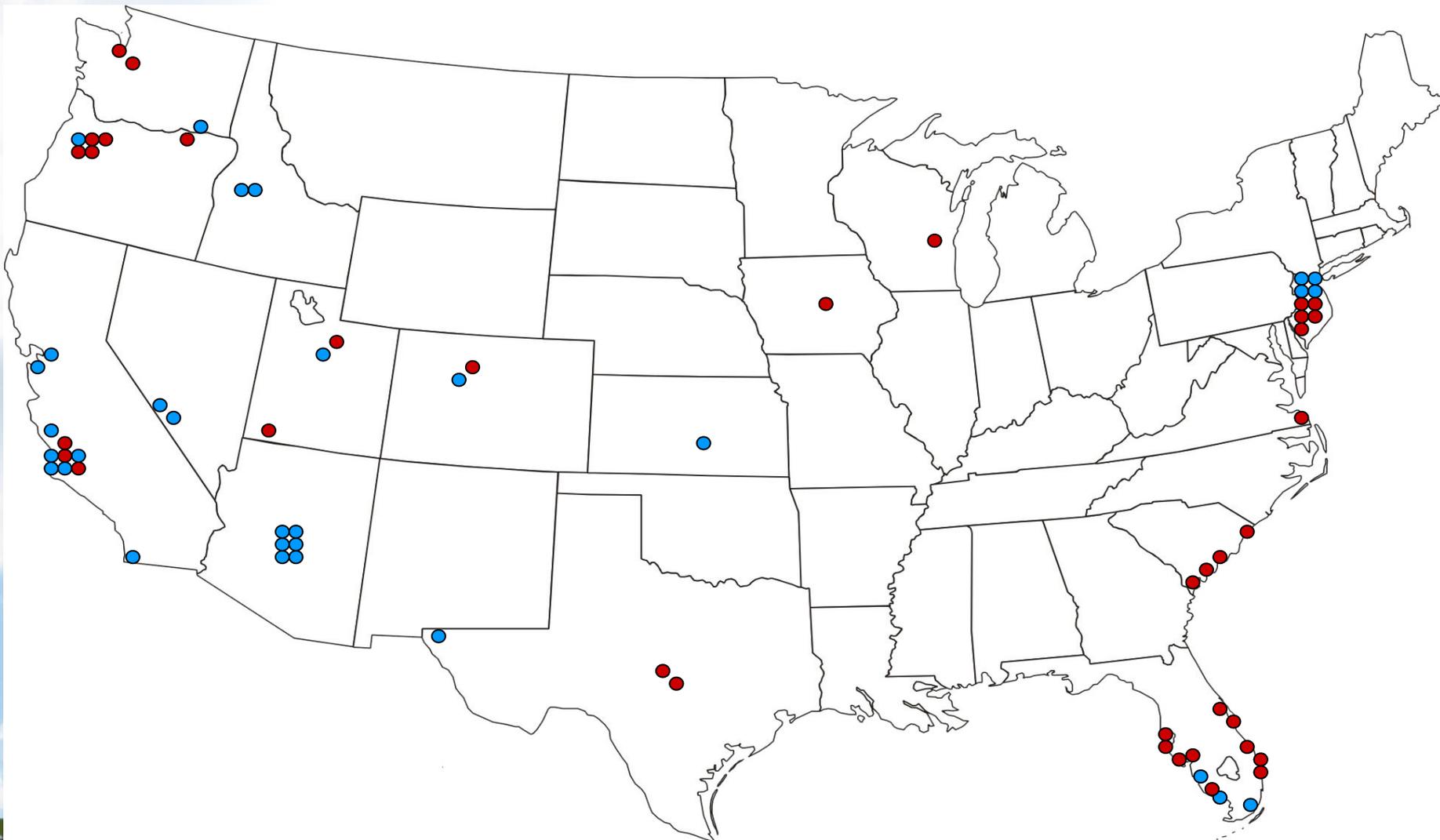
# Background

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- Technology in use for several decades
  - Artificial recharge of aquifers has been employed in the U.S. since 1940's
  - First United States ASR water supply system built in Wildwood, New Jersey, in 1968
  - Several states have multiple ASR systems
  - ASR underway in Canada, England, the Netherlands, Israel, and Australia
  - Most ASR applications are for municipal water supply
  - Florida may be first application for ecosystem restoration

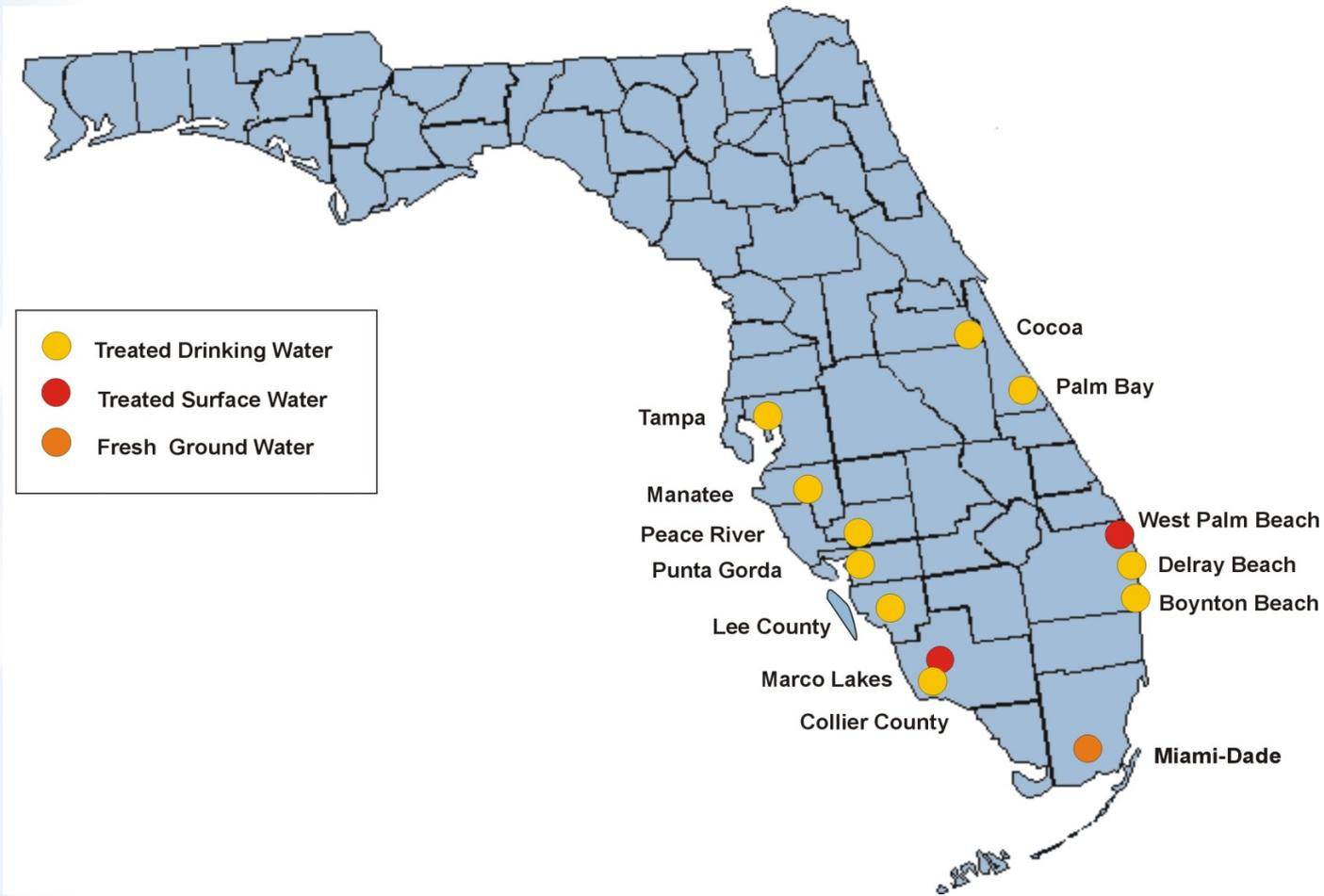
# ASR Well Fields Operating in the U.S. (78)

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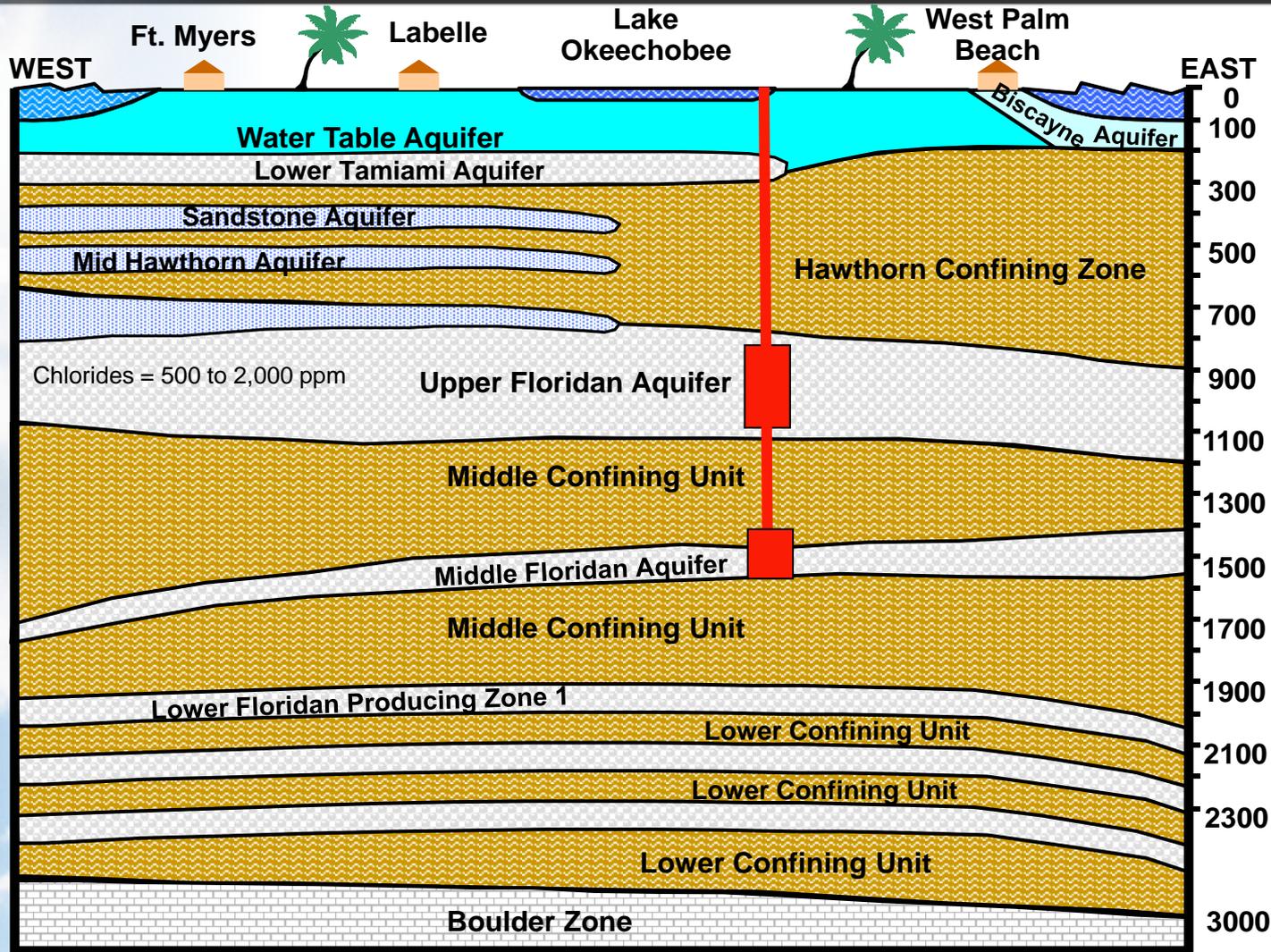
# Permitted ASR well fields operating in Florida (13)

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# Hydrogeology of South Florida

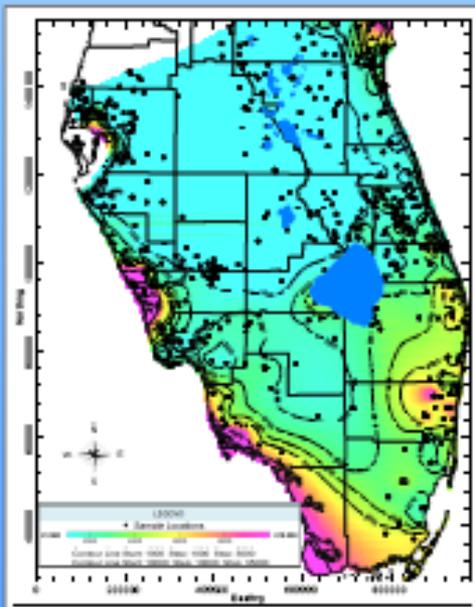
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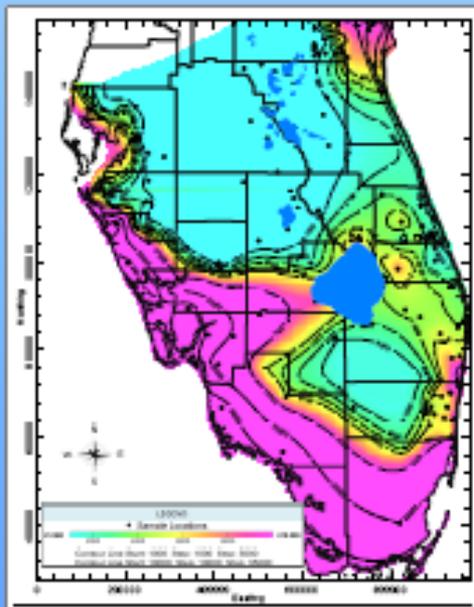
Targeting the Upper and Middle Floridan Aquifer

# Floridan Aquifer Zones

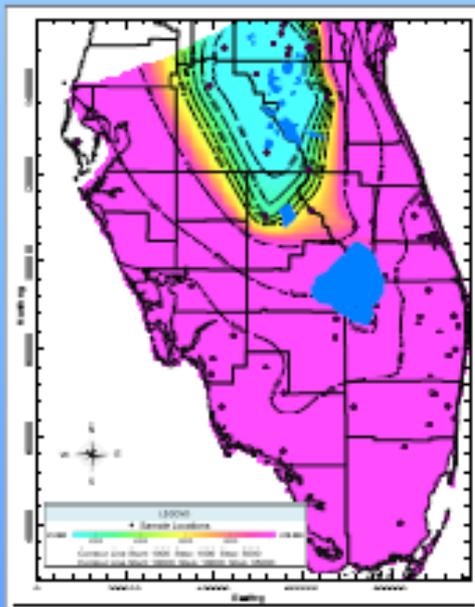
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Upper Floridan



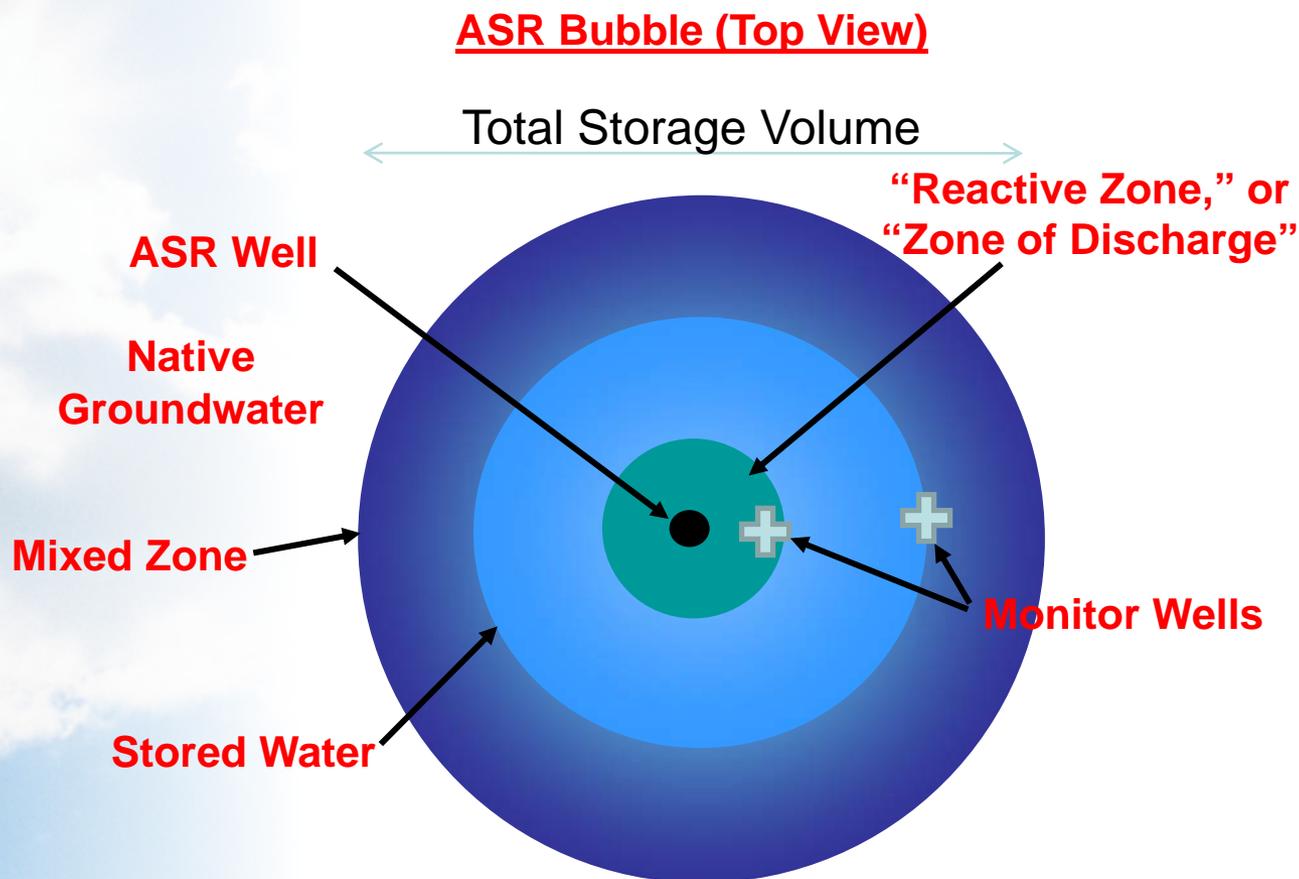
Middle Floridan



Lower Floridan

# ASR Bubble Cross-Section

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## Water Quality Changes:

- Filtration
- Dispersion
- Dilution
- Biological
- Geochemical

# Las Vegas ASR

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- Treated drinking water, from Colorado River at Lake Mead
- 64 wells
  - 42 dual-purpose
  - 22 recharge
- 103 mgd recharge capacity
- 157 mgd recovery capacity
- 81 billion gallons currently stored (250,000 ac-ft)



# The Peace River ASR

## RESTORATION PLANNING

- Ozone treated surface water
- Expanded to 20 mgd
- Operating under a Consent Order and Administrative Order



- Largest ASR system in eastern U.S. at 20 mgd
- 21 ASR wells
- Arsenic exceeded 10 ppb standard, but is declining



# West Palm Beach ASR at Clear Lake

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- Single high capacity well with potential 10 mgd capacity
- City is pursuing an Aquifer Exemption to allow recharge without chlorine disinfection to reduce trihalomethanes



# Marco Lakes ASR

- Largest system in SFWMD
- 1.7 billion gallons currently stored, since 1997
- 6 operating wells, 9 mgd capacity
- Treated creek water, pumped to ~750' bls
- Arsenic not an issue during operational period (arsenic standard changed during operational period- 50 to 10 ppb)



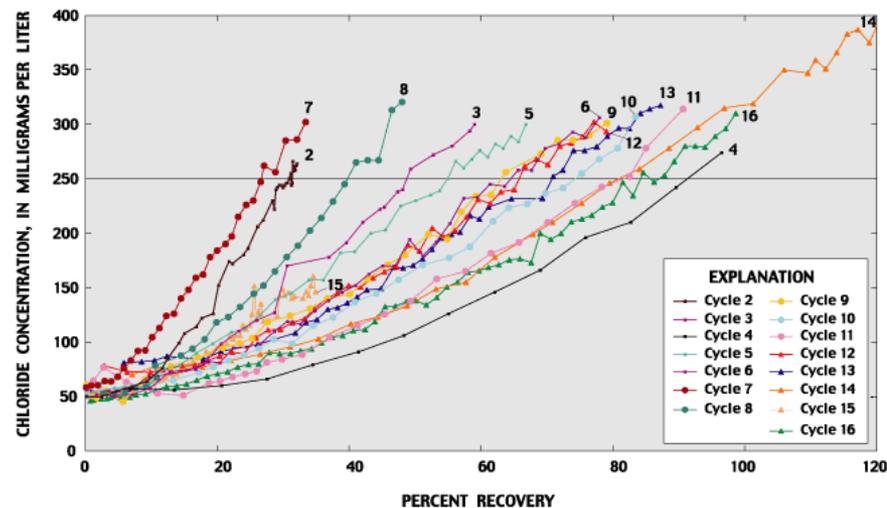
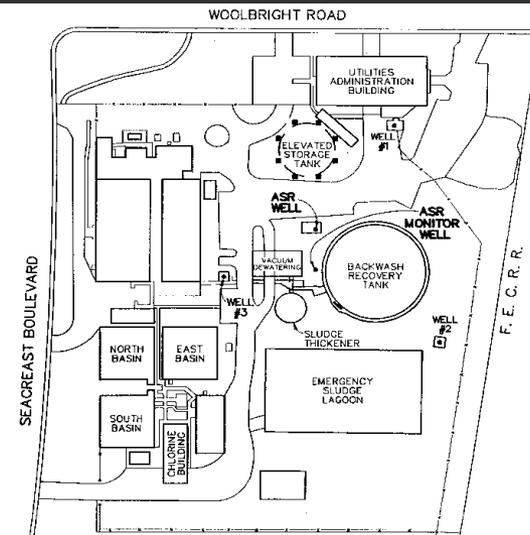
LANNING



# Boynton Beach ASR

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- Initial recovery (1992) efficiencies were low
- Higher recovery with continued cycles
- Development of a Target Storage Volume (with 100% recovery)
- Arsenic not an issue during period of operation



# CERP ASR Issue Team Recommendations

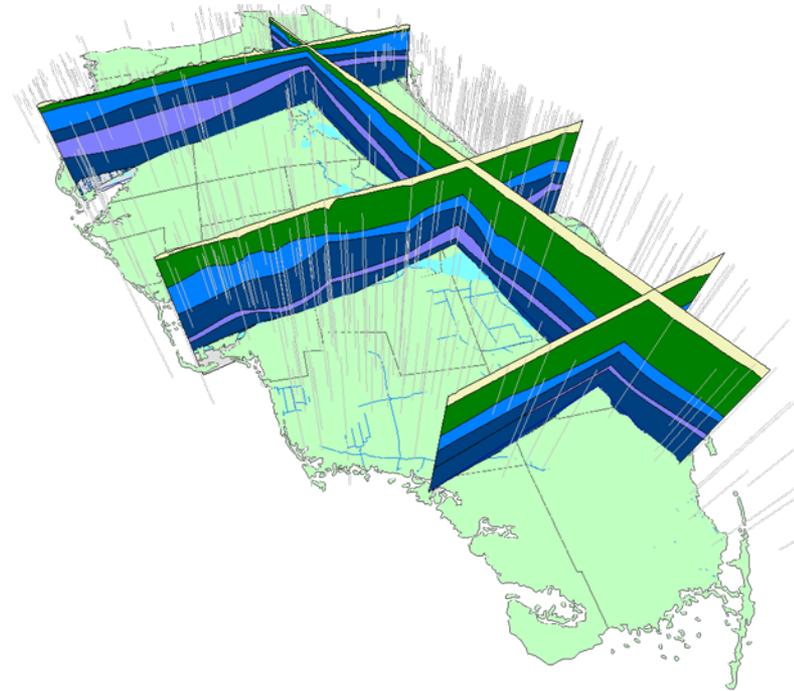
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- Characterize quality and variability of source water
- Study regional hydrology of Floridan aquifer
- Determine critical pressure for rock fracturing
- Identify local and regional changes in Floridan aquifer flow patterns
- Water quality changes in aquifer
- Potential affects on mercury bioaccumulation
- Relationships among ASR storage interval properties, recovery rates, and recharge volume

# CERP ASR Regional Study Interim Results

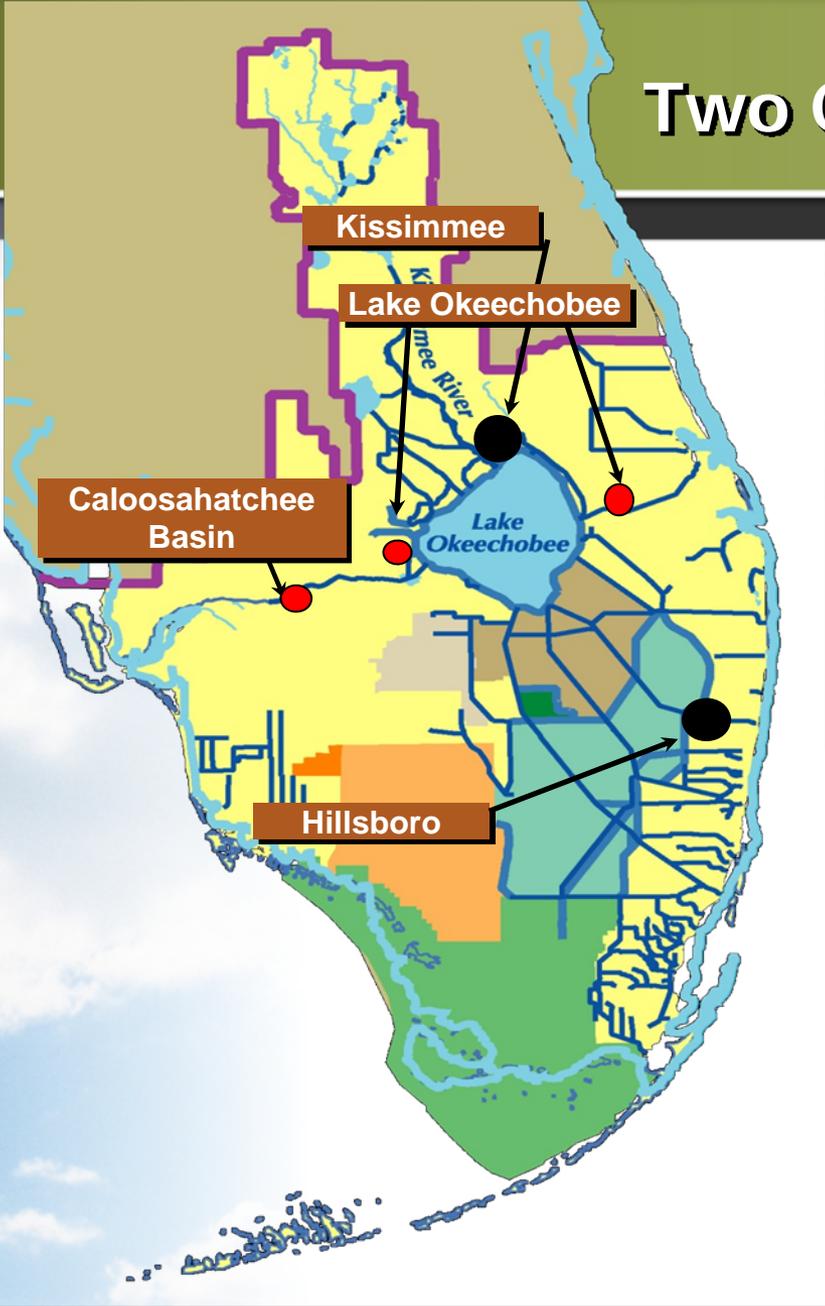
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- Groundwater model under development – will be running scenarios later this year
- Water from canals and lakes requires filtration and disinfection prior to recharge
- Risk of fracture potential can be reduced by low injection pressures less than 200 psi and well spacing
- Initial ecological studies indicate that the recovered water is not toxic to aquatic organisms in the laboratory
- Preliminary mercury studies indicate that recovered water does contain increased mercury concentrations
- Final Report due by 2013



# Two CERP ASR Pilots in Operation

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# Kissimmee River ASR Pilot

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- Good recovery
- No toxicity or bioaccumulation
- Arsenic exceeded 10 ppb during cycle 1, did not in cycle 2, now in cycle 3
- Phosphorus reduction from >100 to <20 (cycles 1 & 2)
- Now into cycle #3
- Sand filter with ultraviolet disinfection (UV)
- Effectiveness of UV is affected by canal water quality variability

# Hillsboro ASR Pilot

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- Fit within a canal right-of-way
- Surface footprint of about  $\frac{1}{4}$  acre
- In 90 days, this system will store 1,350 ac/ft
- One pump pushes water into the aquifer at 80 psi



# Hillsboro ASR Pilot

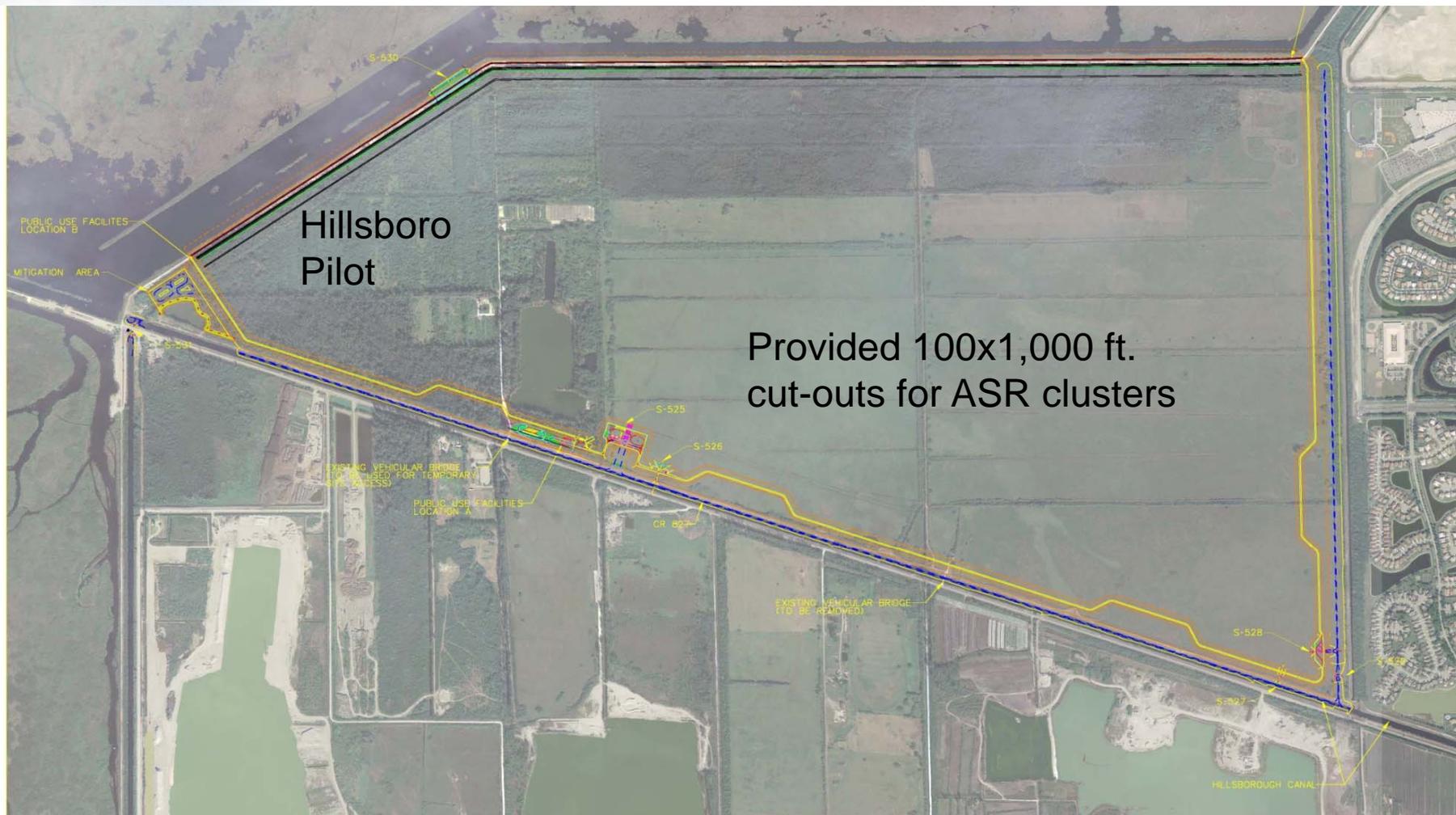
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- Began cycle testing in January 2010
- Mechanical filter with UV disinfection
- ASR wells to be integrated into Site 1 Impoundment
- High-capacity well (8 mgd) - will need fewer wells here than planned
- Arsenic exceeded 10 ppb in cycle 1 (now in cycle 2)

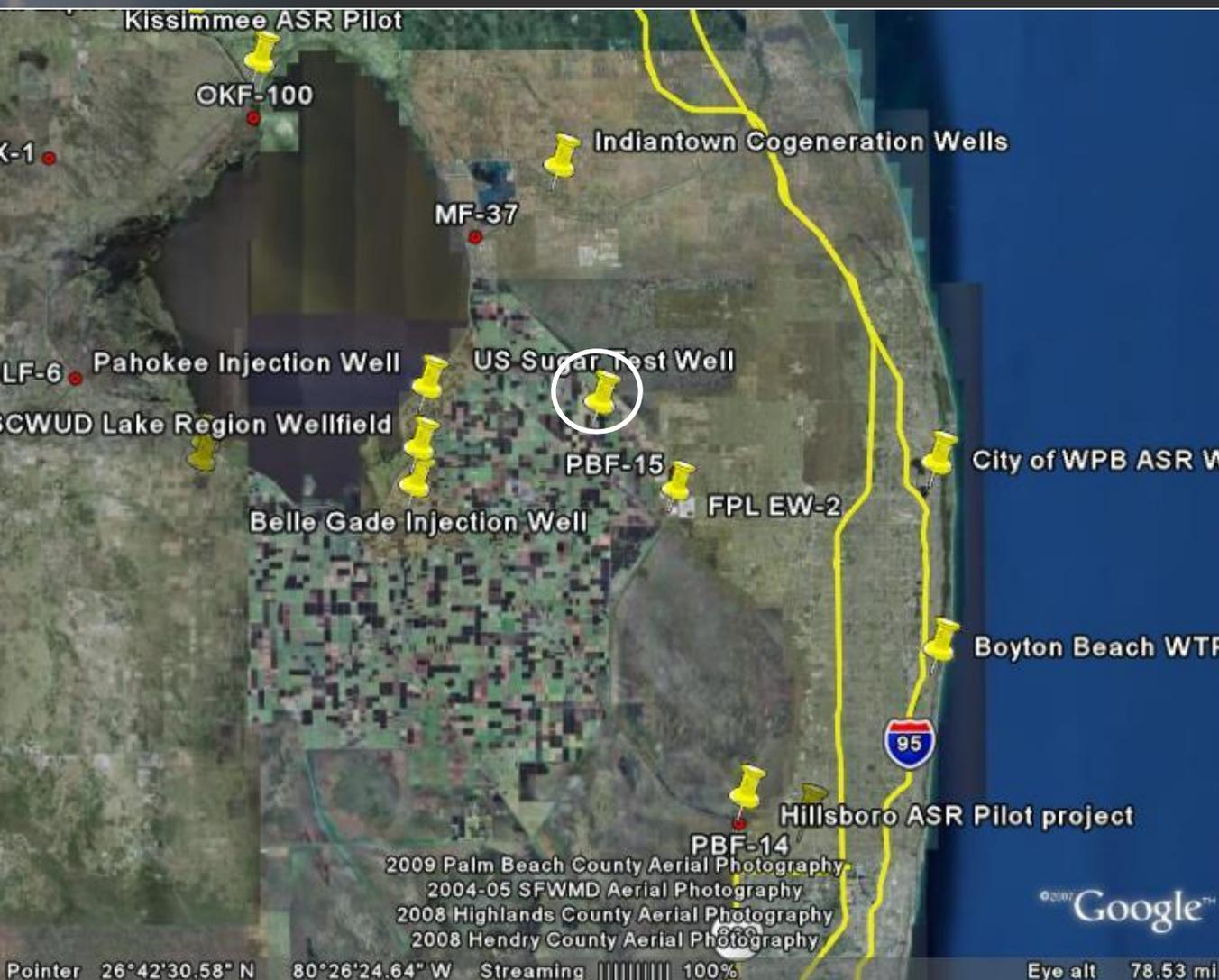
# The Site 1 Impoundment : ASR Levee design

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# Hydrogeologic Conditions in ROG Planning Area

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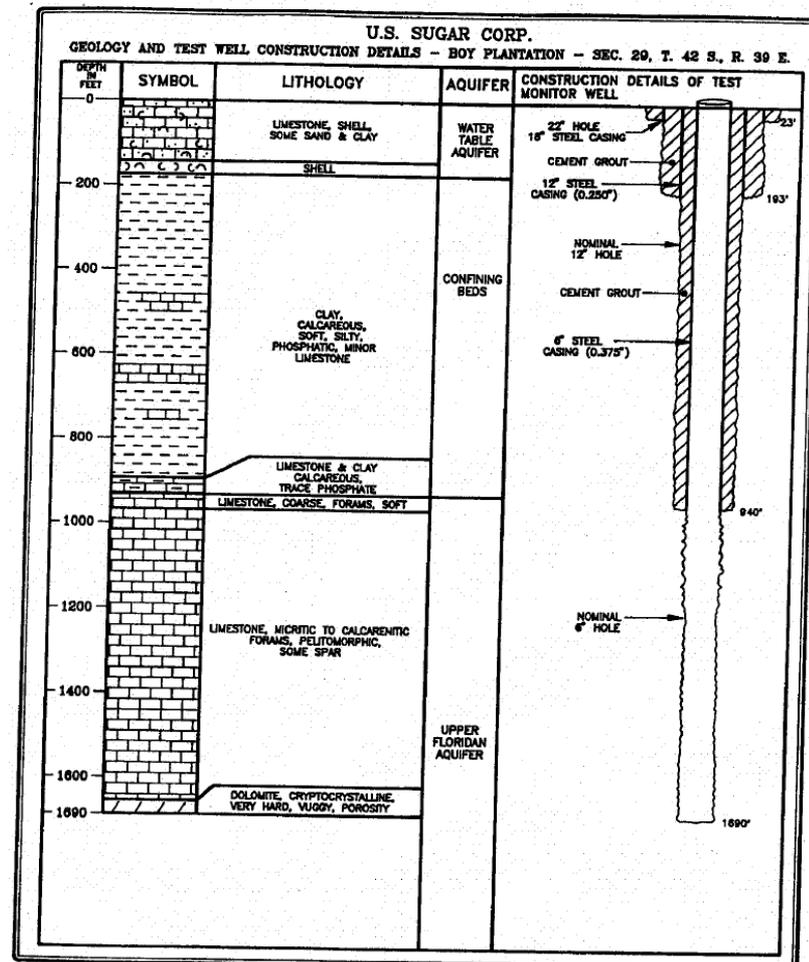


- Floridan aquifer continuous in the EAA region
- Expect conditions to be transitional between Kissimmee and Hillsboro Pilot sites
- Well logs from several other borings confirm condition of Floridan aquifer

# U.S. Sugar Test Well

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- Constructed in 1992
- Small diameter well
- Transmissive limestone found in middle Floridan Aquifer
  - Flow zones found at ~1,350'
  - Apparent 5 mgd capacity
  - Chlorides in middle Floridan about 1,500 ppm



# River of Grass Planning

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- Move forward incrementally
- Potential for cluster of 10 wells in the upper and middle Floridan Aquifer provide ~ 150 ac-ft/day
- Cost to install ~\$45M (wells, intake/discharge structure, piping, treatment and pumping systems)
- Annual O&M ~ \$1.5M and \$3M for electricity, well maintenance, operation, monitoring and compliance (monitoring decreases over time)



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Questions?

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