



Tucson's **CLEAR**WATER Program

*From a "Turbulent" Beginning to Today's
Sustainable and Drought Resistant Water Supply*

George P. Maseeh, P.E., BCEE
Malcolm Pirnie, Inc.

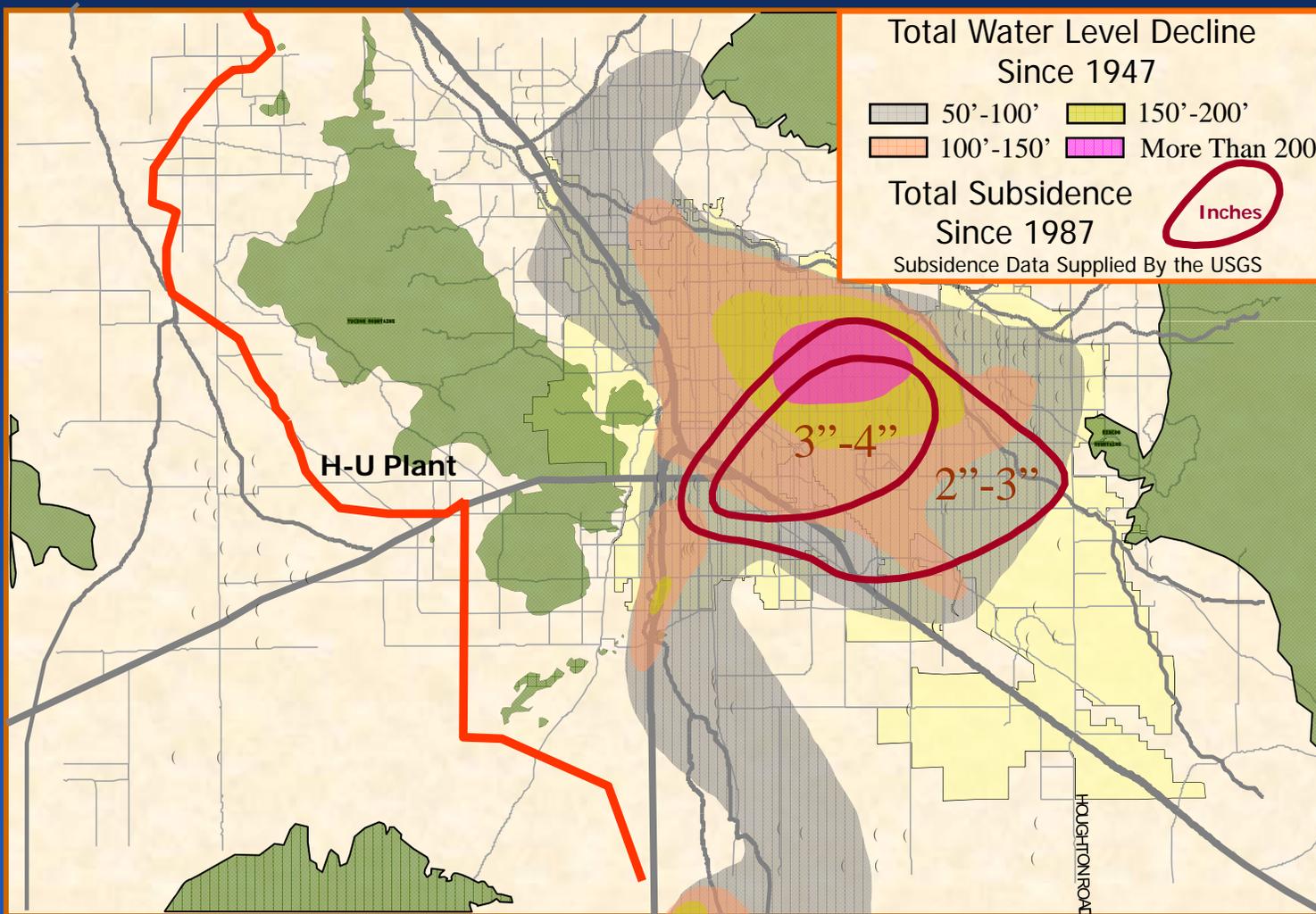


WESTCAS 2009 Fall Conference
October 30, 2009 – Tucson, AZ

Solutions for Life™

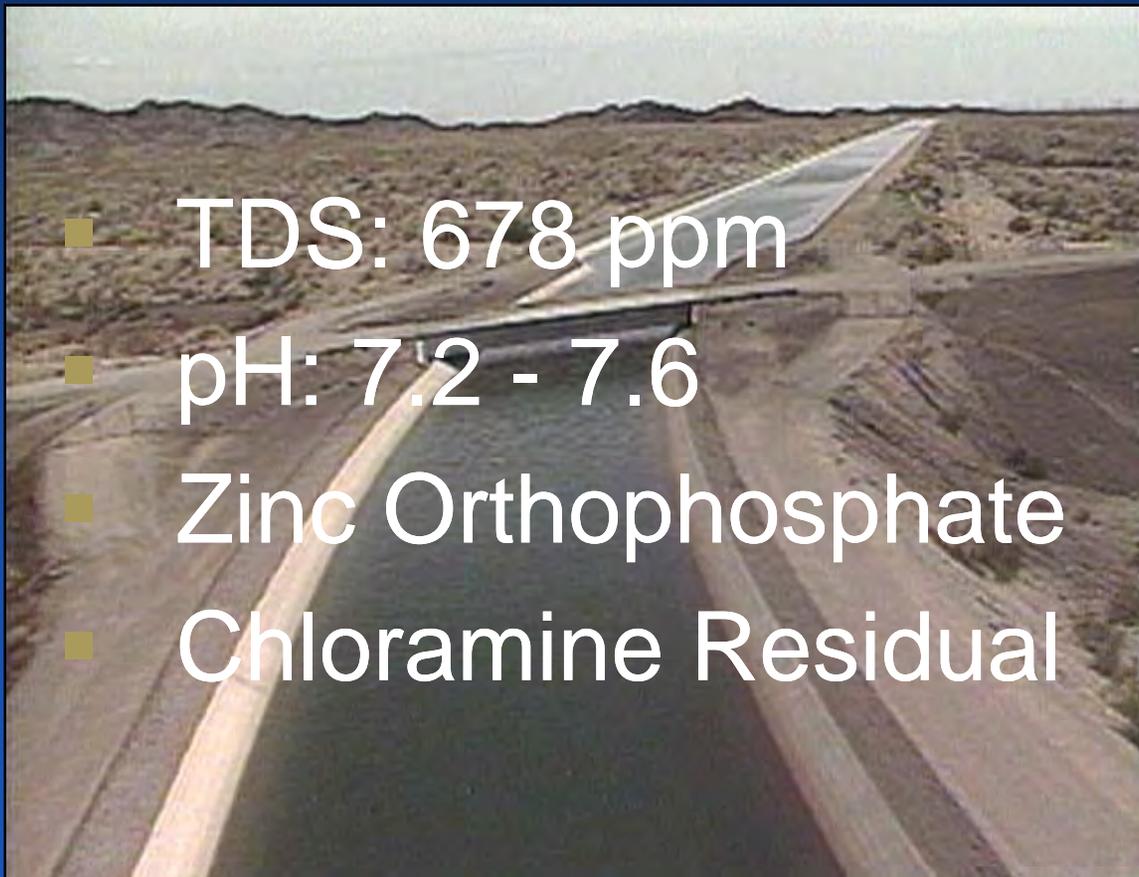
**MALCOLM
PIRNIE**

Groundwater Overdraft in the Tucson Basin

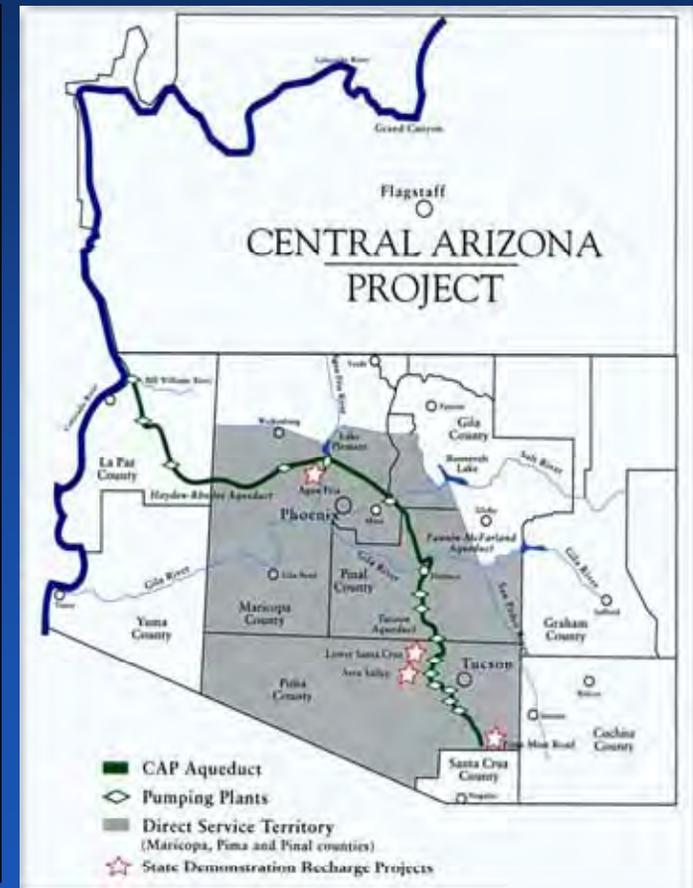


Hayden-Udall WTP

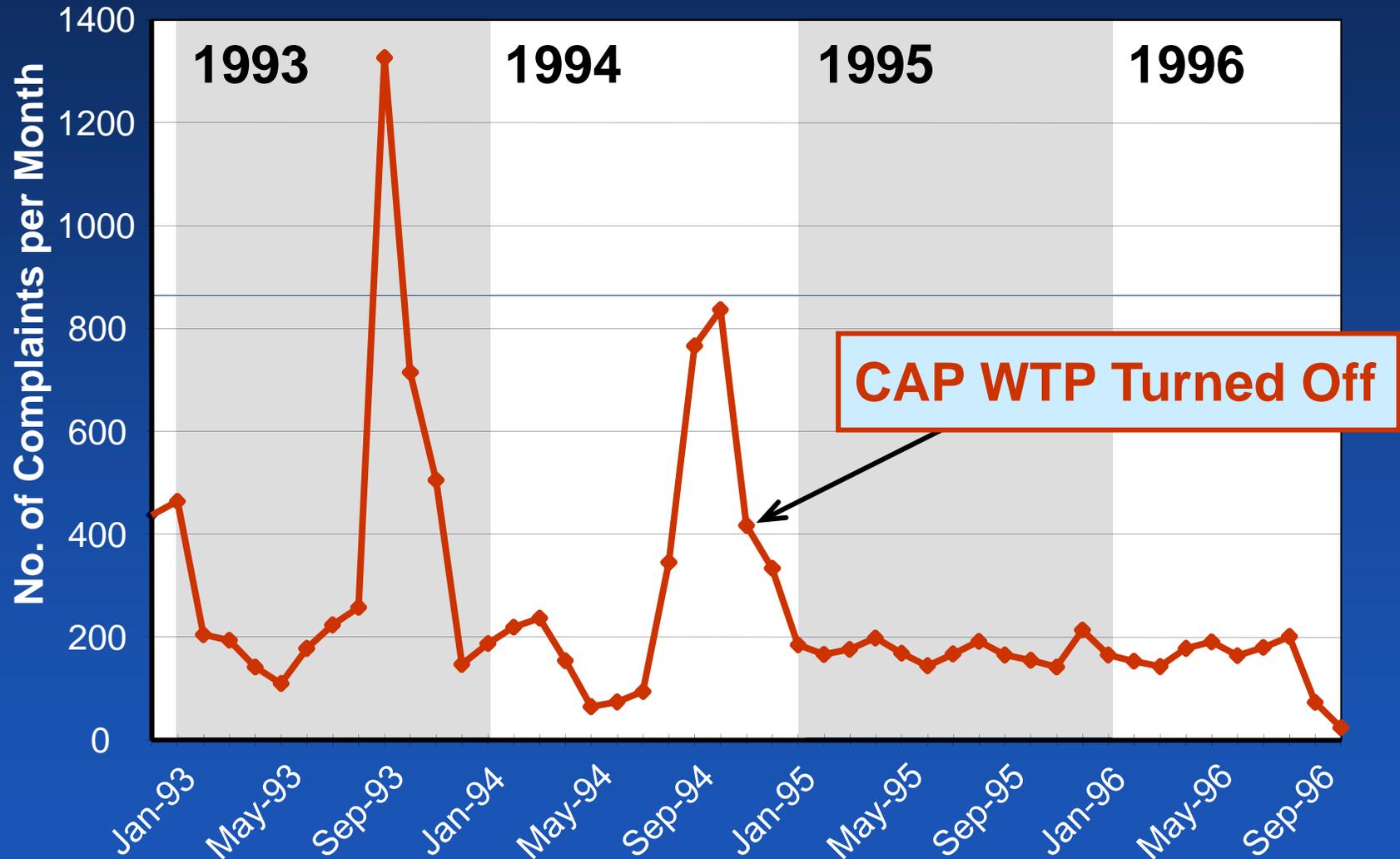
Treated CAP Water Quality: 1992-1994



- TDS: 678 ppm
- pH: 7.2 - 7.6
- Zinc Orthophosphate
- Chloramine Residual



Total Monthly Complaints



Treated CAP Water Issues

Concerns

- Colored Water
- Taste and Odor
- Corrosivity
- Internal Plumbing
- Salty/Hard Water

Causes

- Changes in Chemical Quality
- Microbiological Activity
- System Hydraulics
- Corroded Metallic Infrastructure

Proposition 200

1995 Water Consumer Protection Act

- Sets Stringent Water Quality Standards for Direct Delivery of CAP
- Prescribes Alternative Uses for the City's CAP Water Allocation
- Effectively Limits the City to Enhanced Treatment or CAP Water Recharge

Strategy for Re-Introducing CAP Water Developed in 1995-96

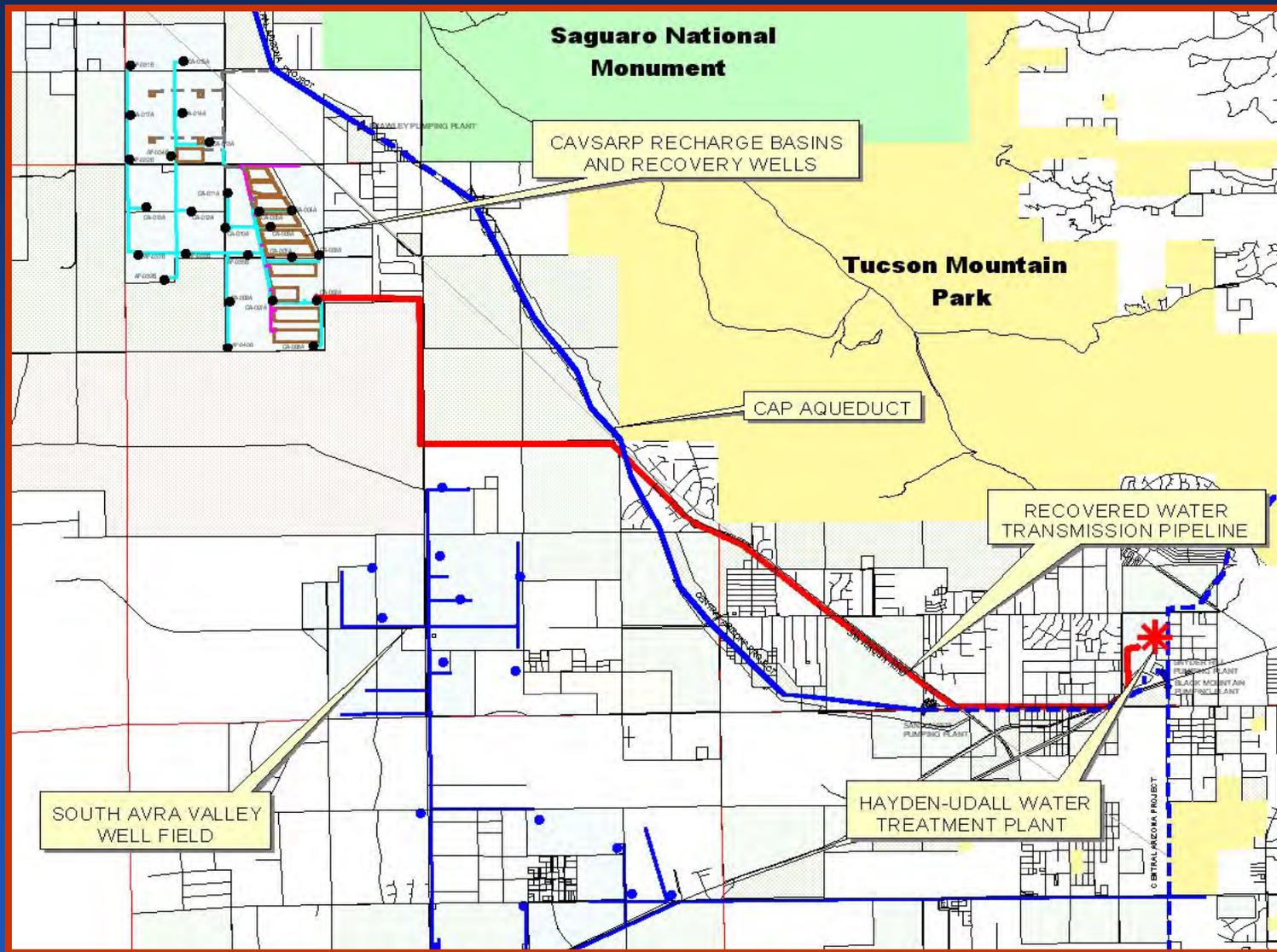
- Re-focus the utility on on water quality at the customer's tap
- Solve red water problem and definitively prevent a recurrence
- Demonstrate acceptability of the blended water supply
- Implement large-scale basin recharge and recovery facilities
- Replace or rehabilitate deteriorated metallic water mains
- Gradually deliver a blend of recharged/recovered CAP water and native groundwater

Clearwater Program Evolution

- Central Avra Valley Storage and Recovery Project (CAVSARP) authorized in 1996
- *At the Tap* program authorized March 1997
- Expanded pilot recharge facility - 1997
- Target water quality developed and demonstrated - 1998-2000
- Blended water delivery initiated - May 2001
- Full-scale CAVSARP recharge facility - 2003
- Southern Avra Valley Storage and Recovery Project (SAVSARP/Clearwater Phase II) implementation 2004-2009



Clearwater Phase I Facilities



“At the Tap” Program Objectives

"AT THE TAP"

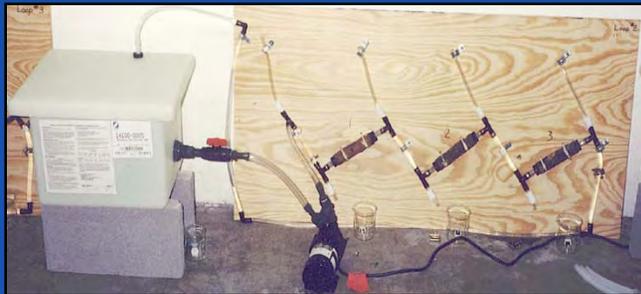


- *Engage customers in the process*
- Distribute water quality information
- Conduct corrosion testing
- Determine effects of water qualities on home plumbing and appliances
- Analyze water disinfection methods
- Conduct water taste and odor preference workshops with customers
- Research customer water quality preferences

Corrosion Studies



- Understand effects of water quality on release of iron from old pipe materials:
 - pH, disinfectant, corrosion control agent, mineral content, temperature
- Develop a method to prevent a repeat of initial problems



Bench Scale



Pilot Scale

Results

Corrosion Study

- Effective pH to protect pipes >8 (8.5 maximum)
- Use of polyphosphate results in better protection than no corrosion treatment
- No difference between residual disinfectants

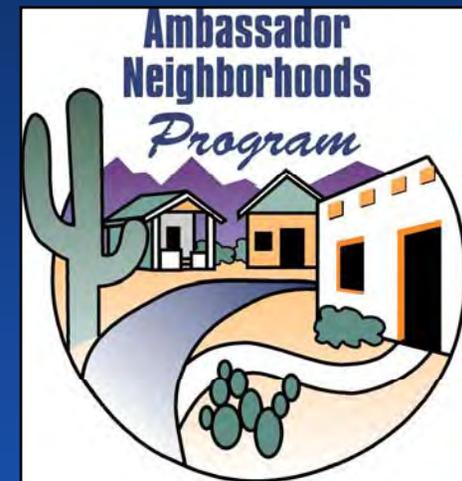
Customer Panels

- 59% rated a blend of 50% recovered CAP Water and 50% Avra Valley groundwater (~450 mg/L TDS) as neutral or better

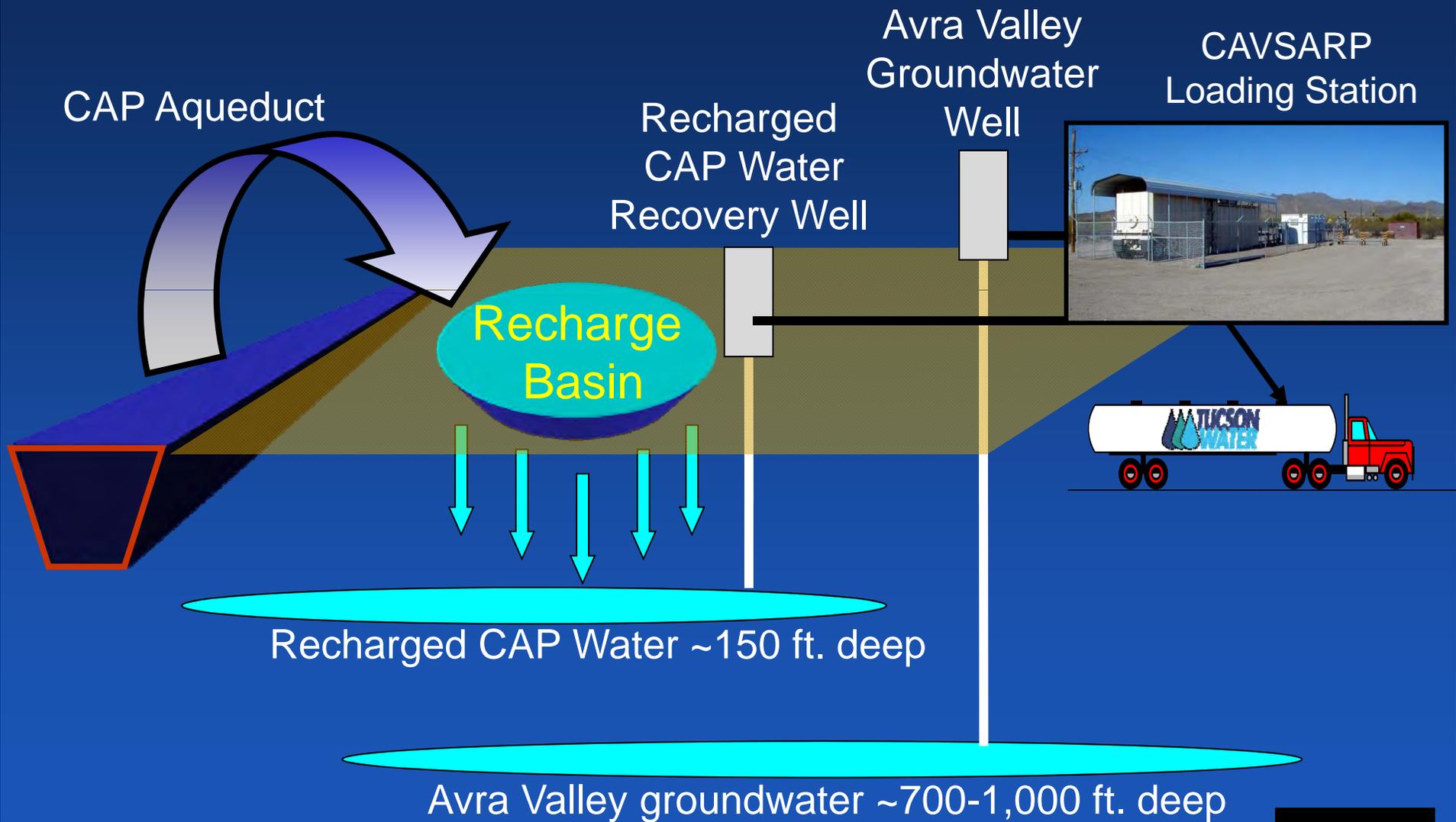


Demonstration Program Elements

- Four volunteer neighborhoods
- Tucson Water's Plant 1 Facility
- Individual home systems
- Large-scale bottled water distribution



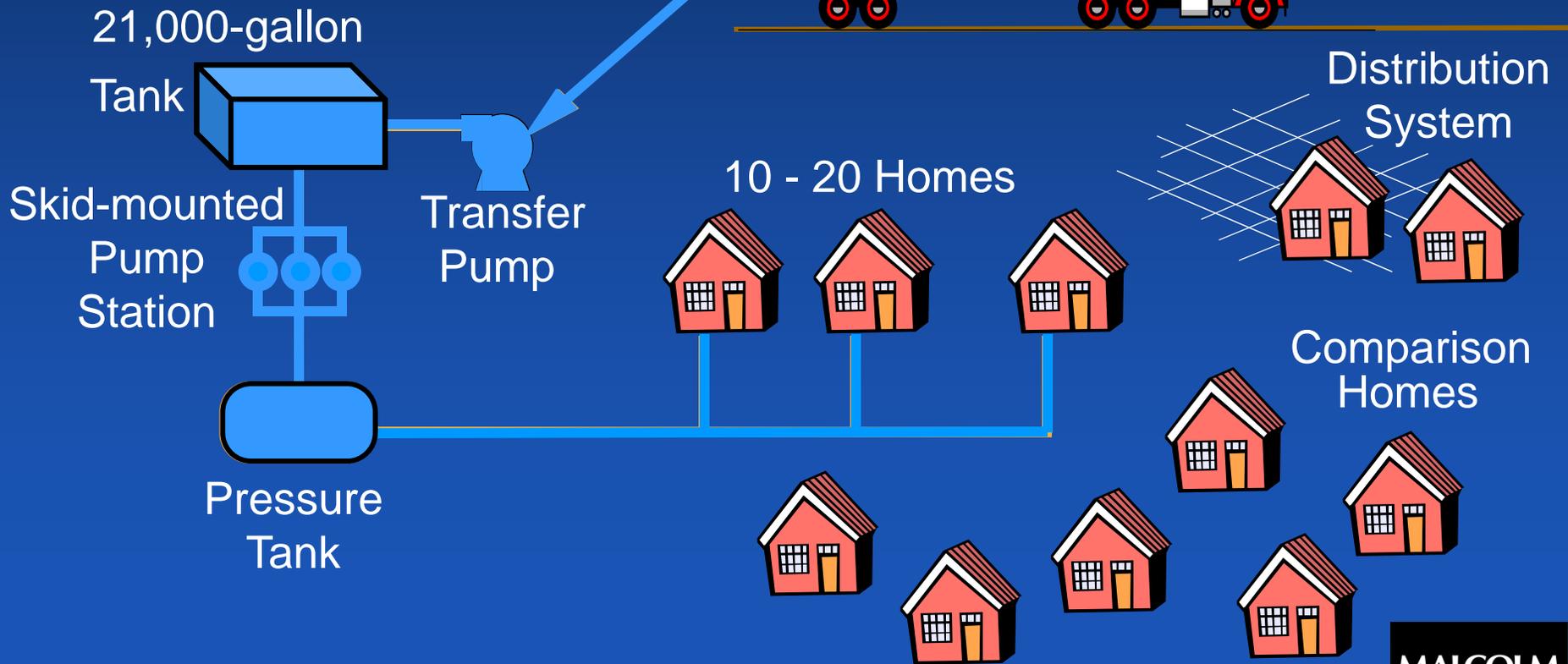
Ambassador Neighborhoods Program





Unloading Blended Water in 4 Neighborhoods

6,000-gallon Tanker

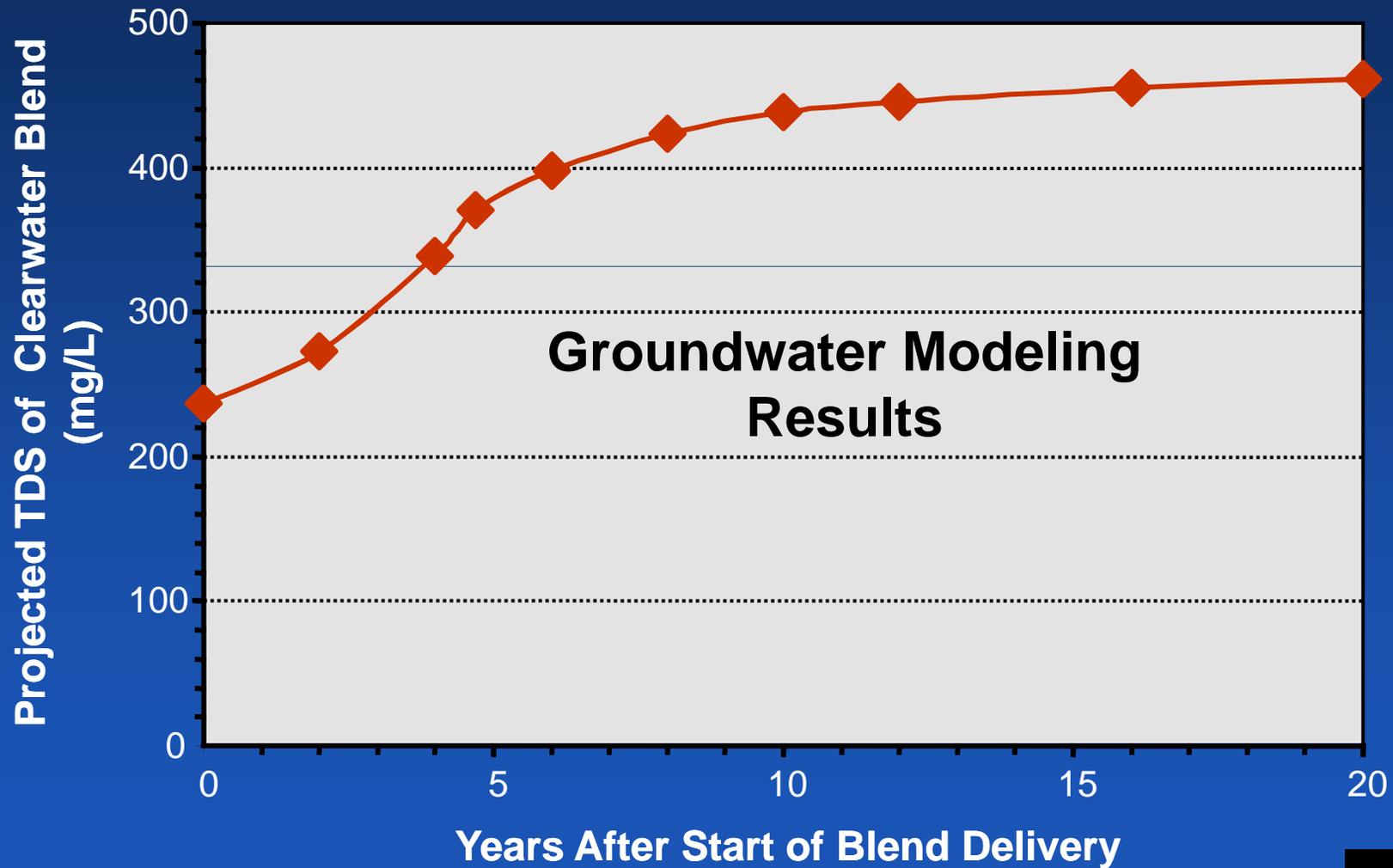


Bottled Water Program

- Ambassador Neighborhoods blend shipped to bottler
- Five-gallon dispensers to City and State facilities and some businesses at request
- 1,000,000 Sport bottles distributed at community events



Projected TDS Levels of Delivered Water



Replace/Rehabilitate Infrastructure

- Replaced 175 miles of old galvanized steel mains
- Relined 40 miles of cast iron pipe

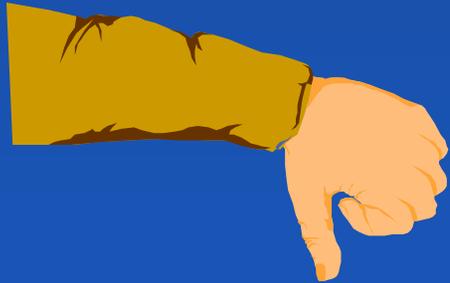


Tucson City Election Results:

November 2, 1999

New Proposition 200

YES:	32,625 (38%)	11 Precincts (6%)
NO:	52,639 (62%)	164 Precincts (94%)



CAVSARP Recovery Facilities Construction

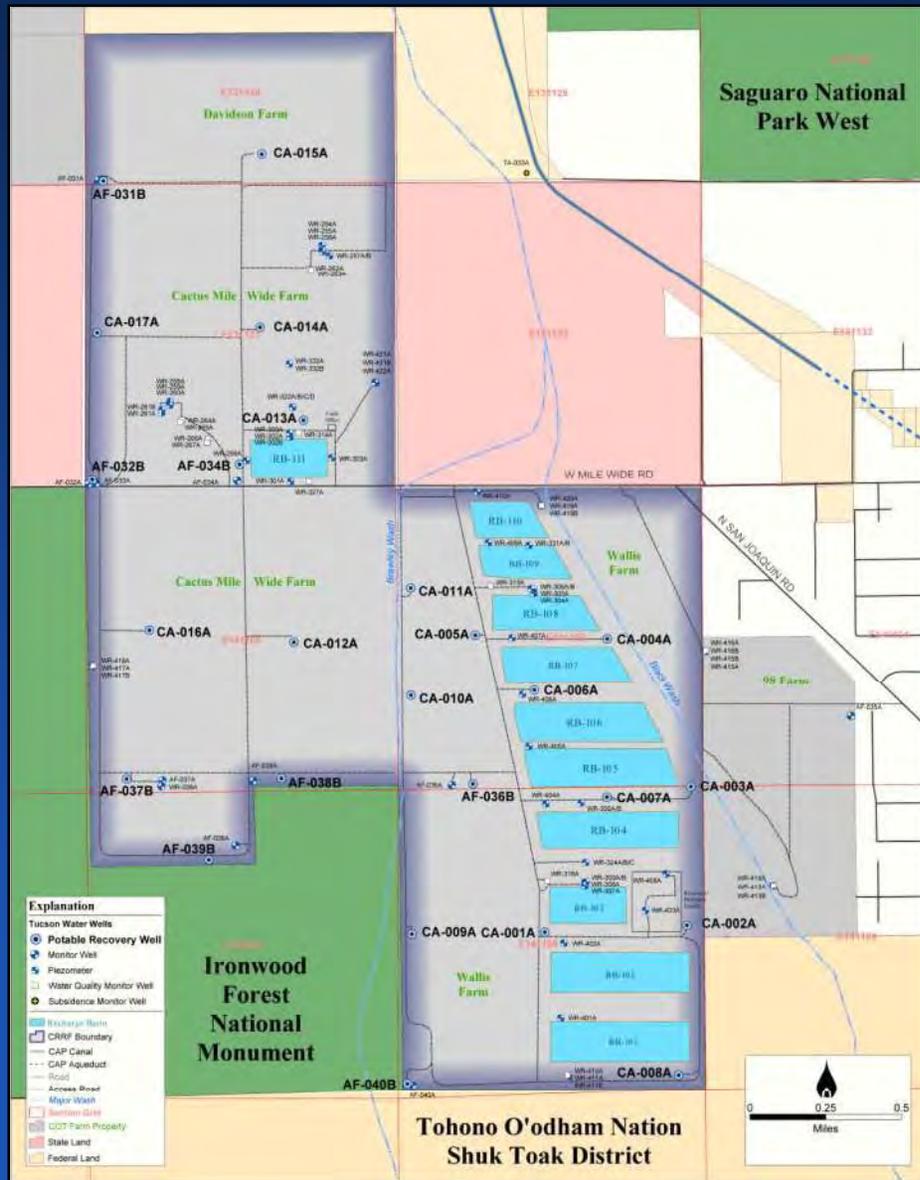


Clearwater Deliveries On-Line

May 3, 2001



CAVSARP Full-Scale Recharge



- Replaced three 20-acre basins in expanded pilot facility that had operated since 1997
- Eleven recharge basins with a combined area of 330 acres
- Initially permitted for 60,000 af/yr of recharge
- Re-permitted for 100,000 af/yr of recharge

Construction of Full-Scale Recharge Facility at CAVSARP

Began May 15, 2002

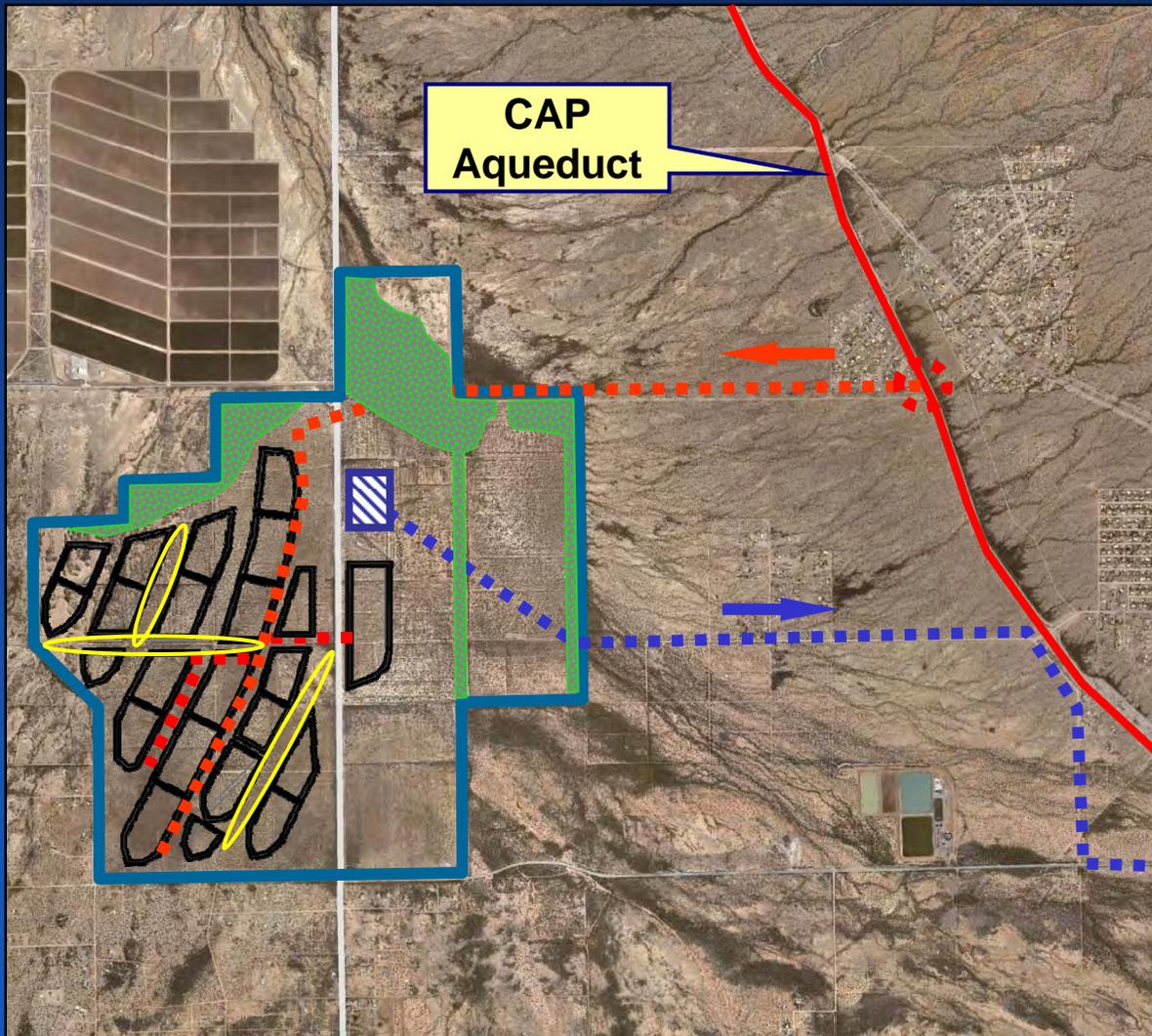


CAVSARP Full-Scale Recharge

May 16, 2003 Dedication



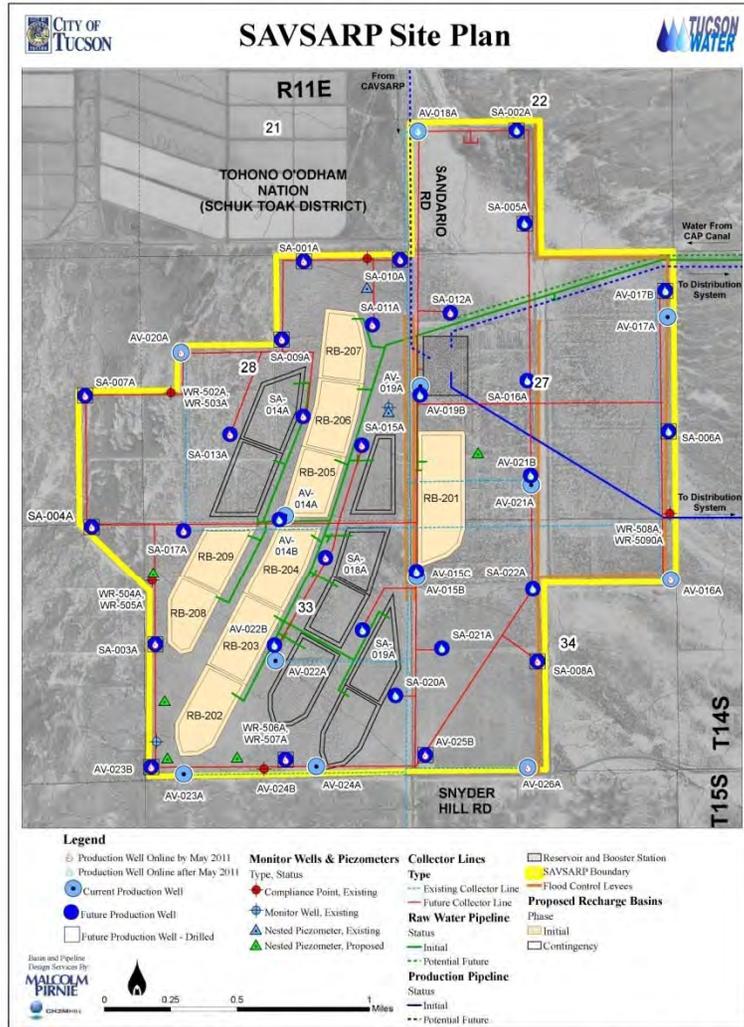
Southern Avra Valley Storage & Recovery Project – SAVSARP (Clearwater Phase II)



Site Master Plan:

- Preserved habitat
- Sited all potential recharge basins
- Created “utility corridors”
- Provided raw water system with expansion features
- Over-sized recovery pipeline
- Build-out recharge/recovery capacity
140,000 AF/YR

SAVSARP



Current Status:

- 9 Recharge basins with a combined area of 220 acres
- Permitted for 100,000 af/yr recharge
- Currently utilized for recharge of 60,000 af/yr
- 12 Recovery wells
- Initial raw water transmission capacity of 70,000 af/yr
- Recovery well drilling ongoing
- 5-yr CIP includes additional wells, pipelines, and reservoir/booster station to increase recovery from 10,000 to 60,000 af/yr in stages

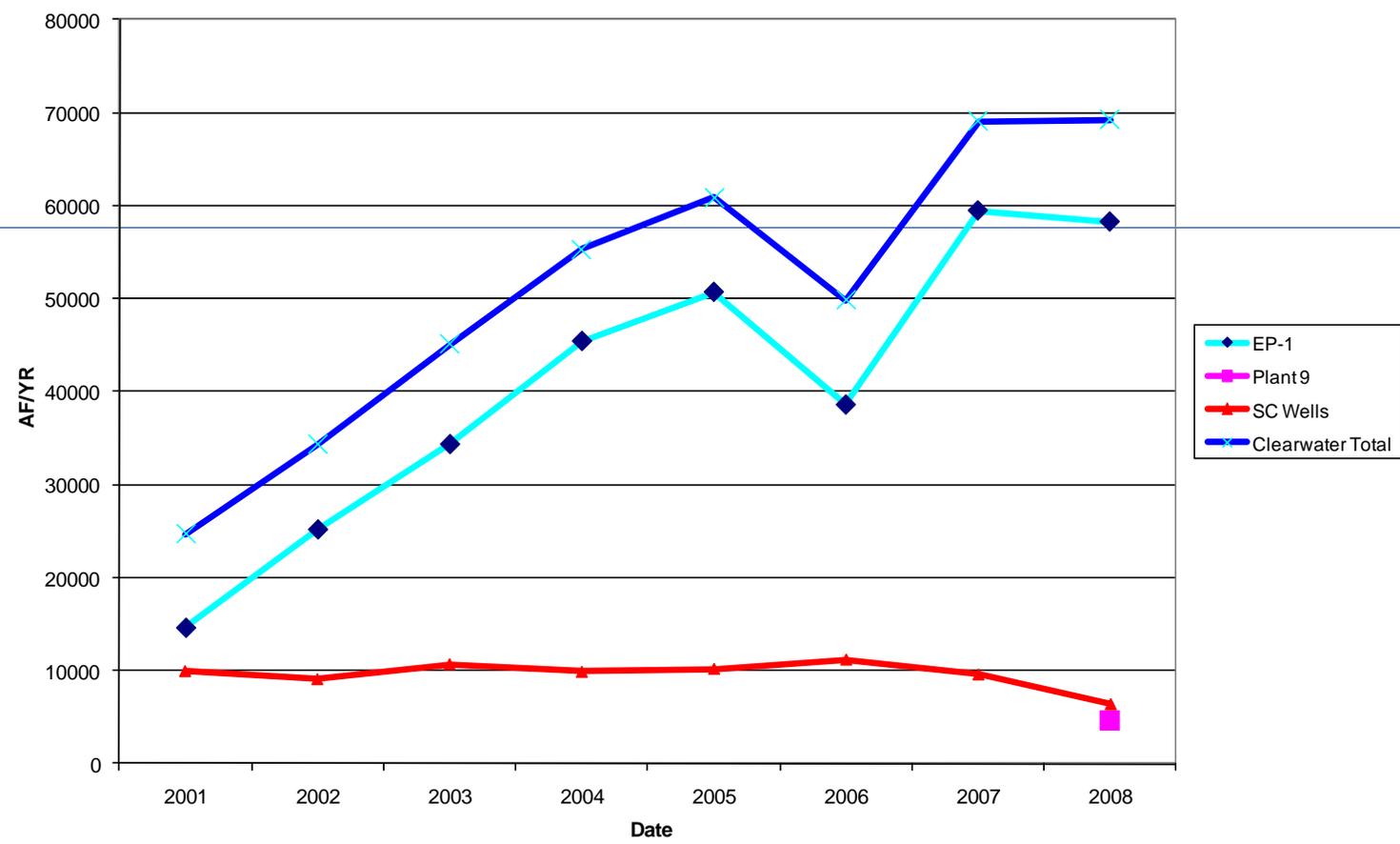
SAVSARP

May 5, 2008 Dedication



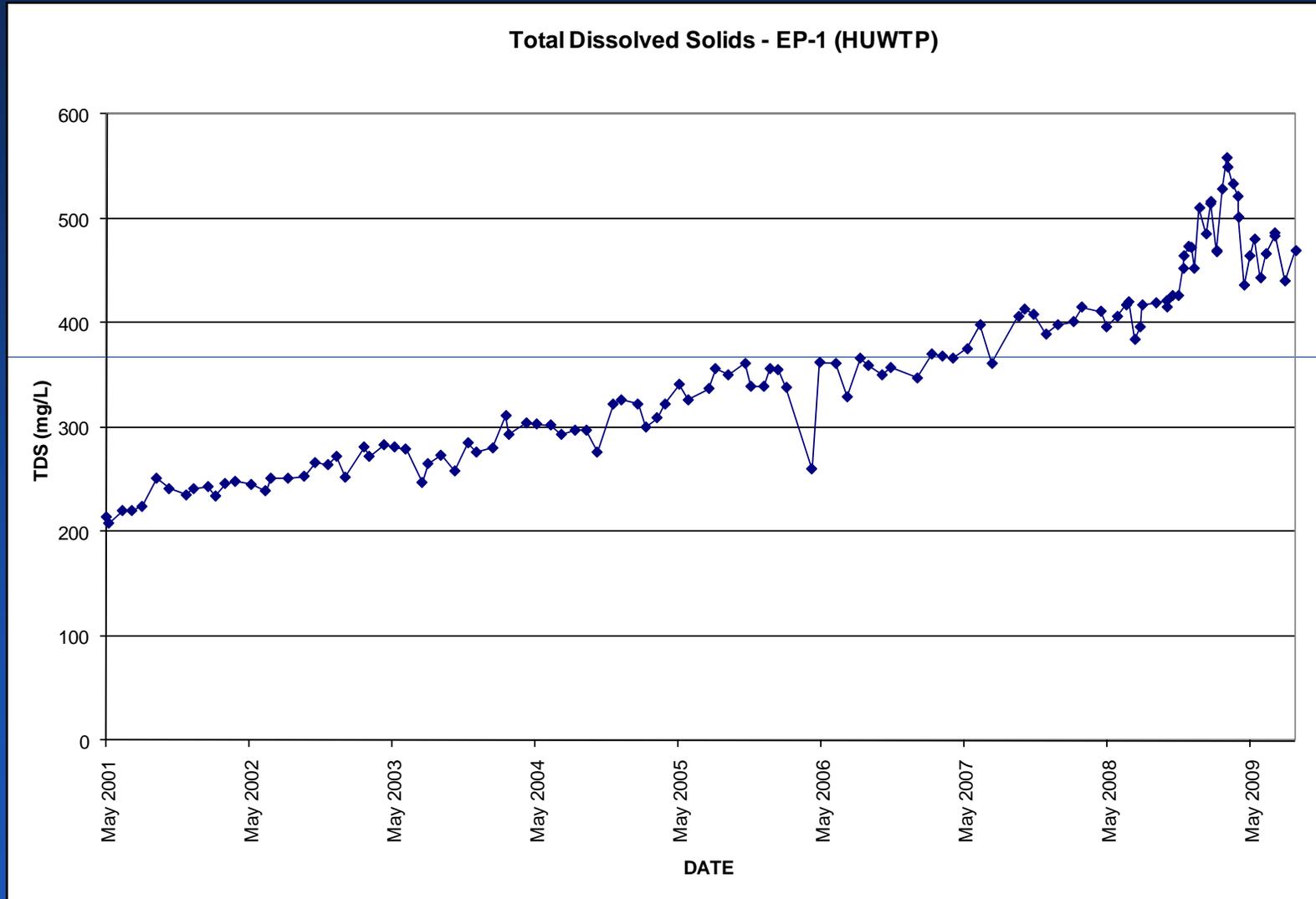
Shifting Reliance to Renewable Clearwater Supply

Clearwater Production



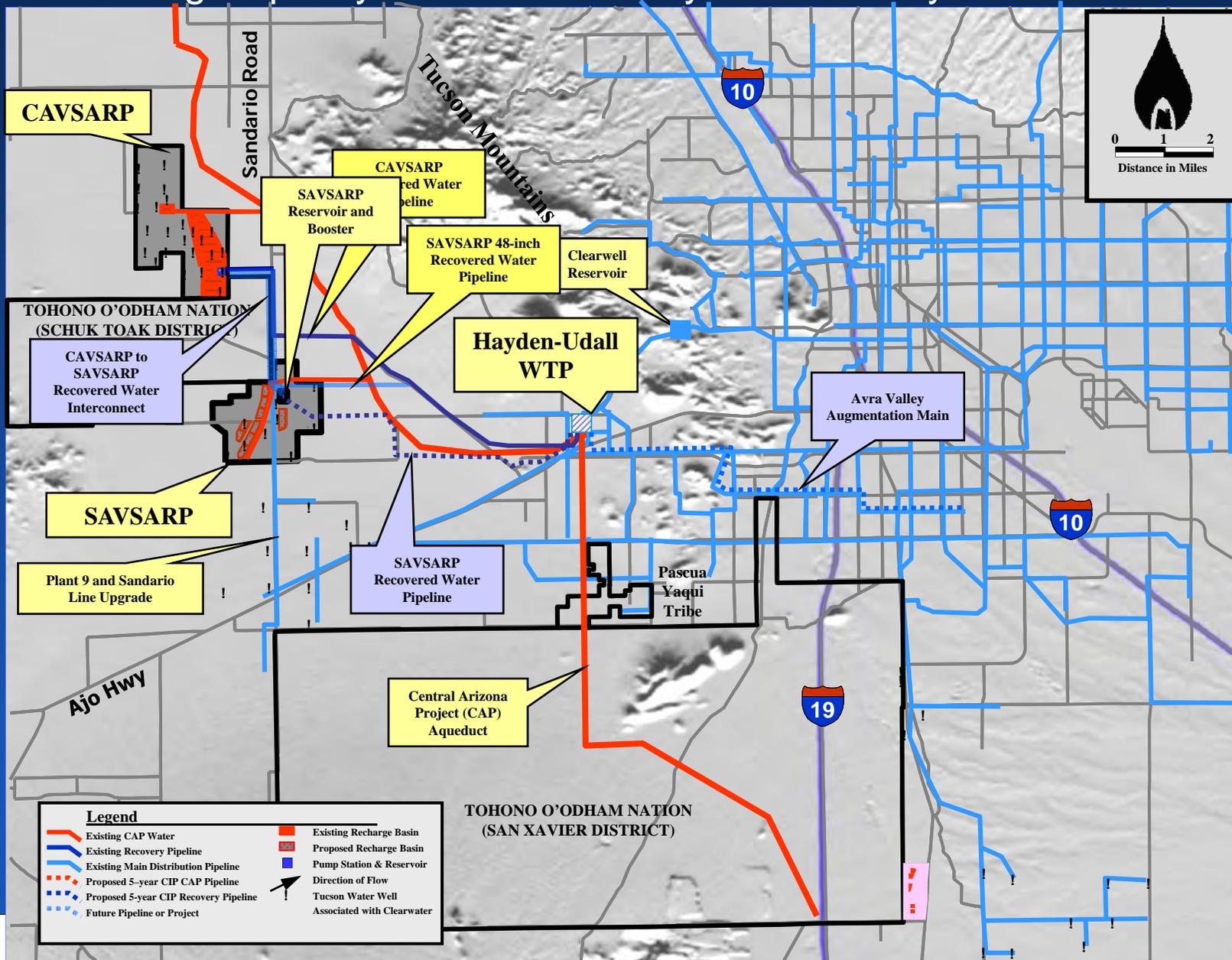
Clearwater provided 57% of system-wide potable supply in 2008

Gradual Water Quality Transition



Future Clearwater Recovery Infrastructure

Increasing Capacity and Redundancy for Reliability



Sustainable Water with Multiple Benefits

- Tucson's primary supply shifted from mined groundwater to renewable surface water
- Drought resistant delivery system
- High delivery reliability unaffected by CAP outages
- Significant water quality benefits
 - Changes occur over extended periods, allowing system acclimation
 - TOC removal through recharge provides robust compliance with D/DBP Rule, including Stage 2 standards
- Excess recharge and recovery capacity allows opportunities for regional and State participation



Questions

George P. Maseeh, P.E., BCEE
Malcolm Pirnie, Inc.
Tucson, AZ
(520) 629-8264
gmaseeh@pirnie.com

Solutions for Life™

**MALCOLM
PIRNIE**