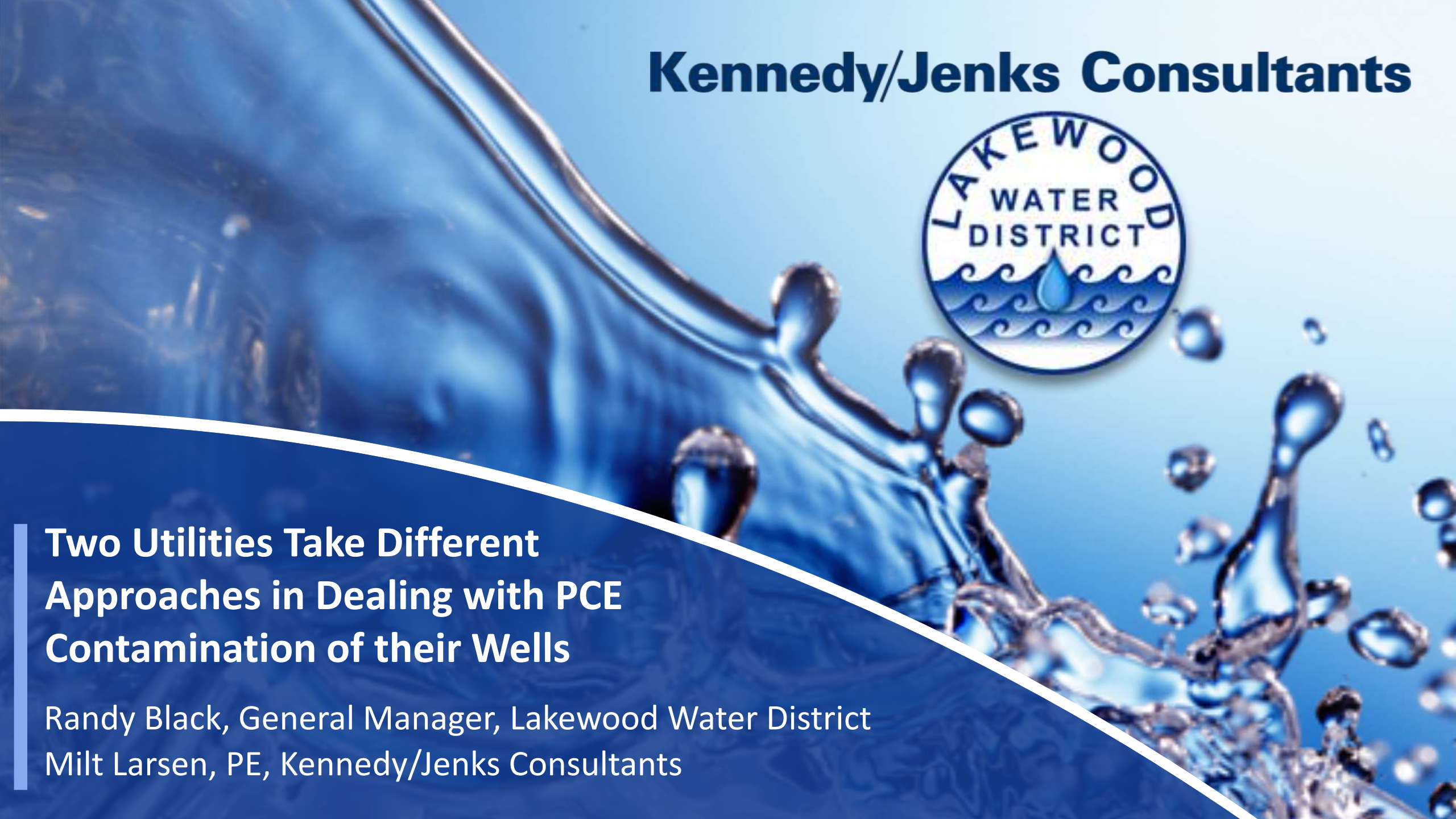

Two Utilities Take Different Approaches in Dealing with PCE Contamination of their Wells

Randy Black, General Manager, Lakewood Water District
Milt Larsen, PE, Kennedy/Jenks Consultants

Tetrachloroethylene (PCE)

- Manufactured chemical used for dry cleaning and metal degreasing
- **1970s** - Peak use as a dry cleaning solvent
- **1980s** - Probable carcinogen, toxic pollutant,
- Drinking water maximum contaminant level (MCL) = 5 µg/L
- In groundwater environment - dense non-aqueous phase liquid (DNAPL)
  - Sinks - Heavier than water
- Can be removed by treatment for drinking water use.

Lakewood Water District

- Formed in 1943
- Serves
  - Over 60,000 retail customers
  - 55,000 wholesale customers (Town of Steilacoom, Summit Water & Supply Co., Spanaway Water Co., Rainier View Water Co.)
- Groundwater supply
- 30 active wells

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Lakewood Water District Ponders Wells

- Ponders Wells
  - H-1 1,200 gpm
  - H-2 800 gpm
  - Water rights 2,800 gpm
  - Annual production 250 MG
- 1980-81 DOH VOC investigation of Chambers Creek-Clover Creek Basin
  - PCE 18 µg/L
  - TCE < 10 µg/L
  - 1,2 (trans) dichloroethylene 61 µg/L
- 1983 10-day pump test
  - PCE 320 to 185 µg/L
  - TCE later measured at 28 µg/L
- Predates the VOC MCL

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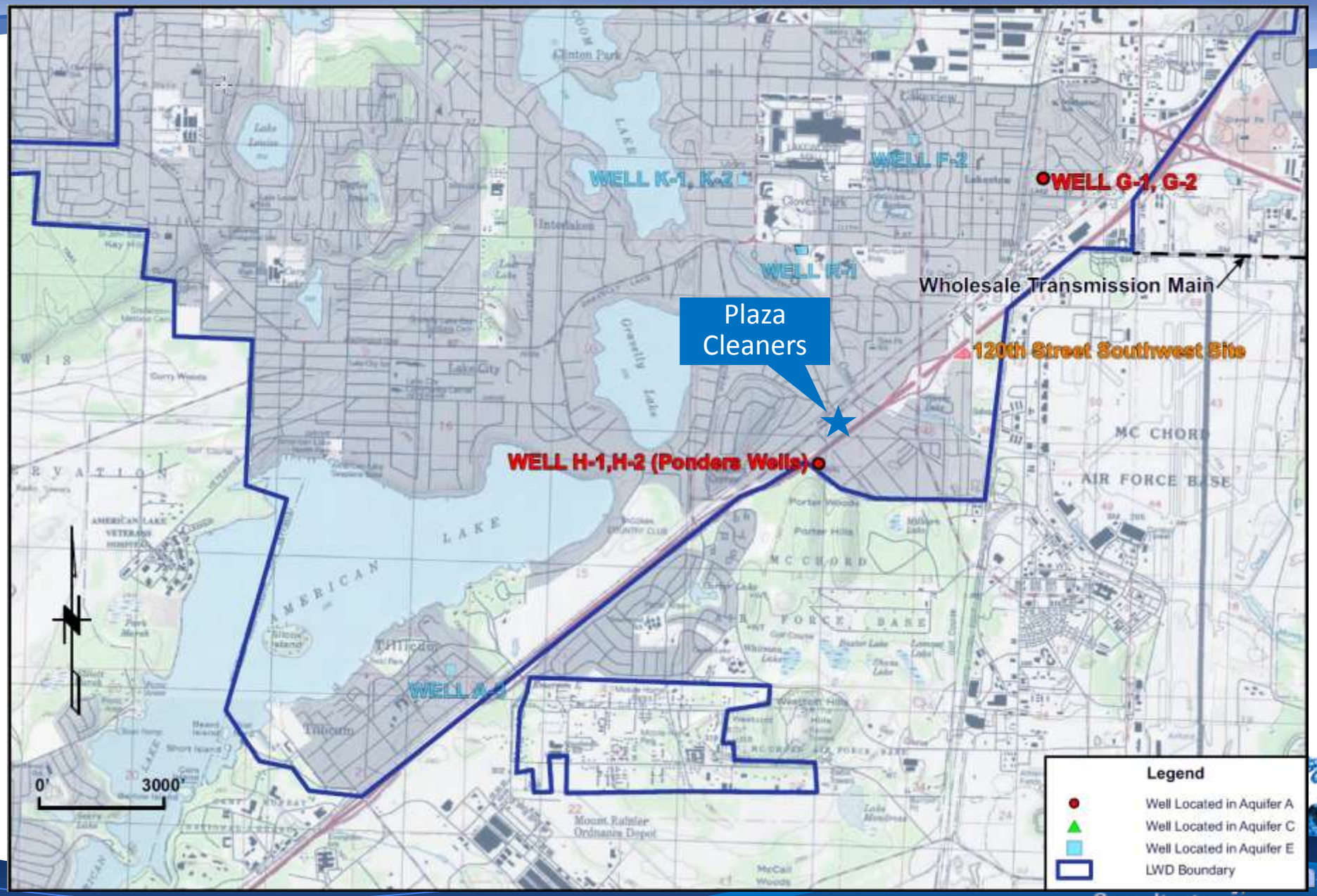
Lakewood Water District's Ponders Wells



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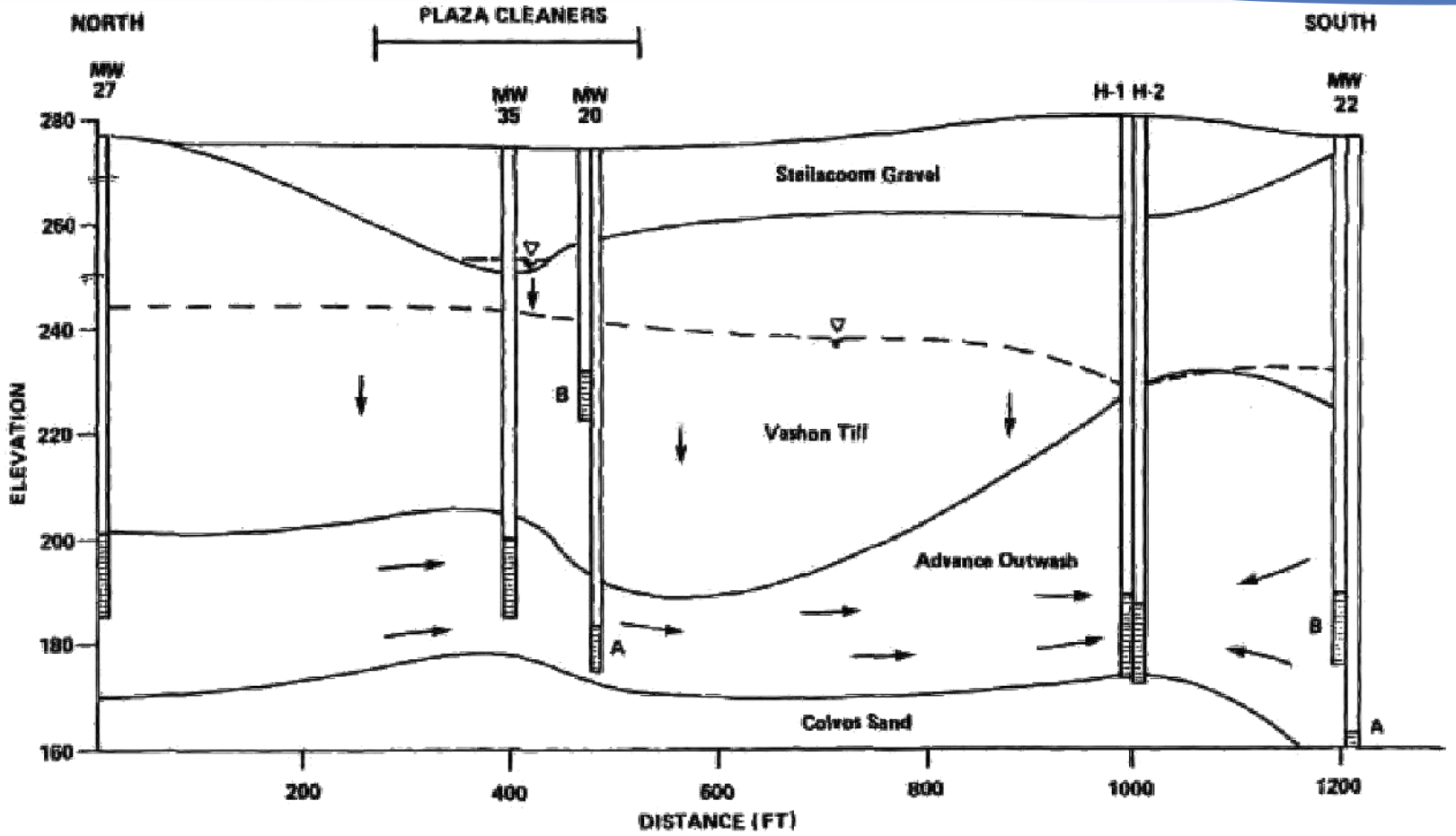
Ponders

- Wells shutdown for 3 years
  - Limited pressure
  - Inadequate fire flow protection
- Declared a Superfund Site
- EPA had air stripping towers designed & installed
- 1984 Record of Decision
  - Interim facility: 3-year life
- 1985 Record of Decision
  - Need for 10 to 12 years
- 2012 5th 5-year review by US Army Corps of Engineers for EPA
  - Need to operate for over 100 years due to PCE leaching from Vashon Till

Geological Cross Section of Site



NORTH-SOUTH CROSS-SECTION BETWEEN PLAZA CLEANERS AND H1 AND H2

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Aging Facilities

- FRP towers delaminating
- Packing depth > recommended by mfr.
- Packing crushed & replaced in 2000
- Tower seismic design
- Well pumps sized to pump to distribution system rather than to the towers
- Electrical/control equipment replacement parts availability
- Clearwell accessibility and sanitary protection

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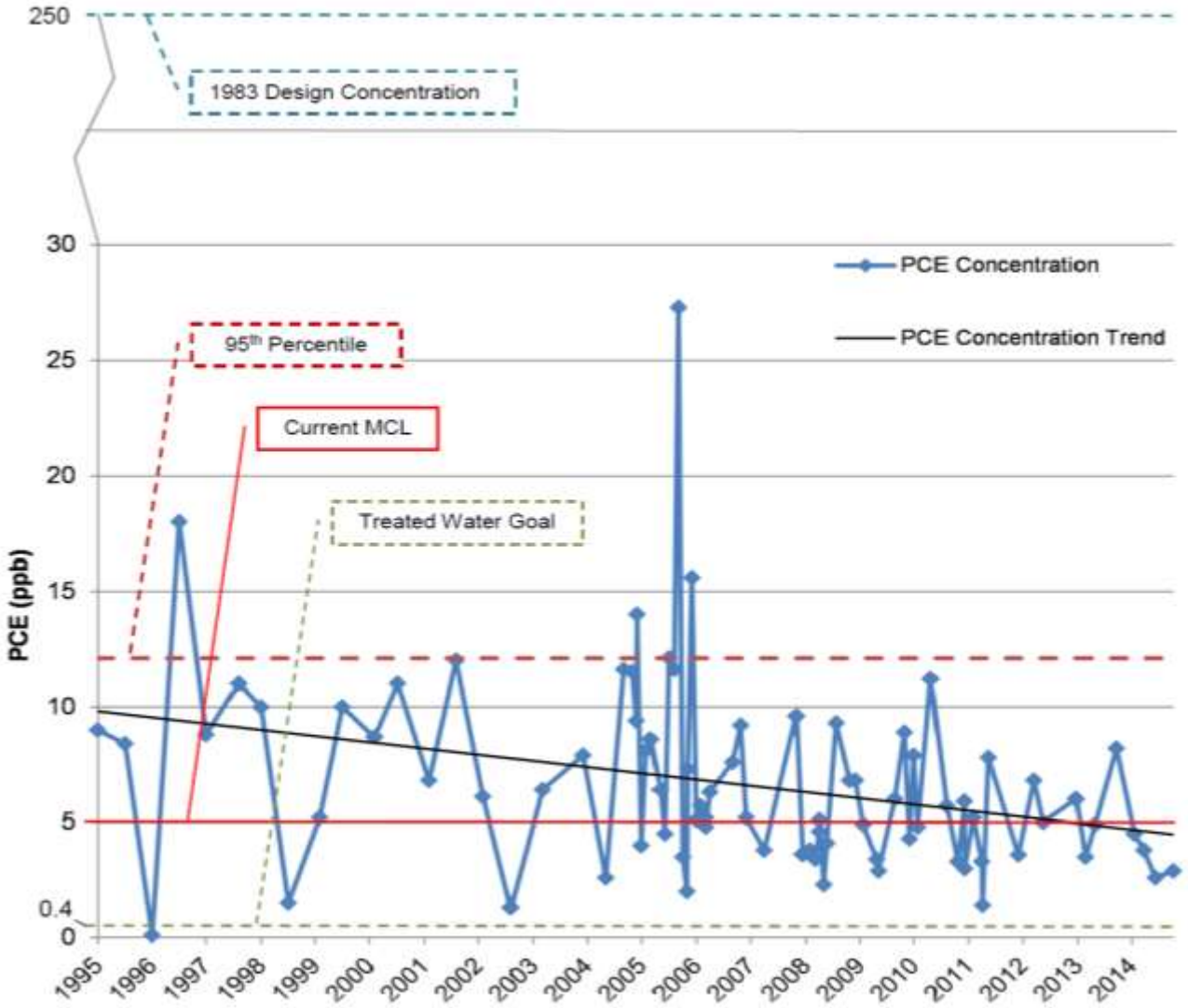
H-1 & H-2 PCE Concentration



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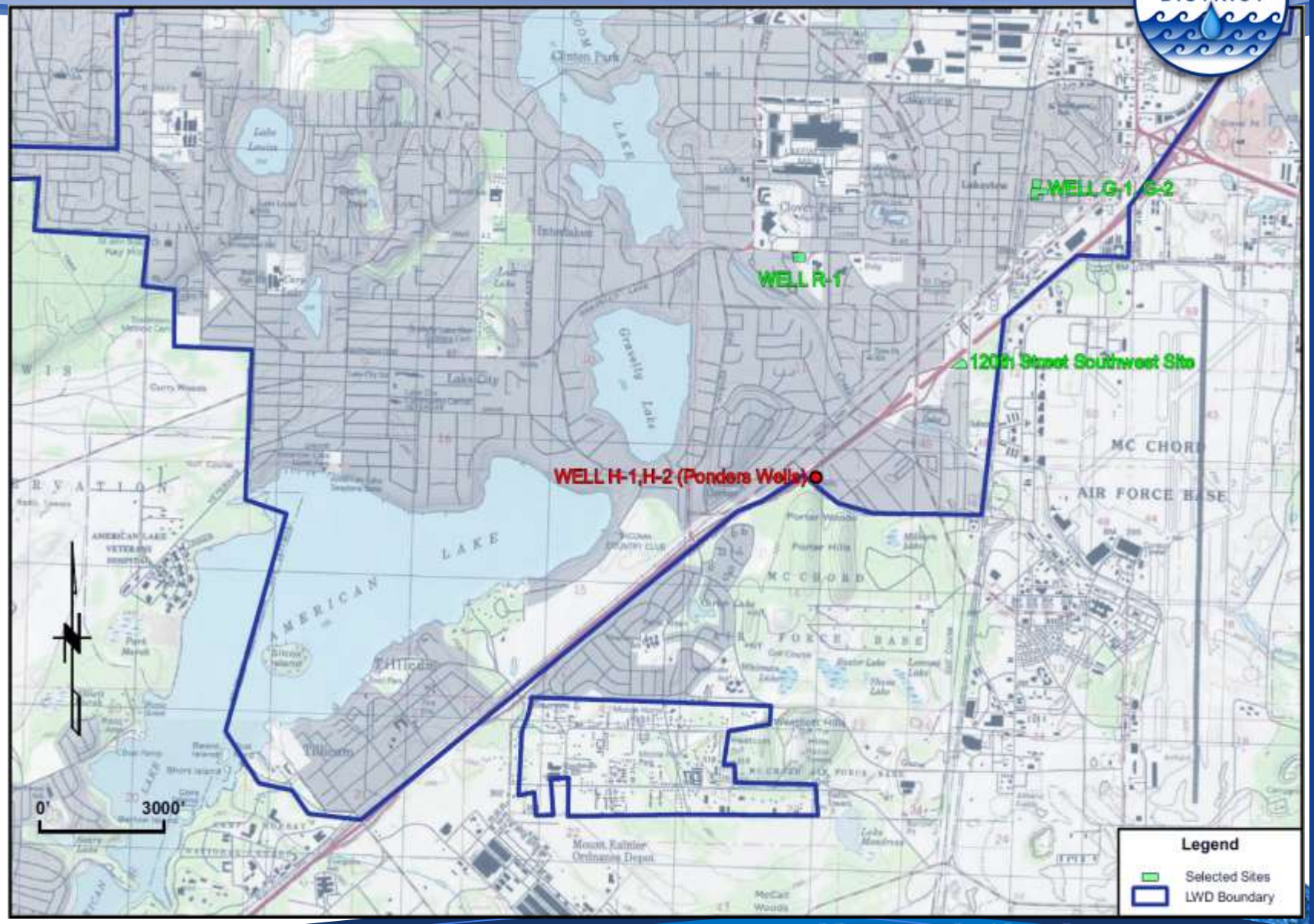
District Goals & PCE Alternatives

- District Goals
  - Deliver water with non-detect PCE
  - Develop full water right
    - » Wholesale pipeline near Ponders
- Alternatives
  - Drill new wells elsewhere
  - Drill deeper wells into Aquifer C
    - » Fe & Mn likely issues with Aquifer C
  - PCE treatment



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Treatment Alternatives

- Air Stripping
  - Packed Tower Aeration
  - Low Profile
    - » Multi-Stage Bubble Aeration
    - » Sieve-Tray (ShallowTray)
    - » Spray Aeration
- Granular Activated Carbon
- Membrane Cell Degassing
- Advanced Oxidation
  - UV-H_2O_2
  - Ozone-H_2O_2

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Alternatives Evaluation

Site	Alternative	Life Cycle Cost $/1,000 gal	Location	Impact Abitibi Water Rights
PCE treatment at Ponders	PTA	$0.88	Good	No
	Sieve Tray Aeration	$1.05	Good	No
	Multistage Bubble Aeration	$1.15	Good	No
	GAC	$1.31	Good	No
	UV/Peroxide	$1.57	Good	No
Deep wells at Ponders	H3 & H4 in Aquifer E	$1.71	Good	No
New Well Site	Well R1 Site	$0.91	Poor	Yes
	120th St SW	$1.94	Good	No
	Scotts Wellfield	$1.72	Fair to Good	Yes
Hybrid	PTA at Ponder & Well W1	$1.83	Good	No

Treatment Process & Funding

- Selected process
  - Packed tower aeration (stainless steel)
- Funding
  - EPA considers replacement facility as maintenance & declined to fund
  - Alternatives Evaluation-WA DOH & Ecology & District
  - WA $1.5 million grant – design, equipment prepurchase
  - WA $1.8 million supplemental grant – construction

Ponders Wellfield - Proposed Layout of Well H-3

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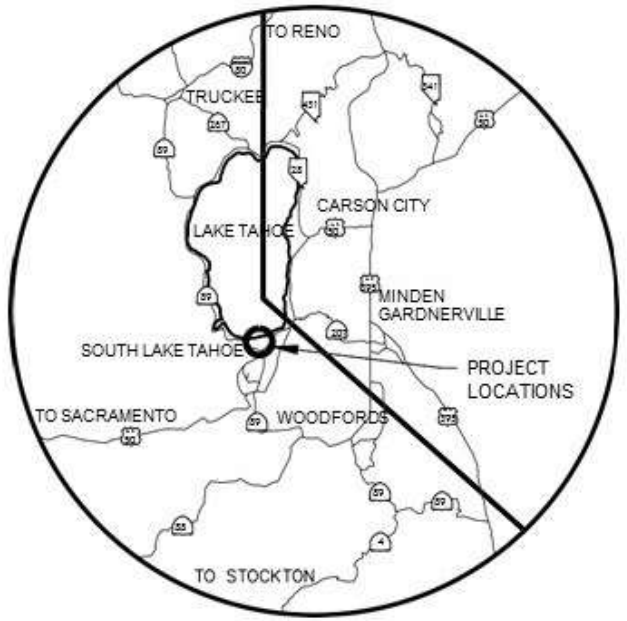
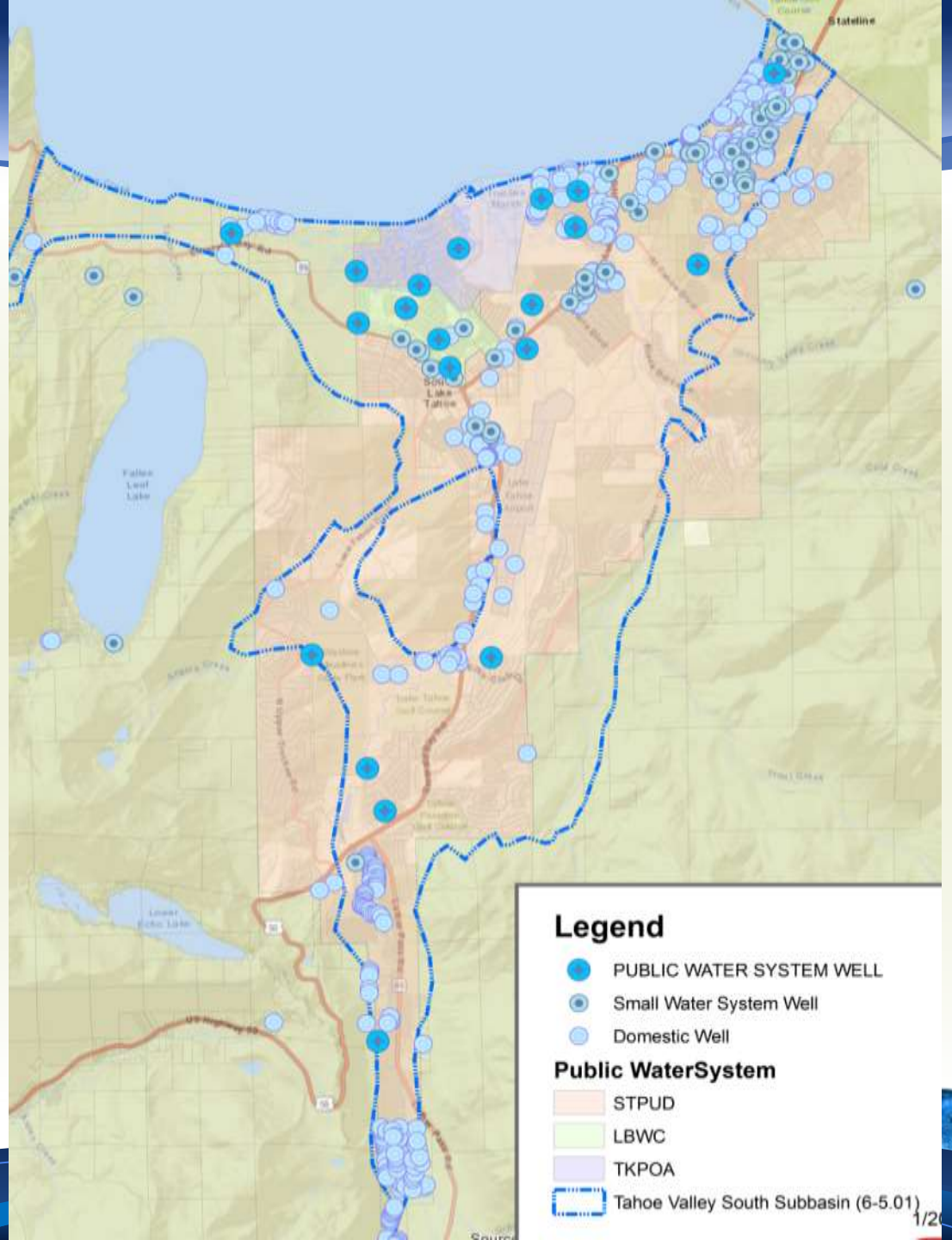
Tahoe Key Property Owners Association



VICINITY MAP

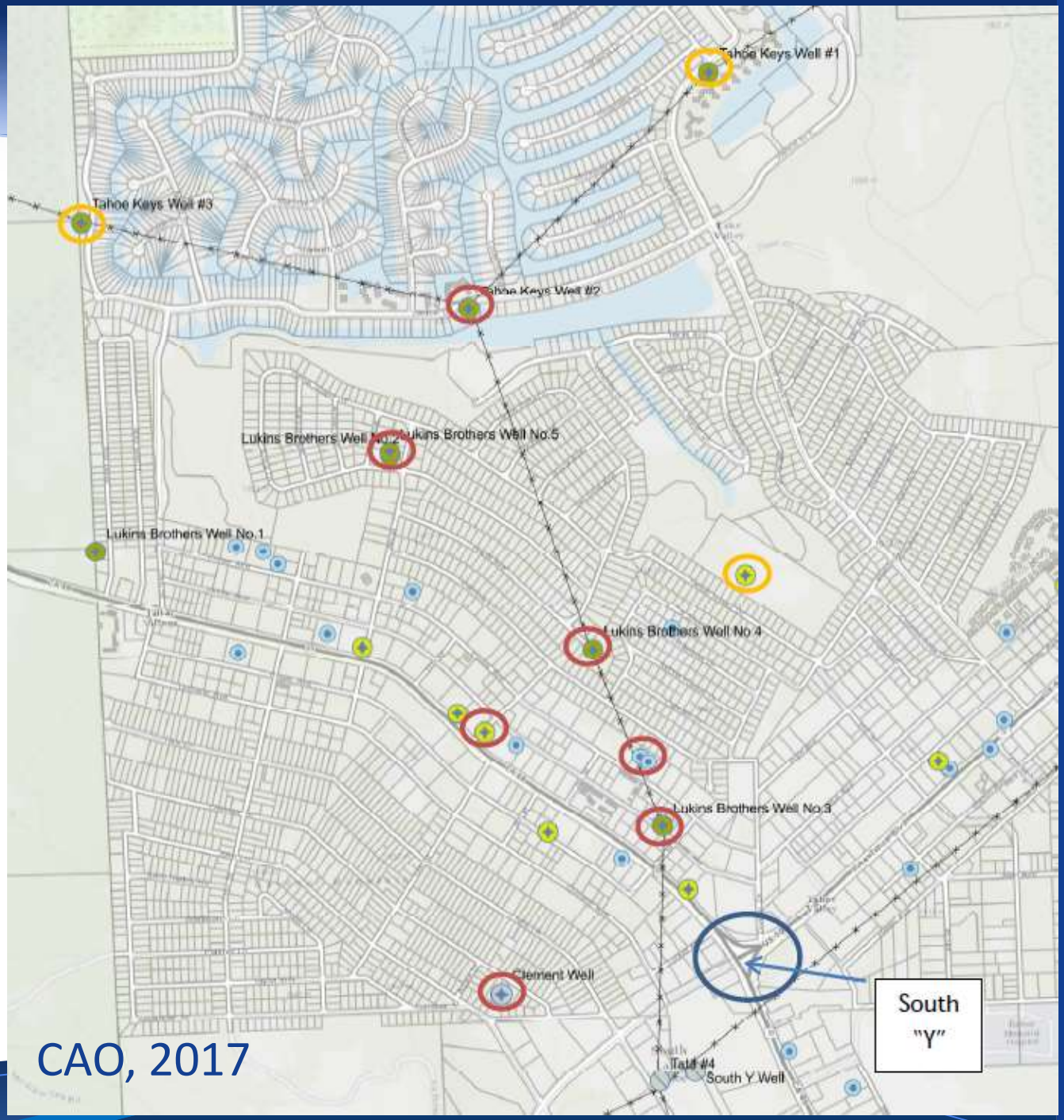
Groundwater BASIN

- Tahoe valley south basin
- Sedimentary Geologic Basin
- Highly productive for groundwater
- Recharged from surrounding watersheds
- Excellent water quality
- High reliance on WELLS
- Susceptible to contamination



South Y Contaminant Plume

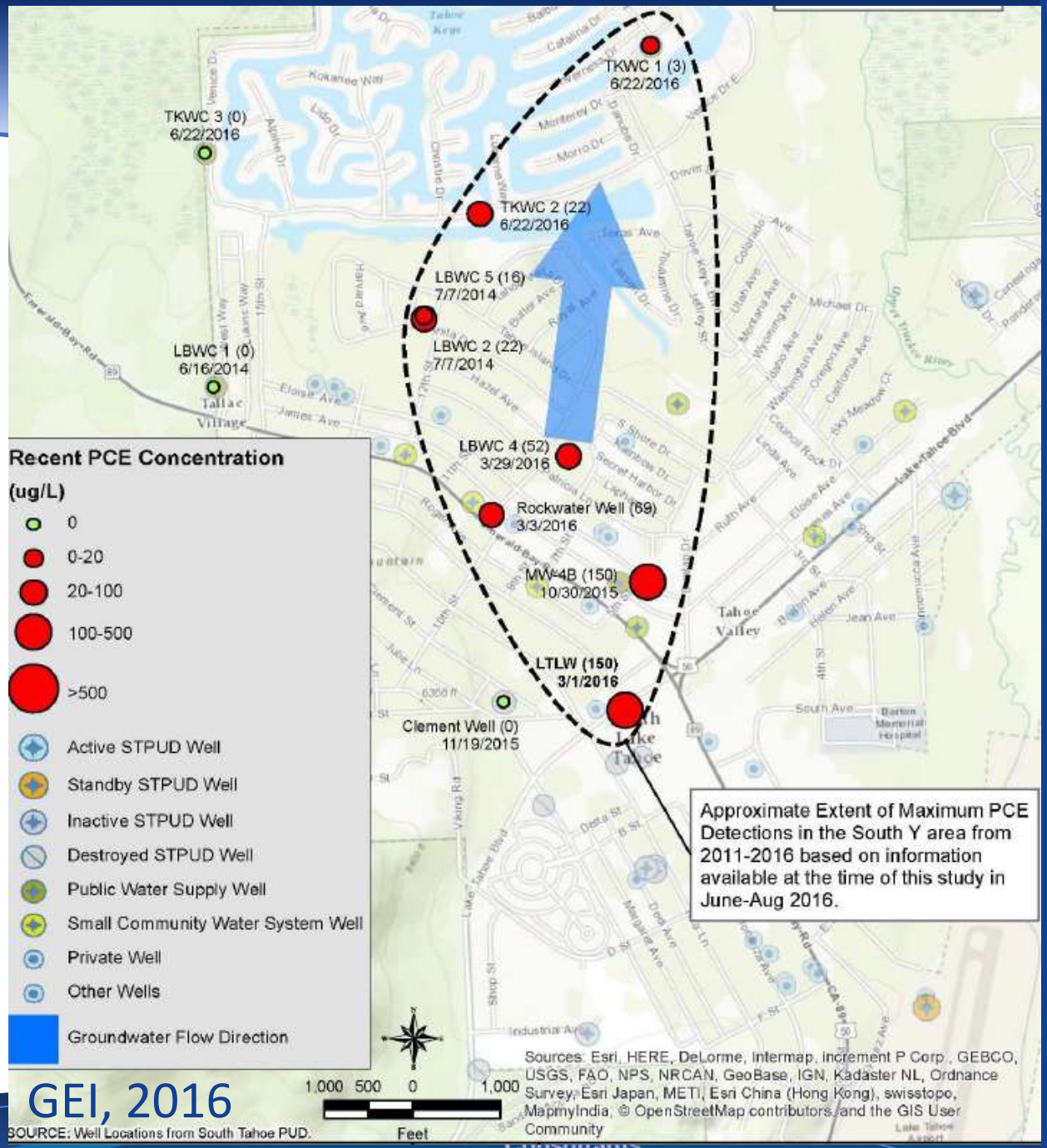
- South Y PCE dates to 1972 activities.
- Initial Investigation required by Lahontan in 2003-2008
- Interim soil remediation activities started in 2010
- Cleanup- and Abatement Order issued 2017 by Lahontan



CAO, 2017

Tahoe Keys & South Y PCE

- Well 2 - 2,150 gpm
  - 1989: PCE detection
  - 2009 well shutdown
  - 2012: GAC treatment installed
  - 2017: PCE ≈ 20 µg/L (4x MCL)
- Well 1 – 1,000 gpm
  - 1989: no detections
  - 1996-2014 – 9 samples, 2 at 0.6 µg/L
  - 2016-2017 – 15 samples 1.6 to 4 µg/L
- Well 3 – 2,000 gpm
  - 1989-2016 - 12 samples - no detections



Well 2 GAC Treatment Facility

- Derated well from 2,250 gpm to 550 gpm
- 2 - 20,000 GAC contactors in lead-lag configuration
- Shoehorned onto site
- Second hand contactors

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Scope of Phase 1 Study: Facilities Plan Overview

- Address the question – what does TKPOA need to do if they lose well(s)?
- Investigated:
  - How much water does TKPOA need to meet Title 22 regulatory requirements?
  - How much supply does TKPOA have?
  - Where is TPKOA you now?
  - What happens if TPKOA loses Well 1
  - What happens if TPKOA loses Well 3
- Developed alternatives to restore/maintain supply reliability

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Existing Facilities: Supply Availability to meet Title 22 Demand

- Test 1 – Must meet Maximum Day Demand with largest well off line.
  - **TKPOA Supply alone fails to meet minimum criteria**
  - Resolution – TKPOA has a Mutual Aid Agreement with STPUD and the manual intertie can provide the make up supply.
- Test 2 – Must meet Peak Hour Demand for 4 hours duration (all wells running)
  - Supply **meets minimum criteria**
- Test 3 - Fire Flow Conditions (Max Day Demand plus 2,500 gpm fire flow)
  - **TKPOA Supply alone fails to meet criteria**
  - Resolution – TKPOA has a Mutual Aid Agreement with STPUD and the manual intertie that can provide the fire flow supply.

Conceptual Alternatives Identification

- TKPOA Only
  1. *New Well to replace Well 1
  2. *Storage tank and booster pump station
  3. *Groundwater Treatment at Well 1 site or Lagoon WTP
  4. *Expand Well 2 treatment at Lagoon WTP
  5. *Replacement Well 1 and Treatment
  6. *Expand Well 2 Treatment at Well 2
  7. Centralized Treatment at Lagoon WTP

- TKPOA With Partners
  8. Regional Surface Water Treatment Plant and well water blend
  9. New STPUD well Outside Plume to import to TKPOA
  10. Water System Consolidation
  11. Develop Surface Water Source (eg Upper Truckee River)
  12. Centralized Treatment at Lagoon WTP

Treatment Screening

- PCE concentration
  - Well 2 max 22 µg/L
  - Upgradient 50 to >280 µg/L
  - Use 50 to 100 µg/L
- Life Cycle cost
- Footprint
  - Limit land availability
  - Height limitations
- O&M complexity
- Flexibility for expansion
- Permitting
- Neighborhood impacts
  - Traffic, visible plume

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Tahoe Keys Treatment Alternatives Evaluation

Treatment Alternative Description	Treatment Footprint Size	Relative Life Cycle Cost of Treatment	Maintenance and Operation Complexity	Flexibility for Expansion	Permitting in Lake Tahoe	DDW Permitting Effort	Neighborhood Impacts (Aesthetics/ Noise)	Timeline for Implementation
1 - GAC	Low	Medium	Low to Medium	High	Low to Medium	Low	Low to Medium	Short
2 - Packed Tower Aeration	High	Low	Low to Medium	Medium to High	High	Low	High	Long
3 - Multi-Stage Bubble Aeration	High	Low to Medium	Low to Medium	Medium	Low to Medium	High	Low to Medium	Short
4 - ShallowTray™ Aeration	Medium	Low to Medium	Low to Medium	Medium to High	Low to Medium	Very High	Low to Medium	Short
5 - Membrane Cell Degassing	Medium	Medium to High	Low to Medium	Medium	Low	Very High	Medium	Short
6 - Spray Aeration	High	High	Low to Medium	Low	Medium	Very High	Medium	Medium
7 - Surface Aeration	High	High	Low to Medium	Low	Medium	Very High	Medium	Medium
8 - UV-Hydrogen Peroxide	Medium	High	High	Medium to High	High	High	Medium	Long
9 - Ozone-Hydrogen Peroxide	High	High	High	Medium to High	High	Very High	Medium	Long

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Tahoe Key Alternative Evaluation

Alternative	Reliable Water Supply	Implementation Cost	Relative O&M Cost	Regional Clean-Up Benefit	Timeline for Implementation	Permitting Ease in Lake Tahoe	Neighborhood Impacts	Land Purchase Needed
1. Construct Replacement Well 1R	High	Low	Low	Low	Short	High	Low	No
2. Tank and Booster Pump Station	Medium	High	Medium	Low	Short-Medium	High	Medium	No
3a. Add 1,000 gpm Treatment to Well 1 at Well 1	Medium	Medium	Medium	Medium-High	Medium	Medium	Medium	No
3b. Add 1,000 gpm Treatment to Well 1 at Lagoon WTP	Medium	Medium	Medium	Medium-High	Medium	Medium	Low Medium	No
4. Expand Well 2 Treatment at Lagoon WTP	High	Medium	Low-Medium	High	Medium	Medium	Low-Medium	No
5. Construct Replacement Well 1R and Add Treatment at Well 1	High	High	Medium	High	Medium	Medium-High	High	No
6. Expand Well 2 Treatment at Well 2	Medium	Medium	Low	High	Medium	Medium	High	No

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Tahoe Keys Next Steps

- Profile Well 2 water quality by depth and evaluate if they can seal off the well from the contaminated aquifer(s)
- Participating in the South Tahoe PUD South Y
  - Currently drilling test well to evaluate pump and treat

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