De-Risking Groundwater Investments in the Age of PFAS

California Water and Environmental Modeling Forum 29th Annual Meeting

CWEMF
CALIFORNIA Water & Environmental Modeling Forum

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INTERA

This is Going to be Expensive

Chemical	Maximum Contaminant Level Goal (MCLG)	Maximum Contaminant Level (MCL)
PFOA	0	4.0 ppt
PFOS	0	4.0 ppt
PFHxS	10 ppt	10 ppt
HFPO-DA (GenX chemicals)	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
Mixture of two or more: PFHxS, PFNA, HFPO-DA, and PFBS	Hazard Index of 1	Hazard Index of 1

*Compliance is determined by running annual averages at the sampling point

- 3 years of monitoring & reporting
- 5 years to achieve compliance

This is Going to be Expensive

Of the **50,000** Community Water Systems in the US, **80% are small**, serving less than 3,300 people

Table 7-1 Annual Costs to Household for Removing PFAS from Drinking Water

PWS Size Category	Population Range	Average Service Population	Approximate Range of Costs per Household
1	25 to 100	59	$3570 - $3570
2	101-500	245	$1675 - $1750
3	501-1,100	736	$1360 - $1390
4	1,001-3,300	1,939	$575 - $640
5	3,301-10,000	5,696	$305 - $325
6	10,001-50,000	20,613	$200 - $225
7	50,001-100,000	67,417	$155 - $175
8	100,001-1,000,000	204, 194	$65 - $70
9	>1,000,000	1,700,000	$115 - $120

Very Small (54%): $298/mo

Small (27%): $48-146/mo

Medium (10%): $25-27/mo

Large (8%): $13-19/mo

Very Large (1%): $5-10/mo

Cost per customer of PFAS removal

American Water Works Association

WITAF 56 TECHNICAL MEMORANDUM, PFAS National Cost Model Report for AWWA, Black & Veatch, March 7, 2023

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Manage Risk & Cost by Understanding Sources

- Treatment is frequently necessary, but less is more
- Understanding sources helps to minimize treatment requirements

pfas AND ("water utility" or "water utilities") AND (groundwater OR "ground water") AND treatment

Treatment: 9,000 results

pfas AND ("water utility" or "water utilities") AND (groundwater OR "ground water") AND ("source identification" OR "alternate source")

Sources: 700 results

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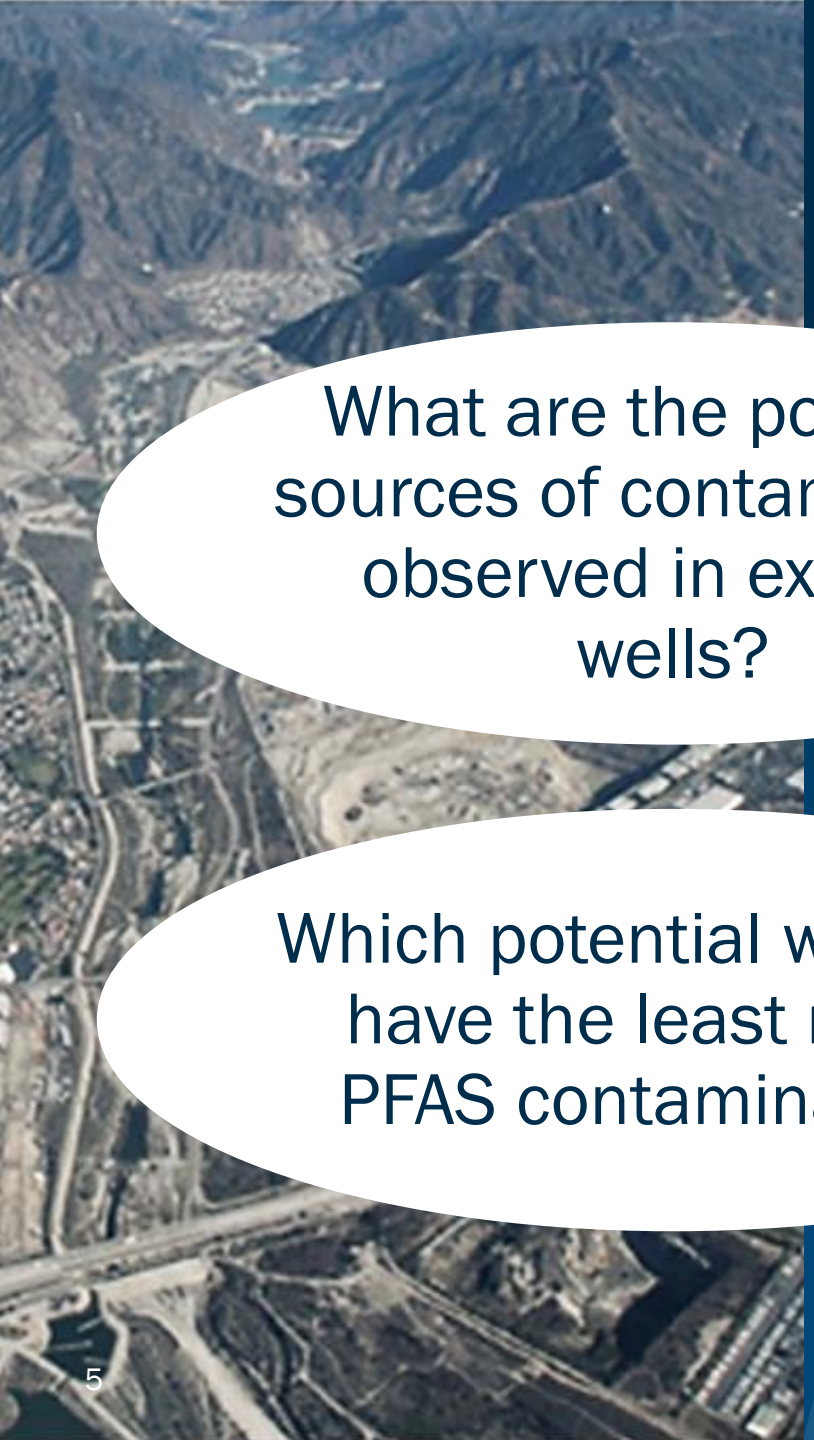

The Problem

What are the potential sources of contamination observed in existing wells?

Which potential well sites have the least risk of PFAS contamination?

- Many wells impacted by PFAS
- Aging wells need replacement, reliability concerns
- Infrastructure investments are significant, reduce risk
- Local data on PFAS occurrence and historical uses is limited

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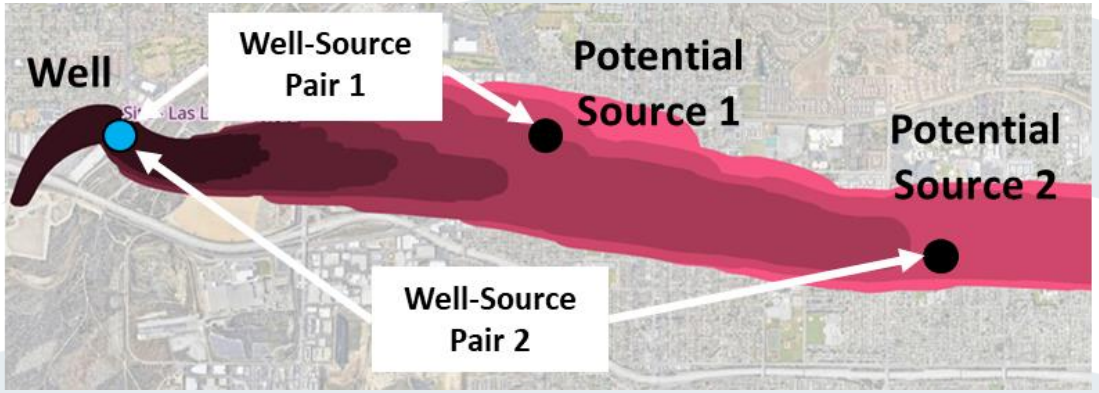
Practical Risk Evaluation and Screening

Objective: Focus & Prioritize

- Leverage existing tools
- Use publicly available data
- Target best candidate sites for further investigation



$$\text{Total Risk Score} = \sum_{i=1}^{n} \text{Capture Zone Component (i)} \times \text{Potential Source Component (i)} \times \text{Infiltration Susceptibility Component (i)}$$

Potential Sources i = 1 to n

0-1 0-1 0-1

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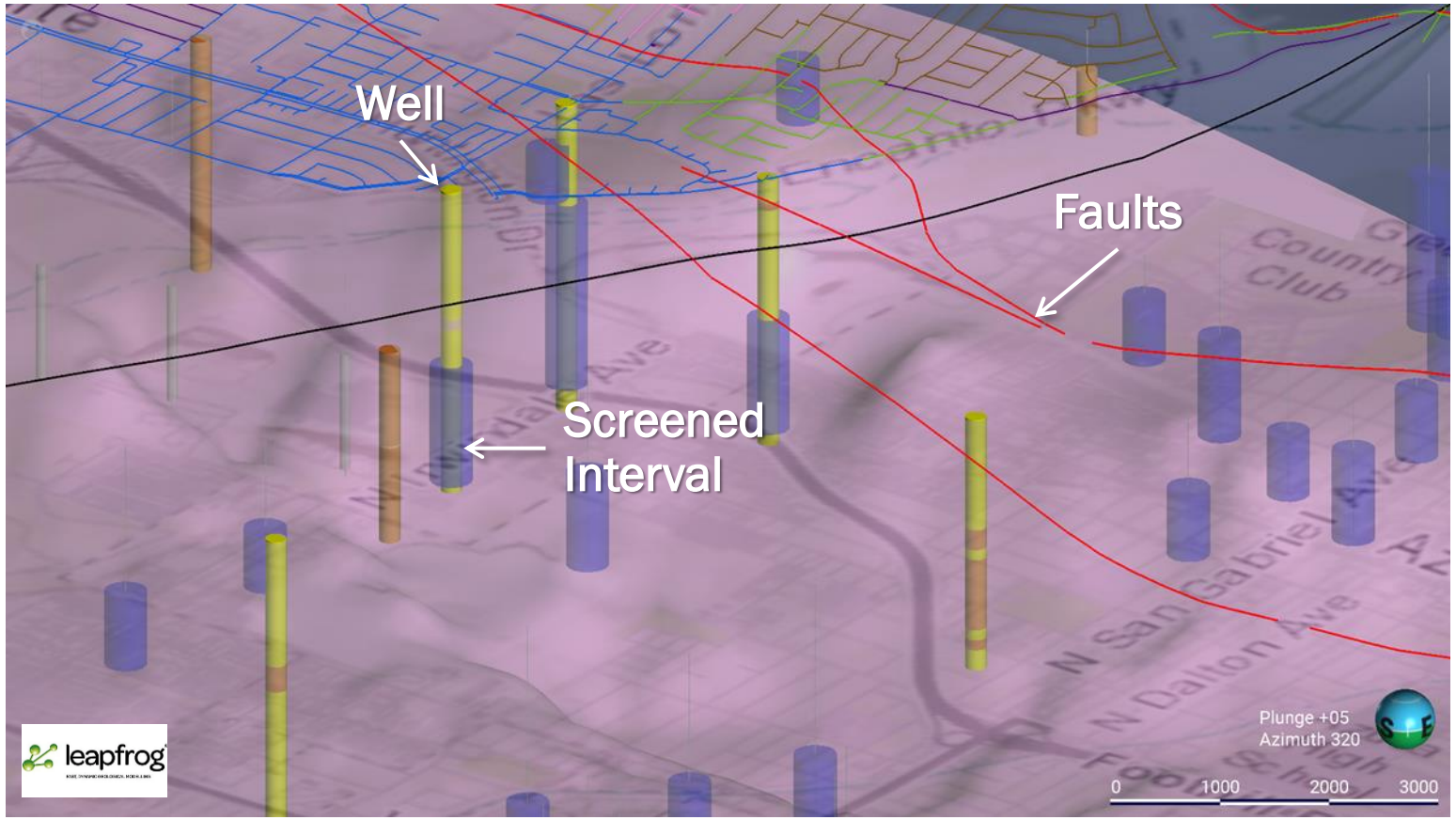
Capture Zone Delineation



- Geology
- Hydrogeology
- Existing wells
- Potential well sites
- Screened intervals

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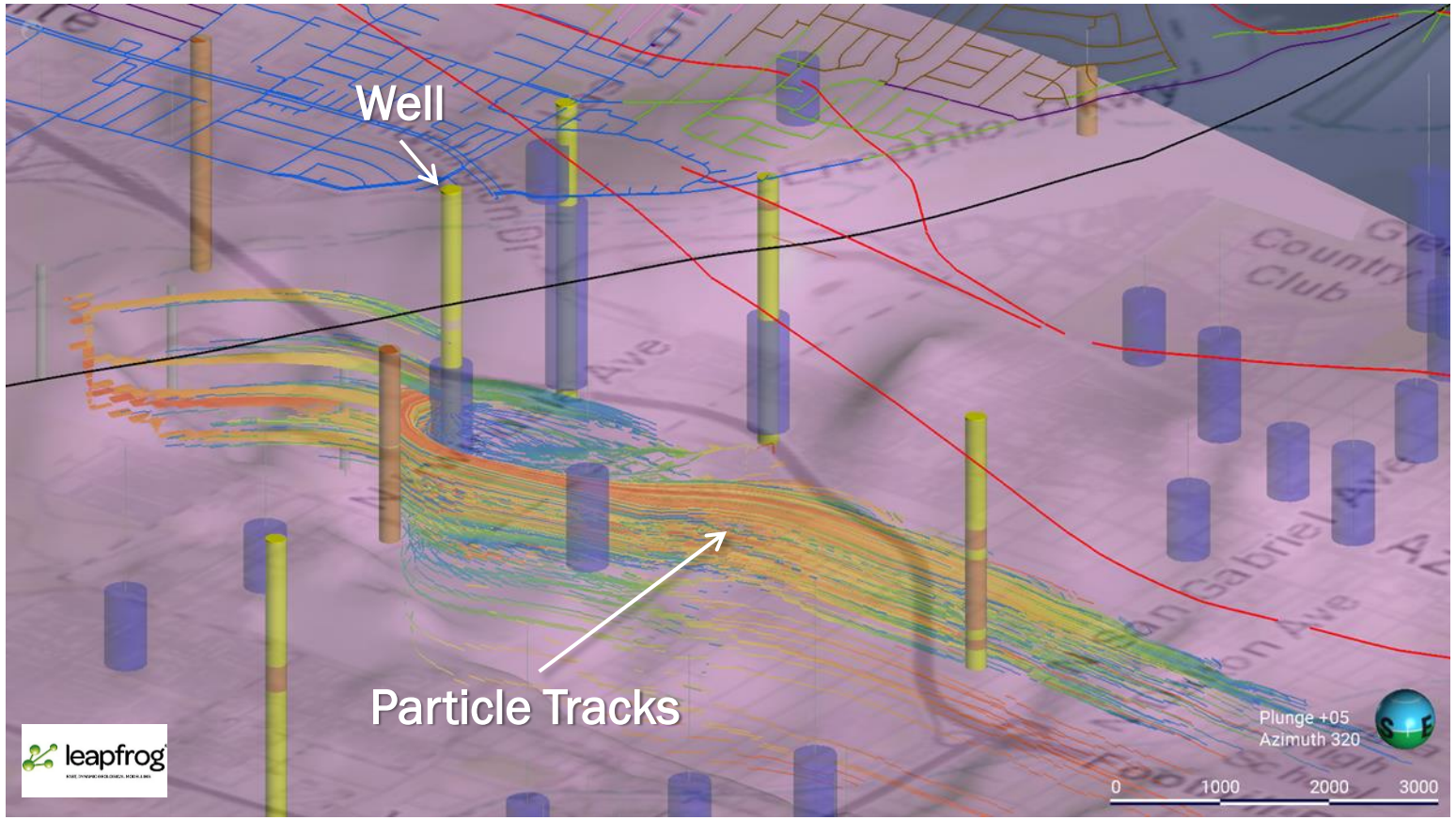
Capture Zone Delineation



- Groundwater flow modeling (MODFLOW)
- Particle tracking (MODPATH)

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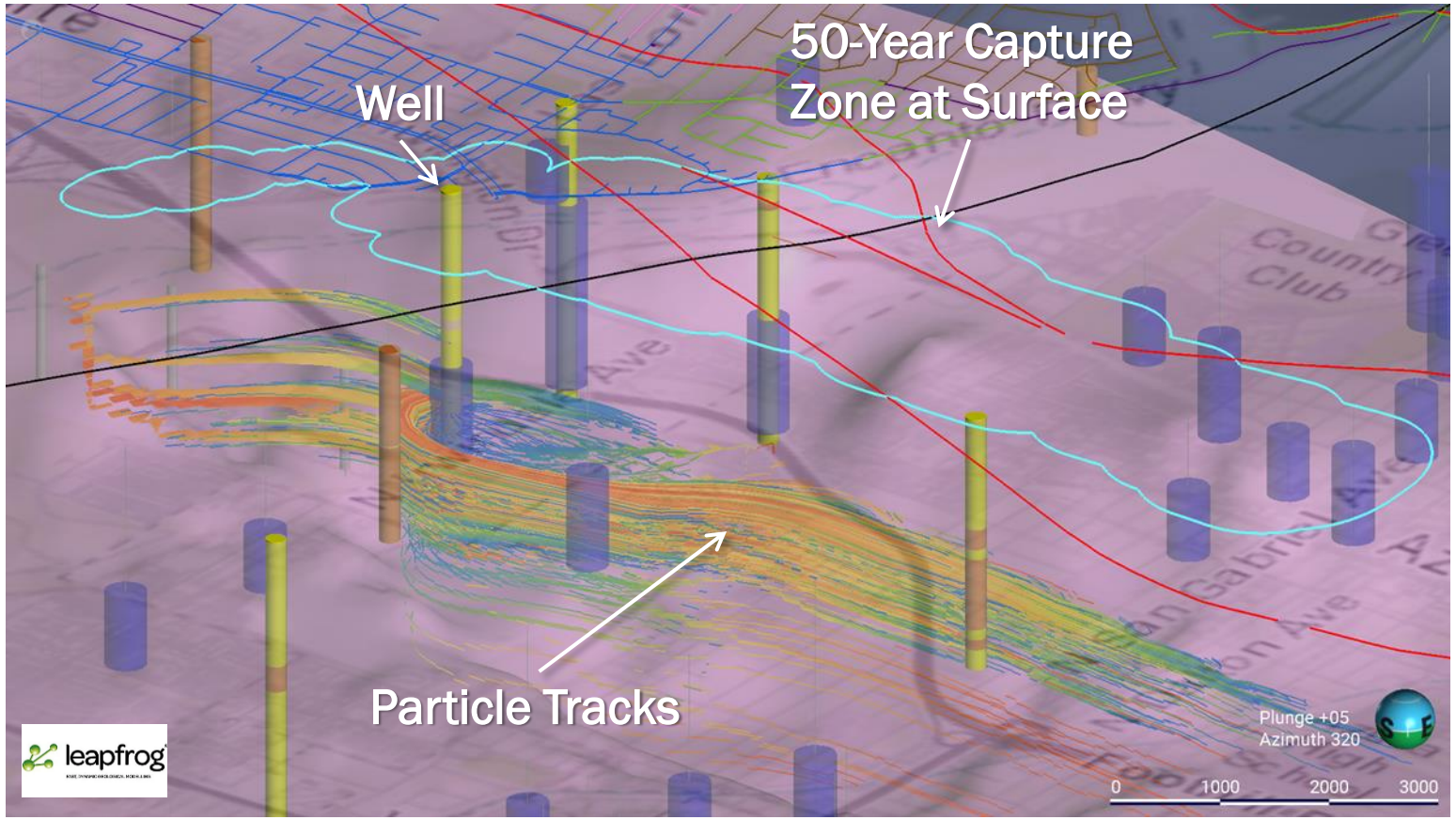
Capture Zone Delineation



- Delineation of 50-yr capture zones w buffers
- 1st risk score component
- Bounds the environmental record search

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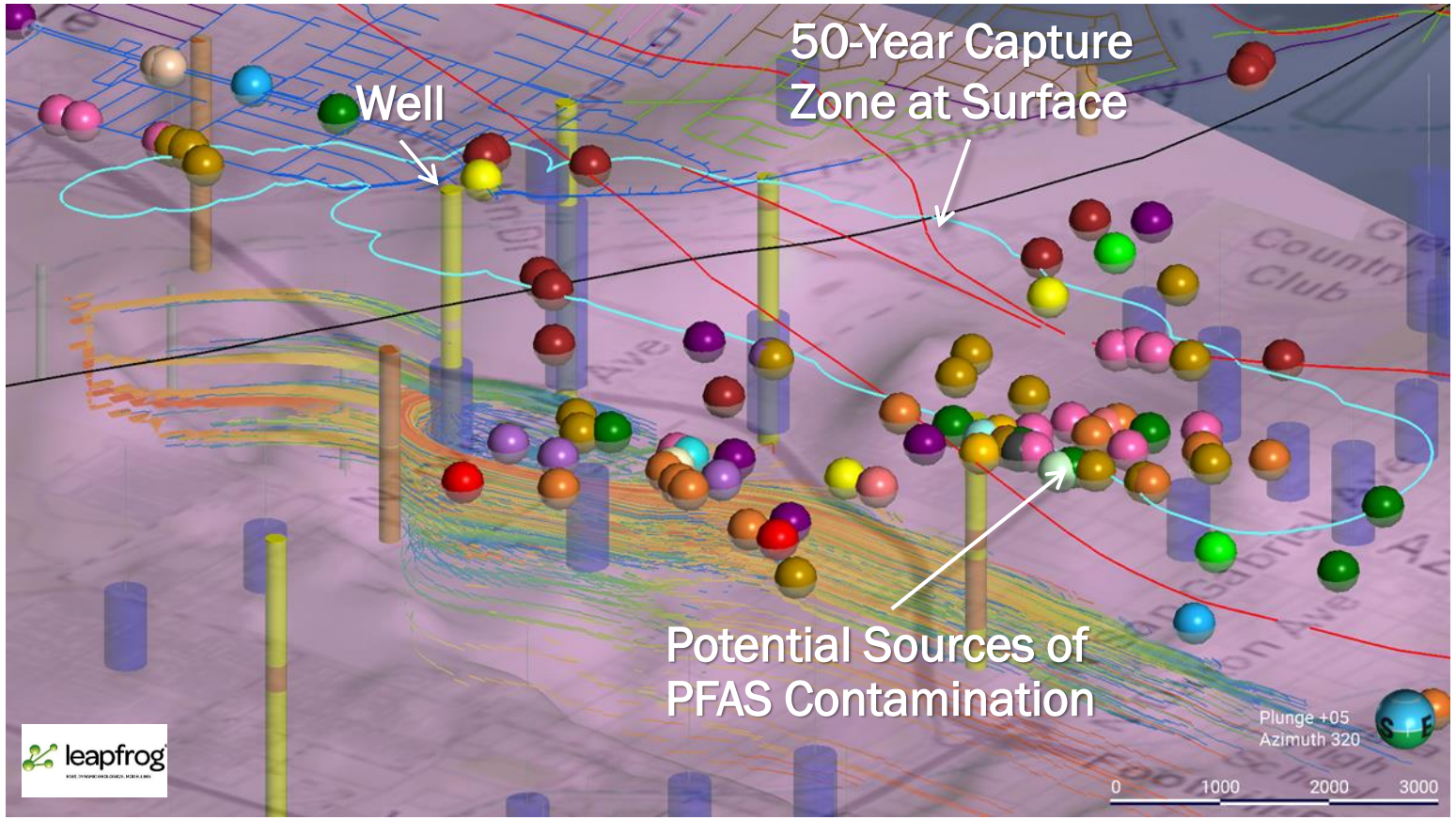
Potential Sources of PFAS Contamination



Environmental_Sites

- Automotive and Paint
- Buildings and Construction
- Car Wash
- Chemical Industry
- Cleaning Product Manufacturing
- Coatings and Paints
- Consumer Products
- Dry Cleaner
- Electronics Industry
- Energy Sector
- Fire Department
- Landfill
- Metal Manufacturing
- Paper Mills and Products
- Photoprocessing
- Plastics and Resins
- Printing
- Textiles and Leather
- Unknown

ERIS

STATE WATER RESOURCES CONTROL BOARD GEOTRACKER

DTSC Department of Toxic Substances Control

GAMA GROUNDWATER INFORMATION SYSTEM

CalRecycle

CAL FIRE SINCE 1885

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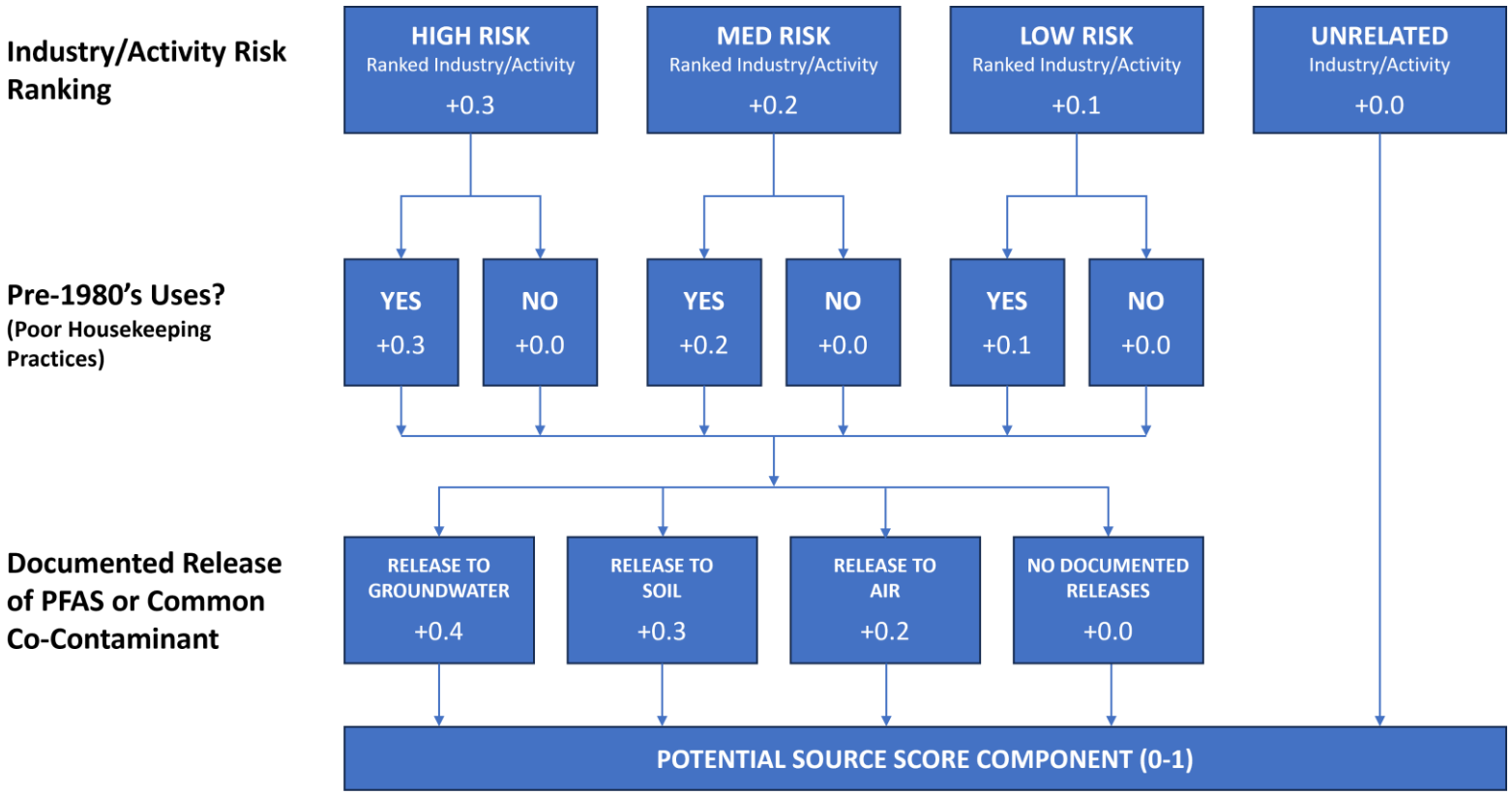
Potential Sources of PFAS Contamination



- 2nd risk score component
- Type of use
- Poorer practices assumed pre-1980's
- Documented releases

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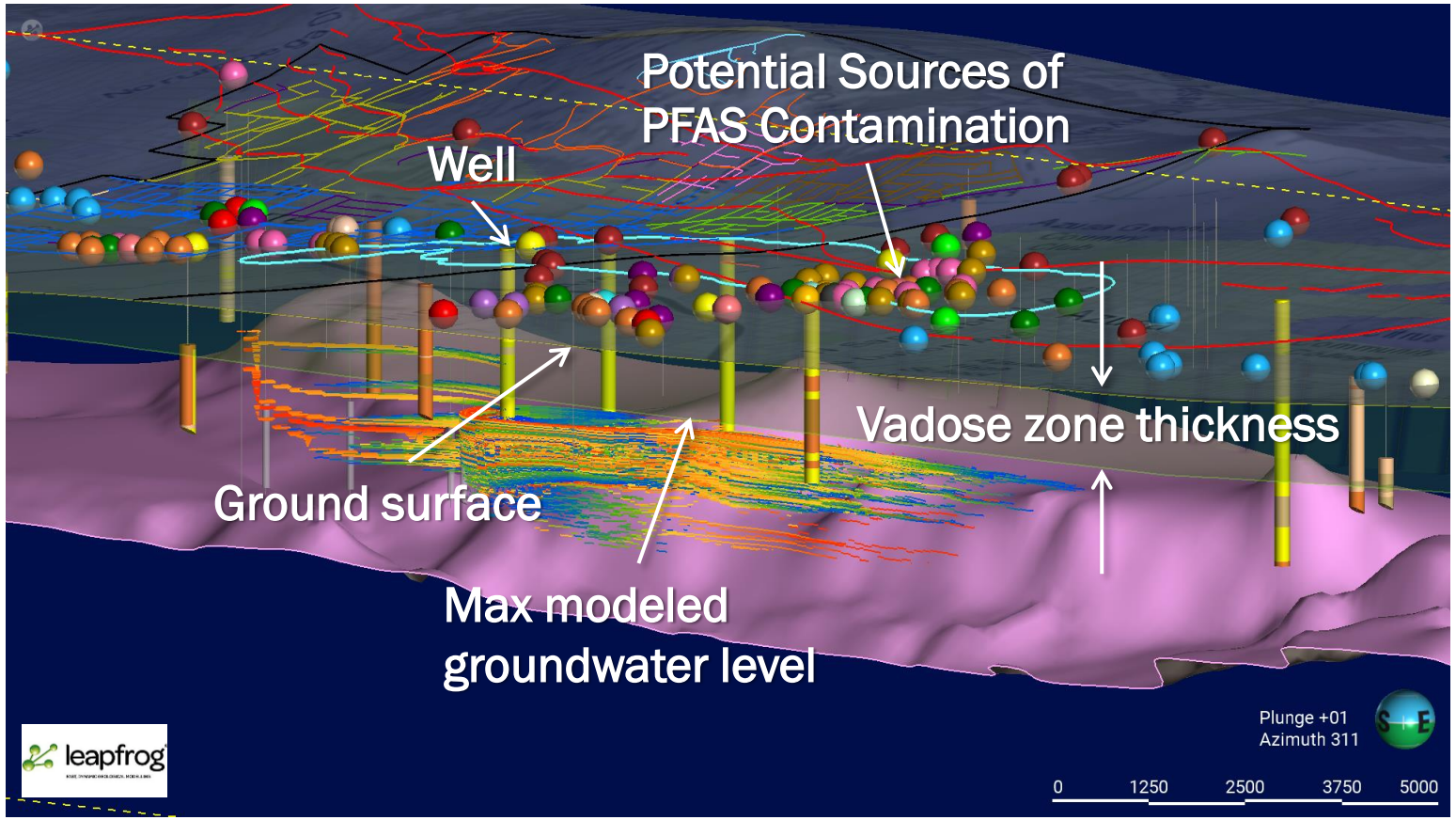
Vulnerability to Surface Contamination



- Relative risk that surface release reaches groundwater
- Soils
- Regulated PFAS
- Vadose zone thickness
- Pervious surfaces

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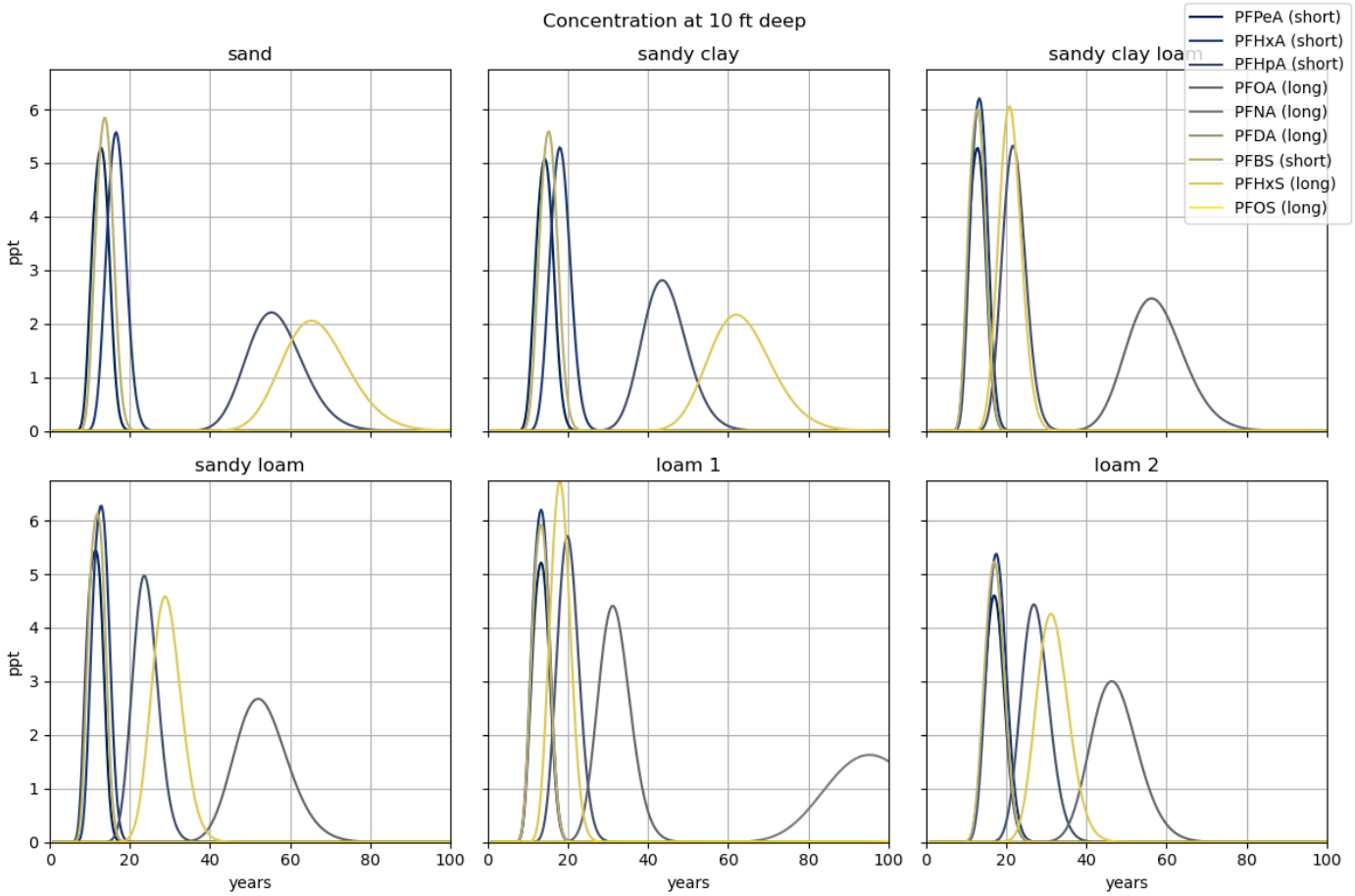
Vulnerability to Surface Contamination



- Applied Gou, et al (2022) vadose zone screening model
- Evaluated parameter sensitivity
- Generalized selected parameters

Guo, B., J. Zheng, M. Brusseau, and Y. Zhang. 2022. A screening model for quantifying PFAS leaching in the vadose zone and mass discharge to groundwater.

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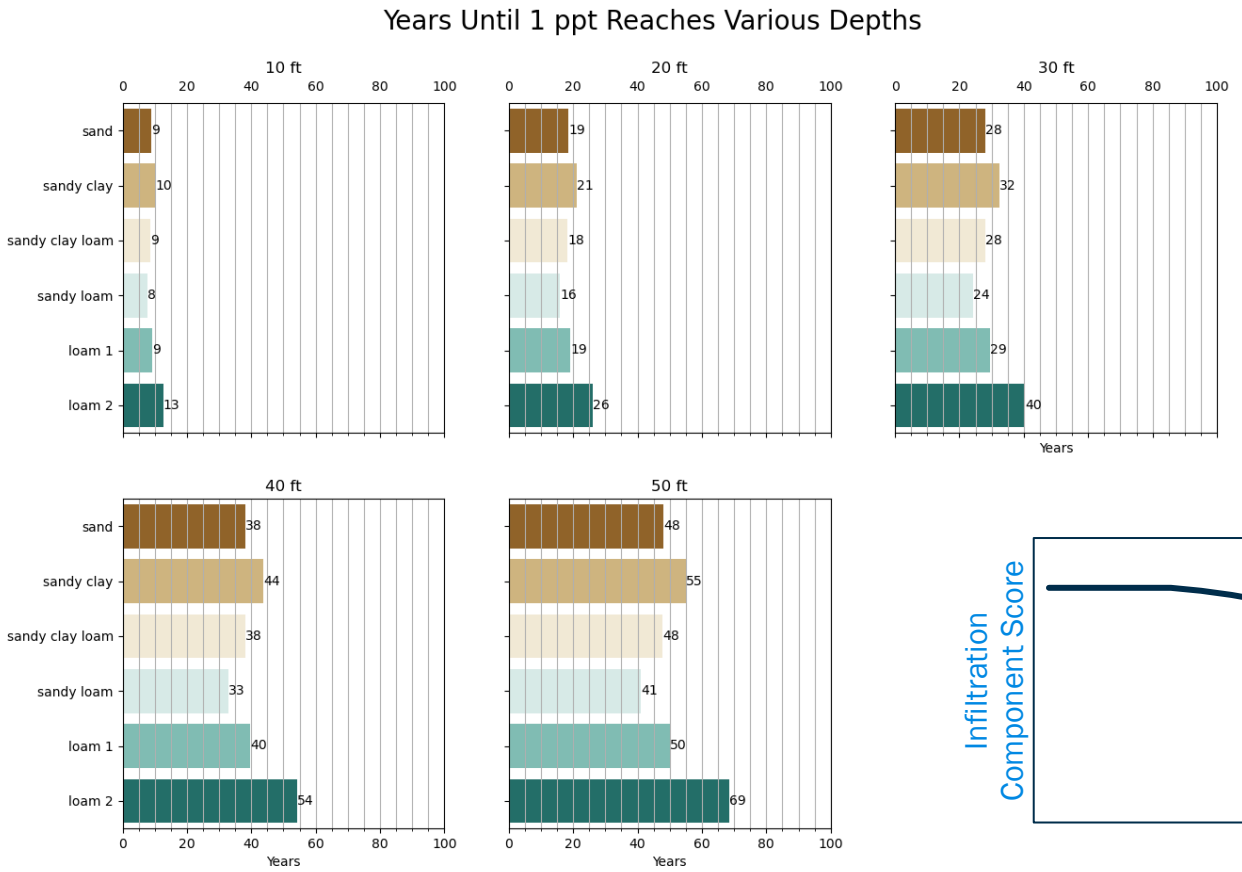
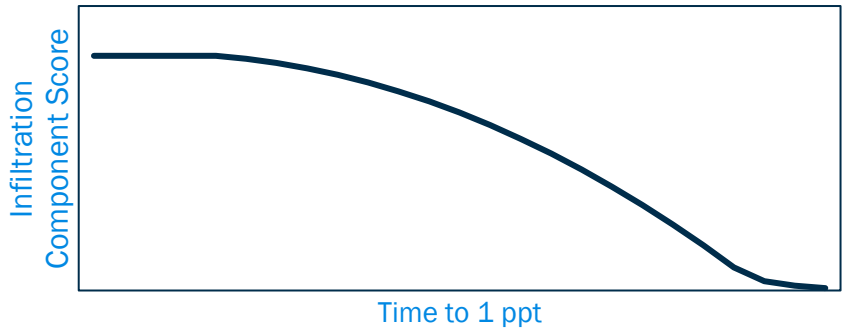
Vulnerability to Surface Contamination



- Time for 1 ppt to reach groundwater from a unit surface release
- Conservatively selected fastest arriving PFAS



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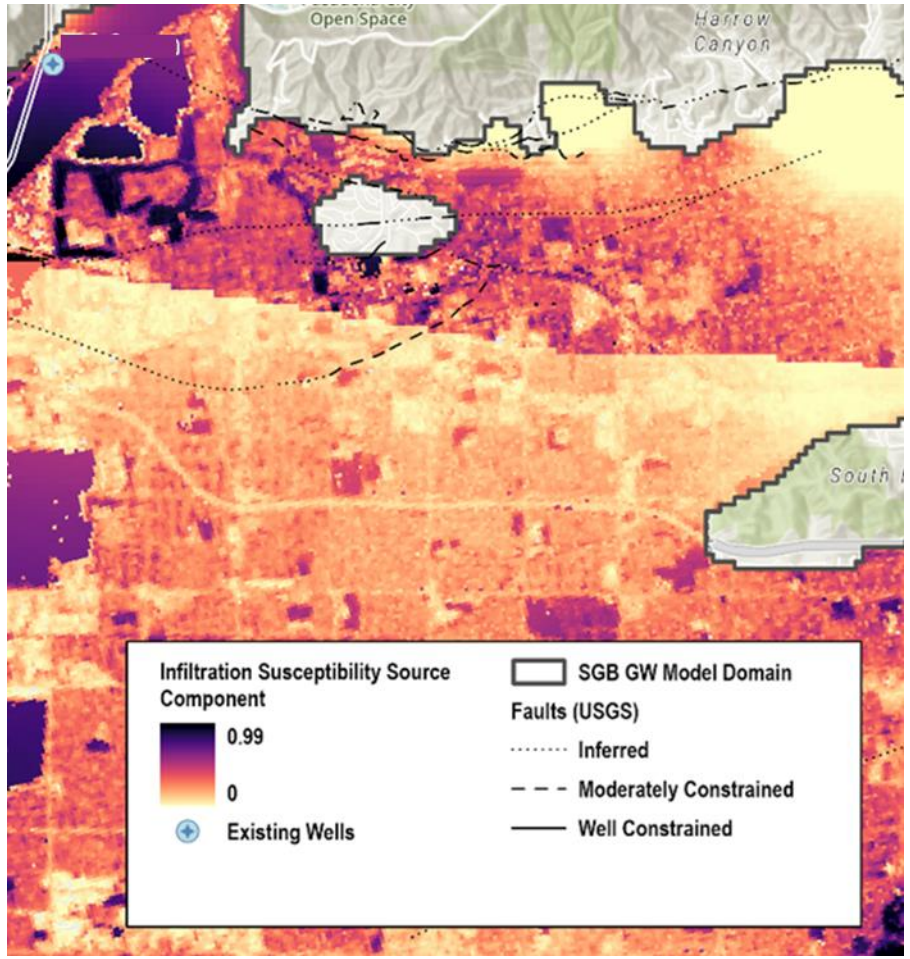
Vulnerability to Surface Contamination

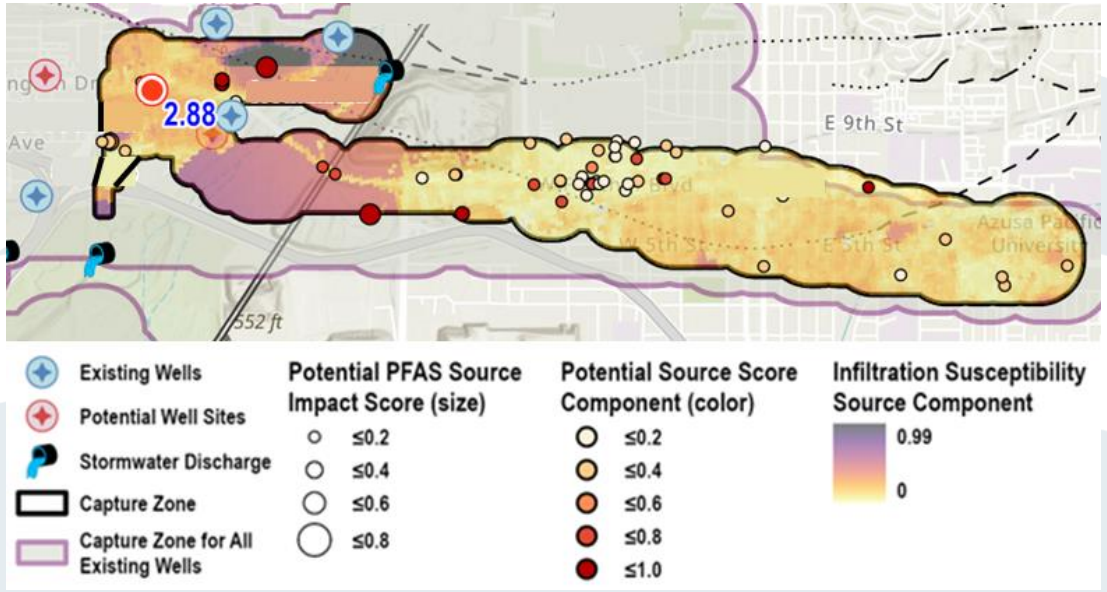


- 3rd risk score component
- Mapped across study area
- Based on quickest arrival of 1 ppt to groundwater
- Predominantly sand & gravel
- Variable vadose zone thickness
- Adjusted for perviousness

INTERA

Score Potential Sites to Evaluate Relative Risk

- Sum risk scores associated with each potential source
- Compare to available water quality data
- Put in context of hydrogeologic understanding & utility system



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0-1 0-1 0-1

Practical Insights

- Higher-risk areas to avoid for new wells
- Potential lower-risk well sites to investigate further, with specific guidance
- Identification of potential sources to existing wells with specific guidance for further investigation. Remediation? Cost recovery?
- Coordination with neighboring agencies to share information – changes in water quality, pumping patterns

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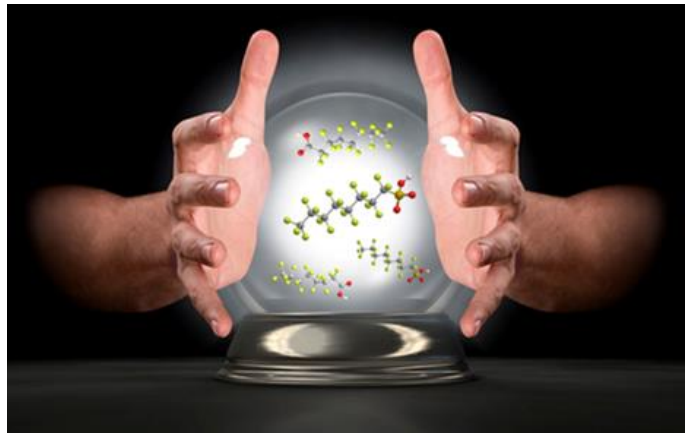
Thank You!



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