

# Movement and Quantification of *E. coli* in a Managed Aquifer Recharge (MAR) Site

Hannah Collins, Environmental Engineering

Mentors: Dr. Rebecca Muenich, Assistant Professor and Dr. Kerry Hamilton, Assistant Professor  
School of Sustainable Engineering and the Built Environment

## Objectives

- Quantify *E. coli* in an aquifer recharge infiltration pond at the Gilbert Riparian Preserve (GRP), which is a MAR site
- Characterize *E. coli* movement through soil at the GRP to see if *E. coli* from Pond 7 (a water recharge pond) moves through soil to Water Ranch Lake, which is used recreationally (for fishing)

## Background

Managed Aquifer Recharge (MAR) Site

- Stores treated wastewater to ease water demand by using it for irrigation and other non-potable uses
- Supports desert riparian wildlife [1]
- On the map to the right are seven water recharge ponds at the GRP

*E. coli*

- Fecal indicator bacteria
- Exposure occurs due to accidental ingestion, dermal contact, and inhalation
- May cause gastrointestinal illness
- About 73,480 illnesses occur each year in the United States [2]

## Methodology

Quantification of *E. coli*

- Sample water from Water Ranch Lake and Pond 7
- Count *E. coli* using culture-based quantification methods and report as CFU/100 mL of sample

*E. coli* Movement Through Soil

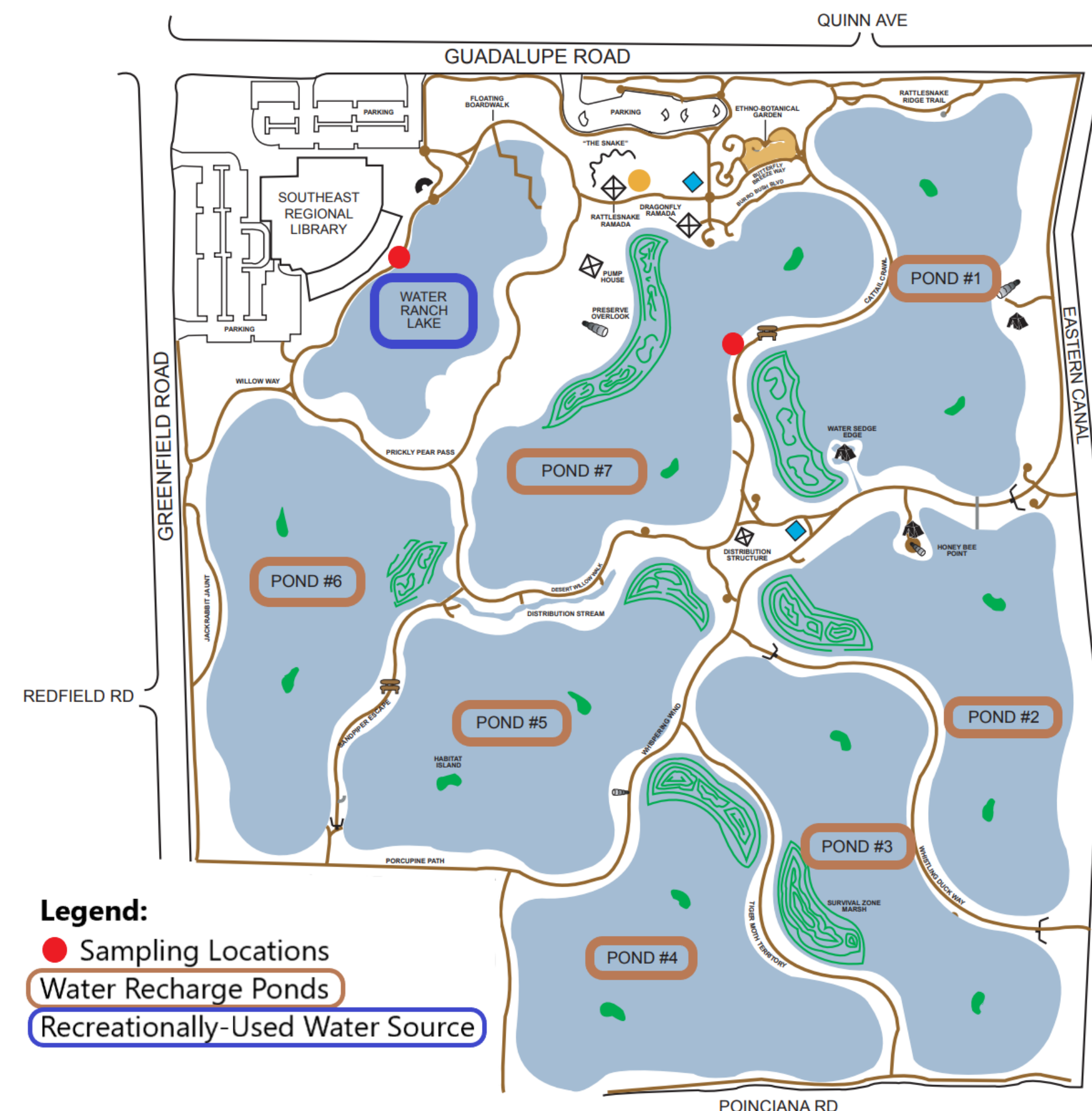
- Soil column tracer test experiment – determine hydraulic characteristics of water as it moves through soil from the GRP

## Results

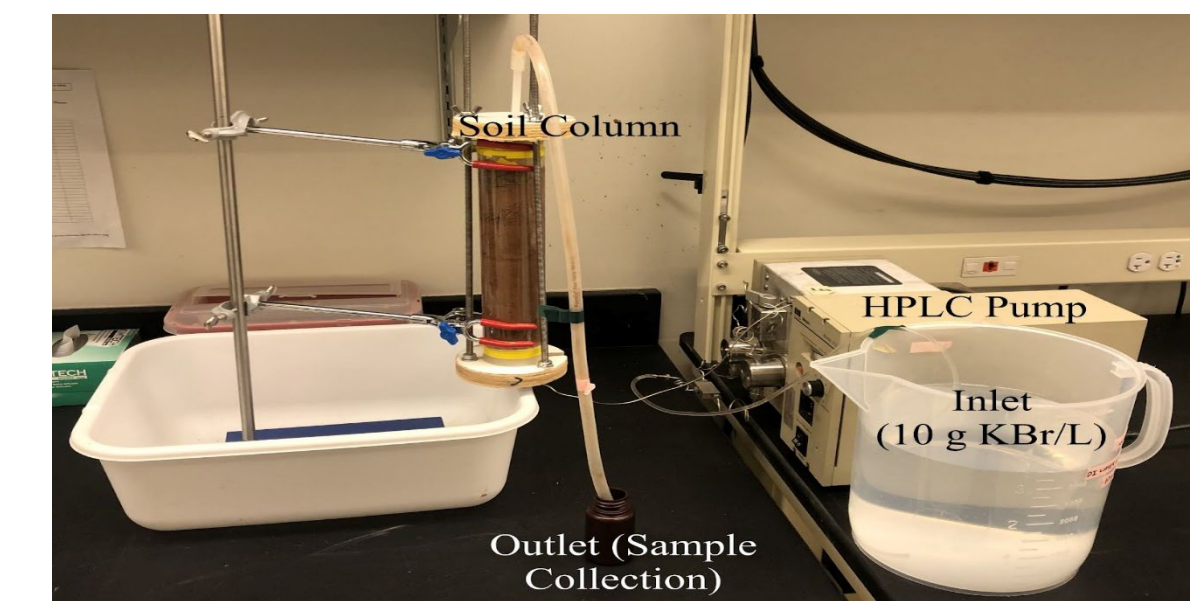
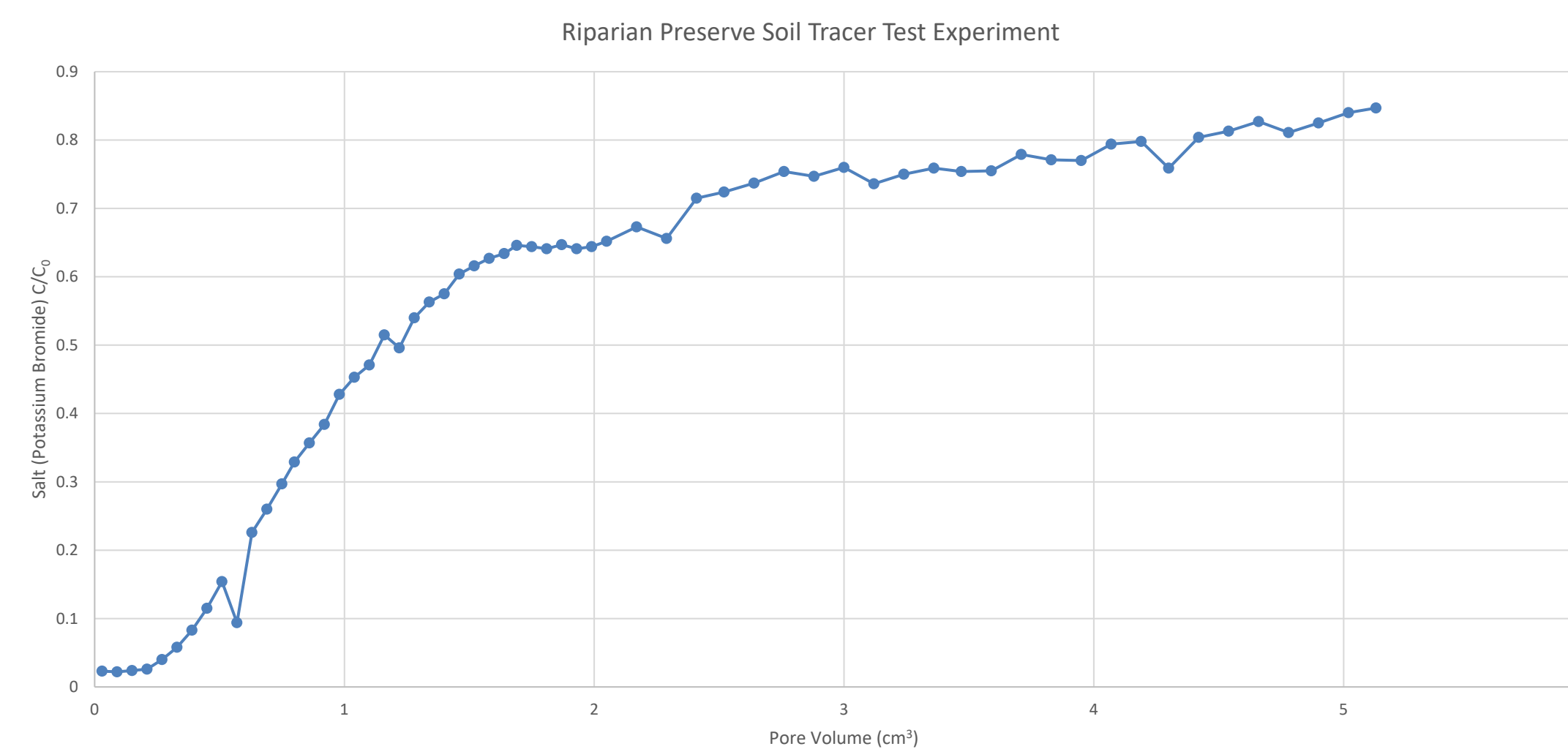
Sampling from Water Ranch Lake and Pond 7 in June 2021 yielded the following results for quantification of *E. coli* (done in triplicates):

	Undiluted	1:10 Dilution	1:100 Dilution
Water Ranch Lake	NA	63, 67, 58	2,7,9
Pond 7	NA	TNTC, TNTC, TNTC	36, 8, 34

TNTC: Too Numerous To Count



A salt tracer test experiment (necessary precursor before doing *E. coli* soil column experiments) was done in February 2022 using soil from the GRP. The breakthrough curve and experiment setup are shown below and to the right, respectively.



## Conclusions

- Quantification of *E. coli*: the results from the table suggest that there could be *E. coli* moving underground through soil from Pond 7 to Water Ranch Lake, meaning that those who use Water Ranch Lake may be exposed to *E. coli* and potential fecal pollution.
- E. coli* Movement Through Soil: A soil column experiment for *E. coli* is yet to be done. Based on the results for the tracer test experiment, the anticipated results are that the majority of the *E. coli* will be retained inside the column because of:
  - E. coli* attachment to the soil
  - E. coli* death inside the column
  - The barrier formed by the clay loam in the column

## Future Work

- Quantification of *E. coli* over the course of a year to see how *E. coli* concentrations vary over time in Water Ranch Lake and Pond 7
- E. coli* attachment experiment – determine how much *E. coli* is not recovered from the soil column due to attachment to soil particles
- E. coli* survival experiment – determine how much *E. coli* is not recovered from the column due to *E. coli* death inside the column
- E. coli* soil column experiment – determine how much *E. coli* is retained in soil and how much infiltrates through soil

## References and Acknowledgements

- [1] "Town of Gilbert, Arizona." <https://www.gilbertaz.gov/departments/public-works/water/water-resources/reclaimed-water>.
- [2] Rangel, Josefa M, et al. "Epidemiology of Escherichia Coli O157:H7 Outbreaks, Volume 11, Number 4-April 2005.

Thank you to Dr. Muenich, Dr. Hamilton, Dr. Ting Liu, Joanna Harrison, Sayalee Joshi, Dr. Clinton Williams, Grace Morgan, Stan Klonowski, and Benjamin Collins for their support on this project.