Shallow Subsurface Artificial Groundwater Recharge

Civil Engineering

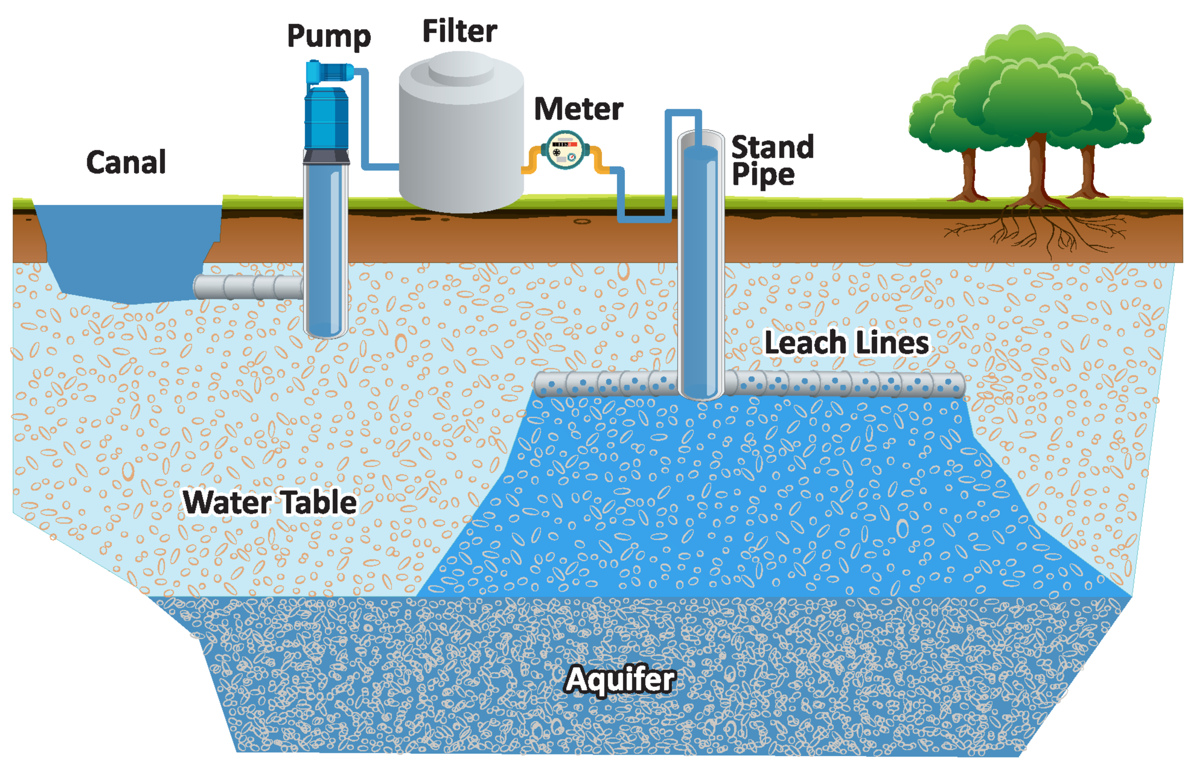
Student: Samuel D Hawley
Advisor: Cordie R Qualle
Consultants: Mary Church, Gabriella Bonilla

Lyles College of Engineering

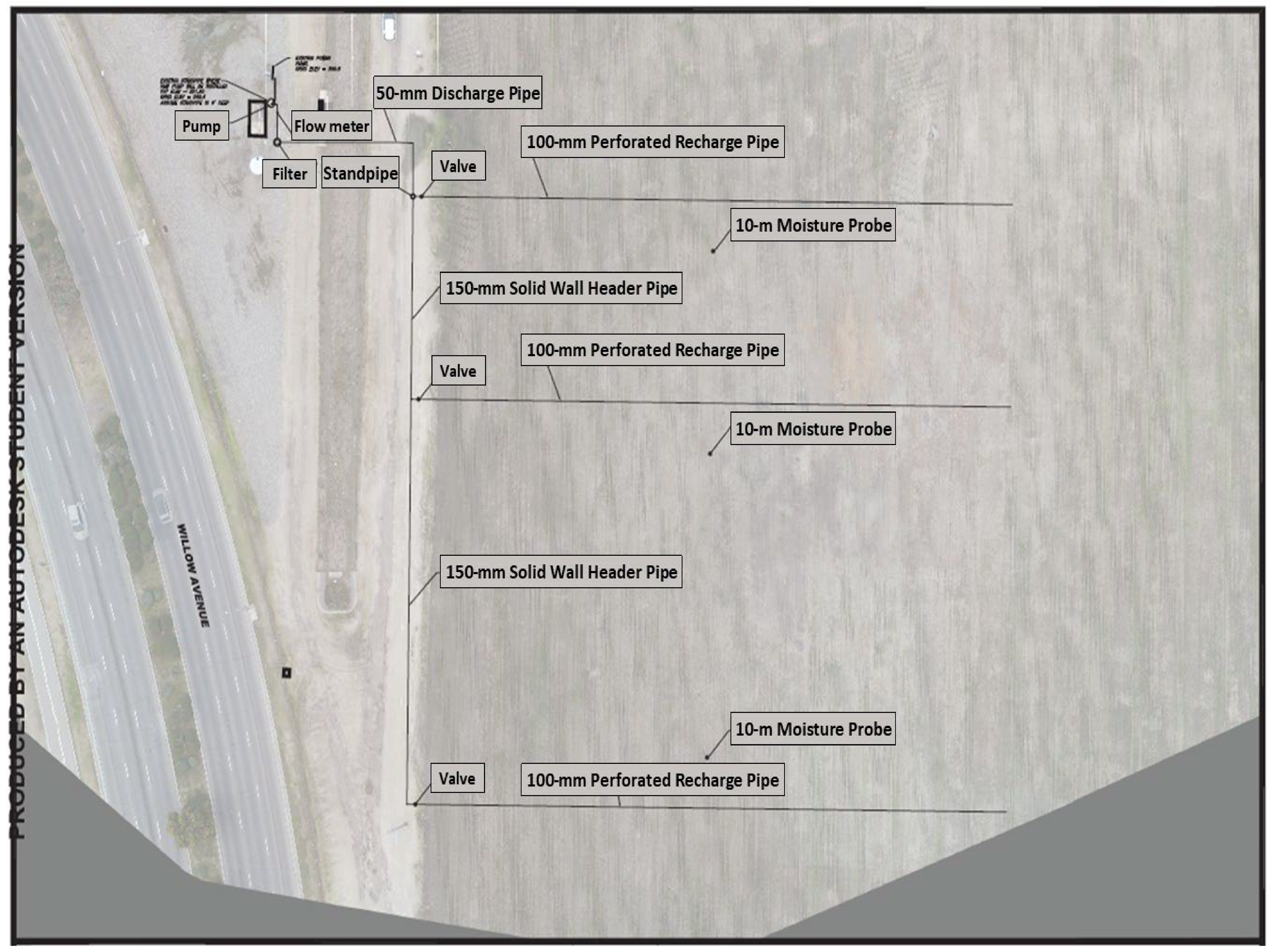
Overview

System

- Perforated pipe (3) system installed in vadose zone at 3 m depth
- Allows the use of active farmland to recharge the groundwater table with excess surface water



- Recharge can occur without impacting farming practices
- Nearly 100% of water delivered to groundwater table



Data Collection

Installation

- Pipe system installed in 2020 by Lidco
- Telemetry installed by Davis Instruments
- Moisture probes from Sentek
- Submersible pump provided by Grundfos

Data Analytics

- Data uploaded to Redtrac

Abstract

Shallow Subsurface Artificial Groundwater Recharge (SSAGR) is a simple concept. We use leach lines to percolate recharge water in agricultural fields below the crop root zone. SSAGR utilizes the existing pump and filter infrastructure of a field's drip system to deliver water to the gravity-fed leach lines through a standpipe. The advantages of SSAGR are: 1) it is below the root zone, so it does not impact crop health and it does not leach residual chemicals and nutrients into the groundwater, 2) it does not impede access, or use of the field due to flooding, and 3) it delivers nearly 100-percent of the recharge water for percolation to the groundwater table. Our research will be successful if we can show that the cost per acre-foot for SSAGR is competitive with other forms of recharge which could open many acres of farmland for recharge where soil strata are appropriate. Our work is focused on researching the efficiency and cost of the SSAGR system in terms of acre-feet of water recharged as a function of the cost to recharge the water. A water balance is used to calculate the net water recharged and actual construction and operations costs are used to determine the cost to recharge the water. The poster presentation will illustrate the SSAGR system, its groundwater recharge performance, and operations costs.

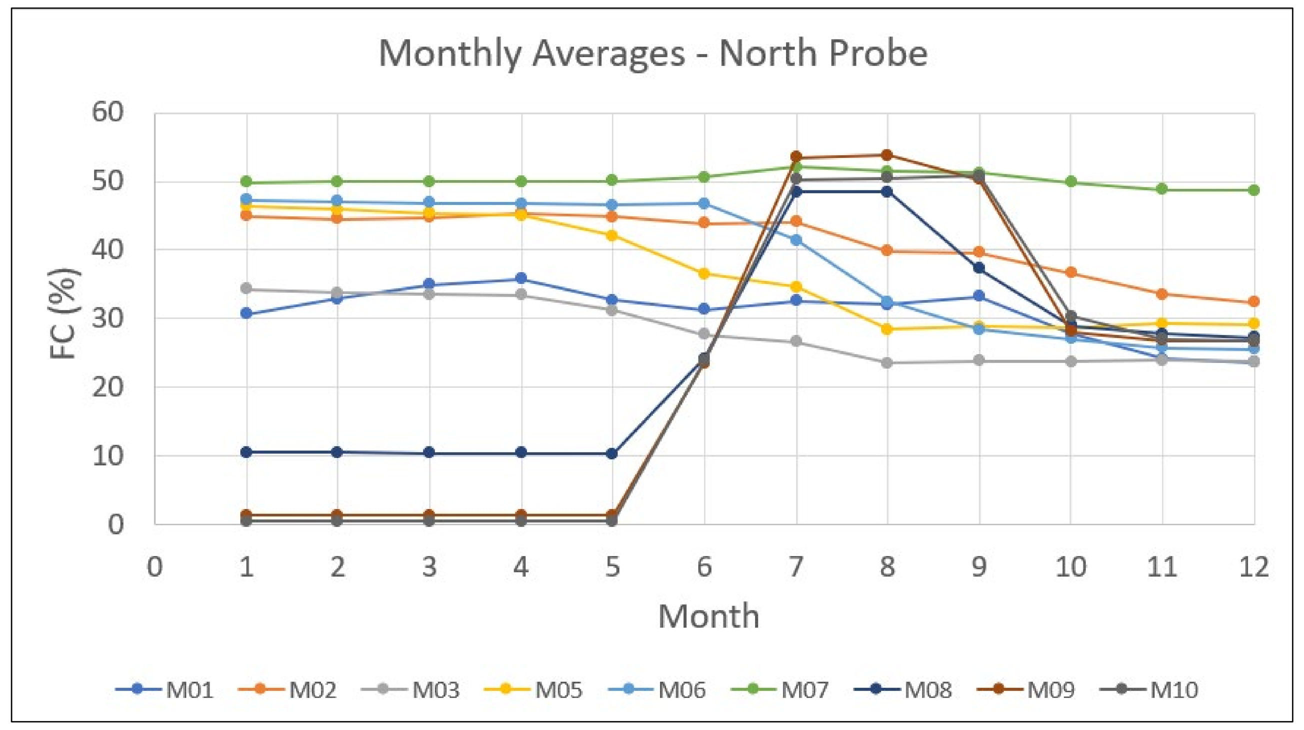
Location

- Southeast of intersection of East Bullard Avenue and North Willow Avenue

Water Balance Results

Soil Moisture Readings (Redtrac)

- Water volume was applied between June and August 2023



Water Budget Equations

- Mass Balance:

NET WATER =
[Water Inputs - Water Exports] =
[(SSAGR + Irrigation + Precipitation) - (Evaporation + Tree Evapotranspiration)]

- Aug 31st Sample Calculations:

NET INCREMENTAL VOLUME = [0 m^3 + 1.37 m^3 + 0 m^3] – [0.10 m^3 + 0 m^3] = 1.27 m^3

ACCUMULATED RECHARGE VOLUME = 123064.34 m^3

EFFICIENCY = (recharge / incremental net volume) x 100% = 12306.34 m^3 / 12469.60 m^3 = 100%

Economic Analysis

Costs

- $4,000 per acre
- requires filtration to preserve the recharge capability of the soil
- It consumes energy to run the pump system to filter the water and deliver it to the system

Sponsors

- ARI, Private Donors
- Research Partners: Lidco, Inc, Grundfos Pumps, Redtrac, LLC, Fresno State Farm, Moore-Twining, Cal West Rain, Davis Instruments, Sentek, City of Clovis, CA, JCAST, LCOE

2023