Hydrogeologic Influences on Water Supply in the Big Hole River

Jenna Dohman, Todd Myse and Ann Hanson

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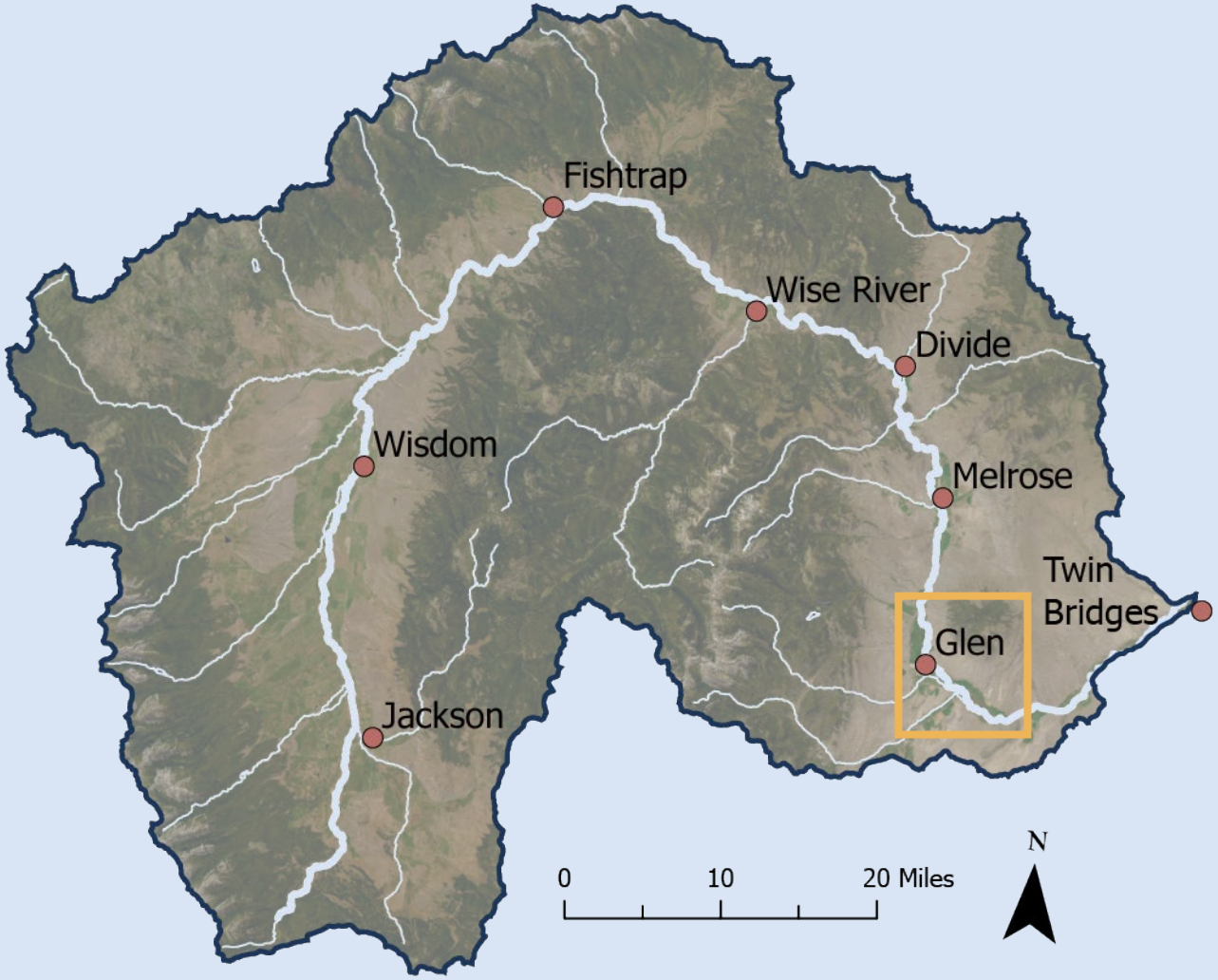
Photo: Ron Breitmeyer

“The Last Best River”



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“The Last Best River”

- Blue-ribbon trout fishery
  - Last naturally-producing population of fluvial Arctic Grayling in the lower 48

Pat Clayton, courtesy Center for Biological Diversity

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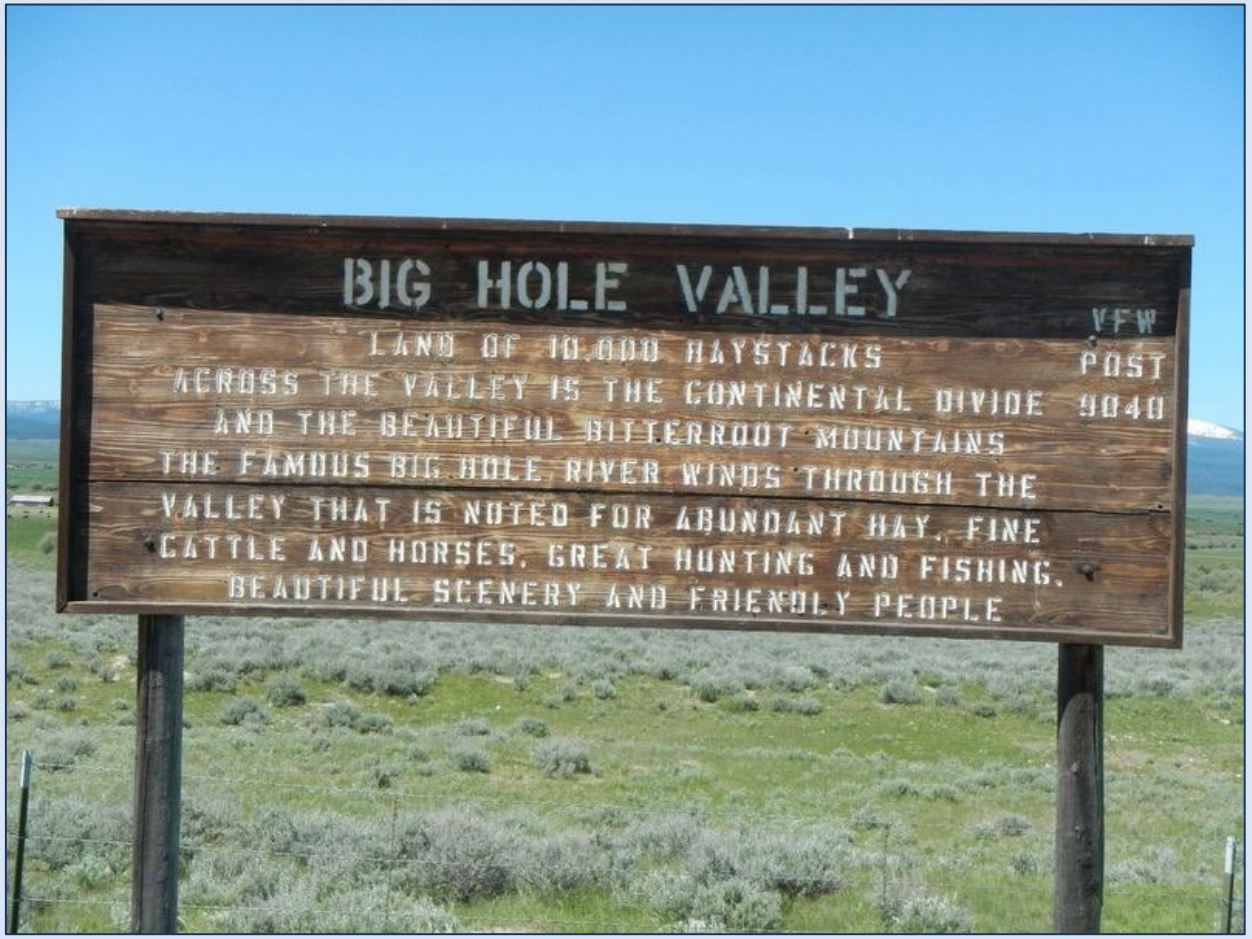
- Agriculture
  - Grass hay and alfalfa
  - Cattle outnumber full-time residents
- Critical resource for local agricultural and recreation economies



Barry Swackhamer, https://www.hmdb.org/m.asp?m=124221

Project Motivation

PURPOSE: Determine the hydrogeologic influences that most affect **water supply** and temperature on the lower Big Hole River near Glen.

Stakeholders can use this information to better understand which land management practices most benefit the water resources in the area.

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Temperature study covered in the following presentation!

Big Hole in the News

The New York Times

‘Zombie Trout’ Unsettle Montana, Long a Fly-Fishing Mecca

Warming waters and other factors along the state’s rivers like the Big Hole appear to be contributing to alarmingly low numbers of the state’s renowned rainbow and brown trout.

The Big Hole River and its continued state of peril; trout numbers again at historic lows

Matthew.Kiewet May 23, 2023 2

ALERT TOPICAL

FWP outlines fisheries mortality study for Big Hole, Beaverhead, Madison and Ruby rivers

M.Kiewiet Jun 27, 2023 0

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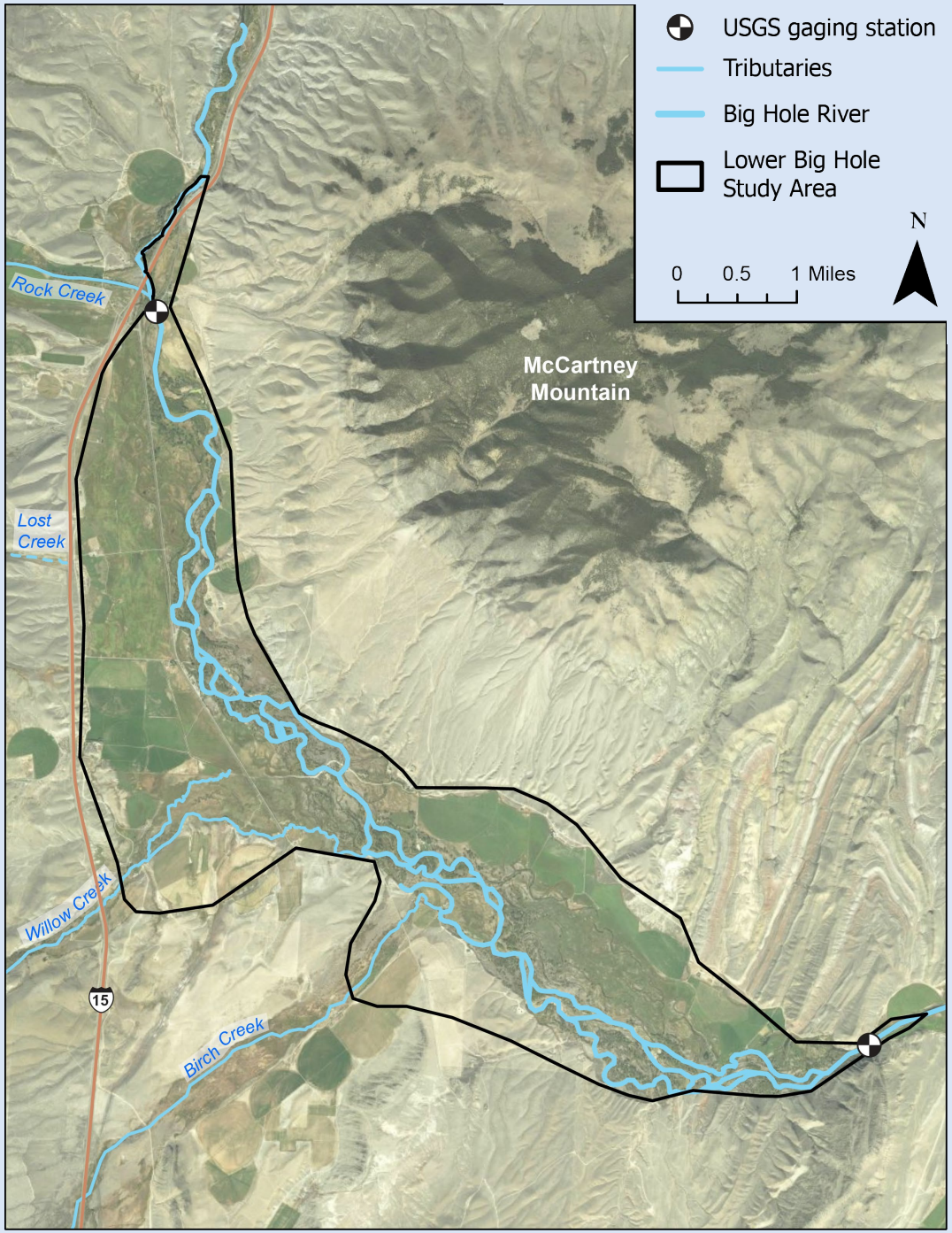
Conservation Efforts on the Big Hole

- Protecting the Big Hole River fishery during drought with **voluntary conservation** & state enforced fishing restrictions

https://bhwc.org/montana/uploads/2022/04/DMP-2022_Final-1.pdf

Big Hole Study Area

- Size
  - Glen Valley is ~15 mi^2
- Surface Water Hydrology
  - Anabranching river system
  - Bounded by USGS gages



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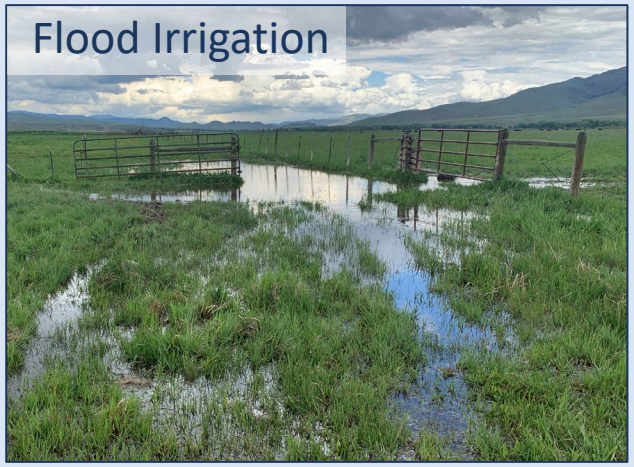
- Land use
  - Cattle ranching
  - Pivot and flood irrigation



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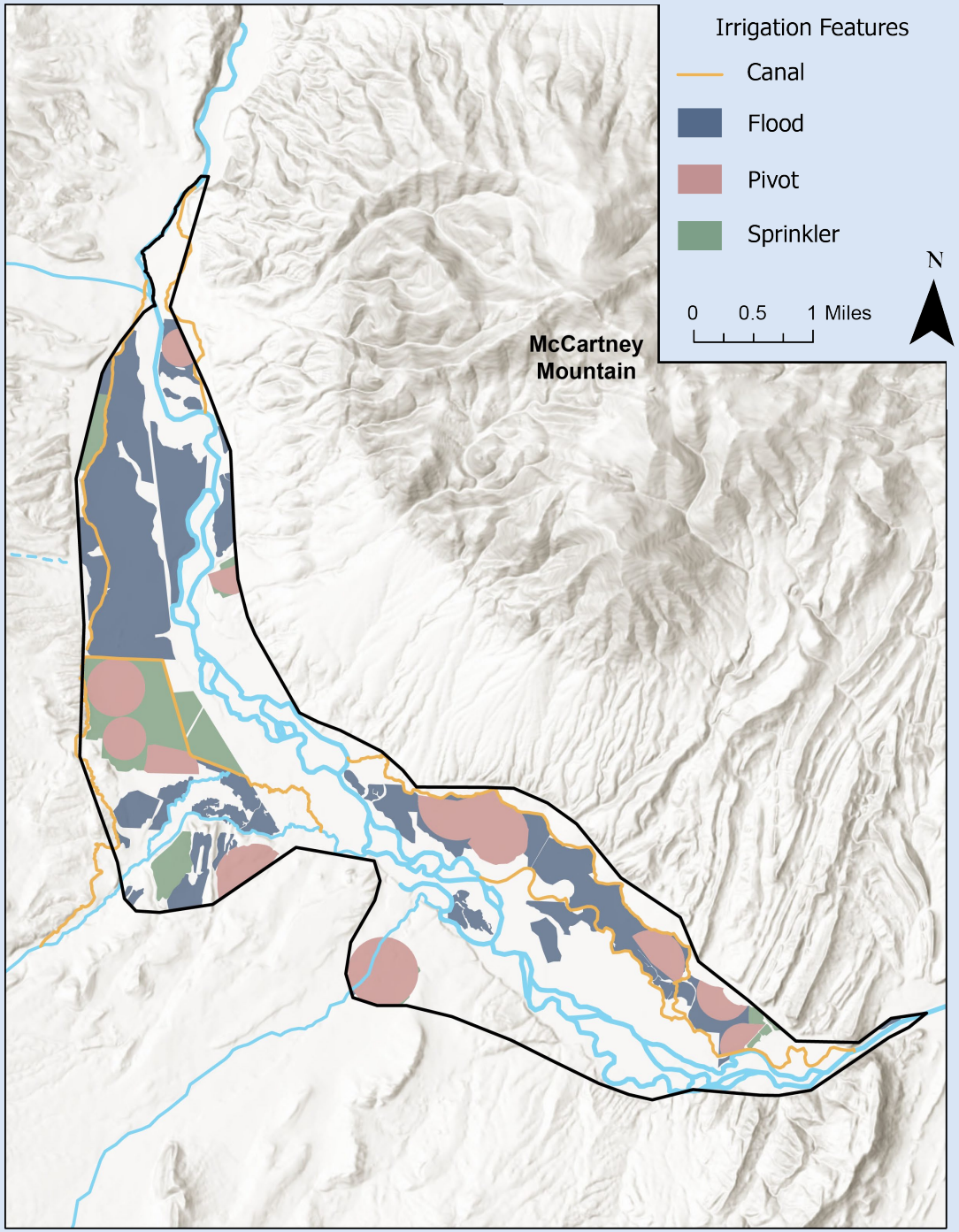

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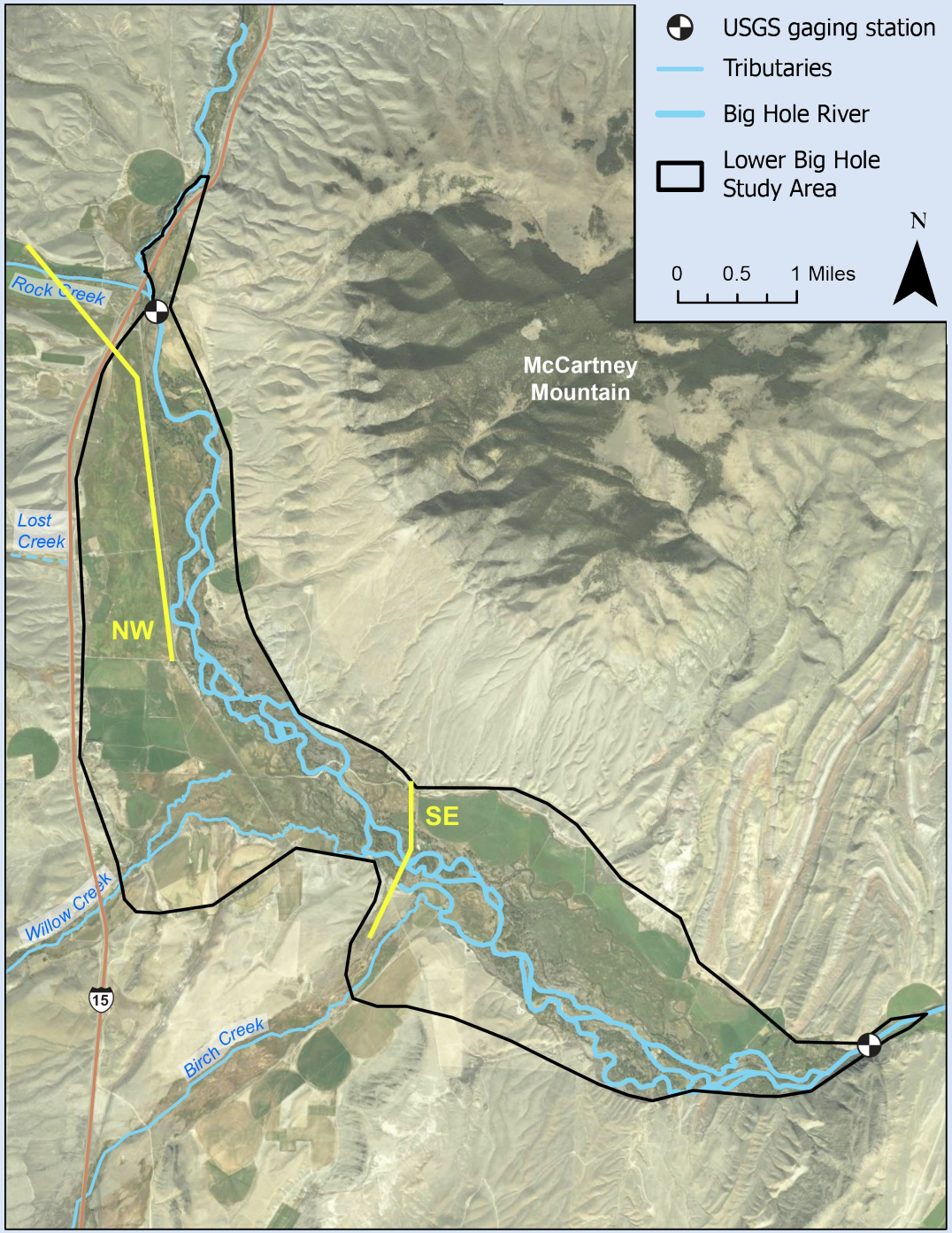

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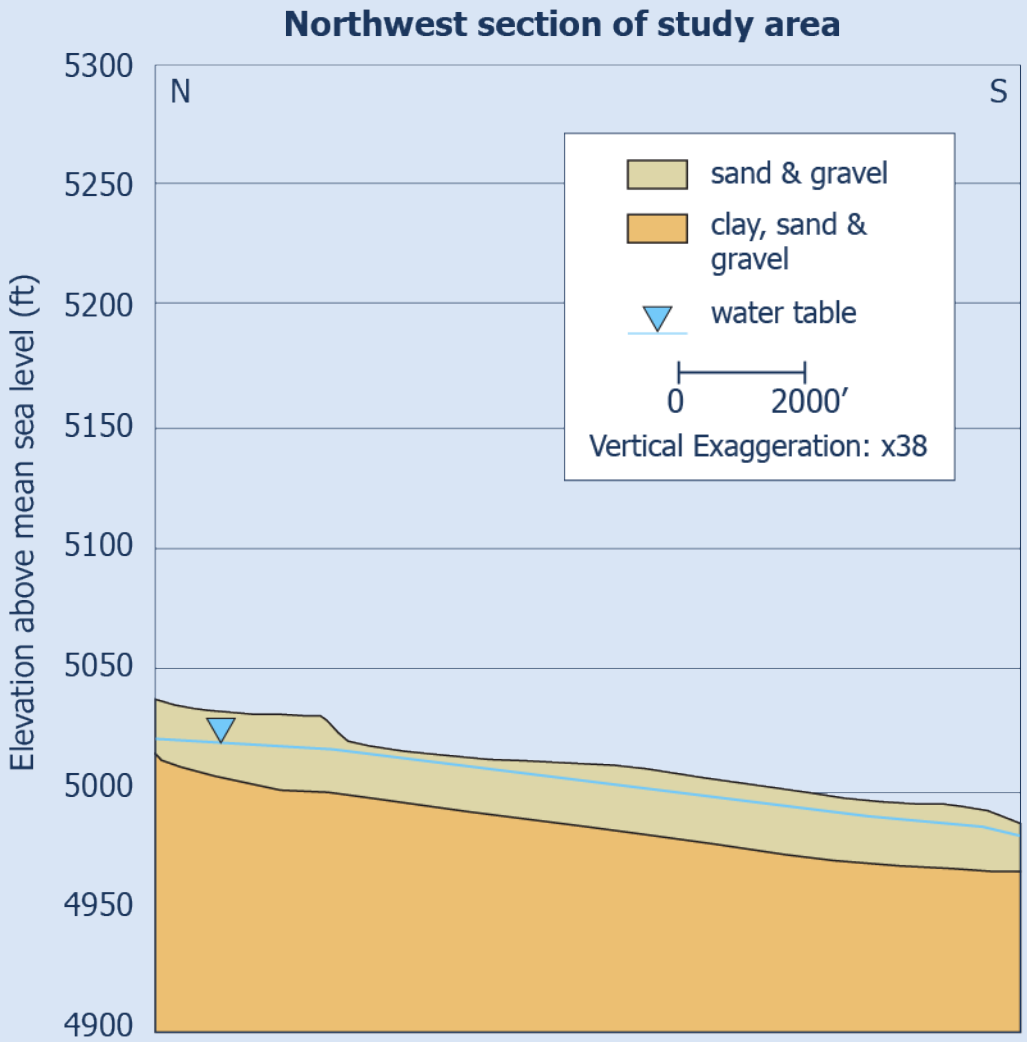
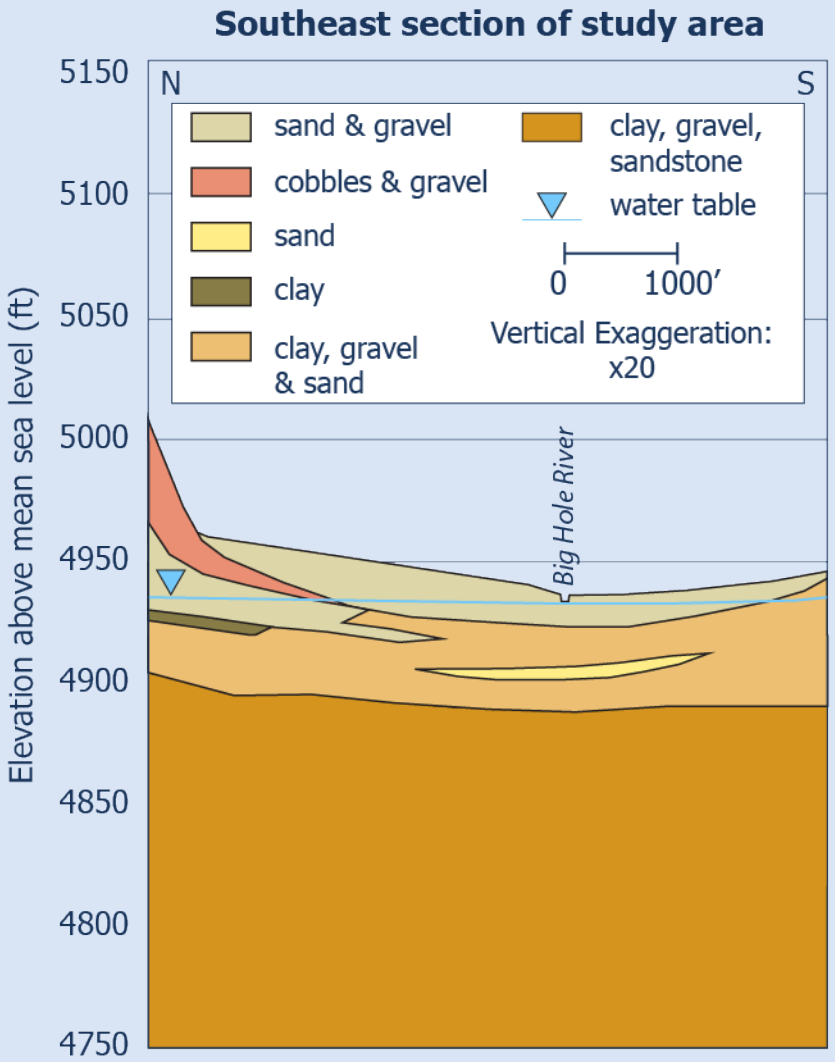
Lower Big Hole Geology





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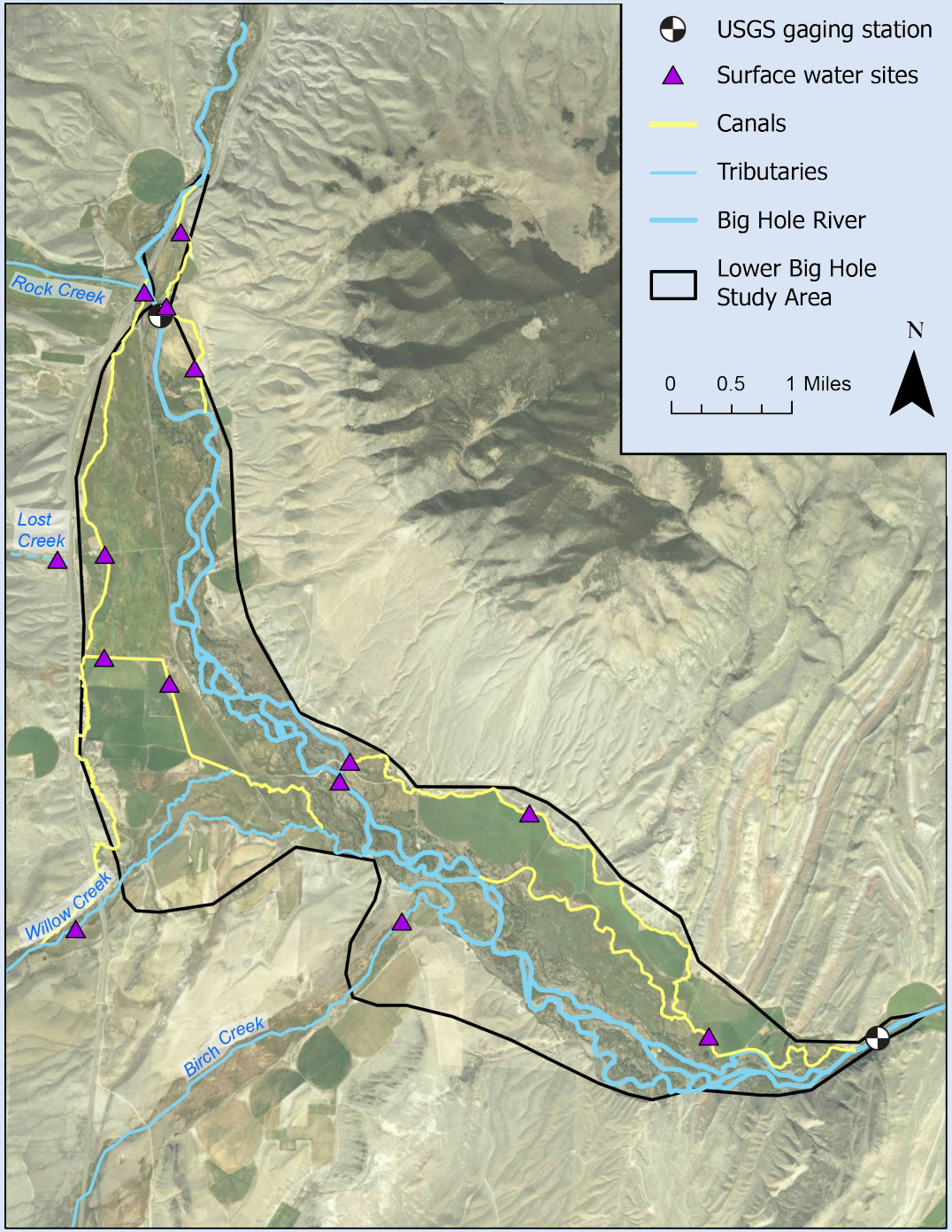
Adapted from Marvin & Voeller, 2000

Surface Water Monitoring

- Stage monitored at 16 sites
  - Staff gage installed at 14 sites
  - 2 USGS gage sites
- Discharge measurements
  - 3 river sites (2 USGS), 3 tributaries
  - Canal sites during synoptic runs
- Water quality sampling at 11 sites
  - Inorganic water chemistry (pre-, during and post-irrigation)
  - Monthly samples of stable water isotopes



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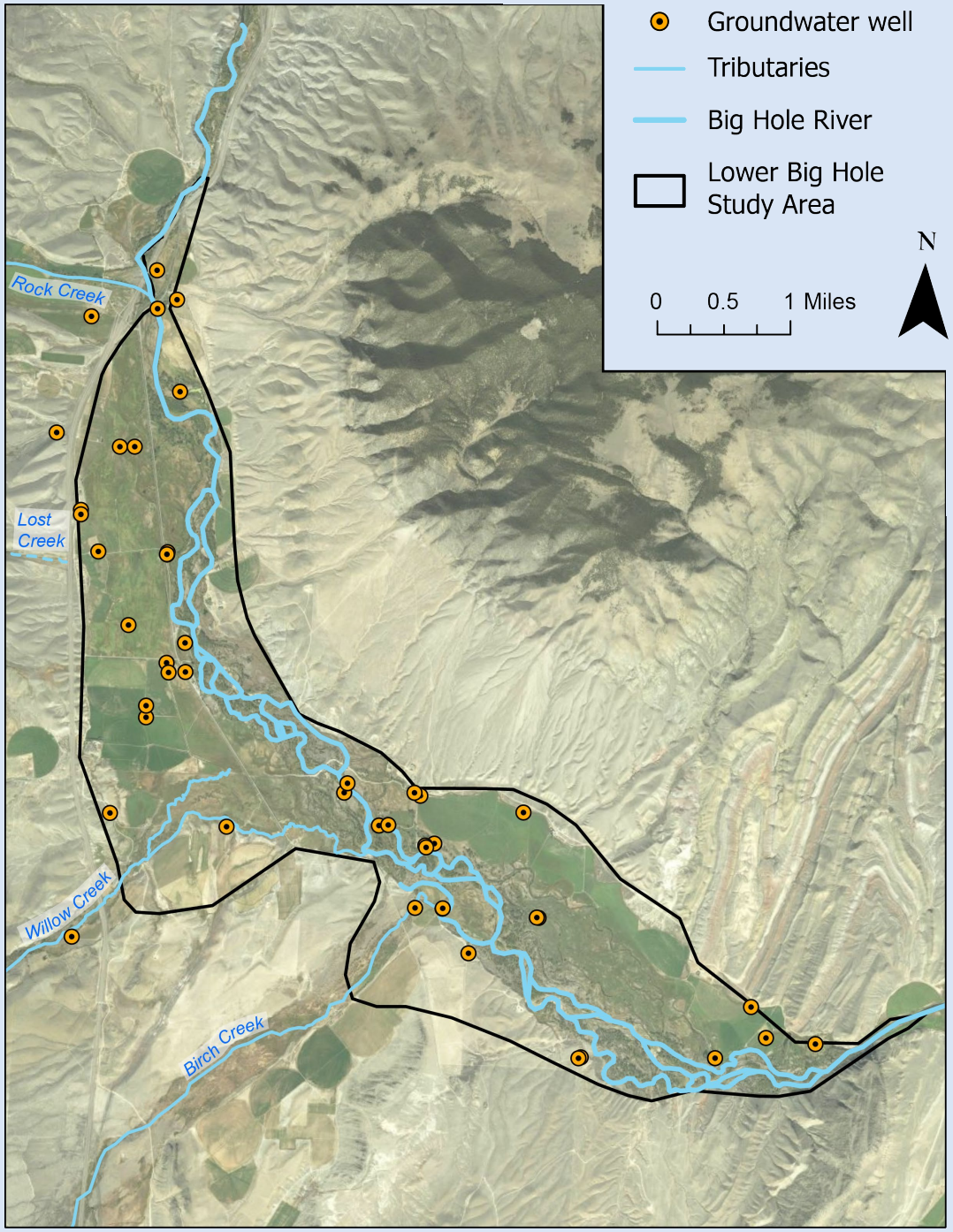
Groundwater Monitoring

- Water levels monitored at 47 wells
  - Monthly manual measurements
  - Hourly transducer data at 24 wells
- Water quality sampling at 16 wells
  - Inorganic water chemistry and stable water isotopes (pre-, during and post-irrigation)



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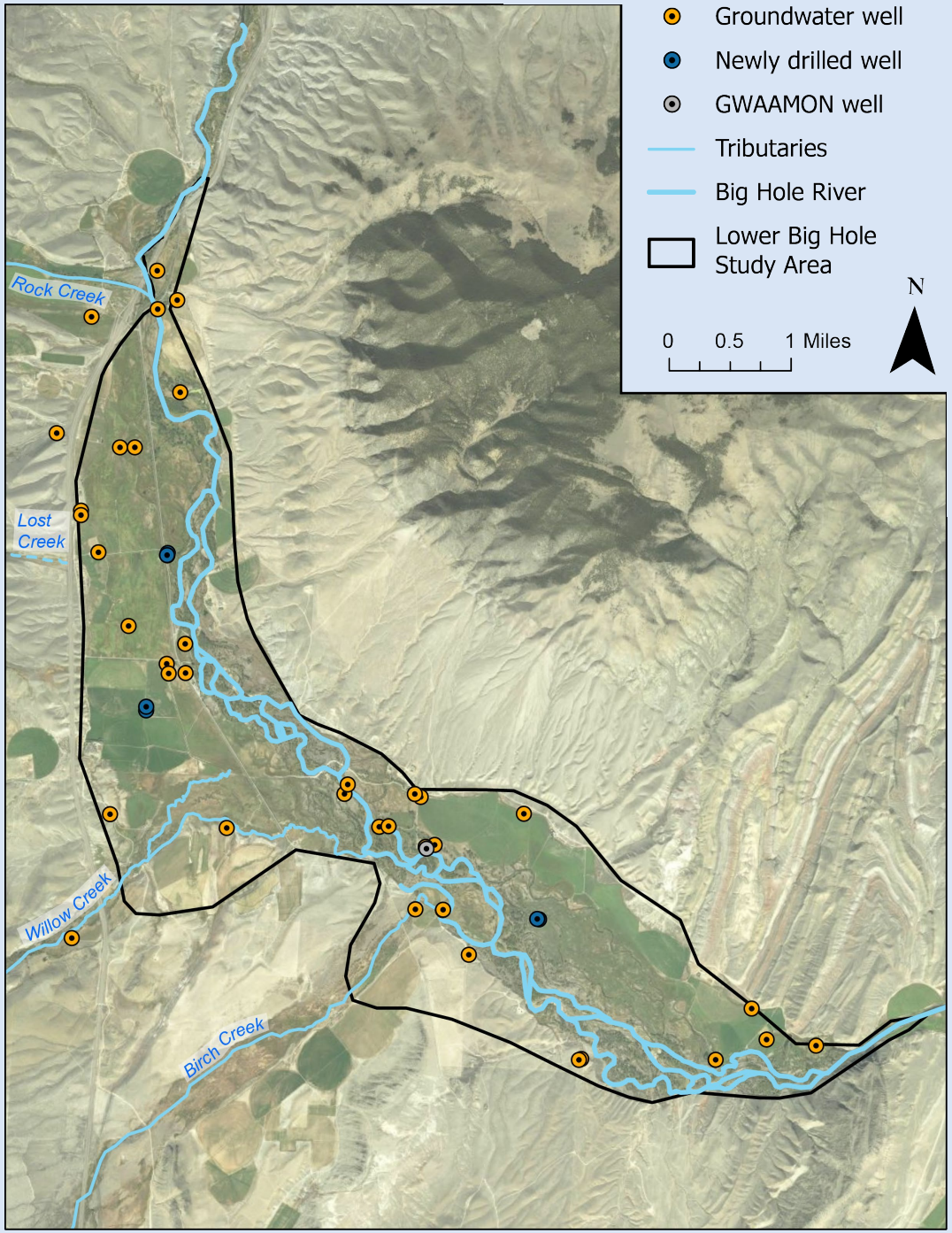
Drilled Wells

- 7 new wells drilled in June 2023

Goal:
Improve monitoring coverage and allow for aquifer testing



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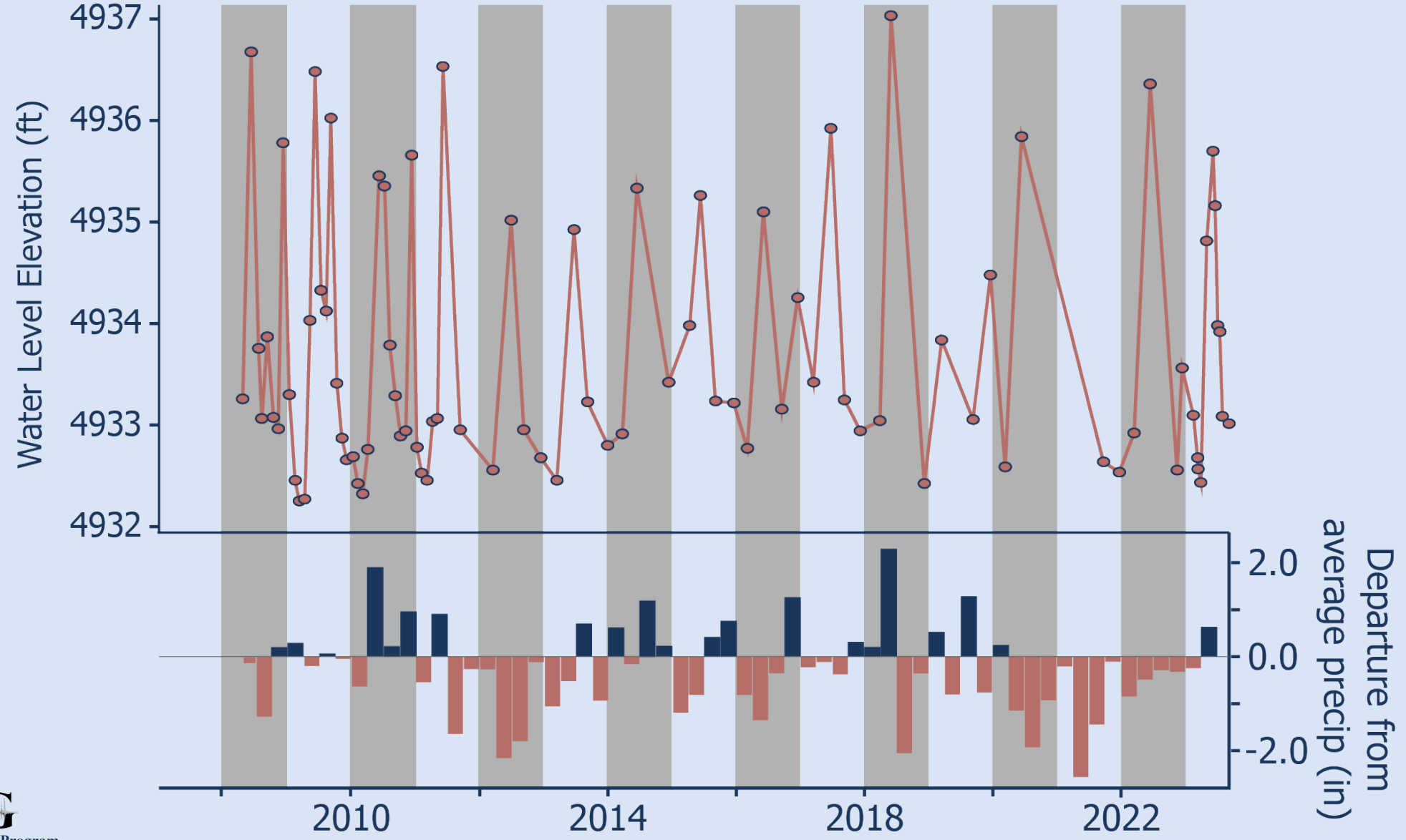
Groundwater Trends



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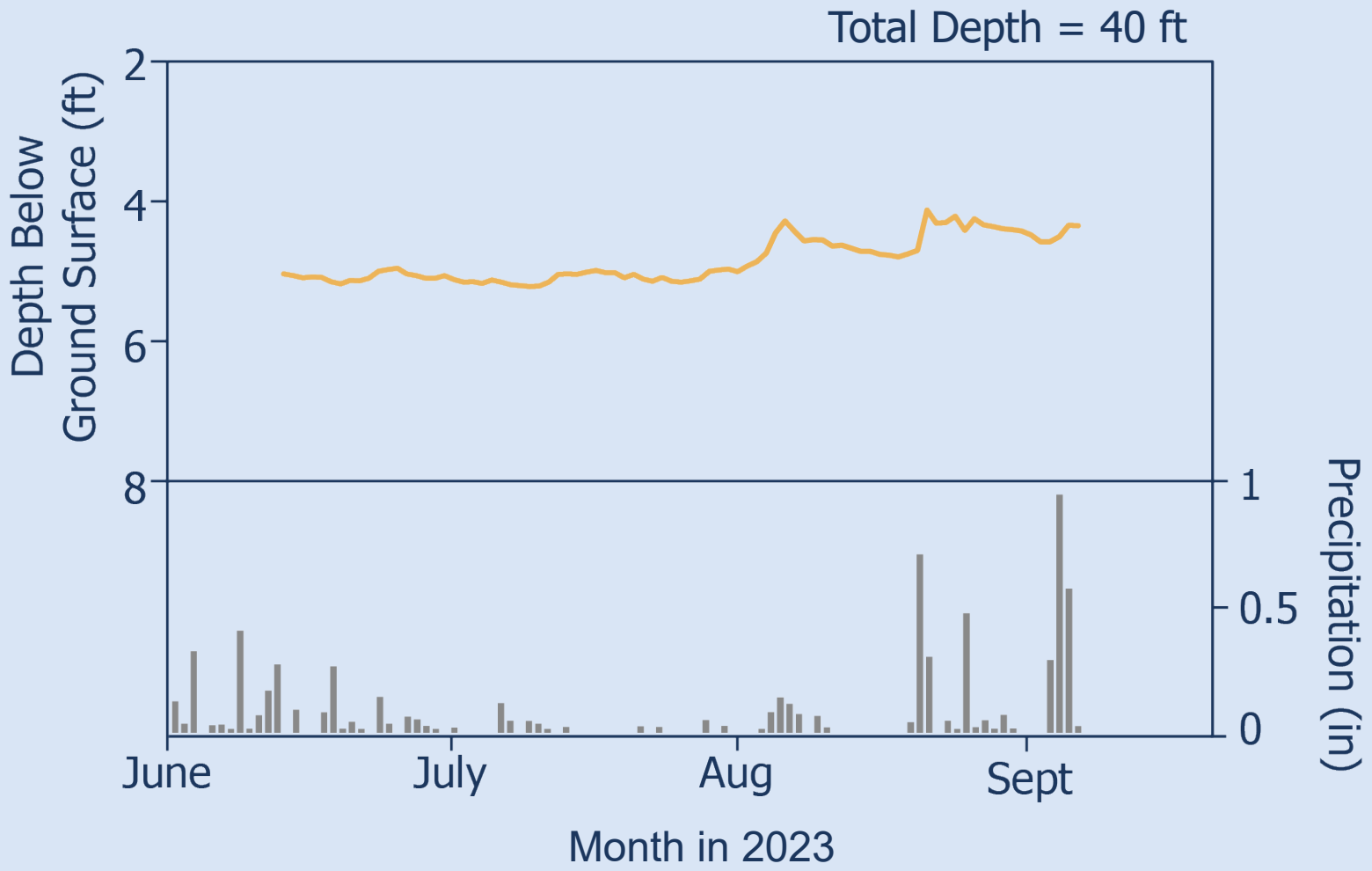
Preliminary Results

Not Directly Irrigated

- Very little variability
- Water level change ~1.2 ft

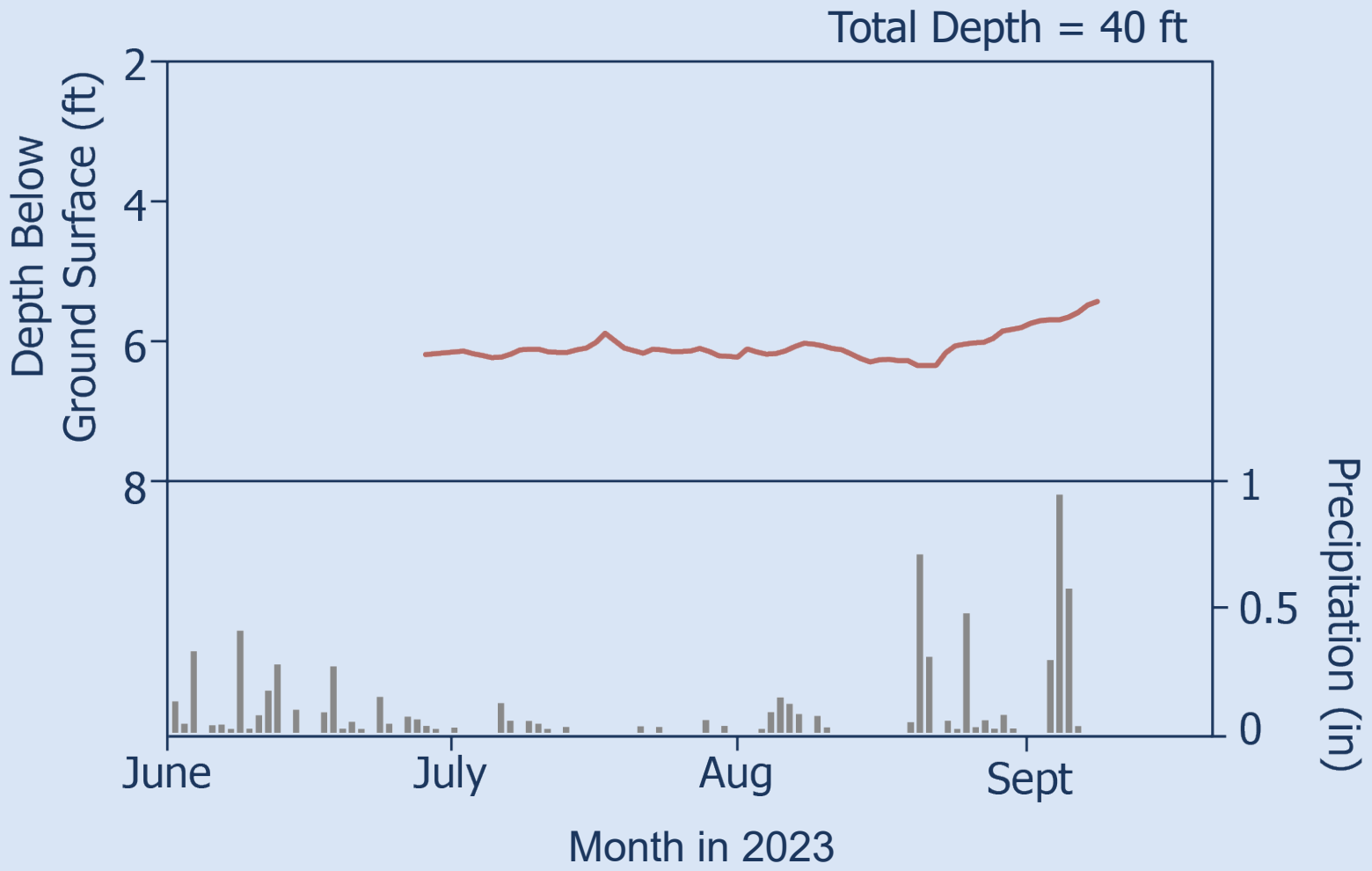
Minimal Groundwater Recharge



Pivot Irrigation

- Actively irrigated from May until present, but little variability
- Water level change ~0.9 ft

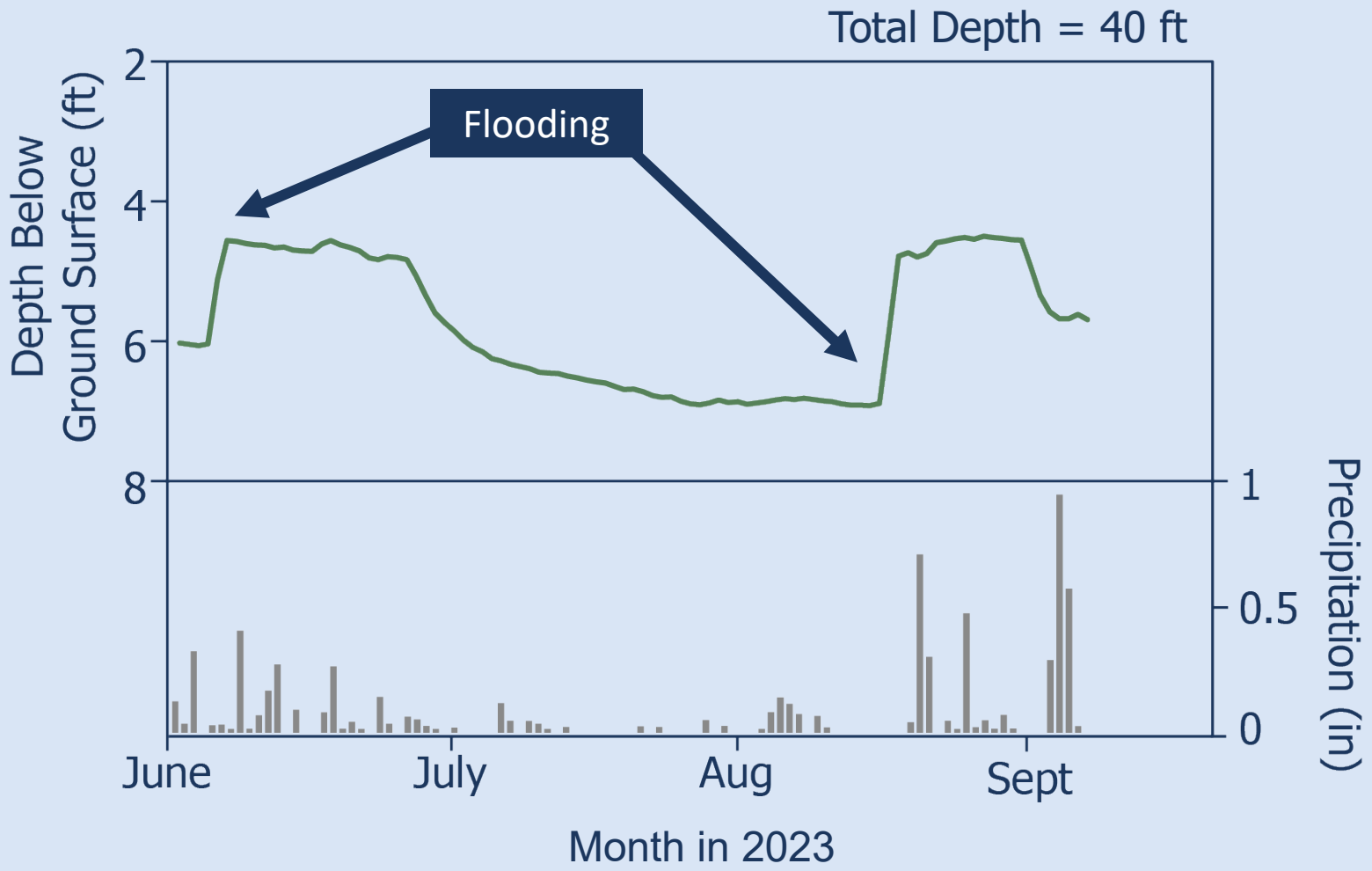
Minimal Groundwater Recharge



Flood Irrigation

- Large, sudden increases in water levels correlate with flood pulses
- Water level change ~2.4 ft

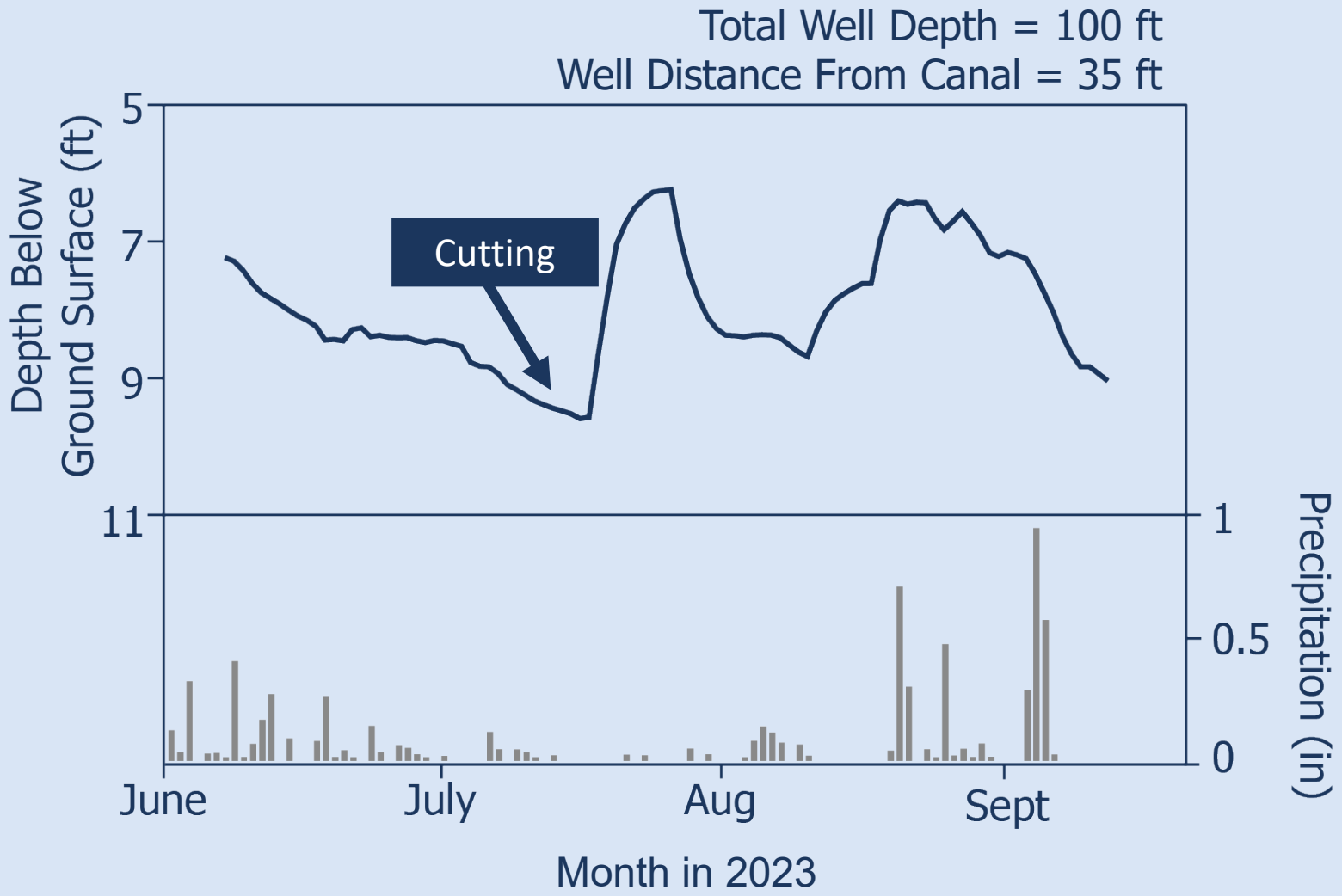
Noticeable Groundwater Recharge



Canal Leakage

- Water level change ~3.3 ft

Noticeable Groundwater Recharge



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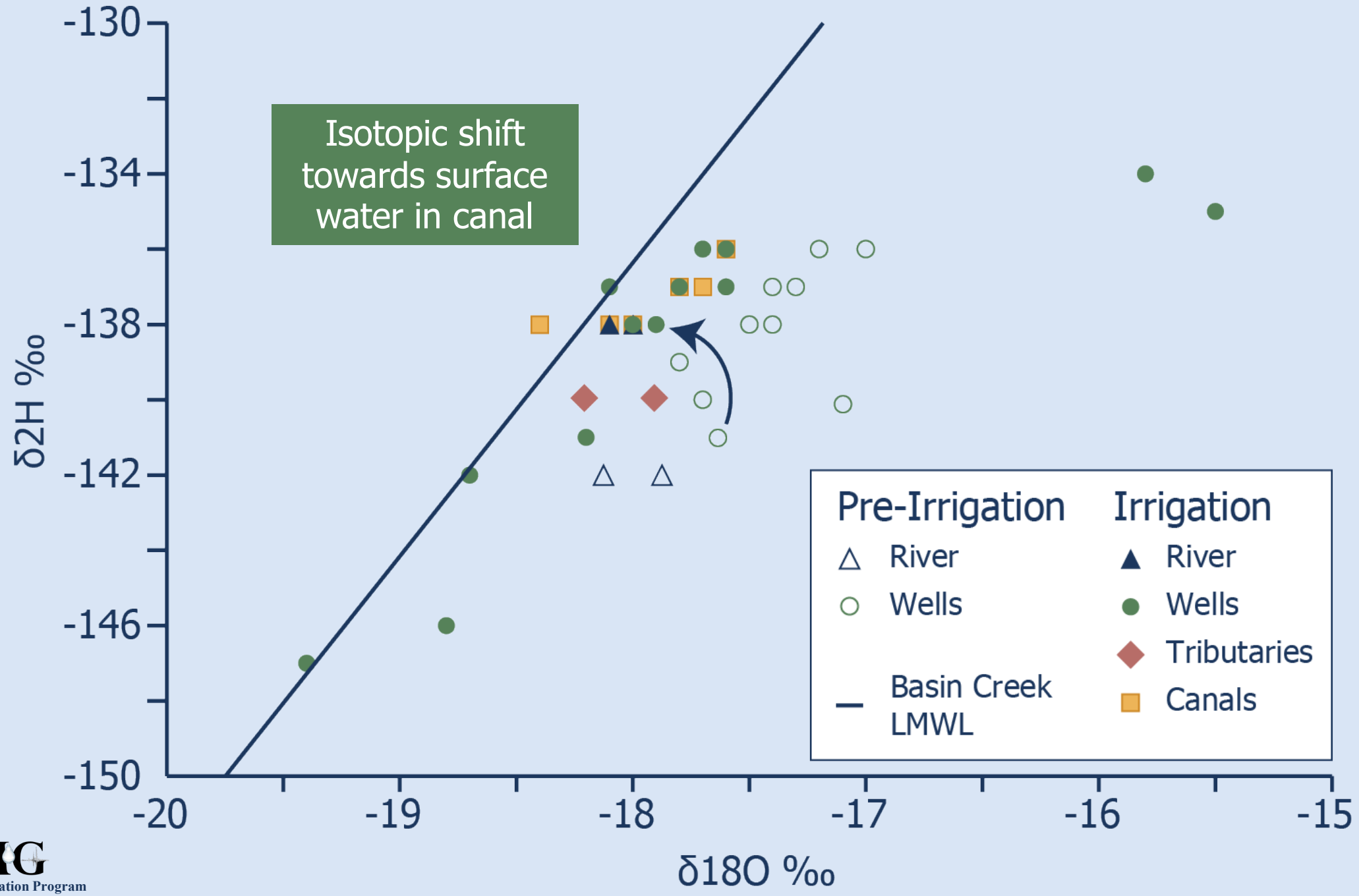

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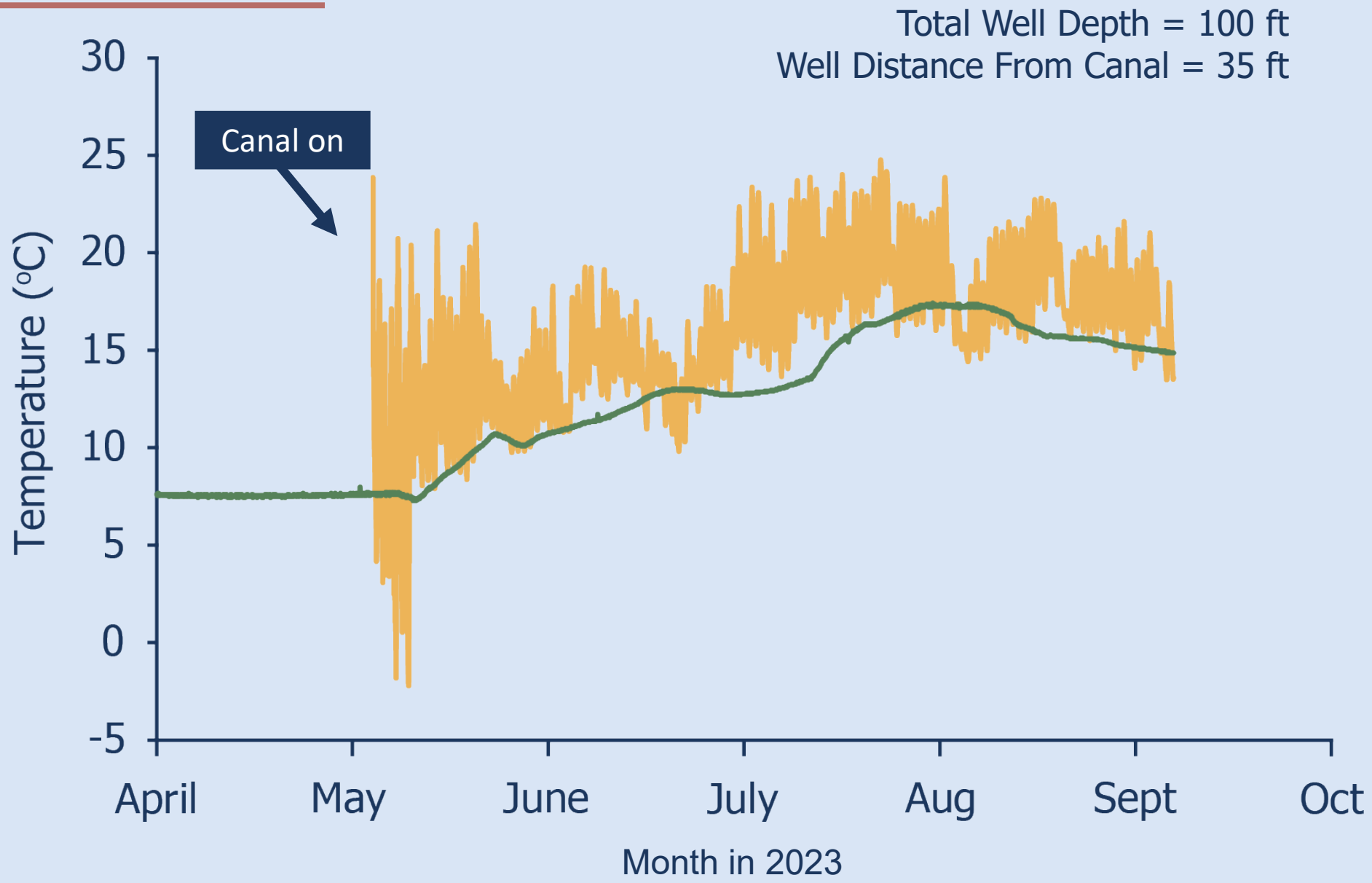
Canal Leakage



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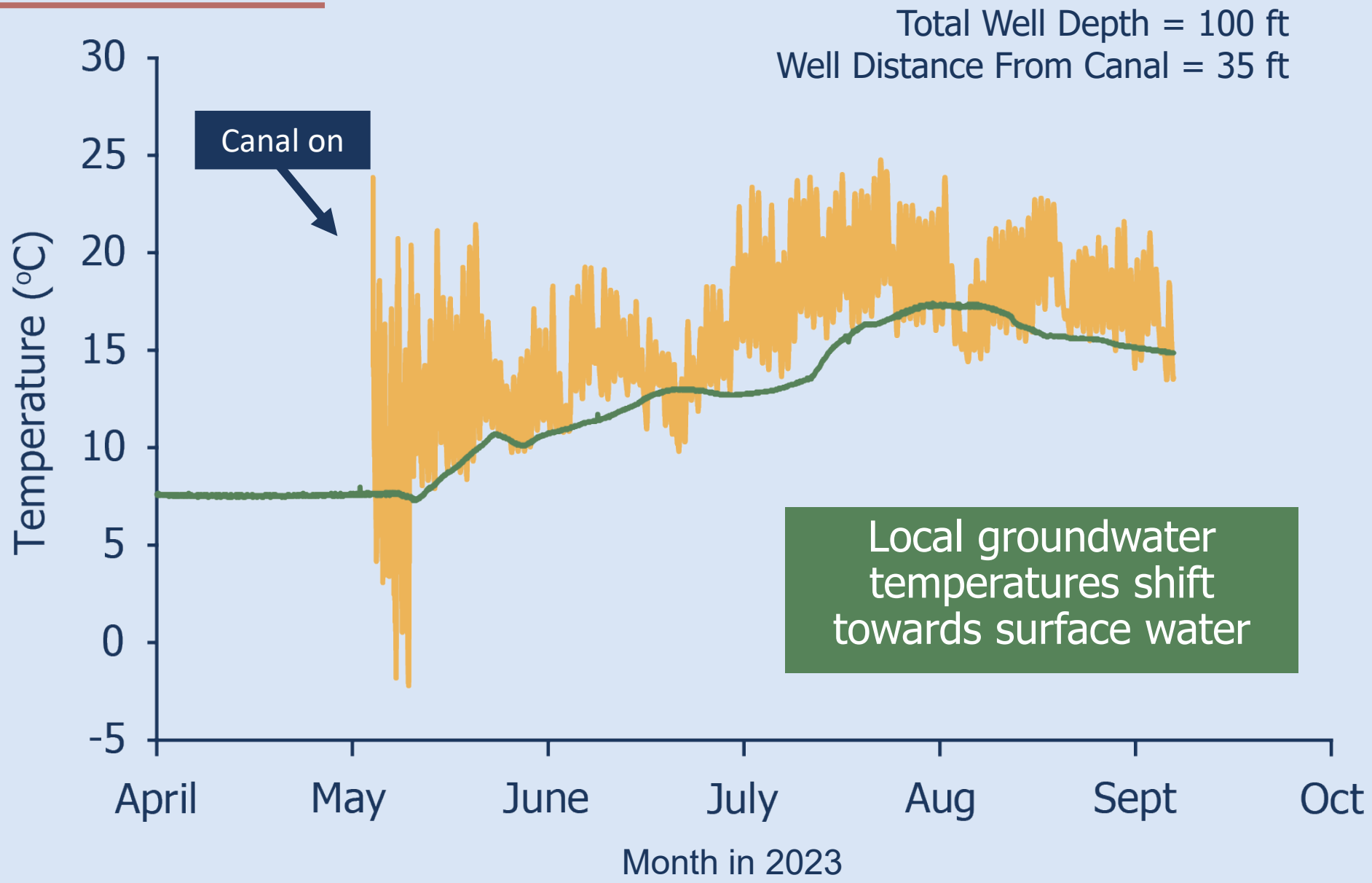
Canal Leakage



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Summary

- Irrigation type influences the amount of groundwater recharge
  - Flood irrigation and canal leakage provide more pronounced increases in groundwater levels
  - Limited variations were observed in water levels near pivots
- Using surface water for irrigation source causes local shifts in groundwater parameters towards surface water
  - Isotopes
  - Temperature

Future Plans

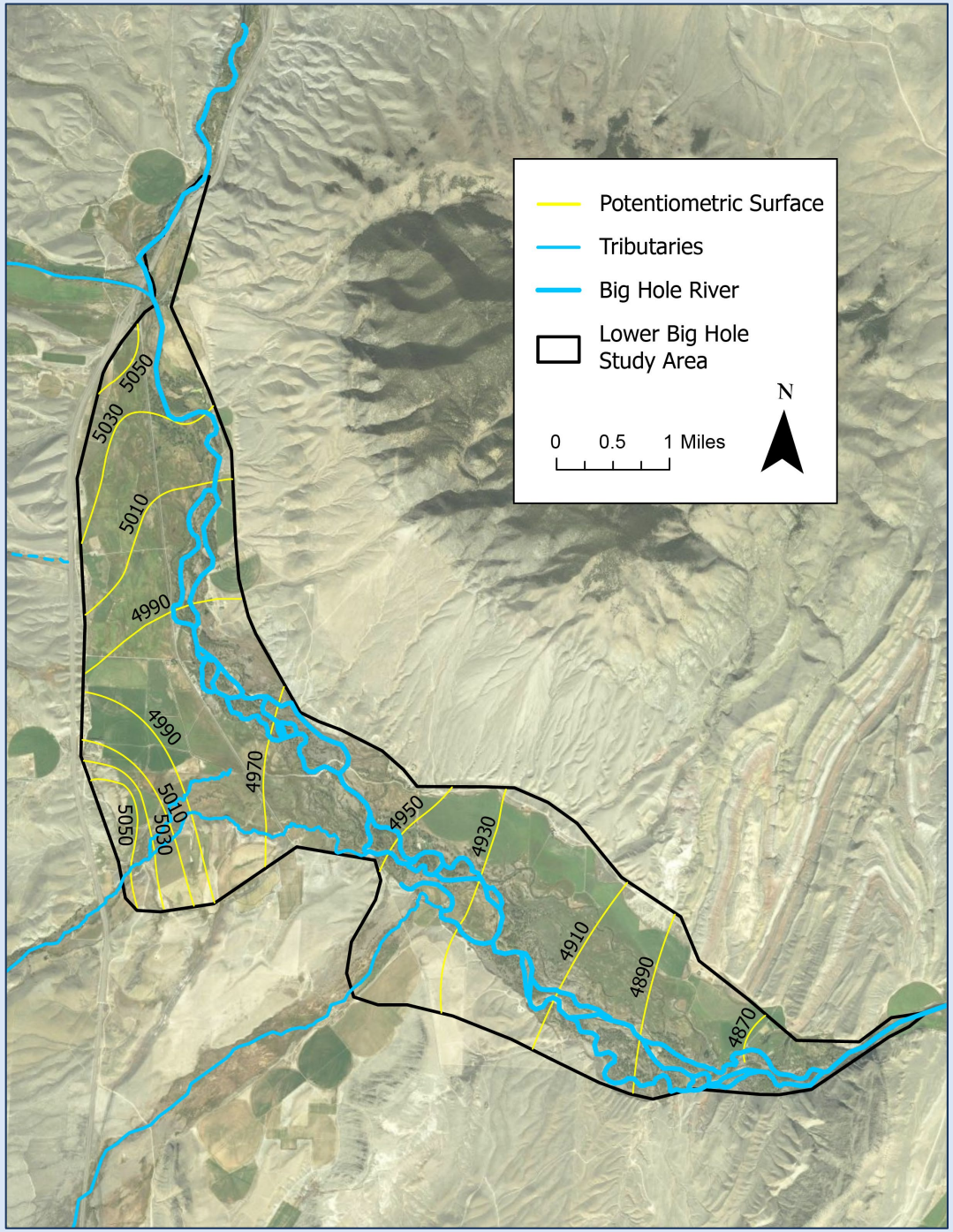
- Continue data collection through 2024 irrigation season
  - Synoptic surface water measurements
- Aquifer Tests
  - Determine aquifer properties
- Develop groundwater flow model to run predictive scenarios

Questions?

jdohman@mtech.edu

Big Hole Study Area

- Groundwater flows N to SE
- Input from Willow Creek



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