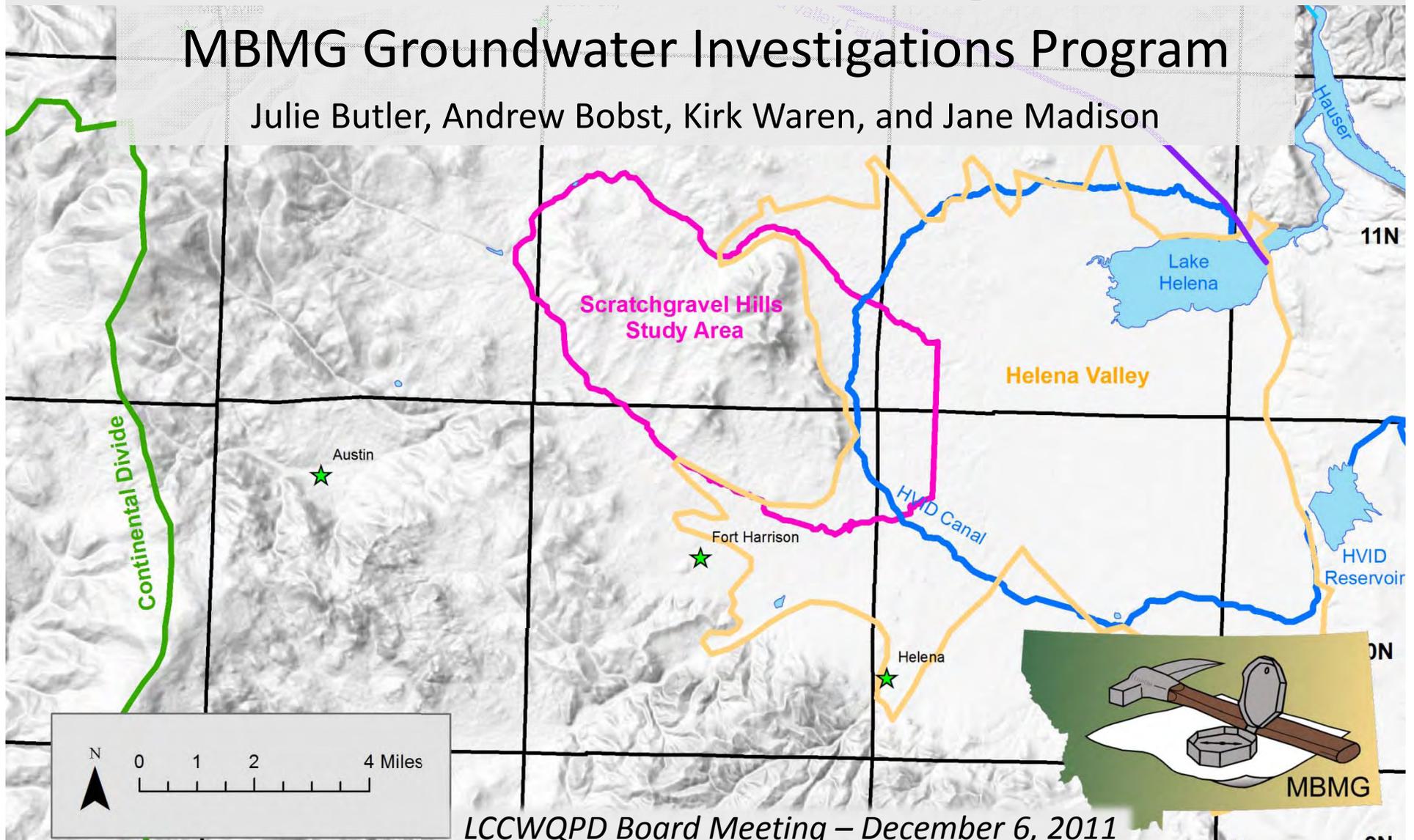


Scratchgravel Hills Groundwater Investigation

MBMG Groundwater Investigations Program

Julie Butler, Andrew Bobst, Kirk Waren, and Jane Madison



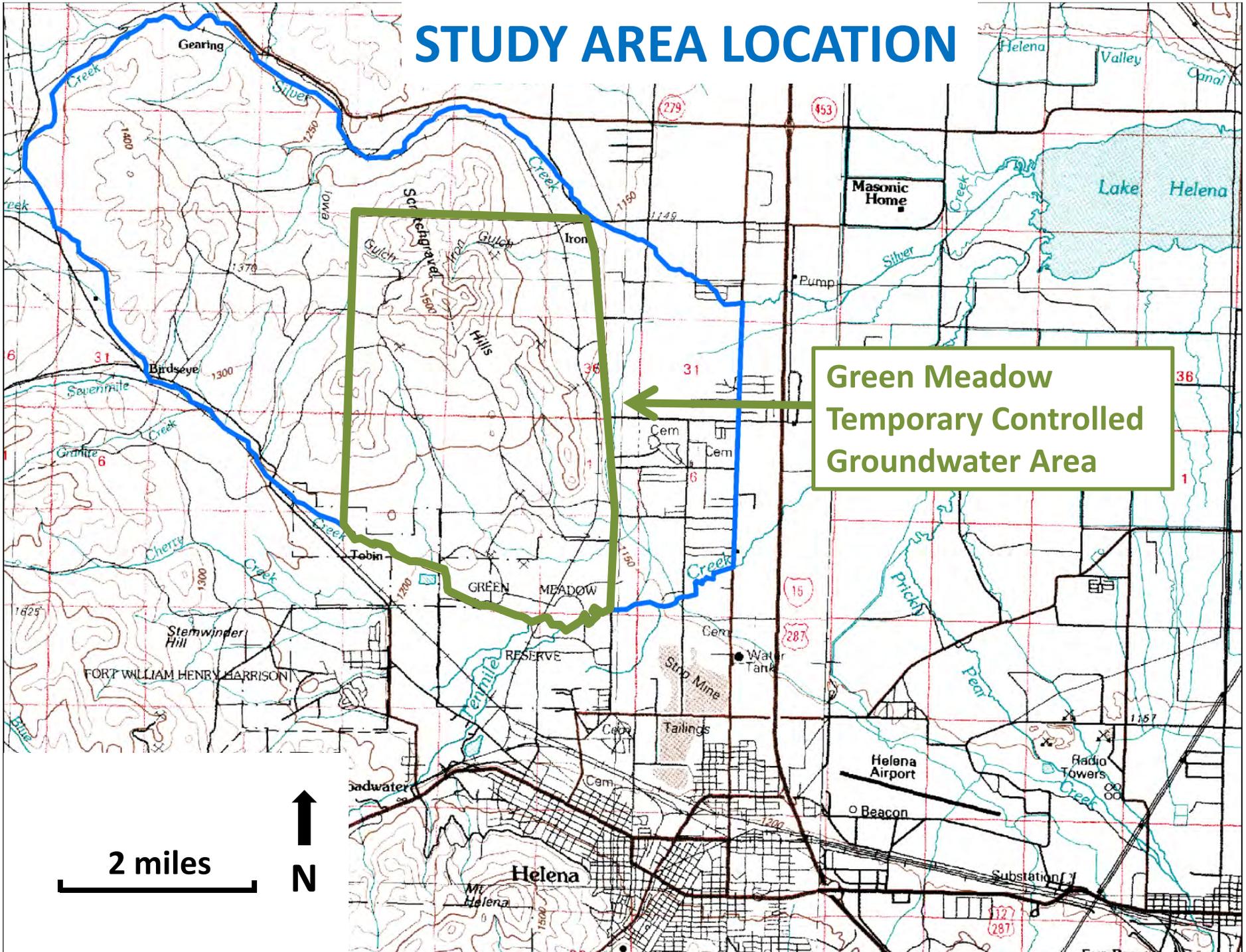
LCCWQPD Board Meeting – December 6, 2011

OUTLINE



- **Study Area Description**
- **Problem Statement**
- **Field Results**
 - **Groundwater Monitoring**
 - **Aquifer Tests**
 - **Water Quality Sampling**
- **Groundwater Modeling**
- **Summary & Recommendations**

STUDY AREA LOCATION



Problem Statement

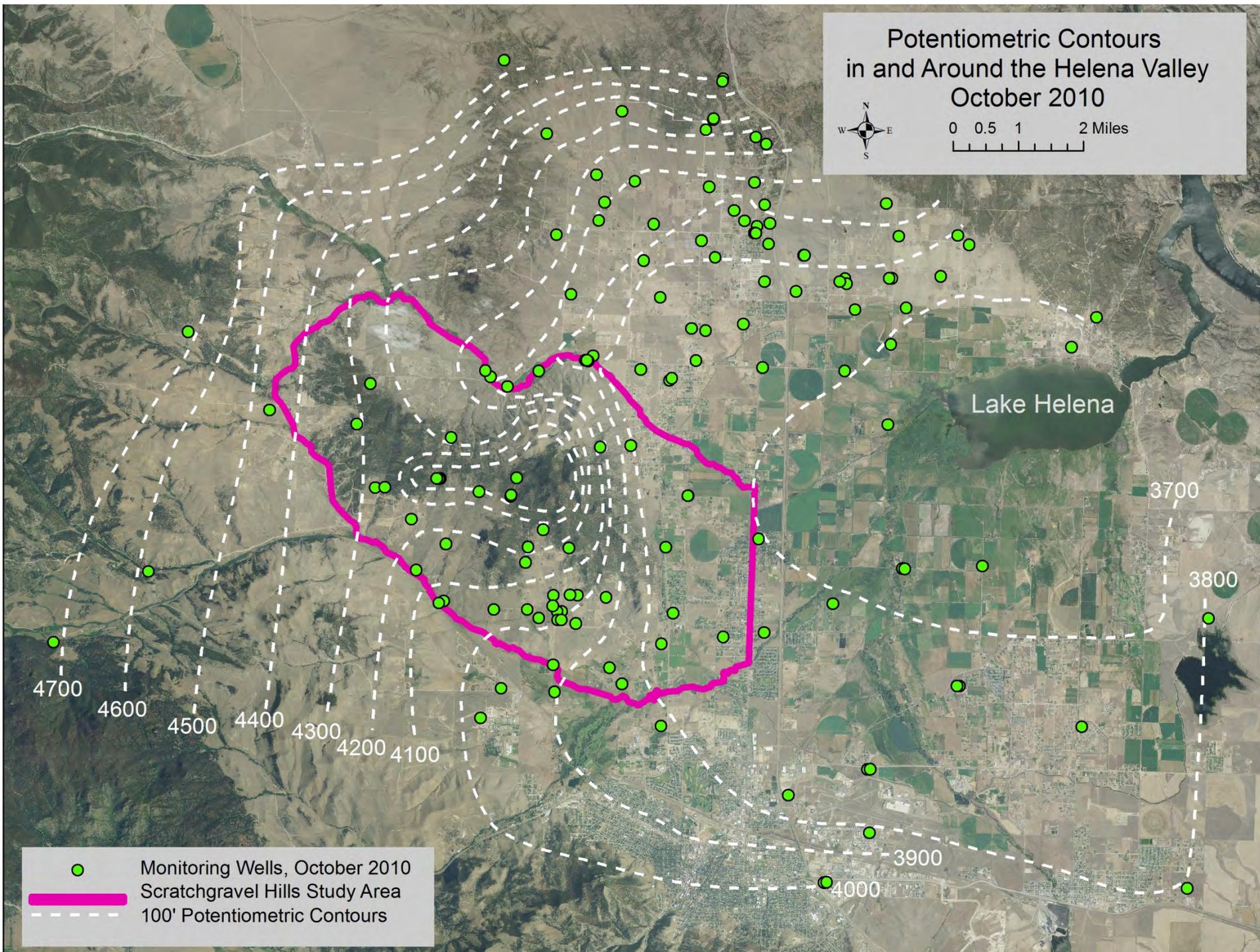


- Increased subdivisions
 - Concerns regarding the amount of water available
- Some high nitrate levels
 - Concerns regarding the use of septic systems
- In 2008 DNRC designated the *Green Meadow Temporary Controlled Groundwater Area* (CGWA)
- MBMG was tasked with evaluating groundwater availability and quality in the Scratchgravel Hills
 - Baseline understanding of the hydrogeologic system
 - Conceptual model
 - Groundwater flow model

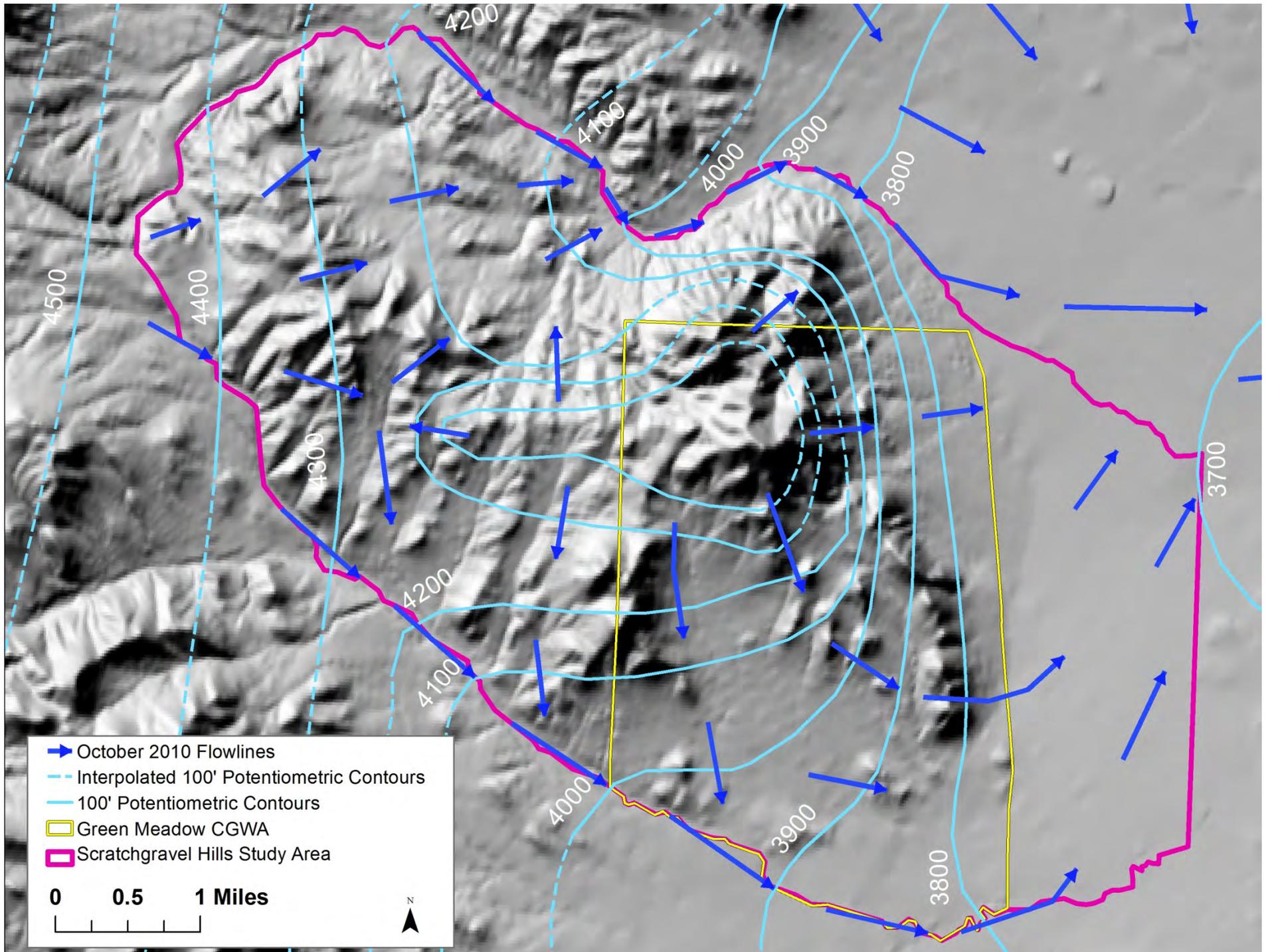
Potentiometric Contours in and Around the Helena Valley October 2010

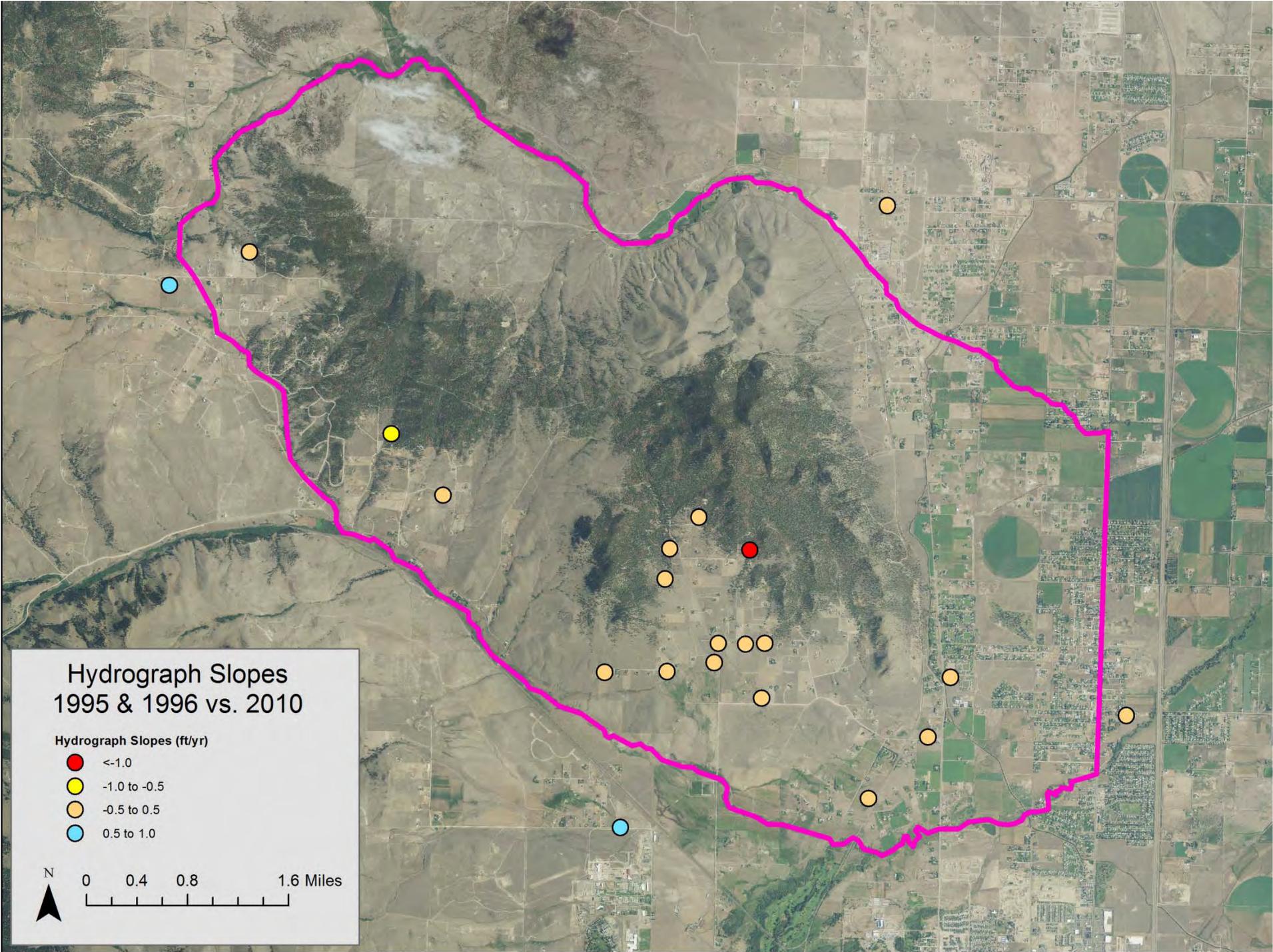


0 0.5 1 2 Miles
Scale bar showing distances in miles.



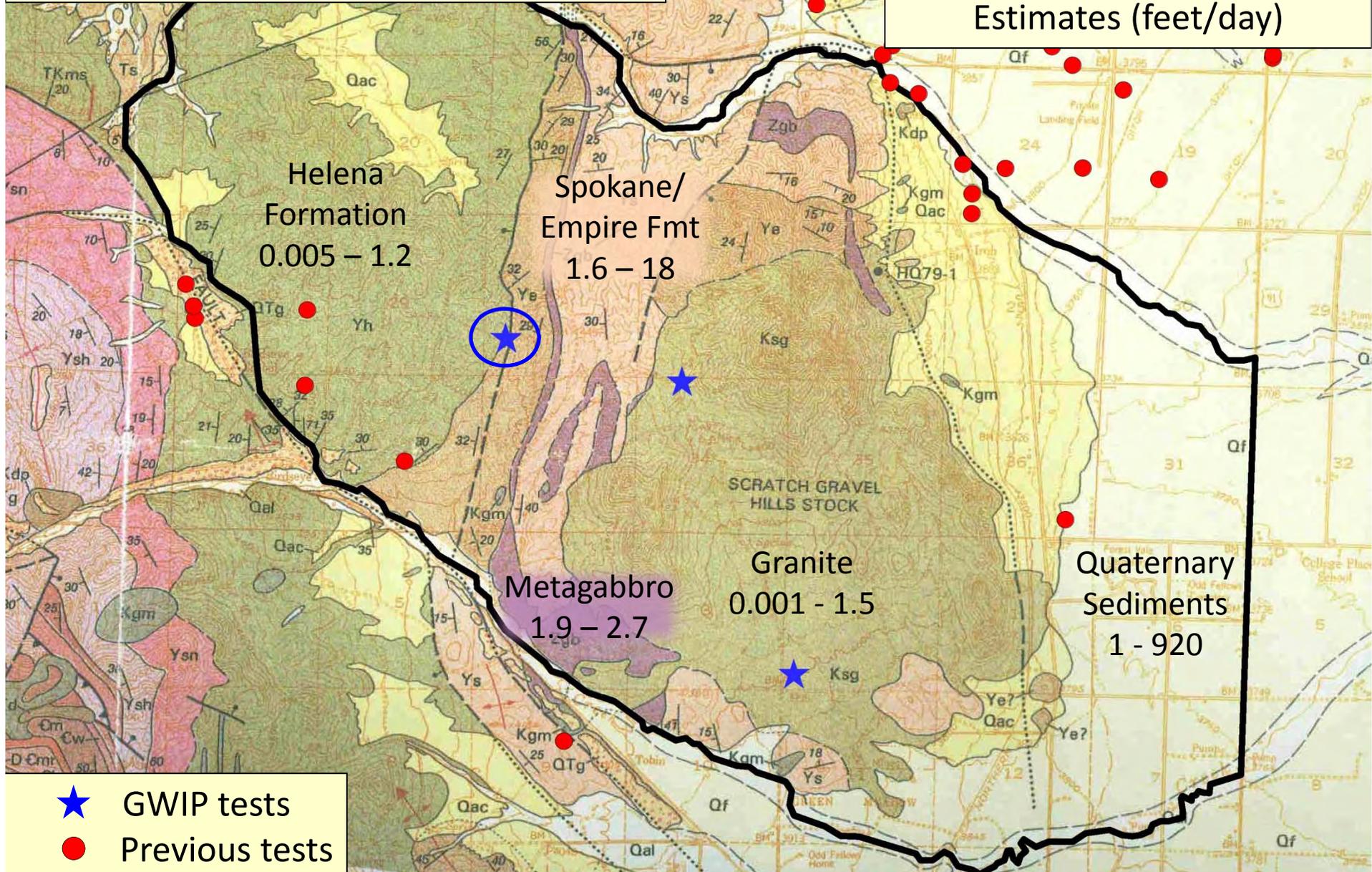
- Monitoring Wells, October 2010
- █ Scratchgravel Hills Study Area
- - - 100' Potentiometric Contours

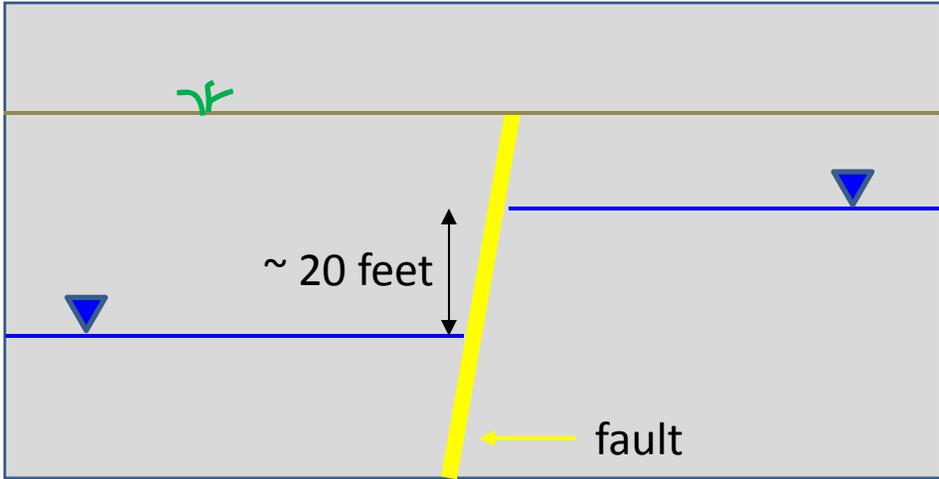




Well productivity is highly dependent on the local fracture distribution

Aquifer Test Locations And Hydraulic Conductivity (K) Estimates (feet/day)

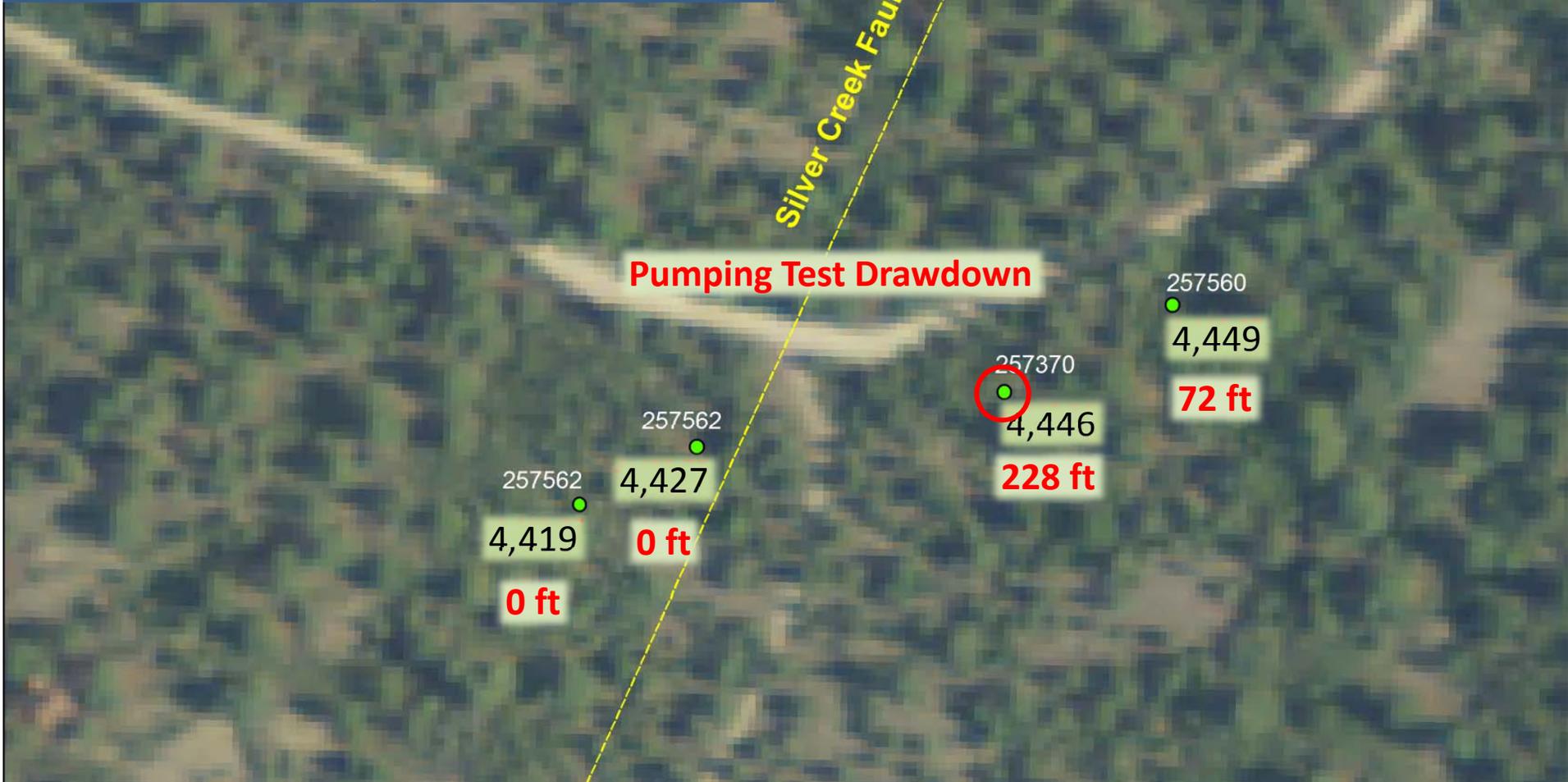




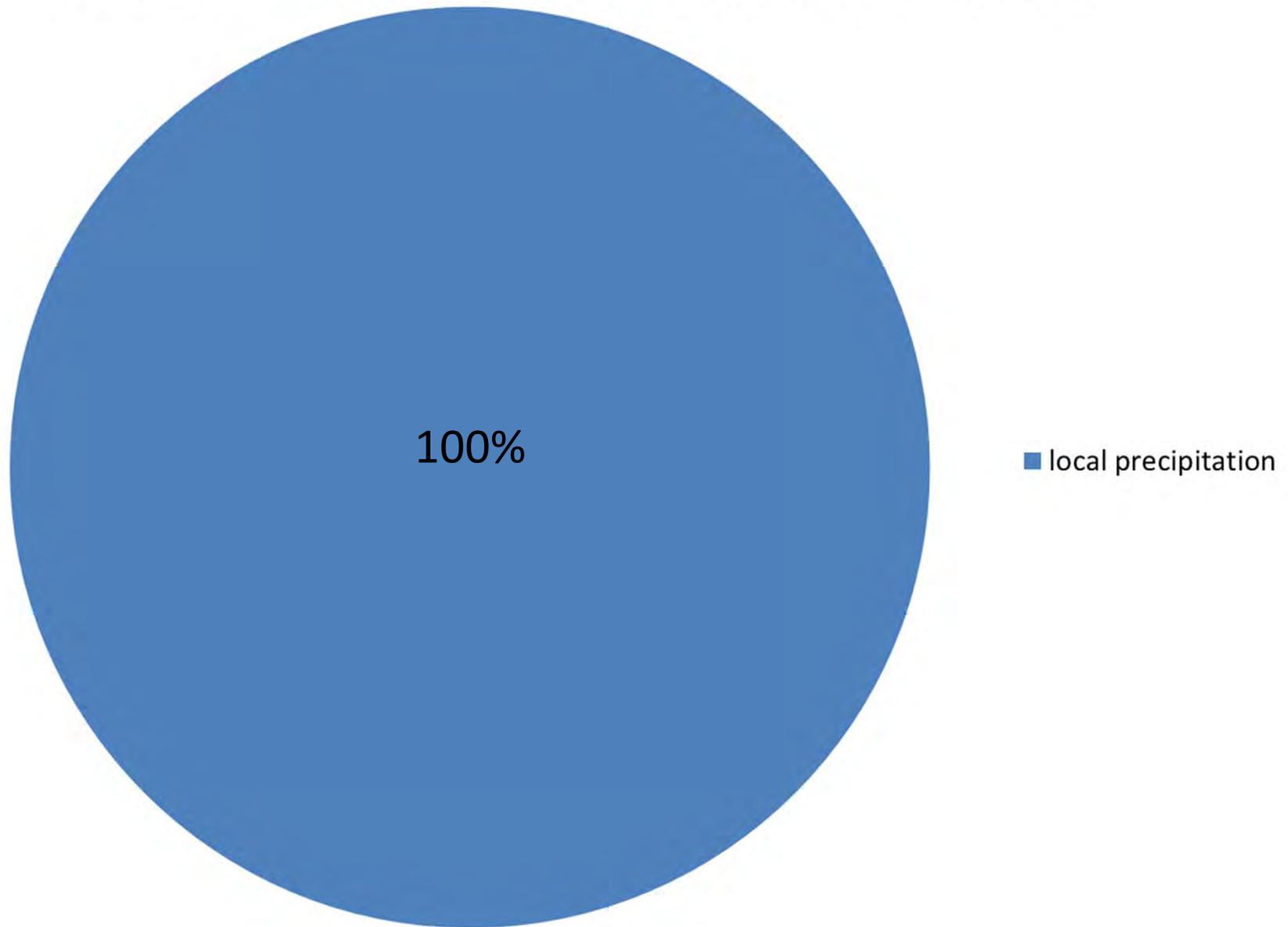
Silver Creek Fault Site Layout and Groundwater Elevations (11/9/10)

N

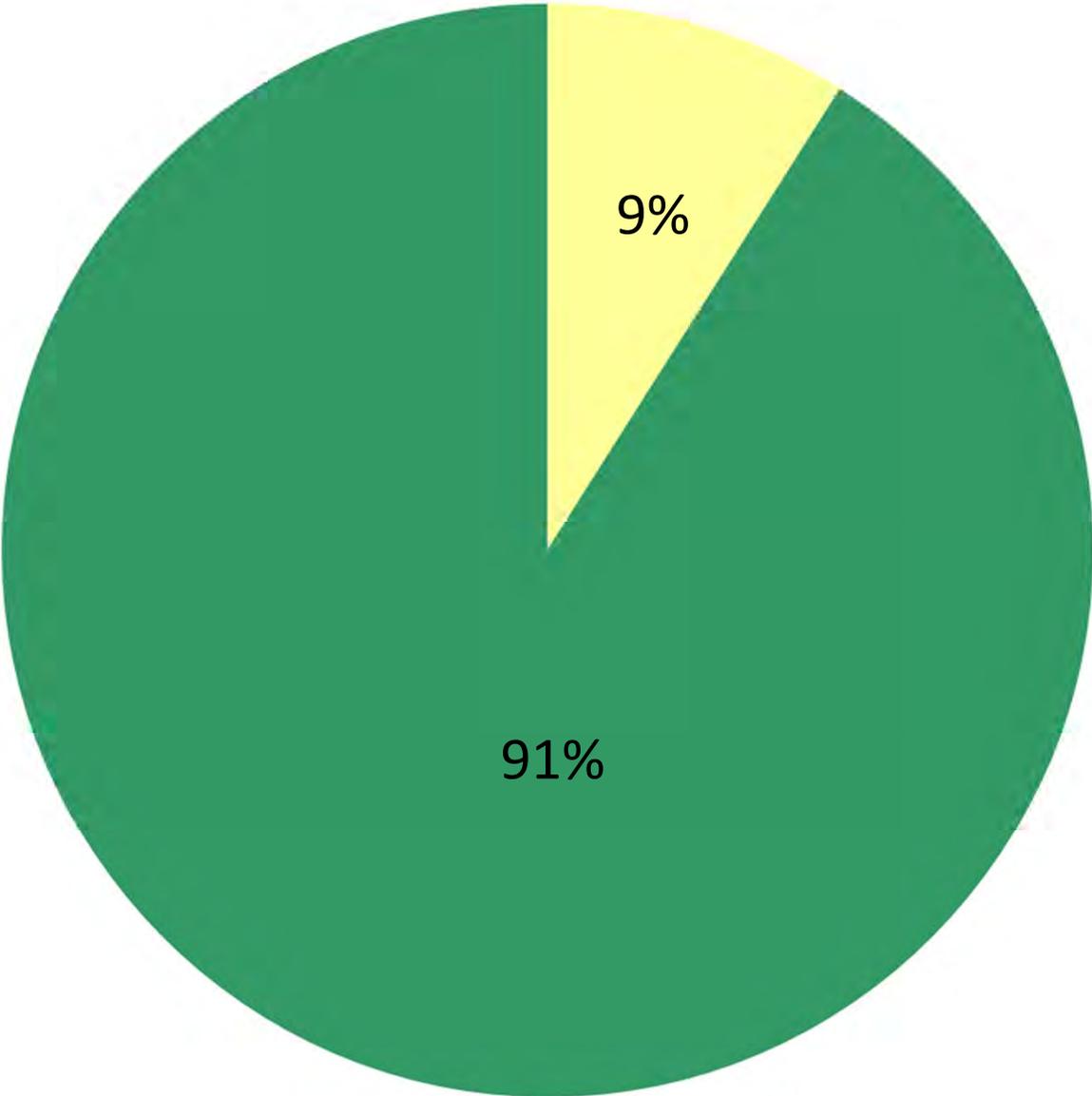
0 30 60 120 Feet



BEDROCK AQUIFER (GREEN MEADOW CGWA) RECHARGE SOURCES



STUDY AREA DISCHARGE SOURCES



well withdrawals

groundwater outflow to Helena Valley Aquifer

Water Quality Sampling

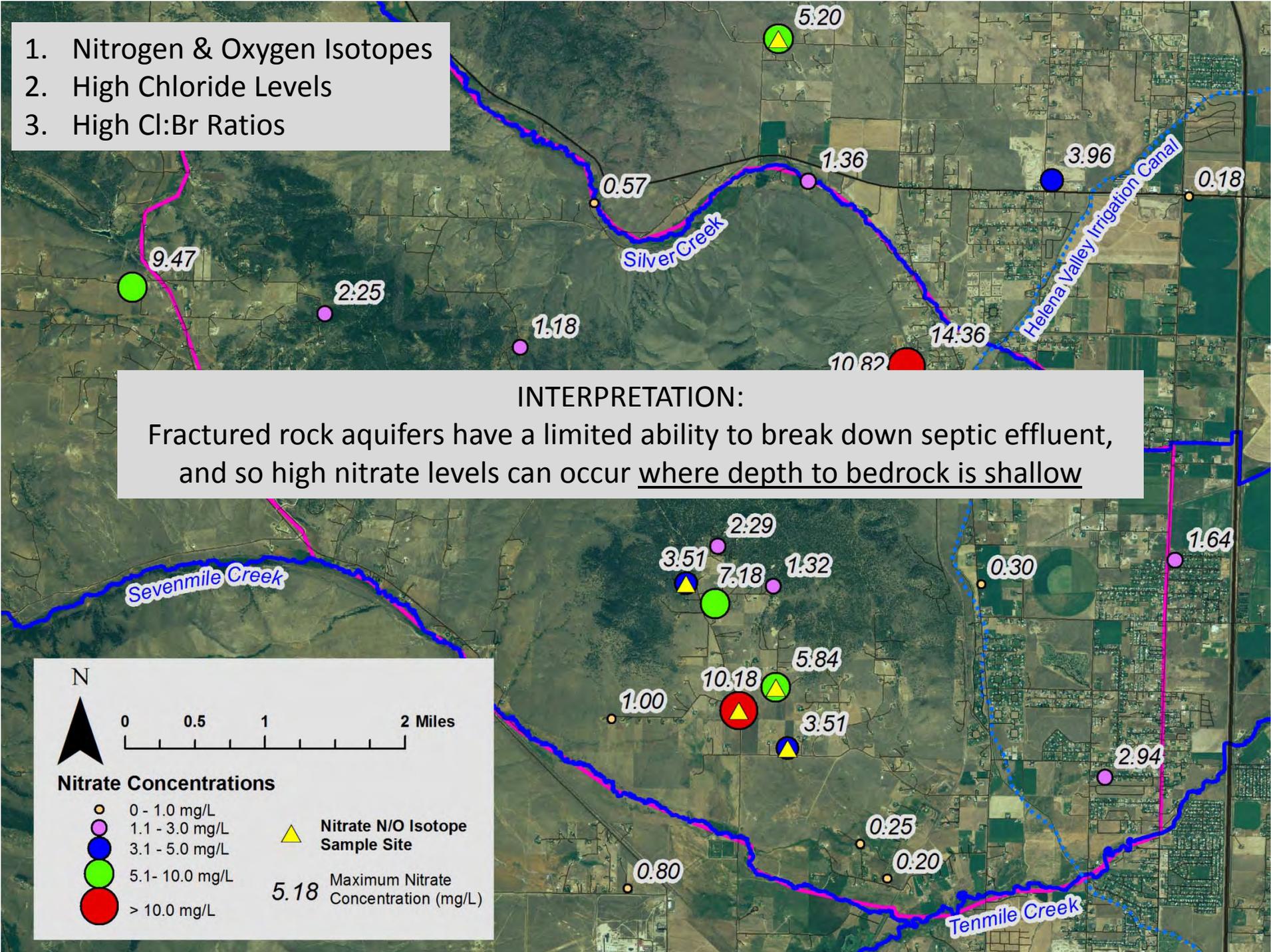


- **3 Events in 2010: April, August, October**
- **Sampled for:**
 - ✦ Major Ions
 - ✦ Nutrients (N & O isotopes for high nitrate samples (>3 mg/L))
 - ✦ Metals
 - ✦ Radon
 - ✦ Sulfate Isotopes
 - ✦ H & O stable Isotopes
 - ✦ Endocrine Disrupters
- **Exceedance of drinking water standards**
 - ✦ N, U, As, Mn
- **Exceedance of aquatic life standard**
 - ✦ N, As, Sr

1. Nitrogen & Oxygen Isotopes
2. High Chloride Levels
3. High Cl:Br Ratios

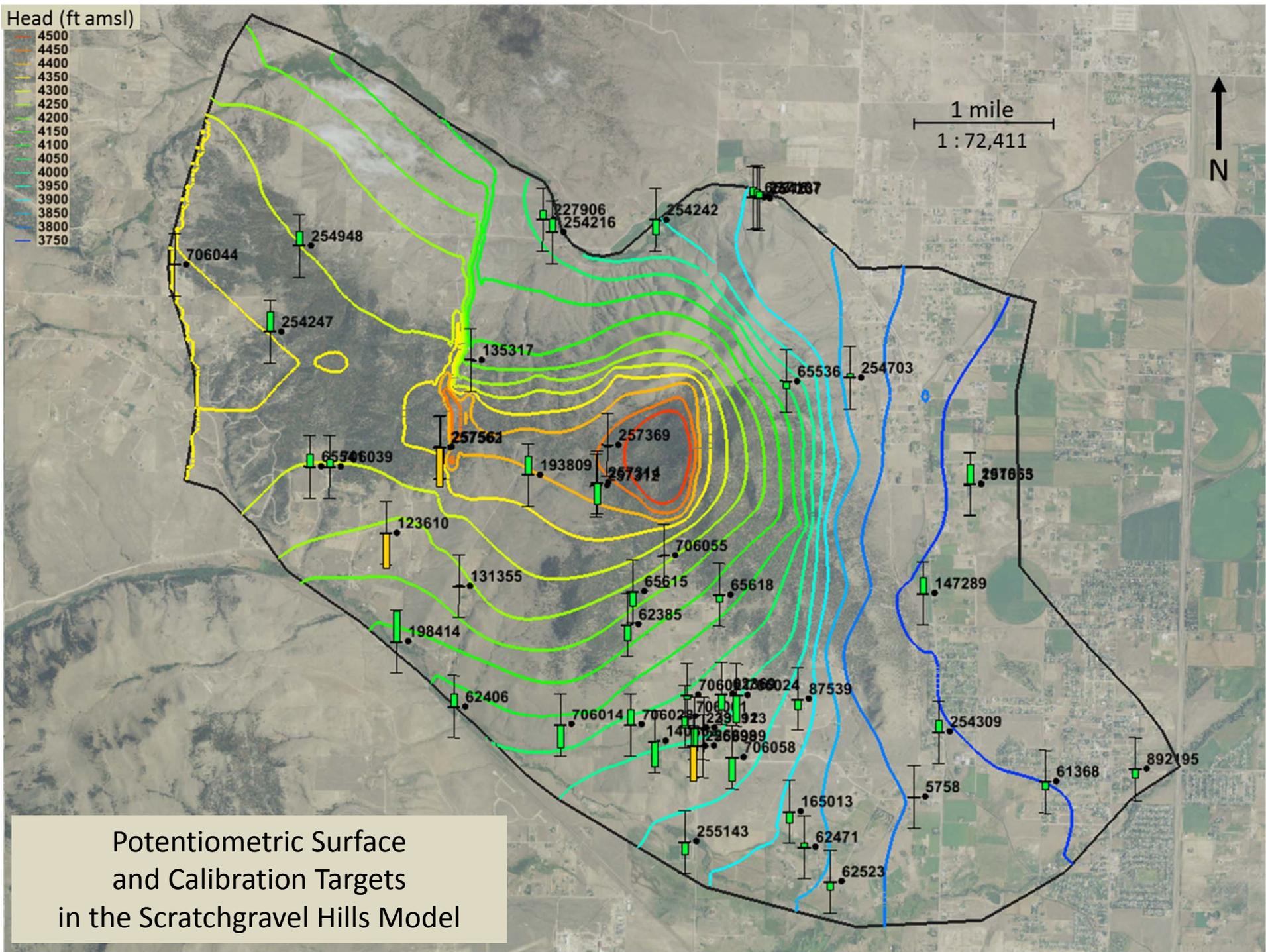
INTERPRETATION:

Fractured rock aquifers have a limited ability to break down septic effluent, and so high nitrate levels can occur where depth to bedrock is shallow

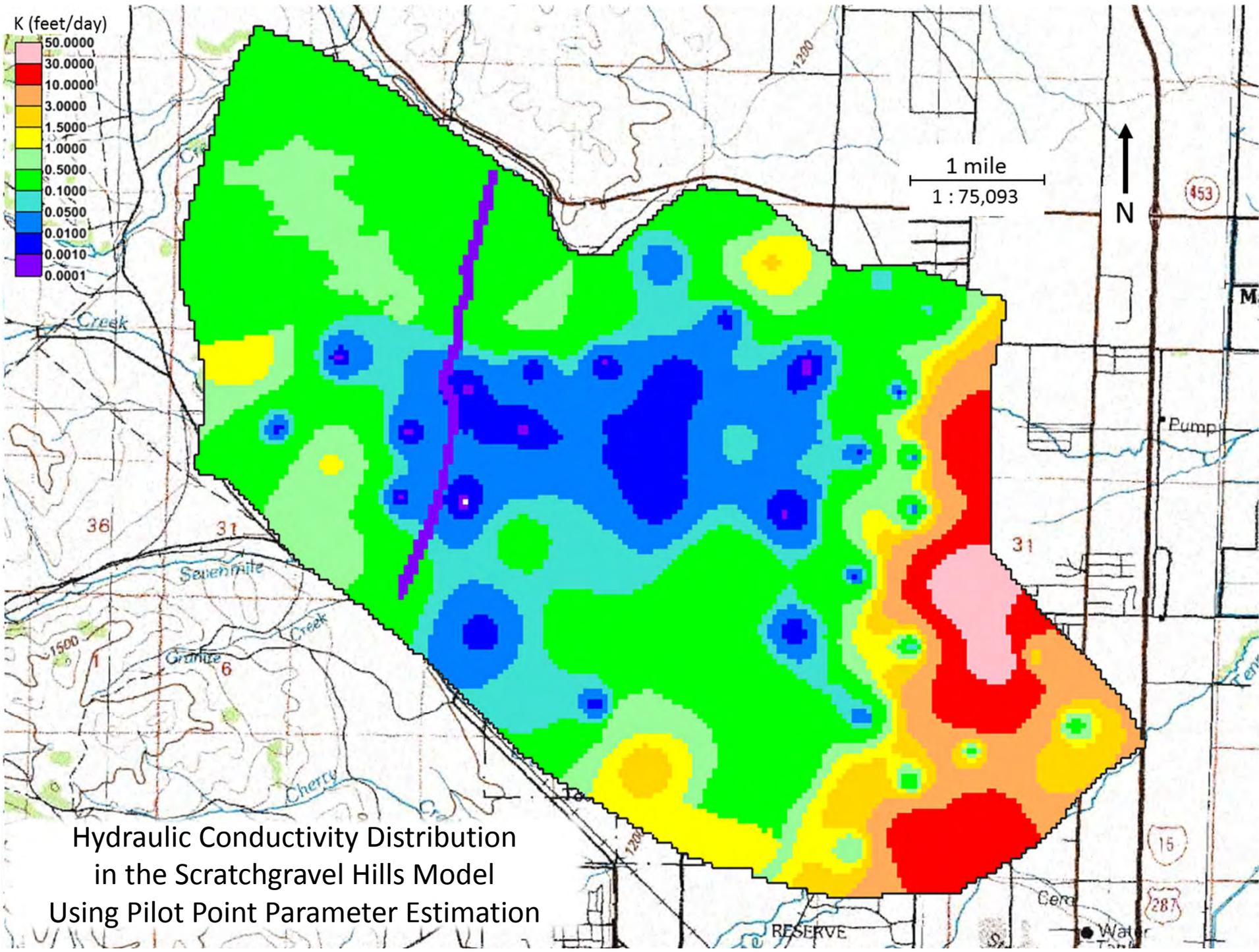


Head (ft amsl)

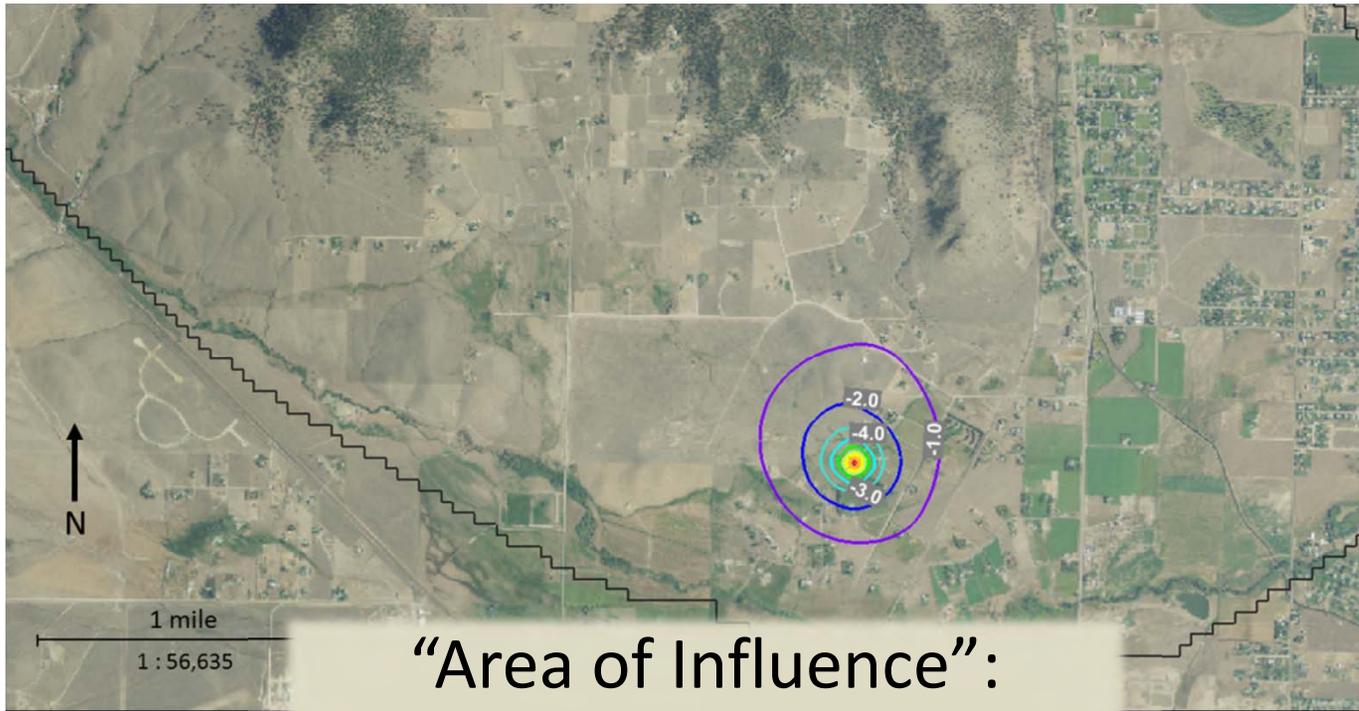
- 4500
- 4450
- 4400
- 4350
- 4300
- 4250
- 4200
- 4150
- 4100
- 4050
- 4000
- 3950
- 3900
- 3850
- 3800
- 3750



Potentiometric Surface and Calibration Targets in the Scratchgravel Hills Model



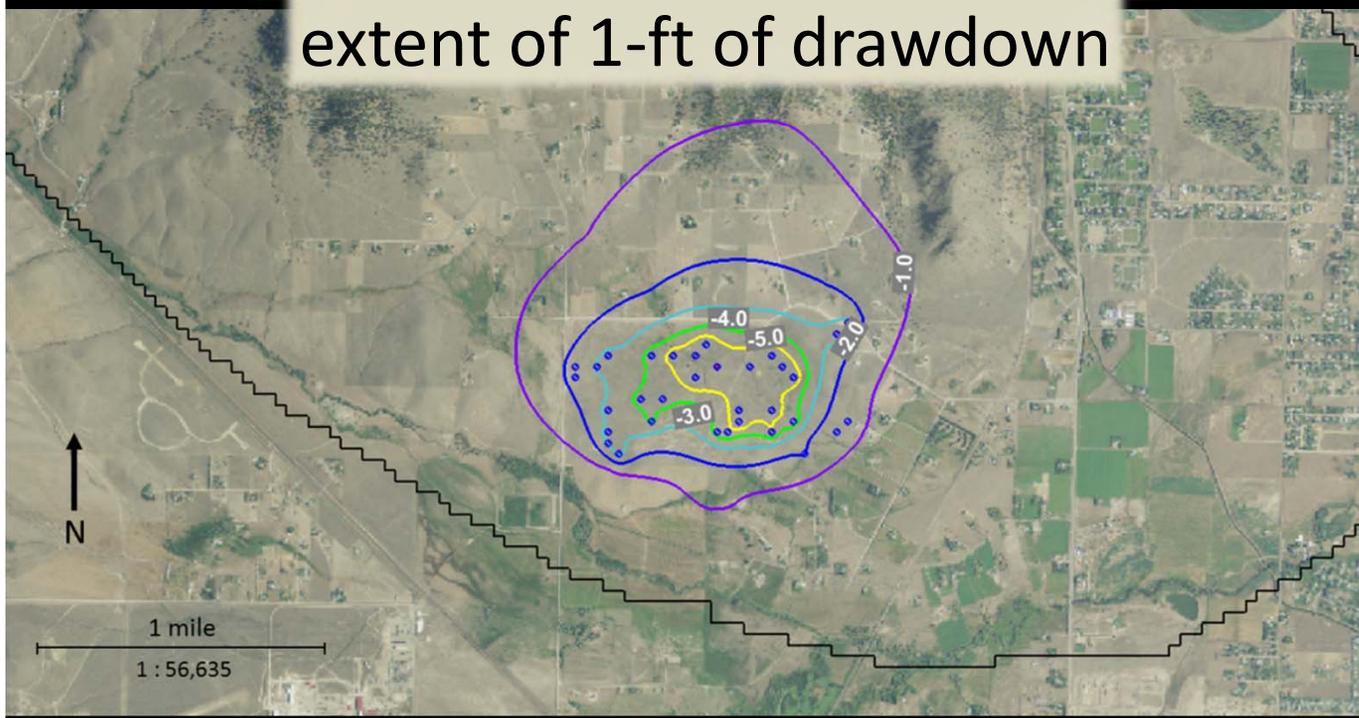
Hydraulic Conductivity Distribution
in the Scratchgravel Hills Model
Using Pilot Point Parameter Estimation



“Area of Influence”:
extent of 1-ft of drawdown

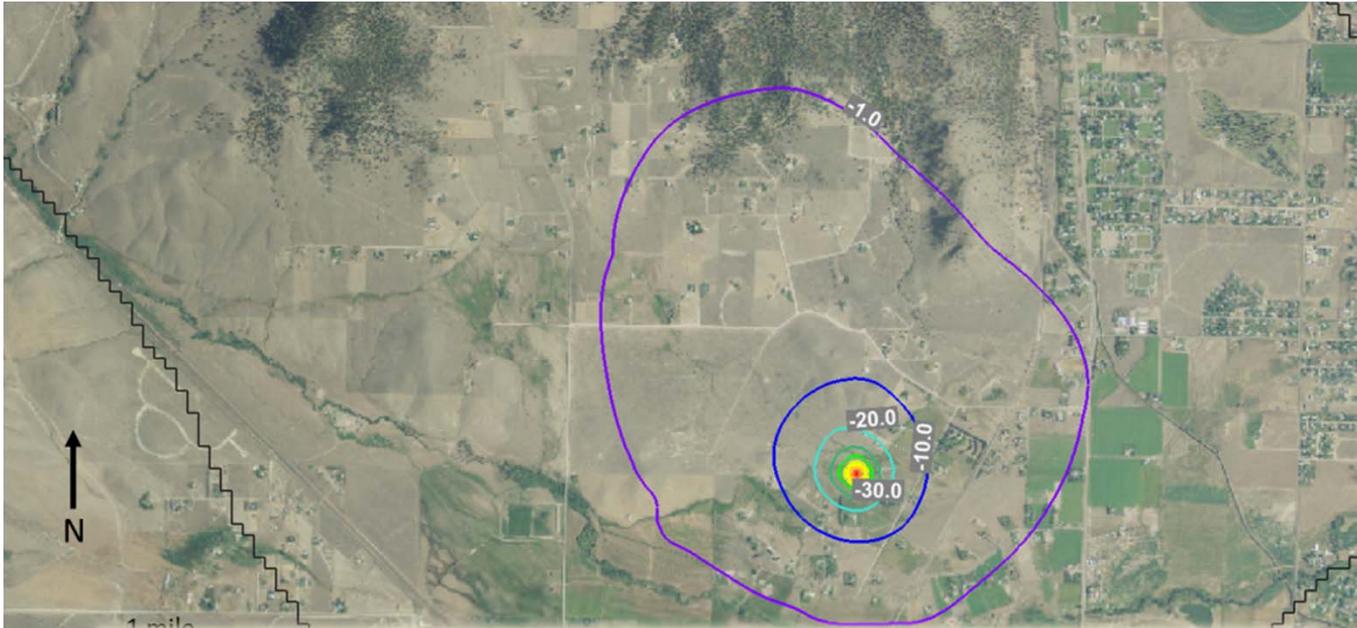
Scenario 1:

- 1 PWS Well
- Supply for **10-acre** lots
- 10 years of pumping
- 1-ft area of influence extended **0.47 miles**



Scenario 2:

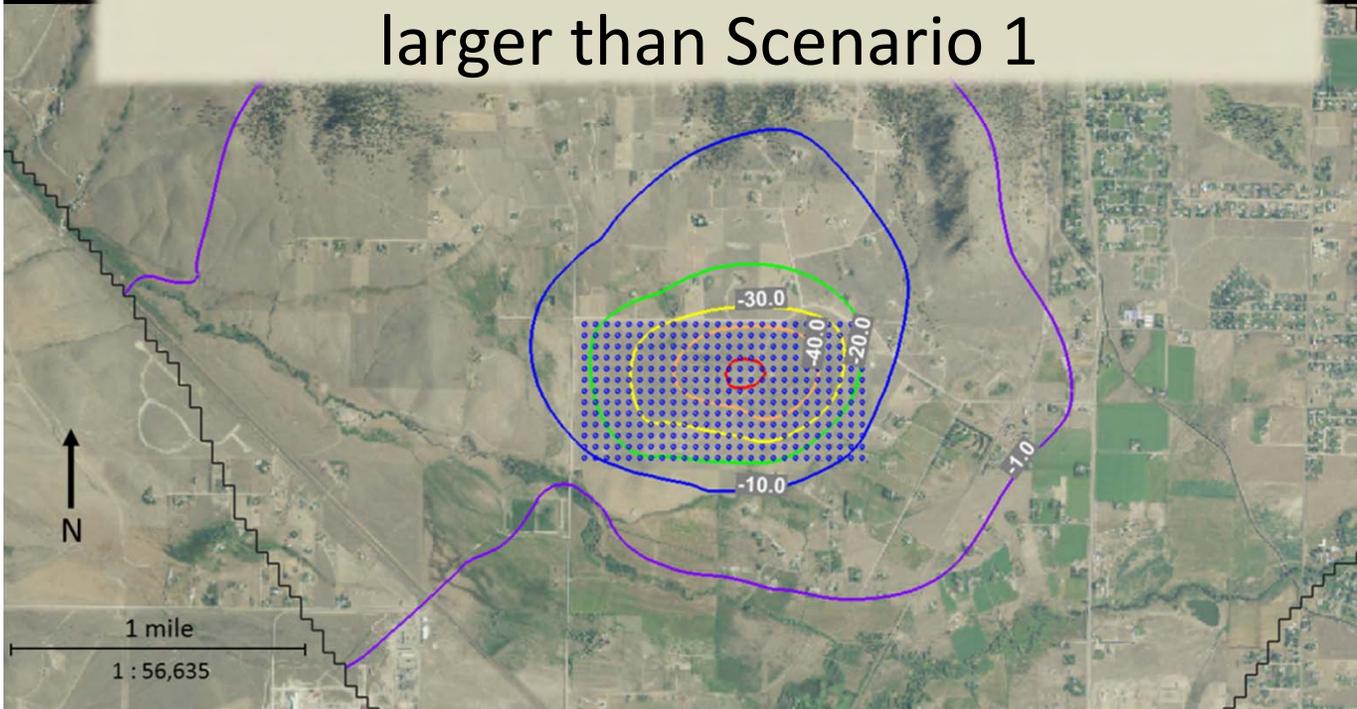
- 33 exempt wells
- Supply for **10-acre** lots
- 10 years of pumping
- 1-ft area of influence extended **0.87 miles**



Scenario 3:

- 1 PWS Well
- Supply for **1.4-acre** lots
- 10 years of pumping
- 1-ft area of influence extended **1.33 miles**

Areas of Influence are 3 to 4 times larger than Scenario 1



Scenario 4:

- 338 exempt wells
- Supply for **1.4-acre** lots
- 10 years of pumping
- 1-ft area of influence extended **2.0 miles**

Scratchgravel Hills Bedrock Aquifer System: Summary



- Well yields vary locally and are highly dependent on:
 - *Degree of fracturing*
 - *Proximity to impermeable faults*
 - *Most variable in the granite and Helena Formation*
- Recharge to the Green Meadow CGWA is local
- Septic effluent could be problematic where depth to bedrock is shallow

Future subdivision developments:

- PWS well preferable to exempt wells
 - *Ability to selectively locate (high-K zone, away from septic effluent)*
 - *Easier management*
 - *Smaller area of influence*

Scratchgravel Hills Bedrock Aquifer System: Recommendations



- Conduct long-term monitoring to better establish groundwater level trends
- Consider depth to bedrock in design of future septic systems
- Conduct monitoring in new developments with a lot density < 10 acres
 - *Water levels and water use*
- Incorporate site-specific data into models to predict impacts of development
 - *Particularly consider local variation in fractures and faults*

A wide-angle photograph of a winter landscape. The foreground is a snow-covered field with some small evergreen trees. In the middle ground, there is a small town or village with several buildings and a road. The background features a range of snow-capped mountains under a clear, light blue sky. The overall scene is peaceful and serene.

THANK YOU

QUESTIONS???