Montana Groundwater Academy

Clark Fork Symposium, University of Montana, Missoula, MT, April 24, 2015

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Overview

- What is Montana Groundwater Academy (MGA)?
- Partners
- Need
- History
- Program
- Site
- Initial Data
- Future

What is MGA?

Through engaging in a place-based STEM education program, students will develop increased capacity to make scientifically informed decisions about pressing water issues in western MT.

- Ed program led by spectrUM Discovery Area, UM
- With many partners
- Groundwater education through…
  - First-hand investigations
  - Learning with regional scale data
- Includes field site in Greenough Park
- Currently funded by EPA EE grant for high school
- Opportunities for further growth & development

MGA Partners

UM
- spectrUM Discovery Area
- Geosciences

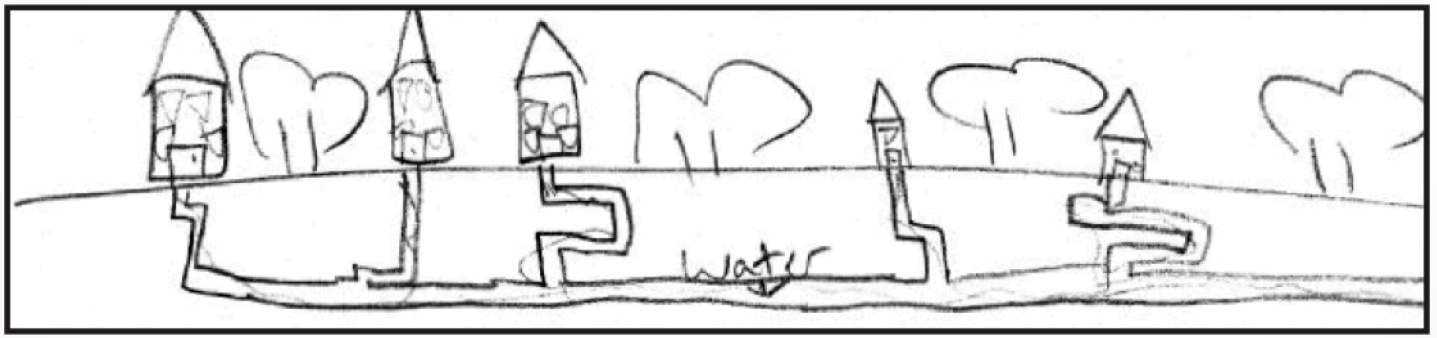
Supporting Partners
- Missoula Parks & Recreation
- Missoula Valley Water Quality District
- Mountain Water Company
- Newfields Companies, LLC

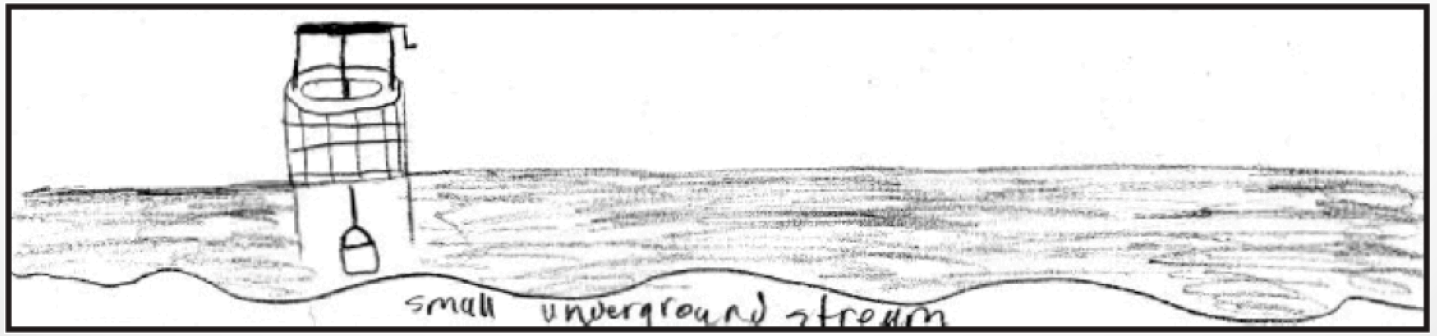
Education Partners
- Watershed Education Network
- Bitter Root RC&D
- Clark Fork Coalition
- Salish Kootenai College

School Districts
- Florence Carlton
- Frenchtown
- Lincoln
- Missoula County (MCPS)
- Ronan

Need

- Water science literacy needed for citizenship
- Understanding is poor
- Current ed opportunities are limited





Need

Common ideas…

- Groundwater is a dead-end
- GW pollution caused by stuff falling in wells
- Contaminants seep through ground w/out need for water transport
- Little to no awareness of…
  - Driving forces: gravity, pressure
  - Constraining factors: permeability, solubility

History

- Visit to GetWET in Fort Collins in 2011

GETWET OBSERVATORY AND SCIENCE PARK

Colorado State University

GETWET OBSERVATORY CSU

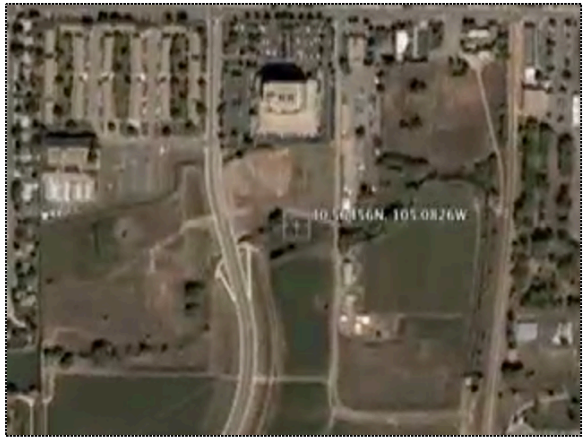
About GetWET | Students & Faculty | Outreach

The GetWET Observatory is a collaborative effort between the CSU Department of Geosciences, the CNS Education & Outreach Center, and the Poudre School District. The GetWET Observatory was initially funded by the National Science Foundation's Course, Curriculum, and Laboratory Improvement initiative and has received generous support from In-Situ, Inc. and the Warner College of Natural Resources

The GetWET Observatory is the only outdoor hands-on water education facility in the Rocky Mountain Region. Located on CSU property along Spring Creek is a groundwater well field that allows students to study the interaction between the creek and the groundwater.

GetWET hosts approximately 800 students per year from grade school through grad school. Students study water quality and quantity issues and how they relate to use, conservation, and flooding.

Annual teacher institutes have attracted 75 teachers from Front Range communities interested in making the study of water more engaging and interactive.

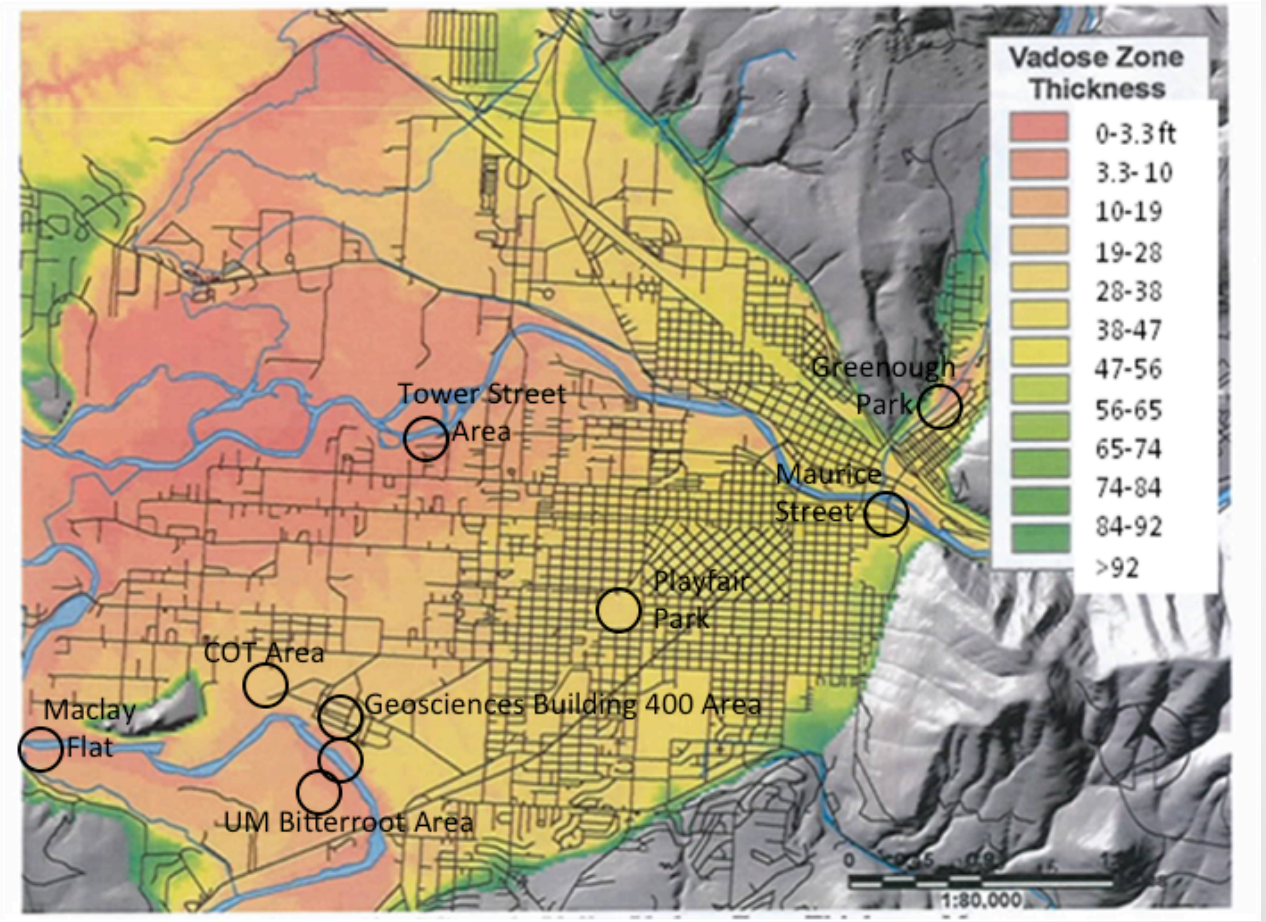


Making connections with maps

Click here for up-to-date

History

- Building a team
- Scouting sites
- Writing grants
  - EPA 2012
  - Honda 2013
  - EPA 2014
- Developing community partnerships



Current Program

- 2 Year EPA EE grant w/matching funds from…
  - Mountain Water Company
  - Missoula Valley Water Quality District
- Additional support from
  - Newfields Companies, LLC (managed site installation)
  - Missoula Parks and Recreation (approved site for Greenough Park)
- Will serve ~800 high school students in western MT

MGA Learning Goals Align with NGSS

- **Integrating:**
  - Core Disciplinary Ideas
  - Scientific Practices
  - Crosscutting concepts

- **HS-ESS2-2:** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

- **HS-ESS3-1:** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

MGA Learning Goals

Explain

- Where GW is located (vertically & horizontally)
- Why GW moves in different directions & at different velocities depending on site conditions
- Seasonal & long term patterns & trends
- How GW becomes contaminated, & how this can be prevented or remediated
- How GW & surface water connect & interact

Investigate GW issues in western MT

Know how to protect, manage & sustain GW resources

3-Day Curriculum

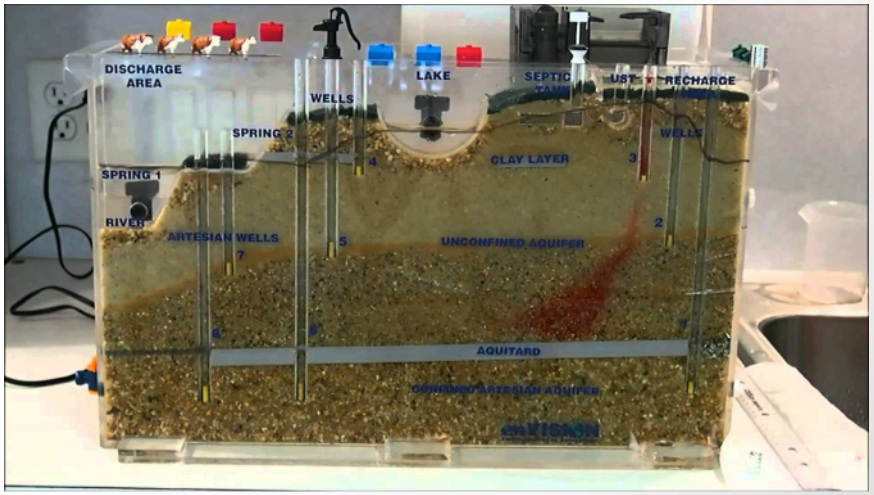
- Day 1: GW structure & function w/models
- Day 2: Landscape scale GW systems at field site
- Day 3: Applications w/regional data sets

- Expanding scope design
  - Spatial scale
  - Temporal scale
  - Complexity of systems

Day 1

- If you had to choose a well to provide water for your house, which would you choose & why?
- At what relative rate does water move through sand versus clay? Why?
- Will pumping water from well X, well Y affect the water in lake? Why?
-

- If a pollutant enters ground at point Z, which wells will be affected? Why?
- What forces drive & constrain water movement in an unconfined aquifer?



Day 2

- Driving Question: Where is groundwater at this site? Where is it coming from? Where is it going to?
- Activity Sequence
  - Engage/Elicit: Students use map to indicate/share initial ideas.
  - Explore: Students/facilitators discuss how to investigate, develop plan, & collect data. Data are pooled.
  - Explain: Students (w/support) use data to create GW elevation contour map, identifying location & direction of GW flow.
  - Apply: Students discuss implications of GW flow, considering issues such as movement of contaminants or seasonal and long term fluctuations.

Day 3

- Students use graphical representations of data sets to investigate other GW systems & issues, e.g.,…
  - How is GW changing in Bitterroot Valley as a result of irrigation?
  - How has GW in western MT been impacted by mining activities?
  - By other activities (e.g., paperboard mill)?
  - Are any impacts of climate change evident in western MT GW data?

Program Evaluation

- Assessing effectiveness of program
  - Students
  - Teachers
  - Education Partners

The contour lines on the map to the right show the groundwater table elevation above sea level (in meters).

The triangle represents a septic tank and drain field, and the circles show the locations of different wells.

If someone installed the septic tank incorrectly and septic wastes percolated into the groundwater, in which well would contaminated groundwater most likely be detected first?

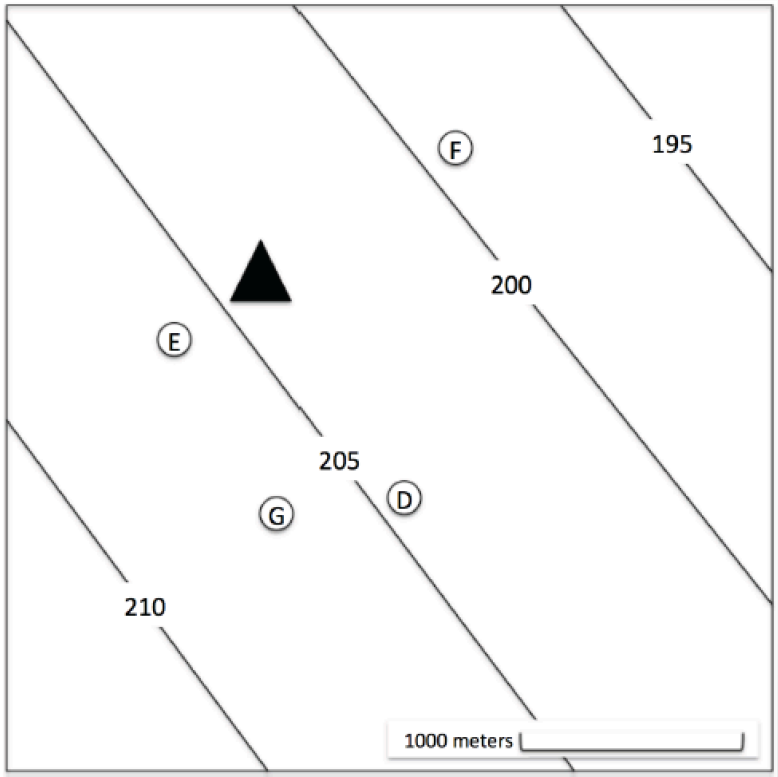
Select one:

___ D

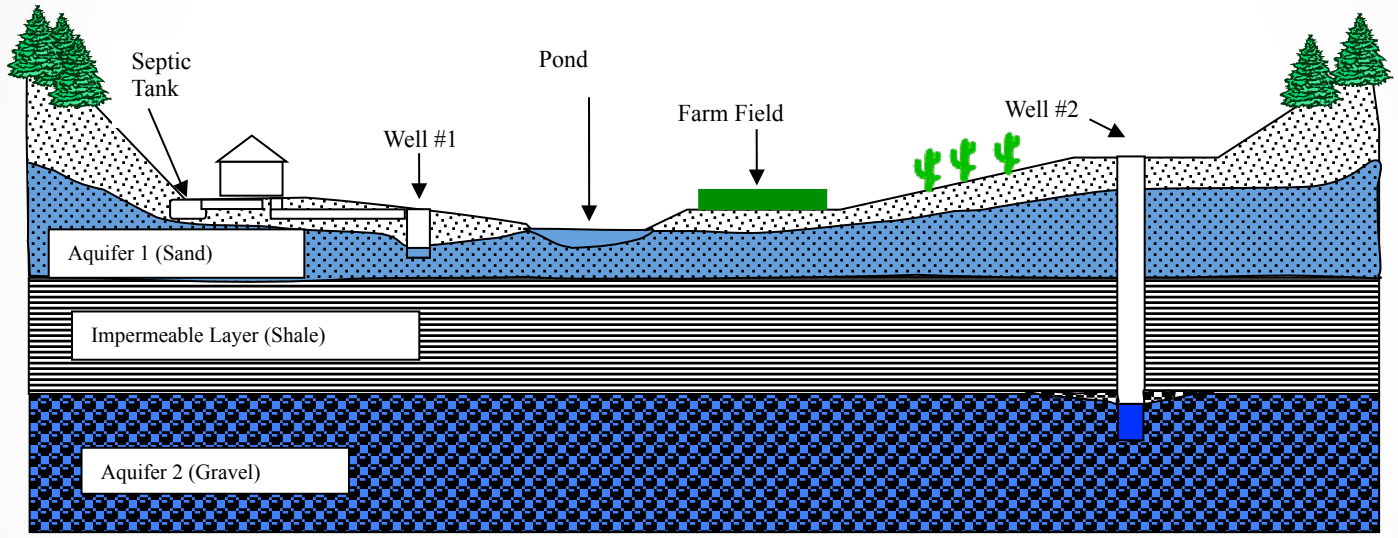
___ E

___ F

___ G



Program Evaluation

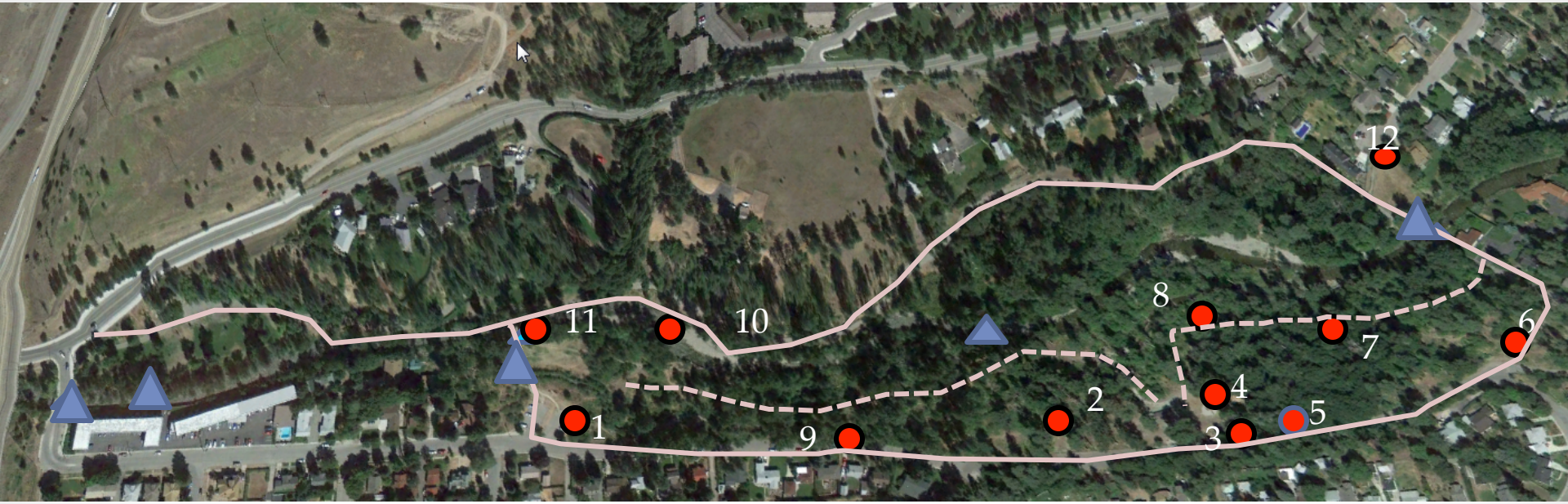


How does water get into the pond? Explain as many pathways as you can.

Could pumping from well #1 affect the water in the pond?
Could pumping from well #2 affect the water in the pond?
Explain your answers.

Greenough Park

Final April 2015 Map



2″ Geoprobe Monitoring Well

Creek Stage Gauge (4)
Climate Station (1))

Paved Path or Road
Existing Path

Stream stations
Bridge
Stream staff
Stream transducer

Site Characteristic Criteria

Necessary

- Accessible to schools
- Access for buses/parking
- Access for students w/low mobility
- Bathrooms
- Shallow groundwater
- Can use shallow wells ($)
- Presence of river/creek
- Novice-comprehensible GW flow & stream interaction
- Safe site
- Location for climate station

Desired

- Electricity
- Paths
- Shelter
- Production well

Monitoring Wells At Ground Level

Geoprobe Installation

Climate Station

Will be pole mounted in Alvina Park

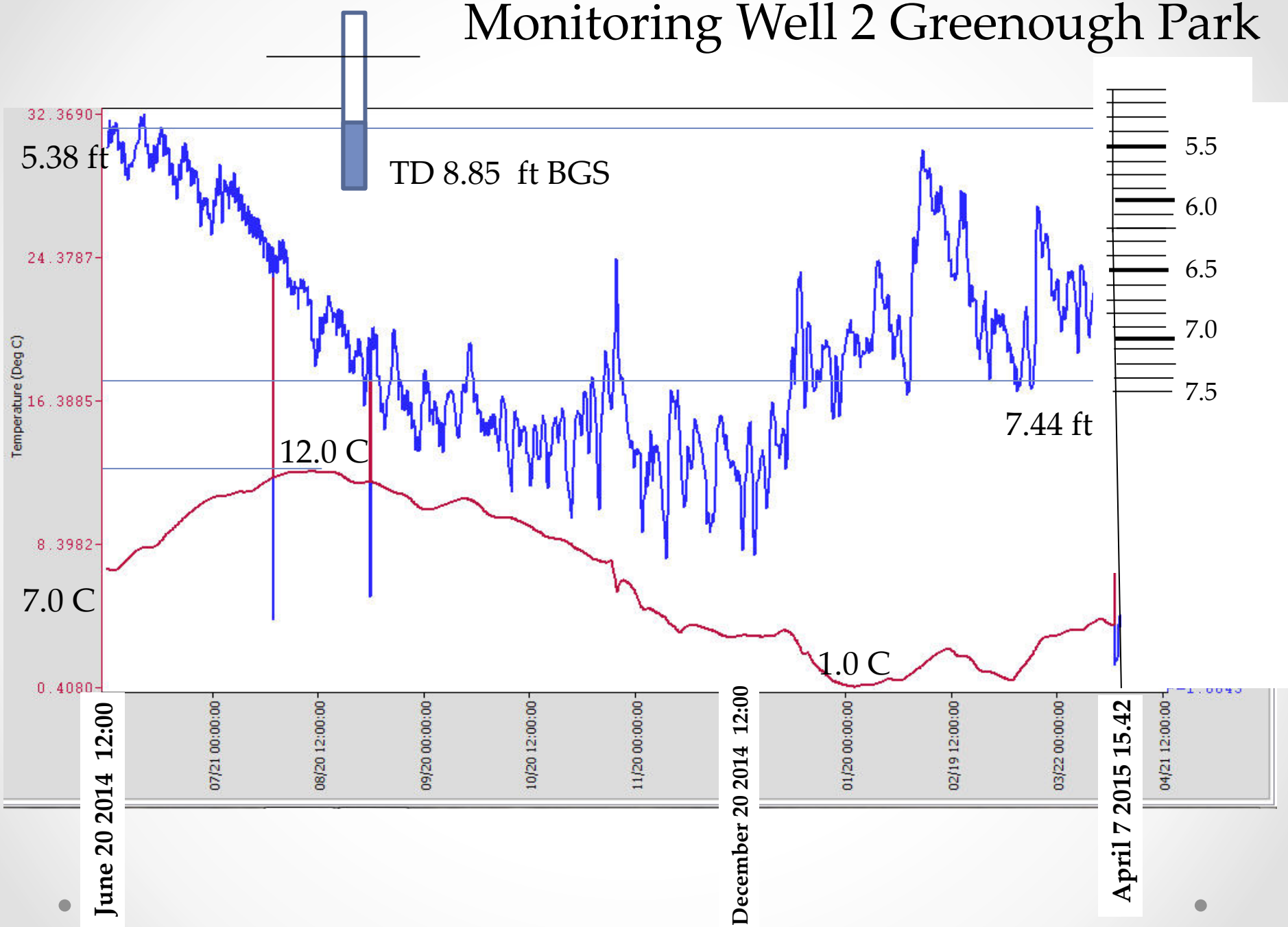
s sensors are ideal for transmitting

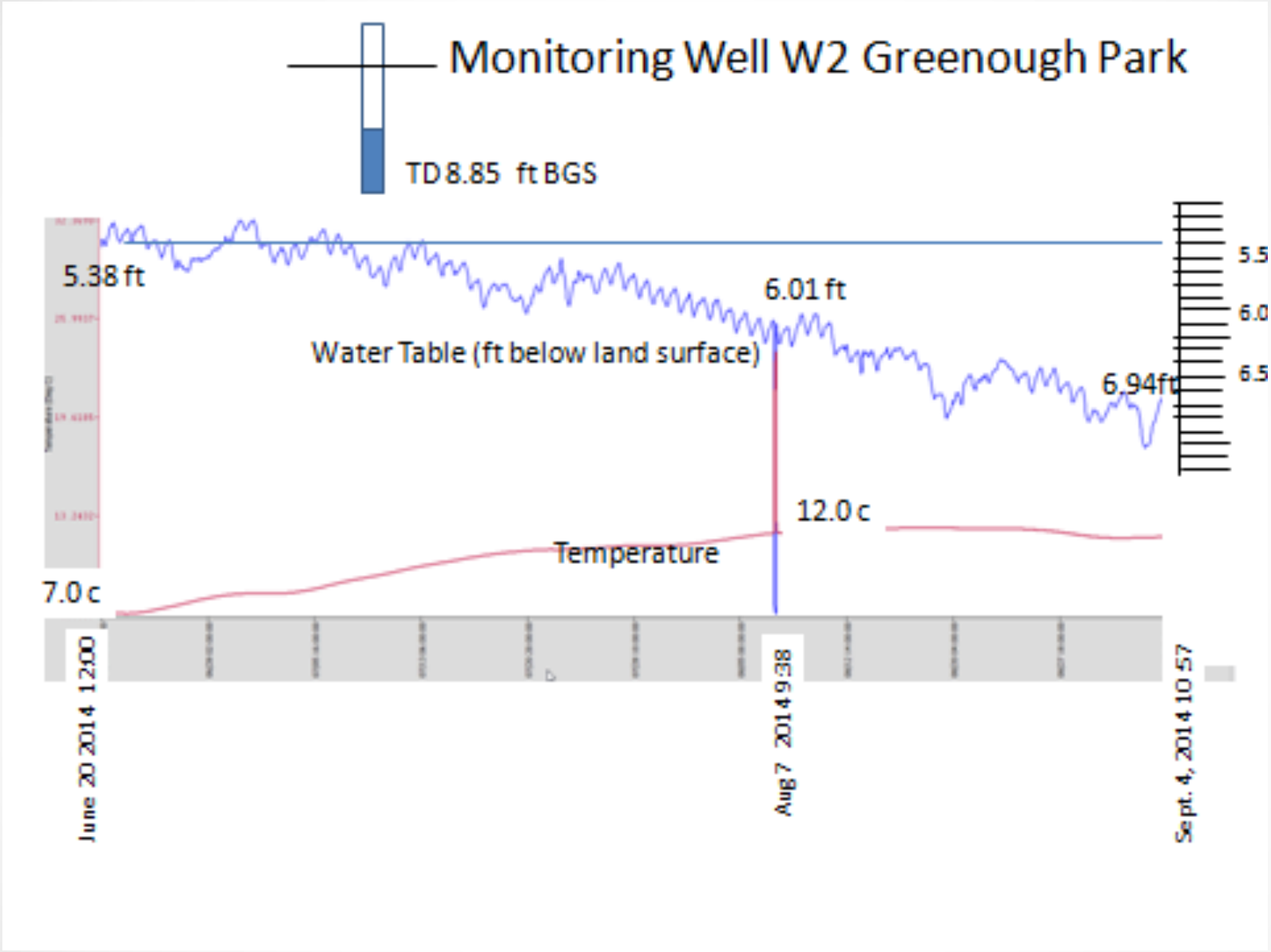
Staff Gauges

Initial Data

- Data collected with transducers in several existing wells in Greenough Park starting in June 2014

Monitoring Well 2 Greenough Park




Monitoring Well W2 Greenough Park
TD 8.85 ft BGS
5.38 ft
6.01 ft
Water Table (ft below land surface)
6.94ft
5.5
6.0
6.5
12.0 c
Temperature
7.0 c
June 20 2014 12:00
Aug 7 2014 9:38
Sept. 4, 2014 10:57

Future Directions

Programming

- Sustain high school program
- Expand to new audiences
  - University
  - Middle School
  - Public
  - Professional
- New emphases – e.g., computational thinking & data analysis

Sites

- Advanced learning: Maurice Street
- Regional satellite sites: Frenchtown, Milltown, Pablo

Research

- Opportunities for scientific investigation
- Informing Parks concerning maintenance & restoration

Questions / Comments

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This work is supported in part by a grant from the Environmental Protection Agency: Montana Groundwater Academy (96830301). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Environmental Protection Agency.

Geoprobe Well Construction