Overview of Past, Current and discussion of possible Future MBMG research in the Clark Fork

Presented by
John Wheaton

Presented to:
Clark Fork Task Force
February 12, 2014

The Montana Bureau of Mines and Geology

A Department of MT Tech of the University of Montana
Providing Earth Science Information for Montana

Home office – Butte
Eastern office – Billings

Non-regulatory

Through multiple programs MBMG provides data on:

- Geologic mapping
- Groundwater characterization
- Groundwater research
- Surface water (limited now, but...)

The Montana Bureau of Mines and Geology

Providing Earth Science Information for Montana

Storing data in public, internet database

Publishing peer reviewed reports

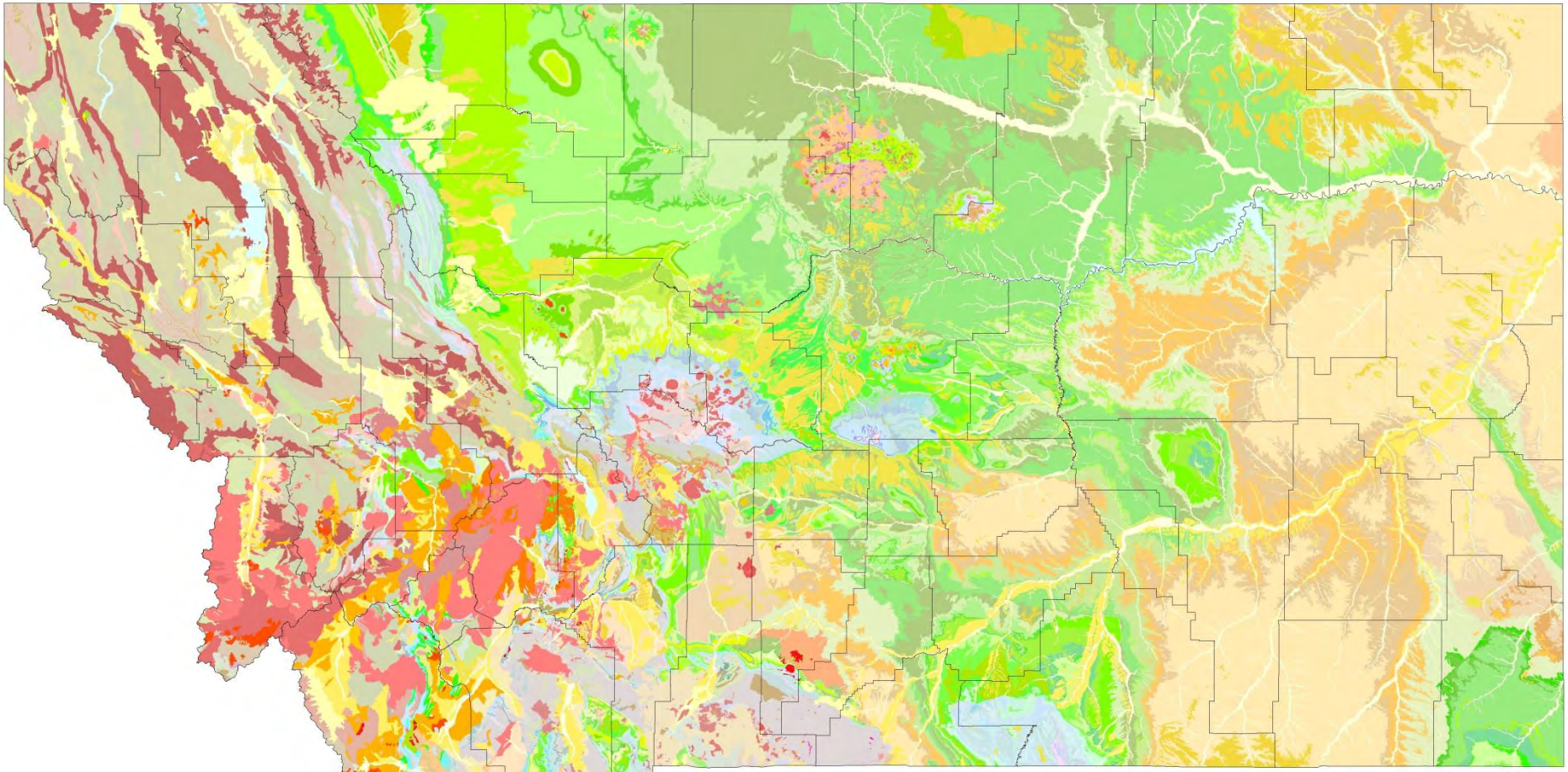
All data and project results are permanently available to the public

Building layers of understanding

Ground Water Investigation Program (GWIP)

At the Montana Bureau of Mines and Geology

But first, a little about the foundation that GWIP builds on.



State-wide Geologic Mapping

Layer 1 :

The foundation of all groundwater projects.
Includes multiple levels of effort.

Layer 2: Ground Water Assessment Program (GWAP)

Groundwater Characterization

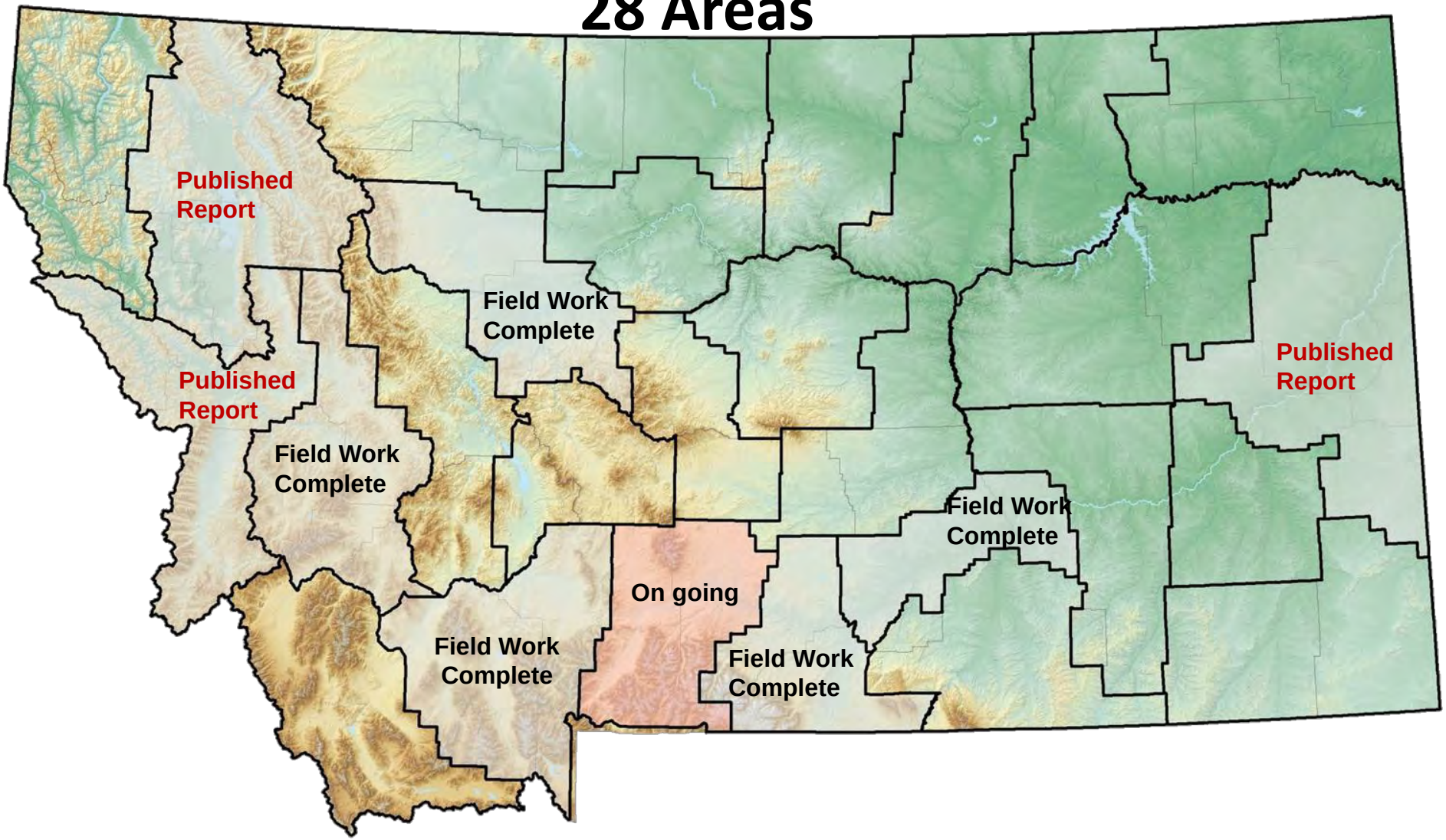
Groundwater Monitoring

Groundwater Data Management (GWIC)

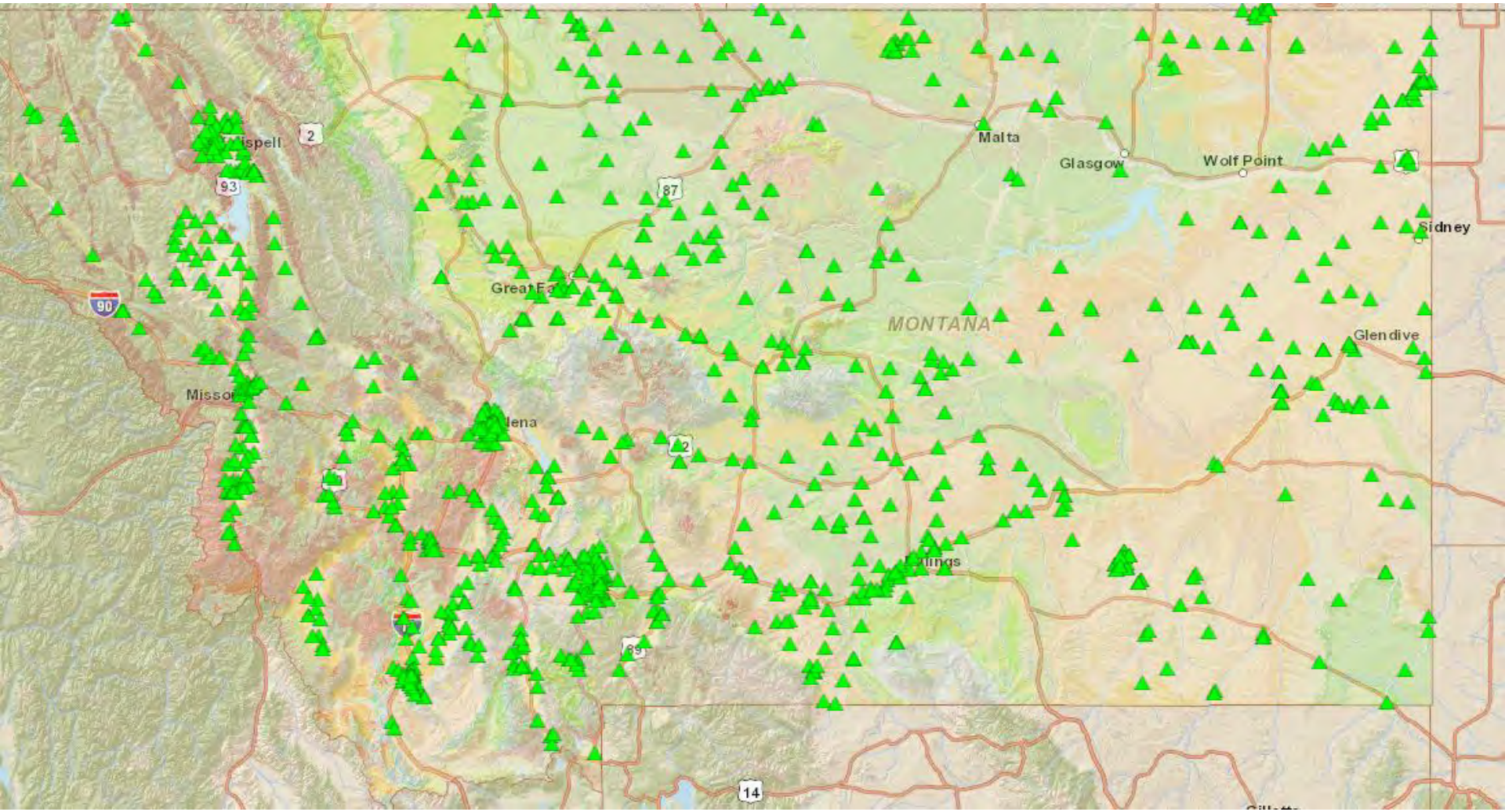
****** John LaFave will come at a later meeting *******

Ground-Water Characterization

28 Areas



GWAP Long-Term Monitoring Wells



Ground Water Information Center

Montana's Ground-Water

mbmggwic.mtech.edu

Apps | Montana Tech of th... | xkcd | UCLICK Games - Do... | Dictionary.com | Fin... | GWIC | MBMG | Billings - 7-Day Fore... | Pandora One | DataGWIC | Wikipedia, the free e... | NOAA National Wea... | Imported From Firef... | Comic | ZEN PENCILS

Groundwater Information Center
Montana Bureau of Mines and Geology
Montana Tech of The University of Montana
1300 West Park Street - Natural Resources Building Room 329
Butte Montana 59701-8997
Ph: (406) 496-4336 Fx: (406) 496-4343

2/11/2014

| Home | Well Data | Reports | DrillerWeb | DNRC | Help! |

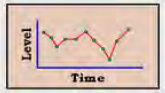
Mapper Release — March 1, 2013

The Montana Bureau of Mines and Geology has released its online web mapping application. Click the image to the right to start using the mapper. Currently displayed are statewide monitoring network wells, GWIC wells and 1:500K geologic maps.

Drought Reports — more reports

Download an Adobe Acrobat file that discusses how aquifers respond to climatic conditions. The document also includes statistics about how wells in Montana's statewide monitoring network are responding to the current drought.

Statewide Monitoring Network



GWIC features current hydrographs for wells that are being measured regularly by MBMG and its cooperators. Click the picture to to the left to view data collected by the Statewide Monitoring Program. Data from other MBMG projects are available through the SWL Menu after you sign in.

View a list of statewide monitoring network wells. The listing is by number of wells per county.

County-wide Statistics — more reports

View statistical overviews of the well data in individual counties. Select the county name from the drop-down box to the right and click the **Go!** button.

BEAVERHEAD ▼ Go!

Sign In Status: Signed Out

Enter your User Id and Proposed Data Use. Click **Sign In** to access GWIC's online services.

If you do not have a User Id, click create one here.

User Id:

Data Use: Pick One ▼

Sign In

Coalbed Methane GW Monitoring Network

MBMG operates the Montana Powder River Regional Coalbed methane ground-water monitoring network of springs and wells. Data for this program plus site specific research such as coalbed methane infiltration pond studies can be viewed online, or downloaded from GWIC. Click on the picture to access the MBMG coalbed methane project data.

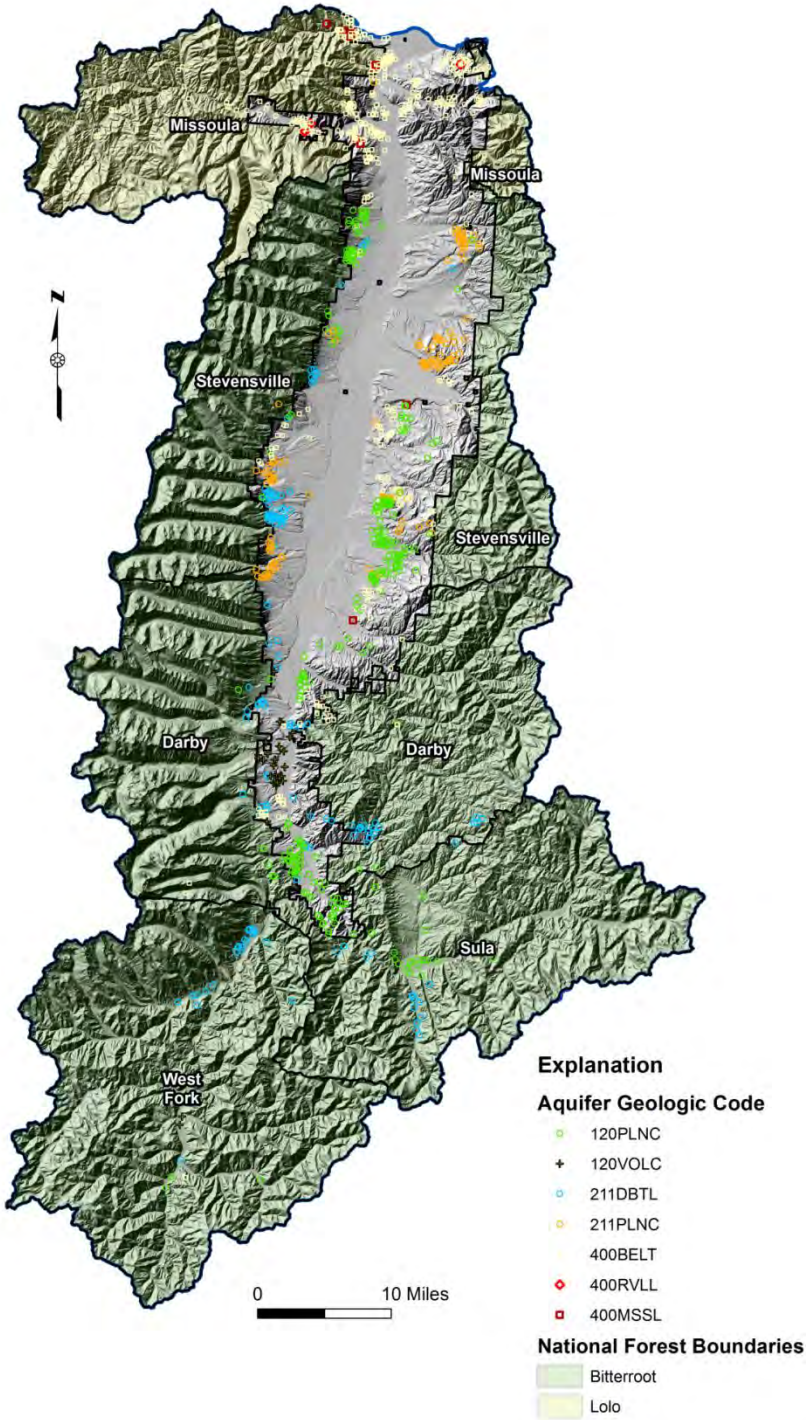
A little about us

The Ground-Water Information Center (GWIC) at the Montana Bureau of Mines and Geology (MBMG) is the central repository for information on the ground-water resources of Montana. The data include well-completion reports from drillers, measurements of well performance and water quality based on site visits, water-level measurements at various wells for periods of up to 60 years, and water-quality reports for thousands of samples. The databases at GWIC are continually updated with new data from driller's logs, MBMG research projects, and research projects from other agencies.

Other sites of interest

- DNRC - Department of Natural Resources and Conservation
- NRIS - Natural Resource Information System (Montana State Library)

Ground Water Information Center Online © 1998 - 2014
Staff | Privacy Statement



Layer 3 : Stand alone projects, such as ---

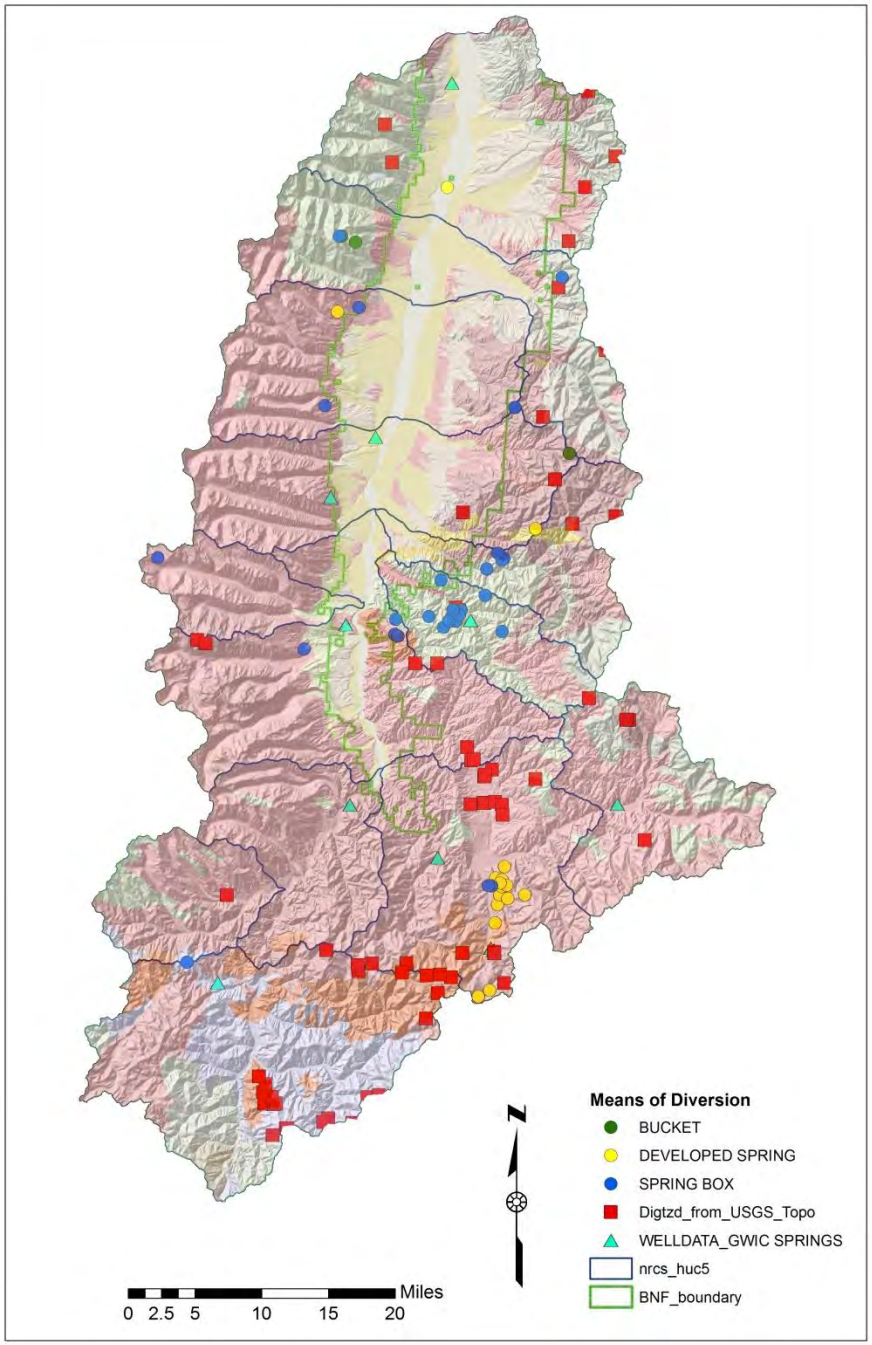
U. S. Forest Service Hydrogeologic Assessment

To understand Forest Service resources, look adjacent.

Springs and wells - GWIC inventory

(Water levels, yield, geologic source, etc)

Report writing is not completed.



U. S. Forest Service Hydrogeologic Assessment

Retrieved and assigned geologic codes:

100 or so wells

60 or so springs

Will project those aquifers to the Forest as appropriate

Forest is recharge for valley as well, but the mechanism is still not well quantified.

Layer 4 : Ground Water Investigation Program (GWIP)

Ground Water Investigation Program (G W I P)

- Answer questions that are crucial for groundwater resource management
- Established research approach in a structured, objective program
- Provide information so aquifers can be intentionally managed, not just used
- State funded program initiated in 2009
- There are currently about 50 nominated projects

http://www.mbmg.mtech.edu/gwip/gwip.asp

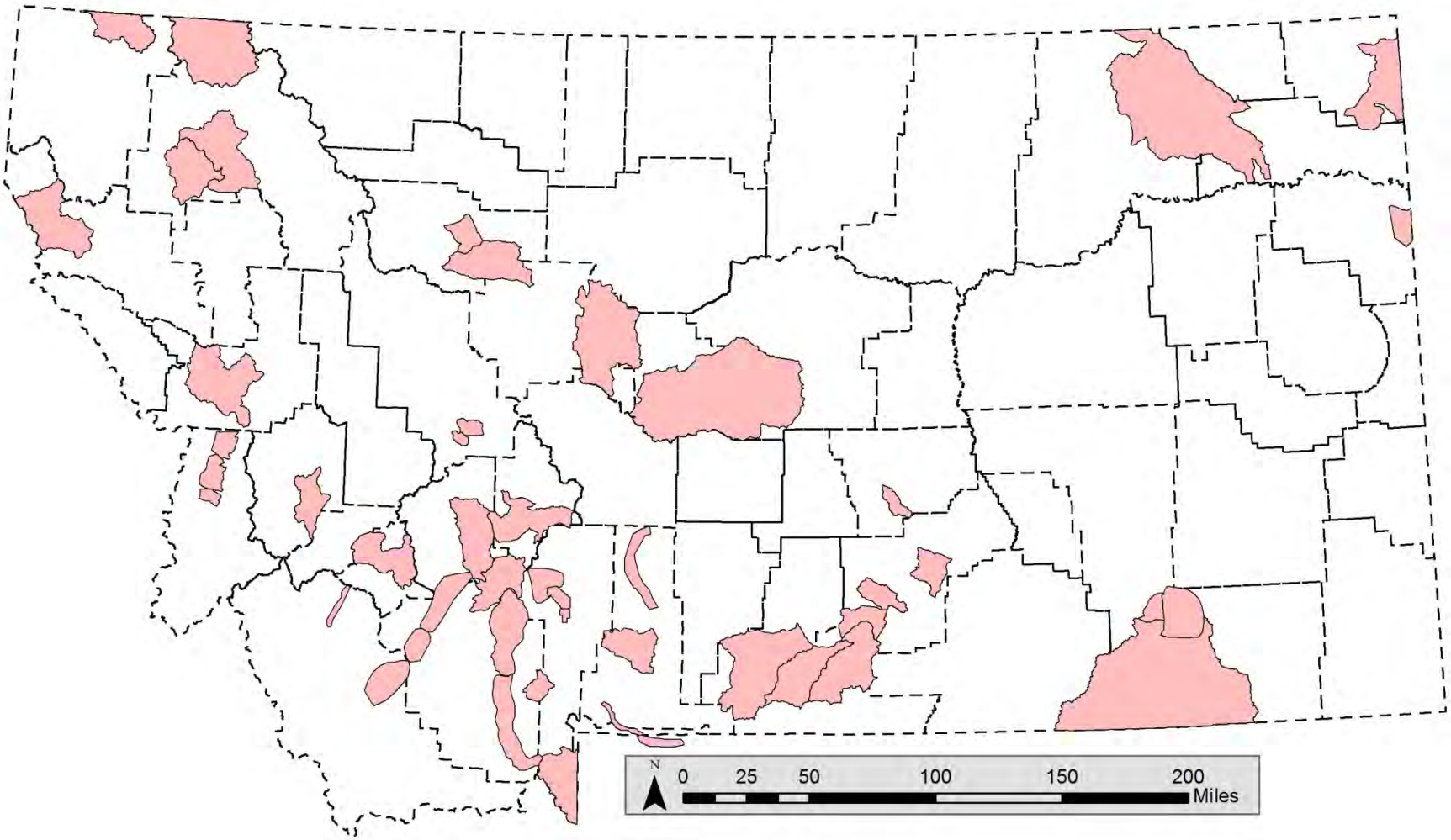
Approach: Build on geologic mapping, GWAP aquifer characterization, collect project-specific data and develop a groundwater flow model

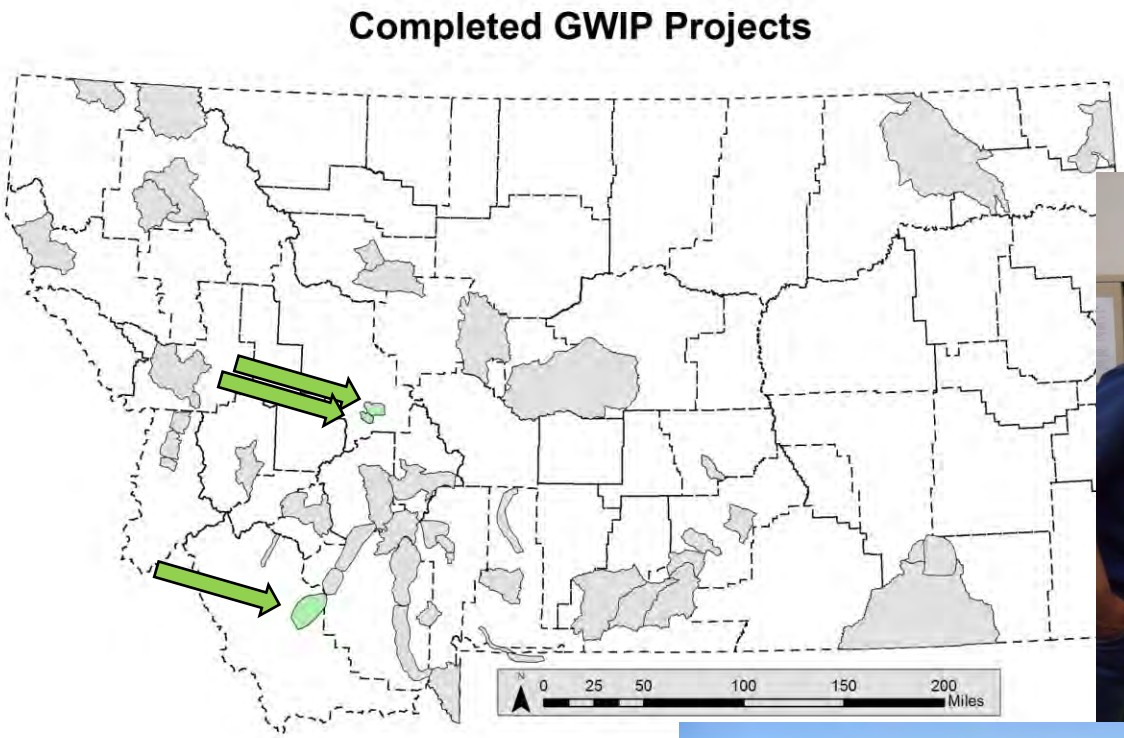
Products:

- Interpretive Report
- Modeling Report - Model files available on line
- Technical Data Report (if appropriate)
- A comprehensive set of hydrogeologic data
  Available through the MBMG
  Ground-Water Information Center (GWIC)
  Archived forever

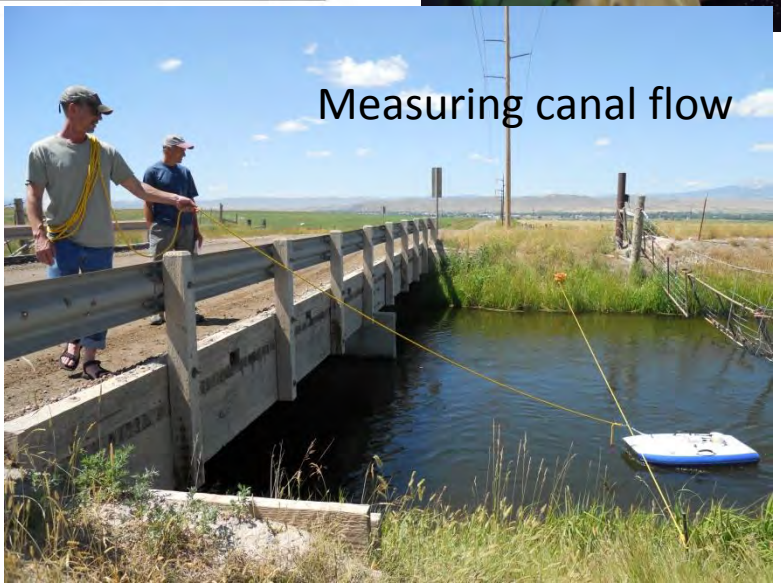
<u>Decision making information for resource optimization</u>

Nominated GWIP Projects





Modeling files are now available on our home page.

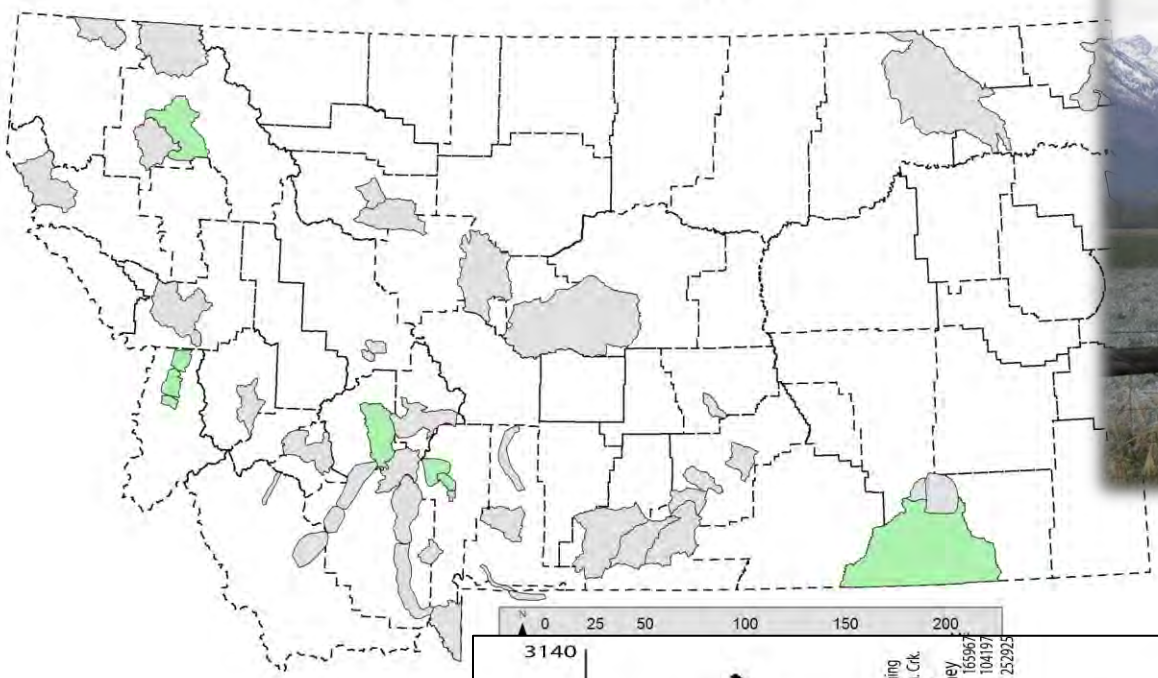


North Hills:

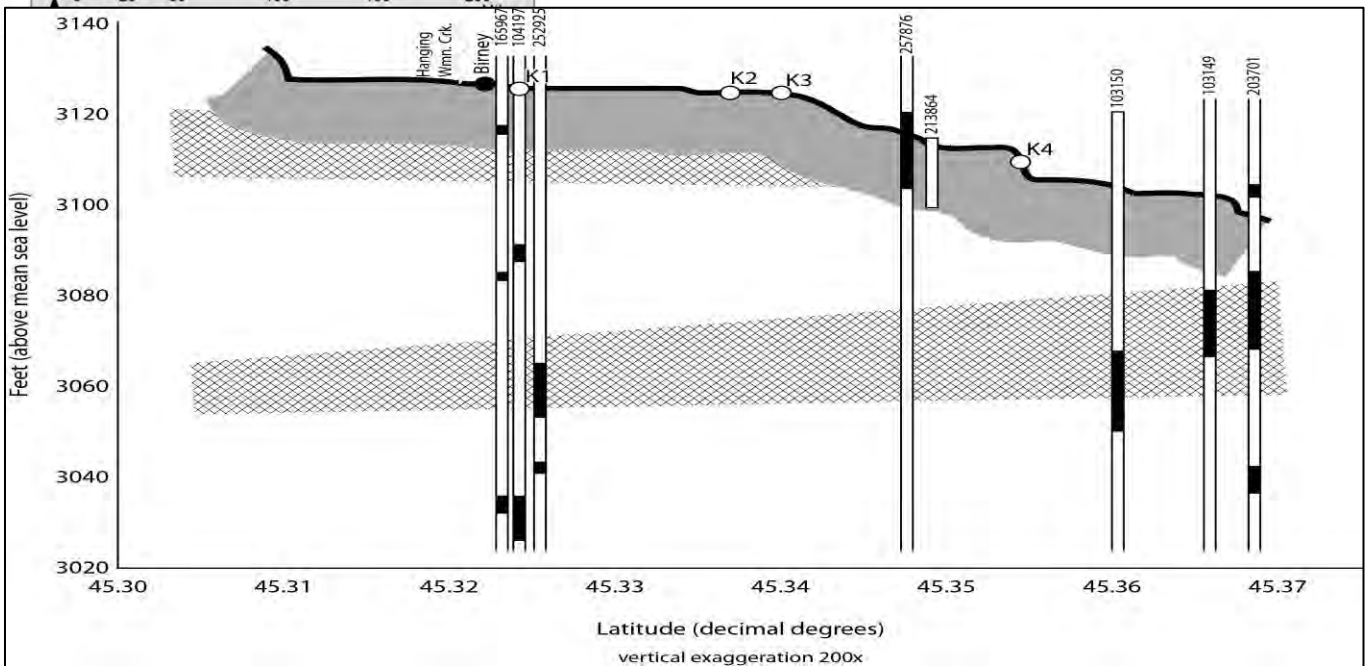
Scratchgravel Hills

Lower Beaverhead

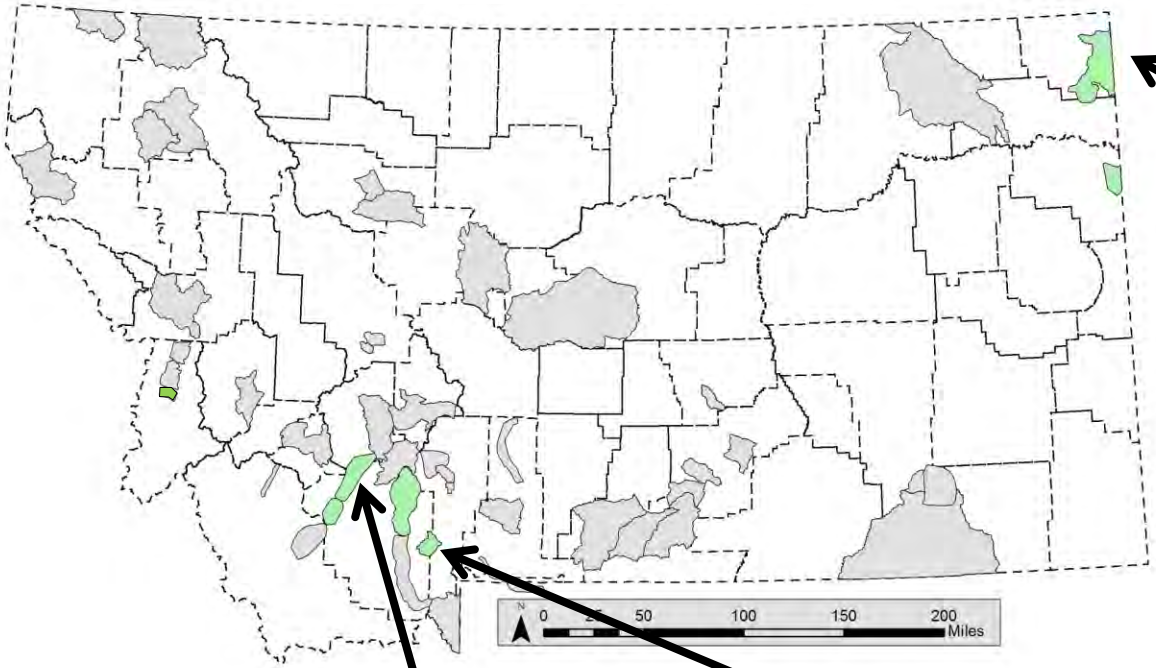
Underway GWIP Projects



Four Corners
Manhattan
Boulder River
Hamilton
Stevensville
Florence
Flathead Valley



Additional Active Projects

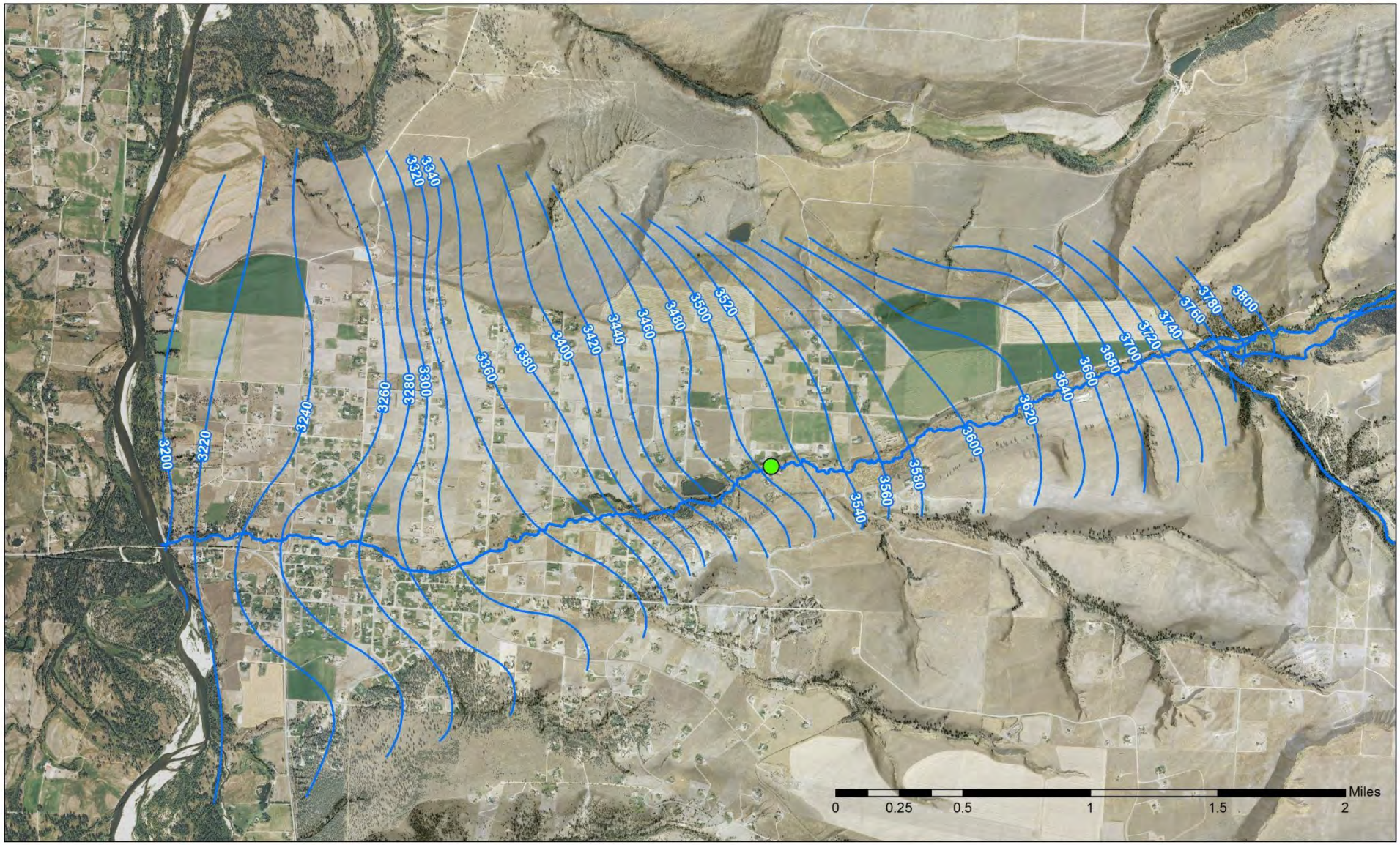


Clear Lake Aquifer

Big Sky

Upper Jefferson River

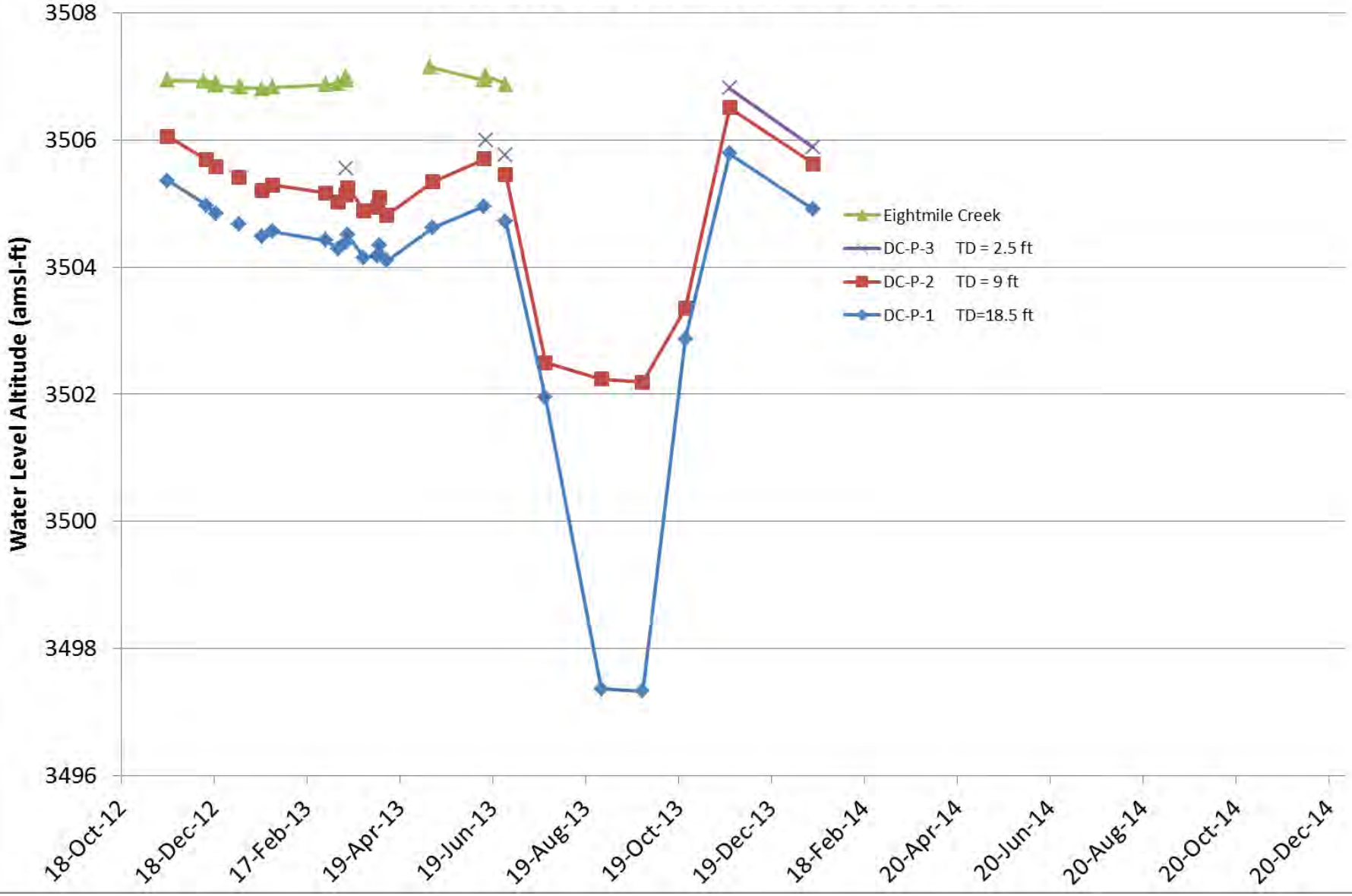
Discussing some GWIP results.



Eightmile Creek, water table surface. Groundwater flows from east to west.

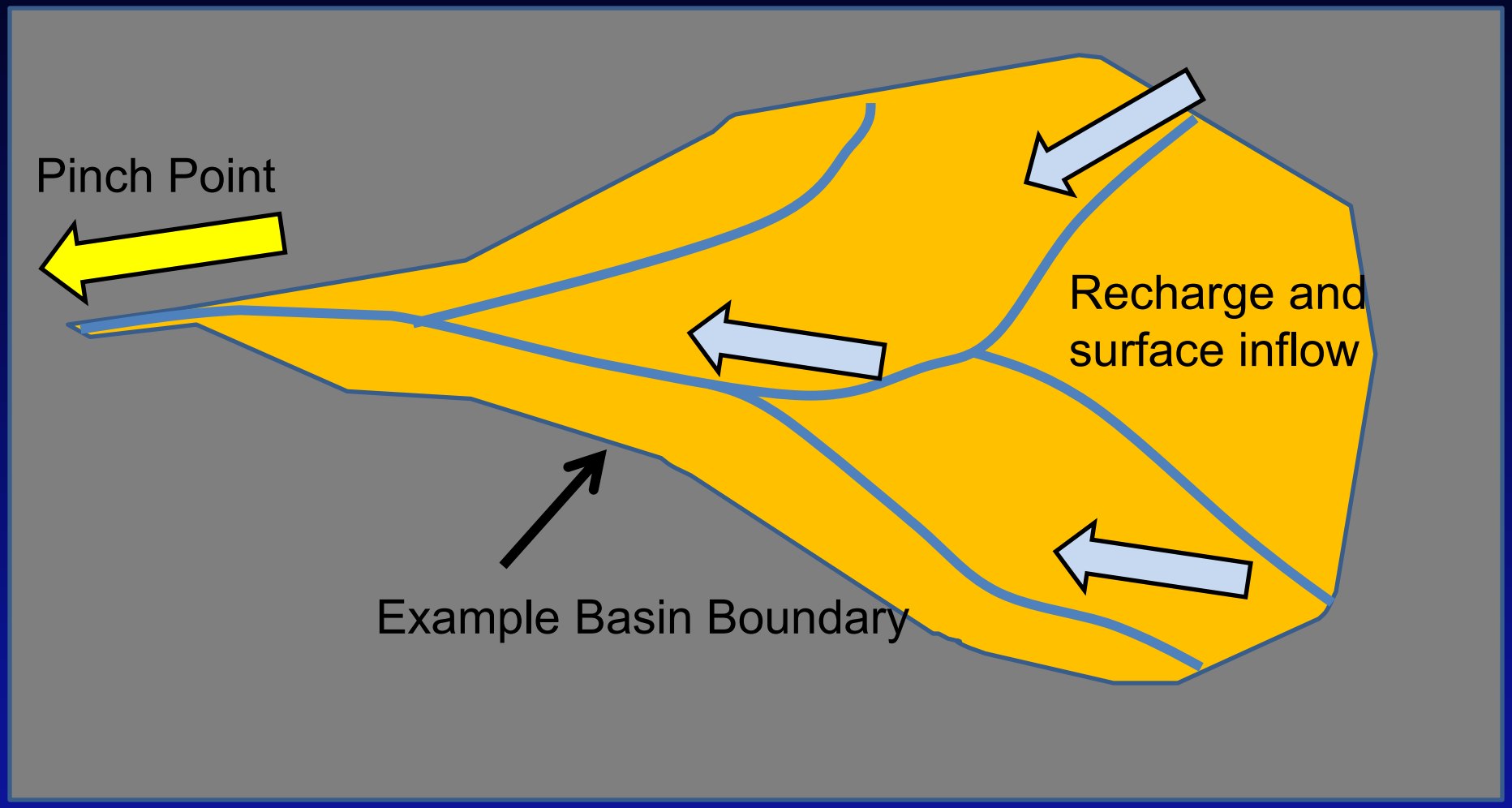
Water table in the alluvium is well below the Eightmile Creek water level.

Eightmile Creek and adjacent shallow groundwater levels.

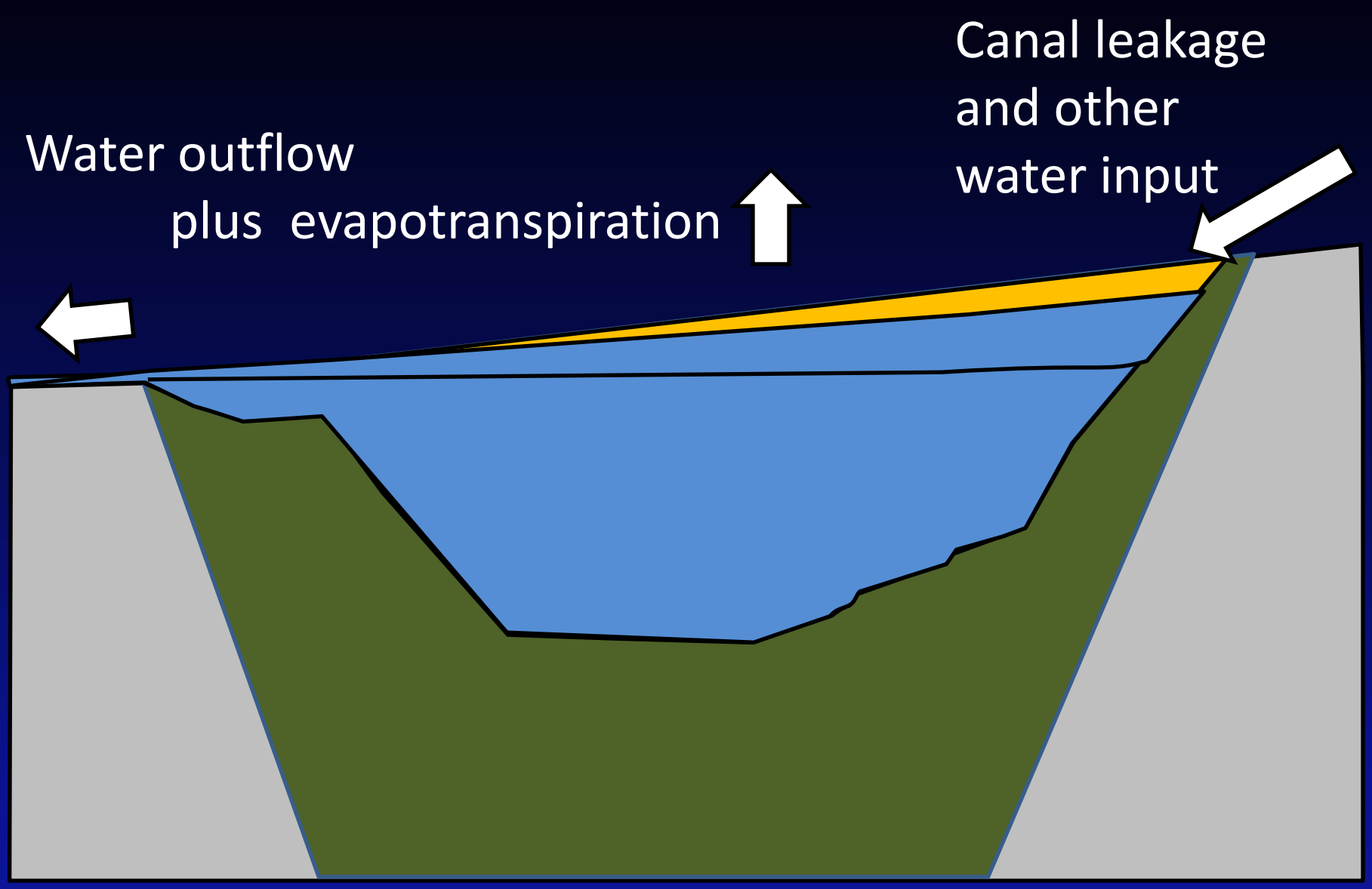


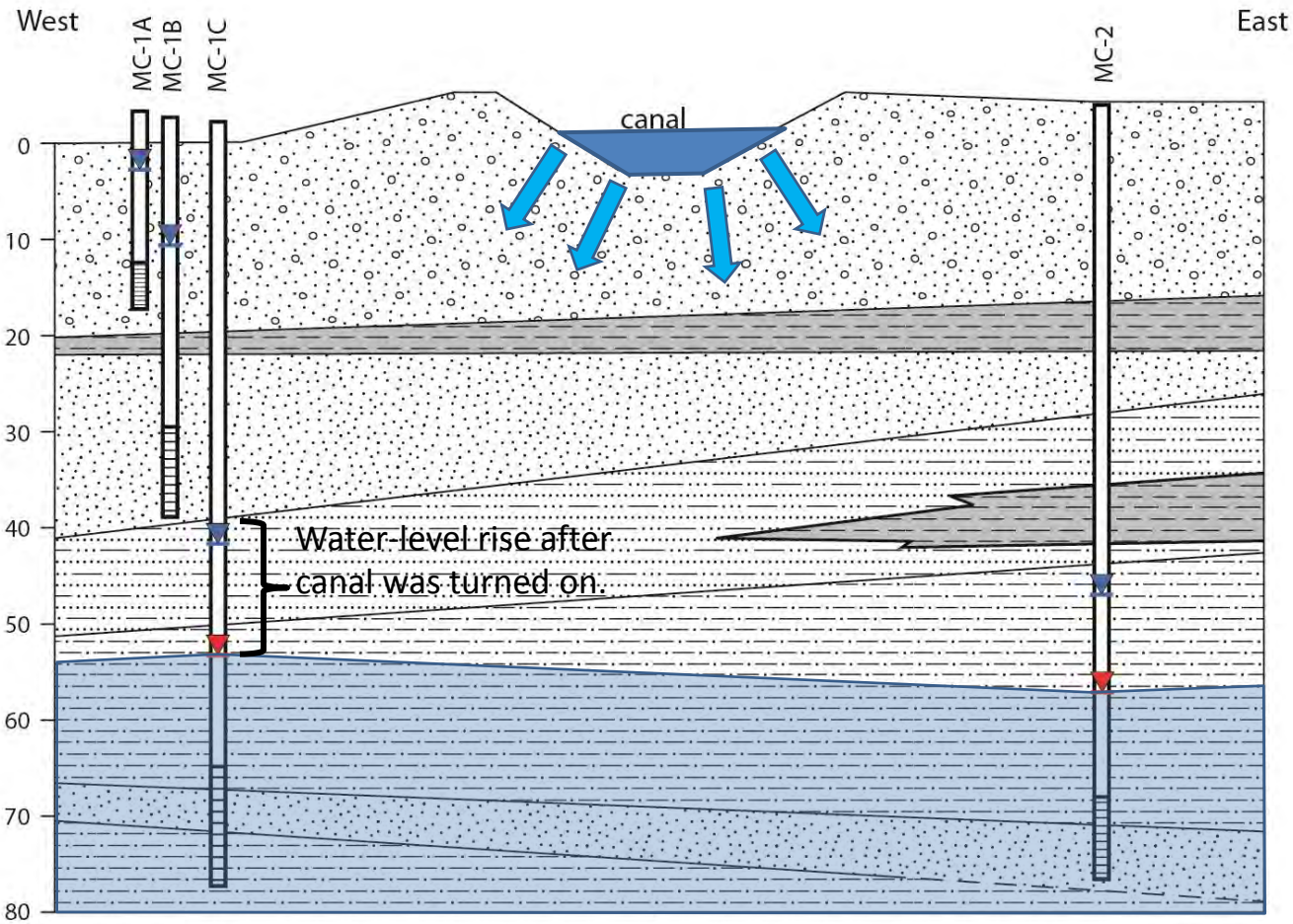
Some valley fill aquifers:

Large basin, both groundwater and surface are forced through a restricted pinch point.

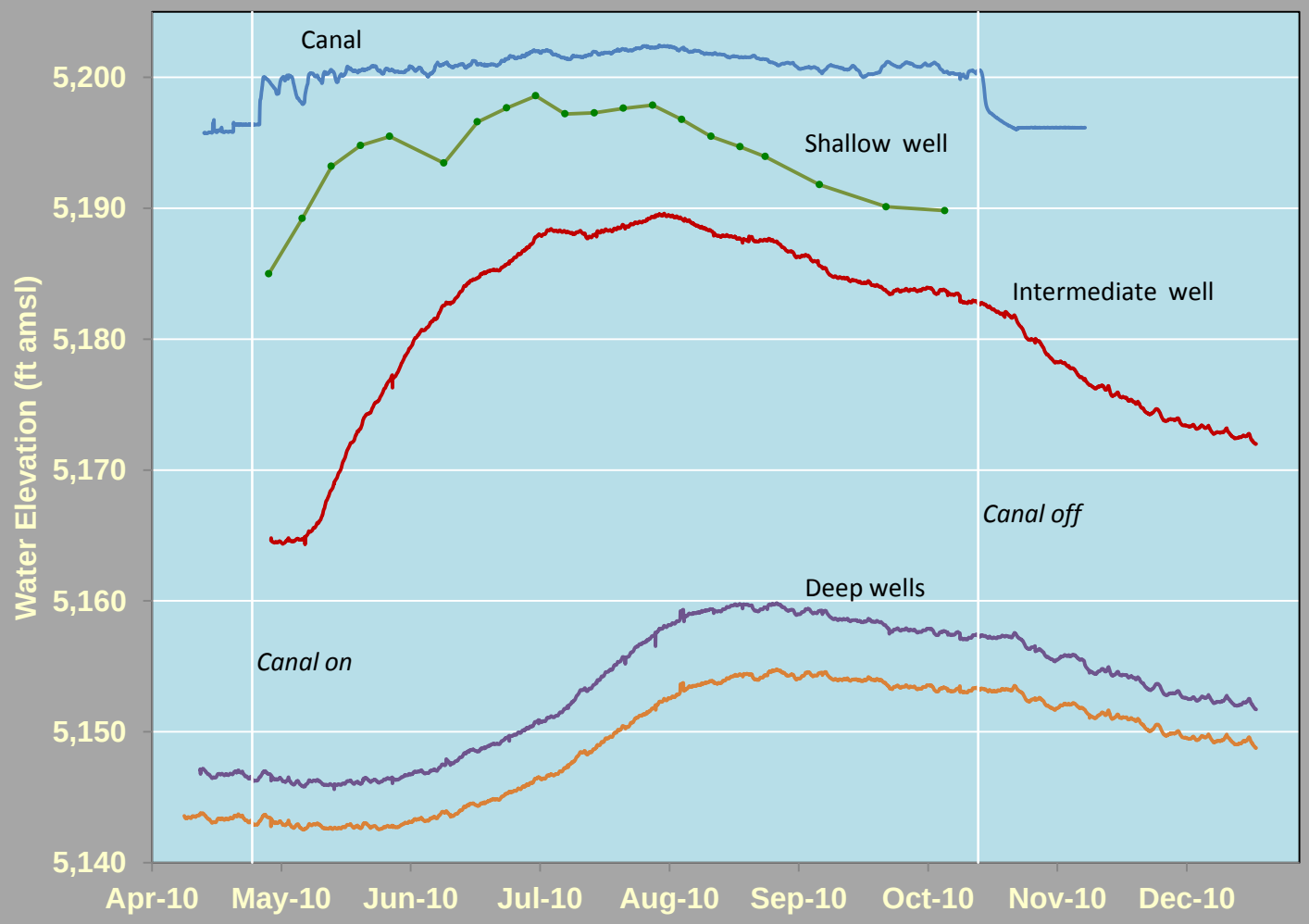


Valley fill aquifer - Annual basin recharge is enhanced by irrigation.





Canal leakage monitoring site, Beaverhead River valley

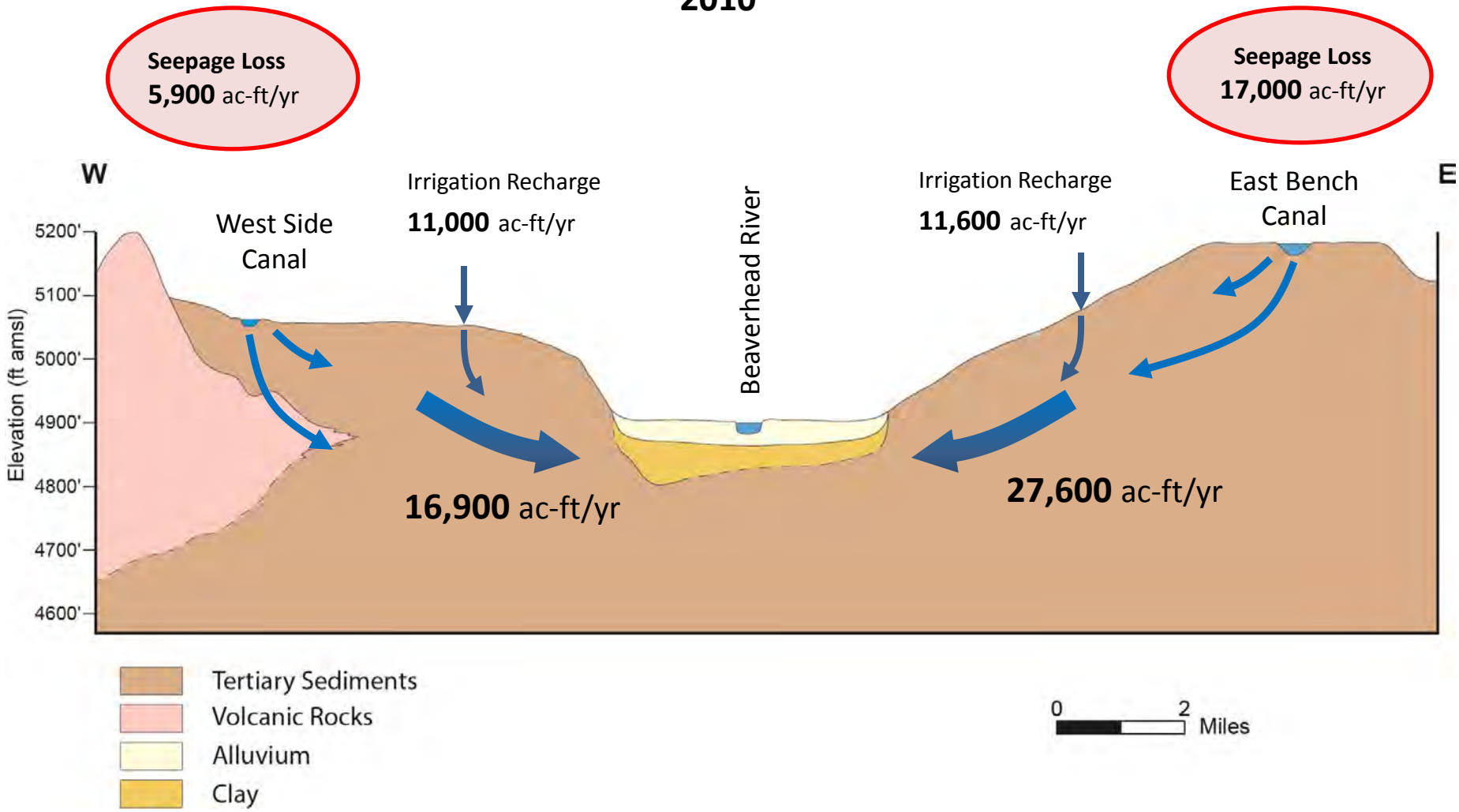


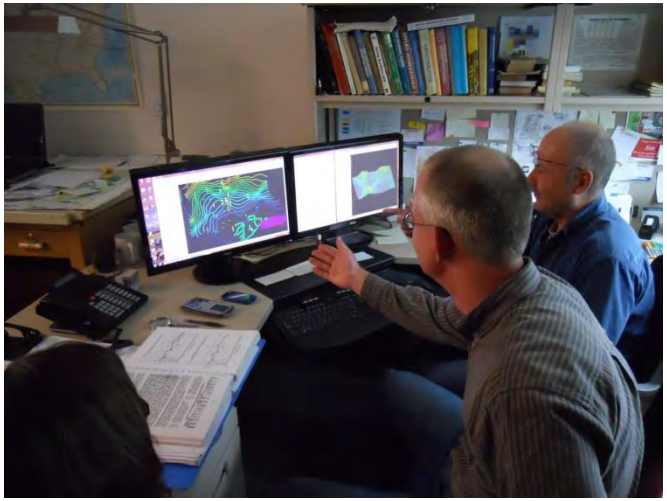
Groundwater response to canal leakage

Seepage Loses for several irrigation canals

• East Bench Canal	2.2 cfs/mile
• West Side Canal	1.2 cfs/mile
• Bozeman area ditches	1.1 cfs/mile
• Upper Big Hole	0.15-1.5 cfs/mile
• Helena Valley	0.6 cfs/mile
• Billings area	0.05-0.5 cfs/mile
• Stillwater-Rosebud Watershed	1.1-1.8 cfs/mile
• Greenfields Bench	0.45-4.7 cfs/mile

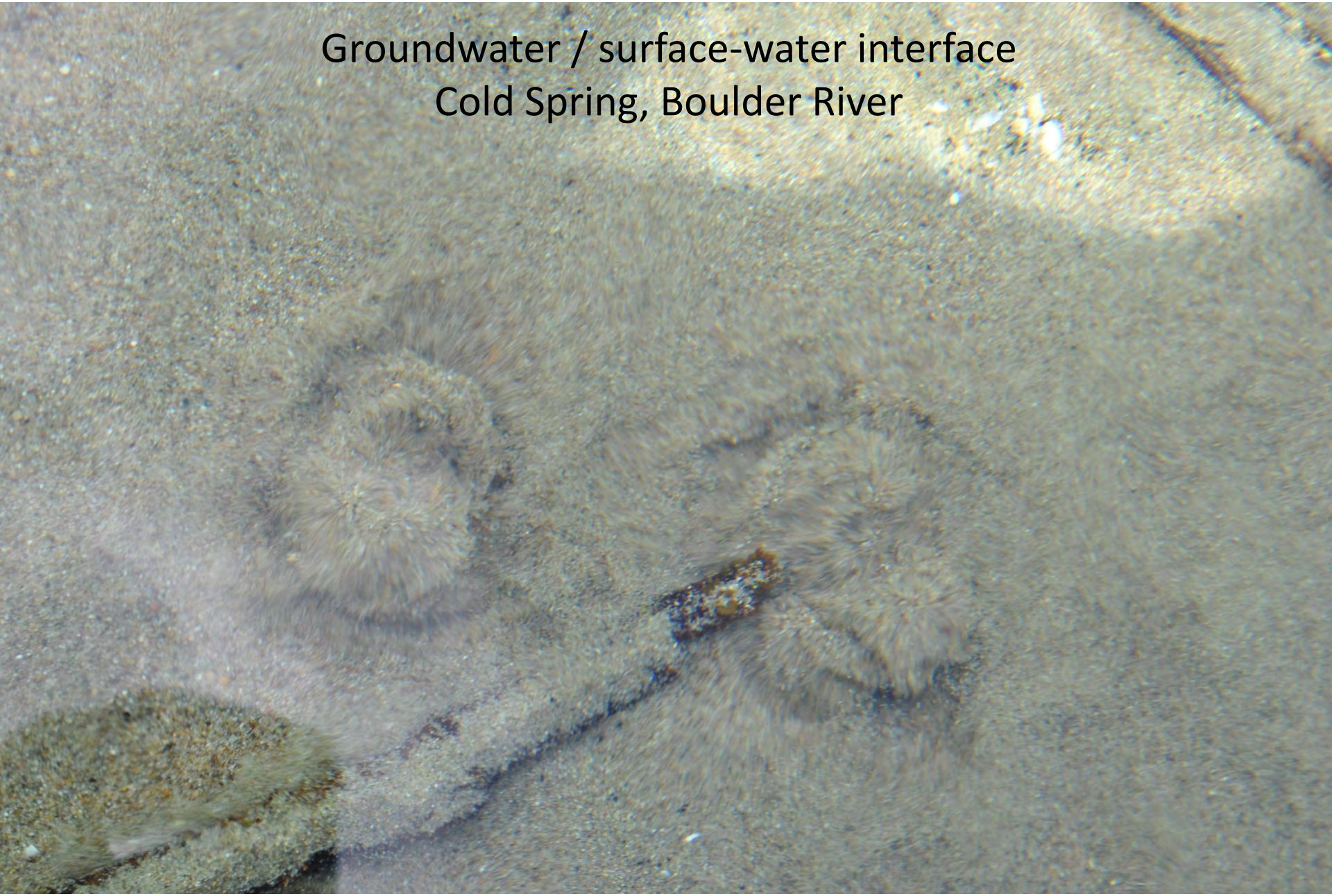
An Example of
Groundwater Recharge from Irrigation and Canal Seepage
2010





Numerous sources of information are included in interpreting and answering the research question.

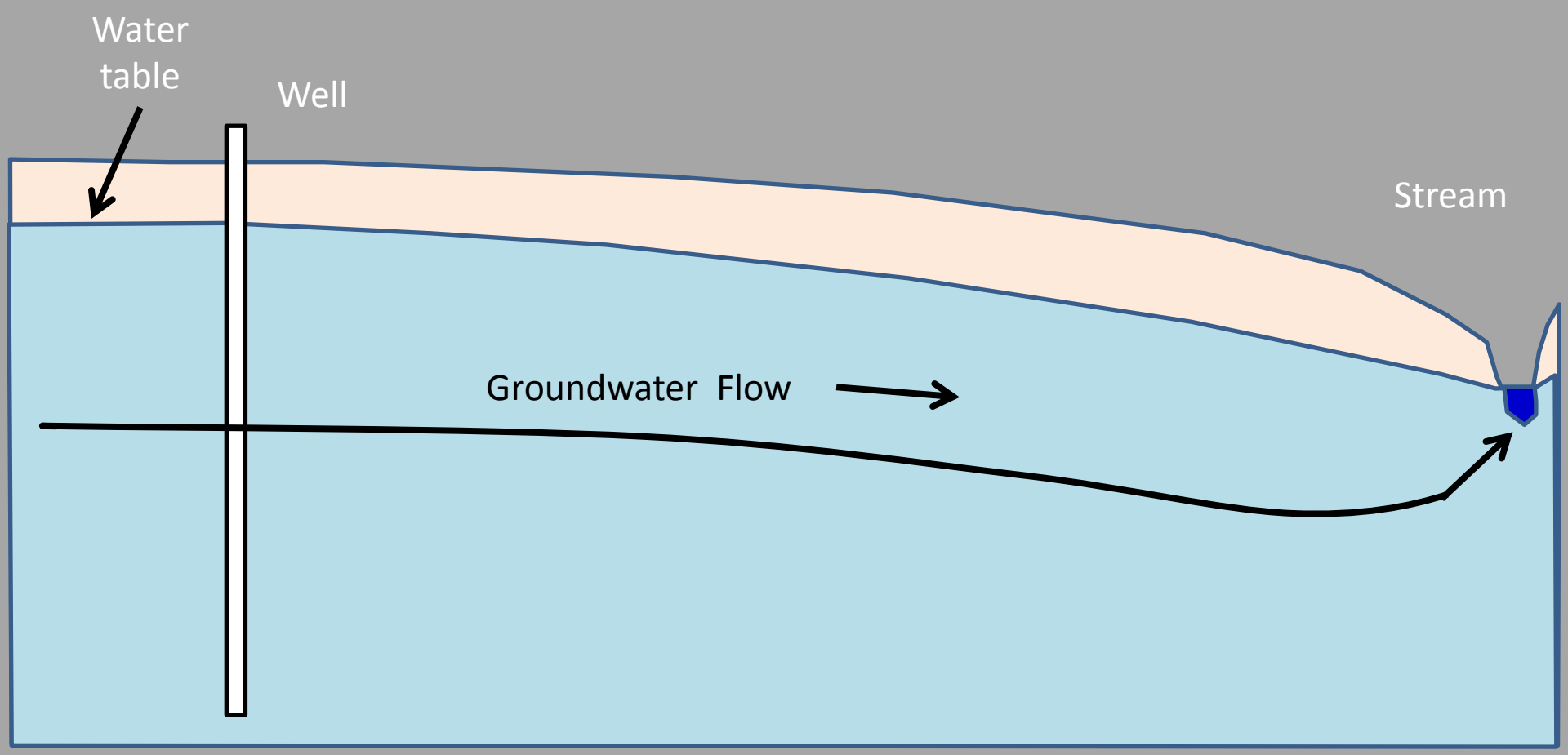
Groundwater / surface-water interface
Beaverhead River



Groundwater discharge area

A little discussion on stream depletion concepts

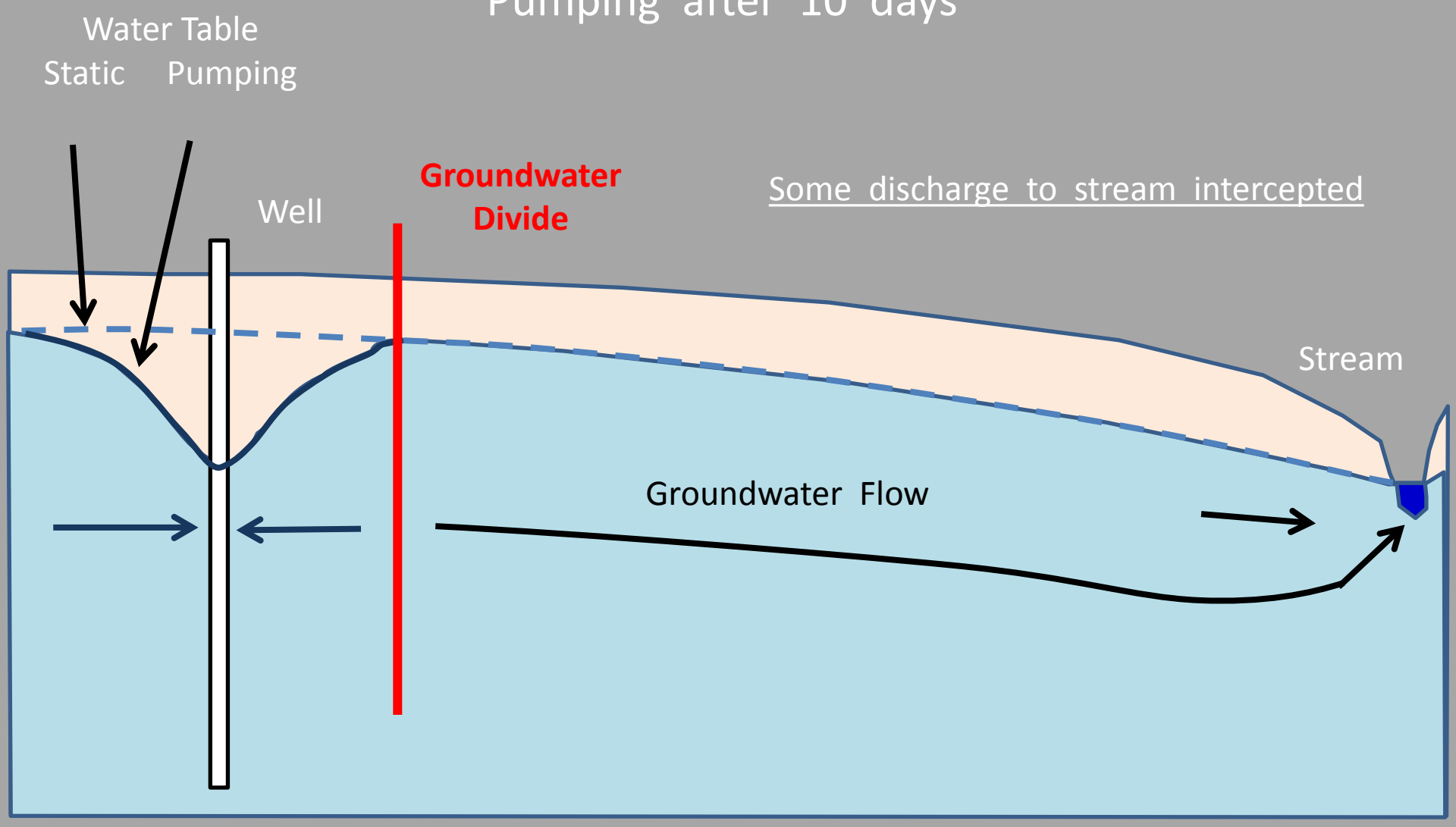
Potential Stream Depletion



Potential Stream Depletion

as an example

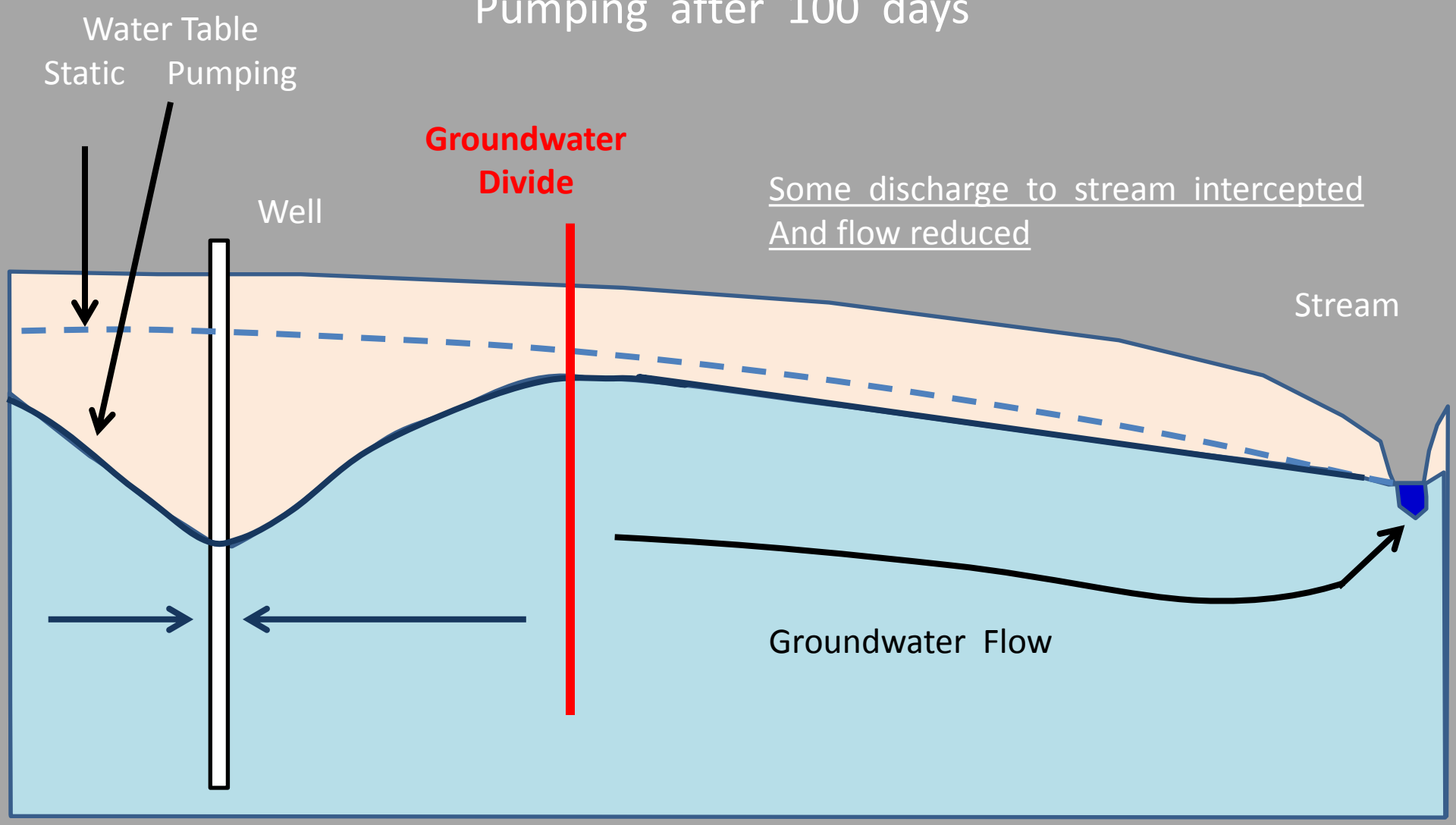
Pumping after 10 days



Potential Stream Depletion

as an example

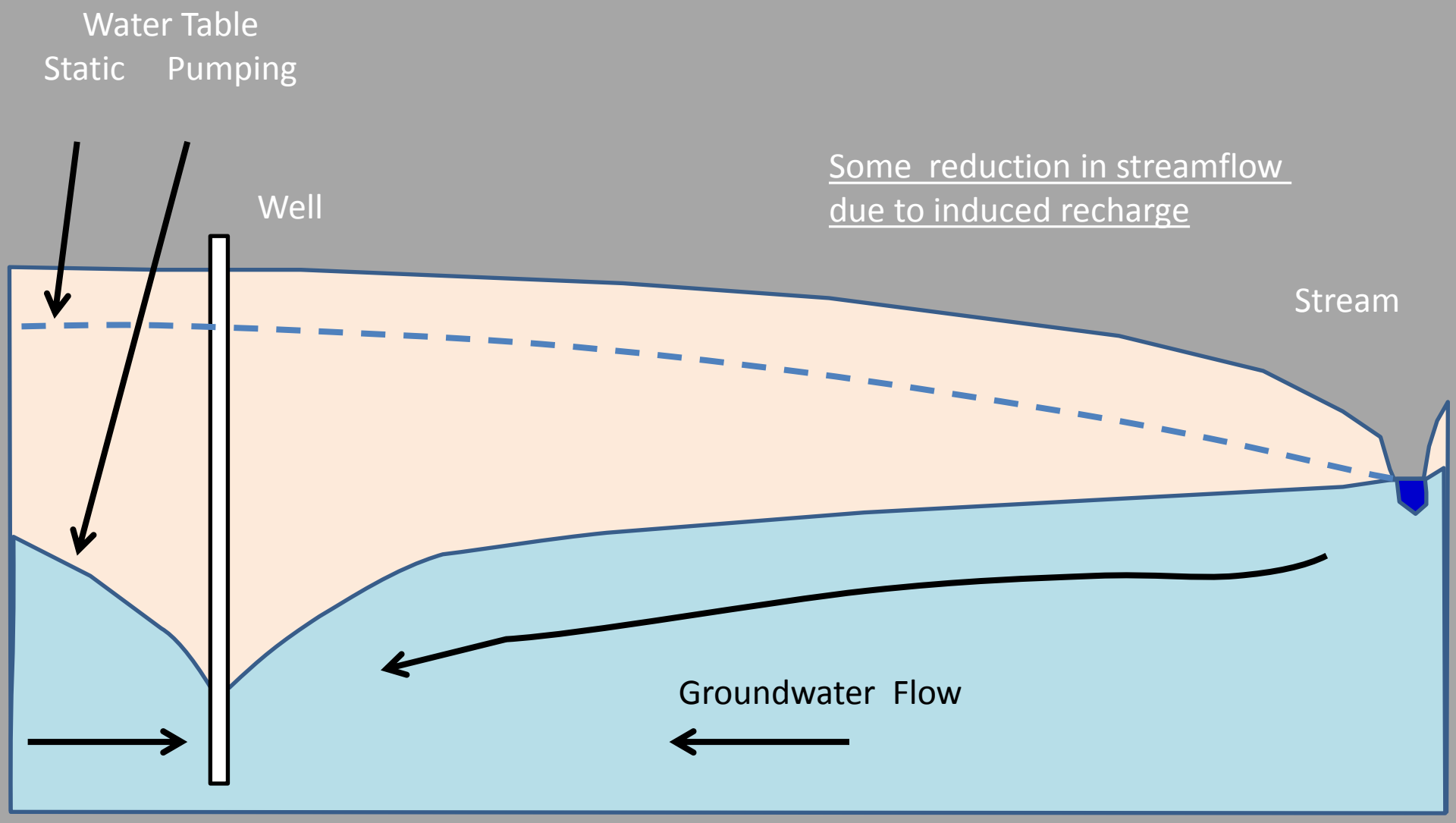
Pumping after 100 days



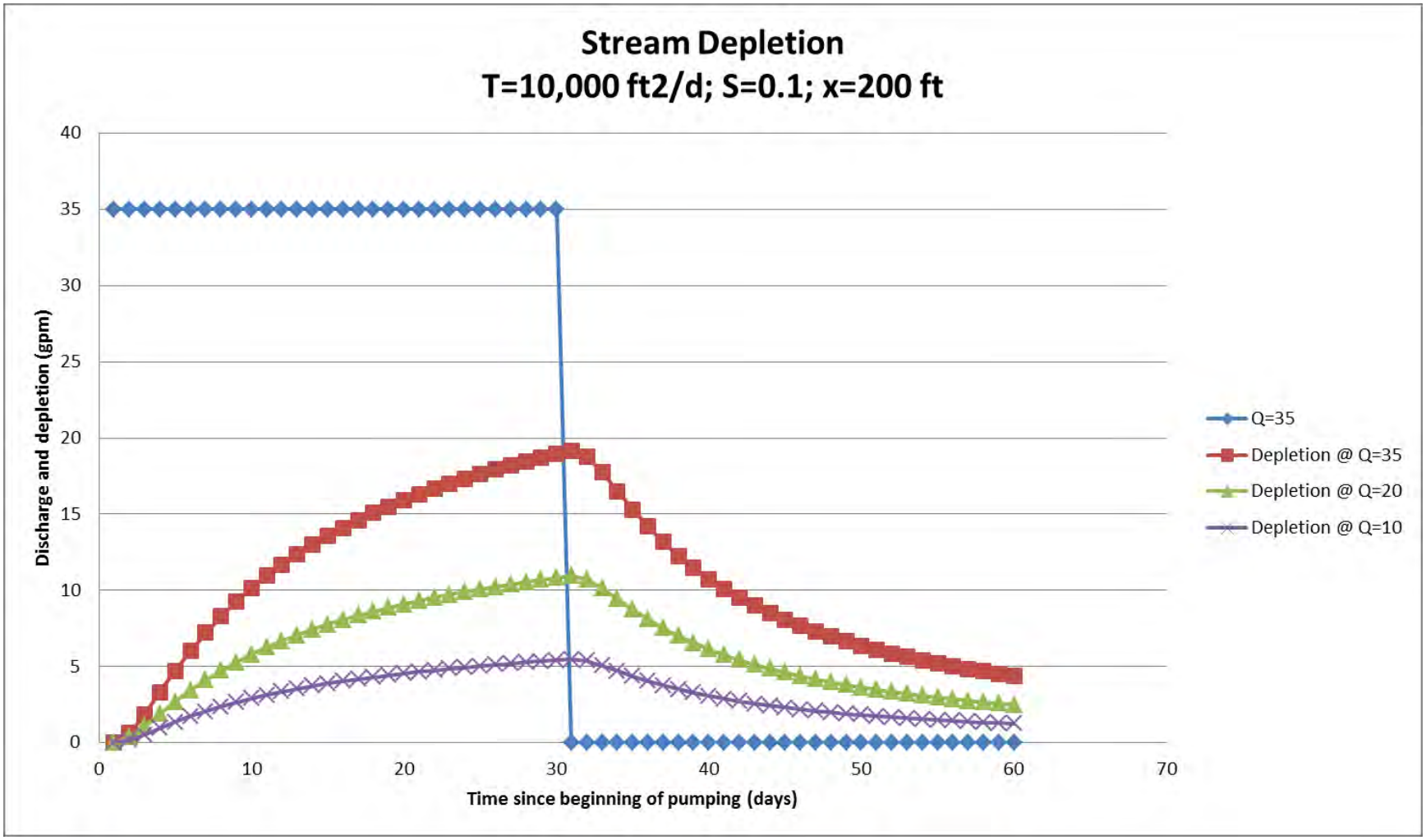
Potential Stream Depletion

as an example

Pumping after 1,000 days

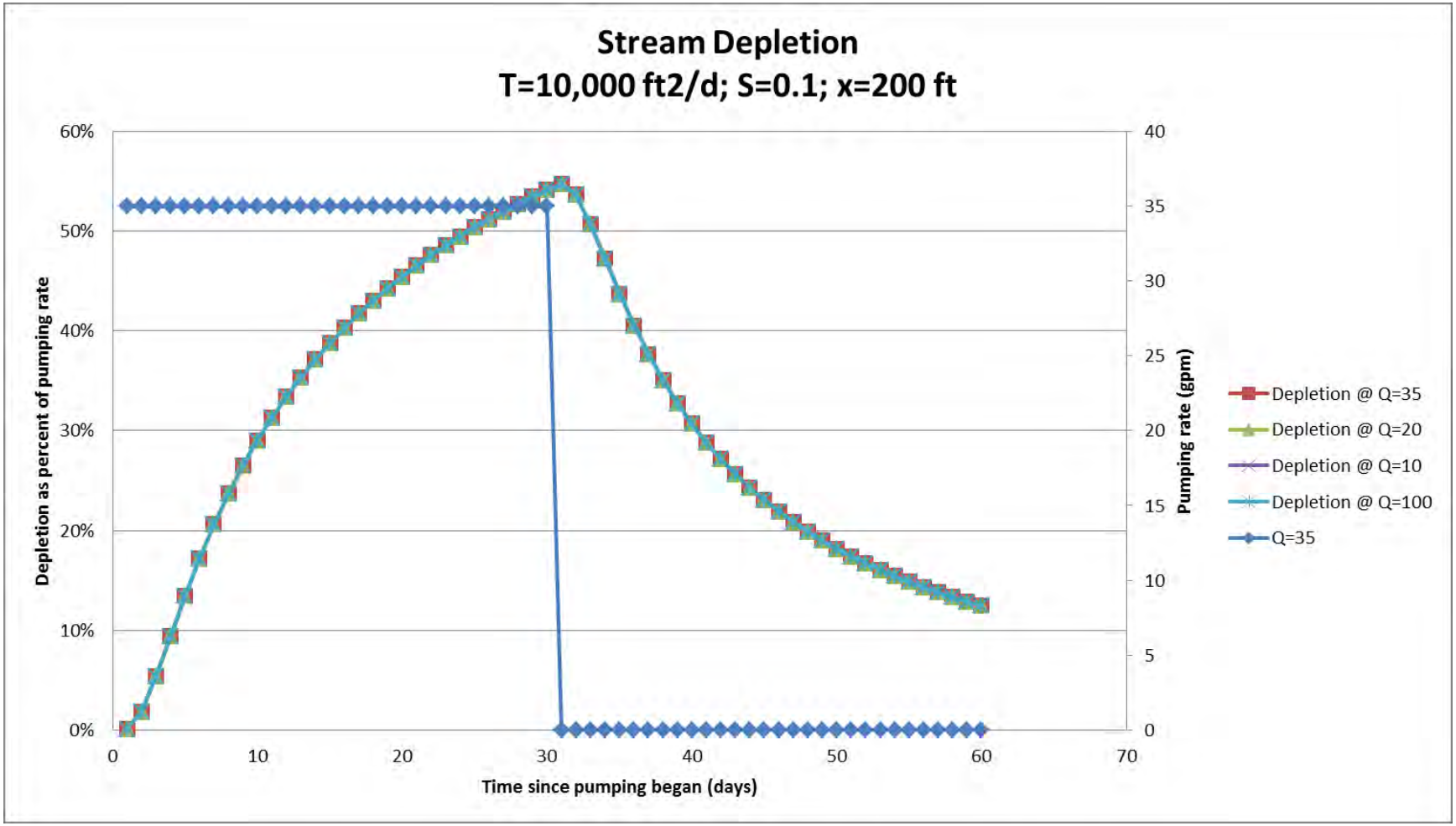


Hypothetical example: Based on Jenkins model (1970)

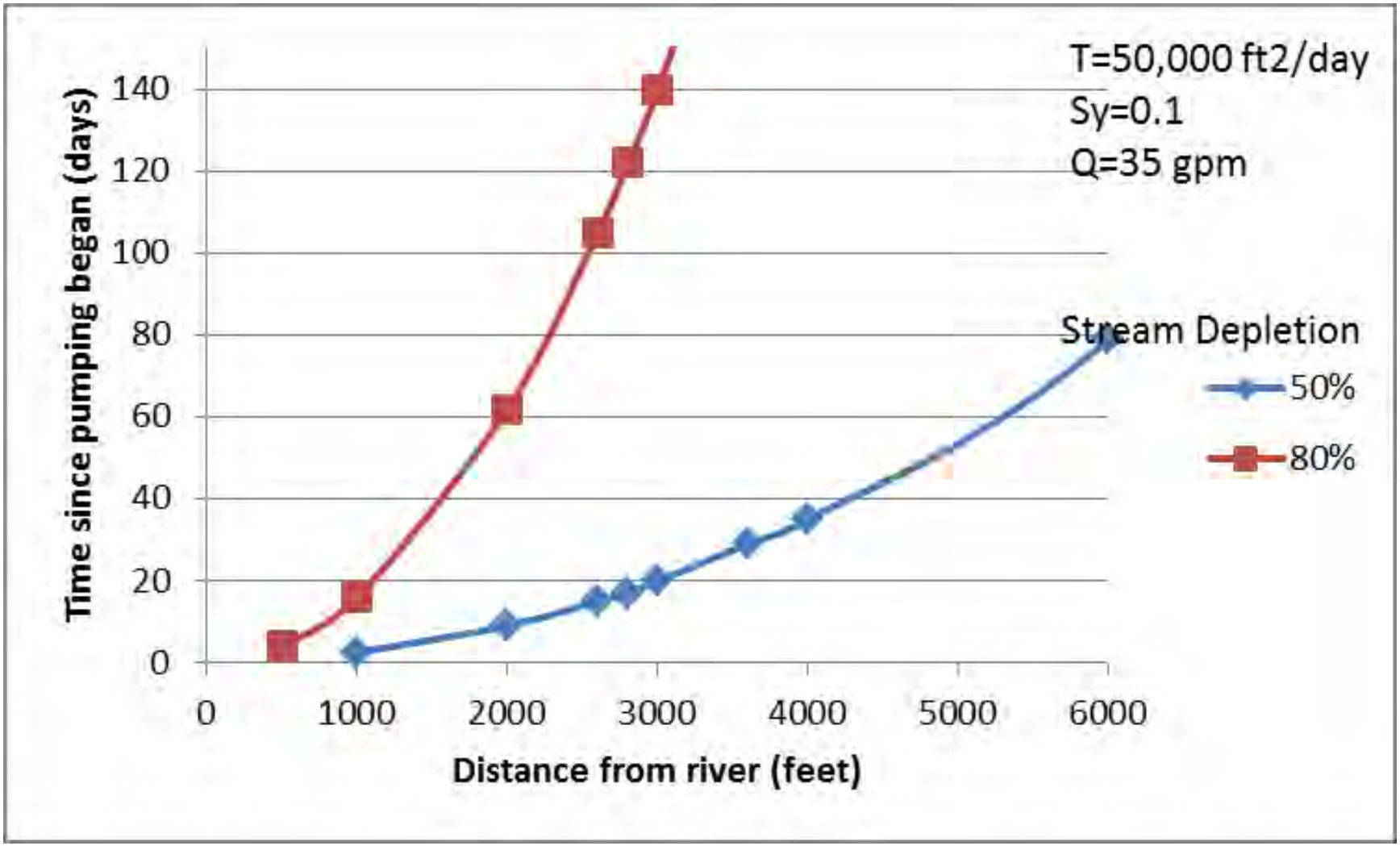


Stream Depletion is the percent of the pumping rate that is reflected in reduced stream flow at that point in time. In this example, stream depletion calculations are based on a number of assumptions including an idealized, homogeneous, isotropic aquifer.

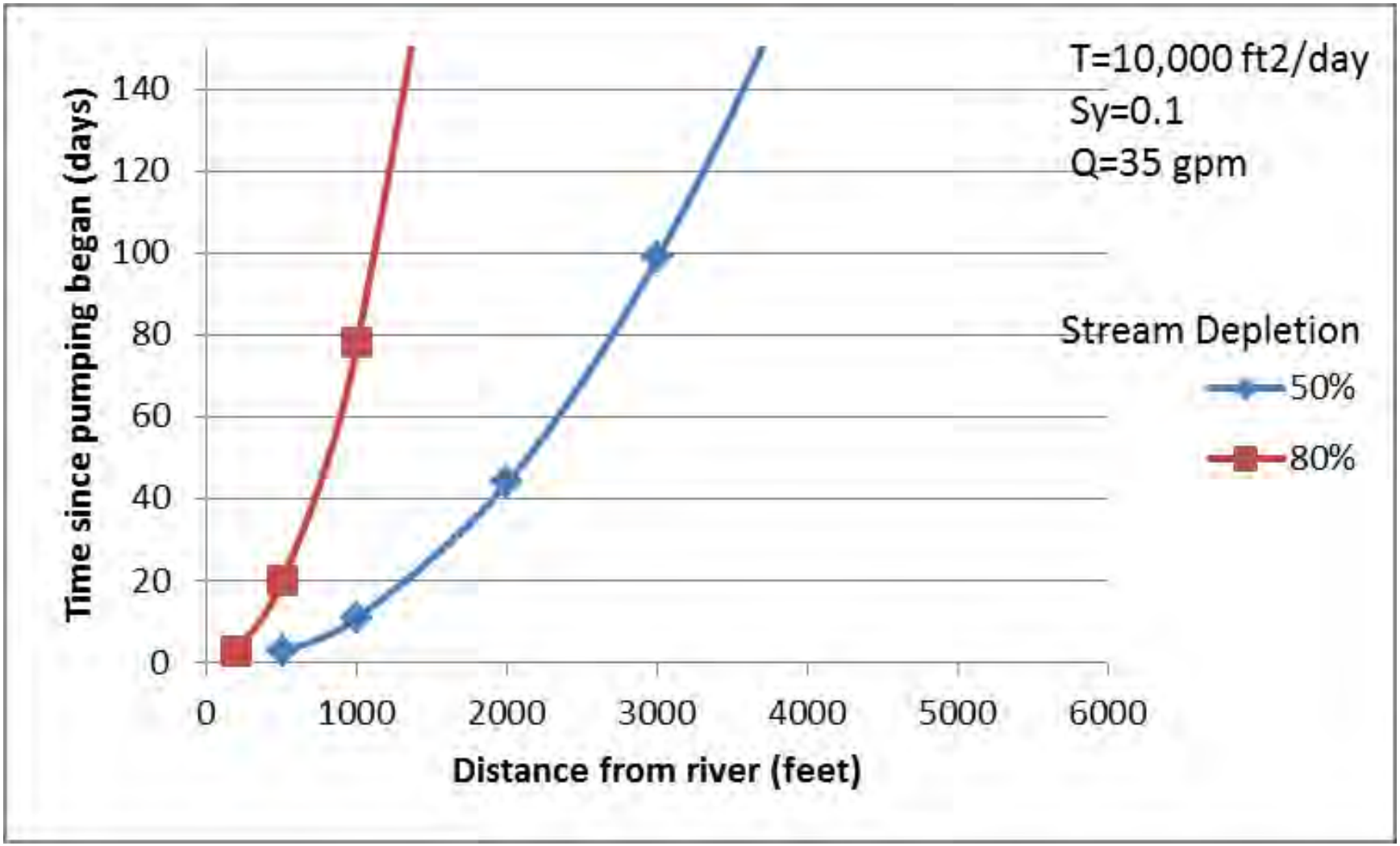
Hypothetical example: Based on Jenkins model (1970)



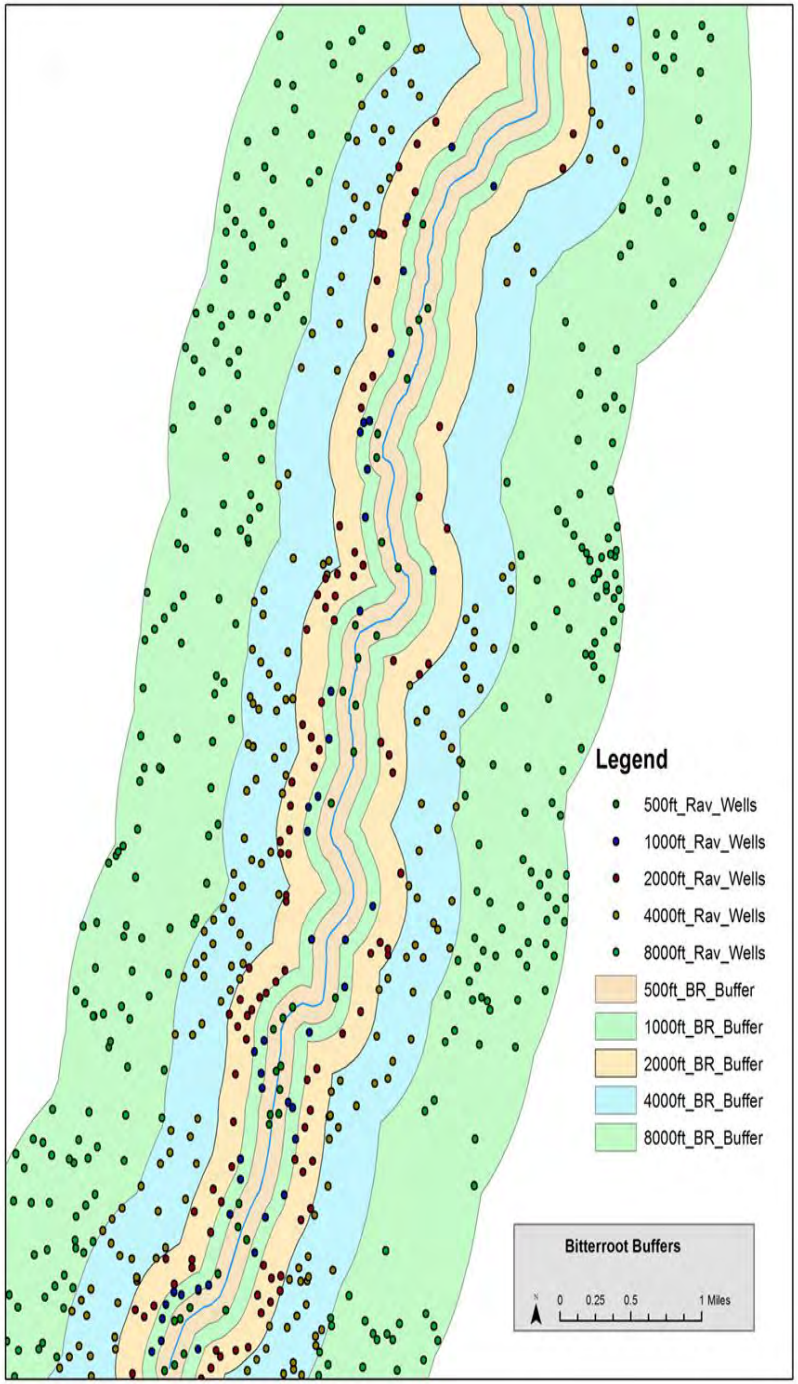
Stream Depletion is the percent of the pumping rate that is reflected in reduced stream flow at that point in time. Stream depletion as a percent is independent of pumping rate or the quantity of stream flow.



Stream depletion comparison of distance from river for the pumping well and duration of pumping for a highly productive aquifer.



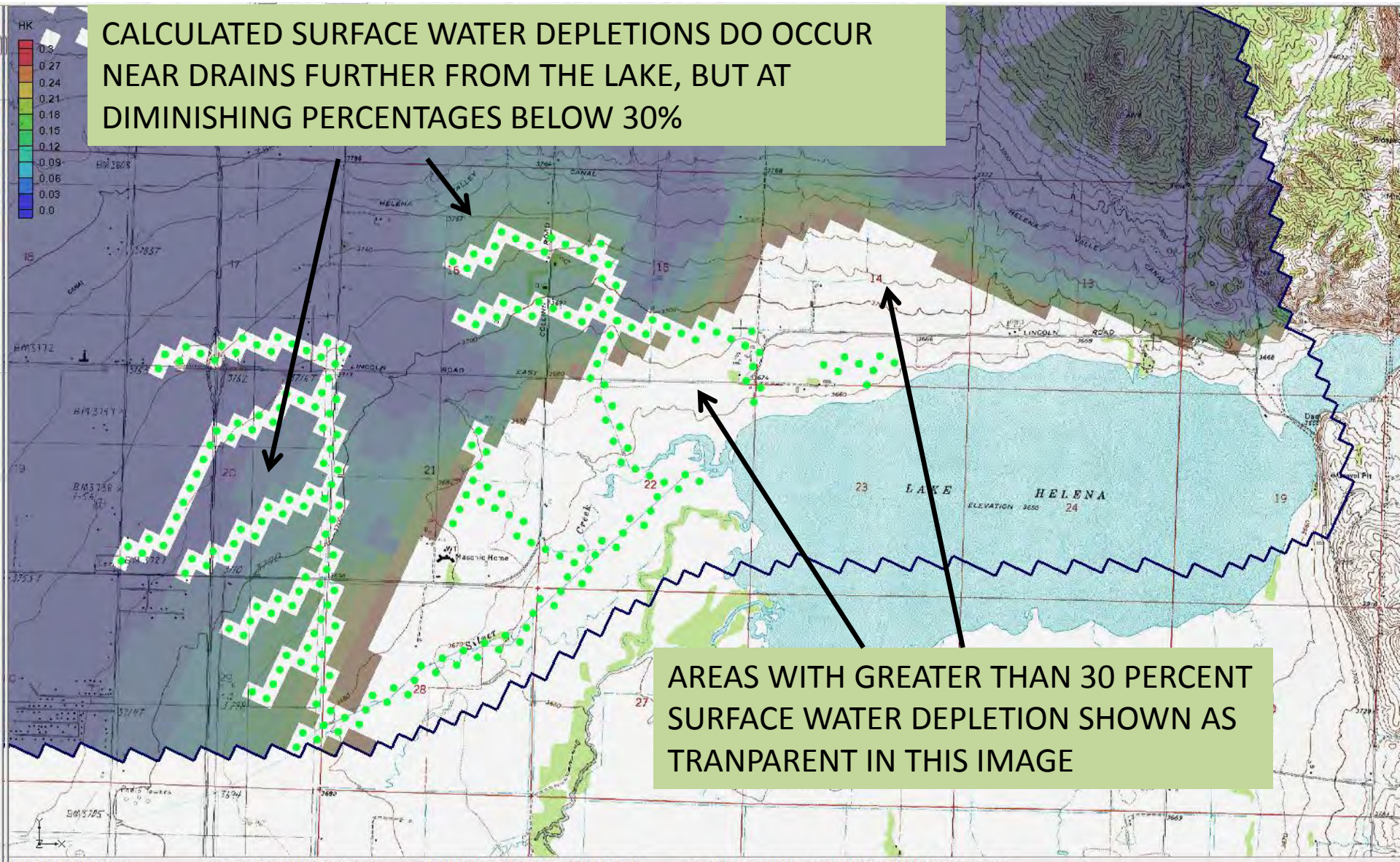
Stream depletion comparison of distance from river for the pumping well and duration of pumping for a moderately productive aquifer.



Estimates of stream depletion rates using a simple model (Jenkins, 1970). Well locations from GWIC.

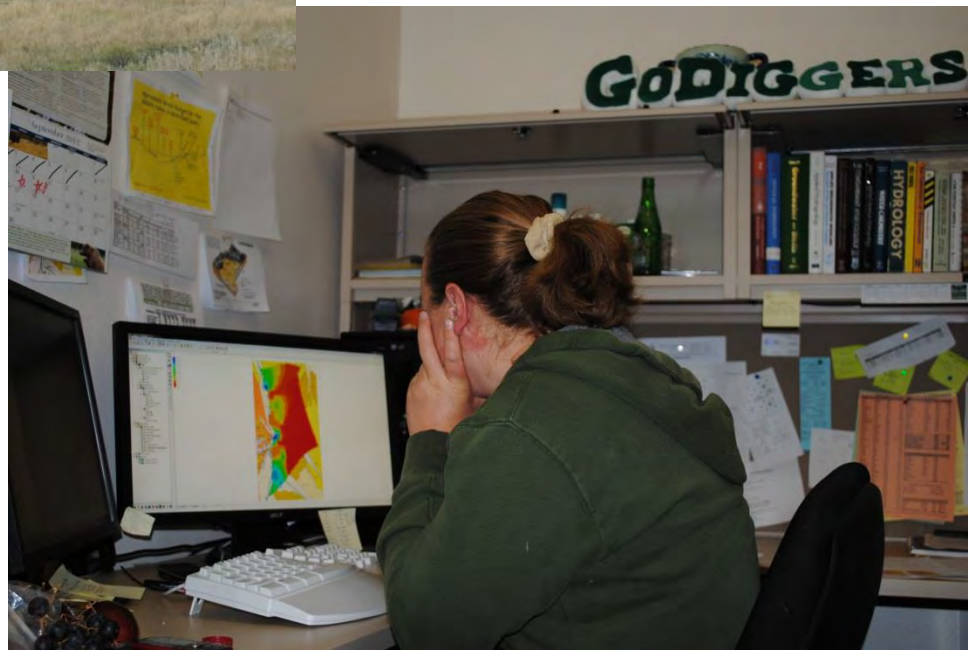
STREAM FLOW DEPLETION TOOL

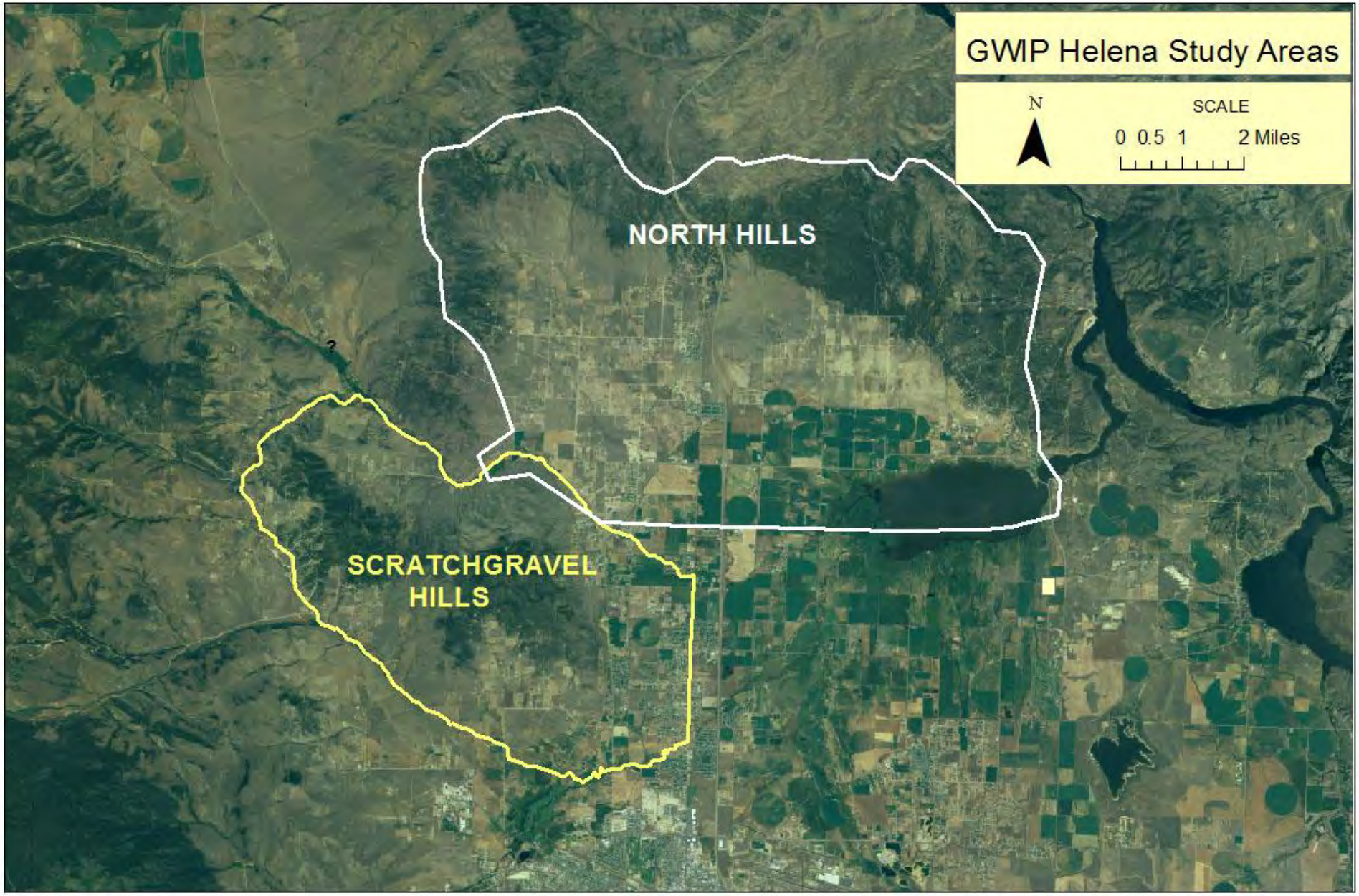
Estimates of stream depletion rates using a robust model allowing for aquifer heterogeneity (MODFLOW).



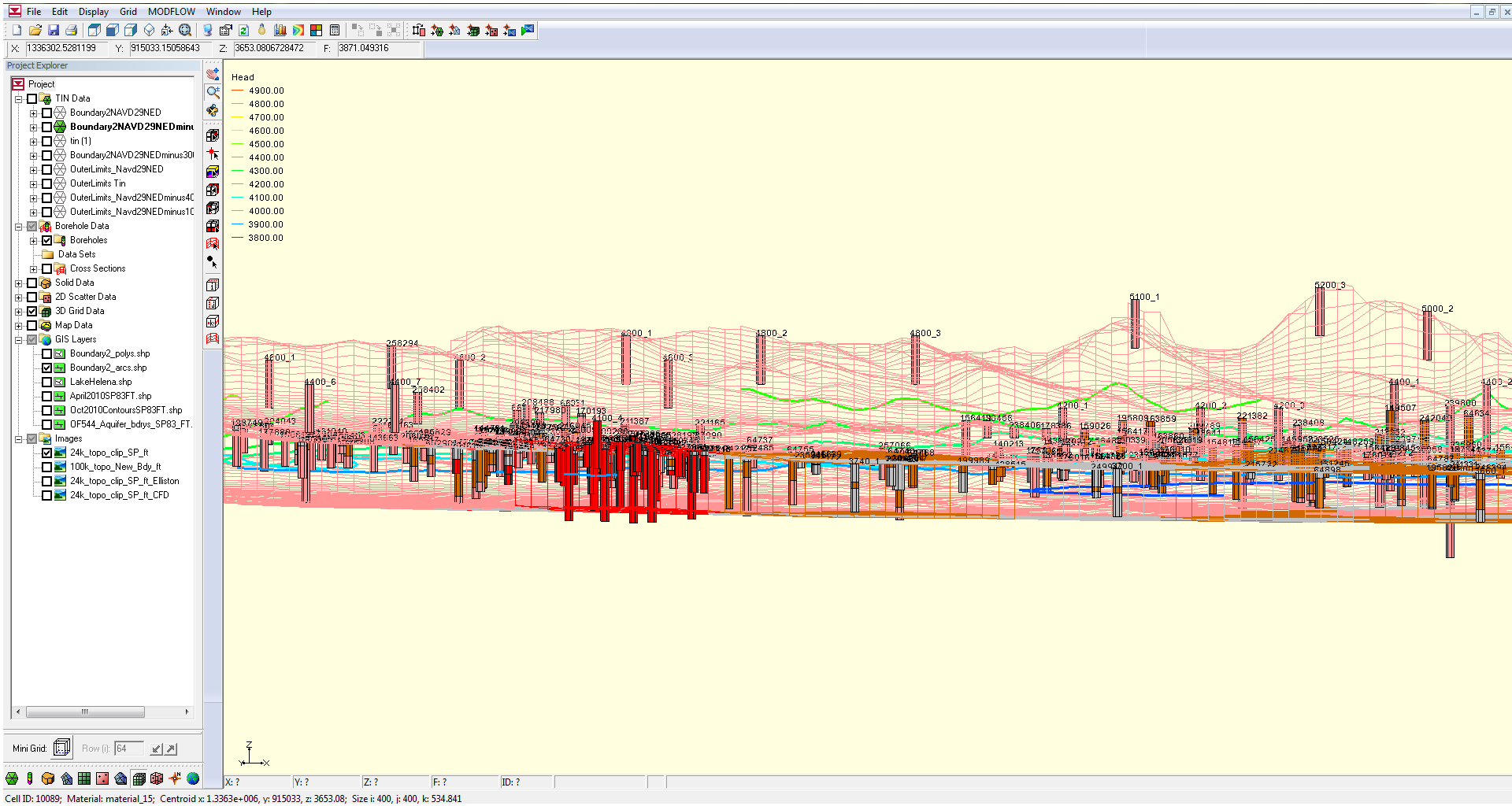
Taking field data to

Numerical Modeling

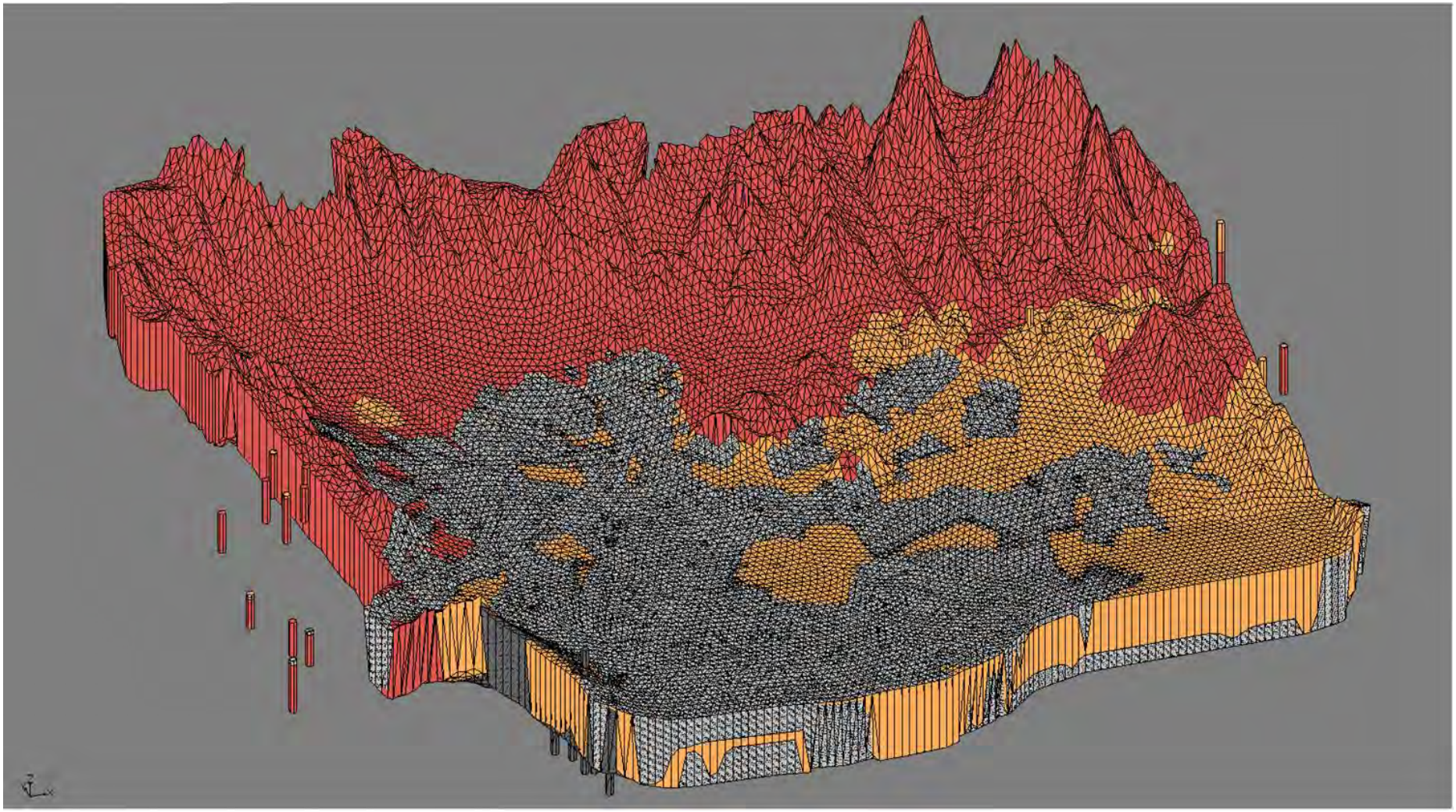



GWIP Helena Study Areas
N
SCALE
0 0.5 1 2 Miles
NORTH HILLS
SCRATCHGRAVEL HILLS

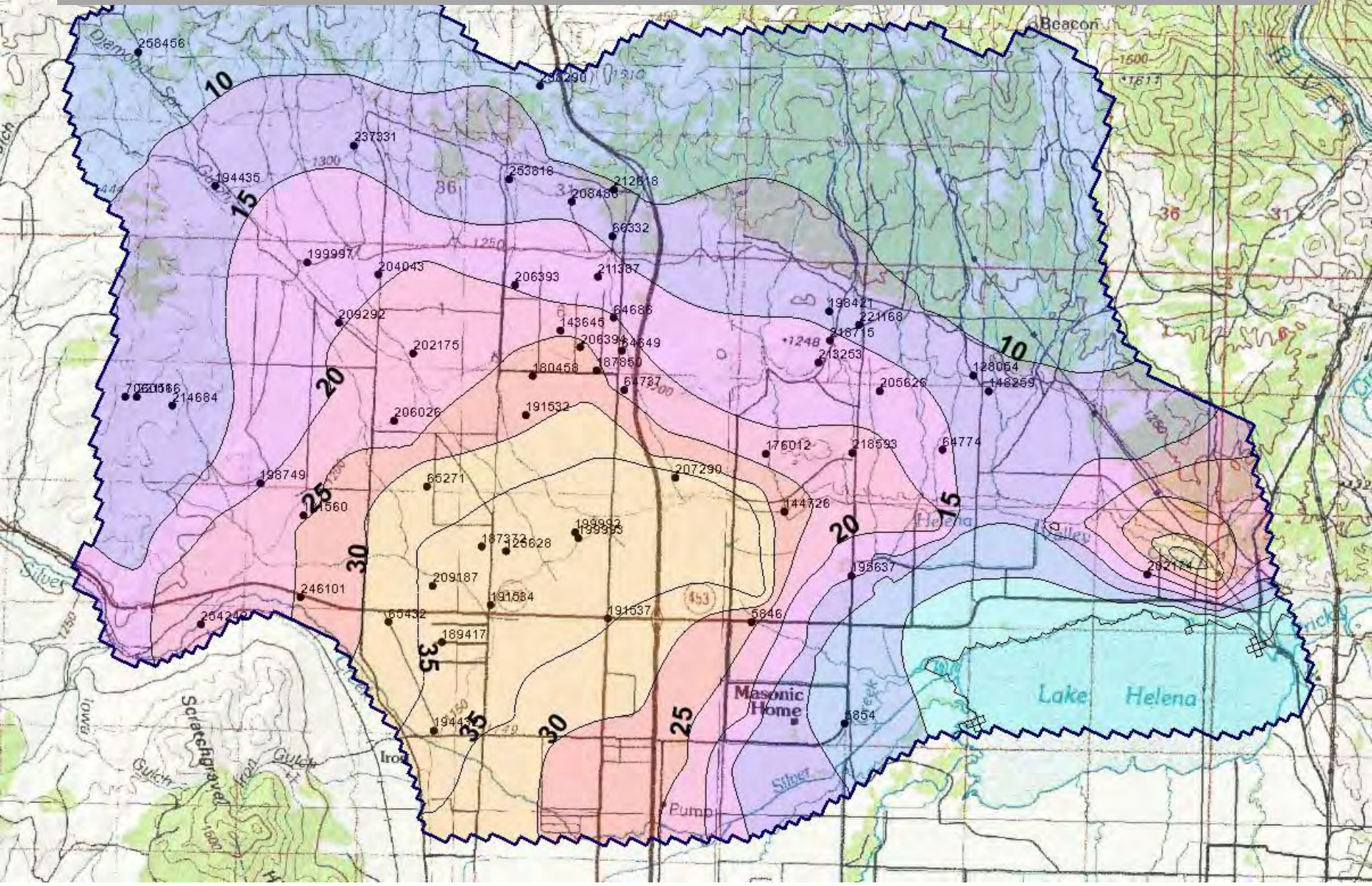
Example: North Hills MODFLOW grid (near Helena).



Example: North Hills MODFLOW grid (near Helena).



Modeled decrease in groundwater levels in North Hills study area with all current irrigation influence removed.



GWIP is task with helping provide a consistent Statewide approach to addressing specific issues. The following are examples of these types of issues.

Stream depletion due to groundwater development

Impacts to aquifers: increasing demand and changing land use

Protection of senior water rights (groundwater and surface water)

Water quality impacts such as septic effluent

Cumulative effects of water development

Aquifer Storage and Recovery (ASR) in Montana

How Projects are Chosen:

Nominations are based on locally identified concerns

Ranked by the:

Ground Water Steering Committee

Voting: DNRC, DEQ, Dept of Ag, State Library

Non-voting: Representatives of other perspectives

Ranking Criteria:

Population growth, increasing number of wells, industrial pressure, land use conversion, complexity.

Discussion

Aquifer test site with monitoring wells in the Gallatin Valley