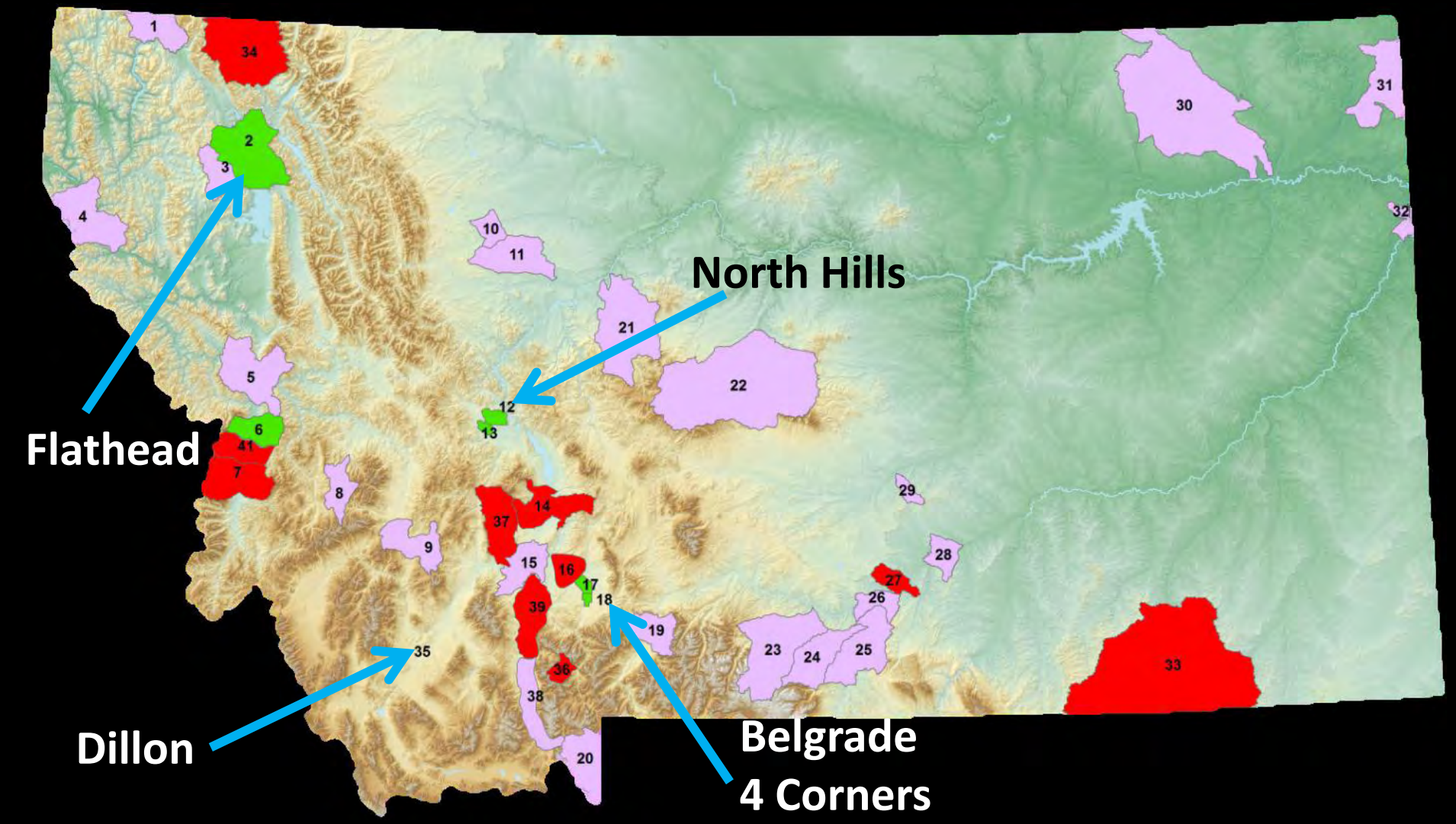
Ground Water Investigation Program (GWIP)

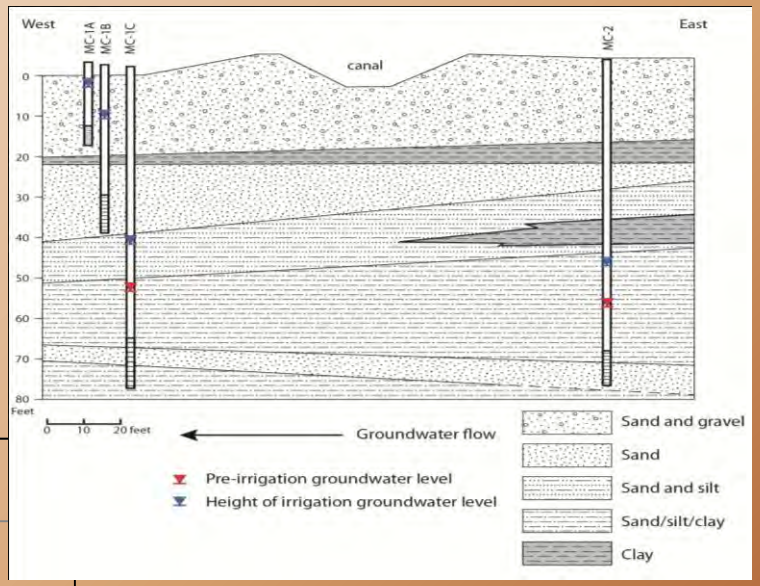
WPIC update September 14, 2011

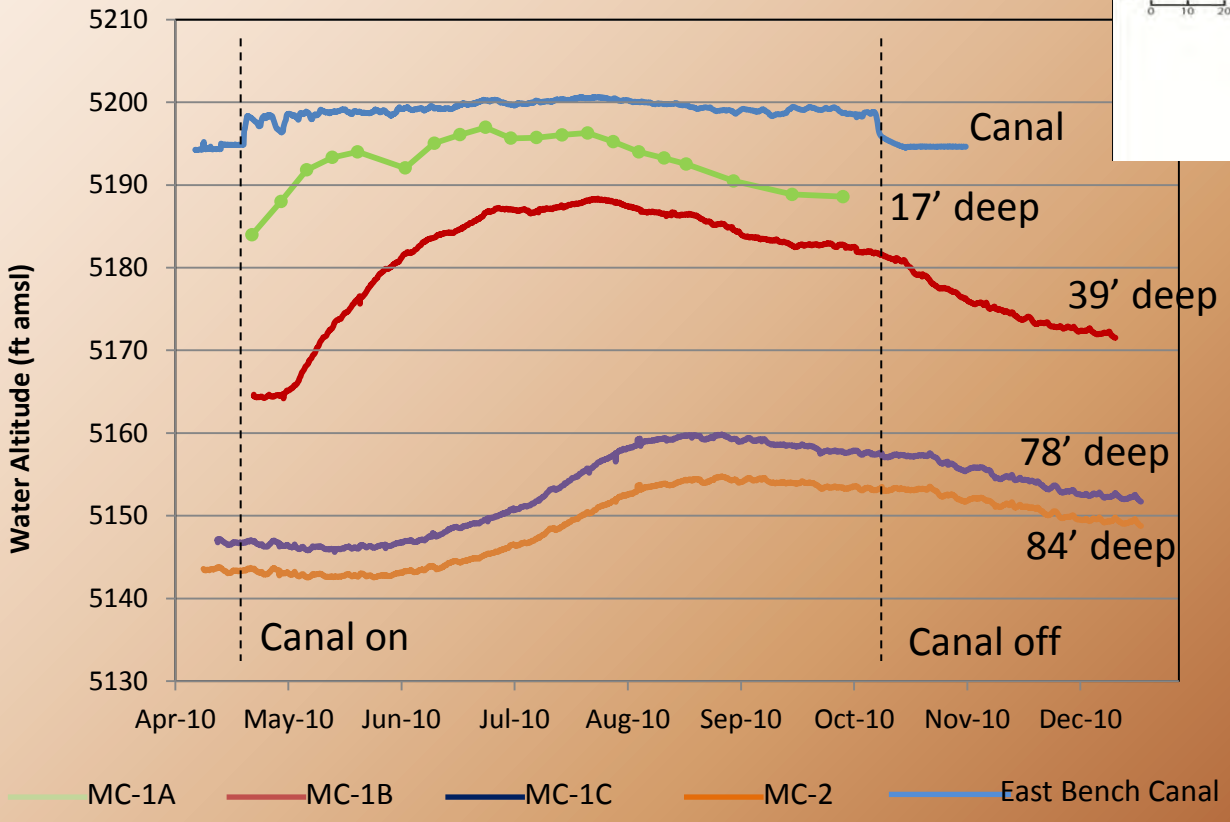
Presented by John Wheaton, MBMG



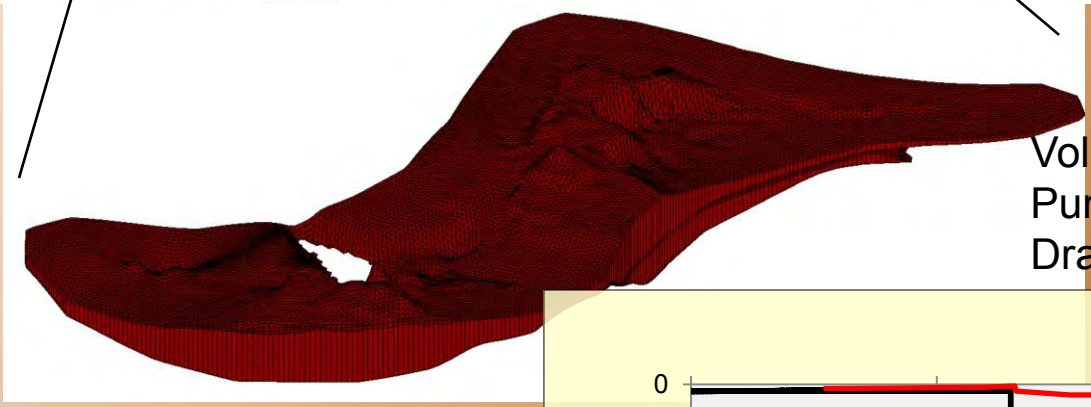
Lower Beaverhead Valley Study

East Bench Canal Influence on groundwater

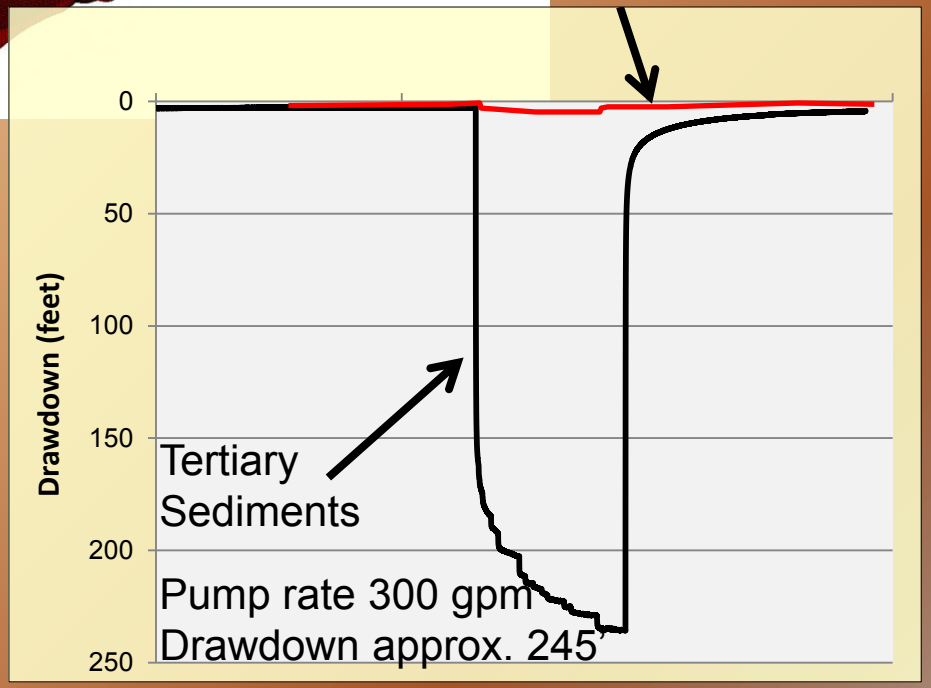

West
East
MC-1A
MC-1B
MC-1C
MC-2
canal
0
10
20
30
40
50
60
70
80
Feet
0
10
20 feet
Groundwater flow
Pre-irrigation groundwater level
Height of irrigation groundwater level
Sand and gravel
Sand
Sand and silt
Sand/silt/clay
Clay


Water Altitude (ft amsl)
5210
5200
5190
5180
5170
5160
5150
5140
5130
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Canal
17’ deep
39’ deep
78’ deep
84’ deep
Canal on
Canal off
MC-1A
MC-1B
MC-1C
MC-2
East Bench Canal

Volcanic rock aquifer near Dillon



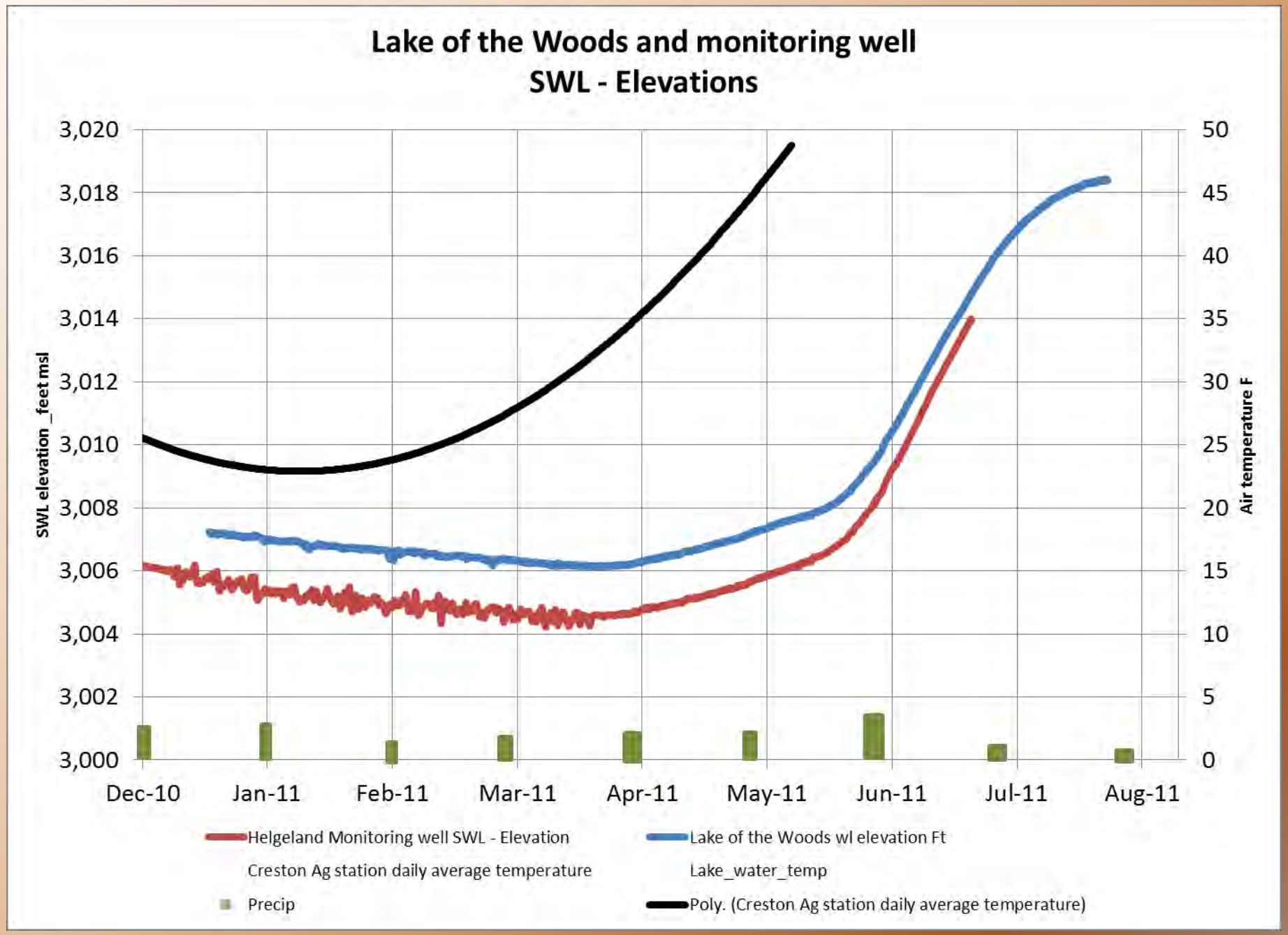
Volcanic Rock
Pump rate 1,200 gpm
Drawdown approx. 4’

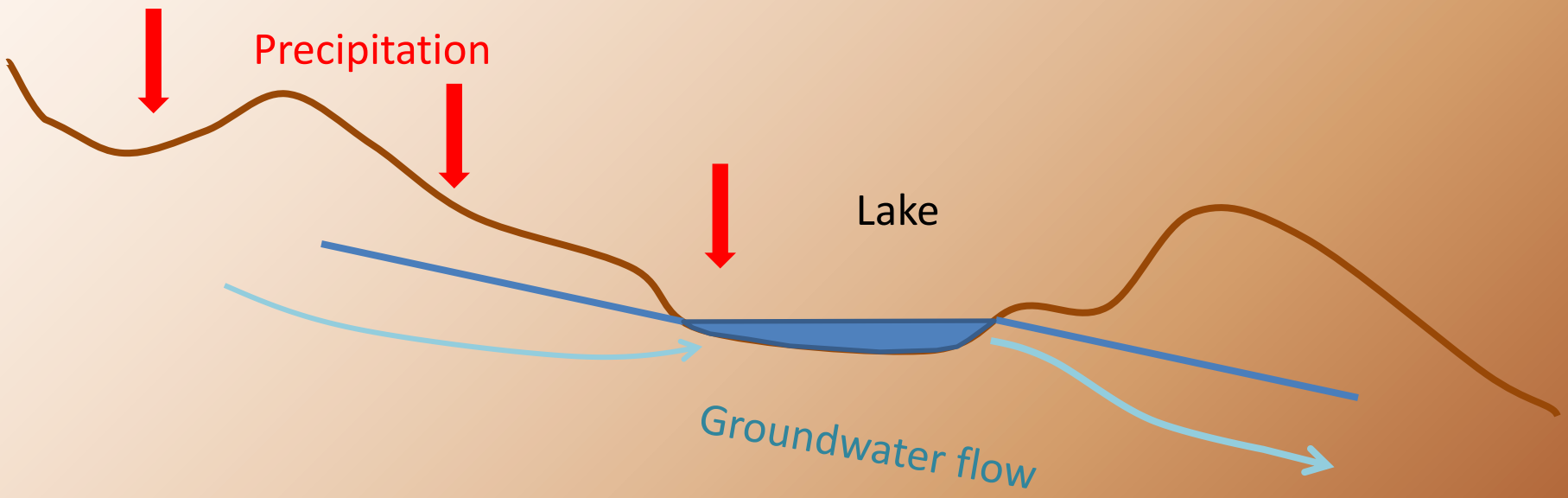


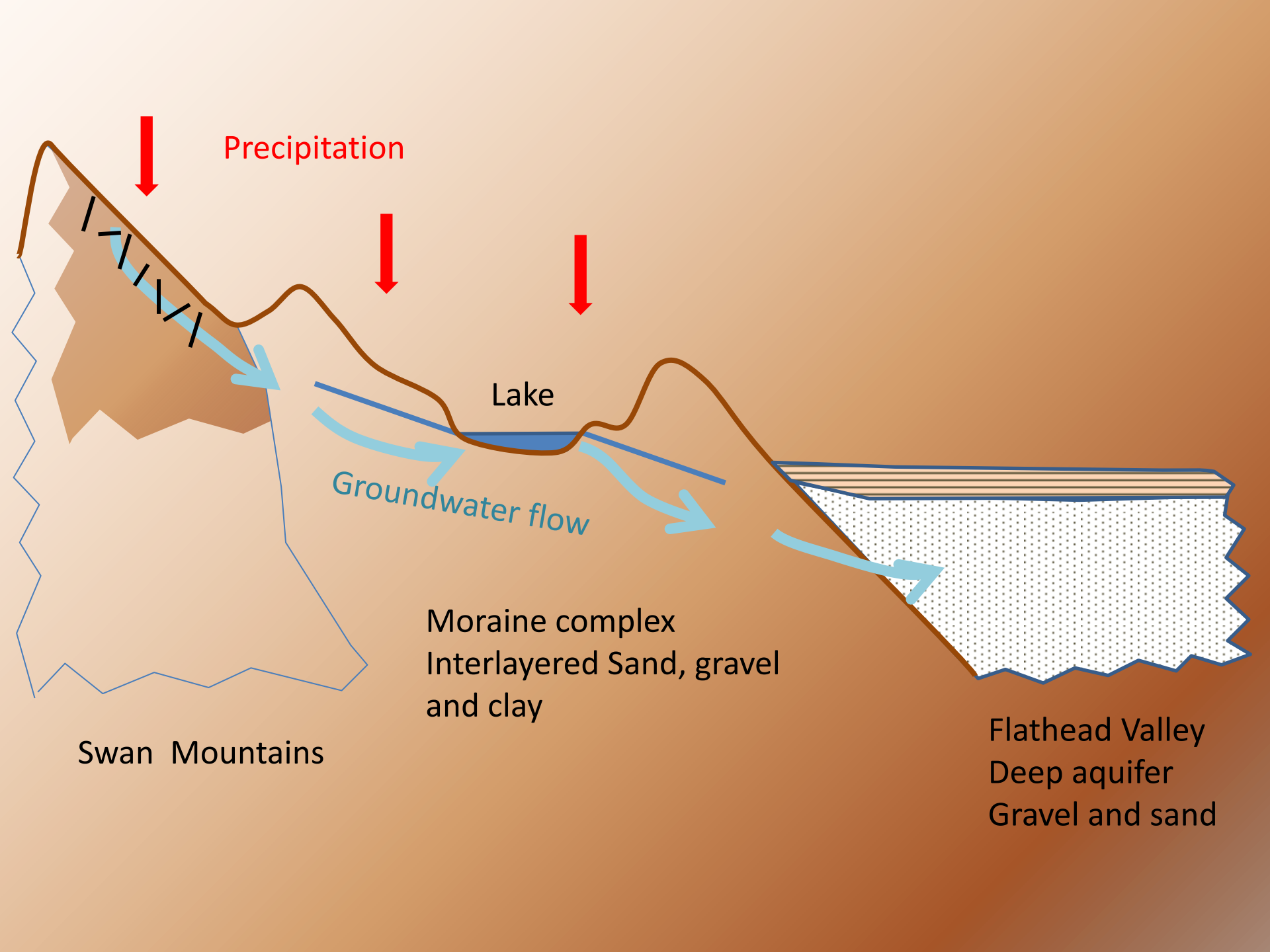

Flathead Valley
Lake of the Woods
Groundwater flow direction

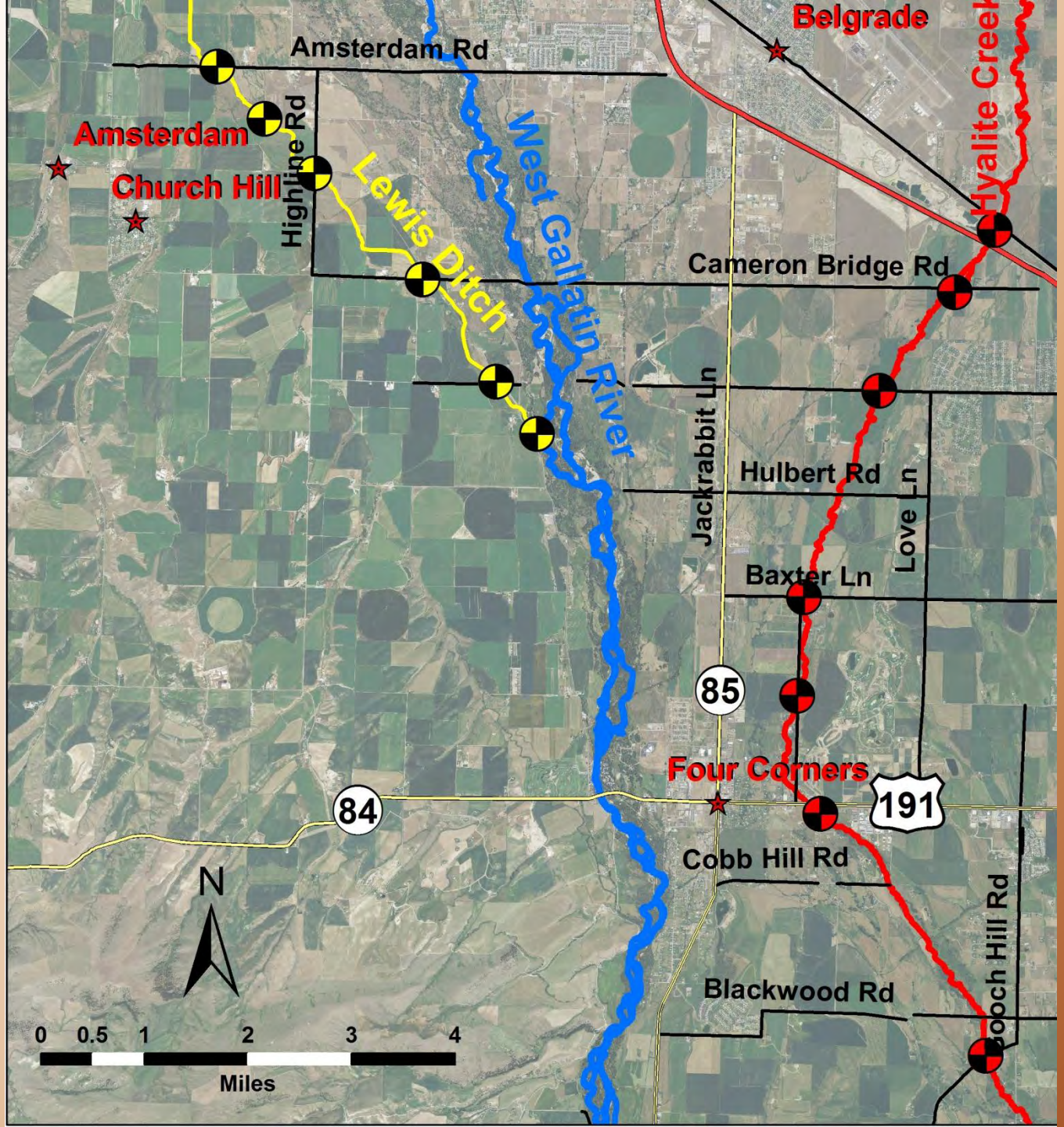

Lake of the Woods site
Installing datalogger and staff gauge


Lake of the Woods site
Downloading datalogger


Lake of the Woods and monitoring well
SWL - Elevations
SWL elevation _feet msl
Air temperature F
3,020
3,018
3,016
3,014
3,012
3,010
3,008
3,006
3,004
3,002
3,000
50
45
40
35
30
25
20
15
10
5
0
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Helgeland Monitoring well SWL - Elevation
Lake of the Woods wl elevation Ft
Creston Ag station daily average temperature
Lake_water_temp
Precip
Poly. (Creston Ag station daily average temperature)

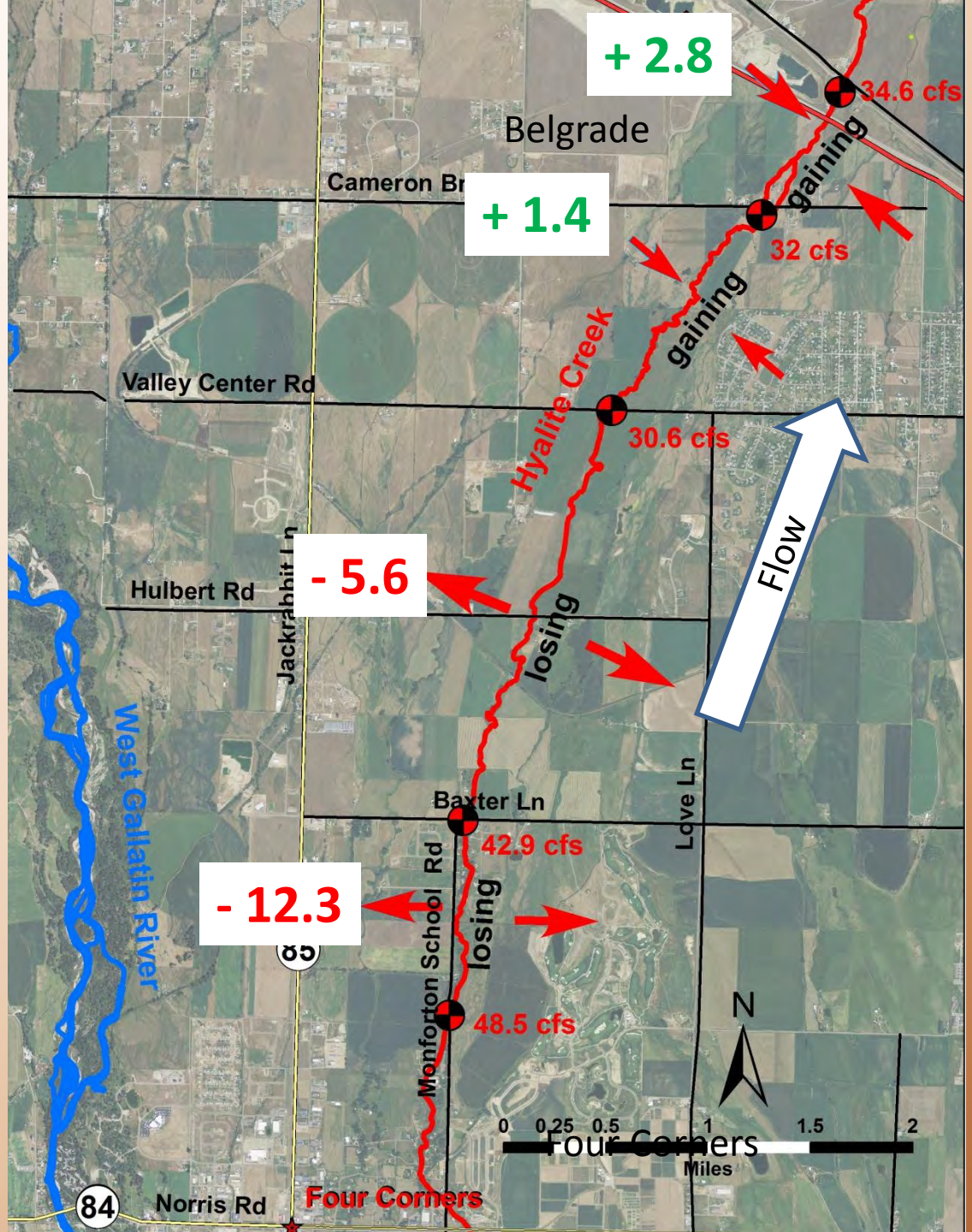

Precipitation
Lake
Groundwater flow


Precipitation
Lake
Groundwater flow
Moraine complex
Interlayered Sand, gravel
and clay
Swan Mountains
Flathead Valley
Deep aquifer
Gravel and sand

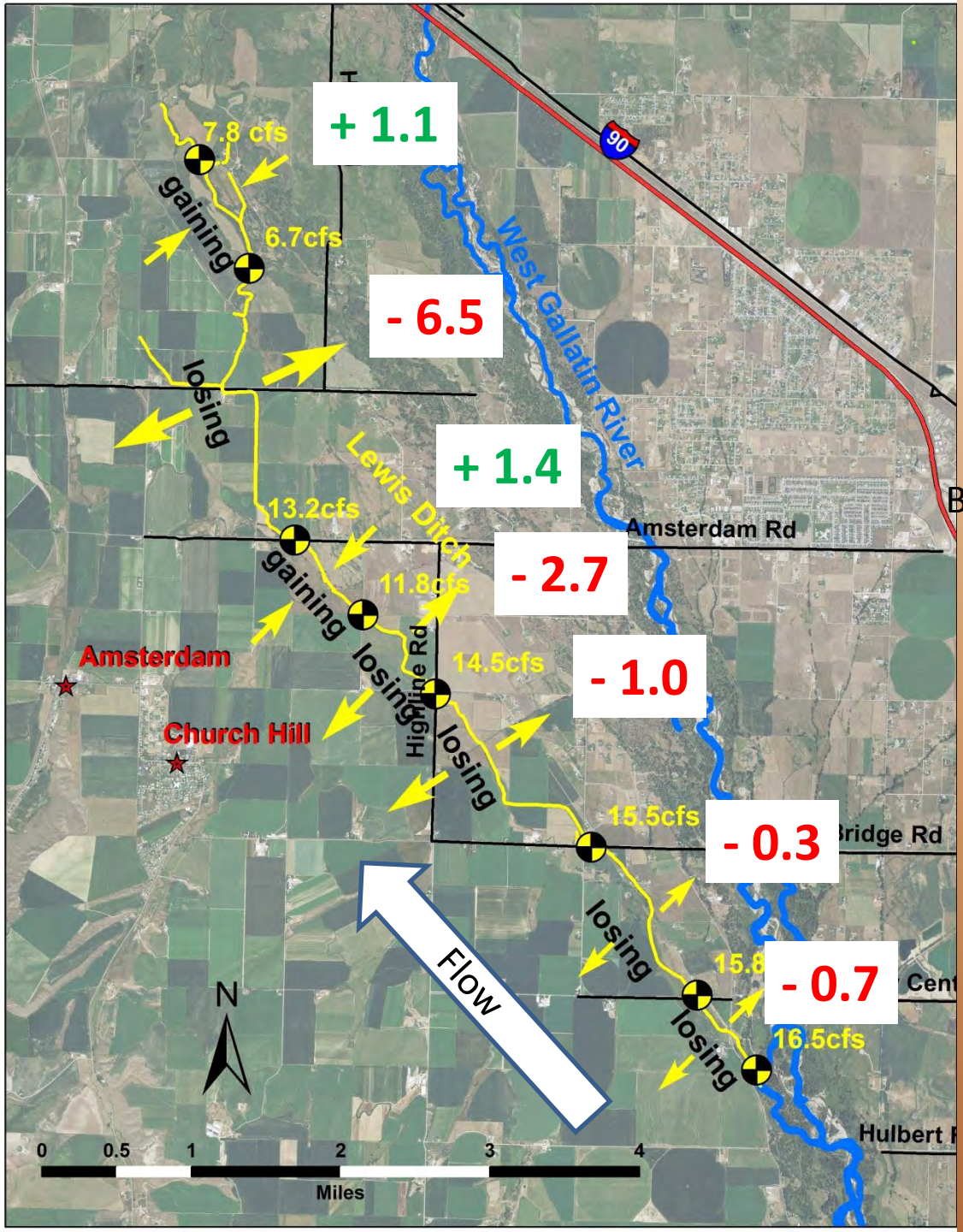


Belgrade Study area

Streams and ditches Both interact with groundwater



Hyalite Creek

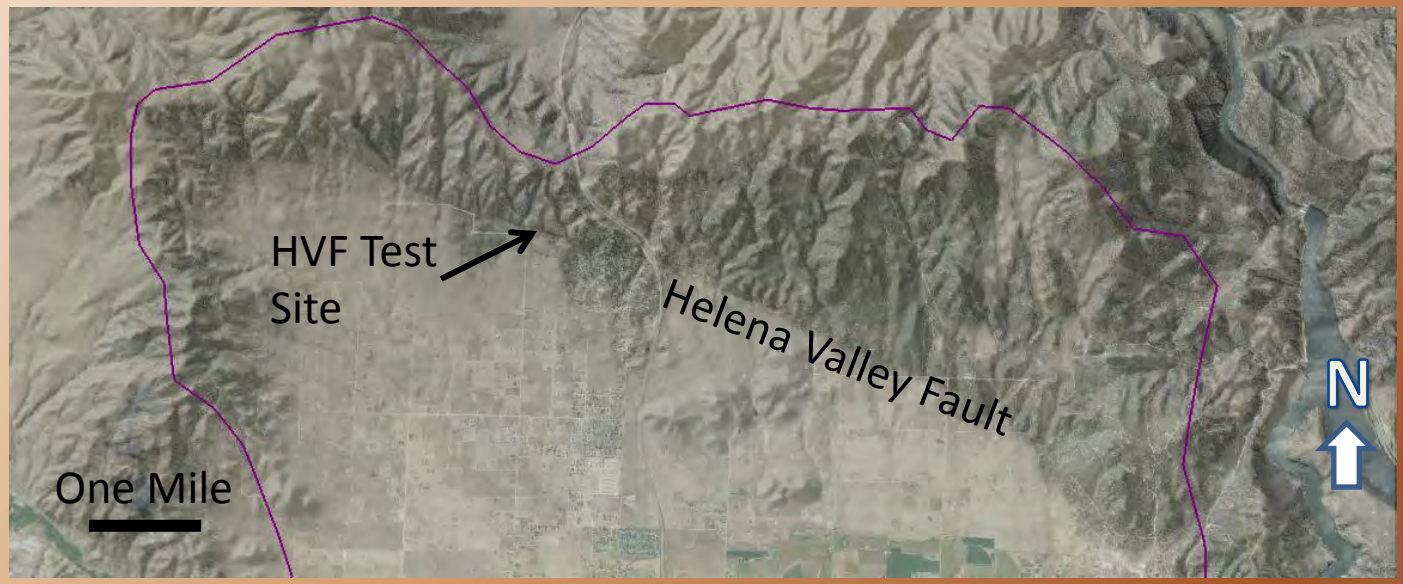


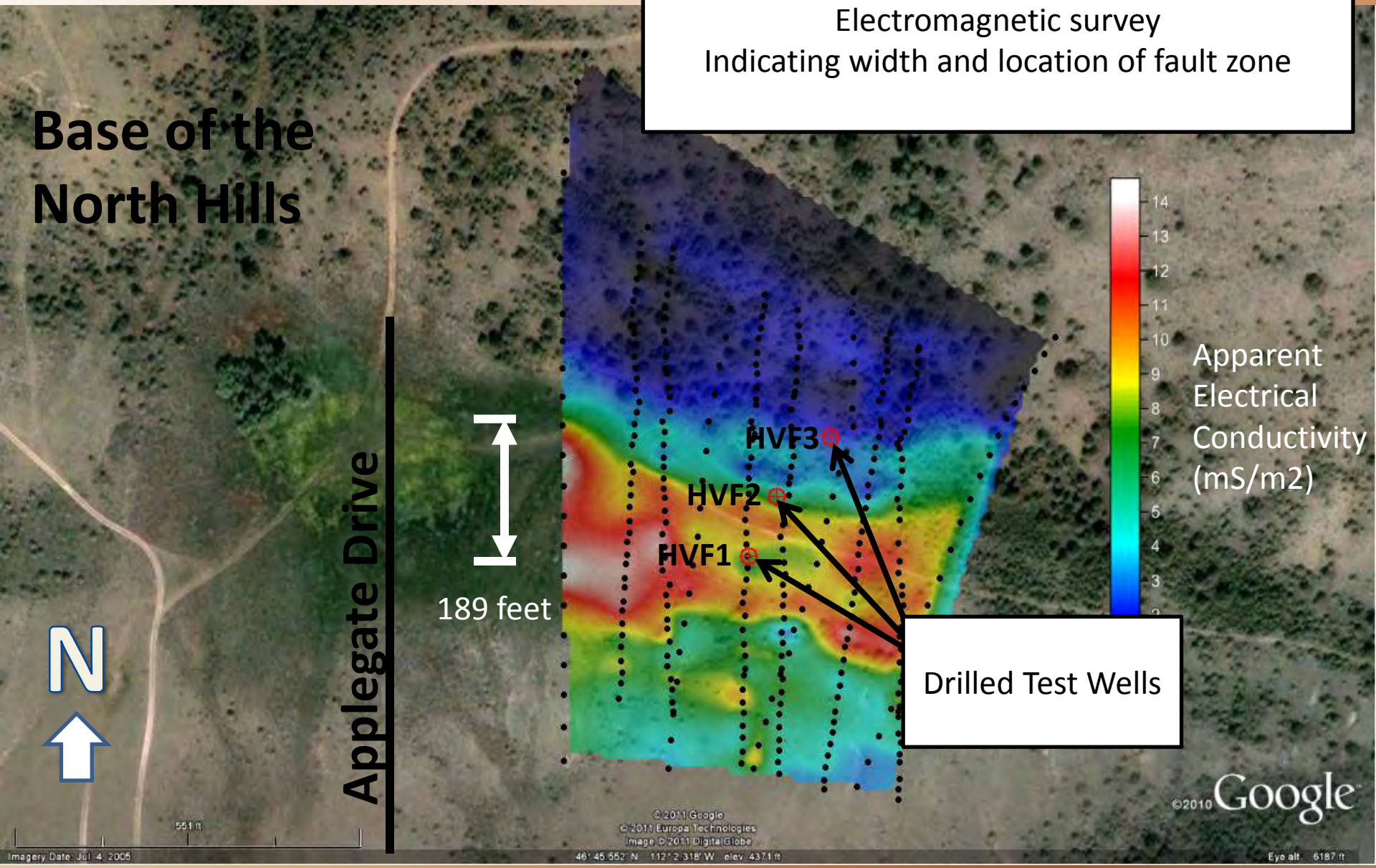
Belgrade

Lewis Ditch

Helena Valley Fault (HVF) Aquifer Test Site

- The Helena Valley fault is a brecciated fault zone some 300 feet wide
- Clayey fault gouge acts as a boundary to groundwater flow
- The fault zone is a groundwater reservoir
- Once water is removed, in some areas it take a long time to recover
- Recharge to the North Hills area crosses the fault.




Electromagnetic survey
Indicating width and location of fault zone
Base of the North Hills
Applegate Drive
189 feet
HVF3
HVF2
HVF1
Drilled Test Wells
Apparent Electrical Conductivity (mS/m2)
14
13
12
11
10
9
8
7
6
5
4
3
N
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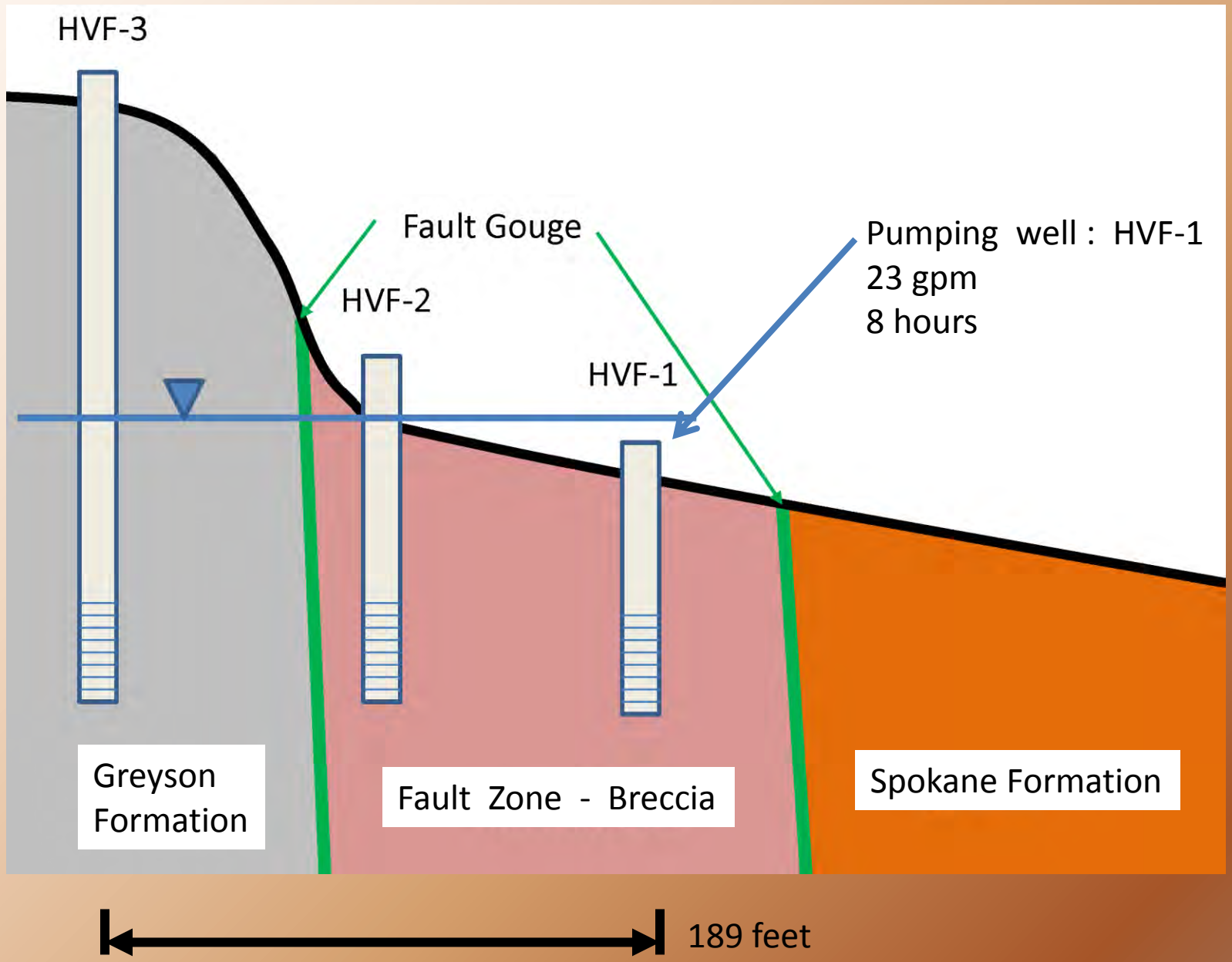
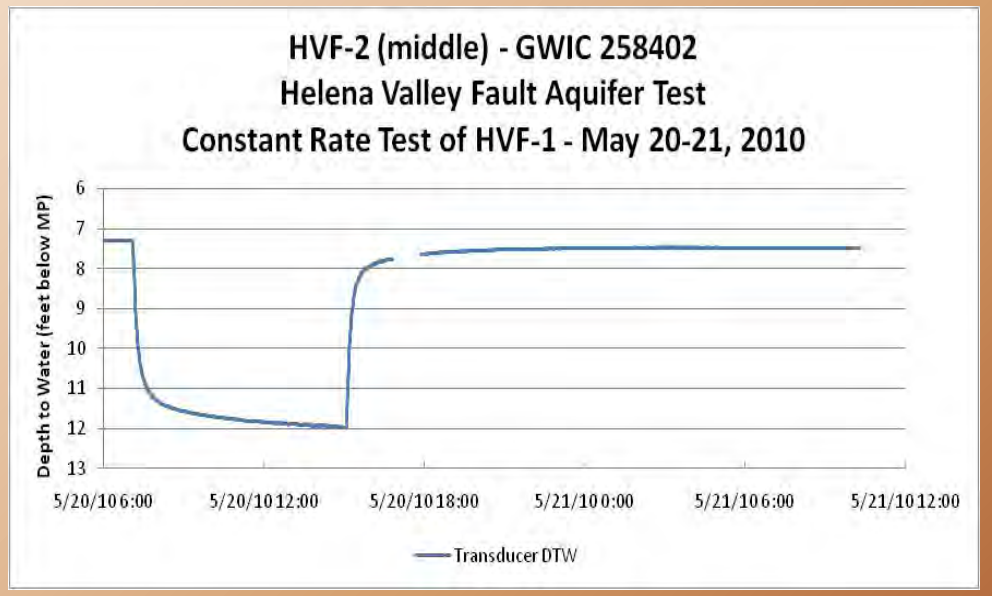

HVF-3
Fault Gouge
HVF-2
HVF-1
Pumping well : HVF-1
23 gpm
8 hours
Greyson Formation
Fault Zone - Breccia
Spokane Formation
189 feet

Well HVF-2
5 feet of drawdown



Well HVF-3
located just north of the fault zone
0.44 feet of drawdown
Little direct connection across the fault zone