GROUND WATER INVESTIGATION PROGRAM

Flathead Valley Deep Aquifer, Flathead County

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Purpose

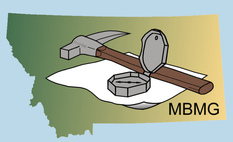
Population in the Flathead Valley has increased by more than 25 percent in the last decade and is currently about 70,000, all of whom, with the exception of Whitefish, rely on groundwater. The deep confined aquifer in the Flathead Valley is a thick deposit of sand and gravel that occurs at depths ranging from 75 to 300 feet below the land surface; it is the most utilized aquifer in the valley, supplying high-capacity municipal and irrigation wells in addition to thousands of domestic wells. Continued growth and localized water-level declines in the deep aquifer have raised concern about the long-term sustainability of the water supply. Another area of concern is the potential interactions between surface water and groundwater with increased development.

Questions to answer

Geologic configuration?
Source and mechanism of recharge?
Discharge area?
Characteristics and extent of the overlying confining unit?
Is increasing water withdrawal sustainable in the Kalispell valley?
What level of production can the deep aquifer support and sustain?
How does the deep aquifer interact with surface water, including Flathead Lake?

Acknowledgments

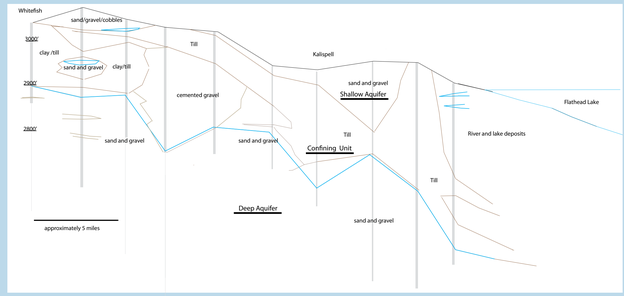
Montana Department of Natural Resources and Conservation
U.S. Fish and Wildlife Service
RLK Hydro
Applied Water
Numerous landowners

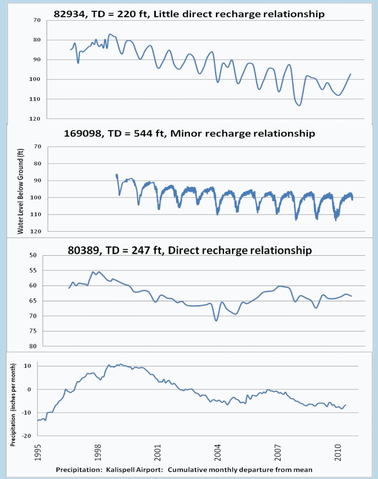


Visit the website
http://www.mbmg.mtech. edu/gwip/gwip.asp
for more details about the GWIP program

Geologic Setting

The Flathead Valley is underlain by a thick package of sedimentary rocks. The deep aquifer is coarse material and a highly productive aquifer. The confining unit seperates it from the shallower systems. The shallow systems are most recent and may in places be prone to pollution. The relationship between the deep aquifer and surface water is not known at this time.





Aquifer responses to precipitation

Preliminary evaluation of likely recharge areas

On the monitoring map, wells are color coded to show inferred relationships with precipitation.

Red - Little direct response to precipitation trends. Wells tend to be on the west side of the valley, indicating less regional recharge likely occurs on this side.

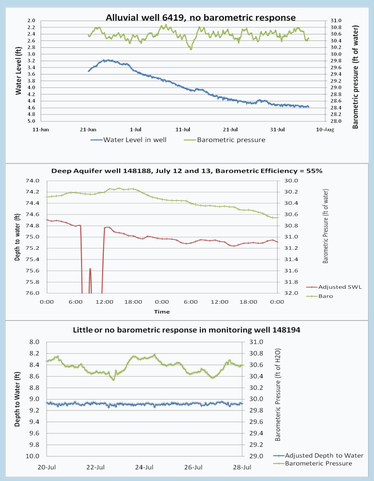
Yellow - Intermediate response to precipitation trends. Wells marked in yellow are more central in the valley, and likely are influenced by recharge to the east.

Green - Flashy, immediate response to precipitation trends. Wells on the east side on the valley, near the Swan Mountain front, indicate this is likely a major area of aquifer recharge. This trend is likely driven by higher precipitation rates to the east, mountain front recharge, and a lack of a competent confining unit along the mountains.

Barometric efficiency

Barometric efficiency provides an insight into the effectiveness of confining units. Higher barometric efficiencies indicate more effective confining units. Investigating the deep aquifer includes critical evaluation of the overlying confining unit which can:

Block recharge due to its low ability to transmit water
Protect the deep aquifer by separating it from the shallow systems
Control discharge direction



The figures show:

Alluvial well with no barometric response – as expected for a water table aquifer

Deep aquifer well 148188 with 55% barometric efficiency – typical for a confined aquifer

Deep aquifer well 148194 with no barometric response – not typical for a confined aquifer

Preliminary interpretations:

The confining unit is missing or relatively transmissive in the area of 148194.

Methods

Correlate
- Groundwater level changes
- Surface water flow and stage
- Spring discharge
- Precipitation
- Barometric pressure

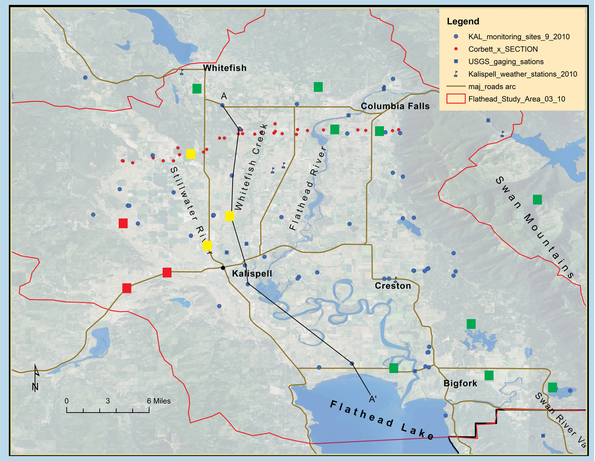
Drill
- Lithologic investigations
- Aquifer test sites

Develop map of confining unit and description of characteristics

Track groundwater flow paths with water chemistry, isotopes and noble gas data.

Identify primary recharge areas

Document capacity of deep aquifer



Monitoring sites in the Flathead Valley include wells, springs, streams and lakes. Colored square site markers refer to the discussion on response to precipitation.

Discussion

The Deep Aquifer
- Very productive aquifer
- Partially protected by confining unit
- Unknown isolation from surface water

The Confining Unit
- Fine grained till
- Deposited on uneven scoured surface
- Not uniform across the valley
- Ability to separate shallow and deep systems is not well documented