Flathead Valley Deep Aquifer:

Geologic Setting and Hydrogeologic Implications

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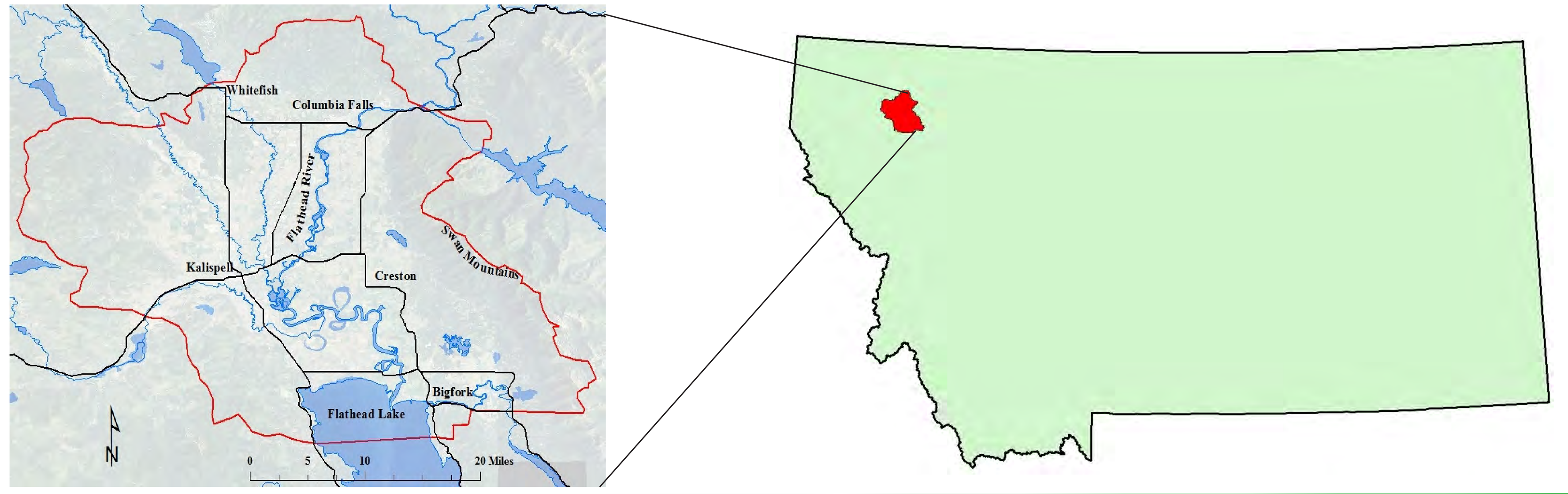
Ground Water Investigation Program



Purpose:

The population in the Flathead Valley has increased by more than 25 percent in the past decade. The current population of about 70,000, with the exception of Whitefish, relies on groundwater. The deep confined aquifer in the Flathead Valley 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 concerns about the long-term sustainability of the water supply and how effectively the overlying confining unit separates it from surface water resources.

Question:

The Deep Aquifer is generally overlain by a tight confining unit consisting of fine-grained lake sediments and glacial till. This confining unit is the primary research question of this project. Does the confining unit separate the Deep Aquifer from surfacewater bodies? Within that question is the concern that natural discharge from the Deep Aquifer is to Flathead Lake and that development of high-yield wells completed in the Deep Aquifer could impact the Lake and Flathead River.

Geology:

Understanding the Deep Aquifer, first requires an understanding the geologic history of the area (fig 1). Compression followed by extension of the earth's crust during formation of the Rocky Mountains (fig 1b, 1c), allowed formation of intermontane valleys which accumulated thick sediment packages during erosion of the newly formed mountains (fig 1d). In the North Flathead Valley, the deep aquifer is composed of pre-glacial, Tertiary and Quaternary alluvial deposits. The last Glacial advance left the Polson moraine and a confining unit of till on the valley floor (fig 1e, 1f). Ice dams and melting glacial ice formed local lakes that deposited layers of clay. Recent stream activity carved through some of the till and lake deposits in the upper parts of the valley and later deposited sands and gravels forming the shallow aquifer. Flathead Lake formed behind the Polson moraine. In the valley today, modern river deposits are filling it in from the north, forming a broad, shallow lake delta in the lower one-half of the valley (south of Kalispell) (fig 2).

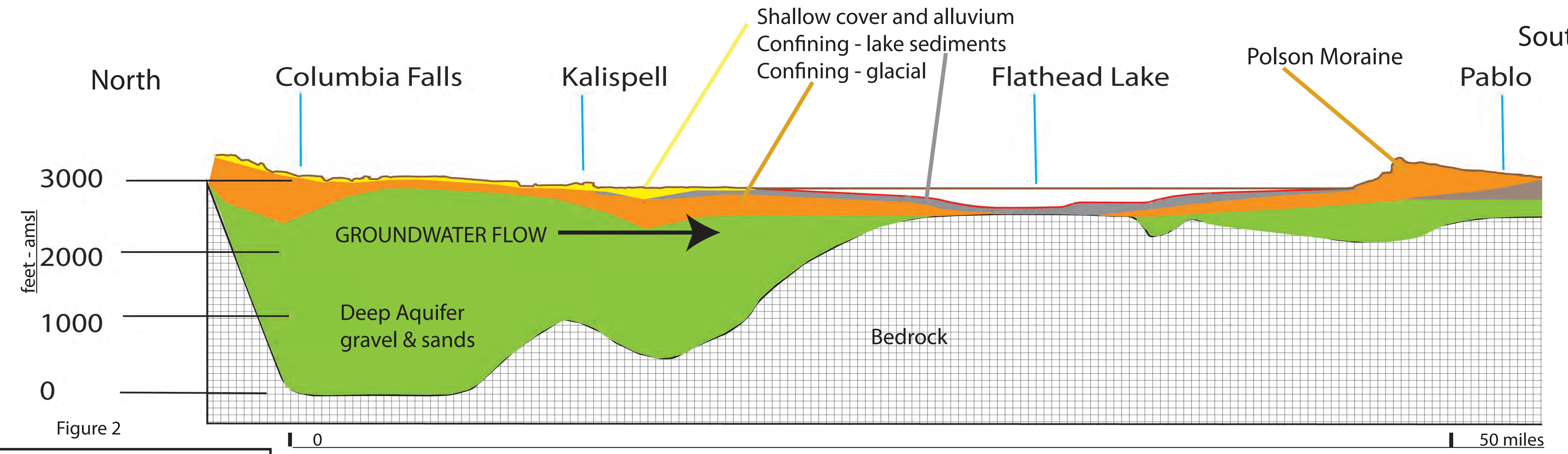
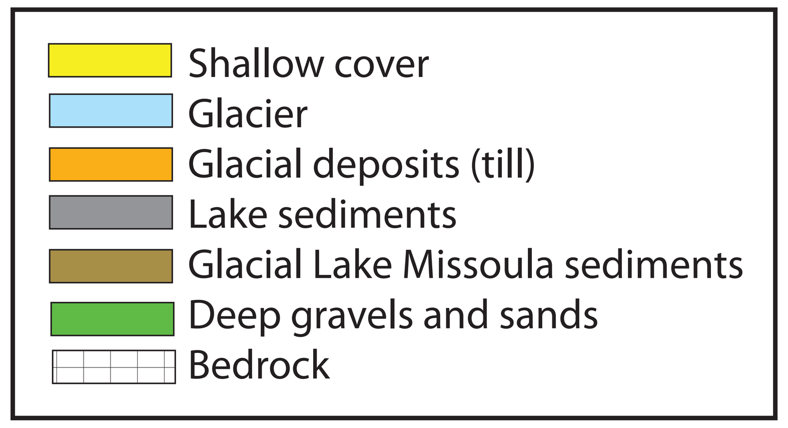


Figure 2



A simplified representation of the suggested geologic history:

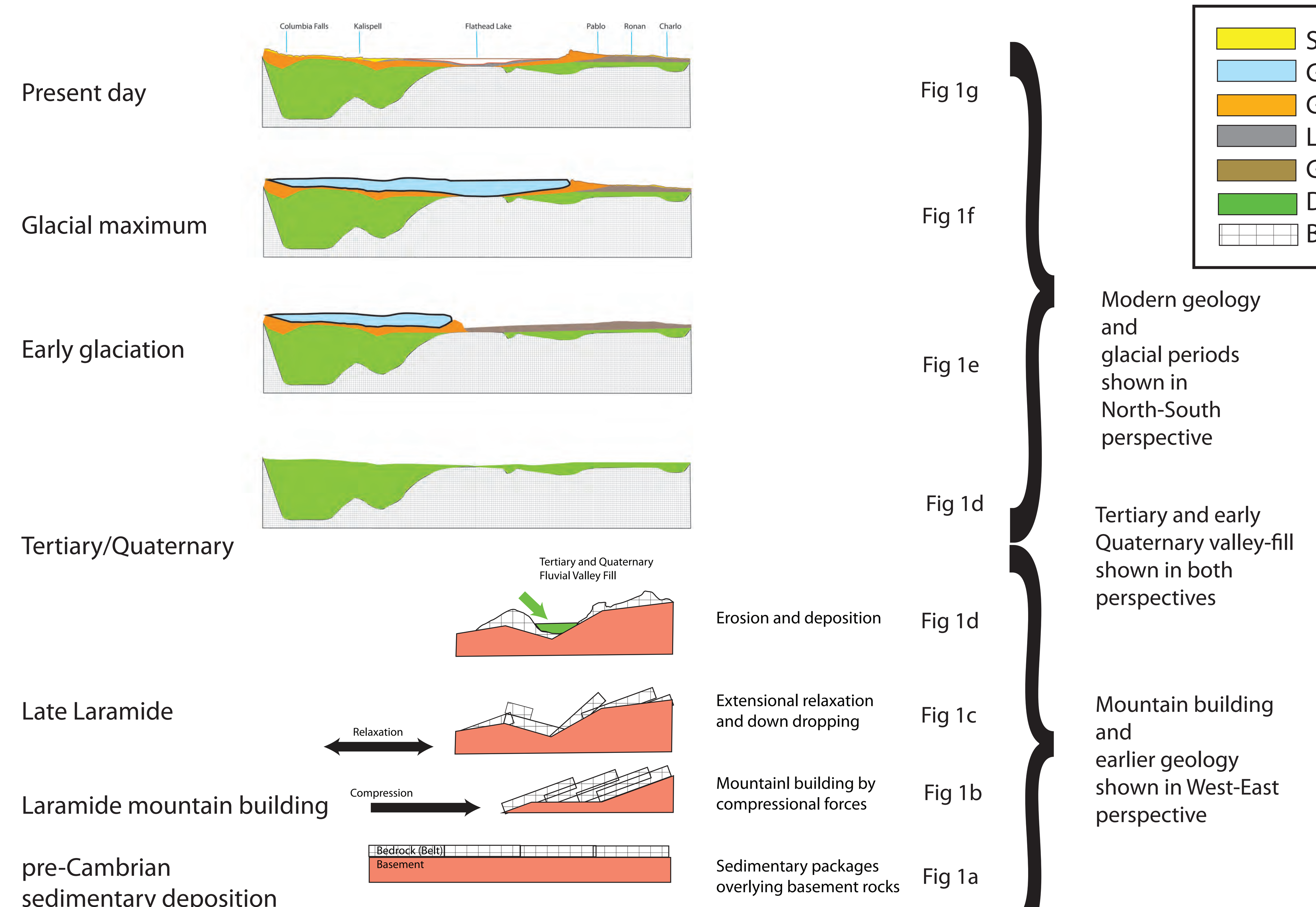


Figure 1

REFERENCES:

Smith, L. N., 2004, Late Pleistocene stratigraphy and implications for deglaciation and subglacial processes of the Flathead Lobe of the Cordilleran Ice Sheet, Flathead Valley, Montana, USA: Sedimentary Geology 165, pgs 295-332.

Hoffmana, M. H., Hendrix, M. S., Moore, J. N., and Sperazza, M., 2006, Late Pleistocene and Holocene depositional history of sediments in Flathead Lake, Montana: Evidence from high-resolution seismic reflection interpretation: Sedimentary Geology 184, pgs 111-131.

Results and Discussion:

The Deep Aquifer is an interbedded succession of conglomerate gravel and coarse sand. Individual well yields of 1,000 gpm or more are reported. The aquifer is used for domestic, irrigation and public water supplies.

Groundwater in the deep aquifer flows south, in the direction of Flathead Lake. An actual discharge area has not been identified. Water levels in the lake and deep aquifer follow only minimally similar trends. (fig 3).

A 7-day aquifer test, about 1 mile north of the lake shoreline, indicated relatively homogeneous aquifer material and only a slight possible vertical leakage (fig 4). Similar slopes for the observation wells indicate similar material character.

The radial distance of drawdown was calculated to extend several miles during the 7-day aquifer test. From the pumping well, the drawdown extended to and roughly a mile beyond the Flathead Lake shoreline (fig 5) without encountering apparent boundary conditions.

Recovery water levels in a well in the deep aquifer and one completed in the confining unit demonstrate the magnitude of difference in aquifer characteristics between the two units (fig 6).

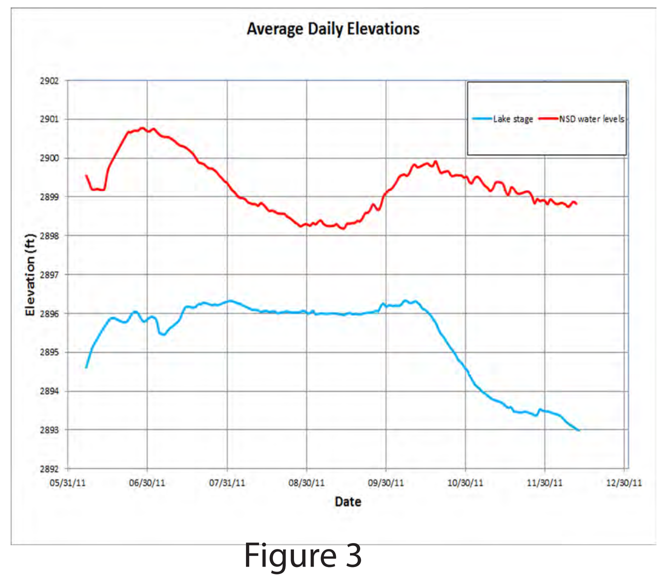


Figure 3

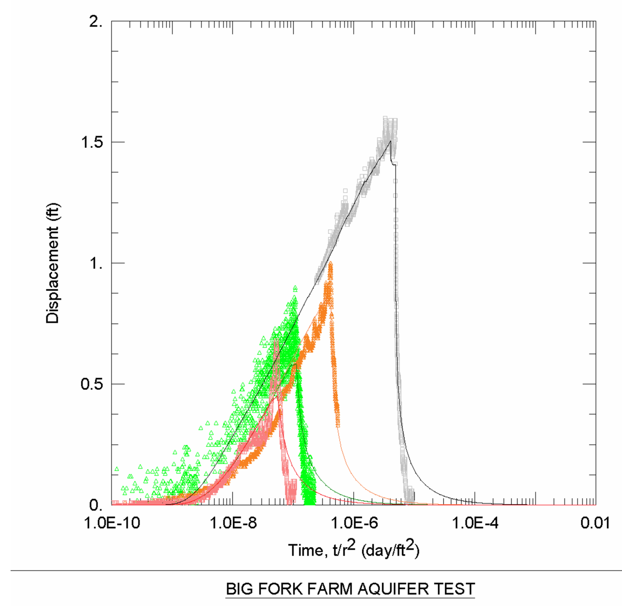


Figure 4

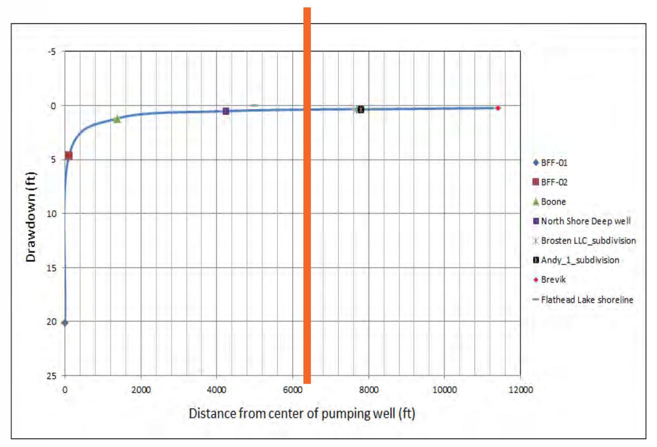


Figure 5
Red line indicates approximate distance to the north shore, Flathead Lake

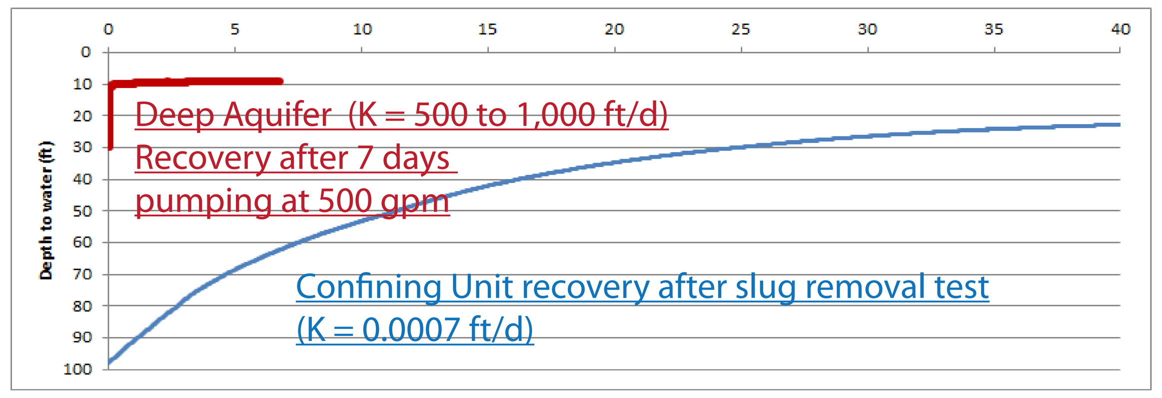


Figure 6

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