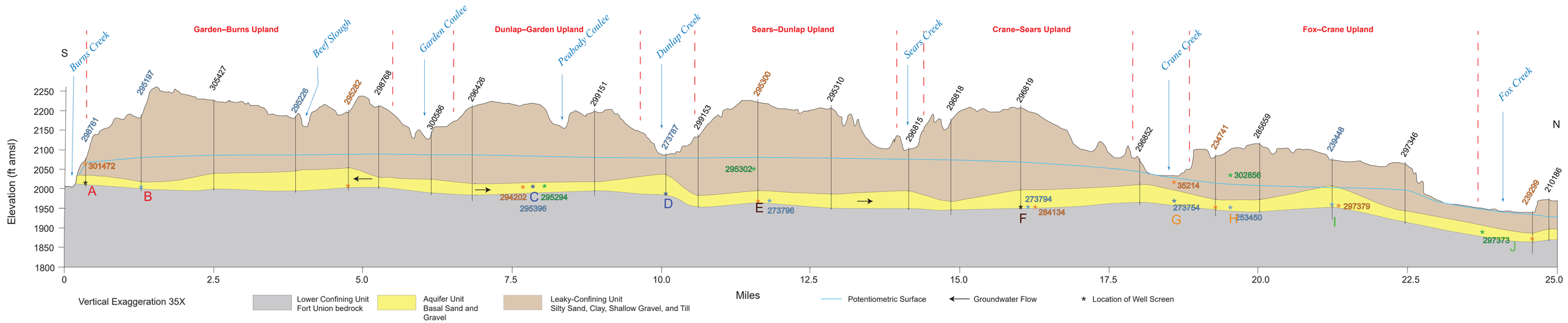
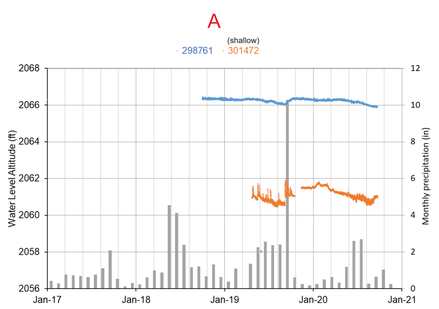
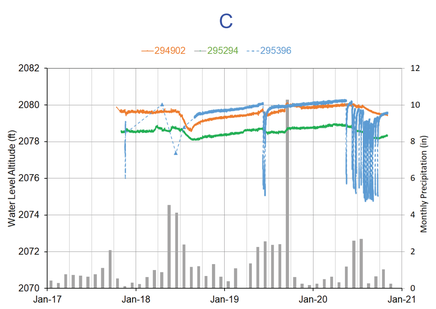
Plate 3: Longitudinal cross-section of the West Crane Aquifer

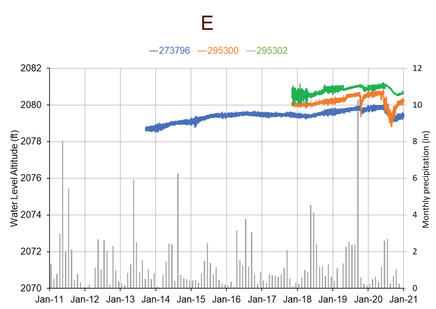




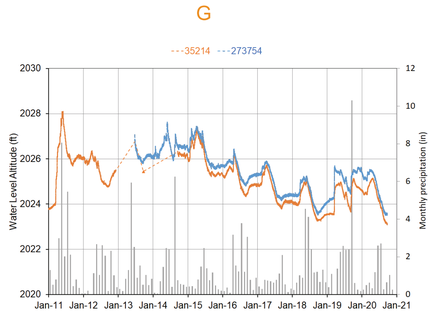
Hydrograph (A) is from wells located on the valley slope above Burns Creek in the southern part of the Garden–Burns upland. The water levels at both sites rise in response to recharge from direct precipitation and snowmelt. Declines are primarily in response to evapotranspiration. No detectable response to pumping is apparent.



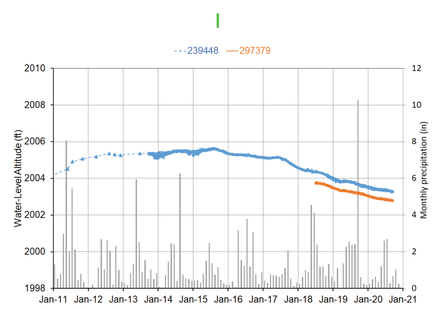
Hydrograph (C) is from wells located in the Dunlap–Garden upland. Water levels in these wells rise until irrigation pumping causes seasonal water-level declines. Drawdown spikes at well 295396 relate to individual pumping cycles whereas the distant wells show cumulative drawdown over the growing season followed by recovery.



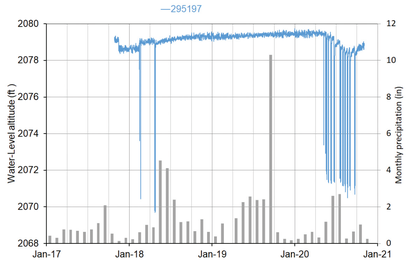
Hydrograph (E) is from wells located in the Sears–Dunlap upland. Prior to pumping in the area, the water levels were slowly rising. Test pumping in fall 2019 and irrigation during the 2020 growing season produced minor drawdown in the distant wells.



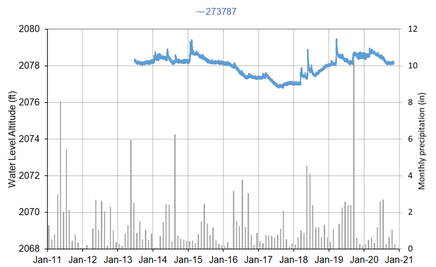
Hydrograph (G) is from a pair of wells located in the Crane Creek valley. Water-level fluctuations at these wells are nearly identical, with the deeper well (273754) having slightly higher heads, indicating an upward flow gradient. Water levels at 35214 rose about 4 ft during the major recharge event during the spring of 2011. Variable annual spring recharge dominates the hydrograph. Evapotranspiration is the main cause of discharges causing water-level declines.



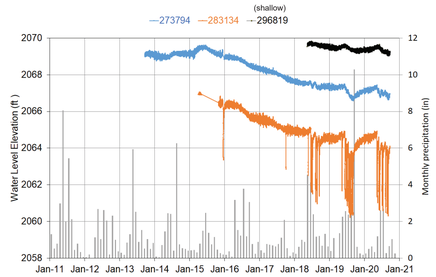
Hydrograph (I) is from wells located near the middle of the Fox–Crane upland. Similar to other sites in the aquifer, water levels rose during the spring 2011 recharge event and declined starting in 2015. Unlike other sites where water levels stabilized and recovered in 2019, declines continued in this area. With the closest irrigation well 1 mile away, no drawdown related to pumping is observed at this site.



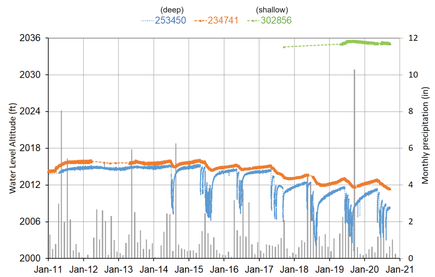
Hydrograph (B) is from a well located in the Garden–Burns upland. The hydrograph depicts slowly rising water levels interrupted by periods of pumping at an irrigation well located 50 ft away. After the first year of irrigation pumping, water levels recovered to within 1 ft of the original static water level about 1 day after pumping ceased.



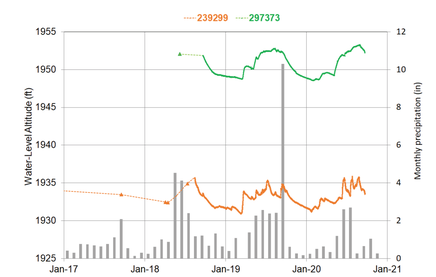
Hydrograph (D) is from a well located in the Dunlap Creek Valley adjacent to the dry streambed. Water levels at this site are very sensitive to climatic factors. This sensitivity is demonstrated by a 2.5 ft decline in water level from 2015 to 2017, 3 years with little aquifer recharge. Water levels recovered to 2013 levels with increased recharge in 2018 and 2019.



Hydrograph (F) is from wells 273794, 283134, and 296819 located in the Crane–Sears upland. Prior to pumping in this area, the water levels declined in these wells from high levels in early 2015. Minimal precipitation from 2015 to 2018 resulted in very little recharge, causing about 2 ft of water-level decline. Irrigation during the 2018, 2019, and 2020 growing season resulted in drawdown in all of these wells. Irrigation drawdown recovered to 1 ft of the original static water level each year.



Hydrograph (H) is from a pair of wells in the Fox–Crane upland, (well 253450 = deep and well 302856 = shallow) near irrigation well 253448, and well 234741 located 1,950 ft southeast of the irrigation well. Well 302856 is completed at a depth of about 90 ft. Water levels in the shallow well are about 20–25 ft higher than in the deep well, indicating a downward flow gradient. Water levels in the shallow well do not respond to pumping. Prior to seasonal pumping, the water levels were declining at the deep well from high levels early in 2015 to 2020. The water-level responses in this well range from 6 to 8 ft annually due to pumping. Most years water levels recover to within 1 ft of the original static water level. During the very dry year of 2017 water levels only recovered to within 2 ft of the original static water level.



Hydrograph (J) is from well 293299, which is located in the Fox Creek Valley where it joins the Yellowstone River Valley. The Lower Yellowstone Irrigation Project (LWIP) main canal is about 1,300 ft south and upgradient of this well. Hydrograph (J) also includes 297373, which is located at the north edge of the Fox–Crane upland 65 ft above the LWIP canal. The LWIP main canal is about 280 ft north of this well. Water-level fluctuations are very similar, with both wells directly responding to the annual filling and draining of the LWIP main canal. Water-level elevations are about 18 ft higher in well 297379 than in well 239448.

This cross-section displays major geologic units associated with the West Crane aquifer. The line of this longitudinal profile and cross section is shown on plate 1.

Water-level fluctuations in the West Crane aquifer depend on location, whether the well is in an upland area or in a tributary valley, and proximity to irrigation pumping. The hydrographs on this plate are labeled from (A) to (J) traversing the profile from south to north, with an asterisk and GWIC ID locating the approximate stratigraphic position of the well screen. The stratigraphic position and well labels are also color-coded to match the trace on the hydrograph.

The hydrographs are scaled with consistent axes. The x-axes encompass either 10 years (2011 to 2021) or 4 years (2017 to 2021) depending on the period of record. The y-axes span 10 ft on all plots.

Wells with high barometric efficiencies respond to barometric changes with relatively minor but high-frequency water-level fluctuations forming a wide line on the hydrographs. Fluctuations in these hydrographs reflect changes in storage in the aquifer. The storage changes include rising water levels caused by precipitation and snowmelt recharge events. Water-level declines indicate discharge events caused by pumping, surface and groundwater outflows, and evapotranspiration.

Montana Bureau of Mines and Geology