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 - a. **Title** Anomalous groundwater pressure responses in the Mahomet aquifer near the Manlove Gas Storage Field
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 - c. **Suggested Citation** -- Roadcap, G. (2018). Anomalous groundwater pressure responses in the Mahomet aquifer near the Manlove Gas Storage Field. Prairie Research Institute, Champaign, IL, 8 p.
 - d. **Abstract** – The Illinois State Water Survey maintains a network of monitoring wells throughout the Mahomet aquifer to study the available water supply and water quality. The wells in the Champaign County area were installed primarily in two rounds between 1995 and 1998 and between 2007 and 2009. In addition to hand measurements with a dropline, many of these wells have transducers and dataloggers, allowing for continuous monitoring of water levels. An unusual water level event started in late 2015 in two, possibly three, of the monitoring wells in the Mahomet aquifer system near the Manlove gas storage field. A summary of the atypical water level data is provided.
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 - h. **Author/Originator/Publisher** (party responsible for the data set)
 - i. George S. Roadcap
 - ii. Hydrogeologist, Illinois State Water Survey
 - iii. +1-217-333-7951
 - iv. roadcap@illinois.edu
 - v. 2204 S. Griffith Drive Champaign, IL, 61820
 - i. **Organization** – Illinois State Water Survey, Prairie Research Institute, University of Illinois
2. Metadata
 - a. **Contacts** (name of metadata point of contact)
 - i. Same as author noted above
 - b. **Constraints** – Non-Disclosure
 - i. **Terms of Use** – The ISWS should be contacted in advance to arrange ISWS review of planned presentations and publications using this data. Data usage must be approved in advance of presentation and publication. As appropriate, at least one ISWS project member should be included as a co-author in the publication(s) that use these data.
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 - iii. **Status** – Final analysis of the data has not been published and as such this dataset is provisional and subject to change. Data have undergone standard project quality control review.
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 - a. **Format** (digital/Adobe Systems Portable Document Format (PDF) file)
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Anomalous groundwater pressure responses in the Mahomet aquifer near the Manlove Gas Storage Field

George Roadcap, PhD
Illinois State Water Survey
Prairie Research Institute
University of Illinois
Feb. 14, 2018

An unusual water level event started in late 2015 in two, possibly three, of the monitoring wells maintained by the Illinois State Water Survey in the Mahomet Aquifer system near the Manlove gas storage field. If these events are related to the gas leak at the McCord #2 well, they may help determine when the leak first occurred and how far away the pressure signal from the leak may have spread within the Mahomet Aquifer system. The data also suggest that real-time monitoring of groundwater levels may be a way to detect further leaks from the gas storage wells.

The Water Survey maintains a network of monitoring wells throughout the Mahomet Aquifer to study the available water supply and water quality (Figure 1). The wells in the Champaign County area were largely installed in two rounds between 1995 and 1998 and between 2007 and 2009. The wells were drilled by the Illinois State Geological Survey and Albrecht Drilling with funding from the State of Illinois and the Illinois-American Water Company. Many of these wells have transducers and dataloggers installed in them, allowing for continuous monitoring of water levels. Transducers work by measuring changes in subsurface fluid pressure which are responsible for how water levels in a well change over time by either rising or falling. The selection of a particular transducer is made such that the expected water level changes do not exceed the pressure rating of the instrument, which would cause the transducer to fail or to not read beyond a certain pressure. Independent hand measurements of water levels are made approximately quarterly as a QA/QC check to verify that the instrument is operating properly and to determine if there is any instrument drift that needs to be corrected for. Illinois-American Water Company is currently a contributor to the ISWS data collection effort. Historical information on the network and the response of water levels in the Mahomet Aquifer to various stresses is available in ISWS reports from 2008, 2011, and 2017 along with the attached 2015 data summary prepared for Illinois-American.

<http://www.sws.uiuc.edu/pubs/pubdetail.asp?CallNumber=ISWS+CR+2011%2D08>

<http://www.sws.uiuc.edu/pubs/pubdetail.asp?CallNumber=ISWS+RI%2D123>

<http://www.sws.uiuc.edu/pubs/pubdetail.asp?CallNumber=ISWS+DCS+2008%2D01>

Well CHAM-08-06 (nested with CHM-95B)

Monitoring well CHAM-08-06 is completed in the Glasford Aquifer to a depth of 172 below ground surface. The Glasford Aquifer is a discontinuous shallow sand and gravel aquifer that lies above the

Mahomet Aquifer; in some areas these two aquifers are physically connected, indicated by similar water levels, but in other areas they are not connected, indicated by significantly different water levels. CHAM-08-06 is nested next to well CHM-95B which is completed to a depth of 280 feet in the Mahomet Aquifer. The two wells are located 6.5 miles southeast of McCord #2. The 50-foot difference in water levels (potentiometric head) between the wells prior to 2015 shown on the hydrograph (Figure 2) indicates that the two aquifers are hydraulically isolated from each other and that the Glasford Aquifer water level is not responding to the seasonal irrigation pumpage from the Mahomet Aquifer (e.g., note drops in water levels below 620 in elevation in the Mahomet well during the summers of 2011 and 2012).

On 5/21/2016 the water level in well CHAM-08-06 suddenly rose 10 feet followed by another 10-foot increase on 5/29/2016 (Figure 3). Such rapid changes in water levels are extremely unusual, and indicate a major disturbance in the aquifer or the well itself. By 6/24/2016 the water level had risen 30 feet above average levels and, because of the large increase in water levels, the pressure limit of the transducer was exceeded and it could no longer measure any water levels above 699 feet in elevation (thus the flat solid line just below 700 feet in elevation on Figure 2). Water levels on 9/12/2016, 12/5/2016, 5/8/2017, and 6/19/2017, were all 30 to 50 feet above the normal water level elevation of around 670 feet. Survey staff thought a possible explanation for the high water levels was a broken casing that plugged the well. However, on the next measurement on 10/2/2017 the water level fell back down to its normal level. On 2/6/2018 Survey staff examined the well and found no obstructions throughout the length of the well and a good hydraulic connection between the well and the aquifer. The well was test pumped at a rate of 1 gallon per minute for 30 minutes with the water level recovering to pre-pumping levels when the pump was shut off, indicating that the physical condition of the well was not responsible for the large spike in water levels.

Prior to this event, a water level rise of greater than 20 feet has not been observed in *any* of the 180 monitoring wells maintained by the Water Survey in the Mahomet Aquifer system, including the two wells with continuous records going back to the 1950s. There is not a natural hydrologic phenomenon familiar to Survey staff that could explain the observed water level rise in CHAM-08-06. Because it takes 1 pound per square inch (psi) to raise a column of water 2.3 feet, the added pressure on the Glasford Aquifer in the vicinity of the well was approximately 21.7 psi.

Wells CHM-96A (nested with CHAM-07-05) and CHAM-08-09A

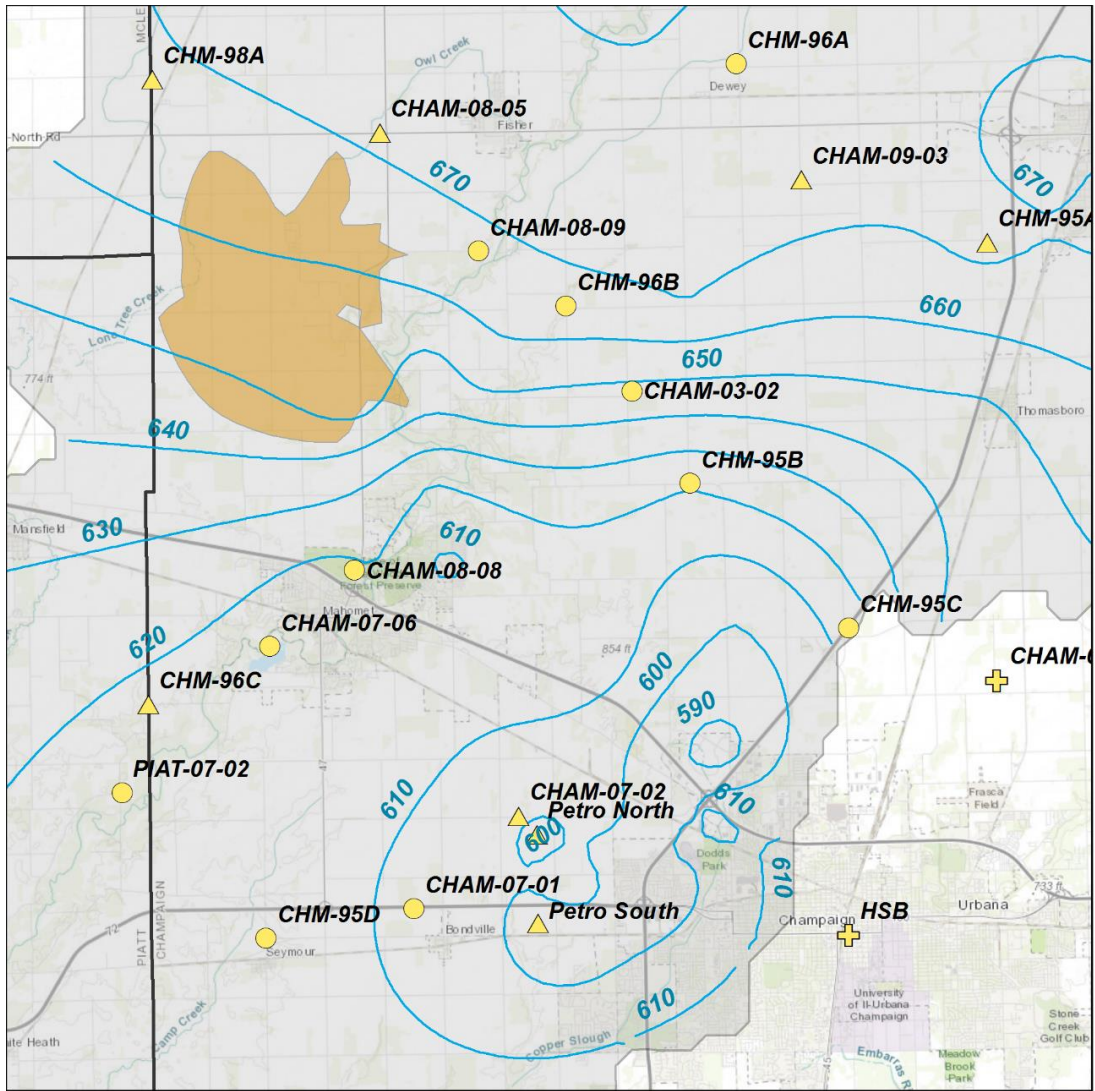
Monitoring well CHM-96A was completed in the Mahomet Aquifer to a depth of 351 below ground surface and is nested next to well CHAM-07-05 which is completed to a depth of 137 feet in the overlying Glasford Aquifer. The two wells are located 7 miles northeast of McCord #2. The water level elevation difference between the two wells is 10-15 feet and the Glasford Aquifer well has a muted response to the nearby irrigation pumpage in the Mahomet Aquifer, indicating the two aquifers are hydraulically connected but at some distance from the wells.

Between hand measurements on 9/14/2015 and 12/21/2015, the water level in well CHM-96A suddenly rose 30 feet and has remained high through the most recent hand measurement made on 2/6/2018. On 1/21/2016 Survey staff found no obstructions throughout the length of the well but it produced sand when water was produced by air lifting, indicating a break in the casing. Survey staff then lined the well to 40 feet to cut off any potential water leaking down from a shallow gravel deposit at 21-25 feet below

the land surface, but this did not affect the water level. The relatively thick Mahomet Aquifer should be permeable enough to take up any water leaking downward from overlying thin aquifers and maintain the water level in the well close to its normal level. The cause of the high water level in CHM-96A will likely not be determined unless a new well is drilled adjacent to it with a screen at the top of the Mahomet Aquifer. The screen in CHM-96A is at the bottom of the aquifer so it may never show any significant accumulation of lighter gases in a water sample.

The timing of the higher water level is coincident with some generally atypical water level data at well CHAM-08-09A (Figures 5 and 6). This well is 264 feet deep and is located 1.8 east of McCord #2. The U.S Geological Survey installed real-time monitoring equipment in this well and serves it up on their website. The reason for this atypical behavior is under further investigation.

<https://waterdata.usgs.gov/il/nwis/current/?type=gw>



Explanation

- Mahomet Head Contour (ft AMSL)
 - County Boundary
 - Manlove Gas Storage Dome
 - Mahomet Aquifer Boundary
 - ISWS Monitoring Wells
 - ▲ Mahomet
 - ⊕ Glasford
 - Nested
- 0 0.5 1 2 Miles
- N

Figure 1. Map of monitoring wells in northwestern Champaign County. The contour lines show groundwater level elevations and directions in 2009 (from Roadcap et al., 2011)

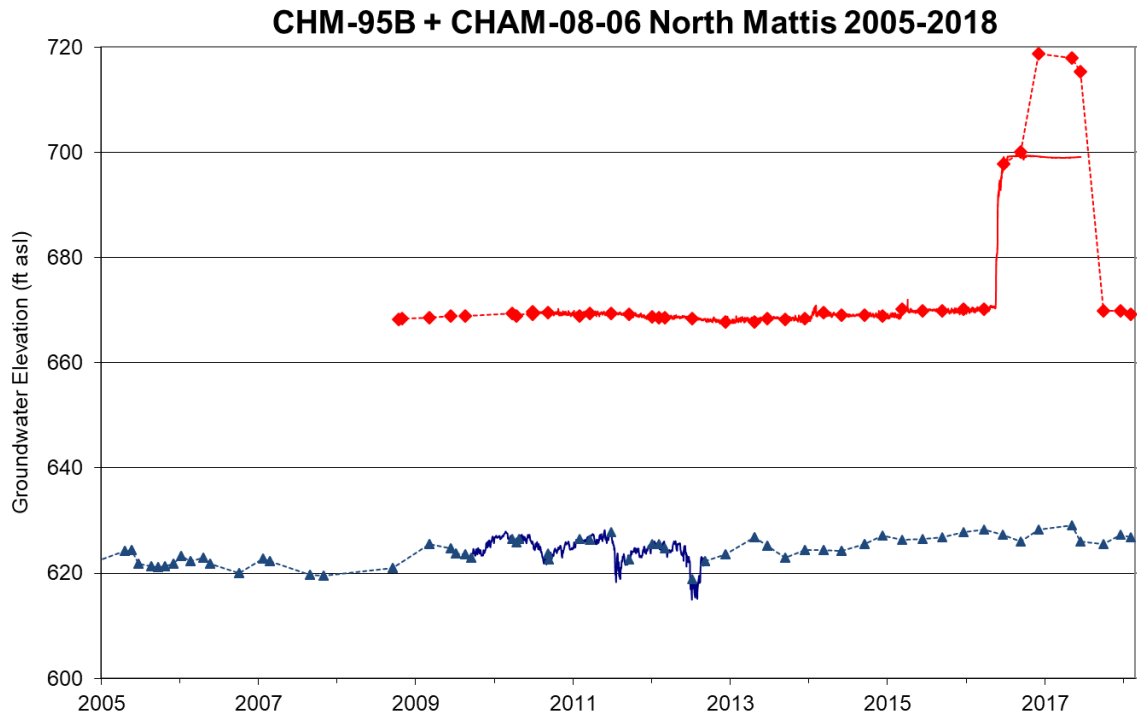


Figure 2. Hydrograph from wells CHAM-08-06 and CHM-95B from 1995 to 2018. Hand measurements are represented with symbols and transducer data is represented with solids lines.

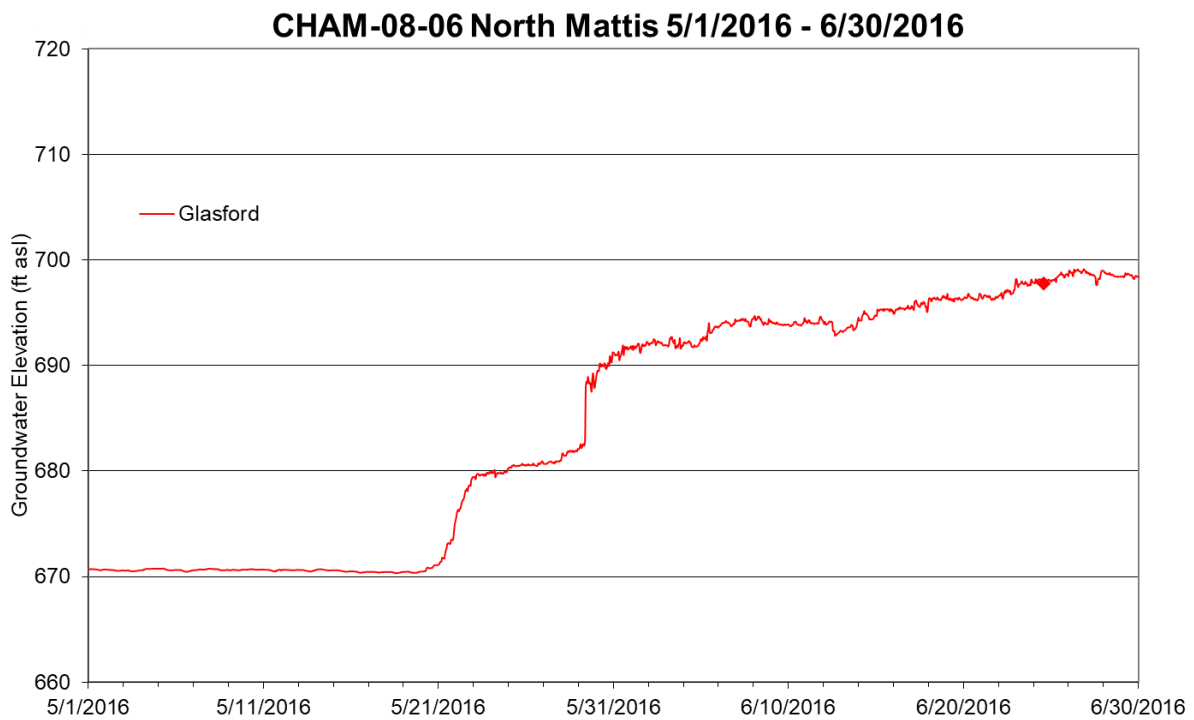


Figure 3. Hydrograph from well CHAM-08-06 from 5/1/2016 to 6/30/2016.

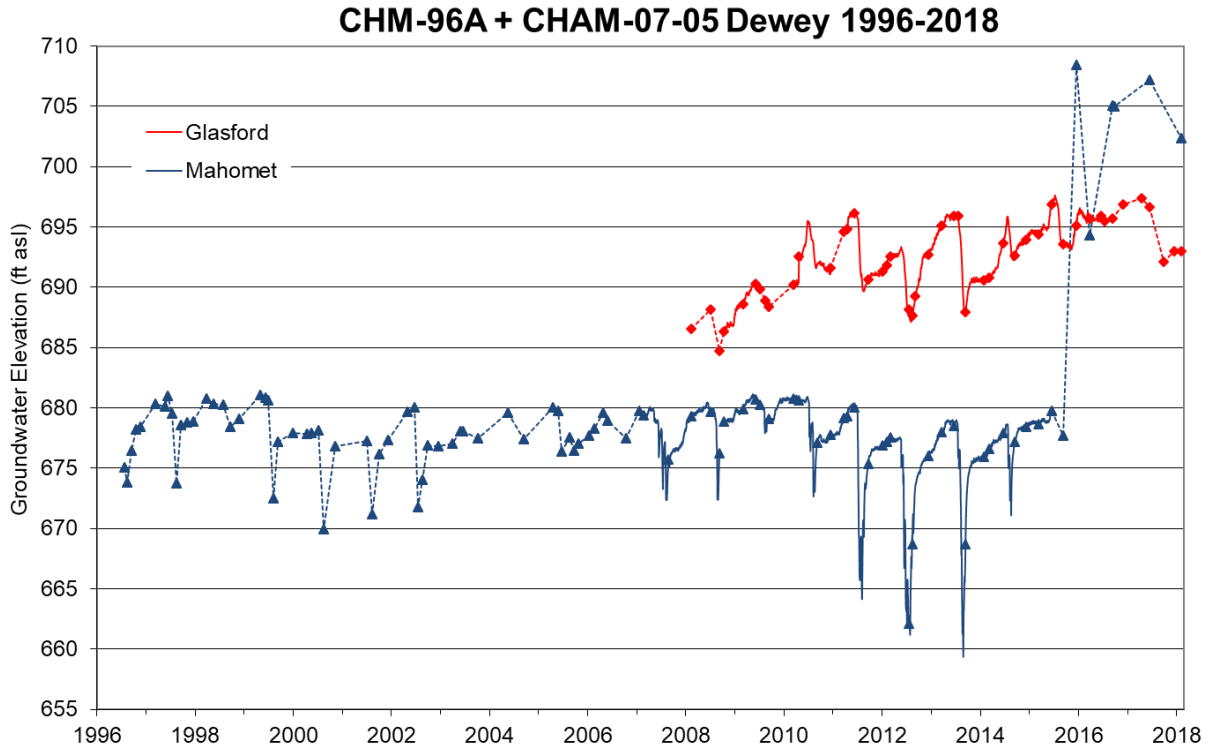


Figure 4. Hydrograph from wells CHM-96A and CHAM-07-05 from 1996 to 2018.

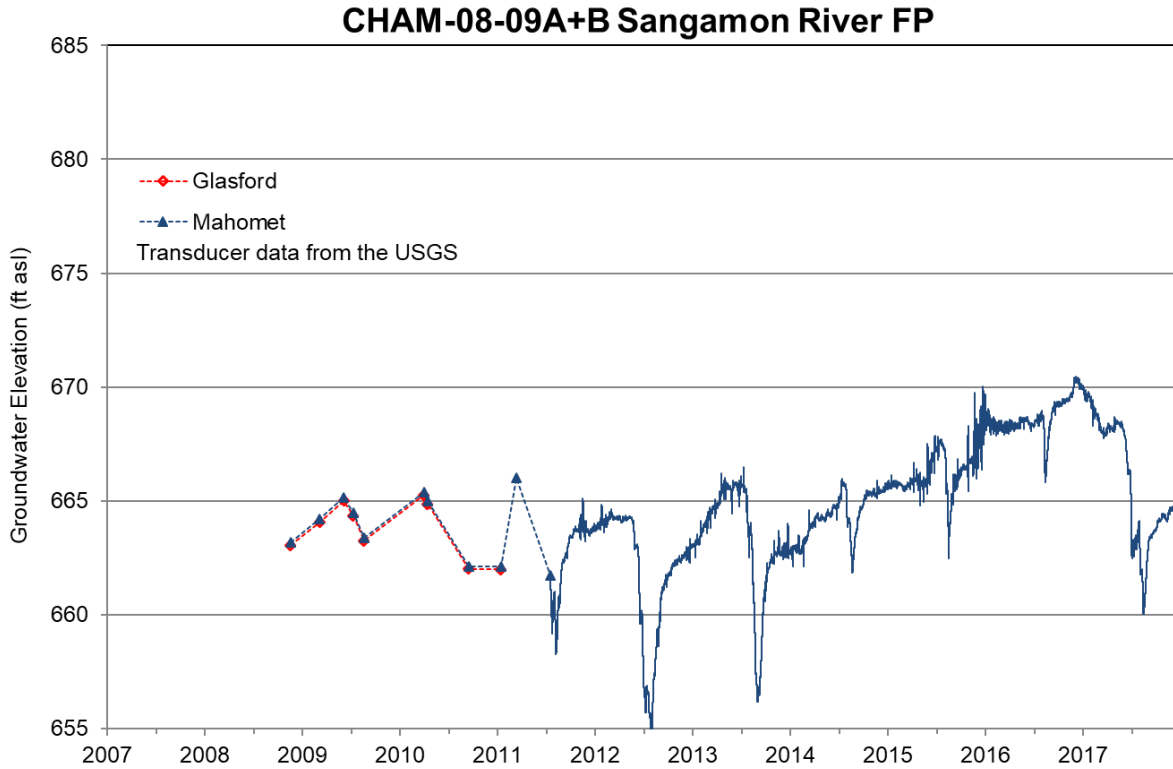


Figure 5. Hydrograph from wells CHAM-08-09A and B.

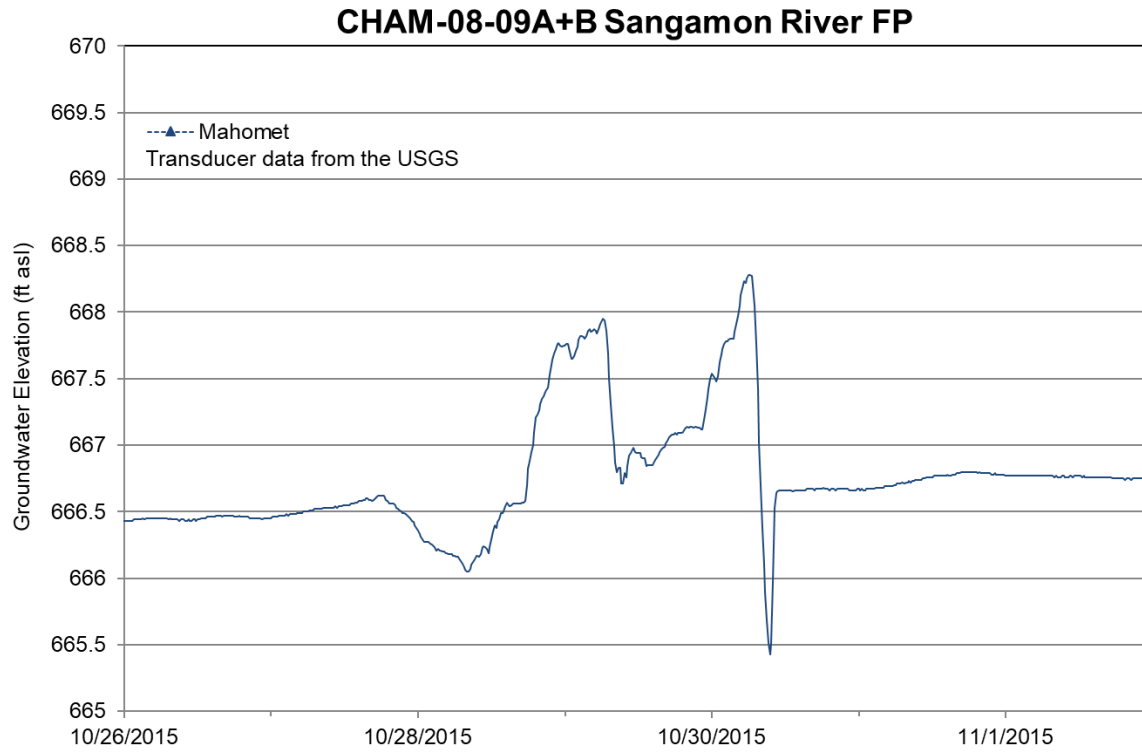


Figure 6. Hydrograph from well CHAM-08-09A from 10/26/2015 to 11/2/2015.