



Preliminary Groundwater Level Changes at Selected Sites in Nebraska Following the Drought of 2012

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INTRODUCTION

Groundwater monitoring in Nebraska began in 1930 to survey Nebraska's vast groundwater resources and monitor long term changes in groundwater quantity and availability. Typically, groundwater level changes in Nebraska are reported as maps showing changes in static water level readings from the spring of one year to the spring of the next year, and from predevelopment to the spring of the current year. These maps have been published yearly since the 1950's and are available free of charge on the University of Nebraska-Lincoln Conservation and Survey Division (CSD) website at <http://go.unl.edu/groundwater>. These maps are based on approximately 5,500 individual

water level readings taken annually by Nebraska NRDs, the CSD, the United States Geological Survey, Nebraska Public Power and Irrigation Districts, and the US Bureau of Reclamation. For more information on the Nebraska groundwater level monitoring program and water level conditions current through the spring of 2012, please see the Nebraska Water Survey Paper Number 80, available in print form from the CSD or as a PDF at <http://go.unl.edu/groundwater>.

The comparison of water levels from spring to spring was selected in the early days of the program to represent water-level change from one growing

season to the next. Nebraska's aquifers are pumped heavily for irrigation water during spring and summer months. This pumping causes drawdowns in wells ranging from only a few feet to 100 feet or more depending on aquifer characteristics, climate conditions and a number of other hydrogeologic factors. Depending on conditions in a given growing year, the peak drawdown occurs between mid-July and the end of October. After the pumping season is complete, water levels begin to rapidly rebound and equilibrate to an un-pumped level in the spring of the following year. Therefore, any representation of water level changes in wells from spring to fall or from fall to fall would not reflect long-term changes in groundwater availability, but rather would indicate differences due to the extreme variability of when the maximum drawdown is reached, when the water level is measured and the overall effect of pumping on a particular aquifer at a particular location. Comparing water level measurements taken in the spring of the year when levels have equilibrated produces a more accurate and reliable map.

The process of collecting water levels, processing the data, and compiling the readings into water level change maps is time consuming. From the time water levels are collected and received by the CSD in the late spring, there is about a six month period during which quality assurance and data analysis is performed before the maps can be published in the fall. Due to the severe drought conditions experienced during the summer and fall of 2012, there is much interest from the



*Downloading data from a digital data recorder,
similar to equipment used at selected sites*

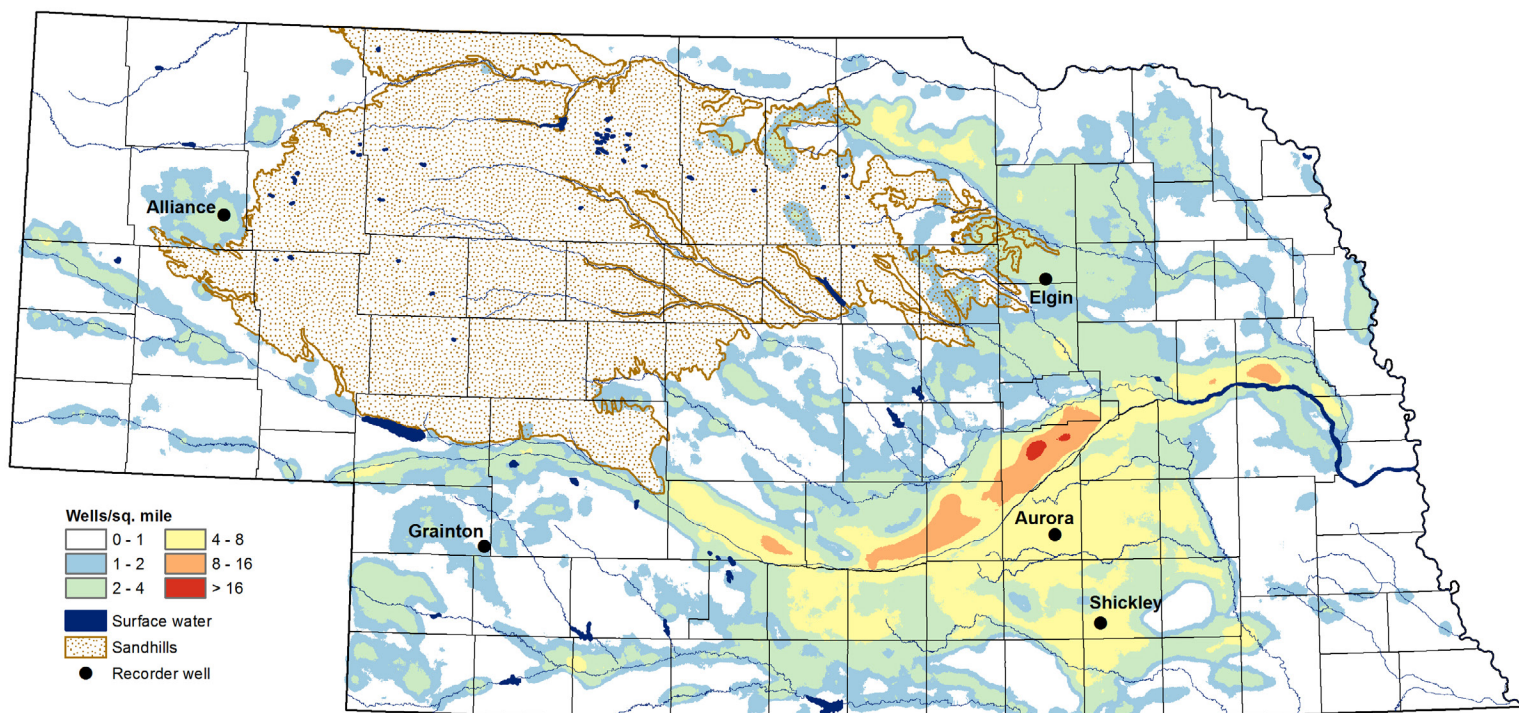


Figure 1. Density of Active Registered Irrigation Wells – December 2012
 Source: Nebraska Department of Natural Resources.

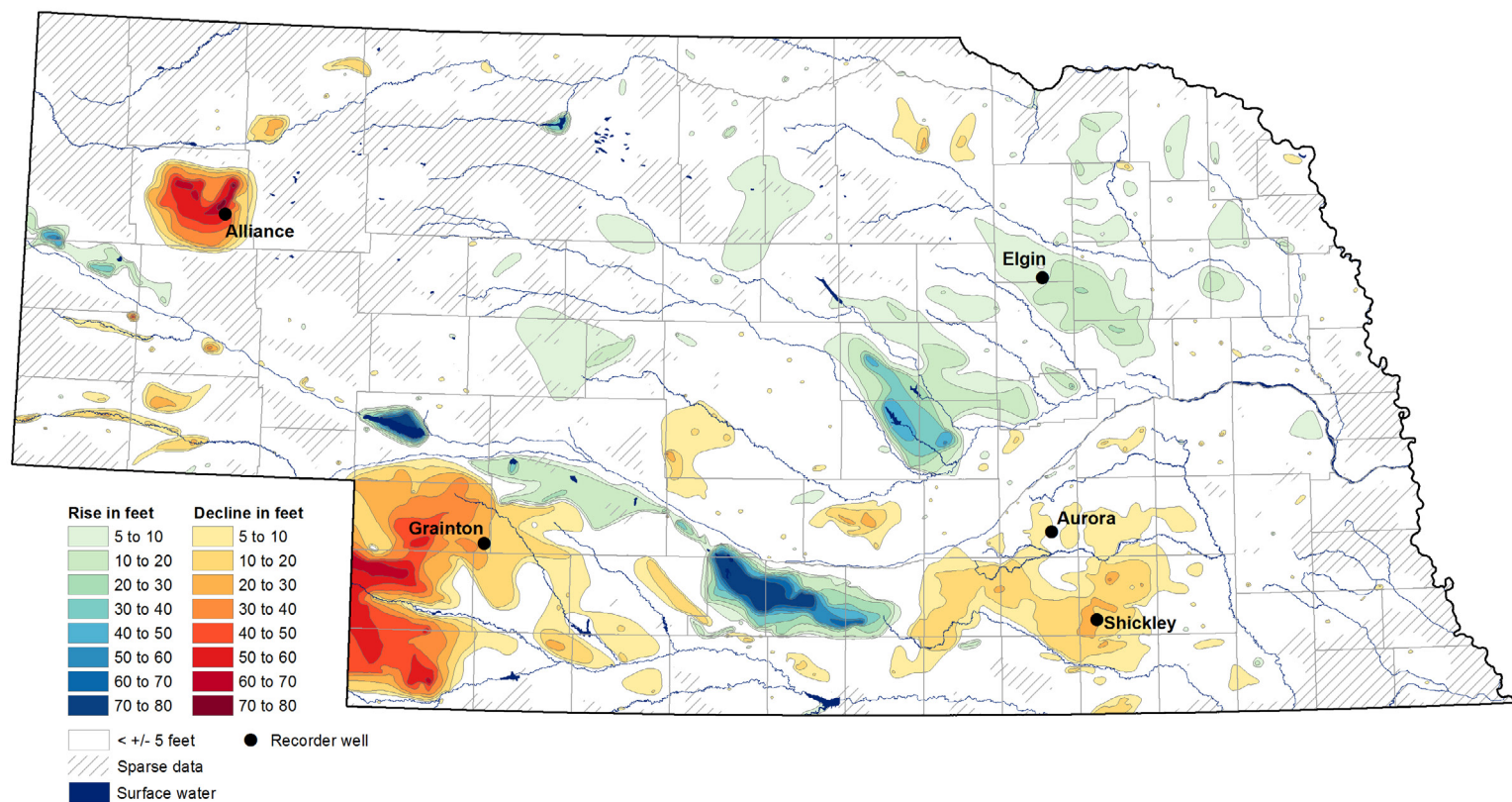


Figure 2. Groundwater –Level Changes in Nebraska – Predevelopment to Spring 2012
 Sources: U.S. Geological Survey, Nebraska Water Science Center; U.S. Bureau of Reclamation, Kansas-Nebraska Area Office; Nebraska Natural Resources Districts; Central Nebraska Public Power and Irrigation District

public regarding spring 2013 ground water levels. Although spring water levels are still being collected and compiled by many agencies at the end of April 2013, we have selected five wells to generally represent water level conditions in areas with high densities of irrigation wells, and areas that have historically had significant groundwater level changes. The authors do not intend this report to be interpreted as a comprehensive review of statewide ground-water level changes in Nebraska, but rather a generalized examination of water levels at selected sites where data is currently available. Although these wells do not accurately represent conditions in all areas, they show the general pattern of groundwater level changes in selected areas. The wells chosen for this report are represented in Fig. 1 and Fig. 2, and include the Grafton Recorder well in Perkins County, the Alliance Recorder well in Box Butte County, the Elgin Recorder well in Antelope County, the Shickley Recorder well in Fillmore County and the Aurora Recorder well in Hamilton County. All selected wells are screened in the High Plains Aquifer. These wells all have long records of data, with most wells having water levels recorded daily or monthly by automated digital data recorders. The 2013 Nebraska Statewide Groundwater Level Monitoring Report will be available from the CSD this fall, and will provide a more comprehensive look at the groundwater level changes in Nebraska as result of the 2012 drought.

AURORA AND SHICKLEY RECORDER WELLS

Both the Aurora and Shickley recorder wells are located in a region dominated by irrigated farmland with high densities of irrigation wells per square mile (Fig. 1). The hydrographs for these wells are shown in figures 3 and 4. The wells are located in the southeastern most portion of the High Plains Aquifer in Nebraska, and both wells responded similarly during the summer of 2012 and the fall of 2013. The total drawdown from spring 2012 to fall 2012 at the Aurora Recorder was 9.59 ft. Since fall, this well has recovered 4.59 ft for a total water level decline from the spring of 2012 to the spring of

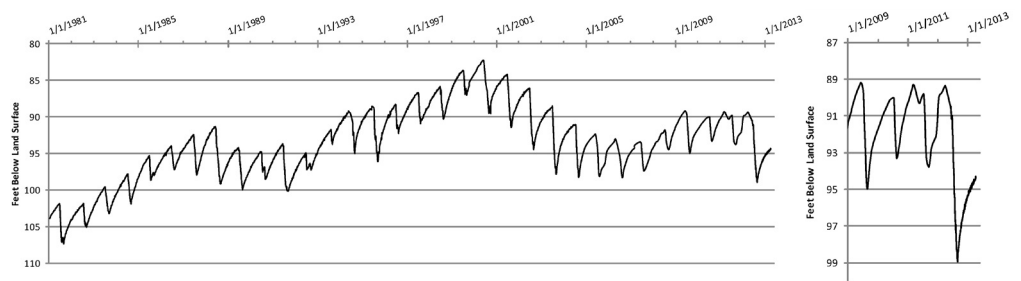


Figure 3. Aurora Recorder Well Hydrograph

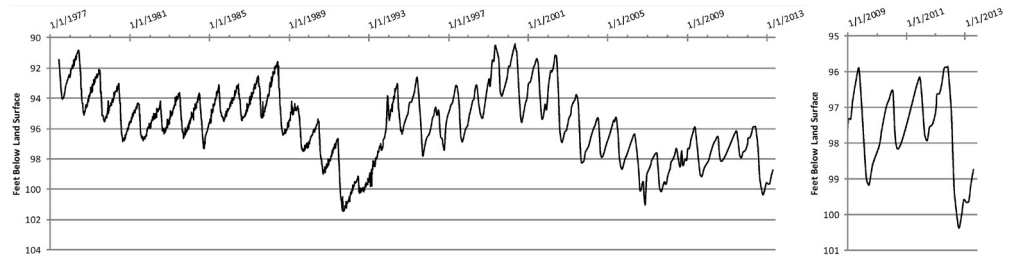


Figure 4. Shickley Recorder Well Hydrograph

2013 of 5.00 ft. The pattern of decline and rebound at the Shickley Recorder well was similar. Total drawdown at Shickley from spring of 2012 to the fall of 2012 was 4.51 ft. Water levels at this location recovered 1.64 ft for a total spring 2012 to spring 2013 decline of 2.87 ft. The difference in the magnitude of the water level change at both of these sites could be the result of differences in aquifer properties, recharge rates, and proximity to nearby high capacity wells. The Aurora well is located on the edge of a farm field, with numerous nearby irrigation wells. The Shickley well is located in downtown Shickley with fewer nearby high capacity wells. Neither of these wells hit all-time low levels in the fall of 2012 due to a relatively wet

period from 2009-2011. However, the water level changes from spring of 2012 to spring of 2013 set new records for the maximum amount of decline in one year. Water level changes of 2-5 feet at both of these sites are consistent with spring readings obtained from observation wells measured by the CSD in this part of the High Plains Aquifer.

GRAINTON RECORDER WELL

The well at Grafton NE is located in southeast Perkins County in an area dominated by a mix of irrigated and dryland farms. The hydrograph for this well is shown in Fig. 5. This region of Nebraska receives on average 15-20 inches of precipitation annually (High Plains Regional Climate Center (HPRCC),

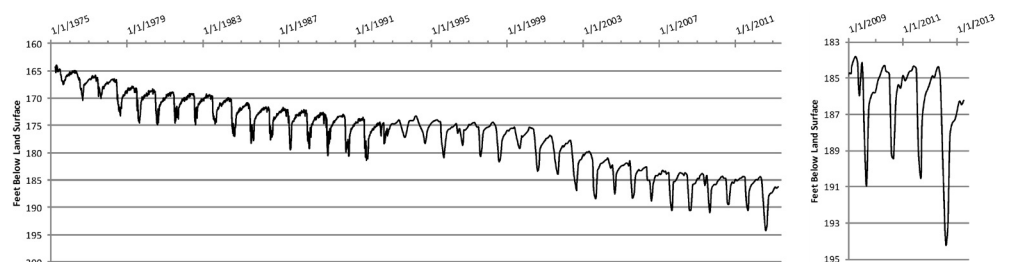


Figure 5. Grafton Recorder Well Hydrograph

University of Nebraska- Lincoln), thus agriculture relies heavily on groundwater for irrigation. As a result, this this region of Nebraska has water level drawdowns in excess of 70 ft in some areas since predevelopment (Figure 2). The Grinton well is screened in the High Plains Aquifer and had a total drawdown from spring of 2012 to fall of 2012 of 9.81 ft. From the fall of 2012 to the spring of 2013, the well recovered 7.96 ft for a total drawdown of 1.85 ft from the spring of 2012 to the spring of 2013. The fall reading was a new all-time low for this well. Though some recovery may yet occur before summer pumping begins, the water level likely won't rise much more than it already has, in which case 2013 may set a new record low spring water level. Overall, these statistics are not unprecedented for this well because, as the graph shows, new records are set almost every year due to the steady long-term decline in this well. Although April readings were not yet available for the Imperial well in Chase County (not graphed), there is likely a similar water level change of about 2 ft from spring of 2012 to spring of 2013 at that location.

ALLIANCE RECORDER WELL

The Alliance recorder is located in southeast Box Butte County in an area where land use is dominated by irrigated farmland. The hydrograph for this well is shown in figure 6. The Alliance Recorder well is in a region of relatively low precipitation with 15-20 inches annually, (HPRCC, University of Nebraska- Lincoln) where groundwater is relied upon heavily for irrigation water in production agriculture. As a result, water levels have steadily declined more than 60 ft since predevelopment in the nearby area. This well is screened in the High Plains Aquifer and had a total drawdown from spring of 2012 to fall of 2012 of 4.92 ft. From the fall of 2012 to the spring of 2013, the well recovered 1.59 ft for a total decline of 3.33 ft from the spring of 2012 to the spring of 2013. A single year decline of 3.33 ft is not unprecedented for Box Butte County; however it is more than the average annual decline for this well.

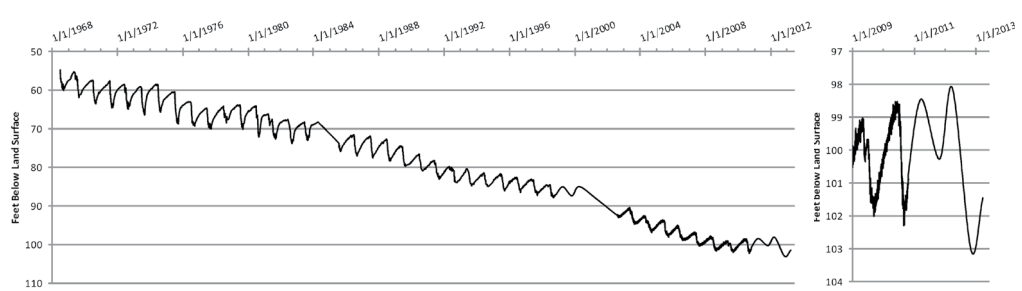


Figure 6. Alliance Recorder Well Hydrograph

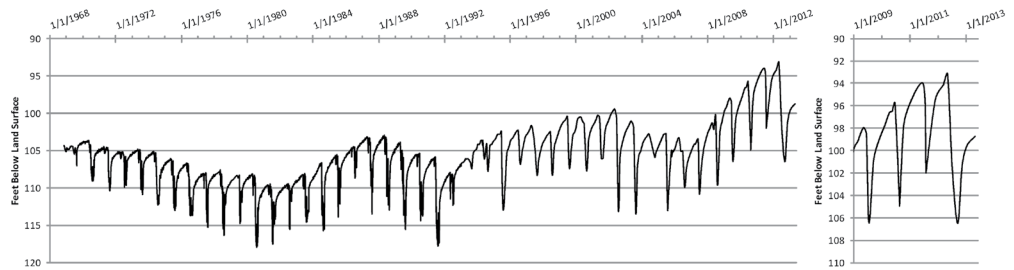


Figure 7. Elgin Recorder Well Hydrograph

ELGIN RECORDER WELL

The Elgin Recorder well is located in south central Antelope County in an area where land use is dominated by irrigated farmland. The hydrograph for this well is shown in figure 7. The well is screened in the eastern part of the High Plains Aquifer. This part of Nebraska receives on average 25 to 30 inches of rainfall per year (HPRCC, University of Nebraska- Lincoln) thus this region is much less dependent on groundwater for irrigation purposes. Extremely wet years from 2008-2011 caused a groundwater level rise of 10.38 feet at this well. This well had a decline of 13.27 ft from the spring of 2012 to the fall of 2012. During the late fall and winter of 2012 this well rebounded

7.76 ft for a total decline from the spring of 2012 to the spring of 2013 of 5.50 ft. Due to several years of above normal precipitation, this well did not experience an all-time low level. A one year decline of 5.50 feet was more than double the previous one year maximum decline of 2.17 feet.

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