Hydrogeologic Conditions in the Central Prairie Subarea of the Rathdrum Prairie Aquifer, 2007 – 2015

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Overview

1. The Central Prairie Subarea is one of five subareas for the Rathdrum Prairie aquifer. This subarea is located in the central portion of the aquifer, from the towns of Athol on the east, to Spirit Lake on the west, and to Rathdrum on the south. The subarea extends to the aquifer boundary on the north.
2. There are six monitoring wells in the Central Prairie Subarea. The Idaho Department of Water Resources (IDWR) monitors five of the wells; the USGS monitors one well.
3. Ground water level and water temperature data are collected at the five IDWR wells by manual electric tape measurements and electronic data transducers. The USGS monitors one well using a transducer and a telemetry system to transmit the data to their office.
4. The three wells in the northern part of the subarea are along the edge of the aquifer. These wells have significantly higher water level elevations than wells to the south, and different water level profiles. They appear to be completed in aquifers shallower than the main Rathdrum Prairie Aquifer.
5. The three wells located from Athol to the southwest are all in good hydraulic communication based on the similarities in the hydrographs.
6. The ground water level trend from 2007 to 2010 was slightly declining. In 2011, water levels rose in most of the wells, with the largest increases occurring in the two southernmost wells in the subarea. The water levels increased further in 2012, and stayed above normal in 2013 and 2014. Water level increases in 2011 and 2012 were the result of high-than-normal snowpacks in those years.
7. The hydrographs support Stevens (2013) conclusion that there are two sources of underflow; one from Lake Pend Oreille to the east, and one from the mountains and lakes to west. It also appears that the contribution of water to the aquifer is greater from the west than from the east.
8. IDWR plans to drill a new monitoring/educational well at the Junior and Senior High Schools complex in Spirit Lake in the summer of 2016. IDWR is evaluating the possibility of drilling a monitoring/educational well at one of the Rathdrum schools in 2017.
9. IDWR will continue to gather monitoring data in an effort to determine the flux from the three probably source areas (Lake Pend Oreille to the east, the area to the north, and the mountains and lakes on the west side of the Rathdrum Prairie).

Detailed Analyses

The Idaho Department of Water Resources (IDWR) has a ground water level and water temperature monitoring program for the Rathdrum Prairie aquifer. The network currently contains 30 wells. The Central Prairie Subarea, which is one of five subareas for the aquifer, is located in the central part of the Rathdrum Prairie aquifer, with the towns of Athol on the east boundary, Spirit Lake on the west boundary, and Rathdrum on the south boundary (Figure 1). The subarea extends to the northern boundary of the aquifer. There are six monitoring wells in the Central Prairie Subarea. IDWR monitors five of these wells; the USGS monitors one well. Figure 1 shows the location of the six wells and Table 1 provides the attributes of each well. In Situ© transducers are deployed in the five IDWR wells. The USGS monitors one well using a transducer and a telemetry system to transmit the data from the well to their office. This subarea is unique in that none of the six wells are near any major surface waters.

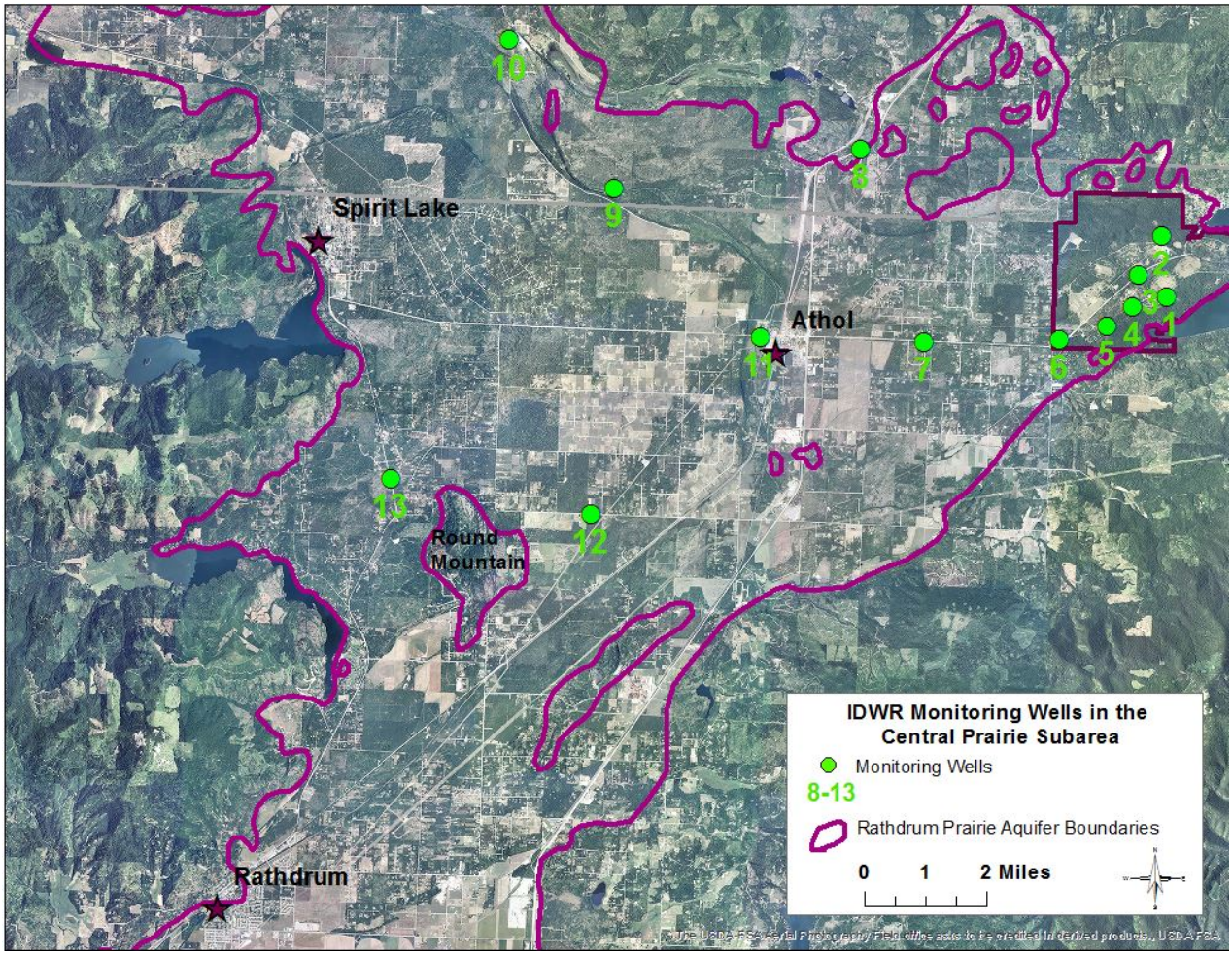

Figure 1. Location of six monitoring wells in the Central Prairie Subarea.

Table 1. List of the Central Prairie Subarea monitoring wells.

Well Number	Station Name Common Name	Year Drilled	Well Depth (feet)	Open Interval[1] (feet from top of casing)	Open Interval (feet above Sea Level)	Water Level Elevation[2]	Height of water column (ft)[3]	Period of Monitoring Data
8	54N 03W 27DDC1 Bonner Rest Area	1967	90	79-89 (S)	2098-2088	2120	35	4/2006-current[4]
9	54N 04W 36DAC1 Sheep Springs	2007	265	265 (O)	2022	2138	115	7/2007-current[4]
10	54N 04W 22ADD1 Clagstone	2007	260	240-255 (P)	2058-2038	2148	110	7/2007-current[4]
11	53N 03W 16BBA1 Athol	2007	402	385-400 (P)	1996-1981	2055	75	7/2007-current[4]
12	53N 04W 36ABB1 Eight Mile Prairie	2006	560	380-420 (P)	2031-1991	2032	190	7/2007-current[4]
13	53N 04W 28CAB1 Round Mountain	1971	449	438-448 (S)	1994-1984	2028	54	7/1971-current[5]

[1]P = Perforations; O = Open Hole; S = Screen [2]Based on the maximum water levels. [3]Based on the maximum water levels.
[4]IDWR manual and transducer measurements. [5]USGS manual and transducer measurements.

Wells #8, #9, and #10

Wells #8, #9, and #10 are located in the northern part of the Central Prairie Subarea. The hydrologic data for these three wells differ significantly from the other network monitoring wells to the east and south in three ways.

First, the hydrographs are unusual in comparison to other hydrographs for the Rathdrum Prairie aquifer. Well #8 has annual maximums that occur in March, and minimums that occur in October or November. Most wells in the network have maximum water levels in September and minimums in March. Well #9 has a very flat hydrograph with no annual cycles of maximum and minimum values. Well #10 has annual cycles of maximums and minimums but the ranges are only one to two feet; normal ranges are five to eight feet.

Second, all three wells have increases in water levels in 2011, but the magnitudes of the increases are smaller than other monitoring wells in the network.

Third, the Water Level Elevations (WLEs) are much higher than nearby monitoring wells. For example, the WLEs for Wells #8, #9, and #10 are about 60 feet, 80 feet, and 90 feet higher, respectively, than the WLE in Well #11, which is just a couple miles to the south-southeast. This results in water level gradients from Wells #9 and #10 to the south that are much higher than the gradients throughout the rest of the Rathdrum Prairie aquifer.

Therefore, the conclusion is that these three wells are completed in aquifers shallower than the main aquifer. However, ground water from this northern part of the subarea probably recharges the main aquifer to the south.

Wells #11, #12, and #13

Well #11 is located just west of Athol; Wells #12 and #13 are located on the east and west sides of Round Mountain, respectively (Figure 1). The hydrograph for Well #11 is very similar to the hydrograph

for Well #7, which is located 3 miles to the east in the Farragut State Park Subarea (Figure 2). Stephens (2013) used isotope data to show the different recharge sources for the waters in the Rathdrum Prairie aquifer. Well #11 is included in the recharge plume coming from Lake Pend Oreille (Figure 3).

The hydrographs for Wells #12 and #13 are nearly identical (Figure 2). Both wells had larger increases in water levels in 2011 than Well #11. Moreover, the water levels started to increase in January, 2011, in these two wells, but the increases in Well #11 didn't commence until April. Maximum water levels in Wells #12 and #13 in 2012-2014 occurred about three months before the maximum levels in Well #11. These observations support Stevens' (2013) conclusion that recharge from the mountains and lakes on the west side of the Rathdrum Prairie is the source for the western part of the aquifer. However, the data from Well #12 indicate that the recharge plume from the western slopes and lakes in the vicinity of Round Mountain extends about three miles further to the east than shown by Stevens (2013).

The ground water gradient from Well #11 to Well #13 was 12 ft per mile (ft/mi) in 2008 (normal snowpack and runoff year) and 9 ft/mi in 2012 (high snowpack and runoff year). The gradient from Well #7 to Well #11 was 0.8 ft/mi in 2008, and 0.6 ft/yr in 2012.

Water Temperatures for Wells #8 - #12

Water temperature data are available for the five wells monitored by IDWR. Well #8 shows annual cycles with maximum temperatures in July or August, and minimum temperatures in March. This is the opposite pattern seen in most of the wells in the Farragut State Park Subarea where maximums occur in January through March, and minimums occur in July through August. Also, the difference between the maximum and minimum values in Well #8 ranges from 10° degrees Fahrenheit (°F) to 20°F, which is a much greater range than any of the other wells in the northern part of the Rathdrum Prairie. This large range suggests that there is a surface influence nearby, which must be from precipitation since Well #8 is not near any significant surface water feature. The temperature profile for Wells #9 and #10 are nearly flat. The profile for Well #11 shows an overall slight increase of 0.4 °F over eight years which is considered to be instrument drift. Well #12 has a gradual increase of about 0.35°F from late 2011 to early 2013, followed by a gradual decline ending in mid 2014 (Figure 4). If this warmer "bump" in the record is related to the two high water years beginning in 2011, then the ground water velocity is about 46 feet per day. Well #13 does not have any temperature data.

Conclusions

Ground water in the Central Prairie Subarea is characterized by two separate hydrologic regimes; the northern part and the central part. The northern part has ground water level elevations that are 60 – 90 feet higher than the elevations in the central part of the subarea. Also, the water level and water temperature profiles for the three monitoring wells in the northern part are significantly different than the monitoring wells in the central part, and most of the other network monitoring wells. The northern part of the subarea has one or more aquifers that are shallower than the main Rathdrum Prairie Aquifer and not directly connected hydraulically to the main aquifer. However, it is probable that the ground water in these shallow aquifers ultimately flows to the south, migrates vertically downward, and eventually provides recharge to the main aquifer.

The central part of the subarea contains the main channel of the Rathdrum Prairie Aquifer. Based on the hydrographs, the three monitoring wells in this area are hydraulically connected. However, two of

the wells have very similar hydrographs, and the third well has a somewhat different hydrograph. These differences are caused by two independent sources of recharge to the aquifer. One source comes from Lake Pend Oreille to the east. The other source originates from the mountains and lakes to the west. The western source probably provides more water to the aquifer than the eastern source, based on the larger changes in water levels in 2011 and 2012 in the Wells #12 and #13. The two sources probably merge a mile or two east of Round Mountain, and then flow to the southwest.

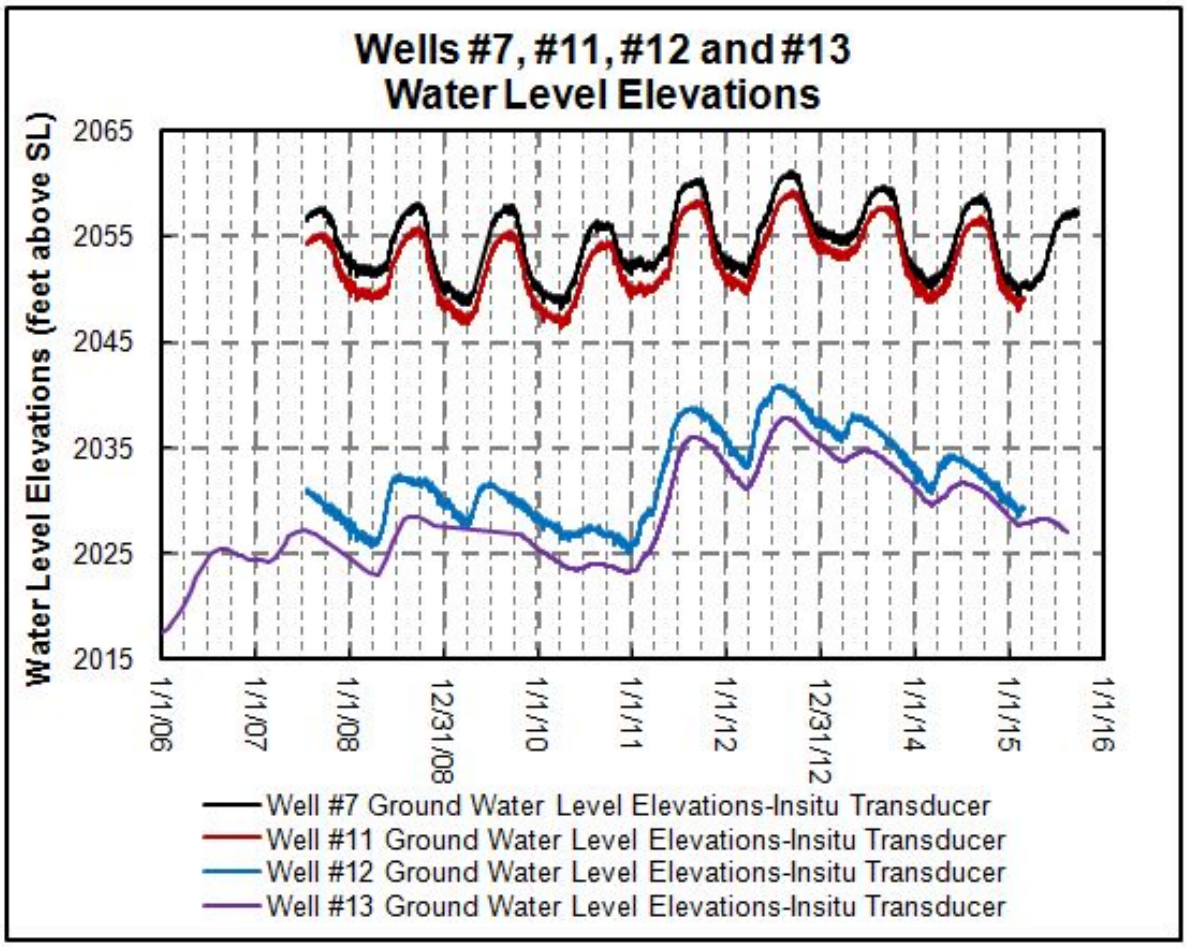

Figure 2. Ground water levels for IDWR Monitoring Well #7, #11, #12, and #13.

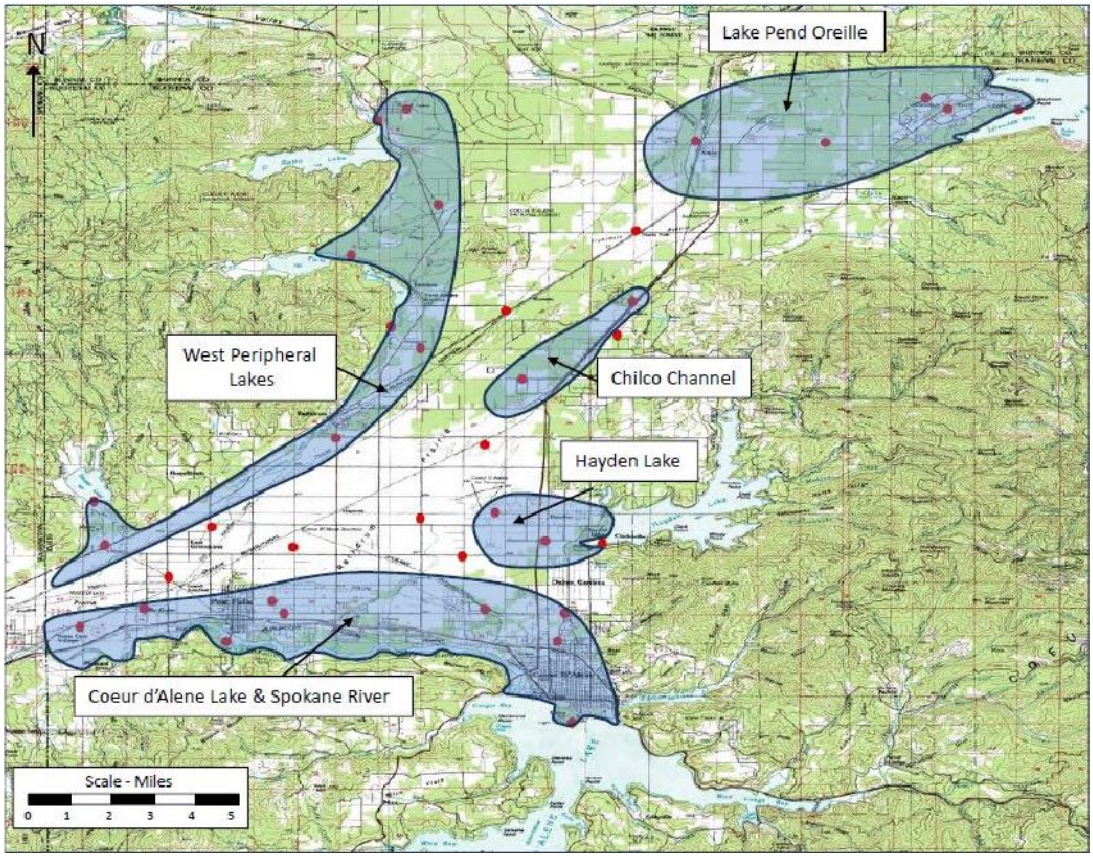

Figure 3. Recharge areas as determined by deuterium (2H) and oxygen (18O) isotope data (from Stephens, 2013).

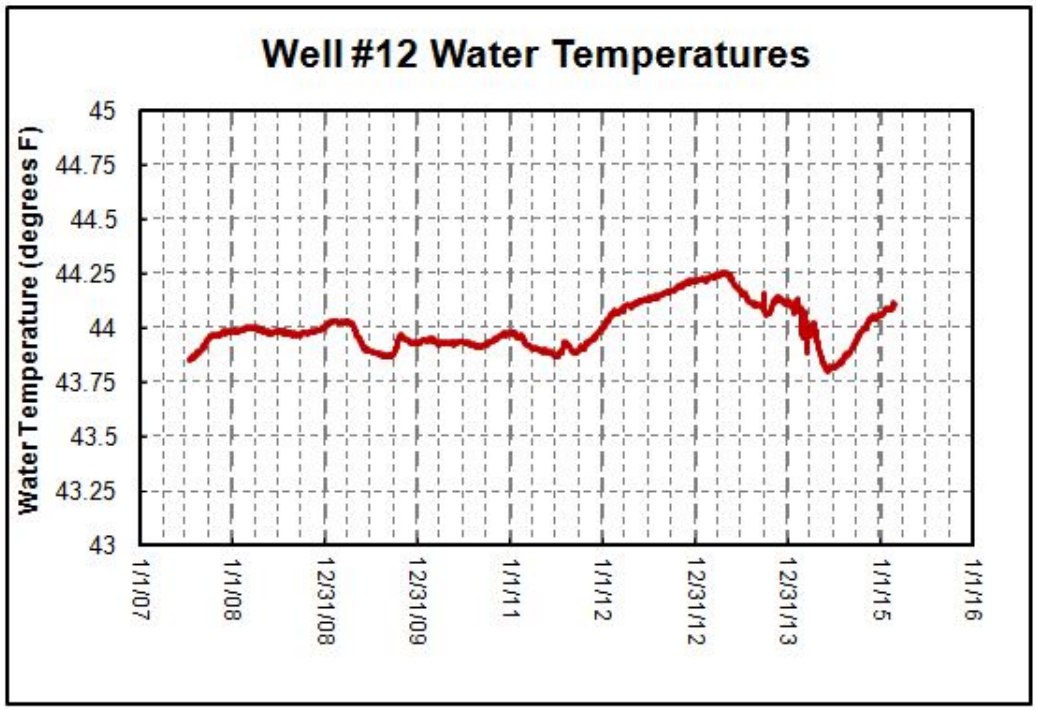

Figure 4. Ground water temperatures for Well #12.

Future Plans

1. Continue to monitor all six wells.
2. Drill a new monitoring well at the Timberlake High School in the town of Spirit Lake. In addition to monitoring water levels and temperatures, the well will be instrumented with a transducer that records water quality parameters so that it can be used for educational purposes by both the Junior and Senior High Schools. The well is to be drilled in the summer of 2016.
3. Investigate the possibility of drilling a monitoring/educational well at one of the Rathdrum schools in 2017. A funding request for part of the cost has been submitted to the Kootenai Aquifer Protection District. IDWR plans to provide the other portion of the funding.
4. Discuss the possibility of installing a temperature transducer in Well #13 with the USGS.

References

Stephens, G.R., 2013, A hydrogeochemical investigation of the Rathdrum Prairie Aquifer. Idaho Department of Environmental Quality, Ground Water Investigation Report DEQ-CRO-03-13, 27 p.