# memo

| | | | |
|---|---|---|---|
| **Project Name** | Groundwater Monitoring Program | **Date** | 11/5/2018 |
| **To / Contact info** | BCWD Managers | | |
| **Cc / Contact info** | Karen Kill, Camilla Correll, PE | | |
| **From / Contact info** | Stu Grubb, PG | | |
| **Regarding** | 2018 Groundwater Elevations and Trends | | |

## Background

EOR has measured groundwater elevations in wells in the BCWD since 2012. DNR also measures groundwater elevations in three observation wells. The wells in the monitoring network were selected to be representative of different areas of the watershed and the different aquifers used for drinking water. The golf course wells are included because they are among the largest users of groundwater. The measurements help identify trends in groundwater elevations that relate to groundwater/surface water interactions in Brown's Creek and other groundwater-dependant natural resources. Groundwater level measurements were collected by Stu Grubb/EOR, assisted by Cameron Blake/Washington Conservation District, in September and October 2018.

## Analysis

*Residential Wells and DNR Observation Wells*

Groundwater elevation data from the residential wells and DNR observation wells are shown in Table 1. Groundwater elevations generally decreased from 2017 to 2018 by an average of about 1.1 feet even though the area had above normal rainfall.

Figure 1 shows the yearly change in water levels since 2012 and may give some insight into why the water levels decreased. Each year the aquifer needs recharge to maintain water levels and offset groundwater discharges to wells and natural features such as springs, wetlands, lakes, and creeks. During the two previous years, groundwater elevations rose by 1-3 feet each year. Those years also had above normal rainfall, and much of it came in early Spring. Spring rainfall tends to recharge aquifers more than later-season rainfall because less of the rainfall is intercepted or stored in the ground. In Spring the ground is still saturated from snow melt, there are fewer leaves on trees to intercept the rainfall, and evapotranspiration rates are much lower. In 2018 there was less rainfall in the Spring and more in the Summer and Fall. It is possible that the aquifers received less recharge in 2018 than necessary to maintain their relatively high levels, despite above normal rainfall.

The Olien well is the only residential well with a water level that rose over the past year. It is also the closest to the St. Croix River and has a significantly lower water elevation than the other wells. The water level in the Olien well may be influenced more by the St. Croix River water levels, which have been unusually high in September and October 2018.

*DNR Observation Wells*

DNR measures water elevations monthly in three observation wells:

- Brown's Creek Park – Deep well completed in the Jordan aquifer
- Brown's Creek Park – Shallow well completed in the Quaternary (glacial) aquifer
- Withrow School – Well completed in the Prairie du Chien aquifer

Groundwater elevation data from the DNR observation wells are shown on Figure 2. The data for the Withrow well and the Brown's Creek Park – Shallow well show similar trends to the other wells. The Brown's Creek Park – Deep well appears to be under the influence of a nearby pumping well, so its

water levels often do not correlate with other wells. More discussion about the deep well is forthcoming in another memo.

*Golf Course Wells*
Groundwater level measurements recorded for the golf course wells are shown in Table 1. The golf course wells showed similar trends to the other wells. The water level in Irrigation well #4 at Stillwater Oaks Golf Course varies considerably from year to year, suggesting that something mechanical is affecting water levels. EOR will work with the golf course staff to figure out what is affecting the water level. The irrigation well at the Stillwater Country Club continues to be difficult to measure because it is deep (770 feet) and has several obstructions in the well pipe. EOR is still investigating a reliable way to measure the water level in this well.

## Recommendations

BCWD should continue to collect groundwater elevation data on an annual basis. The data and analyses are important for understanding conditions throughout the District, particularly the thermal impairment of Brown's Creek as groundwater elevations have a direct impact on baseflow contributions to the stream. At the micro-scale, this data allows the District to identify how existing wells and landuse impact the groundwater system. At the macro-scale, the data can be used to calibrate and refine groundwater and thermal modeling efforts by the watershed district, Washington County and/or state agencies.

The long-term nature of this data set makes it valuable and (to my knowledge) unique among Minnesota watersheds. We have been able to observe changes in the watershed's groundwater flow system through a variety of climate conditions, as described above. It will be valuable to compare these data to groundwater data collected during future climate conditions. In the six years of monitoring, we have observed groundwater levels that have generally risen by six feet or more, but we know from observation records that the groundwater level can vary by at least 14 feet over a 14-year period (See Figure 2). It would be useful to observe all of the wells in the monitoring network over a similar period and range of water levels.

**Table 1. Groundwater Elevations**

| Unique Number | Name | August 2012 Water Elevation | 2013 Water Elevation | 2014 Water Elevation | 2015 Water Elevation | 2016 Water Elevation | 2017 Water Elevation | 2018 Water Elevation | | Change since last measure |
|---|---|---|---|---|---|---|---|---|---|---|
| Approximate Date | | Aug-12 | Aug-13 | Aug-14 | Sep-15 | Oct-16 | Oct-17 | Oct-18 | | |
| **Golf Course Wells** | | | | | | | | | | |
| 515171 | Applewood Hills | 887.97 | 887.34 | | | 891.84 | 895.42 | 894.14 | | -1.28 |
| 151580 | Oak Glen Country Club | 819.62 | | | | 825.50 | 825.88 | 823.56 | | -2.32 |
| 151581 | Oak Glen Country Club | | | | | 829.71 | 830.12 | 828.16 | | -1.96 |
| 208038 | Stillwater Country Club | 749.66 | | | | 769.17 | >200 | >200 | | |
| Stillwater | Stillwater Oaks Golf Club | 904.38 | | | | 910.31 | 913.42 | 910.11 | | -3.31 |
| Stillwater | Stillwater Oaks Golf Club | 898.50 | | | | 908.89 | 910.27 | 909.05 | | -1.22 |
| Stillwater | Stillwater Oaks Golf Club | 903.59 | 906.36 | | | 910.27 | 911.26 | 910.07 | | -1.19 |
| Stillwater | Stillwater Oaks Golf Club | | | | | 963.06 | Artesian | 957.69 | | |
| 566145 | Logger's Trail Golf Course | 898.91 | 900.21 | | | 904.41 | 905.62 | 904.16 | | -1.46 |
| 667998 | Logger's Trail Golf Course | | | | | 911.29 | 906.28 | 905.10 | | -1.18 |
| 761112 | Logger's Trail Golf Course | | | | | 900.53 | 901.16 | 900.09 | | -1.07 |
| | | | | | | | | | | |
| **Domestic Wells** | | | | | | | | | | |
| 428563 | Ed and Laurie Francis | 893.03 | 896.14 | 898.01 | 897.56 | 900.51 | 902.53 | 900.91 | | -1.62 |
| 410987 | Dan and Lori Gunderson | 899.90 | 900.01 | 900.99 | 901.89 | 904.96 | 906.98 | 905.62 | | -1.36 |
| 196839 | Louis J. Bruno | 857.03 | 860.70 | | | 862.92 | 867.75 | 866.75 | | -1.00 |
| Leiser | Craig Leiser | 929.36 | 929.84 | 932.13 | 931.27 | 932.63 | 935.11 | 933.99 | | -1.12 |
| James | Alan and Molly James | 936.47 | | 939.00 | 937.59 | 939.62 | 941.71 | 940.20 | | -1.51 |
| 184049 | Kirk and Tracy Hillquist | 938.25 | 940.29 | 940.86 | 939.20 | 942.27 | | 942.48 | | |
| Thatcher | Jyneen Thatcher | 948.94 | 947.88 | 951.97 | 950.55 | 953.76 | 955.68 | 953.19 | | -2.49 |
| 138188 | Rick Vanzwol | 930.59 | 927.24 | 935.48 | 934.74 | 937.89 | 940.02 | 939.36 | | -0.66 |
| 479665 | John and Michelle Weaver | | 900.99 | | 899.73 | 907.27 | 907.41 | 906.86 | | -0.55 |
| 493250 | Mark and Sharon Olien | 716.97 | 713.74 | 720.64 | | 721.88 | 719.97 | 721.50 | | 1.53 |
| 525197 | James and Marilyn Opp | | 907.93 | 909.80 | 910.04 | 912.08 | 913.88 | 913.02 | | -0.86 |
| 505390 | Larry J and Pamela J Larson | 924.70 | | 925.98 | | 928.67 | 930.48 | 929.18 | | -1.30 |
| 153485 | John P and Carolyn A Rydel | 893.58 | 893.98 | 896.20 | 895.51 | 897.42 | 899.51 | 898.47 | | -1.04 |
| 138904 | Duane and Margaret Burmeister | | | 828.79 | 827.21 | 829.25 | 829.91 | 828.41 | | -1.50 |
| 406204 | Michael and Rita Wiersma | | 938.96 | 939.12 | 939.00 | 941.10 | 941.38 | 940.98 | | -0.40 |
| Boughten | Larry Boughten | | | | | | 953.73 | 951.32 | | -2.41 |
| | | | | | | | | | | |
| **DNR Observation Wells** | | | | | | | | | | |
| 595649 | Brown's Creek Park - Deep | 861.56 | 861.74 | 862.15 | 862.51 | 866.32 | 864.77 | 865.81 | | 1.04 |
| 623066 | Brown's Creek Park - Shallow | 874.48 | 875.43 | 874.91 | 874.03 | 875.53 | 875.77 | 875.05 | | -0.72 |
| 551565 | Withrow Elementary School | 949.39 | 947.80 | 949.40 | 951.27 | 954.28 | 956.88 | 954.91 | | -1.97 |
| | | | | | | | | *Average* | | *-1.10* |

**Figure 1. Yearly Change in Groundwater Elevation – BCWD Wells**

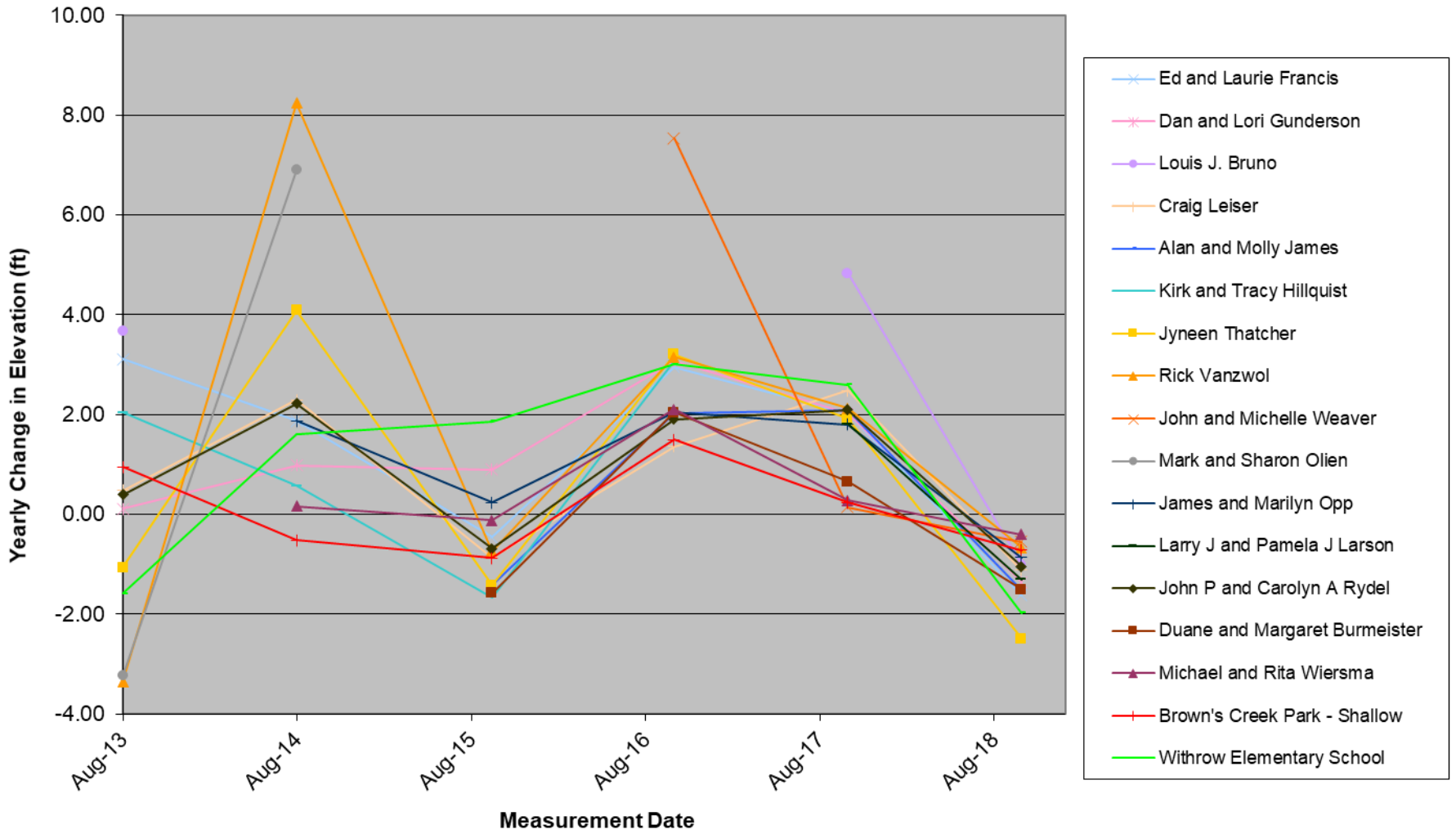
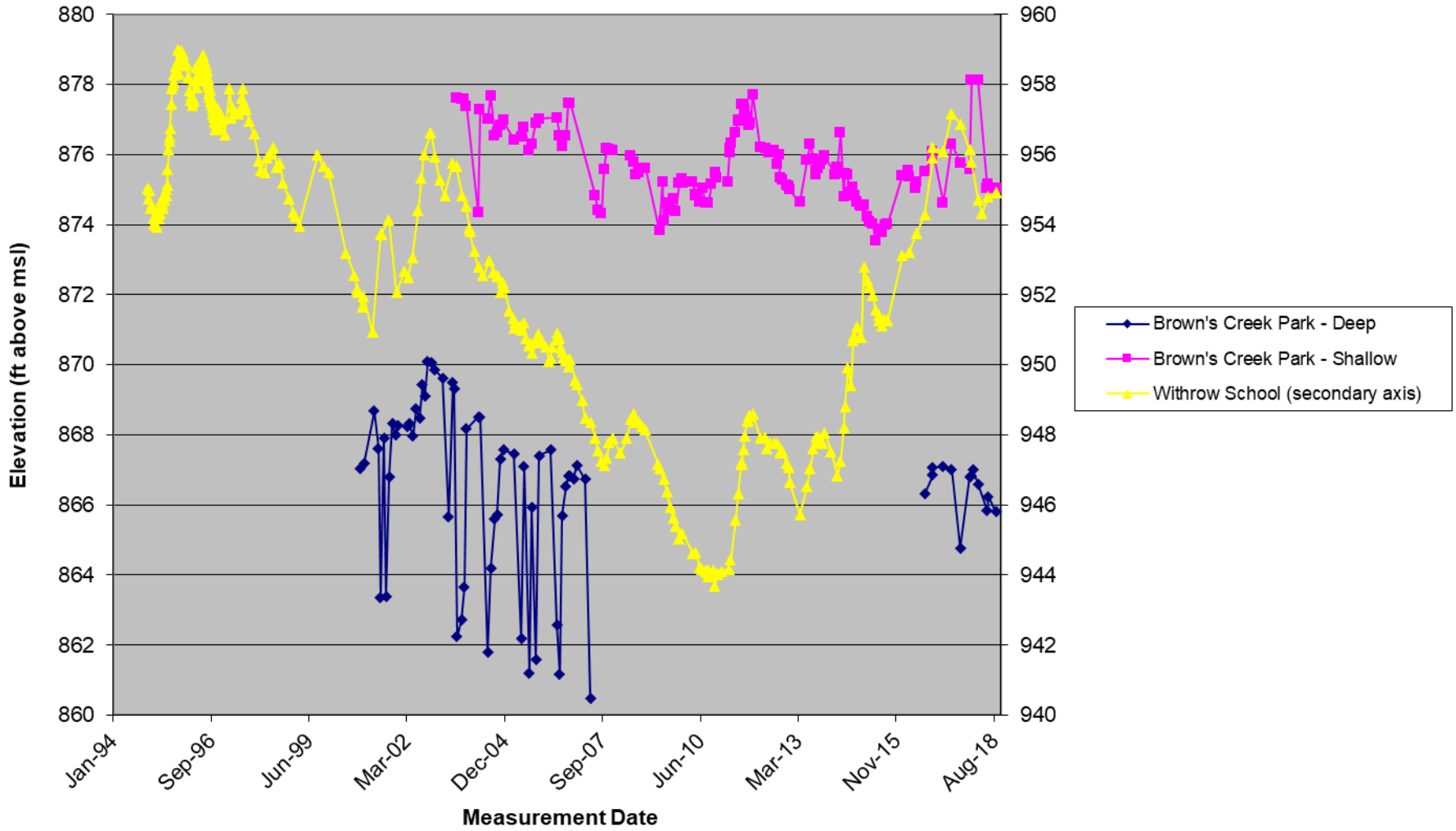
**Figure 2. Groundwater Elevations – DNR Observation Wells**