technical memo

Project Name |	Groundwater Monitoring Program	**Date** |	12/3/2021
To / Contact info |	BCWD Board of Managers		
Cc / Contact info |	Karen Kill, District Administrator		
From / Contact info |	Stu Grubb, PG		
Regarding |	2021 Groundwater Elevation and Trends		

Background

BCWD has established a network of wells for measuring groundwater levels. The network includes residential wells, golf course wells, and DNR observation wells. Water level measurements are collected annually at the residential wells and golf course wells. Water level measurements are recorded hourly at the DNR observation wells using data loggers.

The data has been collected since 2012. The data is used to identify trends in groundwater levels and changes to groundwater flow over time. Changes to levels and groundwater flow can have significant effects on Brown's Creek and other groundwater dependent natural resources, flooded areas such as Kimbro Basin, and stormwater infiltration basins.

The well network was established to cover the entire watershed district, and also to monitor each of the major drinking water aquifers in the watershed district. The distribution of wells by aquifer is:

- Quaternary (Glacial) – 6
- St. Peter - 1
- Prairie du Chien – 11
- Jordan/St. Lawrence – 2
- Tunnel City Group – 3
- Multi-Aquifer – 3

Analysis

Residential Wells

Groundwater elevation data from the golf course wells, residential wells (and DNR observation wells) are shown in Table 1. Groundwater elevations decreased from 2020 to 2021 with an average decrease of 2.41 feet. The decrease is not surprising considering the near average rainfall in 2020 and below average rainfall in 2021, particularly during Spring months when much of the infiltration and aquifer recharge occurs.

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 shows that the water level has been dropping since reaching a high level of 960.05 in June 2020. The groundwater elevation in the Brown's Creek Park – Shallow well does not fluctuate much from year to year (due to its hydraulic connection and influenced by the elevation of Brown's Creek) but has also been dropping since mid-summer 2020. The Brown's Creek Park – Deep well groundwater elevations have also dropped during the recent time period and have experienced the fluctuations seen in the past. Note that the 2021 data is still considered provisional at this time.

Golf Course Wells

The golf course wells showed similar trends to the other wells. The water level in Irrigation well #4 at Stillwater Oaks Golf Course varies a lot from year to year, suggesting that something mechanical is affecting the measurements. We will continue to investigate. The irrigation well at the Stillwater Country Club is difficult to measure because it is deep and has several obstructions in the well pipe. Similar measurement difficulties were noted in recent years at Stillwater Oaks #1 and one of the irrigation wells at Logger's Trail. We are still looking for reliable ways to measure the water level in these well.

Change in Water Levels in Each Aquifer

Groundwater levels in each aquifer were compared to identify trends over time. Residential well and DNR observation well levels were used for the analysis. The golf course wells have not been measured for as long, and the water level readings tend to be less reliable due to the large pumping volume.

Quaternary (Glacial) Aquifer

Groundwater levels in the shallow Quaternary aquifer wells are shown on Figure 2. Three of the wells show an increase of over 10 feet since 2012 (although down slightly from 2020). Three of the wells show significantly less increase, about 3 feet. One well shows very little increase, less than two feet. The well that shows the least increase is located in Brown's Creek Park, near Brown's Creek. The water level in the well is stabilized by the relatively constant water level in the Creek and the discharge of groundwater from the aquifer to the Creek. The variation in water levels among the wells indicates the importance of having water level readings from several areas across the watershed.

Prairie du Chien Aquifer

Groundwater levels in the Prairie du Chien aquifer are shown in Figure 3. Most of the wells showed a consistent increase of eight to 10 feet from 2012 to 2020 and then a dropped during 2021. One well, the Wiersma well, shows less of an increase. This well has a shallow depth to water and is located closest to Brown's Creek (about 300 feet). The relatively stable water level may indicate that this well and this aquifer are influenced by Brown's Creek.

Other Aquifers

Groundwater levels from the St. Peter, Jordan, and Tunnel City Group aquifers are shown on Figure 4. The wells show similar trends over time, a rise from 2012 to 2020 followed by a drop in 2021. The Olien well water level has not changed significantly since 2014. This is the closest well to the Saint

Croix River, and may show the influence of the river level on the Tunnel City Group aquifer in this area.

Recommendations

BCWD should continue to collect groundwater elevation data on an annual basis. The long-term data and analyses are important for understanding groundwater conditions and groundwater/surface water interactions throughout the District. The data will be particularly useful for understanding the thermal impairment of Brown's Creek and water level fluctuations in landlocked areas such as the Kimbro Basin.

Table 1. Groundwater Elevations

Unique Number	Name	2013 Water Elevation	2014 Water Elevation	2015 Water Elevation	2016 Water Elevation	2017 Water Elevation	2018 Water Elevation	2019 Water Elevation	2020 Water Elevation	2021 Water Elevation	Change since last measure
Approximate Date		Aug-13	Aug-14	Sep-15	Oct-16	Oct-17	Oct-18	Oct-19	Oct-20	Oct-21	
Golf Course Wells											
515171	Applewood Hills	887.34			891.84	895.42	894.14		897.65	895.58	-2.07
151580	Oak Glen Country Club				825.50	825.88	823.56	826.12	825.63	823.00	-2.63
151581	Oak Glen Country Club				829.71	830.12	828.16	828.23	828.78	829.19	0.41
208038	Stillwater Country Club				769.17	>200	>200	>200			
Stillwater Oaks 1	Stillwater Oaks Golf Club				910.31	913.42	910.11	912.41			
Stillwater Oaks 2	Stillwater Oaks Golf Club				908.89	910.27	909.05	913.60	913.72	909.95	-3.77
Stillwater Oaks 3	Stillwater Oaks Golf Club	906.36			910.27	911.26	910.07	911.90	912.46	911.02	-1.44
Stillwater Oaks 4	Stillwater Oaks Golf Club				963.06	Artesian	957.69	970.29	970.16	970.81	0.65
566145	Logger's Trail Golf Course	900.21			904.41	905.62	904.16	905.93	907.20		
667998	Logger's Trail Golf Course				911.29	906.28	905.10	907.34	908.40	905.30	-3.10
761112	Logger's Trail Golf Course				900.53	901.16	900.09	901.94	903.55	900.71	-2.84
Domestic Wells											
428563	Ed and Laurie Francis	896.14	898.01	897.56	900.51	902.53	900.91	903.36	906.14	903.71	-2.43
410987	Dan and Lori Gunderson	900.01	900.99	901.89	904.96	906.98	905.62	907.22	910.22	908.10	-2.12
196839	Louis J. Bruno	860.70			862.92	867.75	866.75	866.40	870.28	868.23	-2.05
Leiser	Craig Leiser	929.84	932.13	931.27	932.63	935.11	933.99	935.85	937.65	934.01	-3.64
James	Alan and Molly James		939.00	937.59	939.62	941.71	940.20	942.14	944.20	940.56	-3.64
184049	Kirk and Tracy Hillquist	940.29	940.86	939.20	942.27		942.48	944.77	945.61	941.11	-4.50
Thatcher	Jyneen Thatcher	947.88	951.97	950.55	953.76	955.68	953.19	957.18	958.63	953.89	-4.74
138188	Rick Vanzwol	927.24	935.48	934.74	937.89	940.02	939.36	941.45	943.96	940.84	-3.12
479665	John and Michelle Weaver	900.99		899.73	907.27	907.41	906.86	907.77	908.87	907.23	-1.64
493250	Mark and Sharon Olien	713.74	720.64		721.88	719.97	721.50	721.54	721.89	721.01	-0.88
525197	James and Marilyn Opp	907.93	909.80	910.04	912.08	913.88	913.02	914.69	917.18	914.69	-2.49
505390	Larry J and Pamela J Larson		925.98		928.67	930.48	929.18	932.29	933.50	932.93	-0.57
153485	John P and Carolyn A Rydel	893.98	896.20	895.51	897.42	899.51	898.47	899.31	901.08	897.14	-3.94
138904	Duane and Margaret Burmeister		828.79	827.21	829.25	829.91	828.41	830.33	832.27	828.69	-3.58
406204	Michael and Rita Wiersma	938.96	939.12	939.00	941.10	941.38	940.98		942.78	940.28	-2.50
Boughten	Larry Boughten					953.73	951.32	954.28	956.81	949.52	-7.29
DNR Observation Wells											
595649	Brown's Creek Park - Deep	861.73	862.17	862.51	866.32	864.77	865.81	868.11	868.20	866.17	-2.03
623066	Brown's Creek Park - Shallow	873.13	874.82	874.03	875.53	875.77	875.05	876.84	876.88	875.30	-1.58
551565	Withrow Elementary School	949.91	952.65	951.16	954.17	956.88	954.91	958.64	959.50	954.83	-4.67

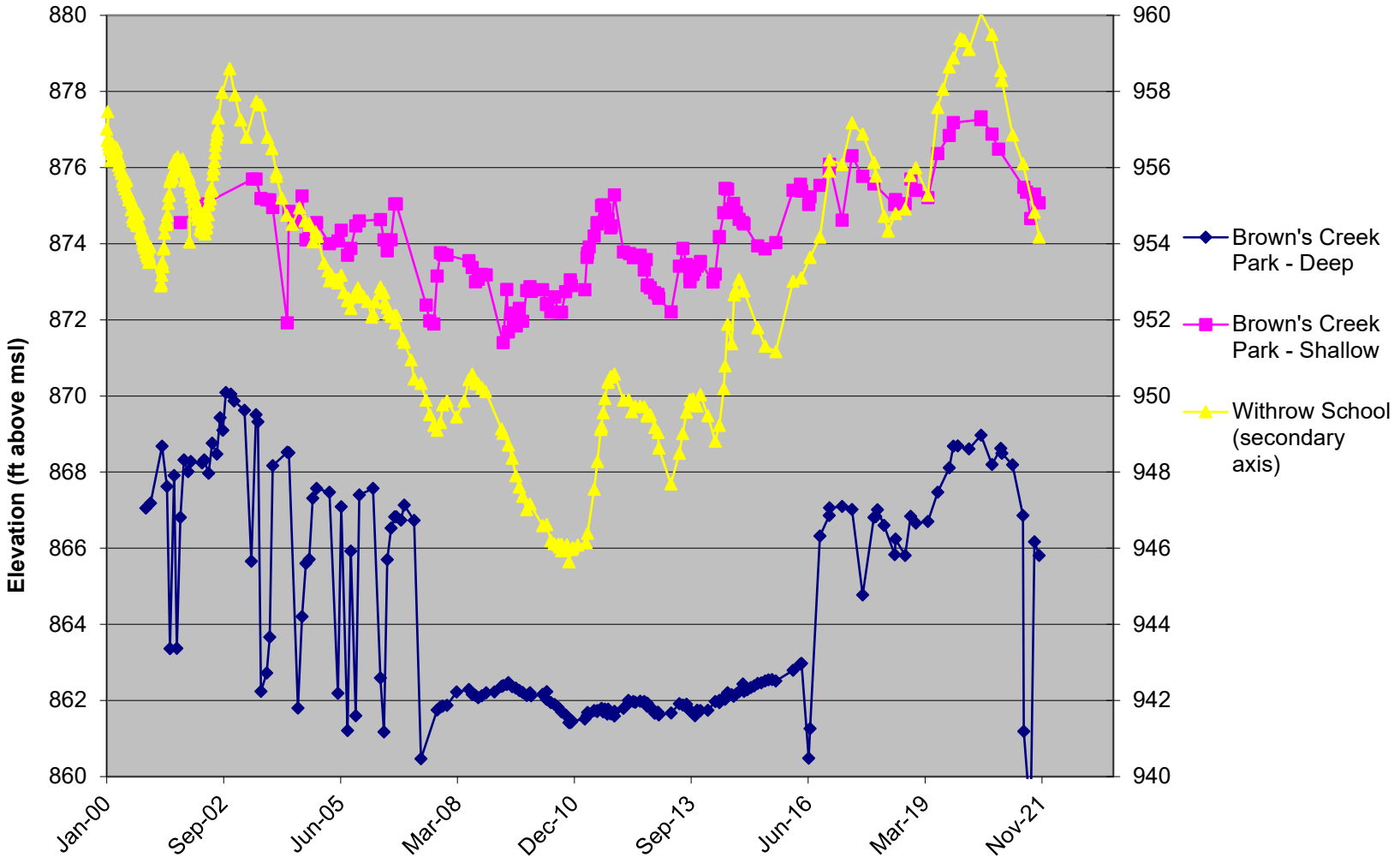

Figure 1. Groundwater Elevations – DNR Observation Wells

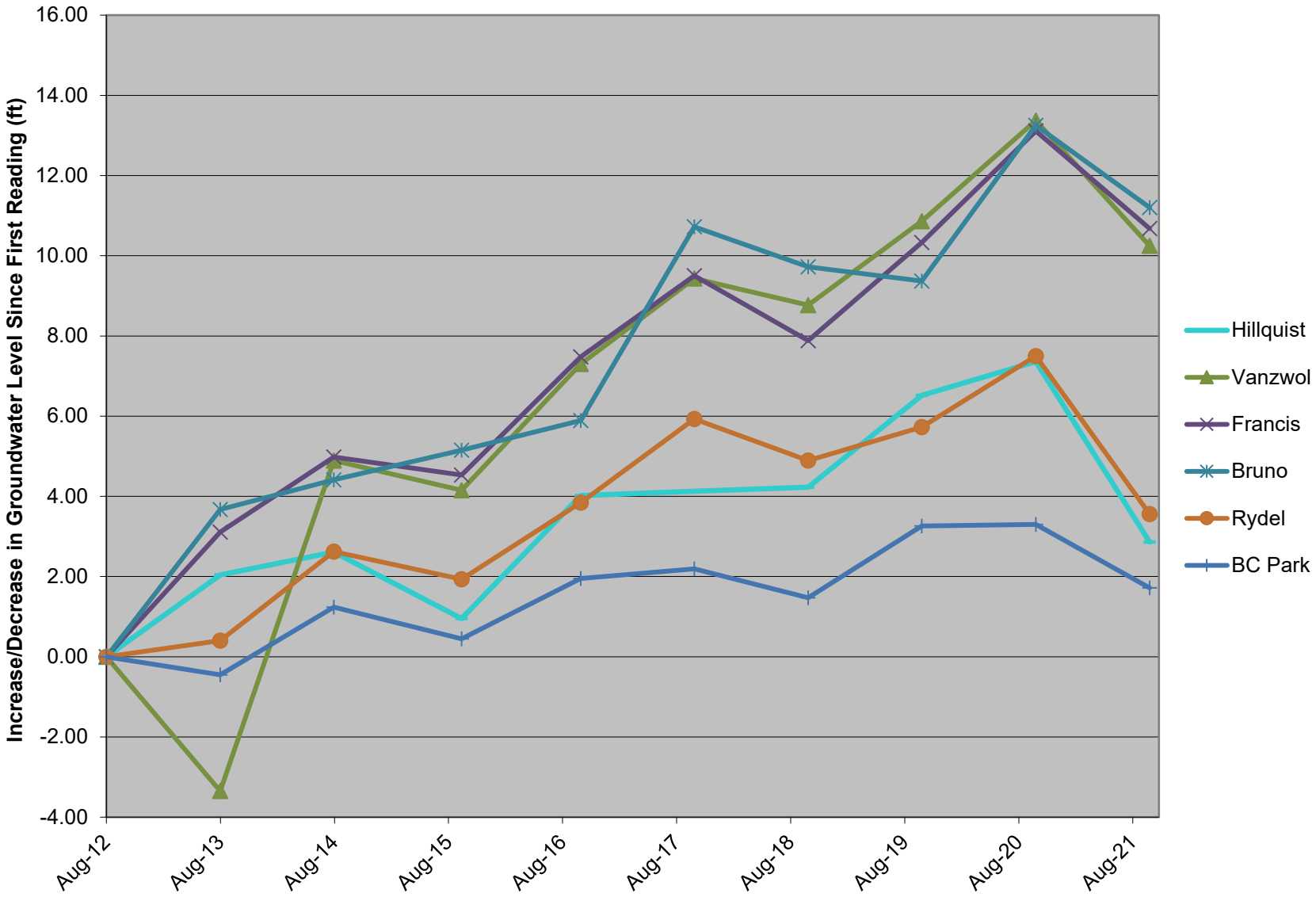

Figure 2. Groundwater Level Change Over Time - Quaternary (Glacial) Aquifer Wells

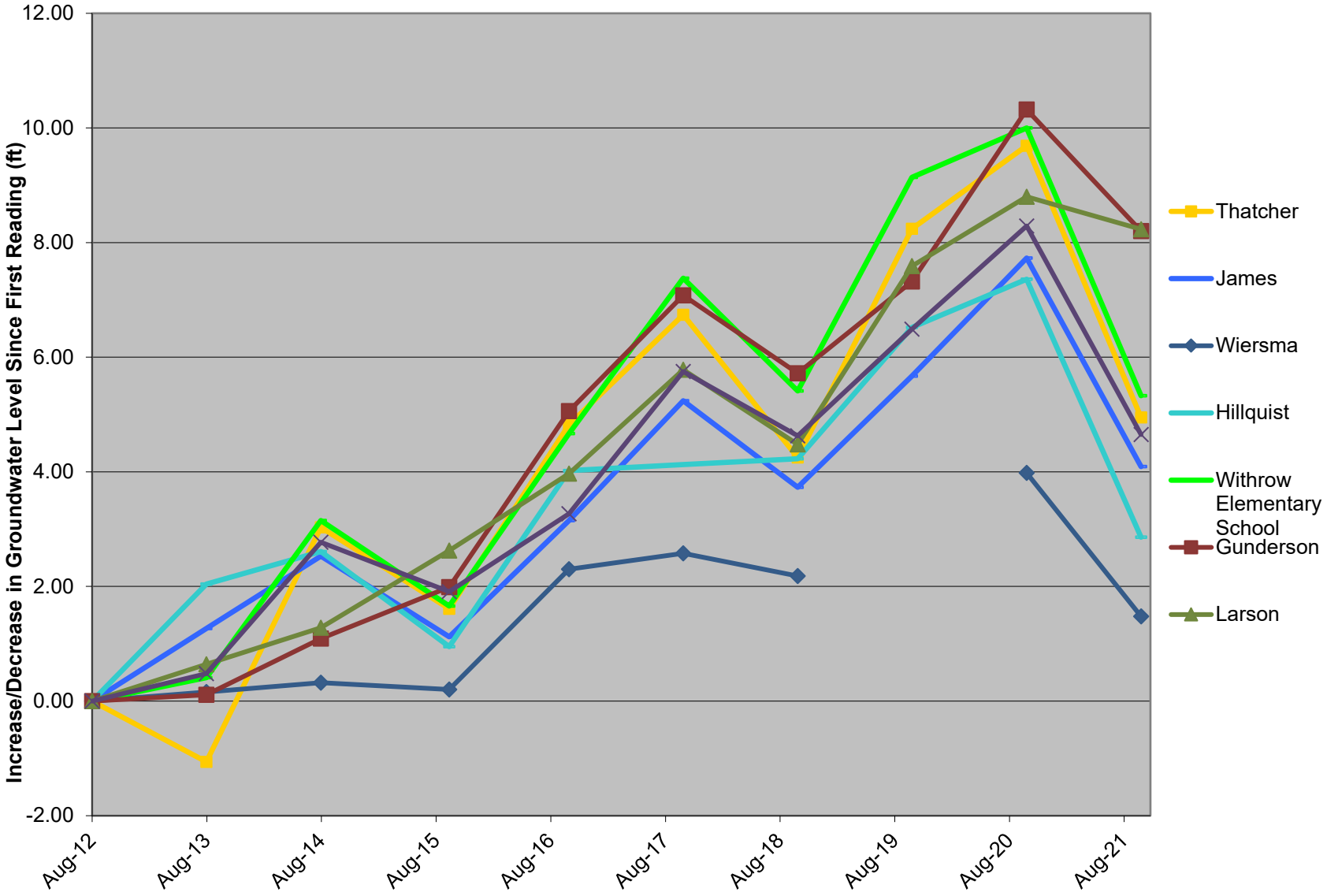

Figure 3. Groundwater Level Change Over Time – Prairie du Chien Aquifer Wells