WALLA WALLA BASIN
WATERSHED COUNCIL

Shallow Aquifer Monitoring in the Walla Walla Basin

2024 Water Year

<u>FINAL REPORT</u>

Submitted: February 2025

In Cooperation with:

STATE OF OREGON WATER RESOURCES DEPARTMENT WRD

OWEB Oregon Watershed Enhancement Board

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Abstract

This project has 63 existing groundwater monitoring wells in the Oregon portion of the Walla Walla basin in Umatilla County near Milton-Freewater. The project collects groundwater data throughout the Walla Walla basin in the Oregon portion. Data are needed to guide current planning efforts to address the Basin's inadequate water supply to meet aquatic life needs and agricultural and municipal uses. The data collected are helping guide the Walla Walla Water 2050 planning process, the Walla Walla Basin Bi-State Flow Study, the USGS basin-wide Surface and Groundwater Study, and have been incorporated into Oregon state database. Data collection and sharing allows basin stakeholders to manage projects adaptively, design better projects, and create enhanced outcomes. The Walla Walla Basin Watershed Council uses guidelines similar to those of the United States Geological Survey and other state agencies for groundwater monitoring. We base our standard operating procedures on their guidelines.

Introduction

Overview

Since 2001, the Walla Walla Basin Watershed Council (WWBWC) has collected data from a network of monitoring wells in the Walla Walla River Valley as part of its long-term efforts to understand groundwater trends in the shallow (unconfined) alluvial aquifer. The primary objectives of this network are to provide data necessary for informed water management in the bi-state basin and help water resource and fisheries managers better understand surface-groundwater interactions as they relate to salmon recovery and groundwater sustainability[1]. The monitoring network also tracks the effectiveness of managed aquifer recharge projects and provides data for hydrologic modeling projects. All of the well data are available on our Groundwater Monitoring page on the WWBWC website.

The WWBWC worked with the Oregon Water Resource Department (OWRD) and the Washington Department of Ecology (WDOE) to develop protocols for monitoring well locations, measurement, and maintenance. Many of the original monitoring wells in the network were established or drilled by OWRD and WDOE. Other partners in the basin, such as Hudson Bay District Improvement Company, Gardena Farms Irrigation District #13, Walla Walla River Irrigation District, Fruitvale Water Users Association, The Native Creek Society, the City of Walla Walla, and dozens of private property owners have contributed to the utility of the monitoring network by providing well access, supplying historical information, and making contact with prospective participants. Some dedicated monitoring wells were established as part of WWBWC's managed aquifer recharge program.

During this monitoring period, the watershed council focused its efforts on groundwater monitoring sites in Oregon. See Table 1 for a summary of the established monitoring wells we are currently monitoring in Oregon.

[1] https://www.usgs.gov/centers/washington-water-science-center/science/walla-walla-river-basin-groundwater-flow-system

Monitoring Group	State	Number of Wells
OWRD	Oregon	5
WWBWC	Oregon	58

Table 1. Overview of the Shallow Aquifer Monitoring Network.

Well monitoring consists of measuring the groundwater level (the depth to water) and specific conductance. The monitoring network is comprised of two types of monitoring wells: continuous monitoring wells that are instrumented with pressure transducers that log water levels at a programmed interval (typically every 15) and non-continuous wells, which are measured manually approximately every three months. If access permits, conductivity measurements are taken quarterly at both types of monitoring wells.

The WWBWC has continued to update and maintain a Monitoring Well Database with historical records and information about wells in the network. The database includes landowner contact information, water rights, well logs, USGS, WDOE, and OWRD historical water level measurements, well GPS coordinates, elevation, maps, and photos of the wells. Wells in the monitoring network has been surveyed with survey-grade GPS units to determine accurate longitude, latitude, and elevation data. The Monitoring Well Database serves as the institutional memory of the monitoring network and gives insight into the historical uses and conditions of the wells and aquifer. It also allows WWBWC to share information with the community and other agencies.

Shallow Aquifer Monitoring Area

The Walla Walla River basin is a bi-state region in northeastern Oregon and southeastern Washington (Figure 1). The river basin covers approximately 1,760 square miles, with an underlying shallow alluvial aquifer of about 200 square miles (Figure 2). Shallow depth-to-water in specific locations in the valley and year-round supply make the shallow aquifer a vital water source for irrigated agricultural lands and domestic and livestock uses.

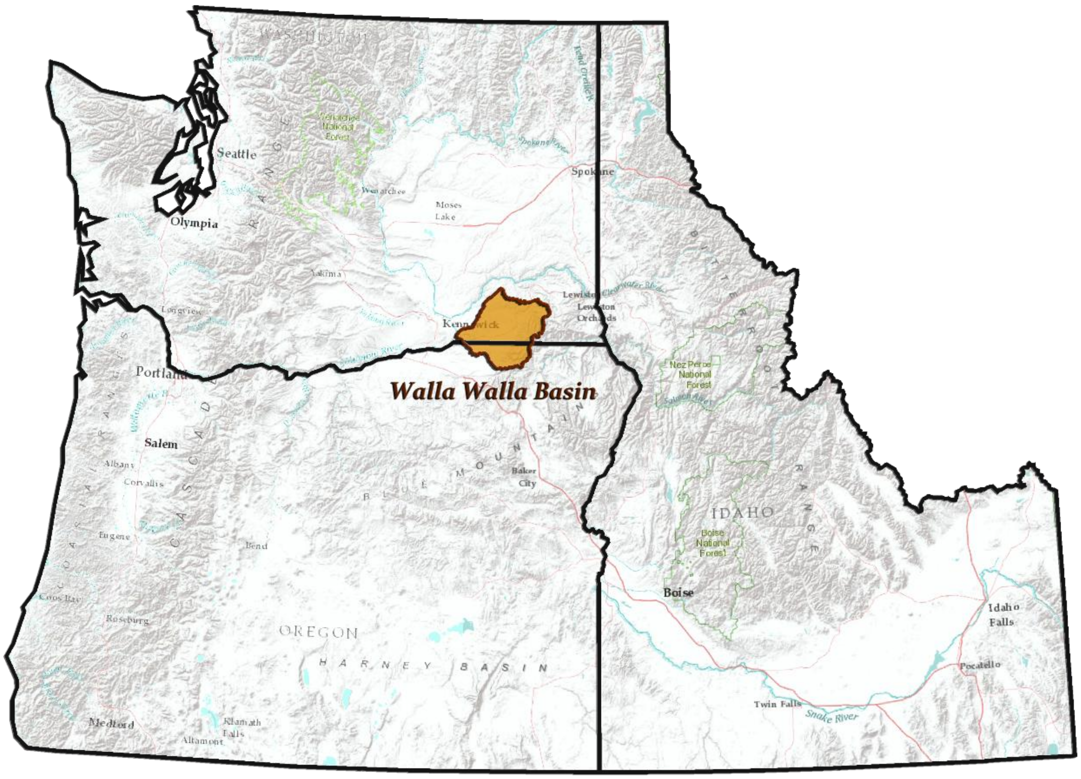

Figure 1. The Walla Walla Basin is a bi-state watershed.

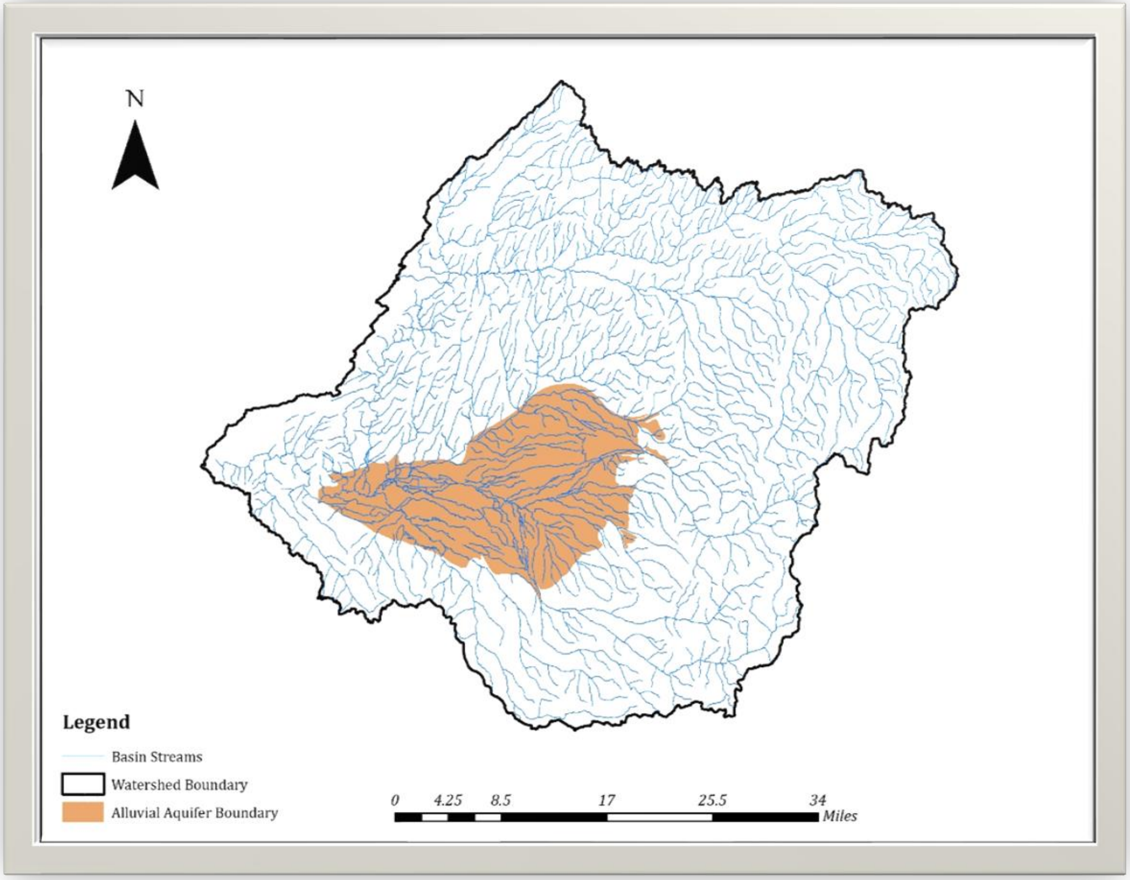

Figure 2. The Walla Walla River basin with the underlying shallow alluvial aquifer.

In addition to supplying water for the wells, the shallow alluvial aquifer feeds the numerous springs, streams, and rivers of the Walla Walla Basin. The high connectivity between the shallow aquifer and surface water bodies is essential for enhancing base flows and cooling summer water temperatures for ESA-listed bull trout, mid-Columbia River summer steelhead, and reintroduced spring Chinook salmon in the basin.[2]

Since 2001, the WWBWC and its partners have utilized a community-based groundwater monitoring network. This network was developed to enhance knowledge about long-term water level trends and provide hydrogeological information. In 2001, only a dozen shallow aquifer wells were monitored in Oregon and Washington. These wells were inadequate to effectively monitor and manage the vast aquifer, which supplies hundreds of domestic and agricultural wells, provides water for the dozens of creeks through springs located throughout the valley, and discharges cool water into the Walla Walla River during base flows. WWBWC and its state and local partners currently monitor 63 wells (Figure 3).

[2] Winter, T.C., *et al*. 1998. *Ground Water and Surface Water: A Single Resource.* U.S. Geological Survey Circular 1139.

Wells in the monitoring network currently include both urban and rural wells in and around Milton-Freewater and Umapine. The wells are owned by various water users, including government agencies (state, county, and city), businesses, universities, and private landowners within the basin. Prior to drilling dedicated monitoring wells, most of the monitoring wells were irrigation (both active and abandoned) or old domestic wells owned by private landowners. All well owners participate voluntarily, aiding in the effort to understand and mitigate the decline of the aquifer, a critically important economic and ecological resource to the communities within the Walla Walla Basin.

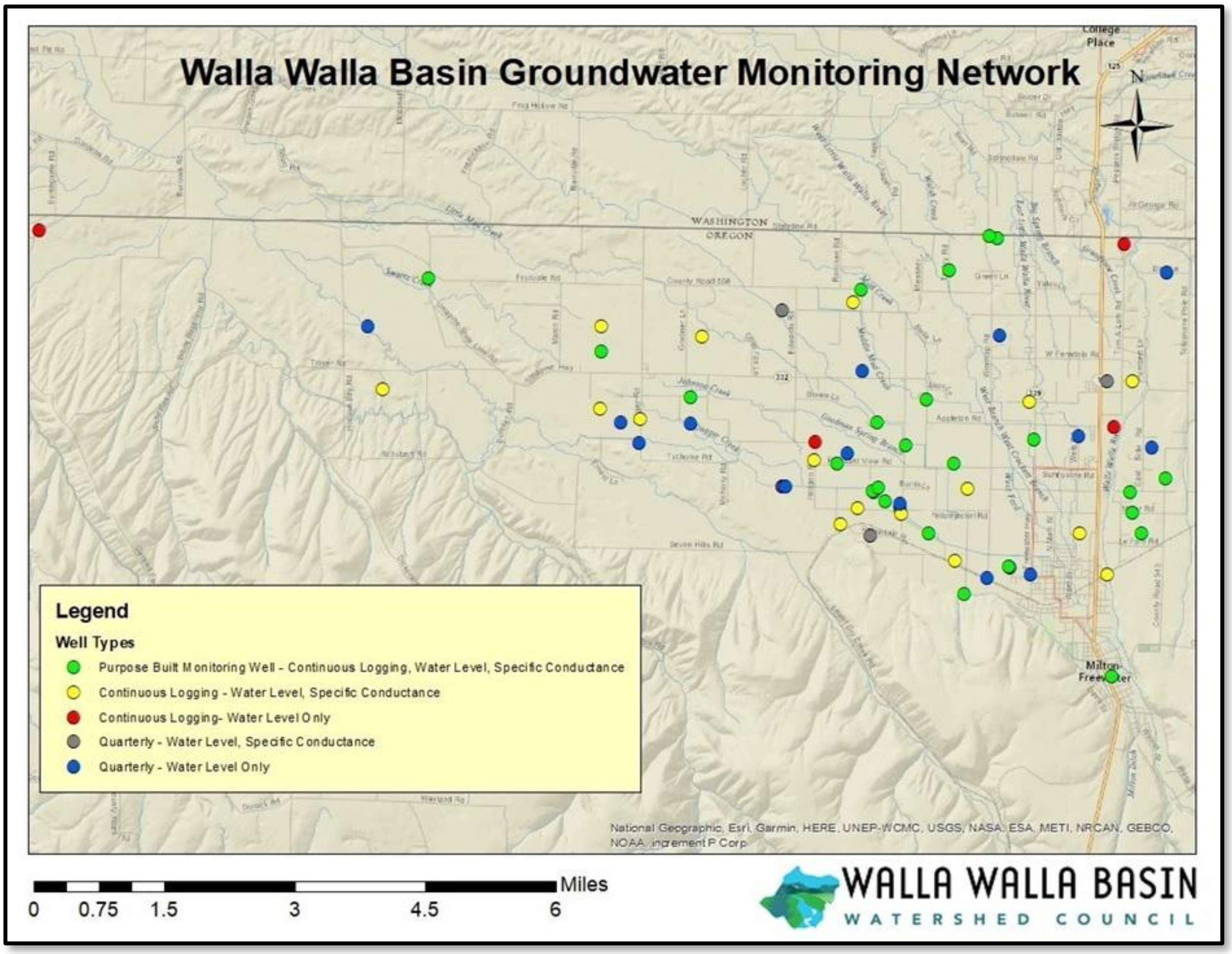

Figure 3. Map overview of wells in the Shallow Aquifer Monitoring Network as of September 2024.

Methodology

All monitoring was conducted according to our standard operating procedures[3] based on USGS, Washington, and Oregon state methods for groundwater monitoring. [Click here for the WWBWC's Standard Operating Procedures.]

Continuous and Non-continuous Wells

The WWBWC shallow groundwater alluvial aquifer well network includes continuous and non-continuously monitored wells. As of September 2024, four of our groundwater monitoring locations have been equipped with a radio, solar panel, battery, and datalogger capable of sending near real-time data through our telemetry network. The data are updated daily and available on the Groundwater Monitoring page on the WWBWC website. These data are available year-round but are particularly useful for tracking aquifer recharge water when the Johnson (GW_046), Chuckhole (GW_169), Mud Creek (GW_170), and Fruitvale (GW_171) recharge sites are operating during the winter months.

During the 2024 water year, over two-thirds of the monitoring wells were continuously monitored using one of three different pressure transducers (Figure 4) suspended below the water level but not resting on the bottom of the well. Pressure transducers were suspended in the well casing using 1/16th inch aviation cable, 14 gauge speaker wire, fishing line, or a communication cable provided by the manufacturer. The pressure transducers electronically determine and record the water pressure (pounds per square inch or feet of water) and water temperature (°C) on a programmed log interval (typically every 15 or 60 minutes). Transducer data were downloaded on a quarterly schedule. During the quarterly download, manual water level measurements were made to standardize the pressure transducer data. Water level measurements were collected manually using an e-tape (Solinst Water Level Meter, Model 102, www.solinst.com). All water level values were measured from an established measurement point, adjusted for the top of grade ("stickup height"), and recorded as "feet below ground surface".

Although it would be ideal to have all of the wells instrumented for continuous data collection, many abandoned wells and currently in-use irrigation wells have small access ports, or the pump is in the way, prohibiting the deployment of a pressure transducer. Static (non-continuous) wells provide an inexpensive way to collect "snapshot" information of the aquifer and track trends throughout the valley. Wells not instrumented with a pressure transducer were monitored quarterly. Manual measurements were taken using the e-tape from an established measurement point, adjusted for the top of grade ("stickup height"), and recorded as "feet below ground surface." At irrigation wells, pump condition (on or off) was recorded during each visit. A summary of continuous and non-continuous monitoring wells is shown in Table 2.

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[2] Walla Walla Basin Watershed Council 2018. *WWBWC Standard Operating Procedures – Version 1.3.* www.wwbwc.org.

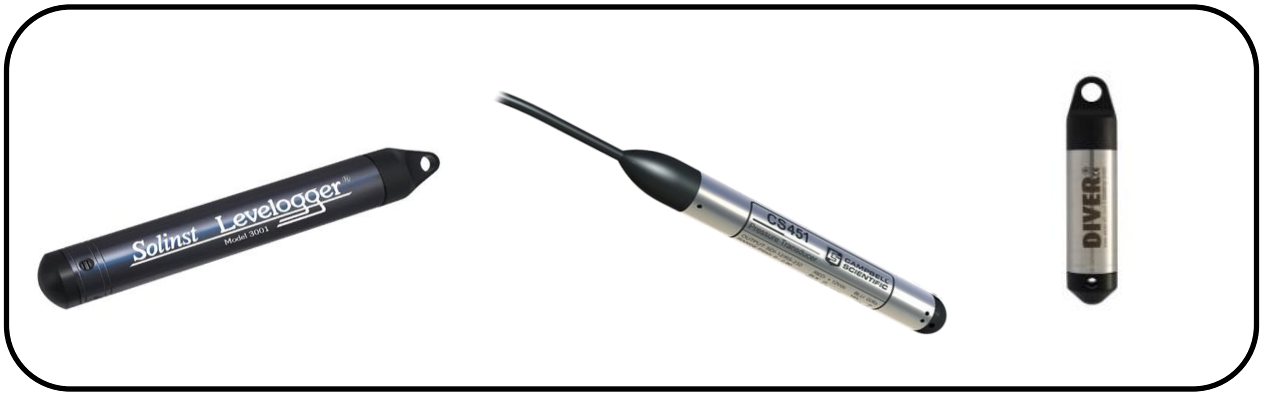

Figure 4. Pressure transducers used in the Shallow Aquifer Monitoring Network. Continuously monitored wells were equipped with one of the above pressure transducers.

Data Type	State	Number of Wells
Continuous water level and quarterly conductivity	Oregon	41
Continuous water level only	Oregon	3
Quarterly static water level and conductivity	Oregon	5
Quarterly static water level only	Oregon	14

Table 2. Summary of data types collected in the Shallow Aquifer Monitoring Network.

Conductivity Sampling

Where well access permitted, conductivity was measured every quarter. Water samples were taken when the pressure transducer was downloaded or a water level measurement was taken. Water samples were collected using a bailer and transferred into a graduated cylinder[4]. Conductivity values were measured using a handheld conductivity meter (YSI 30, www.ysi.com). Further details regarding transducer downloading, deployment, maintenance, and quarterly data collection can be found in the WWBWC 2018 Standard Operating Procedures - Version 1.3[2].

Conductivity data allows the WWBWC to better understand the hydrogeological connections between groundwater and surface water. Knowing the conductivity, we can map where groundwater contributes to surface flows and where surface water is recharging the aquifer.

Data Processing and Analysis

Most loggers used by WWBWC for groundwater monitoring were absolute (non-vented) pressure transducers, creating a need to compensate the water level data for atmospheric pressure. Using AQUARIUS Time-Series software (www.aquaticinformatics.com), water level data were processed by subtracting barometric pressure collected by transducers located at several barometric monitoring stations throughout the valley (Figure 5). Also, using AQUARIUS, water level logger

[4] Oregon Department of Environmental Quality 1998. *DEQ Lab's Field Sampling Reference Guide.*

data were converted from PSI to feet of water when necessary and graphed with manual water level measurements to check the data visually. Corrections were applied to account for pressure transducer drift.

Data were graded to document logger hang-ups on pumps or other obstructions, well pumping during manual water measurement, and other data quality irregularities.

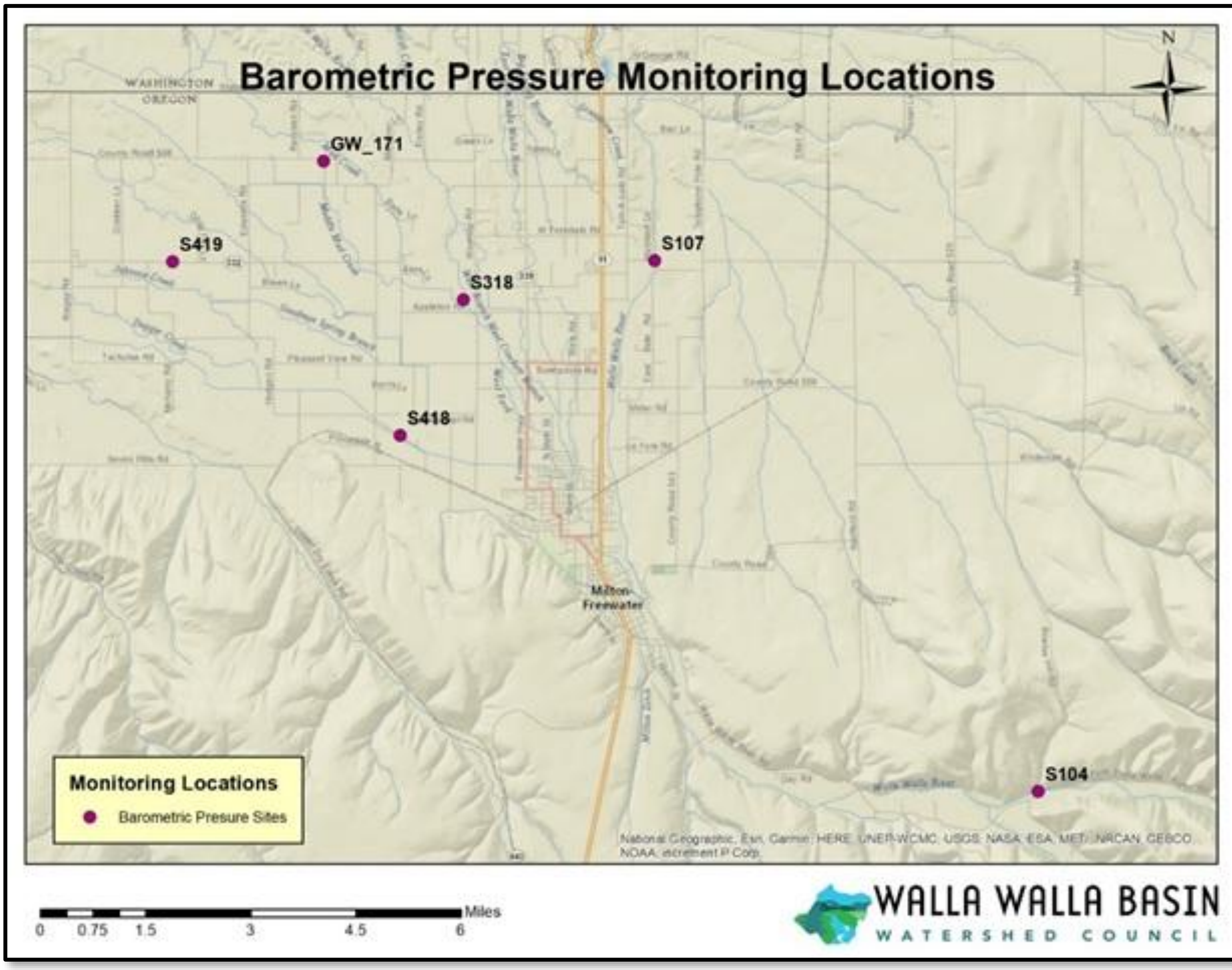

Figure 5. Barometric pressure transducer locations within the Shallow Aquifer Monitoring Network.

Results and Discussion

For all well data, please visit [WWBWC's Groundwater Monitoring Page](). There you can view hydrographs and download data for the wells.

Declining Groundwater Levels

Data indicate groundwater declines are occurring on the east side of the Walla Walla River (Figure 6). Four monitoring wells (GW_152, 160, 161, and 162, Figures 7-10) show consistent declines in seasonal highs and lows. There are sudden increases in the groundwater level at GW_160 (Figure 8) starting to occur in March 2021. This is due to The Miller Road Aquifer Recharge Site operating for the three years. Although the recharge site put 455 acre-feet of water in the ground in four recharge seasons, the groundwater level dropped to its lowest point for water year 2024 in December 2023. Groundwater declines also occur north of Milton-Freewater based on four monitoring wells (GW_010, 028, 116, and 117, Figures 11-14). These four wells show consistent groundwater declines in the seasonal highs, while GW_ 019 (Figure 15) shows consistent declines in seasonal highs and lows, referenced in the Historic Wells section. This trend could be due to less water flowing through the Little Walla Walla River system. As mentioned in the Historic Wells section, significant management changes occurred in 2001, leading to less water flowing through the irrigation ditches.

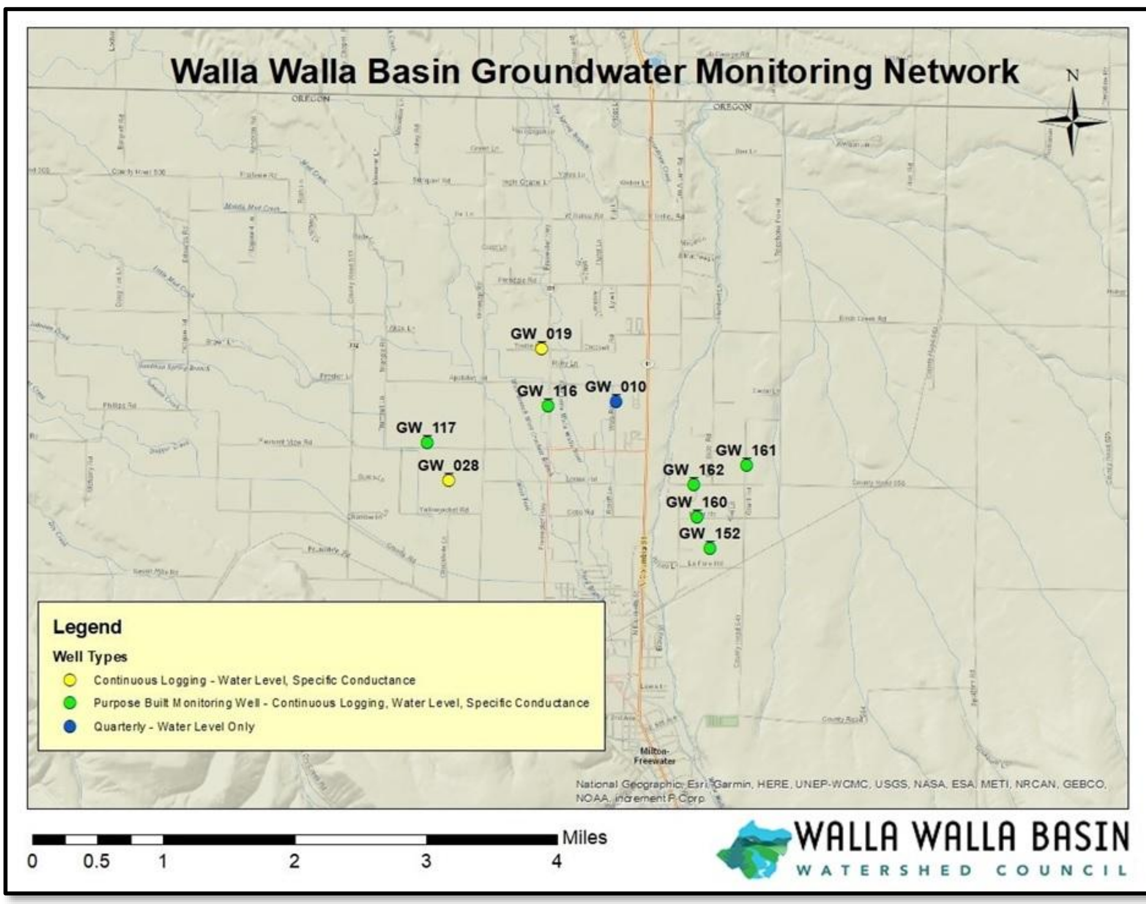

Figure 6. Monitoring wells north of Milton-Freewater.

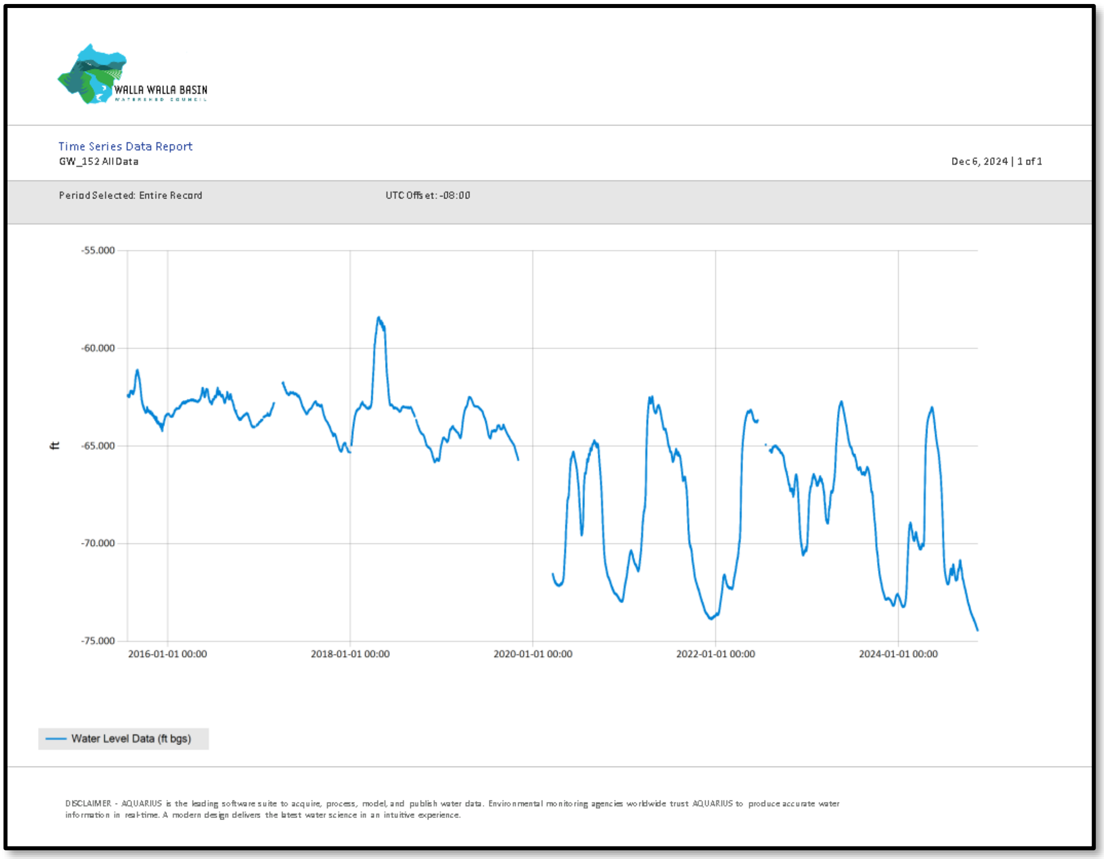

Figure 7. Pressure transducer data (blue line) in feet below ground surface for the well GW_152 located in the WWBWC's Shallow Aquifer Monitoring Network.

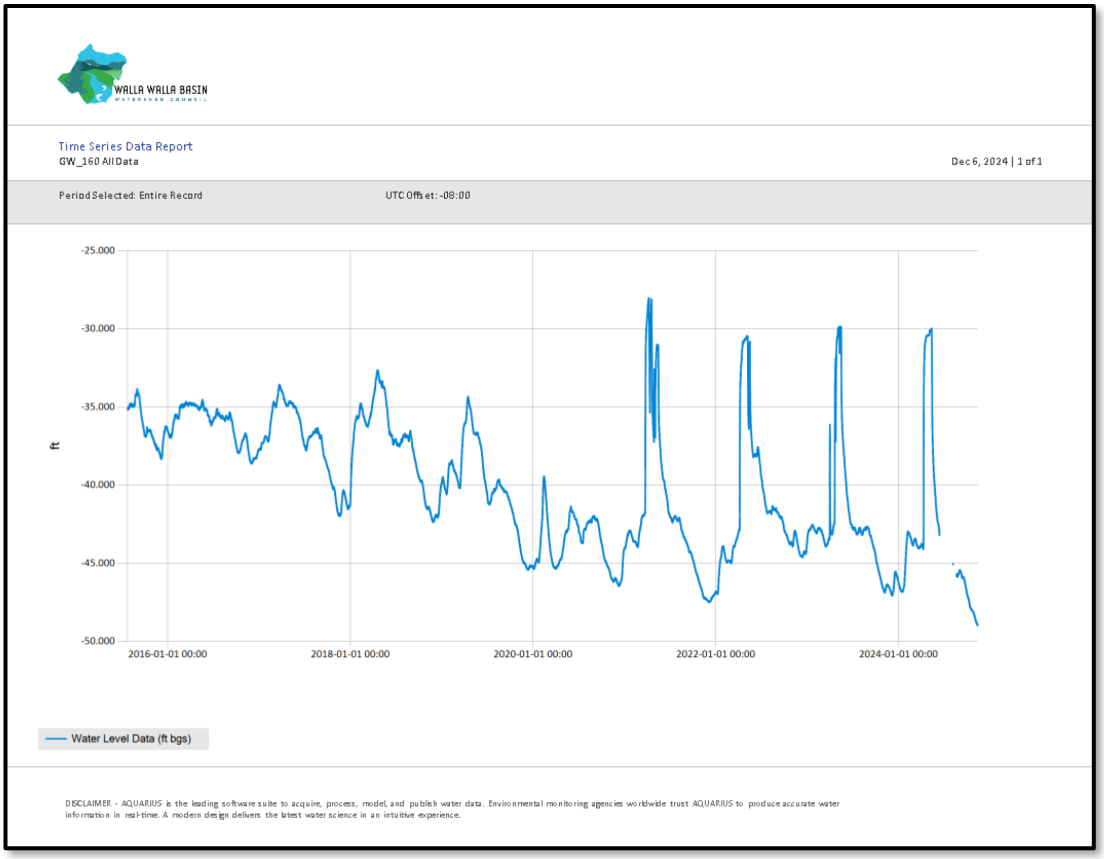

Figure 8. Pressure transducer data (blue line) in feet below ground surface for the well GW_160 located in the WWBWC's Shallow Aquifer Monitoring Network.

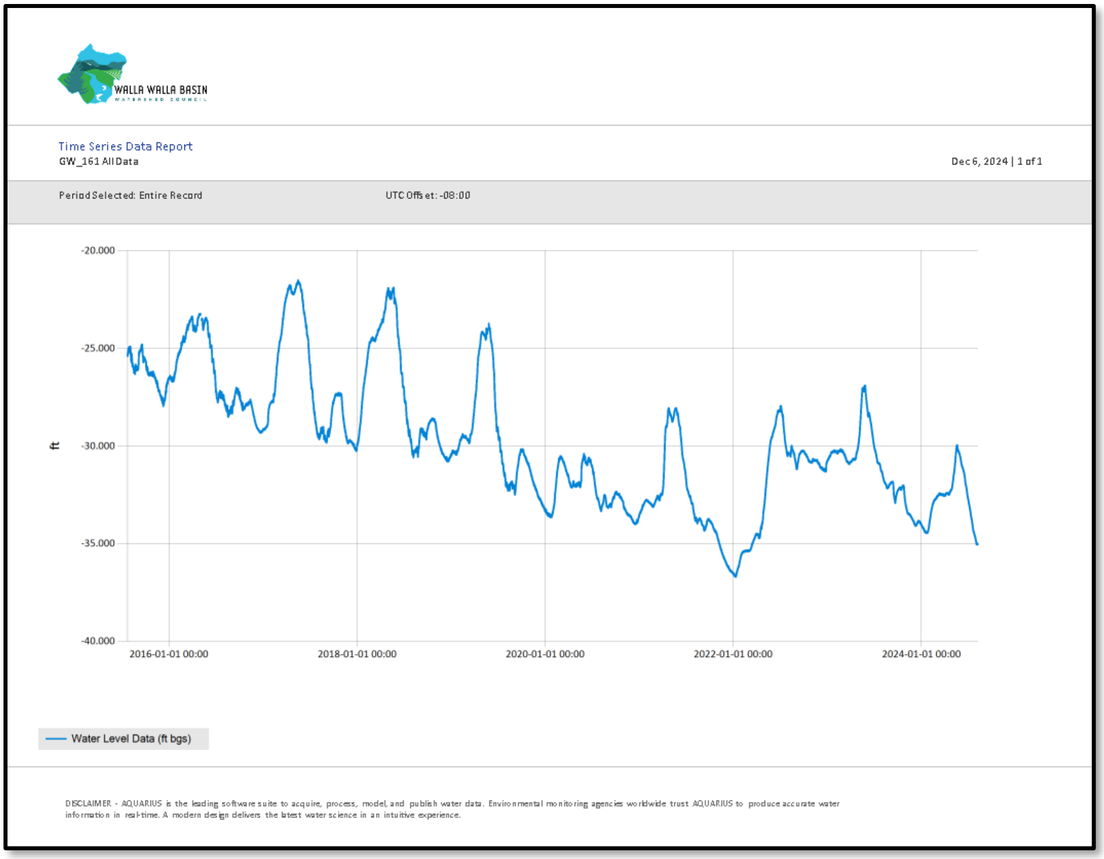

Figure 9. Pressure transducer data (blue line) in feet below ground surface for the well GW_161 located in the WWBWC's Shallow Aquifer Monitoring Network.

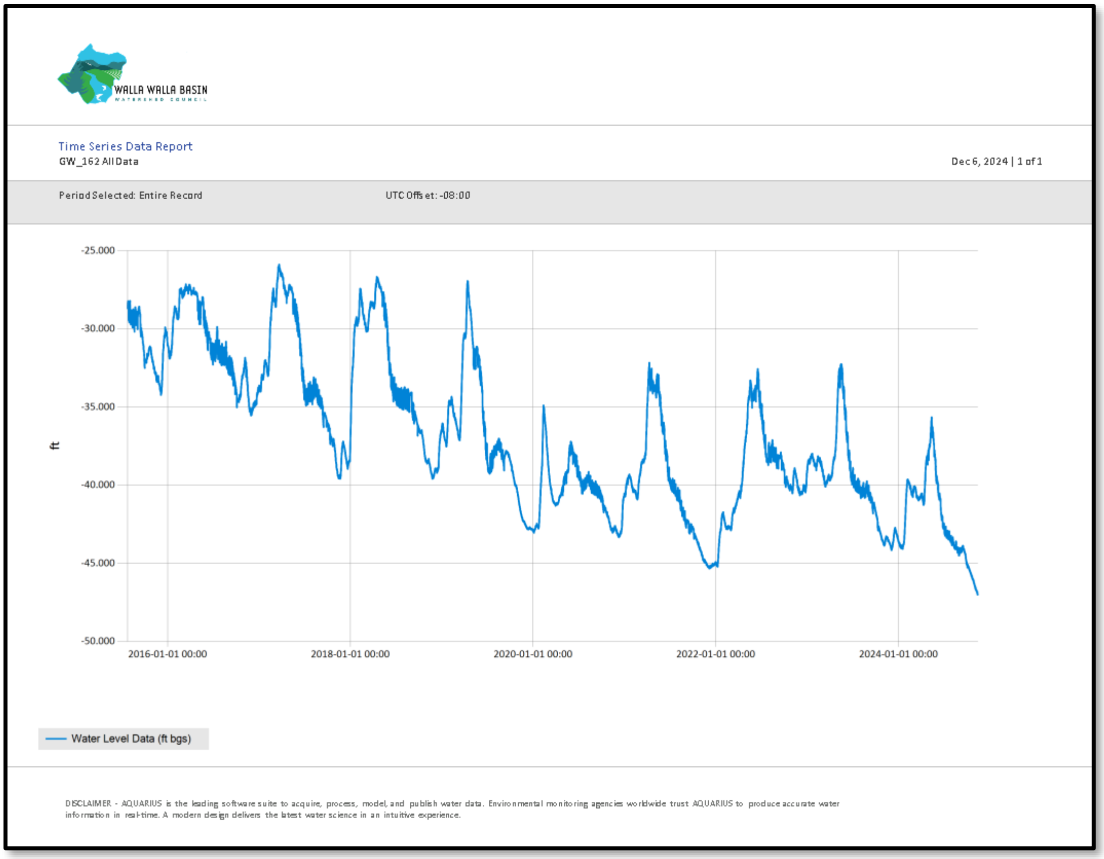

Figure 10. Pressure transducer data (blue line) in feet below ground surface for the well GW_162 located in the WWBWC's Shallow Aquifer Monitoring Network.

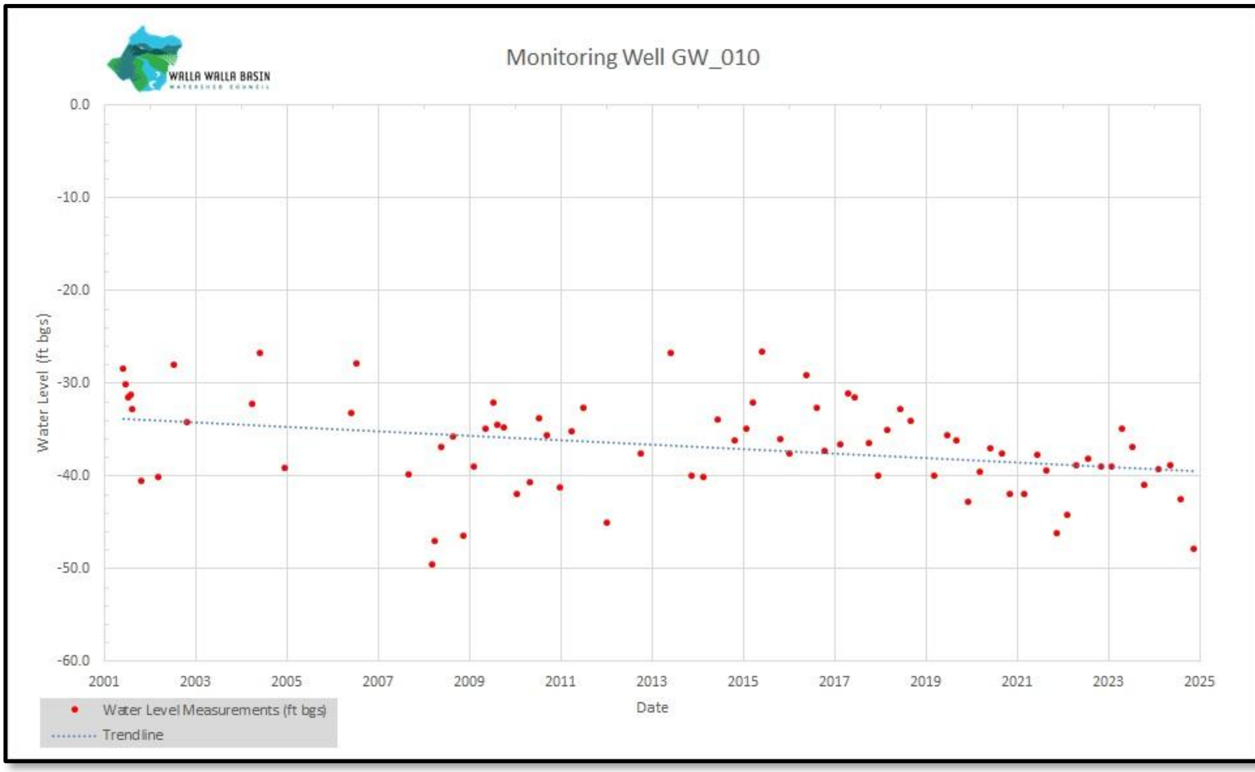

Figure 11. Manual water level measurements (red dots) and a trend line (blue dash line) for the well GW_010 located in the WWBWC's Shallow Aquifer Monitoring Network.

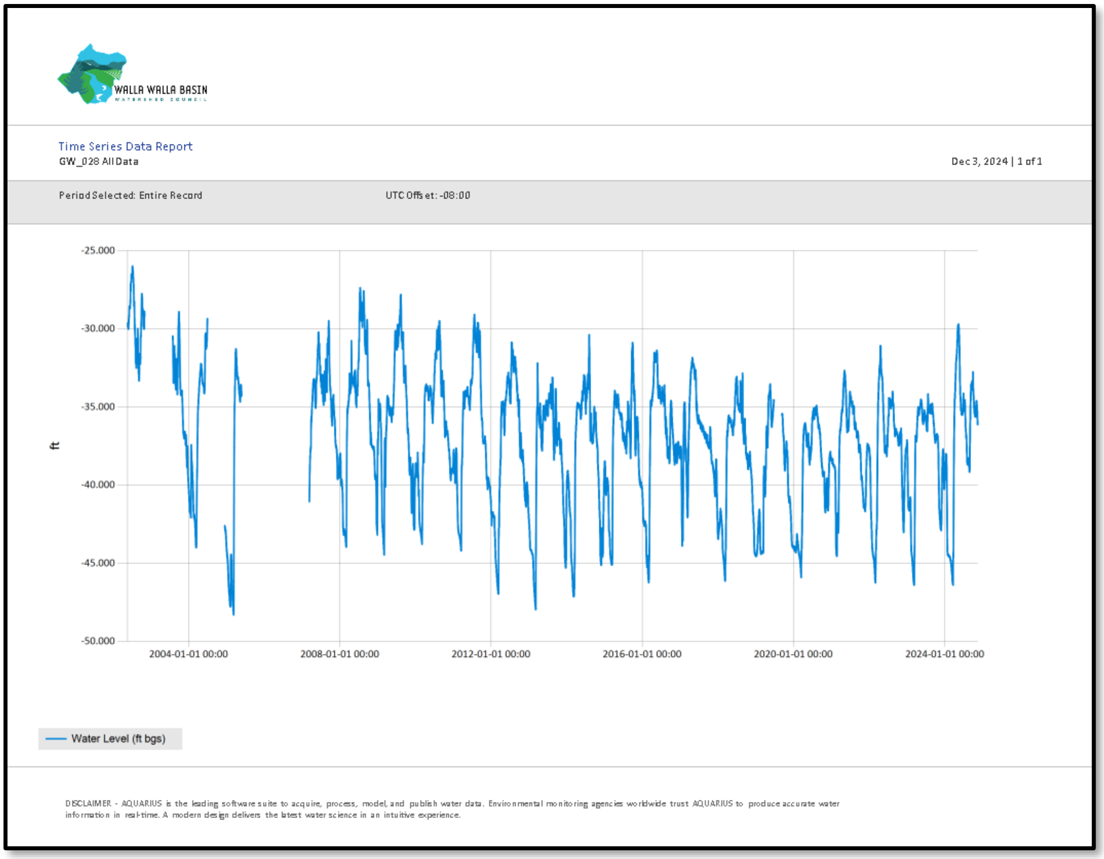

Figure 12. Pressure transducer data (blue line) in feet below ground surface for the well GW_28 located in the WWBWC's Shallow Aquifer Monitoring Network.

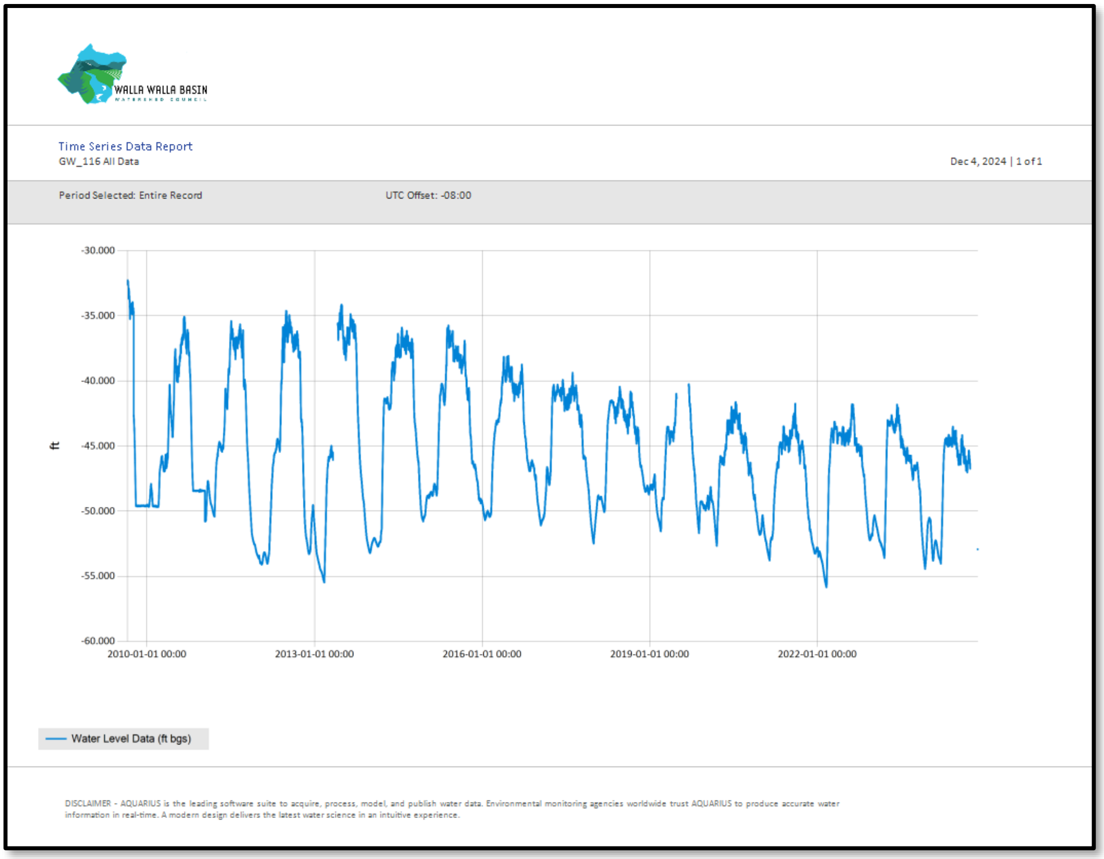

Figure 13. Pressure transducer data (blue line) in feet below ground surface for the well GW_116 located in the WWBWC's Shallow Aquifer Monitoring Network.

Figure 14. Pressure transducer data (blue line) in feet below ground surface for the well GW_117 located in the WWBWC's Shallow Aquifer Monitoring Network.

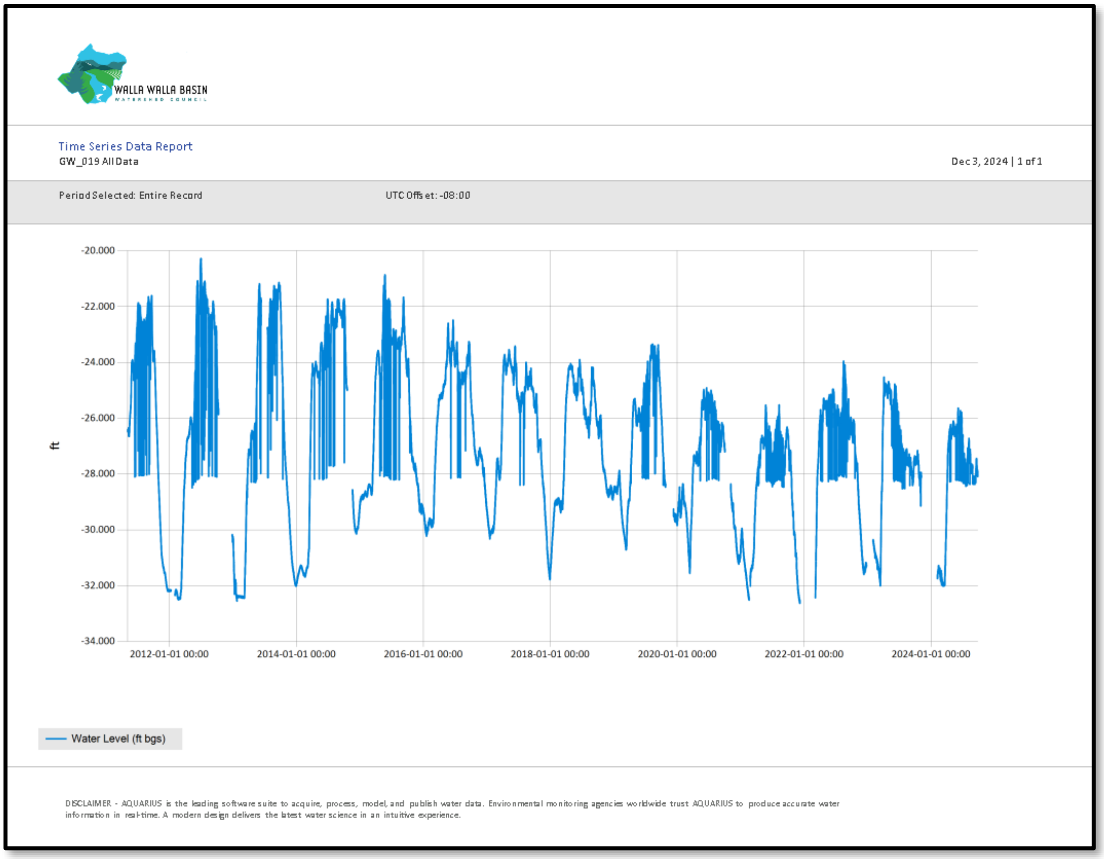

Figure 15. Pressure transducer data (blue line) in feet below ground surface for the well GW_019 located in the WWBWC's Shallow Aquifer Monitoring Network.

Areas of Groundwater Stability and Potential Positive Trends

Not all wells in the valley are showing groundwater declines. Monitoring wells around three of our biggest managed aquifer recharge sites: Northwest Umapine, Johnson, and Anspach (Figure 16), show some stability or minimal declines compared to other areas in the basin. GW_62 and 141 (Figures 17-19) near the Anspach recharge site show an increase in groundwater levels. Stable trends are apparent in the monitoring wells around the Johnson site (GW_40, 45, 46, 47, 48, and 118, Figures 20-25). Northwest Umapine recharge monitoring (GW_34 and 144, Figures 26-27) shows stability for the seasonal lows but declines in the seasonal highs.

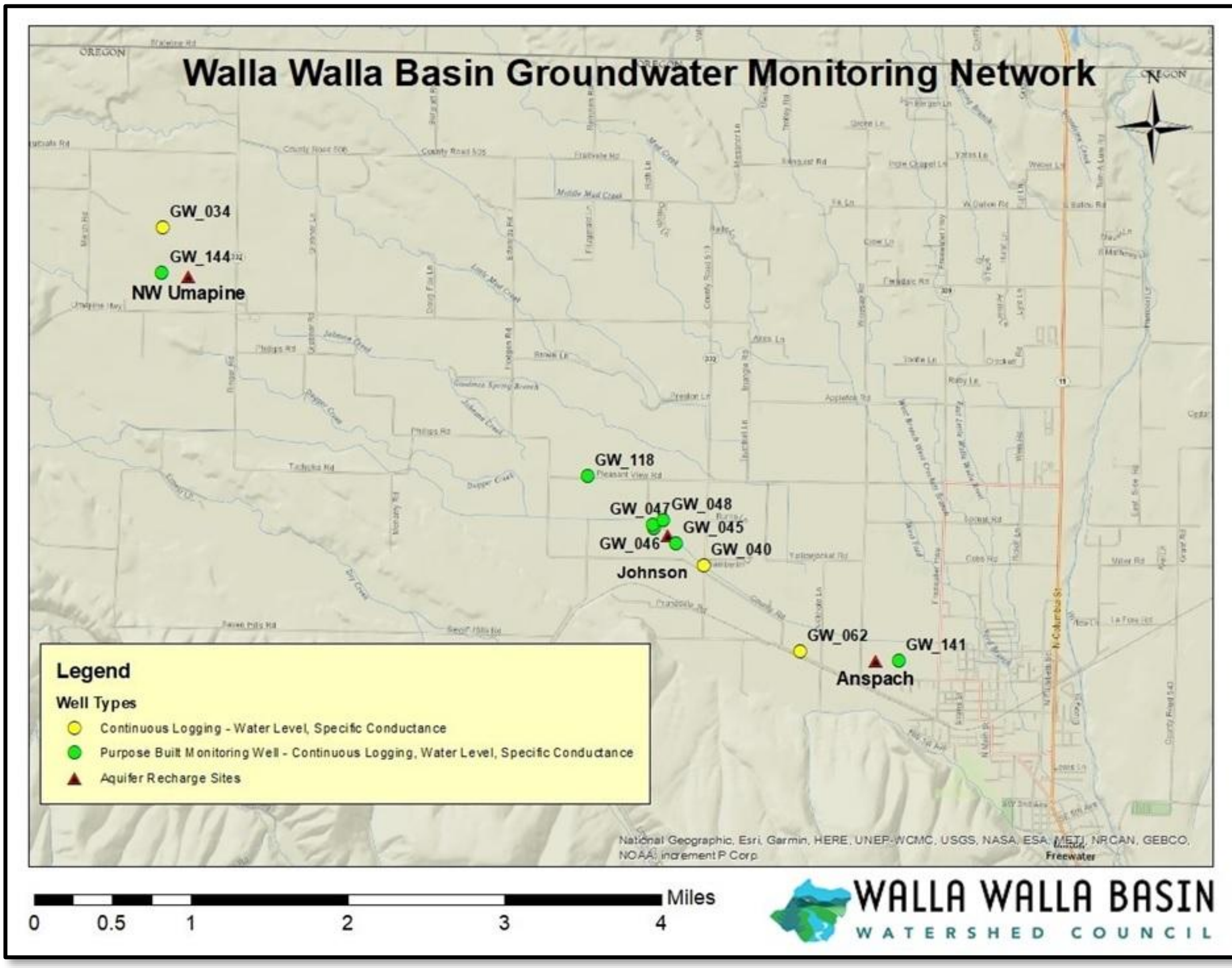

Figure 16. Monitoring wells showing stable and/or increasing groundwater levels in the Walla Walla Valley.

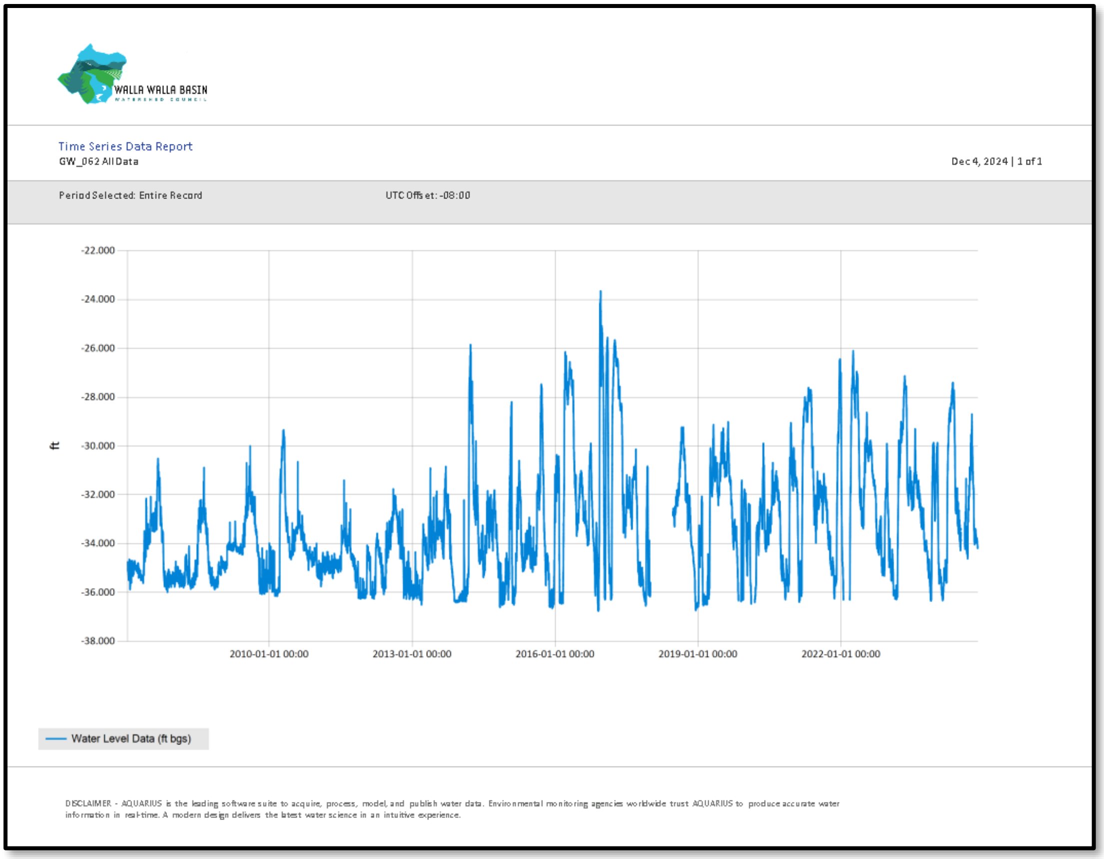

Figure 17. Pressure transducer data (blue line) in feet below ground surface for the well GW_062 located in the WWBWC's Shallow Aquifer Monitoring Network.

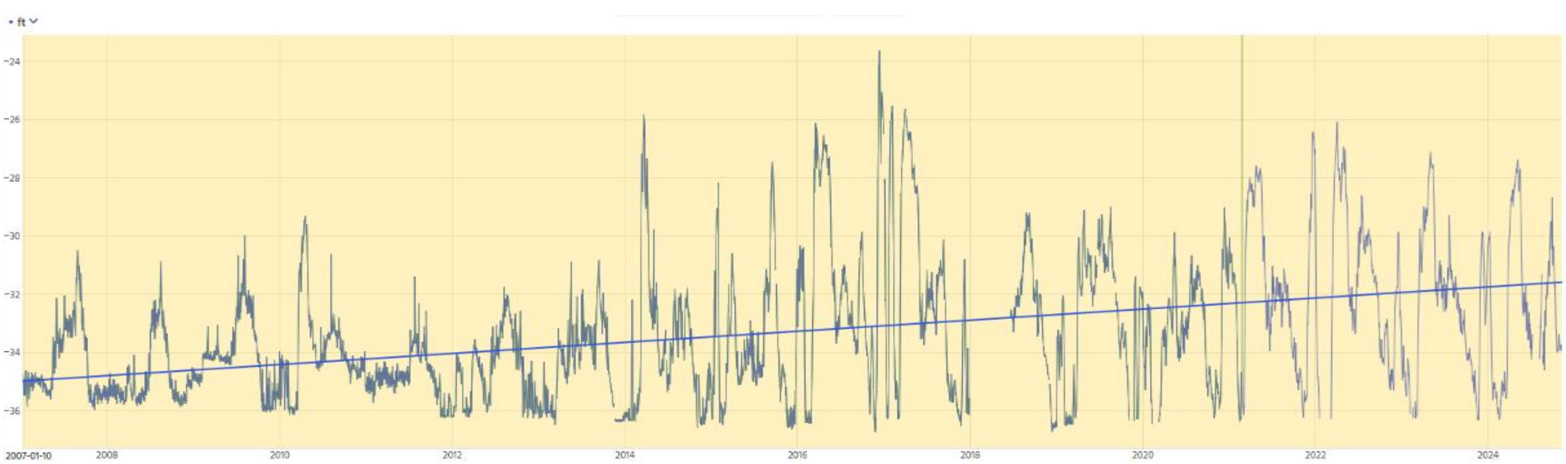

Figure 18. Pressure transducer data (blue line) in feet below ground surface and a trendline for the well GW_062 located in the WWBWC's Shallow Aquifer Monitoring Network.

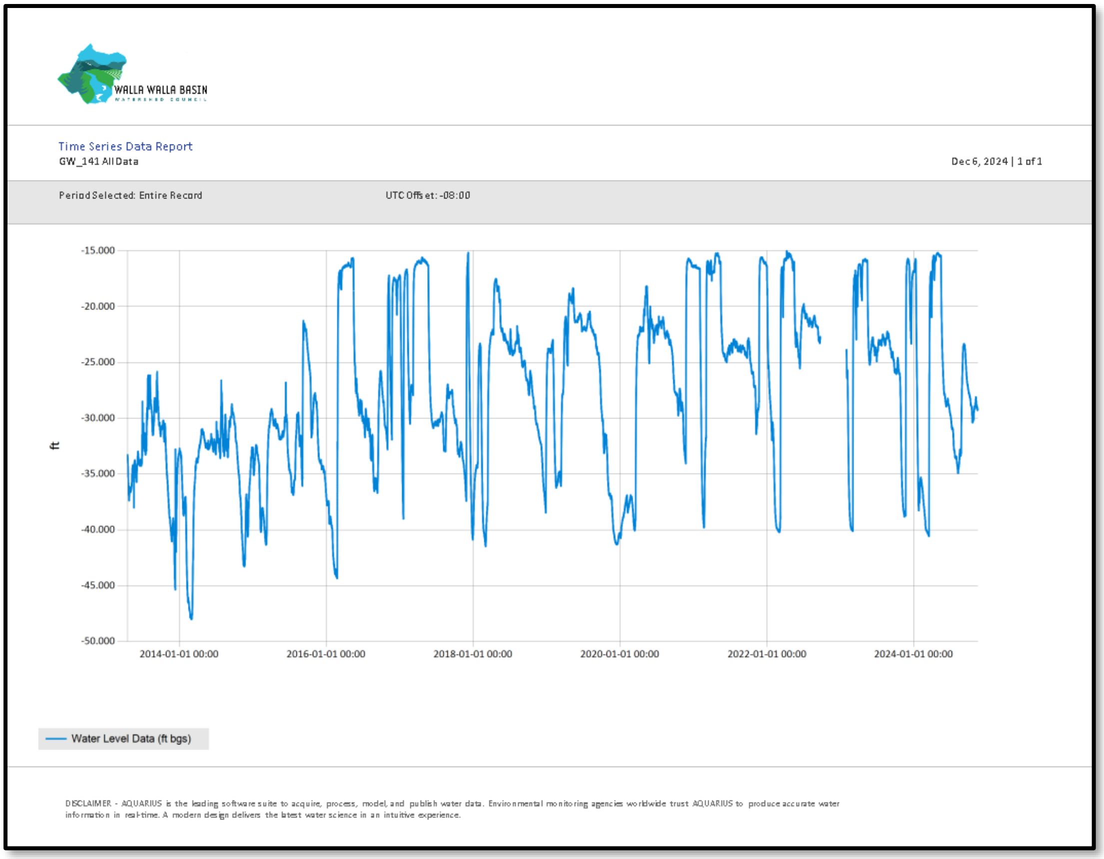

Figure 19. Pressure transducer data (blue line) in feet below ground surface for the well GW_141 located in the WWBWC's Shallow Aquifer Monitoring Network.

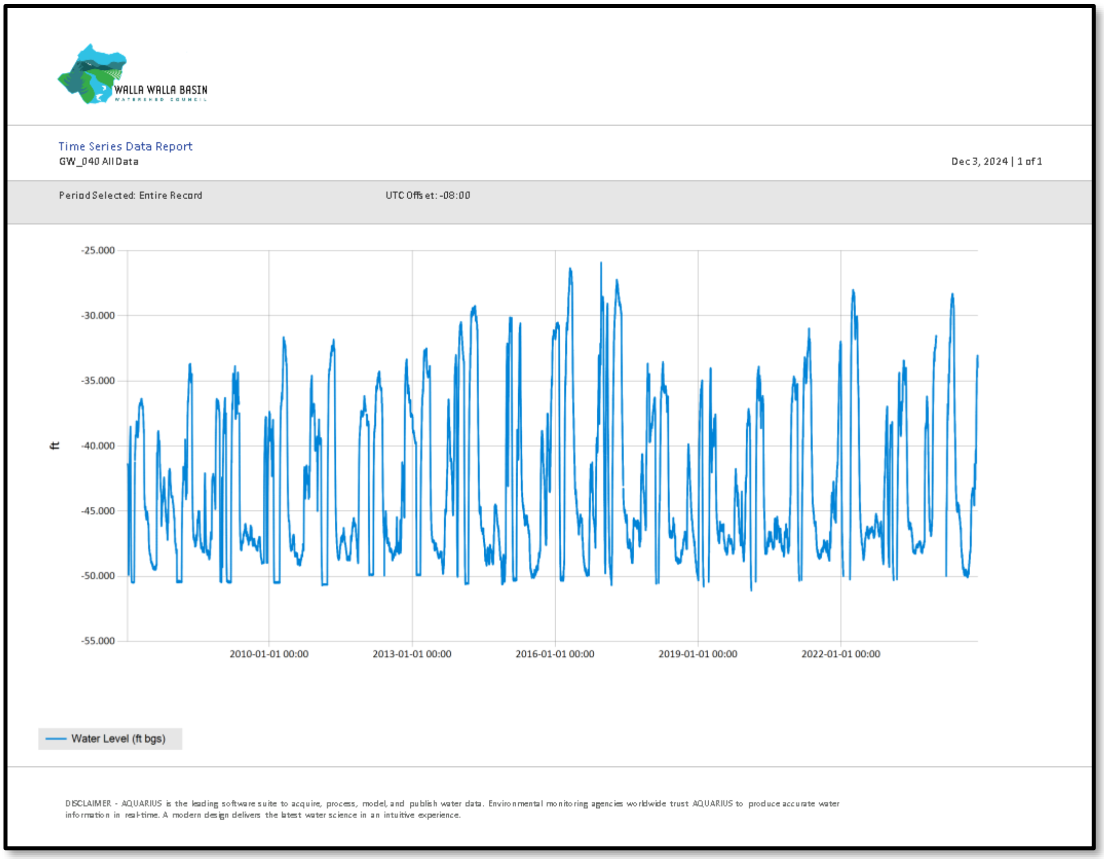

Figure 20. Pressure transducer data (blue line) in feet below ground surface for the well GW_040 located in the WWBWC's Shallow Aquifer Monitoring Network.

Figure 21. Pressure transducer data (blue line) in feet below ground surface for the well GW_045 located in the WWBWC's Shallow Aquifer Monitoring Network.

Figure 22. Pressure transducer data (blue line) in feet below ground surface for the well GW_046 located in the WWBWC's Shallow Aquifer Monitoring Network.

Figure 23. Pressure transducer data (blue line) in feet below ground surface for the well GW_047 located in the WWBWC's Shallow Aquifer Monitoring Network.

Figure 24. Pressure transducer data (blue line) in feet below ground surface for the well GW_048 located in the WWBWC's Shallow Aquifer Monitoring Network.

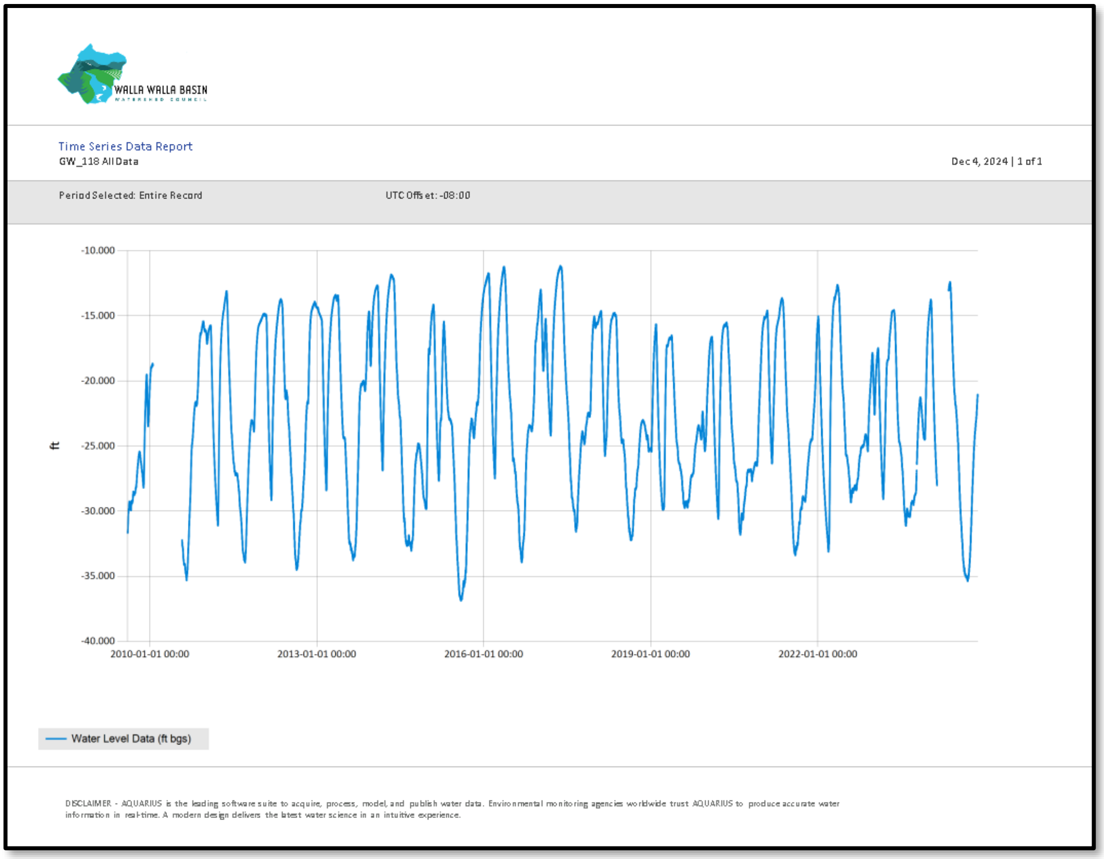

Figure 25. Pressure transducer data (blue line) in feet below ground surface for the well GW_118 located in the WWBWC's Shallow Aquifer Monitoring Network.

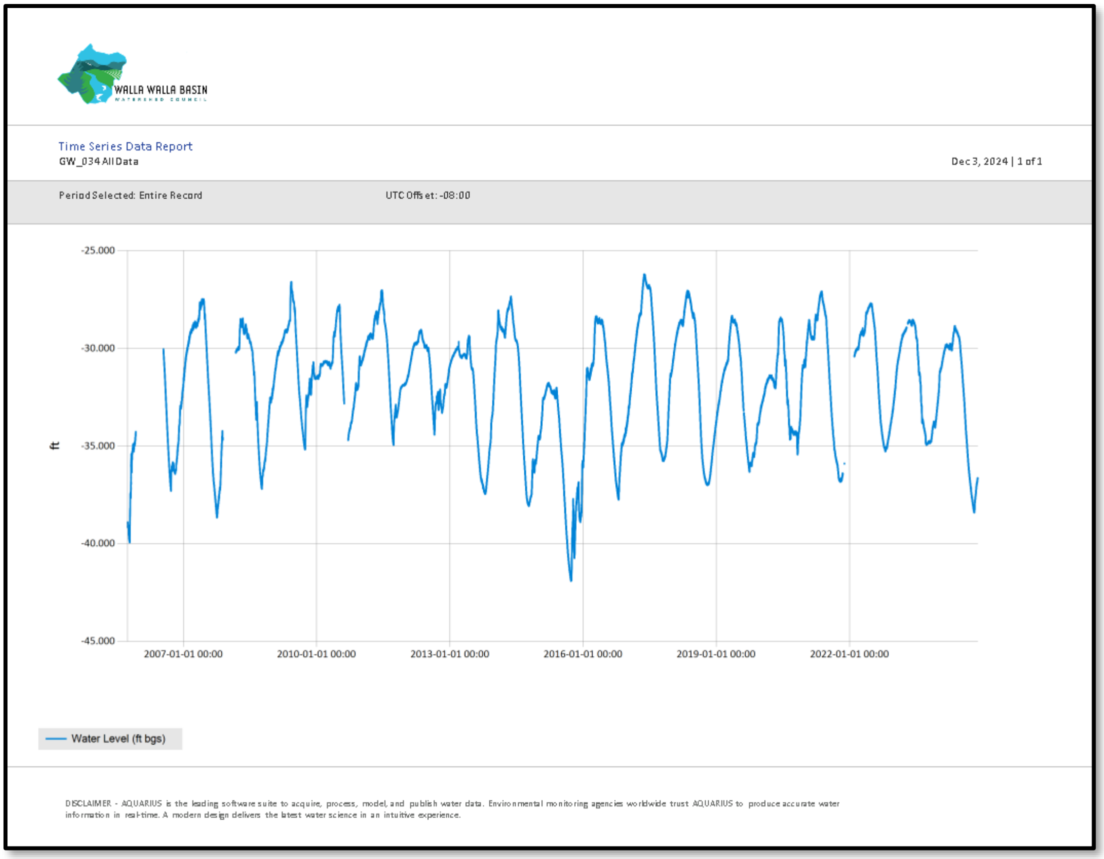

Figure 26. Pressure transducer data (blue line) in feet below ground surface for the well GW_034 located in the WWBWC's Shallow Aquifer Monitoring Network.

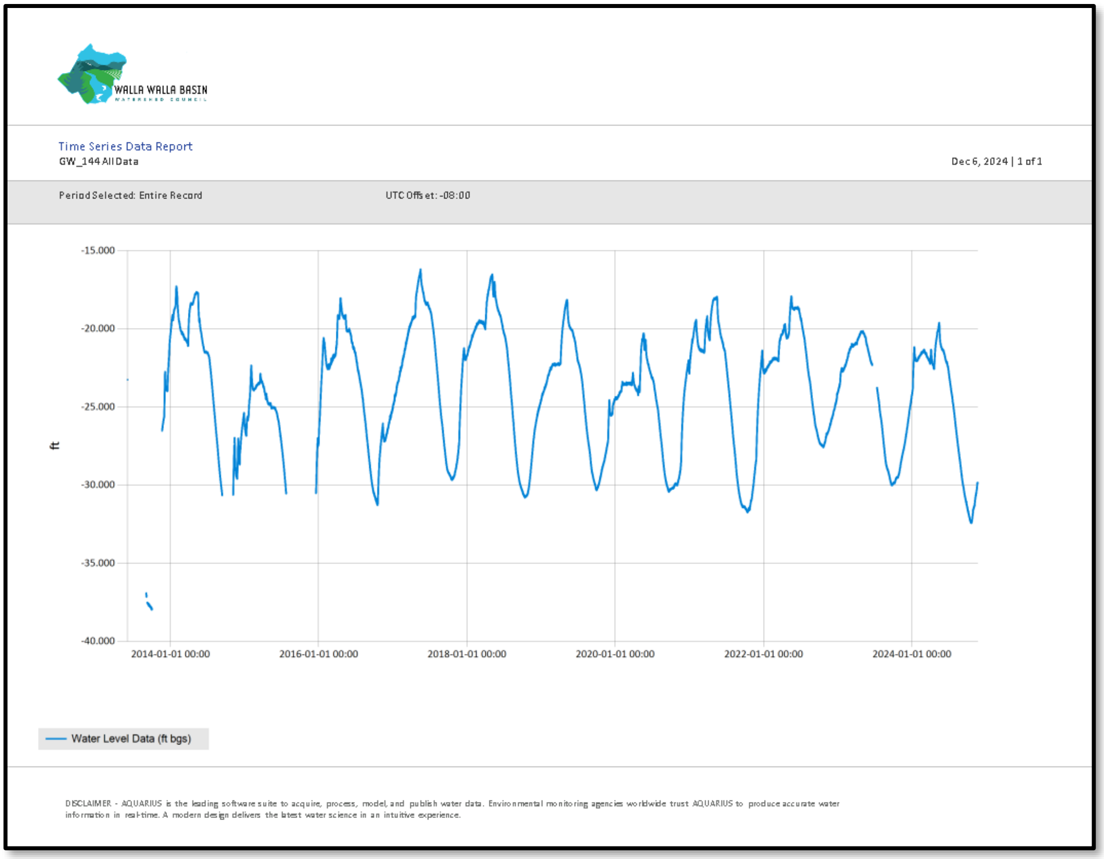

Figure 27. Pressure transducer data (blue line) in feet below ground surface for the well GW_144 located in the WWBWC's Shallow Aquifer Monitoring Network.

Historic Wells

Currently, we are monitoring five wells in the shallow aquifer that are of historical significance, possessing records dating back to 1933 (Figure 28). These wells provide insights into long-term trends within the Walla Walla basin's shallow alluvial aquifer. Notably, all these historic wells had been exhibiting declining levels until 2001. Groundwater declines could be related to the increasing number of wells and increasing water usage for domestic and agricultural activities requiring more water withdrawal than is naturally recharged. Additionally, a significant water management change in 2001 could affect the basin's aquifer. In that year, the Civil Penalty Settlement Agreement between the U.S. Fish and Wildlife Service and the three irrigation districts in the Walla Walla basin (Walla Walla River Irrigation District, Hudson Bay District Improvement Co, Gardena Farms Irrigation District #13) required that 18 cubic feet per second (cfs) remain in the Walla Walla River during summer months and be incrementally raised to 25 cfs during fall and spring. For the previous ~100 years, the Walla Walla River ran dry during the summer because all water was diverted for irrigation. This water flowed through the basin's vast array of irrigation ditches, providing groundwater recharge as seepage occurred within the ditch systems. Since the Settlement Agreement in 2001, less water has been flowing through the Walla Walla/Gardena/Hudson Bay systems during the summer months, leading to reduced groundwater recharge through the ditch system. However, since the decline in the aquifer seems to have started prior to the 2001 Settlement Agreement, the reduced recharge from surface flows in the irrigation system does not fully explain the downward trend. Increased efficiency for irrigation (ditch piping projects and modern irrigation methods) has further reduced the amount of groundwater recharge from irrigation ditches and canals. Historic irrigation practices included flood irrigation, which allowed for groundwater recharge, while newer drip and sprinkler systems only deliver as much water as is needed. Also, many irrigators have begun using supplemental wells more than in the past, and new irrigation wells have been drilled.

Three of the five wells (GW_18, GW_20, and GW_23) were historically declining, but since water management changes in 2001 and the start of the Managed Aquifer Recharge Program in 2004, have stabilized and possibly started to recover (Figure 29-33). While three of the five well shows stability, the other two wells still show declines or no improvements (GW_19 and GW_27, Figures 34 and 35). Some of the historic wells are shallow hand-dug wells and have gone dry in the recent past. GW_27 has been dry since 1989 (Figure 35).

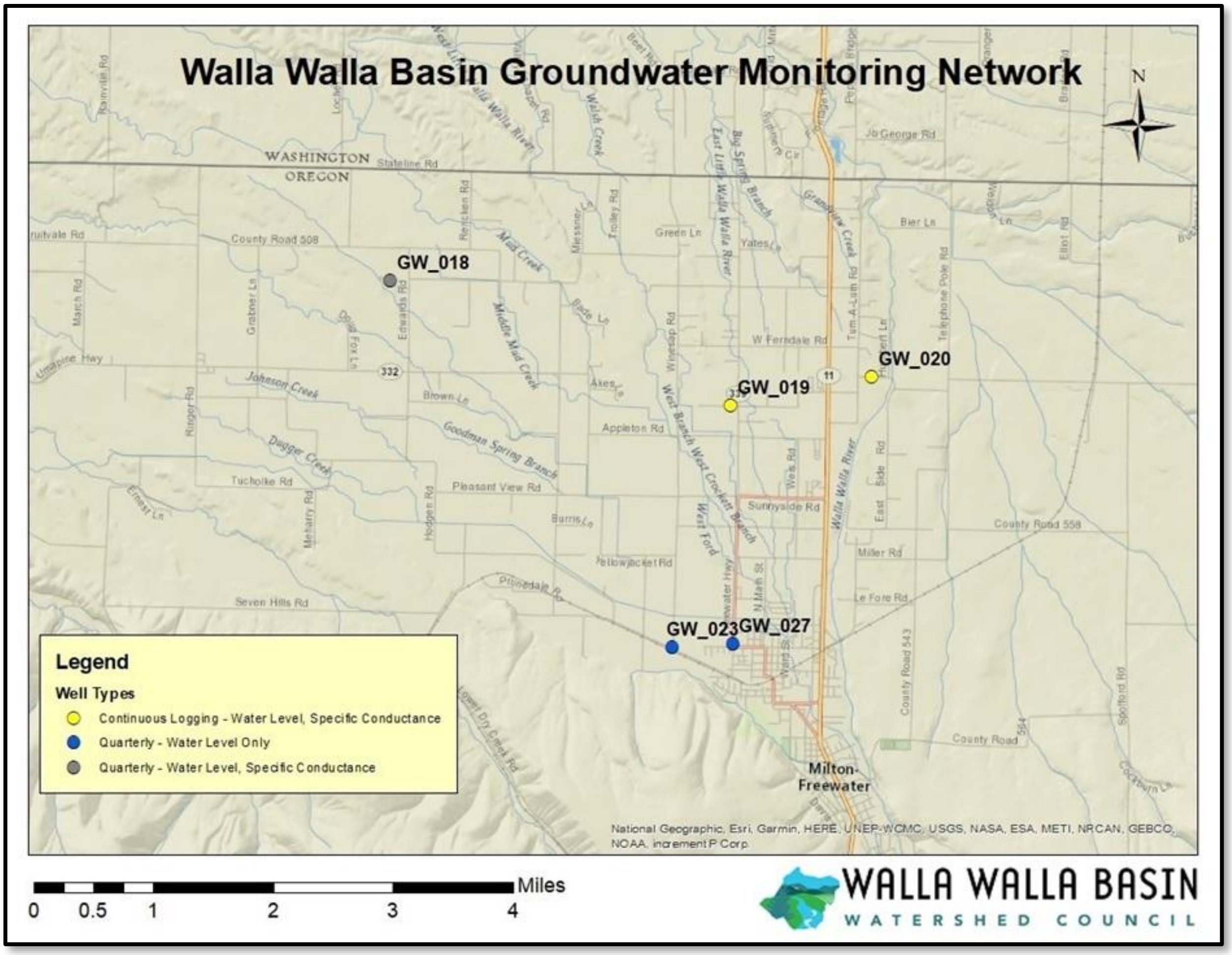

Figure 28. The historic wells that are included in the Shallow Aquifer Monitoring Network.

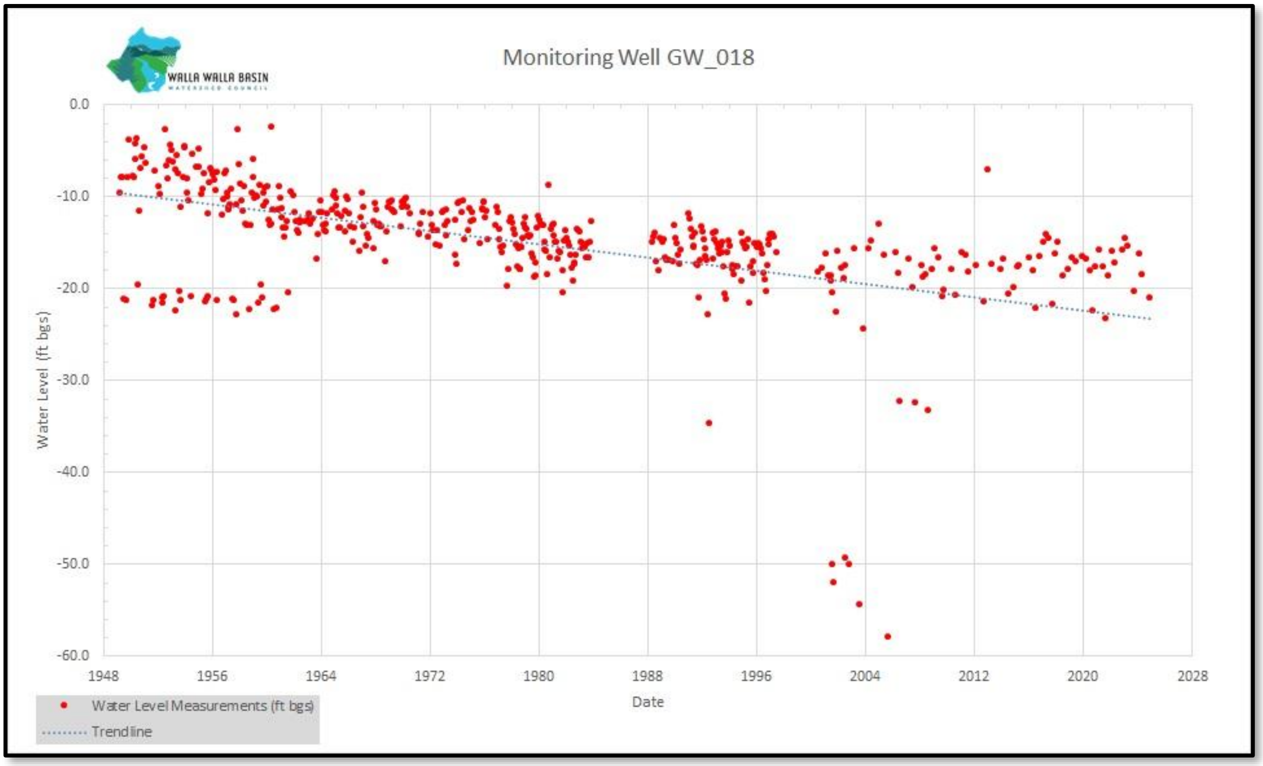

Figure 29. Manual water level measurements (red dots) and a trend line (blue dash line) for the well GW_018 located in the WWBWC's Shallow Aquifer Monitoring Network.

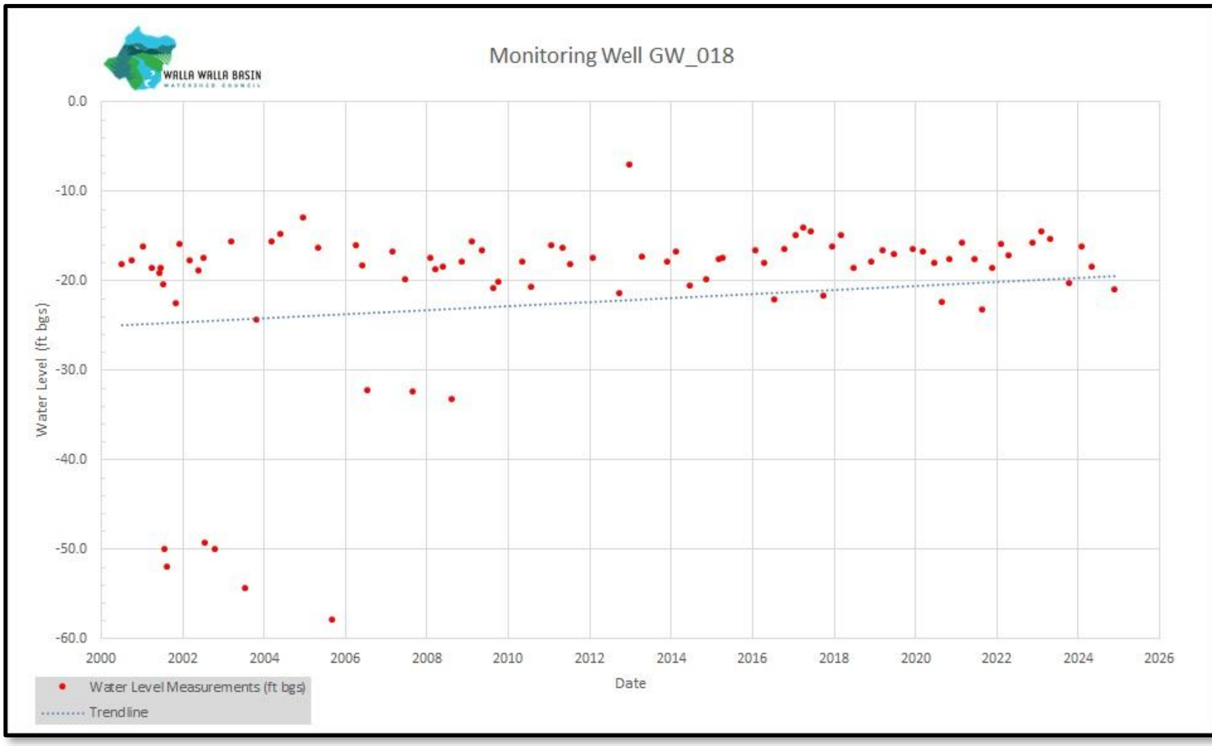

Figure 30. Manual water level measurements (red dots) and a trend line (blue dash line) since 2000 for the well GW_018 located in the WWBWC's Shallow Aquifer Monitoring Network.

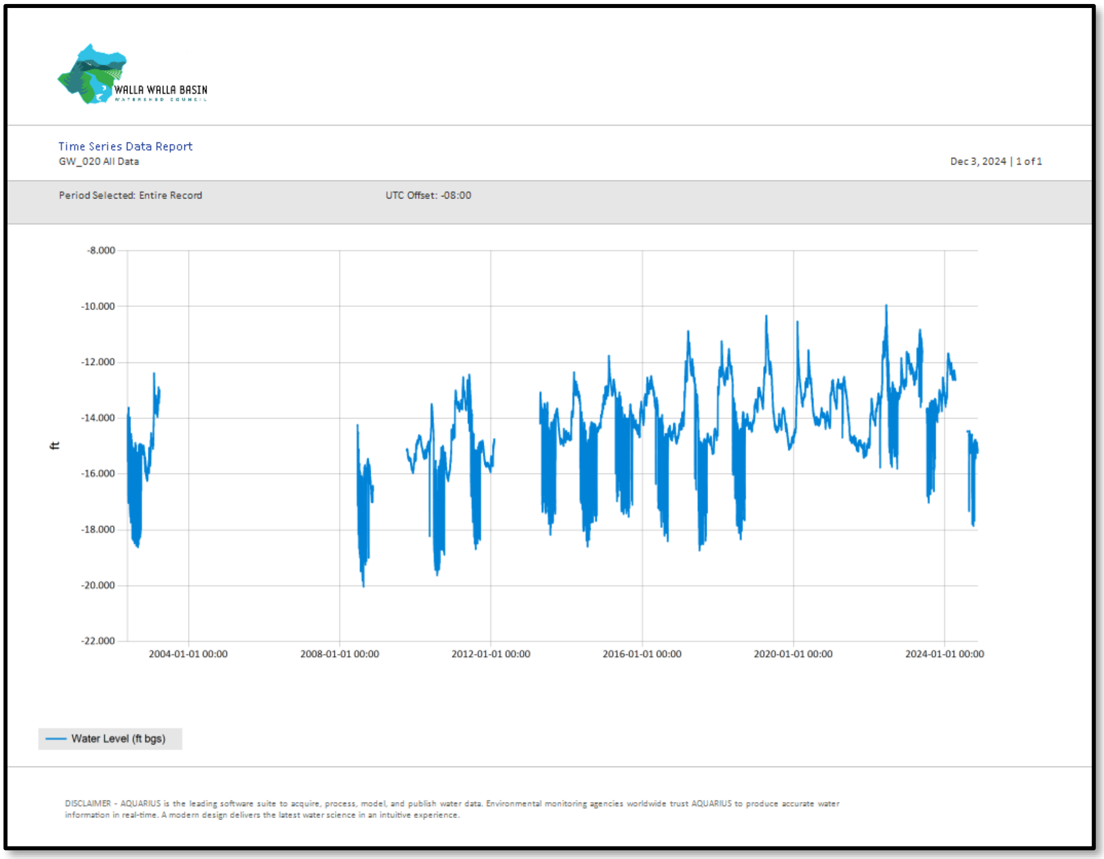

Figure 31. Pressure transducer data (blue line) in feet below ground surface for the well GW_020 located in the WWBWC's Shallow Aquifer Monitoring Network.

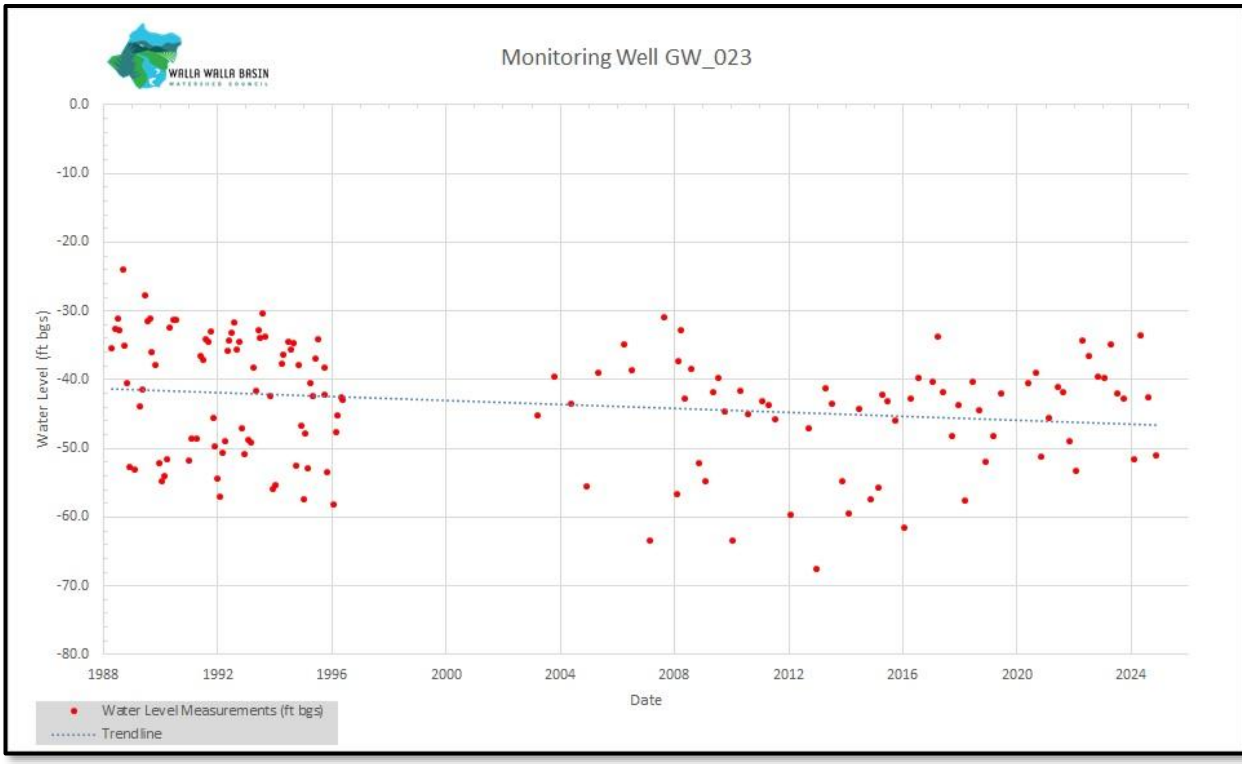

Figure 32. Manual water level measurements (red dots) and a trend line (blue dash line) for the well GW_023 located in the WWBWC's Shallow Aquifer Monitoring Network.

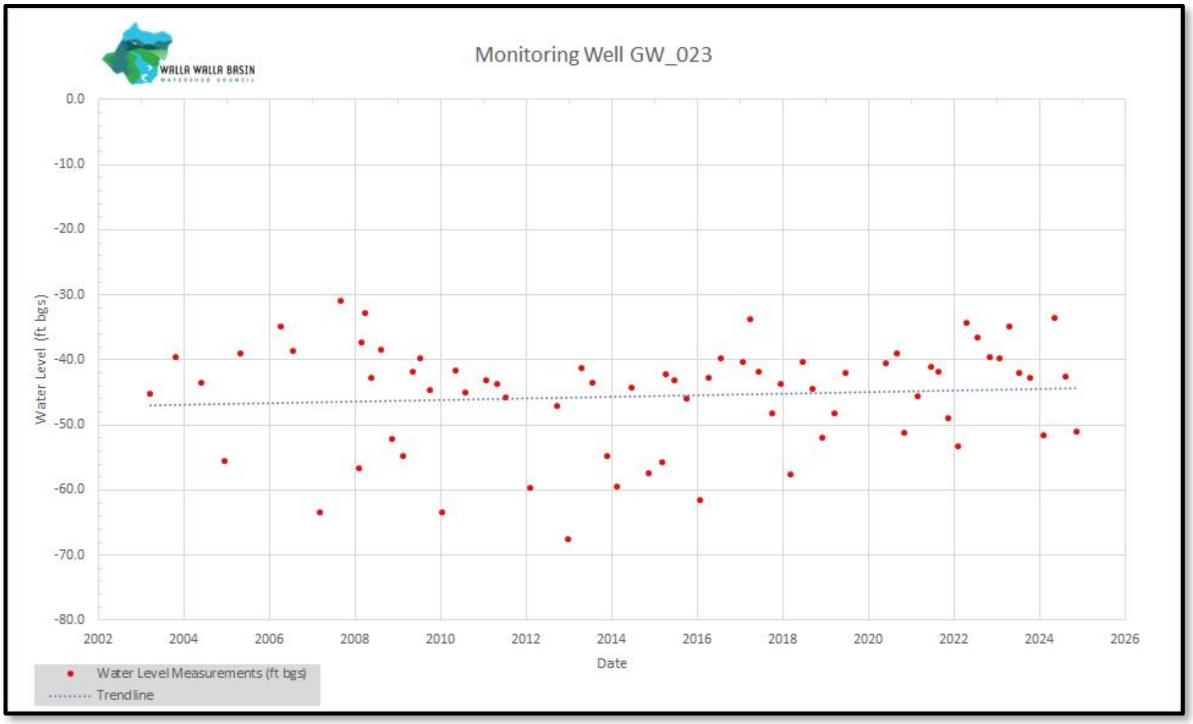

Figure 33. Manual water level measurements (red dots) and a trend line (blue dash line) since 2003 for the well GW_023 located in the WWBWC's Shallow Aquifer Monitoring Network.

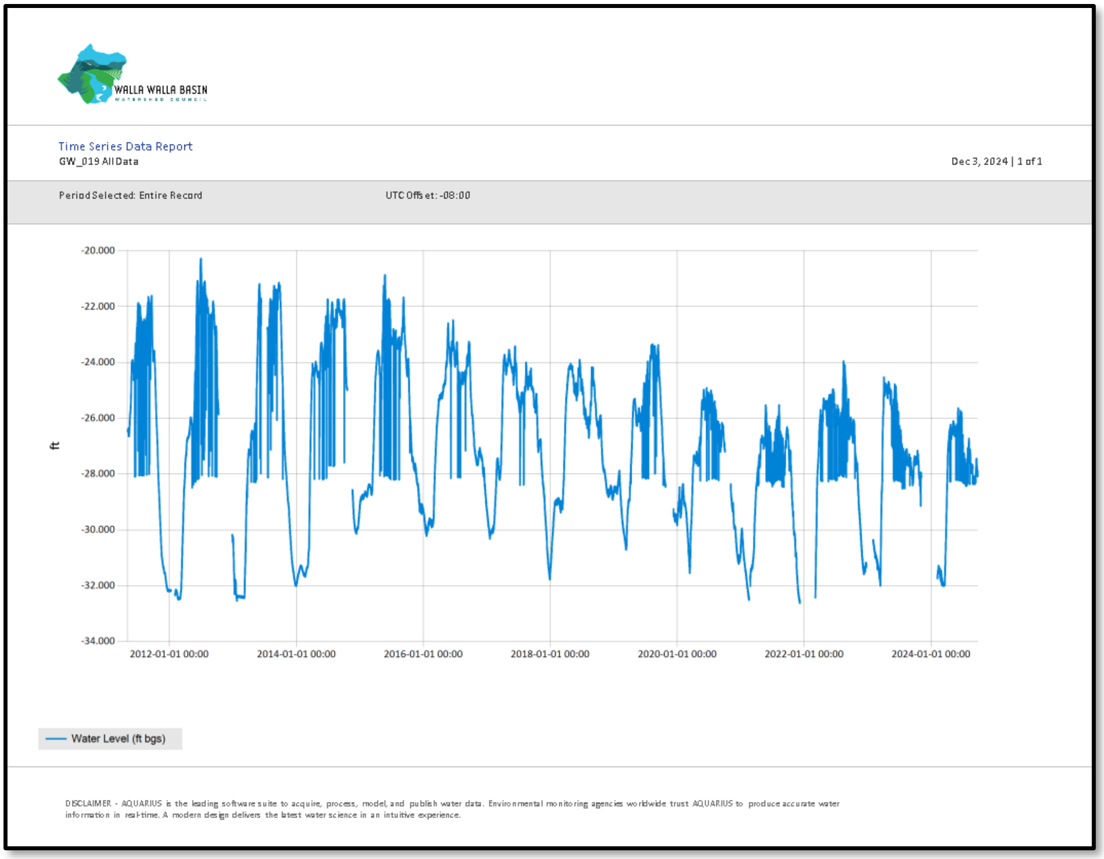

Figure 34. Pressure transducer data (blue line) in feet below ground surface for the well GW_019 located in the WWBWC's Shallow Aquifer Monitoring Network.

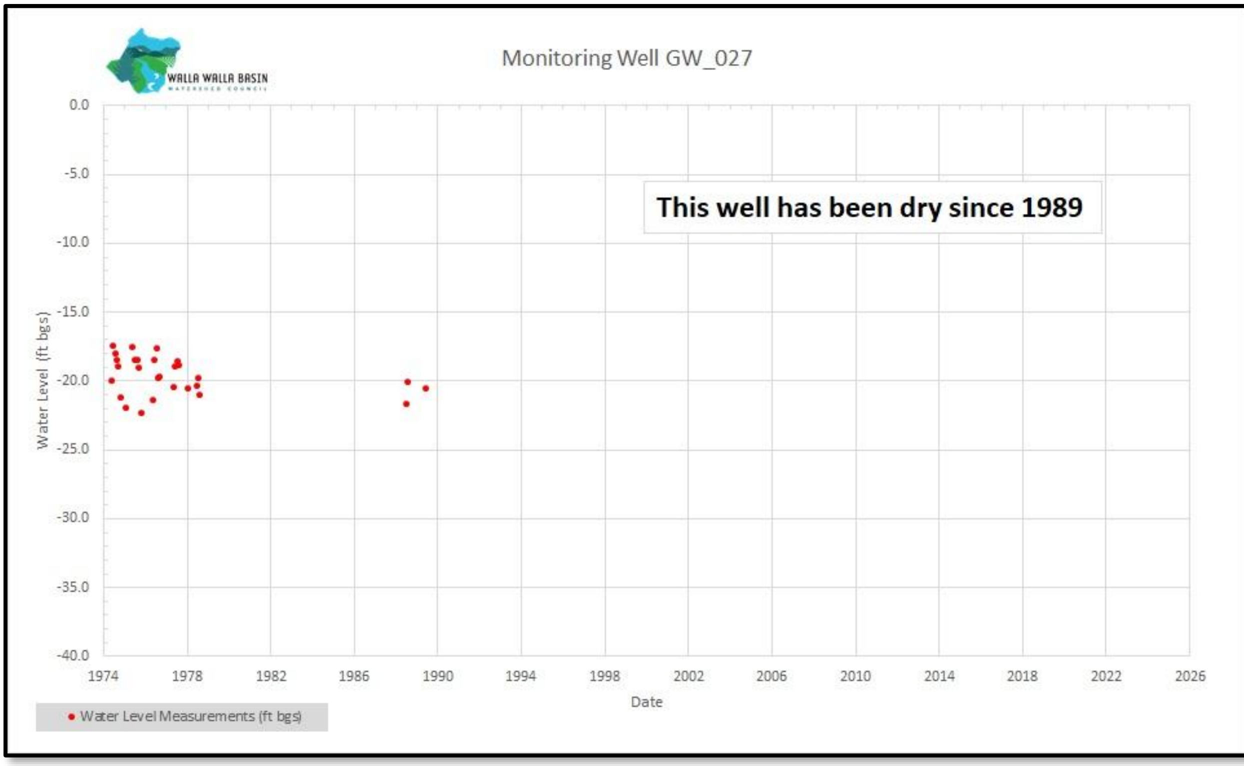

Figure 35. Manual water level measurements (red dots) for the well GW_027 located in the WWBWC's Shallow Aquifer Monitoring Network. The WWBWC still monitors the well.

Near Real-time Groundwater Monitoring

The WWBWC has four near real-time groundwater monitoring locations (Figure 36). These sites allow landowners, water managers, and other interested parties to better understand current groundwater levels. These near real-time monitoring locations also allow for better operation and tracking of managed aquifer recharge sites. Figure 37 is an example of how the near real-time groundwater data are displayed on the WWBWC website.

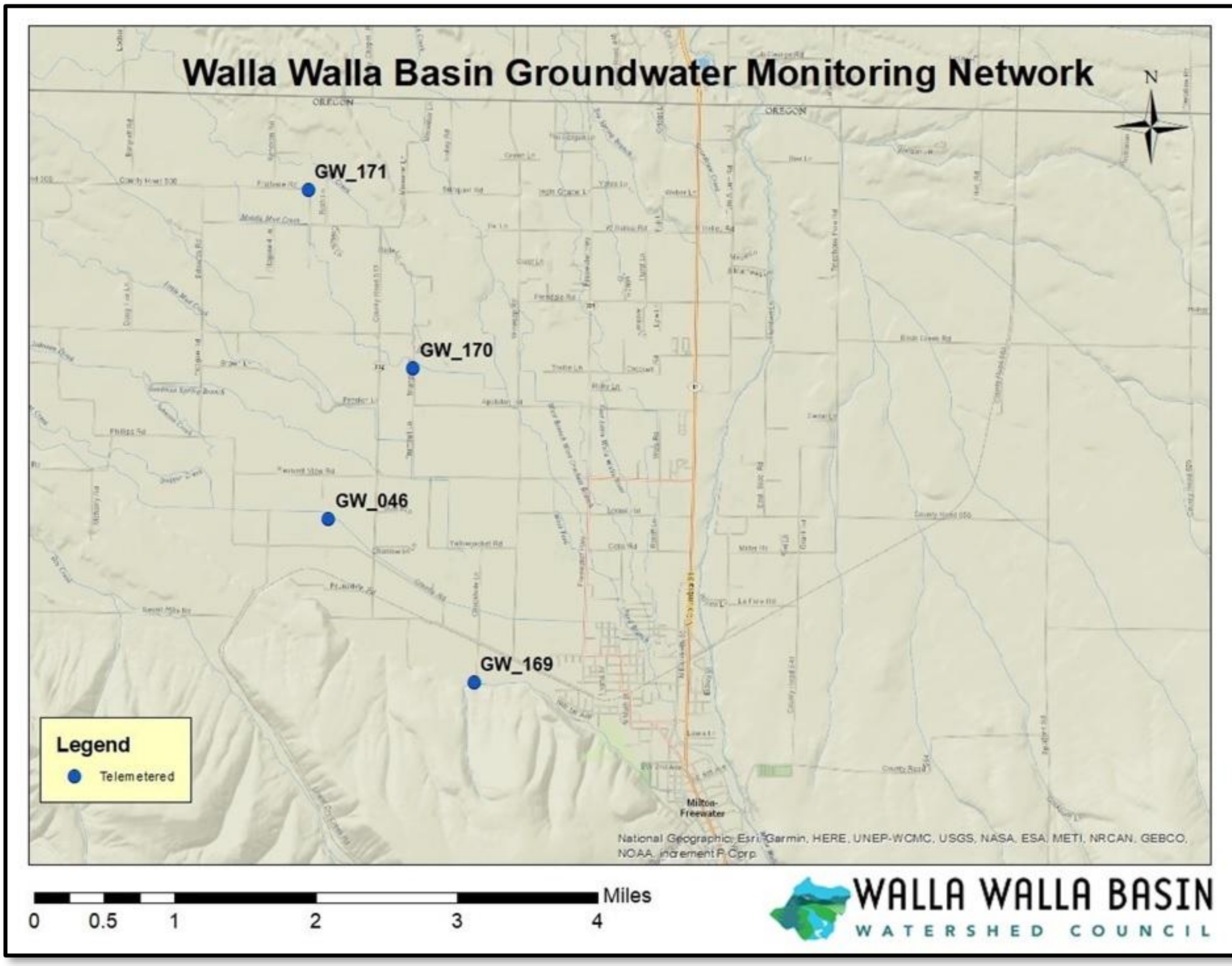

Figure 36. Near Real-time monitoring wells in the Walla Walla Valley.

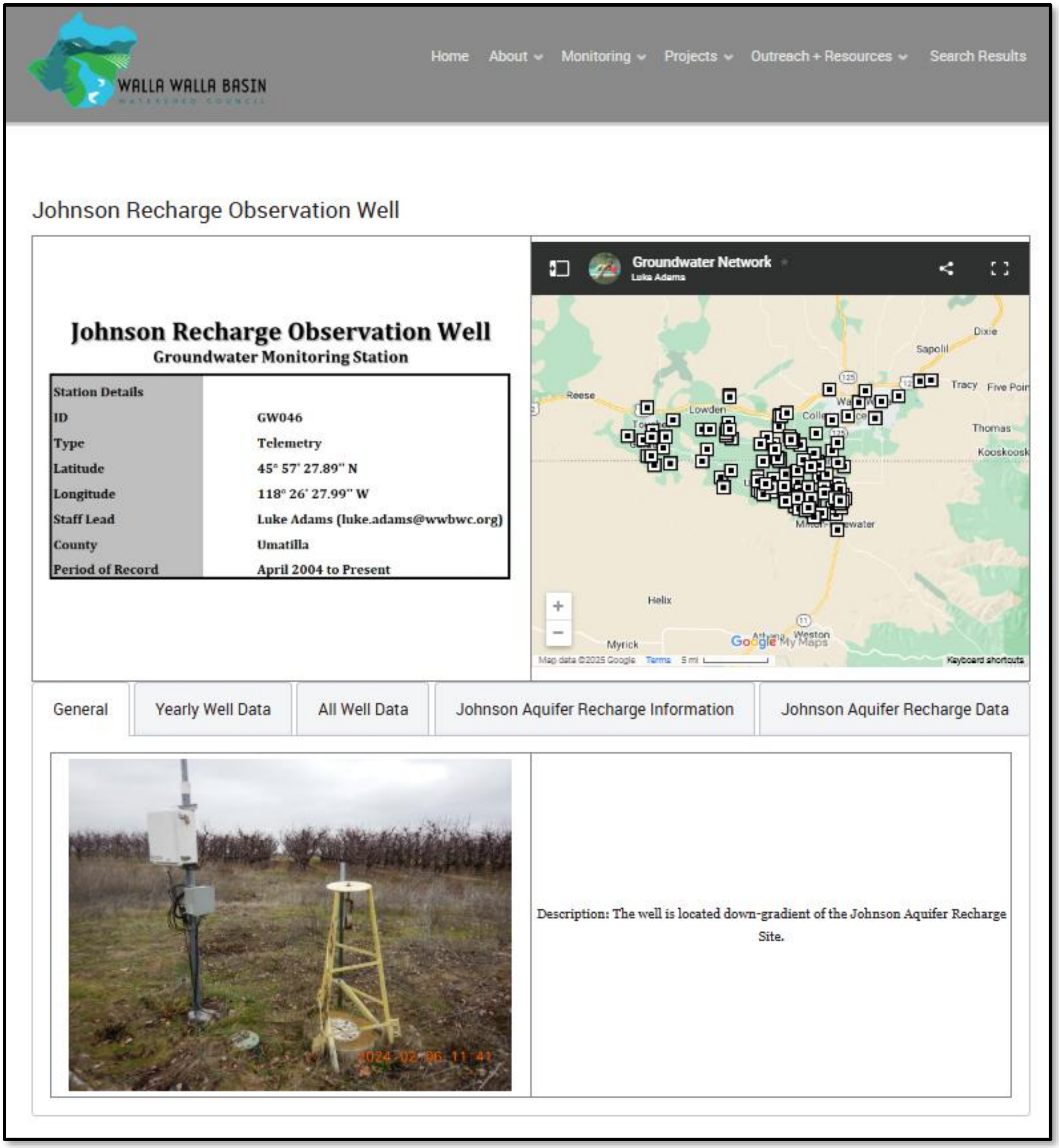

Figure 37. Example webpage for near real-time groundwater monitoring in the WWBWC's Shallow Aquifer Monitoring Network.

Summary

WWBWC's alluvial monitoring program, grown from only a dozen wells in 2001, provides basin partners with a valuable understanding of groundwater conditions and trends during the last 20 years. Although we could not monitor wells on the Washington side of the basin during the 2024 water year, WWBWC continued to extend the data record for 63 alluvial aquifer wells in Oregon. All of the well data are available on our Groundwater Monitoring page (https://wwbwc.org/monitoring/groundwater) on the WWBWC website. WWBWC funders and basin partners continue to support and affirm the value of the shallow aquifer monitoring project as a vital component of current and future understanding of groundwater resources, aquifer decline and recharge, surface-groundwater interactions, and groundwater returns to the Walla Walla River. The well monitoring network data are being used to inform aquifer recharge projects and support the ongoing Walla Walla Basin Integrated Flow Enhancement Study, the Walla Walla Water 2050 Study, and the USGS Basin-wide Surface and Groundwater Study. Each of these efforts is utilizing stream flow and groundwater data collected by WWBWC. The collected data will continue to provide insight for water management professionals and local communities to make water-related decisions in the future.

The Shallow Aquifer Monitoring Project successfully compiles aquifer data as a mechanism for community outreach because it depends heavily on voluntary landowner participation and local support. Many citizens have contributed vital information to the project and have become more aware of the declining aquifer and other water issues in the Walla Walla Basin.

Acknowledgments

We gratefully acknowledge the contributions of our generous funders, the Oregon Water Resources Department, and the Oregon Watershed Enhancement Board. Thanks to local collaborators, including private landowners, irrigation districts, and the City of Milton-Freewater, for allowing property access for groundwater monitoring. Without their support, this work would not be possible.

APPENDIX A

GPS coordinates for wells currently monitored in the Walla Walla Basin Shallow Aquifer.

Note: GPS coordinates are in UTM (Datum = NAD83 and NAVD88 for Elevation)

WELL_ID	Easting	Northing	Well Elevation in Meters	Well Elevation in Feet	Horizontal Confidence in Meters	Vertical Confidence in Meters
GW_03	393477.08	5091165.361	273.745	898.114	0.016	0.012
GW_05	393764.617	5094403.253	248.064	813.920	0.022	0.015
GW_06	392664.181	5092403.474	262.960	867.425	0.015	0.011
GW_07	392787.583	5091551.116	271.717	891.460	0.012	0.012

GW_09	392658.605	5088806.697	306.631	1006.007	0.014	0.01
GW_10	392132.402	5091372.824	273.696	897.950	0.022	0.019
GW_13	390667.86	5093232.622	250.852	823.004	0.013	0.015
GW_14	392157.683	5089568.006	295.488	969.449	0.012	0.009
GW_18	386647.989	5093698.759	225.360	739.367	0.005	0.006
GW_19	391225.116	5092022.761	265.289	870.369	0.014	0.018
GW_20	393114.775	5092400.73	264.392	867.428	0.096	0.101
GW_23	390432.546	5088757.822	292.342	959.125	0.006	0.007
GW_27	391245.146	5088811.531	298.777	980.239	0.008	0.009
GW_28	390083.217	5090403.42	274.565	900.803	0.005	0.004
GW_31	385163.051	5093209.972	218.535	716.976	0.006	0.007
GW_33	387947.465	5093853.935	230.034	754.702	0.008	0.006
GW_34	383288.818	5093418.243	201.734	661.855	0.011	0.008
GW_36	384946.272	5091616.019	220.534	723.534	0.01	0.012
GW_38	392985.262	5094932.606	248.083	812.122	0.021	0.014
GW_39	388823.228	5090045.31	266.394	873.993	0.004	0.002
GW_40	388846.149	5089945.789	266.979	875.913	0.004	0.002
GW_41	388830.34	5090133.816	265.537	871.182	0.004	0.002
GW_45	388555.543	5090167.255	262.553	861.394	0.003	0.003
GW_46	388325.733	5090362.964	259.118	850.123	0.004	0.002
GW_47	388335.675	5090331.38	259.507	851.400	0.003	0.002
GW_48	388432.429	5090413.757	259.608	851.732	0.004	0.002
GW_58	387261.534	5091269.173	245.655	805.953	0.005	0.004
GW_60	388039.791	5090041.577	257.473	844.726	0.003	0.003
GW_61	387730.609	5089747.583	255.862	839.440	0.003	0.003
GW_62	389834.806	5089059.234	283.305	929.478	0.006	0.004
GW_63	383280.245	5091893.17	203.980	669.226	0.014	0.01
GW_64	383657.595	5091641.274	208.550	684.218	0.011	0.013
GW_65	387239.855	5090936.276	246.133	807.520	0.005	0.003
WELL_ID	Easting	Northing	Well Elevation in Meters	Well Elevation in Feet	Horizontal Confidence in Meters	Vertical Confidence in Meters
GW_66	384016.598	5091700.048	209.851	688.485	0.014	0.01
GW_67	378968.413	5093403.081	175.056	574.330	0.019	0.02
GW_68	379255.547	5092242.311	181.305	594.831	0.022	0.018
GW_69	383991.427	5091254.854	212.394	696.829	0.013	0.013
GW_73	390621.47	5095033.16	232.761	763.651		
GW_75	390474.91	5095093.45	230.702	756.897		
GW_92	372892.083	5095185.179	170.620	559.775	0.017	0.016
GW_98	388276.158	5089528.166	263.425	864.255	0.021	0.014
GW_115	392743.234	5086919.977	326.984	1072.780	0.072	0.106
GW_116	391304.129	5091322.097	272.050	892.550	0.022	0.015

GW_117	389825.547	5090864.475	268.409	880.607	0.004	0.004
GW_118	387655.395	5090858.899	250.210	820.898	0.004	0.003
GW_119	384949.15	5092104.046	217.173	712.508	0.01	0.011
GW_120	380094.16	5094289.865	172.605	566.289	0.019	0.013
GW_135	390848.356	5088932.953	294.177	965.146	0.01	0.01
GW_140	388116.677	5092574.411	243.582	799.154	0.006	0.007
GW_141	390842.948	5088970.697	293.484	962.874	0.011	0.01
GW_142	388923.795	5091216.075	258.721	848.822	0.003	0.003
GW_143	388395.621	5091633.293	252.996	830.039	0.005	0.003
GW_144	383287.34	5092945.899	200.103	656.506	0.012	0.018
GW_151	389744.387	5094445.287	234.767	770.233	0.015	0.009
GW_152	393286.724	5089571.48	296.604	973.110	0.015	0.011
GW_160	393147.417	5089956.004	290.045	951.591	0.003	0.003
GW_161	393734.325	5090589.237	278.018	912.133	0.003	0.004
GW_162	393090.749	5090347.905	284.768	934.278	0.003	0.003
GW_165	387848.965	5091049.631	251.695	825.771	0.004	0.002
GW_166	386644.834	5090448.375	243.503	798.894	0.006	0.004
GW_169	390001.583	5088453.461	290.135	951.887	0.006	0.006
GW_170	389307.391	5092050.988	255.411	837.963	0.007	0.004
GW_171	388106.856	5094086.999	228.983	751.257	0.013	0.008

* Well locations not yet surveyed. Values shown here were obtained from Google Earth.

APPENDIX B

Explanation of Data Gaps during the 2024 Water Year

Well ID	Gap Dates	Explanation
GW_019	11/05/23 – 02/05/24 09/23/24 – 09/30/24	Water dropped below level of sensor. Dry data were deleted. Sensor failure.
GW_020	04/12/24 – 08/20/24	Sensor failure.
GW_031	08/22/24 – 09/30/24	Sensor failure.
GW_033	12/20/23 – 12/23/23 03/26/24 – 05/09/24	Interference with sensor by livestock. Sensor failure.
GW_040	01/01/24 – 03/18/24	Water dropped below level of sensor. Dry data were deleted.
GW_045	06/19/24 – 08/20/24	Sensor failure.
GW_058	10/01/23 – 10/31/23 11/26/23 – 12/12/23 02/14/24 – 04/12/24 07/07/24 – 09/30/24	Water dropped below level of sensor. Dry data were deleted. Water dropped below level of sensor. Dry data were deleted. Water dropped below level of sensor. Dry data were deleted. Water dropped below level of sensor. Dry data were deleted.
GW_060	10/01/23 – 10/10/23 02/07/24 – 03/27/24 07/01/24 – 08/29/24 08/29/24 – 09/30/24	Water dropped below level of sensor. Dry data were deleted. Water dropped below level of sensor. Dry data were deleted. Pumping, Water dropped below level of sensor intermittently. Dry data were deleted. Sensor failure.
GW_062	07/03/24 – 08/05/24 08/17/24 – 08/20/24	Sensor failure intermittently. Sensor failure.
GW_065	01/13/24 – 05/15/24	Sensor failure intermittently.
GW_066	08/08/24 – 09/30/24	Sensor failure.
GW_116	09/25/24 – 09/30/24	Sensor failure.
GW_118	10/10/23 – 10/12/23 02/21/24 – 05/08/24	Sensor failure. Sensor failure.
GW_120	08/08/24 – 09/30/24	Sensor failure.
GW_142	10/01/23 – 11/07/23 02/10/24 – 03/29/24 07/18/24 – 09/22/24	Sensor failure. Water dropped below level of sensor. Dry data were deleted. Water dropped below level of sensor. Dry data were deleted.
GW_151	10/01/23 – 10/18/23 10/24/23 – 11/07/23	Sensor failure. Sensor failure.
GW_160	06/12/24 – 08/20/24	Sensor failure.
GW_161	08/06/24 – 09/30/24	Sensor failure.

Explanation of Data Gaps during the 2024 Water Year

Well ID	Gap Dates	Explanation
GW_169	02/20/24 – 02/23/24	Water dropped below level of sensor. Dry data were deleted.
	03/03/24 – 05/13/24	Water dropped below level of sensor. Dry data were deleted.
GW_170	10/01/23 – 10/18/23	Datalogger lost power. No data were recorded.
	12/31/23 – 01/08/24	Datalogger lost power. No data were recorded.