GeoEngineers

Memorandum

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Kevin A Lindsey exp 9/4/2021

To:	Elsa Bowen, Lincoln County Conservation District
From:	Kevin Lindsey, PhD, LHG
Date:	June 14, 2021
File:	14253-001-00
Subject:	2021 Groundwater Level Summary Report

The purpose of this memorandum (memo) is to summarize visual observations and simple statistics of water level data collected by Lincoln County Conservation District (LCCD) from wells throughout Lincoln County. Funding for LCCD's effort was provided by the Washington Department of Ecology, Office of Columbia River. GeoEngineers, Inc. efforts were authorized in an agreement with LCCD dated June 11, 2018. This memo: (1) builds on the results of earlier work by EA Engineering Science and Technology, Inc., PBC (EAEST) for LCCD which evaluated historical basalt aquifer system water level data collected in Lincoln County and (2) includes water level data collected by LCCD staff from the basalt aquifer system between 2018 and early 2021. The objective of this memorandum (memo) is to describe long-term groundwater level changes across Lincoln County.

INTRODUCTION AND BACKGROUND

The earlier EAEST work focused on 56 wells with 20 or more annual water level measurements. Most of the wells evaluated in the EAEST report were irrigation and water system water supply wells. Small yield domestic wells were poorly represented in the earlier effort. Statistical analysis of individual hydrographs for the 56 wells in the EAEST report revealed the following:

- Thirty-three wells, most of which are in the Grande Ronde aquifer, displayed declining water levels.
- Five wells, predominantly in the Wanapum aquifer, displayed increasing water levels.
- Eighteen wells, most of which are in the Wanapum aquifer, did not display any statistically measurable trend.

That report concluded that shallower portions of the basalt aquifer system appear to be able to generally support existing groundwater extraction rates while the deeper basalt aquifer system cannot support existing groundwater extraction rates. With respect to these conclusions:

- The report interpreted relatively stable shallow basalt aquifer water levels to be reflective of relatively low historical pumping demands coupled with seasonal recharge largely replenishing water removed from storage.
- Conversely, observed deeper basalt aquifer water level declines were interpreted to be indicative of historical pumping demands from high-capacity irrigation and municipal wells coupled with limited recharge reaching deeper portions of the basalt aquifer system resulting in groundwater being removed from storage faster than it can be replaced.

Following up with the EAEST analysis LCCD identified, gained access to, and began collecting water level data from additional wells beginning in 2018. Many of those wells are domestic wells which were underrepresented

in the EAEST effort. This memo summarizes water level data collected from 79 wells by LCCD staff. Seventeen of the 79 wells were included in the previous EAEST effort.

The wells evaluated herein are listed on Table 1, All-Well Data Summary, and their locations are shown in Figure 1, Water Level Measurement Wells, a figure produced and provided by LCCD staff. Water level data for these wells is available from LCCD and has been downloaded to the Ecology EIM website.

This evaluation of long-term groundwater level changes focuses on visual examination of well hydrographs and average water level changes seen in the water level data records for the 79 wells. The evaluation effort centers on data records beginning and ending in the late winter or early spring, times of year when groundwater pumping is generally at its lowest and most wells are not operated, or only minimally operated. This was done to remove seasonal water level drops related to seasonal pumping demands, most commonly those related to increased irrigation season pumping. In addition, water level data from wells that show abrupt water level drops in the spring was edited to remove these abrupt drops which are interpreted to reflect ephemeral pumping effects and not long-term groundwater level changes.

Using this informal filter allowed the evaluation to get as close as it could, allowing for available budget, to evaluating the long-term groundwater level changes that are the focus of this effort. In addition, by filtering the water level data along these lines some data for individual wells and some well water level records in their entirety were not used in this evaluation.

WATER LEVEL SUMMARY

With respect to the 79 wells listed on Table 1, depths, ranging from 78 to over 4,000 feet below ground surface (bgs), were found for 69 of them. For 20 of the wells listed in Table 1 water level data was divided into two, or in a few cases three, time windows. This was done because water level data for these wells showed significant gaps in their temporal record and/or significant shifts of tens of feet, or more, suggesting a shift in baseline water level conditions. Wells with these types of records are hereafter referred to as wells with baseline shifts. These data are explored further later in this memo.

For the wells listed in Table 1:

- Overall estimated annual water level changes range from a decline of approximately -21.4 feet per year (feet/year) to an increase of approximately 5.9 ft/yr.
- The average rate of change for all 79 wells and time windows is approximately -2.4 ft/yr.

In the following sections this water level data is explored in various ways, including evaluating wells without baseline shifts, with baseline shifts, and by depth.

Water Levels Without Baseline Shifts

Table 2, Water Levels without Base Line Shifts, lists fifty-four wells that are interpreted to not display baseline shifts. The average depth of these wells is 549 feet, but they range from 78 to over 4500 feet deep. The length of the data records for these wells is variable, ranging 2 years to over 50 years. With respect to these wells:

- The average annual water level rate of change is a decline of approximately -1.6 feet/year, and ranges from -18.6 feet/year to 5.9 feet/year.
- Thirteen wells display rising water levels ranging from approximately between 0.1 and 5.9 feet/year. Of these:
  - The average rise rate is approximately 1 foot/year.
  - The average well depth is 400 feet, and the wells in this group range from 120 to 766 feet deep.
- Forty-one wells display declining water levels, ranging from -0.1 to -18.6 feet/year. Of these:
  - The average decline rate is -2.5 feet/year.
  - The average well depth is approximately 580 feet, and the wells range from 78 to over 4500 feet deep.

Based on this subset of wells, declining groundwater levels generally are common in Lincoln County wells, and in deeper wells.

Water Levels with Baseline Shifts

As introduced above, water levels interpreted to have baseline shifts are identified because of a noticeable change in water level with or without a hiatus in the temporal data record and/or an abrupt change in water level resulting in what visually appears to be a new set of water levels. Twenty wells of the 79 wells summarized on Table 1 display a baseline shift. Several probable scenarios may explain these baseline shifts, including:

- Deepening of a well resulting in an abrupt water level increase because the new well intersects a high-pressure water-bearing zone with an associated higher water level.
- Deepening the pump column and associated airline resulting in an abrupt apparent increase in water level because the deeper airline reference point is not adequately recorded and revised.
- A break in an airline, commonly resulting in an abrupt drop in water level as the airline is reading less pressure.
- Changes in the measurement reference point such as from modifications at the wellhead or a change in the topographic datum used to calculate water level elevation.

Wells with data interpreted to have baseline shifts are identified on Table 3, Water Levels with Baseline Shifts. Table 3 also shows the initial and final groundwater level measurement for each time window for each well, and the annual groundwater level change rate for each window. Subdividing these records provides some insight into whether baseline shifts also record shifts in groundwater level change rates. With respect to these 20 wells, and their associated data time windows:

- Average water level change rates before and after 2019 appear to have decreased slightly, from -3.6 feet/year to -3.0 feet/year, respectively.
- However, eleven wells display increased change rates in recent years while 8 wells display decreased decline rates.
- One well displays unchanged decline rates.

Based on these observations it is not clear if there has been a significant increase or decrease in water level change rates, or the numbers of wells displaying declining water levels.

2019 Through 2021 Water Level Changes

Thirty-five wells—listed on Table 4, 2019–2021 Water Level Summary—with water level records for the 2019 to 2021 period were evaluated. Many of these wells also have data predating this time frame. Nevertheless, for these wells in the 2019–2021-time frame:

- Five display rising water levels, ranging from rates of 0.1 to 5.9 feet/year and averaging 1.4 feet per year.
- Thirty display declining water levels, ranging from -0.1 to -18.6 feet/year and averaging -3.2 feet/year.

The average change rate for the 36 wells is -2.9 feet/year.

Water Level Change by Well Depth

Well depth was found for 69 wells (Table 5, Water Level Changes by Well Depth). These wells, ranging from a depth of 78 feet to a depth of 4525 feet, were divided into three depth categories. These categories generally reflect shallow domestic wells (78 to 200 feet deep) interpreted to primarily be within the Wanapum aquifer, a mix of domestic and shallow irrigation wells (greater than 200 to 500 feet deep interpreted to primarily be within the Wanapum and/or upper Grande Ronde aquifer), and deeper irrigation wells (greater than 500 feet deep interpreted to be primarily within the deeper Grande Ronde aquifer. With respect to these categories:

- Average decline rate in the shallowest wells is -1.8 feet/year. Of these wells:
  - One record shows an increasing water level of approximately 0.1 feet/year.
  - Twenty-one records show water levels declining at an average rate of -1.9 feet/year.
- Average decline rate in the intermediate group of wells is -2.8 feet/year. Of these wells:
  - Seven records show increasing water levels, ranging from 0.1 to 5.9 feet/year.
  - Thirty-four records show declining water levels, ranging from -0.1 to -18.6 feet/year.
- The deepest group of wells have an average decline rate of -3.4 feet/year. Of these wells:
  - One record shows an increasing water level changing at approximately 1.4 feet/year.
  - Thirty-four records show declining water levels, ranging from -1.2 to -10.7 feet/year.

Examining these wells by these depth categories reveals a long-term water level change picture like those summarized previously in this memo. Regardless of depth more wells display declining water levels and as well depth increases the water level change rates becomes increasingly negative.

SUMMARY AND CONCLUSIONS

The data reviewed herein generally reflects the same basic trends noted in the previous report prepared by EAEST. While the newer data included far more shallow and domestic wells then the previous analysis, taking all of them together water levels are more commonly falling than rising across the County. This becomes more pronounced in the deeper basalt aquifer wells. Based on the groundwater level data evaluated for this effort we conclude that water level declines are common across the County, and that they will persist if historical pumping rates and recharge conditions prevail into the future. With few exceptions water stored in the basalt aquifer system is being extracted faster than it is replaced.

While these decline rates may not appear to be high on an annual basis, they are commonly less than -2.0 feet/year, over the course of several decades these water level declines will add up. One also must understand that the declines will increase if groundwater extraction increases in the future and/or aquifer recharge is not in some way enhanced. In either case, or taken together, more water is being removed from groundwater storage then is being restored. These will put additional pumping stress on the aquifer system and during periods of peak demand, most commonly the dry summer months, pumping drawdown has the potential to dewater individual wells during these high demand periods.

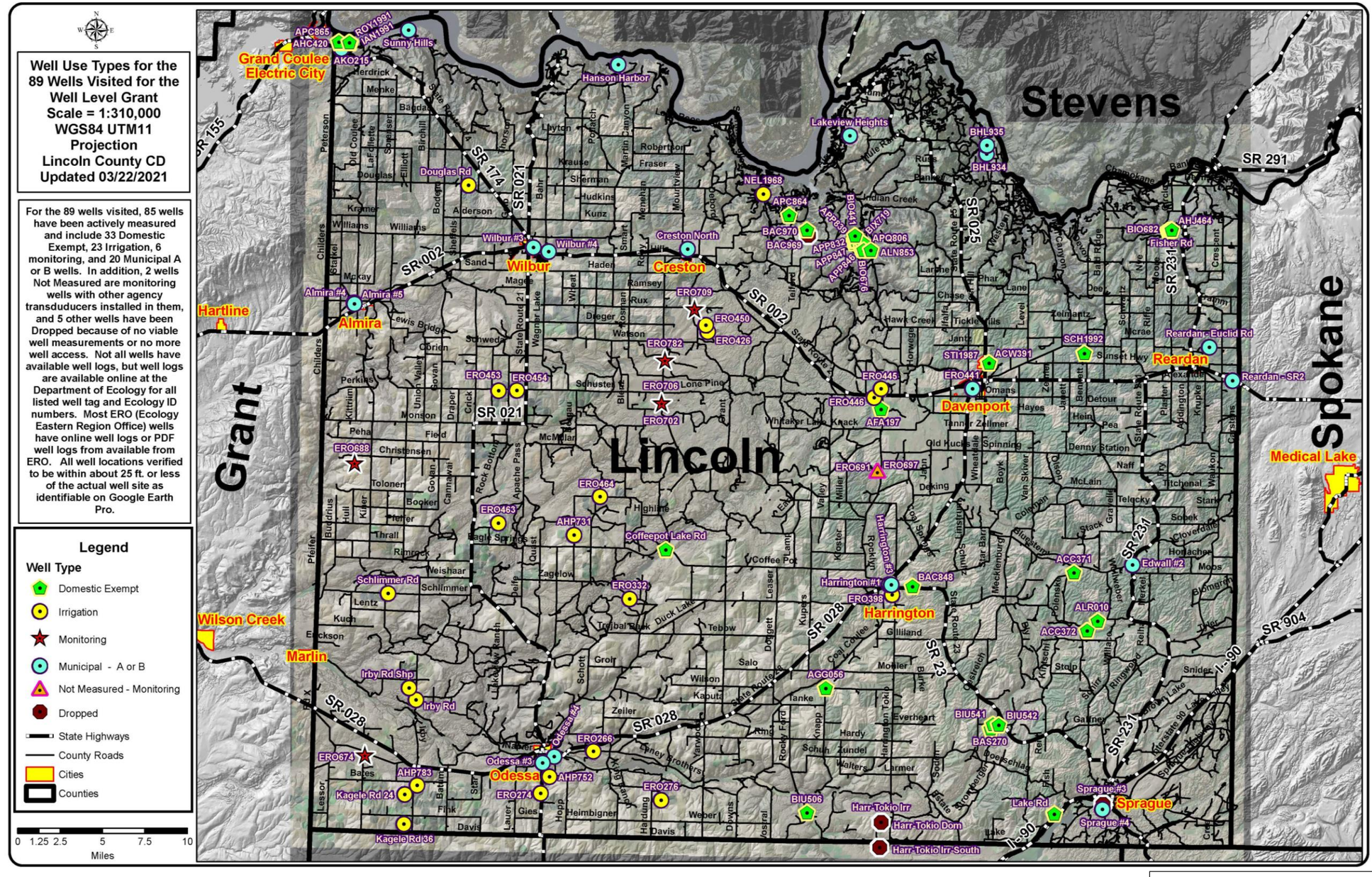
Given these future challenges we recommend that water level measurement efforts continue and are expanded to include peak pumping periods. In addition, the water level data for the 79 wells reviewed in this memo could be subject to more rigorous statistical and geospatial analysis to better characterize the historical trends, predict future trends, and understand if there are areas with more, or less potential stress on the aquifer system. These types of analyses, including attempts to correct the data for factors which effects it such as those noted above, were beyond the scope and budget of this review effort.

KAL:mls

Attachments:
Figure 1. Water Level Measurement Wells
Table 1. All-Well Data Summary
Table 2. Water Levels without Baseline Shifts
Table 3. Water Levels with Baseline Shifts
Table 4. 2019–2021 Water Level Summary
Table 5. Water Level Change by Well Depth

Well Use Types for the 89 Wells Visited for the Well Level Grant
Scale = 1:310,000
WGS84 UTM11 Projection
Lincoln County CD
Updated 03/22/2021

For the 89 wells visited, 85 wells have been actively measured and include 33 Domestic Exempt, 23 Irrigation, 6 monitoring, and 20 Municipal A or B wells. In addition, 2 wells Not Measured are monitoring wells with other agency transduducers installed in them, and 5 other wells have been Dropped because of no viable well measurements or no more well access. Not all wells have available well logs, but well logs are available online at the Department of Ecology for all listed well tag and Ecology ID numbers. Most ERO (Ecology Eastern Region Office) wells have online well logs or PDF well logs from available from ERO. All well locations verified to be within about 25 ft. or less of the actual well site as identifiable on Google Earth Pro.



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Lincoln County Conservation District

Water Level Measurement Wells

Groundwater Level Data Review
Lincoln County, Washington

GeoEngineers

Figure 1

14253-001-00 Date Exported: 06/14/21

Table 1

All-Well Data Summary

Groundwater Level Data Review

Lincoln County, Washington

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)	Pumping Effects Apparent
AAL726	284	2124.3	4/26/2019	2125.1	4/21/2021	0.8	0.4	x
AAN570	290	1874.7	4/30/2019	1868.7	4/15/2021	-6.0	-3.0	x
ABR561	375	2178.0	4/6/2011	2176.0	4/21/2021	-2.0	-0.2	x
ABR564 1979-1989	660	1504.0	3/8/1979	1492.0	3/29/1989	-12.0	-1.2	
ABR564 2012-2021	660	1476.2	2/15/2012	1441.4	4/7/2021	-34.8	-3.5	x
ABR763	452	2360.5	4/20/2011	2371.5	4/26/2021	11.1	1.1	x
ABR822	300	2469.4	4/20/2011	2465.5	4/26/2021	-3.9	-0.4	
ACC371		2161.8	4/26/2019	2162.1	4/21/2021	0.3	0.1	
ACC372	105	2151.1	4/26/2019	2149.5	4/21/2021	-1.6	-0.8	x
ACW391 2011-2015	80	2413.0	2/22/2011	2410.3	2/25/2015	-2.7	-0.7	x
ACW391 2019-2021	80	2418.2	4/16/2019	2415.8	4/29/2021	-2.4	-1.2	x
AFA197 2011-2015	180	2331.8	4/12/2011	2318.9	4/29/2015	-12.9	-3.2	
AFA197 2019-2021	180	2342.6	4/24/2019	2326.9	4/26/2021	-15.7	-7.8	x
AGG056	178	1950.6	4/24/2019	1949.0	4/21/2021	-1.6	-0.8	x
AHC420	300	1369.7	1/19/2010	1360.1	4/12/2021	-9.6	-1.0	x
AHJ464	397	1480.5	4/30/2019	1443.3	4/26/2021	-37.2	-18.6	x
AHP752	1615	1519.4	12/21/1967	1282.3	3/4/2021	-237.1	-4.5	x
AHP783	2430	1165.6	4/9/2019	1151.8	3/4/2021	-13.8	-6.9	x
AKO215	236	1326.7	4/23/2019	1321.7	4/12/2021	-5.0	-2.5	x
Almira #4	377	1715.2	11/8/2018	1709.5	10/15/2020	-5.7	-2.9	x
ALN853 2010-2015	680	1520.1	3/8/2010	1511.5	2/24/2015	-8.6	-1.7	
ALN853 2019-2021	680	1521.7	4/1/2019	1518.9	4/15/2021	-2.8	-1.4	x
ALR010	350	2174.7	7/19/2018	2171.8	4/21/2021	-2.9	-1.4	x
APC864 2011-2015	178	2338.6	3/24/2011	2332.5	4/30/2015	-6.1	-1.5	
APC864 2019-2021	178	2342.6	4/18/2019	2336.7	4/29/2021	-5.9	-0.6	x
APC865 2010-2015	404	1300.6	3/9/2010	1260.0	3/11/2015	-40.6	-8.1	
APC865 2019-2021	404	1299.2	4/23/2019	1311.0	4/12/2021	11.8	5.9	x
APP832		2328.6	10/23/2019	2329.3	4/15/2021	0.7	0.4	x
APP839	300	2214.3	3/8/2010	2190.6	4/15/2021	-23.7	-2.2	x
APP846	120	2273.7	4/28/2020	2272.5	4/15/2021	-1.2	-1.2	x
APP847	100	2298.0	4/18/2019	2293.1	4/15/2021	-4.9	-2.5	x
APP852	260	2349.4	4/26/2019	2343.6	4/21/2021	-5.8	-2.9	x
APQ806 2010-2015	420	1966.4	4/20/2010	1953.9	2/24/2015	-12.5	-2.5	
APQ806 2019-2021	420	1972.9	4/18/2019	1970.9	4/15/2021	-2.0	-1.0	x
APQ847	235	1273.9	4/22/2019	1272.7	4/30/2021	-1.2	-0.6	
BAC848	205	2200.8	4/13/2011	2168.0	4/21/2021	-32.8	-3.3	x
BAC970 2010-2015	242	2328.1	4/27/2010	2326.7	4/30/2015	-1.4	-0.3	
BAC970 2019-2021	242	2337.0	4/18/2019	2334.7	4/29/2021	-2.3	-0.2	
BAS270		1919.1	11/2/2018	1919.3	11/19/2020	0.2	0.1	

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)	Pumping Effects Apparent
BHL934	396	1289.8	7/13/2018	1289.6	7/21/2020	-0.2	-0.1	
BHL935	375	1290.3	7/13/2018	1290.9	7/21/2020	0.6	0.3	
BHP252		1884.9	4/23/2019	1880.3	4/12/2021	-4.6	-0.7	x
BIO441		1680.4	4/28/2020	1672.1	11/20/2020	-8.3	-8.3	
BIO676		2119.0	5/31/2019	2116.2	4/28/2020	-2.8	-2.8	
BIO682	300	1614.4	4/30/2019	1614.7	4/26/2021	0.3	0.1	x
BIU506	140	1684.8	3/11/2017	1683.3	4/3/2021	-1.5	-0.3	x
BIU541	160	1927.7	4/24/2019	1926.7	4/21/2021	-1.0	-0.5	x
BIU542	120	1929.7	11/2/2018	1929.9	11/19/2020	0.2	0.1	x
BIX719	390	2064.6	4/18/2019	2061.0	4/15/2021	-3.6	-3.6	x
Coffeepot Domestic		1838.1	4/17/2019	1837.6	4/16/2020	-0.5	-0.5	
Creston North	766	2268.2	2/3/2012	2279.4	4/21/2020	11.2	1.4	
Douglas Rd Irr		2209.3	3/28/2010	2210.6	4/12/2021	1.3	0.1	x
ER0266 2011-2017	200	1555.6	3/31/2011	1549.8	3/27/2017	-5.8	-1.0	
ER0266 2018-2021	200	1523.1	4/26/2018	1510.5	3/4/2021	-12.6	-4.2	x
ER0269 1968-1984	595	1418.5	3/12/1968	1288.0	4/2/1984	-130.5	-8.2	
ER0269 2012-2021	595	1319.2	2/15/2012	1278.2	4/7/2021	-41.0	-4.6	x
ER0274	722	1518.0	3/12/1969	1325.8	3/4/2021	-192.2	-3.7	x
ER0276 1968-1995	737	1545.4	3/8/1968	1505.6	3/2/1995	-39.8	-1.5	
ER0276 2016-2021	737	1574.8	3/24/2016	1521.2	3/4/2021	-53.6	-10.7	x
ER0332 1998-2017	682	1757.1	3/24/1998	1695.9	3/27/2017	-61.2	-3.2	
ER0332 2019-2021	682	1737.5	3/12/2020	1732.9	3/5/2021	-4.6	-2.3	
ER0398	300	2151.0	3/13/1983	2139.5	3/2/2021	-11.5	-0.3	x
ER0426 2004-2016	320	2221.7	3/29/2004	2218.3	4/14/2016	-3.4	-0.3	
ER0426 2019-2021	320	2249.3	4/11/2019	2240.0	3/5/2021	-9.3	-4.7	x
ER0441 1999-2015	360	2295.9	3/25/1999	2289.0	2/5/2015	-6.9	-0.4	
ER0441 2019-2021	360	2302.6	4/16/2019	2299.5	3/2/2021	-3.1	-0.1	
ER0445 1972-2002	450	2335.0	3/16/1972	2266.8	4/4/2002	-68.2	-2.3	
ER0445 2017-2021	450	2261.1	4/13/2017	2230.7	4/6/2021	-30.4	-7.6	x
ER0446 1974-1995	400	2348.0	2/19/1974	2328.8	3/24/1995	-19.2	-0.9	
ER0446 1995-2004	400	2328.8	3/24/1995	2139.1	3/25/2004	-189.7	-21.1	
ER0446 2019-2021	400	2343.2	4/24/2019	2322.2	4/6/2021	-21.0	-10.5	x
ER0450 1980-2017	610	2249.8	3/25/1980	2189.6	4/13/2017	-60.2	-1.6	
ER0450 2019-2021	610	2249.1	4/11/2019	2241.0	3/5/2021	-8.1	-4.0	x
ER0453	900	1959.3	3/29/1978	1833.8	3/5/2021	-125.5	-2.9	x
ER0454	635	1891.4	3/7/1984	1773.8	3/5/2021	-117.6	-3.2	x
ER0463 1978-1993	635	1641.0	3/29/1978	1594.7	4/8/1993	-46.3	-3.1	
ER0463 1998-2016	635	1789.5	3/25/1998	1687.8	4/14/2016	-101.7	-5.7	x

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)	Pumping Effects Apparent
ER0463 2018-2021	635	1693.6	4/26/2018	1682.0	3/5/2021	-11.6	-3.9	
ER0464	1653	1831.2	3/29/1978	1780.3	3/12/2021	-50.9	-1.2	x
ER0674	4525	1373.6	3/16/1973	1154.1	4/7/2021	-219.5	-4.7	
ER0688	750	1490.8	3/16/1973	1415.3	3/5/2021	-75.5	-1.5	
ER0706	352	2216.3	12/1/1983	2203.2	11/24/2020	-13.1	-0.4	x
ER0709	116	2292.2	4/27/2017	2282.6	4/20/2021	-9.6	-2.4	x
ER0782		2191.2	4/3/2018	2182.3	4/20/2021	-8.9	-2.2	x
Fisher Rd Old		1327.8	6/26/2018	1333.0	4/26/2021	5.2	1.7	
Harrington #1	300	2123.0	4/26/2019	2122.1	4/21/2021	-0.9	-0.5	x
IAN1991	168	1283.6	4/11/2013	1275.4	3/3/2021	-8.2	-1.0	x
Irby Rd Irre	500	1301.9	3/11/2011	1297.4	3/9/2020	-4.5	-0.5	
Kagele Rd 24 Irr	650	1257.8	4/17/2019	1254.3	4/7/2021	-3.5	-1.8	x
Kagele Rd 36 Irr		1207.7	4/17/2019	1199.6	3/4/2021	-8.1	-4.1	x
Lake Rd Dom	270	2055.5	10/26/2018	2055.5	11/19/2020	0.0	0.0	
NEL1968 2010-2015	240	1509.8	3/16/2010	1501.2	4/30/2015	-8.6	-1.7	
NEL1968 2019-2021	240	1545.8	4/18/2019	1527.1	4/29/2021	-18.7	-9.4	
ROY1991	178	1288.8	4/22/2010	1278.2	4/28/2021	-10.6	-1.1	x
SCH1992 2010-2015	125	2498.7	6/10/2010	2491.4	6/8/2015	-7.3	-1.5	
SCH1992 2019-2021	125	2505.5	4/30/2019	2497.6	4/26/2021	-7.9	-4.0	
Schlimmer Rd Irr	1200	1293.9	3/5/2012	1278.3	3/5/2021	-15.6	-1.7	x
Sprague #4	500	1882.1	4/13/2011	1891.5	11/19/2020	9.4	1.0	
STI1987	78	2416.7	4/16/2019	2414.0	4/29/2021	-2.7	-1.3	x
Sunny Hills	150	1292.4	7/13/2018	1292.2	7/9/2020	-0.2	-0.1	
Wilbur #3	294	2160.2	2/3/2012	2083.4	4/21/2020	-76.8	-9.6	x

Notes:

amsl - feet above mean sea level

Table 2

Water Levels without Baseline Shifts

Groundwater Level Data Review

Lincoln County, Washington

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)
AAL726	284	2124.3	4/26/2019	2125.1	4/21/2021	0.8	0.4
AAN570	290	1874.7	4/30/2019	1868.7	4/15/2021	-6.0	-3.0
ABR561	375	2178.0	4/6/2011	2176.0	4/21/2021	-2.0	-0.2
ABR763	452	2360.5	4/20/2011	2371.5	4/26/2021	11.1	1.1
ABR822	300	2469.4	4/20/2011	2465.5	4/26/2021	-3.9	-0.4
ACC371		2161.8	4/26/2019	2162.1	4/21/2021	0.3	0.1
ACC372	105	2151.1	4/26/2019	2149.5	4/21/2021	-1.6	-0.8
AGG056	178	1950.6	4/24/2019	1949.0	4/21/2021	-1.6	-0.8
AHC420	300	1369.7	1/19/2010	1360.1	4/12/2021	-9.6	-1.0
AHJ464	397	1480.5	4/30/2019	1443.3	4/26/2021	-37.2	-18.6
AHP752	1615	1519.4	12/21/1967	1282.3	3/4/2021	-237.1	-4.5
AHP783	2430	1165.6	4/9/2019	1151.8	3/4/2021	-13.8	-6.9
AKO215	236	1326.7	4/23/2019	1321.7	4/12/2021	-5.0	-2.5
Almira #4	377	1715.2	11/8/2018	1709.5	10/15/2020	-5.7	-2.9
ALR010	350	2174.7	7/19/2018	2171.8	4/21/2021	-2.9	-1.4
APC865 2019-2021	404	1299.2	4/23/2019	1311.0	4/12/2021	11.8	5.9
APP832		2328.6	10/23/2019	2329.3	4/15/2021	0.7	0.4
APP839	300	2214.3	3/8/2010	2190.6	4/15/2021	-23.7	-2.2
APP847	100	2298.0	4/18/2019	2293.1	4/15/2021	-4.9	-2.5
APP852	260	2349.4	4/26/2019	2343.6	4/21/2021	-5.8	-2.9
APQ847	235	1273.9	4/22/2019	1272.7	4/30/2021	-1.2	-0.6
BAC848	205	2200.8	4/13/2011	2168.0	4/21/2021	-32.8	-3.3
BAS270		1919.1	11/2/2018	1919.3	11/19/2020	0.2	0.1
BHP252		1884.9	4/23/2019	1880.3	4/12/2021	-4.6	-0.7
BIO682	300	1614.4	4/30/2019	1614.7	4/26/2021	0.3	0.1
BIU506	140	1684.8	3/11/2017	1683.3	4/3/2021	-1.5	-0.3
BIU541	160	1927.7	4/24/2019	1926.7	4/21/2021	-1.0	-0.5
BIU542	120	1929.7	11/2/2018	1929.9	11/19/2020	0.2	0.1
BIX719	390	2064.6	4/18/2019	2061.0	4/15/2021	-3.6	-3.6
BLH934	396	1289.8	7/13/2018	1289.6	7/21/2020	-0.2	-0.1
BLH935	375	1290.3	7/13/2018	1290.9	7/21/2020	0.6	0.3
Creston North	766	2268.2	2/3/2012	2279.4	4/21/2020	11.2	1.4
Douglas Rd Irr		2209.3	3/28/2010	2210.6	4/12/2021	1.3	0.1
ERO274	722	1518.0	3/12/1969	1325.8	3/4/2021	-192.2	-3.7

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)
ER0398	300	2151.0	3/13/1983	2139.5	3/2/2021	-11.5	-0.3
ER0453	900	1959.3	3/29/1978	1833.8	3/5/2021	-125.5	-2.9
ER0454	635	1891.4	3/7/1984	1773.8	3/5/2021	-117.6	-3.2
ER0464	1653	1831.2	3/29/1978	1780.3	3/12/2021	-50.9	-1.2
ER0674	4525	1373.6	3/16/1973	1154.1	4/7/2021	-219.5	-4.7
ER0688	750	1490.8	3/16/1973	1415.3	3/5/2021	-75.5	-1.5
ER0706	352	2216.3	12/1/1983	2203.2	11/24/2020	-13.1	-0.4
ER0709	116	2292.2	4/27/2017	2282.6	4/20/2021	-9.6	-2.4
ER0782		2191.2	4/3/2018	2182.3	4/20/2021	-8.9	-2.2
Fisher Rd Old		1327.8	6/26/2018	1333.0	4/26/2021	5.2	1.7
Harrington #1	300	2123.0	4/26/2019	2122.1	4/21/2021	-0.9	-0.5
IAN1991	168	1283.6	4/11/2013	1275.4	3/3/2021	-8.2	-1.0
Irby Rd Irr	500	1301.9	3/11/2011	1297.4	3/9/2020	-4.5	-0.5
Kagele Rd 24 Irr	650	1257.8	4/17/2019	1254.3	4/7/2021	-3.5	-1.8
Kagele Rd 36 Irr		1207.7	4/17/2019	1199.6	3/4/2021	-8.1	-4.1
ROY1991	178	1288.8	4/22/2010	1278.2	4/28/2021	-10.6	-1.1
Schlimmer Rd Irr	1200	1293.9	3/5/2012	1278.3	3/5/2021	-15.6	-1.7
Sprague #4	500	1882.1	4/13/2011	1891.5	11/19/2020	9.4	1.0
STI1987	78	2416.7	4/16/2019	2414.0	4/29/2021	-2.7	-1.3
Sunny Hills	150	1292.4	7/13/2018	1292.2	7/9/2020	-0.2	-0.1
Wilbur #3	294	2160.2	2/3/2012	2083.4	4/21/2020	-76.8	-9.6

Notes:

amsl - above mean sea level

Table 3

Water Levels with Baseline Shifts

Groundwater Level Data Review

Lincoln County, Washington

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)
ACW391 2011-2015	80	2413.0	2/22/2011	2410.3	2/25/2015	-2.7	-0.7
ACW391 2019-2021	80	2418.2	4/16/2019	2415.8	4/29/2021	-2.4	-1.2
AFA197 2011-2015	180	2331.8	4/12/2011	2318.9	4/29/2015	-12.9	-3.2
AFA197 2019-2021	180	2342.6	4/24/2019	2326.9	4/26/2021	-15.7	-7.8
ALN853 2010-2015	680	1520.1	3/8/2010	1511.5	2/24/2015	-8.6	-1.7
ALN853 2019-2021	680	1521.7	4/1/2019	1518.9	4/15/2021	-2.8	-1.4
APC864 2011-2015	178	2338.6	3/24/2011	2332.5	4/30/2015	-6.1	-1.5
APC864 2019-2021	178	2342.6	4/18/2019	2336.7	4/29/2021	-5.9	-0.6
APC865 2010-2015	404	1300.6	3/9/2010	1260.0	3/11/2015	-40.6	-8.1
APC865 2019-2021	404	1299.2	4/23/2019	1311.0	4/12/2021	11.8	5.9
APQ806 2010-2015	420	1966.4	4/20/2010	1953.9	2/24/2015	-12.5	-2.5
APQ806 2019-2021	420	1972.9	4/18/2019	1970.9	4/15/2021	-2.0	-1.0
BAC970 2010-2015	242	2328.1	4/27/2010	2326.7	4/30/2015	-1.4	-0.3
BAC970 2019-2021	242	2337.0	4/18/2019	2334.7	4/29/2021	-2.3	-0.2
ER0266 2011-2017	200	1555.6	3/31/2011	1549.8	3/27/2017	-5.8	-1.0
ER0266 2018-2021	200	1523.1	4/26/2018	1510.5	3/4/2021	-12.6	-4.2
ER0269 1968-1984	595	1418.5	3/12/1968	1288.0	4/2/1984	-130.5	-8.2
ER0269 2012-2021	595	1319.2	2/15/2012	1278.2	4/7/2021	-41.0	-4.6
ABR564 1979-1989	660	1504.0	3/8/1979	1492.0	3/29/1989	-12.0	-1.2
ABR564 2012-2021	660	1476.2	2/15/2012	1441.4	4/7/2021	-34.8	-3.5
ER0276 1968-1995	737	1545.4	3/8/1968	1505.6	3/2/1995	-39.8	-1.5
ER0276 2016-2021	737	1574.8	3/24/2016	1521.2	3/4/2021	-53.6	-10.7

ER0332 1998-2017	682	1757.1	3/24/1998	1695.9	3/27/2017	-61.2	-3.2
ER0332 2019-2021	682	1737.5	3/12/2020	1732.9	3/5/2021	-4.6	-2.3
ER0426 2004-2016	320	2221.7	3/29/2004	2218.3	4/14/2016	-3.4	-0.3
ER0426 2019-2021	320	2249.3	4/11/2019	2240.0	3/5/2021	-9.3	-4.7
ER0441 1999-2015	360	2295.9	3/25/1999	2289.0	2/5/2015	-6.9	-0.4
ER0441 2019-2021	360	2302.6	4/16/2019	2299.5	3/2/2021	-3.1	-0.1
ER0445 1972-2002	450	2335.0	3/16/1972	2266.8	4/4/2002	-68.2	-2.3
ER0445 2017-2021	450	2261.1	4/13/2017	2230.7	4/6/2021	-30.4	-7.6
ER0446 1974-1995	400	2348.0	2/19/1974	2328.8	3/24/1995	-19.2	-0.9
ER0446 1995-2004	400	2328.8	3/24/1995	2139.1	3/25/2004	-189.7	-21.1
ER0446 2019-2021	400	2343.2	4/24/2019	2322.2	4/6/2021	-21.0	-10.5
ER0450 1980-2017	610	2249.8	3/25/1980	2189.6	4/13/2017	-60.2	-1.6
ER0450 2019-2021	610	2249.1	4/11/2019	2241.0	3/5/2021	-8.1	-4.0
ER0463 1978-1993	635	1641.0	3/29/1978	1594.7	4/8/1993	-46.3	-3.1
ER0463 1998-2016	635	1789.5	3/25/1998	1687.8	4/14/2016	-101.7	-5.7
ER0463 2018-2021	635	1693.6	4/26/2018	1682.0	3/5/2021	-11.6	-3.9
NEL1968 2010-2015	240	1509.8	3/16/2010	1501.2	4/30/2015	-8.6	-1.7
NEL1968 2019-2021	240	1545.8	4/18/2019	1527.1	4/29/2021	-18.7	-9.4
SCH1992 2010-2015	125	2498.7	6/10/2010	2491.4	6/8/2015	-7.3	-1.5
SCH1992 2019-2021	125	2505.5	4/30/2019	2497.6	4/26/2021	-7.9	-4.0

Notes:

amsl - above mean sea level

Table 4

2019 - 2021 Water Level Summary

Groundwater Level Data Summary

Lincoln County, Washington

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Weater Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate for 2 Years (feet/yr)
AAL726	284	2124.3	4/26/2019	2125.1	4/21/2021	0.8	0.4
AAN570	290	1874.7	4/30/2019	1868.7	4/15/2021	-6.0	-3.0
ACC371		2161.8	4/26/2019	2162.1	4/21/2021	0.3	0.1
ACC372	105	2151.1	4/26/2019	2149.5	4/21/2021	-1.6	-0.8
ACW391 2019-2021	80	2418.2	4/16/2019	2415.8	4/29/2021	-2.4	-1.2
AFA197 2019-2021	180	2342.6	4/24/2019	2326.9	4/26/2021	-15.7	-7.8
AGG056	178	1950.6	4/24/2019	1949.0	4/21/2021	-1.6	-0.8
AHJ464	397	1480.5	4/30/2019	1443.3	4/26/2021	-37.2	-18.6
AHP783	2430	1165.6	4/9/2019	1151.8	3/4/2021	-13.8	-6.9
AKO215	236	1326.7	4/23/2019	1321.7	4/12/2021	-5.0	-2.5
ALN853 2019-2021	680	1521.7	4/1/2019	1518.9	4/15/2021	-2.8	-1.4
APC864 2019-2021	178	2342.6	4/18/2019	2336.7	4/29/2021	-5.9	-3.0
APC865 2019-2021	404	1299.2	4/23/2019	1311.0	4/12/2021	11.8	5.9
APP832		2328.6	10/23/2019	2329.3	4/15/2021	0.7	0.4
APP847	100	2298.0	4/18/2019	2293.1	4/15/2021	-4.9	-2.5
APP852	260	2349.4	4/26/2019	2343.6	4/21/2021	-5.8	-2.9
APQ806 2019-2021	420	1972.9	4/18/2019	1970.9	4/15/2021	-2.0	-1.0
APQ847	235	1273.9	4/22/2019	1272.7	4/30/2021	-1.2	-0.6
BAC970 2019-2021	242	2337.0	4/18/2019	2334.7	4/29/2021	-2.3	-1.2
BHP252		1884.9	4/23/2019	1880.3	4/12/2021	-4.6	-2.3
BIO676		2119.0	5/31/2019	2116.2	4/28/2020	-2.8	-2.8
BIO682	300	1614.4	4/30/2019	1614.7	4/26/2021	0.3	0.1
BIU541	160	1927.7	4/24/2019	1926.7	4/21/2021	-1.0	-0.5
BIX719	390	2064.6	4/18/2019	2061.0	4/15/2021	-3.6	-3.6
Coffeepot Lk Dom		1838.1	4/17/2019	1837.6	4/16/2020	-0.5	-0.5
ERO426 2019-2021	320	2249.3	4/11/2019	2240.0	3/5/2021	-9.3	-4.7
ERO441 2019-2021	360	2302.6	4/16/2019	2299.5	3/2/2021	-3.1	-1.5
ERO446 2019-2021	400	2343.2	4/24/2019	2322.2	4/6/2021	-21.0	-10.5
ERO450 2019-2021	610	2249.1	4/11/2019	2241.0	3/5/2021	-8.1	-4.0
Harrington #1	300	2123.0	4/26/2019	2122.1	4/21/2021	-0.9	-0.5
Kagele Rd 24 Irr	650	1257.8	4/17/2019	1254.3	4/7/2021	-3.5	-1.8
Kagele Rd 36 Irr		1207.7	4/17/2019	1199.6	3/4/2021	-8.1	-4.1
NEL1968 2019-2021	240	1545.8	4/18/2019	1527.1	4/29/2021	-18.7	-9.4
SCH1992 2019-2021	125	2505.5	4/30/2019	2497.6	4/26/2021	-7.9	-4.0
STI1987	78	2416.7	4/16/2019	2414.0	4/29/2021	-2.7	-1.3

Notes:

amsl - above mean sea level

Table 5

Water Level Change by Well Depth

Groundwater Level Data Review

Lincoln County, Washington

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)
STI1987	78	2416.7	4/16/2019	2414.0	4/29/2021	-2.7	-1.3
ACW391 2011-2015	80	2413.0	2/22/2011	2410.3	2/25/2015	-2.7	-0.7
ACW391 2019-2021	80	2418.2	4/16/2019	2415.8	4/29/2021	-2.4	-1.2
APP847	100	2298.0	4/18/2019	2293.1	4/15/2021	-4.9	-2.5
ACC372	105	2151.1	4/26/2019	2149.5	4/21/2021	-1.6	-0.8
ERO709	116	2292.2	4/27/2017	2282.6	4/20/2021	-9.6	-2.4
APP846	120	2273.7	4/28/2020	2272.5	4/15/2021	-1.2	-1.2
BIU542	120	1929.7	11/2/2018	1929.9	11/19/2020	0.2	0.1
SCH1992 2010-2015	125	2498.7	6/10/2010	2491.4	6/8/2015	-7.3	-1.5
SCH1992 2019-2021	125	2505.5	4/30/2019	2497.6	4/26/2021	-7.9	-4.0
BIU506	140	1684.8	3/11/2017	1683.3	4/3/2021	-1.5	-0.3
Sunny Hills	150	1292.4	7/13/2018	1292.2	7/9/2020	-0.2	-0.1
BIU541	160	1927.7	4/24/2019	1926.7	4/21/2021	-1.0	-0.5
IAN1991	168	1283.6	4/11/2013	1275.4	3/3/2021	-8.2	-1.0
AGG056	178	1950.6	4/24/2019	1949.0	4/21/2021	-1.6	-0.8
APC864 2011-2015	178	2338.6	3/24/2011	2332.5	4/30/2015	-6.1	-1.5
APC864 2019-2021	178	2342.6	4/18/2019	2336.7	4/29/2021	-5.9	-3.0
ROY1991	178	1288.8	4/22/2010	1278.2	4/28/2021	-10.6	-1.1
AFA197 2011-2015	180	2331.8	4/12/2011	2318.9	4/29/2015	-12.9	-3.2
AFA197 2019-2021	180	2342.6	4/24/2019	2326.9	4/26/2021	-15.7	-7.8
ERO266 2011-2017	200	1555.6	3/31/2011	1549.8	3/27/2017	-5.8	-1.0
ERO266 2018-2021	200	1523.1	4/26/2018	1510.5	3/4/2021	-12.6	-4.2
BAC848	205	2200.8	4/13/2011	2168.0	4/21/2021	-32.8	-3.3
APQ847	235	1273.9	4/22/2019	1272.7	4/30/2021	-1.2	-0.6
AKO215	236	1326.7	4/23/2019	1321.7	4/12/2021	-5.0	-2.5
NEL1968 2010-2015	240	1509.8	3/16/2010	1501.2	4/30/2015	-8.6	-1.7
NEL1968 2019-2021	240	1545.8	4/18/2019	1527.1	4/29/2021	-18.7	-9.4
BAC970 2010-2015	242	2328.1	4/27/2010	2326.7	4/30/2015	-1.4	-0.3
BAC970 2019-2021	242	2337.0	4/18/2019	2334.7	4/29/2021	-2.3	-1.2
APP852	260	2349.4	4/26/2019	2343.6	4/21/2021	-5.8	-2.9
Lake Rd Dom	270	2055.5	10/26/2018	2055.5	11/19/2020	0.0	0.0
AAL726	284	2124.3	4/26/2019	2125.1	4/21/2021	0.8	0.4
AAN570	290	1874.7	4/30/2019	1868.7	4/15/2021	-6.0	-3.0
Wilbur #3	294	2160.2	2/3/2012	2083.4	4/21/2020	-76.8	-9.6
ABR822	300	2469.4	4/20/2011	2465.5	4/26/2021	-3.9	-0.4
AHC420	300	1369.7	1/19/2010	1360.1	4/12/2021	-9.6	-1.0
APP839	300	2214.3	3/8/2010	2190.6	4/15/2021	-23.7	-2.2
BIO682	300	1614.4	4/30/2019	1614.7	4/26/2021	0.3	0.1
ERO398	300	2151.0	3/13/1983	2139.5	3/2/2021	-11.5	-0.3
Harrington #1	300	2123.0	4/26/2019	2122.1	4/21/2021	-0.9	-0.5
ERO426 2004-2016	320	2221.7	3/29/2004	2218.3	4/14/2016	-3.4	-0.3
ERO426 2019-2021	320	2249.3	4/11/2019	2240.0	3/5/2021	-9.3	-4.7
ALR010	350	2174.7	7/19/2018	2171.8	4/21/2021	-2.9	-1.4
ERO706	352	2216.3	12/1/1983	2203.2	11/24/2020	-13.1	-0.4

Well ID	Well Depth (feet)	Initial Water Level (feet amsl)	Initial Water Level Date	Final Water Level (feet amsl)	Final Water Level Date	Water Level Change (feet)	Annual Change Rate (feet/year)
ERO441 1999-2015	360	2295.9	3/25/1999	2289.0	2/5/2015	-6.9	-0.4
ERO441 2019-2021	360	2302.6	4/16/2019	2299.5	3/2/2021	-3.1	-1.5
ABR561	375	2178.0	4/6/2011	2176.0	4/21/2021	-2.0	-0.2
BHL935	375	1290.3	7/13/2018	1290.9	7/21/2020	0.6	0.3
Almira #4	377	1715.2	11/8/2018	1709.5	10/15/2020	-5.7	-2.9
BIX719	390	2064.6	4/18/2019	2061.0	4/15/2021	-3.6	-3.6
BHL934	396	1289.8	7/13/2018	1289.6	7/21/2020	-0.2	-0.1
AHJ464	397	1480.5	4/30/2019	1443.3	4/26/2021	-37.2	-18.6
ERO446 1974-1995	400	2348.0	2/19/1974	2328.8	3/24/1995	-19.2	-0.9
ERO446 1995-2004	400	2328.8	3/24/1995	2139.1	3/25/2004	-189.7	-21.1
ERO446 2019-2021	400	2343.2	4/24/2019	2322.2	4/6/2021	-21.0	-10.5
APC865 2010-2015	404	1300.6	3/9/2010	1260.0	3/11/2015	-40.6	-8.1
APC865 2019-2021	404	1299.2	4/23/2019	1311.0	4/12/2021	11.8	5.9
APQ806 2010-2015	420	1966.4	4/20/2010	1953.9	2/24/2015	-12.5	-2.5
APQ806 2019-2021	420	1972.9	4/18/2019	1970.9	4/15/2021	-2.0	-1.0
ERO445 1972-2002	450	2335.0	3/16/1972	2266.8	4/4/2002	-68.2	-2.3
ERO445 2017-2021	450	2261.1	4/13/2017	2230.7	4/6/2021	-30.4	-7.6
ABR763	452	2360.5	4/20/2011	2371.5	4/26/2021	11.1	1.1
Irby Rd Irre	500	1301.9	3/11/2011	1297.4	3/9/2020	-4.5	-0.5
Sprague #4	500	1882.1	4/13/2011	1891.5	11/19/2020	9.4	1.0
ERO269 1968-1984	595	1418.5	3/12/1968	1288.0	4/2/1984	-130.5	-8.2
ERO269 2012-2021	595	1319.2	2/15/2012	1278.2	4/7/2021	-41.0	-4.6
ERO450 1980-2017	610	2249.8	3/25/1980	2189.6	4/13/2017	-60.2	-1.6
ERO450 2019-2021	610	2249.1	4/11/2019	2241.0	3/5/2021	-8.1	-4.0
ERO454	635	1891.4	3/7/1984	1773.8	3/5/2021	-117.6	-3.2
ERO463 1978-1993	635	1641.0	3/29/1978	1594.7	4/8/1993	-46.3	-3.1
ERO463 1998-2016	635	1789.5	3/25/1998	1687.8	4/14/2016	-101.7	-5.7
ERO463 2018-2021	635	1693.6	4/26/2018	1682.0	3/5/2021	-11.6	-3.9
Kagele Rd 24 Irr	650	1257.8	4/17/2019	1254.3	4/7/2021	-3.5	-1.8
ABR564 1979-1989	660	1504.0	3/8/1979	1492.0	3/29/1989	-12.0	-1.2
ABR564 2012-2021	660	1476.2	2/15/2012	1441.4	4/7/2021	-34.8	-3.9
ALN853 2010-2015	680	1520.1	3/8/2010	1511.5	2/24/2015	-8.6	-1.7
ALN853 2019-2021	680	1521.7	4/1/2019	1518.9	4/15/2021	-2.8	-1.4
ERO332 1998-2017	682	1757.1	3/24/1998	1695.9	3/27/2017	-61.2	-3.2
ERO332 2019-2021	682	1737.5	3/12/2020	1732.9	3/5/2021	-4.6	-2.3
ERO274	722	1518.0	3/12/1969	1325.8	3/4/2021	-192.2	-3.7
ERO276 1968-1995	737	1545.4	3/8/1968	1505.6	3/2/1995	-39.8	-1.5
ERO276 2016-2021	737	1574.8	3/24/2016	1521.2	3/4/2021	-53.6	-10.7
ERO688	750	1490.8	3/16/1973	1415.3	3/5/2021	-75.5	-1.5
Creston North	766	2268.2	2/3/2012	2279.4	4/21/2020	11.2	1.4
ERO453	900	1959.3	3/29/1978	1833.8	3/5/2021	-125.5	-2.9
Schlimmer Rd Irr	1200	1293.9	3/5/2012	1278.3	3/5/2021	-15.6	-1.7
AHP752	1615	1519.4	12/21/1967	1282.3	3/4/2021	-237.1	-4.5
ERO464	1653	1831.2	3/29/1978	1780.3	3/12/2021	-50.9	-1.2
AHP783	2430	1165.6	4/9/2019	1151.8	3/4/2021	-13.8	-6.9
ERO674	4525	1373.6	3/16/1973	1154.1	4/7/2021	-219.5	-4.7

Notes:

amsl - above mean sea level