Groundwater Application Review Summary Form

Application # G- 19427

GW Reviewer Darrick E. Boschmann Date Review Completed: 12/11/2024

Summary of GW Availability and Injury Review:

☒ Groundwater for the proposed use is either over appropriated, will not likely be available in the amounts requested without injury to prior water rights, OR will not likely be available within the capacity of the groundwater resource per Section B of the attached review form.

Summary of Potential for Substantial Interference Review:

☐ There is the potential for substantial interference per Section C of the attached review form.

Summary of Well Construction Assessment:

☒ The wells do not appear to meet current well construction standards per Section D of the attached review form. Route through Well Construction and Compliance Section.

This is only a summary. Documentation is attached and should be read thoroughly to understand the basis for determinations and for conditions that may be necessary for a permit (if one is issued).

WATER RESOURCES DEPARTMENT

MEMO **_12/11/2024_**

TO: **Application** G-**_19427_**

FROM: **GW:** **_Darrick E. Boschmann_**
(Reviewer's Name)

SUBJECT: Scenic Waterway Interference Evaluation

☐ **YES**
☒ **NO** The source of appropriation is hydraulically connected to a State Scenic Waterway or its tributaries

☐ **YES**
☒ **NO** Use the Scenic Waterway Condition (Condition 7J)

☐ Per ORS 390.835, the Groundwater Section is **able** to calculate ground water interference with surface water that contributes to a Scenic Waterway. The calculated interference is distributed below

☐ Per ORS 390.835, the Groundwater Section is **unable** to calculate ground water interference with surface water that contributes to a scenic waterway; **therefore, the Department is unable to find that there is a preponderance of evidence that the proposed use will measurably reduce the surface water flows necessary to maintain the free-flowing character of a scenic waterway**

DISTRIBUTION OF INTERFERENCE

Calculate the percentage of consumptive use by month and fill in the table below. If interference cannot be calculated, per criteria in 390.835, do not fill in the table but check the "unable" option above, thus informing Water Rights that the Department is *unable to make a Preponderance of Evidence finding.*

Exercise of this permit is calculated to reduce monthly flows in _[Enter]_ Scenic Waterway by the following amounts expressed as a proportion of the consumptive use by which surface water flow is reduced.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date 12/11/2024

FROM: Groundwater Section Darrick E. Boschmann
Reviewer's Name

SUBJECT: Application G- **19427** Supersedes review of N/A
Date of Review(s)

PUBLIC INTEREST PRESUMPTION; GROUNDWATER

OAR 690-310-130 (1) *The Department shall presume that a proposed groundwater use will ensure the preservation of the public welfare, safety and health as described in ORS 537.525.* Department staff review groundwater applications under OAR 690-310-140 to determine whether the presumption is established. OAR 690-310-140 allows the proposed use be modified or conditioned to meet the presumption criteria. **This review is based upon available information and agency policies in place at the time of evaluation**.

A. GENERAL INFORMATION: Applicant's Name: **Green Fields III LLC** County: **Harney**

A1. Applicant(s) seek(s) 1.74 cfs from 3 well(s) in the Malheur Lake Basin, Alvord Lake/Pueblo Valley subbasin

A2. Proposed use 104.2 acres primary irrigation Seasonality: March 15 to October 1

A3. Well and aquifer data **(attach and number logs for existing wells; mark proposed wells as such under logid)**:

POA Well	Logid	Applicant's Well #	Proposed Aquifer*	Proposed Rate(cfs)	Location (T/R-S QQ-Q)	Location, metes and bounds, e.g. 2250' N, 1200' E fr NW cor S 36
1	HARN 1803	SW-2	Basin fill	1.74	39.00S-35.00E-23-NW SW	2245 FEET NORTH AND 2420 FEET WEST FROM S1/4 CORNER, SECTION 23
2	HARN 1800	SW-3	Basin fill	1.74	39.00S-35.00E-22-SE SW	760 FEET NORTH AND 40 FEET WEST FROM S1/4 CORNER, SECTION 22
3	HARN 1802	TC-3	Basin fill	1.74	39.00S-35.00E-23-NW NE	1310 FEET SOUTH AND 80 FEET EAST FROM N1/4 CORNER, SECTION 23
4						

* Alluvium, CRB, Bedrock

POA Well	Well Depth (ft)	Seal Interval (ft)	Casing Intervals (ft)	Liner Intervals (ft)	Perforations Or Screens (ft)	Well Yield (gpm)	Drawdown (ft)	Test Type
1	448	0-20	0-448	None	165-448	1525	56	P
2	448	0-20	0-448	None	118-448	2470	88	P
3	296	0-20	0-296	None	None	2950	115	P
4								

POA Well	Land Surface Elevation at Well (ft amsl)	Depth of First Water (ft bls)	SWL (ft bls)	SWL Date	Reference Level (ft bls)	Reference Level Date
1	4135	48	40.00	2/3/1978		
2	4181	?	86.33	3/22/2017		
3	4110	25	18.16	3/22/2017		
4						

Use data from application for proposed wells.

A4. **Comments:**

The proposed wells are located in Pueblo Valley about 8 miles southeast of Fields.

The area immediately underlying the proposed wells is mapped as Qal (Quaternary alluvium – unconsolidated fluviatile gravel, sand, and silt; in places includes talus, fanglomerate, and slope wash), which is underlain by Tcs (conglomerate and sandstone) and Tts (tuffaceous sediments) (Rytuba and others, 1982). At the existing depths the wells will likely develop groundwater from the Quaternary valley filling alluvium.

The proposed wells are currently authorized under certificate 97614. Additionally, proposed well HARN 1800 is also authorized under certificate 64436.

A5. ☐ **Provisions of the** Malheur Lake Basin rules relative to the development, classification and/or management of groundwater hydraulically connected to surface water ☐ **are**, *or* ☒ **are not**, activated by this application. (Not all basin rules contain such provisions.)
Comments: _____

A6. ☐ **Well(s) #** _____ , _____ , _____ , _____ , _____ , tap(s) an aquifer limited by an administrative restriction.
Name of administrative area: _____
Comments: Currently no administrative area.

B. GROUNDWATER AVAILABILITY CONSIDERATIONS, OAR 690-310-130, 400-010, 410-0070

B1. **Based upon available data**, I have determined that groundwater* for the proposed use:

a. ☐ **is** over appropriated, ☒ **is not** over appropriated, *or* ☐ **cannot be determined to be** over appropriated during any period of the proposed use. * This finding is limited to the groundwater portion of the over-appropriation determination as prescribed in OAR 690-310-130;

b. ☐ **will not** *or* ☒ **will** likely be available in the amounts requested without injury to prior water rights. * This finding is limited to the groundwater portion of the injury determination as prescribed in OAR 690-310-130;

c. ☒ **will not** *or* ☐ **will** likely to be available within the capacity of the groundwater resource; or

d. ☐ **will, if properly conditioned**, avoid injury to existing groundwater rights or to the groundwater resource:

i. ☐ The permit should contain condition #(s) _____;

ii. ☐ The permit should be conditioned as indicated in item 2 below.

iii. ☐ The permit should contain special condition(s) as indicated in item 3 below;

B2. a. ☐ **Condition** to allow groundwater production from no deeper than _____ ft. below land surface;

b. ☐ **Condition** to allow groundwater production from no shallower than _____ ft. below land surface;

c. ☐ **Condition** to allow groundwater production only from the _____ groundwater reservoir between approximately _____ ft. and _____ ft. below land surface;

d. ☐ **Well reconstruction** is necessary to accomplish one or more of the above conditions. The problems that are likely to occur with this use and without reconstructing are cited below. Without reconstruction, I recommend withholding issuance of the permit until evidence of well reconstruction is filed with the Department and approved by the Groundwater Section.

Describe injury –as related to water availability– that is likely to occur without well reconstruction (interference w/ senior water rights, not within the capacity of the resource, etc): _____

B3. **Groundwater availability remarks:** _____

The available water level record does not meet the Division 8 definition of excessively declining or declined excessively (for the *storage* portion of the source of water to wells).

If this application is approved it would likely result in an increase in interference with existing water rights, however any increase in interference with existing wells will not meet the standard for substantial or undue interference given the thickness of the aquifer system in Pueblo Valley.

The nearest current State Observation Well HARN 1806 (SOW 198) is located about 2 miles southeast of the proposed wells. The hydrograph for HARN 1806 shows approximately 8-10 feet of overall decline since the late 1960s.

Wells in this project area including the wells under this application have limited water level data with which to evaluate groundwater level trends. Application G-18918 provides 3/2017 water levels for four wells. The only other water level data available is from the 1978-1979 drillers wells logs, and three measurements for HARN 1798. Overall, these records suggest fairly stable to slightly declining water levels in this project area, however these limited records and reliance on drillers' measurements are limiting for this analysis.

Approximately three miles to the northwest, HARN 52803 has been equipped with a static water level data logger since 2019 and recorded approximately 2 feet per year of decline from 2020 to 2022. Over the significantly wetter seasons of 2023 and 2024 water level trends in this well were relatively stable.

Elsewhere in the Pueblo Valley, including further south on the Nevada side of the border, water level records from the Nevada Division of Water Resources (NDWR) associated with areas of groundwater development indicate water level declines over the available period of record. While these records may not be representative of groundwater conditions in the immediate vicinity of the proposed groundwater development, they may be indicative of the effect of groundwater development within the Pueblo Valley.

The proposed project area has similar climate and underlying geology as other areas within the Pueblo Valley that are experiencing water level declines in response to groundwater development. Issuance of a permit for groundwater withdrawals at the rate and duty proposed here will likely contribute to these water level declines and could impair the function of the aquifer by precluding its perpetual use. Therefore, the proposed use is found to be not within the capacity of the resource as defined in OAR 690-400-0010.

If a permit is issued the following conditions are recommended:

7N: Annual Measurement and Decline Condition

7P: Well Tag Condition

7T: Dedicated Measuring Tube Condition for all POA wells

Flow meter condition: Use the water rights "large" permit condition requiring a totalizing flow meter and reporting

Special Permit Condition:

The permittee shall construct one (1) minimum six-inch diameter observation well to penetrate the same aquifer as the production wells. The well shall meet the Department's minimum well construction standards and shall be drilled, cased and sealed to the same depth as the production wells. The well shall be constructed at a location approved by the Department for the purpose of instrumentation with continuous water-level monitoring equipment. The landowner, permittee, or agent shall consult with the Department on the details of well construction and well location prior to construction of the well. The landowner or permittee shall provide access to Department staff to install and maintain the monitoring equipment. The well shall not be used for any other purpose while the Department is monitoring water levels. The well shall be completed prior to water use under the terms of any permit issued. Water level data collected by the Department from the observation well will be used in addition to water level data collected under condition 7N for any evaluation of water level decline or interference.

C. GROUNDWATER/SURFACE WATER CONSIDERATIONS, OAR 690-09-040

C1. **690-09-040 (1):** Evaluation of aquifer confinement:

Well	Aquifer or Proposed Aquifer	Confined	Unconfined
1	**Basin fill**	☐	☒
2	**Basin fill**	☐	☒
3	**Basin fill**	☐	☒
		☐	☐

Basis for aquifer confinement evaluation:

The unconsolidated alluvial material (Qal) is unconfined. The deeper valley fill may become semi-confined at depth.

C2. **690-09-040 (2) (3):** Evaluation of distance to, and hydraulic connection with, surface water sources. All wells located a horizontal distance less than ¼ mile from a surface water source that produce water from an unconfined aquifer shall be assumed to be hydraulically connected to the surface water source. Include in this table any streams located beyond one mile that are evaluated for PSI.

Well	SW #	Surface Water Name	GW Elev ft msl	SW Elev ft msl	Distance (ft)	Hydraulically Connected? YES	NO	ASSUMED	Potential for Subst. Interfer. Assumed? YES	NO
1	**1**	**Little Cottonwood Creek**	**~4090**	**4225**	**2700**	☒	☐	☐	☐	☒
2	**1**	**Little Cottonwood Creek**	**~4090**	**4225**	**6000**	☒	☐	☐	☐	☒
3	**1**	**Little Cottonwood Creek**	**~4090**	**4225**	**8900**	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation:

Perennial reaches of streams in this setting generally infiltrate into the alluvial valley fill material along the valley margins, below which the streams are intermittent/seasonal, only flowing during spring high-flow runoff events. Groundwater down-gradient of these perennial reaches generally does not provide base flow to these streams, however, where groundwater is hydraulically connected, pumping in proximity to these perennial losing reaches can induce streamflow depletion by increasing the hydraulic gradient between the stream and the groundwater system. The point at which these creeks are hydraulically connected with groundwater is likely variable seasonally and from year to year. The lowermost point of the perennial reach as depicted on the NHD was used to calculate the distances listed above.

Water Availability Basin the well(s) are located within: No WAB data available.

C3a. **690-09-040 (4):** Evaluation of stream impacts for each well that has been determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water (SW) source. Limit evaluation to instream rights and minimum stream flows that are pertinent to that SW source, not lower SW sources to which the stream under evaluation is tributary. Compare the requested rate against the 1% of 80% *natural* flow for the pertinent Water Availability Basin (WAB). If Q is not distributed by well, use full rate for each well. Any checked ☒ box indicates the well is assumed to have the potential to cause PSI.

Well	SW #	Well < ¼ mile?	Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
1	**1**	☐	☐	**N/A**	**N/A**	☐	**N/A**	☐	**0.19**	☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

C3b. **690-09-040 (4):** Evaluation of stream impacts by total appropriation for all wells determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. **Complete only if Q is distributed among wells**. Otherwise same evaluation and limitations apply as in C3a above.

	SW #		Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
			☐			☐		☐		☐
			☐			☐		☐		☐

Comments:

C3a.
There are no instream water rights in this part of Pueblo Valley.

There is no WAB data available for evaluation against 80% natural flow.

Hunt (2003) was used to calculate the interference between the proposed wells within a mile of hydraulically connected surface water. Very little data is available about aquifer parameters at this location. The values used for the calculation are conservative and appropriate until better values become available. The calculations used the average transmissivity derived from pump tests on area wells (see report attached) (6,285 ft2/day). Additionally, the calculation used an assumed intermediate storage coefficient (0.001). The pumping rate used is the maximum rate proposed for the application (1.74 cfs). Interference is much less than 25% at 30 days. See reports attached.

C3b.
No distributed rate requested.

C4a. **690-09-040 (5):** Estimated impacts on **hydraulically connected surface water sources greater than one mile** as a percentage of the proposed pumping rate. Limit evaluation to the effects that will occur up to one year after pumping begins. This table encompasses the considerations required by 09-040 (5)(a), (b), (c) and (d), which are not included on this form. Use additional sheets if calculated flows from more than one WAB are required.

Non-Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
(A) = Total Interf.													
(B) = 80 % Nat. Q													
(C) = 1 % Nat. Q													
(D) = (A) > (C)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(E) = (A / B) x 100		%	%	%	%	%	%	%	%	%	%	%	%

(A) = total interference as CFS; (B) = WAB calculated natural flow at 80% exceed. as CFS; (C) = 1% of calculated natural flow at 80% exceed. as CFS; (D) = highlight the checkmark for each month where (A) is greater than (C); (E) = total interference divided by 80% flow as percentage.

Basis for impact evaluation:

No analysis here as no PSI was found above in C3a.

C4b. **690-09-040 (5) (b) The potential to impair or detrimentally affect the public interest is to be determined by the Water Rights Section.**

C5. ☐ **If properly conditioned**, the surface water source(s) can be adequately protected from interference, and/or groundwater use under this permit can be regulated if it is found to substantially interfere with surface water:

i. ☐ The permit should contain condition #(s)_____;

ii. ☐ The permit should contain special condition(s) as indicated in "Remarks" below;

C6. **SW / GW Remarks and Conditions:**

C1. 690-09-040 (1)
It is determined that all proposed wells will produce water from an unconfined aquifer.

C2. 690-09-040 (2) (3)
It is determined that all proposed wells are hydraulically connected with Little Cottonwood Creek.

C3a. 690-09-040(4)
PSI is not assumed for any of the proposed wells.

C3b. 690-09-040(4)
This section does not apply

C4a. 690-09-040(5)
No analysis here as no PSI was found in C3a.

References Used:

Rytuba J.J., Vander Meulen, D.B., Vercoutere, T.L., Minor, S.A., Caress, M.E., Kriens, B.J.C., 1987. Reconnaissance geologic map of the Tum Tum Lake quadrangle, Harney County, Oregon. U.S. Geological Survey Open File Report OF-82-1127.

Hunt, B., 2003. Unsteady stream depletion when pumping from semiconfined aquifer. Journal of Hydrologic Engineering, 8(1), pp.12-19.

USGS National Hydrology Dataset

NDWR water level data.

OWRD water well reports, water level data, and/or hydrographs

Oregon Administrative Rules

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #:** **1; 2; 3** **Logid: HARN 1803; HARN 1800; HARN 1802**

D2. **THE WELL does not appear to meet current well construction standards based upon:**

a. ☒ review of the well log;

b. ☐ field inspection by _____;

c. ☐ report of CWRE _____;

d. ☒ other: (specify) **Findings in the IR for application G-18918**

D3. **THE WELL construction deficiency or other comment is described as follows:** The following findings are from the IR for application G-18918, which involved the wells proposed here.

~~SW1 (HARN 1799),~~ SW2 (HARN 1803, and SW3 (HARN 1800) – The well report indicates that the wells were constructed with a 16-inch diameter steel casing sealed with concrete in a 20-inch diameter bore hole. Concrete can only be used when the oversized drill hold is a minimum of eight inches larger in diameter than the well casing used in construction of the well. In addition, the well report also indicates that the 16-inch diameter, 0.25 gage steel casing extends from zero feet above ground surface to a depth of 448 feet below ground surface. To meet minimum well construction standards, the casing must extend a minimum of 1 foot above ground surface and the 16-inch diameter, 0.25 gage steel casing must not exceed a maximum depth of 250 feet below land surface. The annular seals and well casings on all three wells will need to be properly replaced.

TC3 (HARN 1802) – The well report indicates that the well was constructed with a 16-inch diameter steel casing sealed with concrete in a 20-inch diameter bore hole. Concrete can only be used when the oversized drill hold is a minimum of eight inches larger in diameter than

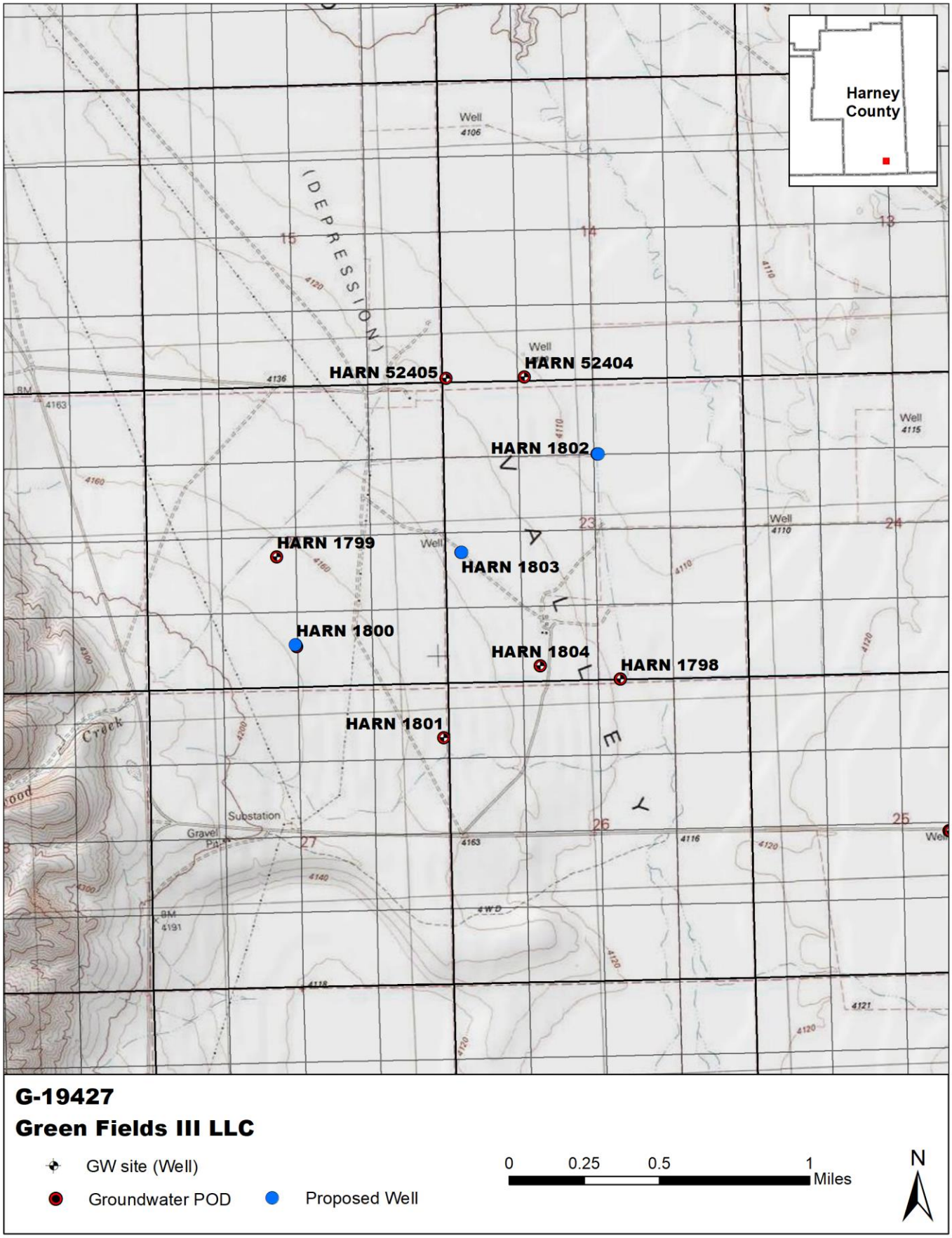
G-18918 Page 2 of 7 Initial Review

the well casing used in construction of the well. In addition, the well report also indicates that the 16-inch diameter, 0.25 gage steel casing extends from zero feet above ground surface to a depth of 296 feet below ground surface. To meet minimum well construction standards, the casing must extend a minimum of 1 foot above ground surface and the 16-inch diameter, 0.25 gage steel casing must not exceed a maximum depth of 250 feet below land surface. The annular seal and well casing will need to be properly replaced.

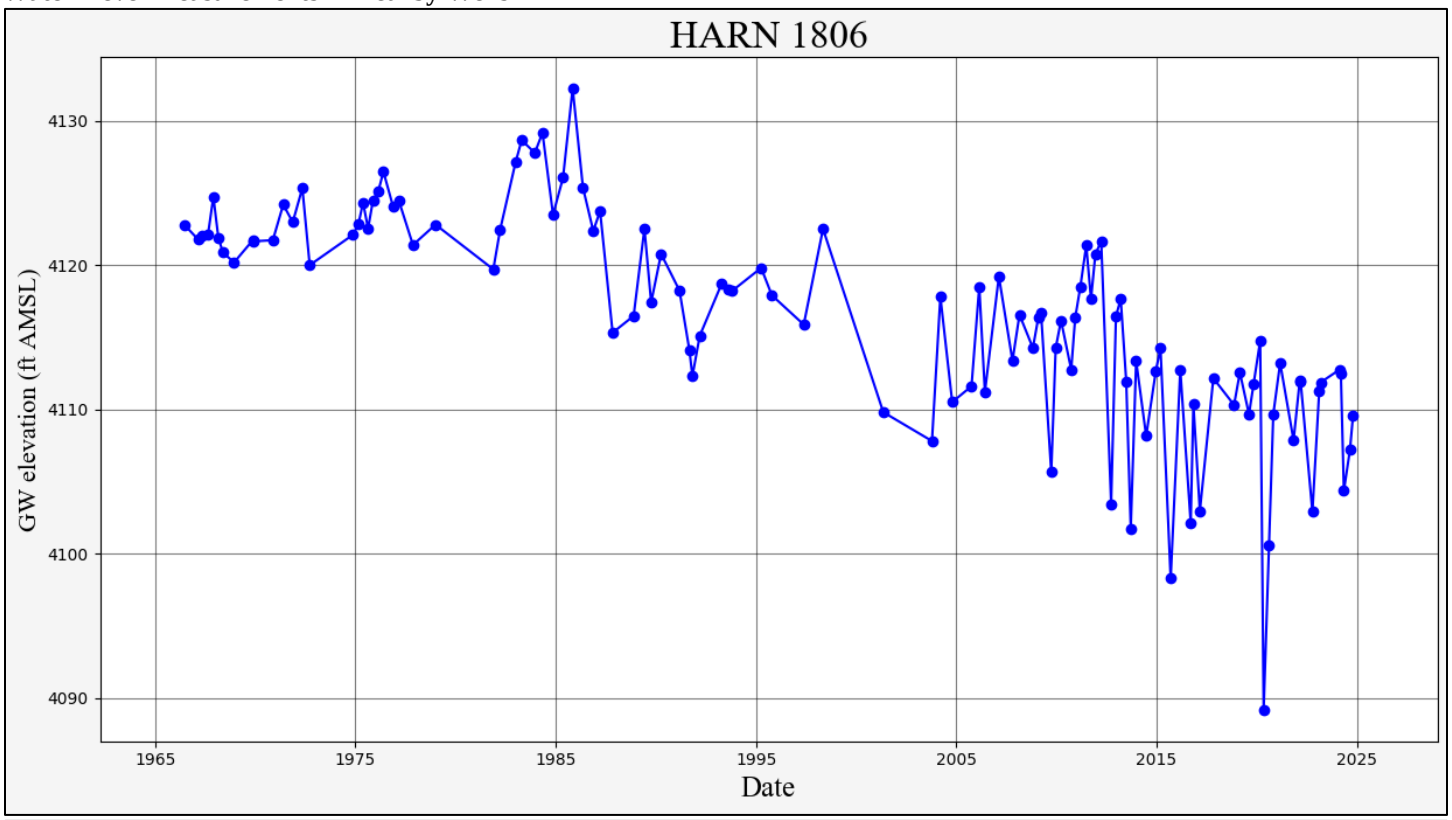
D4. ☐ **Route to the Well Construction and Compliance Section for a review of existing well construction.**

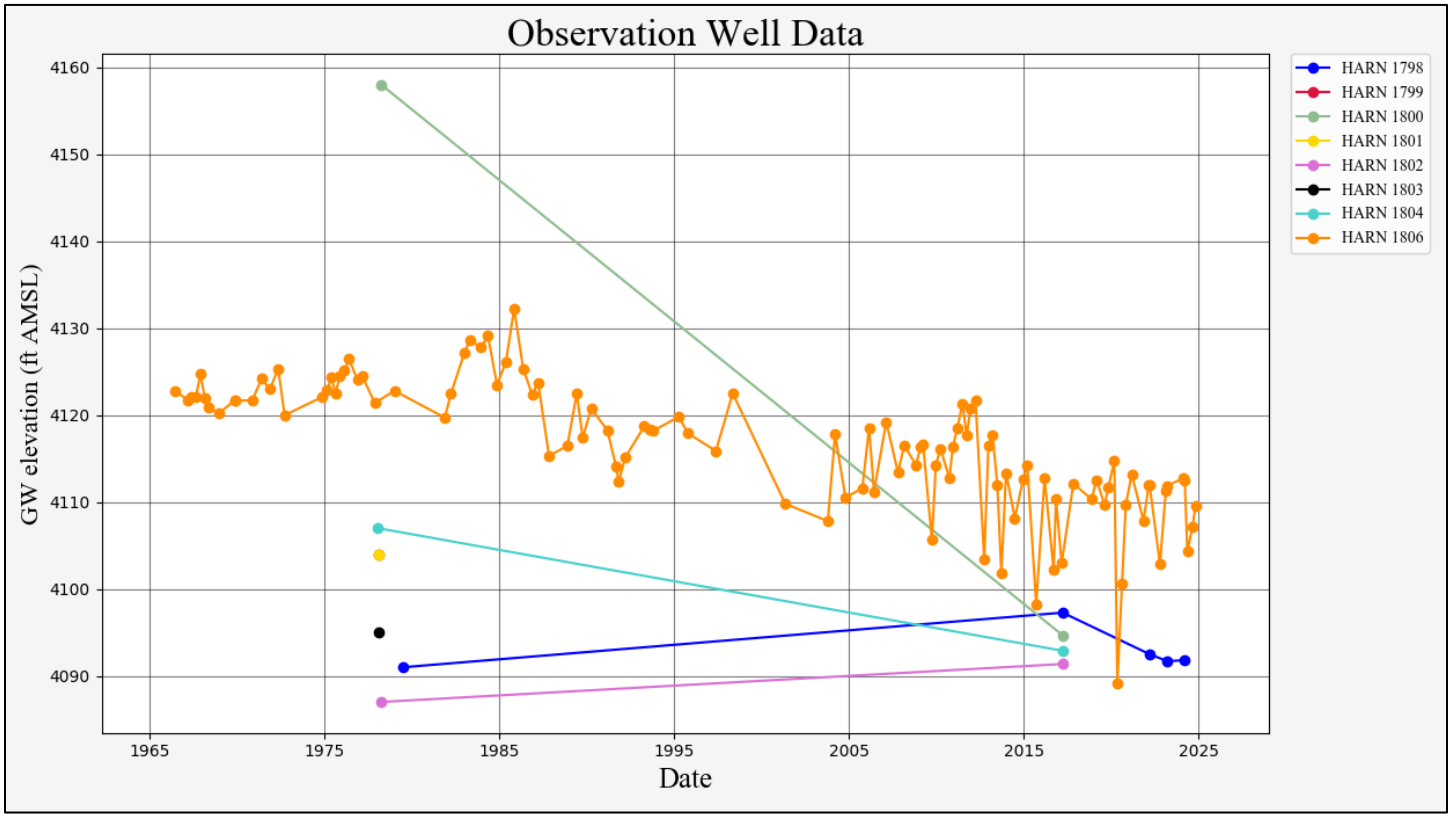
Water Availability Tables
No WAB data available.

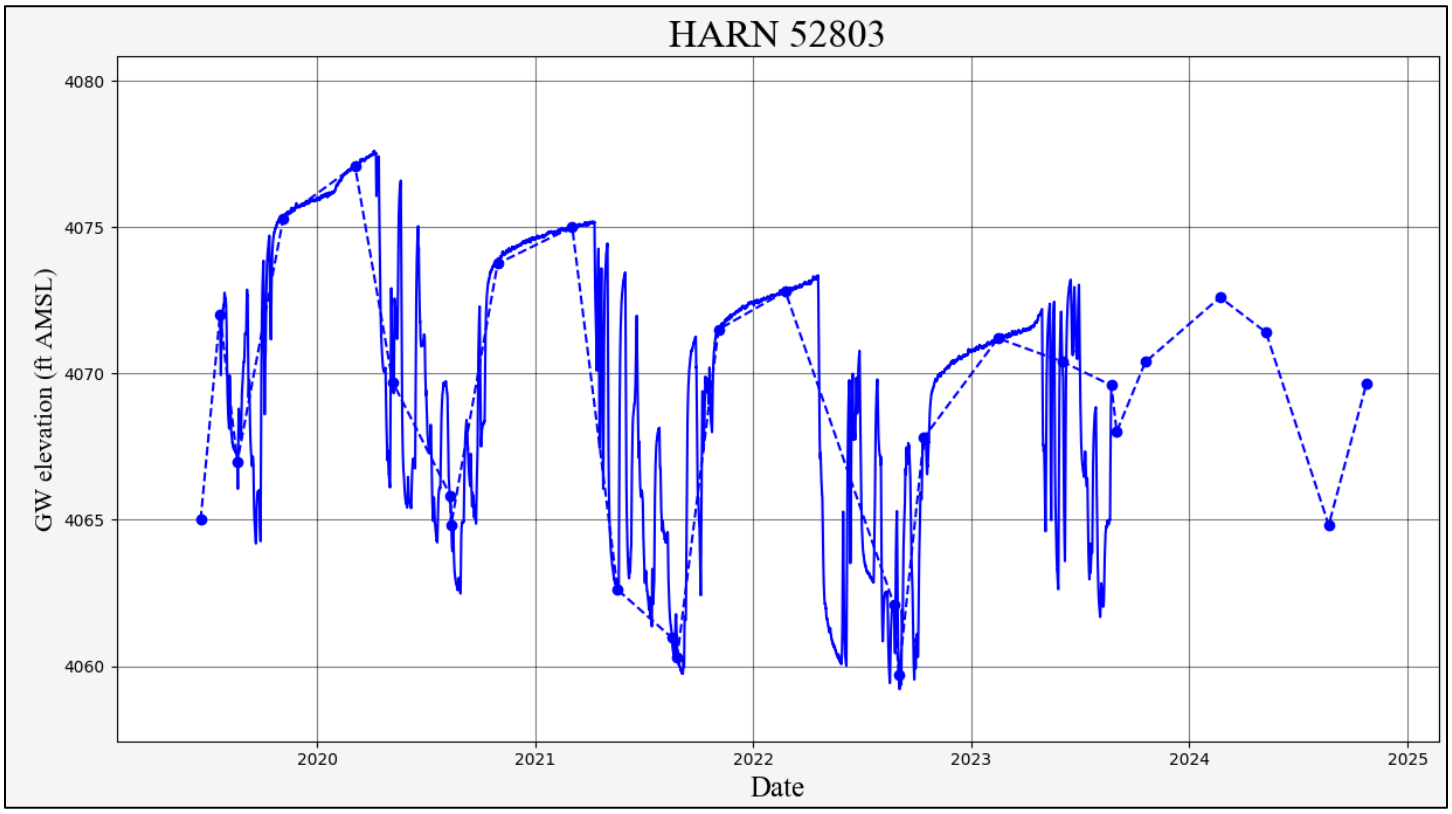
Well Location Map



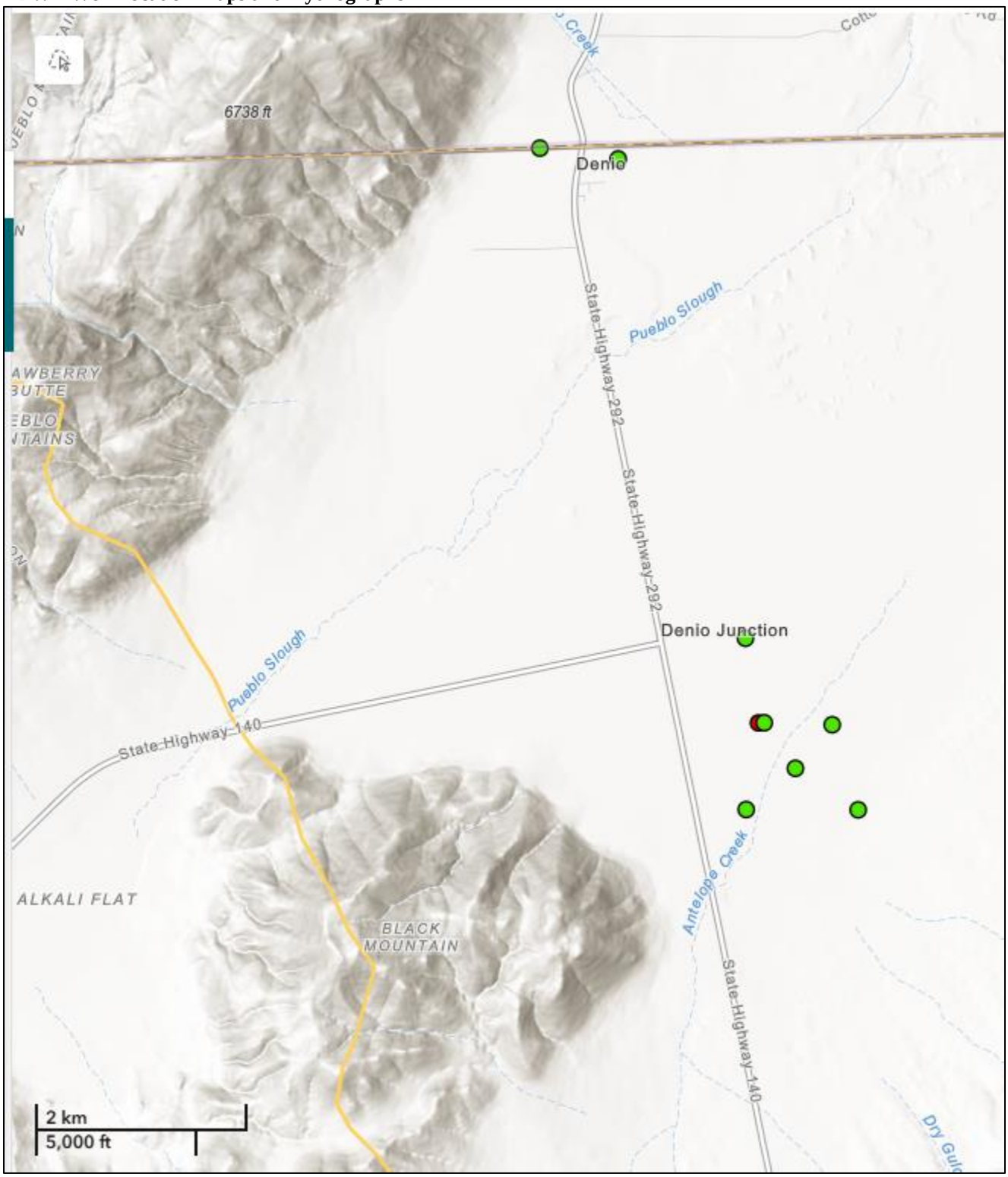
Water-Level Measurements in Nearby Wells



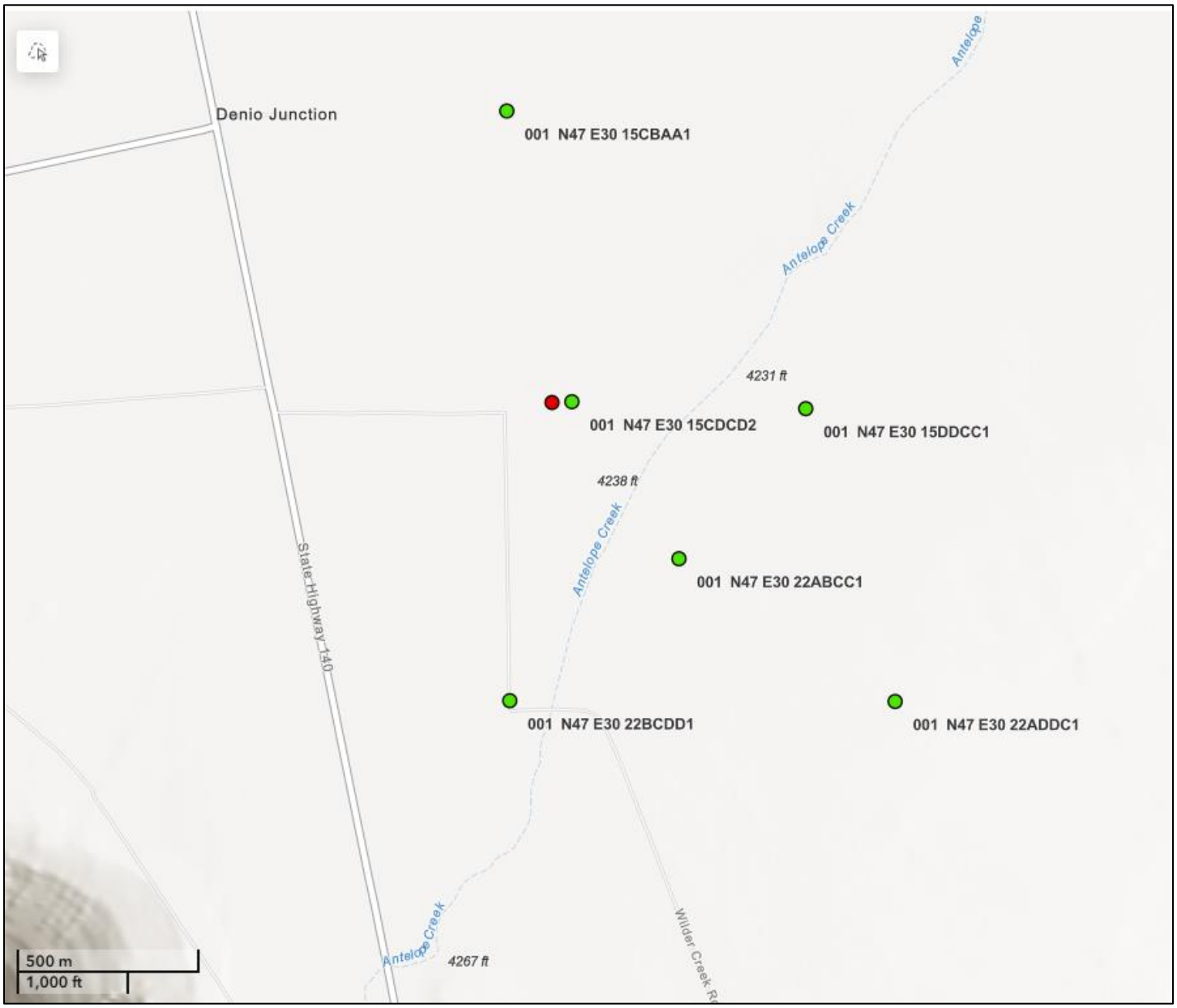


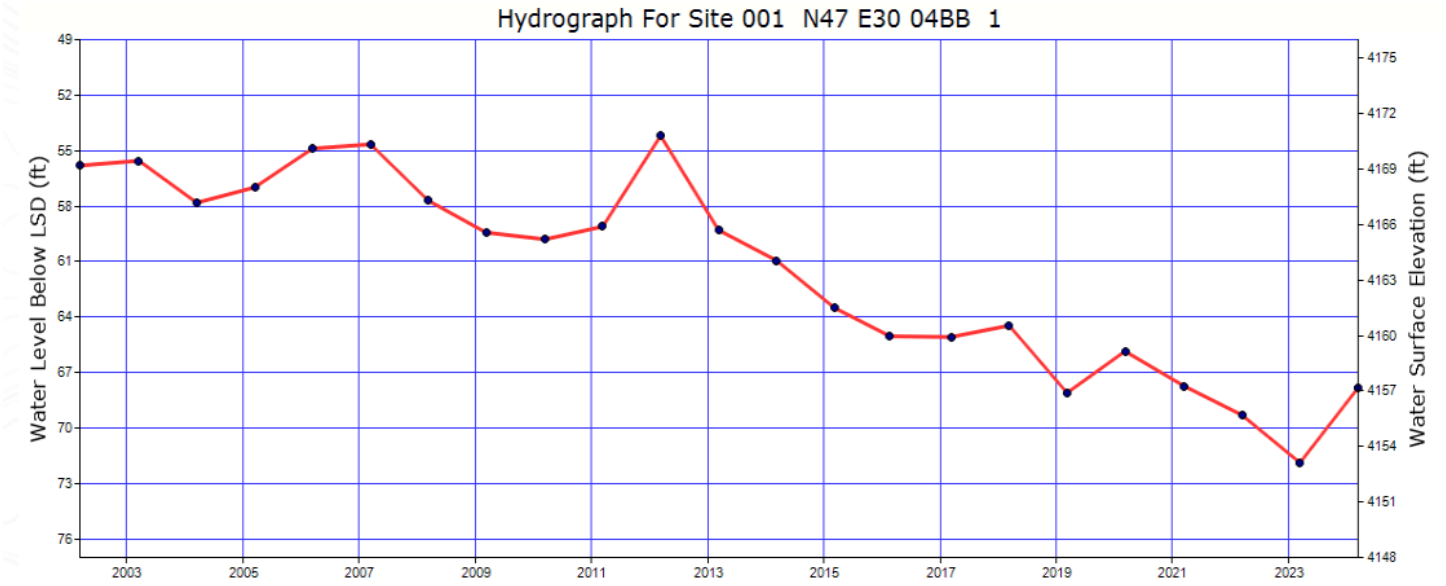

HARN 52803
GW elevation (ft AMSL)
4080
4075
4070
4065
4060
2020
2021
2022
2023
2024
2025
Date

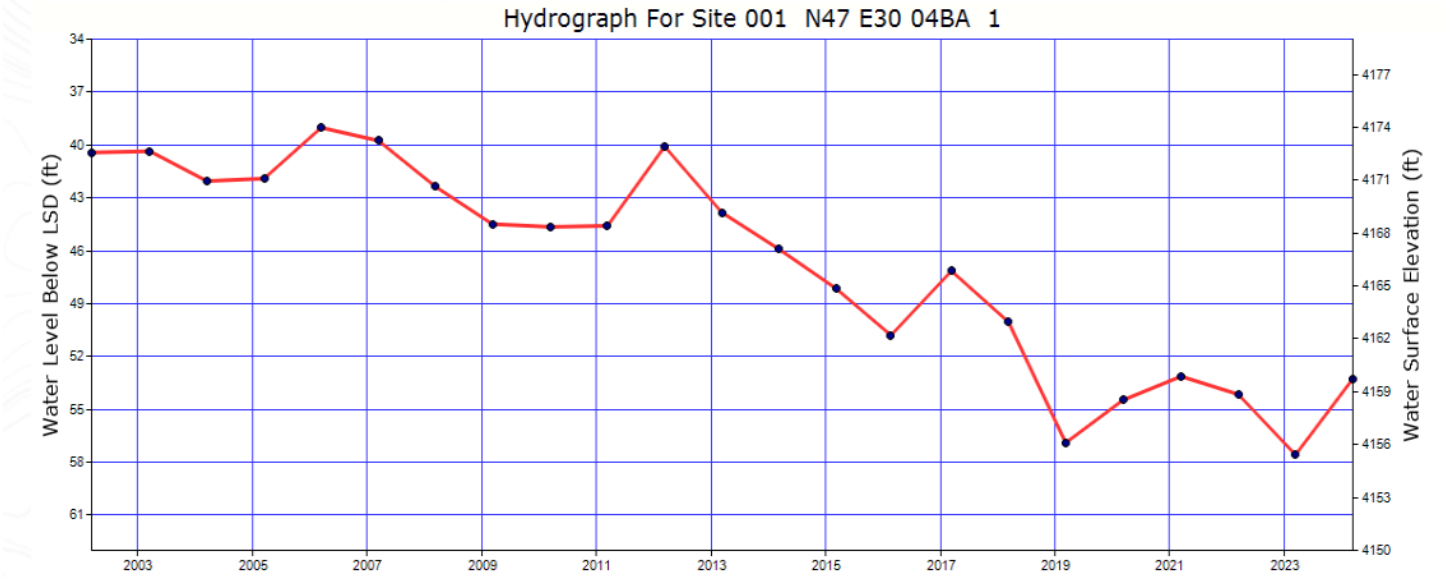
NDWR Well Location Maps and Hydrographs

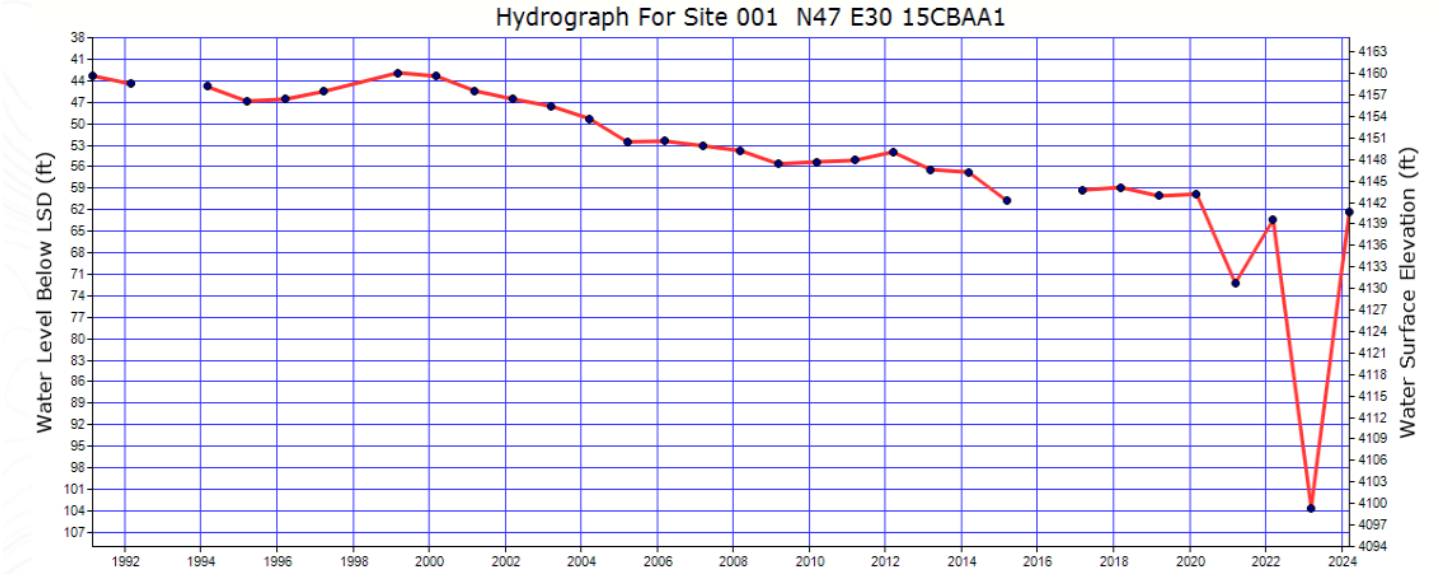


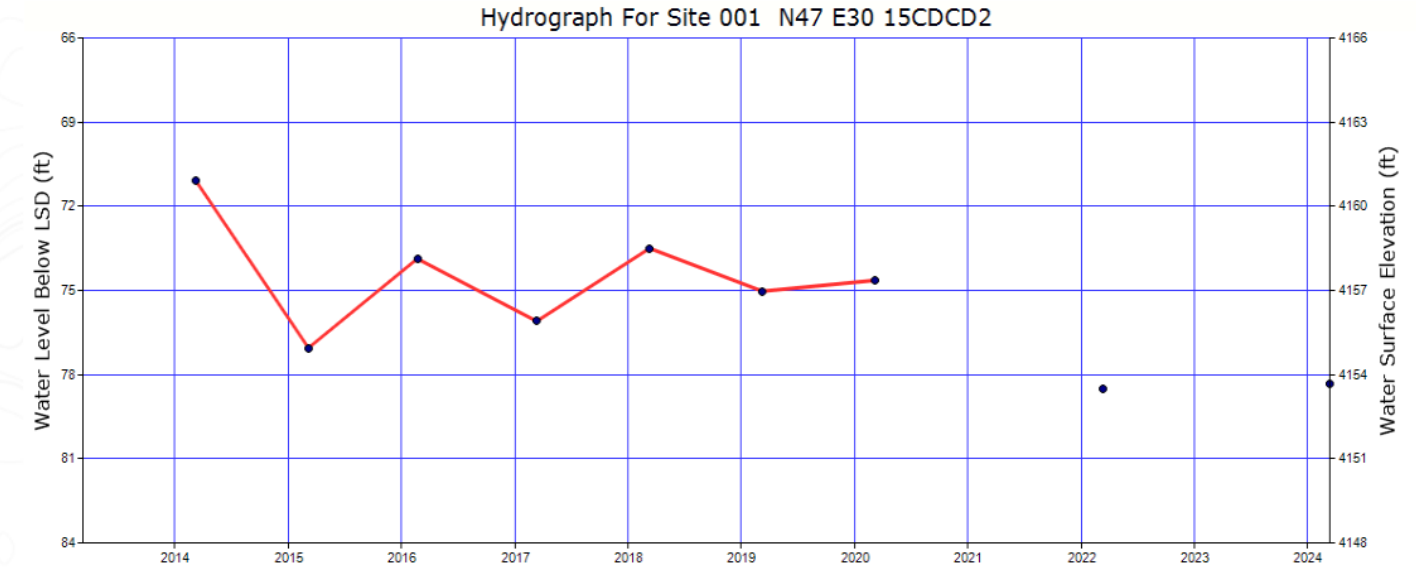

Fields-Den
Denio Creek
Cottonwood-Fields-Rd
Denio Creek
Fields-Denio-Rd
Denio Creek
4220 ft
Rodeo-Dr
001 N47 E30 04BB 1
001 N47 E30 04BA 1
Denio
4192 ft
Juniper-Dr
Hunters-Dr
Pueblo-Blvd
Rodeo-Dr
Tumbleweed Ln
Stephen Ln
500 m
1,000 ft
Sunset-Blvd

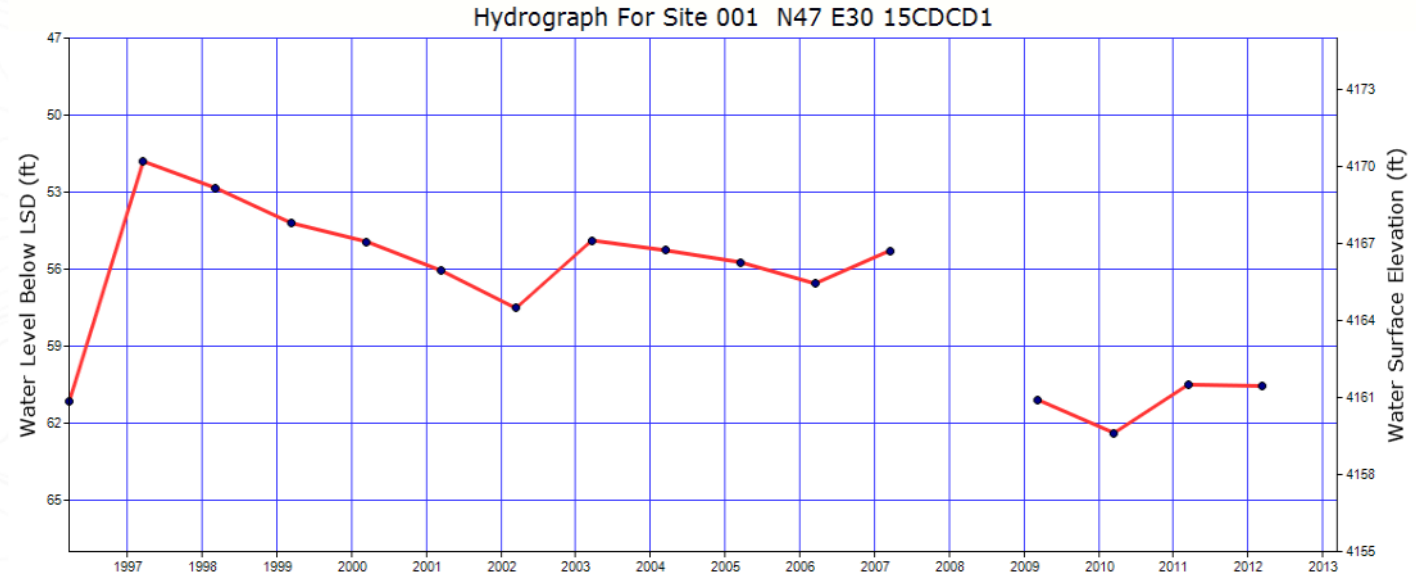

Denio Junction
001 N47 E30 15CBAA1
Antelope Creek
4231 ft
001 N47 E30 15CDCD2
001 N47 E30 15DDCC1
4238 ft
Antelope Creek
State Highway 140
001 N47 E30 22ABCC1
001 N47 E30 22BCDD1
001 N47 E30 22ADDC1
Antelope Creek
4267 ft
Wilder Creek
500 m
1,000 ft

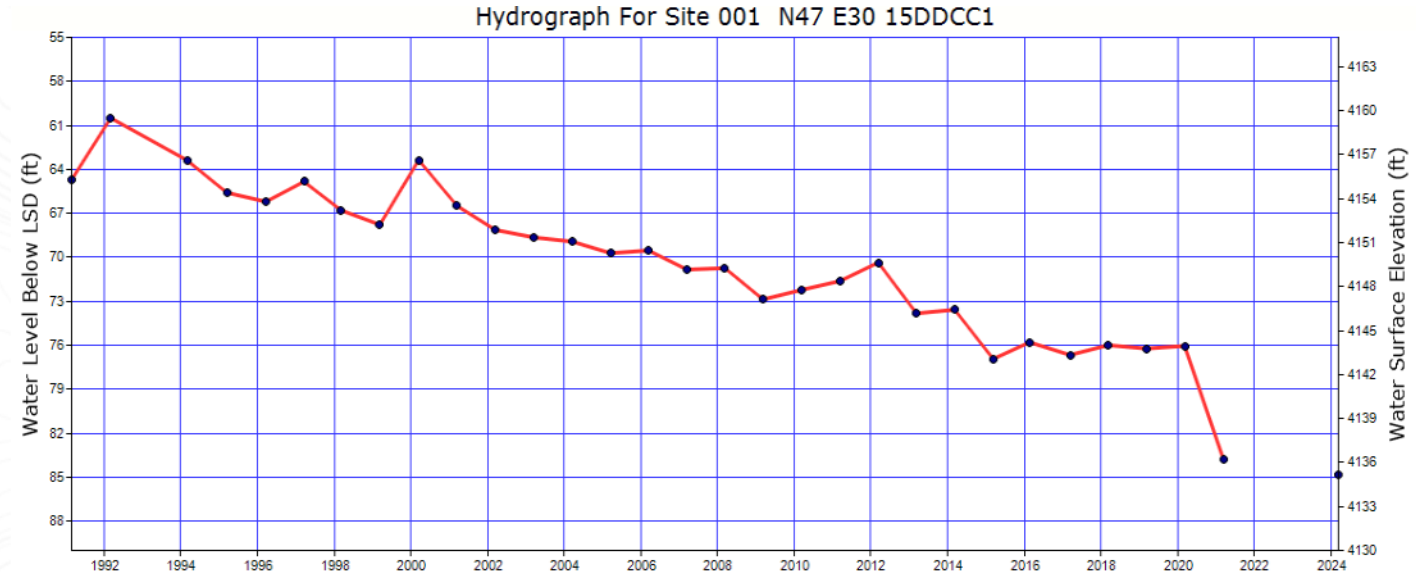

Hydrograph For Site 001 N47 E30 04BB 1
Water Level Below LSD (ft)
Water Surface Elevation (ft)
49
52
55
58
61
64
67
70
73
76
4175
4172
4169
4166
4163
4160
4157
4154
4151
4148
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023

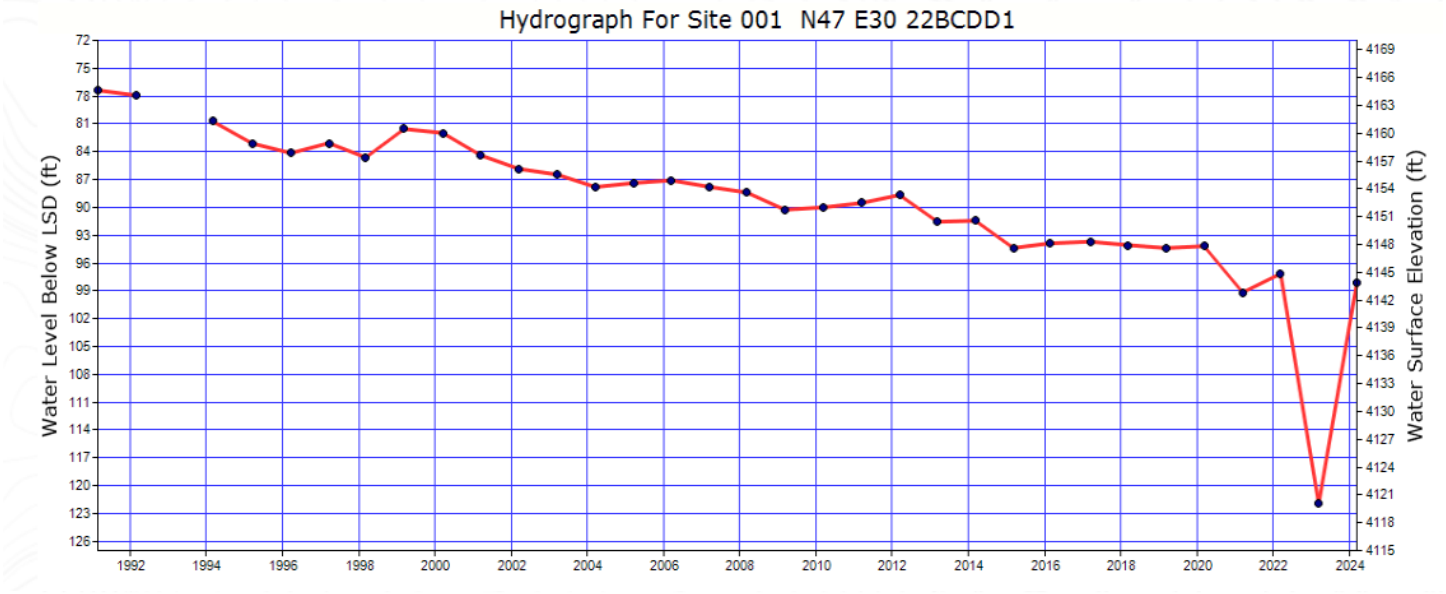

Hydrograph For Site 001 N47 E30 04BA 1
Water Level Below LSD (ft)
Water Surface Elevation (ft)
34
37
40
43
46
49
52
55
58
61
4177
4174
4171
4168
4165
4162
4159
4156
4153
4150
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023

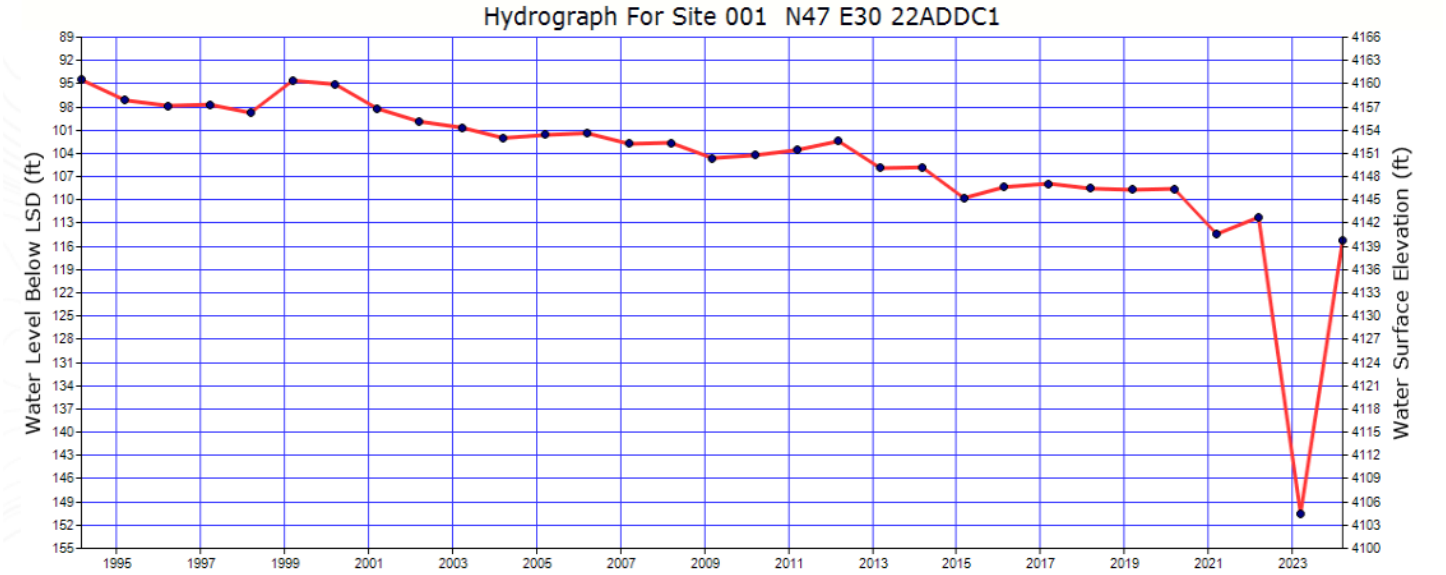

Hydrograph For Site 001 N47 E30 15CBAA1
Water Level Below LSD (ft)
Water Surface Elevation (ft)
38
41
44
47
50
53
56
59
62
65
68
71
74
77
80
83
86
89
92
95
98
101
104
107
4163
4160
4157
4154
4151
4148
4145
4142
4139
4136
4133
4130
4127
4124
4121
4118
4115
4112
4109
4106
4103
4100
4097
4094
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


Hydrograph For Site 001 N47 E30 15CDCD2
Water Level Below LSD (ft)
Water Surface Elevation (ft)
66
69
72
75
78
81
84
4166
4163
4160
4157
4154
4151
4148
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024


Hydrograph For Site 001 N47 E30 15CDCD1
Water Level Below LSD (ft)
Water Surface Elevation (ft)
47
50
53
56
59
62
65
4173
4170
4167
4164
4161
4158
4155
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013


Hydrograph For Site 001 N47 E30 15DDCC1
Water Level Below LSD (ft)
Water Surface Elevation (ft)
55
58
61
64
67
70
73
76
79
82
85
88
4163
4160
4157
4154
4151
4148
4145
4142
4139
4136
4133
4130
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


Hydrograph For Site 001 N47 E30 22BCDD1
Water Level Below LSD (ft)
Water Surface Elevation (ft)


Hydrograph For Site 001 N47 E30 22ADDC1
Water Level Below LSD (ft)
Water Surface Elevation (ft)

Stream Depletion (Hunt) Model Analysis

Transmissivity from Specific Capacity using the Theis Equation
(Adapted from Vorhis (1979))

Application: G-19427
Basin: Malheur lake

Theis Equation:
T = [Q/(4*s*pi)][W(u)]
u = (r*r*S)/(4*T*t)
W(u) = (-ln u)-(0.5772157)+(u/1*1!)-(u*u/2*2!)+(u*u*u/3*3!)-(u*u*u*u/4*4!)+...
T = transmissivity (L*L/T) s = drawdown (L) r = radial distance (L) S = storage coefficient (dimensionless) t = time (T) pi = 3.141592654 u = dimensionless
W(u) = well function

Note: Transmissivity is derived using an iterative process . The calculations use a known or assumed Storage Coeficient (S) provided by the user. Specific Capacity (Q/s) is used to first approximate the Transmissivity (T) used to calculate u in the first Theis equation iteration. The Transmissivity of the previous iteration is used to calculate u in a given Theis equation iteration. Total Theis Equation iterations = 25 iterations. Can accept answer if difference in calculated Transmissivity (T(diff)) for the last 2 iterations is < 0.0001. Can accept answer if u in the last iteration is < 7.1

Note: Well efficiency is not included in the calculations
Note: An intermediate storage coefficient of 0.001 is used in all calcuations.

References:

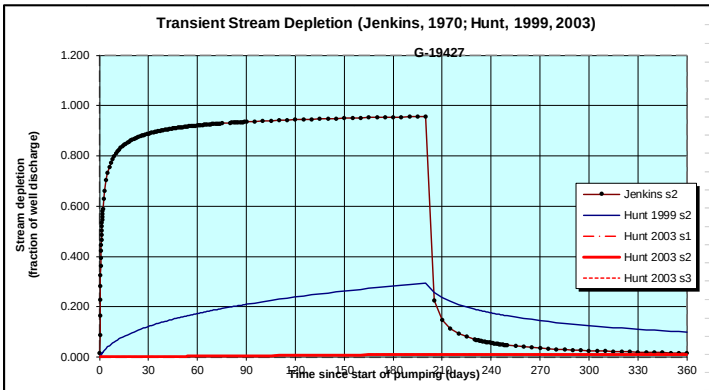
Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground water storage. American Geophysical Union Transactions, 16 annual meeting, vol. 16, pg. 519-524.
Vorhis, R.C. 1979. Transmissivity from pumped well data. Well Log, National Water Well Association newsletter, vol. 10, no. 11, Dec. 1979, pg. 50-52.

SPECIFIC CAPACITY CALCULATION

Well Log ID	Pumping Rate (Q) (gpm)	Drawdown (s) (ft)	Specific Capacity (gpm/ft)
HARN 1803	1525	56	27.2321
HARN 1800	2470	88	28.0682
HARN 1802	2950	115	25.6522
HARN 1798	1514	81	18.6914
HARN 1801	2700	100	27.0000
HARN 1804	2950	115	25.6522
		MIN:	18.69
		MAX:	28.07
		AVE:	25.38
		STDEV:	3.41

TRANSMISSIVITY/HYDRAULIC CONDUCTIVITY CALCULATION

Well Log ID	T/R-S Q-Q	Time (t) (hours)	Well Diameter (d) (inches)	T (diff)	u	Transmissivity (T) (ft2/day)	Transmissivity (T) (gpd/ft)
HARN 1803	0	22	16	0.0000E+00	1.68E-08	7228	54068
HARN 1800	0	8	16	0.0000E+00	4.76E-08	7001	52372
HARN 1802	0	4	16	0.0000E+00	1.10E-07	6070	45407
HARN 1798	0	6	16	0.0000E+00	9.99E-08	4450	33289
HARN 1801		3	16	0.0000E+00	1.41E-07	6284	47010
HARN 1804	0	17	16	0.0000E+00	2.35E-08	6676	49940
0	0						
0	0						
0	0						
					MIN:	4450	33289
					MAX:	7228	54068
					AVE:	6285	47015
					STDEV:	997	7456



Input data

yellow = required blue = recommended

Parameter	Scenario 1	Scenario 2	Scenario 3	Unit	Description
Plot Title		G-19427			Plot title
Qw		1.74		cfs	Net steady pumping rate of well
tpon		200		days	Time pump on (pumping duration)
a	2700	2700	2700	ft	Perpendicular distance from well to stream
d		448		ft	Well depth
K	12.57	12.57	12.57	ft/day	Aquifer hydraulic conductivity
b	500	500	500	ft	Aquifer saturated thickness
S	0.001	0.001	0.001		Aquifer storativity or specific yield
Kva	0.02	0.02	0.02	ft/day	Aquitard vertical hydraulic conductivity
ba	3	3	3	ft	Aquitard saturated thickness
babs	3	3	3	ft	Aquitard thickness below stream
n	0.2	0.2	0.2		Aquitard porosity
ws	20	20	20	ft	Stream width

Recalculate

Output for Stream Depletion, Scenerio 2 (s2):	Time pump on (pumping duration) = 200 days											
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	88.9%	92.2%	93.6%	94.5%	95.0%	95.5%	14.8%	5.7%	3.6%	2.6%	2.0%	1.6%
H SD 1999	12.2%	17.4%	21.0%	23.9%	26.3%	28.3%	23.7%	17.6%	14.5%	12.5%	11.1%	9.9%
H SD 2003	0.19%	0.34%	0.50%	0.66%	0.81%	0.97%	1.02%	1.03%	1.02%	1.01%	0.98%	0.96%
Qw, cfs	1.740	1.740	1.740	1.740	1.740	1.740	1.740	1.740	1.740	1.740	1.740	1.740
H SD 99, cfs	0.212	0.302	0.365	0.415	0.457	0.493	0.412	0.306	0.253	0.218	0.193	0.173
H SD 03, cfs	0.003	0.006	0.009	0.011	0.014	0.017	0.018	0.018	0.018	0.017	0.017	0.017

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	1.74	1.74	1.74	cfs
Time pump on (pumping duration)	tpon	200	200	200	days
Perpendicular from well to stream	a	2700	2700	2700	ft
Well depth	d	448	448	448	ft
Aquifer hydraulic conductivity	K	12.57	12.57	12.57	ft/day
Aquifer saturated thickness	b	500	500	500	ft
Aquifer transmissivity	T	6285	6285	6285	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	0.02	0.02	0.02	ft/day
Aquitard saturated thickness	ba	3	3	3	ft
Aquitard thickness below stream	babs	3	3	3	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	20	20	20	ft
Streambed conductance (lambda)	sbc	0.133333	0.133333	0.133333	ft/day
Stream depletion factor	sdf	1.159905	1.159905	1.159905	days
Streambed factor	sbf	0.057279	0.057279	0.057279	
input #1 for Hunt's Q_4 function	t'	0.862140	0.862140	0.862140	
input #2 for Hunt's Q_4 function	K'	7.732697	7.732697	7.732697	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.057279	0.057279	0.057279	

Parameter	Scenario 1	Scenario 2	Scenario 3	Units	
Qw	1.74	1.74	1.74	cfs	
T	6,285	6,285	6,285	ft*ft/day	= K*b
T	47,012	47,012	47,012	gpd/ft	= K*b
sbc	0.133333	0.133333	0.133333	ft/day	= Ks*ws/bs
sdf	1.159905	1.159905	1.159905	days	= (a^2*S)/(T)
sbf	0.057279	0.057279	0.057279		= sbc*a/T
t'	0.862140	0.862140	0.862140	1/days	= T/(a^2*S) input #1 for Hunt's Q_4 function
K'	7.732697	7.732697	7.732697		= (Ks/bs)*a^2/T input #2 for Hunt's Q_4 function
epsilon'	0.005000	0.005000	0.005000		= S/n input #3 for Hunt's Q_4 function
lamda'	0.057279	0.057279	0.057279		= sbc*a/T input #4 for Hunt's Q_4 function