Groundwater Application Review Summary Form

Application # G- _19225_

GW Reviewer _Andrew Wentworth/Travis Brown_ Date Review Completed: _12/20/2022_

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 well does 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 **_December 20, 2022_**

TO: **Application** G-**_19225_**

FROM: **GW:** **_Andrew Wentworth/Travis Brown_**
(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 12/20/2022
FROM: Groundwater Section Andrew Wentworth/Travis Brown
Reviewer's Name
SUBJECT: Application G- **19225** Supersedes review of
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: **Juan Ramon Zaragoza Roa and Paulina Maciel Salas**
County: **Marion**

A1. Applicant(s) seek(s) 0.22 cfs from 2 well(s) in the Willamette Basin, Molalla-Pudding subbasin

A2. Proposed use Irrigation (17.5 acres, 43.75 AF) Seasonality: March 1st – October 31st

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

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	PROP 263	2	Alluvium	0.22	6.00S-2.00W-15-NW SW	605' S, 565' E fr W1/4 cor,S 15
2	PROP 264	3	Alluvium	0.22	6.00S-2.00W-15-NW SW	960' S, 400' E fr W1/4 cor S 15

* Alluvium, CRB, Bedrock

Well	Well Elev ft msl	First Water ft bls	SWL ft bls	SWL Date	Well Depth (ft)	Seal Interval (ft)	Casing Intervals (ft)	Liner Intervals (ft)	Perforations Or Screens (ft)	Well Yield (gpm)	Draw Down (ft)	Test Type
1	170	NA	NA	NA	100	>18'	TBD	TBD	TBD	TBD	TBD	TBD
2	169	NA	NA	NA	100	>18'	TBD	TBD	TBD	TBD	TBD	TBD

Use data from application for proposed wells.

A4. **Comments:** The proposed wells are located approximately 1.4 miles east of Brooks and approximately 0.5 miles west of Lake Labish

A5. ☒ **Provisions of the** Willamette 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: 690-502-0240 classifies use from unconfined alluvial aquifers. This application proposes use from a confined portion of the Willamette aquifer, therefore the basin rules laid out in 690-502-0240 are not activated.

A6. ☐ **Well(s) #** _____ , _____ , _____ , _____ , _____ , tap(s) an aquifer limited by an administrative restriction.
Name of administrative area:
Comments:

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) **Medium water use reporting condition, 7c (7 years of measurements)**;

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 **alluvial** 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:** In this area the Willamette Aquifer is approximately 100 ft thick and overlain by approximately 60 feet of Willamette Silt, which is saturated beginning at depths ranging from about 5–15 feet (Conlon and others, 2005; Gannett and Caldwell, 1998; Woodward and others, 1998).

Water levels have been reasonably stable in nearby wells over the last several decades (MARI 4019, MARI 4086, MARI 4160, MARI 4332, and MARI 4369). Seasonal water-level fluctuations are approximately 10–20 feet. Yields from nearby irrigation wells completed in the Willamette Aquifer range from ~0.22–1.5 cfs, indicating that the groundwater resource should be capable of providing the requested maximum production rate of 0.22 cfs.

There are approximately 32 permitted wells within a mile of the applicant's well, the closest of which is ~1,550 feet away. Adjacent tax lot 1000 to the west is likely supplied by an exempt well, estimated to be 165 feet from the applicant's well, posing the highest risk to senior groundwater users. Even though the estimated location for the nearest neighboring well is very close to the proposed well, the proposed use is not likely to cause injury because the requested rate is low and aquifer transmissivity is moderate (see attached Theis interference analysis).

The preponderance of evidence indicates that groundwater is available for the proposed use. The conditions specified in B1(d)(i) and B2(c) are recommended to protect senior users and the groundwater resource.

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	**Alluvial Sediments – Willamette Valley**	☒	☐
2	**Alluvial Sediments – Willamette Valley**	☒	☐
		☐	☐
		☐	☐

Basis for aquifer confinement evaluation: Static water levels reported in nearby wells were approximately 20 feet shallower than the first water-bearing zone, indicating a confined aquifer.

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 Pudding River**	**140**	**130**	**7,200**	☒	☐	☐	☐	☒
2	**1**	**Little Pudding River**	**140**	**130**	**7,000**	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation: Groundwater elevations in the alluvial aquifer are above the elevation of SW1 and upstream bends in groundwater elevation contour lines near the proposed wells indicate groundwater discharge to streams incised into the Willamette Silt (Conlon and others, 2003, 2005; Gannet and Caldwell, 1998). No perennial surface water sources were identified within 1 mile of the proposed POA.

Water Availability Basin the well(s) are located within: Pudding River > Molalla River – above Mill Creek (WID 151)

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?
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

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:
Not applicable.

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
2	**1**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**	**<0.1%**
Well Q as CFS		**0**	**0**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0**	**0**
Interference CFS		**0**	**0**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**

Distributed Wells

Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Well Q as CFS													
Interference CFS													
(A) = Total Interf.		**0**	**0**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**	**<< 0.673**
(B) = 80 % Nat. Q		**1040**	**1180**	**1010**	**787**	**425**	**224**	**109**	**71**	**67.3**	**91.6**	**363**	**957**
(C) = 1 % Nat. Q		**10.40**	**11.80**	**10.10**	**7.87**	**4.25**	**2.24**	**1.09**	**0.71**	**0.673**	**0.916**	**3.63**	**9.57**
(D) = (A) > (C)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(E) = (A / B) x 100		--	--	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**	**<< 1 %**

(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: Stream depletion resulting from appropriation of water from the proposed wells was estimated using the Hunt 2003 analytical model. The analysis was based on the proposed location of Well 2, which is closest to SW1 (Little Pudding River). We assumed that the entire proposed appropriation occurred from Well 2 because pumping rates were not specified individually for the proposed wells and Well 2's closer proximity to SW1 will result in more interference than if pumping were split between both proposed wells. Interference calculations during the months of March–October represent an active well, whereas November and December represent residual interference.

Estimated interference over the proposed period of use (245 days total) was < 25% of well production. The value selected to represent the Willamette Silt's vertical hydraulic conductivity (0.005 ft/d) was chosen to as a moderately conservative estimate from the range reported in the literature (0.00004–0.01 ft/d) (Iverson 2002, Woodward and others 1998).

The depletion of local streams by the proposed wells is expected to be attenuated, but not eliminated, by the low vertical hydraulic conductivity (permeability) of the Willamette Silt and other clays and silts that lie between the deeper sands and gravels and the stream beds. Net impacts will be small at the onset of pumping but will increase with time until a new equilibrium between local recharge and discharge is reached. At that time depletion is expected to be relatively constant throughout the year.

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:**

References Used: Application G-19225 and application map received 11/29/2021.

Conlon, T.D., Wozniak, K.C., Woodcock, D., Herrera, N.B., Fisher, B.J., Morgan, D.S., Lee, K.K., and Hinkle, S.R., 2005, Ground-water hydrology of the Willamette Basin, Oregon, Scientific Investigations Report 2005-5168: U. S. Geological Survey, Reston, VA.

Gannett, M.W. and Caldwell, R., 1998, Geologic framework of the Willamette Lowland aquifer system, Oregon and Washington, Professional Paper 1424-A, 32 p: U. S. Geological Survey, Reston, VA.

Hunt, B., 2003, Unsteady stream depletion when pumping from semiconfined aquifer: Journal of Hydrologic Engineering, Janu
Iverson, J., 2002, Investigation of the hydraulic, physical, and chemical buffering capacity of Missoula flood deposits for water quality and supply in the Willamette Valley of Oregon: Unpublished M.S. thesis, Oregon State University, 147 p.

Iverson, J., 2002, Investigation of the hydraulic, physical, and chemical buffering capacity of Missoula flood deposits for water quality and supply in the Willamette Valley of Oregon: Unpublished M.S. thesis, Oregon State University, 147 p.

Woodward, D.G., Gannett, M.W., and Vaccaro, J.J., 1998, Hydrogeologic framework of the Willamette Lowland aquifer system, Oregon and Washington: U.S. Geological Survey Professional Paper 1424-B, 82 p.

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #:** _____ **Logid:** _____

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) _____

D3. **THE WELL construction deficiency or other comment is described as follows:** _____

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

Water Availability Tables

WATER AVAILABILITY TABLE

PUDDING R > MOLALLA R - AB MILL CR

Watershed ID #: 151 Basin: WILLAMETTE Exceedance Level: 80

Time: 4:17 PM Date: 11/03/2022

Nest	# Watershed ID Number	Stream Name	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	STOR
1	181	WILLAMETTE R > COLUMBIA R - AT MOUTH	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2	69796	MOLALLA R > WILLAMETTE R - AT MOUTH	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES
3	69998	PUDDING R > MOLALLA R - AT MOUTH	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES
4	151	PUDDING R > MOLALLA R - AB MILL CR	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES

DETAILED REPORT ON THE WATER AVAILABILITY CALCULATION

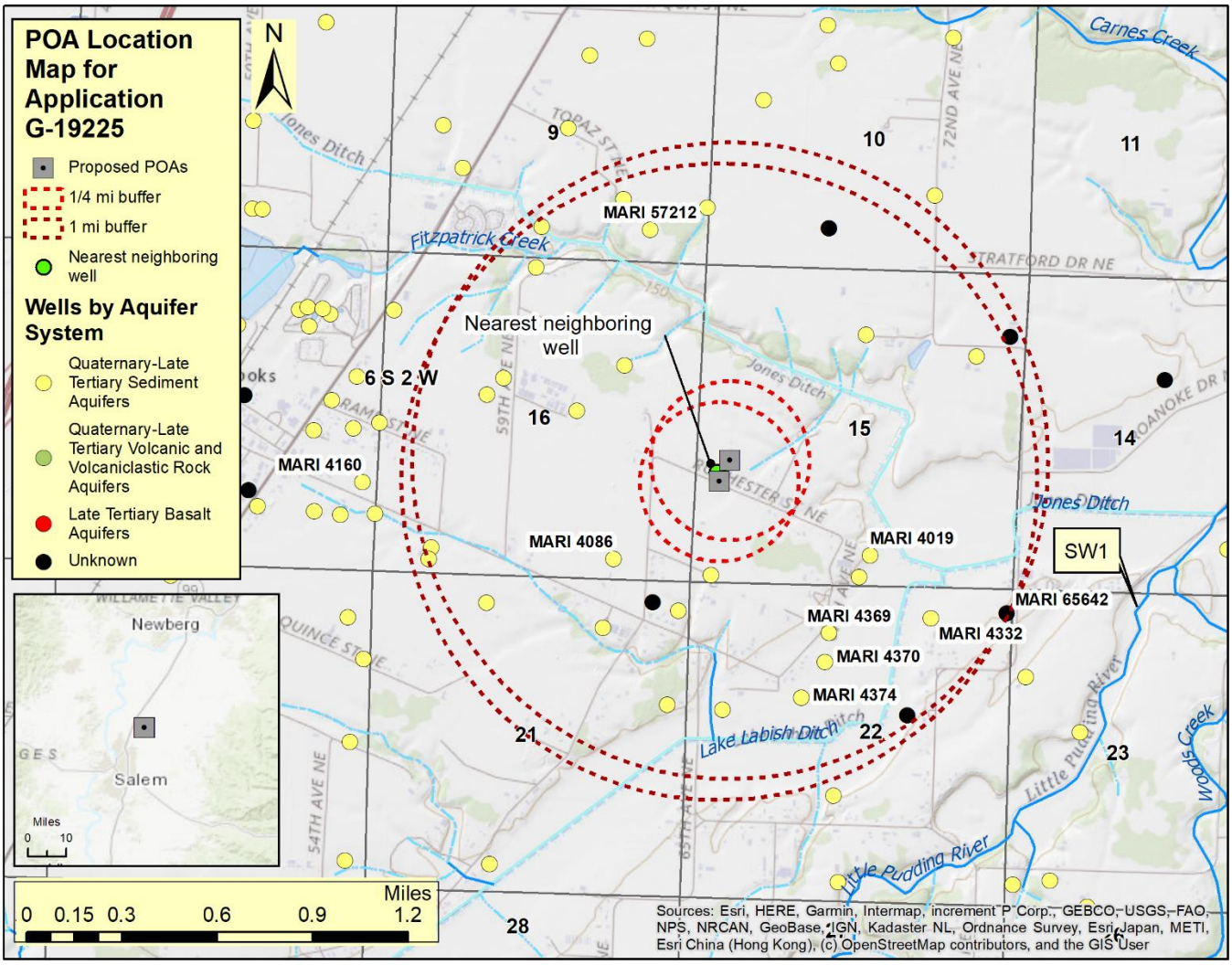
PUDDING R > MOLALLA R - AB MILL CR

Watershed ID #: 151 Basin: WILLAMETTE Exceedance Level: 80

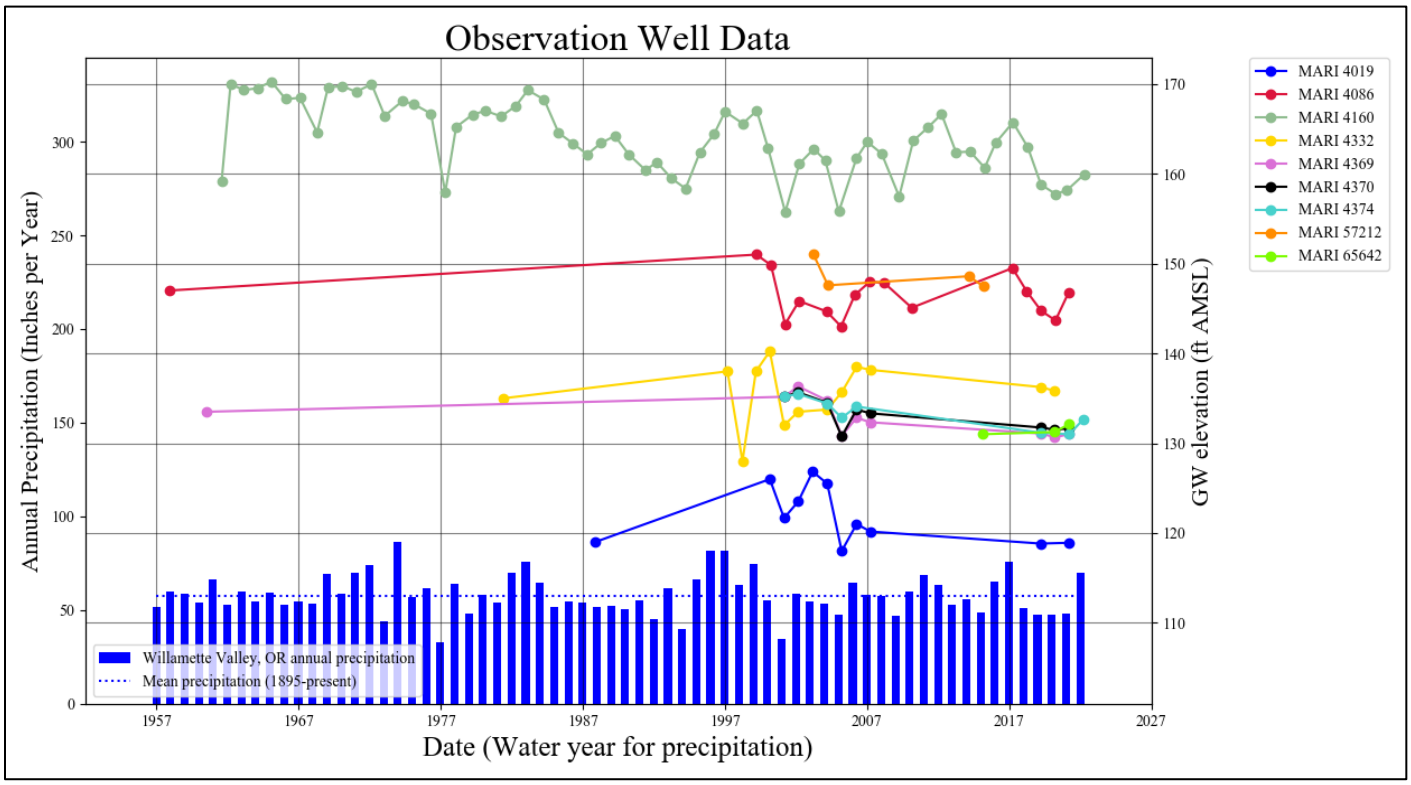
Time: 3:45 PM Date: 11/03/2022

Month	Natural Stream Flow	Consumptive Use and Storage	Expected Stream Flow	Reserved Stream Flow	Instream Requirements	Net Water Available
		Monthly values are in cfs. Storage is the annual amount at 50% exceedance in ac-ft.				
JAN	1,040.00	125.00	915.00	0.00	36.00	879.00
FEB	1,180.00	114.00	1,070.00	0.00	36.00	1,030.00
MAR	1,010.00	76.50	933.00	0.00	36.00	897.00
APR	787.00	52.40	735.00	0.00	36.00	699.00
MAY	425.00	50.90	374.00	0.00	36.00	338.00
JUN	224.00	73.00	151.00	0.00	36.00	115.00
JUL	109.00	115.00	-5.88	0.00	36.00	-41.90
AUG	71.00	94.10	-23.10	0.00	36.00	-59.10
SEP	67.30	53.40	13.90	0.00	36.00	-22.10
OCT	91.60	11.50	80.10	0.00	36.00	44.10
NOV	363.00	48.60	314.00	0.00	36.00	278.00
DEC	957.00	118.00	839.00	0.00	36.00	803.00
ANN	706,000	56,300	650,000	0	26,100	626,000

Well Location Map



Water-Level Measurements in Nearby Wells



Theis Interference Analysis

Note: Several well logs were identified for wells probably located within ¼ mile of the proposed new well locations. However, the exact location of the nearest well could not be determined with a high degree of confidence. In order to assess the scenario in which the greatest amount of interference would occur, we assumed the nearest well was located adjacent to the residence on the neighboring tax lot (300 feet from the POA 1 and 165 feet from POA 2).

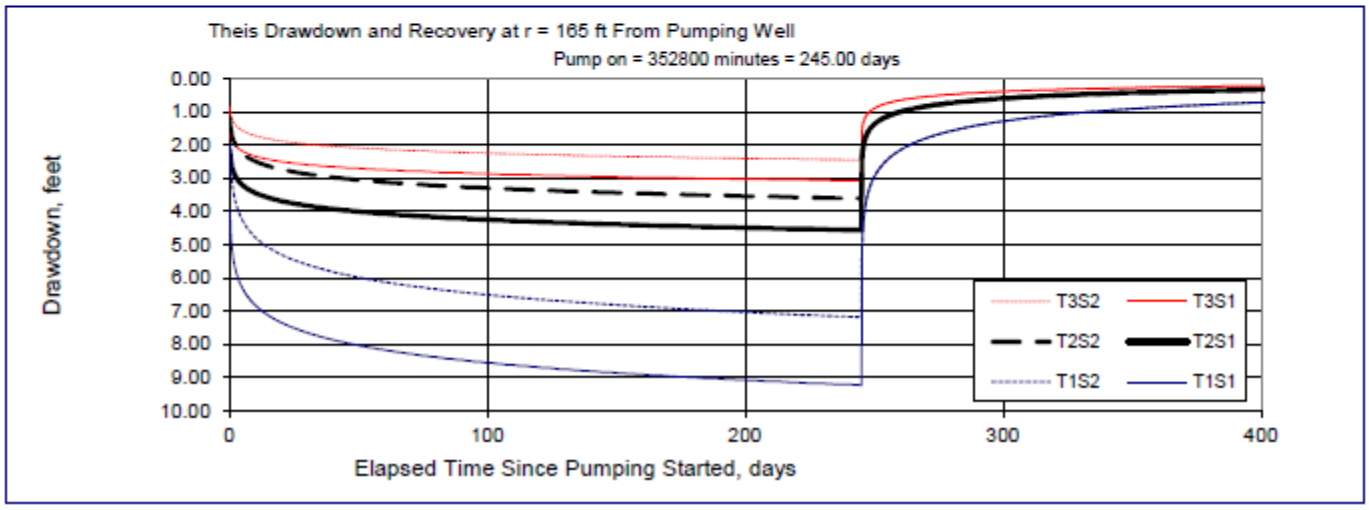
Theis Time-Drawdown Worksheet v.5.00

Calculates Theis nonequilibrium drawdown and recovery at any arbitrary radial distance, r, from a pumping well for 3 different T values and radial distance, r, from a pumping well for 3 different T values and 2 different S values.

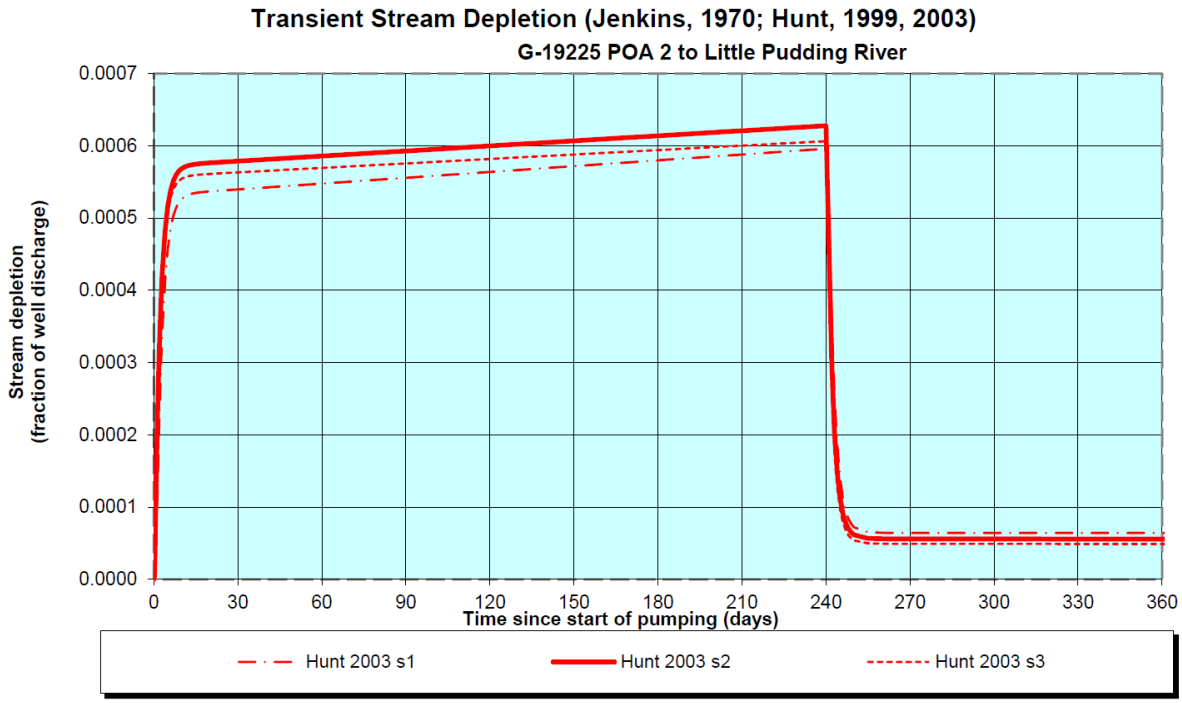
Written by Karl C. Wozniak September 1992. Last modified December 17, 2019

Input Data:	Var Name	Scenario 1	Scenario 2	Scenario 3	Units	
Total pumping time	t		245		d	
Radial distance from pumped well:	r		165		ft	Q conversions
Pumping rate	Q		0.22		cfs	98.74 gpm
Hydraulic conductivity	K	20	43	66	ft/day	0.22 cfs
Aquifer thickness	b		100		ft	13.20 cfm
Storativity	S_1		2.00E-04			19,008.00 cfd
	S_2		3.00E-03			0.44 af/d
Transmissivity Conversions	T_f2pd	2000	4300	6600	ft2/day	
	T_ft2pm	1.3888889	2.9861111	4.5833333	ft2/min	
	T_gpdpft	14960	32164	49368	gpd/ft	

Use the Recalculate button if recalculation is set to manual



Stream Depletion Analysis



Output for Stream Depletion, Scenerio 2 (s2):						Time pump on (pumping duration) = 240 days						
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	84.6%	89.0%	91.0%	92.2%	93.1%	93.7%	94.1%	94.5%	10.3%	6.0%	4.3%	3.3%
H SD 1999	0.5%	0.7%	0.9%	1.1%	1.2%	1.3%	1.4%	1.5%	1.2%	1.0%	0.9%	0.9%
H SD 2003	0.058%	0.059%	0.059%	0.060%	0.061%	0.061%	0.062%	0.063%	0.006%	0.006%	0.006%	0.006%
Qw, cfs	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220	0.220
H SD 99, cfs	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002
H SD 03, cfs	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	0.22	0.22	0.22	cfs
Time pump on (pumping duration)	tpon	240	240	240	days
Perpendicular from well to stream	a	6995	6995	6995	ft
Well depth	d	100	100	100	ft
Aquifer hydraulic conductivity	K	20	43	66	ft/day
Aquifer saturated thickness	b	100	100	100	ft
Aquifer transmissivity	T	2000	4300	6600	ft*ft/day
Aquifer storativity or specific yield	S	0.0002	0.0002	0.0002	
Aquitard vertical hydraulic conductivity	Kva	0.005	0.005	0.005	ft/day
Aquitard saturated thickness	ba	60	60	60	ft
Aquitard thickness below stream	babs	55	55	55	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	20	20	20	ft
Streambed conductance (lambda)	sbc	0.001818	0.001818	0.001818	ft/day
Stream depletion factor	sdf	4.893003	2.275815	1.482728	days
Streambed factor	sbf	0.006359	0.002958	0.001927	
input #1 for Hunt's Q_4 function	t'	0.204373	0.439403	0.674433	
input #2 for Hunt's Q_4 function	K'	2.038751	0.948256	0.617803	
input #3 for Hunt's Q_4 function	epsilon'	0.001000	0.001000	0.001000	
input #4 for Hunt's Q_4 function	lamda'	0.006359	0.002958	0.001927	