WATER RESOURCES DEPARTMENT MEMO 03/17, 2015

TO: **Application G-** 17979

FROM: LRONDIN/BOECHMANN **- Groundwater Section**

SUBJECT: **Scenic Waterway Interference Evaluation**

_____ YES
_X_ NO

The source of appropriation is within or above a Scenic Waterway

_____ YES
_X_ NO

Use the Scenic Waterway condition (condition 7J)

_____ Per ORS 390.835, the Groundwater Section is able to calculate groundwater interference with surface water that contributes to a Scenic Waterway. The calculated interference distribution is provided below.

_____ Per ORS 390.835, the Groundwater Section is unable to calculate groundwater 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 flows necessary to maintain the free-flowing character of a scenic waterway.

DISTRIBUTION OF INTERFERENCE

Calculate interference as the monthly fraction of the annual consumptive use and fill in the table below. If interference cannot be calculated, per criteria in 390.839, do not fill in the table but check the "unable" option above, thus informing the Water Rights Section that the Department is unable to make a Preponderance of Evidence finding.

Exercise of this permit is calculated to reduce monthly flows in the _____ Scenic Waterway by the following amounts, expressed as a proportion of the annual consumptive use pumped from the well.

Monthly Fraction of Annual Consumptive Use

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

PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date 3/17/2015

FROM: Groundwater Section Gerald H. Grondin (Darrick E. Boschmann)
Reviewer's Name

SUBJECT: Application G- 17979 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 ground water 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: Phillip Ross Defenbaugh County: Harney

A1. Applicant(s) seek(s) 2.31 cfs from 1 well(s) in the Malheur Lake Basin, Willow Creek subbasin Quad Map: Pole Canyon

A2. Proposed use: Irrigation (185 acres primary) Seasonality: March 1 to October 31

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	Proposed	2	bedrock	2.31	39S/37E-11 NW-NW	1326'S, 20'E fr SE cor S3
2						
3						
4						
5						

* 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	4700	?	?	-	500+	0-20	?	?	?	?	?	-

Use data from application for proposed wells.

A4. **Comments:**

The proposed well is located in southeast Harney County in the Willow Creek subbasin, 1.5 miles east of Flagstaff Butte summit. The area is surficially mapped as QTc (Quaternary and Tertiary Conglomerate) which is underlain at a shallow depth by Ttc (Miocene Trout Creek Formation) (Rytuba, 1983). The Trout Creek Formation is described as "gray to tan tuffaceous sandstone and siltstone and shale interstratified with white to tan diatomite. Pumice lapilli tuff and tuffaceous conglomerate are present locally." Barrow (1983) describes the Trout Creek Formation generally as volcaniclastic sediments deposited in a lacustrine environment and interbedded with diatomite and small basaltic flows and domes. At the proposed location the Trout Creek Formation is underlain by rhyolite domes and flows of Flagstaff Butte (Trf; Rytuba, 1983).

Well HARN 52159 is located in 39S/37E-11 NW-NW; 350 feet northeast of the proposed well. Materials penetrated by this 465 foot deep well include clay and gravel to a depth of 6 feet, underlain by a sequence of sandstone, shale, clay, and fractured rock. From 6-89 feet the descriptions are consistent with the materials in the Trout Creek Formation. Below 89 feet the driller describes fractured brown and black rock - most likely the Rhyolite of Flagstaff Butte.

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

The rule states: "(1) Except as provided in section (3) of this rule, the Department shall not accept an application for permit, or issue a permit, for any use of surface water, or of groundwater the use of which has the potential to substantially interfere with surface water, in the Malheur Lake Basin unless the applicant shows, by a preponderance of evidence, that unappropriated water is available to supply the proposed use at the times and in the amounts requested. The evidence provided shall be prepared by a qualified hydrologist or other water resources specialist and shall include:

(a) Streamflow measurements of gage records from the source or, for use of groundwater, the stream in hydraulic connection with the source; or

(b) An estimate of water availability from the source or, for use of groundwater, the stream in hydraulic connection with the source which includes correlations with streamflow measurements or gage records on other, similar streams and considers current demands for water affecting the streamflows."

This review does not find a potential for substantial interference with surface water.

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

Currently no administrative area.

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

B1. **Based upon available data**, I have determined that ground water* 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 ground water 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 ground water 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 ground water resource; or

d. ☒ **will, if properly conditioned**, avoid injury to existing ground water rights or to the ground water resource:
   i. ☒ The permit should contain condition #(s) 7F, 7N, 7P, 7T, flow meter.;
   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 ground water production from no deeper than _____ ft. below land surface;
b. ☐ **Condition** to allow ground water production from no shallower than _____ ft. below land surface;
c. ☐ **Condition** to allow ground water production only from the _____ ground water 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 Ground Water 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. **Ground water availability remarks:** _____

There are no State Observation Wells or other located wells with water level data in the vicinity of the proposed well. State Observation Well 198 (HARN 1806) is located over 10 miles to the southwest within the Pueblo Valley, and records a ~0.5 ft/year decline since the 1990s. However, HARN 1806 is completed in valley fill sediment, and is within an area with current groundwater development for irrigation. It is doubtful that the record for HARN 1806 represents conditions at the proposed well. Very little groundwater development has occurred in the area - the nearest permitted groundwater POU is 6.8 miles to the southwest.

If a permit is issued, the following conditions are recommended:

7F: Proposed Well location Condition

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 condition: During any pump test required by this permit, observation water-level measurements shall be made in at least one nearby well that is completed in the same aquifer as the pumped well. The observation well should be idle prior to and during the test, and should be at least 200 feet, and not more than about 2000 feet, from the pumped well. Measurements shall be made at the same times as in the pumped well, shall be accurate to at least 0.1 of a foot, and shall be recorded on the Department's Pump Test Data Sheets. The pump test report shall include a summary description of the test, water-level readings for each well, well logs for each well, and a map, at a scale of 1:24000 or larger, showing the well locations to an accuracy of at least 50 feet.

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

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

Well	Aquifer or Proposed Aquifer	Confined	Unconfined
1	Trout Creek Fm/fractured rock	☐	☒
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Basis for aquifer confinement evaluation:

The water well report for HARN 52159 (see description above) reports a water bearing zone in fractured rock from 89-465 feet with a static water level of 89 feet, which indicates unconfined conditions.

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	Warm Spring	4611	4538	20469	☒	☐	☐	☐	☒
1	2	Trout Creek	4611	4611	12545	☒	☐	☐	☐	☒
1	2	Little Trout Creek	4611	4845	5255	☐	☒	☐	☐	☒
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation:

This evaluation considers perennial reaches of surface water only (see memo by Ivan Gall, 1/15/2008).

The groundwater elevation at the location of the proposed well is from the drillers 2/13/2015 reported static water level for HARN 52159 located 350 feet northeast of the proposed well.

The nearest perennial reach of surface water is the reach of Little Trout Creek located 5255 feet south at an elevation of 4845 feet, well above the elevation of groundwater at the proposed location. Groundwater does not appear to provide baseflow to Little Trout Creek or any other surface water within 1 mile of the proposed well.

It is not known with certainty where hydraulic connection with surface water occurs, but based on the head relationship it is likely to be ~2.5 miles southwest at Trout Creek. To the northeast, several springs (Little Cole Spring, Warm Spring, Twin Springs, other unnamed springs) are likely in hydraulic connection as well. It is not known if these springs flow perennially.

Water Availability Basin the well(s) are located within: WILLOW CR > ALVORD DESERT - AT MOUTH

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 source. Limit evaluation to instream rights and minimum stream flows that are pertinent to that surface water source, and 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:

C3a./C3b.: No analysis here. All wells are located at a distance greater than 1 mile from perennial reaches of hydraulically connected surface water.

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
1	**1**	%	%	%	%	%	%	%	%	%	%	%	%
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													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
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:

C4a. The potential drawdown at Warm Spring was calculated using the Theis equation with a range of values for transmissivity (see attachment). The values used in the calculation are conservative and appropriate until better values become available. At the pro-rated rate of the full duty over the full irrigation season (1.1 cfs), the results show a drawdown of 0.2-4.9 feet.

Non-Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	0 %	0 %	0.01%	0.01%	0.01%	0.02%	0.03%	0.03%	0.04%	0.04%	0.04%	0.04%
Well Q as CFS		0	0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0	0
Interference CFS		0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(A) = Total Interf.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(B) = 80 % Nat. Q	1.12	3.02	5.78	10.5	14.2	9.53	1.71	0.62	0.48	0.49	0.82	1.06
(C) = 1 % Nat. Q	0.011 2	0.030 2	0.057 8	0.105	0.142	0.095 3	0.0171	0.006 2	0.004 8	0.004 9	0.008 2	0.0106
(D) = (A) > (C)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
(E) = (A / B) x 100	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %	0.000 %

(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:

C4a. Hunt (2003) was used to calculate the interference between Well 1 and SW #2 with a range of values for transmissivity. The values used in the calculation are conservative and appropriate until better values become available. The calculation considered a range of transmissivity from 100-10,000 ft^2/day. The pumping rate used represents the maximum allowable duty prorated over the irrigation season (1.1 cfs). See report attached.

Interference is determined to be much less than 1% of the 80% flow in all months evaluated.

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 ground water use under this permit can be regulated if it is found to substantially interfere with surface water:

i. ☒ The permit should contain condition #(s) 7F, 7N, 7P, 7T, flow meter.;

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 wells will produce water from an unconfined aquifer.

C2. 690-09-040 (2) (3)
It is determined that the proposed well is hydraulically connected with Trout Creek and springs to the northeast.

C3a./C3b. 690-09-040 (4)
No analysis here. All wells are located at a distance greater than 1 mile from perennial reaches of hydraulically connected surface water.

C4a. 690-09-040 (5)
It is determined that interference for all wells will be less than 1% of the 80% flow in all months evaluated.

If a permit is issued, the following conditions are recommended:

7F: Proposed Well location Condition

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 condition: During any pump test required by this permit, observation water-level measurements shall be made in at least one nearby well that is completed in the same aquifer as the pumped well. The observation well should be idle prior to and during the test, and should be at least 200 feet, and not more than about 2000 feet, from the pumped well. Measurements shall be made at the same times as in the pumped well, shall be accurate to at least 0.1 of a foot, and shall be recorded on the Department's Pump Test Data Sheets. The pump test report shall include a summary description of the test, water-level readings for each well, well logs for each well, and a map, at a scale of 1:24000 or larger, showing the well locations to an accuracy of at least 50 feet.

References Used:

Rytuba, J.J., Minor, S.A., and Vander Meulen, D.B., 1983, Geologic map of the Pole Canyon quadrangle, Harney County, Oregon: U.S. Geological Survey, Open-File Report OF-83-285, scale 1:24,000

Barrow, 1983, Trout Creek Formation Southeastern Oregon: Stratigraphy and Diatom Paleoecology. Stanford University Masters Thesis.

Waring, Gerald Ashley, 1909, Geology and water resources of the Harney Basin region, Oregon: Govt. Print. Off., Water Supply Paper 231, 93 p.

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

Memo by Ivan Gall, 1/15, 2008

Oregon Administrative Rules

Hunt, Bruce. "Unsteady stream depletion when pumping from semiconfined aquifer." Journal of Hydrologic Engineering 8.1 (2003): 12-19.

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 Analysis

Detailed Reports

WILLOW CR > ALVORD DESERT - AT MOUTH
MALHEUR LAKE BASIN
Water Availability as of 3/17/2015

Watershed ID #: 31309808 (Map)
Date: 3/17/2015

Exceedance Level: 50% -
Time: 9:10 AM

Water Availability Calculation | Streamflow Characteristics | Instream Flow Requirements | Water Rights | Reservoir Characteristics | Hydrographs

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

JAN	1.12	0.01	1.11	0.00	0.00	1.11
FEB	3.02	0.02	3.00	0.00	0.00	3.00
MAR	5.78	1.62	4.16	0.00	0.00	4.16
APR	10.50	7.72	2.78	0.00	0.00	2.78
MAY	34.29	39.78	-5.49	0.00	0.00	-5.49
JUN	9.53	15.99	-6.41	0.00	0.00	-6.41
JUL	1.71	5.32	-3.61	0.00	0.00	-3.61
AUG	0.62	2.14	-1.52	0.00	0.00	-1.52
SEP	0.48	1.11	-0.63	0.00	0.00	-0.63
OCT	0.49	0.54	-0.05	0.00	0.00	-0.05
NOV	0.02	0.01	0.01	0.00	0.00	0.01
DEC	1.06	0.01	1.05	0.00	0.00	1.05
ANN	6,753.00	3,280.00	3,090.00	0.00	0.00	3,090.00

Download Data (Text - Formatted , Text - Tab Delimited , Excel)

Theis Time-Drawdown – To Warm Spring

Drawdown Calculations Using Theis Equation

Theis Equation: $s = [Q/(4*T*pi)][W(u)]$

$u = (r^2*S)/(4*T*t)$

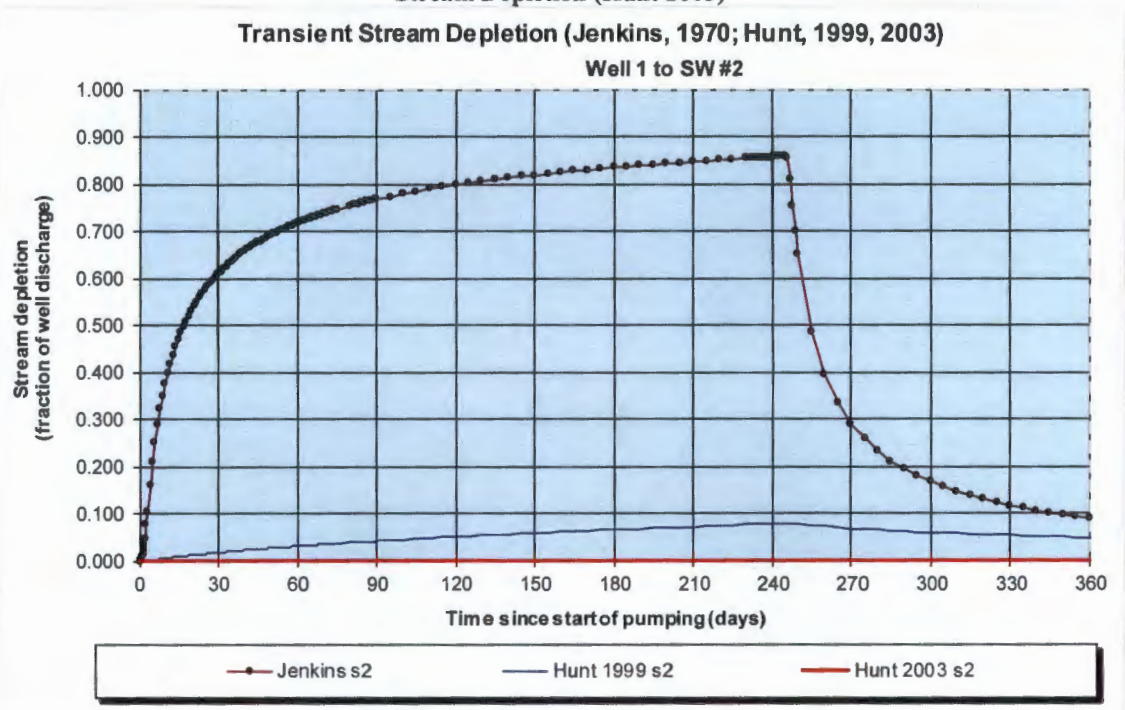
$W(u) = (-ln\ u)-(0.5772157)+(u/1*1!)-(u^2/2*2!)+(u^3/3*3!)-(u^4/4*4!)+...$

s = drawdown (L)
T = transmissivity (L*L/T)
S = storage coefficient (dimensionless)
pi = 3.141592654
r = radial distance (L)
t = time (T)
u = dimensionless
W(u) = well function

Note : W(u) calculation valid when u < 7.1
7.0000 1.1548E-04

Analysis #	Transmissivity T (gpd/ft)	Transmissivity T (ft2/day)	Storage Coefficient S	Pumping Rate Q (gal/min)	Pumping Rate Q (ft3/sec)	Time t (days)	Distance r (feet)	pi	u	W(u)	Drawdown s (feet)	Comments
1	750.00	100.26	0.00100	493.68	1.10	245.00	20,469.00	3.14	4.2642	0.0027	0.2073	
2	7,500.00	1,002.60	0.00100	493.68	1.10	245.00	20,469.00	3.14	0.4264	0.6601	4.9788	
3	75,000.00	10,026.04	0.00100	493.68	1.10	245.00	20,469.00	3.14	0.0426	2.8199	1.9762	

Stream Depletion (Hunt 2003)



Output for Stream Depletion, Scenerio 2 (s2):						Time pump on (pumping duration) = 245 days						
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	60.9%	71.7%	76.7%	79.8%	81.9%	83.4%	84.7%	85.6%	29.0%	16.6%	11.6%	8.9%
H SD 1999	1.8%	3.1%	4.2%	5.1%	5.8%	6.5%	7.2%	7.8%	6.8%	5.9%	5.3%	4.8%
H SD 2003	0.01%	0.01%	0.01%	0.02%	0.02%	0.03%	0.03%	0.04%	0.04%	0.04%	0.04%	0.04%
Qw, cfs	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
H SD 99, cfs	0.020	0.034	0.046	0.056	0.064	0.072	0.079	0.085	0.075	0.065	0.058	0.053
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	1.10	1.10	1.10	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	12545	12545	12545	ft
Well depth	d	500	500	500	ft
Aquifer hydraulic conductivity	K	100	100	100	ft/day
Aquifer saturated thickness	b	1	100	10	ft
Aquifer transmissivity	T	100	10000	1000	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	0.023	0.023	0.023	ft/day
Aquitard saturated thickness	ba	15	15	15	ft
Aquitard thickness below stream	babs	15	15	15	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	25	25	25	ft
Streambed conductance (lambda)	sbc	0.038333	0.038333	0.038333	ft/day
Stream depletion factor	sdf	1573.770250	15.737703	157.377025	days
Streambed factor	sbf	4.808917	0.048089	0.480892	
input #1 for Hunt's Q_4 function	t'	0.000635	0.063542	0.006354	
input #2 for Hunt's Q_4 function	K'	2413.114383	24.131144	241.311438	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	4.808917	0.048089	0.480892	

Location Map