Groundwater Review Summary Form

Application # G- 18327 - rereview

GW Reviewer Aurora Bouchier **Date Review Completed:** April 18, 2017

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:

[X] There is the potential for substantial interference per Section C of the attached review form.

Summary of Well Construction Assessment:

[X] 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).

PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date April 18, 2017
FROM: Groundwater Section Aurora C Bouchier
Reviewer's Name
SUBJECT: Application G- 18327 Supersedes review of February 23, 2017
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: **Treco Investments LLC/Brent Smith** County: **Marion**

A1. Applicant(s) seek(s) 0.73 cfs from 3 well(s) in the Willamette Basin, Molalla-Pudding subbasin

A2. Proposed use Irrigation (58.6 acres) Seasonality: March 1 – 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	MARI 2068 **	1	Alluvium	0.73 [1]	5S/1W-29 SE-SW	1200' N, 3750' W fr SE cor S 29
2	MARI 2105	2	Alluvium	0.73 [2]	5S/1W-30 SE-NE	940' S & 460' E fr SE cor, LOT 1, S30
3	MARI 65739	3	Alluvium	0.73 [3]	5S/1W-32 SE-NW	1920' S, 1795' E fr NW cor S 32

* 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	149	?	13	4/25/1978	363	0-22	+2'6" – 228'7", +2'5" – 232'7"	Na	16" casing: 107-207, 8" casing: 152-212	?		
2	166	39	22	6/4/1958	140	0-20	0-121	Na	90-117	?		
3	147	?***	37	6/17/2015	299	0-65	+1.5-153	128.5-148.5, 180-198, 294-299	148-180, 198-294	1200	53	P

Use data from application for proposed wells.

A4. **Comments:** **Note in application reads "Well 1 was constructed with 2 separate casings side-by-side within the borehole." The second casing (6 inch) is labeled as a gravel feed on the well log and is likely not for production, see end of review for potential well construction diagram.

[1]Well 1 has two well specific requested rates of 750 gpm (16" casing) and 325 gpm (8" casing). The total maximum rate requested is 0.73 cfs (327.6 gpm), therefore this review analyzes against 0.73 cfs. Well 1 is authorized under Inchoate T 11837 (1.31 cfs primary irrigation split between 3 wells, 0.69 cfs supplemental irrigation from well 1, and 0.09 cfs commercial use from well 1) and Certificate 89886 RR (0.16 cfs split between 2 wells) – if all authorized water was produced at this well the stacking would sum to 2.98 cfs, this groundwater review evaluates the stacked rate.

[2]Well 2 is has a specific requested rate of 340 gpm (0.756 cfs). The total maximum rate requested is 0.73 cfs (327.6 gpm), therefore this review analyzes against 0.73 cfs. Well 2 is authorized under Certificate 30611 (0.69 cfs), Inchoate T 11837 (1.31 cfs primary irrigation split between 3 wells) and Certificate 89886 RR (0.16 cfs split between 2 wells) – if all authorized water was produced at this well the stacking would sum to 2.89 cfs, this groundwater review evaluates the stacked rate.

[3]Well 3 has a specific requested rate of 835 gpm (1.86 cfs). The total maximum rate requested is 0.73 cfs (327.6 gpm), therefore this review analyzes against 0.73 cfs. Well 3 is authorized under Inchoate T 11837 (1.31 cfs primary irrigation split between 3 wells) – if all authorized water was produced at this well the stacking would sum to 2.04 cfs, this groundwater review evaluates the stacked rate.

*** There is a sealed off water bearing zone from 18-37 feet, but no static water level was measured for this interval. The log says all sand and gravel layers were water bearing. The well is sealed to a depth of 65 feet with the first sand and gravel layer below the seal listed at 79 – 86 feet (described as being cemented). It is difficult to determine if the seal is holding.

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: Although these three well logs are not clear-cut, based on additional well logs in the area and published water table maps, it is likely that the wells are producing from a confined aquifer. Therefore, the pertinent rules (OAR 690-502-0240) do not apply.

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) **7N, Large water use reporting**;
   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:**

Over 900 feet of alluvial sediments occur beneath land surface in the vicinity of the proposed POAs (Gannett et al, 1998). The water table occurs approximately 20-30 feet below land surface in this region (Conlon et al., 2005, and Woodward et al., 1998). Productive sand and gravel beds occur throughout the sequence separated layers of lower permeability silts and clay which progressively confine deeper water-bearing zones (Gannet and Caldwell, 1998, and Woodward et al., 1998).

State Observation Well 253 (MARI 2666) is located approximately 1.7 miles west, and State Observation Well 165 (MARI 3054) is located approximately 1.9 miles southwest. The hydrograph of the nearby State Observation Wells show relatively stable long-term trends for alluvial wells in the vicinity of the proposed POAs , with approximately 4-f feet of decline since the mid 1960's - although the seasonal fluctuation may be increasing. This possible increased seasonal fluctuation in groundwater level, plus increased groundwater development in the area, indicates a need for additional water-level monitoring (7N) if this permit is issued.

There is a note in the application that reads "It is understood that the OWRD will likely make a finding that there will be the Potential for Substantial Interference with the Pudding River from the proposed groundwater use. The applicant has an existing surface water right on the property and is willing to propose cancellation of part or all of the surface water right to mitigate for the estimated impacts to the surface water.

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**	☒	☐
2	**Alluvial**	☒	☐
3	**Alluvial**	☒	☐

Basis for aquifer confinement evaluation: Based on well logs in the area (MARI 2105, MARI 18349) and published Willamette Silt thickness maps (Gannett and Caldwell, 1998), it is likely that the wells are producing from 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	**Pudding river**	**~136**	**105-112**	**725**	☒	☐	☐	☐	☒
2	1	**Pudding River**	**~144**	**105-107**	**2595**	☒	☐	☐	☐	☒
3	1	**Pudding River**	**~110**	**105-120**	**2330**	☒	☐	☐	☐	☒
1	2	**Farmers Ck/Sam Brown Ck**	**~136**	**105-130**	**1950**	☒	☐	☐	☐	☒
2	2	**Farmers Ck/Sam Brown Ck**	**~144**	**105-137**	**4100**	☒	☐	☐	☐	☒
3	2	**Farmers Ck/Sam Brown Ck**	**~110**	**105-124**	**970**	☒	☐	☐	☐	☒
1	3	**Unnamed stream[1]**	**~136**	**112-140**	**340**	☒	☐	☐	☐	☒
2	3	**Unnamed stream[1]**	**~144**	**112-156**	**1700**	☒	☐	☐	☐	☒
3	3	**Unnamed stream[1]**	**~110**	**112-139**	**1540**	☒	☐	☐	☐	☒

Basis for aquifer hydraulic connection evaluation: Published water-table maps indicate that groundwater in the alluvial aquifer flows toward, and discharges to, the Pudding River and its perennial tributaries (Woodward et al., 1998 Plate 1, and Conlon et al., 2005, Plate 1). Head data from MARI 2105 and nearby wells corroborate this. However, there is a layer of low permeability Willamette Silt between the aquifer and the bottom of the surface water bodies, so the connection is likely inefficient. Farmers Creek and Sam Brown Creek join together and enter the Pudding River as a single tributary, therefore they are treated as a single entity for this analysis.

[1]Under rule (OAR 690-502-0120(1)(c)) the unnamed stream flowing into the Same Brown/Farmers Creek within T5S/R1W-32 is withdrawn from further appropriation except storage.

Water Availability Basin the well(s) are located within: 151: PUDDING R> MOLALLA R- AB MILL CR

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?
1	1	☒	☐	**Na**	**Na**	☐	**67.30**	☒	**<<25%**	☒
2	1	☐	☐	**Na**	**Na**	☐	**67.30**	☒	**<<25%**	☒
3	1	☐	☐	**Na**	**Na**	☐	**67.30**	☒	**<<25%**	☒
1	2	☐	☐	**Na**	**Na**	☐	**Na**	☐	**<<25%**	☐
2	2	☐	☐	**Na**	**Na**	☐	**Na**	☐	**<<25%**	☐
3	2	☒	☐	**Na**	**Na**	☐	**Na**	☐	**<<25%**	☒
1	3	☒	☐	**Na**	**Na**	☐	**Na**	☐	**<<25%**	☒
2	3	☐	☐	**Na**	**Na**	☐	**Na**	☐	**<<25%**	☐

3	3	☐	☐	Na	Na	☐	Na	☐	<<25%	☐

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: Well 1 (MARI 2068) was modeled at the stacked rate (2.98 cfs, or 1338 gpm) at a distance of 725 feet for interference with the Pudding River. The stream depletion at 30 days was estimated using the Hunt 2003 model. Well 1 was not modeled against Farmers/Sam Brown Creek - due to the greater distance the interference would likely be less. Nor was it modeled against the withdrawn creek - due to the smaller creek width the interference would likely be less.

Well 2 (MARI 2105) was modeled at the stacked rate (2.89 cfs, or 1297 gpm) at a distance of 1,700 feet for interference with the withdrawn stream. Well 2 was also modeled at the stacked rate (2.89 cfs, or 1297 gpm) at a distance of 2,595 feet for interference with the Pudding River. In both cases, the stream depletion at 30 days was estimated using the Hunt 2003 model. Well 2 was not modeled against Farmers/Sam Brown Creek - due to the greater distance the interference would likely be less.

Well 3 (MARI 65739) was modeled at the stacked rate (2.04 cfs, or 916 gpm) at a distance of 970 feet for interference with Farmers/Sam Brown Creek. The stream depletion at 30 days was estimated using the Hunt 2003 model. Well 3 was not modeled against the Pudding River or the withdrawn stream - due to the greater distance the interference would likely be less. The presence of low permeability Willamette Silt between the aquifer and the beds of the streams result in an inefficient connection between the aquifer and the streams. Therefore, the stream depletion at 30 days is likely to be << 25% in all cases.

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													
		%	%	%	%	%	%	%	%	%	%	%	%
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:

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:**

In the area surrounding the wells, about 80 feet of Willamette Silt overly the alluvium aquifer (Gannett and Caldwell, 1998). The Pudding River and other small streams are not completely incised through the Willamette Silt. In general, the silt has a low vertical hydraulic conductivity that will lower the efficiency the interchange of water between these streams and the alluvial aquifer.

References Used:

Application file: G-18321, and nearby G-15815, G-16061, and G-17965.

Conlon, Terrence D., Wozniak, Karl C., Woodcock, Douglas, Herrera, Nora B., Fisher, Bruce J., Morgan, David S., Lee, Karl K., and Hinkle, Stephen R., 2005, Ground-Water Hydrology of the Willamette Basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2005-5168.

Gannett, Marshall W., and Caldwell, Rodney R., 1998, Geologic Framework of the Willamette Lowland Aquifer System, Oregon and Washington: U. S. Geological Survey Professional Paper 1424-A.

Hunt, B., 2003, Unsteady stream depletion when pumping from semiconfined aquifer: Journal of Hydrologic Engineering, January/February, 2003.

Woodward, Dennis BG., Gannett, Marshall W., and Vaccaro, John J., 1998 Hydrogeologic Framework of the Willamette Lowland Aquifer System, Oregon and Washington: U. S. Geological Survey Professional Paper 1424-B.

Nearby well logs and water level data, specifically: MARI 2068, MARI 2105, MARI 65739, MARI 18439, MARI 2666, and MARI 3054.

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #:** 1, 2 **Logid:** MARI 2068 , MARI 2105

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:**

Well 1 (MARI 2068): the gravel feed 6" casing inside the 16" casing is confusing, Well Construction and Compliance should examine the log.

Well 2 (MARI 2105): Puddled Clay was used as seal, this is not to code.

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

Water Availability Tables

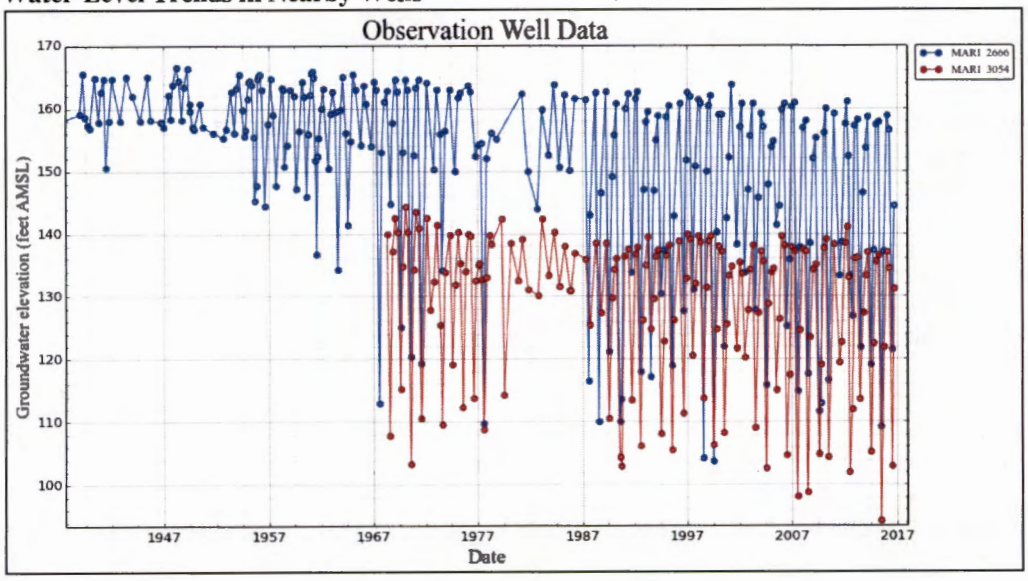
DETAILED REPORT ON THE WATER AVAILABILITY CALCULATION

PUDDING R > MOLALLA R - AB MILL CR
Watershed ID #: 151 Basin: WILLAMETTE Exceedance Level: 80
Time: 10:10 AM Date: 11/14/2016

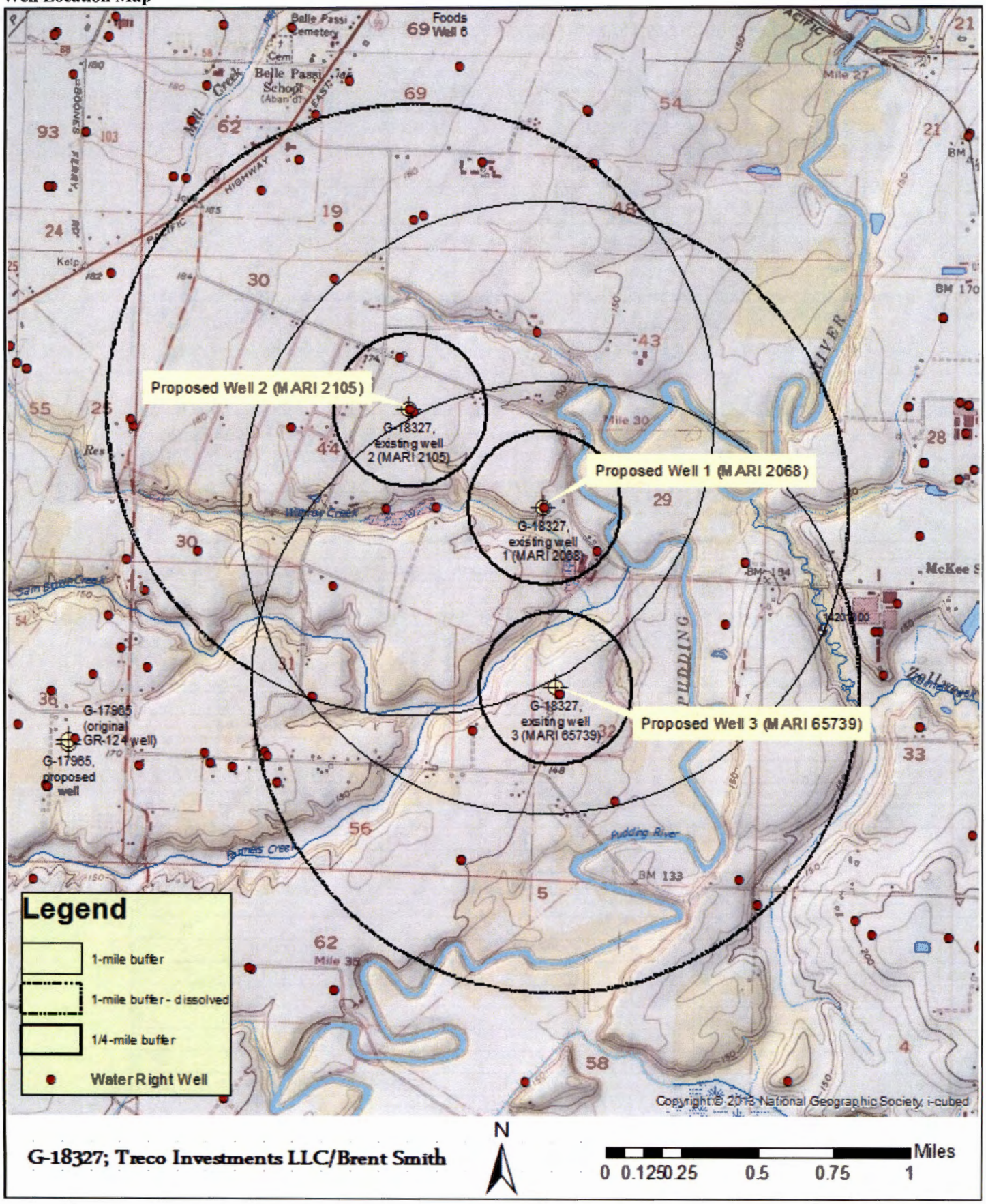
Monthly values are in cfs.
Storage is the annual amount at 50% exceedance in ac-ft.

Month	Natural Stream Flow	Consumptive Use and Storage	Expected Stream Flow	Reserved Stream Flow	Instream Requirements	Net Water Available
JAN	1,040.00	123.00	917.00	0.00	36.00	881.00
FEB	1,180.00	113.00	1,070.00	0.00	36.00	1,030.00
MAR	1,010.00	78.30	932.00	0.00	36.00	896.00
APR	787.00	54.20	733.00	0.00	36.00	697.00
MAY	425.00	51.70	373.00	0.00	36.00	337.00
JUN	224.00	72.90	151.00	0.00	36.00	115.00
JUL	109.00	113.00	-4.01	0.00	36.00	-40.00
AUG	71.00	93.30	-22.30	0.00	36.00	-58.30
SEP	67.30	54.50	12.80	0.00	36.00	-23.20
OCT	91.60	14.00	77.60	0.00	36.00	41.60
NOV	363.00	48.00	315.00	0.00	36.00	279.00
DEC	957.00	117.00	840.00	0.00	36.00	804.00
ANN	706,000	56,400	650,000	0	26,100	626,000

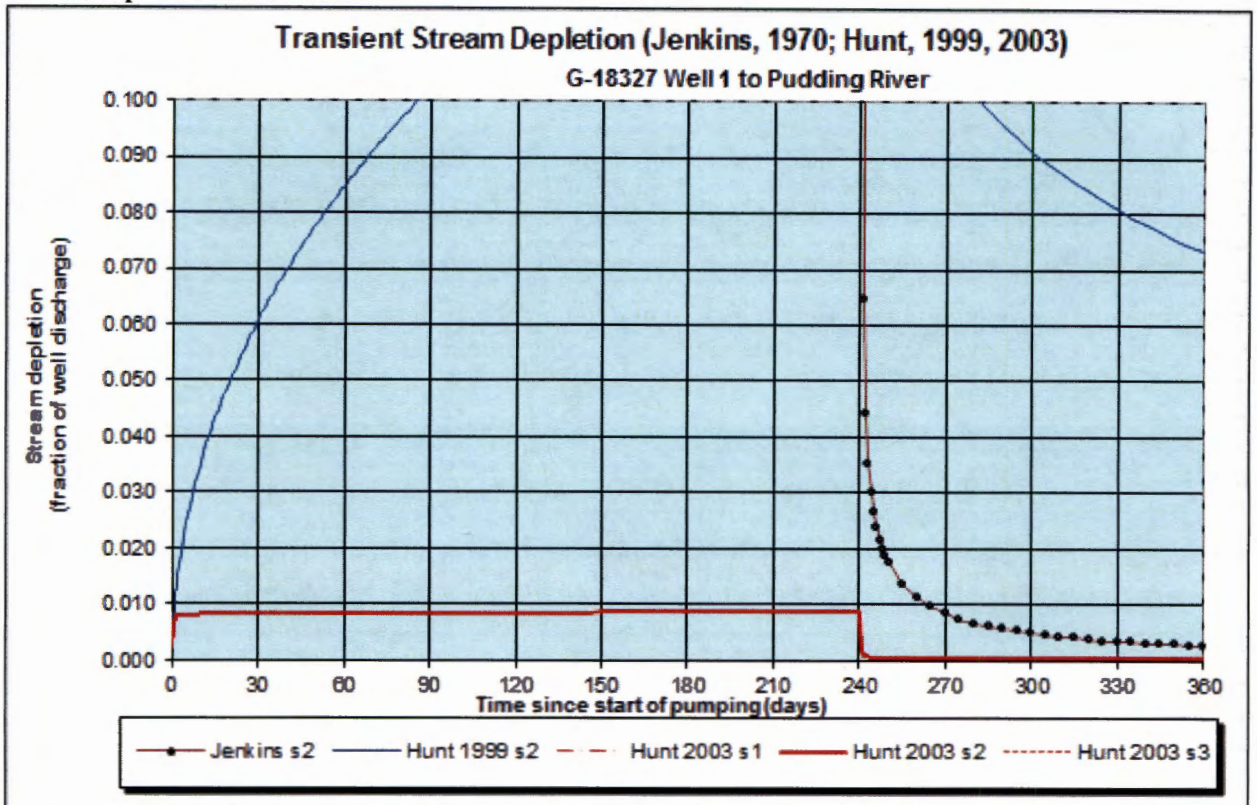
Water-Level Trends in Nearby Wells



Well Location Map

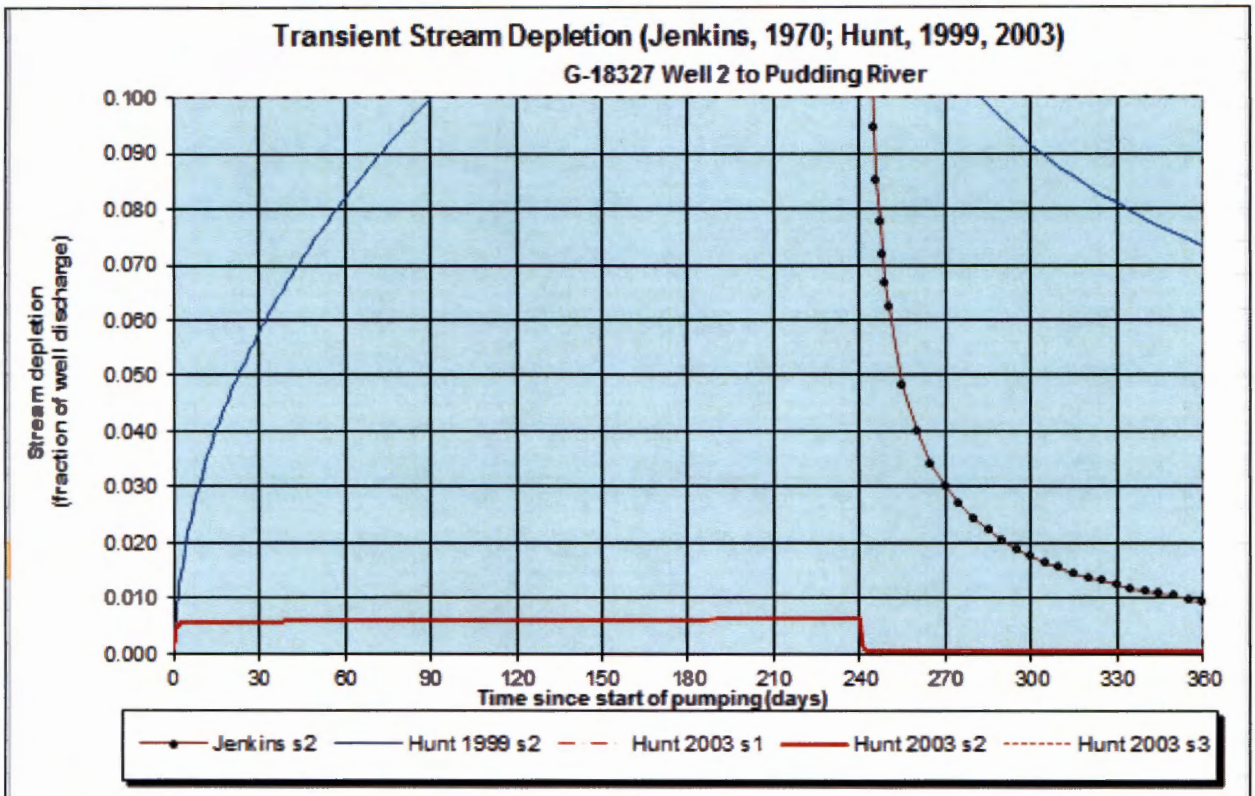


Stream Depletion Model Result



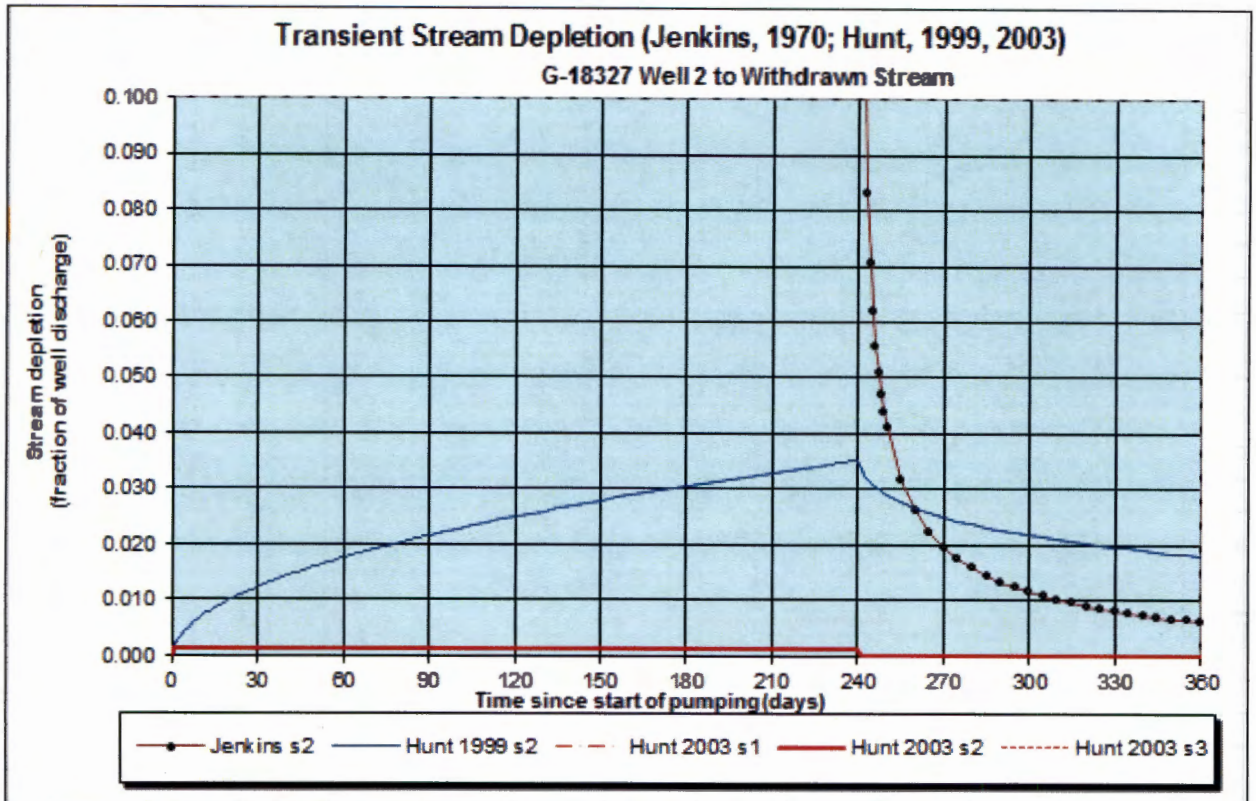
Output for Stream Depletion, Scenerio 2 (s2):	Time pump on (pumping duration) = 240 days											
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	98.7%	99.1%	99.3%	99.4%	99.4%	99.5%	99.5%	99.6%	0.8%	0.5%	0.3%	0.3%
H SD 1999	6.1%	8.5%	10.3%	11.7%	13.0%	14.1%	15.1%	16.0%	10.7%	9.1%	8.1%	7.3%
H SD 2003	0.82%	0.83%	0.84%	0.85%	0.86%	0.87%	0.88%	0.88%	0.07%	0.07%	0.07%	0.07%
Qw, cfs	2.981	2.981	2.981	2.981	2.981	2.981	2.981	2.981	2.981	2.981	2.981	2.981
H SD 99, cfs	0.181	0.253	0.306	0.349	0.386	0.419	0.449	0.476	0.320	0.272	0.241	0.218
H SD 03, cfs	0.025	0.025	0.025	0.025	0.026	0.026	0.026	0.026	0.002	0.002	0.002	0.002

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	1338.00	1338.00	1338.00	gpm
Time pump on (pumping duration)	tpon	240	240	240	days
Perpendicular from well to stream	a	725	725	725	ft
Well depth	d	363	363	363	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer saturated thickness	b	70	70	70	ft
Aquifer transmissivity	T	3500	3500	3500	ft*ft/day
Aquifer storativity or specific yield	S	0.0001	0.0001	0.0001	
Aquitard vertical hydraulic conductivity	Kva	0.01	0.01	0.01	ft/day
Aquitard saturated thickness	ba	80	80	80	ft
Aquitard thickness below stream	babs	40	40	40	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	50	50	50	ft
Streambed conductance (lambda)	sbc	0.012500	0.012500	0.012500	ft/day
Stream depletion factor	sdf	0.015018	0.015018	0.015018	days
Streambed factor	sbf	0.002589	0.002589	0.002589	
input #1 for Hunt's Q_4 function	t'	66.587396	66.587396	66.587396	
input #2 for Hunt's Q_4 function	K'	0.018772	0.018772	0.018772	
input #3 for Hunt's Q_4 function	epsilon'	0.000500	0.000500	0.000500	
input #4 for Hunt's Q_4 function	lamda'	0.002589	0.002589	0.002589	



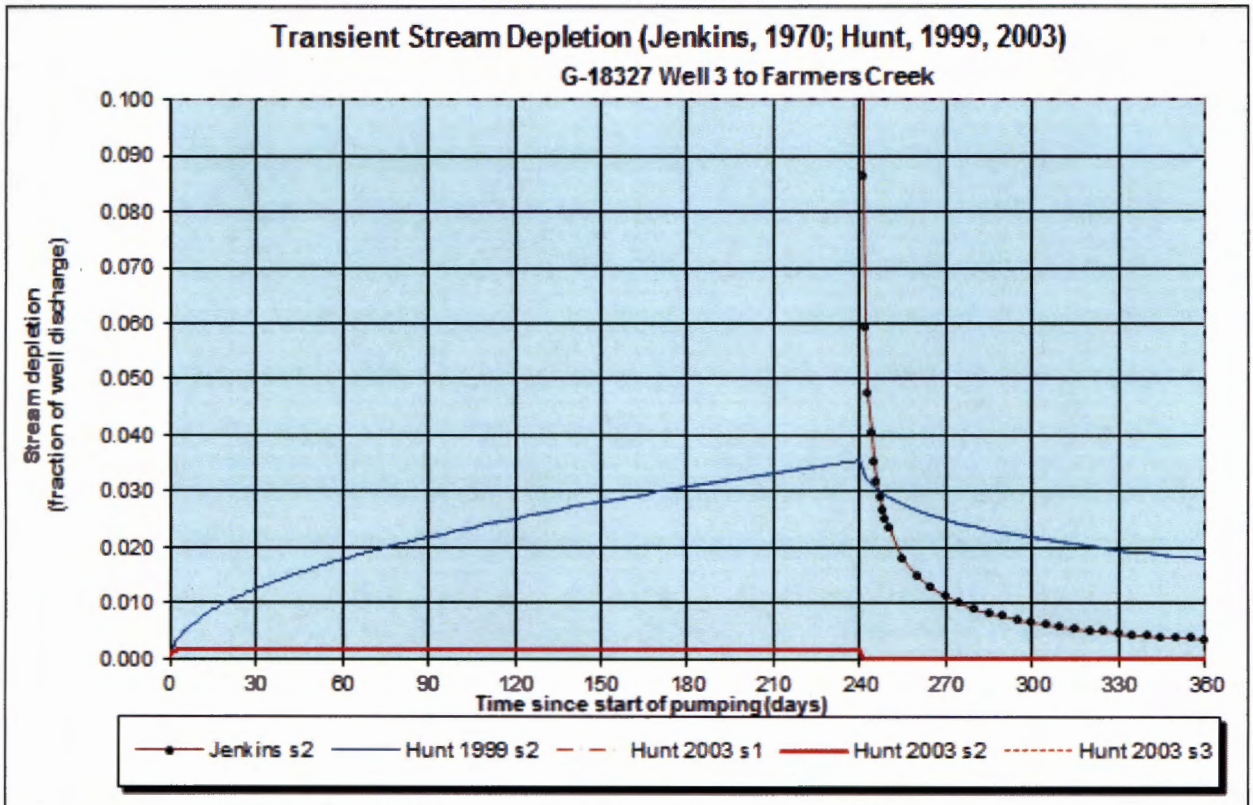
Output for Stream Depletion, Scenerio 2 (s2):	Time pump on (pumping duration) = 240 days											
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	95.5%	96.8%	97.4%	97.7%	98.0%	98.2%	98.3%	98.4%	3.0%	1.8%	1.2%	1.0%
H SD 1999	5.8%	8.2%	10.0%	11.4%	12.7%	13.8%	14.8%	15.7%	10.8%	9.1%	8.1%	7.3%
H SD 2003	0.58%	0.59%	0.60%	0.60%	0.61%	0.62%	0.63%	0.64%	0.06%	0.06%	0.06%	0.06%
Qw, cfs	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890
H SD 99, cfs	0.167	0.237	0.288	0.330	0.366	0.398	0.427	0.454	0.311	0.264	0.234	0.212
H SD 03, cfs	0.017	0.017	0.017	0.017	0.018	0.018	0.018	0.018	0.002	0.002	0.002	0.002

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	1297.00	1297.00	1297.00	gpm
Time pump on (pumping duration)	tpon	240	240	240	days
Perpendicular from well to stream	a	2595	2595	2595	ft
Well depth	d	140	140	140	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer saturated thickness	b	70	70	70	ft
Aquifer transmissivity	T	3500	3500	3500	ft*ft/day
Aquifer storativity or specific yield	S	0.0001	0.0001	0.0001	
Aquitard vertical hydraulic conductivity	Kva	0.01	0.01	0.01	ft/day
Aquitard saturated thickness	ba	80	80	80	ft
Aquitard thickness below stream	babs	40	40	40	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	50	50	50	ft
Streambed conductance (lambda)	sbc	0.012500	0.012500	0.012500	ft/day
Stream depletion factor	sdf	0.192401	0.192401	0.192401	days
Streambed factor	sbf	0.009268	0.009268	0.009268	
input #1 for Hunt's Q_4 function	t'	5.197486	5.197486	5.197486	
input #2 for Hunt's Q_4 function	K'	0.240501	0.240501	0.240501	
input #3 for Hunt's Q_4 function	epsilon'	0.000500	0.000500	0.000500	
input #4 for Hunt's Q_4 function	lamda'	0.009268	0.009268	0.009268	



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	97.0%	97.9%	98.3%	98.5%	98.7%	98.8%	98.9%	99.0%	2.0%	1.2%	0.8%	0.6%
H SD 1999	1.2%	1.8%	2.2%	2.5%	2.8%	3.1%	3.3%	3.5%	2.5%	2.2%	2.0%	1.8%
H SD 2003	0.14%	0.14%	0.14%	0.14%	0.15%	0.15%	0.15%	0.15%	0.01%	0.01%	0.01%	0.01%
Qw, cfs	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890	2.890
H SD 99, cfs	0.036	0.051	0.063	0.072	0.081	0.088	0.096	0.102	0.072	0.063	0.057	0.052
H SD 03, cfs	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.000	0.000	0.000	0.000

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	1297.00	1297.00	1297.00	gpm
Time pump on (pumping duration)	tpon	240	240	240	days
Perpendicular from well to stream	a	1700	1700	1700	ft
Well depth	d	140	140	140	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer saturated thickness	b	70	70	70	ft
Aquifer transmissivity	T	3500	3500	3500	ft*ft/day
Aquifer storativity or specific yield	S	0.0001	0.0001	0.0001	
Aquitard vertical hydraulic conductivity	Kva	0.01	0.01	0.01	ft/day
Aquitard saturated thickness	ba	80	80	80	ft
Aquitard thickness below stream	babs	40	40	40	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	10	10	10	ft
Streambed conductance (lambda)	sbc	0.002500	0.002500	0.002500	ft/day
Stream depletion factor	sdf	0.082571	0.082571	0.082571	days
Streambed factor	sbf	0.001214	0.001214	0.001214	
input #1 for Hunt's Q_4 function	t'	12.110727	12.110727	12.110727	
input #2 for Hunt's Q_4 function	K'	0.103214	0.103214	0.103214	
input #3 for Hunt's Q_4 function	epsilon'	0.000500	0.000500	0.000500	
input #4 for Hunt's Q_4 function	lamda'	0.001214	0.001214	0.001214	



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	98.3%	98.8%	99.0%	99.2%	99.2%	99.3%	99.4%	99.4%	1.1%	0.7%	0.5%	0.4%
H SD 1999	1.3%	1.8%	2.2%	2.5%	2.8%	3.1%	3.3%	3.6%	2.5%	2.2%	2.0%	1.8%
H SD 2003	0.16%	0.16%	0.16%	0.16%	0.17%	0.17%	0.17%	0.17%	0.01%	0.01%	0.01%	0.01%
Qw, cfs	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041
H SD 99, cfs	0.026	0.036	0.045	0.052	0.058	0.063	0.068	0.073	0.051	0.044	0.040	0.037
H SD 03, cfs	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.000	0.000	0.000	0.000

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	916.00	916.00	916.00	gpm
Time pump on (pumping duration)	tpon	240	240	240	days
Perpendicular from well to stream	a	970	970	970	ft
Well depth	d	299	299	299	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer saturated thickness	b	70	70	70	ft
Aquifer transmissivity	T	3500	3500	3500	ft*ft/day
Aquifer storativity or specific yield	S	0.0001	0.0001	0.0001	
Aquitard vertical hydraulic conductivity	Kva	0.01	0.01	0.01	ft/day
Aquitard saturated thickness	ba	80	80	80	ft
Aquitard thickness below stream	babs	40	40	40	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	10	10	10	ft
Streambed conductance (lambda)	sbc	0.002500	0.002500	0.002500	ft/day
Stream depletion factor	sdf	0.026883	0.026883	0.026883	days
Streambed factor	sbf	0.000693	0.000693	0.000693	
input #1 for Hunt's Q_4 function	t'	37.198427	37.198427	37.198427	
input #2 for Hunt's Q_4 function	K'	0.033604	0.033604	0.033604	
input #3 for Hunt's Q_4 function	epsilon'	0.000500	0.000500	0.000500	
input #4 for Hunt's Q_4 function	lamda'	0.000693	0.000693	0.000693	

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