# Groundwater Review Summary Form

**Application # G-** 18369

**GW Reviewer** DENNIS ORLOWSKI **Date Review Completed:** 5/2/2017

**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:**

[ ] 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** 5/2, 20 17

**TO:** **Application** G- 18369

**FROM:** **GW:** Dennis Orlowski
(Reviewer's Name)

**SUBJECT: Scenic Waterway Interference Evaluation**

☐ YES
The source of appropriation is within or above a Scenic Waterway
☒ NO

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

☐ 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 ______________ 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 05/02/2017

FROM: Groundwater Section — Dennis Orlowski (Reviewer's Name)

SUBJECT: Application G- 18369 — 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: **TSW Nursery Sales** County: **Marion**

A1. Applicant(s) seek(s) 1.0* cfs from two well(s) in the Willamette Basin, Mill Creek – Pudding River subbasin

A2. Proposed use Nursery (13.41 acres)* Seasonality: Year-round

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 414 | 1 | Alluvium | 1.0 | T4S,R1W-S11 NE-NW | 300' N, 245' W fr SE cor S 11 |
| 2 | Proposed | 2 | Alluvium | 1.0 | T4S,R1W-S11 NE-NW | 500' N, 755' W fr SE cor S 11 |

* 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 | 190 | 52 | 56 | 2/6/1982 | 126 | 0-25 | +1-126 | | None | 45 | ? | Air |
| 2 | 190 | TBD | TBD | TBD | 150* | 0-25* | ? | | ? | TBD | TBD | |

Use data from application for proposed wells.

A4. **Comments:**

***Note: for 13.41 acres of nursery use, only 1/40th of a cfs/acre would be permitted, which equates to a maximum allowable pumping rate of 0.335 cfs. Thus, although the applicant is requesting 1.0 cfs, technical analyses for this review instead used 0.335 cfs as a maximum allowable pumping rate.**

Both Well 1 (existing well MARI 414) and proposed Well 2 are located in the French Prairie region approximately ¾ mile northwest of Aurora, Oregon.

The well log for existing Well 1, MARI 414, indicates the well is located in the NW-NE section of Section 11. This appears to be incorrect, and should instead be the NE-NW section of Section 11, as corroborated by the correct address shown on the log, as well as tax lot and other location information shown on the application map.

The well log for Well 1 (MARI 414) states there are no screened or perforated sections, and thus presumably solid casing throughout the entire 126 ft depth, open only at the bottom.

**Note: well construction details shown for proposed Well 2 are as indicated on the permit application.

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: The wells produce/will produce groundwater from a confined aquifer, so the pertinent Willamette Basin 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 (annual measurement condition) and 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:**
Yields from nearby wells completed in the alluvial aquifer are typically low to moderate (50-250 gpm).

Water level data available from nearby alluvial wells show fairly stable trends over the past 15-20 years. However, in some nearby wells seasonal groundwater levels have fluctuated by as much as 25-30 feet (see hydrograph). Furthermore, the productive sand and gravel deposits are relatively thin, and well interference is likely to extend over broad areas due to the confined aquifer conditions (low storativity). Consequently, seasonal pumping interference between area wells is possible.

Also, there are two very nearby water rights with wells/POAs that are likely within 250 to 500 feet of this application's proposed wells: certificate 30014 (MARI 444/0.05 cfs) and groundwater claim GR-2053 (MARI 432/0.2228 cfs). Both of the nearby wells are completed to almost the same depth as this application's wells, so it is highly likely that all of the wells obtain/will obtain groundwater from the same water-bearing sand and gravel deposits.

Due to the nearby POAs and the potential for seasonal well interference, if a permit is issued the following conditions are recommended:

- 7N: annual measurement condition
- Large water-use reporting condition

## 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** | **Alluvium** | ☒ | ☐ |
| **2** | **Alluvium** | ☒ | ☐ |

**Basis for aquifer confinement evaluation:**

The log for Well 1 (existing well MARI 414) indicates that the well taps water-bearing sands and gravels that are confined by 80-90 ft of overlying low-permeability fine grained sediments (Willamette Silt). Well 2 is planned to be deeper than existing Well 1, so it will also be confined by a possibly greater thickness of fine-grained sediments. In the central Willamette Valley, Conlon and others (2005) report that fine-grained deposits (silt and clay) of 'more than 40 ft' thickness typically create confined conditions in the underlying water-bearing sand/gravel deposits.

Additionally, the reported static water level on the MARI 414 log and levels in nearby wells rise above the level of water-bearing layers.

These factors suggest that Well 1 (existing MARI 414) and Well 2 (proposed) produce groundwater 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** | **Deer Creek** | **130-135** | **130-135** | **2300** | ☒ | ☐ | ☐ | ☐ | ☒ |
| **2** | **1** | **Deer Creek** | **130-135** | **130-135** | **1750** | ☒ | ☐ | ☐ | ☐ | ☒ |
| **1** | **2** | **Pudding River** | **130-135** | **80-90** | **6000** | ☒ | ☐ | ☐ | ☐ | ☒ |
| **2** | **2** | **Pudding River** | **130-135** | **80-90** | **6500** | ☒ | ☐ | ☐ | ☐ | ☒ |

**Basis for aquifer hydraulic connection evaluation:**

**Wells 1 & 2 / SW1 (Deer Creek):** Groundwater level elevations in the alluvial aquifer at the Well 1 and 2 locations are essentially equivalent to the elevation range of Deer Creek (SW1) in the area. Furthermore, water table maps in the area indicate that groundwater in the alluvial aquifer system flows towards and discharges into local streams incised in the French Prairie plateau (Conlon and others, 2005; Gannett and Caldwell, 1998). These facts indicate that the alluvial aquifer and local streams are hydraulically connected.

Other streams within the same WAB are located from approximately 1 to1 ½ miles from the Well 1 and 2 locations, most notably Senecal Creek and minor unnamed tributaries to the southwest and south, and Mill Creek to the southeast and east. These other streams would also be impacted by pumping of Wells 1 and 2, but Deer Creek is the limiting case because the wells are/will be closer to it than the other streams.

**Wells 1 & 2 / SW2 (Pudding River):** The mainstem Pudding River (different WAB) is located just more than 1 mile east of both well locations. The elevation range of the Pudding in this reach is approximately 50-60 ft lower than groundwater elevations at Well 1 and 2. Also, water table maps show that groundwater flows towards, and discharges into, the Pudding River. These facts indicate hydraulic connection between the alluvial aquifer and the Pudding River.

The depletion of local streams by proposed Well 1 and Well 2 will be buffered, 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.

**Water Availability Basin the well(s) are located within:** SW1: Mill Creek > Pudding River – at mouth (Watershed ID 30200901); SW2: Pudding River > Molalla River – at mouth (Watershed ID 69998).

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 | ☐ | ☐ | | | ☐ | **1.88** | ☒ | **<<25%** | ☒ |
| 2 | 1 | ☐ | ☐ | | | ☐ | **1.88** | ☒ | **<<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:**

C3a: Potential depletion of SW1 (Deer Creek) by both Well 1 and Well 2 was estimated using the Hunt 2003 analytical stream depletion model (Hunt, 2003). Because distributed well discharge (Qw) was not specified in the application, both wells were simulated to pump the total Qw (0.335 cfs) for an entire year; two models were developed to simulate pumping of only one of the wells at a time. Aquifer parameters used for the models are typical of those reported for this hydrogeologic regime (Conlon and others, 2003, 2005; Iverson, 2002; Woodward and others, 1998); published parameter values were substantiated by derived results from nearby pumping tests (primarily from MARI 53448, which is nearest to the two well locations and similarly completed).

The Hunt 2003 analytical modeling results for both Well1/SW1 and Well 2/SW1 scenarios indicate that stream depletion is expected to be much less than 25% after 30 days of continuous pumping.

**C3b**: Not completed because Q is not distributed amongst the two wells in the application.

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 | 2 | % | % | % | % | % | % | % | % | % | % | % | % |
| Well Q as CFS | | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** | **0.335** |
| Interference CFS | | | | | | | | | | | | | |
| **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.** | | | | | | | | | | | | | |
| **(B) = 80 % Nat. Q** | | **1120** | **1260** | **1080** | **834** | **448** | **231** | **111** | **71.60** | **67.90** | **91.50** | **364** | **1010** |
| **(C) = 1 % Nat. Q** | | **11.20** | **12.60** | **10.80** | **8.34** | **4.48** | **2.31** | **1.11** | **0.716** | **0.679** | **0.915** | **3.64** | **10.10** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (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**: Because the limiting maximum pumping rate of 0.335 cfs (and not the requested rate of 1.0 cfs) is far lower than the lowest 1% of the 80% exceedance flows for SW2, analytical modeling was not required to estimate potential stream interference.

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**

Application file: G-18369

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: U.S. Geological Survey Scientific Investigations Report 2005-5168.

Conlon, T.D., Lee, K.K., and Risley, J.R., 2003, Heat tracing in streams in the central Willamette Basin, Oregon, *in* Stonestrom, D.A. and Constantz, Jim, eds., Heat as a tool for studying the movement of groundwater near streams: U.S. Geological Survey Circular 1260, chapter 5, p. 29-34.

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

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

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

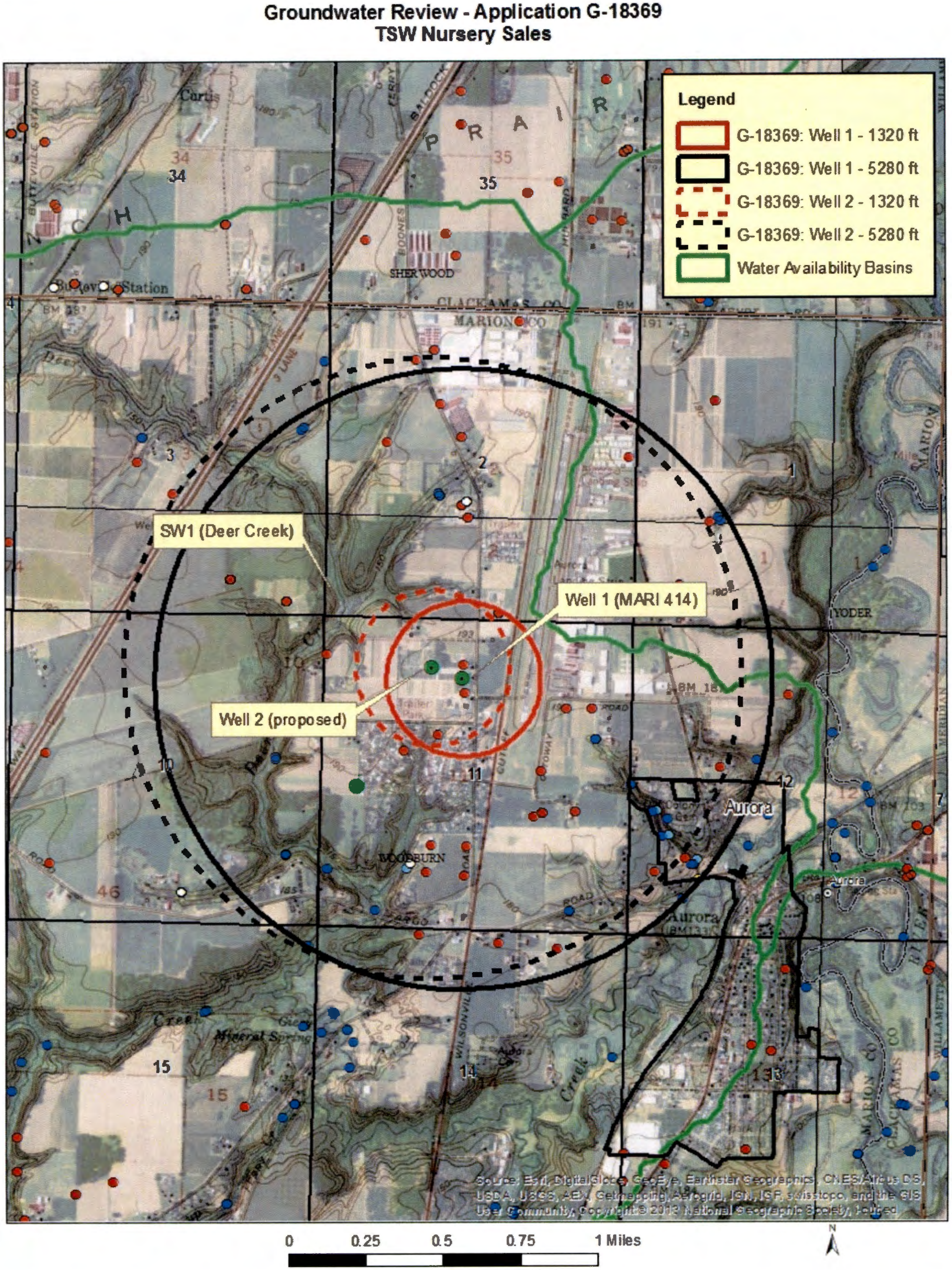
D1. **Well #:** ______________ **Logid:** ______________________________

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.**

**Well Location Map**



## Water Availability Tables

Oregon Water Resources Department
Water Availability Analysis

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# Water Availability Analysis
### Detailed Reports

MILL CR > PUDDING R - AT MOUTH
WILLAMETTE BASIN
Water Availability as of 3/9/2017

Watershed ID #: 30200901 (Map)
Date: 3/9/2017

Exceedance Level: 80%
Time: 9:24 AM

Water Availability Calculation | Consumptive Uses and Storages | Instream Flow Requirements | Reservations | Water Rights | Watershed Characteristics

### Water Availability Calculation

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

| Month | Natural Stream Flow | Consumptive Uses and Storages | Expected Stream Flow | Reserved Stream Flow | Instream Flow Requirement | Net Water Available |
|---|---|---|---|---|---|---|
| JAN | 39.20 | 9.91 | 29.30 | 0.00 | 0.00 | 29.30 |
| FEB | 53.90 | 10.10 | 43.80 | 0.00 | 0.00 | 43.80 |
| MAR | 38.40 | 9.61 | 28.80 | 0.00 | 0.00 | 28.80 |
| APR | 27.60 | 7.17 | 20.40 | 0.00 | 0.00 | 20.40 |
| MAY | 13.70 | 5.77 | 7.93 | 0.00 | 0.00 | 7.93 |
| JUN | 8.72 | 7.12 | 1.60 | 0.00 | 0.00 | 1.60 |
| JUL | 3.79 | 10.80 | -6.98 | 0.00 | 0.00 | -6.98 |
| AUG | 2.09 | 8.76 | -6.67 | 0.00 | 0.00 | -6.67 |
| SEP | 1.88 | 4.77 | -2.89 | 0.00 | 0.00 | -2.89 |
| OCT | 2.39 | 1.33 | 1.06 | 0.00 | 0.00 | 1.06 |
| NOV | 6.05 | 7.33 | -1.28 | 0.00 | 0.00 | -1.28 |
| DEC | 25.90 | 9.71 | 16.20 | 0.00 | 0.00 | 16.20 |
| ANN | 30,000.00 | 5,570.00 | 25,200.00 | 0.00 | 0.00 | 25,200.00 |

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Water Availability Analysis

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# Water Availability Analysis
### Detailed Reports

PUDDING R > MOLALLA R - AT MOUTH
WILLAMETTE BASIN
Water Availability as of 5/2/2017

Watershed ID #: 69998 (Map)
Date: 5/2/2017

Exceedance Level: 80%
Time: 11:04 AM

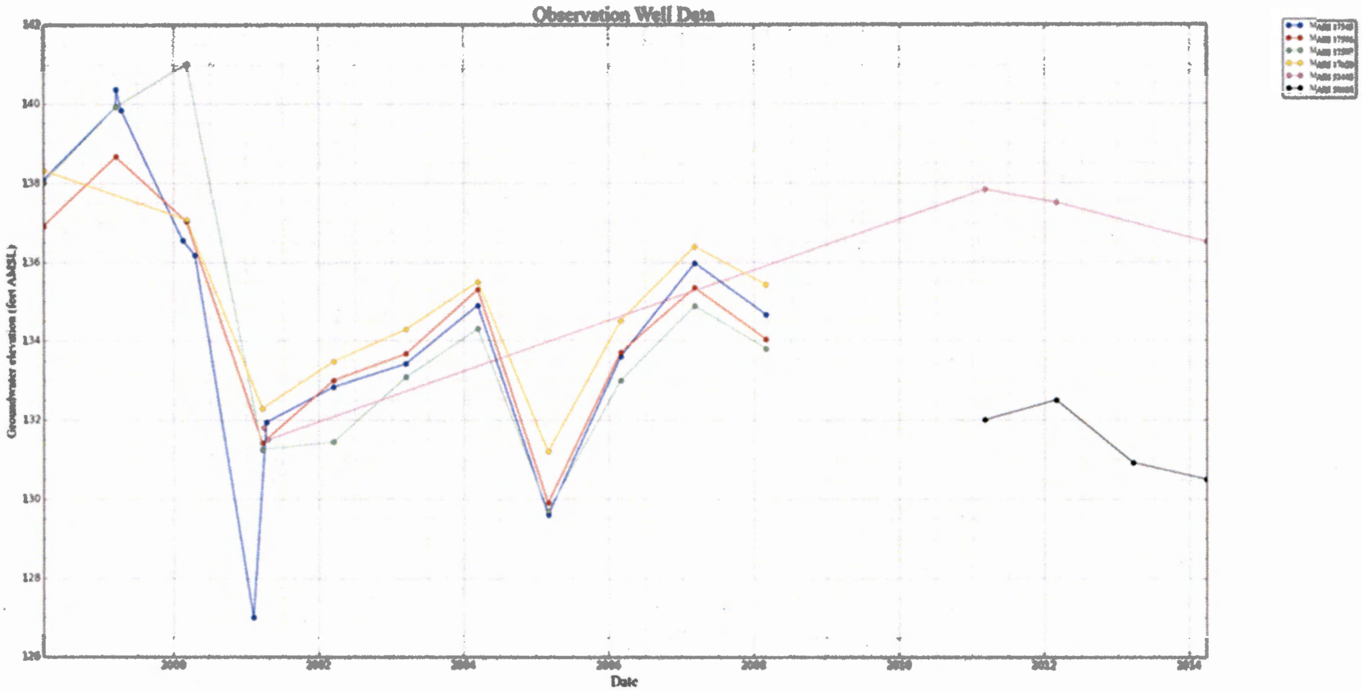
Water Availability Calculation | Consumptive Uses and Storages | Instream Flow Requirements | Reservations | Water Rights | Watershed Characteristics

### Water Availability Calculation

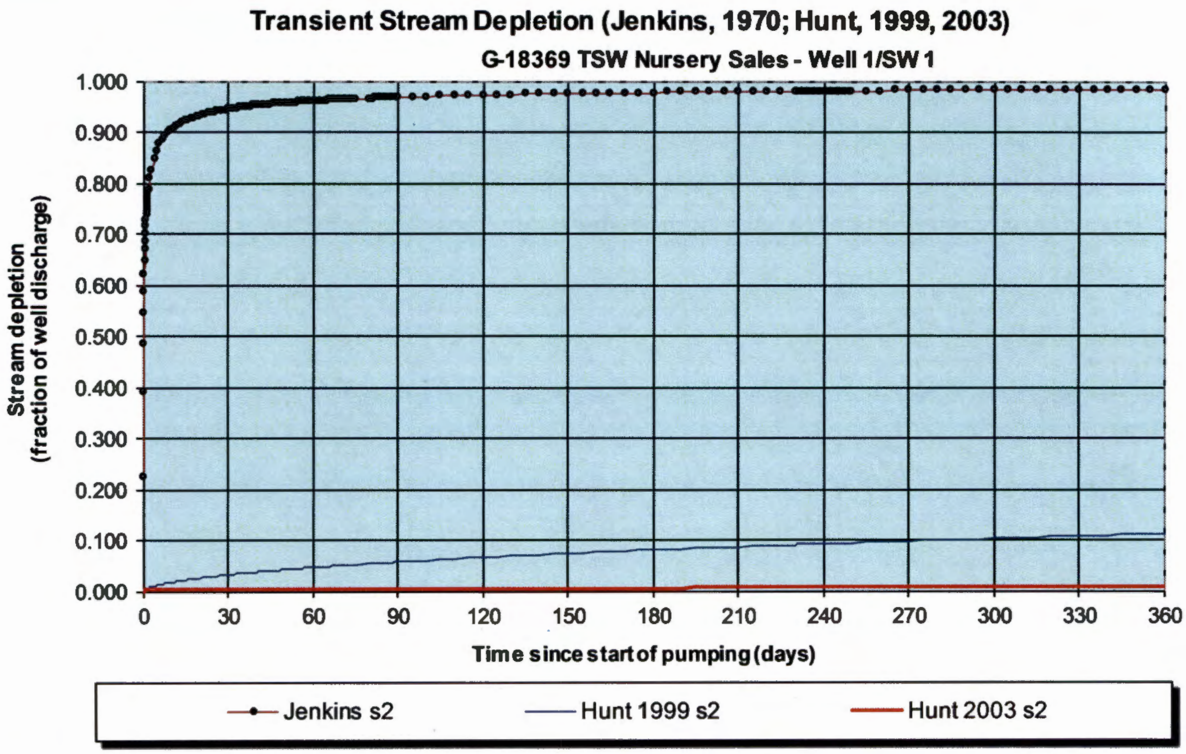
Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre-Feet

| Month | Natural Stream Flow | Consumptive Uses and Storages | Expected Stream Flow | Reserved Stream Flow | Instream Flow Requirement | Net Water Available |
|---|---|---|---|---|---|---|
| JAN | 1,120.00 | 128.00 | 992.00 | 0.00 | 80.00 | 912.00 |
| FEB | 1,260.00 | 119.00 | 1,140.00 | 0.00 | 80.00 | 1,060.00 |
| MAR | 1,080.00 | 86.30 | 994.00 | 0.00 | 80.00 | 914.00 |
| APR | 834.00 | 59.70 | 774.00 | 0.00 | 80.00 | 694.00 |
| MAY | 448.00 | 56.20 | 392.00 | 0.00 | 80.00 | 312.00 |
| JUN | 231.00 | 79.10 | 152.00 | 0.00 | 60.00 | 91.90 |
| JUL | 111.00 | 124.00 | -12.80 | 0.00 | 50.00 | -62.80 |
| AUG | 71.60 | 102.00 | -30.00 | 0.00 | 40.00 | -70.00 |
| SEP | 67.90 | 58.00 | 9.88 | 0.00 | 40.00 | -30.10 |
| OCT | 91.50 | 13.30 | 78.20 | 0.00 | 60.00 | 18.20 |
| NOV | 364.00 | 53.70 | 310.00 | 0.00 | 80.00 | 230.00 |
| DEC | 1,010.00 | 123.00 | 887.00 | 0.00 | 80.00 | 807.00 |
| ANN | 748,000.00 | 60,400.00 | 688,000.00 | 0.00 | 46,900.00 | 644,000.00 |

## Water-Level Trends in Nearby Wells

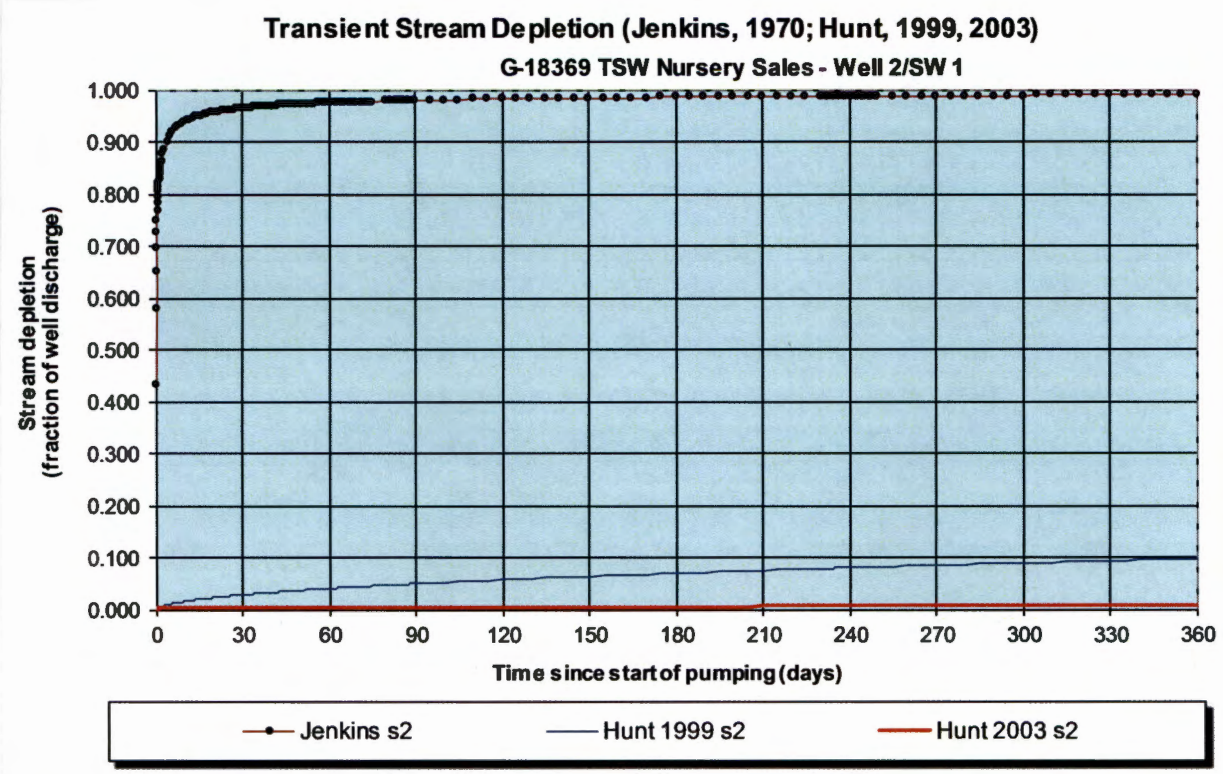


**Stream Depletion Model Results**




| Output for Stream Depletion, Scenerio 2 (s2): | | | | | Time pump on (pumping duration) = 365 days | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |
| J SD | 94.4% | 96.1% | 96.8% | 97.2% | 97.5% | 97.7% | 97.9% | 98.0% | 98.1% | 98.2% | 98.3% | 98.4% |
| H SD 1999 | 3.2% | 4.7% | 5.7% | 6.6% | 7.4% | 8.0% | 8.7% | 9.2% | 9.8% | 10.3% | 10.7% | 11.2% |
| H SD 2003 | 0.38% | 0.41% | 0.45% | 0.49% | 0.52% | 0.55% | 0.59% | 0.62% | 0.65% | 0.68% | 0.71% | 0.74% |
| Qw, cfs | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 |
| H SD 99, cfs | 0.011 | 0.016 | 0.019 | 0.022 | 0.025 | 0.027 | 0.029 | 0.031 | 0.033 | 0.034 | 0.036 | 0.037 |
| H SD 03, cfs | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |

| Parameters: | | Scenario 1 | Scenario 2 | Scenario 3 | Units |
|---|---|---|---|---|---|
| Net steady pumping rate of well | Qw | 0.34 | 0.34 | 0.34 | cfs |
| Time pump on (pumping duration) | tpon | 365 | 365 | 365 | days |
| Perpendicular from well to stream | a | 2300 | 2300 | 2300 | ft |
| Well depth | d | 126 | 126 | 126 | ft |
| Aquifer hydraulic conductivity | K | 100 | 500 | 1000 | ft/day |
| Aquifer saturated thickness | b | 36 | 36 | 36 | ft |
| Aquifer transmissivity | T | 3600 | 18000 | 36000 | ft*ft/day |
| Aquifer storativity or specific yield | S | 0.001 | 0.001 | 0.001 | |
| Aquitard vertical hydraulic conductivity | Kva | 0.1 | 0.1 | 0.1 | ft/day |
| Aquitard saturated thickness | ba | 100 | 100 | 100 | ft |
| Aquitard thickness below stream | babs | 40 | 40 | 40 | ft |
| Aquitard porosity | n | 0.2 | 0.2 | 0.2 | |
| Stream width | ws | 20 | 20 | 20 | ft |
| Streambed conductance (lambda) | sbc | 0.050000 | 0.050000 | 0.050000 | ft/day |
| Stream depletion factor | sdf | 1.469444 | 0.293889 | 0.146944 | days |
| Streambed factor | sbf | 0.031944 | 0.006389 | 0.003194 | |
| input #1 for Hunt's Q_4 function | t' | 0.680529 | 3.402647 | 6.805293 | |
| input #2 for Hunt's Q_4 function | K' | 1.469444 | 0.293889 | 0.146944 | |
| input #3 for Hunt's Q_4 function | epsilon' | 0.005000 | 0.005000 | 0.005000 | |
| input #4 for Hunt's Q_4 function | lamda' | 0.031944 | 0.006389 | 0.003194 | |




| Output for Stream Depletion, Scenerio 2 (s2): | | | | | | Time pump on (pumping duration) = 365 days | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Days | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |
| J SD | 96.4% | 97.5% | 97.9% | 98.2% | 98.4% | 98.5% | 98.6% | 98.7% | 98.8% | 98.9% | 98.9% | 99.0% |
| H SD 1999 | 2.8% | 4.1% | 5.0% | 5.7% | 6.4% | 7.0% | 7.5% | 8.0% | 8.5% | 8.9% | 9.3% | 9.7% |
| H SD 2003 | 0.38% | 0.42% | 0.45% | 0.48% | 0.51% | 0.54% | 0.57% | 0.60% | 0.63% | 0.65% | 0.68% | 0.70% |
| Qw, cfs | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 | 0.335 |
| H SD 99, cfs | 0.010 | 0.014 | 0.017 | 0.019 | 0.021 | 0.023 | 0.025 | 0.027 | 0.028 | 0.030 | 0.031 | 0.033 |
| H SD 03, cfs | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |

| Parameters: | | Scenario 1 | Scenario 2 | Scenario 3 | Units |
|---|---|---|---|---|---|
| Net steady pumping rate of well | Qw | 0.34 | 0.34 | 0.34 | cfs |
| Time pump on (pumping duration) | tpon | 365 | 365 | 365 | days |
| Perpendicular from well to stream | a | 1750 | 1750 | 1750 | ft |
| Well depth | d | 150 | 150 | 150 | ft |
| Aquifer hydraulic conductivity | K | 100 | 500 | 1000 | ft/day |
| Aquifer saturated thickness | b | 50 | 50 | 50 | ft |
| Aquifer transmissivity | T | 5000 | 25000 | 50000 | ft*ft/day |
| Aquifer storativity or specific yield | S | 0.001 | 0.001 | 0.001 | |
| Aquitard vertical hydraulic conductivity | Kva | 0.1 | 0.1 | 0.1 | ft/day |
| Aquitard saturated thickness | ba | 100 | 100 | 100 | ft |
| Aquitard thickness below stream | babs | 40 | 40 | 40 | ft |
| Aquitard porosity | n | 0.2 | 0.2 | 0.2 | |
| Stream width | ws | 20 | 20 | 20 | ft |
| Streambed conductance (lambda) | sbc | 0.050000 | 0.050000 | 0.050000 | ft/day |
| Stream depletion factor | sdf | 0.612500 | 0.122500 | 0.061250 | days |
| Streambed factor | sbf | 0.017500 | 0.003500 | 0.001750 | |
| input #1 for Hunt's Q_4 function | t' | 1.632653 | 8.163265 | 16.326531 | |
| input #2 for Hunt's Q_4 function | K' | 0.612500 | 0.122500 | 0.061250 | |
| input #3 for Hunt's Q_4 function | epsilon' | 0.005000 | 0.005000 | 0.005000 | |
| input #4 for Hunt's Q_4 function | lamda' | 0.017500 | 0.003500 | 0.001750 | |