Groundwater Application Review Summary Form

Application # G- 18412

GW Reviewer Gerald H. Grondin **Date Review Completed:** 21 September 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 **21 September 2017**

TO: **Application G- 18412**

FROM: **GW: Gerald H. Grondin**
(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 GROUND WATER APPLICATIONS

TO: Water Rights Section Date **21 September 2017**

FROM: Ground Water/Hydrology Section **Gerald H. Grondin**
Reviewer's Name

SUBJECT: Application G- **18412** 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 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: **Danny L. & Laurita Cron** County: **Lake**

A1. Applicant(s) seek(s) **2.77 cfs (1,243.26 gpm)** cfs from **2** well(s) in the **Goose & Summer Lakes** Basin, **Warner Lakes** subbasin Quad Map: **Plush & Friday Reservoir**

A2. Proposed use: **Supplemental Irrigation (427.7 acres)** Seasonality: **1 March to 31 October (245 days)**

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	LAKE 52694	116	Basalt	1.20	37S/24E-sec 16 BBA	80'S, 1330'W fr N qtr cor S 16
2	Not Drilled	117	Basalt	1.57	37S/24E-sec 09 CBA	2650'N, 1930'W fr N qtr cor S 16

* 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	4479	65	11.0	02/11/2016	431	0-78	+2-78	+3-357	117-357	750	?	Air
2	4475	**	**	**	**	**	**	**	**	**	**	**

Use data from application for proposed wells.

A4. **Comments:**

The application requests a total maximum pumping rate of 2.77 cfs (1,243 gpm) and a total maximum annual volume of 664.66 acre-feet from two wells to supplemental irrigate 427.7 acres (1.55 ac-ft per acre). The application proposes 1.20 cfs (540 gpm) and 288.75 ac-ft total annual volume for existing well LAKE 52694 (owner well 116) and 1.57 cfs (703 gpm) and 375.91 ac-ft total annual volume for the proposed well. The proposed maximum pumping rate and maximum annual volume are about half of what is typically allowed for 427.7 acres,

**** The proposed POA well (owner well 117) is anticipated to be similar to the existing well LAKE 52694 (owner well 116).**

A5. ☐ **Provisions of the in general OAR 690-513; particularly OAR 690-513-0040 (Warner Lakes sub-basin)** 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: _____

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

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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) **7B, 7F, 7N, 7P, 7T**;
   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:** _____

The state observation well with long term data (early 1960s to 2015) closest to the proposed POA well is state observation well 377 (well LAKE 1886) located in T36S/R24E-sec 33 abb about 2.3 to 2.8 miles north of the proposed POA wells. The water level data for the state observation well shows long term climate influences as well as annual seasonal influences. Before the 2000, peak annual groundwater levels were generally between 15 and 17 feet below land surface at the well. After 2001, the peak annual groundwater level has often been from 17 to 20 feet below land surface at the well. Climate may be partly to entirely responsible for the lower annual peak levels after 2001. Ongoing groundwater level measurements will help that determination.

The Theis equation was used to calculate the seasonal groundwater level drawdown at the closest POA well (apparently owned by the applicant) due to pumping the proposed POA wells. The calculations are shown in the attachments and the results are summarized in the table below. The calculations used the maximum distributed pumping rate at each proposed POA well and a pro-rated (maximum annual volume divided by the total annual pumping time period) distributed pumping rate at each proposed POA. The seasonal groundwater level drawdown will be less at wells further away from the proposed POA wells. The additional seasonal groundwater level drawdowns should be within the capacity of the neighboring wells.

Well	Elapsed Time (days)	Calculated Drawdown (feet) at Nearest POA Well			
		Full Proposed Rate	Drawdown (feet)	Pro-Rated Rate	Drawdown (feet)
POA 1	30	1.20 cfs	5.32	0.59 cfs	2.61
LAKE 52694	245	(540 gpm)	7.41	(265 gpm)	3.64
POA 2	30	1.57 cfs	4.75	0.77 cfs	2.34
Not Drilled Yet	245	(703 gpm)	7.46	(345 gpm)	3.67
Total	30	2.77 cfs	10.07	1.36 cfs	4.95
POA 1 & POA 2	245	(1243 gpm)	14.87	(610 gpm)	7.31

The Theis calculations used the following values:

Full pumping rate: 1.20 cfs (540 gpm) for POA 1 and 1.57 cfs (703 gpm) for POA 2 = 2.77 cfs (1,243 gpm)
Pro-rated pumping rate: 0.59 cfs (265 gpm) for POA 1 and 0.77 cfs (346 gpm) for POA 2 = 1.36 cfs (610 gpm),
Aquifer transmissivity = 8,300 ft2/day based on specific capacity of LAKE 1779, LAKE1825, LAKE 1839, & LAKE 4070. The value is within the range noted by Sammel and Craig (1981)
An intermediate storage coefficient = 0.001

If a permit is issued, the following conditions should be included: 7B, 7F, 7N, 7P, 7T, and

The "large" water use condition: (require a totalizing flow meter at each well. Each flow meter shall be located within 50 feet of the wellhead and adjacent to each flow meter shall be a clearly visible monument with a sign noting the flow meter. Lastly, require for every flow meter the reading, recording (monthly at minimum), and annual reporting of the flow meter data, all flow meters).

Special Condition for groundwater production: "All POA wells under this permit shall comply with existing well construction standards. Groundwater production shall occur from the predominantly basalt unit below the predominantly basin fill unit by continuous casing and continuous seal through the predominantly basin fill unit and into the predominantly basalt unit." The existing POA well (LAKE 52694) meets this condition.

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	Basalt (as proposed and required by permit condition)	☐	☒
2	Basalt (as proposed and required by permit condition)	☐	☒

Basis for aquifer confinement evaluation:

Walker and Repenning (1965) map the surface geology at the proposed POA wells as Qal (unconsolidated fluviatile gravel, sand, and silt). QTs (lacustrine, fluviatile, and Aeolian sedimentary rocks, interstratified tuff, ashy diatomite and unconsolidated clay, sand, and gravel), Tts (mostly fine-grained tuffaceous sedimentary rocks and tuffs representing flood plain or shallow lake deposits), and QTp (pyroclastic rocks of basaltic cinder cones) are exposed to the west of the wells. Basalt (Tb) is exposed in the uplands to the west and southeast of the wells.

The groundwater system is identified as generally unconfined with discontinuous low permeability layers causing local (discontinuous, limited) confinement. Generally, lower transmissivity (lower permeability) sediment (predominantly basin-fill sediment unit) of varying thickness overlies higher transmissivity (higher permeability) basalt (predominantly basalt unit). Groundwater occurs in both the predominantly basin-fill sediment unit and the predominantly basalt unit. Groundwater is vertically connected within each unit and between each unit. This is based upon investigations by Sammel and Craig (1981) for Warner Valley, Morgan (1988) for Goose Lake Valley and Miller (1984 and 1986) for the Fort Rock and Christmas Valley area. Sammel and Craig (1981) particularly note the similarity of the hydrogeology in the Warner Lakes Valley to the Klamath Basin.

The predominant basin-fill sediment unit thickness can vary. For example, the depth to the top of the predominantly basalt unit is about 65 feet at the proposed POA well LAKE 52694; the depth to the top of the predominantly basalt unit is 152 feet at state observation well 377 (well LAKE 1886) located about 2.3 to 2.8 miles north of the proposed POA wells; the depth to the top of the predominantly basalt unit exceeds 640 feet (below well bottom) at well LAKE 4281 located about 5.9 to 6.3 miles northeast of the proposed POA wells.

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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	Hart Lake	4469	4473	4630	☒	☐	☐	☐	☒
2	1	Hart Lake	4469	4473	4430	☒	☐	☐	☐	☒
1	2	Honey Creek	4469	4505	18200	☒	☐	☐	☐	☒
2	2	Honey Creek	4469	4505	15450	☒	☐	☐	☐	☒
1	3	Fish Cr. below Priday Res.	4469	4480	285	☒	☐	☐	☒	☐
2	3	Fish Cr. below Priday Res.	4469	4475	510	☒	☐	☐	☒	☐
1	4	Priday Reservoir	4469	4653	8960	☒	☐	☐	☐	☒
2	4	Priday Reservoir	4469	4653	11725	☒	☐	☐	☐	☒

Basis for aquifer hydraulic connection evaluation:

Available reports indicate groundwater and surface water are connected in the Warner Lakes Valley, and groundwater flows from south to north in the valley.

The groundwater elevation in the table is based on the driller reported static groundwater level at proposed POA well 1 (well LAKE 52694, owner well 116), and it is likely within the south to north groundwater gradient.

Hart Lake appears to be coincident with groundwater.

The POA distance to Honey Creek is to eastern end of the perennial flow portion of the creek. The stream elevation is for the perennial portion north and west of Plush. The groundwater elevation in that vicinity appears to be coincident with the perennial end portion of the creek, and then likely slopes east and north to the Warner Lakes Valley lakes.

The Fish Creek channel passes through Priday Reservoir. The USGS topographic Priday Reservoir map (1:24,000 scale) and GIS coverage of high resolution (1:24,000 scale) hydrography indicate Fish Creek above and below Priday Reservoir is an intermittent or seasonal stream that appears to be dry during certain times of the year. The applicants further noted stream flow during the 2014 and 2015 droughts was insufficient to allow any irrigation by surface water. Conversely, OWRD water availability data for FISH CR > HART L – AT MOUTH (80 percent exceedance) indicates a perennial stream with some natural flow all 12 months ranging from 0.19 cfs (85 gpm) in October to 3.21 cfs (1440 gpm) in May. Additionally, 6 surface water right certificates were found: 2 for storage, 1 for supplemental irrigation (401.5 acres) and 3 for primary irrigation (434.55 acres total). The applicants note they hold at least 2 of the certificates.

This review is obligated to use the current OWRD water availability data until such time that OWRD surface water hydrologists obtain sufficient data that meets certain criteria to change the OWRD water availability data.

Under OAR 690-009-040, this review is required to make a finding of an assumed potential for substantial interference given OWRD water availability data for FISH CR > HART L – AT MOUTH (80 percent exceedance) indicates a perennial stream with some natural flow all 12 months, the proposed POA wells are determined to be hydraulically connected to the stream, and the horizontal distance from the proposed POA wells to the stream is less than 0.25 miles.

Water Availability Basin the well(s) are located within: FISH CR > HART L – AT MOUTH
Are adjacent and hydraulically connected to: HONEY CR > HART L – 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?
1	3	☒	☐	None	None	☐	0.19	☒	1.0	☒
2	3	☒	☐	None	None	☐	0.19	☒	0.9	☒

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?
	3		☐	None	None	☐	0.19	☒	0.96	☒

Comments:

The wells are less than 1.0 mile from Fish Creek. Under OAR 690-009-040, this review is required to make a finding of an assumed potential for substantial interference given OWRD water availability data for FISH CR > HART L – AT MOUTH (80 percent exceedance) indicates a perennial stream with some natural flow all 12 months, the proposed POA wells are determined to be hydraulically connected to the stream, the horizontal distance from the proposed POA wells to the stream is less than 0.25 miles, and the proposed individual pumping rate at each POA well as well as the proposed combined pumping rate exceeds the one-percent of the natural flow (80-percent exceedance). Hunt 2003 was used to calculate the groundwater pumping interference of both proposed POA 1 and POA 2 with Fish Creek (see attachments). The Hunt 2003 calculation used a pro-rated pumping rate only (the proposed total volume per well divided by the total proposed time of pumping) for each POA well.

The proposed POA wells are less than 1.0 mile from Hart Lake also. Use of Hunt 1999 or 2003 is not appropriate for this case. The Theis equation (Theis, 1935) was used to calculate the groundwater level drawdown at Hart Lake. The Theis calculations used both the proposed full pumping rate and the pro-rated pumping rates for each POA well. The calculated drawdowns are shown in the table below.

Well	Elapsed Time (days)	Calculated Drawdown (feet) at Hart Lake			
		Full Proposed Rate	Drawdown (feet)	Pro-Rated Rate	Drawdown (feet)
POA 1 LAKE 52694	30	1.20 cfs (540 gpm)	3.27	0.59 cfs (265 gpm)	1.61
	245		5.35		2.62
POA 2 Not Drilled Yet	30	1.57 cfs (703 gpm)	4.37	0.77 cfs (345 gpm)	2.15
	245		7.07		3.48
Total POA 1 & POA 2	30	2.77 cfs (1243 gpm)	7.64	1.36 cfs (610 gpm)	3.76
	245		12.42		6.10

Regarding the other water bodies, the proposed POAs are more than 1.0 mile from Priday Reservoir and Honey Creek.

Both the Hunt 2003 and the Theis calculations used the following values:

Pro-rated pumping rate: 0.59 cfs (265 gpm) for POA 1 and 0.77 cfs (346 gpm) for POA 2 = 1.36 cfs (610 gpm),
Aquifer transmissivity = 8,300 ft2/day based on specific capacity of LAKE 1779, LAKE1825, LAKE 1839, & LAKE 4070. The value is within the range noted by Sammel and Craig (1981)
An intermediate storage coefficient = 0.001

Hunt 2003 calculations additionally used:

Used, sediment hydraulic conductivity Kv = 1.00 ft/day (based well LAKE 4281)
Used sediment thickness below creek = 65 feet (based on proposed POA well 1 = LAKE 52694)
Used stream width = 10 feet.

Theis calculations additionally used:

Full pumping rate: 1.20 cfs (540 gpm) for POA 1 and 1.57 cfs (703 gpm) for POA 2 = 2.77 cfs (1,243 gpm)

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
1	**2**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**
Well Q as CFS		**0.00**	**0.00**	**0.59**	**0.59**	**0.59**	**0.59**	**0.59**	**0.59**	**0.59V**	**0.59**	**0.00**	**0.00**
Interference 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**
2	**2**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**	**0.0 %**
Well Q as CFS		**0.00**	**0.00**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**	**0.00**	**0.00**
Interference 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**
(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		**5.06**	**6.64**	**12.6**	**41.5**	**53.8**	**26.8**	**4.32**	**2.27**	**2.07**	**2.14**	**3.01**	**3.74**
(C) = 1 % Nat. Q		**0.0506**	**0.0664**	**0.1260**	**0.4150**	**0.5380**	**0.2680**	**0.0432**	**0.0227**	**0.0207**	**0.0214**	**0.0301**	**0.0374**
(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:

Analysis is done in this section given the proposed POA wells are more than 1.0 mile from Honey Creek and Priday Reservoir.

The Table above was used for interference with Honey Creek only given it is the water body greater than 1-mile from the POA wells with water availability data. Hunt (2003) was used to calculate the interference. A pro-rated pumping rate of 0.59 cfs (265 gpm) was used for proposed POA well 1 (LAKE 52694) and 0.77 cfs (345 gpm) was used for proposed POA well 2. The pro-rated rate is the maximum annual volume of water allowed divided the total annual time. This distributes the pumping over the entire proposed irrigation season. The results of 0.00% and 0.000 cfs indicate the calculated interference was less than 0.0005 cfs.

The Theis equation (Theis, 1935) was used to calculate the groundwater level drawdown at Priday Reservoir. The calculated drawdowns are shown in the table below.

Well	Elapsed Time (days)	Calculated Drawdown (feet) at Priday Reservoir			
		Full Proposed Rate	Drawdown (feet)	Pro-Rated Rate	Drawdown (feet)
POA 1	30	1.20 cfs	2.01	0.59 cfs	0.99
LAKE 52694	245	(540 gpm)	4.03	(265 gpm)	1.98
POA 2	30	1.57 cfs	1.99	0.77 cfs	0.98
Not Drilled Yet	245	(703 gpm)	4.57	(345 gpm)	2.25
Total	30	2.77 cfs	4.00	1.36 cfs	1.97
POA 1 & POA 2	245	(1243 gpm)	8.60	(610 gpm)	4.23

Both the Hunt 2003 and the Theis calculations used the following values:

Used pro-rated pumping rate = 0.59 cfs (265 gpm) for POA 1 and 0.77 cfs (346 gpm) for POA 2.
Used aquifer transmissivity = 8,300 ft2/day based on specific capacity of LAKE 1779, LAKE1825, LAKE 1839, & LAKE 4070. The value is within the range noted by Sammel and Craig (1981)
Used, an intermediate storage coefficient = 0.001

Hunt 2003 calculations additionally used:

Used, sediment hydraulic conductivity Kv = 1.00 ft/day (based well LAKE 4281)
Used sediment thickness below creek = 150 feet (based on LAKE 1886 near Honey Creek)
Used stream width = 20 feet.

Theis calculations additionally used:

Full pumping rate: 1.20 cfs (540 gpm) for POA 1 and 1.57 cfs (703 gpm) for POA 2 = 2.77 cfs (1,243 gpm)

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) **7B, 7F, 7N, 7P, 7T, and other (see below)**;
- ii. ☒ The permit should contain special condition(s) as indicated in "Remarks" below;

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

If a permit is issued, the following conditions should be included: 7B, 7F, 7N, 7P, 7T, and

Special Groundwater Reference Level Condition: "The Groundwater Reference Level at proposed the POA well (LAKE 52568) shall be 5.75 feet below land surface based on the 18 march 2015 measurement at that well."

The "large" water use condition: (require a totalizing flow meter at each well. Each flow meter shall be located within 50 feet of the wellhead and adjacent to each flow meter shall be a clearly visible monument with a sign noting the flow meter. Lastly, require for every flow meter the reading, recording (monthly at minimum), and annual reporting of the flow meter data, all flow meters).

Special Condition for groundwater production: "All POA wells under this permit shall comply with existing well construction standards. Groundwater production shall occur from the predominantly basalt unit below the predominantly basin fill unit by continuous casing and continuous seal through the predominantly basin fill unit and into the predominantly basalt unit." The proposed POA well (LAKE 52568) meets this condition.

The groundwater system is identified as generally unconfined with discontinuous low permeability layers causing local (discontinuous, limited) confinement. Generally, lower transmissivity (lower permeability) sediment (predominantly basin-fill sediment unit) of varying thickness overlies higher transmissivity (higher permeability) basalt (predominantly basalt unit). Groundwater occurs in both the predominantly basin-fill sediment unit and the predominantly basalt unit. Groundwater is vertically connected within each unit and between each unit. This is based upon investigations by Sammel and Craig (1981) for Warner Valley, Morgan (1988) for Goose Lake Valley and Miller (1984 and 1986) for the Fort Rock and Christmas Valley area. Sammel and Craig (1981) particularly note the similarity of the hydrogeology in the Warner Lakes Valley to the Klamath Basin.

References Used:

References consulted were:

Hampton, E.R., 1964, Geologic factors that control the occurrence and availability of ground water in the Fort Rock Basin, Lake County, Oregon: USGS Professional Paper 383-B, 29 p.

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

McFarland, W.D. and Ryals, G.N., 1991, Adequacy of available hydrogeologic data for evaluation of declining ground-water levels in the Fort Rock Basin, south-central Oregon: USGS Water Resources Investigations Report 89-4057, 47 p.

Miller, D.W., 1984, Appraisal of ground-water conditions in the Fort Rock Basin, Lake County, Oregon: OWRD Open File Report, 157 p.

Miller, D.W., 1986, Ground-water conditions in the Fort Rock Basin, northern Lake County, Oregon: OWRD Ground Water Report No. 31, 196 p.

Morgan, D.S., 1988, Geohydrology and numerical model analysis of ground-water flow in the Goose Lake Basin, Oregon and California: USGS Water Resources Investigations Report 87-4058, 92 p.

Oregon Water Resources Department, 1989, Goose and Summer Lakes Basin report: OWRD Basin Report, 112 p.

Peterson, N.V. and McIntyre, J.R., 1970, The reconnaissance geology and mineral resources of eastern Klamath County and western Lake County, Oregon: DOGAMI Bulletin 66, 70 p.

Phillips, K.N. and VanDenburgh, A.S., 1971, Hydrology and geochemistry of Abert, Summer, and Goose Lakes, and other closed-basin lakes in south-central Oregon: USGS Professional Paper 502-B, 86p.

Sammel, E.A. and Craig, R.W., 1981, The geothermal hydrology of Warner Valley, Oregon: a reconnaissance study: USGS Professional Paper 1044-I, 147 p.

Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. American Geophysical Union Transactions, 16 annual meeting, vol. 16, pg. 519-524.

Walker, G.W., 1963, Reconnaissance geologic map of the eastern half of the Klamath Falls (AMS) quadrangle, Lake and Klamath Counties, Oregon: USGS Mineral Investigations Field Studies Map MF-260.

Walker, G.W. and Repenning, C.A., 1965, Reconnaissance geologic map of the Adel quadrangle, Lake, Klamath, and Malheur Counties, Oregon: USGS Miscellaneous Geologic Investigations Map I-446.

Walker, G.W., 1973, Preliminary geologic and tectonic maps of Oregon east of the 121st meridian: USGS Miscellaneous Field Studies Map MF-495

Waring, G.A., 1908, Geology and water resources of a portion of south-central Oregon: USGS Water Supply Paper 220, 85 p.

Goose and Summer Lakes Basin Program rules (OAR 690-513).

State Obesrvation Wells SOW 377 (LAKE 1886).

Water well reports for wells in Township 35 & 36 South/Range 24 & 25 East

USGS Plush and Hart Lake quad maps (1:24,000 scale)

D. WELL CONSTRUCTION, OAR 690-200

D1. Well #: 1 Logid: LAKE 52694
Well #: 2 Logid: Not Drilled Yet

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) _____

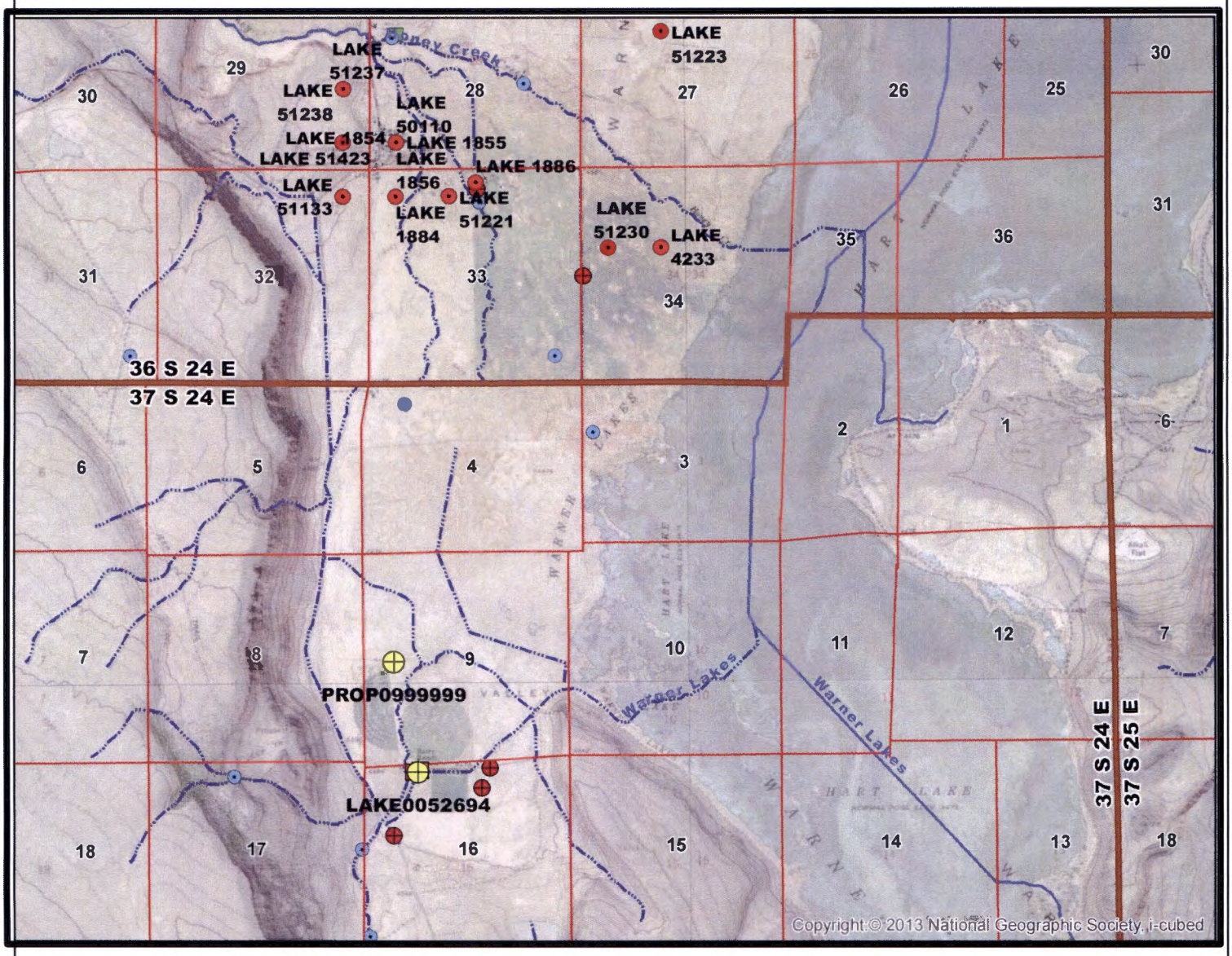
D3. **THE WELL construction deficiency or other comment is described as follows:** _____

Special Condition for groundwater production: "All POA wells under this permit shall comply with existing well construction standards. Groundwater production shall occur from the predominantly basalt unit below the predominantly basin fill unit by continuous casing and continuous seal through the predominantly basin fill unit and into the predominantly basalt unit." The existing POA well (LAKE 52694) meets this condition.

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

Water Availability Tables
Other Attachments

Groundwater Permit Application G-18412
Danny L. & Laurita L. Cron



0 0.5 1 2
Miles

Yellow = Application Noted Well(s)
Red = Other Existing or Proposed Wells

Blue and Other = surface water rights

N

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

LAKE 52694

2/25/2016

WELL I.D. LABEL# L 120022
START CARD # 1029089
ORIGINAL LOG #

(1) LAND OWNER

Owner Well I.D.
First Name DANNY L. Last Name CRON
Company LAURITA L. CRON
Address 26277 PLUSH ADEL RD.
City PLUSH State OR Zip 97637

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Conversion [ ] Alteration (complete 2a & 10) [ ] Abandonment(complete 5a)

(2a) PRE-ALTERATION

	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
Casing:									

	Material	From	To	Amt	sacks/lbs
Seal:					

(3) DRILL METHOD

[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger [ ] Cable Mud
[ ] Reverse Rotary [ ] Other

(4) PROPOSED USE

[ ] Domestic [X] Irrigation [ ] Community
[ ] Industrial/ Commericial [ ] Livestock [ ] Dewatering
[ ] Thermal [ ] Injection [ ] Other

(5) BORE HOLE CONSTRUCTION

Special Standard [ ] (Attach copy)
Depth of Completed Well 431.00 ft.

BORE HOLE

Dia	From	To
24	0	78
16	78	357
12	357	431

SEAL

Material	From	To	Amt	sacks/lbs
Bentonite Chips	0	15	11	S
		Calculated	11	
Cement	15	78	68	S
		Calculated	65	

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[X] Other POURED DRY
Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size
Explosives used: [ ] Yes Type Amount

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
(•)	( )	16	[X]	2	78	.250	(•)	( )	[X]	[ ]
( )	(•)	12	[X]	3	357	.250	(•)	( )	[X]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]

Shoe [ ] Inside [ ] Outside [ ] Other Location of shoe(s)
Temp casing [ ] Yes Dia From To

(7) PERFORATIONS/SCREENS

Perforations Method plasma cutter
Screens Type Material

Perf/ Screen	Casing/ Screen Liner	Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
Perf	Liner	12	117	357	.25	3	5928	

(8) WELL TESTS: Minimum testing time is 1 hour

( ) Pump ( ) Bailer (•) Air ( ) Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
750		220	2

Temperature 63 °F Lab analysis [ ] Yes By
Water quality concerns? [ ] Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)

County LAKE Twp 37.00 S N/S Range 24.00 E E/W WM
Sec 16 NW 1/4 of the NW 1/4 Tax Lot 1500
Tax Map Number Lot
Lat ° ' " or DMS or DD
Long ° ' " or DMS or DD
( ) Street address of well (•) Nearest address
26277 PLUSH ADEL RD.
PLUSH, OR.

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration				
Completed Well	2/12/2016			11

Flowing Artesian? [ ] Dry Hole? [ ]

WATER BEARING ZONES Depth water was first found 65.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
2/12/2016	65	425	750			11

(11) WELL LOG

Ground Elevation

Material	From	To
topsoil	0	3
sandy clay	3	12
sandy soil/small gravel	12	38
basalt	38	45
sandy clay	45	53
sandy clay w/gravel	53	65
broken basalt	65	70
baslat	70	82
broken basalt	82	91
broken red lava	91	97
hard fractured basalt	97	102
broken basalt/soft tan claystone	102	109
hard broken basalt	109	117
basalt w/red claystone	117	123
hard fractured basalt	123	147
broken basalt w/tan claystone	147	158
hard fractured basalt	158	162
soft claystone/sandstone conglomerate	162	170
hard broken basalt	170	175

Date Started 12/14/2015 Completed 2/11/2016

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 1940 Date 2/25/2016
Signed BENJAMIN FRY (E-filed)

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

License Number 1355 Date 2/25/2016
Signed ARTHUR L FRY (E-filed)
Contact Info (optional)

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version:

WATER SUPPLY WELL REPORT - continuation page

LAKE 52694

2/25/2016

WELL I.D. LABEL# L	120022
START CARD #	1029089
ORIGINAL LOG #	

(2a) PRE-ALTERATION

Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

Material	From	To	Amt	sacks/lbs

Water Quality Concerns

From	To	Description	Amount	Units

(5) BORE HOLE CONSTRUCTION

BORE HOLE Dia	From	To

SEAL Material	From	To	Amt	sacks/lbs
		Calculated		
		Calculated		
		Calculated		
		Calculated		

FILTER PACK

From	To	Material	Size

(10) STATIC WATER LEVEL

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(6) CASING/LINER

Casing Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

(11) WELL LOG

Material	From	To
broken basalt w/tan claystone	175	178
hard broken basalt	178	189
broken basalt w/tan claystone	189	191
hard fractured basalt	191	201
broken basalt w/red claystone	201	220
red sandstone	220	222
broken basalt	222	284
soft red claystone	284	302
broken basalt w/tan claystone	302	312
hard fractured basalt	312	318
soft fractured tan claystone	318	322
broken red claystone	322	336
soft sandstone, sand and gravel	336	425
hard basalt	425	431

(7) PERFORATIONS/SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size

Comments/Remarks

(8) WELL TESTS: Minimum testing time is 1 hour

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Oregon Water Resources Department
Water Availability Analysis

Main Help
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Water Availability Analysis

FISH CR > HART L - AT MOUTH
GOOSE & SUMMER LAKE BASIN
Water Availability as of 9/20/2017

Watershed ID #: 31300709 (Map)
Date: 9/20/2017

Exceedance Level: 80%
Time: 8:50 AM

Download Data

Water Availability

Select any Watershed for Details

Nesting Order	Watershed ID #	Stream Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sto
1	31300709	FISH CR> HART L- AT MOUTH	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes

Limiting Watersheds

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

Month	Limiting Watershed ID #	Stream Name	Water Available?	Net Water Available
JAN	31300709	FISH CR > HART L - AT MOUTH	Yes	0.47
FEB	31300709	FISH CR > HART L - AT MOUTH	Yes	0.81
MAR	31300709	FISH CR > HART L - AT MOUTH	Yes	1.76
APR	31300709	FISH CR > HART L - AT MOUTH	Yes	2.50
MAY	31300709	FISH CR > HART L - AT MOUTH	Yes	1.97
JUN	31300709	FISH CR > HART L - AT MOUTH	Yes	0.62
JUL	31300709	FISH CR > HART L - AT MOUTH	No	-0.69
AUG	31300709	FISH CR > HART L - AT MOUTH	No	-0.55
SEP	31300709	FISH CR > HART L - AT MOUTH	No	-0.31
OCT	31300709	FISH CR > HART L - AT MOUTH	No	-0.02
NOV	31300709	FISH CR > HART L - AT MOUTH	Yes	0.27
DEC	31300709	FISH CR > HART L - AT MOUTH	Yes	0.41
ANN	31300709	FISH CR > HART L - AT MOUTH	Yes	1,560.00

Detailed Reports for Watershed ID #31300709

FISH CR > HART L - AT MOUTH
GOOSE & SUMMER LAKE BASIN
Water Availability as of 9/20/2017

Watershed ID #: 31300709 (Map)
Date: 9/20/2017

Exceedance Level: 80%
Time: 8:50 AM

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	0.47	0.00	0.47	0.00	0.00	0.47
FEB	0.82	0.01	0.81	0.00	0.00	0.81
MAR	1.84	0.08	1.76	0.00	0.00	1.76
APR	3.20	0.70	2.50	0.00	0.00	2.50
MAY	3.21	1.24	1.97	0.00	0.00	1.97
JUN	1.89	1.27	0.62	0.00	0.00	0.62
JUL	0.54	1.23	-0.69	0.00	0.00	-0.69
AUG	0.37	0.92	-0.55	0.00	0.00	-0.55
SEP	0.34	0.65	-0.31	0.00	0.00	-0.31
OCT	0.19	0.21	-0.02	0.00	0.00	-0.02
NOV	0.27	0.00	0.27	0.00	0.00	0.27
DEC	0.41	0.00	0.41	0.00	0.00	0.41
ANN	1,880.00	383.00	1,560.00	0.00	0.00	1,560.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FEB	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
MAR	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.08
APR	0.04	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.70
MAY	0.03	1.21	0.00	0.00	0.00	0.00	0.00	0.00	1.24
JUN	0.01	1.26	0.00	0.00	0.00	0.00	0.00	0.00	1.27
JUL	0.00	1.23	0.00	0.00	0.00	0.00	0.00	0.00	1.23
AUG	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.92
SEP	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.65
OCT	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.21
NOV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DEC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detailed Report of Reservations for Storage and Consumptive Uses

Reserved Streamflow in Cubic Feet per Second

No reservations were found for this watershed.

Detailed Report of Instream Flow Requirements

Instream Flow Requirements in Cubic Feet per Second

No instream flow requirements were found for this watershed.

Oregon Water Resources Department
Water Availability Analysis

Main Help
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Water Availability Analysis

HONEY CR > HART L - AT MOUTH
GOOSE & SUMMER LAKE BASIN
Water Availability as of 9/20/2017

Watershed ID #: 31300713 (Map)
Date: 9/20/2017

Exceedance Level: 80%
Time: 9:17 AM

Download Data

Water Availability

Select any Watershed for Details

Nesting Order	Watershed ID #	Stream Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sto
1	31300713	HONEY CR> HART L- AT MOUTH	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Limiting Watersheds

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

Month	Limiting Watershed ID #	Stream Name	Water Available?	Net Water Available
JAN	31300713	HONEY CR > HART L - AT MOUTH	Yes	4.85
FEB	31300713	HONEY CR > HART L - AT MOUTH	Yes	6.32
MAR	31300713	HONEY CR > HART L - AT MOUTH	Yes	10.50
APR	31300713	HONEY CR > HART L - AT MOUTH	Yes	33.10
MAY	31300713	HONEY CR > HART L - AT MOUTH	Yes	33.60
JUN	31300713	HONEY CR > HART L - AT MOUTH	Yes	11.30
JUL	31300713	HONEY CR > HART L - AT MOUTH	No	0.00
AUG	31300713	HONEY CR > HART L - AT MOUTH	Yes	0.04
SEP	31300713	HONEY CR > HART L - AT MOUTH	Yes	0.06
OCT	31300713	HONEY CR > HART L - AT MOUTH	Yes	0.85
NOV	31300713	HONEY CR > HART L - AT MOUTH	Yes	2.87
DEC	31300713	HONEY CR > HART L - AT MOUTH	Yes	3.55
ANN	31300713	HONEY CR > HART L - AT MOUTH	Yes	15,400.00

Detailed Reports for Watershed ID #31300713

HONEY CR > HART L - AT MOUTH
GOOSE & SUMMER LAKE BASIN
Water Availability as of 9/20/2017

Watershed ID #: 31300713 (Map)
Date: 9/20/2017

Exceedance Level: 80%
Time: 9:17 AM

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	5.06	0.21	4.85	0.00	0.00	4.85
FEB	6.64	0.33	6.32	0.00	0.00	6.32
MAR	12.60	2.06	10.50	0.00	0.00	10.50
APR	41.50	8.36	33.10	0.00	0.00	33.10
MAY	53.80	20.20	33.60	0.00	0.00	33.60
JUN	26.80	15.50	11.30	0.00	0.00	11.30
JUL	4.32	4.32	0.00	0.00	0.00	0.00
AUG	2.27	2.23	0.04	0.00	0.00	0.04
SEP	2.07	2.01	0.06	0.00	0.00	0.06
OCT	2.14	1.29	0.85	0.00	0.00	0.85
NOV	3.01	0.14	2.87	0.00	0.00	2.87
DEC	3.74	0.19	3.55	0.00	0.00	3.55
ANN	18,800.00	3,440.00	15,400.00	0.00	0.00	15,400.00

Detailed Report of Consumptive Uses and Storage

Consumptive Uses and Storages in Cubic Feet per Second

Month	Storage	Irrigation	Municipal	Industrial	Commercial	Domestic	Agricultural	Other	Total
JAN	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
FEB	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
MAR	0.71	1.35	0.00	0.00	0.00	0.00	0.00	0.00	2.06
APR	2.05	6.31	0.00	0.00	0.00	0.00	0.00	0.00	8.36
MAY	2.81	17.40	0.00	0.00	0.00	0.00	0.00	0.00	20.20
JUN	1.18	14.40	0.00	0.00	0.00	0.00	0.00	0.00	15.50
JUL	0.19	4.13	0.00	0.00	0.00	0.00	0.00	0.00	4.32
AUG	0.07	2.16	0.00	0.00	0.00	0.00	0.00	0.00	2.23
SEP	0.07	1.94	0.00	0.00	0.00	0.00	0.00	0.00	2.01
OCT	0.09	1.20	0.00	0.00	0.00	0.00	0.00	0.00	1.29
NOV	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
DEC	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19

Detailed Report of Reservations for Storage and Consumptive Uses

Reserved Streamflow in Cubic Feet per Second

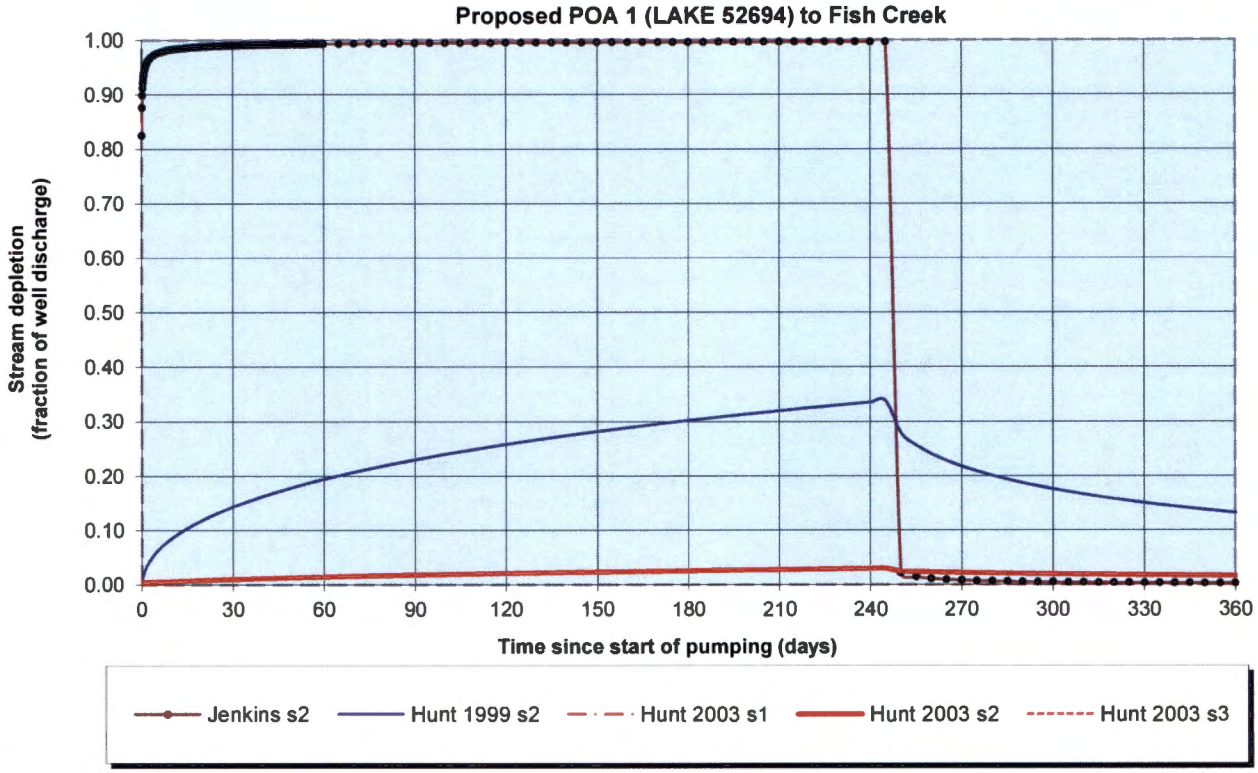
No reservations were found for this watershed.

Detailed Report of Instream Flow Requirements

Instream Flow Requirements in Cubic Feet per Second

No instream flow requirements were found for this watershed.

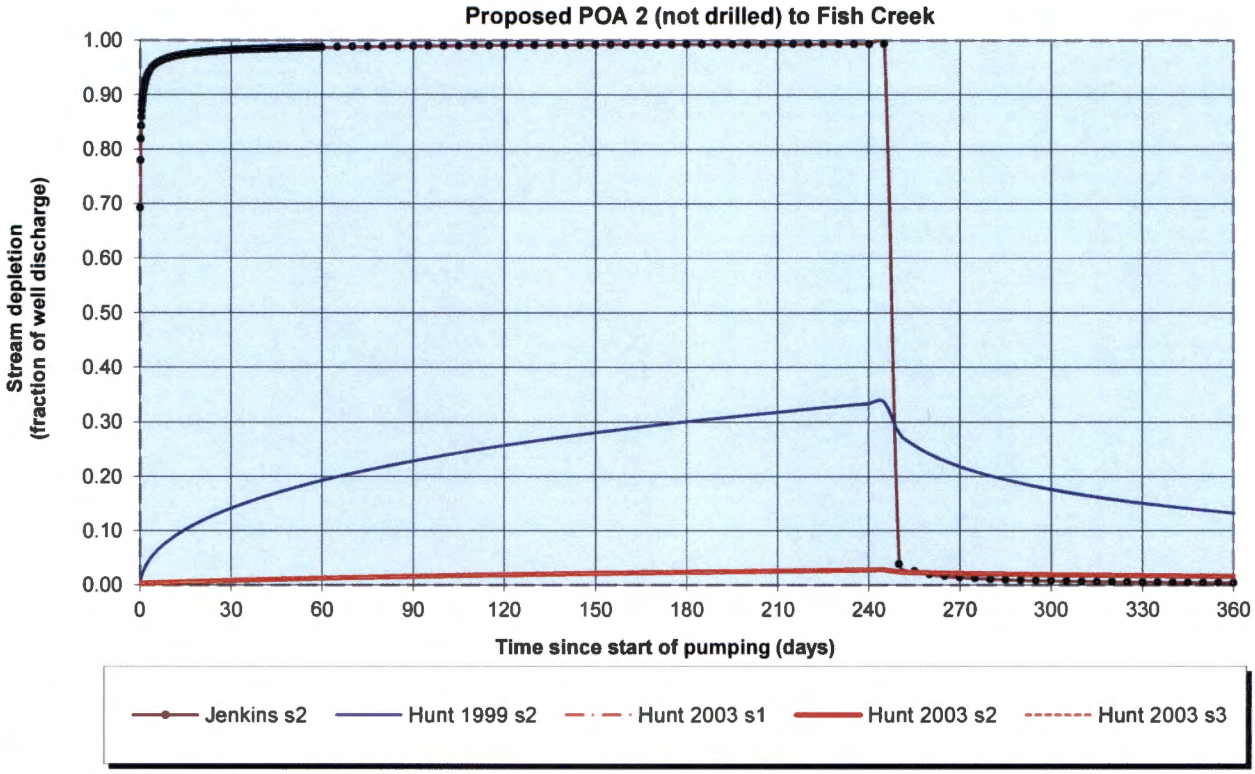
Transient Stream Depletion (Jenkins, 1970; Hunt, 1999, 2003)



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	99.0%	99.3%	99.4%	99.5%	99.5%	99.6%	99.6%	99.6%	0.8%	0.4%	0.3%	0.2%
H SD 1999	14.4%	19.4%	23.0%	25.8%	28.2%	30.2%	32.0%	33.5%	21.8%	17.6%	15.0%	13.2%
H SD 2003	1.0%	1.5%	1.8%	2.1%	2.4%	2.6%	2.8%	3.0%	2.2%	2.0%	1.8%	1.6%
Qw, cfs	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590
H SD 99, cfs	0.085	0.115	0.136	0.152	0.166	0.178	0.189	0.198	0.128	0.104	0.089	0.078
H SD 03, cfs	0.006	0.009	0.011	0.012	0.014	0.015	0.017	0.018	0.013	0.012	0.010	0.010

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	0.59	0.59	0.59	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	285	285	285	ft
Well depth	d	431	431	431	ft
Aquifer hydraulic conductivity	K	83	83	83	ft/day
Aquifer saturated thickness	b	100	100	100	ft
Aquifer transmissivity	T	8300	8300	8300	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	1	1	1	ft/day
Aquitard saturated thickness	ba	65	65	65	ft
Aquitard thickness below stream	babs	65	65	65	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	10	10	10	ft
Streambed conductance (lambda)	sbc	0.153846	0.153846	0.153846	ft/day
Stream depletion factor	sdf	0.009786	0.009786	0.009786	days
Streambed factor	sbf	0.005283	0.005283	0.005283	
input #1 for Hunt's Q_4 function	t'	102.185288	102.185288	102.185288	
input #2 for Hunt's Q_4 function	K'	0.150556	0.150556	0.150556	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.005283	0.005283	0.005283	

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999, 2003)

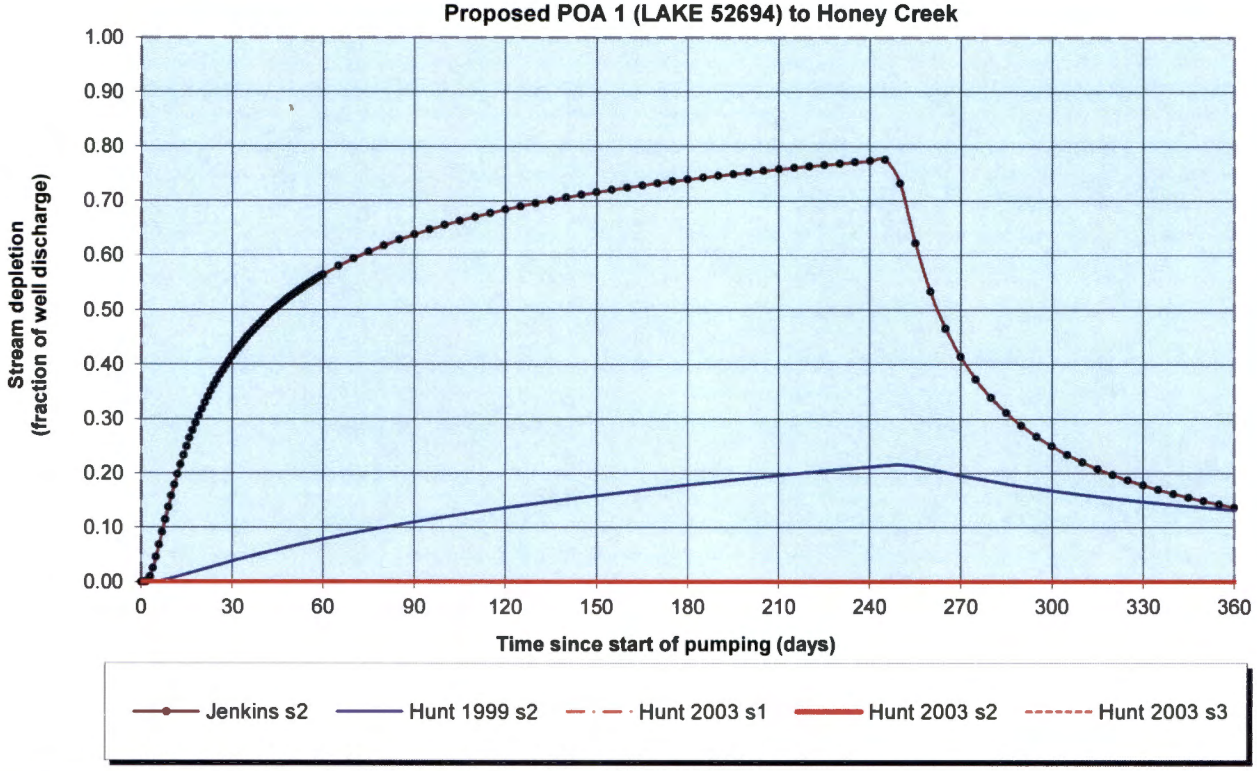


Output for Stream Depletion, Scenerio 2 (s2):						Time pump on (pumping duration) = 245 days						
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	98.2%	98.7%	98.9%	99.1%	99.2%	99.3%	99.3%	99.4%	1.4%	0.8%	0.5%	0.4%
H SD 1999	14.2%	19.3%	22.8%	25.7%	28.0%	30.0%	31.8%	33.4%	21.8%	17.6%	15.0%	13.2%
H SD 2003	0.9%	1.3%	1.6%	1.9%	2.2%	2.4%	2.6%	2.8%	2.2%	1.9%	1.8%	1.6%
Qw, cfs	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770
H SD 99, cfs	0.109	0.148	0.176	0.198	0.216	0.231	0.245	0.257	0.168	0.136	0.116	0.102
H SD 03, cfs	0.007	0.010	0.013	0.015	0.017	0.018	0.020	0.022	0.017	0.015	0.014	0.013

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	0.77	0.77	0.77	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	510	510	510	ft
Well depth	d	431	431	431	ft
Aquifer hydraulic conductivity	K	83	83	83	ft/day
Aquifer saturated thickness	b	100	100	100	ft
Aquifer transmissivity	T	8300	8300	8300	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	1	1	1	ft/day
Aquitard saturated thickness	ba	65	65	65	ft
Aquitard thickness below stream	babs	65	65	65	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	10	10	10	ft
Streambed conductance (lambda)	sbc	0.153846	0.153846	0.153846	ft/day
Stream depletion factor	sdf	0.031337	0.031337	0.031337	days
Streambed factor	sbf	0.009453	0.009453	0.009453	
input #1 for Hunt's Q_4 function	t'	31.910804	31.910804	31.910804	
input #2 for Hunt's Q_4 function	K'	0.482113	0.482113	0.482113	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.009453	0.009453	0.009453	

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999, 2003)

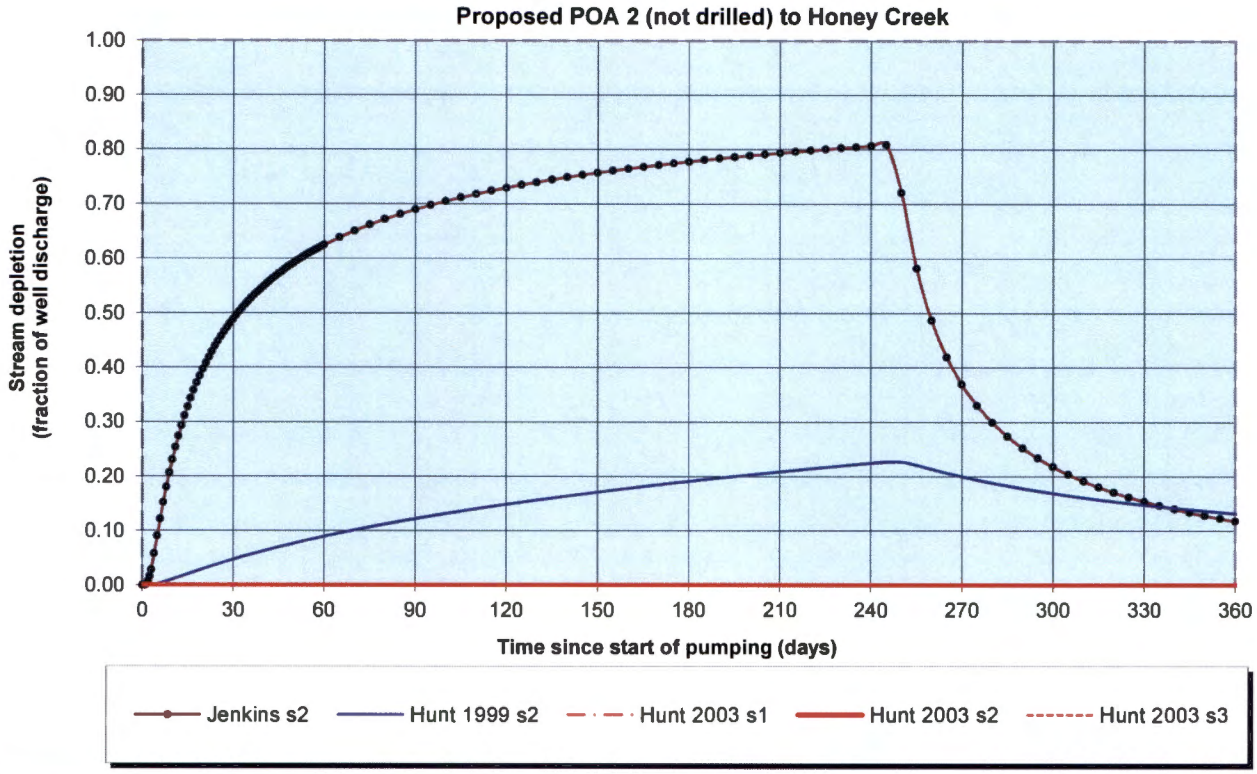
Proposed POA 1 (LAKE 52694) to Honey Creek



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	41.5%	56.4%	63.8%	68.3%	71.5%	73.9%	75.8%	77.3%	41.4%	25.0%	17.8%	13.7%
H SD 1999	3.9%	7.8%	11.0%	13.6%	15.9%	17.8%	19.6%	21.2%	19.6%	16.7%	14.7%	13.2%
H SD 2003	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Qw, cfs	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590
H SD 99, cfs	0.023	0.046	0.065	0.080	0.094	0.105	0.116	0.125	0.115	0.099	0.087	0.078
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	0.59	0.59	0.59	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	18200	18200	18200	ft
Well depth	d	431	431	431	ft
Aquifer hydraulic conductivity	K	83	83	83	ft/day
Aquifer saturated thickness	b	100	100	100	ft
Aquifer transmissivity	T	8300	8300	8300	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	1	1	1	ft/day
Aquitard saturated thickness	ba	150	150	150	ft
Aquitard thickness below stream	babs	150	150	150	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	20	20	20	ft
Streambed conductance (lambda)	sbc	0.133333	0.133333	0.133333	ft/day
Stream depletion factor	sdf	39.908434	39.908434	39.908434	days
Streambed factor	sbf	0.292369	0.292369	0.292369	
input #1 for Hunt's Q_4 function	t'	0.025057	0.025057	0.025057	
input #2 for Hunt's Q_4 function	K'	266.056225	266.056225	266.056225	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.292369	0.292369	0.292369	

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999, 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	48.9%	62.4%	68.9%	72.9%	75.7%	77.7%	79.4%	80.7%	36.9%	21.8%	15.4%	11.8%
H SD 1999	4.8%	9.0%	12.2%	14.8%	17.1%	19.1%	20.9%	22.4%	20.0%	16.9%	14.8%	13.2%
H SD 2003	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Qw, cfs	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770
H SD 99, cfs	0.037	0.069	0.094	0.114	0.132	0.147	0.161	0.173	0.154	0.130	0.114	0.102
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	0.77	0.77	0.77	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	15450	15450	15450	ft
Well depth	d	431	431	431	ft
Aquifer hydraulic conductivity	K	83	83	83	ft/day
Aquifer saturated thickness	b	100	100	100	ft
Aquifer transmissivity	T	8300	8300	8300	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	1	1	1	ft/day
Aquitard saturated thickness	ba	150	150	150	ft
Aquitard thickness below stream	babs	150	150	150	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	20	20	20	ft
Streambed conductance (lambda)	sbc	0.133333	0.133333	0.133333	ft/day
Stream depletion factor	sdf	28.759337	28.759337	28.759337	days
Streambed factor	sbf	0.248193	0.248193	0.248193	
input #1 for Hunt's Q_4 function	t'	0.034771	0.034771	0.034771	
input #2 for Hunt's Q_4 function	K'	191.728916	191.728916	191.728916	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.248193	0.248193	0.248193	

Drawdown Calculations Using Theis Equation

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

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

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

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

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)	Total Drawdown (feet)	Comments
								Note : W(u) calculation valid when u < 7.1				
Note:	yellow grid areas are where values are calculated							7.0000	1.1545E-04			W(u) calculation test
Proposed POA Well 1 (LAKE 52694, owner well 116) to Hart Lake (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	540.00	1.20	30.00	4,630.00	3.14	0.0215	3.2828	3.2718		Maximum Pumping Rate
62,088.32	8,300.00	0.00100	540.00	1.20	245.00	4,630.00	3.14	0.0026	5.3641	5.3461		Maximum Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Hart Lake (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	703.00	1.57	30.00	4,430.00	3.14	0.0197	3.3693	4.3716	7.6434	Maximum Pumping Rate
62,088.32	8,300.00	0.00100	703.00	1.57	245.00	4,430.00	3.14	0.0024	5.4522	7.0741	12.4201	Maximum Pumping Rate
Proposed POA Well 1 (LAKE 52694, owner well 116) to Hart Lake (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	265.00	0.59	30.00	4,630.00	3.14	0.0215	3.2828	1.6056		Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	265.00	0.59	245.00	4,630.00	3.14	0.0026	5.3641	2.6235		Pro-Rated Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Hart Lake (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	346.00	0.77	30.00	4,430.00	3.14	0.0197	3.3693	2.1516	3.7572	Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	346.00	0.77	245.00	4,430.00	3.14	0.0024	5.4522	3.4817	6.1052	Pro-Rated Pumping Rate

Drawdown Calculations Using Theis Equation

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

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

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

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

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)	Total Drawdown (feet)	Comments
								Note : W(u) calculation valid when u < 7.1				
Note:	yellow grid areas are where values are calculated							7.0000	1.1545E-04			W(u) calculation test
Proposed POA Well 1 (LAKE 52694, owner well 116) to Priday Reservoir (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	540.00	1.20	30.00	8,960.00	3.14	0.0806	2.0200	2.0132		Maximum Pumping Rate
62,088.32	8,300.00	0.00100	540.00	1.20	245.00	8,960.00	3.14	0.0099	4.0509	4.0373		Maximum Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Priday Reservoir (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	703.00	1.57	30.00	11,725.00	3.14	0.1380	1.5365	1.9936	4.0068	Maximum Pumping Rate
62,088.32	8,300.00	0.00100	703.00	1.57	245.00	11,725.00	3.14	0.0169	3.5200	4.5671	8.6043	Maximum Pumping Rate
Proposed POA Well 1 (LAKE 52694, owner well 116) to Priday Reservoir (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	265.00	0.59	30.00	8,960.00	3.14	0.0806	2.0200	0.9880		Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	265.00	0.59	245.00	8,960.00	3.14	0.0099	4.0509	1.9813		Pro-Rated Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Priday Reservoir (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	346.00	0.77	30.00	11,725.00	3.14	0.1380	1.5365	0.9812	1.9691	Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	346.00	0.77	245.00	11,725.00	3.14	0.0169	3.5200	2.2478	4.2291	Pro-Rated Pumping Rate

Drawdown Calculations Using Theis Equation

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

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

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

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

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)	Total Drawdown (feet)	Comments
								Note : W(u) calculation valid when u < 7.1				
Note:	yellow grid areas are where values are calculated							7.0000	1.1545E-04			W(u) calculation test
Proposed POA Well 1 (LAKE 52694, owner well 116) to Closest POA Well (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	540.00	1.20	30.00	1,640.00	3.14	0.0027	5.3398	5.3219		Maximum Pumping Rate
62,088.32	8,300.00	0.00100	540.00	1.20	245.00	1,640.00	3.14	0.0003	7.4375	7.4125		Maximum Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Closest POA Well (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	703.00	1.57	30.00	3,820.00	3.14	0.0147	3.6606	4.7496	10.0714	Maximum Pumping Rate
62,088.32	8,300.00	0.00100	703.00	1.57	245.00	3,820.00	3.14	0.0018	5.7479	7.4577	14.8702	Maximum Pumping Rate
Proposed POA Well 1 (LAKE 52694, owner well 116) to Closest POA Well (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	265.00	0.59	30.00	1,640.00	3.14	0.0027	5.3398	2.6117		Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	265.00	0.59	245.00	1,640.00	3.14	0.0003	7.4375	3.6376		Pro-Rated Pumping Rate
Proposed POA Well 2 (Not Drilled Yet) to Closest POA Well (transmissivity is from specific capacity data)												
62,088.32	8,300.00	0.00100	346.00	0.77	30.00	3,820.00	3.14	0.0147	3.6606	2.3376	4.9493	Pro-Rated Pumping Rate
62,088.32	8,300.00	0.00100	346.00	0.77	245.00	3,820.00	3.14	0.0018	5.7479	3.6705	7.3081	Pro-Rated Pumping Rate

Theis_Equation_specific_capacity_to_transmissivity							
Basalt							
Well County	**Well Num**	**Transmissivity**	**Transmissivity**	**Open Interval**	**Conductivity**		
		ft2/day	**gpd/ft**	**feet**	**ft/day**		
LAKE	1779	4,299.52	32,162.65				
LAKE	1825	15,338.56	114,740.40				
LAKE	1839	12,012.45	89,859.37		#DIV/0!		
LAKE	4070	1,551.71	11,607.60		#DIV/0!		
		8,300.56	**62,092.51**	**Average**		**#DIV/0!**	**ft/day**
Basin-Fill							
Well County	**Well Num**	**Transmissivity**	**Transmissivity**	**Open Interval**	**Conductivity**		
		ft2/day	**gpd/ft**	**feet**	**ft/day**		
LAKE	4281	631.62	4,724.85	640.00	0.99		
		631.62	**4,724.85**	**Average**		**#DIV/0!**	**ft/day**