Groundwater Application Review Summary Form

Application # ~~G~~ LL-1784

GW Reviewer M. Thoma **Date Review Completed:** 07-24-19

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 07-24, 2019

TO: Application ~~G~~ LL-1784

FROM: GW: M. Thoma
(Reviewer's Name)

SUBJECT: Scenic Waterway Interference Evaluation

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

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

☒ Per ORS 390.835, the Groundwater Section is **able** to calculate ground water interference with surface water that contributes to a Scenic Waterway. The calculated interference is distributed below.

See Memo dated Feb. 19, 2013

☐ 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

State of Oregon
Water Resources Department

Memorandum

To: Barry Norris – Administrator, Technical Services Division
Dwight French – Administrator, Waterights Division
Tom Paul – Deputy Director
Doug Woodcock – Administrator, Field Services Division

From: Ivan Gall – Manager, Groundwater Section

Date: February 19, 2013

Subject: Analysis of Groundwater Pumping Impacts on Klamath Scenic Waterway Flows

In 1971 the Oregon Legislature created the Scenic Waterway Act, codified by Oregon Revised Statutes 390.805 to 390.925, to preserve for the benefit of the public Waldo Lake and selected parts of the state's free-flowing rivers. The Klamath Scenic Waterway was part of the Act and includes the Klamath River from the John Boyle Dam powerhouse downstream to the Oregon-California border. Under the Act, the Water Resources Commission is allowed to allocate small amounts of surface water for human consumption and livestock watering, as long as issuing the water right does not significantly impair the free-flowing character of these waters in quantities necessary for recreation, fish and wildlife, and the amount allocated may not exceed a cumulative total of one percent of the average daily flow or one cubic foot per second (cfs), whichever is less.

In 1995 the Scenic Waterway Act was modified to address the impact of groundwater uses that, based upon a preponderance of evidence, would measurably reduce the surface water flows within a scenic waterway. "Measurably reduce" means that the use authorized will individually or cumulatively reduce surface water flows within the scenic waterway in excess of a combined cumulative total of one percent of the average daily flow or one cfs, whichever is less.

In 2012 the United States Geological Survey (USGS), in cooperation with OWRD and the US Bureau of Reclamation, completed groundwater flow and management models for the Upper Klamath Basin. The 2012 groundwater flow model uses generally accepted hydrogeologic methods and the relevant field data to model the cumulative effects of groundwater pumping within the Klamath Scenic Waterway, and provides a comprehensive methodology for analyzing the relevant field data necessary to determine whether the cumulative use of groundwater in the Klamath Basin will measurably reduce the surface water flow necessary to maintain the free-flowing character of the Klamath Scenic Waterway.

In September 2012 the OWRD Groundwater Section conducted two model simulations. The two simulations used the 2012 USGS flow model, incorporating groundwater permits issued (61.96 cfs) since adoption of the 1995 Scenic Waterway Act amendment up through 2004. Each simulation was run to steady-state, where inflows and outflows for that model run balanced. An evaluation of the water budgets showed that groundwater discharge to the Klamath Scenic Waterway decreased by 5.88 cfs as a result of the 61.96 cfs of groundwater uses issued between 1995 and 2004. These results indicate to the OWRD that a preponderance of evidence exists to establish that groundwater development occurring in the Upper Klamath Basin in Oregon since 1995 has "measurably reduced" surface water flows within the Klamath Scenic Waterway.

In January 2013 the OWRD Groundwater Section conducted flow model simulations to evaluate impacts to streams from pumping groundwater within the Lost River subbasin. Groundwater pumping was simulated by placing wells in the model that correspond to the center of 39 townships in the southeast part of the Klamath Basin in Oregon. Each of the simulations was run to steady-state, where inflows and outflows for that model run balanced. These results indicate that the scenic waterway is impacted by pumping groundwater in all of the townships evaluated in Oregon in the Lost River subbasin. In summary, a preponderance of evidence exists to establish that groundwater development occurring in Oregon since 1995 in the Upper Klamath Basin and Lost River subbasin has "measurably reduced" surface water flows within the Klamath Scenic Waterway.

References:

Gannett, M.W., Lite, K.E., Jr., La Marche, J.L., Fisher, B.J., and Polette, D.J., 2007. Ground-water hydrology of the upper Klamath Basin, Oregon and California: U.S. Geological Survey Scientific Investigations Report 2007-5050, 84p.

Gannett, M.W., Wagner, B.J., and Lite, K.E., Jr., 2012. Groundwater simulation and management models for the upper Klamath Basin, Oregon and California: U.S. Geological Survey Scientific Investigations Report 2012-5062, 92p.

PUBLIC INTEREST REVIEW FOR GROUND WATER APPLICATIONS

TO: Water Rights Section **Date** **July 24, 2019**

FROM: Ground Water/Hydrology Section **Michael Thoma**
Reviewer's Name

SUBJECT: Application **LL-1784** Supersedes review of LL-1540*
Date of Review(s)

*** This application proposes the same rate, use, and POA as LL-1540 which was submitted to the Department on 07/08/2014 and issued on 08/01/2014. LL-1540 expires on 08/03/2019. This application is basically an extension of LL-1540 and this review is, in large part, a modification of the Groundwater Review for LL-1540.**

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: **Jeld-Wen, Inc.** County: **Klamath**

A1. Applicant(s) seek(s) **0.50 (224 gpm)** cfs from **1** well(s) in the **Klamath** Basin, **Upper Klamath Lake** sub basin

A2. Proposed use: **Industrial / Manufacturing** Seasonality: **Year Round (365 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	**KLAM 11674**	**1**	**Basalt**	**0.50**	**38S/09E-19 SWNE**	**30' N, 2215' W fr E 1/4 cor S 19**
2						

* 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	**4155**	**9**	**3.35**	**4/10/2019**	**1021**	**0-237.5**	**+1-237.5**	**None**	**None**	**1700**	**153**	**P**

Use data from application for proposed wells.

A4. **Comments:**

This proposed POA is the same well used on the following water rights:
File G-10815: 2.228 cfs for pollution abatement (reduce algae in harbor inlets sub-division channels)
File G-11550: 0.6684 cfs for primary irrigation of 75.8 acres
File G-11966: 0.52 cfs for primary irrigation of 41.7 acres

A5. ☐ **Provisions of the** ________ 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: **No basin rules apply**

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

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) **7N, 7J, 7T, 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 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:** Sufficient data on recharge estimates and groundwater withdrawals (natural and artificial) are not available to determine, to a reasonable certainty, if groundwater is over-appropriated in the vicinity of the proposed POA. Water availability without Injury and within the Capacity of the Resource cannot be conclusively determined either so conditions presented in B1(d) are recommended if this limited license is approved.

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	**Basaltic volcanic units**	☐	☒
		☐	☐

Basis for aquifer confinement evaluation: The water well report (well log) for the proposed POA indicates a predominance of "hard" (crystalline) basaltic rock beginning at 223 feet below land surface at this well site. Overall the aquifer system in the area is identified as generally unconfined with discontinuous low-permeability layers causing local confined conditions. The aquifer system consist generally of low-permeability sediments of varying thickness interlayered with high-permeability basaltic units, where the basaltic units are the main target zones for high-production wells.

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	**Upper Klamath Lake**	**4152**	**4143**	**2,290**	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation: Groundwater elevations are near, or slightly above, surface water elevations in the proposed well and in wells nearby implying that groundwater is flowing towards, and discharging to, surface water. Additionally, groundwater contours displayed in Gannett et al., (2007) indicate that groundwater is flowing towards Upper Klamath Lake in the vicinity of the proposed POA and that Upper Klamath Lake Valley is a regional discharge source for groundwater.

Water Availability Basin the well(s) are located within: LINK R > KLAMATH R - AB UNN STR (ID# 31420305)

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	☐	☐	**multiple**	**20.0***	☒	**808**	☐	**46.7**	☒
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

Comments: *there are several instream water rights for the WAB containing the proposed POA with the flow in the lowest month being 20.0 cfs (this would be the first instream right to be triggered and thus is the most-protective).

The proposed well site is less than 1 mile to Upper Klamath Lake and is subject the OAR 690-009-0040(4) rules. The Hunt (2003) stream-depletion model was used to calculate the interference at Upper Klamath Lake given that the proposed POA penetrates through the sediments to obtain groundwater from the basaltic units below. The unit thicknesses, the transmissivity used (17,525 ft2/day), and the vertical hydraulic conductivity for the overlying unit is based upon USGS analysis of the thickness of the local hydrogeologic units and their hydraulic properties. A conservative 1,000 foot lake "width" was used for the calculation (the model in the given parameter space has relatively low sensitivity to stream width). The model estimates stream-depletion of 46.7 percent after 30 days of pumping.

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?
			☐			☐	8	☐		☐

Comments: ______

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													
(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 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)______;

ii. ☐ The permit should contain special condition(s) as indicated in "Remarks" below;

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

The Potential for Substantial Interference is assumed given the following: the proposed pumping rate is greater than one-percent of the in-stream water rights (cfs) and the interference at Upper Klamath Lake at the end of 30 days pumping is greater than 25% of the pumping rate. Additionally, the proposed POA is assumed to have the Potential for Substantial Interference based on OAR 690-009-0040(5) because of the existing, cumulative effects of groundwater pumping in the Klamath Basin on surface water (see attached Technical Memorandum dated: April 26, 2018) – this assumption is based, in part, on the findings of a corporative study by the USGS and OWRD which is summarized in Gannett et al., (2007) and Gannett et al., (2012) The application folder contains a letter from the applicant's agent stating that the applicant is aware of the likelihood that PSI will be assumed and the applicant proposes to mitigate the impacts to surface water (including impacts to the Klamath River Scenic Waterway) through forbearance of an existing surface water right, KA-107. Any proposed mitigation plan should be reviewed thoroughly before a limited license is issued, paying particularly close attention to the maximum rate and duty of the water right being offered as mitigation. Of specific concern is that the existing surface water right, **KA-107, is limited to a maximum rate of 1.0 cfs and a maximum duty of 100 acre-feet annually**. The proposed use under this limited license application is for 0.5 cfs but does not give a maximum duty. Maximum appropriation of 0.5 cfs for the full year would total 361 acre-feet – exceeding the maximum duty authorized under KA-107. **It is recommended that if this limited license is issued with only KA-107 offered as mitigation, it be further limited to a maximum annual duty of 100 acre-feet**.

References Used:

Gannett, M.W., Lite, K.E., La Marche, J.L., Fisher, B.J., and Polette, D.J., 2007. Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California. USGS Scientific Investigations Report 2007-5050.

Gannett, M.W., Wagner, B.J., and Lite, K.E. 2012. Groundwater Simulation and Management Models for the Upper Klamath Basin, Oregon and California. USGS Scientific Investigations Report 2012-5062.

Grondin, G.H., 2004. Ground Water in the Eastern Lost River Sub-Basin, Langell, Yonna, Swan Lake, and Poe Valleys of Southeastern Klamath County, Oregon. Ground Water Report 41, Oregon Water Resources Department, Salem, Oregon.

USGS, 2005. Assessment of the Klamath Project pilot water bank: a review from a hydrologic perspective. Prepared by the U.S. Geological Survey Oregon Water Science Center, Portland, Oregon for the U.S. Bureau of Reclamation Klamath Basin Area Office, Klamath Falls, Oregon, May 3, 2005.

Leonard, A.R. and Harris, A.B. 1974. Ground water in selected areas in the Klamath Basin, Oregon. OWRD Ground Water Report No. 21, 104 pgs.

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

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

Water level data for wells KLAM 50315 & KLAM 11656

USGS Wocus and Klamath Falls quadrangle maps (1:24,000 scale)

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.**

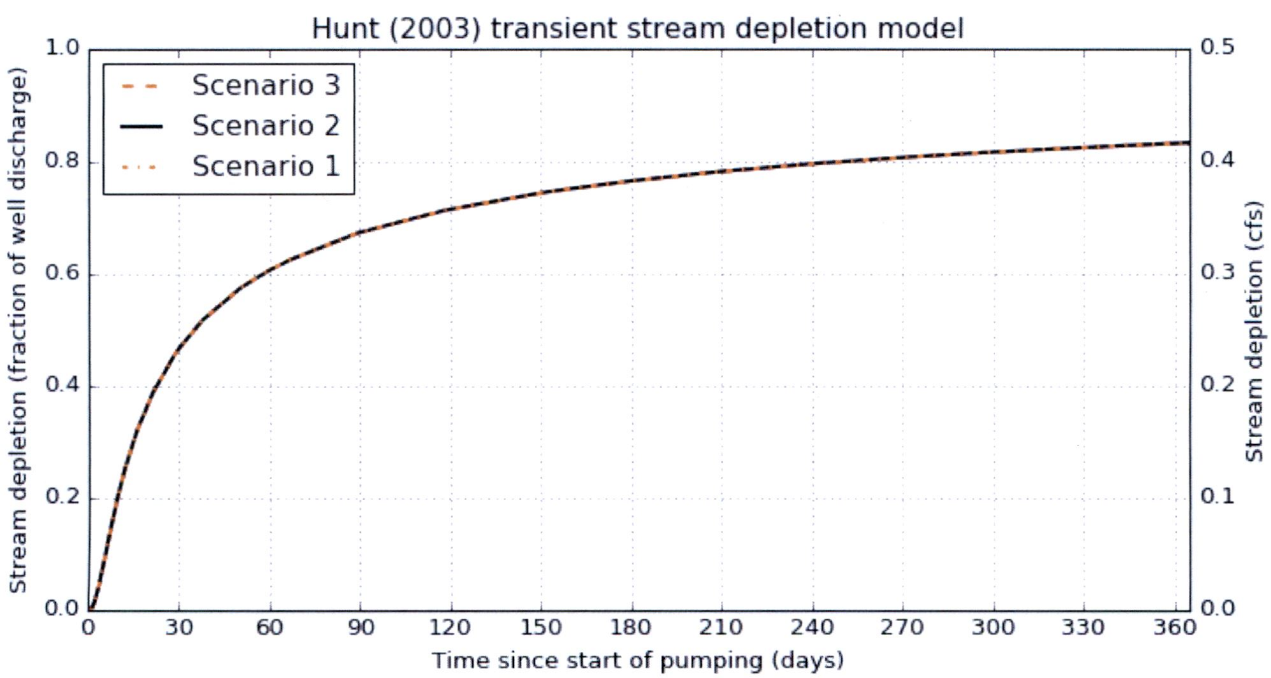
Stream-Depletion Model Results

Application type:	LL
Application number:	1784
Well number:	1
Stream Number:	1
Pumping rate (cfs):	0.5
Pumping duration (days):	365
Pumping start month number (3=March)	1

Parameter	Symbol	Scenario 1	Scenario 2	Scenario 3	Units
Distance from well to stream	a	2290	2290	2290	ft
Aquifer transmissivity	T	17524	17524	17524	ft2/day
Aquifer storativity	S	0.001	0.001	0.001	-
Aquitard vertical hydraulic conductivity	Kva	28.47	28.47	28.47	ft/day
Aquitard saturated thickness	ba	44	44	44	ft
Aquitard thickness below stream	babs	44	44	44	ft
Aquitard specific yield	Sya	0.1	0.1	0.1	-
Stream width	ws	1000	1000	1000	ft

Stream depletion for Scenario 2:

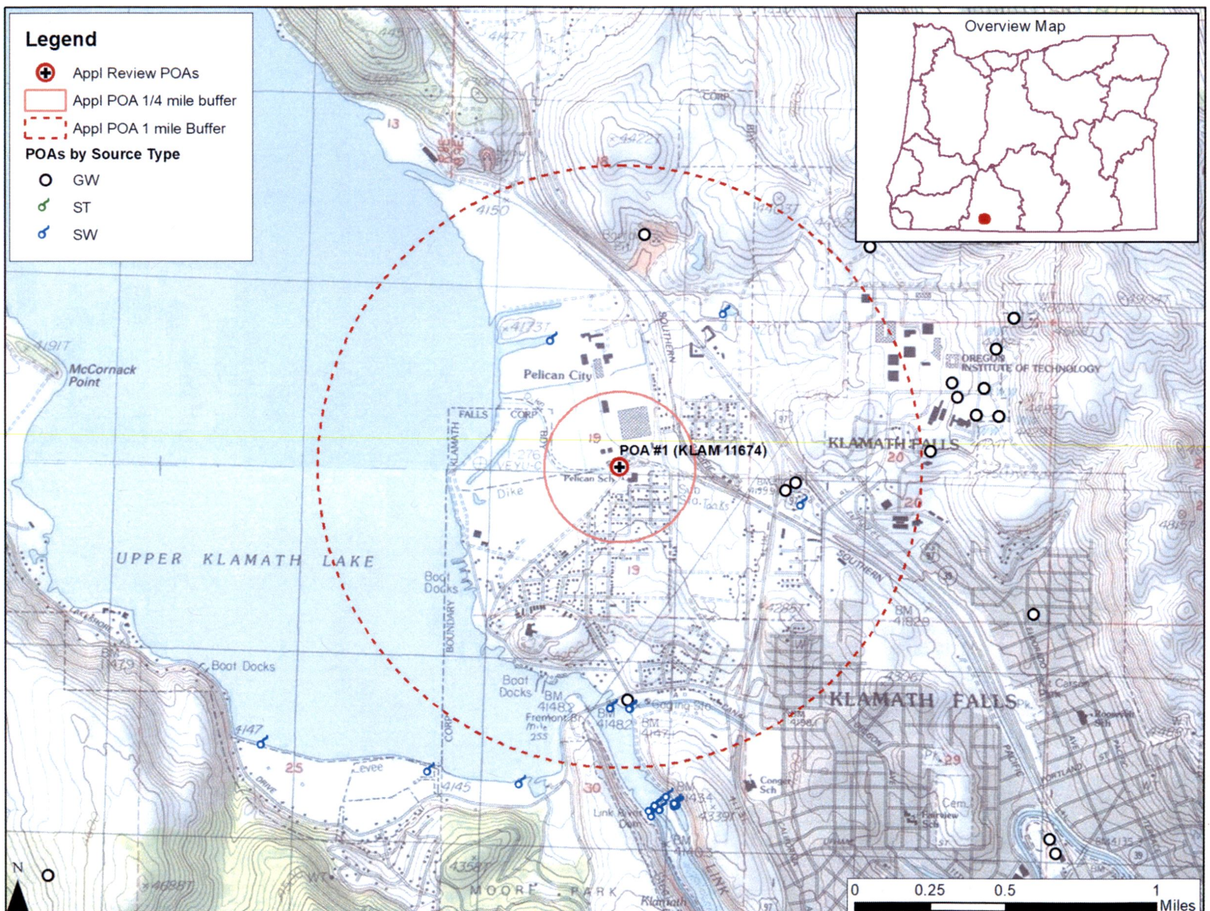
Days	10	30	60	90	120	150	180	210	240	270	300	330	360
Depletion (%)	21	47	61	67	72	74	77	78	80	81	82	82	83
Depletion (cfs)	0.10	0.23	0.30	0.34	0.36	0.37	0.38	0.39	0.40	0.40	0.41	0.41	0.42



Application Review Map

Application LL- 1784 continued

Date 07/24/2019



7/24/2019

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Oregon Water Resources Department

Technical Memorandum

Groundwater Regulation in the Upper Klamath Basin Area under OAR 690-009

Date: April 26, 2018

Prepared by:

Michael Thoma, PhD, RG, Hydrogeologist
Justin Iverson, RG, Manager – Groundwater Section

REGISTERED OREGON MICHAEL J. THOMA G2580 GEOLOGIST
EXPIRES: 2/1/2019

REGISTERED OREGON JUSTIN IVERSON G2045 GEOLOGIST
EXPIRES: 12/01/2018

On 12/28/2017 the Secretary of the Interior published a "Negative Notice" terminating the Upper Klamath Basin Comprehensive Agreement ("Settlement Agreement").[1]

OAR 690-025-0010(16)[2] states that if the Settlement Agreement terminates, groundwater regulation in the Off-Project Area of the Klamath Basin (hereafter "Upper Klamath Basin Area" – see Figure 1) will be in accordance with OAR 690-009[3] ("Division 9").

This memorandum describes the methodology, based on the best available science, that will be used to produce data products to support determinations of whether permitted wells in the Upper Klamath Basin Area are subject to control under OAR 690-009.

For the purpose of this memo, the "Upper Klamath Basin Area" includes all watersheds tributary to Upper Klamath Lake, Upper Klamath Lake itself, and other lands within one mile of Upper Klamath Lake (Figure 1).

The Department's working conceptual model of the groundwater system of the Upper Klamath Basin Area (supported by, among other work, Gannett and others, 2007[4]; Gannett and others, 2012[5]) is that aquifers in the Upper Klamath Basin Area are hydraulically connected to surface water, and that existing groundwater appropriations proximal to surface water bodies may have the potential for substantial interference (PSI) with surface water. This triggers a review of existing groundwater appropriations in the Upper Klamath Basin Area to assess PSI with surface water in accordance with Division 9 rules. The methodology used in this assessment is described in the remaining sections of this memo.

I. Identification of wells subject to an evaluation for PSI requires identifying groundwater points of appropriation (POAs) by water right, and associating the water right to a specific well. These steps occur according to the following method:

    A. The Groundwater Section queries the Water Rights Information System (WRIS) database for valid groundwater POAs located within the Upper Klamath Basin Area (Figure 1).

    B. Where available, water right POAs are associated with specific wells that have been identified by the "Well Log ID." The Well Log ID is a unique identifier assigned to a

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[1] https://www.federalregister.gov/documents/2017/12/28/2017-28050/notice-regarding-upper-klamath-basin-comprehensive-agreement
[2] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3148
[3] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3134
[4] https://pubs.er.usgs.gov/publication/sir20075050
[5] https://pubs.er.usgs.gov/publication/sir20125062

specific well construction log (new, deepening, alteration, etc.) and the earliest available Well Log ID is used to identify a specific well, notwithstanding subsequent logs. Appendix A provides a list of the permitted wells in the Upper Klamath Basin Area derived from this process.

II. OAR 690-009-0050 requires that each of the wells identified in Appendix A be reviewed on a case-by-case basis to determine PSI in accordance with the methods indicated in OAR 690-009-0040. This determination includes the subsections of rule OAR 690-0040 as follows:

A. OAR 690-009-0040 (1) requires a finding of whether the well produces from a confined or unconfined aquifer and whether the aquifer is hydraulically connected to a surface water source.

1) Based on the best available science embodied in the Department's working conceptual model and general knowledge of typical irrigation well construction and target aquifers in the area, permitted wells in the Upper Klamath Basin Area generally produce water from confined aquifers.

2) Furthermore, the Department's working conceptual model asserts that aquifers in the Upper Klamath Basin Area are hydraulically connected to surface water sources. Supporting evidence comes from comparison of reported or estimated groundwater elevations to surface water elevations (with considerations of well construction), and an absence of substantial evidence to the contrary. Hydraulic connection is defined in OAR 690-009-0010

B. OAR 690-009-0040(3) requires measurement of the horizontal distance from the well to the nearest hydraulically-connected surface water source. These distances were based on the Department's best available well location information and the National Hydrography Dataset[6] high resolution spatial coverage of perennial surface water bodies. Horizontal distances calculated by the Department are documented in Appendix A.

C. OAR 690-009-0040(2) and (4) assumes a well has PSI if:

1) -0040(2): the well produces from an aquifer that is unconfined AND is less than one-quarter mile from the nearest surface water source ; or

2) -0040(4)(a): the well produces from an aquifer that is hydraulically connected to surface water AND is less than one-quarter mile from the hydraulically-connected surface water source ; or

3) -0040(4)(b-c): the well produces from an aquifer that is hydraulically-connected to surface water, is less than one mile from the hydraulically-connected surface water source, AND the rate of appropriation is greater than:

a) Five cubic feet per second; or

[6] https://nhd.usgs.gov/chapter2/index.html

b) One percent of the pertinent adopted minimum perennial streamflow or instream water right with a senior priority date of the Water Availability Basin encompassing the nearest hydraulically-connected surface water source; or

c) One percent of the eighty-percent exceedance discharge for the Water Availability Basin encompassing the nearest hydraulically-connected surface water source.

   i. For b) and c) above, flow values were referenced from the Department's Water Availability Reporting System[7] for the applicable Water Availability Basin[8].

   ii. For b) and c) above, the well's rate of appropriation included all permits or certificates authorizing use of the well as a POA

4) -0040(4)(d): The rate of appropriation, if continued for a period of 30 days, would result in stream depletion greater than 25 percent of the rate of appropriation.

D. OAR 690-009-0040(5) allows for any wells not covered in section -0040(4) above an assessment of PSI taking into consideration the following factors:

1) -0040(5)(a): the potential for a reduction in streamflow or surface water supply; or
2) -0040(5)(b): The potential to impair or detrimentally affect the public interest as expressed by an applicable closure on surface water appropriation, minimum perennial streamflow, or instream water right with a senior priority date; or
3) -0040(5)(c): the percentage of groundwater appropriation that was, or would have become, surface water; OR
4) -0040(5)(d): whether the potential interference would be immediate or delayed; or
5) -0040(5)(e): the potential for a cumulative adverse impact on streamflow or surface water supply.

III. The remainder of this memo outlines how the Groundwater Section evaluated requirements of Division 9 and quantitatively evaluated the potential impacts to major surface water bodies from permitted groundwater pumping in the Upper Klamath Basin Area. Impacts were quantified using a numerical groundwater model ("the model") developed by the U.S. Geological Survey (USGS) using the MODFLOW software package and documented in Scientific Investigations Report 2012-5062 (Gannett and others, 2012[5]) and the following methodology.

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[7] https://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/MainMenu1.aspx
[8] http://www.oregon.gov/owrd/SW/docs/SW02_002.pdf

A. The calibrated, peer-reviewed, dynamic steady-state version of the model was obtained from the USGS Oregon Water Science Center. Specific details of the model can be found in Gannett and others (2012[5]) but relevant points are presented here:

    1) The model is the end-result of the model development and calibration process described in Gannet and others, 2012[5].

    2) The model simulates seasonal changes in evapotranspiration and recharge (i.e., boundary conditions) within each year but repeats this same cyclical input year after year. Seasonal variations in evapotranspiration and recharge were based on an "average" weather year. All other boundary conditions remain constant throughout the model simulation period.

    3) The model does not include simulation of streams for all surface water bodies in the basin (Figure 1), so the nearest modeled stream to any well may not be the nearest actual surface water source to that well as documented in Section II.B. Generally, the consequence of this will be an overall underestimation of stream-depletion because the distance between a well and a modeled stream will either be the same or greater than, the distance between a well and the nearest stream.

B. The model was set up with a five-year simulation period, with pumping occurring during a six-month (183-day) irrigation period in the second year. Six separate scenarios were run: one non-pumping scenario and five pumping scenarios incorporating permitted wells in different distance groups (described in Section III.C. below), by adjusting which wells were simulated (i.e., pumping) in the model. This was accomplished by modifying the model's "well input file." The well input file includes the following:

    1) The spatial location of each permitted well simulated, as described by the model cell (Row, Column, and Layer) that the well is located within. Each permitted well was assigned to a specific model cell based on an overlay of the well locations with the georeferenced model grid and well depth.

    2) The assigned well pumping layer, which was determined from the open interval of each well. Where the open interval extends over more than one model layer, each model layer was assigned a fraction of the pumping rate based on the fraction of the well open interval covered by that layer.

        a) The well open interval was determined from a review of the well log. In general, the open interval was assigned from the depth of the bottom of the seal to the total depth of the well

    3) The assigned pumping rate for each simulated well by layer. If a well is open to multiple layers, a separate line in the well input file is used for each layer. The pumping rate for each well ("modeled pumping rate") was determined for each water right the well is associated with using the following method:

        a) For water rights that describe a specific acreage [*acres*] and duty [*acre-feet per acre*] of use, the well's modeled pumping rate was estimated from the acreage and number of POAs:

            i. Total seasonal water use was estimated by multiplying the acreage by the duty and dividing this value by the number of days between April 1 and September 30 (183 days) resulting in a value in *acre-feet per day*. This step ensures that, for irrigation rights, the well's modeled pumping rate does not exceed the seasonal duty limitations. This "irrigation-season rate" may be larger or smaller than the maximum rate permitted by the water right

ii. This irrigation-season rate calculated in (a)(i) [*acre-feet per day*] was divided by 1.98 to convert from *acre-feet per day* to *cubic-feet per second* (cfs) and this value was distributed among the POAs on the water right by multiplying it by a "Q-factor" which is between 0 and 1 and was calculated as follows:

1. where the maximum permitted rate is not specified for individual POAs, it is assumed to be divided evenly among the POAs and the Q-factor is 1 divided by the number of POAs on the permit
2. where the maximum permitted rate is specified for each POA, the Q-factor for a POA is the rate specified for a POA divided by the maximum permitted rate
3. where there is only one POA on a water right, the Q-factor is 1

b) For wells on water rights that do not describe a specific acreage (e.g., municipal rights), the well's modeled pumping rate was assigned the rate permitted to the POA in the water right. This value is either the maximum permitted rate divided by the number of POAs or is the specific rate assigned to the POA by the water right.

c) Where the calculated modeled pumping rate in (a) or (b) above is greater than the maximum permitted rate, the modeled pumping rate for the well was assigned the maximum permitted rate. This ensures that modeled pumping rates do not exceed permitted rates.

d) The final modeled pumping rate [*cfs*] was then used in the model scenarios described below, and constitutes the sum of all the well's pumping rates calculated for all water rights the well is associated with (documented in Appendix A).

4) The modeled pumping duration was set to 183 days, corresponding to April 1 through September 30, by setting the modeled pumping rates for each well to the final modeled pumping rate for stress-periods associated with that time frame and setting the rates to zero for the rest of the model time. Although the irrigation season in the Klamath Basin begins in March and extends through October, it has been generally observed that actual irrigation does not extend over that full time period and that the 183 days of simulated pumping is a reasonable assumption.

C. Six pumping scenarios were modeled by creating a separate MODFLOW "name" file and "well" file for each scenario. All other model input files remained the same among all scenarios so that the only change between model scenarios was the presence of pumping wells. The six pumping scenarios that were modeled, with distance to surface water bodies being the mapped distance as per section II.B. above, were:

1) No Pumping – no wells were active
2) Pumping of wells within one-quarter mile of surface water bodies (Number of Wells = 25; Total Model Pumping Rate from all wells = 37.91 cfs)
3) Pumping of wells within one-half mile of surface water bodies (71 Wells; 115.66 cfs)
4) Pumping of wells within three-quarter mile of surface water bodies (106 Wells; 181.89 cfs)
5) Pumping of wells within one mile of surface water bodies (140 Wells; 252.84 cfs)
6) Pumping of all wells in the Upper Basin (210 Wells; 374.19 cfs)

D. Streamflow at specified model cells, representing specific locations along major streams (Figure 1), was extracted from the model's output files for each simulation using the USGS HYDMOD package[9]. Calculated streamflow at these locations for each of the model scenarios 2-6 in Section III.C. (pumping scenarios) was subtracted from calculated streamflow from model scenario 1 in Section III.C. (non-pumping scenario). This calculation provided the modeled reduction in streamflow, or stream depletion, at specific locations along streams within the Upper Klamath Basin Area, due to the cumulative effects of pumping all permitted wells within a specified distance of hydraulically-connected surface water bodies.

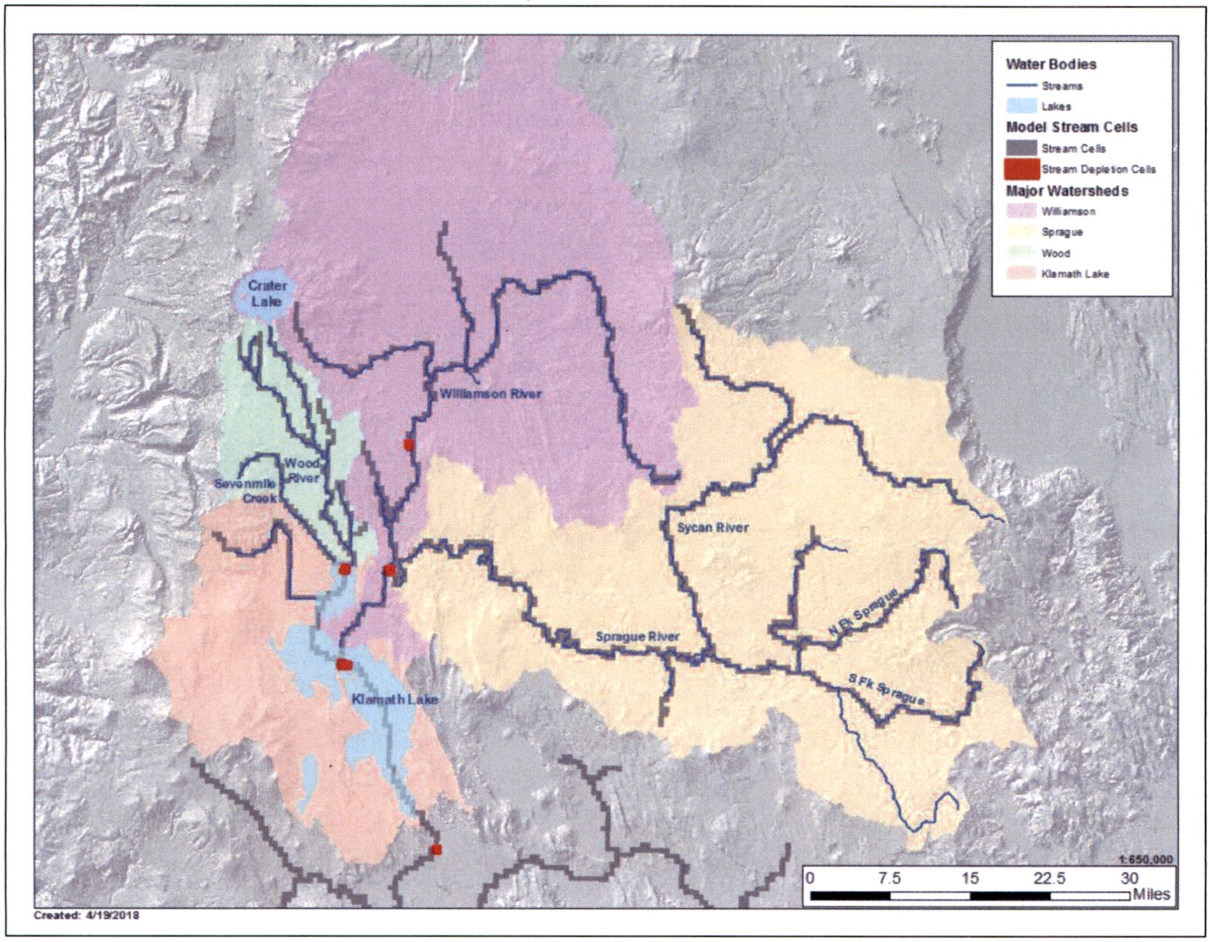
IV. The results of the modeling exercise described in the above section are presented in Table 1 and graphically presented in Figures 2A-2E. The results estimate that pumping from the 210 permitted wells modeled in the Upper Klamath Basin Area reduces streamflow by 113.07 cfs after 183 days of pumping. With consideration of OAR 690-009-0050(b), pumping of 140 wells that are hydraulically connected within one mile of surface water sources is estimated to reduce streamflow by 90.47 cfs in the Upper Klamath Basin Area.

[9] https://pubs.er.usgs.gov/publication/ofr98564

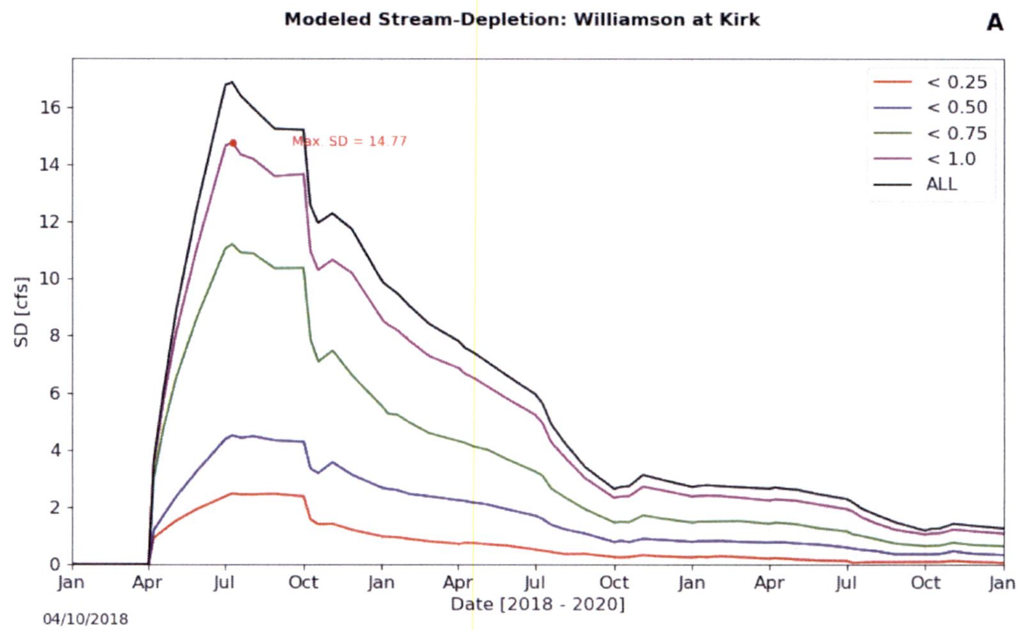
Table 1: Modeled total pumping rate for each permitted well-distance grouping and maximum calculated stream depletion, in cubic-feet per second (cfs), on indicated stream locations after 183 days of pumping.

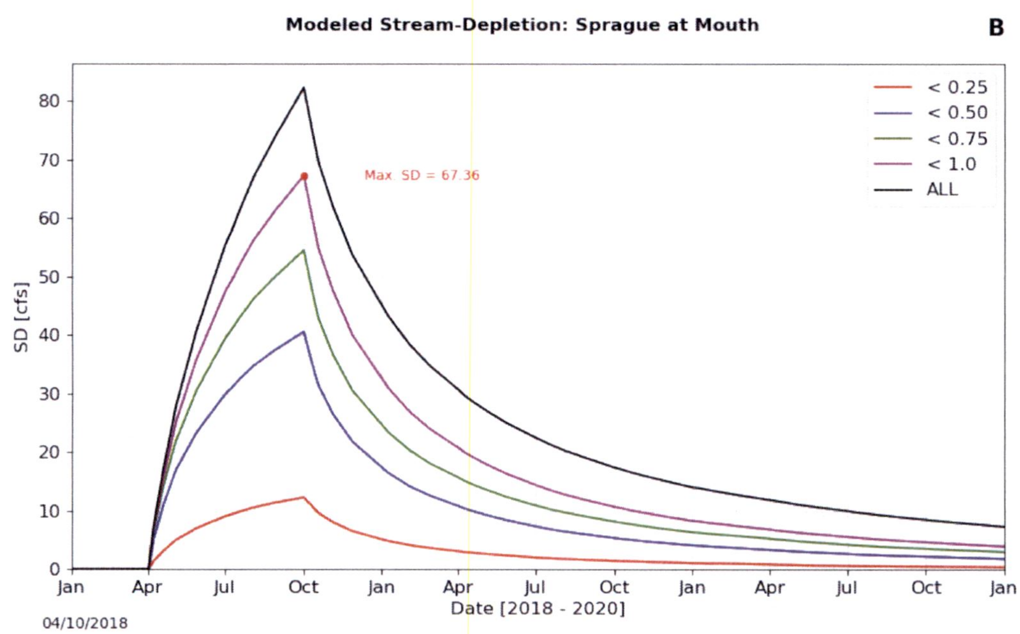
	Well-Distance Groups				
	< 1/4 Mile	< 1/2 Mile	< 3/4 Mile	< 1 Mile	All Wells
Total Modeled Pumping Rate	37.91	115.66	181.89	252.84	374.19
Stream Point	**Stream-Depletion (cfs)**				
Williamson at Kirk	2.48	4.50	11.22	14.77	16.87
Sprague at Mouth	12.30	40.59	54.54	67.36	82.33
Williamson at Mouth	15.52	48.11	69.64	86.67	103.89
Wood At Mouth	0.16	1.23	2.48	3.71	7.64
Total Modeled Stream Depletion in Upper Klamath Basin Area (Upper Basin Lake Inflow)	15.68	49.38	72.16	90.47	113.07
Percent impact after 183 days of pumping	41%	43%	40%	36%	30%

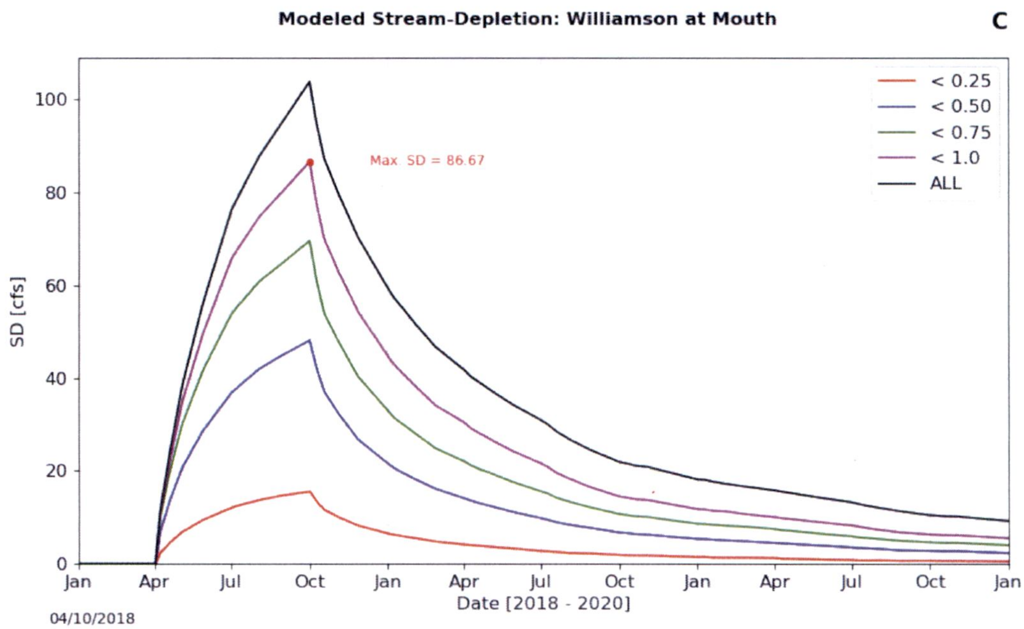
Figure 1: Overview map of Upper Klamath Basin Area watersheds and major stream systems along with model stream cells and cells where stream depletion was calculated.

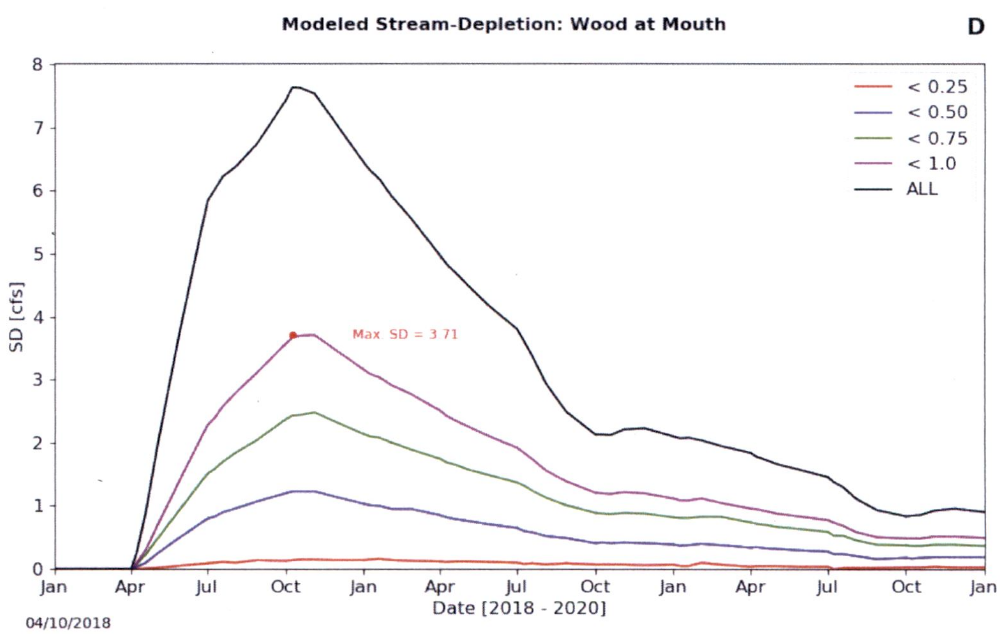


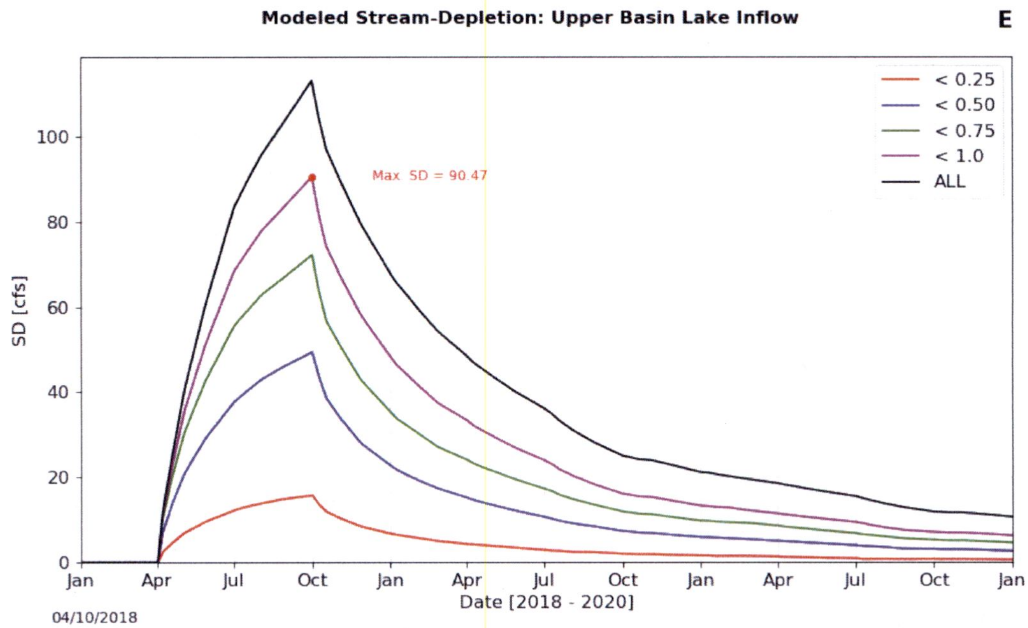
Figures 2A through 2E: Modeled stream depletion (SD) in cubic-feet per second (cfs) for each of the model scenarios described in Section III.C and listed in Table 1. Maximum SD values are for wells located within one mile of surface water.






Modeled Stream-Depletion: Williamson at Mouth
C
< 0.25
< 0.50
< 0.75
< 1.0
ALL
Max SD = 86.67
SD [cfs]
0
20
40
60
80
100
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Date [2018 - 2020]
04/10/2018


Modeled Stream-Depletion: Wood at Mouth
D
< 0.25
< 0.50
< 0.75
< 1.0
ALL
Max SD = 3.71
SD [cfs]
0
1
2
3
4
5
6
7
8
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Date [2018 - 2020]
04/10/2018


Modeled Stream-Depletion: Upper Basin Lake Inflow
E
< 0.25
< 0.50
< 0.75
< 1.0
ALL
Max SD = 90.47
SD [cfs]
0
20
40
60
80
100
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Date [2018 - 2020]
04/10/2018

Appendix A: List of permitted wells used in the model along with select well information

Well Log ID	Distance to Surface Water Source [ft]	Nearest Surface Water Source	Model Cell Number	Well Depth [ft]	Model Pumping Rate [cfs]
KLAM0000485	3136	Sprague R	28477	358	1.507
KLAM0000521	5287	Miller Cr	7001	167	0.010
KLAM0000522	4454	Miller Cr	7001	361	0.050
KLAM0000589	21496	Big Springs Cr	12035	123	0.013
KLAM0000592	6730	Trib. to Klamath Marsh	12260	71	0.013
KLAM0000601	3087	Trib. to Klamath Marsh	13099	312	1.000
KLAM0000603	1212	Trib. to Klamath Marsh	13100	640	0.270
KLAM0000616	8000	Scott Cr	13721	150	2.930
KLAM0000619	180	Trib. to Williamson	11841	455	1.093
KLAM0000670	2466	Scott Cr	13929	274	5.748
KLAM0000672	5963	Trib. to Big Springs Cr	14355	160	3.049
KLAM0000675	4798	Sand Cr	15401	322	15.600
KLAM0000677	2818	Williamson R	16454	430	10.000
KLAM0000702	2843	Williamson R	17500	188	2.257
KLAM0000769	401	Williamson R	19852	300	0.986
KLAM0000770	1057	Sevenmile Cr	22304	90.5	0.100
KLAM0000932	3265	Crooked Cr	23788	35	0.245
KLAM0000935	1230	Upper Klamath Lk	24208	70	0.083
KLAM0000942	2010	Upper Klamath Lk	24208	50	0.084
KLAM0000959	1836	Williamson R	24633	480	0.061
KLAM0001055	2662	Sprague R	24015	722	1.329
KLAM0001064	2600	Sprague R	24228	353	0.556
KLAM0001090	1820	Sprague R	23394	120	0.331
KLAM0001098	9887	Sprague R	24029	651	1.480
KLAM0001175	3630	Upper Klamath Lk	24839	326	1.000
KLAM0001176	1334	Upper Klamath Lk	24838	280	1.000
KLAM0001200	1369	Upper Klamath Lk	25468	250	0.200
KLAM0001268	6770	Williamson R	25470	453	1.780
KLAM0001287	3207	Upper Klamath Lk	25469	430	0.890
KLAM0001337	4309	Williamson R	26313	818	1.110
KLAM0001338	4073	Williamson R	26313	1200	1.110
KLAM0001362	12400	Williamson R	27153	510	0.700
KLAM0001434	5159	Sprague R	25083	1200	3.694
KLAM0001499	9712	Sprague R	25926	1625	4.512
KLAM0001501	12105	Sprague R	25930	925	2.053
KLAM0001512	18126	Sprague R	26146	1194	0.994
KLAM0001611	6488	Sycan R	25958	956	11.112
KLAM0001613	4890	Snake Cr	26170	965	1.159
KLAM0001618	2869	Snake Cr	26379	975	7.947
KLAM0001619	1316	Snake Cr	26380	1168	0.415
KLAM0001625	1514	Snake Cr	26588	720	0.980
KLAM0001628	2508	Sycan R	26377	794	5.991
KLAM0001635	1886	Sycan R	27009	845	1.138
KLAM0001674	2327	Meyrl Cr	26818	320	0.058
KLAM0001824	12350	Odessa Cr	29437	460	0.045

Well Log ID	Distance to Surface Water Source [ft]	Nearest Surface Water Source	Model Cell Number	Well Depth [ft]	Model Pumping Rate [cfs]
KLAM0001895	3292	Sprague R	28246	439	0.891
KLAM0001897	3645	Sprague R	28246	400	0.134
KLAM0001899	3390	Sprague R	28247	400	0.200
KLAM0001906	4278	Sprague R	28245	527	0.497
KLAM0001921	4390	Sprague R	28243	912	0.624
KLAM0001928	4467	Sprague R	28457	344	1.278
KLAM0001945	1857	Sprague R	28041	523	1.169
KLAM0001960	1406	Whiskey Cr	28259	1141	0.158
KLAM0001962	5868	Sprague R	28257	361	1.251
KLAM0001963	5886	Whiskey Cr	28467	580	0.763
KLAM0001965	4939	Sprague R	28255	260	0.834
KLAM0001966	6416	Sprague R	28465	558	1.267
KLAM0001968	3269	Sprague R	28255	248	0.503
KLAM0001970	4057	Sprague R	28252	350	1.169
KLAM0001972	2840	Sprague R	28043	590	1.169
KLAM0001973	7338	Sprague R	28462	213	1.169
KLAM0001974	7224	Sprague R	28463	225	1.169
KLAM0001976	6845	Sprague R	28461	446	0.651
KLAM0001977	6569	Sprague R	28461	330	0.651
KLAM0001978	4045	Sprague R	28252	386	3.474
KLAM0001980	2027	Sprague R	28249	625	1.500
KLAM0001992	10841	Sprague R	28881	667	5.663
KLAM0001994	8765	Sprague R	28675	417	1.325
KLAM0001996	11738	Sprague R	28884	220	0.662
KLAM0001997	6609	Whiskey Cr	28678	130	0.238
KLAM0001998	7527	Whiskey Cr	28677	445	0.818
KLAM0001999	7935	Whiskey Cr	28677	402	1.019
KLAM0002001	7842	Whiskey Cr	28888	117	0.132
KLAM0002004	1813	Whiskey Cr	28890	410	3.867
KLAM0002012	7309	Whiskey Cr	28888	140	0.139
KLAM0002014	10533	Whiskey Cr	29097	634	1.173
KLAM0002021	4892	Whiskey Cr	29727	384	1.661
KLAM0002029	1448	Whiskey Cr	29310	223	2.688
KLAM0002033	1914	Sycan R	27219	1127	3.029
KLAM0002034	2731	Sycan R	27429	613	0.744
KLAM0002035	3092	Sycan R	27220	310	0.455
KLAM0002039	849	Sycan R	27218	909	0.670
KLAM0002040	2855	Sycan R	27426	612	2.879
KLAM0002043	3987	Sprague R	27421	950	0.794
KLAM0002047	2047	Sprague R	27632	960	1.320
KLAM0002050	4483	Sycan R	27635	730	1.227
KLAM0002069	3897	Sprague R	28268	512	0.616
KLAM0002073	1842	Sprague R	28476	524	1.338
KLAM0002076	4585	Sprague R	28685	245	0.466
KLAM0002078	6730	Sprague R	28688	597	1.656
KLAM0002081	5344	Sprague R	28478	300	3.266

Well Log ID	Distance to Surface Water Source [ft]	Nearest Surface Water Source	Model Cell Number	Well Depth [ft]	Model Pumping Rate [cfs]
KLAM0002084	5892	Spring Cr	28688	140	0.281
KLAM0002085	1155	Spring Cr	28691	350	2.600
KLAM0002088	3554	Spring Cr	28479	520	1.406
KLAM0002090	4630	Whiskey Cr	29099	400	0.164
KLAM0002099	1096	Whiskey Cr	29522	150	3.146
KLAM0002108	11208	Spring Cr	29318	520	1.450
KLAM0002126	3874	Sprague R	28491	180	5.166
KLAM0002134	1868	Sprague R	27030	305	8.380
KLAM0002135	3418	Sprague R	27658	143	0.633
KLAM0002142	1642	Deming Cr	28717	890	2.559
KLAM0002145	2108	Sprague R	28926	708	2.284
KLAM0002147	2371	Sprague R	29343	438	4.265
KLAM0002150	4706	Sprague R	29130	485	3.477
KLAM0002151	3590	Sprague R	28919	615	2.719
KLAM0002153	4610	Sprague R	28916	376	0.849
KLAM0002155	1704	Sprague R	28919	500	2.300
KLAM0002158	8772	Sprague R	29127	440	0.360
KLAM0002159	7215	Sprague R	29127	324	0.828
KLAM0002168	4025	Fishhole Cr	29766	400	5.911
KLAM0002169	1087	Sprague R	29768	533	0.664
KLAM0002237	11318	Upper Klamath Lk	32415	419	3.762
KLAM0002245	4530	Upper Klamath Lk	32622	87	0.044
KLAM0002299	2957	Whiskey Cr	29939	137	0.447
KLAM0002303	3496	Whiskey Cr	30149	280	0.324
KLAM0002384	5990	Whiskey Cr	29949	470	3.662
KLAM0002387	2349	Whiskey Cr	29945	340	1.617
KLAM0002395	3313	Sprague R	29767	260	0.097
KLAM0002402	1325	Sprague R	29768	905	3.417
KLAM0002404	4150	Fishhole Cr	29977	301	0.428
KLAM0002406	1316	Fishhole Cr	29976	385	1.896
KLAM0002409	2517	Fishhole Cr	29763	360	0.180
KLAM0002412	1305	Fishhole Cr	29764	250	0.031
KLAM0002415	4634	Fishhole Cr	30183	277	1.380
KLAM0002431	180	Sprague R	29980	880	3.334
KLAM0002535	7247	Upper Klamath Lk	33462	25	0.022
KLAM0010146	4582	Upper Klamath Lk	33672	530	3.342
KLAM0010157	8287	Whiskey Cr	28888	248	0.657
KLAM0010188	691	Sycan R	27639	570	1.441
KLAM0010189	2786	Annie Cr	19786	412	0.890
KLAM0010228	5558	Sprague R	23177	186	2.610
KLAM0010326	3281	Sprague R	27422	1011	1.812
KLAM0010343	7870	Snake Cr	27012	475	0.926
KLAM0010355	6809	Upper Klamath Lk	33462	146	0.476
KLAM0010398	1509	Sprague R	23594	145	0.088
KLAM0010435	1286	Sprague R	27031	424	5.209
KLAM0010447	8301	Sprague R	28897	267	1.564

Well Log ID	Distance to Surface Water Source [ft]	Nearest Surface Water Source	Model Cell Number	Well Depth [ft]	Model Pumping Rate [cfs]
KLAM0010505	711	Spring Cr	28481	253	1.596
KLAM0010603	6832	Deming Cr	28294	852	3.533
KLAM0010636	3585	Crooked Cr	23578	167	0.107
KLAM0010749	10758	Fishhole Cr	33141	413	0.178
KLAM0010791	720	Sand Cr	15606	350	0.278
KLAM0011544	5018	Upper Klamath Lk	34716	309	3.340
KLAM0011614	3226	Sprague R	27853	200	0.580
KLAM0011660	1877	Upper Klamath Lk	34092	249	0.180
KLAM0011674	2362	Upper Klamath Lk	34512	1003	3.201
KLAM0011696	3371	Upper Klamath Lk	24839	869	1.000
KLAM0011766	11884	Cottonwood Cr	9520	131	0.030
KLAM0011769	19520	Cottonwood Cr	9310	135	0.020
KLAM0011770	19397	Big Springs Cr	10990	120	0.013
KLAM0011773	13302	Klamath Marsh	8694	380	0.020
KLAM0011785	1753	Williamson R	17502	340	2.713
KLAM0011797	2027	Larkin Cr	22956	288	0.491
KLAM0011825	7947	Upper Klamath Lk	34304	1205	1.073
KLAM0011828	7670	Upper Klamath Lk	34304	1224	0.295
KLAM0011836	6915	Upper Klamath Lk	34304	314	0.400
KLAM0050315	110	Upper Klamath Lk	34722	701	2.450
KLAM0050366	5331	Upper Klamath Lk	33663	512	1.673
KLAM0050552	5940	Upper Klamath Lk	33873	645	0.926
KLAM0050590	50	Scott Cr	14138	452	3.852
KLAM0050838	2181	Sprague R	28269	503	0.960
KLAM0050853	1798	Upper Klamath Lk	24838	360	0.111
KLAM0050865	175	Haystack Draw	17329	434	1.633
KLAM0051059	6628	Wood R	20628	19	9.480
KLAM0051232	3607	Sprague R	27193	1035	1.100
KLAM0051473	6466	Sprague R	27432	1149	1.308
KLAM0051561	10100	Whiskey Cr	28887	723	2.085
KLAM0051725	4642	Fishhole Cr	29762	455	1.550
KLAM0051957	1569	Williamson R	24424	750	1.560
KLAM0052035	1399	Sprague R	28489	300	0.613
KLAM0052129	6404	Sprague R	26348	900	2.100
KLAM0052803	2032	Upper Klamath Lk	24418	723	0.552
KLAM0053127	14923	Snake Cr	26596	312	0.331
KLAM0053270	5135	Upper Klamath Lk	33874	545	1.338
KLAM0053513	4970	Williamson R	11652	260	8.062
KLAM0053558	10378	Upper Klamath Lk	31994	245	0.166
KLAM0053833	1814	Snake Cr	27009	403	1.162
KLAM0054052	600	Denny Cr	30920	114	4.150
KLAM0054337	7333	Upper Klamath Lk	35136	650	7.800
KLAM0055028	1491	Williamson R	12068	270	1.727
KLAM0055389	1884	Sprague R	27631	950	0.794
KLAM0055522	4107	Upper Klamath Lk	35138	1355	1.611
KLAM0056194	4995	Sprague R	27424	960	1.147

Well Log ID	Distance to Surface Water Source [ft]	Nearest Surface Water Source	Model Cell Number	Well Depth [ft]	Model Pumping Rate [cfs]
KLAM0056638	6226	Wood R	20628	695	3.188
KLAM0057112	1447	Fishhole Cr	29765	186	0.207
KLAM0057328	1083	Sevenmile Cr	22304	120	0.070
KLAM0057441	4865	Upper Klamath Lk	34513	300	0.066
KLAM0057442	4589	Upper Klamath Lk	34513	300	0.033
KLAM0057478	6735	Williamson R	25260	286	0.030
KLAM0057662	7690	Sevenmile Cr	20625	534	8.728
KLAM0058165	10379	Sprague R	25297	980	0.597
KLAM0058286	1840	Annie Cr	20209	675	3.188
KLAM0058382	3957	Upper Klamath Lk	30292	249	4.150
KLAM0058398	2227	Spring Cr	28480	417	0.361
KLAM0058399	5451	Scott Cr	14559	535	3.485
KLAM0058400	218	Fishhole Cr	29765	110	0.213
KLAM0058401	5070	Sycan R	25957	250	0.270
KLAM0058402	6971	Sprague R	28463	500	1.159
KLAM0058403	6706	Sprague R	26347	15	1.168
KLAM0058404	1072	Williamson R	24425	1240	1.448
KLAM0058406	2470	Upper Klamath Lk	33670	108	0.251
KLAM0058409	1751	Williamson R	17502	367	2.713
KLAM0058410	3937	Big Springs Cr	12466	176	5.733
KLAM0058411	7677	Sprague R	26983	300	0.083
KLAM0058412	2436	Wood R	23998	300	0.662
KLAM0058432	606	Upper Klamath Lk	32200	400	0.279
KLAM0059319	4521	Wood R	20419	695	3.188
KLAM0059411	2893	Scott Cr	14349	318	3.117
KLAM0059916	3716	Annie Cr	20209	705	3.188
KLAM0059921	5967	Wood R	20418	657	3.188