PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date **12/7/2015**

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

SUBJECT: Application G- **18129** Supersedes review of **N.A.**
Date of Review(s)

PUBLIC INTEREST PRESUMPTION; GROUNDWATER

OAR 690-310-130 (1) *The Department shall presume that a proposed groundwater use will ensure the preservation of the public welfare, safety and health as described in ORS 537.525.* Department staff review groundwater applications under OAR 690-310-140 to determine whether the presumption is established. OAR 690-310-140 allows the proposed use be modified or conditioned to meet the presumption criteria. **This review is based upon available information and agency policies in place at the time of evaluation**.

A. GENERAL INFORMATION: Applicant's Name: **Otley Brothers Inc.** County: **Harney**

A1. Applicant(s) seek(s) **5.33** cfs from **5** well(s) in the **Malheur Lake** Basin, **Lower Donner und Blitzen River** subbasin

A2. Proposed use **Irrigation (426 acres primary)** Seasonality: **March 1 to September 30**

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	no log on file	BV 1	tuffaceous rocks & sediment	5.33	29S/31E-9 SE-NW	1828 FEET SOUTH AND 1429 FEET EAST FROM NW CORNER, SECTION 9
2	HARN 51892	BV 2	tuffaceous rocks & sediment	5.33	29S/31E-9 SE-NW	1657 FEET SOUTH AND 1608 FEET EAST FROM NW CORNER, SECTION 9
3	HARN 51895	BV 3	tuffaceous rocks & sediment	5.33	29S/31E-9 NW-NW	805 FEET SOUTH AND 891 FEET EAST FROM NW CORNER, SECTION 9
4	HARN 51894	BV 4	tuffaceous rocks & sediment	5.33	29S/31E-9 SE-NW	2271 FEET SOUTH AND 2184 FEET EAST FROM NW CORNER, SECTION 9
5	Proposed	BV 5	tuffaceous rocks & sediment	5.33	29S/31E-9 SE-SE	3920 FEET SOUTH AND 4937 FEET EAST FROM NW CORNER, SECTION 9

* 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	4157	?	*32	*2012	?	?	*40	?	?	?	?	?
2	4156	27	27	11/1/2012	200	0-20	0-40	None	None	600	-	Air
3	4159	35	35	10/13/2012	250	0-20	0-60	None	None	300	-	Air
4	4157	29	29	10/8/2012	210	0-40	0-40	None	None	600	-	Air
5	4186	?	?	?	?	?	?	?	?	?	?	?

Use data from application for proposed wells.

A4. **Comments:**

The proposed wells are located along the western margin of the Blitzen Valley 0.6 – 1.4 miles west of the Malheur National Wildlife Refuge Buena Vista Guard Station. The area is mapped as Qal/Qs (alluvium and Holocene sediments), Tmbh (Basalt of Harney Lake), Tmtd (Devine Canyon ash-flow tuff) and Tmst3 (Tuffaceous sedimentary rocks) by Brown and others (1980). The available water well reports for the existing wells show tuffaceous rocks and sediment including sand, clay, pumice, pumice stone, claystone, and conglomerate.

***Note:** No well log on file for well 1. The information listed in the table above is taken directly from the application. The original source of this information is not known.

Note: Satellite imagery clearly shows two irrigated center pivots already exist at this location.

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

OAR 690-512-0040
The rule states: "(1) Except as provided in section (3) of this rule, the Department shall not accept an application for permit, or issue a permit, for any use of surface water, or of groundwater the use of which has the potential to substantially interfere with surface water, in the Malheur Lake Basin unless the applicant shows, by a preponderance of evidence, that unappropriated water is available to supply the proposed use at the times and in the amounts requested. The evidence provided shall be prepared by a qualified hydrologist or other water resources specialist and shall include:

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

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

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

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

Currently no administrative area.

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

B1. **Based upon available data**, I have determined that groundwater* for the proposed use:

a. ☒ **is** over appropriated, ☐ **is not** over appropriated, *or* ☐ **cannot be determined to be** over appropriated during any period of the proposed use. * This finding is limited to the groundwater portion of the over-appropriation determination as prescribed in OAR 690-310-130;

b. ☒ **will not** *or* ☐ **will** likely be available in the amounts requested without injury to prior water rights. * This finding is limited to the groundwater portion of the injury determination as prescribed in OAR 690-310-130;

c. ☒ **will not** *or* ☐ **will** likely to be available within the capacity of the groundwater resource; or

d. ☐ **will, if properly conditioned**, avoid injury to existing groundwater rights or to the groundwater resource:
   i. ☐ The permit should contain condition #(s) _____;
   ii. ☐ The permit should be conditioned as indicated in item 2 below.
   iii. ☐ The permit should contain special condition(s) as indicated in item 3 below;

B2. a. ☐ **Condition** to allow groundwater production from no deeper than _____ ft. below land surface;

b. ☐ **Condition** to allow groundwater production from no shallower than _____ ft. below land surface;

c. ☐ **Condition** to allow groundwater production only from the _____ groundwater reservoir between approximately _____ ft. and _____ ft. below land surface;

d. ☐ **Well reconstruction** is necessary to accomplish one or more of the above conditions. The problems that are likely to occur with this use and without reconstructing are cited below. Without reconstruction, I recommend withholding issuance of the permit until evidence of well reconstruction is filed with the Department and approved by the Groundwater Section.

Describe injury –as related to water availability– that is likely to occur without well reconstruction (interference w/ senior water rights, not within the capacity of the resource, etc):

B3. **Groundwater availability remarks:**

The proposed well(s) for this application is within the greater Harney Valley area where observed groundwater level declines are occurring in most areas (see attached map). The decline indicates that demand for groundwater is exceeding the average annual recharge. An analysis by the Department confirms the volume of groundwater permitted for annual use exceeds the average annual volume of recharge to groundwater. The Department also estimates that approximately 30 percent of the total acreage permitted for groundwater use has yet to be developed. Groundwater development for these acres under already-existing permits will further increase the groundwater level decline rate. Based on the location of the proposed POA(s), the Department finds that the proposed groundwater use will occur from the same groundwater source exhibiting groundwater level declines. Groundwater is therefore determined to be over-appropriated [see OAR 690-400-0010(11)(a)(B)] and the proposed use for this application is not within the capacity of the resource.

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

7N: Annual Measurement and Decline Condition

7P: Well Tag Condition

7T: Dedicated Measuring Tube Condition for all POA wells

Flow meter condition: Use the water rights "large" permit condition requiring a totalizing flow meter and reporting

7F: Well Location Condition

Special Permit Condition:

The permittee shall construct one (1) minimum six-inch diameter observation well to penetrate the same aquifer as the production wells. The well shall meet the Department's minimum well construction standards and shall be cased and sealed to the same depth as the production wells. The well shall be constructed at a location approved by the Department for the purpose of instrumentation with continuous water-level monitoring equipment. The landowner or permittee shall provide access to Department staff to install and maintain the monitoring equipment. The well shall not be used for any other purpose while the Department is monitoring water levels. The well shall be completed prior to water use under the terms of any permit issued.

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

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

Well	Aquifer or Proposed Aquifer	Confined	Unconfined
1	tuffaceous rocks & sediment	☐	☒
2	tuffaceous rocks & sediment	☐	☒
3	tuffaceous rocks & sediment	☐	☒
4	tuffaceous rocks & sediment	☐	☒
5	tuffaceous rocks & sediment	☐	☒

Basis for aquifer confinement evaluation:

Leonard (1970) found that near the edges of the valley there is likely good interconnection between individual water-bearing beds in the valley fill and those in the adjacent and underlying Tertiary rocks.

Available data, including Piper and others (1939), Leonard (1970), and water well reports indicate ground water in the basin fill is generally unconfined and hydraulically connected to Malheur and Harney Lakes. Some local confinement can occur where discontinuous low permeability layers are present. Leonard (1970) indicates confined ground water occurs at depth in the basin in deep basin fill sediments and underlying Tertiary volcanic and sedimentary rocks. Hubbard (1975) indicates the ground water contribution to flow into Malheur Lake is small with the lake perched above ground water in most areas.

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**	**Donner und Blitzen River**	**4125**	**4130**	**13200**	☒	☐	☐	☐	☒
2	**1**	**Donner und Blitzen River**	**4129**	**4130**	**13000**	☒	☐	☐	☐	☒
3	**1**	**Donner und Blitzen River**	**4124**	**4130**	**13750**	☒	☐	☐	☐	☒
4	**1**	**Donner und Blitzen River**	**4128**	**4130**	**12400**	☒	☐	☐	☐	☒
5	**1**	**Donner und Blitzen River**	**?**	**4130**	**9890**	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation:

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

The groundwater elevations cited above are derived from the static water levels reported on the water well reports for HARN 51892, HARN 51895, and HARN 51894. The groundwater elevation cited for well 1 is derived from information provided in the application - the original source of this information is not known.

Within the uncertainty of the groundwater elevation estimates, the groundwater elevation for wells 1, 2, 3, and 4 are roughly coincident with the elevation of the closest perennial reach of the Donner und Blitzen River, suggesting that groundwater likely provides baseflow to this surface water body at this location.

Water Availability Basin the well(s) are located within: DONNER UND BLITZEN R > MALHEUR L - AT MOUTH

C3a. **690-09-040 (4):** Evaluation of stream impacts for <u>each well</u> that has been determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. Limit evaluation to instream rights and minimum stream flows that are pertinent to that surface water source, and not lower SW sources to which the stream under evaluation is tributary. Compare the requested rate against the 1% of 80% *natural* flow for the pertinent Water Availability Basin (WAB). If Q is not distributed by well, use full rate for each well. Any checked ☒ box indicates the well is assumed to have the potential to cause PSI.

Well	SW #	Well < ¼ mile?	Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

C3b. **690-09-040 (4):** Evaluation of stream impacts <u>by total appropriation</u> for all wells determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. **Complete only if Q is distributed among wells**. Otherwise same evaluation and limitations apply as in C3a above.

	SW #		Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
			☐			☐		☐		☐
			☐			☐		☐		☐
			☐			☐		☐		☐
			☐			☐		☐		☐

Comments: _____

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

C4a. **690-09-040 (5):** Estimated impacts on **hydraulically connected surface water sources greater than one mile** as a percentage of the proposed pumping rate. Limit evaluation to the effects that will occur up to one year after pumping begins. This table encompasses the considerations required by 09-040 (5)(a), (b), (c) and (d), which are not included on this form. Use additional sheets if calculated flows from more than one WAB are required.

Non-Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	**1**	**6.19**%	**5.78**%	**0.72**%	**2.08**%	**3.37**%	**4.55**%	**5.61**%	**6.59**%	**7.50**%	**7.80**%	**7.23**%	**6.67** %
Well Q as CFS		**0**	**0**	**3.01**	**3.01**	**3.01**	**3.01**	**3.01**	**3.01**	**3.01**	**0**	**0**	**0**
Interference CFS		**0.186**	**0.174**	**0.022**	**0.063**	**0.102**	**0.137**	**0.169**	**0.198**	**0.226**	**0.235**	**0.218**	**0.201**
Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
(A) = Total Interf.		**0.186**	**0.174**	**0.022**	**0.063**	**0.102**	**0.137**	**0.169**	**0.198**	**0.226**	**0.235**	**0.218**	**0.201**
(B) = 80 % Nat. Q		**56.30**	**35.80**	**45.80**	**107.0**	**263.0**	**214.0**	**77.00**	**37.30**	**26.00**	**35.70**	**28.90**	**50.30**
(C) = 1 % Nat. Q		**0.563**	**0.358**	**0.458**	**1.07**	**2.63**	**2.14**	**0.77**	**0.373**	**0.26**	**0.357**	**0.289**	**0.503**
(D) = (A) > (C)		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
(E) = (A / B) x 100		**0.330** %	**0.486** %	**0.048** %	**0.059** %	**0.039** %	**0.064** %	**0.219** %	**0.531** %	**0.869** %	**0.658** %	**0.754** %	**0.400** %

(A) = total interference as CFS; (B) = WAB calculated natural flow at 80% exceed. as CFS; (C) = 1% of calculated natural flow at 80% exceed. as CFS; (D) = highlight the checkmark for each month where (A) is greater than (C); (E) = total interference divided by 80% flow as percentage.

Basis for impact evaluation:

C4a. Hunt (1999) was used to calculate the interference between Well 5 and SW #1, the closest surface water body outside of a mile from the proposed wells. Very little data is available about aquifer parameters at this location. The values used for the calculation are conservative and appropriate until better values become available. The calculations used an intermediate transmissivity of 1000ft2/day. Additionally, the calculation used an assumed intermediate storage coefficient (0.001). The pumping rate used represents the maximum allowable duty prorated over the irrigation season (3.01 cfs). See reports attached.

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

C4b. **690-09-040 (5) (b) The potential to impair or detrimentally affect the public interest is to be determined by the Water Rights Section.**

C5. ☐ **If properly conditioned**, the surface water source(s) can be adequately protected from interference, and/or groundwater use under this permit can be regulated if it is found to substantially interfere with surface water:

i. ☐ The permit should contain condition #(s)_____;

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

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

C1. 690-09-040 (1)

It is determined that all wells will produce water from an unconfined aquifer.

C2. 690-09-040 (2) (3)

It is determined that all wells are hydraulically connected with the Donner und Blitzen River..

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

C4a. 690-09-040 (5)

Interference is determined to be less than 1% of the 80% flow in all months evaluated for Well 5 to SW#1.

The proposed well(s) for this application is within the greater Harney Valley area where observed groundwater level declines are occurring in most areas (see attached map). The decline indicates that demand for groundwater is exceeding the average annual recharge. An analysis by the Department confirms the volume of groundwater permitted for annual use exceeds the average annual volume of recharge to groundwater. The Department also estimates that approximately 30 percent of the total acreage permitted for groundwater use has yet to be developed. Groundwater development for these acres under already-existing permits will further increase the groundwater level decline rate. Based on the location of the proposed POA(s), the Department finds that the proposed groundwater use will occur from the same groundwater source exhibiting groundwater level declines. Groundwater is therefore determined to be over-appropriated [see OAR 690-400-0010(11)(a)(B)] and the proposed use for this application is not within the capacity of the resource.

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

7N: Annual Measurement and Decline Condition

7P: Well Tag Condition

7T: Dedicated Measuring Tube Condition for all POA wells

Flow meter condition: Use the water rights "large" permit condition requiring a totalizing flow meter and reporting

7F: Well Location Condition

Special Permit Condition:

The permittee shall construct one (1) minimum six-inch diameter observation well to penetrate the same aquifer as the production wells. The well shall meet the Department's minimum well construction standards and shall be cased and sealed to the same depth as the production wells. The well shall be constructed at a location approved by the Department for the purpose of instrumentation with continuous water-level monitoring equipment. The landowner or permittee shall provide access to Department staff to install and maintain the monitoring equipment. The well shall not be used for any other purpose while the Department is monitoring water levels. The well shall be completed prior to water use under the terms of any permit issued.

References Used:

Piper, A.M., Robison, T.W., and Park C.F. 1939. Geology and Ground Water Resources of the Harney Basin, Oregon. USGS Water Supply Paper 841.

Brown, D. E., McLean, G. D., and Black, G. L., 1980, Preliminary geology and geothermal resource potential of the southern Harney Basin, Oregon: Portland, Oreg., Oregon Department of Geology and Mineral Industries Open-File Report O-80-7, Plate 2, scale 1:62,500.

Leonard, A.R. 1970. Ground-Water Resources in Harney Valley, Harney County, Oregon. Ground Water Report 16, Oregon Water Resources Department, Salem, Oregon.

Memo by Ivan Gall, 1/15, 2008

Oregon Administrative Rules

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

Hubbard, Larry. L. 1975. Hydrology of Malheur Lake, Harney County, Southeastern Oregon. USGS Water Resources Investigation 75-21.

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #**: _____ **Logid:** _____

D2. **THE WELL does not appear to meet current well construction standards based upon:**

a. ☐ review of the well log;
b. ☐ field inspection by _____;
c. ☐ report of CWRE _____;
d. ☐ other: (specify) _____

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

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

Water Availability Tables

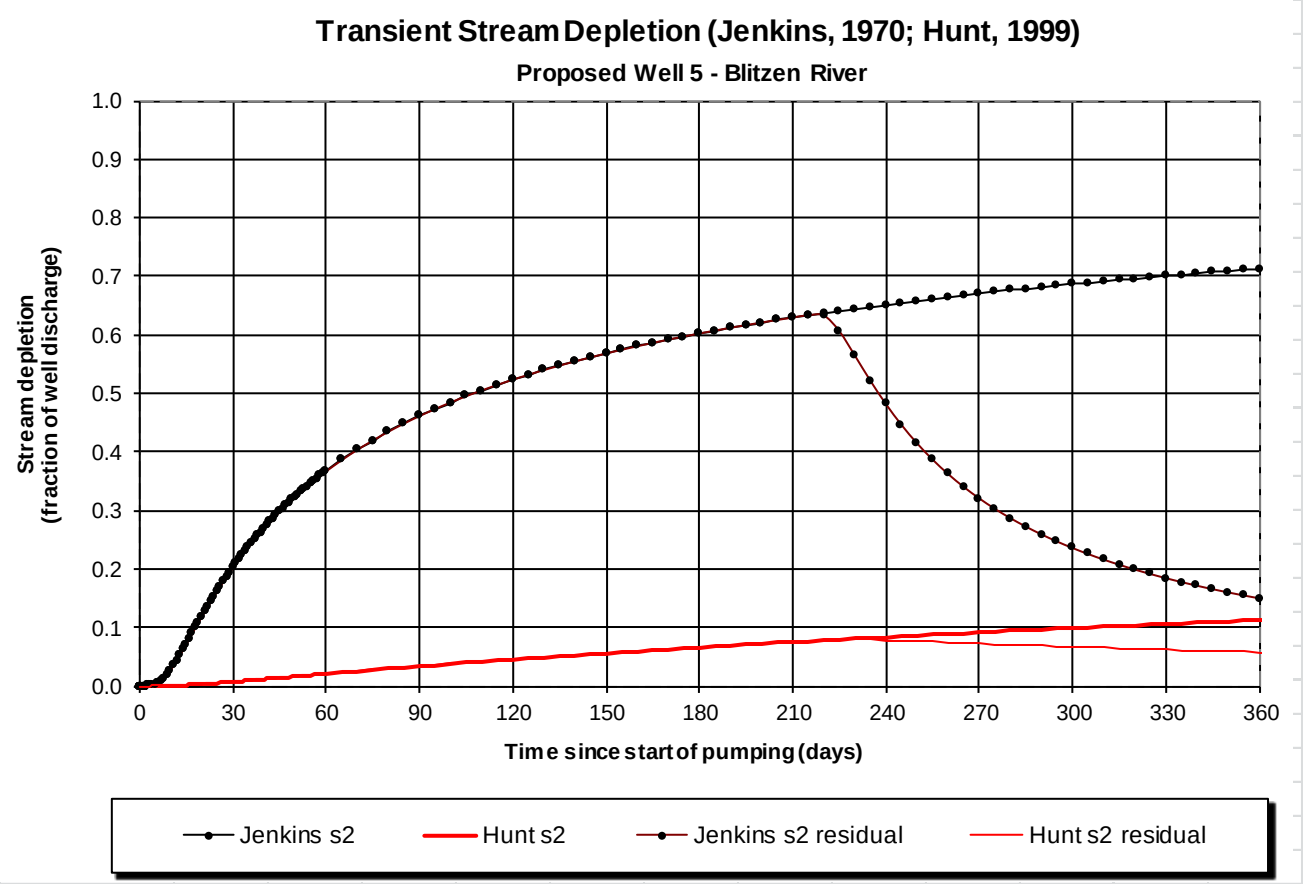
DETAILED REPORT ON THE WATER AVAILABILITY CALCULATION

DONNER UND BLITZEN R > MALHEUR L - AT MOUTH

Watershed ID #: 31200311 Basin: MALHEUR LAKE Exceedance Level: 80

Time: 3:04 PM Date: 12/02/2015

Month	Natural Stream Flow	Consumptive Use and Storage	Expected Stream Flow	Reserved Stream Flow	Instream Requirements	Net Water Available
	Monthly values are in cfs. Storage is the annual amount at 50% exceedance in ac-ft.					
JAN	56.30	87.30	-31.00	0.00	0.00	-31.00
FEB	35.80	87.70	-51.90	0.00	0.00	-51.90
MAR	45.80	107.00	-60.90	0.00	0.00	-60.90
APR	107.00	105.00	2.17	0.00	0.00	2.17
MAY	263.00	267.00	-3.75	0.00	0.00	-3.75
JUN	214.00	215.00	-0.67	0.00	0.00	-0.67
JUL	77.00	71.50	5.47	0.00	0.00	5.47
AUG	37.30	29.60	7.67	0.00	0.00	7.67
SEP	26.00	17.00	8.98	0.00	0.00	8.98
OCT	35.70	92.70	-57.00	0.00	0.00	-57.00
NOV	28.90	86.00	-57.10	0.00	0.00	-57.10
DEC	50.30	87.30	-37.00	0.00	0.00	-37.00
ANN	84,700	75,700	16,300	0	0	16,300



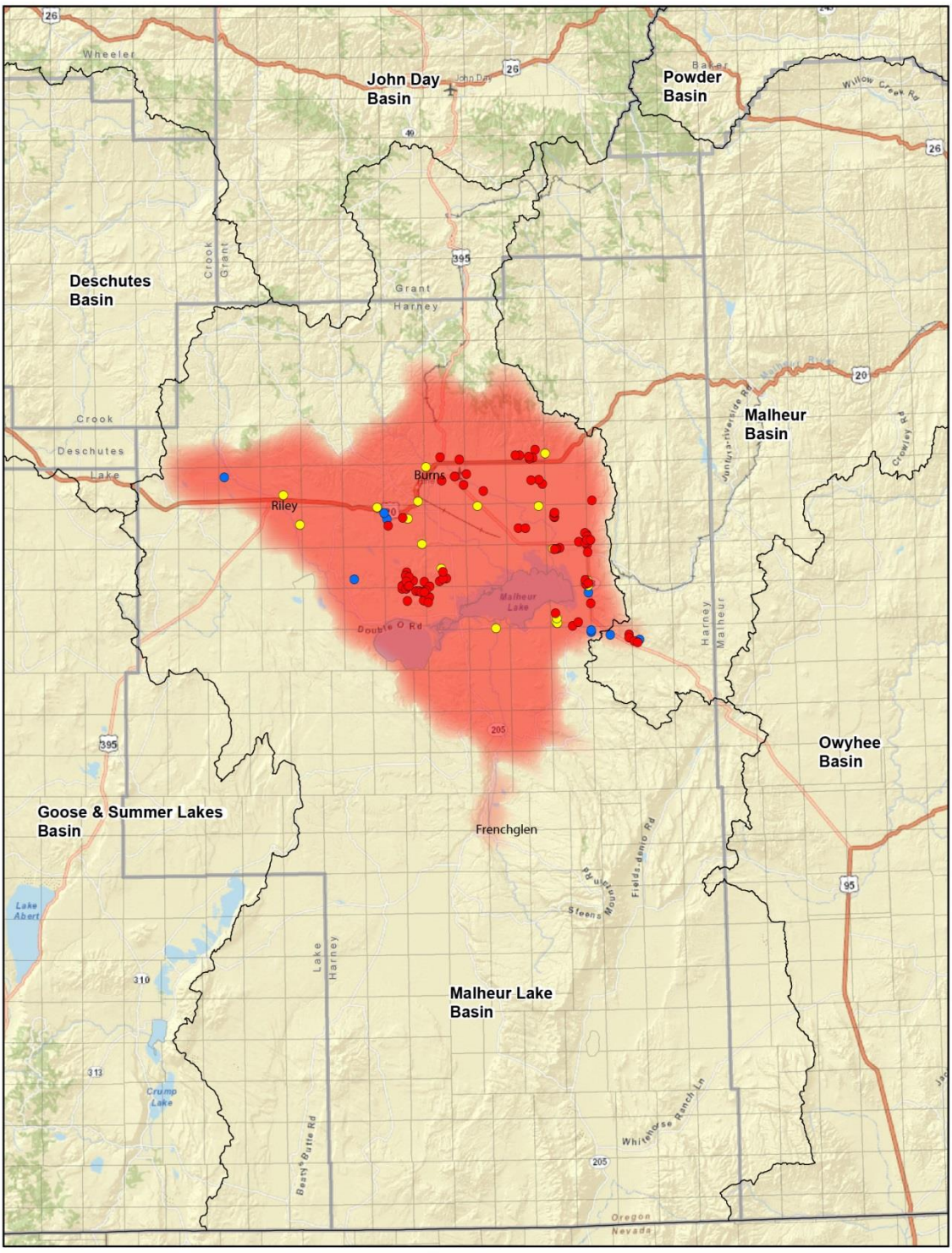
Output for Hunt Stream Depletion, Scenerio 2 (s2):						Time pump on = 214 days						
Days	**30**	60	90	120	150	180	210	240	270	300	330	360
Qw, cfs	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010
Jenk SD s2 %	**20.17**	36.66	46.10	52.32	56.80	60.22	62.94	48.15	32.04	23.56	18.41	14.97
Jen SD s2 cfs	0.607	1.104	1.388	1.575	1.710	1.813	1.894	1.449	0.964	0.709	0.554	0.451
Hunt SD s2 %	**0.72**	2.08	3.37	4.55	5.61	6.59	7.50	7.80	7.23	6.67	6.19	5.78
Hunt SD s2 cfs	0.022	0.063	0.102	0.137	0.169	0.198	0.226	0.235	0.218	0.201	0.186	0.174

Parameters:		**Scenario 1**	**Scenario 2**	**Scenario 3**	**Units**
Net steady pumping rate	Qw	3.01	3.01	3.01	cfs
Distance to stream	a	9890	9890	9890	ft
Aquifer hydraulic conductivity	K	0.5	5	50	ft/day
Aquifer thickness	b	200	200	200	ft
Aquifer transmissivity	T	100	1000	10000	ft*ft/day
Aquifer storage coefficient	S	0.001	0.001	0.001	
Stream width	ws	50	50	50	ft
Streambed hydraulic conductivity	Ks	0.01	0.01	0.01	ft/day
Streambed thickness	bs	25	25	25	ft
Streambed conductance	sbc	0.02	0.02	0.02	ft/day
Stream depletion factor (Jenkins)	sdf	978.121	97.8121	9.78121	days
Streambed factor (Hunt)	sbf	1.978	0.1978	0.01978	

Well Location Map

G-18129
Otley Brothers Inc.

Water-Level Trends in Nearby Wells



Explanation

- Wells with water level decline
- Wells with no decline
- Wells with uncertain trend

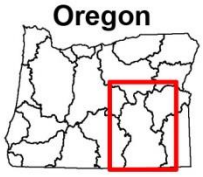
Counties

Basins

Greater Harney Valley Area

N

Oregon



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, OpenStreetMap contributors, and the GIS USer Community.

Oregon Lambert Projection, NAD 83 (EPSG# 2992)

Software: ESRI ArcMap ver. 10.1; Adobe Illustrator 2014.0.0 release.

OWRD (db), 4/14/2015

Greater Harney Valley Groundwater Level Trends
Oregon Water Resources Department
April 2015 Draft

0 5 10 20 30 40 Miles

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