MEMO

State of Idaho
Department of Water Resources
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Date: September 4, 2009

To: Ernie Carlsen

From: Mike McVay MM

cc: Sean Vincent, Rick Raymondi, Lyle Swank, Jeff Peppersack, Shelly Keen

Subject: Preliminary hydrological evaluation of permit 15-7307, Malad Basin.

Introduction

Per your request, the Hydrology Section in the State Office has reviewed the hydrogeology of the Malad Basin with respect to water right permit application number 15-7307. It should be noted that this memo precedes our forthcoming assessment of water resources in the Malad Basin. This memo necessarily relies upon preliminary findings based primarily upon a literature-review that has been undertaken as part of that assessment.

Permit Summary

The permit application 15-7307 proposes to divert 0.8 cfs from 4/1 to 10/31 for the irrigation of 40 acres. The proposed point of diversion (POD) is an existing well (16S36E-14SESWSE) located in Oneida County approximately 2 miles from the Utah border (Figure 1). This well is located within a narrow corridor (outlet gap) near the southern end of the Basin 15 (Figure 2) and produces water from an interval of 155 to 216 feet bgs (Appendix A).

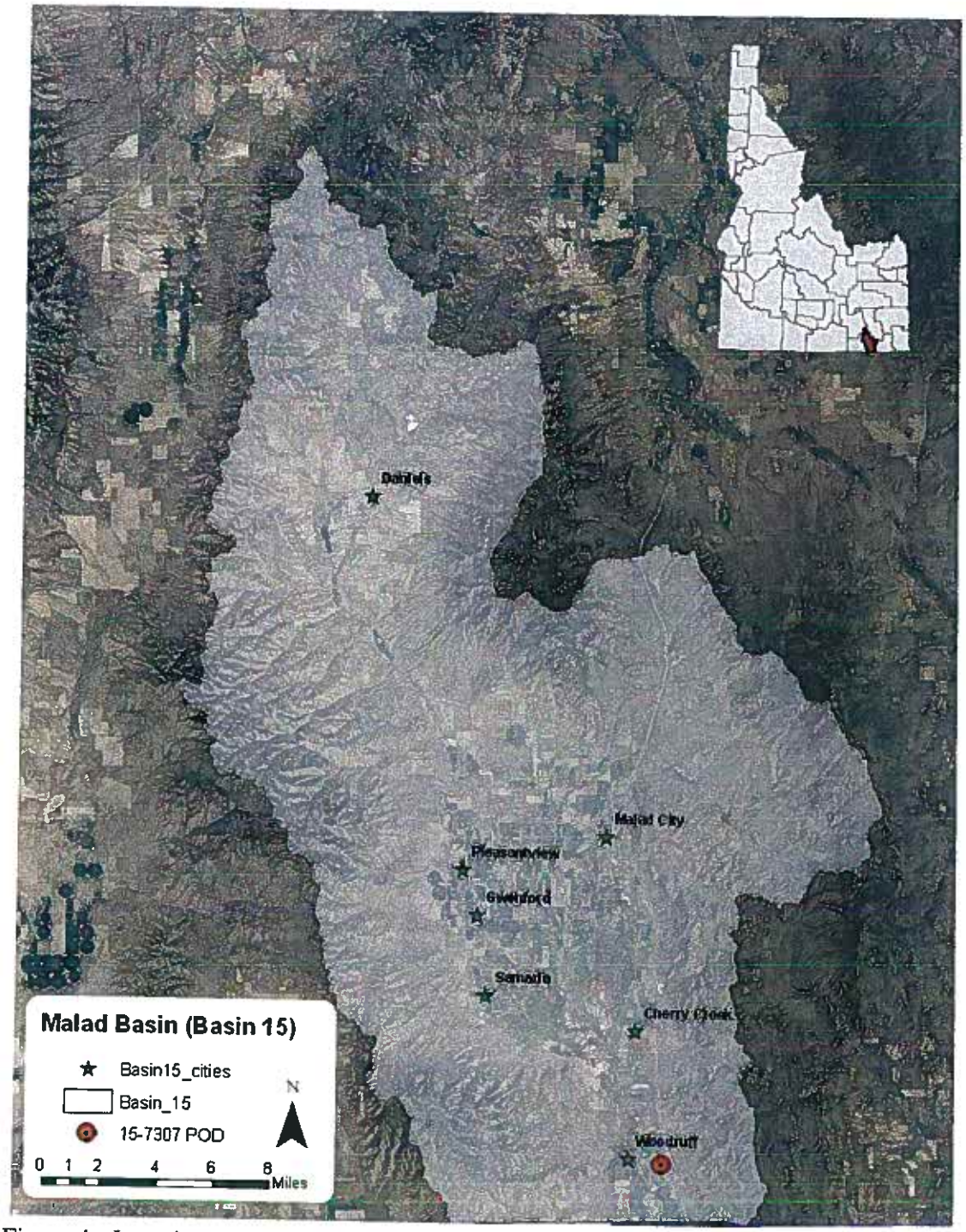

Figure 1. Location of the Malad Basin (Basin 15) and POD for permit application 15-7307.

Figure 2. Location of the 15-7307 POD in relation to important hydrologic and structural features. Also shown are well 16S36E-14DBC1, the Malad River, basin-bounding faults, and Woodruff Spring.

Impact Assessment

Assessing hydrologic impacts is difficult due to the complicated geologic setting and the general lack of hydrogeologic data for the area. Available information is summarized below.

Hydrogeologic Setting

The valley is surrounded by mountains composed of crystalline, metamorphic, and consolidated sedimentary rocks, and the valley floor consists of hundreds to thousands of feet of sediment that overlie a deeply depressed structural block (Pluhowski, 1970). The depression was formed primarily by normal faulting which is associated with the Basin and Range physiographic province (Figure 3).

The valley fill sediments constitute the aquifer in the valley. Based on geophysical data, the depth of the sediments range from approximately 2,500 ft near Malad City, to 600 feet in the southwest, to 400 feet in the basin outlet gap where the permit 15-7307 well is located (Burnham, et al., 1969). The aquifer consists of several connected water bearing units within the sediments that are composed primarily of gravel. These distinct yet hydraulically connected layers form a single aquifer from the northern alluvium down through the outlet gap into Utah (Burnham, et al., 1969; Pluhowski, 1970). Although the basin is thousands of feet deep in places, the upper few hundred feet host the only known aquifer capable of producing large amounts of water (Burnham, et al., 1969).

It is important to note the locations of the alluvium and lake sediments in Figure 3. The alluvium is highly permeable and serves as the primary recharge area for the entire basin. It has been hypothesized that the vast majority of the water in the basin is a result of infiltration of precipitation runoff into the alluvium. The lake sediments cap the majority of the valley floor, and serve as the principal confining unit, producing artesian conditions across the valley from Malad City south to the Woodruff Fault (Burnham, et al., 1969).

The impermeable cap of lake sediments also confines the aquifer in the outlet gap, which is the area south of the Woodruff Fault where the POD for permit 15-7307 is located, although pressures are not great enough to cause artesian conditions. The sediments appear to greatly limit recharge directly from the surface in this area. Water issuing from Woodruff Spring is reported to be warm (89° F) and of poor quality, and the Malad River in this area is also of poor quality (Burnham, et al., 1969; Mower and Nace, 1957; Pluhowski, 1970, http://nwis.waterdata.usgs.gov). Driller's reports in the gap indicate the wells near the POD are accessing cold (50° F), good quality water. This implies the aquifer is receiving recharge as underflow from the regional aquifer to the north.

The outlet gap has an effective aquifer thickness of approximately 200 feet based on geophysical and well drilling information (Burnham, et al., 1969). Previous researchers estimated the width of the aquifer in the gap to be approximately one mile, and a review

of geologic maps and driller's logs indicate that the gap could be up to two miles wide (Figure 3).

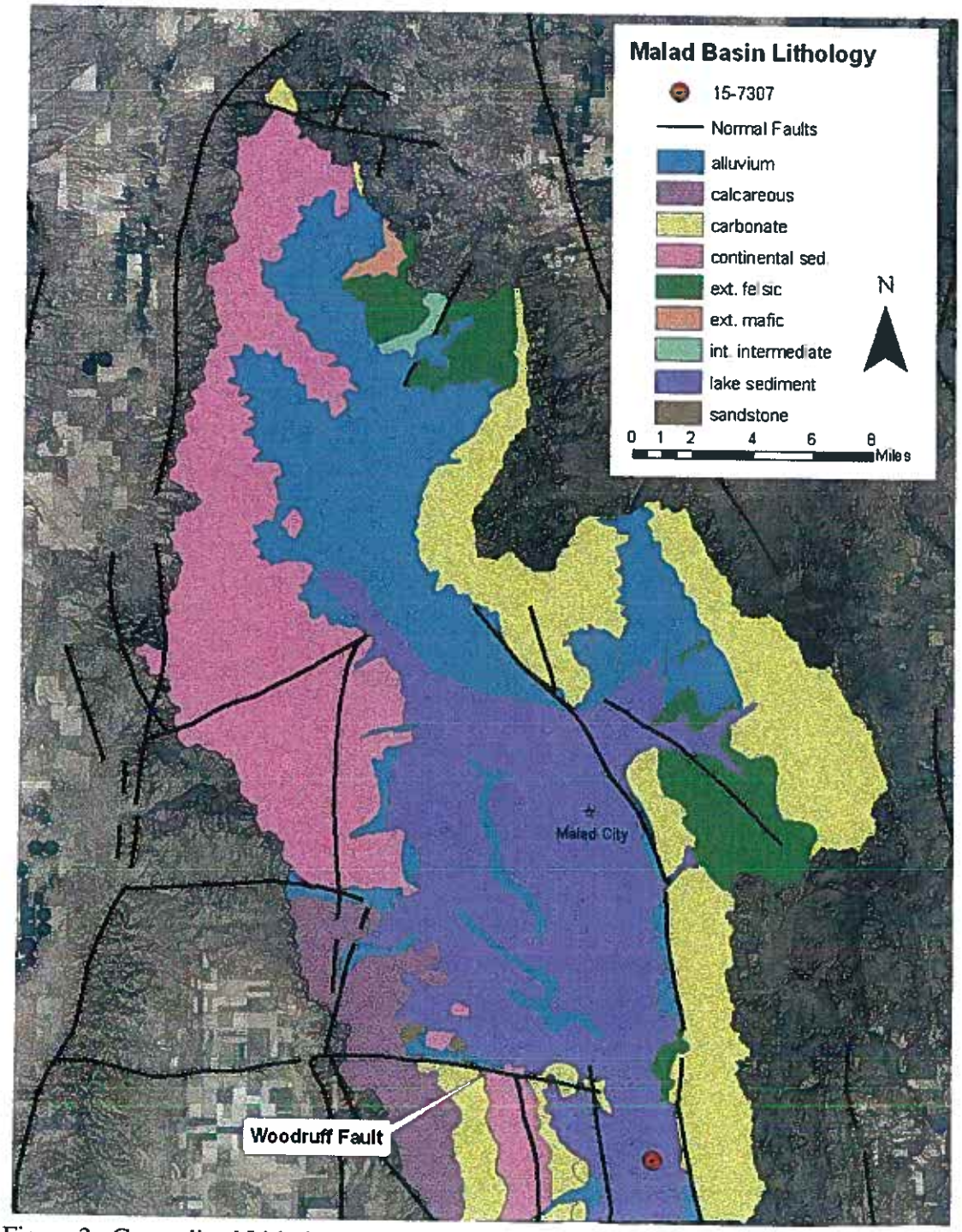

Figure 3. Generalized Lithology in the Malad Basin. The outlet gap area is the fault-bounded corridor south of the Woodruff Fault denoted as "lake sediment". The southern extent of this map ends at the Utah border.

Water Levels in the Outlet Gap

Only one well (16S 36E-14DBC1) with historic water level information was identified in the outlet gap area, and it is located approximately 1,600 ft to the north of the 15-7307 POD (Appendix A). Although well 16S 36E-14DBC1 is only 81 feet deep, it is assumed to be completed within the regional aquifer due to the extensive and connected nature of the layered aquifer. Furthermore, water quality indicates that the well is accessing water with much lower salinity (28.9 mg/L chloride) than what is found in the water at Woodruff Spring (2780 mg/L chloride) or the Malad River at Woodruff (1125 mg/L chloride) (Pluhowski, 1970; http://nwis.waterdata.usgs.gov). Because these wells are in close proximity to each other and appear to access the same confined aquifer, well 16S 36E-14DBC1 provides a reasonable indication of aquifer conditions at the 15-7307 POD.

As shown in Figure 4, water levels have dropped at an average rate of 0.7 ft/year since 1991. These data indicate that water levels in the outlet gap have a general downward trend during the period of record.

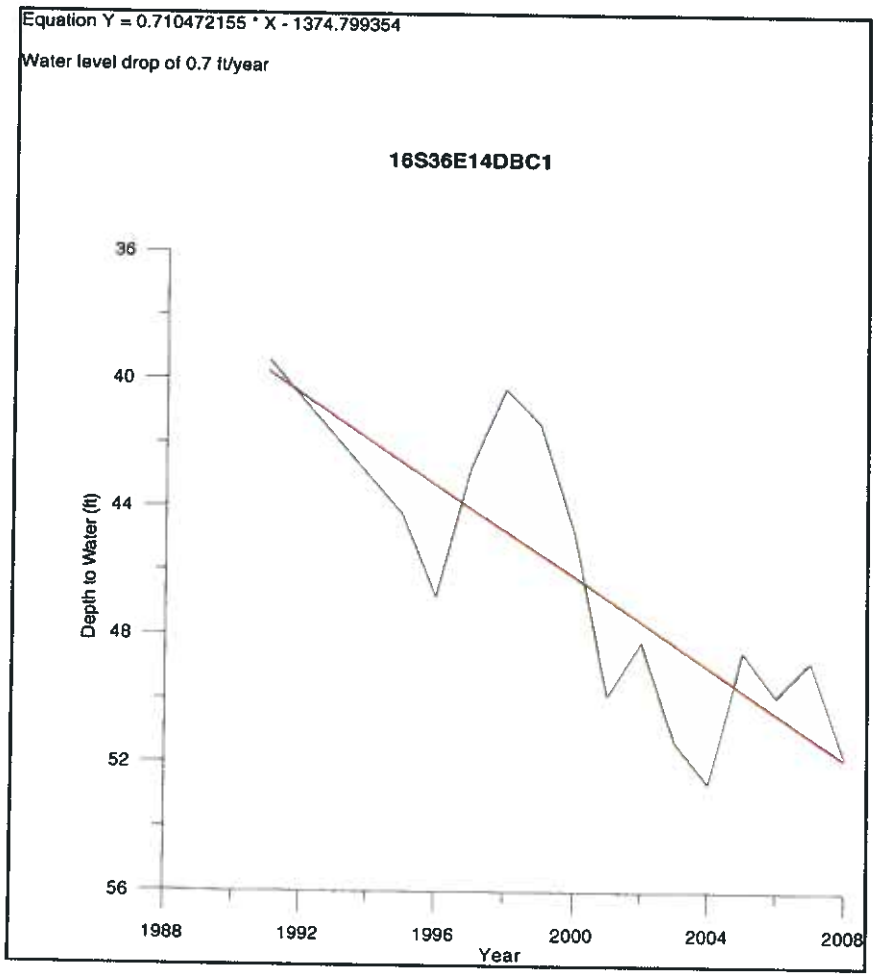

Figure 4. Water levels in 16S36E-14DBC1. This well is approximately 1,600 ft north of the 15-7307 POD and is assumed to represent the aquifer conditions in this area.

Pumping Effects

An image well analysis (see, for example, Freeze and Cherry, 1979, p. 330) was performed using the fault boundary package in Aqtesolv® in order to estimate water level drawdown caused by the proposed pumping well. Inputs were derived from textbook values or previously published research. Hydraulic conductivity was assumed to range from 20 ft/day to 200 ft/day based upon review of estimates presented in Burnham, et al., 1969 and WGI, 2001. The assumed storage coefficient is 0.0001, which is the mean storage coefficient for confined aquifers (Driscoll, 1986). Other assumed inputs include a six-month pumping duration, and an aquifer thickness of 200 feet based on well driller's reports and geophysical data (Pluhowski, 1969). The idealized aquifer geometry is based on faults mapped in Figures 2 and 3, and from drillers report's in the area. The drawdown estimates are presented in Table 1.

Table 1.

Transmissivity (ft^2/day)	Time (days)	Storativity	Aquifer Thickness (ft)	Fault Spacing (ft)	Drawdown at POD	Drawdown 1 mile north of POD
8,000	180	0.0001	200	12,000	**88**	**64**
80,000	180	0.0001	200	12,000	**9**	**6**

It is important to note that irrigation wells located north of the proposed POD in the main part of the aquifer experience seasonal pumping declines on the order of 20 to 40 ft (Burnham, et al., 1969), and that these declines are within the range of the drawdown estimates for the proposed POD.

Conclusions

Available information suggests that the production zone for the irrigation well that is proposed as the POD is the regional aquifer in the Malad Valley. The location of the proposed POD is in a narrow, fault-bounded portion of the basin in which the regional confined aquifer is approximately 200 ft thick. The narrow, fault-bounded geometry of the gap causes pumping effects to propagate preferentially to the north and south, extending the cone of depression further into the main aquifer than if the outlet gap was not bounded. In combination with the fact that the aquifer is confined, the narrowing of the aquifer in the gap tends to cause greater drawdown than elsewhere and serves to hasten the flow of water from the central part of the basin toward the Woodruff Fault. Water level data from nearby 16S36E-14DBC1 indicate that water levels in the area have been declining in recent years.

References

Burnham, W.L., Harder, A.H., and Dion, N.P., 1969. Availability of ground water for large-scale use in the Malad Valley-Bear River areas of Southeastern Idaho – An initial assessment. USGS open-file report.

Driscoll, F.G., 1986. Groundwater and wells, 2nd editon. Johnson Division, St. Paul, MN.

Freeze, R.A., and J.A. Cherry, 1979, Groundwater, Prentice-Hall, Inc., 604 pp.

Mower, R.W., Nace, R.L., 1957. Water-loving plants in the Malad Valley Oneida County, Idaho. USGS Water-Supply Paper 1412

Pluhowski, E.J., 1970. Hydrology of the Upper Malad River Basin, Southeastern Idaho. USGS Water-Supply Paper 1888.

Washington Group International, 2001. Source area delineation report Malad Valley Hydrologic Province. Prepared for the Idaho Department of Environmental Quality.

National Water Information System, USGS Web Interface, http://nwis.waterdata.usgs.gov

APPENDIX A

WELL LOGS

Form 238-7
6/07

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

15

1. WELL TAG NO. D 60051338
Drilling Permit No.
Water right or injection well #
2. OWNER: Lex Smith
Name Lex Smith
Address 11696 S. 19000 W.
City Malad State ID Zip 83252
3. WELL LOCATION:
Twp. 16 North ☐ or South ☒ Rge 36 East ☒ or West ☐
Sec. 14 SE 1/4 SW 1/4 SE 1/4
Govt Lot County Oneida
Lat. ° (Deg and Decimal minutes)
Long. ° (Deg and Decimal minutes)
Address of Well Site 11696 S 19000 W
City M
Lot Blk Sub. Name
4. USE:
☒ Domestic ☐ Municipal ☐ Monitor ☒ Irrigation ☐ Thermal ☐ Injection
☐ Other
5. TYPE OF WORK:
☒ New well ☐ Replacement well ☐ Modify existing well
☐ Abandonment ☐ Other
6. DRILL METHOD:
☒ Air Rotary ☐ Mud Rotary ☐ Cable ☐ Other
7. SEALING PROCEDURES:

Seal material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method/procedure
Bentonite	0	78	27 bags	Gravity

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/ Schedule	Material	Casing	Liner	Threaded	Welded
8"	+2	218	.250	Steel	☒	☐	☒	☒
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 218
9. PERFORATIONS/SCREENS:
Perforations ☒ Y ☐ N Method Knife
Manufactured screen ☐ Y ☐ N Type
Method of installation

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule
155	216	¼ x 1½"	1000	8"	steel	.250

Length of Headpipe Length of Tailpipe
Packer ☐ Y ☒ N Type
10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method
	NA			

11. FLOWING ARTESIAN:
Flowing Artesian? ☐ Y ☒ N Artesian Pressure (PSIG)
Describe control device

12. STATIC WATER LEVEL and WELL TESTS:
Depth first water encountered (ft) Static water level (ft) 76'
Water temp. (°F) Bottom hole temp. (°F)
Describe access port
Well test:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (hrs/min)

Test method: Pump ☐ Bailer ☐ Air ☐ Flowing artesian ☐
Water quality test or comments:
13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	water Y	water N
10"	0	18	Clay		X
	18	30	Cemented Gravel		X
	30	55	Clay		X
	55	60	Cemented gravel		X
	60	78	Clay		X
8"	78	88	Cemented gravel	X	
	88	93	Clay		X
	93	95	Clay		X
	95	100	Cemented gravel	X	
	100	110	Clay		X
	110	130	Cemented gravel	X	
	130	145	Clay		X
	145	218	Cemented gravel	X	

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Department of Water Resources
Eastern Region

Completed Depth (Measurable) 218'
Date Started 9-11-08 Date Completed 9-16-08
14. DRILLER'S CERTIFICATION:
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Company Name Valley Drilling Co. No. 383
*Principal Driller Date 9-19-08
*Driller Date
*Operator II Joey Wallace Date 9/19/08
Operator I Date
* Signature of Principal Driller and rig operator are required.

Figure A-1. Proposed POD well owned by Lex Smith.

USE TYPEWRITER OR BALL POINT PEN

State of Idaho
Department of Water Administration

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Administration within 30 days after the completion or abandonment of the well

1. WELL OWNER
Name Orvis Lloyd
Address Malad.
Owner's Permit No.

2. NATURE OF WORK
(X) New well ( ) Deepened ( ) Replacement
( ) Abandoned (describe method of abandoning)

3. PROPOSED USE
(X) Domestic ( ) Irrigation ( ) Test ( ) Other (specify type)
( ) Municipal ( ) Industrial ( ) Stock ( ) Waste Disposal or Injection

4. METHOD DRILLED
( ) Cable (X) Rotary ( ) Dug ( ) Other

5. WELL CONSTRUCTION
Diameter of hole 6 inches Total depth 81 feet
Casing schedule: (X) Steel ( ) Concrete

Thickness	Diameter	From	To
.250 inches	6 inches	1 feet	81 feet
inches	inches	feet	feet
inches	inches	feet	feet
inches	inches	feet	feet
inches	inches	feet	feet

Was a packer or seal used? ( ) Yes (X) No
Perforated? (X) Yes ( ) No
How perforated? ( ) Factory ( ) Knife (X) Torch
Size of perforation 1/4 inches by 3 inches

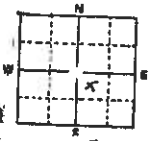
Number		From	To	
30	perforations	61 feet	81 feet	
	perforations	feet	feet	
	perforations	feet	feet	

Well screen installed? ( ) Yes (X) No
Manufacturer's name
Type Model No.
Diameter Slot size Set from feet to feet
Diameter Slot size Set from feet to feet

Gravel packed? ( ) Yes (X) No Size of gravel
Placed from feet to feet

Surface seal depth 18 Material used in seal (X) Cement grout (X) Puddling clay ( ) Well cuttings
Sealing procedure used ( ) Slurry pit ( ) Temporary surface casing (X) Overbore to seal depth

6. LOCATION OF WELL
Sketch map location must agree with written location



Subdivision Name
Lot No. Block No.
County Oneida
NW¼ SE¼ Sec. 14 T. 16 N R. 36 E W

7. WATER LEVEL
Static water level 38 feet below land surface
Flowing? ( ) Yes (X) No G.P.M. flow
Temperature 49 ° F. Quality
Artesian closed-in pressure p.s.i.
Controlled by ( ) Valve ( ) Cap ( ) Plug

8. WELL TEST DATA
( ) Pump ( ) Bailer (X) Other

Discharge G.P.M.	Draw Down	Hours Pumped
35-38		24

9. LITHOLOGIC LOG 47235

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
6	0	3	Top Soil		
	3	68	Clay		
	68	81	Gravel		

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10. Work started Sept 1974 finished Sept 1974

11. DRILLERS CERTIFICATION
Firm Name Northwest Pump & Rig Firm No. 238
Address 1423 Pershing Date
Signed by (Firm Official) Dean Mitchell
and
(Operator) Dean Mitchell

USE ADDITIONAL SHEETS IF NECESSARY FORWARD THE WHITE COPY TO THE DEPARTMENT

Figure A-2. Well log for well 16S 36E 14DBC1.