Ground Water Quality Technical Report No. 32

Ground Water Report, Silverwood area of the Rathdrum Prairie Sensitive Resource Aquifer

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Abstract

This report presents monitoring results for ground water samples collected during late 2006 and early 2007 from wells in the area of the Silverwood Theme Park, located south of the community of Athol, Idaho. During the study, water samples were collected on a quarterly basis from wells in the Silverwood Theme Park area, beginning in September 2006. The theme park discharges wastewater generated during the summer operating season to a series of septic tanks and drain fields, and there is a concern that ground water in the Rathdrum Prairie Sensitive Resource Aquifer (RPSRA) may be impacted by this discharge.

The initial goal of the study was to establish 15 ground water sampling locations in the area. However, following a review of well logs, and field visits to the area, nine wells and one wastewater discharge source were identified for the sampling network. All nine wells are community water supply wells.

The general ground water flow direction in the RPSRA is from the northeast to the southwest, but a potentiometric map prepared by Campbell (2005) indicated that in the Silverwood area ground water moves from southeast to northwest. The potentiometric surface in this area was based on water level elevations from two wells located near the eastern margin of the aquifer. At the time, these were the only wells within a 24-square-mile area where water levels were available. Two test wells completed in July 2007 at the Silverwood site provide more site-specific water level information and indicate that the direction of ground water flow in the Silverwood area is to the south-southwest. In any case, the nearest sample location for this project was approximately 1 mile west of the facility, which is believed to be cross-gradient to the theme park, and the next nearest sample location was about 3 miles to the southwest. Well samples were analyzed for major ions, nitrate as nitrogen (NO_3-N), total dissolved solids, the environmental isotopes of oxygen and hydrogen (also called deuterium) and the field parameters pH, temperature, specific conductance, and dissolved oxygen were measured.

Major ion results indicate that ground water at most sites is a calcium-magnesium bicarbonate type water. One well completed in the underlying granitic bedrock and hydrologically isolated from the overlying RPSRA is a sodium bicarbonate water. Nitrate concentrations for four ground water samples ranged from 1.02 to 2.6 milligrams per liter (mg/L); nitrate concentrations for the other 34 ground water samples were below 1.0 milligrams per liter (mg/L). Nitrate concentrations in two samples collected from a swimming pool filtration system (Water Park backflush) had nitrate concentrations of 2.6 and 1.54 mg/L. Total and E coli bacteria concentrations were greater than 2,400 and 6 MPN/100 mL, respectively (where MPN/100 mL is the most probable number of organisms per 100 milliliters of the original sample) in one sample of the Water Park backflush water. The stable isotope results indicated that oxygen and deuterium can serve as useful tracers of wastewater impacts to ground water provided suitable down-gradient monitoring locations are available.

Introduction

The purpose of this study is to evaluate ground water quality in an area surrounding the Silverwood Theme Park, located north of Coeur d'Alene, Idaho. The theme park's location, shown in Figure 1, is on the eastern edge of the Rathdrum Prairie Sensitive Resource Aquifer (RPSRA) in Township 53 North, Range 03 West, Section 28 (T53N, R03W, S28).

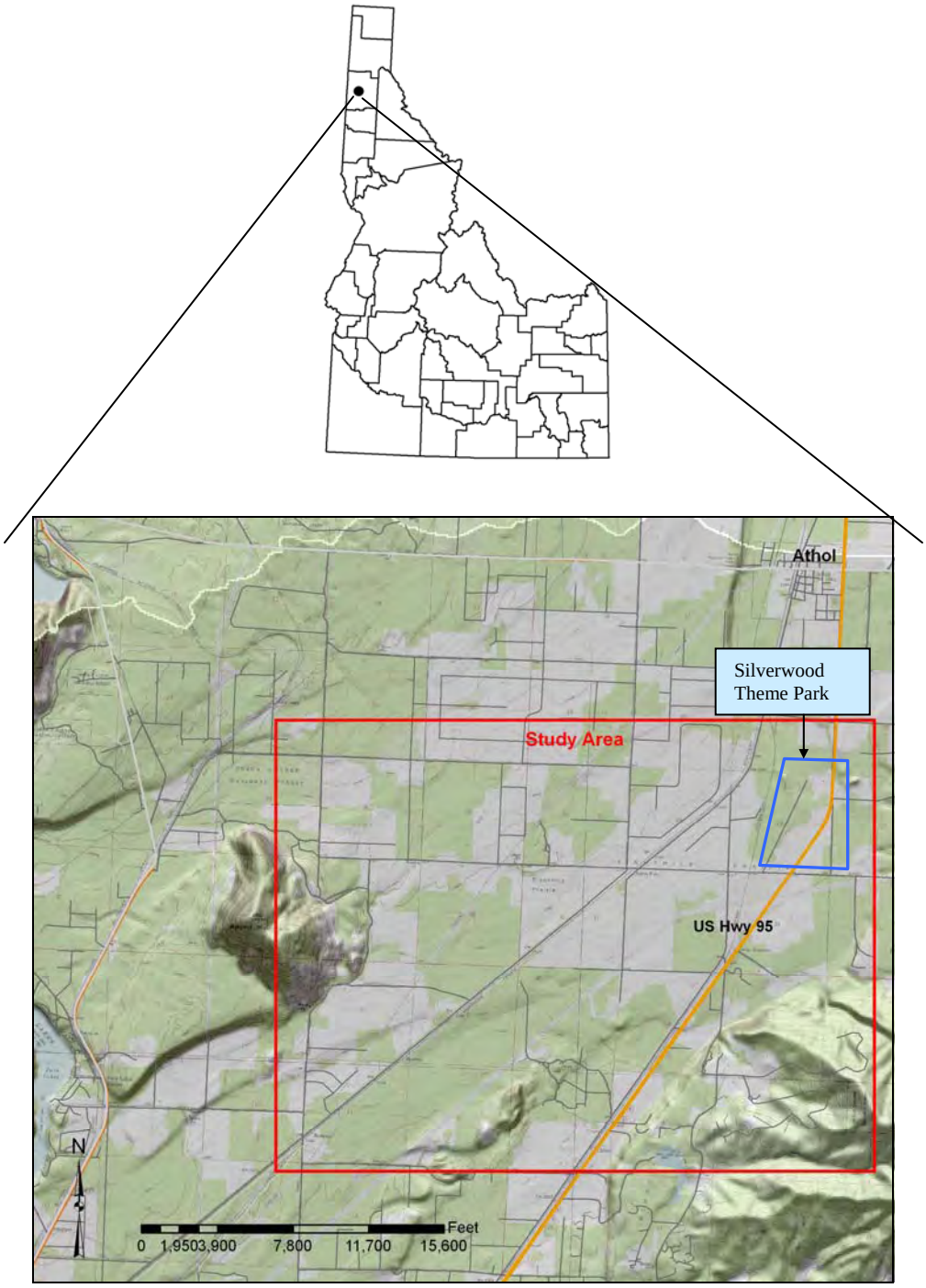


Figure 1. Location of Silverwood study area and general location of Silverwood Theme Park.

The theme park is operated during the summer months and attracts up to 500,000 visitors annually who use the public drinking water and sewage systems serving the facility, including the water park and public restrooms. The water park portion of the facility has a filtration system that is back flushed periodically to refresh the filtration system. The sewer system currently is comprised of septic tanks and drain fields operating under a number of subsurface sewage disposal permits issued over the past 20 years by the Panhandle Health District.

Drinking water and water for the water park is supplied from wells located east of the theme park along East Bunco Road, east of Highway 95. Wastewater generated from the various facilities and from the filtration system associated with the water park is generated over the summer operating period of approximately 110 days. Maintenance and custodial care occurs during the fall, winter, and spring with minimal wastewater generation during this time. The wastewater effluent volume generated at the facility is approximately 10 million gallons per year. Water from the water park filtration system does not undergo any treatment and is not included in the 10 milion gallons of wastewater effluent.

Wastewater from the public facilities undergoes primary treatment in septic tanks and is disposed of in several drainfields located around the facility. Wastewater from the water park filtration system (water park back flush) is disposed of in an unlined pit on the western part of the theme park. This discharge was measured at 16 gallons per minute during the September 2006 sampling event.

There is a concern that the wastewater effluent could contribute contaminants including phosphorus, nitrate, and pathogens to the aquifer. A nutrient-pathogen (N-P) evaluation conducted by the facility estimated that ground water nitrate concentrations at the downgradient facility boundary could be 6.8 mg/L due to impacts from site operations.

Climate

The Silverwood area is characterized by warm, dry summers and cool, moist winters (Molenaar, 1988). The mean annual precipitation (1971-2000) near Bayview is 25.3 inches (Western Regional Climate Center, 2005).

RPSRA Designation

The RPSRA was designated a sole source aquifer in 1978 (Federal Register, Vol. 43, No. 28-Thursday, February, 9, 1978). The aquifer supplies potable water to the residents in Kootenai and Bonner Counties, Idaho and the surrounding area of Spokane, Washington. The designation concluded that if contamination to the aquifer occurred, it could create a significant public health hazard as this aquifer is the sole source of drinking water for much of the area. Subsequent to the sole source aquifer designation by the U.S. Environmental Protection Agency, Idaho designated it a sensitive resource aquifer with additional water quality requirements.

Hydrogeology

The Silverwood Theme Park is situated on the eastern edge of the RPSRA. The RPSRA is largely an unconfined aquifer and covers an area from Lake Pend Orielle, Hodoo Lake, and Blanchard Lake in the north to the cities of Coeur d'Alene and Post Falls in the south. The aquifer extends west through Spokane, Washington, to its discharge area at the confluence of the Spokane and Little Spokane Rivers (Kahle and others, 2005).

East of the Silverwood Theme Park, erosional channels in the bedrock have been backfilled with coarse sand, gravel, cobbles, and boulders derived from Pleistocene glacial flood events. Fine-grained deposits of the Latah Formation may occur around the margins and in the lowermost part the aquifer. These deposits were the result of lacustrine deposition in lakes dammed behind Columbia Plateau basalts. The landscape of the underlying bedrock consists of an uneven surface with ridges and isolated hills that were buried by the flood water deposits. These low-permeability bedrock features may protrude above the existing landscape, as in the case of Round Mountain or the bedrock features mapped northeast of the Silverwood area, or they may occur at various depths below the land surface. In most areas, the bedrock does not yield significant quantities of water to wells. In many cases, the location of the buried bedrock can only be determined from well drillers' logs. Large-scale features related to the aquifer extent and thickness have been identified by gravity measurements collected across the aquifer (Oldow and Sprenke, 2006).

West of the Silverwood area, three bedrock channels have been identified: the West or Main Channel, the Ramsey or Middle channel, and the Chilco Channel. The Chilco Channel is believed to be closed on its north end. The Ramsey Channel, however, may extend northeast into the Silverwood area. Figure 2, modified from Kahle and Bartolino (2007) shows the location of Round Mountain, the northern extent of the aquifer, the three channels west and southwest of the Silverwood area, and the bedrock outcrops in the northern part of the Silverwood facility.

Figure 3, geologic cross section O-O' along the line indicated in Figure 2, shows the nature of the bedrock surface, estimated aquifer thickness, and location of the water table as interpreted from well drillers' logs from the area (modified from Kahle and Bartolino, 2007). The cross section shows the bedrock outcrop in T53N, R03W, S28, where the Silverwood facility is located. Several wells were drilled in the past in the central part of the Silverwood area in an effort to develop a reliable water supply for the facility. These wells all encountered granite or metasediments at shallow depths and produced small volumes of water. The Norton Aero well (Appendix B) is an example – the driller noted that granite was encountered at 35 feet below land surface and the well was drilled to a total depth of 575 feet. The well produced two gallons per minute from the bedrock material. Successful water supply wells for the facility were finally drilled east of the facility. Silverwood Well #3 (Appendix B), east of Highway 95 (Figure 1) in the southeast corner of Section 28, encountered 36 feet of saturated cobbles at 317 to 343 feet below land surface, and the well produced 270 gallons per minute. This and two adjacent wells form the water supply system for the theme park. The data from these wells indicate that a channel of the RPSRA may exist east of Highway 95 (Figure 2).

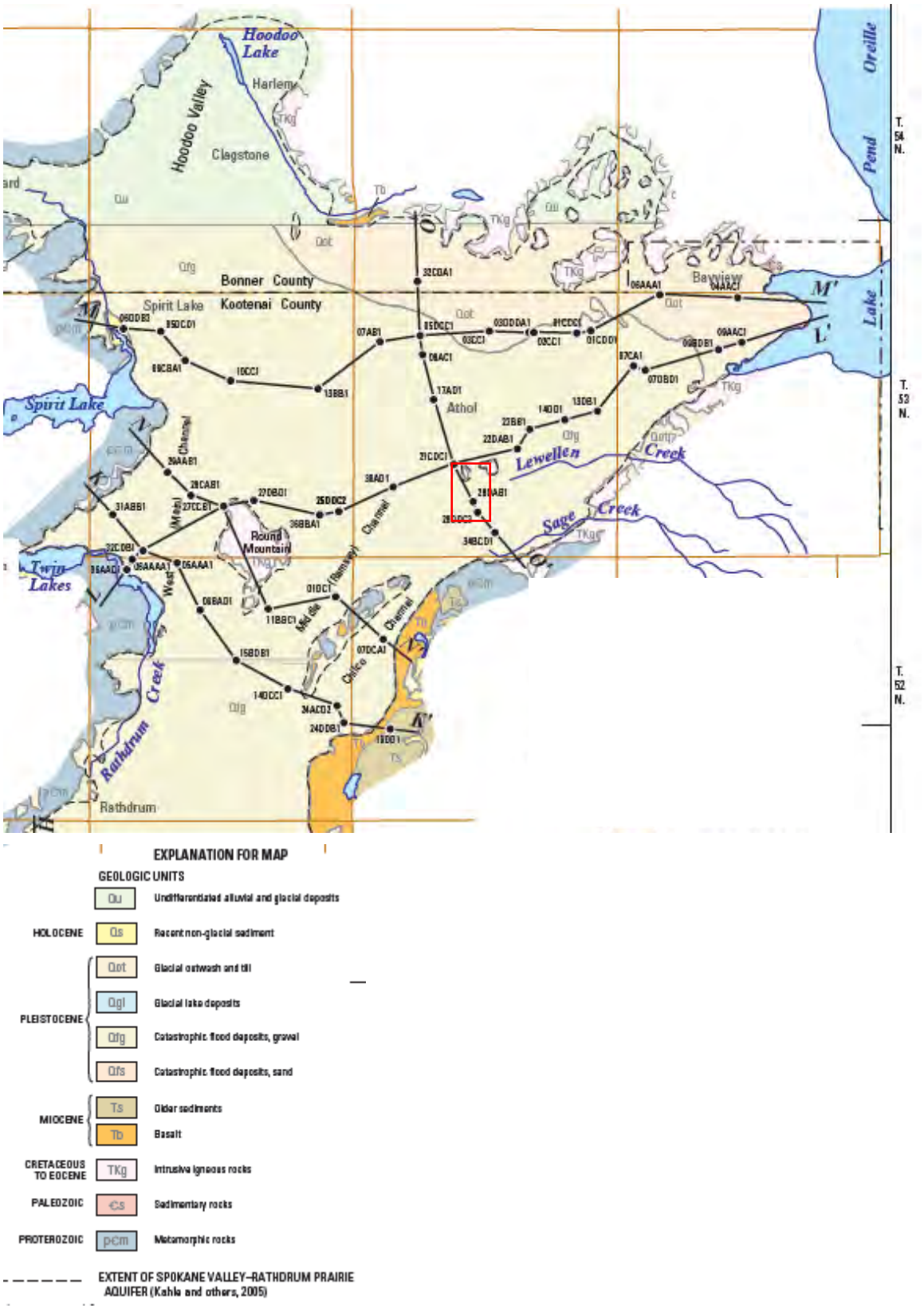


Figure 2. Map showing the northern portion of the RPSRA aquifer. The red outline marks the approximate location of the Silverwood Theme Park. Modified from Kahle and Bartolino (2007).

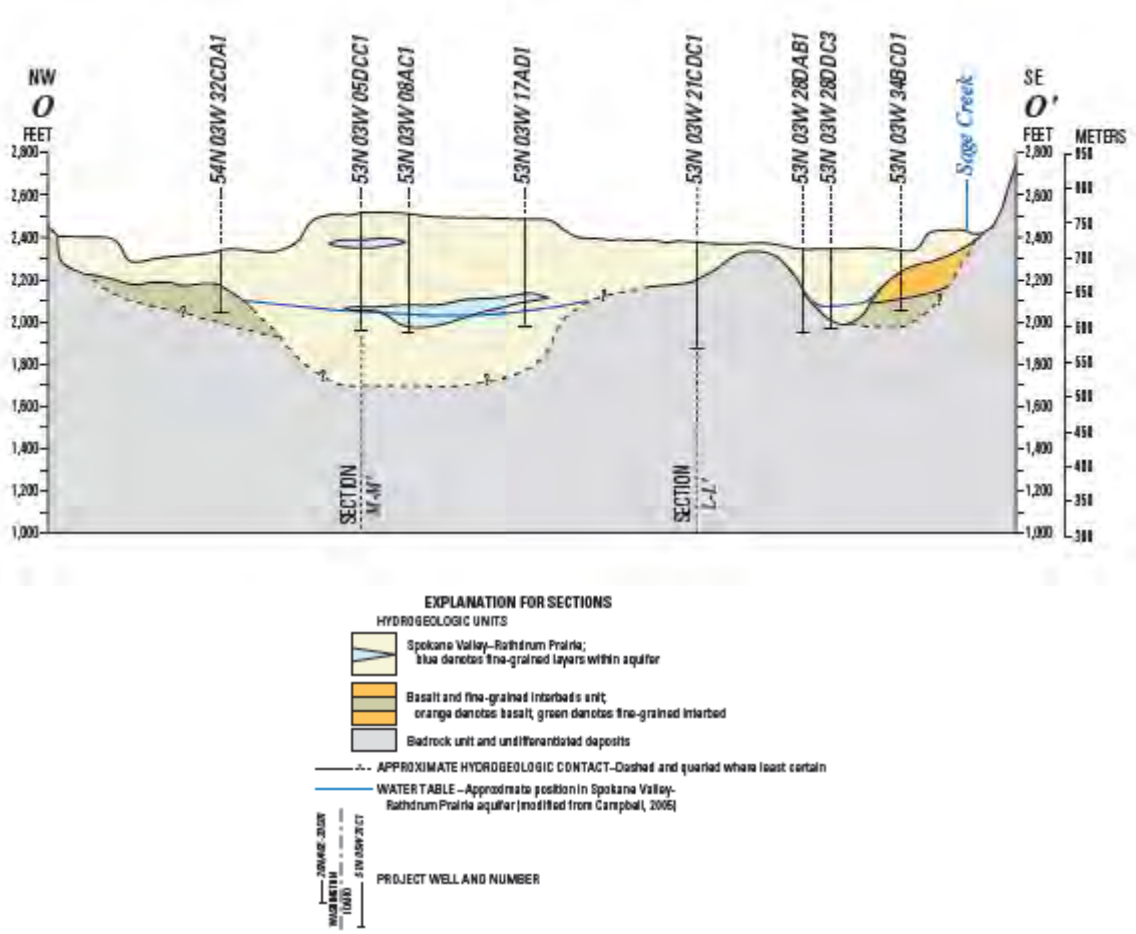
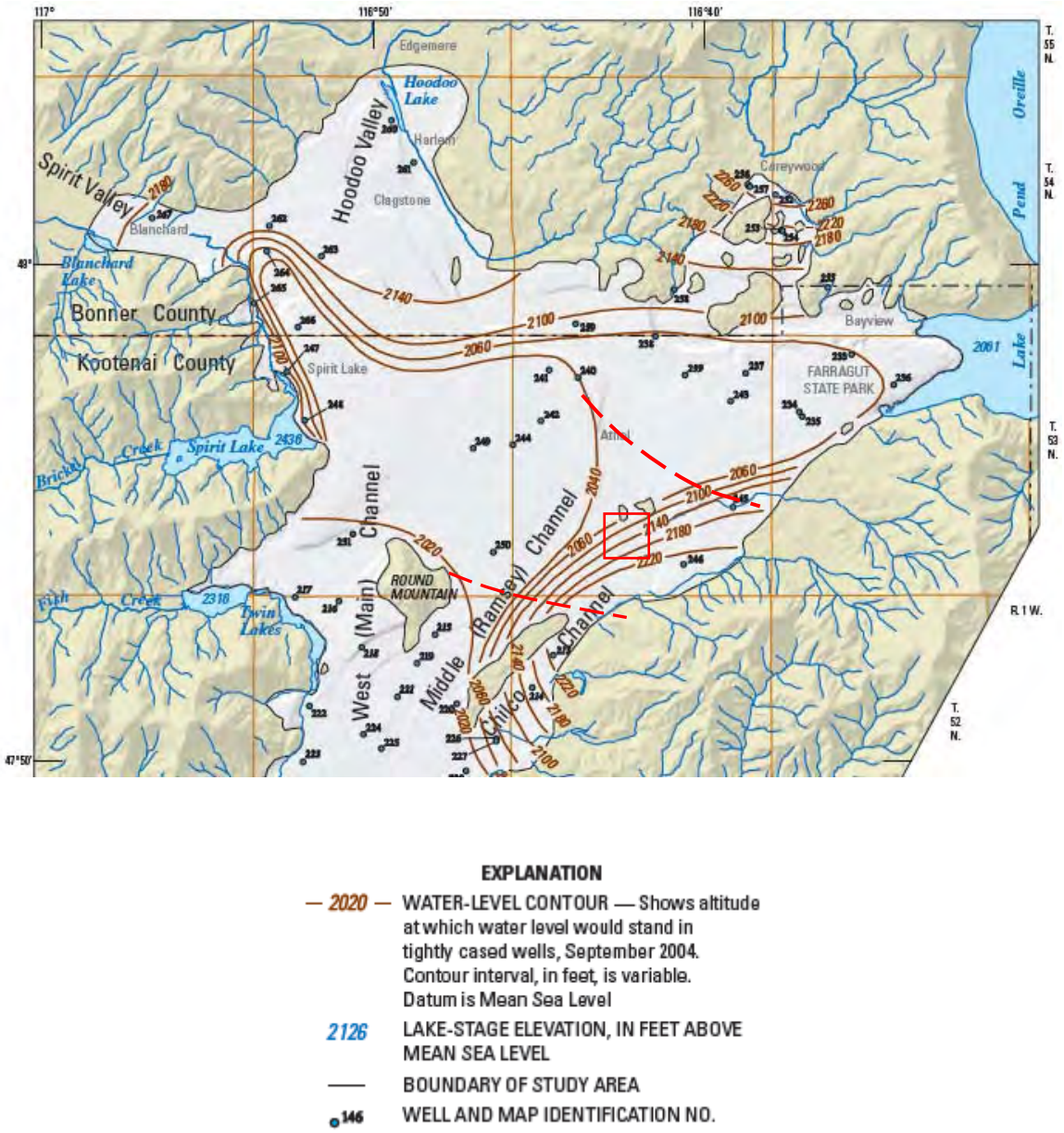


Figure 3. North-south cross section through the Silverwood area showing character of the bedrock surface, thickness of the RPSRA aquifer, and water table. Modified from Kahle and Bartolino, 2007. Location of cross section O-O' is shown on Figure 2.

The general ground water flow direction in the RPSRA is from the northeast to the southwest. A potentiometric map prepared by Campbell (2005) indicates that in the Silverwood area, ground water moves from southeast to northwest, and implies that a major source of recharge enters the aquifer from the mountains to the east (Figure 4, modified from Campbell, 2005). Sage and Lewellen Creeks flow onto the Rathdrum Prairie in this area and form a watershed of about 16 square miles. This watershed drains some of the highest terrain on the east side of the RPSRA, including South Chilco Mountain at an elevation of 5,661 feet and Chilco Mountain at an elevation of 5,635 feet. However, the watershed is not believed to provide enough recharge to create the contours shown in Figure 4. Kahle and Bartolino (2007) prepared a water budget that presents sources and rates of inflow to the RPSRA; for the aquifer north of Coeur d'Alene, the major inflows are from Hayden, Pend Orielle, Spirit, Coeur d'Alene, and Twin Lakes. Inflow from all tributaries to the aquifer is less than half of the contribution from these five lakes (112 cubic feet per second for all tributary inflow versus 232 cubic feet per second for the five lakes).



EXPLANATION

— 2020 — WATER-LEVEL CONTOUR — Shows altitude at which water level would stand in tightly cased wells, September 2004. Contour interval, in feet, is variable. Datum is Mean Sea Level

2126 LAKE-STAGE ELEVATION, IN FEET ABOVE MEAN SEA LEVEL

—— BOUNDARY OF STUDY AREA

146 WELL AND MAP IDENTIFICATION NO.

Figure 4. Potentiometric map for the northern portion of the RPSRA aquifer. Solid red outline is approximate location of the Silverwood Theme Park facility; dashed red lines are revised potentiometric contours based on 2007 water level elevations from Silverwood test wells. (Modified from Campbell, 2005).

It should be noted that within a 3-mile radius of the Silverwood facility, water level elevations for preparation of the potentiometric map were available from only two wells (Campbell, 2005, Table 1, wells 245 and 246). These two wells are located close to the mountains on the east and their water level elevations are from 120 to 215 feet higher than at wells farther west of the facility on the prairie. Table 1 shows historic water level elevations for the eight wells nearest to the Silverwood facility from Campbell, 2005, Table 1, including wells 245 and 246, and also water level elevations for two test wells

commissioned by Silverwood in July 2007. Silverwood Test Well #1 is located in T53N, R03W, S33BDC and Silverwood Test Well #2 is located in T53N, R03W, S33BAC (the well locations listed on the drillers' logs are: Silverwood Test well #1 - T53N, R03W, S33CB and Silverwood Test Well #2 - T53N, R03W, S33CB). Silverwood Test Wells #1 and #2 are located just south of the Silverwood facility. The well locations are shown on Figure 6 and drillers' logs for the test wells are included in Appendix B.

Table 1. Well identification, depth to water, and water level elevation for wells surrounding the Silverwood Theme Park facility. Locations for wells 238-250 are shown on Figure 4; locations for Silverwood Test Wells #1 and #2 are shown on Figure 6. bls = below land surface. NAVD 88 = North American Vertical Datum of 1988.

Well Identification Number	Depth to Water (feet bls)	Water Level Elevation (feet above mean sea level - NAVD 88)
238	355.75	2051.51
239	318.28	2055.72
240	475.83	2040.33
242	451.05	2039.45
244	467.24	2024.2
245	279.44	2177.93
246	222.26	2237.99
250	393.55	2022.78
Silverwood Test Well #1	299.6	2025.4
Silverwood Test Well #2	310.6	2024.4

Table 1 shows that water level elevations for wells 238, 239, 240, 242, 244 and 250 are all within the range of about 2,022 to 2,055 feet above sea level. Water level elevations at Silverwood Test Wells #1 and #2 also fall within this range. Although completed in outwash deposits, water level elevations at wells 245 and 246 are not believed to be representative of the hydraulic head in the main area of the RPSRA, including the Silverwood facility. Figure 4 shows suggested revisions to the 2,020- and 2,040-foot potentiometric contour lines based on 2007 water level data from the Silverwood test wells. The 2,020- and 2,040-foot contour lines have been extended to the east and reflect the broad flat water table that exists over a large part of the aquifer west of the Silverwood area. In this scenario, ground water moves from the northeast to the southwest. One implication of the above discussion is that wells selected to monitor for impacts from the Silverwood facility should be located west or southwest of the facility, rather than north or northwest of the facility.

Methods

Due to the great depth to water and the expense of drilling individual wells, most homes in the Silverwood area are served by small community water supply systems. One well may serve several households, so the number of wells available for sample collection is far fewer than if each house was served by a single well. Because of this, all samples for the project were collected from community water supply systems. Figure 5 shows a typical community water supply system that was sampled as part of this project.

The goal was to establish 15 sampling locations, but only nine wells were identified within a reasonable distance from the facility. Ramsey #2 was only sampled once since it is located about 100 feet from Ramsey #1. Access to the water park back flush site was only available for the first sample round, and the 8 Mile Prairie site was added later in the project. Figure 6 shows the sample locations. The sample location nearest to the Silverwood facility, located approximately one half mile west of the facility, is probably a cross-gradient location and the next nearest sample site is located approximately 3 miles southwest of the facility.

Figure 5. Photo showing a typical community water supply well head and building housing pressure tanks and distribution equipment.

The initial sample from each site was analyzed for major ions (calcium, magnesium, sodium, potassium, bicarbonate, chloride, and sulfate), total dissolved solids (TDS), nitrate as nitrogen (NO_3-N) and the stable isotopes of oxygen (^{18}O) and deuterium (^{2}H). Field parameters (pH, specific conductance, temperature, and dissolved oxygen) were recorded as the wells were purged, and samples were collected only after successive field measurements were within 10% of the previous reading. Subsequent samples from the sites were analyzed for chloride, sulfate, TDS, NO_3-N, and stable isotopes. Samples were collected quarterly except for those locations where the system was winterized or was inaccessible. Laboratory analytical results are shown in Table 2, (page 19) and field parameters are listed in Table 3 (page 20).

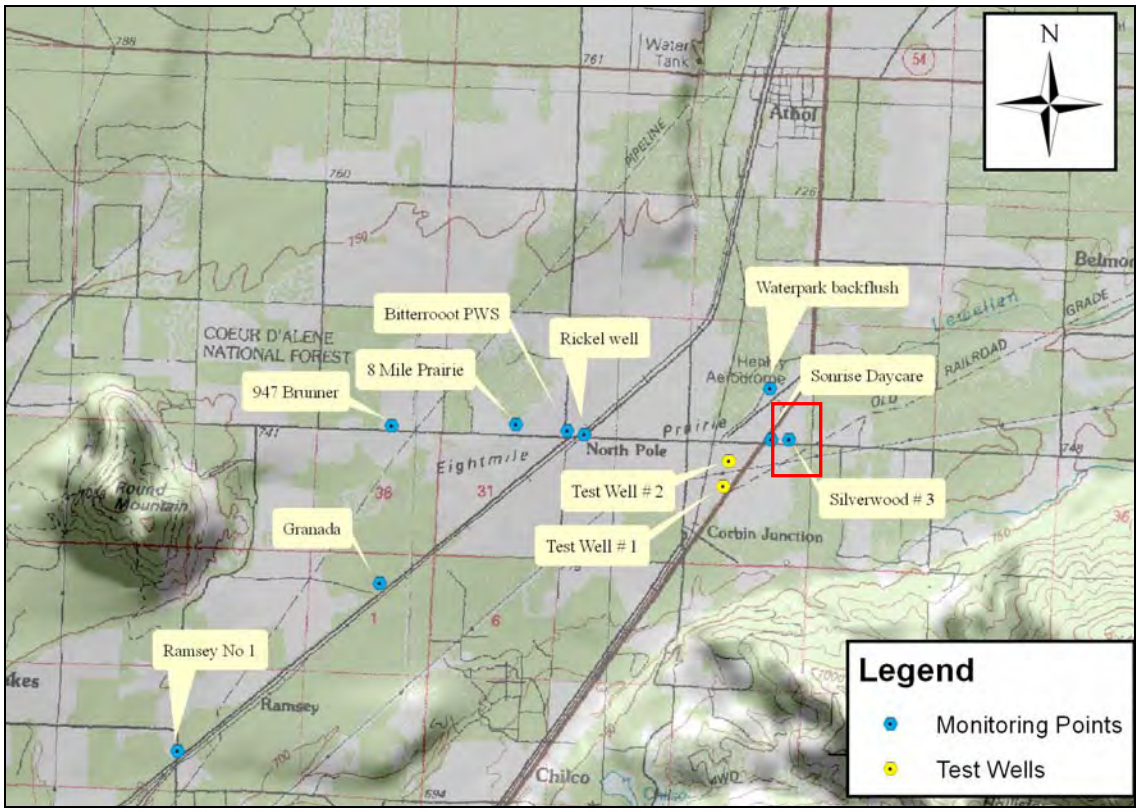


Figure 6. Sample locations for Silverwood study area. Red outline marks location of the Silverwood facility.

Results

Major Ions and Field Results

A Piper diagram was used to evaluate major ions results from the September 2006 sampling event (Figure 7). The diagram shows that water from most wells is a calcium-magnesium bicarbonate type water. The exceptions are the water park back flush and the Granada community supply system. Elevated sodium in the water park back flush sample can be attributed to chlorination of the pool and other water park facilities; the chloride ion concentration was correspondingly elevated in this sample.

The sample from the Granada water system well contained low percentages of calcium and magnesium relative to sodium, had low bicarbonate and high sulfate compared to other wells, and had low total dissolved solids concentration (TDS) compared to other wells. This water would be classified as a sodium bicarbonate type water. The pH of this water, as measured in the field, ranged from 9.15 to 10.70, compared to the pH range of 7.50 to 8.93 for other samples collected during the quarterly sampling events. The elevated pH values in the Granada water samples were confirmed by laboratory testing results. Field-measured dissolved oxygen concentrations in Granada water samples ranged from 0.63 to 2.76, which is low in comparison to water from other sample locations in the area. These data provide geochemical evidence of ground water that has been hydraulically isolated from the overlying RPSRA.

The driller's log for this well, included in Appendix B, indicates that the total depth is 645 feet. The material consists of cobbles, sand, and gravel to a depth of 340 feet, sandy green clay from 340 to 450 feet, decomposed green granite from 450 to 475 and green, black, and white granite from 475 to 645 feet. The first water was encountered at 450 feet in the decomposed granite, so the overlying alluvial material is unsaturated at this location. The well is cased to 494 feet and produces water from the granitic rocks below the sandy clay unit. The geochemical makeup of ground water in the granitic rocks has a significantly different water chemistry from alluvial wells in the area.

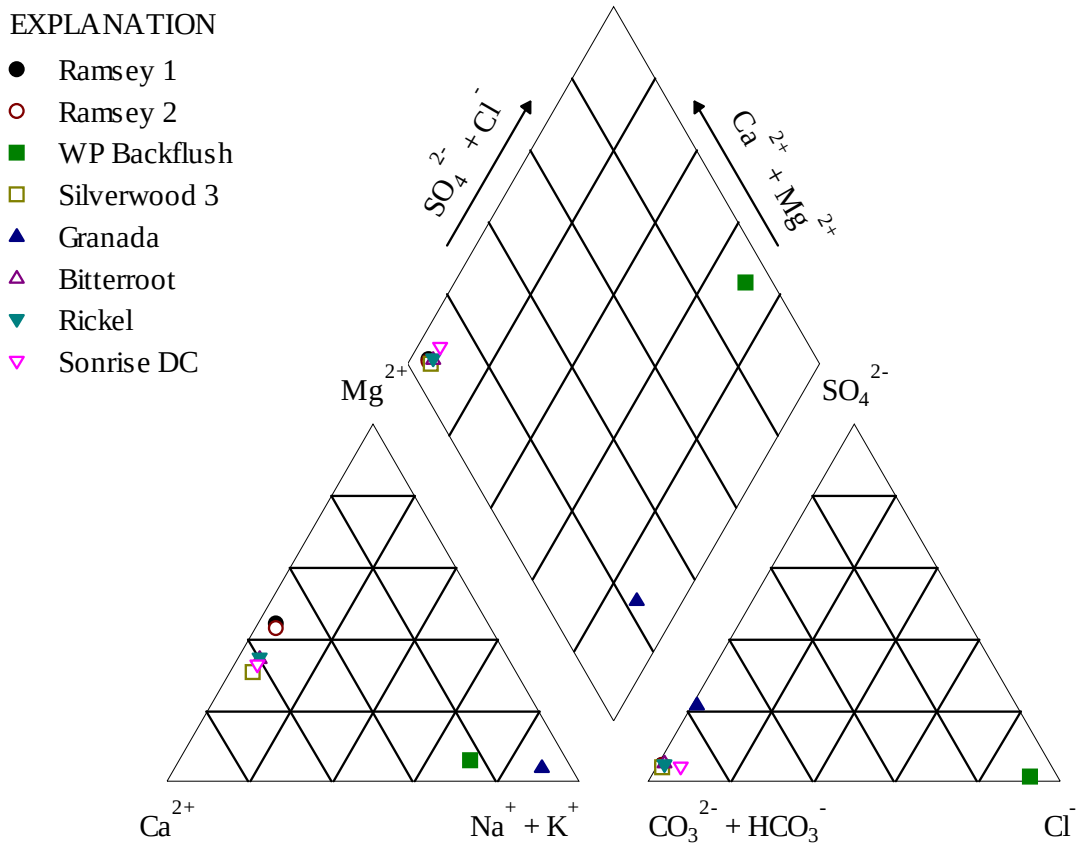


Figure 7. Piper diagram showing major ion results from wells sampled during September 2006 sample event.

Nitrate

Forty samples were analyzed for nitrate concentration. Nitrate concentrations ranged from less than the laboratory detection limit of 0.02 mg/L (three samples) to 2.6 mg/L (one sample). A histogram of all nitrate sample results shows how nitrate results are distributed (Figure 8). Six samples, including the water park back flush samples, had NO_3-N concentrations greater than 1.0 mg/L. Nitrate concentrations in the Granada well were non-detect for two sample events and 0.022 mg/L in the sample from the third event (Table 2, page 17). The nitrate concentration in two samples from the water park back flush site were 1.54 and 2.6 mg/L. Water used in the water park facility is circulated through a series of filters before it is returned to the facility. These filters are back flushed

periodically and the untreated back flush water is disposed of into an unlined pit on the site. The water source for the facility (Silverwood Well #3) had nitrate concentrations ranging from 0.345 to 0.583 mg/L, so nitrate in the back flush discharge in concentrations greater than these probably originates from human contact with the water.

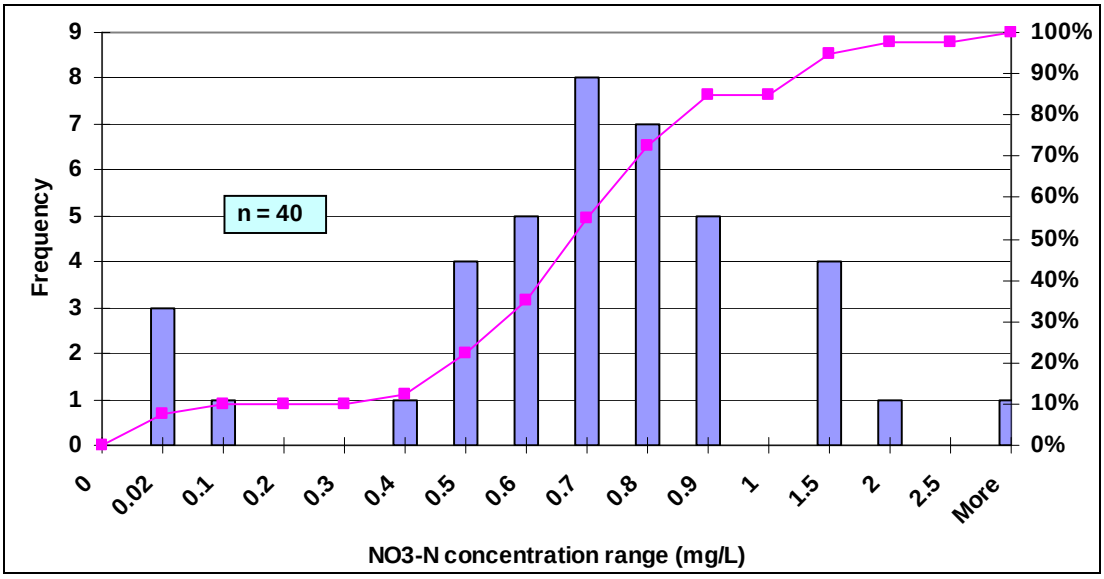


Figure 8. Histogram showing NO_3-N concentration ranges for samples collected in the Silverwood area.

Bacteria

Samples collected in September 2006 from the water park back flush source were analyzed for total coliform and E. coli. The results indicated that bacteria were present in the sample in amounts greater that 2,400 MPN/100 mL total coliform and 6 MPN/100 mL E. coli (where MPN/100 mL is the most probable number of organisms per 100 milliliters of the original sample). The water park back flush discharges from a 2-inch black PVC pipe into an unlined pit. The discharge was measured at 16 gallons per minute with a bucket and stopwatch. Figure 9 is a photo showing the discharge pipe for the water park back flush. The source of both the total and E. coli bacteria are presumed to have been from human contact in the pools and water slides in the water park facility.

Figure 9. Photo taken September 2, 2006 showing discharge pipe for water park back flush water. Discharge was measured at 16 gallons per minute.

Isotopes

Samples were analyzed for the stable isotopes of oxygen and hydrogen. The following general discussion of the relationship between these stable isotopes is summarized from Clark and Fritz, 1997. The ratios of the stable isotopes of oxygen, particularly oxygen-18 (^{18}O), and of hydrogen, particularly deuterium (^{2}H), in atmospheric water vapor are subject to changes that begin when water evaporates from the ocean. Oxygen and deuterium isotope ratios continue to evolve as an air mass moves inland and the water vapor condenses to form precipitation. Oxygen and deuterium isotope ratios in precipitation can vary for different storm events in a particular area and for summer versus winter storm events for the same area. Isotope ratios can also vary for storm events that occur at different latitudes and at differing altitude and/or temperature conditions. Once precipitation infiltrates and enters the ground water system further changes in oxygen and deuterium ratios are limited because evaporative processes are no longer active. Seasonal isotopic variations in the recharged water become damped out once the water enters an aquifer. The oxygen and deuterium content of a water sample are often compared to the Global Meteoric Water Line (GWML), which describes the world-wide relationship between oxygen and deuterium in worldwide fresh surface waters. The equation describing a best-fit line for these data is:

$$\delta^{2}H = 8\ \delta^{18}O + 10\ ‰\ \text{SMOW (Craig, 1961),}$$

where SMOW is Standard Mean Ocean Water, used as a reference. VSMOW (Vienna Standard Mean Ocean Water) has since replaced SMOW as the accepted reference for the GWML.

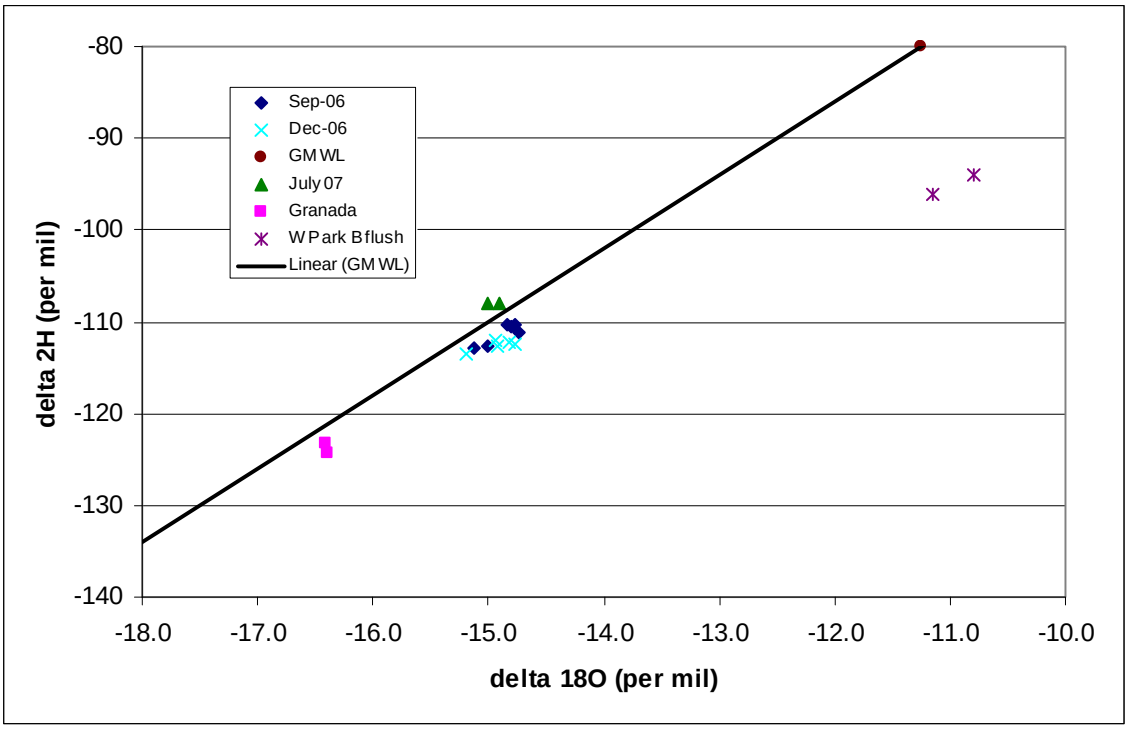


Figure 10. Plot of ^{18}O versus ^{2}H for sample events in September and December 2006 in the Silverwood study area. GMWL = Global Meteoric Water Line.

Figure 10 shows a plot of oxygen versus deuterium for samples collected during the September and December 2006 sample events. The isotopic results for the water park back flush sample show that significant evaporation of this source has occurred, resulting in a plotting position in the upper right area of the graph. Because of this unique signature, oxygen and deuterium isotopes can serve as a useful indicator of effluent impacts to ground water from the Silverwood facility. For this method to be useful, however, sample sites must be located in a down-gradient position from the source. Although the general ground water flow direction is from northeast to southwest, the local ground water flow direction has not been sufficiently identified to determine where an appropriate down-gradient sample location should be. Also, the source could only be detected if mixing with ambient ground water has not diluted the source and if a suitable sampling location exists.

Isotope results from the Granada water supply well plot in the lower left part of the graph. This plotting position indicates that this water was recharged under cooler climatic conditions, possibly during glacial times that existed thousands of years in the past and/or that recharge occurred at a higher altitude. The 110-foot thick sandy clay unit apparently provides adequate isolation from the overlying RPSRA so that water in the two units doesn't mix. The isotopic data, together with the major ion and nitrate data, provide evidence that the Granada well does not produce water from the RPSRA.

The isotope signature noted in the water park back flush sample was not detected in any ground water samples. However, none of the sites are located immediately west or

southwest of the facility, which is believed to be the down-gradient ground water flow direction.

Conclusions

Samples were collected from nine wells and one wastewater source over the course of a year to evaluate ground water impacts from subsurface discharge of wastewater effluent generated at the Silverwood Theme Park. Ideal sample sites would be located immediately down-gradient of the facility so an accurate knowledge of local ground water flow conditions is important.

The hydrogeology and ground water flow direction in the Silverwood area is not well known but the general ground water flow direction in the northern part of the aquifer is from northeast to southwest. A potentiometric map prepared by Campbell (2005) indicated that the flow direction in the Silverwood area is from southeast to northwest, at right angles to the expected flow direction. There were only two wells with water level elevations within a 3- mile radius of the Silverwood area, and the water levels in these wells were anomalously high compared to water level elevations in the main RPSRA. The potentiometric map generated from these data implies that a large volume of recharge enters the aquifer east of Silverwood. That source would have to be surface water but this is unlikely given the limited size of the adjacent water sheds.

Two test wells drilled in 2007 provide site-specific water level data that correlate well with water level data from wells to the west, in the main part of the aquifer. Based on these data, a revised potentiometric map indicates that the ground water flow direction in the Silverwood area is from northeast to southwest.

After a thorough search of drillers' logs, and later for wells, during the field visits, nine wells were sampled. Based on the revised potentiometric map that reflects water level data from two test wells installed in 2007, none of these wells were immediately down-gradient of the facility.

A Piper trilinear diagram shows that most water samples were a calcium bicarbonate type water. The exception was water from the Granada public water supply well. This water is derived from a bedrock source that is believed to be hydraulically isolated from the overlying RPSR aquifer by 110 feet of sandy green clay. A plot of oxygen and deuterium isotopes confirms this observation – isotope results from the Granada well are typical of water that was recharged under cooler climatic conditions and/or at higher altitudes.

Nitrate concentrations in samples from all wells for all sample dates ranged from less than the laboratory detection limit of 0.02 mg/L to 2.6 mg/L; 85 percent of the results had nitrate concentrations of 1 mg/L or less. The main nitrate source in the area is onsite wastewater treatment systems (septic tank/drainfield systems). The nitrate sample results reflect the low septic tank density and large volume of water moving through the aquifer. The nitrate concentration from one sample of the water park back flush source was 2.6 mg/L. Ground water that provides water to the facility had a mean nitrate concentration of 0.49 mg/L (n=6), so nitrate in excess of the amount in this source would have to come from human contact with the water.

The water park back flush source was sampled for Total and E. coli bacteria once, in September 2007. The results showed that the sample contained bacteria in amounts greater than 2,400 MPN/100 mL of total coliform and 6 MPN/100 mL E. coli.

Isotope results show that oxygen and deuterium in the water park backflush water has a distinctive signature and can serve as a useful tracer since evaporative processes have resulted in more positive values from this source compared to ambient ground water. Stable isotopes may also enable well completions to be differentiated in terms of bedrock or alluvial aquifer completions. An example is the Granada community supply well that produces water from granitic rocks that are isolated from the overlying RPSRA.

Impacts from the Silverwood wastewater system to ground water were not documented in this study, in part because ground water sample points immediately down-gradient of the facility were not available. It also is possible that any impacts from the facility are not detectable because the contribution is small and/or there is a high degree of dilution in the aquifer. An adequate evaluation of impacts from the facility would require a better definition of the local ground water flow direction and then sampling points that are located up-gradient and down-gradient of the facility.

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Table 2. Analytical results for sample locations in the Silverwood study area. (^{18}O = oxygen isotope ratio, ^{2}H = hydrogen isotope ratio, Ca = calcium, Mg = magnesium, Na = sodium, K = potassium, HCO_3 = bicarbonate, Cl = chloride, SO_4 = sulfate, TDS = total dissolved solids, and NO_3-N = nitrate as nitrogen).

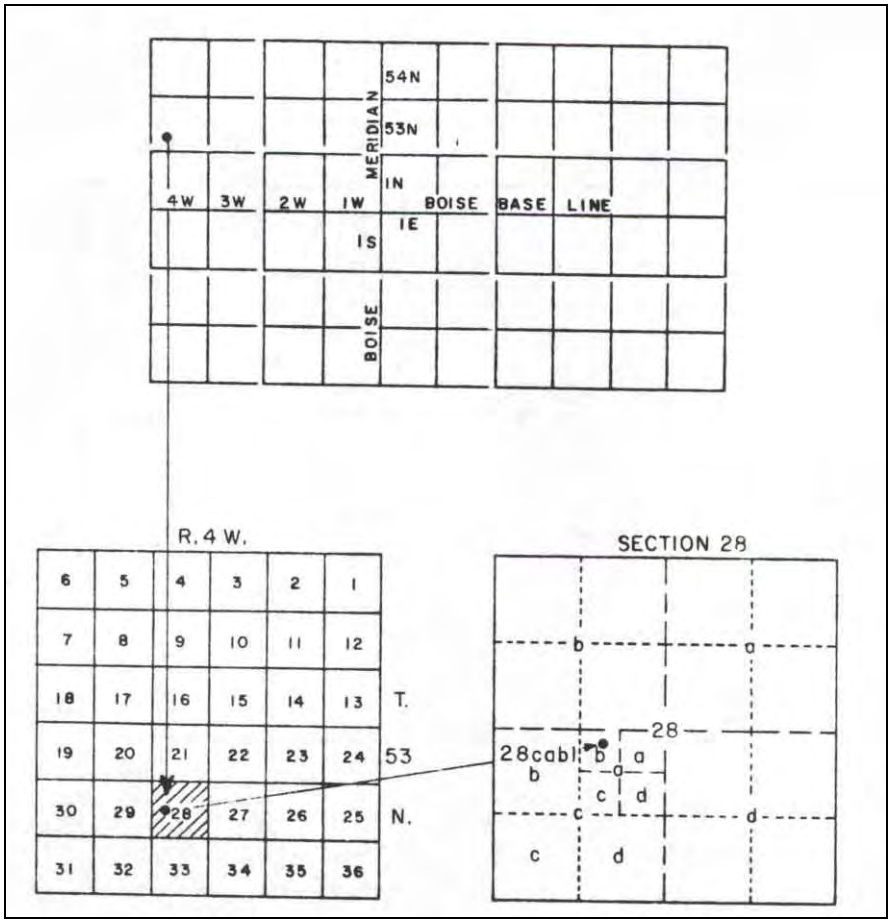
Site Name	Site Location	Sample Date	$\delta^{18}O$ (permil)	$\delta^{2}H$ (permil)	Alkalinity (mg CaCO3/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO3 (mg/L)	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	NO3-N (mg/L)
Water Park Backflush	53N03W28ABD1	9/2/2006	-11.1	-96	62.7	89.4	13	299	7.2	76	579	9	1310	2.6
Water Park Backflush	53N03W28ABD1	7/11/2007	-10.8	-94							537	7.14	1220	1.54
Sonrise Day Care	53N03W28DCD	9/1/2006	-14.8	-110	123	34.2	10.9	2.77	1.64	150	5.77	5.39	144	0.64
Sonrise Day Care	53N03W28DCD	3/6/2007									1.15	5.43	138	0.589
Sonrise Day Care	53N03W28DCD	4/27/2007									2.07	4.99	154	0.49
Sonrise Day Care	53N03W28DCD	7/11/2007									1.24	4.38	74	0.433
Sonrise Day Care	53N03W28DCD	9/27/2007									6.73	4.99	96	1.1
Silverwood #3	53N03W28CDD1	9/1/2006	-14.8	-111	124	33.5	9.64	2.24	1.52	151	1.1	5.04	136	0.5
Silverwood #3	53N03W28CDD1	12/12/2006												0.522
Silverwood #3	53N03W28CDD1	3/6/2007									1.14	5.26	144	0.531
Silverwood #3	53N03W28CDD1	4/27/2007									1.9	5.02	148	0.448
Silverwood #3	53N03W28CDD1	7/11/2007									0.98	4.07	204	0.345
Silverwood #3	53N03W28CDD1	9/27/2007									1.45	4.35	124	0.583
Rickel PWS	53N03W29DCD1	9/1/2006	-14.7	-111	129	35.1	12	2.51	1.7	157	1.53	6.24	148	0.66
Rickel PWS	53N03W29DCD1	12/12/2006												0.851
Rickel PWS	53N03W29DCD1	3/6/2007									1.48	5.55	158	0.642
Rickel PWS	53N03W29DCD1	4/27/2007									3.67	6	154	0.755
Rickel PWS	53N03W29DCD1	7/11/2007									1.51	5.97	124	0.626
Rickel PWS	53N03W29DCD1	9/27/2007									1.53	6.02	134	1.09
Ramsey Estates #1	52N04W11CBC2	9/2/2006	-15.1	-113	181	37.4	19.4	3.03	1.6	221	2	8	154	0.53
Ramsey Estates #1	52N04W11CBC2	12/12/2006												0.798
Ramsey Estates #1	52N04W11CBC2	3/6/2007									1.86	8.25	166	0.643
Ramsey Estates #1	52N04W11CBC2	4/27/2007									2.73	7.48	180	1.1
Ramsey Estates #1	52N04W11CBC2	7/11/2007	-15.1	-110							1.92	8.06	174	0.62
Ramsey Estates #2	52N04W11CBC1	9/2/2006	-15.0	-113	158	34.1	17	2.9	1.5	193	2	7	168	0.81
Granada	52N04W01BCA1	9/1/2006	-16.4	-123	53.6	2.01	**0.6**	28	**0.5**	65	0.46	14.3	80	**0.02**
Granada	52N04W01BCA1	12/12/2006												**0.02**
Granada	52N04W01BCA1	3/6/2007									0.48	14.2	118	0.022
Granada	52N04W01BCA1	4/27/2007									0.89	14.4	116	**0.02**
8 Mile Prairie	52N03W30DCC	3/6/2007									1.17	7.02	160	1.02
8 Mile Prairie	52N03W30DCC	4/27/2007									2.05	6.04	154	0.819
8 Mile Prairie	52N03W30DCC	7/11/2007	-14.9	-108	130	38.7	12.3	2.75		158	2.7	5.92	52	0.759
947 Brunner	53N04W25CCD	12/12/2006			91.4	29.9	5.79	2.08	1.19	111	0.93	3.81	176	0.653
947 Brunner	53N04W25CCD	3/6/2007									1	4.09	120	0.78
947 Brunner	53N04W25CCD	4/27/2007									1.71	4.28	116	0.713
Bitterroot PWS	53N03W29CCC1	9/1/2006	-14.8	-110	128	35	12.2	2.53	1.73	156	1.51	6.51	144	0.72
Bitterroot PWS	53N03W29CCC1	12/12/2006												0.802
Bitterroot PWS	53N03W29CCC1	3/6/2007									1.42	5.86	164	0.707
Bitterroot PWS	53N03W29CCC1	4/27/2007									4.18	5.89	164	0.825
Hester	53N03W32DBD	7/11/2007	-15.0	-108	97	33.9	6.13	2.38		118	0.987	3.46	118	0.655

A number in **bold** indicates the result was below the laboratory detection limit.

Table 3. Field parameters for sample locations in the Silverwood study area. (DO = dissolved oxygen, pH = hydrogen ion concentration, SC = specific conductance, and temp = temperature). Field parameters were not recorded for Silverwood #3 on 12/12/2006, or for 947 Bruner on 9/01/2006.

Site Name	Site Location	Sample Date	DO (mg/L)	pH units	SC uS/cm	Temp deg C
Water Park Backflush	53N03W28ABD1	9/2/2006	6.07	7.85	1910	19.7
Sonrise Day Care	53N03W28DCD	9/1/2006	10.21	8.78	234	9.2
Sonrise Day Care	53N03W28DCD	3/6/2007	13.85	8.60	222	7.5
Sonrise Day Care	53N03W28DCD	4/27/2007	11.66	7.60	227	8
Silverwood #3	53N03W28CDD1	9/1/2006	10.92	8.84	222	8.6
Silverwood #3	53N03W28CDD1	12/12/2006				
Silverwood #3	53N03W28CDD1	3/6/2007	14.5	8.51	225	7.7
Silverwood #3	53N03W28CDD1	4/27/2007	11.81	7.50	231	8.3
Rickel PWS	53N03W29DCD1	9/1/2006	11.44	8.85	242	8.6
Rickel PWS	53N03W29DCD1	12/12/2006		8.63	264	8.3
Rickel PWS	53N03W29DCD1	3/6/2007	13.7	8.61	236	8.3
Rickel PWS	53N03W29DCD1	4/27/2007	10.54	7.67	246	8
Ramsey Estates #1	52N04W11CBC2	9/2/2006	11.24	8.49	284	8.4
Ramsey Estates #1	52N04W11CBC2	12/12/2006		8.49	292	8.1
Ramsey Estates #1	52N04W11CBC2	3/6/2007	14.29	8.46	287	8.2
Ramsey Estates #1	52N04W11CBC2	4/27/2007	10.9	7.61	276	7.7
Ramsey Estates #2	52N04W11CBC1	9/2/2006	10.96	8.50	259	8.1
Granada	52N04W01BCA1	9/1/2006	0.68	10.96	125	12.4
Granada	52N04W01BCA1	12/12/2006		10.59	135	10.5
Granada	52N04W01BCA1	3/6/2007	2.76	10.70	127	10
Granada	52N04W01BCA1	4/27/2007	0.63	9.15	131	11.2
8 Mile Prairie	52N03W30DCC	4/27/2007	11.27	7.64	252	8.3
8 Mile Prairie	52N03W30DCC	3/6/2007	14.96	8.69	254	6.5
947 Brunner	53N04W25CCD	9/1/2006				
947 Brunner	53N04W25CCD	12/12/2006		8.91	184	7.3
947 Brunner	53N04W25CCD	3/6/2007	14.5	8.93	181	7.1
947 Brunner	53N04W25CCD	4/27/2007	11.47	7.81	191	7.2
Bitterroot PWS	53N03W29CCC1	9/1/2006	10.15	8.90	245	9.1
Bitterroot PWS	53N03W29CCC1	12/12/2006		8.80	265	7.9
Bitterroot PWS	53N03W29CCC1	3/6/2007	11.95	8.61	239	8
Bitterroot PWS	53N03W29CCC1	4/27/2007	9.85	7.66	246	8.2

Appendix A -- Well Numbering system



Appendix B – Drillers' Logs for Silverwood Area Wells

Silverwood Test Well #1

Form 238-7
3/95-C96

IDAHO DEPARTMENT OF WATER RESOURCES
CORRECTED REPORT WELL DRILLER'S REPORT

Office Use Only
Inspected by _____
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 84 8102
Other IDWR No. D0053839

2. OWNER:
Name Silverwood Inc
Address 27843 N. Highway 95
City Athol State ID Zip 83801

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location

N
W E
S

Twp. 53 North ☒ or South ☐
Rge. 3 East ☐ or West ☒
Sec. 33 1/4 (10 acres) NW 1/4 (40 acres) SW 1/4 (160 acres)
Gov't lot _____ County Kootenai
Lat: : : Long: : :
Address of Well Site s. of Brunner, w. of 95, north of the powerline City Athol
(Give at least name of road + Distance to Road or Landmark)
Lt. _____ Blk. _____ Sub. Name _____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☒ Other test/monitor

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Bentonite	0	58	2350#	dry granular

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____
Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	+2	308	280	Steel	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS
☐ Perforations Method _____
☒ Screens Screen Type johnson ss telescoping

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
308	318	25	cont	6"	S.S.	☐	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
305 ft. below ground Artesian Pressure ____ lb
Depth flow encountered ____ ft. Describe access port or control devices: _____

53N 3W 33

11. WELL TESTS:
☐ Pump ☒ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min.	Drawdown	Pumping Level	Time
25+			2 hrs

Water Temp. _____ Bottom hole temp. _____
Water Quality test or comments: _____
Depth first Water Encountered 325'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Water Bore Dia	From	To	Remarks:Lithology, Water Quality & Temp.	Y	N
10"	0	1	Topsoil, gravel		☒
	1	6	Gravel, coarse		☒
	6	33	Cobbles		☒
	33	58	Boulders, cobbles		☒
8"	58	74	Boulders, cobbles		☒
	74	89	Gravel, sand		☒
	89	135	Boulders		☒
	135	160	Boulders, gravel		☒
	160	162	Boulder, big, granite		☒
	162	185	Boulders, cobbles		☒
	185	212	Cobbles, boulders		☒
	212	285	Cobbles, gravel		☒
	285	316	Gravel, cobbles, silt, brown		☒
	316	346	Gravel, sand, silt, brown	☒	
	346	352	Gravel, sand, coarse, silt	☒	
	352	376	Clay, grey, sand, coarse	☒	
	376	382	Sand, fine, clay, grey, heaving	☒	
			Unable to drill further due to heaving sand with no returns		

RECEIVED
OCT 15 2007
IDWR/North

Completed Depth: 318 (Measurable)
Date: Started 07/25/07 Completed 07/30/07

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name McCarty Drilling & Pump Inc Firm No. 586
Firm Official _____ Date 8-20-07
Supervisor or Operator _____ Date _____
(Sign once if Firm Official & Operator)

Date: 10/3/2007 Time:11:26:53 AM

Silverwood Test Well #2

ENTERED

Form 238-7
3/95-C96

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

Office Use Only
Inspected by _____
Twp _____ Rge _____ Sec _____
_____1/4 _____1/4 _____1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. __-__-__-____-____
Other IDWR No. D 0051778

2. OWNER: 848101
Name Silverwood Inc
Address 27843 N. Highway 95
City Athol State ID Zip 83801

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location

N / W / E / S

Twp. 53 North ☒ or South ☐
Rge. 3 East ☐ or West ☒
Sec. 33 1/4 (10 acres) NW 1/4 (40 acres) SW 1/4 (160 acres)
Gov't lot _____ County Kootenai
Lat: 47:53:922 Long: 116: 42: 844
Address of Well Site same
City Athol
(Give at least name of road + Distance to Road or Landmark)
Lt. _____ Blk. _____ Sub. Name _____

RECEIVED
JUL 25 2007
IDWR/North

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☒ Other test well

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Bentonite	0	20	400#	Dry granular

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____
Was drive shoe seal tested? ☐ Y ☒ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
6"	+2	398	.250	Steel	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Length of Headpipe _____ Length of Tailpipe _____

9. PERFORATIONS/SCREENS
☐ Perforations Method _____
☒ Screens Screen Type johnson telescoping

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
388	398	35	cont	tele	S.S.	☐	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
294 ft. below ground Artesian Pressure _____ lb
Depth flow encountered _____ ft. Describe access port or control devices: _____

53N 3W 33

11. WELL TESTS:
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal/min.	Drawdown	Pumping Level	Time
100+			3 hrs

Water Temp. _____ Bottom hole temp. _____
Water Quality test or comments: Cold & clear
Depth first Water Encountered 377

12. LITHOLOGIC LOG: **(Describe repairs or abandonment)**

Bore Dia.	From	To	Remarks:Lithology, Water Quality & Temp.	Water Y	Water N
10"	0	1	Topsoil		☒
	1	12	Gravel, cobbles, sand, brown		☒
	12	19	Gravel, coarse, sand		☒
8"	19	30	Gravel, coarse, sand		☒
	30	47	Cobbles, gravel		☒
	47	78	Gravel, sand		☒
	78	83	Gravel, sand, silt		☒
	83	112	Gravel, coarse		☒
	112	147	Cobbles, gravel		☒
	147	180	Gravel, coarse		☒
	180	211	Cobbles, coarse		☒
	211	233	Sand, gravel, coarse		☒
	233	255	Gravel, coarse		☒
	255	261	Sand, fine with brn silt	☒	
	261	273	Gravel, sand, brown		☒
	273	287	Gravel, cobbles, sand, grey		☒
	287	295	Cobbles. gravel		☒
	295	350	Boulders, cobbles		☒
	350	352	Big boulder, granite, hard		☒
	352	355	Sand, grey, gravel, medium		☒
	355	370	Sand, gravel, coarse		☒
	370	377	Sand, grey, silt, dark brown	☒	
	377	386	Gravel, coarse, sand, coarse	☒	
	386	398	Gravel, coarse, clean	☒	
			NOTE: 10' Screen set @ 398' to 388'		
			w/ top of K Packer at 387'.		

Completed Depth: 398 (Measurable)
Date: Started July 19, 2007 Completed July 24, 2007

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name McCarty Drilling & Pump Inc Firm No. 586
Firm Official _____ Date 7-24-07
Supervisor or Operator _____ Date _____
(Sign once if Firm Official & Operator)

Date: 7/24/2007 Time:5:10:48 PM

947 Bruner

Form 238-7 11/97

RECEIVED
MAY 07 2001
IDWR/North

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

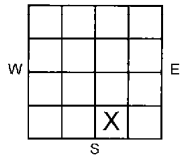
Office Use Only
Inspected by_____
Twp_____ Rge____Sec_____
____1/4 ____1/4 ____1/4
Lat: : : Long: : :

1. WELL TAG NO. D0017120
DRILLING PERMIT N
Other IDWR No 768458

POSTED

2. OWNER:
Name Chastity Bates
Address E.887 Brunner RD
City Athol State ID Zip 83801

3. LOCATION OF WELL by legal description:



Twp 53N North ☑ or South ☐
Rge 04W East ☐ or West ☑
Sec 25 1/4 SW 1/4 SE 1/4
10 Ac 40 Ac 160 Ac
Gov't Lot ___ County Kootenai
Lat Long
Address of Well Site: (see next line)
BRUNNER RD City
Lot Blk Sub. Name (see next line)

4. USE:
☑ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement etc.)
☑ New Well ☐ Modify ☐ Abandonment ☐ Other

6. DRILL METHOD
☑ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEAL/FILTER PACK			Amount	Method
Material	From	To	Sacks/Lbs	
Bentonite	0	18	12 sacks	pour in

Drive Shoe Used? ☐ Y ☑ N Shoe Depth(s)
Drive Shoe Seal Tested? ☐ Y ☑ N How?

8. CASING/LINER

Diam	From	To	Gauge	Material	Casng	Liner	Weld	Thrded
6	2	438	0.250	steel	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Length Headpipe ____ Length Tailpipe ____

9. PERFORATIONS/SCREENS
☑ Perforations? Method air perforator
☐ Screens? Screen Type

From	To	Slot	Nmbr	Diam	Material	Casng	Liner
415	4	1"	400		Steel	☑	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL or ARTESIAN PRESSURE
408 ft. below ground. Artesian pressure ___ lb.
Depth flow encountered 408 ft. Describe access port or control devices: Steel cap welded

11. WELL TESTS:
☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pump Level	Time
20+	100%	435	2 hrs

Water Temp. cold Bottom hole temp. cold
Water Quality test or comments: (below) Depth first Water Encountered 408
clear, cold, no smell

12. LITHOLOGIC LOG (Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality and Temperature	Water Y	Water N
8	0	1	Topsoil	☐	☑
8	1	18	Sand & gravel - 1/2" minus	☐	☑
6	18	240	Sand & gravel - 3/4" minus	☐	☑
6	240	260	Boulder & cobbles	☐	☑
6	260	438	Sand & gravel - 3/4" minus	☑	☐

RECEIVED
JUL 30 2001
Department of Water Resources

Completed Depth 438 (Measurable)
Date: Started 4/2/01 Completed 4/4/01

13. DRILLERS CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name United Drilling Inc. Firm No 414
Firm Official and [signature] Date 4/4/01
Supervisor or Operator Jason C. Beckham Date 4/4/01

FORWARD WHITE COPY TO WATER RESOURCES 375

53N 4W 25

Silverwood #3

Form 238-7
6/02

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

RECEIVED
AUG 11 2003
IDWR/North

Office Use Only
Well ID No. _____
Inspected by _____
Twp _____ Rge _____ Sec _____
_____ 1/4 _____ 1/4 _____ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D 0028533
DRILLING PERMIT NO. 803592
Water Right or Injection Well No. _____

2. OWNER:
Name Silverwood Inc
Address 27843 N. Hwy 95
City Athol State ID Zip 83801

3. LOCATION OF WELL by legal description:
You must provide address or Lot, Blk, Sub. or Directions to well.
Twp. 53 North ☒ or South ☐
Rge. 3 East ☐ or West ☒
Sec. 28, _____ 1/4 (10 acres) SE 1/4 (20 acres) SE 1/4 (160 acres)
Gov't Lot _____ County Kootenai
Lat: : : Long: : :
Address of Well Site same
(Give at least name of road + Distance to Road or Landmark) City _____
Lt. _____ Blk. _____ Sub. Name _____

POSTED

4. USE:
☐ Domestic ☒ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other _____

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other _____

6. DRILL METHOD:
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other _____

7. SEALING PROCEDURES

Seal Material	From	To	Weight / Volume	Seal Placement Method
Bentonite	0	58	2400#	dry granular

Was drive shoe used? ☐ Y ☒ N Shoe Depth(s) _____
Was drive shoe seal tested? ☐ Y ☐ N How? _____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
10"	+2	345	365	Steel	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Length of Headpipe _____ Length of Tailpipe _____
Packer ☐ Y ☐ N Type _____

9. PERFORATIONS/SCREENS PACKER TYPE
Perforation Method mechanical roller 1/4" x 1"
Screen Type & Method of Installation _____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
330	343	1/4	300	10"	Steel	☒	☐
						☐	☐
						☐	☐

10. FILTER PACK

Filter Material	From	To	Weight / Volume	Placement Method

11. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
317 ft. below ground Artesian pressure _____ lb.
Depth flow encountered _____ ft. Describe access port or control devices: _____

53N 3W 28

12. WELL TESTS:
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
270	0	340'	24 hrs

Water Temp. _____ Bottom hole temp. _____
Water Quality test or comments: cold & clear, no sand. Well capable of 400+ gpm Depth first Water Encountered 317

13. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
14	0	1	Topsoil, gravel, cobbles		
	1	3	Cobbles, gravel		
	3	6	Boulders		
	6	11	Cobbles, gravel, silt, brown		
	11	17	Gravel, cobbles, silt, brown		
	17	36	Gravel		
	36	39	Boulders, cobbles		
	39	49	Gravel		
	49	50	Boulder, granite		
	50	58	Gravel, coarse		
12	58	73	Gravel, cobbles, silt, brown		
	73	116	Gravel, coarse, silt, brown		
	116	130	Gravel, cobbles		
	130	133	Boulder, granite		
	133	167	Gravel, coarse		
	167	179	Gravel, medium to coarse		
	179	211	Gravel, coarse		
	211	245	Gravel, coarse, cobbles		
	245	260	Gravel, cobbles		
	260	291	Cobbles, gravel		
	291	320	Cobbles	x	
	320	330	Granite boulder	x	
	330	343	Cobbles	x	
	343	376	Granite		

Completed Depth 376' (Measurable)
Date: Started June 16, 2003 Completed July 10, 03

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 McCarty Drilling & Pump Inc Firm No. 586
Principal Driller _____ Date 8-6-03
and
Driller or Operator II _____ Date _____
Operator I _____ Date _____
Principal Driller and Rig Operator *Required.*
Operator I must have signature of Driller/Operator II.

FORWARD WHITE COPY TO WATER RESOURCES

Sonrise Daycare

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DEC 10 1999
IDWR/North

Form 238-7
11/97

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

77167

Office Use Only
Inspected by_____
Twp_____ Rge____Sec____
____1/4 ____1/4 ____1/4
Lat: : : Long: : :

1. WELL TAG NO. D0010993
DRILLING PERMIT NO 96-99-N-301
Other IDWR No.

2. OWNER:
Name John Reese
Address 13303 E Mission, Apt. 178
City Spokane State WA Zip 99216

3. LOCATION OF WELL by legal description:
Twp 53N North ☑ or South ☐
Rge 03W East ☐ or West ☑
Sec 28 1/4 10 Ac SW 1/4 40 Ac SE 1/4 160 Ac
Gov't Lot ____ County Kootenai
Lat Long
Address of Well Site: (see next line)
95 and Bunco City
Lot ____ Blk ____ Sub. Name (see next line)

4. USE:
☒ Domestic ☑ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement etc.)
☑ New Well ☐ Modify ☐ Abandonment ☐ Other

6. DRILL METHOD
☑ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEAL/FILTER PACK			Amount	Method
Material	From	To	Sacks/Lbs	
Bentonite	0	19	12 sacks	pour in

Drive Shoe Used? ☐ Y ☑ N Shoe Depth(s)
Drive Shoe Seal Tested? ☐ Y ☑ N How?

8. CASING/LINER

Diam	From	To	Gauge	Material	Casng	Liner	Weld	Thrded
6"	2	355	0.25	Steel	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Length Headpipe ____ Length Tailpipe ____

9. PERFORATIONS/SCREENS
☐ Perforations? Method
☐ Screens? Screen Type

From	To	Slot	Nmbr	Diam	Material	Casng	Liner
						☐	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL or ARTESIAN PRESSURE
305 ft. below ground. Artesian pressure ____ lb.
Depth flow encountered 305 ft. Describe access port or control devices: Steel cap welded

11. WELL TESTS
☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pump Level	Time
20+	100%	355	1 hr.

Water Temp. cold Bottom hole temp. cold
Water Quality test or comments: (below) Depth first Water Encountered 305
clear, cold, no smell

12. LITHOLOGIC LOG (Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality and Temperatyre	Water Y	Water N
10	0	2	Topsoil	☐	☑
10	2	19	Sand & gravel with cobbles	☐	☑
6	19	185	Sand & gravel - 1" with cobbles and	☐	☑
			boulders	☐	☐
6	185	270	Sand & gravel - fine	☐	☑
6	270	338	Sand & gravel - 3/4" with cobbles	☑	☐
6	338	347	Granite - brown/green/white - soft	☐	☑
6	347	355	Granite - black/green/white/tan - hard	☐	☑

Completed Depth 355 (Measurable)
Date: Started 12/3/99 Completed 12-8-99

13. DRILLERS CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name United Drilling Inc. Firm No 414
Firm Official and Supervisor or Operator Jason C. Beckham Date 12/8/99
Date 12/8/99

FORWARD WHITE COPY TO WATER RESOURCES 243

53N 3W 28

Granada Estates PWS

Form 238-7 4/92

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

USE TYPEWRITER OR BALLPOINT PEN

ENT'D

WELL DRILLER'S REPORT

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

1. WELL OWNER
Name RAY VAUDREUIL
Address 1410 LINCOLN WAY, CDA, ID 83814
Drilling Permit No. 95-93-N-76-000
Water Right Permit No.

2. NATURE OF WORK
☒ New well ☐ Deepened ☐ Replacement
☐ Well diameter increase ☐ Modification
☐ Abandoned (describe abandonment or modification procedures such as liners, screen, materials, plug depths, etc. in lithologic log, section 9.)

3. PROPOSED USE
☒ Domestic ☐ Irrigation ☐ Monitor
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

4. METHOD DRILLED
☒ Rotary ☒ Air ☐ Auger ☐ Reverse rotary
☐ Cable ☐ Mud ☐ Other _____ (backhoe, hydraulic, etc.)

5. WELL CONSTRUCTION
Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____

Thickness	Diameter	From	To
.250 inches	8" inches	+ 2 feet	198 feet
.250 inches	6" inches	194 feet	494 feet
_____ inches	_____ inches	_____ feet	_____ feet

Was casing drive shoe used? ☒ Yes ☐ No
Was a packer or seal used? ☒ Yes ☐ No
Perforated? ☐ Yes ☒ No
How perforated? ☐ Factory ☐ Knife ☐ Torch ☐ Gun
Size of perforation? _____ inches by _____ inches

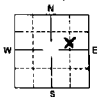
Number	From	To
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet

Well screen installed? ☐ Yes ☒ No
Manufacturer _____ Type _____
Top Packer or Headpipe _____
Bottom of Tailpipe _____

Diameter ____ Slot size ____ Set from ____ feet to ____ feet
Diameter ____ Slot size ____ Set from ____ feet to ____ feet
Gravel packed? ☐ Yes ☒ No ☐ Size of gravel _____
Placed from _____ feet to _____ feet
Surface seal depth 190 Material used in seal: ☐ Cement grout
☒ Bentonite ☐ Puddling clay ☐ _____
Sealing procedure used: ☐ Slurry pit
☐ Temp. surface casing ☒ Overbore to seal depth
Method of joining casing: ☐ Threaded ☒ Welded
☐ Solvent Weld ☐ Cemented between strata

Describe access port N/A

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



Subdivision Name GRANADA Estates
Lot No. 4 Block No. 1
County KOOTENAI
Address of Well Site DIAGONAL RD. CDA. ID
(give at least name of road)
S½ NW¼ NE¼ Sec. 1, T. 52N N ☐ or S ☐, R. 4W E ☐ or W ☐

7. WATER LEVEL
Static water level 300 feet below land surface.
Flowing? ☐ Yes ☒ No G.P.M. flow _____
Artesian closed-in pressure _____ p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature _____ °F. Quality GOOD
Describe artesian or temperature zones below.

8. WELL TEST DATA
☐ Pump ☐ Bailer ☒ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
20 ESTIMATED	645	1

9. LITHOLOGIC LOG 89547

Bore Diam.	Depth From	Depth To	Material	Water Yes	Water No
9½	0	1	SOIL		X
	1	60	SAND & GRAVEL 3/4-		X
	60	65	COBBLES, SAND, GRAVEL		X
	65	120	SAND & GRAVEL 3/4-		X
	120	125	COBBLES, SAND, GRAVEL		X
	125	198	SAND & GRAVEL 3/4-		X
7⅞	198	340	SAND, GRAVEL, 3/4-		X
	340	450	SANDY, CLAY GREEN		X
	450	475	DECOMPOSED GRANITE GREEN	X	
	475	494	GRANITE GREEN, BLACK WHT		X
5½	494	535	GRANITE GREEN, B/W		X
	535	545	GRANITE GREEN, B/W	X	
	545	595	GRANITE B/W		X
	595	620	GRANITE B/W	X	
	620	645	GRANITE B/W	X	

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JUL 09 1993
NORTHERN REGION
IDWR

FEB 09 1995

10. Work started 5/10/93 finished 6/12/93

11. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Firm Name UNITED DRILLING Firm No. 414
Address P.O. BOX 1690 HAYDEN, ID 83835 Date 6/14/93
Signed by Drilling Supervisor _____
and
(Operator) Larry Vaudeleuden JR. (If different than the Drilling Supervisor)

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

Bitterroot PWS

Form 238-7
6/93

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT
WR96-8796 092243

RECEIVED MAY 06 1994 Department of Water Resources

Please Type or Use Ball Point Pen

1. DRILLING PERMIT NO. 96-94-N-65
Other IDWR No.

2. OWNER:
Name SILVER MEADOWS, INC./JEFF CUSICK
Address P.O. BOX 318
City BAY VIEW State ID Zip 83803

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

N / W / E / S

T. 53 North [X] or South [ ]
R. 3 East [ ] or West [X]
Sec. 29, SW 1/4 (10 acres) SW 1/4 (40 acres) 1/4 (160 acres)
Gov't Lot ____ County KOOTENAI

Address of Well Site
(Give at least Direction + Distance to Road or Landmark)
Lot No. 1 Block No. 1 Subd. Name Silver Meadows

4. PROPOSED USE:
[ ] Domestic [X] Municipal [ ] Monitor [ ] Irrigation
[ ] Thermal [ ] Injection [X] Other

5. TYPE OF WORK
[X] New Well [ ] Modify or Repair [ ] Replacement [ ] Abandonment

6. DRILL METHOD
[X] Mud Rotary [X] Air Rotary [ ] Cable [ ] Other

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
BENTONITE	0	50	30SKS	OVERBORE

Was drive shoe seal tested? YES [ ] NO [X] How?

8. CASING/LINER:

Diameter	From	To	Guage	Casting	Liner	Steel	Plastic	Welded	Threaded
8	+2	464	.025	X		[X]	[ ]	[X]	[ ]
						[ ]	[ ]	[ ]	[ ]
						[ ]	[ ]	[ ]	[ ]
						[ ]	[ ]	[ ]	[ ]

Final location of shoes 464
Top Packer or Headpipe Bottom Tailpipe

9. PERFORATIONS/SCREENS
[X] Perforations Method STAR TYPE
[ ] Screens Type Material

From	To	Slot Size	Number	Diameter	Tele/Pipe Size	Casting	Liner
440	460	¼ X 2	240	8"		[X]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

SWSW 29 53N 3W

10. WELL TESTS:
[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian

Yield gal./min.	Drawdown	Pumping Depth	Time
50+		440	25.5

Temperature of water ____ Was a water analysis done? Yes [ ] No [ ]
By whom?
Water Quality (odor, etc.)
Bottom Hole Temperature

11. STATIC WATER LEVEL:
344 ft. below surface Depth artesian flow found
Artesian pressure ____ lb. Describe access port
Describe Controlling Devices:

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	GPM	SWL
12	0	3	TOP SOIL		
	3	180	GRAVEL BOULDERS		
	180	280	GRAVEL, COBBLES		
	280	400	CEMENTED GRAVELS		
	400	420	GRAVEL, COBBLES		
8	420	455	GRAVEL COBBLES	20	
	455	460	SAND	30	
	460	464	GRAVEL	50	
	464	470	DECOMPOSED GRANITE		
			8" DRIVE SHOE UTILIZED		

RECEIVED
MAY 02 1994
NORTHERN REGION
IDWR

FEB 09 1995

Date: Started 4-13-94 Completed 4-28-94

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name PONDEROSA DRILLING & DEVELOPMENT, INC. Firm No. 228
Firm Official and Supervisor or Operator W. SCOTT BARRATT Date 4/29/94
PON LINNEMON (Signature of Firm Official and/or Operator) Date 4-28-94

FORWARD WHITE COPY TO WATER RESOURCES

Norton Aero Exploration well

Form 238-7
9/82

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

USE TYPEWRITER OR BALLPOINT PEN

WELL DRILLER'S REPORT

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

1. WELL OWNER

Name Norton Aero, Ltd.

Address Rt. 1 Box 98V Athol, Id. 83801

Owner's Permit No. 96-86-N-102

2. NATURE OF WORK

☒ New well ☐ Deepened ☐ Replacement
☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

3. PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Test ☐ Municipal
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other _____ (specify type)

4. METHOD DRILLED

☒ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary
☐ Cable ☐ Dug ☐ Other _____

5. WELL CONSTRUCTION

Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____

Thickness	Diameter	From	To
.250 inches	6 inches +	2 feet	43 feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet
_____ inches	_____ inches	_____ feet	_____ feet

Was casing drive shoe used? ☒ Yes ☐ No
Was a packer or seal used? ☐ Yes ☒ No
Perforated? ☐ Yes ☒ No
How perforated? ☐ Factory ☐ Knife ☐ Torch
Size of perforation _____ inches by _____ inches

Number	From	To
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet
_____ perforations	_____ feet	_____ feet

Well screen installed? ☐ Yes ☒ 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 ☒ No ☐ Size of gravel _____
Placed from _____ feet to _____ feet
Surface seal depth 43 Material used in seal: ☐ Cement grout
☒ Bentonite ☐ Puddling clay ☒ Cuttings
Sealing procedure used: ☐ Slurry pit ☒ Temp. surface casing
☒ Overbore to seal depth
Method of joining casing: ☐ Threaded ☒ Welded ☐ Solvent Weld
☐ Cemented between strata
Describe access port _____

6. LOCATION OF WELL

Sketch map location must agree with written location.

N / W / E / S

Subdivision Name _____
Lot No. ___ Block No. ___
County Kootenai
NE ¼ NE ¼ Sec. 28, T. 53 N, R. 3 E W

7. WATER LEVEL

Static water level 75 feet below land surface.
Flowing? ☐ Yes ☒ No G.P.M. flow _____
Artesian closed-in pressure _____ p.s.i.
Controlled by: ☐ Valve ☒ Cap ☐ Plug
Temperature cold °F. Quality Excellent
Describe artesian or temperature zones below.

8. WELL TEST DATA

☐ Pump ☐ Bailer ☒ Air ☐ Other _____

Discharge G.P.M.	Pumping Level	Hours Pumped
2	Variable	1 hr.

9. LITHOLOGIC LOG

Bore Diam.	Depth From	Depth To	Material	Water Yes	Water No
8	0	1	Topsoil		X
	1	8	Gravel		X
	8	35	Boulders		X
	35	43	Granite		X
6	43	575	Granite	X	
			26GPM @ 100'		

10013

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SEP 15 1986
Department of Water Resources

10. Work started 5/28/86 finished 5/30/86

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Associated Well
Firm Name Drillers Inc Firm No. 245
Address Box 723 C.D.A. Date 5/30/86
Signed by (Firm Official) Bud Thornton
and
(Operator) Robert F Wagy

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