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May 2013

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970-225-3515

Assessment of the public water-supply well at South Jenny Lake, Grand Teton National Park

Plans are being developed to rehabilitate the South Jenny Lake water system (PMIS 18929). Park staff requested an assessment of the water-supply well and recommendations regarding whether any repair work for the existing well or construction of a new well might be necessary.

Well Construction

The South Jenny Lake water-supply well was constructed near the Exum Guide buildings in 1982 (Figure 1). The well provides water for an 85-site campground, a ranger station, visitor center, store, public restroom, trailhead, and two concessioner facilities. Peak use is about 15,000 gallons/day. The water system is a seasonal operation, from May to September.

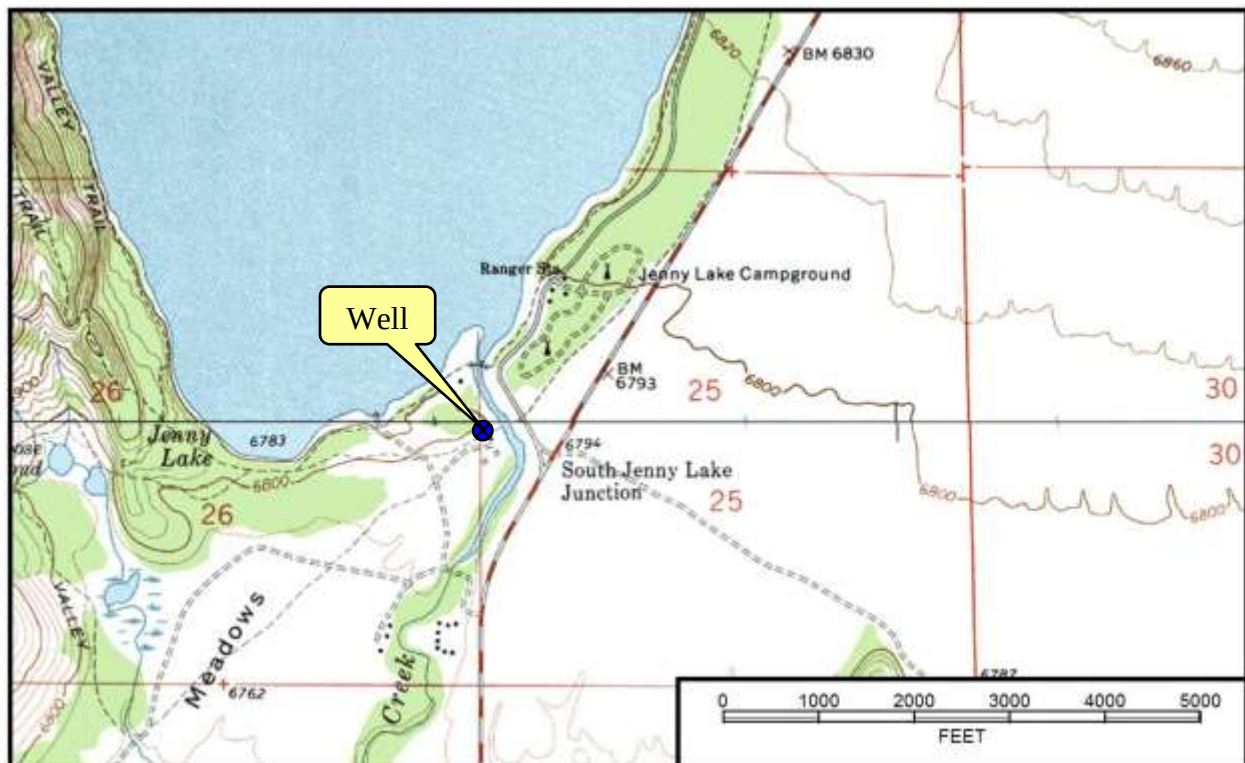


Figure 1. Location of water-supply well at South Jenny Lake.

The well was constructed in 1982 by drilling to 250 feet. Drilling encountered a series of glaciofluvial sediment layers including; gravel-sand, silt-sand, small gravel-sand-clay, pea-gravel

and sand, clay, and gravel. The main water bearing zone was from the pea gravel and sand unit from 210-235 feet below ground surface. The well was completed with 8-inch steel casing having 40 torch-cut perforations from 200-240 feet. The perforations are approximately 12 inches long by ¼ inch wide. The well was tested in August 1982 by pumping for 24 hours at 65 gallons/minute, resulting in 17 feet of drawdown.

Geology

A geologic map of the area (Figure 2) was made by joining the geologic maps for two quadrangles, the Jenny Lake quad to the north and the Moose Quad to the south (Love and Reed, 2001 and Love, 2003). The map shows a narrow band of glacial moraine deposit ringing the perimeter of the lake (labeled Qg³ on the map). The moraine deposit is an unsorted mix of material deposited at the terminus of the glacier that carved out Cascade Canyon. The moraine contains a considerable amount of clay, as evidenced by the many notations of clay in the drillers log for the well. The clay-rich moraine effectively acts as a dam to contain the water in Jenny Lake.

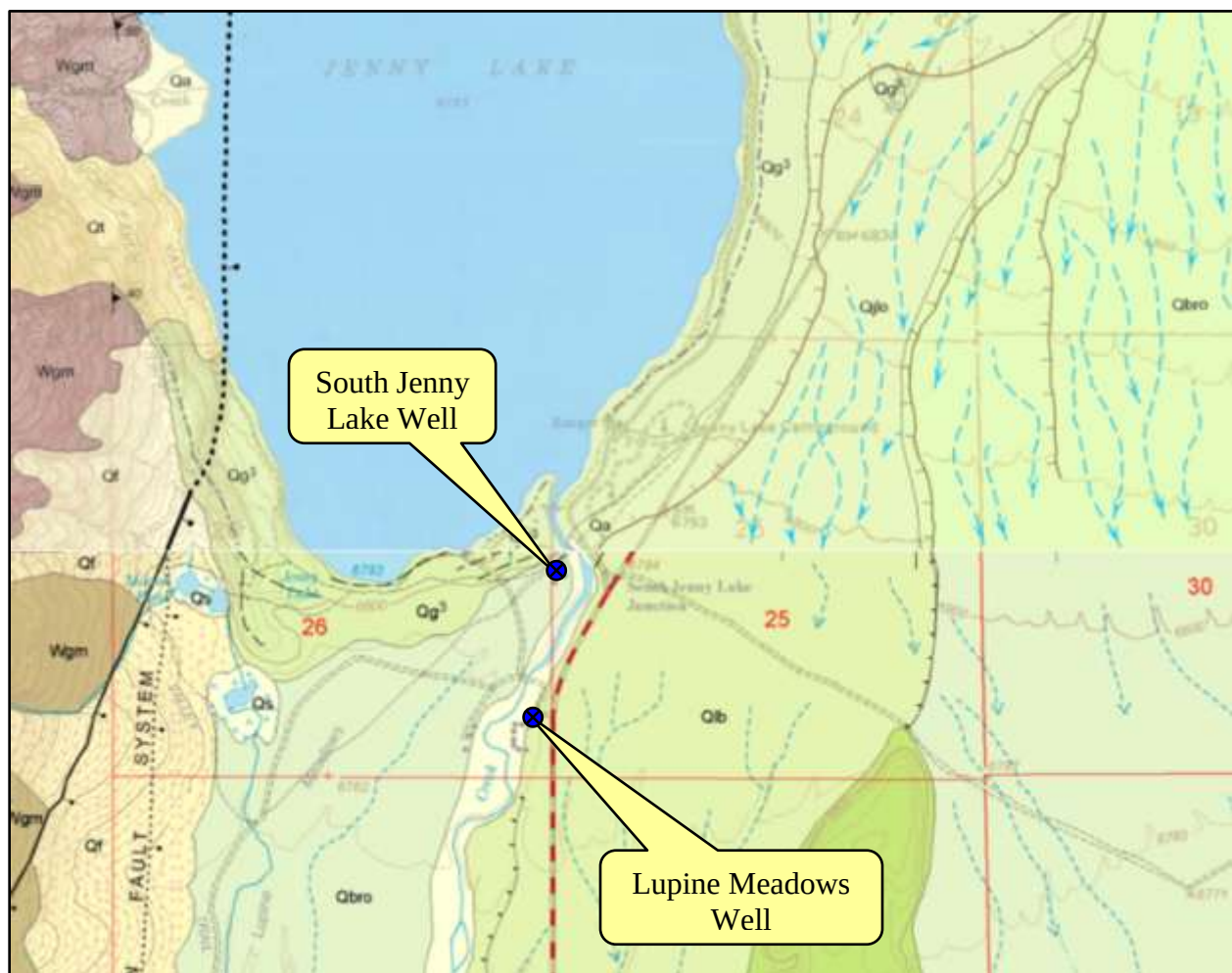


Figure 2. Geologic map of the South Jenny Lake area.

At the north end of Jenny Lake, two water-supply wells for the Jenny Lake Lodge were constructed in the glacial moraine deposits and failed to produce a reliable source of water. A

third well was constructed about a half mile east of the lake in glacial outwash sediments and produces abundant water (Martin, 2008).

Similar to the first two wells that were constructed at Jenny Lake Lodge, the South Jenny Lake well is located very close to the glacial moraine deposits. The driller's log showed a significant amount of clay until a depth of 210 feet, where a water-rich stratum of pea gravel and sand was encountered.

The Lupine Meadows well is about a quarter mile south is constructed in an area of glacial outwash. Drilling there encountered only sand and gravel for the entire 150 feet of the well. The well produces abundant water. A pumping test at that well in 1978 produced 176 gallons/minute for 24 hours with only 2 feet of drawdown.

The large difference in the productivity of the two wells illustrates the effect of constructing a well in glacial moraine deposits versus glacial outwash deposits. Although the South Jenny Lake well produces an adequate supply of water, much higher productivity could be achieved by locating a well a short distance to the south or east.

Well Testing

A pumping test was conducted at the South Jenny Lake well in August 1982, a few months after it was constructed. The well was pumped at 65 gallons per minute for 24 hours, resulting in 17 feet of drawdown. The specific capacity of the well was 3.8 gallons per foot of drawdown (65 gpm/17 feet of drawdown). The static water level was reported to be 75 feet and the pumping water level stabilized at 92 feet after 1½ hours and remained at that level for the duration of the test. The water level recovered to the static level within 25 minutes of turning the pump off. A graph of the data for the test is show in Figure 3. Water levels for this test were reported only to the nearest foot.

The South Jenny Lake well was tested again on May 2, 2013. The well was pumped at 50 gallons per minute for 3¾ hours, resulting in 9 feet of drawdown. The specific capacity of the well was 5½ gallons per foot of drawdown (50 gpm/9 feet of drawdown). The static water level was measured at 155 feet below the top of the well casing and the pumping water level stabilized at 164.25 feet after 2½ hours and remained at that level for the duration of the test. The water level recovered to within a half foot of the static level during the 45 minutes that we monitored water levels after turning the pump off. A graph of the data for the test is show in Figure 4.

We see similar results for both pumping tests. The water level decreases a few feet during the first 1-2 hours and then becomes stable for the remainder of the test. The water level recovers to the pre-pumping static level within a short time after pumping stops.

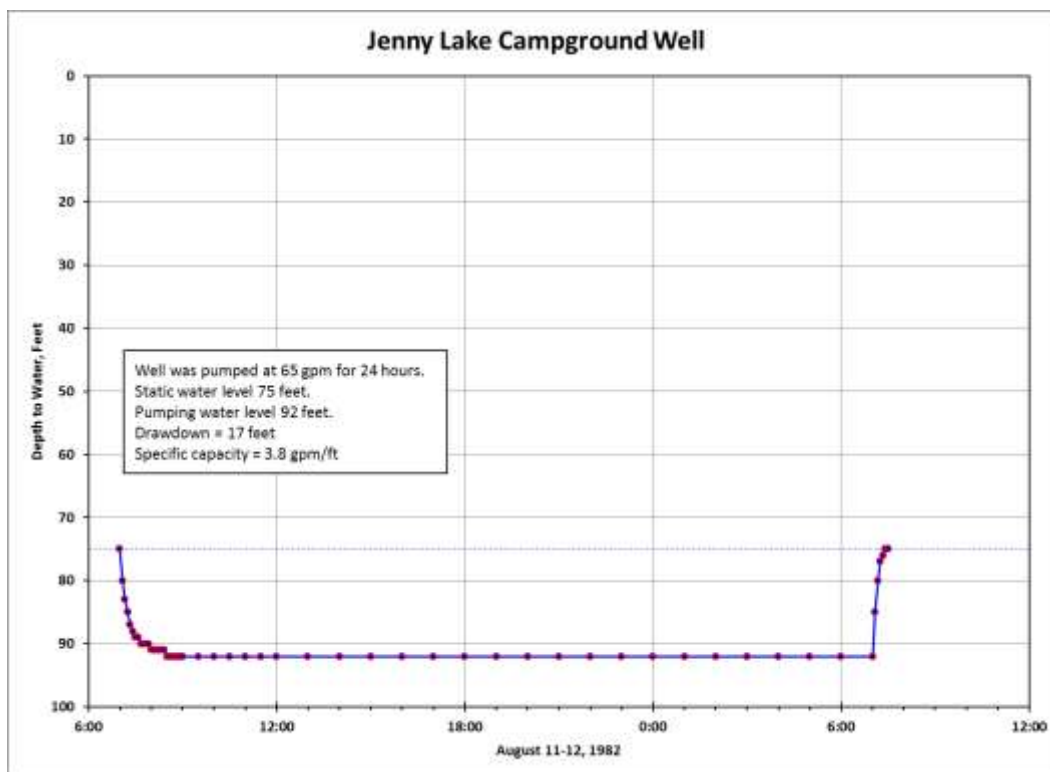


Figure 3. Data plot of depth to water during the August 1982 pumping test.

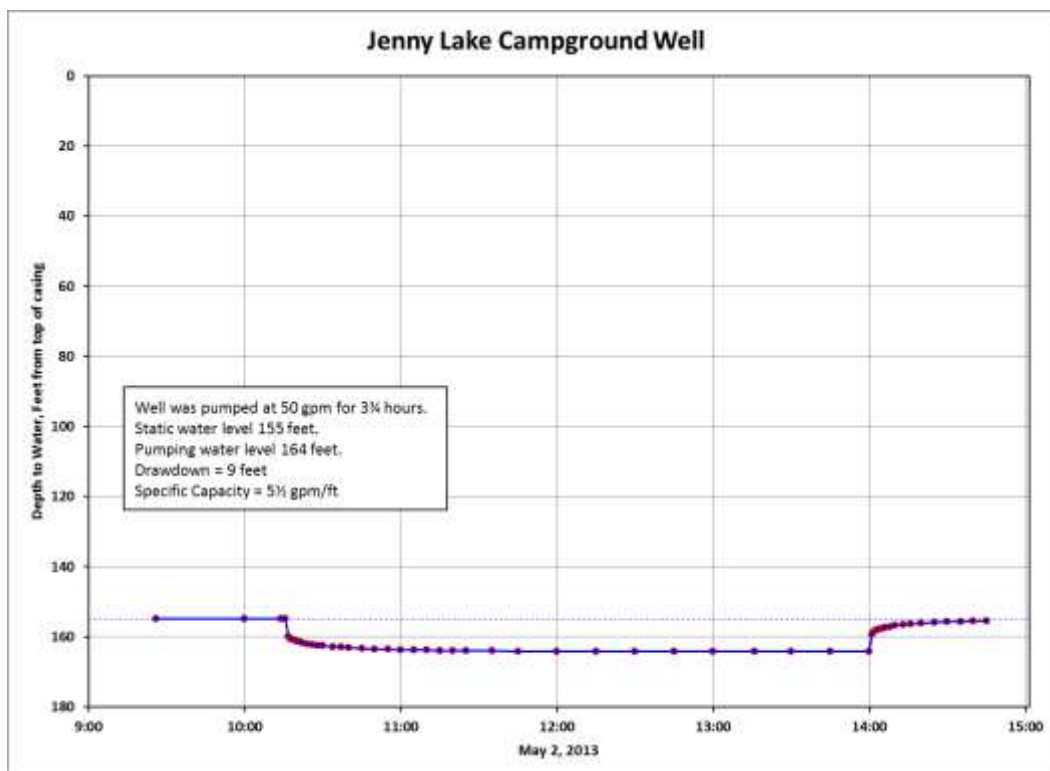


Figure 4. Data plot of depth to water during the May 2013 pumping test.

The specific capacity of a well is calculated by dividing the pumping rate by the drawdown. Specific capacity provides a good measure of comparing the efficiency of a well over time. If the well screen or perforations are becoming plugged, the specific capacity will decrease. More drawdown will be required to induce the flow of water through the openings as the size of the openings in the screen or perforation decrease. The specific capacity during the May 2013 test was much greater than during the August 1982 test, implying that the well has become more efficient. It is likely that regular pumping of the well over the past 30 years has resulted in flushing much of the fine-grained sediment from near the perforations, resulting in easier flow of water into the well and a larger specific capacity.

I cannot explain the large difference in the depth to water as measured in August 1982 (75 feet) compared to May 2013 (155 feet). The U.S. Geological Survey measured water levels in the well for several years from 1989-95 (Figure 5). Measurements were generally made in early-June and early-September. Water levels fluctuated several tens of feet annually, from about 100-130 feet below ground surface. Measurements made by the USGS in 1989-95 show the water table much deeper than was reported during the construction and initial testing of the well in 1982.

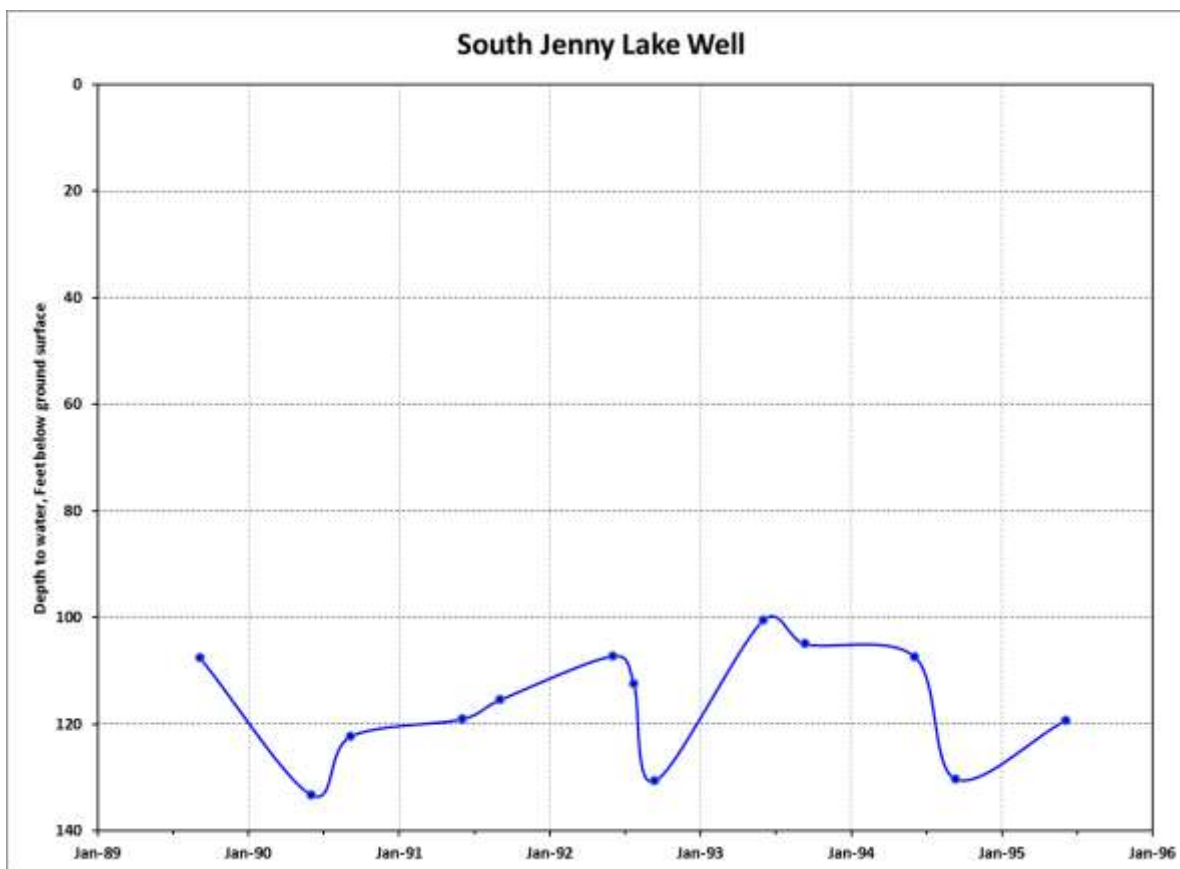


Figure 5. USGS water level measurements at the South Jenny Lake Well.

Measurements made in May 2013 show the water table farther below ground surface than it was in 1989-95. I have no explanation for what appears to be a continuing decline of the water table at this well location. It is unlikely that the relatively small amount of groundwater that is pumped

would cause a decline of the water table, or that the water table would not recover during the seven months of the off-season when no groundwater pumping occurs.

Notes from when the well was constructed in 1982 indicate that the pump was set at a depth of 220 feet. If that is still the case, then the pump is about 60 feet below the pumping water level.

Testing of the South Jenny Lake well in May 2013 shows that the well can be pumped nearly continuously at 50 gallons per minute. That would provide 70,000 gallons per day. The short period of use during the summer and the long period of non-use in the winter provide a measure of protection against overpumping from the aquifer. Additionally, there are no other large withdrawals of groundwater in the immediate vicinity. The well for the Jenny Lake Lodge is 2½ miles to the north and the Taggart Creek wells are 4 miles to the south. Pumping from other wells closer to South Jenny Lake is very minimal, too low to affect the regional water table elevation.

Records

A copy of the original well driller's report is attached along with a copy of the pumping test data from August 1982. It is interesting to note that the report is on a form from the Idaho Department of Water Resources. Presumably, this is because the well driller was from Idaho. There is no record of this well at the Wyoming State Engineer's Office.

Conclusions

The existing South Jenny Lake well is in very good shape. The well can produce 50 gallons per minute for extended periods. Water level recovers quickly after pumping has stopped. The excellent water quality of the aquifer has nearly no potential for corrosion or scaling of the perforations in the well casing, resulting in continued good flow of groundwater from the aquifer into the well. The well appears to have gotten more efficient since it was initially tested after construction. This is likely due to the fine-grained sediments having been flushed from the aquifer during regular pumping of the well. Park staff made no mention of sand-pumping problems for this well, leading me to conclude that it isn't an issue.

It would be a good idea to measure the water level in the South Jenny Lake well twice a year to learn more about the range of fluctuation of the water table and to provide warning should the water table continue to decline. Measurements should be made prior to startup of the system in the spring and after the water system has been shut down in the fall.

The PMIS statement includes reference to installing 20 feet of well screen as a liner sleeve inside the existing well to prevent fine-grained sediments from entering the well and causing excessive wear to the pump. The perforated section of the well spans 40 feet from 200-240 feet, so a well screen would need to be at least 40 feet long to cover the perforated interval. Installing a screen in a 30-year old well could be problematic. Also, a well screen that would prevent fine-grained sediment from entering the well would also restrict the flow of water into the well, resulting in increased drawdown during pumping. There is no record of problems with pumping sand or silt from this well. The age of the current pump is unknown; no one can remember when it was last replaced, so apparently there is no problem with excessive wear on the pump. I recommend deleting this item from the scope of work for the project.

The existing well will likely continue to be a reliable source of groundwater for NPS facilities at South Jenny Lake. If a larger volume of water is needed, it can be obtained from the Lupine Meadows well 2000 feet to the south. If a new well is desired at some time in the future, it should be located at least 1000 feet south or east of the current well to locate it within an area of glacial outwash which is a more productive aquifer.

References

- Love, J.D., and Reed, J.C., Jr., 2001, Geologic map of the Moose Quadrangle, Teton County, Wyoming, Wyoming State Geological Survey J. David Love Geologic Map Series Map LM-3, scale 1:24,000
- Love, J.D., 2003, Geologic map of the Jenny Lake Quadrangle, Teton County, Wyoming, Wyoming State Geological Survey J. David Love Geologic Map Series Map LM-12, scale 1:24,000
- Martin, Larry, 2008, Hydrogeology and Water-Supply Wells, Grand Teton National Park, Natural Resource Technical Report NPS/NRPC/WRD/NRTR-2008/091, National Park Service, Fort Collins, Colorado, 34 pp.

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCESUSE 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 <u>GRAND TETON U.P.</u> Address <u>JENNY LAKE DAM, GRAND TETON NATIONAL PARK</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>75</u> feet below land surface. Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed-in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature <u>60</u> °F. Quality <u>good</u>																																																																																																																																																																																																																																																																		
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____		8. WELL TEST DATA ☒ Pump ☐ Bailor ☐ Air ☐ Other _____ <table border="1"><thead><tr><th>Discharge G.P.M.</th><th>Pumping Level</th><th>Hours Pumped</th></tr></thead><tbody><tr><td><u>65</u></td><td><u>92</u></td><td><u>14</u></td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></tbody></table>		Discharge G.P.M.	Pumping Level	Hours Pumped	<u>65</u>	<u>92</u>	<u>14</u>																																																																																																																																																																																																																																																											
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4. METHOD DRILLED ☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary ☒ Cable ☐ Dug ☐ Other _____		5. WELL CONSTRUCTION Casing schedule: ☒ Steel ☐ Concrete ☐ Other _____ <table border="1"><thead><tr><th>Thickness</th><th>Diameter</th><th>From</th><th>To</th></tr></thead><tbody><tr><td><u>3/4</u> inches</td><td><u>8</u> inches</td><td><u>2</u> feet</td><td><u>250</u> feet</td></tr><tr><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td></tr></tbody></table> 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 <u>1/2</u> inches by <u>1/4</u> inches <table border="1"><thead><tr><th>Number</th><th>From</th><th>To</th></tr></thead><tbody><tr><td><u>40</u> perforations</td><td><u>200</u> feet</td><td><u>240</u> feet</td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></tbody></table> Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Model No. _____ Type _____ 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 <u>25</u> Material used in seal: ☒ Cement grout ☐ Puddling clay ☐ Well 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 _____		Thickness	Diameter	From	To	<u>3/4</u> inches	<u>8</u> inches	<u>2</u> feet	<u>250</u> feet																	Number	From	To	<u>40</u> perforations	<u>200</u> feet	<u>240</u> feet																																																																																																																																																																																																																																			
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6. LOCATION OF WELL Sketch map location must agree with written location.  Subdivision Name _____ Lot No. _____ Block No. _____ County _____ _____ 1/4 Sec. _____ T. _____ N/S, R. _____ E/W.		10. DRILLERS CERTIFICATION I/We certify that all minimum well construction standards were compiled with at the time the rig was removed. Firm Name _____ Firm No. _____ Address _____ Date _____ Signed by (Firm Official) _____ and (Operator) _____																																																																																																																																																																																																																																																																		

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

Date, Aug 11-12, 1982

JENNY LAKE CAMPGROUND WELL

AKA: Exams Well Test Yield (~~South Jenny Lake~~)

(~~Not Jenny Lake~~)

Start:

Time	GPM	Draw Down	Murky	Sand	Clear
7:00am.	65	75 ft.	yes	no	no
7:05	"	80	yes	no	no
7:10	"	83	yes	no	no
7:15	"	85	yes	no	no
7:20	"	87	yes	no	no
7:25	"	88	yes	no	no
7:30	"	89	yes	no	no
7:35	"	89	yes	no	no
7:40	"	90	"	"	"
7:45	"	90	"	"	"
7:50	"	90	"	"	"
7:55	"	90	"	"	"
8:00	"	91	"	"	"
8:05	"	"	"	"	"
8:10	"	"	"	"	"
8:15	"	"	"	"	"
8:20	"	"	"	"	"
8:25	"	"	"	"	"
8:30	"	92	"	"	"
8:35	"	"	"	"	"
8:40	"	"	"	"	"
8:45	"	"	"	"	"
8:50	"	"	"	"	"
8:55	"	"	"	"	"
9:00	"	"	"	"	"
9:30	"	"	"	"	"
10:00	"	"	no	"	yes
10:30	"	"	"	"	"
11:00	"	"	"	"	"
11:30	"	"	"	"	"
12:00	"	"	"	"	"
1:00pm	"	"	"	"	"
2:00	"	"	"	"	"
3:00	"	"	"	"	"
4:00	"	"	"	"	"
5:00	"	"	"	"	"
6:00	"	"	"	"	"
7:00	"	"	"	"	"
8:00	"	"	"	"	"
9:00	"	"	"	"	"
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11:00	"	"	"	"	"
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1:00am.	"	"	"	"	"
2:00	"	"	"	"	"
3:00	"	"	"	"	"
4:00	"	"	"	"	"
5:00	"	"	"	"	"
6:00	"	"	"	"	"
7:00	"	"	"	"	"

set pump at 220 ft.
Goulds pump UJ66LM12
10 hp 1ph. 230v.

Recovery Time	
Time	Static Level
0 min.	92 ft.
5 min.	85 ft.
10 min.	80 ft.
15 min.	77 ft.
20 min.	76 ft.
25 min.	75 ft.
30 min.	75 ft.

L.W. Frandsen and Sons Well Drilling
Box 357
Lava Hot Springs, Idaho 83246
Phone: (208) 776-5325