

Recommendations for Constructing a New Water Supply Well at Moran Junction, Grand Teton National Park

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Introduction

The original water supply well for facilities in the Moran Junction area was constructed in 1961. It continues to be the water supply source for NPS facilities in the area; however, production is limited to prevent pumping sand from the well. A new well was drilled in September 1999 and completed with screen and casing in June 2001. The new well produces very little water (less than 1 gallon per minute).

This report describes the construction and testing of the 1961 well. Construction of the 2001 well and cause of the low yield from this well is discussed. Recommendations are provided for the location and construction design for a new well to meet water supply demand for NPS facilities at Moran Junction.

Hydrogeology

Three geologic units are important to understanding the hydrogeology of the Moran Junction area. These units are: 1) bedrock, 2) lacustrine deposits, and 3) alluvium. The Buffalo Fork River valley near Moran Junction was eroded into bedrock to a depth of about 100 feet below the elevation of the present valley floor. A lake later covered the area, and a thick layer of sediment was deposited in the bottom of the lake. These lacustrine deposits, of late-Quaternary age, are overlain by a thin veneer of alluvial sand and gravel. A diagrammatic cross section showing the probable relations of alluvium, lacustrine deposits, and bedrock near the junction of the Snake and Buffalo Fork Rivers, as interpreted by McGreevy and Gordon (1964), is shown on a figure attached to this report.

Bedrock outcrops on the high hills to the northeast and west of Moran Junction. Bedrock in this area is the Cretaceous Harebell Formation, a conglomerate of quartzite cobbles interbedded with greenish sandstone and claystone (Lageson and Spearing, 1991). Inclusion of claystone in the formation probably limits the availability of groundwater from bedrock in the area.

Lacustrine deposits are sediments that were deposited in a lake. Sometime in the late-Quaternary age, the Buffalo Fork River was dammed and a large lake formed in this area, causing the previously formed valley to fill with sediments. Lacustrine deposits overly bedrock in test holes and wells drilled near the junction of the Snake and Buffalo Fork Rivers. They consist of light-gray, very-fine sand, silt, clay, and some beds of coarser sand and gravel. The lacustrine deposits can yield small quantities of water to some wells, but generally, it is not a significant source of water.

Alluvium is the most permeable aquifer in the Moran Junction area, but it is relatively thin. The thickest known alluvium in the area is 31 feet at the 1961 Well. Test wells about ¼ mile to the south encountered only a few feet of saturated alluvium. Alluvium is the only reliable source of significant quantities of ground water in the area.

1961 Well

Several test wells and borings were constructed in the area in 1961 (and possibly earlier). Based on the results of the test drilling, the current water supply well was constructed in June 1961. The well was drilled to a depth of 55 feet and passed through alluvium to a depth of 31 feet and then lacustrine deposits from 31-55 feet. The well was completed by installing black steel casing (6" ID) to a depth of 55 feet with ¼" perforations at 28-30 feet. The well was test pumped for 31 hours at 30 gpm with 12 feet of drawdown. It was concluded that the well could safely be pumped at 30-35 gpm but pumping at higher rates would probably pull sand into the well. That this well could provide 30-35 gpm through a two-foot interval of perforated casing is a testament to the large permeability of the alluvium in the area. Production from the well is currently limited to prevent pumping of sand from the well. The report describing construction and testing of the well (McGreevy and Gordon, 1964) recognized the potential for the well to produce sand at any pumping rate and suggested that a replacement well should be constructed using well screen and sand pack to act as a filter and provide a larger open area for water to enter the well.

2001 Well

A replacement well was drilled in the area in 1999. The well was located on the east side of Hwy 89/287 in an effort to place it far enough from the Snake River to avoid classification as "groundwater under the direct influence of surface water". Such a classification would require treatment of the water as if it came directly from a surface water source. Information from the well driller's log seemed to indicate that the interval from 50-62 feet produced 25-30 gpm. A well was designed to place well screen and sand filter in this interval, while preventing water from the overlying alluvium from entering the well. Final construction of the well occurred in June 2001. The well now produces less than 1 gpm.

In retrospect, it appears that we misinterpreted the information in the driller's log. Although it was reported that the highest water production occurred as drilling passed through the 50-62 foot interval, most of that water must have been coming from the overlying alluvium. When the well

was constructed to prevent the alluvial groundwater from entering the well, we eliminated the primary source of water. The screened interval of the well is opposite the lacustrine deposits.

Proposed New Well

Now that we know that the only reliable source of significant quantities of groundwater in the area is the alluvium, we can design and construct a well that should be capable of providing 30 gpm of virtually sand free water. The proposed location of this new well is slightly south and east of the 1961 well, as shown on the attached figure. The well should be located more than 200 feet from the river. The location is picked based on the likelihood of encountering an adequate thickness of alluvium, access via an existing road, and the potential for visually screening the well site from the highway by placing it behind or among the trees in the area.

Planned depth of the well is 35-40 feet, to insure that the well penetrates the full thickness of alluvium. Drilling will be halted after penetrating several feet of lacustrine deposits. Planned well construction is shown on the attached figures. Wyoming well construction standards require a 20-foot cement grout surface seal. We anticipate that the bottom of the alluvium will be about 30-32 feet below ground surface at this location. A 5-foot section of stainless steel, vee-wire, telescoping well screen will be placed within the interval between 20 feet deep and the bottom of the alluvium. Location of the well screen will be opposite the most permeable interval of sand and gravel encountered between 20 feet and the base of the alluvium. A 5-foot section of well screen should be sufficient to pass an ample quantity of water to the well. As an example, a 5-foot section of 8-inch Johnson stainless steel, vee-wire, telescoping screen with a slot opening size of 0.10" should pass 45 gpm. I would anticipate that we would use a larger slot opening size for the proposed well, which would increase the potential yield of the well.

The initial construction of the well, as shown in Figure 1, will start with drilling and driving 12-inch casing to a depth of 20 feet. This will facilitate installation of the cement grout well seal at a later date. Construction will continue by drilling and driving 8-inch casing until the lacustrine sediments are encountered. We anticipate that will be at a depth of 30-32 feet. Geologic samples of the alluvium will be collected during drilling. These samples will be analyzed by sieving to determine the grain-size distribution. This information will be used to determine the proper slot size for the well screen.

Figure 2 shows the final well construction. An 8-inch, stainless steel, vee-wire, telescoping well screen will be installed inside the 8-inch casing at the desired depth. (The outside diameter of 8-inch telescoping screen is 7½".) The 8-inch casing will then be pulled back to expose the screen to the alluvium. A k-packer will be used to seal the annular space between the casing and well screen. The 12-inch casing will then be pulled while pumping a cement grout mixture into the annular space outside the 8-inch casing to form a surface seal.

The well will then be developed by a combination of surging, jetting, and pumping to flush and remove sand from the alluvium near the well. In this manner, a natural gravel pack will form around the well screen.

The construction methods described are standard construction for a well constructed in alluvium. Developing a natural gravel pack in the alluvium should result in maximizing the potential yield of the well and minimizing drawdown during pumping.

Because of its proximity to the Snake River and the shallow depth of the well, water pumped from the well might be classified as “groundwater under the direct influence of surface water”. EPA would need to conduct an assessment of the site to determine if further testing, in the form of a microparticulate analysis, is required. If no microorganisms are found in the microparticulate analysis, the well would be classified as a groundwater source and no treatment would be needed, other than chlorination.

Additional testing by NPS might provide further evidence of whether water from the well should be classified as being from a “groundwater” source or is “groundwater under the direct influence of surface water”. Typically, the testing consists of a series of tests to compare water from the well with water from the adjacent river. Testing parameters include pH, temperature, conductivity, and turbidity. If the test results show a direct correlation in variation between water quality in the well and river, it will be classified as “under the direct influence” and water from the well will need to be treated as if it came from a surface water source. If water quality from the well remains fairly constant, while the quality of surface water varies seasonally in response to changes in runoff and streamflow, then it may not be “under the direct influence”.

References

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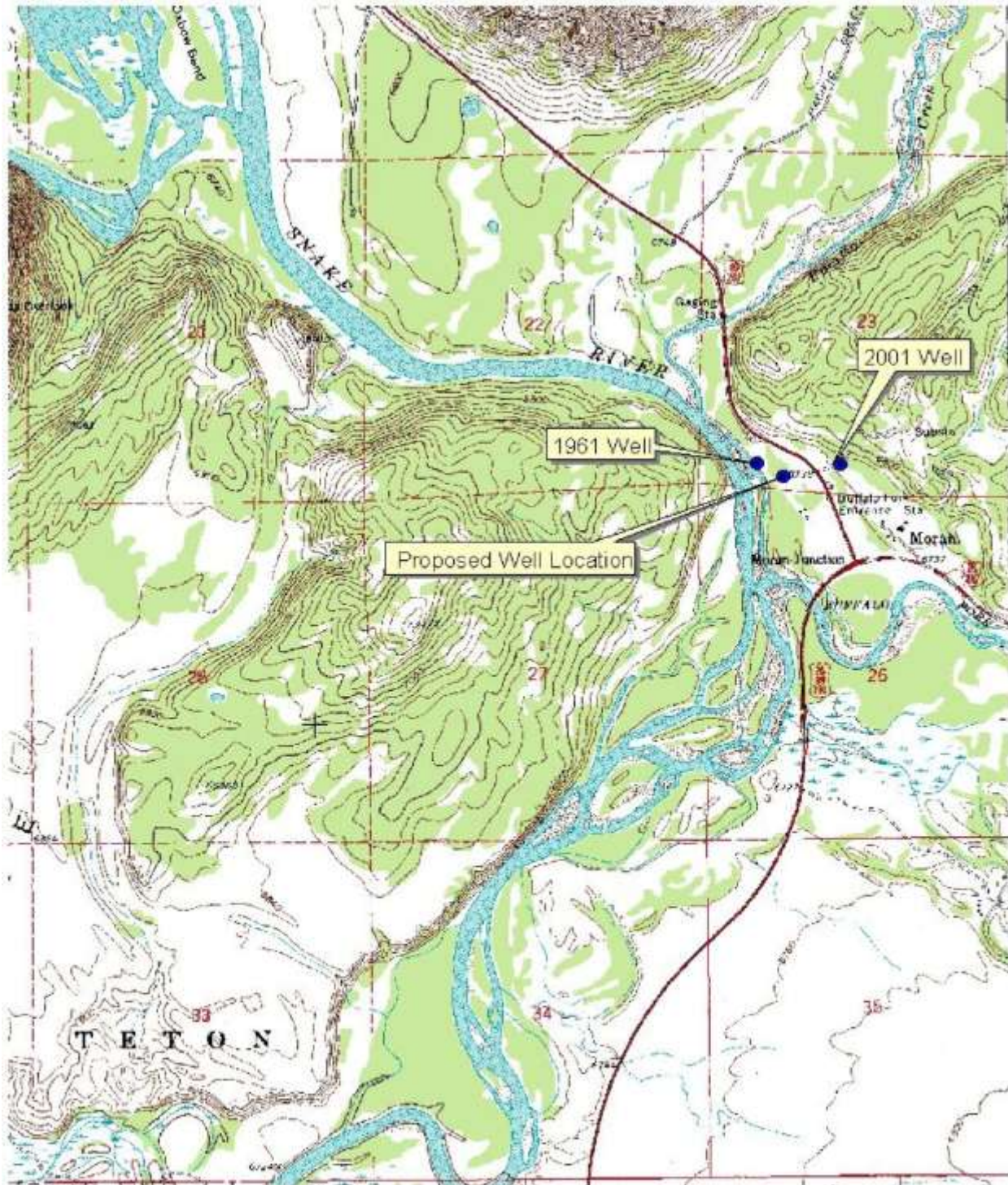
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Wemple, Bob, 2000, Memo to Mike Martin, WRD, 5/25/00, Moran Well



Moran Junction Well Locations

0.5 0 0.5 1 1.5 Miles



Another well was constructed at Moran in 2002. Following is a brief description of construction and testing of that well. The well was located at the location shown on the preceding map.

Larry,

I met with Bob Wemple Tuesday morning and then he and I met the driller out at the well site. Tyson Thomas had set surface casing to 20 feet the previous day and was ready to drill ahead from the 20 feet depth to the proposed TD. Weather was a bit snowy as they had 3 or more inches the previous night and was still spitting a little snow that morning. Tyson indicated these shallow sands appeared saturated when drilling through the previous day. He had a sample of medium to coarse dark brown/black sand from the 0 to 20 foot depth which I have a sample of. We drilled ahead 2 more feet to a depth of approximately 22 feet and got into largely angular gravels with a dark coarse gravelly sand encountered at a depth of approximately 37 to 38 feet. This dark coarse sand was present to the total depth reached of roughly 40 feet. The air rotary drill blew out quite a bit of water (est. at 40+ gpm) throughout much of the gravel section indicating a highly permeable zone and a likely good well. Tyson recommended not going any further into the sand at the bottom of the boring and completing the well (5 foot screen interval) in the 32 to 37 foot interval to minimize the possibility of producing any sand from the lower part of the hole. I concurred that this seemed like a reasonable interval to screen and emphasized that despite us returning with samples, the contract called for his submitting the gravels for sieve analysis which he indicated he would do and then order the appropriate screen. I suspect a 20 or 30 slot (0.020 to 0.030) will provide all the water needed if 45 gpm is the goal although the aquifer may take an even larger slot size without producing sand, if needed. Because of the nature of the sampling mechanism (the samples were blown out from tubing at the top end of the drill string and collected in a large tub on the ground), there may have been some loss of fines or separation of the wet cuttings between those thrown close to the rig (sand) and those (largely gravels) thrown out 15 or more feet and captured by the tub. There was definitely a high percentage of gravels in the 12 to 37 foot interval however, so there is little question that gravel is the predominant component. I don't think there was sediment much finer than a coarse sand accompanying this gravel interval so fine sand production should be negligible from this zone if the well is completed properly (correct interval) with a natural gravel pack.

The four samples collected are as follows:

- medium to coarse dark brown to gray sand from 0 to 22 feet
- angular gray gravel from 22 feet to 30 feet
- angular gray gravel with some coarse sand 30 to 37 feet
- gravelly dark gray to black medium to coarse sand from 37 to 40 feet (i.e. at TD)

It was not clear if we made it into the lacustrine sediments but should have been close upon coming out of the gravels at 37 to 38 feet. The drilling went fast so the depths should be considered approximate although drilling a little slower near the bottom of the hole. I did not get a static water level as there did not look like a lot of annular space between the drill string and the casing. Also the well produced a lot of water (mostly quite clear) during drilling so not sure how fast the water level would have equilibrated. When the driller returns he should get a water level the first thing after removing the weld plate. I suspect it will be around 20 feet +/- a few feet. Driller will weld on a cover plate as before and will be back to install well once a screen has been sized (few weeks), ordered and shipped to him. Met with Bob for a while back at this office to discuss other groundwater issues at the park (mostly contaminant related). I think this well will resolve their water supply issues at Moran Junction for the time being but I agree, the location that close to the river will likely require it meet additional testing requirements to ensure it does not fall into the category as "under the influence" of surface water.

Peter E. Penoyer

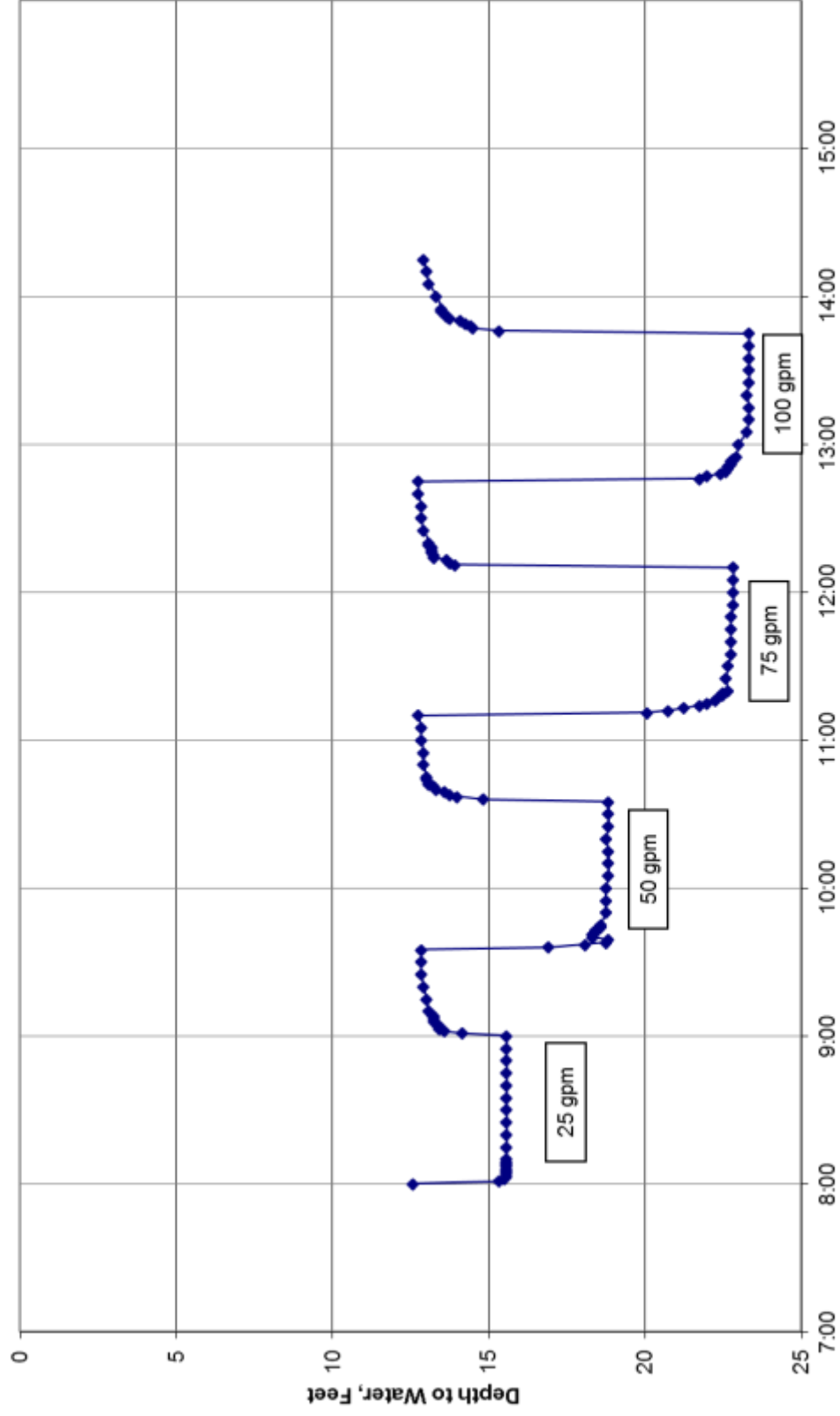


Photo of well constructed at Moran Junction in September 2002. View is toward the south with the Ranger Station in the background. Snake River is about 110 yards to the west (right side of photo) from the well.



View of the new well at Moran Junction. View is toward the North. Snake River is behind the trees on the left side of the photo.

Moran Junction Well
September 19, 2002



Moran Junction Well
September 20-21, 2002

