

Potential Well Construction and Groundwater Supply for Facilities at Horseshoe Bend, Bighorn Canyon National Recreation Area, Wyoming

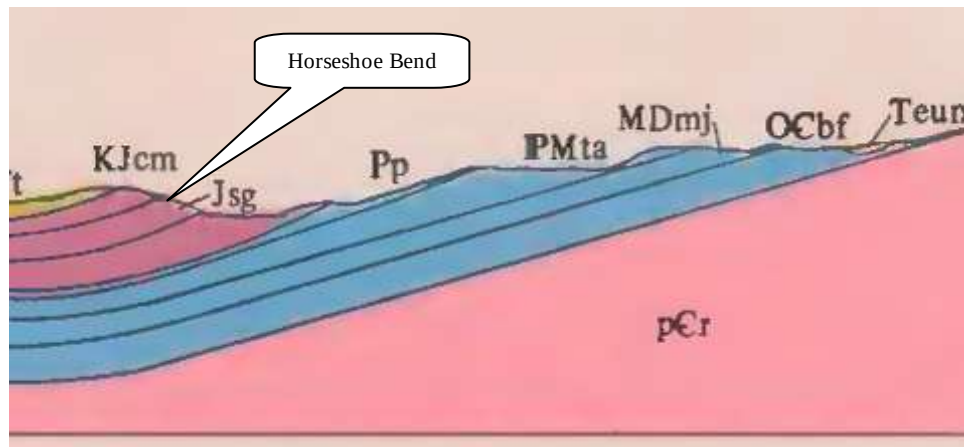
Water for facilities at Horseshoe Bend is supplied from a spring about 1¼ miles NNW of the road intersection to the campground. The spring development and pipeline were constructed ca. 1968. Additional water supplies are needed to meet the current level of demand.

Redevelopment

The first thought that comes to mind is whether the collection system at the spring needs to be redeveloped. It is very common for collection systems to become less efficient over the years as fine-grained sediments and plant roots work their way into the gravel envelope surrounding the perforated pipe. It has been my experience at a number of NPS sites that spring collection systems need redeveloping after a number of years; sometimes as frequently as every 10 years. Redevelopment may be as simple as backflushing the collection pipes with pressurized water, as from a fire truck, or it might require excavation of the collection area and replacing the perforated pipe and gravel envelope. It has been 40 years since construction of the spring collection system. The test for determining whether redevelopment is necessary is to compare the current springflow rate with historic rates. If it appears that springflow has decreased, it's likely that redevelopment could restore the original flow rate.

Hydrogeology

The area is underlain by sedimentary rock formations that dip 6-8° (750 feet/mile) toward the southwest. A SW-NE geologic cross-section of the area would look like this....



The formation labeled MDmj is the Madison Formation.

A very generalized geologic map of the area is superimposed on a GoogleEarth screenshot in the following figure.



General Geologic Map of the Horseshoe Bend Area

A well drilled at the proposed location would pass through the Goose Egg, Tensleep, and Amsden Formations before reaching the Madison Limestone.

Formation	Description	Water Characteristics
Chugwater Fm.	Fine-grainer, red sandstone, siltstone, and shale, contains gypsum	Might produce small amounts of poor-quality water in some areas
Goose Egg Fm.	Red sandstone and siltstone, white gypsum, and a few thin beds of dolomite	Might produce small amounts of poor-quality water in some areas
Tensleep Sandstone	Light-gray, well-sorted sandstone with thin beds of dolomite in the lower part of the formation	Previous test drilling at Horseshoe Bend (1966) showed that the Tensleep produces poor quality water in this area. (1000-1500 ppm sulfate)
Amsden Fm.	Red shale with some limestone and dolomite in the lower part	Might produce small amounts of poor-quality water in some areas
Madison Limestone	Blue-gray massive limestone and dolomite	Generally a source of abundant, good-quality water. No known test wells or water quality samples in the immediate vicinity

Previous Test Drilling

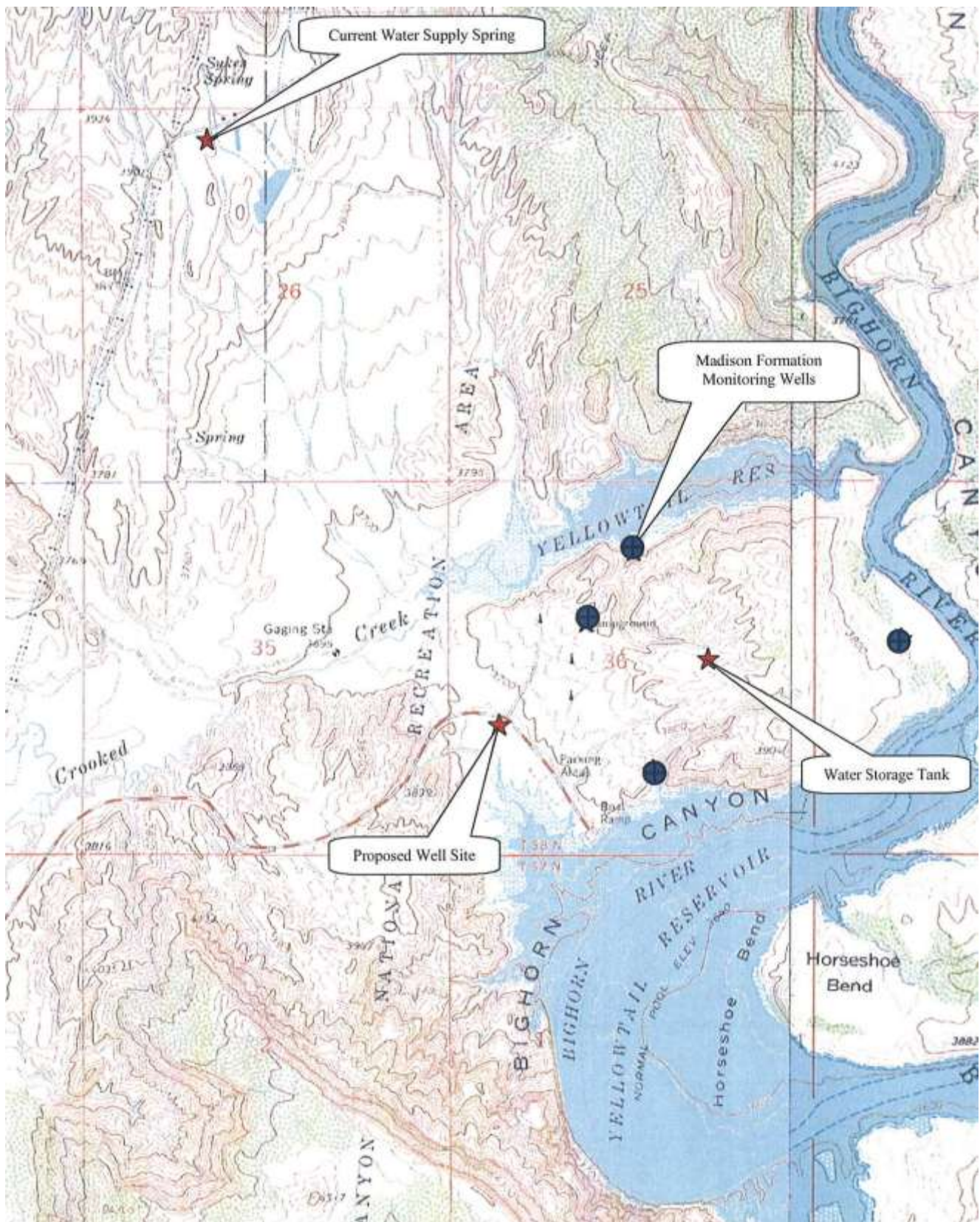
Two test wells were constructed in this area in 1966. Geology and water quality for the test wells is described in reports by Joe Rawlins, consulting geologist. Both wells were completed in the Tensleep Sandstone. One well is described as being ½ mile north of the boat ramp and was 138 feet deep. The other well was located ¼ mile WNW of the boat ramp and was 213 feet deep. No information was provided regarding the water-producing characteristics of either well. Several water quality samples were collected and analyzed. The water is described as being very hard and containing high concentrations of sulfate (1000-1500 ppm). It is unsuitable for human consumption without treatment. There is no explanation for why drilling did not continue into the Madison Formation.

Also in 1966, five test/monitor wells were drilled into the Madison Formation. Four of these wells are shown on the attached figure. The fifth well is located a short distance south of the area shown on the map. These holes were 3½" diameter and completed with 1¼" steel pipe. It might be possible to obtain a water chemistry sample from one of these wells for testing prior to committing to construction of a new water supply well at Horseshoe Bend. The elevation of the top of the Madison Limestone in the 3 wells closest to the proposed well site ranges from 3350-3450 feet msl. These wells are about ½ mile east of the proposed well site and the formations dip toward the southwest at about 750 feet/mile.

At the proposed well site, the elevation of the top of the Madison Limestone should be expected at an elevation of 3000 feet. [The depth to the top of the Madison was estimated by using the average depth (3350-3450) at the 3 nearby holes and subtracting the dip of the formations (750 ft/mi x ½ mile.)] Land surface is about 3700 feet msl. Therefore we should expect the top of the Madison to be about 700 feet below ground surface. A well will probably need to penetrate 100-200 feet into the Madison, so we should plan on an 800-900 foot deep well at this location. A shallower well could be constructed by moving toward the northeast (where the top of the Madison is at a higher elevation), but the savings in drilling costs might be negated by the cost of running electrical service and water lines to/from an alternative location. Also, the topography rises toward the northeast partially offsetting the savings due to moving updip.

As an example, a well near the water storage tank might encounter the top of the Madison at 3500 feet msl and the land surface is at about 3900 feet msl. If we allow for drilling 200 feet into the Madison, a well at the storage tank would need to be about 600 feet deep (3900-3500+200). A compromise might be to drill a well at lower elevation in the campground. Then the land surface at the well would be about 3750 feet msl and the elevation of the top of the Madison would be about 3450 feet msl and the well would need to be about (3750-3450+200) 500 feet deep. There are a lot of variations and it probably depends more on where the chlorination occurs, where there is electrical service, and long-term convenience for O&M procedures.





Water Supply Features at Horseshoe Bend

References

- Lowry, Marlin E., Hugh W. Lowham, and Gregory C. Lines, 1976, *Water Resources of the Bighorn Basin, Northwestern Wyoming*, U.S. Geological Survey Hydrologic Atlas HA-512, scale 1:250,000, 2 sheets
- Pierce, William G., 1997, *Geologic Map of the Cody 1°x2°Quadrangle, Northwestern Wyoming*, U.S. Geological Survey Miscellaneous Investigations Series Map I-2500, scale 1:250,000, 1 sheet
- Rawlins, Joe H., 1966, *Water Supply Report*, report to Bighorn Canyon National Recreation Area, Montana and Wyoming, 14 pp.
- Rawlins, Joe H., 1966, *Water Supply Report II*, report to Bighorn Canyon National Recreation Area, Montana and Wyoming, 19 pp.