

Hydrogeologic Assessment of the water-supply well at Cloverleaf Campground Lake Roosevelt National Recreation Area

Cloverleaf Campground is located on the eastern shore of Lake Roosevelt, about 25 miles south of Kettle Falls (Figure 1). The campground has 9 sites and is open all year long, but the water system is only available seasonally from June to September. The campground does not have flush toilets. The only source of water is from the hand pump on the well. Water from the well is piped through an iodine treatment system into an underground tank to provide some contact time. Water from the tank is piped back to the discharge spout of the hand pump.



Figure 1. Location of Cloverleaf Campground.

Water is supplied to Cloverleaf Cove campground from a 60-foot well that was constructed by the National Park Service in 2000. The well has the Unique Well ID # AHC128 in the WA Dept. of Ecology database. The location of the well is incorrect on the Water Well Report and the Department of Ecology database. The location is shown as NE¼, NW¼, Sec. 10, T32N, R37E. The correct location is SW¼, SW¼, Sec. 3, T32N, R37E.

The drillers log for the well shows;

Sand.....0 – 15 feet

Sand & gravel w/Water.....15-47 feet

Brown clay 47-60 feet

Well screen was placed from 42-47 feet, at the bottom of the water-bearing sand and gravel.

There are no overlying clay layers that would isolate the groundwater entering the well from the adjacent surface waters. The well is about 110 feet from the normal full-pool shoreline of the lake (Figure 2).

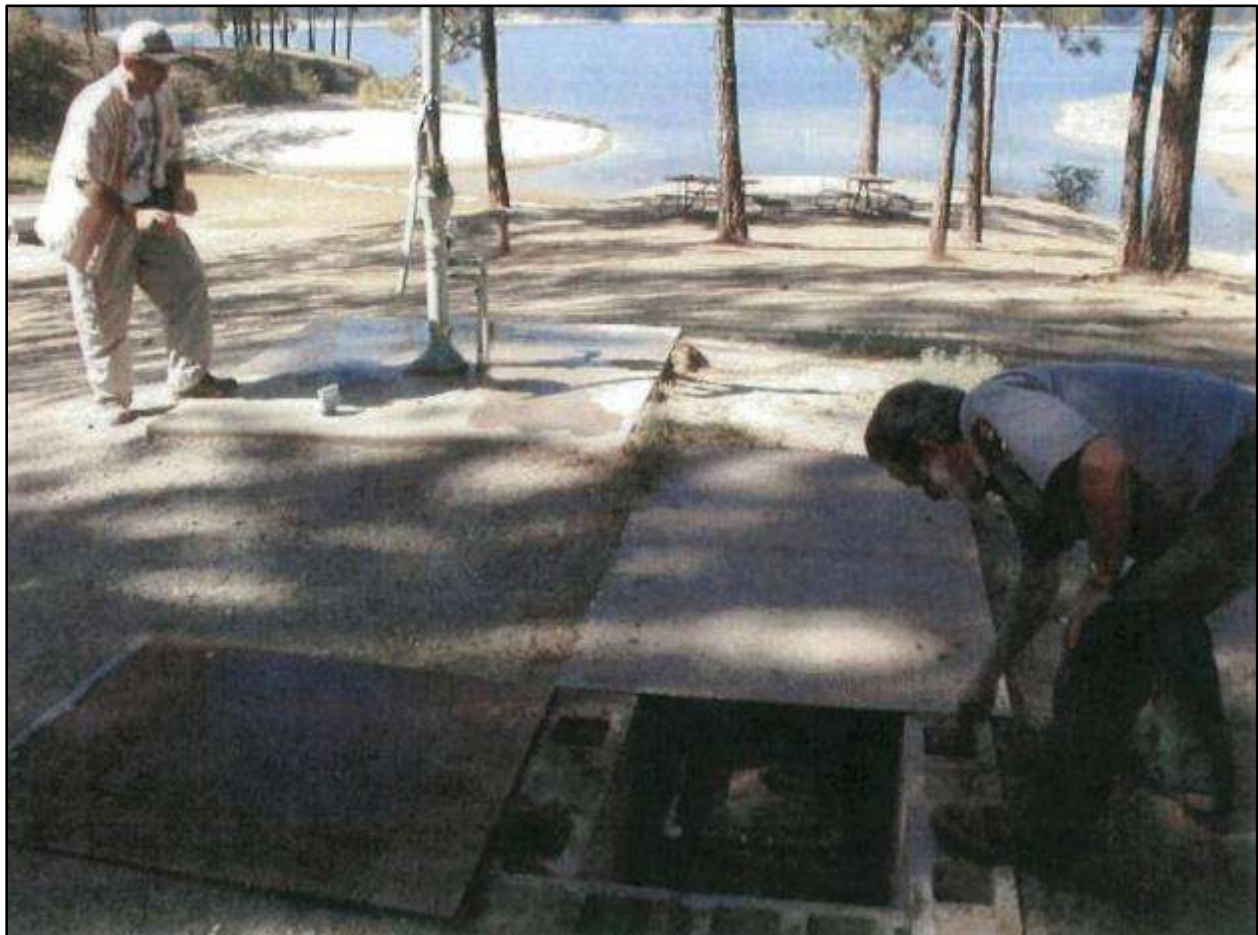


Figure 2. Cloverleaf campground hand pump and iodine treatment tank.

Water use at the campground is estimated to be no more than a couple hundred gallons per day. For example, if usage is 20 gallons per day per campsite and all of the campsites are occupied, then the total usage (9 sites) would be 180 gallons per day. Pumping from the well is not great enough to induce rapid flow of water from the reservoir to the well. However, park staff have noted in the past that the water level in the well varies with the water level in the reservoir. Thus, it is obvious that groundwater pumped from the well is recharged by lateral infiltration from the reservoir.

Geology

The well at Cloverleaf campground is on a small peninsula jutting into a small embayment (Figure 3). The well is on a low-lying terrace between the river and Hwy 25. A higher terrace occupies much of the area between the highway and the bedrock outcropping of the mountains rising to the east. The geologic map of the area shows the location of the well on the lowest terrace, near the river (Figure 4).



Figure 3. Google Earth view of the Cloverleaf Campground area.



Figure 4. Surficial geology in the vicinity of Cloverleaf campground.
 From NPS Geologic Resources Inventory Program. (2009).

Geologic units near Cloverleaf campground shown on Figure 4.

Qa2/Qlz - Quaternary alluvial fan deposits over Quaternary lacustrine clay and/or silt interbedded with sand

Qem/Qls/Qog/Qlz - Quaternary eolian silt over Quaternary lacustrine sand overlying Quaternary outwash gravels (fine gravel to cobbles) overlying Quaternary lacustrine clay/silt

Qls/Qog/Qlz - Quaternary lacustrine sand over outwash gravel (fine gravel to cobbles) over Quaternary lacustrine clay and/or silt interbedded in sand

Ou – Ordovician bedrock, undivided

The material comprising the terraces in this area are likely largely derived from sediments transported down Stranger Creek and deposited as delataic deposits where Stranger Creek entered the larger valley of the Columbia River.

Snook and others (1990) described the geology of the terraces in more general terms, lumping them into a single unit they called Quaternary surficial deposits – glacial debris and related lacustrine deposits, alluvium, and colluvium.

Previous Drilling and Well Construction

Review of other well logs in the area (from the Dept of Ecology database) showed that most wells were drilled deeper and encountered layers of sand, gravel, and clay, indicating that the unconsolidated deposits continue to greater depth.

Previous to constructing the well in 2000, water for the campground was obtained from a 30-foot well that was jetted into silt and fine sand deposits by NPS in 1956.

Several wells have been constructed in a similar hydrogeologic setting by NPS at the Gifford campground, about ¾ mile south of Cloverleaf. One of the wells was deemed to have a potential yield of 1,000 gpm (Anderson, 1969).

Alternative Water Sources for Cloverleaf Campground

It is likely that a deeper well could be constructed in the campground area that would obtain water from greater depth. Additionally, locating a new well farther from the reservoir (and drilling deeper) would lessen concerns about groundwater interconnection with the surface water of the reservoir. Neither of these alternatives would alleviate the concerns regarding the potential for groundwater in the area to be hydraulically connected with surface water in the reservoir.

Conclusions

Groundwater pumped from the well at Cloverleaf campground is most likely from lateral infiltration of water from the reservoir into the sediments underlying the area. The well is dry when the water level in the reservoir is low, providing a fairly good indication that the reservoir is the source of water for the well. Therefore, we must assume that the water pumped from the

well is hydraulically connected with the adjacent surface water. MPA tests should be conducted to determine the degree of filtration that occurs as the water flows from the reservoir to the well.

References

- Anderson, Henry W., 1969, *Water Supplies for Coulee Dam National Recreation Area*, Washington, U.S. Geological Survey Open-File Report OFR-69-8, 141 pp.
- Kiver E.P. and Stradling, D.F., 1995, *Geology of the Franklin D. Roosevelt Reservoir Shoreline: Glacial Geology, Terraces, Landslides, and Lineaments*, report to Bureau of Reclamation (BOR), 148 p., 21 geologic maps, scale 1:24,000 or 1:62,500
- NPS Geologic Resources Inventory Program. 2009. Digital Surficial Geologic Map of the Bangs Mountain quadrangle, Washington (NPS, GRD, GRI, LARO, BAMO digital map). NPS Geologic Resources Inventory Program. Lakewood, CO. Geospatial Dataset-1047534.
- Snook, J. R.; Campbell, A. B.; Lucas, H. E.; Abrams, M. J.; Janzen, John; Smith, Bruce, 1990, *Geologic map of the Inchelium Quadrangle, Stevens and Ferry counties, Washington*, USGS Miscellaneous Field Studies Map: 1752

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