

Hydrogeologic Assessment of the water-supply well at the Haag Cove Campground, Lake Roosevelt National Recreation Area

Haag Cove Campground is located on the western shore of Lake Roosevelt, about 5 miles southwest of Kettle Falls (Figure 1). The campground has 16 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.

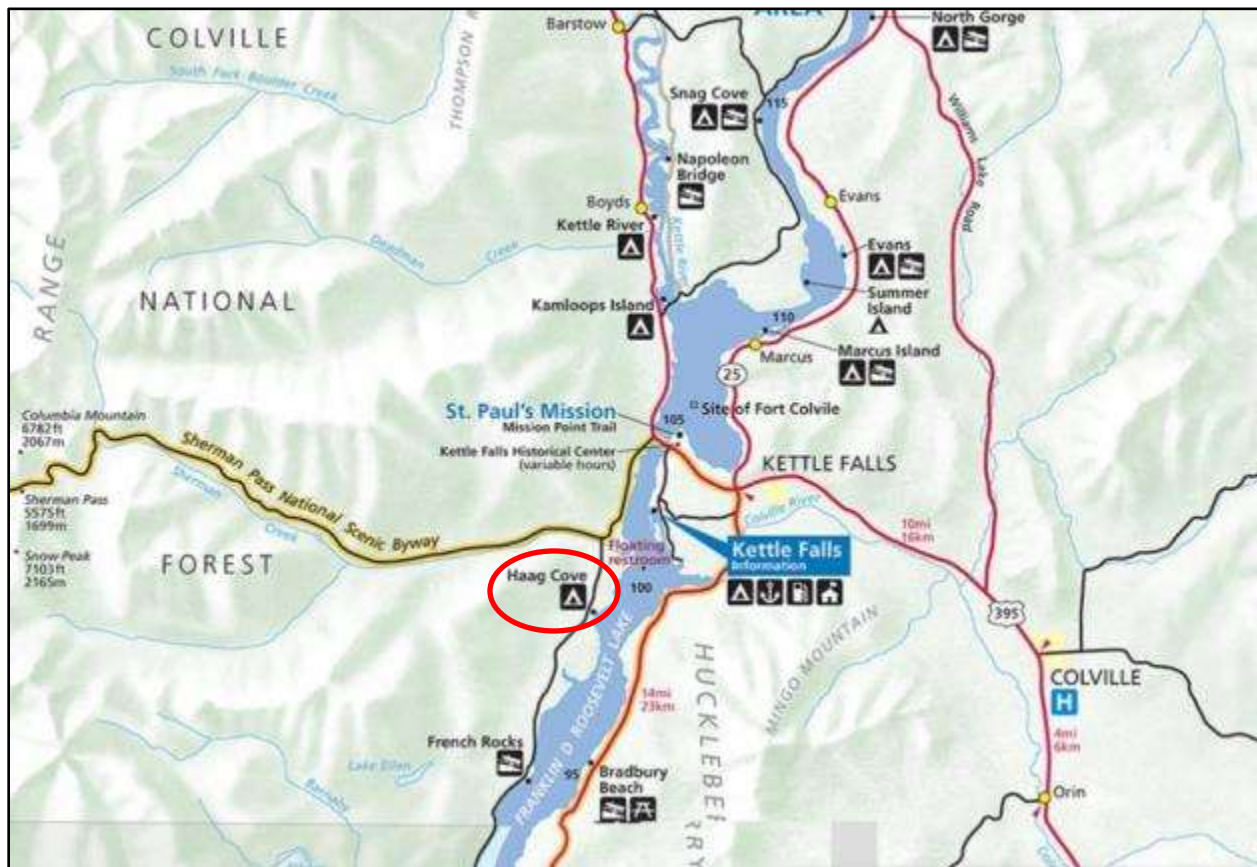


Figure 1. Location of Haag Cove Campground.

Water is supplied to Haag Cove campground from a 25-foot well that was jetted by the National Park Service in 1956. There is no geologic log for this well. There is no record of the well completion or method of construction. There is no record of this well in the WA Dept. of Ecology database. The well is about 110 feet from the normal full-pool shoreline of the lake (Figure 2).



Figure 2. Hand pump on well at Haag Cove campground.

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 would be 320 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 campground area at Haag Cove overlies an ancient slump of glaciolacustrine deposits at the southernmost part of the Reed Terrace (Figure 3). The slumped area at the lowest elevation near the river was subsequently covered by alluvial sediments. The former terrace deposits were jumbled during the slumping, resulting in at least some degree of higher permeability.

Groundwater in the slump block is most likely from lateral infiltration of water from the river. The sedimentary deposits underlying Reed Terrace have been shown (by construction of private wells in the area) to have low permeability and little groundwater, and thus are unlikely to be a significant source of groundwater recharge to the slumped sediments at the campground.

The geology of the terrace area can generally be described as having a thin veneer of eolian sand overlying a layer of outwash, which is underlain by lacustrine clay and silt (Kiver and Stradling, 1995). Wilson more generally describes the terraces as Pleistocene Outwash, comprised of loosely consolidated, moderately-sorted sand and gravel deposits.



Figure 3. GoogleEarth view of the Haag Cove campground, looking north. The flat area to the north is Reed Terrace. The bowl shaped area around (black, dashed line) the well is an ancient slump of glaciolacustrine deposits.

Jones and others (1961) conducted detailed investigation of the geology of the Reed Terrace area which generally includes the flat terraces to the north of Haag Cove campground and into the Sherman Creek area. They conclude that the terraces are underlain by several tens of feet of sand and gravel (glacial outwash) which rests disconformably on varved silt and clay. The varved silt and clay are thin, alternating layers of silt and clay that were deposited in a lake environment, quite likely one of the glacial lakes that were formed by ice dams on the Columbia River. Subsequently, sand and gravel were deposited over the silt and clay layers during flood and runoff events when the glaciers were melting and receding. The primary source of the sand and gravel was sediment carried by Sherman Creek. The sand and gravel were deposited somewhat as an alluvial fan spreading southward from the mouth of the creek. Most of the sand and gravel

sediments were deposited on the terrace north of Haag Cove Campground, only a thin veneer of the coarser sediments occur as far south as the campground. The natural layering of the clay, silt, sand, and gravel has been disrupted by slumping of the material in the immediate vicinity of the campground during a landslide in the recent geological past. Data from a seismic refraction survey of the area provide an estimated depth to bedrock at the campground of about 300 feet (Jones and others, 1961).

The Geologic Resources Division of NPS compiled geologic maps from various sources to produce a GIS-based geologic map of the entire area of Lake Roosevelt National Recreation Area. A detailed geologic map of the Haag Cove area, extracted from the parkwide map, is provided in Figure 4.

Geologic units shown on Figure 4.

Qa - Quaternary alluvium

Qs - Quaternary slump earth flow

Qes/Qog/Qlz - Quaternary eolian sand over Quaternary outwash (mostly coarse gravel to cobbles) over Quaternary lacustrine clay and/or silt interbedded with sand

PZu – Paleozoic bedrock, undivided

Locally at Haag Cove, we would expect a well to encounter a jumbled mix of gravel, sand, silt, and clay, resulting from a large slump that occurred prior to European settlement of the area. Those sediments have higher permeability than the in-situ sediments underlying Reed Terrace. Water wells drilled within the slump area in the campground have a good chance of yielding sufficient water for use at the campground. Unfortunately, these wells (and the existing well) are likely to draw groundwater that is recharged by lateral infiltration from the adjacent reservoir.

As an alternative, a well could be drilled on Reed Terrace, to the north of the campground, to obtain groundwater that has less hydraulic connection with the reservoir. However, other wells drilled in that area are not very productive.

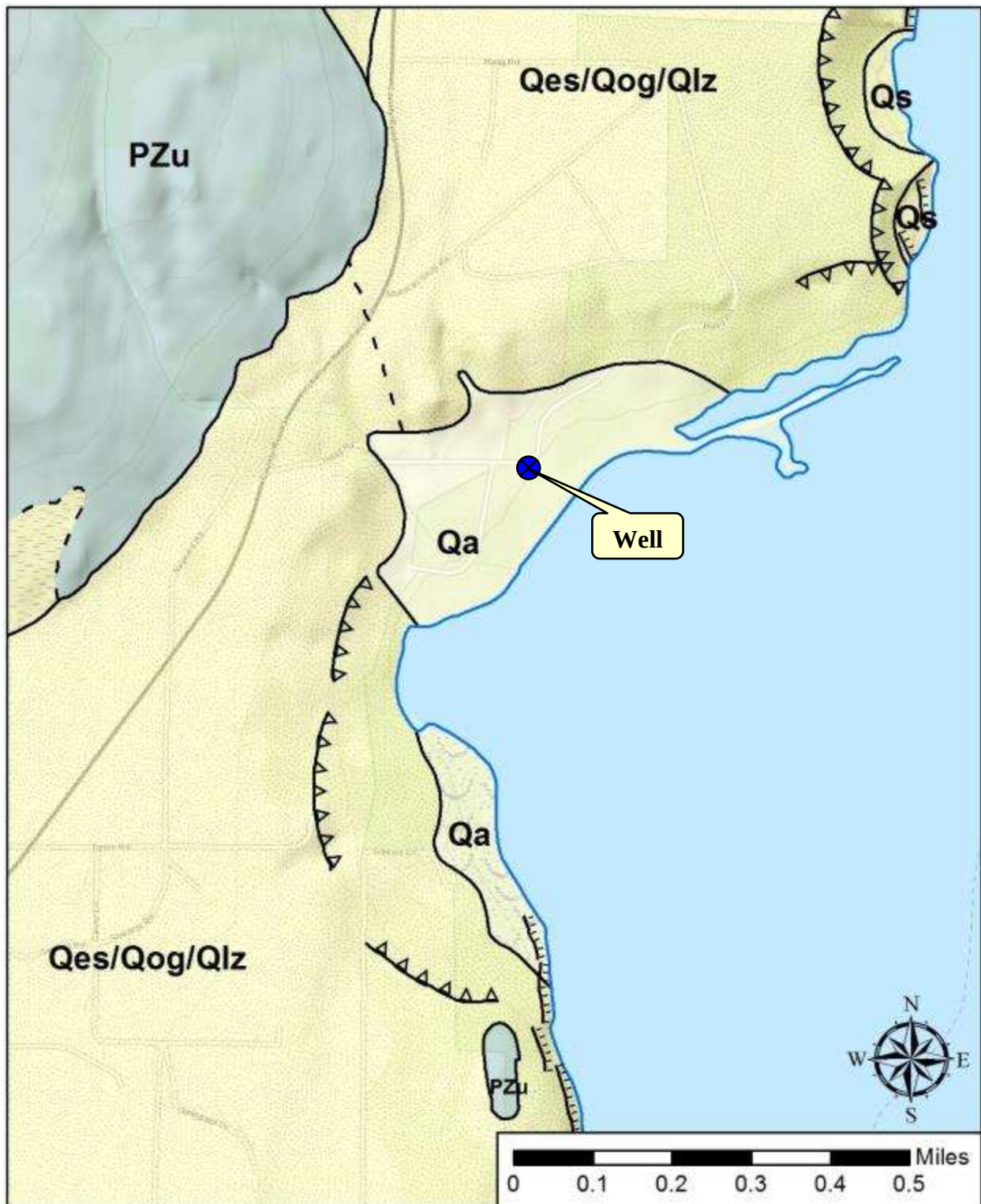


Figure 4. Geologic map of the Haag Cove area.
From NPS Geologic Resources Inventory Program. (2009).

Previous Drilling and Well Construction

The depth of the sand and gravel in the campground area was explored by two auger holes that were drilled by the USGS in 1967 (Anderson, 1969). Both auger holes encountered layers of gravel and sand interlayered with silt and clay. A 4-inch casing, with perforations between 38 and 44 feet, was installed to a depth of 44 feet in the more southerly auger hole. The well was test pumped at 25 gpm for 1 hours and the drawdown was only 0.32 foot. The chemical quality of the water from auger hole 1 is excellent. There is no record of testing the yield or quality of water from auger hole 2. Although it was noted that the geologic log of the well looked promising for developing a well completed in the sandy layers. See attached map and logs.

Dept. of Ecology records for private water wells on land adjacent (primarily north and west) from Haag Cove show that groundwater in the area is scarce. Much of the geologic material encountered during drilling these wells was silt and clay. Several of the well completion reports show that there was not a measurable yield after drilling 500 feet.

Alternative Water Sources for Haag Cove

A deeper well could be drilled in the campground. Such a well would be constructed in the same geologic materials and the same aquifer as the existing well. It would be subject to the same concerns as the existing well regarding infiltration of surface water from the adjacent reservoir. The advantage to constructing a new well would be that the well screen could be placed deeper and the surface seal could extend deeper. However, contamination infiltrating from the surface is not the main concern, rather it is lateral infiltration from the reservoir and that wouldn't be addressed by drilling a deeper well.

A well could be constructed on the south end of Reed Terrace in the area north of the Haag Cove slump block. A well in this area would be more distant from the reservoir and would be constructed in sediments that are not as well-connected hydraulically with the reservoir. Previous construction of private wells in the area has not resulted in productive wells. It would also be necessary to construct a water line from the well to the campground. The water line would be maybe a half mile long.

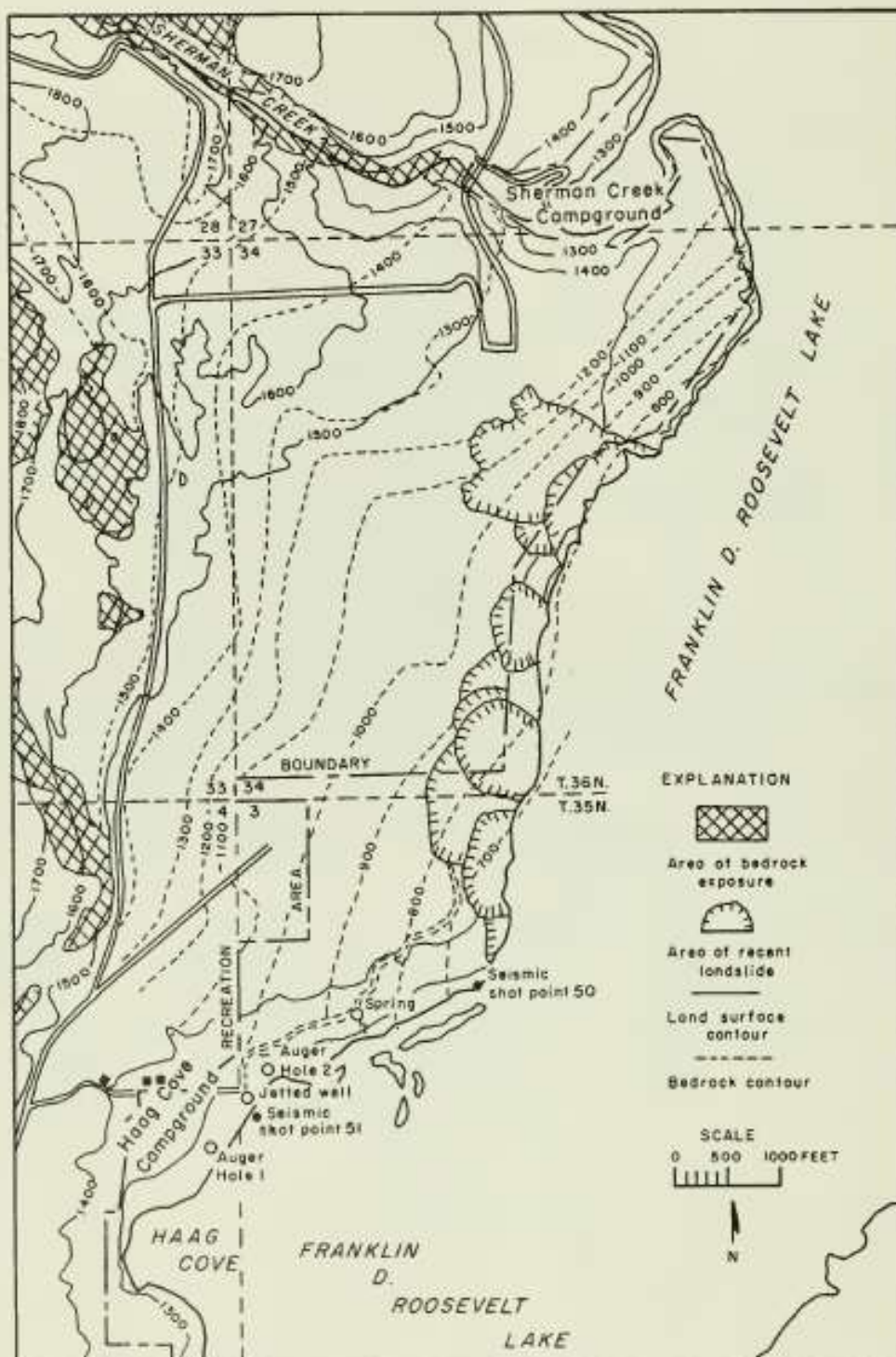


FIGURE 25.--Haag Cove campground and Sherman Creek campground (Nos. 25 and 27 on fig. 1). Land-surface and bedrock-surface contours are shown. Bedrock exposure and landslide areas are indicated. Map from "Geologic map of Reed Terrace area, Washington" (Jones, 1961, pl. 1).

TABLE 14.--Logs of two auger holes at Haag Cove campground.
Bored by U.S. Geological Survey, 1967

<u>Auger hole 1:</u> Altitude 1,296 ft; 4-inch casing to 44.1 ft; perforations 37.8 to 43.8 ft; water level 7.62 ft below land surface, 9-26-67; yield 25 gpm for 1½ hrs, drawdown 0.32 ft.		
	Thick- ness (feet)	Depth (feet)
Sand and gravel layers-----	30	30
Gravel, sandy; permeable zone indicated by low gamma radiation 36-47 ft-----	17	47
Sand, silty-----	3	50
Sand, most permeable zone indicated by low gamma radiation-----	7	57
Gravel, probably very permeable (no gamma log)-----	5	62
Clay-----	1	63
<u>Auger hole 2:</u> Altitude 1,295 ft.		
Sand, coarse, clayey-----	13	13
Silt and clay-----	6	19
Gravel, coarse, silty and clayey-----	6	25
Gravel, coarse, most permeable zone indicated by low gamma radiation-----	13	38
Gravel, coarse, silty-----	10	48

Geologic logs of two auger holes at Haag Cove (Anderson, 1969).
Locations of auger holes are shown on figure 25 from Anderson (1969).

Conclusions

Groundwater pumped from the well at Haag Cove 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

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