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Hydrogeology in the vicinity of a proposed wastewater disposal leachfield, Florissant Fossil Beds National Monument

NPS plans to construct a leachfield for wastewater disposal at a site approximately 1000 feet southeast of the visitor center. The area is underlain by sedimentary rocks of lake shale and volcanic tuff belonging to the Florissant Lake Beds Formation. The sediments are expected to be several tens to more than a hundred feet thick. The sediments partially fill a valley underlain by granitic bedrock. The same granite outcrops at higher elevations surrounding the valley.

Well and water sources inventory (1988)

Rick Inglis (retired NPS-WRD hydrologist) conducted an inventory of water sources at Florissant Fossil Beds in April 1988. The locations of water sources found by Rick are shown on Figure 1. Information for each of these sites is summarized in the following paragraphs.

NPS Spring No. 5 – A wet seep area was found at this location. There was broken concrete and old pipes at the site, indicating there had been a windmill at this location.

NPS Well No. 6 – This is a drilled well with 5½” casing. The well is 60 feet deep. The static water level in April 1988 was 8.5 feet below ground surface. The well was tested by pumping at 8 gpm for 130 minutes and 18 gpm for 600 minutes, resulting in maximum drawdown of 15 feet. The water pumped from the well was very black during most of the test. The water had an iron concentration of 2.8 mg/l and conductivity of 790 umhos.

NPS Well No. 7 – This is a drilled well with 5½” casing. The well is 92 feet deep. The static water level in August 1988 was 15 feet below ground surface. The well was tested by pumping at 11 gpm for 108 minutes and 16 gpm for 560 minutes, resulting in maximum drawdown of 7 feet. The water pumped from the well was very black during most of the test. The water had an iron concentration of 2.3 mg/l and conductivity of 640 umhos.

Ghist Well – This is a drilled well with 6” steel casing. The well is 143 feet deep. The static water level in June 1988 was 28 feet below ground surface. The well was tested by pumping at 3 gpm for 77 minutes, resulting in maximum drawdown of 111 feet. The water was rusty red throughout the pumping test. The water had conductivity of 500 umhos.

A-Frame Well – This is a drilled well with 6” steel casing at the surface and a 4½” PVC liner to the total depth of 250 feet. The well log shows that it was drilled into granitic bedrock starting at 12 feet and continuing to the total depth of 250 feet. The static water level in the well was 32 feet

below ground surface in June 1994. The well was tested by pumping at ½ gpm for 2 hours, resulting in pumping the well dry.

VC Well – This is a drilled well with 6” steel casing at the surface and a 4” PVC liner from 11-471 feet. It is believed that the well is drilled through mostly granitic bedrock. There may be some lake shale and volcanic tuff near the surface, but given its location and the topography, it’s likely that the well is mostly in granite. A driller’s log or geologic log for the well has never been found. The static water level was about 45 feet below ground surface in September 2009.

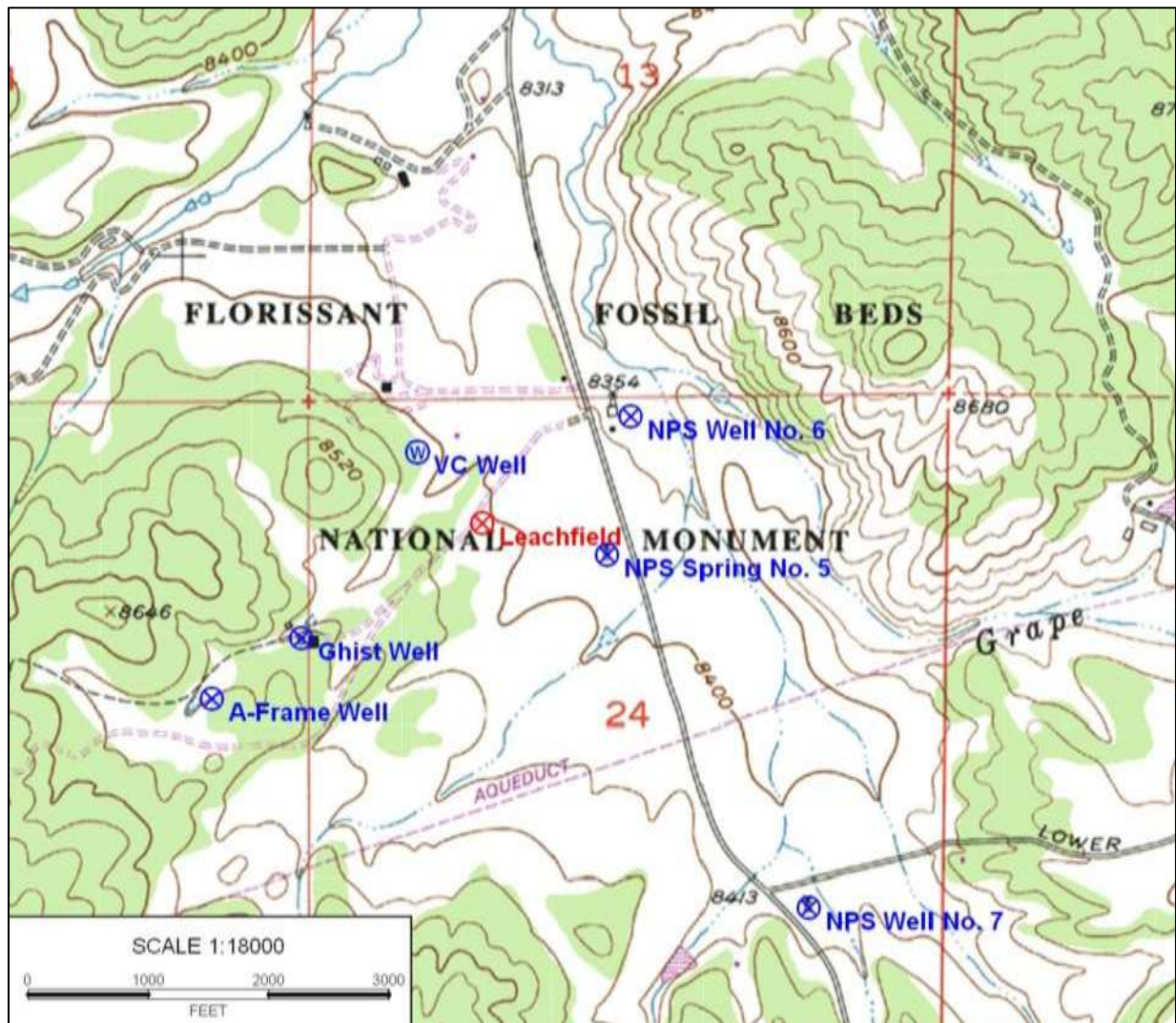


Figure 1. Map showing locations of wells and springs at Florissant Fossil Beds.

Geology

A geologic map of the Florissant 15-minute quad includes the area of the park (Wobus and Epis, 1978). The map shows that the main valley is underlain by lake-bed sediments and volcanic tuff. The valley is surrounded by, and underlain by, granitic bedrock. A portion of the geologic map is reproduced in Figure 2, along with the descriptions on the map units.

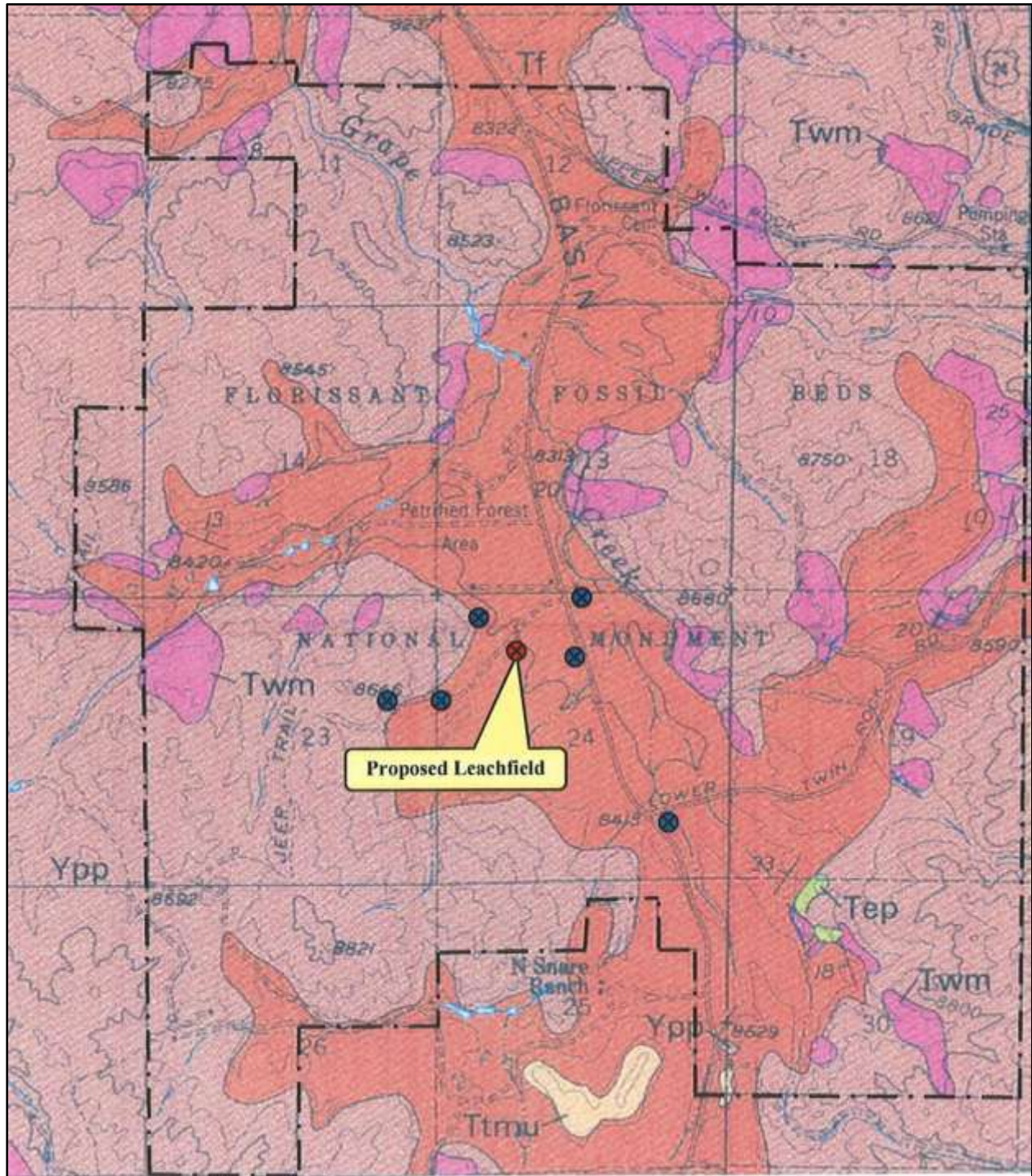


Figure 2. Geologic map of Florissant Fossil Beds National Monument.

Description of Geologic Units at Florissant Fossil Beds

Tt

FLORISSANT LAKE BEDS (OLIGOCENE)—Pink arkosic conglomerate, purple and gray andesitic tuff and volcanic mudflow breccia, light-colored laminated tuffaceous shale and mudstone, white pumiceous tuff, and gray volcanic conglomerate. Beds are generally horizontal, but locally dip moderately toward center of basin. Aggregate thickness less than 150 feet (50 m). Tuffaceous shale and mudstone beds near the middle of the sequence contain abundant plant and insect fossils; the underlying andesitic tuff beds and mudflows contain stumps and logs of fossilized *Sequoia* trees

Ypp

PIKES PEAK GRANITE (PRECAMBRIAN Y)—Pink to reddish-tan, medium- to coarse-grained, biotite or hornblende-biotite granite and quartz monzonite. Weathers to rounded boulders and coarse gravel. A part of the southwestern margin of the Pikes Peak batholith; dated by whole-rock Rb-Sr isochron as $1,041 \pm 13$ m.y. (Hedge, 1970)

Locations of wells shown on Figure 1 are repeated on the geologic map to aid in interpreting the geologic setting for each well. The A-Frame Well is constructed in granitic bedrock. The VC Well may penetrate a few tens of feet of lake-bed sediments before reaching the underlying granitic bedrock. The geology of the Ghist well is not known with certainty, but information from the pumping test in 1988 indicates it is likely completed in lake-bed sediments. The wells in the central part of the valley are completed in lake-bed sediments.

There are no data regarding the thickness of the Florissant Lake Beds Formation in the vicinity of the proposed leachfield. It seems reasonable to assume the sediments are at least 50 feet, and quite likely more than 100 feet thick in this part of the valley.

Five soil borings were drilled to a depth of 12 feet in the general vicinity of the proposed leachfield. Subsurface conditions encountered at the proposed infiltration area can be described as native soils consisting of sand with varying amounts of silt and clay.

Groundwater Flow and Monitoring Well Locations

There has been no detailed mapping of the water table surface or groundwater flow patterns in the vicinity of the proposed leachfield. Existing data and the distribution of existing wells is insufficient to provide reliable estimates of groundwater flow. We would surmise that the shallow groundwater underlying the site would flow in a north-northeasterly direction, toward the creek flowing down the valley.

Five soil borings were made in the vicinity of the proposed leachfield in April 2011. Each of the soil borings was drilled to 12 feet deep. None of the borings encountered groundwater. Thus, we know that the monitoring wells will need to be more than 12 feet deep.

We would expect the water table to slope toward the center of the valley and down the valley; generally in a northeast-north direction. Thus, the upgradient monitoring well should be southwest of the leachfield. The downgradient monitoring wells should be north and northeast of the leachfield. The proposed locations for upgradient and downgradient monitoring wells are shown on Figure 3. Additional monitoring wells may be needed pending the analysis of data from the initial monitoring wells.

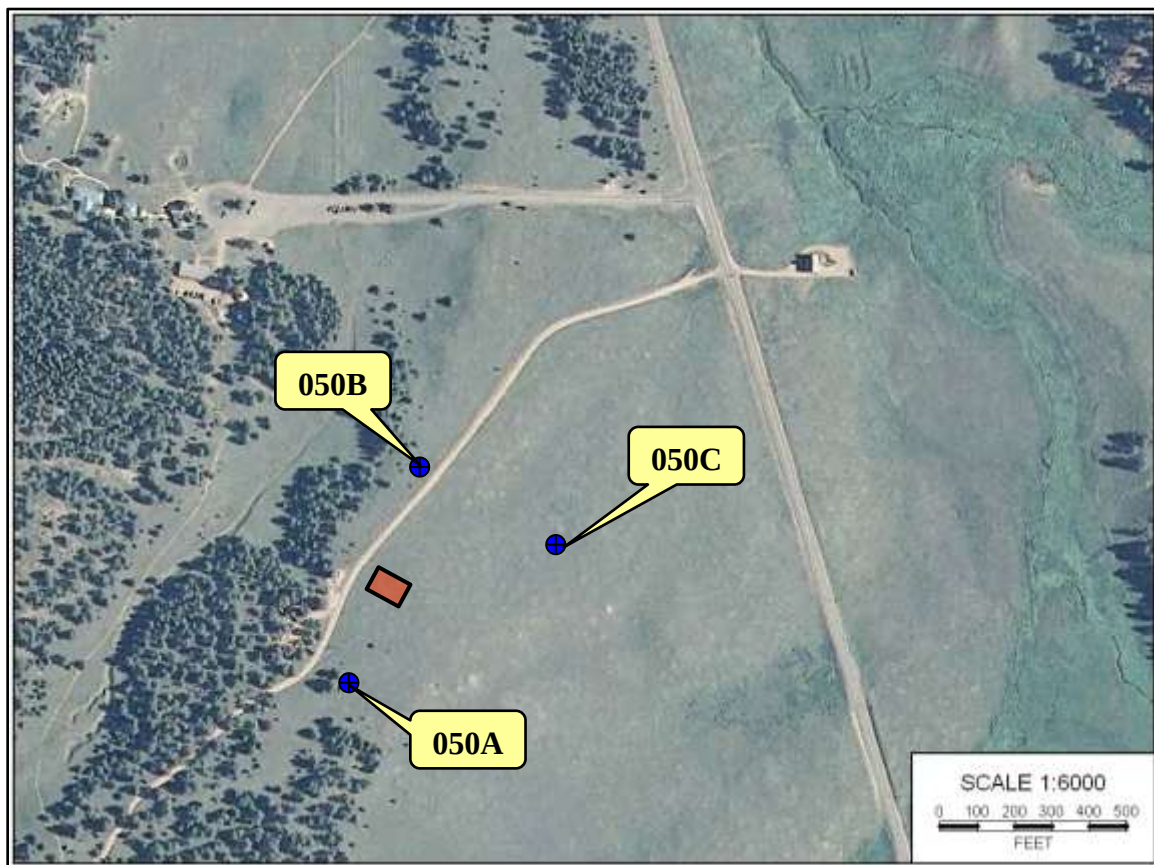


Figure 3. Locations of proposed monitoring wells and leachfield.

We would expect groundwater in the lakebed sediments to be recharged by infiltration in the upland areas and along the margins of the valley where runoff from the granite outcrops infiltrates into the sediments. Groundwater would then flow toward the creek in the center of the valley and down the gradient of the valley toward the north. Some portion of the groundwater will discharge to the creek. The depth to groundwater is expected to be small in the center of the valley, near the creek. Greater depth to groundwater would be expected as we move away from the creek and into the upland areas. Examination of images on GoogleEarth show more green grass in the lowland areas adjacent to the creek where the water table is close enough to land surface to support grass growth. Upland areas are more sparsely vegetated, and not as green, because the water table is below the root zone.

The depth to water at NPS Well No. 6, near the creek in the center of the valley, was measured at 8½ feet below ground surface. Depth to water at the Ghist Well, in an upland area near the margin of the valley, was measured at 28 feet below ground surface. Groundwater at NPS Spring No. 5 is at ground surface: it's a spring, or maybe more correctly termed a seep. (It would have been common practice for a rancher to construct a shallow well and windmill for stock watering at a site where a seep indicated that groundwater was present at shallow depths.) Depth to groundwater at the NPS visitor center well is not a good indicator of potential depth to groundwater at the leachfield as that well is likely constructed in a different geologic formation (granite). Thus, it is reasonable to estimate the depth to groundwater at the leachfield at more than 12 feet and less than 25 feet below ground surface.

References

- Wobus, Reinhard A., and Rudy C. Epis, 1978, *Geologic Map of the Florissant 15-minute quadrangle, Park and Teller Counties, Colorado*, U.S. Geological Survey Miscellaneous Investigations Map I-1044.
- Terracon Consultants, Inc, 2011, *Geotechnical Engineering Report*, Florissant Fossil Beds National Monument, Project No. 23115005, 51 pp.