APPENDIX D.

HYDROLOGY

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HYDROLOGY INFORMATION

This write-up is not intended to provide a comprehensive evaluation of the hydrology associated with the Pack River, or the operation of water levels within Lake Pend Oreille, but provide basic information as collected from the previous projects and public sources. It is especially important for the Contractor to have a full understanding of the water levels fluctuations that can occur. No specific site data for hydrology was collected other than periodic water levels encountered during topographic surveying.

Background

Located in north Idaho, the Pack River is the second largest tributary to Lake Pend Oreille and is fed by a number of tributary watersheds including Grouse and Rapid Lightning Creek. From its headwaters at Harrison Lake on the Selkirk Crest, the river flows approximately 45 miles through forested and agricultural lands to Lake Pend Oreille (see Figure 1). The water levels at the project site are primarily controlled during the summer months by the operation downstream at the Albeni Falls dam (AFD) controlled by the US Army Corps of Engineers (USACE) although water levels at the project site can change daily due to local runoff from weather changes during the period of low lake pool.

The Pack River delta is located where the Pack River enters Lake Pend Oreille just south of the Highway 200 bridge. The operation of AFD has flooded much of the land that was historically hayland and raised the water table in the area resulting in altered hydrology. Higher summer levels of Lake Pend Oreille resulted in the lower five miles of the Pack River being inundated for a period of about six months, from May to November. The existing ground elevations within the project boundaries on areas to be raised varies but generally is between elevation 2056 and 2057 which is approximately 5-7 feet below summer pool elevation (2062.5). Elevations down to 2051 have been measured for the main channel of the Pack River through the project site reach. Secondary channel elevations within the project site are generally in the 2053 to 2055 range.

Lake Pend Oreille levels can fluctuate due to sustained wind or high inflow/floods can occur periodically. Typically, periods of increasing or high inflow upstream of Albeni Falls Dam (AFD) are correlated with air temperature. This is due to the relationship between storms, which increase the inflow, and warmer air. When the air temperature is cold enough to promote freezing conditions, the local weather is often clear with low potential for precipitation. If there is precipitation, it typically falls as snow which would not raise inflow. It is thus unusual for there to be rapidly increasing inflow with below freezing conditions, although it does occur.

The USACE operates Albeni Falls Dam (AFD) on the Pend Oreille River near the Washington border well downstream of the project area. The majority of inflow and outflow of Lake Pend Oreille is regulated by hydroelectric facilities along the Clark Fork River. No control projects are along the Pack River. AFD was constructed in 1952 and impounds 28 miles (45 km) of the Pend Oreille River and regulates the lake's elevation between 2051 feet above mean sea level (msl) (winter) and 2062.5 msl (summer). The dam impounds and regulates the top 11.5 feet of Lake Pend Oreille as

well as approximately 25 miles of the Pend Oreille River downstream of the lake outlet. The minimum authorized lake elevation is 2049.7 feet. The normal high pool is elevation 2062.5 feet. Winter drawdown generally begins near September 15. Minimum pool (2051 msl) is normally reached between November 15 and December 1, with a target date of November 15 to facilitate kokanee salmon spawning. For general USACE operational charts see Figure 2.

Photo 1 is a 2024 image of the project site during low lake level water condition. In the photo, most of the water has receded from the project area except for flows in the main channel of the Pack River to the east and some low-lying areas and secondary channels.

Hydrology

The Pack River watershed above the Highway 200 bridge is approximately 183,300 acres in size. There is currently a USGS stream gage (12392300) near Colburn ID which measures 77,700 acres or 42% of the area above the Highway 200 bridge (see Figure 1). Flows in Pack River generally are the highest in the spring (April, May, June) with low flow during later summer months (August, September). Hydrographs for the Colburn gage for 2023, and 2018 are provided in Figures 3 and 4, respectively. Notice there are periodic spikes in both of these hydrographs in the fall and winter. It is not unusual to have periodic high flows during periods of rain-on-snow episodes and warmer weather earlier than the typical spring runoff period. There is a fair amount of lower ground in the watershed that can contribute to early quick runoff and early flooding.

Table 1 provides the Peak Flow statistics for the gage at Colburn and Table 2 is based on the USGS Streamstat program for the watershed above Highway 200. Table 2 provides the flow value that is exceeded 50% of the time.

Annual lake hydrographs are shown in Figures 3 and 4 for the lake levels (gage at Hope, Idaho). Figure 5 provides more detail of the fall drawdown timing. As mentioned above, typically, the lake is held at 2062.5 during the summer months and then drawdown beginning mid-September to approximately 2051 by mid-November and held at 2051+-during winter months. BPA has implemented, through the Corps, a flexible winter power operation (FWPO). The FWPO allows the lake to be filled or drafted up to several times from January to March between elevations 2051-2056 depending on availability of inflows and expectations of future power benefits. Contractor should check with USACE Reservoir Operations regarding upcoming FWPO.

Table 1. Peak Flow Statistic for USGS gage near Colburn, ID

Peak-Flow Statistics- USGS Gage		
Statistic Name	**Return Interval, Yr.**	**Flow, cfs**
50-percent AEP flood	2	2610
20-percent AEP flood	5	3510
10-percent AEP flood	10	4140
4-percent AEP flood	25	4950
2-percent AEP flood	50	5570
1-percent AEP flood	100	6210
0.5-percent AEP flood	200	6870
0.2-percent AEP flood	500	7790

Table 2. Flow Exceedance Values for 50% of the time at Highway 200 based on Streamstat.

Annual Flow Duration Statistics	**Exceedance %**	**Flow, cfs**
January	50 Percent Duration	128
February	50 Percent Duration	134
March	50 Percent Duration	209
April	50 Percent Duration	529
May	50 Percent Duration	939
June	50 Percent Duration	577
July	50 Percent Duration	166
August	50 Percent Duration	63.1
September	50 Percent Duration	53.8
October	50 Percent Duration	74
November	50 Percent Duration	122
December	50 Percent Duration	134

Additional Data Sources/References

USGS Gaging station at Colburn for the Pack River and at Hope, Idaho for Lake Pend Oreille.

USGS Current Conditions for USGS 12392300 PACK RIVER NR COLBURN ID USGS Current Conditions for USGS 12392500 LAKE PEND OREILLE NR HOPE, ID

National Weather Service Advanced Hydrologic Prediction Service. Provide lake level forecast for the Pack River @ Colburn and Lake Pend Oreille at Hope

https://water.weather.gov/ahps2/hydrograph.php?wfo=otx&gage=paki1

https://water.weather.gov/ahps2/hydrograph.php?wfo=otx&gage=hopi1

US Army Corp of Engineers, Reservoir Control Center. Operational control over Lake Pend Oreille water levels.

http://www.nwd-wc.usace.army.mil/nws/hh NRCS NWCC.

Water Supply Forecast, Snowpack, etc

https://www.wcc.nrcs.usda.gov/ Bonneville Power

Administration Final EA, 2011

https://www.bpa.gov/efw/Analysis/NEPADocuments/nepa/AFD-FWPO/AFD_FWPO_Final_EA.pdf

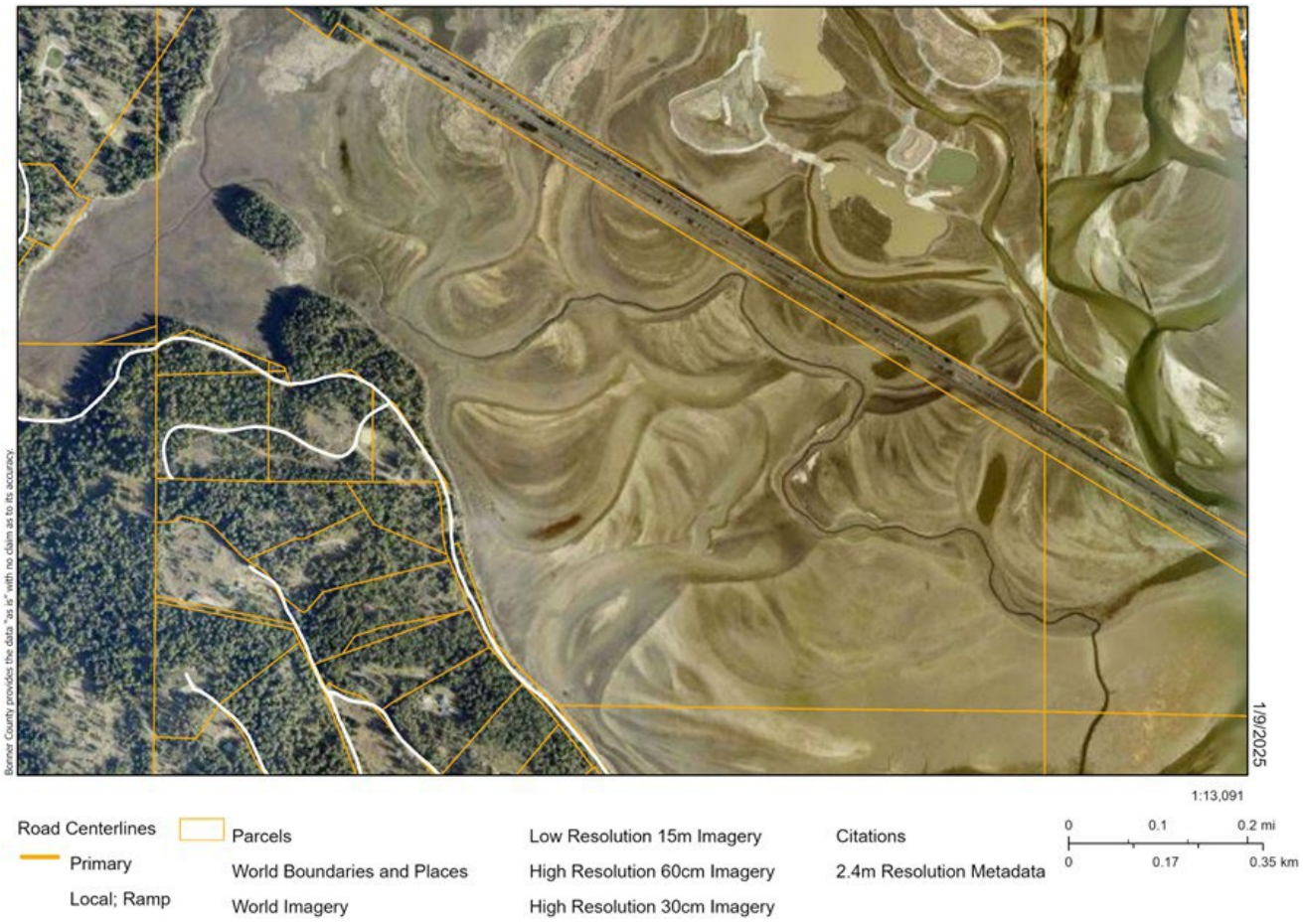

Photo 1. 2024 low water imagery of project site southwest of railroad trestle. Railroad trestle in upper part of photo.

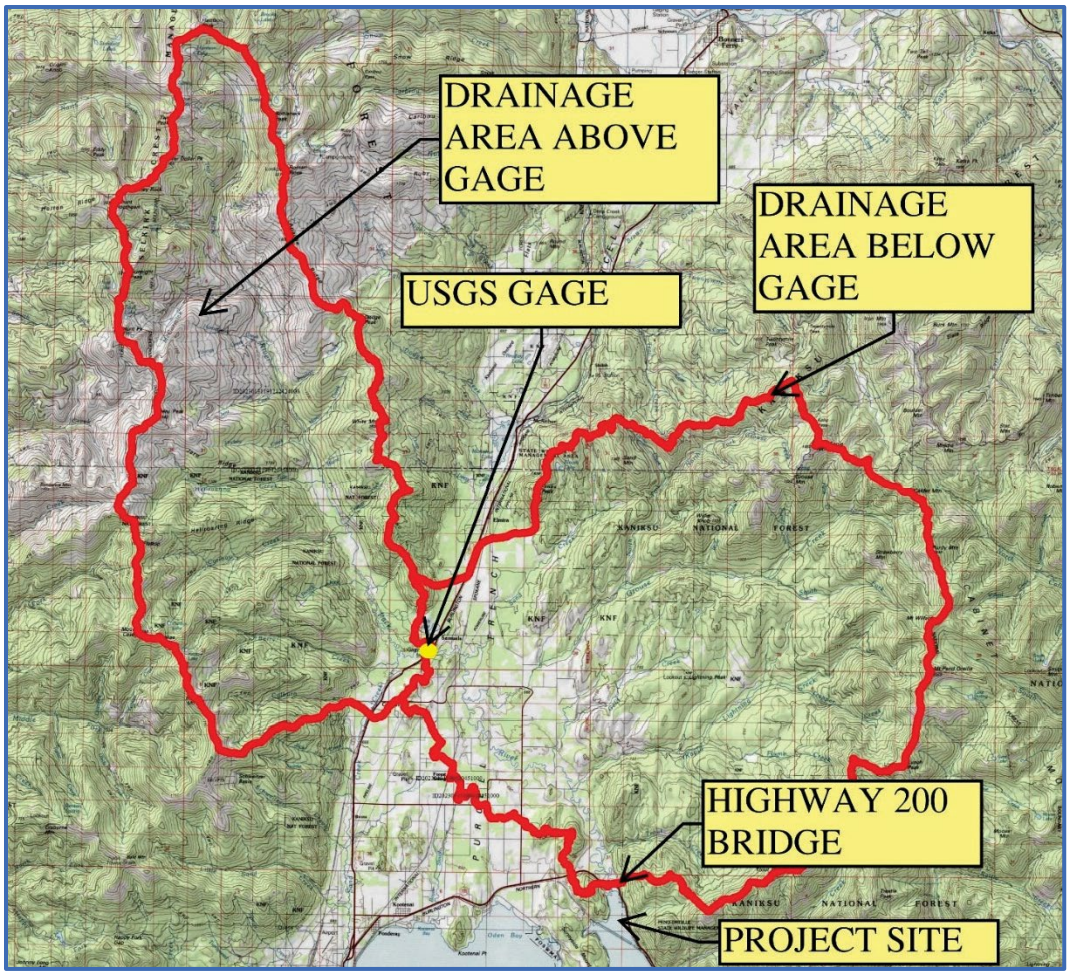

Figure 1. Pack River Watershed above Highway 200, gaging location, and project site.

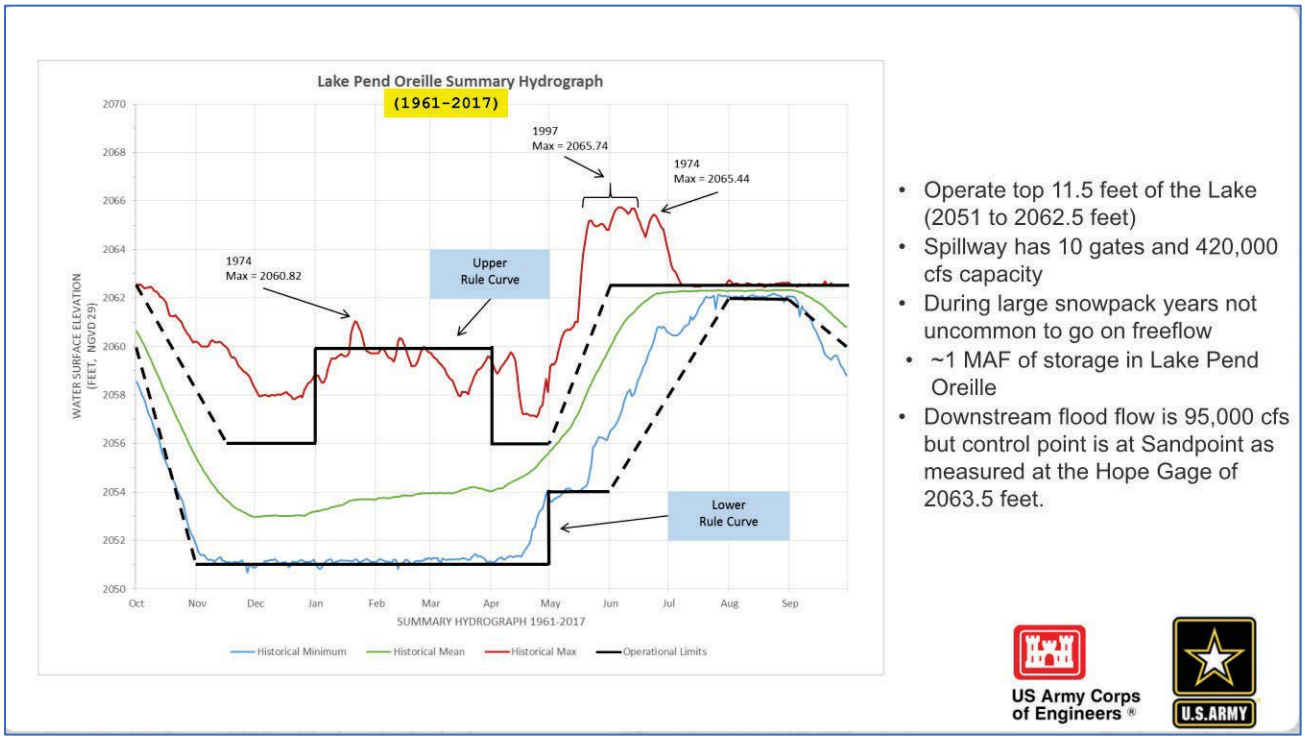

Figure 2. Typical USACE Operation for Lake Pend Oreille.

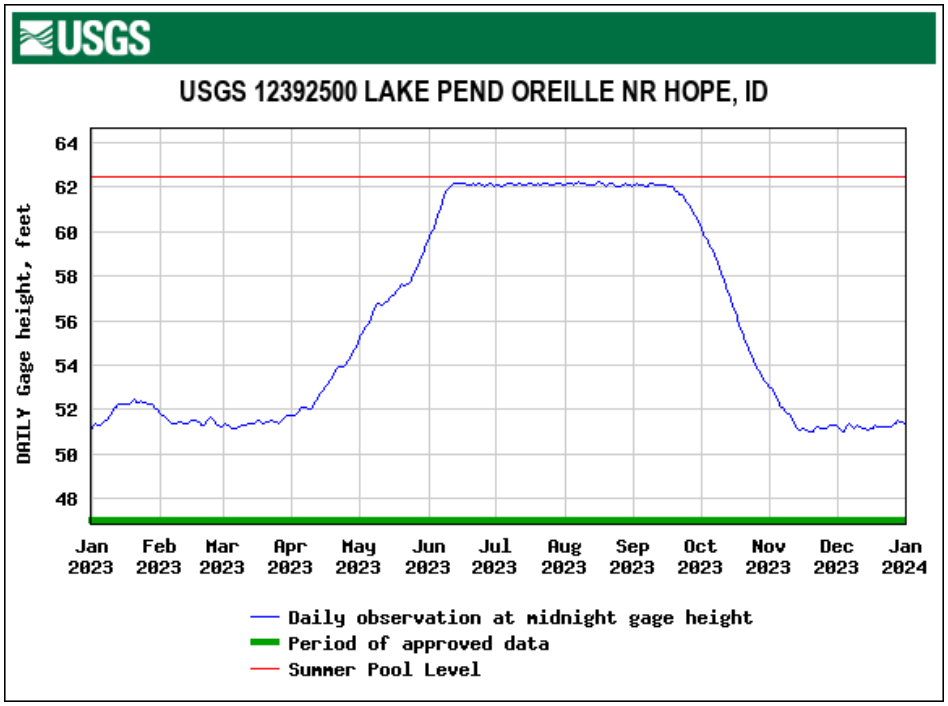

Figure 3. Hydrograph for Pack River at Colburn gage 01-01-2023 to 01-01-2024.

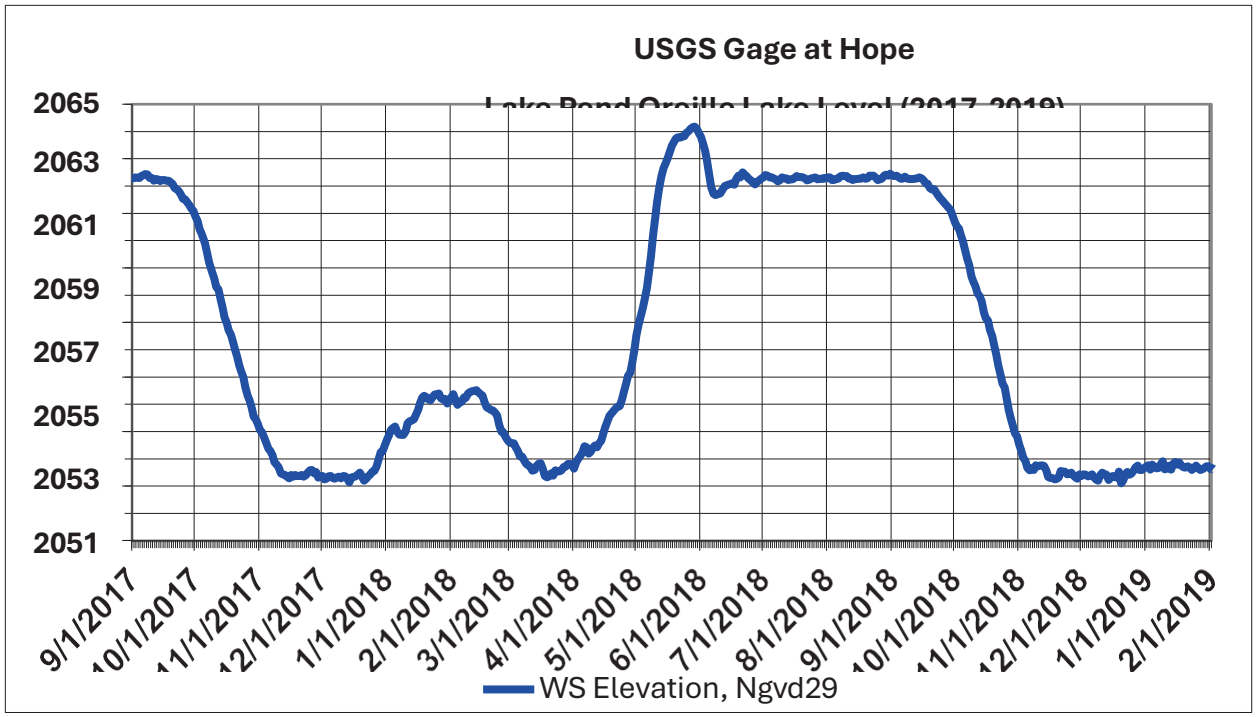

Figure 4. Lake Pend Oreille hydrograph 2017-2019 for USGS gage at Hope, Idaho.

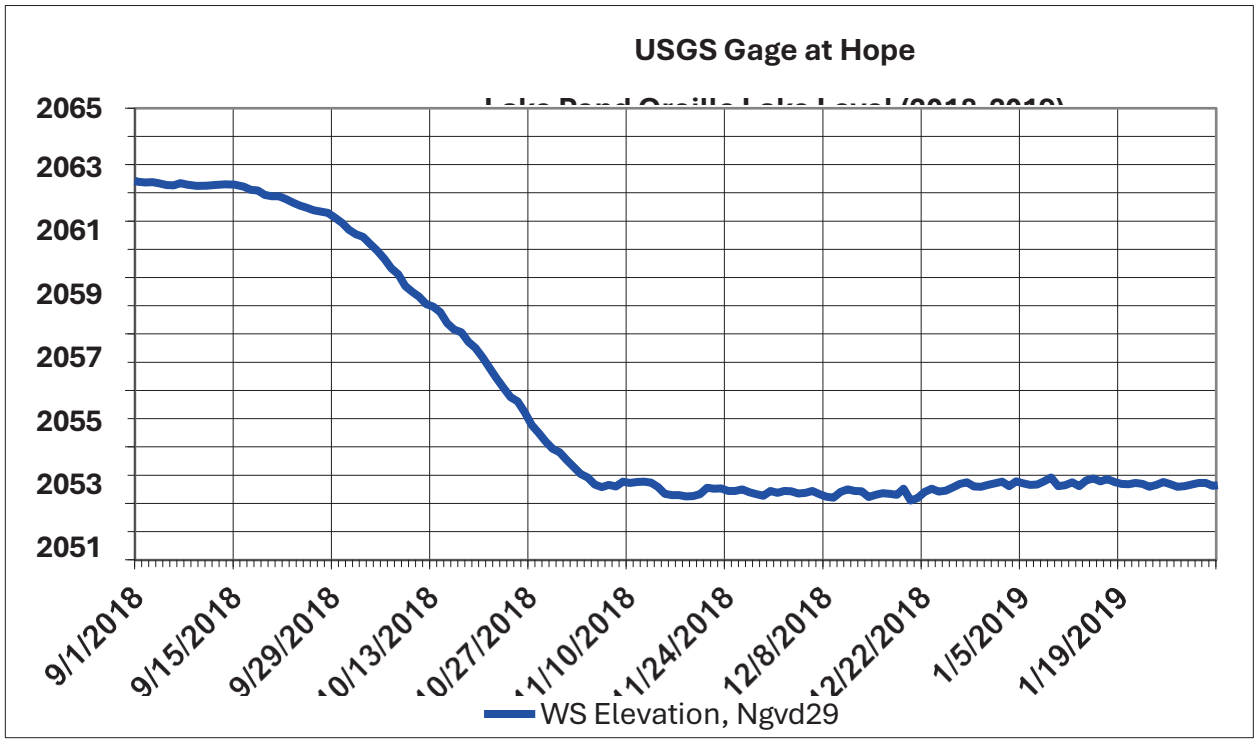

Figure 5. Lake Pend Oreille fall drawdown hydrograph for 2018 for USGS gage at Hope, Idaho.