Revelstoke Reservoir and Dam. Photo by Brandon Mercer.

Columbia River Operations Summary

Spring 2023

This publication provides an overview of BC Hydro's operations on the Columbia River. At 2,000 kilometres long, the Columbia River is the fourth largest river in North America. The headwaters of the Columbia River are in Canal Flats, British Columbia (B.C.). The river then flows northwest through the Rocky Mountain trench before heading south through B.C. and Washington, emptying into the Pacific Ocean at Astoria, Oregon. Other major tributaries of the Columbia River in Canada include the Kootenay and Pend d'Oreille rivers.

Only 15% of the Columbia River basin lies in Canada. The Canadian portion of the basin is mountainous, receives a lot of snow, and produces, on average, 30% to 35% of the runoff for Canada and the United States (U.S.) combined. The river's large annual discharge and relatively steep gradient gives it tremendous potential for generating electricity. The hydroelectric dams on the Columbia's mainstem and its many tributaries produce more hydroelectric power than on any other North American river.

BC Hydro's facilities in the Columbia basin include 13 hydroelectric dams, two water storage dams, and a system of reservoirs. Four of the larger reservoirs within Canada are operated according to the Columbia River Treaty and other agreements signed between Canada and the U.S.

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BC Hydro's operating agreements

COLUMBIA RIVER TREATY

The Columbia River Treaty between Canada and the U.S. was ratified in 1964. The Treaty resulted in the construction of three dams in British Columbia (Duncan, Hugh L. Keenleyside and Mica) for flood control and to increase hydroelectric generating potential in both countries. The Treaty also provided for the construction of Libby Dam in the U.S. and the resulting Koocanusa Reservoir, which crosses the Canada–U.S. border.

The water that is stored and released by Canadian reservoirs provides the U.S. with the potential to generate additional electricity. Under the terms of the Treaty, Canada receives a one–half share of the U.S.'s extra power generation potential. This is called the Canadian Entitlement to Downstream Benefits and is owned by the Province of British Columbia. The Canadian Entitlement varies from year to year but is currently about 3,990 gigawatt hours (GWh) per year of energy and 1,141 megawatts (MW) of capacity for the period between August 1, 2021 and July 31, 2022.

Since September 16, 2014, both Canada and the U.S have had the option to terminate the Treaty. In March 2014, after extensive consultation with basin residents, the Province of British Columbia decided to continue with the Columbia River Treaty and to seek improvements within the existing Treaty framework. More information on the Treaty and its review process can be found online at: **engage.gov.bc.ca/columbiarivertreaty**.

Other agreements

The Treaty Entities—BC Hydro, Bonneville Power Administration (BPA), and the U.S. Army Corps of Engineers (USACE)—periodically negotiate and sign supplemental operating agreements when there is mutual benefit to modify the water releases specified by the Columbia River Treaty.

In September 2013, the Treaty Entities signed a short–term agreement to address some of Canada's concerns about the timing of water releases from Libby Dam (known as the VarQ operating regime). This agreement was extended to August 2023 and is supplemental to the Libby Coordination Agreement (signed in 2000). Under this agreement, the U.S. committed to continued coordination with Canada to consider alternative reservoir operations that reduce flood risk in both countries (similar to the extensive collaboration that occurred during the 2012 high water event). In addition, BC Hydro was compensated for energy losses at its Kootenay Canal operations that resulted from the timing of water releases from Libby Dam. The Entities also agreed to continue working together to reach a long–term agreement.

In late 2022, the Columbia River Treaty Operating Committee signed the 2023 Non–Power Uses Agreement. This annual operating agreement allowed Arrow Lakes Reservoir releases to be reshaped between January and July 2023 to protect Canadian whitefish in exchange for flow benefits for endangered U.S. salmon.

NON–TREATY STORAGE AGREEMENT (NTSA)

Kinbasket Reservoir, created by Mica Dam, is licensed by the Province of British Columbia for more water storage than was required under the terms of the Columbia River Treaty. This additional water is called Non–Treaty Storage. The additional water can be released across the Canada–U.S. border only under agreement between BC Hydro and its U.S. partners. The current NTSA was signed by BC Hydro and BPA in 2012 and remains in effect until 2024.

The NTSA provides BC Hydro more control over reservoir levels, more energy benefits to B.C., and more operating flexibility to balance competing non–power interests on the Columbia system. These interests include recreational activities, wildlife habitat, and fisheries. Since the agreement was signed, BC Hydro and BPA have made good use of NTSA flexibility to reduce high and low water impacts downstream of Arrow Lakes Reservoir and to improve power and non–power benefits for both countries.

The Columbia River at Genelle. Photo by Mary Anne Coules.

BC Hydro's Columbia operations

SNOWPACK AND RUNOFF

Snowpack in the Columbia basin during the 2022/23 winter was well below average, particularly in the Canadian portion of the basin, due to low precipitation in the fall and winter. As of April 2023, the forecast runoff between April and September 2023 is low at 83% of normal for the Canadian portion of the basin, and 86% of normal for the entire Columbia basin. By comparison, the runoff in the Canadian basin in 2022 was 111% of normal and the overall runoff in the Columbia basin was 107% of normal.

KINBASKET RESERVOIR

Kinbasket Reservoir is created by Mica Dam. Kinbasket Reservoir regulates discharges for both Mica and Revelstoke dams as well as for power plants further downstream.

On September 18, 2022, Kinbasket Reservoir refilled to a maximum level of 752.89 metres (2,470.5 feet). This is about 1.3 metres (4.5 feet) below the normal maximum operating level of 754.38 metres (2,475.0 feet), equivalent to 98% of full storage.

Province-wide precipitation had been generally below average for much of the fall and winter of 2022/2023. Precipitation for the Canadian Columbia basin amounts to only 77% of normal since October 1, 2022. At Mica, this represents the third driest year on record. Snowpack in the Upper Columbia is currently at only 75% of normal. With low snowpack, forecast runoff is expected to be low at 83% of normal for February to September 2023, or the fourth driest year on record based on the latest April water supply forecast.

> The normal licensed range for Kinbasket Reservoir is between 754.4 metres (2,475 feet) and 706.96 metres (2,319.42 feet) respectively. The reservoir can be operated up to two feet above its normal maximum level, if approved by the Comptroller of Water Rights. Kinbasket Reservoir provides seven-million-acre feet (MAF) of Treaty storage and five MAF of non-Treaty storage.

Kinbasket reservoir is expected to draft deeper in the spring and refill in the summer to levels lower than 2022 levels due to the low water supply forecast combined with seasonally cooler winter loads. Kinbasket Reservoir reached a minimum level of 715.8 metres (2,348.5 feet) on April 22, 2023. On May 2, 2022, the minimum water level reached was 718.84 metres (2,358.5 feet)—about 7 metres (23 feet) below average. The current forecast maximum is 745.8 metres (2442 ft) in August 2023—6 metres (20 feet) below average.

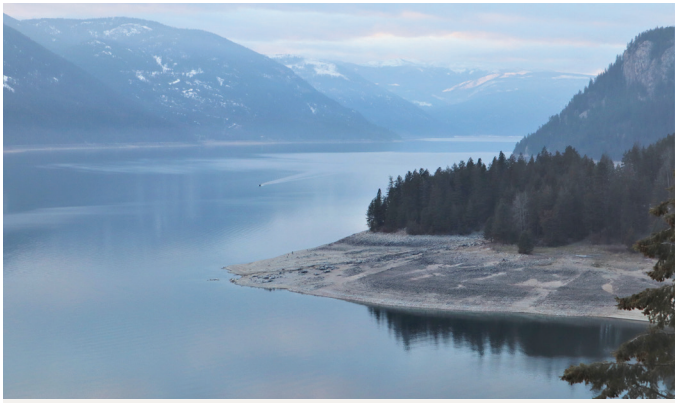
Kinbasket Reservoir. Photo by Murray Chapple.

REVELSTOKE RESERVOIR

Revelstoke Reservoir is created by Revelstoke Dam. Revelstoke Reservoir water levels may fluctuate in response to weather patterns, inflow levels, and electricity demand. It is common to have daily fluctuations of the reservoir within 1.5 metres (five feet) of full pool during the spring freshet and winter peak load periods. The reservoir is also periodically lowered below its normal minimum level of 571.5 metres (1,875 feet) to meet increasing system needs for short-term generating capacity. The reservoir may fill to near full pool during periods of high reservoir inflows.

Water is occasionally released over the Revelstoke Dam spillway during low demand and high inflow periods to maintain minimum flows, or to maintain the reservoir water level. This year, spills were minimal and limited to only three days.

The licensed range for Revelstoke Reservoir is between 573 metres (1,880 feet) and 554.7 metres (1,820 feet). Most of the time, Revelstoke Reservoir is maintained at or above 571.5 metres (1,875 feet).



Arrow Lakes Reservoir by Deer Park. Photo by Matt Casselman.

Reed canary grass in the Arrow drawdown zone. Photo by Jen Walker-Larsen.

ARROW LAKES RESERVOIR

Arrow Lakes Reservoir is impounded by the Hugh L. Keenleyside Dam. Arrow water releases are regulated under the Columbia River Treaty and its supplemental operating agreements. For operations to be consistent with the principles of the Treaty, it is necessary to store excess water under wet conditions so that surplus energy is not generated by downstream U.S. Columbia River projects. Conversely, under dry conditions, storage must be drafted as far as necessary to meet Treaty firm loads consistent with the principles of proportional draft.

On July 8, 2022, Arrow reached a maximum level of 438.7 metres (1,439.3 feet) – about 1.4 metres (4.7 feet) below full pool or 92% of full storage. Arrow Lakes Reservoir drafted across the summer months, but water levels were within the recreational target ranges until September 5, 2022 (Labour Day).

Runoff conditions in the overall Columbia basin had become drier in the summer. Persistent dry conditions in the fall and winter of 2022/2023 resulted in lower basin inflows and increased draft of Arrow Lakes Reservoir. Arrow reached a minimum level of 424.0 metres (1,391 feet) on January 9, 2023 and has been refilling since. By comparison, the minimum level reached in 2022 was 426.4 metres (1,399 feet) on March 12, 2022.

From February to September 2023, forecast inflows into Arrow is only 85% of normal based on the latest April water supply forecast. Arrow is expected to fill to within 1.5 to 3 metres (5 to 10 feet) from full by the end of June, depending on inflows and nonpower flow objectives. Summer levels are expected to be lower this year than last year due to year-over-year drier conditions.

The normal licensed range for Arrow Lakes Reservoir is between 440.1 metres (1,444 feet) and 419.9 metres (1,377.9 feet). The reservoir can be operated up to two feet above its normal maximum level (to 440.7 metres or 1,446 feet) if approved by the Comptroller of Water Rights. Arrow Lakes Reservoir provides 7.1 million-acre-feet (MAF) of Treaty storage.

Arrow Lakes Reservoir. Photo by Sue Heaton–Sherstobitoff.

DUNCAN RESERVOIR

Duncan Reservoir is impounded by Duncan Dam. The dam's operations help meet Treaty flood control requirements, help minimize flood risk on Kootenay Lake, and provide minimum fish flows year–round as required by the Water Use Plan.

Duncan Reservoir reached a maximum level of 576.4 metres (1,891 feet) on August 9, 2022. This water level is about 0.3 metres (1 foot) below full pool. The reservoir then drafted to about 575.5 metres (1,888 feet) by September 3, 2022.

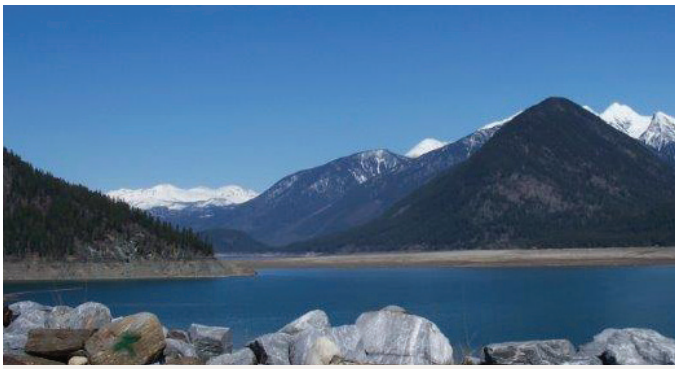
From September through late December 2022, Duncan Reservoir was operated to provide the flows necessary for kokanee and whitefish spawning downstream of the dam. Discharges were later increased to facilitate drafting the reservoir for Treaty flood control requirements during the winter period.

Similar to the Columbia basin, the snowpack in the Kootenay basin and runoff forecast is expected to be below average. From February to September 2023, reservoir inflows are forecast at 86% of average based on the latest April water supply forecast.

Duncan Reservoir is normally drafted each year to its licenced minimum level of 546.9 metres (1,794.2 feet) by April, or before the start of the freshet for flood risk management. Duncan Reservoir reached a minimum level of 547.2 metres (1,795.3 feet) on April 20, 2023. By comparison, the minimum level reached in 2022 was 547 metres (1,794.7 feet) on May 3, 2022. Lesser draft is expected this spring to improve odds of refilling the reservoir this summer based on current low runoff forecast. To begin reservoir refill, Duncan discharges are normally reduced to a minimum of 3 cubic metres per second (m^3/s) or 100 cubic feet per second (cfs) starting in May. Actual duration of low flows will be adjusted as required to target reservoir refill to a maximum of 576.4 metres (1,891 feet), 0.3 metres (1 foot) below full by the end of July.

The Columbia River in Castlegar. Photo by Mary Anne Coules.

The normal operating range for Duncan Reservoir is between 576.7 metres (1,892 feet) and 546.9 metres (1,794.2 feet). The reservoir can be operated up to 1.2 feet above its normal maximum level (577 metres or 1,893.2 feet) if approved by the Comptroller of Water Rights. Duncan Reservoir provides 1.4 MAF of Treaty storage.



Duncan Reservoir. Photo by Mary Anne Coules.

COLUMBIA RIVER FLOWS

Columbia River flows, downstream of the Kootenay River confluence at Castlegar, are the result of flow regulation at Hugh L. Keenleyside and other dams on the mainstem Columbia, as well as dams on the Kootenay River system. Actual discharges depend on many factors, including upstream runoff and storage operations and Treaty discharge requirements.

In 2022, despite above normal runoff, there were no flood concerns on the Columbia River downstream of the Hugh L. Keenleyside Dam. Columbia River flows are measured at the Birchbank flow measuring station downstream of the Kootenay River confluence between Castlegar and Trail.

Current 2023 flow forecast for the Columbia and Kootenay basin is expected to be below normal. As such, there are currently no flooding concerns in the forecast. Columbia River flows are expected to peak to about normal in early June at about 2,382 m^3/s or 100,000 cfs. This flow is well below the peak regulated flow experienced in 2012 of 6,090 m^3/s (215,000 cfs), and the peak pre–dam flow of 10,590 m^3/s (374,000 cfs) in 1961.

BC Hydro's water licence has no minimum discharge requirements for the Columbia River downstream of the Hugh L. Keenleyside Dam. However, BC Hydro is obliged (per the Columbia River Treaty) to reduce flows to a minimum weekly average flow of 141.5 m^3/s or 5,000 cfs under certain water conditions.

KOOCANUSA RESERVOIR

Koocanusa Reservoir on the Kootenay River is controlled by Libby Dam in Libby, Montana, and is operated by the USACE. The reservoir backs into Canada and provides approximately five–million–acre feet (MAF) of storage.

Koocanusa Reservoir is typically drafted during the winter for Treaty flood risk management. The latest April official forecast from USACE is 77% of normal for April to August 2023. Due to well–below–average inflow forecast, lesser draft is required to manage flood risk this year. As such, Libby has been operating on minimum flows of 113.3 m^3/s (4,000 cfs) since January 31, 2023. The reservoir reached a minimum level of 732 metres (2,401.5 feet) on April 10, 2023. By comparison in 2022, the reservoir reached a minimum of 720.4 metres (2,363.5 feet) on February 28, 2022, 3.6 metres (11.8 feet) below average for this date.

Libby Dam continues to be operated under VarQ[1] procedures for U.S. fisheries interests and flood control. The latest Libby Operating Plan provides for:

- Flows as needed during March to April to meet the April 30 flood control target;
- Minimum flows in May and June necessary to meet the flow rates and sturgeon volume objectives in the U.S. Fish & Wildlife Service Biological Opinion (BiOp) for sturgeon spawning and recruitment;
- Minimum bull trout flows as outlined in the BiOp; and Augmented downstream flows for salmon after the sturgeon flow operation is completed.

Information regarding the operation of Libby Dam and Koocanusa Reservoir water levels is available from the USACE at **nws.usace.army.mil** or by calling **406 293 3421**.

The normal operating range for Koocanusa Reservoir is between 749.5 metres (2,459 feet) and 697.1 metres (2,287 feet). During periods of high downstream flood risk, the Treaty Entities may coordinate additional storage in Koocanusa Reservoir.

KOOTENAY LAKE

For information regarding Kootenay Lake, please contact FortisBC.

Website: **fortisBC.com**

Phone: **1 866 436 7847**

Koocanusa Reservoir. Photo by Sally MacDonald.

Koocanusa Reservoir. Photo by Sally MacDonald.

1 VarQ was developed to improve the multi–purpose operation of Libby and Hungry Horse while maintaining the current level of system flood control protection in the Columbia River. VARQ reduces the contribution of reservoir space at Libby and Hungry Horse for system flood control of spring runoff in the Columbia River in years with low to moderate potential for flooding. For more information, please visit: **nwd–wc.usace.army.mil/cafe/forecast/VARQ/varq.htm.**

Want to stay informed of BC Hydro operations?

REGIONAL OPERATIONS UPDATE MEETINGS

BC Hydro hosts annual Operations Update meetings every spring for Columbia basin communities. These meetings are held to:

- Listen to, and learn from local residents, stakeholders, First Nations and community representatives who have an interest in the operation of the Columbia River Treaty facilities and BC Hydro facilities in the Southern Interior;
- Provide information on the operations of Columbia River Treaty facilities in Canada and other facilities that are operated in a coordinated manner on the Columbia system; and
- Provide an update on BC Hydro's activities.

To register, please contact Dave Cooper at **david.cooper@bchydro.com**.

OPERATIONS UPDATE CONFERENCE CALLS

BC Hydro periodically hosts conference calls to provide updates on our Columbia and Kootenay system operations. If you would like to receive email notifications regarding these meetings and conference calls, please contact us at **southern-interior.info@bchydro.com**.

BC HYDRO'S RESERVOIR LEVEL UPDATES

BC Hydro provides reservoir water level forecasts by email each week. To receive these updates, please email **southern-interior.info@bchydro.com.**

Near real-time water level information for various locations around our reservoirs is available online at: **bchydro.com/energy-in-bc/operations/transmission-reservoir-data/previous-reservoir-elevations/columbia.html**.

BC Hydro's toll-free reservoir information line is 1 877 924 2444 and also provides up-to-date reservoir elevation and river flow information. The recording is updated every Monday, Wednesday and Friday and includes:

- Current elevation levels: Arrow Lakes Reservoir, Duncan Dam Reservoir, Kinbasket Reservoir, Koocanusa Reservoir, Kootenay Lake, Revelstoke Reservoir, Sugar Lake Reservoir and Whatshan Lake Reservoir.
- Current flows: Columbia River at Birchbank, Duncan River at the Lardeau Confluence, Shuswap River and the flow downstream from Wilsey Dam at Shuswap Falls.

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Arrow Lakes Reservoir behind the Hugh L. Keenleyside Dam.
Photo by Sue Heaton-Sherstobitoff.