Columbia River water use plan update

April 2016

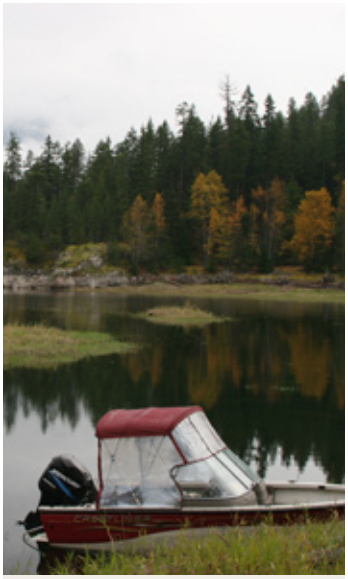
BC Hydro is pleased to provide highlights from the Columbia River Water Use Plan (WUP). Approved in 2007, the plan calls for a large number of monitoring programs and physical works projects to be implemented on the mainstem Columbia River from Kinbasket Reservoir in the north downstream to the Canada–United States border on the lower Columbia River over 12 years. Many of these projects expected to provide benefits to recreation, fisheries, wildlife, and archaeology, are now complete or approaching completion.

Boat ramp improvements

In 2016, we completed four more Arrow Lakes Reservoir boat ramp improvement projects at Shelter Bay, Nakusp, Edgewood, and Anderson Point. The table below lists Arrow Lakes Reservoir and Kinbasket Reservoir boat ramps recently constructed or improved and their elevations for reference.

Kinbasket and Arrow Lakes Reservoir boat ramp elevations				
Location	Elevation of ramp toe		Lowest operational water level*	
	Metres	Feet	Metres	Feet
Arrow Lakes Reservoir				
Syringa Creek	421.87	1,384.08	422.87	1,387.37
Anderson Point	425.00	1,394.30	426.00	1,399.02
Edgewood	425.76	1,396.7	426.76	1,400.13
Fauquier	424.66	1,393.24	425.66	1,396.52
Burton	425.40	1,395.67	426.40	1,398.95
McDonald Creek	426.00	1,397.64	427.00	1,400.92
Nakusp Boat	420.50	1,379.59	421.50	1,382.87
Shelter Bay	422.86	1,387.34	423.86	1,390.62
Kinbasket Reservoir				
Bush Harbour	724.60	2,377.30	725.60	2,380.58
Valemount Marina	727.59	2,387.11	728.59	2.390.39

*Operational according to the following boat dimensions: 9.3 metre length, 3.1 metre width, 1 metre maximum draft (amount below waterline), and maximum weight of 4 tonnes.



Boat moored at Shelter Bay Provincial Park.

BC Hydro
Power smart

Boat ramp floating walkway.

Boat ramp use study

We are continuing to monitor use of upgraded boat ramps on Kinbasket and Arrow Lakes Reservoirs through the use of vehicle counters. Face–to–face surveys conducted from 2009 to 2013 indicated that user satisfaction has increased significantly with almost all boat ramp upgrades. Another round of face–to–face surveys is planned now that all the planned boat ramp updates are complete.

Recreation use study

We completed the Arrow Lakes Reservoir recreation use study in 2015. The study used both face–to–face and online surveys to better understand if and how recreational use was affected by reservoir operations. Results indicate that the number of people using the area for recreation is primarily influenced by the weather (rainfall and temperature), day of the week, and season. Water levels have only a modest effect.

Woody debris stored in a holding pen at Bush Harbour, Kinbasket Reservoir.

Woody debris removal

We continue to remove floating woody debris from Kinbasket and Arrow Lakes reservoirs and meet with Debris Management Committees in Nakusp, Golden, and Valemount to plan and prioritize work. Since 2007, we have funded close to $6 million of debris removal work on Kinbasket and Arrow Lakes Reservoirs and we estimate that we have removed over 400,000 cubic meters of woody debris from Kinbasket Reservoir and over 80,000 cubic meters from Arrow Lakes Reservoir.

BC Hydro and the respective committees met in summer 2015 to discuss program priorities, revise strategies, and review annual budgets for the debris management programs moving forwards. The provincial Comptroller of Water Rights recently reviewed the debris management programs for each reservoir and set the direction and funding for the next three years of the programs under the Columbia River Water Use Plan (2016 to 2018).

For Kinbasket Reservoir, it is anticipated that there will be a significant amount of debris removal occurring in the northern part of the basin. Kinbasket Reservoir water levels are currently above usual levels for this time of year and we are currently forecasting water levels near full pool this fall. Similar to recent years, we are planning a water–based debris removal program again in 2016 that will use tugs and barges to collect and corral woody debris using floating boomsticks.

On Arrow Lakes Reservoir spring 2016 work has started in the Edgewood area on lower Arrow Reservoir and then crews will move up to the north end of the reservoir in the Galena Bay/Shelter Bay area.

Revegetation

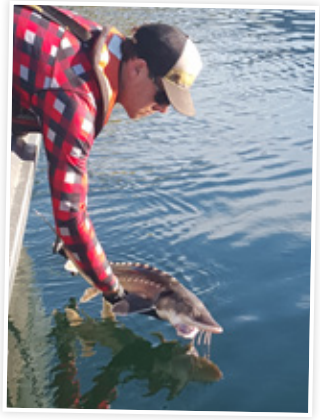
New mounds to provide wildlife habitat.

The goal of the revegetation program is to increase native plant cover and diversity in the drawdown zone of Arrow Lakes and Kinbasket Reservoirs to benefit wildlife, fish, archaeological site protection and shoreline stability. The large-scale planting in these reservoirs that focused on sedge, cottonwood and other native plant species is largely complete. Monitoring to date of planted sites shows mixed results for sites in Arrow Lakes Reservoir and generally poor results for Kinbasket Reservoir sites.

A technical review of the revegetation program with representatives from First Nations, government agencies and contractors was held in 2014. This group suggested piloting a new approach for Kinbasket Reservoir to increase plant diversity and build small mounds using woody debris and reservoir soil. The mounds once planted with native vegetation would provide additional island habitat for birds, insects, small mammals, and amphibians when reservoir water levels are high.

In 2015, we started a trial to test this approach and constructed seven mounds and windrows with wood debris and soil in the upper drawdown zone of Kinbasket Reservoir at Bush Arm. The wood debris used to construct the mounds and windrows was cleared from several natural wood-covered wetlands. Removing the wood from the wetlands should help promote the natural re-establishment of vegetation and improve habitat for amphibians, water-associated birds, and other wildlife. The mounds and windrows will be planted with live shrub stakes and sedge plants this spring to kickstart the natural revegetation process. The ability of the sites to withstand the reservoir environment and wave action may be tested this summer as we are currently forecasting high water levels. The mounds will be monitored to evaluate the success of the planting.

White sturgeon



We are working in cooperation with First Nations, stakeholders, and federal and provincial Government partners to help restore Columbia River white sturgeon populations through long-term monitoring programs and projects developed under the Water Use Plan.

We are conducting several studies to better understand white sturgeon spawning, egg incubation, growth, and survival throughout the Columbia River. Results have shown sturgeon spawn each year at multiple locations throughout the Columbia River including downstream of Revelstoke Dam, near Kinnaird Rapids downstream of Hugh L. Keenleyside Dam and the Arrow Lakes Generating Station, downstream of Waneta Dam, and in the United States. Genetic work indicates that more than 100 individual adult fish spawn each year in Canada.

We fund a white sturgeon conservation aquaculture program through the Columbia River Water Use Plan that has released hatchery-raised sturgeon into the Columbia River each year since 2002. This program has proven to be a success. Monitoring since the releases began shows that more of the young fish survive than originally expected and we estimate that there are now over 30,000 hatchery-origin white sturgeon in the Columbia River between Hugh L. Keenleyside Dam in Castlegar and Lake Roosevelt in the U.S.

Given this success, the approach of the aquaculture program has shifted. In the early years white sturgeon adults were captured and spawned at the hatchery to produce a large number of eggs for rearing. Now the focus is to collect eggs and larvae from the wild for rearing while sturgeon are still reproducing naturally in the river so the released sturgeon are as genetically diverse as possible.

We are continuing stock assessments that estimate the number of wild White Sturgeon remaining in the Columbia River between Hugh L. Keenleyside and Grand Coulee Dams. This information, along with juvenile survival numbers, will be used to help plan future white sturgeon recovery efforts.

Lower Columbia River fish studies

We are continuing annual surveys on fish abundance, distribution and life history in the Columbia River below vHugh L. Keenleyside Dam to better understand the effects of dam operations on fish populations. The Lower Columbia River large river fish indexing program completed eighth year of monitoring in 2014. Key species monitored include Rainbow Trout, Mountain Whitefish and Walleye.

We are also continuing field surveys during flow changes from Hugh L. Keenleyside Dam to assess current fish protection flows. Juvenile fish are at risk of being stranded during flow reductions during the summer period when they are typically found in shallow, warm productive inshore areas. We are also conducting yearly Rainbow Trout spawning assessments in the lower Columbia River to assess the effectiveness of Rainbow Trout protection flows. Rainbow Trout are a key sportfish in the mainstem Columbia River downstream of Hugh L. Keenleyside Dam, and typically spawn in March, April and May. Key spawning areas are Norn's Creek, and Norn's Creek Fan.

Rainbow Trout eggs are vulnerable to reductions in water flows until the fry hatch about six to eight weeks after the eggs are laid. Since 1999, we have managed Columbia River flows to protect Rainbow Trout spawning locations (redds) from dewatering. Discharge flows from the facility are lowered during the peak Rainbow Trout spawning period to encourage the trout to spawn in areas of deeper water and reduce the chance that incubating eggs will be exposed during flow changes. So far, Rainbow Trout spawning surveys have shown that Rainbow Trout protection flows have protected, on average, more than 99.5% of the total number of eggs laid each year and the numbers of Rainbow Trout spawners and redds found during the surveys continue to increase. In 2015, the number of Rainbow Trout spawners below Hugh L. Keenleyside Dam, estimated by spawner surveys, was just under 15,000 fish. The year befire the number of spawners was estimated to be 13,000 fish.

Field crew sampling for index netting program. Photo Credit: J. Baxter.

Snorkelling survey to locate rainbow trout redds in the lower Columbia River.

Revelstoke Dam minimum flow

We are continuing a suite of aquatic studies under the Revelstoke Flow Management Plan in the mid–Columbia River to determine whether minimum flows at Revelstoke Dam will provide expected fisheries benefits. We began operating Revelstoke Dam to provide a minimum flow of 142 cubic metres per second in December 2010. Discharge flows over the last four years have varied throughout the day and typically been maintained well above the minimum flow level. The data collected so far has not shown any changes in fish distribution or diversity.

Understanding effects of reservoir operations

A key component of the Columbia River Water Use Plan is to better understand how our Arrow Lakes and Kinbasket Reservoir operations affect fish, wildlife, vegetation, recreation and archaeology to aid future decision making. Although a number of studies are now complete, the following studies are still underway.

A freshwater crustacean called Daphnia that is an important food source for fish.
Photo Credit: L. Vidmanic.

Reservoir productivity

We are continuing with programs in 2016 that investigate links between reservoir productivity and the operation of Kinbasket and Revelstoke Reservoirs. These programs are focusing on learning how the aquatic food webs work and whether we could make changes to reservoir operations to improve biological production. The food webs start with how nutrients, such as phosphorus and nitrogen, are made available to phytoplankton (algae) and then on up the food chain to zooplankton and kokanee. Field sampling for water and plankton is conducted from April to October and kokanee populations are assessed in late summer and fall. Moored temperature monitoring stations were installed in the reservoirs in 2012 to provide more continuous data on how water, and thus nutrients, moves through the system. The results suggest a more dynamic pattern of movement through Revelstoke Reservoir than previously thought. Preliminary results depict internal waves that may allow nutrients once thought to bypass the upper layers to be available for phytoplankton.

While low in productivity, both Kinbasket and Revelstoke Reservoirs support short, efficient food chains that have resulted in relatively good kokanee populations. Kokanee numbers can vary widely by year as they are dominated by fry (up to 86%). Numbers of all other ages in Kinbasket Reservoir have remained relatively consistent over the years, averaging about 2 million. Recent declines in kokanee abundance in Revelstoke Reservoir were coupled with a substantial increase in the size of fish, an expected response for kokanee.

Bird migration

We have two studies underway that specifically examine how reservoir operations affect stop-over habitat for birds during the spring and fall migrations. Close to year-round monitoring has been ongoing since 2008 to count and determine the distribution of waterfowl in the Revelstoke Reach of Arrow Lakes Reservoir. Results show that waterfowl and shorebirds use various wetland, shoreline, and open water habitats during their migrations. In the open water, large rafts of Western Grebe, groups of Horned Grebe, and single or flocked up Common Loon are often observed during spring and fall migration. Along the shorelines of Arrow Lakes, a number of different shorebirds have been observed but are generally uncommon. The most notable shorebird migration is probably that of the Dowitchers, which stop to rest and forage relatively late in the fall migration. Yellowlegs and several of the smaller 'peeps' sandpipers used the shorelines to a variable degree, depending on the year. Spotted Sandpipers are the most commonly observed shorebird during the migrations and also during the breeding season.

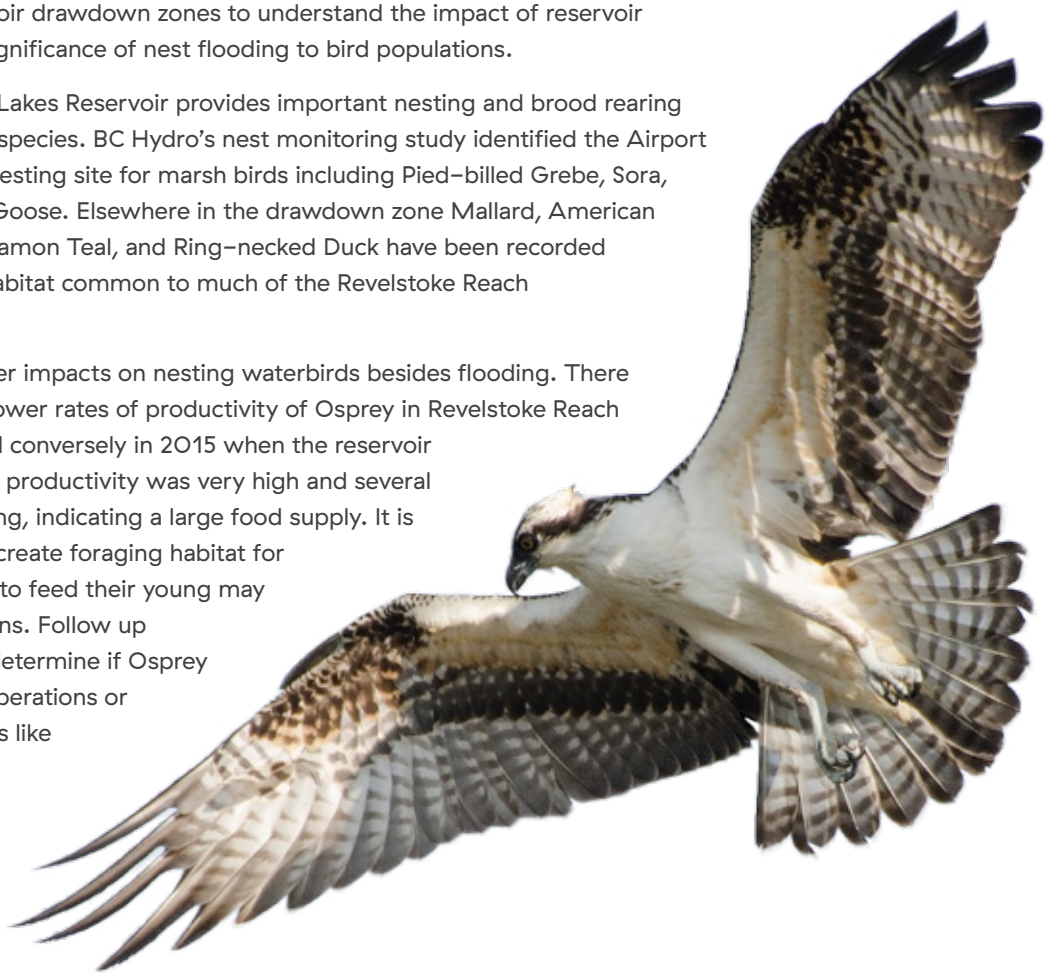
Nowhere is the migration of waterbirds more obvious, than in the various wetlands of Revelstoke Reach. Cartier Bay is the most important wetland for dabbling ducks, but these birds avoid this wetland more often in the fall when it is submerged by the reservoir. The Airport Marsh provides a very high diversity of shallow and deeper pond habitat for a larger diversity of waterbirds during the migration that is very rarely impacted by spring or fall reservoir levels. Monitoring of waterbird migrations has shown that some terrestrial grassland habitats in the Arrow Lake drawdown zone are selected by waterfowl during the migration when the reservoir rises and these sites are covered by a shallow layer of water.

Nesting birds

The drawdown zones of Kinbasket and Arrow Lakes Reservoirs provide important nesting habitat for as many as 60 bird species. Most bird nests are at risk from predators, including snakes, mammals, and other birds. Birds nesting in reservoir drawdown zones (below the high water mark) also face the risk of flooding. Since 2008, we have been examining the patterns of habitat use by nesting birds in Kinbasket and Arrow Lakes Reservoir drawdown zones to understand the impact of reservoir operations on bird nests and the significance of nest flooding to bird populations.

The drawdown zone of the Arrow Lakes Reservoir provides important nesting and brood rearing habitat for a diversity of waterbird species. BC Hydro's nest monitoring study identified the Airport Marsh as a particularly important nesting site for marsh birds including Pied-billed Grebe, Sora, Virginia Rail, Mallard, and Canada Goose. Elsewhere in the drawdown zone Mallard, American Wigeon, Green-winged Teal, Cinnamon Teal, and Ring-necked Duck have been recorded nesting, typically in the tall grass habitat common to much of the Revelstoke Reach drawdown zone.

Reservoir operations may have other impacts on nesting waterbirds besides flooding. There has been consistent tendency for lower rates of productivity of Osprey in Revelstoke Reach in years of higher water levels. And conversely in 2015 when the reservoir water levels were very low, Osprey productivity was very high and several nests successfully raised three young, indicating a large food supply. It is possible that while reservoirs may create foraging habitat for Osprey, their ability to capture fish to feed their young may be influenced by reservoir operations. Follow up monitoring is being conducted to determine if Osprey productivity is linked to reservoir operations or whether other correlated conditions like rainfall could be causing changes in productivity among years.



Unique nesting habitat in Montana Slough

One unique site that is commonly used for nesting by dabbling ducks is a floating bog mat in Montana Slough, which rises and falls with the operations of the Arrow Lakes Reservoir. An analysis of nest success indicated that dabbling ducks nesting on this floating island are slightly more successful than ducks nesting elsewhere on the flats. One reason for this could be that the floating island protects the nests from flooding.

Amphibians and reptiles

We are continuing an amphibian and reptile monitoring program every two years in the drawdown zones of Arrow Lakes Reservoir and every year in Kinbasket Reservoir. In Kinbasket surveys are conducted in Canoe Reach (Valemount Peatland and Ptarmigan Creek area) and Bush Arm. In Arrow Lakes surveys are conducted in Revelstoke Reach (Airport Marsh, Montana Slough, Cartier Bay), Beaton Arm, East Arrow Park and Burton Creek, and north and south of Eagle Creek near Edgewood. The objective of these monitoring programs is to understand how amphibians and reptiles are using the drawdown zone areas.

In Arrow Lakes Reservoir, four species of amphibians (Long–toed Salamander, Western Toad, Columbia Spotted Frogs and Pacific Chorus Frog) and six species of reptiles (Northern Alligator Lizard, Western Painted Turtle, Common Garter Snake, Western Terrestrial Garter Snake, Western Skink, and Rubber Boa) have been found. In Kinbasket Reservoir work is focused on the Canoe Reach peatlands near Valemount. So far species found include Western Toad, Columbia Spotted Frog, Long–toed Salamander, and Common Garter Snakes.

Work also continues on a study to understand the life history of Western painted turtles living in the Upper Arrow Lakes Reservoir near Revelstoke. Visual surveys and radio telemetry of tagged turtles along with environmental monitoring will continue to understand turtles' distribution, habitat use, abundance, and productivity. In 2015, work focused on juvenile movements in Airport Marsh.

Rubber boa found in Arrow Lakes Reservoir.

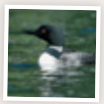
Study finding new species

Prior to starting the amphibian and reptile monitoring programs in both reservoirs, the occurrence and distribution of these species in the drawdown zone was not well understood. Even after eight years of monitoring, the study is still finding animals that were not previously documented in Kinbasket Reservoir. During study fieldwork in 2015, the first official sighting of a Western Painted Turtle for Kinbasket Reservoir was made at Bush Arm.

Wildlife enhancement projects

In response to concerns raised by the public, we commissioned an independent detailed impact assessment of two proposed wildlife habitat enhancement projects south of Revelstoke at Cartier Bay in 2014. The proposed projects involved filling gaps in the abandoned railbed with engineered dykes to protect and expand the existing Cartier Bay wetland and create a new adjacent wetland. The assessment concluded that the Cartier Bay area, particularly the existing wetlands, already have high ecological values and the proposed projects may put those at risk. As a result, we are now planning to protect Cartier Bay by reinforcing the eroding culvert on the abandoned railbed that creates the wetland. We will not expand Cartier Bay or create a new adjacent wetland. This year we are also continuing work to look at the feasibility of other potential wildlife enhancement sites in lower Arrow Lakes Reservoir.

Arrow Lakes Reservoir soft constraints performance 2015

Soft constraint	Target	2015 Performance
 Recreation	Reservoir water levels between 1,435 feet and 1,440 feet from May 24 to September 30.	The reservoir was within target range 0% of the time between May 24 and September 7.
 Wildlife	Ensure inundation of nesting bird habitat by rising reservoir levels and availability of fall migratory bird habitat is no worse than recent average (1984–1999). Target a reservoir level of 1,438 feet or lower by August 7.	Arrow Lakes Reservoir was below 1,424 feet for about 47% of the time between April 30 and July 16, providing better than average habitat for nesting birds. The reservoir was below 1,438 feet for 100% of the time between August 7 and October 31 for fall migratory birds.
 Fish	Reservoir levels above 1,424 feet to ensure tributary access during kokanee spawning period from late August to early November.	Reservoir was above 1,424 feet 0% of the time between August 25 and November 15.
 Vegetation	Maintain current (2004) level of vegetation in the drawdown zone by maintaining lower reservoir water levels during the growing season.	Reservoir was below 1,424 feet for 100% of the time between May 1 and July 31.
 Erosion	Minimize duration of full pool events and avoid sudden drawdown once full pool has been reached to avoid shoreline slumping. Reservoir water level of 1,440 feet is ideal.	The reservoir reached a peak level of about 1428.7 feet on June 13. Due to low freshet flows and the Columbia system in deep proportional draft, the reservoir drafted relatively quickly to 1,407.3 feet on August 31 but maintain relatively stable levels with reservoir ending at 1,407.6 feet on September 30.
 Culture and Heritage	The original WUP target is 'reservoir levels at or below 1,430 feet for as long as possible to limit impacts to archaeological sites'. However during the Five-year interim review of the Arrow soft constraints, this target was determined not to be effective due to the presence of 102 archaeological sites at elevations below 1,430 feet. As a result, BC Hydro will no longer report on the original culture and heritage target.	BC Hydro is implementing a multiyear Reservoir Archaeology Program in the Upper and Lower Arrow Lakes to inventory heritage sites and identify impacts as a result of normal reservoir operations. Information gathered by the Reservoir Archaeology Program is expected to assist future decision makers and development of an Archaeological Management Plan.

How to get more information

Copies of the Columbia River Water Use Plan, study terms of reference, reports, performance measures, Columbia River WUP Consultative Committee report, and other water use planning information are available at **https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river.html.**

Contact a BC Hydro community relations representative

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