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Analysis

Finding the right balance

By NS Energy Staff Writer 14 Sep 2005

POWER HYDRO

The 170MW Jordan river hydroelectric facility on Vancouver Island in British Columbia, Canada, has been subject to a detailed water use plan designed to bring benefits to fish, wildlife and recreation on the river

The Jordan river hydroelectric project, located in the Canadian province of British Columbia, was built in 1911, and upgraded from 26MW to 170MW in 1971. Owned and operated by BC Hydro, the project has recently gone through a detailed water use plan (WUP) that looks to balance all water use interests, with operations opened up to the community to determine the right balance of social, environmental and economic considerations.

Water use planning

The tradeoffs made between maintaining reservoir levels, meeting energy production demands and managing downstream impacts are at the heart of every hydroelectric utility's sustainability challenge. BC Hydro has worked for some time to bring order to their decision making processes around the use of water. In 1998, a set of 'Water Use Planning Guidelines' were developed and agreed to by provincial and federal regulatory agencies and BC Hydro, with input from First Nations (aboriginal peoples).

The purpose of a water use planning process is to develop recommendations defining a preferred operating strategy using a multi-interest consultative process. A WUP is a technical document that, once reviewed by provincial and federal agencies and accepted by the provincial Comptroller of Water Rights, defines how water control facilities – such as hydroelectric dams and power plants – will be operated. In addition to outlining detailed operating parameters, the plan can also specify:

• Physical works programmes to be implemented in lieu of operating changes, where these are more cost effective.

• Monitoring programmes designed to collect information concerning any remaining uncertainties about the impact of operations on key environmental and social objectives, so that future review of the plan can be better informed.

BC Hydro prepared WUPs for all 23 of its hydroelectric systems (including 30 facilities) between 1999 and 2005, with the aim of improving water management and gaining maximum public benefits from the resource. These 23 systems represent just over 10,000MW or about 90% of the province's electricity generation. These plans will now guide the future operations of BC Hydro's hydroelectric facilities.

The Jordan river WUP

Historically, a water issue or concern would be discussed between BC Hydro and the interested party. This one-on-one interaction would sometimes solve the issue, but by doing so other interests may have been affected. By having all river interests in one room, the dialogue switched to a group discussion, with committee members talking amongst themselves to understand each other's interests.

The 14-member consultative committee included federal and provincial government agencies, First Nations, community interest groups and BC Hydro itself. The committee, led by a facilitator, met regularly over an 18 month period in the nearby community of Sooke near Jordan river. BC Hydro provided the committee with a project team to provide assistance in historical water inflow information, modelling various operating alternatives, undertaking studies to fill information gaps, and general support.

The committee documented the water objectives with respect to their interests, translated them into performance measures where those interests can be weighted and defined, and then carried out a trade-off analysis. From the analysis, an outcome was developed that provides the best balance between all competing water uses.

As much as possible, the goal of the WUP programme is to strive for consensus on a set of operating rules for each facility that satisfies the full range of water use interests at stake, while respective of legislative and other boundaries. However consensus is not a requirement, and perhaps for this reason people seem more inclined to work together.

The committee agreed on the final operational changes, although the T'Sou ke First Nation supported a run of river alternative in terms of achieving their treaty rights.

Outcomes of the process

While BC Hydro has held a water license at the Jordan river for many years water is, of course, not just for power generation. The multi-party committee considered power generation, recreation, cultural use and heritage, fish, wildlife, flood control, water quality, industry and socio-economic factors. At the conclusion of the committee's detailed and collaborative consultations, it recommended that BC Hydro implement a series of operational changes that are expected to result in positive social and environmental benefits.

Fish benefits in the river

Resident fish, such as trout, and wildlife are expected to benefit from increased habitat, when a minimum river flow in the lower Jordan river is established downstream of the Elliott dam for the first time in nearly 35 years. Salmon in the lower 200m of the river are also expected to benefit from the changes.

In 1971, with the addition of the Elliott dam and Elliott headpond, the power facilities no longer released constant river flows downstream. This resulted in an reduced river flow along a 7km section of the river from the dam to the power house maintained solely by spill events and natural inflows from several creeks.

BC Hydro will now install an outlet valve in the dam in the next few years (the upstream works were completed in 2004 in coordination with a dam safety drawdown) to provide a minimum flow of 0.25m³/sec. This flow will provide the steep river canyon with a constant wetted area to benefit fish, amphibians and wildlife. Habitat during the summer months and winter freezes will be maintained in areas not wetted under the current operational regime. The release of water below the dam was viewed as not only an environmental gain, but a gain socially for the local community. The estimated cost per year for the water that will pass down the river and not be used for power generation is $414,000 (2003 C$), with the capital cost of the outlet valve estimated to be less than C$1M .

Diversion reservoir

In the diversion reservoir, it is expected that trout health will improve with better water quality and temperatures, as BC Hydro will increase the lower operating level of the diversion reservoir.

The diversion reservoir is the primary water storage for the Jordan river hydroelectric facility. The Bear Creek reservoir located upstream is operated as a natural lake as a result of seismic concerns identified in the early 1990s. The range of operation for the diversion reservoir is approximately 18m (367.9m to 386.2m), and at lower operating levels in the summer months there was concern about temperature and water quality conditions for resident trout. The result was to increase the minimum operating level to 376m during the summer months to reduce fish stress and therefore increase trout productivity. For the rest of the year the minimum would be 372m.

Recreation

Just downstream of the power house at the mouth of the Jordan river, recreation through surfing will benefit at Jordan beach by reducing water discharges and power generation for a number of weekend days each March – the peak surfing month of the year. The operational changes benefited the surfing community and resident trout in the reservoir; these were seen as social and environmental benefits at low cost to BC Hydro. However, these two changes can constrain operations. The committee agreed that in emergency Vancouver island electricity supply conditions or for dam safety, BC Hydro would operate the Jordan river facility as required.

For the four hydroelectric systems on Vancouver island there was neither a decrease nor increase in net power generation, with two facilities having increases and Jordan river and one other facility having decreases. However, there are expected to be significant environmental and social benefits as a result of the water regime changes. For Jordan river, in many ways it didn't sit well with committee members that a constant river flow was absent along the 7km stretch of the river from the dam to the power station. Creating a flow was seen as very beneficial. Using water in different ways can gain the maximum benefits from our valuable water resource.

WUP challenges

A number of challenges arose during the committee's deliberations on the WUP recommendations. These included information gaps, past industrial activities on the watershed, a finite amount of water, and the fact that BC Hydro could only look into its own operations and not at other watershed issues.

Inaccessibility and gaps in the data

The Jordan river facility is quite old, with some facilities in place for 95 years. However, it is fairly remote and hard to access beside the Seymour Mountain range. Below Elliott dam, the Jordan river has steep topography with some boulders the size of houses within the riverbed. Very limited data had been collected on fish and wildlife in this area, so productivity was unknown. The project team did acquire river habitat transects throughout the lower 7km section of the river and the types of fish and wildlife to be expected. This limited information made water flow decisions grey rather than black and white, with biologist's professional opinions having more weight. The committee was still comfortable with the decisions and instigated a monitoring programme to glean more information for future reviews.

Decline of fish species

Mining and forestry operations on the lower river, along with the construction of the Elliott dam, led to the decline of anadromous fish species. Sediment and water quality issues associated with an old and abandoned copper mine starting 500m upstream of the power house, and the removal of estuarine wetlands by a log sort at the mouth of the Jordan river, were issues outside the scope of the WUP but determining factors to consider in water flows from BC Hydro's facilities. Given the river obstacles for salmon located 200m above the power house and the area unable to sustain fish, and that steelhead were unable to surpass a barrier 1.5km upstream, the amount of river habitat available was small. Still, a minimum base flow was seen as a positive to improve the river and help provide an impetus for the mine site conditions to change. The primary benefit of the base flow was the 5.5km of habitat for resident trout immediately below the dam.

Providing enough water

There was also the issue of trade-off of water in the reservoirs versus water released down the river. Although the precipitation along the region is high – 345cm/yr at the Bear Creek dam – stream flows vary considerably throughout the year. Compared to the volume of inflow, the combined storage capacity of the three reservoirs is rather small. Approximately three days worth of power house utilisation can be stored within the reservoirs. For this reason the facility is used as a peaking plant during the morning and afternoon hours, but would be run at full output during inflow events. During the dry summer months there was concern about maintaining minimum river flows and minimum reservoir levels for fish. During extreme dry years there would not be enough water to provide both. A communication protocol was developed so that a month or so in advance, when BC Hydro inflow forecasts show a potential water shortage, government agencies and the utility would meet to determine where reductions could be eased. In those dry years, the committee put more weight on providing river flows. This discussion provided BC Hydro with the regulatory guidance it was looking for.

Re-adjusting funds

There was some frustration that other operations within the Jordan river watershed could not be included in BC Hydro's process. The reason was the utility had no jurisdiction other than its own operations. Similarly, with the industrial components of the lower Jordan river, it was suggested that it would be better for fish if funds could be directed to an adjacent watershed for better results. C$414,000 each year on fish habitat improvements and productivity on a nearby system would have far greater results than on Jordan. The committee did agree that water flow improvements on Jordan would have benefits not only for fish, and that this improvement may eventually lead to other watershed improvements in helping bring back the lower Jordan to a healthier system. Members of the committee encouraged others to take the WUP process on to other watershed initiatives.

Monitoring programmes

In addition to developing recommendations about operational changes, the committee also agreed on a monitoring programme to study the results both prior to and after the operational changes are made, and to measure the outcomes. Currently a programme is in place to measure habitat and productivity in the Jordan river below Elliott dam with no flows released from the dam. With two years of study to be obtained, the minimum 0.25m³/sec flow will then be provided and studied to compare the before and after results. This information is critical in order to be better informed on possible future changes. For example, in some WUPs BC Hydro has increased river flows for 48 hours to create 'fish pulse flows' that allow fish to migrate above river obstacles and access upstream spawning habitat.

Implementation of Jordan river WUP

The Jordan river WUP, now reviewed and authorised under British Columbia's 'Water Act', regulates operations for the licensed facility. The operational changes were reviewed and accepted by British Columbia's Provincial Government, through the Comptroller of Water Rights. This WUP, like the WUPs for all of BC Hydro's other 23 hydroelectric systems, will be reviewed to determine if assumptions on the benefits and costs are as anticipated, but if further changes can be made to provide better results. Should the operational change turn out to be not as is anticipated, then a future committee could also look at revising an operating change.

The committee agreed to conduct a review of the monitoring results six years after implementation, unless the possible remediation of a nearby mine site triggered the need for one earlier.

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Jordan river facts

• Jordan river is 72km up the west coast of Vancouver island from Victoria, British Columbia's capital.
• The Jordan river development was built in 1911 by the BC Electric Railway Company to supply power to Victoria and surrounding area.
• The power house was replaced in 1971 from 26MW to 170MW
• The facility comprises the Jordan river power station, the Jordan river Substation, Elliott, Diversion and Bear Creek dams, and Elliott, Diversion and Bear Creek reservoirs.
• The Elliott reservoir is approximately 290m above the power house with the water delivered through a 5.3km tunnel and a 1.6km penstock.
• The Jordan river is 35km long.
• The Jordan river power house is BC Hydro's largest on Vancouver island, and when power at full capacity, can provide 35% of the island's total hydroelectric generation.
• Vancouver island electricity demand peaks at around 2200MW in the winter

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