

Columbia River Treaty 2014/2024 Review Recent Study Results

Background

The Columbia River Treaty has provided significant flood control and power generation to Canada and the United States since being implemented in 1964. However, after nearly 50 years, both parties are examining its future. The Treaty states that either nation can terminate most of its provisions beginning Sept. 16, 2024, with a minimum 10 years' written notice. In addition, when the Treaty was implemented, the U.S. purchased from Canada 60 years of assured flood control storage. That original purchase ends in 2024. The Treaty gives the U.S. rights to storage in Canadian reservoirs after 2024, but that operation fundamentally changes to a system referred to as "Called Upon" flood risk management. As will be described below, many details of that new flood risk management system must be better understood.

The Columbia River Treaty 2014/2024 Review (Treaty Review) is a series of studies being undertaken by the Bonneville Power Administration and the Army Corps of Engineers on behalf of the U.S. Entity, the body that implements the Treaty for the U.S. government. The purpose of the Treaty Review is to conduct the technical analyses necessary to understand whether it is in the best interest of the U.S. to continue, modify or terminate the Treaty after 2024. The Treaty Review, being conducted by the U.S. Entity in collaboration with other regional sovereign interests and stakeholders, will form the basis for a regionally-vetted recommendation on the future of the Treaty to the U.S. Department of State.

The analytical work in the United States is being coordinated through the Sovereign Review Process. There are two major components, which serve to define the interests and issues establishing the scope of the analytical work being developed for the Treaty Review. At the center is the Sovereign Review Team (SRT). Formed in October 2010, the SRT is a group of regional sovereigns with whom the U.S. Entity is working to develop a recommendation on the appropriate future of the Treaty. Representatives of the four Northwest states, 15 tribal governments and 11 Northwest federal agencies are cooperating in this process. Supporting the SRT is the Sovereign Technical Team (STT), responsible for completing the technical work to inform the SRT and the U.S. Entity.

The second critical component of this process is the stakeholder outreach conducted by the U.S. Entity, often in collaboration with the SRT. While the alternatives analyzed were developed around the primary functions of flood risk management, hydropower production and ecosystem function, the U.S. Entity and the SRT are soliciting input from other interests including regional power, flood control, water management, irrigation, environmental and navigation. These interests will be included and considered together with sovereign interests as future analyses and recommendations are developed.

These studies are being conducted in three steps or "iterations," each building on the previous studies. Iteration 1 is complete. Iterations 2 and 3 are yet to come; thus there is an opportunity for those interested in the

outcome of the Treaty Review to share their thoughts and concerns at public Listening Sessions.

At the current early stage in the analysis (Iteration 1), the U.S. Entity and SRT have completed computer simulations that evaluated four different ways to operate the hydrosystem after 2024. These four alternatives were evaluated against a reference case that reflects current operations under the Treaty. The study results presented in this document are quantified through six physical hydrosystem attributes. These attributes are important because they allow us to compare modeling results from each alternative scenario in a common currency. (See sidebar on page 4 for details on the alternatives and physical attributes.)

The next round of computer modeling (Iteration 2), which the U.S. Entity and SRT expect to complete by the end of 2012, will consider effects on a broader range of needs of Northwest river users, tribes and stakeholders, including irrigation, water supply and quality, navigation, recreation, cultural resources, fish protection operations and ecosystem function needs, as well as potential effects of climate change.

The U.S. Entity and SRT want to hear the concerns and interests of Columbia River users and other stakeholders as the next computer simulations are developed. This is an important opportunity to participate in the Columbia River Treaty 2014/2024 Review process.

The U.S. Entity will continue hosting public Listening Sessions with interested stakeholders throughout the region to review, discuss and refine the next step in these analyses. It is important to underscore that these findings only represent an early step in a multi-year process. The analyses are expected to evolve as the next, more complete, round of studies is developed and refined.

What was learned from the current studies?

After completing the most recent computer simulation, the U.S. Entity and SRT reviewed the results to see how each operational alternative compared across four key areas. These key areas are:

- Flood risk management
- Hydroelectric power generation
- Reservoir elevation and river flow
- Ecosystem and Biological Opinion

Under the Treaty, the U.S. sends power to British Columbia that, under a specific set of assumptions, would be equal to half of the downstream hydropower benefits produced in the United States from the operation of the Canadian Treaty dams. This payment is known as the “Canadian Entitlement.” In addition to evaluating the four key areas above, a rough estimate of the amount and dollar value of the Canadian Entitlement for the year 2024 was calculated for the studies.

Let’s look at a quick summary to see how the different alternatives compare in each of those four key areas. For the purposes of these analyses, an assumption had to be made about how those operations might change. These assumptions can have a significant effect on the outcome of the computer simulations. Primarily, it was assumed that to the extent possible, Canada would optimize its dam operations for electric power production.

FLOOD RISK MANAGEMENT. The alternatives evaluated in Iteration 1 included three different flood risk management operations. They included continuation of the current coordinated flood control operation, which stays in place under the Treaty up to 2024, plus procedures for implementing Called Upon flood control after 2024 with two different flood flow objectives, 450 and 600 thousand cubic feet per second (or kcfs), as measured at The Dalles Dam. Kcfs refers to water passing a specific point in the river — in this case The Dalles Dam — at a rate of 450,000 cubic feet



Columbia River Gorge

each second; for reference, 1 cubic foot of water is about 7½ gallons. Flood risk management was evaluated across four areas of consideration:

- **Effective Use** is the United States' obligation to use all available storage in U.S. reservoirs that can be effective in managing downstream flood peaks before calling upon Canada to provide additional flood storage. The studies measured the number of years that effective use flood risk management was required, the volume of storage needed, and the effects of those operations on storage elevations and refill at U.S. reservoirs.
- The Corps of Engineers had to make assumptions about how U.S. reservoirs might be operated after 2024. These assumptions are still being discussed with the SRT. The current analysis placed greater reliance on U.S. reservoirs for flood risk management before Called Upon assistance was requested from Canada. Computer simulation results using the current 450 kcfs flood protection level showed that it was necessary to implement Effective Use in 18 to 23 of the 70 study years using Treaty Continues or Treaty Terminates assumptions respectively. Using a peak flow of 600 kcfs, Effective Use was implemented only once in 70 years regardless of whether the Treaty continues.
- Effective Use is important because if United States reservoirs are being operated primarily to reduce flood peaks and duration, instead of the current coordinated operation between Canada and the United States, some of the U.S. reservoirs may be drawn down to lower water levels more frequently than they are now. Due to the natural variability in river flows and how critical forecasting is to flood storage operations, implementing effective use in the United States may limit the ability to refill a reservoir at the end of the spring runoff. Failure to refill could affect the ability to meet other needs later in the season, such as providing water for irrigation, summer fish flows and recreation.
- Studies that assumed higher flood flow objectives at The Dalles (the 600 kcfs scenarios) reduced the amount of flood storage space required in reservoirs used for flood control under the Treaty.

This finding needs to be coupled with additional analysis to truly understand the risk associated with relaxing flood flow objectives at The Dalles and reducing flood storage in the United States.

- **Called Upon Flood Control Procedures:** The studies also evaluated how often calls had to be made to Canada to change its reservoir operations to provide additional storage to manage down-

stream flooding in the United States, and the volume of storage required during those events.

- For the Iteration 1 alternatives using the current flood protection level of 450 kcfs, the Treaty Terminates scenario required more frequent Called Upon requests to Canada compared to the Treaty Continues scenario. Six years would see Called Upon flood risk management action out of

ITERATION 1

Five modeling scenarios and associated physical hydrosystem parameters

The SRT is formulating and evaluating Treaty Review alternatives in three groups or “iterations.” Each iteration will have scenarios, or “alternatives” that will be used to compare and contrast how different assumptions about the Columbia River Treaty may affect the river’s hydrosystem after 2024.

Iteration 1 is now complete and the SRT is beginning to develop Iteration 2 alternatives. Iterations 2 and 3 will be formulated and evaluated over the next year. The successive iterations will be informed and refined based on knowledge gained in the previous iterations. In addition, at each iteration, the evaluation of impacts and alternatives will become more detailed. For the first iteration, the SRT only compared and contrasted the physical effects of system operations based on the results of hydroregulation models — principally changes in reservoir operations and downstream flows. Other models and tools to quantify the impacts of alternatives, such as ecological models to evaluate effects to fish and wildlife habitat and species, will be added to the second and third iterations.

The Reference Case and four alternatives were analyzed in Iteration 1.

1. Reference Case — Current Conditions: This is the baseline against which the alternatives are compared. This provides a better understanding of how an alternative might change conditions after 2024. Because of the mandatory change in flood control operations after 2024, this case cannot be implemented after that date.

2. Post-2024: Treaty Continues with Called Upon Flood Control and 450 kcfs Flood Flow Objective:

Under this alternative, the Treaty remains in place. Current coordinated power planning protocols and procedures continue, along with Canadian Entitlement payments to Canada. The current coordinated flood control operating procedure is replaced by procedures for the U.S. to “call upon” Canada to provide storage for forecast floods that cannot be controlled by related U.S. reservoirs. The trigger for calling upon Canada is based on an objective of keeping flood flows measured at The Dalles Dam below 450 thousand cubic feet per second (kcfs).

3. Post-2024: Treaty Continues with Called Upon Flood Control and 600 kcfs Flood Flow Objective:

This alternative is similar to the previous one except that the flood flow objective at The Dalles shifts to 600 kcfs. The intent of this alternative is to evaluate the effects of the Called Upon flood control operation with a less conservative flood flow objective. While managing to this level increases flood risk and affects power production, it may have other benefits such as flows for fish. Thus the U.S. Entity and SRT decided to model what river operations might be like with this higher level of flood risk. However, further analytical work on the risk associated with this objective will be required to make an informed decision on the acceptable level of flood protection and the tradeoffs that might require.

70 study years if the Treaty were terminated, compared to four years if it continued. This is because without the Treaty, Canada would likely operate its reservoirs differently, and there would be less water storage space in Canada available to the United States to capture high flows during the spring runoff without a call for assistance from the United States.

- There were zero calls to Canada for additional flood management in the 70-year period of study for both the Treaty Continues and Treaty Terminates alternatives where the flood flow objective was set to 600 kcfs.

- **The estimated payment to Canada for Called Upon Flood Control:** The Treaty requires the U.S. to pay Canada for its operating costs and economic

4. Post-2024: Treaty Terminates with Called Upon Flood Control and 450 kcfs Flood Flow Objective:

This alternative evaluates the same Called Upon Flood Control operation used in alternative 2. However, it assumes that the Treaty is terminated so there is no longer any coordinated hydropower operation between the U.S. and Canada, and Canadian Entitlement payments end. A key element of this alternative is assumptions about how Canada might operate its reservoirs after 2024 in the absence of the coordinated Treaty operation.

5. Post-2024: Treaty Terminates with Called Upon Flood Control and 600 kcfs Flood Flow Objective:

This alternative evaluates the same Called Upon Flood Control operation used in alternative 3, with the 600 kcfs flood flow objective. However, like alternative 4, it assumes that the Treaty is terminated so there is no longer any coordinated hydropower operation between the U.S. and Canada, and Canadian Entitlement payments end. This alternative uses the same assumptions about how Canada might operate its reservoirs after 2024 in the absence of the coordinated Treaty operations as were used in alternative 4.

All five of the Iteration 1 studies do assume that environmental operating criteria required for U.S. projects under current Biological Opinions are carried forward after 2024. Although those Biological Opinions will expire before 2024, the assumption is that those basic environmental requirements, or at least similar ones, will continue after 2024, regardless of Treaty status.

The most recent studies have quantified six hydrosystem attributes for each of the four operations scenarios.

These six attributes represent physical characteristics of the hydrosystem that can be used to quantitatively evaluate how different operational paradigms affect real world conditions such as reservoir elevation. The six attributes are:

- **Inflow.** This is how much water is going into each reservoir for the 14 periods per year that system operators use when planning hydrosystem operations. The 14 periods are really just the calendar months, but April and August are each split into two because flows can be quite variable in those months.
- **Outflow.** This is how much water is flowing out of each reservoir.
- **Peak discharge.** Simply stated, that's the greatest amount of water released at each dam. Typically it will be reported as the highest outflow in kcfs.
- **Reservoir elevation.** This refers to the water level in every reservoir. These studies specify the elevation at the end of each month.
- **Project spill.** For each dam, this is how much water is being passed through spillways, as opposed to generators, as a percent of total river flow, or in kcfs.
- **Hydropower generation.** This is a measure of the megawatts produced by the hydrosystem under the various operations analyzed. Typically, these results are reported as the increase or decrease in average megawatts, or aMW, from the current reference case operation.

losses incurred when the U.S. calls on Canada for flood storage after 2024. For Iteration 1, the SRT used Canadian hydropower generation losses as a preliminary first estimate of the possible range of U.S. payments for future Called Upon flood storage.

- The results from this round of analyses indicated that scenarios under Treaty termination potentially had higher Called Upon payments for the United States than those in which the Treaty continued. Without the Treaty, Canada is likely to operate its reservoirs differently, and there would be a bigger change in operations (and a higher cost to the United States) for Canada to provide flood control storage to the United States.
- The use of Called Upon has financial implications because there will be a cost to the United States associated with those requests to Canada for flood control. The preliminary estimates of Canadian hydropower revenue losses due to Called Upon were between \$4 million and \$34 million per request. These estimates are only for Canada's direct operational revenue losses from using its hydrosystem differently than it otherwise would if it were not providing flood risk management to the United States. Because the U.S. would reimburse Canada for these losses, they represent a cost to the U.S. The average annual cost of Called Upon and the addition of other possible cost obligations will be calculated in the next round of analyses.
- **Peak river flows** are a critical component of flood risk management. Iteration 1 evaluated the change in peak flood flows.
 - The computer simulations indicated that the highest river flows—or peaks—increased for most years under the 600 kcfs alternatives. Higher peak flows may indicate a potential increase in flood damage in parts of the Columbia River Basin; however additional analysis is required to better estimate the potential consequences of a 600 kcfs

flood flow objective combined with post-2024 Called Upon flood risk management.

- The 600 kcfs alternatives resulted in higher peak flows—an average of 17 to 21 kcfs higher—than the 450 kcfs alternatives. In the top 10 wettest years, this average difference increased to 28 to 49 kcfs. The effect of higher peak flows with the 600 kcfs alternative was generally more pronounced in higher water years. Higher flows may indicate increased flood risk but may also be associated with a greater likelihood of meeting flow targets for fish, for example.

HYDROELECTRIC POWER GENERATION. The various alternatives studied in this analysis changed the timing of how much water flowed down the river. For example, changing winter and summer flows have an influence on hydroelectric power generation in those seasons. Higher flows in the spring may exceed the capability of generators to use the water for electricity production, while lower winter and summer flows may make it more difficult to meet the higher demand for electricity at those times of year.

The results presented in the bullets below are the average across the 70 historic water years used as a basis for hydrosystem analyses. In this context, generation is expressed in average megawatts or aMW. At its simplest, an aMW refers to the production of one megawatt continuously over one year.

- Under the Treaty Continues alternatives, initial computer simulation results suggested the United States had an overall loss of revenue (about \$4 million to \$34 million), while for Canada they ranged from some loss, to a gain (\$500,000 loss, to gain of \$2 million).
- Treaty Termination resulted in an overall increase in annual revenue for the United States (about \$180 million to \$280 million), but a decrease for Canada (of about \$220 million to \$320 million).
- Additionally, if the Treaty is terminated, the United States will no longer be obligated to pay the Treaty



Vanport flood of 1948

Canadian Entitlement to Canada. Based on the Iteration 1 evaluation, the value of this payment is forecast to have an annual value of \$229 million to \$335 million. This range is dependent on assumptions made about the price of energy.

- Revenue associated with the Treaty is generated or forgone by BPA ratepayers. All revenue estimates were computer modeling results that depended on assumptions about the price of electricity.

RESERVOIR ELEVATION AND RIVER FLOW.

Reservoir elevations and river flows were influenced by three factors in the studies. First, the assumed flows from Arrow reservoir in Canada had a large effect on the flows down through the Columbia River all the way to its mouth. The amount of water released from Arrow was a result of the Treaty assumptions for each study.

Generally, if the assumption was for the Treaty to continue:

- Water released from Arrow Lake in Canada was guided by Treaty flood control and power requirements. This resulted in higher winter flows out of

Arrow for power needs, lower spring flows as the Treaty reservoirs refilled from the spring snowmelt, and higher flows for power needs in low flow months in the summer.

Under scenarios in which the assumption was for the Treaty to terminate:

- The assumed outflows from Canada's Arrow Lake were relatively constant across the year for the one scenario simulated. This change in Arrow operations from current conditions was a result of optimizing power operations in Canada solely for Canada's benefit.

Second, the reservoir elevations and river flows were influenced by how often and to what extent the U.S. had to show effective use of its reservoirs before calling on Canada for storage. In general, effective use caused some of the U.S. reservoirs to be drawn down to lower water levels more frequently than they are currently, and in a few cases, not refill as often compared to years when effective use was not used.

Lastly, the less conservative flood risk operations in the 600 kcfs alternatives resulted in higher reservoir elevations at some of the projects, including Grand Coulee, Dworshak and Brownlee, because their water levels were not drawn down as far as they might be under other alternatives.

ECOSYSTEM AND BIOLOGICAL OPINION.

Biological Opinions, or BiOps, are documents issued by regulatory agencies — in this case NOAA Fisheries and the U.S. Fish and Wildlife Service — outlining the steps BPA and the Corps of Engineers (as well as the Bureau of Reclamation) must take to protect fish and wildlife affected by the operation of the federal dams in the Columbia River Basin. There are generally no significant changes in Snake River flows under the scenarios presented here, so BiOp objectives in that basin would be largely unaffected by any of these outcomes. There was also little difference among alternatives in the Pend Oreille sub-basin.

Columbia River flow will likely change depending on whether the Treaty continues or terminates. This has the potential to affect broader ecosystem functions as well as specific BiOp operations. Additional analysis is needed to evaluate the significance of potential changes. In these studies, options under which the Treaty terminated reduced winter and late summer flow on the Columbia, while there was an increase in early spring flow. Lower summer flows may affect the likelihood of meeting summer BiOp flow targets for fish, and reduction in winter flows could affect wintertime salmon protection flows. Effective Use

requirements periodically resulted in lower reservoir elevations and — for most of the reservoirs used for system flood risk management — increased the number of times the U.S. reservoirs were unable to fully refill. Reservoirs that are not full may have implications for salmon flows, resident fish, recreational users and possibly water availability for irrigators.

What's next?

The U.S. Entity has summarized the results of the most recent analyses. The information will be posted at www.crt2014-2024review.gov.

The U.S. Entity and SRT are hosting regional Listening Sessions in June and July to review, discuss and refine the next step in this effort. This is an important phase in the further development of the Treaty Review. With additional analyses that you can help shape, the process will lead to a recommendation on the future of the Treaty.

For more information on the Columbia River Treaty Review effort, contact the Columbia River Treaty Review team at treatyreview@bpa.gov, or for technical reports, go to www.crt2014-2024review.gov.

This publication of the 2014/2024 Columbia River Treaty Review was developed to inform you of issues surrounding the Columbia River Treaty. It is published by the U.S. Entity, which includes the Bonneville Power Administration and the U.S. Army Corps of Engineers. For more information, call the Bonneville Power Administration at 1-800-622-4519 or the U.S. Army Corps of Engineers at (503) 808-4510.



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