

# EXECUTIVE SUMMARY

## Overview

Water Use Planning was announced in 1996 to ensure provincial water management decisions reflect changing public values and environmental priorities. A Water Use Plan (WUP) is a technical document that, once approved by the provincial Comptroller of Water Rights, defines how water control facilities will be operated. The purpose of a Water Use Planning process is to develop recommendations defining a preferred operating strategy using a public participatory process.

The Coquitlam-Buntzen hydroelectric development is located approximately 24 km east of Vancouver on the shores of Indian Arm. The system is the oldest hydroelectric facility in the Lower Mainland, and contributes just over 7 percent of regional generating capacity for the Lower Mainland/Coastal/Fraser Region (about 0.4 percent of BC Hydro's total capacity). Water for the Coquitlam-Buntzen system originates in the **Coquitlam River**, which flows from the Lower Mainland coastal mountains south to the Fraser River via the **Coquitlam Reservoir**. Tunnels divert water from the Coquitlam Reservoir to the Greater Vancouver Regional District (**GVRD**) for domestic water and to **Buntzen Lake Reservoir** where the intakes are located for the two **powerhouses** situated on the shore of **Indian Arm**.<sup>1</sup>

Coquitlam Reservoir is closed to the public and has no fish access other than for resident species. It is one of three Lower Mainland drinking water sources for the GVRD. Buntzen Reservoir and the Coquitlam River (downstream of the dam) are widely used for recreation. Buntzen Reservoir is artificially stocked with fish and also supports some wild resident species. The Coquitlam River is an important environment for fish and wildlife and has received a great deal of attention from local and provincial interest groups over the years. The area encompasses provincial, regional, and municipal parks as well as extensive urban development. There are also a number of gravel operations adjacent to the river. Since construction of the hydroelectric facilities in 1903, access by anadromous fish to the river is restricted to 17-18 km from the Fraser River to the dam. Serious concern about the decline of salmonid populations in the Coquitlam River has been expressed since the early 1980's. In response, several enhancement and conservation initiatives were introduced, including escalation of minimum flow releases, hatchery production, and off-channel habitat creation. The Coquitlam Reservoir provides significant downstream flood control benefits to municipalities and to the Kwikwetlem First Nations reserves, IR#1 and IR#2, both located adjacent to the river. The Coquitlam- Buntzen hydroelectric system is in the asserted traditional use areas of five First Nations: Kwikwetlem First Nation, Tsleil-Waututh First Nation, Katzie First Nation, Squamish First Nation and Musqueam First Nation. It is also within the asserted traditional territory claimed by Sto:lo Nation.

## The Consultative Committee

The structure of the Consultative Committee (CC) was inclusive with two levels of involvement, active and observer status. Active participants attended most CC meetings and were directly involved in making decisions, whereas observer status enabled members to attend meetings to observe the proceedings and to receive meeting minutes. The Consultative Committee began with 37 active members and 18 observers (December 1999) but some active members changed to observer status as the process advanced. Others

---

<sup>1</sup> GVRD (Greater Vancouver Regional District) is meant to refer to both the geographical area of the GVRD and the services provided by the GVRD and its drinking water supply utility (Greater Vancouver Water District, GVWD).

were replaced by different people from their organization or left the process because others represented their interests on the CC. At the end of the process, there were 26 CC members of whom 22 were on the original committee.<sup>2</sup> In addition, 36 people received Consultative Committee minutes (see Appendix C for a complete listing of who received the minutes).

The Consultative Committee as a whole met 22 times, from November 8, 1999 to March 11, 2002 to move through steps outlined in the provincial *Water Use Plan Guidelines*. During this time there were also 65 additional subcommittee meetings held to aid the CC's work: involving First Nations, technical committees, and other working groups.

## Objectives

The committee explored issues and interests that could be affected by facility operations and from this a list of objectives was drawn up for the Coquitlam-Buntzen Water Use Plan (see Table ES 1 below). The CC then established performance measures that determined the degree to which each objective would be achieved by changes to the facilities' operations. Where possible, performance measures were modelled quantitatively. In other cases, impacts were described qualitatively.

**Table ES 1: Objectives for the Coquitlam-Buntzen Water Use Plan**

<b>Archaeological, Cultural &amp; Historical</b>	<ul style="list-style-type: none"> <li>? Maximize access for First Nations traditional uses</li> <li>? Maximize access for recovery of artifacts/inventory of sites</li> <li>? Maximize protection of sites from erosion, pot hunting, flooding</li> </ul>
<b>Domestic Water</b>	<ul style="list-style-type: none"> <li>? Maximize reliability of access to water supply</li> <li>? Minimize cost</li> </ul>
<b>Fish (Coquitlam River)</b>	<ul style="list-style-type: none"> <li>? Mimic natural hydrograph</li> <li>? Maximize the availability of suitable (fish) habitat</li> <li>? Optimize secondary (invertebrate) productivity</li> </ul>
<b>Fish (Coquitlam Reservoir)</b>	<ul style="list-style-type: none"> <li>? Optimize secondary productivity</li> </ul>
<b>Flood Control (Coquitlam River)</b>	<ul style="list-style-type: none"> <li>? Minimize adverse effects of flood damage &amp; public safety</li> </ul>
<b>Hydroelectricity</b>	<ul style="list-style-type: none"> <li>? Maximize the financial value of power generation</li> <li>? Minimize the loss of generating capability in the Lower Mainland</li> </ul>
<b>Industry (Coquitlam River)</b>	<ul style="list-style-type: none"> <li>? Improve gravel industry storm management through sediment dilution</li> </ul>
<b>Recreation (Coquitlam River)</b>	<ul style="list-style-type: none"> <li>? Maximize opportunities for recreation on Coquitlam River</li> <li>? Maximize quality of recreation</li> <li>? Maximize public safety</li> </ul>
<b>Wildlife/Environment</b>	<ul style="list-style-type: none"> <li>? Maximize the area &amp; suitability of aquatic &amp; riparian habitat for indigenous wildlife, including species at risk and organisms not captured by fish objectives.</li> </ul>

<sup>2</sup> This tally includes neither the First Nations representatives nor representatives from the Ministry of Sustainable Resource Management and the City of Coquitlam whose status changed from member to observer near the end of the consultation period. It also excludes one of the DFO representatives on the Committee who left for maternity leave before the final trade-off meeting.

Throughout the process, the CC removed several objectives and associated performance measures from further consideration because they did not aid in decision making between the alternatives or it was recognized that changes in operations had an insignificant affect on the performance measure. These are listed below with a short rationale.

- ? Archaeological, Cultural and Historical objectives: only archeological sites were affected by BC Hydro operations and the CC accepted Kwikwetlem First Nation's recommendation that these should be addressed directly with BC Hydro, GVRD and First Nations.
- ? Flood Control: BC Hydro's current operations, which lowers the reservoir elevation before the fall storm season, and the use of a 1 meter flood buffer was applied to each alternative. Acceptance of these operational procedures by the CC addressed their concerns regarding concerns related to public safety and property damage.
- ? Fish (Coquitlam Reservoir): the changes to this objective from the final set of alternatives were considered insignificant.
- ? Industry: a current minimum in-stream flow (.65 cms) was established so that changes from alternatives were considered marginally beneficial to industry storm water management.
- ? Recreation (Coquitlam River): a current minimum in-stream flow (.65 cms) was established so that changes from alternatives were considered marginally beneficial.
- ? Wildlife/Environment: due to the maintenance of the current minimum in-stream flow (.65 cms) in all alternatives, concerns about adverse impacts to the low bench ecosystem were addressed and therefore, given the range of alternatives considered by the CC, the performance measures for this objective did not significantly change.

The CC also developed objectives for Buntzen Reservoir and Indian Arm. Issues at Buntzen Reservoir were addressed through recommended reservoir elevations in the summer, and issues at Indian Arm were not pursued by the CC as preliminary analysis suggested water use plan alternatives would have little or no effect.

Fish in Coquitlam River, Domestic Water and Hydroelectric Power objectives experienced significant change resulting from the final alternatives considered by the CC.

## **Alternatives**

Based on the objectives adopted for each interest, different operating changes were suggested and evaluated by the Consultative Committee. The changes fell into three categories, each of which was separately evaluated:

- ? Flow alternatives each consisting of target monthly flow nominations to GVRD and the Coquitlam River;
- ? Flushing flows (also referred to as system maintenance flows) to improve the quality of habitat in the Coquitlam River, downstream of the dam;<sup>3</sup>
- ? Operating protocols and procedures which would be applied to every operating alternative:

---

<sup>3</sup> Operating alternatives were evaluated without incorporating the effects of flushing flows primarily because of the high degree of uncertainty associated with trying to quantify fish benefits for this Water Use Plan.

- ? Satisfy recreation & public safety objectives on Buntzen Reservoir; and
- ? Address issues related to specific flooding, domestic water, fish, and emergency power situations.<sup>4</sup>

During the WUP process, over 24 operating alternatives were considered and these were eventually narrowed and combined to six flow alternatives. One opportunistic flushing flow experiment was also recommended. In addition, numerous operating protocols were adopted (mostly from current operating procedures) and carried forward into the operating alternatives considered. From the final six alternatives, two alternatives formed the basis for the recommendations adopted by the consultative committee at the last decision making meeting (Oct 2001) and these (as well as the base case) are briefly described below:

**Reference Base Case (2FVC):** 2 Fish Valves always open with the GVRD current agreement: this alternative reflects the current situation under existing agreements (although the GVRD does not typically use all their water allocations at present as allowed under their current agreement).

**(4FVN):** 4 Fish Valves New (Optimized) with GVRD proposed agreement: this alternative is equivalent to a doubling of current river flows through the existing 2 fish valves and includes the GVRD water nominations described in their proposed agreement. River flows are optimized on a monthly basis according to fish requirements.

**(STP#5):** “Sharing the Pain” (STP) alternatives were designed to provide a target flow nomination to both the river and GVRD on a monthly basis. The “Share the Pain” idea is to try and accommodate both domestic water objectives and in-stream flow objectives more equitably during dry water years and therefore ‘share the pain’. The STP#5 alternative (like other STP alternatives considered) varies according to target flows, seasonal priorities and yearly rainfall between domestic water, water for fish down the Coquitlam River, and water for power. The prioritization is operationalized according to target reservoir elevations. For example, BC Hydro diversion from Coquitlam Reservoir is the first to be restricted when the reservoir elevation drops by approximately 1 metre below target levels. When the reservoir elevation drops further (approximately 2 m below target elevation) depending on the priority of the water user, nominations are gradually reduced to the minimum targets for both/either GVRD and river flows.

All alternatives included a flood buffer (1 metre) and minimum in-stream flow (.65 cms). The minimum in stream flow includes up to .25cms discharge into Grant’s Tomb pond, currently delivered through GVRD’s intake and piping facilities.

## **Trade-offs**

Among the alternatives considered at the final CC meeting, domestic water, fish and hydroelectric objectives experienced the greatest change. The CC focused on alternatives that first attempted to satisfy domestic water and fish objectives. However, during dry years none of the alternatives could provide the minimum water needs to satisfy both domestic water and fish requirements during the summer months, excluding hydroelectric power production altogether. Facing these trade-offs, two alternatives emerged as the final “frontrunners”: 4FVN and STP#5, as described in the previous section. The key trade-offs between these two alternatives, using indicator performance measures, are described below and highlighted in Table ES2.

---

<sup>4</sup> Emergencies include those required to address dam safety, actual or potential loss of power supply to customers, dam breach or potential dam breach, extreme flood flows, fire or explosion, environmental incidents, major equipment failure, or threat to employee or public safety.

- ✍ For domestic water, the performance measure shown in Table ES2 reflects the annualized cost savings associated with developing an alternative water source later than would be required, based on the GVRD satisfying their future use nominations of water from the Coquitlam reservoir in their proposed agreement. The annualized cost saving to the GVRD and ratepayers is \$3.7 million for 4FVN and \$1.8 million for STP#5 (a difference of \$1.9 million annually)<sup>5</sup>.
- ✍ For hydroelectric power, the performance measure shown below is the average annual revenue to BC Hydro (including VOE and GVRD payments), which is \$8.0 million for 4FVN and \$7.2 million for STP#5 (a difference of \$800,000 annually; revenue under current operations is \$9.4 million).
- ✍ For fish in the Coquitlam River, rearing habitat is one of the key limiting factors. Table ES2 highlights the difference in expected rearing habitat using the weighted useable area (referred to as WUA and is calculated by weighting habitat quality considerations for different sections of the river) for steelhead parr, which is considered the most sensitive species and therefore a good indicator of all rearing habitat. Projected habitat gains (over current operations) are 8,500 m<sup>2</sup> for 4FVN and 16,100m<sup>2</sup> for STP#5 (difference of 7,600m<sup>2</sup>). However, this habitat measure was criticized as not sufficiently sensitive, particularly considering the importance of flows during the summer months. Therefore, CC members often cited a flow threshold performance measure which indicated the frequency with which river flows did not meet minimum rearing requirements (based on 20% of the mean annual discharge) for steelhead during August, also shown in Table ES2. Under the 4FVN alternative, these minimum flows are not met 87% of the time while under STP#5 they are not met 58% of the time (a difference of 29%).

**Table ES 2: Impacts to Objectives using Key Performance Measures**

<b>Objective (performance measure)</b>	<b>4FVN</b>	<b>STP#5</b>
<u>Domestic Water</u> : (GVRD annualized capital costs savings for development of a new water source compared with current agreement and operations ) (millions)	\$3.7	\$1.8
<u>Hydroelectric Power</u> : (BC Hydro annual average revenue losses from current operations) (millions)	\$1.4	\$2.2
<u>Fish</u> : Steelhead Parr rearing (increase in habitat – weighted usable area in sq. metres – over current operations)	8,500	16,100
<u>Fish</u> : Steelhead Parr (Flows less than 5.4cms at PoCo gauge in August)	87%	58%

Significant uncertainty also played an important role in assessing trade-offs, especially regarding how fish would respond to increased flows. This uncertainty was largely attributed to (1) incomplete field studies resulting from a lack of water for flow trials during the WUP timeframe, (2) how fish habitat areas would improve with increased base flows given the poor condition (high embeddedness) of the substrate, and (3) how fish habitat areas would improve with the use of opportunistic flushing flows (described in detail in Section 6.4). Also weighing into the trade-off discussions was the certainty that the GVRD was looking for in order to make long term planning and development decisions. It was recognized that in the short

<sup>5</sup> GVRD estimated the following annualized capital costs associated with having to raise Seymour Dam *earlier* than would be necessary if GVRD secured the proposed water allocation agreement from Coquitlam Reservoir: current agreement (2FVC): \$6.3 million; 4FVN: \$2.6 million; STP5: \$4.5 million. Thus cost savings associated with going from 2FVC to 4FVN are \$3.7 million (\$6.3 million less \$2.6 million) and cost saving associated with going from 2 FVC to STP5 are \$1.8 million (\$6.3 million less \$4.5 million).

term they might not immediately need their proposed nominations for domestic supply (but may depending on their other supply reservoirs). Similarly, BC Hydro expressed the importance of operating certainty regarding hydropower planning and operations.

## **Value-Based Trade-offs**

The importance of these technical trade-offs was captured through formal value-based analysis and discussion at the final decision making meeting held in October 2001. This analysis indicated that value-based thresholds limited the opportunity for consensus on a single alternative. The 4FVN alternative was “Blocked”<sup>6</sup> by nine CC members including the provincial fish representative, NGO representatives and local citizens. In addition, three others expressed major reservations with this alternative including the representative from the Department of Fisheries and Oceans and two local NGO representatives. They consistently cited a lack of flow for fish, particularly during the summer months, as their primary reason for blocking the 4FVN alternative.

GVRD and BC Hydro representatives blocked the STP#5 alternative. The GVRD representatives indicated that fish benefits beyond 4FVN did not appear to warrant the trade-off with domestic water, a value judgement that was compounded by the significant uncertainty surrounding the potential benefits to fish objectives. Furthermore, the GVRD representatives stated that they did not have a mandate from their board to support anything beyond the 4FVN alternative and the GVRD board would require a sufficiently strong case for fish benefits to support any flow alternatives greater than 4FVN. BC Hydro representatives cited the uncertainty regarding fish benefits, in terms of fish response to increased flow levels and in regards to other factors, such as substrate quality, as not justifying the trade-off with power and domestic water values.

One local resident initially blocked both alternatives because he could not support any alternative that provided additional water to the GVRD, which would support regional population growth, but expressed support for providing additional flows to the Coquitlam River for fish and to BC Hydro for power.<sup>7</sup>

In summary, the two most significant reasons for a lack of consensus to a single flow alternative were: 1) the uncertainty associated with the fish performance measures; and, 2) the need for operating certainty for BC Hydro and GVRD. Therefore, the CC generated a new adaptive management alternative at the final meeting to address these issues and arrive at a consensus recommendation.<sup>8</sup>

## **Recommendations**

The consensus recommendation from the CC identifies an operating plan that incorporates an adaptive management program (flow testing and monitoring) to help address uncertainty and make more informed recommendations within fifteen years. At the core of the consensus agreement are flow and time parameters. The agreed upon adaptive management program consists of two flow trials: the first is the operating alternative 4FVN and would continue for 6 years; the second, a higher flow alternative, is STP5 (or slightly less depending on the results from the still to be completed In-stream Flow Needs Assessment) and would also continue for 6 years. The entire adaptive management program was

---

<sup>6</sup> Defined as one or more CC members who would not accept the alternative.

<sup>7</sup> In the end, this CC member (an area resident) expressed strong reservations about the agreement but accepted the group’s decision and arriving at consensus (see following footnote).

<sup>8</sup> Consensus is defined as all CC members who attended the October 22, 2001 CC meeting supporting the Consultative Committee’s final recommendations.

recommended to be complete within a 15 year time period<sup>9</sup> (starting from October 2001). It was further agreed that any future WUP operating regimes be constrained (in terms of volume of water allocation down the Coquitlam River) between 4FVN and STP5; this provided the GVRD with the certainty they required for their future planning and capital works decisions and fish interests with an increased minimum in-stream flow level.

The CC also accepted the FTC’s recommendation to perform an opportunistic flushing flow test<sup>10</sup>. However upon further review (after the October 2001 CC meeting), the FTC recommended to not implement opportunistic flushing flow experiment within the review period of this WUP (depending on the results of the statistical power analysis, described below), as it may confound the results from the adaptive management program.

Table ES3 is a summary of the operating recommendations agreed to at the October 22<sup>nd</sup>, 2001 CC meeting.

**Table ES 3: Summary of CBWUP Operating Recommendations<sup>11</sup>**

<b>Operating Recommendations</b>	<b>Comments</b>
Instream Flow Needs (IFN) Assessment	? Complete the IFN study (that began with this WUP) as soon as possible (anticipated to be within the next 2 years) and this information is to be used to finalize the second test flow (STP5) parameters
Change one low level (LLO) outlet at Coquitlam Dam to permit 4FVN & STP5 flows	? Both flow regimes (4FVN & STP5) will require the same infrastructure change, allowing regulated and variable flows through one of the LLOs (expected to be complete within 2-3 years)
<u>Adaptive Management Program</u> Implement and monitor 2 flow trials: ? Test flow #1: 4FVN and ? Test flow #2: STP5 or less	? Part of adaptive management program to test fish benefits from increased flows to Coquitlam River ? 10-12 years to better understand benefits to fish from higher dam flow releases to the Coq. River to inform review ? Test flow #1 will be tested first ? Test flow #2 to be selected after due consideration of IFN results ? Both test flows will be complete within 15 years of Oct 2001 ? Develop a monitoring plan with clear design measures (by the FTC)
Recommend that a Monitoring Committee be formed	? For duration of review period to oversee implementation of the adaptive management program & to ensure that there is sufficient information in place by the end of the review period to determine the fish benefits of both test flows & to enable a better understanding of trade-offs between fish, domestic water & power generation. ? Agreed that results from the committee be made available to the community through an information session to be held annually.
After monitoring, recommend and implement “final” flow alternative between 4FVN & STP5	? To follow 10-12 year flow testing program ? Agreed that future flow regimes to the river will not be less than 4FVN, will not exceed STP5, and that all water allocations within the 4FVN & STP#5 will be on the table for review at that time. ? To be done within 15 years or less from October 22, 2001

<sup>9</sup> This timeframe was selected to coincide with the GVRD’s future planning needs to clarify water allocations in the Coquitlam reservoir

<sup>10</sup> The opportunistic flushing flow test is dependent on coordinating flows in Or Creek; as a result the timing is unpredictable.

<sup>11</sup> “4FVN” represents approximately a doubling of the present fish flows to the river, an increase in flows to GVRD, and a reduction in flows to the power generating station. “STP5” represents higher flows to the river and lower flows to GVRD and power than “4FVN”. A more detailed explanation of these operating alternatives is found in Chapter 5 (“Operating Alternatives”).

Operating Recommendations	Comments
Implement and monitor opportunistic flushing flow experiment as recommended by FTC and subject to monitoring program design <sup>12</sup>	? To be incorporated into adaptive management program design ? In coordination with the FTC's recommendations, the CC supported the testing of an opportunistic flushing flow experiment with the monitoring program ? Fish and other impacts to be monitored ? Incorporate continued investigation of other possible options for substrate maintenance.
Operationalizing target flow rates for the flow trials	? Target flow releases from Coquitlam dam would be modified once per week and only if the release is outside of +/- 10% range of the target, except for July and September when -10% becomes a hard constraint.

Finally, there were a number of recommendations and/or acknowledgements, which were made during the course of this WUP which were accepted by the CC and are summarized below:

Operations:

- ? BC Hydro system emergency situations would take precedence over the Water Use Plan alternatives. Historically these events are very rare and of a short-term nature (normally hours). Emergencies include those required to address dam safety, actual or potential loss of power supply to customers, dam breach or potential dam breach, extreme flood flows, fire or explosion, environmental incidents, major equipment failure, or threat to employee or public safety.
- ? Ramping rates at Buntzen #1 and #2—no restrictions apply
- ? Diversion tunnel between Coquitlam and Buntzen reservoirs—no restrictions apply
- ? Ramping rates at Coquitlam dam—these are considered a *work-in-progress* and no ramping rates were agreed to. This item is to be finalized as a part of the monitoring program. However, the CC agreed to target ramping rates based on DFO's suggested maximum water level changes in the river of 5 centimeters per hour. In the interim (until an accurate stage/flow relationship is established) the following three-step ramping rate protocol is proposed as a starting point:
  - ? Above 7.1cms, ramp down at 9.5cms (cubic metres per second/hour)
  - ? Below 7.1cms, ramp down at 0.71cms per every half hour
  - ? Below 2.8cms, ramp down at 0.42cms per every half hour
  - ? Ramping up rates are currently at 9.5cms/hour
- ? The CC recommended the following reservoir target elevations for the Buntzen Reservoir<sup>13</sup>:
  - ? Restrict minimal operating level to 122.2m between 15 May to 1 October during daylight hours

<sup>12</sup> The FTC has subsequently recommended that opportunistic flushing flows (OFFs) be postponed until after the review period and flow trials have been conducted so as to not confound the monitoring results. There may be an opportunity to carryout OFFs if the flow trials are completed earlier than expected (i.e. if preliminary flow trials show conclusive results and/or their duration reduced), or if there is a weak correlation between increased flows and habitat improvements.

<sup>13</sup> Operating levels specified in the plan were implemented by BC Hydro in June 2001 prior to final CC approval of the plan in January 2002.

- ? At other times the operating range is 120.09-122.9 m<sup>14</sup>
- ? When emergency drawdowns below this point are required, the Buntzen Reservoir Warden will be contacted. A procedure is being developed for employing additional staff and placing additional signage to advise the public of the increased hazard when such drawdowns do occur.
  
- ? The operational and maintenance requirements at Grant's Tomb (a tripartite agreement between DFO, BC Hydro, and GVRD) were not addressed within this WUP. However, the allocation of water (up to 9 cubic feet per second) was included in the operating alternatives.

Other issues and recommendations (outside the scope of this Water Use Plan):

- ? First Nations access to the Coquitlam Reservoir is best addressed through direct consultation between First Nations and GVRD.
- ? The development of an Archeological Management Plan between BC Hydro, First Nations, and GVRD was acknowledged to be First Nations' preferred approach to address archaeological issues.
- ? The CC supported the idea for the Kwikwetlem First Nations' desire to restore sockeye to the Coquitlam Reservoir.<sup>15</sup> However, this issue was considered beyond the scope of this water use plan, but was to be addressed through the Bridge Coastal Restoration program<sup>16</sup>. It was recommended by the CC that if efforts are undertaken to return sockeye to the Coquitlam reservoir, that this should trigger the re-opening of the WUP. The GVRD indicated that they would support the return of sockeye assuming it would not significantly impair drinking water quality.
- ? Tower Creek (located just upstream of the Coquitlam Dam) is now being wholly diverted into the Coquitlam River. Committee members expressed a concern that the creek is being diverted directly into the river only when it is turbid. GVRD representatives indicated that this occurs only during the winter months and agreed to look into the issue, but pointed out that this is a larger issue would need to involve other agencies and would need to be resolved outside this WUP.

## **Expected Impacts from the Adaptive Management Program**

The impacts from the adaptive management program (aside from addressing the high level of uncertainty associated with fish impacts and benefits) according to each of the principal trade-off objectives—domestic water, fish and power—are summarized in Table ES4 below. These impacts are based on comparisons to current operations and referred to as the *reference base case* (2FVC). Some of these impacts are uncertain and are designed to be addressed as a part of the adaptive management program.

---

<sup>14</sup> Although the operating range is not being changed, the way in which BC Hydro operates the reservoir during part of the year is being changed. Reservoir elevation below 120.09 m can cause vortexing at the intake; above 122.9 m creates an unacceptable risk of spilling.

<sup>15</sup> This WUP dealt with access issues for all salmonids from the mouth of the Coquitlam River to the dam.

<sup>16</sup> A feasibility study was conducted on the Coquitlam River system and concluded that it is not a strong candidate for salmon passage initiatives because of technical uncertainties around smolt screening during out migration.

**Table ES 4: Expected Impacts of the Recommended Package**

Objective	Flow Trial #1 - 4FVN	Flow Trial #2 - STP5
<b>Domestic Water</b> (values supplied by GVRD)	<ul style="list-style-type: none"> <li>? Increases regional water supply capacity on average by 4.0 cms<sup>17</sup> (from 7.88cms to 11.88cms)</li> <li>? Delay raising Seymour dam by about 23 years (2030 to 2053)</li> <li>? Delay flooding 390 ha of valley floor ecosystem at Seymour by 23 years</li> <li>? Save GVRD ratepayers approx. \$59 million by delaying costs for raising Seymour by 23 yrs (annualized costs of approx. \$3.7 million per year)</li> </ul>	<ul style="list-style-type: none"> <li>? Increases regional water supply capacity on average by 2.6 cms (from 7.88cms to 10.48cms)</li> <li>? Delay raising Seymour dam by about 15 years (2030 to 2045)</li> <li>? Delay flooding 390 ha of valley floor ecosystem at Seymour by 15 years</li> <li>? Save GVRD ratepayers approx. \$29 million by delaying costs for raising Seymour by 15 yrs (annualized costs of approx. \$1.8 million per year)</li> </ul>
<b>Fish</b>	<ul style="list-style-type: none"> <li>? Steelhead spawning habitats increase by 7700m<sup>2</sup> (50% change)</li> <li>? Steelhead parr habitats increase by 8600m<sup>2</sup> (10% change)</li> <li>? Invertebrate habitats increase by 11,500m<sup>2</sup> (12% change)</li> <li>? August short-term survival flows are provided at all times for a major portion of the river (61% improvement from current)</li> <li>? 25% improvement in spawning flow provisions for Steelhead</li> <li>? Yearly average base flows doubled: spawning and rearing habitat increase substantially over current operations</li> </ul>	<ul style="list-style-type: none"> <li>? Chinook spawning habitats increase by 4100m<sup>2</sup> (24% change)</li> <li>? Steelhead spawning habitats increase by 11,000m<sup>2</sup> (69% change)</li> <li>? Steelhead parr habitats increase by 16,100m<sup>2</sup> (18% change)</li> <li>? Invertebrate habitats increase by 22,700m<sup>2</sup> (24% change)</li> <li>? Short-term survival flows are provided year round every year (16-61% improvements over current)</li> <li>? Rearing flows provided 43% more often than current flows</li> <li>? Yearly average target base flows are almost 4 times the current flow agreement: spawning and rearing habitat for all species are improved considerably</li> </ul>
<b>Power</b>	<ul style="list-style-type: none"> <li>? Annual total power production is reduced by 65 GWh on average (from 125 to 60 GWh)</li> <li>? Total value of power production and GVRD payments is reduced by \$1.37 million per year (from \$9.4 to \$8.03 million)</li> <li>? Capital cost for modifications to one low level outlet = \$310,000</li> </ul>	<ul style="list-style-type: none"> <li>? Annual total power production is reduced by 77 GWh on average (from 125 to 48 GWh)</li> <li>? Total value of power production and GVRD payments is reduced by \$2.18 million per year (from \$9.4 to \$7.22 million)</li> <li>? Capital cost for modifications to one low level outlet = \$310,000</li> </ul>

<sup>17</sup> Cubic metres per second (cms)

## Monitoring Program

The purpose of the monitoring program (as defined by the CC) was to ensure that there would be sufficient information in place by the end of the review period to address the uncertainty of fisheries benefits and therefore provide a future committee with improved information to make better decisions. To achieve this objective, the FTC developed a comprehensive monitoring program to be used in conjunction with the two flow trials. Initially consisting of 17 components, the monitoring program was screened<sup>18</sup> by the FTC and reduced in scope to include 8 items, which are summarized in Table ES 5 below (for a complete listing of all the components considered for the monitoring program, refer to *Appendix L Detailed Monitoring Program Summary*).

**Table ES 5: Monitoring Plan Components and Uncertainties**

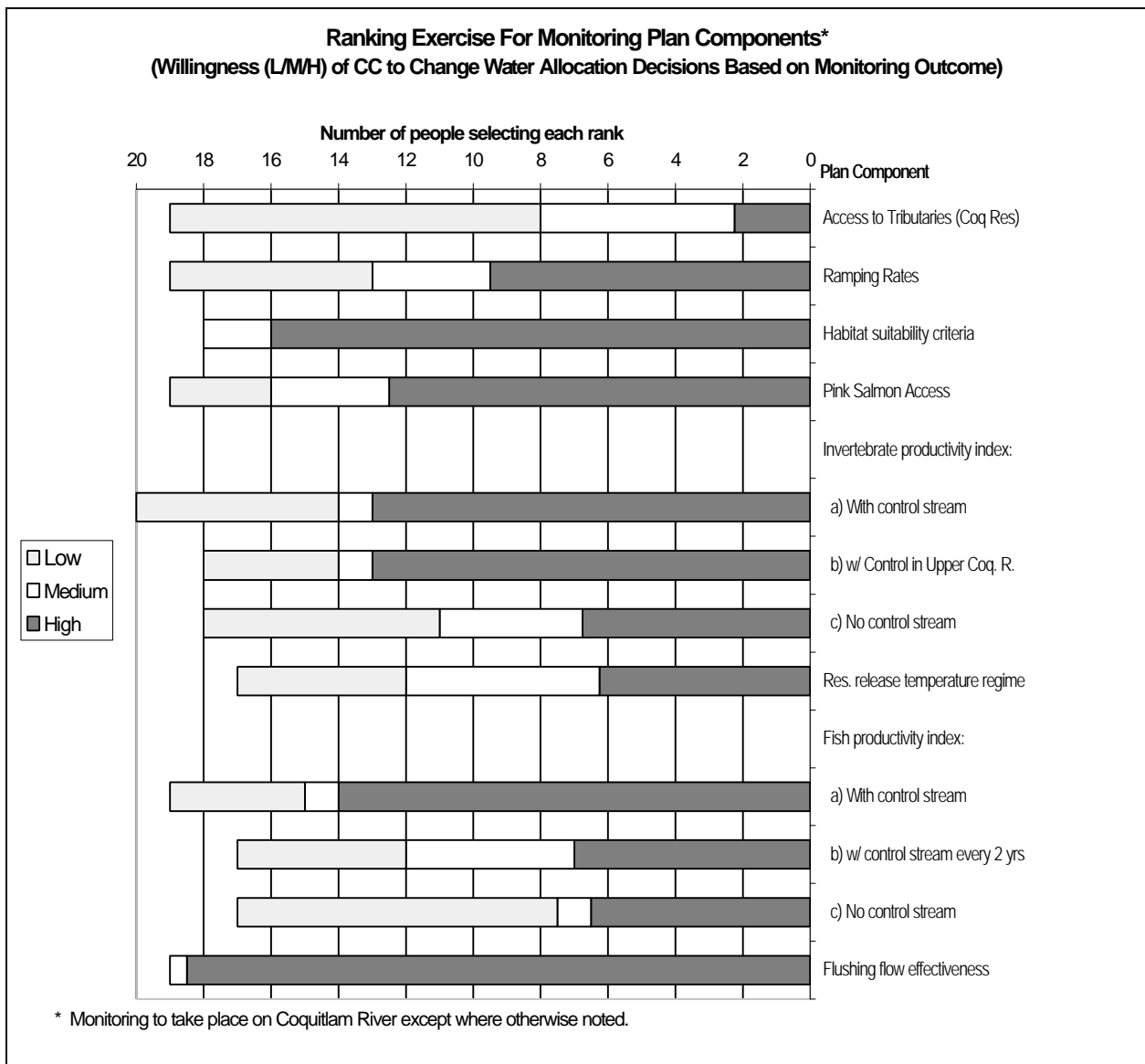
Site	Monitoring Aspect:	Uncertainty being Addressed:
<i>Reser- voir</i>	<i>Access to Tributaries</i>	Complete database of streams which have access issues associated with reservoir operations, and determine the fish use of those affected streams.
<i>River</i>	<i>Ramping Rates</i>	Need to identify the stranding and dewatering impacts associated with operational changes at the dam. Previous assessments lacked field validation.
	<i>Habitat Suitability Criteria</i>	Refine available species habitat use data by collecting in-situ data at varying flow, mesohabitat and seasonal conditions
	<i>Pink Salmon Access to Mainstem</i>	Access issues for pink salmon will be evaluated during lower September flows, to augment previous assessments which did not include pink salmon.
	<i>Invertebrate Productivity Index</i>	Determine the productive response of invertebrates to flow changes in the Coquitlam River. Invertebrate response is expected to be more immediate than for fish, and will therefore be valuable where fish responses are not detected.
	<i>Reservoir Release Temperature Regime</i>	The operational influence on release temperatures needs to be better understood.
	<i>Fish Productivity Index</i>	Determine the productive response of fish to flow changes in the Coquitlam River. A control stream will help to eliminate variables contributing to production outside of operational control.
	<i>Flushing Flow Effectiveness</i>	Determine the effectiveness of flushing flows in improving the quality of Coquitlam River fish habitat for evaluation of future water planning initiatives.

<sup>18</sup> The FTC screening process reviewed: (a) the data gap being addressed (competing hypotheses), (b) the value of information (or amount of learning) that the study would produce, (c) duration of the study to produce meaningful results (as compared to the flow trial durations), (d) timeframe that the information would be used, and (e) the study costs.

## Consultative Committee Evaluation of the Monitoring Plan

At the Final CC Meeting on March 11, 2002, the Consultative Committee was asked to evaluate the monitoring program developed by the FTC (for specific member comments and more detail see Section 7.0 and the minutes of final meeting included in Appendix K). CC members were asked to rank each component of the proposed monitoring program on a scale of high, medium, or low based on the impact they expect its outcome to have on their own water allocation choices. Of the 23 CC members at the meeting, 20 filled out evaluation forms although some completed them only partially. Rankings for each monitoring plan components are summarized below:

Figure ES 1: Ranking Exercise for Monitoring Plan Components



The estimated annual costs (over the review period) associated with the 8 components of the monitoring program are outlined in Table ES6 below:

**Table ES 6: Monitoring Program Costs (\$ in thousands)**

Site	Monitoring Aspect:	Start-Up	Treatment A: Four Fish Valves Optimized						Treatment B: "Share the Pain 5" or Less					
		Yr 1-3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15
<i>Reser- voir</i>	<i>Access to Tributaries</i>	15	10											
	<i>Ramping Rates</i>	3	12											
<i>River</i>	<i>Pink Salmon Access</i>	2		4		4		4		4		4		7
	<i>Habitat Suitability Criteria</i>	15	15						15					
	<i>Invert. Productivity Index</i>													
	<i>w/ control stream</i>	86	40	40	40	40	40	45	40	40	40	40	40	45
	<i>w/ U.Coq.R. ctrl strm</i>	71	30	30	30	30	30	40	30	30	30	30	30	40
	<i>w/o ctrl strm</i>	46	20	20	20	20	20	25	20	20	20	20	20	25
	<i>Reservoir Release</i>	5	10	5										
	<i>Temperature Regime</i>													
	<i>Fish Productivity Index</i>													
	<i>w/ control stream</i>	595	190	190	190	190	190	205	190	190	190	190	190	205
	<i>w/ ltd ctrl strm</i>	505	100	190	100	190	100	205	100	190	100	190	100	205
	<i>w/o ctrl strm</i>	415	100	100	100	100	100	115	100	100	100	100	100	115
	<i>Flushing Flow Effectiveness</i>	30				30						30		10
	<b>Totals (without control stream):</b>		<b>531</b>	<b>167</b>	<b>129</b>	<b>120</b>	<b>154</b>	<b>120</b>	<b>144</b>	<b>135</b>	<b>124</b>	<b>120</b>	<b>154</b>	<b>120</b>

## **Conclusion**

In summary, the Coquitlam-Buntzen Water Use Plan Consultative Committee succeeded in achieving a consensus on an operating strategy that will enable more informed decisions to be made on a preferred operating flow regime within fifteen years. The process was complicated by large uncertainties related to anticipated fish benefits and this was addressed through the adoption of an adaptive management program.

This document is to forward these recommendations to BC Hydro and the Provincial Comptroller of Water Rights. The consultation process provided a framework to share information and learn, promote understanding between parties and interests, explore alternative ways to operate the facilities, evaluate impacts in a structured way and thus allow each participant to make clear choices based on explicit trade-offs between technical and value-based information. Through this interest-based process, a consensus decision was reached whereby fish, domestic water, industry, and recreation interests will be all improved over current operations.

## **Important Final Note on Report Submission and Monitoring Plan Implementation**

At the final meeting held on March 11, 2002, it was brought to the attention of the Consultative Committee that there is a possibility that the two recommended flow trials might not yield meaningful results: In other words, the information gathered through monitoring may not clearly distinguish between the two flow trials and, therefore, not adequately inform a future Consultative Committee. To determine this possibility, BC Hydro is undertaking a statistical power analysis to gain insight into the effectiveness of the monitoring plan. In light of this information, the Consultative Committee agreed to submit this report to the Comptroller of Water Rights along with BC Hydro's Water Use Plan with the understanding that the report is subject to the following two conditions:

1. An effective monitoring plan can and will be implemented. "Effective" is defined as being cost effective and having sufficient statistical power to distinguish between the two flow trials as documented in this Consultative Committee Report. Modification to the proposed monitoring plan can be made (i.e. based on a review by the Fisheries Advisory Team) but the Coquitlam-Buntzen Fish Technical Committee will determine effectiveness. Any recommended changes to the monitoring plan will be submitted to the Comptroller of Water Rights and the Consultative Committee will be informed of the result.
2. If an effective monitoring plan cannot be implemented (again, subject to review and agreement by the Coquitlam-Buntzen Fish Technical Committee), the Consultative Committee will be reconvened for one final meeting to discuss alternatives and perhaps change recommendations. The results of this meeting will be submitted to the Comptroller of Water Rights.