

## Summary Tables from CRT Review Technical Studies

### Columbia System

**Table 1: Columbia River Alternatives**

Alternative	Description
Ref- TC (reference)	<p><b>Current Operating Constraints (TC)</b> – This alternative includes all current hard operating constraints and the Treaty power operations. Flows below Arrow are adjusted to meet whitefish and rainbow trout spawning flows. For whitefish, Arrow discharge is reduced in Jan and then excessive flow reductions are managed through March. Rainbow trout require increasing flow April through June.</p> <p>Appendix D provides detailed description of constraints and assumptions.</p>
Ref - TT (reference)	<p><b>Optimum Power (TT)</b> – This alternative includes all current hard operating constraints but is not constrained by the Treaty. To optimize power, Arrow reservoir is held close to full throughout the year. Trout spawning flows are met. Whitefish spawning flows are met in approximately 40% of years.</p>
Alt 3 TC	<p><b>Arrow Wildlife/Vegetation (TC)</b> – This alternative holds Arrow Lakes Reservoir lower until mid-July to allow vegetation to extend into lower elevations, provides benefits to nesting birds, increases the length of flowing river, and provides shore based recreation in the Revelstoke reach. The following maximum month end elevations are used as constraints to model this alternative: April (1427.2 ft/435.0 m) , May (1427.2 ft/435.0 m), June (1427.2 ft/435.0 m), July (1433.8 ft/437.0 m), August (1433.8 ft/437.0 m)</p>
Alt 3 TT	<p><b>Arrow Wildlife/Vegetation (TT)</b> – same as above except no Treaty constraints</p>
Alt 4 TC	<p><b>Mica Environmental/Recreation (TC)</b> – This alternative generally supports fish, navigation and recreation on Kinbasket Reservoir. Its objective is to maintain a minimum elevation of 2395 ft (730 m) year round.</p>
Alt 4 TT	<p><b>Mica Environmental/Recreation (TT)</b> - same as above except no Treaty constraints</p>
Alt 5 TT	<p><b>Fisheries hydrograph #1- Flushing flow (TT)</b> – Provide flushing flows of 200 kcfs (5663.4 cms) at Birchbank for 5 days.</p>
Alt 6 TT	<p><b>Fisheries hydrograph #2 – Sturgeon (TT)</b> – Provide flows of 185 kcfs (5238.6 cms) at Birchbank for 4 weeks starting ~ mid-June in at least 60 % of the years. The ramping up rate doubles the discharge in about 2 weeks, and the ramping down rate reduces flows to 55% of the peak flow in 4 weeks.</p>

Notes:

- 1) TC = Treaty Continue; TT = Treaty Terminate
- 2) Alt 4 TC - There were 16 out of 70 yrs where maintaining the minimum was not possible and the reservoir was drafted deeper to meet domestic load.
- 3) Alt 6 TT – in years when the peak could not be sustained for 4 weeks the operation was the same as the reference case (Alt 2 TT) to minimize cost of the alternative.

**Table 2: Performance of Alternatives in Kinbasket Reservoir**

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
<b>Kinbasket</b>												
Veg & Wildlife	Elevation bands flooded > 18 wks	# 2m bands	L	6.1	7.2	6.0	6.8	6.8	8.6	6.8	7.0	(#5)
Aquatic Productivity	Residence time	Days	H	622	529	427	687	709	496	670	727	(#7)
Heritage	Site erosion	Weighted Days	L	203	239	238	203	201	267	204	202	(#3)
Heritage	Site inundation	Weighted Days	H	524	627	568	556	555	770	555	559	(#3)
Rec - Water - Canoe	Pref range: 2404 < days < 2475	Days	H	148	170	170	145	145	185	146	146	(#2)
Rec - Water - Columbia	Pref range: 2375 < days < 2475	Days	H	52	68	69	51	52	52	52	50	(#2)
Rec - Shore - Columbia	Pref range: 2444 < days < 2473	Days	H	175	182	184	175	175	184	176	176	(#2)
Dust	Areal extent	SqKm - Days	L	1,468	1,134	1,133	1,393	1,240	991	1,407	1,229	(#6)
Erosion	Elev>=2470	Days	L	54	85	35	70	65	123	68	79	(#4)
Navigation	Downie Timber access (>=2360)	Ave Days/yr	H	348	362	365	362	364	365	363	361	(#1)

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**Table 3: Performance of Alternatives in the Mid-Columbia River**

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
<b>Mid Columbia River</b>												
Veg & Wildlife - Veg Flooding	Hectares flooded >18 wks	Hectares	L	2,352	1,388	1,388	3,234	2,352	3,426	3,234	1,871	(#11)
Veg & Wildlife - Nesting birds	% Useable habitat	Percent	H	20	48	40	-	17	-	0	70	(#13)
Veg & Wildlife - Fall Mig. Birds	% Useable habitat	Percent	H	15	87	71	-	55	-	0	34	(#13)
Aquatic - River Habitat	Functional large river habitat	Km	H	31	35	34	18	23	19	19	26	(#12)
Aquatic - Sturgeon	Larval habitat availability	Km	H	2.84	2.85	2.85	2.77	2.85	2.83	2.79	2.85	(#12)
Rec - Boat Access	Days > 1435	Days	H	64	2	21	153	26	153	145	59	(#10)
Rec - Shore Access	Days < 1435	Days	H	119	181	162	-	157	-	8	94	(#10)

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**Table 4: Performance of Alternatives in Arrow Lakes Reservoir**

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
<b>Arrow Lakes</b>												
Aquatic - Kok Trib. Access	Days > 1430'	Days	H	60	37	50	82	82	82	82	22	(#20)
Aquatic Productivity	Epilimnetic residence time	Days	H	107	101	98	95	93	84	94	70	(#7)
Heritage	Site erosion	Weighted Days	L	227	135	151	365	332	357	363	233	(#17)
Heritage	Site inundation	Weighted Days	H	190	56	95	763	524	750	735	430	(#17)
Recreation - General	1435 < days < 1440	Days	H	97	75	72	197	197	197	197	41	(#16)
Dust	days < 1410	Days	L	41	61	61	-	-	-	-	-	(#18)
Navigation	Weighted-Days	Days	H	219	226	219	211	248	211	226	248	(#15)

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**Table 5: Performance of Alternatives in the Lower Columbia River**

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
<b>Lower Columbia River</b>												
Boat Access	40000 < days < 103000	Days	H	95	98	94	79	78	71	75	83	(#26)
Shoreline Access	60000 < days < 99000	Days	H	79	75	86	61	65	54	57	45	(#26)
Flooding at Genelle (1)	days > 165 kcfs	Days	L	2	2	2	6	6	8	6	32	(#27)
Flooding at Genelle (2)	days > 177 kcfs	Days	L	1	1	1	3	3	4	3	11	(#27)
Whitefish / Trout	INDEX	INDEX	H	-	-	- 0.13	0.63	- 0.18	0.97	0.36	- 0.15	APPX E
TGP	days > 115%	Days	L	NA	NA	NA	NA	NA	NA	NA	NA	(#28)
Sturgeon	Pulse provided	Yes / No	H	No	No	No	No	No	No	No	Yes	NA

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**Table 6: System Wide Impacts**

Objective	Performance Measure	Units	Dir	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT	PM
<b>System Wide</b>												
Relative loss in Power Values	Incremental Cost	\$M/yr	L	-	22	181	180	186	350	181	201	(#30)

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**Table 7: Summary of Systemic Trade-offs**

	Treaty Continue			Treaty Terminate				
	Ref TC	3TC	4 TC	Ref TT	3 TT	4 TT	5 TT	6 TT
Kinbasket Rec/ Nav / Dust	NA	Rec Days (+15-30%)	Rec Days (+5-30%)			Rec Days (+0-20%)		
Mid-Columbia River Veg / Wildlife/River Habitat		Veg Area (+40%) Bird Hab. (>100%) River Hab (+12%)	Veg Area (+40%) Bird Hab. (>100%)	Veg Area (-38%) All Bird Habitat Lost River Hab (-40%)	River Hab (-25%)	Veg Area (-46%) All Bird Habitat Lost River Hab (-40%)	Veg Area (-38%) All Bird Habitat Lost River Hab (-39%)	Veg Area (+70%) Bird Hab. (>100%) River Hab (-17%)
Arrow Rec / Dust /Kokanee access		Rec Days (-23%) Kok Access (-38%)	Rec Days (-26%) Kok Access (-17%)	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Rec range all season Full Kok Trib Access	Res drops 60' in summer
LCR Fish				Possibly better for MW / RBT		Possibly better for MW / RBT		Major sturgeon pulse
LCR Flooding							Flow >177kcfs (5012 cms) every year	Flow >177kcfs (5012 cms) every year
Annual Power Value Change		-\$22m	-\$180m	-\$180m	-\$190m	-\$350m	-\$180m	-\$200m

**Legend**

- Better than Ref-TC
- Worse than Ref-TC

Preliminary key findings may be summarized as follows:

**Operating constraints on Kinbasket reservoir have the highest costs (especially if firm energy is impacted), regardless of Treaty Termination**

*Improvements to recreation, navigation and potentially vegetation/wildlife and the operating cost and cost of building new sources of firm energy are similar whether the Treaty continues or is terminated.*

Treaty Continue	Treaty Terminate
Due to the large generation capability at Mica and Revelstoke (5700 MW, ~50% of BC Hydro's capacity), changes at Mica are the most costly and provide limited gains for interests around the reservoir.	In Treaty Terminates, more radical changes to operations could be developed that could provide greater benefits to interests around the reservoir, but at an even higher cost. This domestic trade-off remains the same.

**With Treaty Termination, Arrow Lakes operational choices become less linked to choices made at Kinbasket**

Treaty Continue	Treaty Terminate
Under the Treaty Continue scenario, there will always be a need to balance between Kinbasket/Arrow as the <i>border flow</i> releases from Canadian storage are set by the Treaty operations. If Arrow is low, Kinbasket will be higher and vice versa.	Under a Treaty Terminate scenario, Arrow reservoir levels can change without having the same impact on Kinbasket reservoir, thereby creating more opportunity to operate Arrow for other interests.

**Regardless of the Treaty's future, value trade-offs at Arrow will remain**

Treaty Continue	Treaty Terminate
Alternative 3 demonstrates the trade-off at Arrow reservoir under a Treaty Continue scenario where significant benefits to vegetation, bird and wildlife values in the Mid-Columbia River can be gained by a lower reservoir elevation, however these result in the loss of power revenues and declines in kokanee tributary access and recreation days in Arrow Lakes Reservoir	The de-linking of Kinbasket and Arrow reservoirs enables different operations at Arrow reservoir that could provide a different (and potentially better) balance between the high and low Arrow reservoir interests. However, as <b>Error! Reference source not found.</b> illustrates, several of the key interests in Arrow Lakes reservoir are mutually exclusive, and so tough trade-off choices will remain.

**Treaty Terminate opens up new trade-off opportunities / constraints between Arrow and the Lower Columbia River**

Treaty Continue	Treaty Terminate
Under the Treaty Continue scenario, BC Hydro is able to meet Lower Columbia River spawning flows in the January through June period, although this does result in high Arrow reservoir levels in the spring which impacts the Mid-Columbia interests that prefer lower levels in the spring but benefits reservoir based recreation.	The potential for different operations creates quite different trade-offs between Arrow reservoir and the downstream river section that were not investigated in the WUP.

## Kootenay System

**Table 8: Kootenay River Alternatives**

Alternative	Description
1	<b>Current Libby Operation</b> - VarQ flood control regime and discharges for fish based on latest U.S. Endangered Species Act objectives for sturgeon, bull trout, and salmon.
2	<b>Standard Flood Control and deep August draft</b> - Libby operates to standard flood control regime. Spring sturgeon and bull trout not included; however Libby drafts 20 ft (6.1 m) by the end of August for Salmon in US.
3a	<b>Early refill at Libby (1 Jun)</b> – Current Libby operating regime adjusted to target refill of Kootenusa by 1 June.
3b	<b>Early Refill at Libby (30 Jun)</b> – Current Libby operating regime adjusted to target refill of Kootenusa by 30 June .

**Table 9: Comparison of Alternatives 1, 2 and 3b**

Alternative 1: Current Conditions

Alternative 2: Power & Standard Flood Control

Alternative 3b: Refill by 30 Jun

Objective	Performance Measure	Units	Dir	Alt 1	Alt 2	Alt 3b	PM #
<b>Kootenusa Reservoir</b>							
Reservoir Vegetation and Wildlife	Hectares flooded >10 wks	Hectares	L	2,673	1,443	2,720	(#50)
Fish and Aquatic Ecosystem Health	Primary production	Tons	H	14.5	12.6	15.2	(#51)
General Recreation and Tourism	Preferred Elevation Range	Days	H	28.5	16.5	27.0	(#52)
Kokanee Angling	Angling Effort	Angler Days	H	23,629	26,627	29,008	(#52)
<b>Kootenai River and Creston Valley Floodplain</b>							
Dyke Management Operations	Preferred Lake Elevation	Days	H	163	165	165	(#53)
Farming Equipment Handling	Preferred Lake Elevation	Days	H	21	19	21	(#53)
<b>Kootenay Lake</b>							
Fish and Aquatic Ecosystem Health	West Arm Spawner Length	cm	H	31.1	30.2	30.9	(#55)
Recreation, Tourism and Industry	Preferred Lake Elevation	Days	H	67	65	73	(#56)
Flooding	% Yrs above 1752'	Days	L	14%	6%	8%	(#57)
<b>Kootenay River Downstream of Corra Linn Dam</b>							
Vegetation and Wildlife	Cumulative Habitat Loss	Ha	L	4,307	3,242	4,089	(#58)
Fish and Aquatic Ecosystem Health	Total Dissolved Gases	% Sat'n Days	L	45	29	40	(#59)
<b>System-Wide Impacts</b>							
Canadian Financial Value	Increase in Value of Energy	\$m/yr	H	-	19.4	4.6	(#60)
<b>US Jurisdiction</b>							
Sturgeon & Bull trout in the Kootenai R	Meets US regulations	Yes / No	H	Yes	No	No	App H
Salmon in the United States	Meets US regulations	Yes / No	H	Yes	No	Maybe	App H

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**Deeper Libby drafts provides benefits in Canada over the current regime for some interests while other interests perform better under the current regime.**

*The Libby Power and Standard Flood Control operating regime that existed prior to 1993 drafts Libby deeper than the current regime*

*Called Upon operations are expected to cause Kooconusa to draft deeper more often, possibly resulting in an operation somewhere between the current regime (Alt1) and the Standard Flood Control regime (Alt 2)*

Benefits	Impacts
Less flooding on Kootenay Lake, more power benefit, less spill, improvements for aquatic health in Kootenay River below Nelson, potential benefit to vegetation and wildlife on Kooconusa Reservoir.	May have negative impacts on aquatic productivity and recreation on Kooconusa reservoir

**There is potential that current operations could be altered to benefit a wider range of interests in Canada through an operation such as that illustrated in Alternative 3b.**

*Alternatives that do not meet the U.S. fisheries requirements that are court ordered under the Biological Opinion are unlikely to be implemented*

Benefits	Impacts
May benefit Kooconusa resident fish and recreation, flood reduction at Kootenay Lake, reduced spill in the Kootenay River which produces environmental benefits and power benefits	May increase the risk of surcharging Kooconusa Reservoir Does not meet the current U.S. fisheries requirements