

DECEMBER 2022

**PERFORMANCE MEASURE INFORMATION SHEET****ARROW LAKES RESERVOIR: NAVIGATION****SUMMARY**

**Goal:** Minimize disruptions to commercial navigation and transportation.

**Recommended Performance Measure:**

Objective/ Location	Performance Measure	Description										
Navigation/ Arrow Lakes Reservoir	Navigability	Number of weighted days annually that the reservoir water level allows for log transport through the Narrows, according to the following table. More is better. <table border="1"> <thead> <tr> <th>Elevation Range</th> <th>Weighting</th> </tr> </thead> <tbody> <tr> <td>Above 1420 ft</td> <td>1</td> </tr> <tr> <td>1415– 1420 ft</td> <td>0.5</td> </tr> <tr> <td>1400–1415 ft</td> <td>0.3</td> </tr> <tr> <td>Below 1400 ft</td> <td>0</td> </tr> </tbody> </table>	Elevation Range	Weighting	Above 1420 ft	1	1415– 1420 ft	0.5	1400–1415 ft	0.3	Below 1400 ft	0
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**INTRODUCTION**

Commercial operations (primarily local forest companies) can be affected by reservoir elevations. When reservoir levels do not fall within critical elevations, forest companies respond by changing sites or routes, altering equipment, breaking down log rafts, and/or by delaying logging or transport operations, all of which increase costs.

The primary concern related to commercial navigation on Arrow Lakes Reservoir is periods of low water levels when transport of log rafts through the Narrows is impeded. Transport during the winter and spring period (Jan - May) is especially problematic. Reservoir water levels are generally high enough to facilitate log transport operations during the June to December period, although there are occasions when the reservoir elevation is below the optimal level.

If logging operations occur during periods of low water, operators generally either store the logs in staging areas and wait for higher levels or break down the rafts. Breaking the log rafts down into smaller rafts requires additional tows and reassembly on the downstream side of the Narrows. This increases the time required and therefore the overall cost of log transport operations on Arrow Lakes Reservoir.

**PAST PERFORMANCE MEASURES**

The objective of maintaining navigability through the Narrows for log transport operations was not considered during the Columbia Water Use Plan process. During the [Non-Treaty Storage Agreement Options Review](#) in 2010, a Celgar representative provided input that allowed for development of a performance measure to evaluate navigation alternatives. This representative reported that, at that time, when the reservoir was above 1420ft, Celgar was able to tow 16+ rafts

through the area.<sup>1</sup> However, when the reservoir was between 1415ft and 1420ft, Celgar was required to respond by breaking down the rafts in sizes capable of making it through the Narrows. This was further impeded at reservoir levels between 1410ft and 1415ft. Operations north of Burton were generally shut down when reservoir water levels were drafted below 1415ft. At that time, log transport operations did not typically occur between April 15 and June 1 due to spring breakup.

Based on this information, two separate parameters were developed for analysis during the NTSA process.

**Parameter 1**

The first parameter simply focused on a key season and elevation threshold. The key season selected was Jan 1- Apr 15 (the season when log transport was historically most difficult), and a key elevation threshold selected was 1415ft.

**Parameter 2**

The second parameter applied weights to both elevations and seasons to reflect the overall performance across the entire year. Elevation and seasonal weights were then multiplied together to develop a combined weighting factor (Table 1).

Table 1. Selection of Navigation Weighting Factors by Elevation and Season<sup>1</sup> (BC Hydro, 2010)

			Seasonal Weight		
			Jan-01 Apr-15	Apr-16 Jun-01	Jun-02 Dec-31
			1	0.25	1
Elevation Weight	Above 1420	1	1.0	0.25	1.0
	above 1415	0.5	0.5	0.125	0.5
	Below 1410	0	0.0	0.0	0.0

<sup>1</sup> Elevation weighting factors are interpolated for each metre elevation band (i.e., 1419 is 0.9)

The NTSA performance measures were also used in the 2013 [Columbia River Treaty Review Technical Studies](#) process.

**NEW INFORMATION**

Since the CRT Review Technical Studies, one Arrow-focused study has reported on navigational issues, and the research team has also engaged with forestry interests around this issue.

The [Arrow Lakes Reservoir Mid-Elevation Scenarios: Scoping Evaluation](#) reported on interviews with forestry operators (Thomson et al., 2017). These confirmed that low-water restrictions at

<sup>1</sup> Email correspondence from Mike Lynn, Celgar to BC Hydro

the Narrows from January to mid-April are a significant source of operational inefficiency. Interviewees stated that large tows of 18 rafts are unable to navigate the Narrows below 1420ft (432.8m). Between 1410ft (429.8m) and 1420ft (432.8m) the 18 raft tows have to be broken down into smaller 8 raft tows and reassembled. Below 1410ft, tows are further reduced in size to 5 rafts. Below 1400ft (426.7m), navigation through the Narrows becomes extremely difficult and the tug must follow the narrow and winding Burton channel. When log transport is compromised as described above, the cascading economic impact is felt by upstream suppliers and downstream buyers and users of the wood fiber. Logs are difficult to unload under low water conditions, and this affects logging and trucking contractor employment and scheduling. Downstream, Celgar and Interfor may be required to source alternative supplies of fiber, and/or incur higher costs to bring the tows down the Arrow Lakes Reservoir and through the Narrows under sub-optimal conditions.

The research team contacted Interfor staff and learned:

- There is no break-up in forestry operations in the spring anymore so seasonal weighting, or performance measures that only consider the winter period, are no longer relevant
- In general, the numbers in the Thomson et al. report are accurate and appropriate weightings would be as summarized in Table 2 below.
- Additional floating debris at high water levels does not impede towing. Low water levels can cause “dead heads” (debris that sinks straight down so that only the top end protrudes from the water), which represent a safety risk to the tugs and therefore require removal and relocation (V. Welychko, pers. comm., 2022).

Table 2: Elevation range weightings for log transport on Arrow Reservoir (V. Welychko, pers. comm., 2022)

<b>Elevation</b>	<b>Number of log rafts</b>	<b>Weighting (applies all year)</b>
1420ft+ (432.8 m)	16	1
1415-1420ft (431.3-432.8m)	8	0.5
1400-1415ft (426.7-431.3m)	5	0.3
Below 1400ft (426.7m)	Uncertain – No towing to the representative’s knowledge	0

The research team has also heard that certain water levels can affect navigation to/from water access communities around the reservoir, especially the Lower Arrow Lake portion (e.g., Renata); however, the team has not had responses from local residents to verify these comments.

### **RECOMMENDED PERFORMANCE MEASURE**

Given the information above, the research team recommends the following performance measure (Table 3) which:

- applies the same weights throughout the year in recognition of the fact that break-up no longer halts logging activities in the spring; and
- adjusts the elevation ranges in recognition of recent information confirming that towing is possible (though inefficient) at elevations below 1415ft (431.3m).

Table 1: Recommended performance measure for Arrow Reservoir navigation

Area	Performance Measure	Dates	Critical Elevation Zone	
Arrow Lakes Reservoir	Navigable days	All year	Weighted days by elevation.	
			Elevation	Weighting
			Above 1420 ft (432.8 m)	1
			1415-1420 ft (431.3-432.8 m)	0.5
			1400-1415 ft (426.7-431.3 m)	0.3
Below 1400 ft (426.7 m)	0			

### COMPARISON OF PROPOSED PERFORMANCE MEASURE WITH HISTORICAL OPERATIONS

1969 – 2020 operational regimes for the Arrow Lakes Reservoir have resulted in elevations that fall below optimal log towing levels (i.e., below 1420ft or 432.8m), but within the operable towing range (1400ft or 426.7m) in most years from January to June. Reservoir elevations have fallen below minimum log towing levels for portions of the January to June period, especially in March and April. From July to December reservoir levels have usually been within the optimal towing range and always above the minimum level.

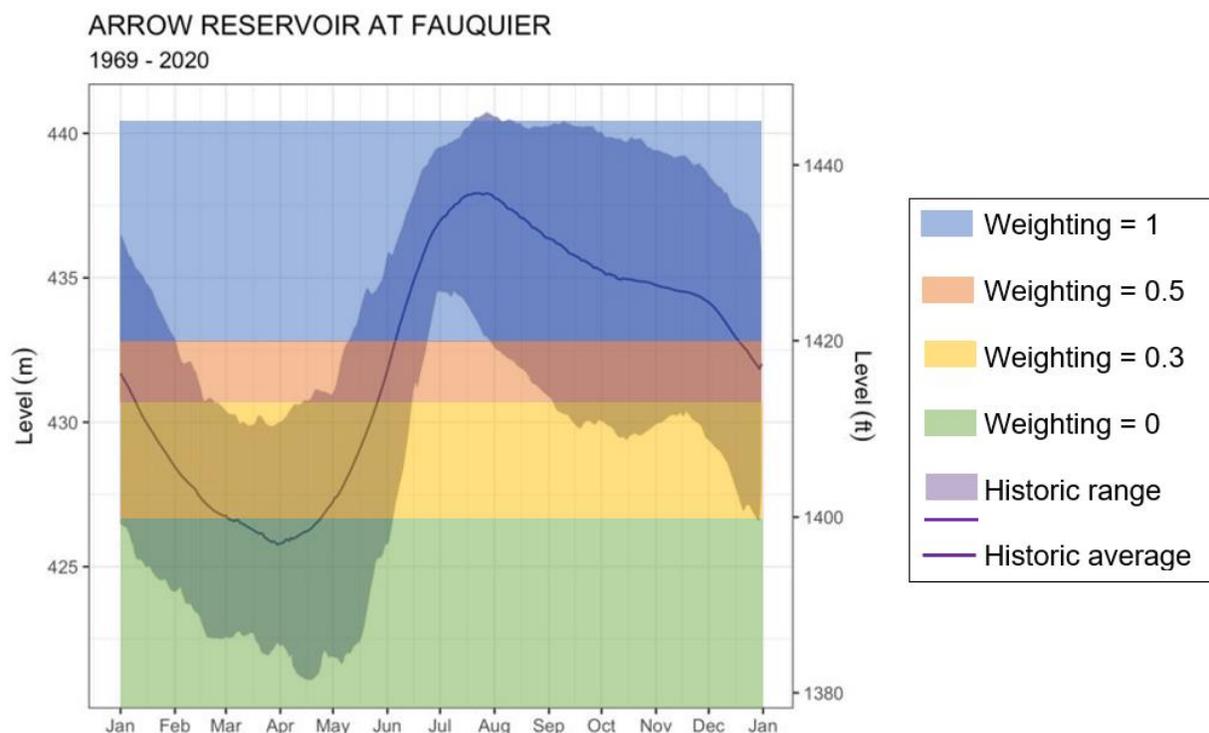


Figure 1: Ranges of recommended performance measure in comparison to historic reservoir elevations

### CALCULATIONS

For each alternative:

1. Assemble the daily simulated results for reservoir elevations over the simulation timeframe.

2. Calculate the annual weighted days by sampling each day against the weighting factors and summing over the year.
3. Summarize all statistics.

## KEY ASSUMPTIONS AND UNCERTAINTIES

- Each scenario is simulated using the same set of system constraints, input assumptions (e.g., load forecasts) and historic basin inflows.
- Assumes that the weightings applied to the preferred elevation ranges and are accurate.

## REFERENCES

BC Hydro (2010). Non Treaty Storage Agreement Options Assessment: Performance Measure Information Sheet #15: Arrow Lakes Reservoir Navigation:

<https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/community/ntsa/pm-info-sheet-arr-navigation.pdf>

Thomson, A., G. Utzig, B. Green and N. Kapell. (2017). *Arrow Lakes Reservoir Mid-Elevation Scenarios: Scoping Evaluation*. Prepared for the Province of British Columbia and BC Hydro and Power Authority. [https://engage.gov.bc.ca/app/uploads/sites/6/2017/07/Mid-Arrow-Report\\_REV3.0\\_MEM-Review\\_Apr\\_13\\_17.pdf](https://engage.gov.bc.ca/app/uploads/sites/6/2017/07/Mid-Arrow-Report_REV3.0_MEM-Review_Apr_13_17.pdf)