PERFORMANCE MEASURE INFORMATION SHEET #15

ARROW LAKES RESERVOIR: NAVIGATION

Objective / Location	Performance Measure	Units	Description	MSIC
Navigation/ Arrow Lakes Reservoir	Navigability	1) # days elevation is greater than 1415 ft between 1 January and 15 April 2) Weighted-Days (by season and elevation)	Reports # of days that the reservoir water level allows for log transport through the Narrows	7 days

Description

Commercial operations (primarily local forest companies) can be affected by reservoir elevations. Either low or high reservoir elevations can result in a disruption to operations. 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 in Arrow Lakes Reservoir is periods of low water levels when transport of log rafts through the Narrows is impeded. It is reported that when the reservoir is above 1420 ft, Celgar is able to tow 16+ rafts through the area[1]. However, when the reservoir is between 1415 and 1420 ft, Celgar is required to respond by breaking down the rafts in sizes capable of making it through the Narrows. This is further impeded at reservoir levels between 1410 and 1415 ft.

A key constraint for log transport is water levels during the winter period (Jan 1- Apr 15). 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. Log transport operations typically do not occur between April 15 and June 1; however, if logging operations continue into this period, Celgar generally responds to lower reservoir water levels by either storing the logs in staging areas and waiting for higher levels or breaking 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. Operations north of Burton are generally shut down when reservoir water levels are drafted below 1415 ft.

Note: As specified in the Local Operating Order, BC Hydro maintains a minimum discharge of 10 kcfs year round from Arrow Lakes Reservoir to facilitate log transport operations below HLK Dam. As this has been built into the assumptions of the HYSIM for the NTS scenario evaluation, a performance measure was not developed for commercial navigation in the lower Columbia River.

[1] Email correspondence from Mike Lynn, Celgar to BC Hydro

Performance Measures

The objective of maintaining navigability through the Narrow for the log transport operations was not considered during the Columbia Water Use Plan process. As a result, no performance measure was developed, and there are no former methods and models to apply to evaluate the NTS scenarios. Based on input from the Celgar representative, two separate parameters were developed for this analysis.

Parameter 1

The first parameter mimics the approach used for the Arrow Soft Constraints by simply focusing on a key season and elevation threshold. From the above description, the key season selected is Jan 1- April 15, and a key elevation threshold selected is 1415 ft. This parameter emerged in discussion at the NTS Stakeholder Session #1.

Parameter 2

The second parameter applies weights to both elevations and seasons to reflect the overall performance across the entire year. From the description above, the following logic is used to derive the weights:

1. Elevation weighting factors: Above 1420 weight = 1, below 1410 weight = 0, and each meter in between is scaled between these two points (i.e., 1419 is 0.9).
2. Seasonal weighting factors: Peak operational seasons weight = 1 (Jan 1 – Apr 15, and Jun 2 - Dec 31); Spring season weight = 0.25.

Elevation and seasonal weights are then multiplied together to develop a combined weighting factor (Table 1).

Table 1. Selection of Navigation Weighting Factors by Elevation and Season[1]

			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

[1] Weighting factors are interpolated for each week and each metre elevation band

Calculations

For each scenario:

1. Assemble the daily simulated results for reservoir elevations over 60 years (derived from HYSIM 1940-2000; Figure 1) for each scenario.
2. Parameter (1): Count the number of days between January 1 and April 15 when the reservoir elevation is greater than 1415 ft.
3. Parameter (2): Calculate the annual Weighted-Day by sampling each day against the combined weighting factors (Table 1) and summing over the year.
4. Summarize all statistics (Figures 2 and 3).

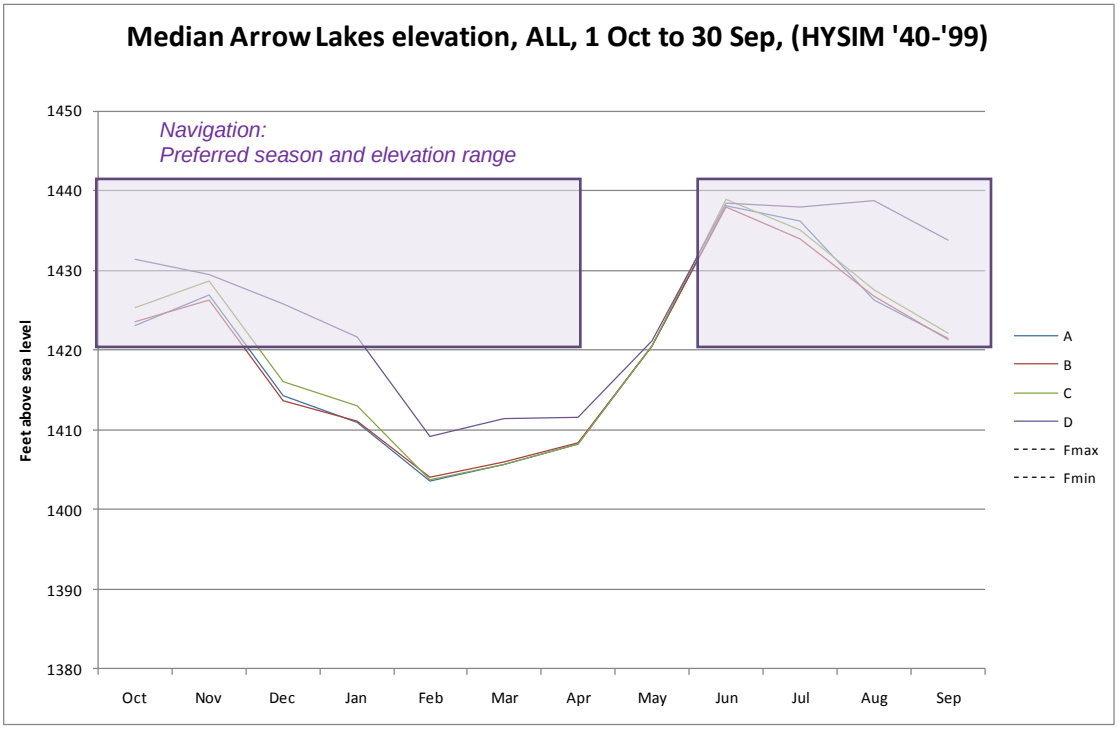

Figure 1. HYSIM Simulated Arrow Lakes Reservoir elevations. Median over 60 years showing the preferred elevation ranges for commercial navigation

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 (1940 – 2000).
- Assumes that the weightings applied to the preferred elevation ranges and operational seasons are accurate.

Results

Regardless of the approach taken, the modeling results reveal the same pattern. When considering the mean, median and 10th percentile statistics, Scenario D (no NTS) would provide a significantly greater number of navigation days for commercial operators on Arrow Lakes Reservoir than the “with NTS” scenarios (A, B and C).

Figure 2. Days above Preferred Elevation in Key Season –Results for all NTS scenarios

	Scen A	Scen B	Scen C	Scen D
Max	105	105	105	105
90th	99	99	101	105
Mean	29	29	33	52
Med	7	3	20	45
10th	-	-	-	7
Min	-	-	-	-

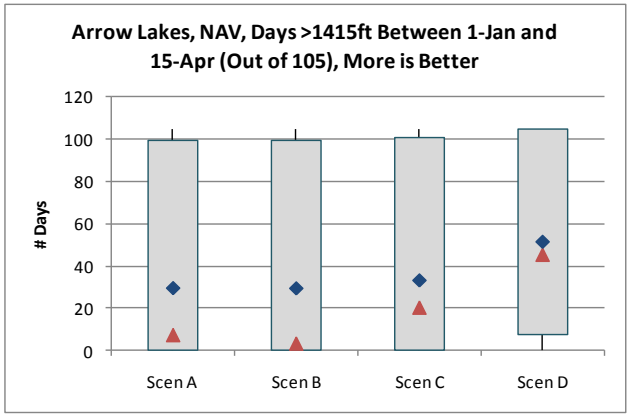

Figure 3. Weighted-Days across Entire Year – HYSIM Results for all NTS scenarios

	Scen A	Scen B	Scen C	Scen D
Max	346	349	347	349
90th	291	290	290	295
Mean	221	220	229	257
Med	214	216	221	259
10th	180	175	200	217
Min	109	102	127	163