

PERFORMANCE MEASURE INFORMATION SHEET #16

ARROW LAKES RESERVOIR: RECREATION

Objective / Location	Performance Measure	Units	Description	MSIC
Recreation/Arrow Lakes Reservoir	Access Days	1) # Access Days by Activity	Reports # of weighted days that the reservoir water level is within the preferred ranges during the key shore-based and water-based recreation seasons	7 days
		2) # Access Days – All Activities		
		3) Weighted-Days – All Activities		

Description

Arrow Lakes Reservoir provides for a variety of recreational opportunities. The most popular activities include fishing, boating and day use (swimming and picnicking). Recreation use by both residents and tourists is increasing and will likely be enhanced by the provision of additional water-based facilities. Several boat ramp improvement projects are currently underway as part of BC Hydro's Water Licence Requirement Program, including construction of new ramps at Burton and Anderson Point and upgrades to existing ramps at Fauquier, MacDonald Creek and Edgewood.

Recreation access and associated benefits are important in Arrow Lakes Reservoir. Local communities benefit from improvements to the quality and diversity of recreation and tourism experiences through a greater quality of life, as well as through local economic development benefits that result from increased usage. A number of key factors that affect recreational quality and use include:

- Diversity and abundance of fish and wildlife, since many recreational activities are focused on enjoyment of these natural resources
- Ability to safely access the water or shorelines for water-based and shore-based activities
- Visual quality of viewsapes (appearance of the reservoir related to avoidance of exposed mudflats/dust and exposed standing debris)
- Avoidance of navigational hazards associated with standing debris

During the Columbia WUP process, it was agreed that boat access and shoreline access would capture most recreational interests. For boat access, the Recreation Technical Subcommittee identified preferred elevations over the recreation season that would provide "good opportunity" for a broad range of interests, including access via boat ramps, usability of boat ramps and quality of boating within that range of elevations. The boat access measure was not tied directly to physical structures (i.e., boat ramps). The shoreline access measure was defined around a range of elevations that constituted "good opportunity" for shore-based activities, with activities decreasing in frequency when the water is above or below this elevational zone. Again, this measure was not tied to site-specific elevation issues.

Performance Measures

There are multiple ways to measure recreation performance. In addition to the Soft Constraint that is reported in a separate PM Information Sheet, three additional approaches are presented below for consideration in evaluating the NTS scenarios.

Approach 1

The first approach was presented at the first NTS Stakeholder Session (October 2010), and is based on critical water level ranges for water-based activities (boat access) and shore-based activities, as summarized in RL&L (2001). This approach, which was used in the Columbia WUP, calculates separate measures for boat access and shoreline access using the parameters defined in Table 1.

Table 1. Parameters for Boat Access and Shoreline Access from RL&L (2001)

Area	Measure	Dates	Critical Elevation Zone	MSIC
Arrow Lakes Reservoir	Boat Access Days	01 May to 30 Sept	# days between 1435 – 1444 ft	7 days
	Shoreline Access Days	01 May to 30 Sept	# days between 1425 – 1435 ft	7 days

Approach 2

The second approach emerged from discussions during the NTS Stakeholder Session #1. The basic premise was that there is a range of overlap in the preferred elevation ranges across shore-based and water-based activities, and that a compromise definition may be possible. In developing the new approach (Table 2), it was noted that reaching full pool elevation was less desirable and that, given increases in property development and full-time residency, a wider seasonal definition would be appropriate (April 1 to October 15).

Table 2. Parameters for Overall Recreation Performance

Area	Measure	Dates	Critical Elevation Zone	MSIC
Arrow Lakes Reservoir	Recreation Days	01 April to 15 October	# days between 1425 – 1440 ft	7 days

Approach 3

The concept for the third approach also emerged during Stakeholder Session #1. Weights are applied to both elevations and seasons to reflect the overall performance across the entire year.

The following logic is used to derive the weights:

1. Elevation weighting factors: Between 1435 and 1440 weight = 1; Transition down to a weight = 0 at elevations above 1444; Transition down to weight = 0 at elevations below 1415.
2. Seasonal weighting factors: Peak recreation season weight = 1 (Jul 1 to Aug 31); Shoulder seasons transition down to weight = 0.1 (Apr 16 to Jun 30; Sep 1 to Oct 15); Off-peak seasons transition down to weight = 0 (Oct 16 to Dec 31; Jan 1 to Apr 15).

Elevation and seasonal weights are then multiplied together to develop a combined weighting factor (Table 3).

Table 3. Selection of Recreation Weighting Factors by Elevation and Season¹

			Seasonal Weight				
			Jan-01 Apr-15	Apr-16 Jun-30	Jul-01 Aug-31	Sep-01 Oct-15	Oct-10 Dec-10
			0 to 0.1	0.1 to 1	1	1 to 0.1	0.1 to 0
Elevation Weight	Above 1444	0	0	0	0	0	0
	1435 to 1440	1	0.05	0.5	1	0.5	0.1
	above 1430	0.6	0.03	0.3	0.60	0.3	0.03
	Below 1425	0.2	0.01	0.1	0.20	0.100	0.01
	Below 1415	0	0	0	0	0	0

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

There are a number of recreational activities that take place in the Arrow drawdown zone that may be directly linked to reservoir elevations (e.g., hiking, ATV use, cross country skiing), which have different preferred or optimal water levels. However, there is little systematic information on how fluctuating reservoir levels influence the recreation behaviour of these key user groups. As part of implementing the WUP, a recreational demand study is being implemented over a 5-year period (2009-2013). The results of this study should provide a better understanding of how reservoir water levels affect the quantity, quality and frequency of a broad range of water-based and shore-based recreation activities, and help to develop better performance measures that link aspects of recreation by local/tourist groups to reservoir levels for future operational decision-making.

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 thresholds for boat access (1435 – 1444 ft) and shoreline access (1425 – 1435 ft) between 1 May and 30 Sept.
3. Parameter (2): Count the number of days between thresholds for overall recreation (1425 – 1440 ft) between 1 April and 15 Oct.
4. Parameter (3): Calculate the annual Weighted-Day by sampling each day against the combined weighting factors (Table 1) and summing over the year.
5. Summarize all statistics (Figures 2-4).

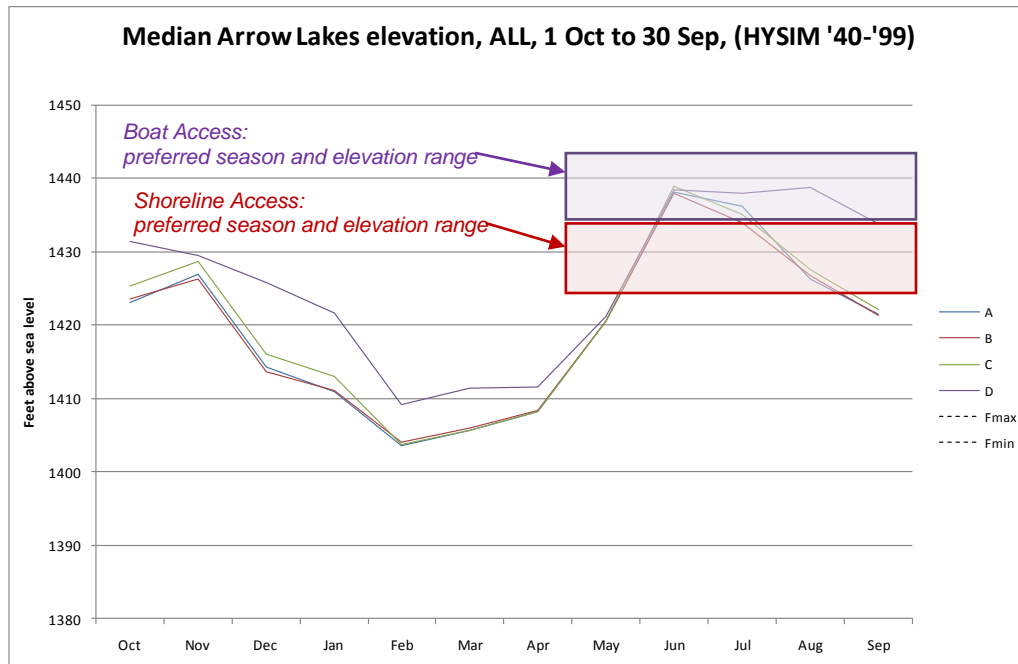


Figure 1. HYSIM Simulated Arrow Lakes Reservoir elevations. Median over 60 years showing the preferred elevation ranges and season for boat access and shoreline access.

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 there is minimal recreational use outside the defined recreation season.
- Assumes that the preferred season and elevations are accurate.
- There is uncertainty regarding which approach is best at capturing the essence of access issues for boating and shoreline use.

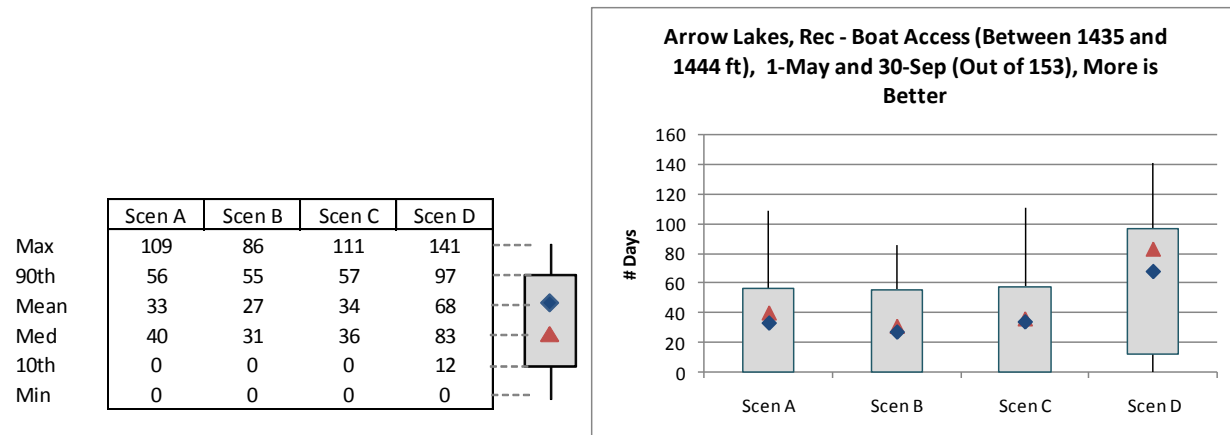
Results

By separating out water and shoreline recreational preferences (Approach 1), the modeling shows some clear distinctions across the scenarios. Scenario D (no NTS) would provide the greatest number of boat access days within the preferred elevation zones on Arrow Lakes Reservoir. Conversely, this scenario would perform the worst in providing shoreline access to the reservoir (Figure 2). On average, the “with NTS” scenarios (A through C) perform similarly for both boat and shoreline access. However, there would be greater variability under Scenario B due to the slower refill and deeper draft of the reservoir in dry years, which would result in fewer boat access days and greater shoreline access days.

Regardless of the approach (i.e., non-weighted vs. weighted), modeling based on a combined recreational preference provides the same overall results (Figures 3 and 4). On average, Scenario D would perform significantly better overall for recreation on Arrow Lakes Reservoir. This is being driven largely by the fact the no use of Non-Treaty storage would keep the reservoir within the higher elevation range for longer throughout the year than the “with NTS”

scenarios, particularly during the latter part of the recreation season and that this would be better for a range of shoreline and water-based recreational activities.

Figure 2. Parameter (1) Boat Access Days – HYSIM Results for all NTS scenarios



Parameter (1) Shoreline Access Days – HYSIM Results for all NTS scenarios

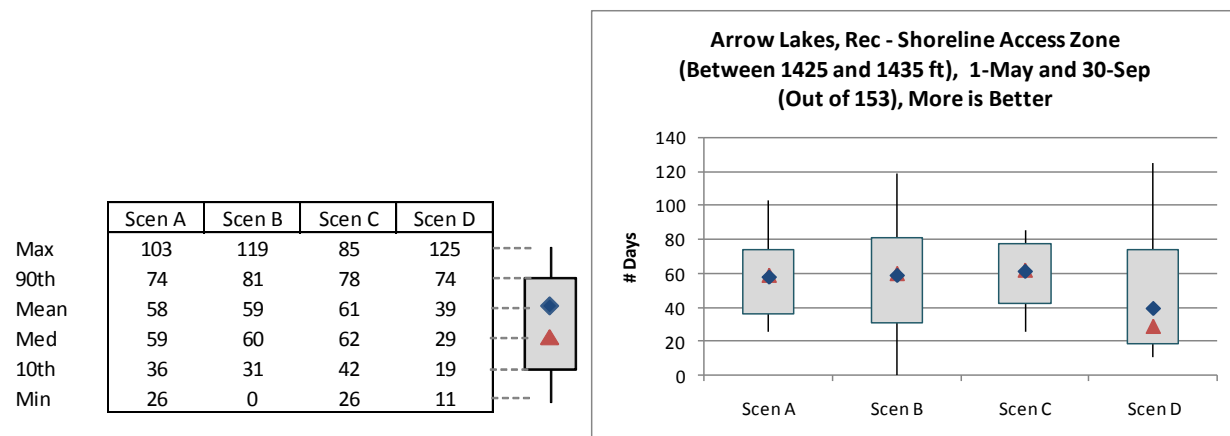


Figure 3. Parameter (2) Combined Recreation Days – HYSIM Results for all NTS scenarios

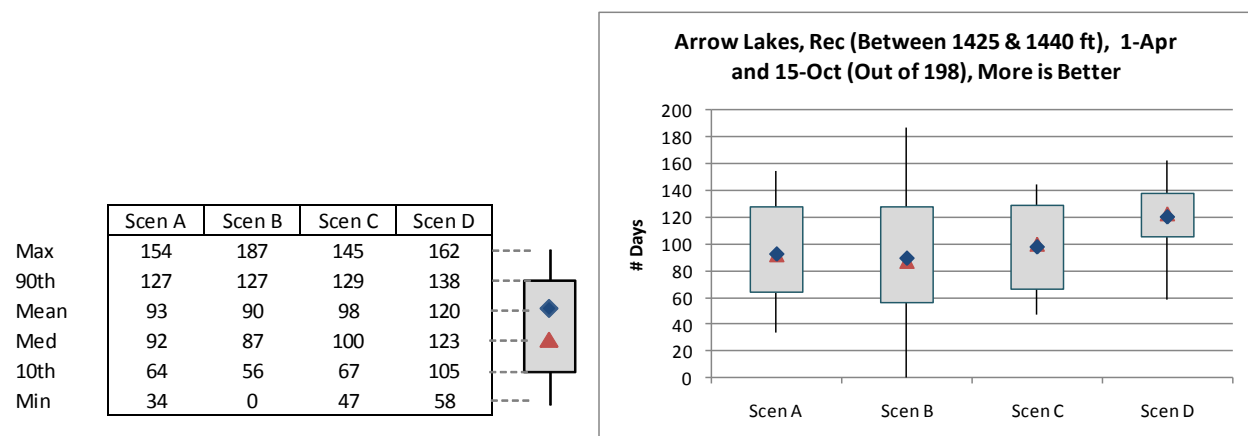
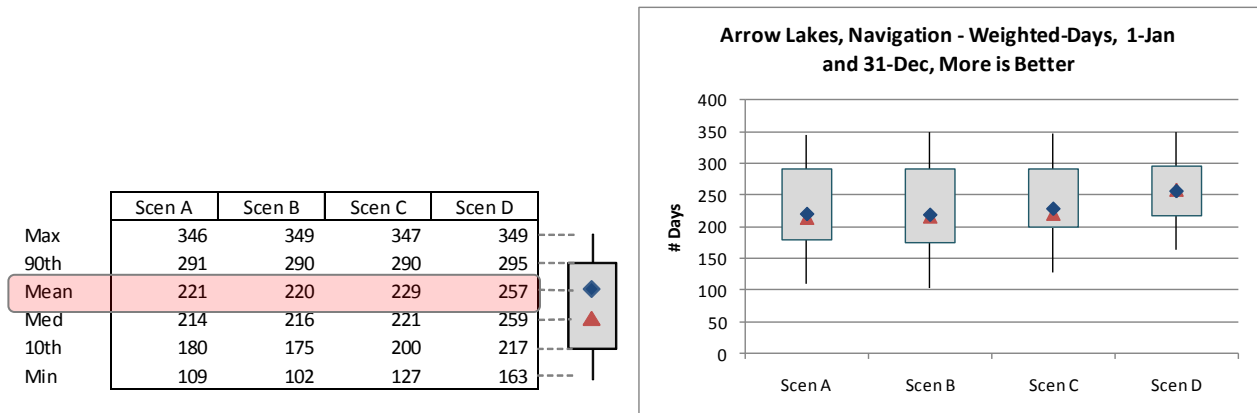


Figure 4. Parameter (3) Weighted-Days – HYSIM Results for all NTS scenarios



References

RL&L Environmental Services Ltd. 2001. Water Use Plans – Environmental information review and data gap analysis. Volumes 1 & 2. Prepared for BC Hydro, Burnaby by RL&L Environmental Services in association with Robertson Environmental Services Ltd., Pandion Ecological Research Ltd., Bruce Haggerstone Landscape Architect, Pomeroy & Neil Consulting Ltd. and DVH Consulting. RL&L Report No. 858V1-F.