Cowichan Lake Weir Shoreline Assessment Project Update

> June 27, 2022 Cowichan Watershed Board Update



Why are we doing this? Climate Change

- To ensure sufficient water flow into the Cowichan River today and into the future.
- To secure a healthy aquatic environment.
 - 1991 Cowichan Lake Storage Assessment Report
 - To achieve a minimum flow 19 years out of 20, raise weir 57 cm. Cost \$1M.
 - 2006-08 Cowichan Basin Plan
 - Raise weir 88cm for greatest benefit. Cost >\$3M
 - 2018 Water Use Plan
 - Completes stages 1-8 of the formal Provincial permitting process
 - Raise weir 70cm. Cost TBD.
 - Further shoreline assessment recommended.
 - 2019-22 Weir Design Project and Shoreline Assessment Project
 - Raise weir (70 cm) as per the 2018 Water Use Plan. Cost >\$20M

Shoreline Assessment Project Overview





Objectives



Map and assess the current shoreline conditions (110 km of shoreline).
 Create an 'AS IS' picture.



- Forecast changes to the shoreline based on:
 - 1. a raised weir
 - 2. climate change



- Identify impacts to riparian access rights and use of property (876 properties).
- Provide supporting documentation for the Future Water License Process.



Final Weir Design Concept

Overflow Weir Replaced

Control Structure Upgraded structure and refurbished structure with new mechanical and electrical equipment

Control Room Includes a monitoring station for DFO Connection to future cold water intake option

Island Sill Replaced with extended weir and new fishway

Existing Vertical Slot Fish Passage Maintained and extended

Overhead Walkway Design complete.

Boat Lock

Upgraded structure and

refurbished structure with

new mechanical and

electrical equipment

South Abutment Fishway New structure

Potential Impacts

Natural Boundary Potential for change of the natural boundary

Inundation

Beach covered in water more time out of the year within property title boundary

Shoreline/Riparian Vegetation

How vulnerable the vegetation is to changes in water level and wave energy

Flooding

Potential change in flood risk to the primary residences.

Considered to occur when lake level exceeds the lowest ground elevation of the primary residence (foundation level)

Shoreline Protection Structures

Potential for erosion if located between the present natural boundary and the estimated future natural boundary

Dock Access

Access to dock structures during recreational season

Riparian Access Access to water **Beach Use** Useable beach days during recreational season

Low Water Mark

Minimum Licensed Lake Level – With Pumping

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Cross Section (Samples

Point of Interest

i.

Existing Weir Crest at 162.65 m

Proposed Weir Crest at 163.35 m

Average Annual High Water Mark (164.2 m)

Cowichan Lake Floodplain Boundary (167.2 m

Present Natural Boundary - 2020 (Elevation Varies)

Shoreline Photos (Bazett Land Surveying

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Digital Road Atlas

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Shoreline Assessment Project Outcomes



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What work went into the assessment?

24+ months of gathering and analyzing data

110 km of shoreline assessed and mapped

876 properties assessed

12 multi-disciplinary professionals

on the consultant project team

8 reports produced

Project Approach and Methodology (KWL) Mapping, Field Work, Shoreline Characterization (KWL) 2020 Natural Boundary at Cowichan Lake (Bazett Land Surveying) Cowichan Lake Inflow and Water Level Analysis (KWL) Wave Energy Assessment (KWL) Natural Boundary Change (KWL) Property Impacts (KWL) Cowichan Lake Shoreline Assessment (KWL)

6+ types of data

this project

used to generate maps

and perform analyses for

Steering Committee

- CWB
- Catalyst
- Cowichan Tribes
- Ts'uubaa-asatx
- DFO
- CLRSS
- CVRD
- Mosaic
- Town of Lake Cowichan
- FLNRORD



Inflow and Water Level Analysis

Changes to Flow into Cowichan Lake - Climate

	Avera Cowi	ige Daily Infl ichan Lake (i	% Change in Inflow			
Season	Past Climate (1981 to 2010)	2050s Climate	2080s Climate	Past to 2050s Climate	Past to 2080s Climate	
Winter (JFM)	63.5	62.8	69.2	-1.4%	8.4%	
Spring (AMJ)	22.6	19.5	18.7	-15.7%	-18.2%	
Summer (JAS)	5.9	4.2	3.6	-30.7%	-40.4%	
Fall (OND)	57.6	66.4	70.7	14.5%	21.6%	
Annual	37.3	38.1	40.4	2.1%	8.3%	

- Longer, hotter, dryer summers.
- More evaporation.
- Lower lake, less flow.
- Warmer wetter winters.
- Less snow pack.
- More immediate and intense inflows.

Note: Inflow projections based hydrological model results using climate input from the ensemble of 12 downscaled GMC models from the CMIP5 provided by PCIC using RCP 8.5. The averages shown is the average of all twelve models and include direct precipitation and evaporation on the lake surface.



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Changes to Lake Levels

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Cowichan Lake 2050s Water Level Frequency - 2030 to 2069



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Raised Weir and Lake Levels

- The hydraulic rating curves converge at 164.2m. Downstream restrictions then start controlling discharge rates.
- Raised weir creates increased storage capacity of the lake. Approx. 40M cubic meters



Rating Curves - Cowichan Lake

Proposed Weir - All Gates Open

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Changes to Peak Lake Levels

Return Period	Return Period (m-CVGD2013)	
(Years)	Existing Weir	Elevation due to Raised Weir
500	166	0.00 m
200	165.9	0.00 m
100	165.7	0.00 m
50	165.5	+0.02 m (1")
20	165.3	+0.03 m (1")
10	165	+0.04 m (1.5")
2	164.2	+0.06 m (2.5")
Note: Cowichan Lake Provincial Flood	plain Elevation is 167.53 m CGVD2013 including freeboard allowance and climate change	•

Most changes within the accuracy of the model (+/- 0.05 m).

- Very Minor increases in modelled peak water levels
- Water levels remain within ranges previously observed
- Recorded high of 165.59m (1968)



Wave (wind) Energy Assessment

- The wave regime on Cowichan Lake will change with the proposed weir raising.
- Wave impact is not uniform across the lake (see map)
- In the deep parts of the lake, the changes will be very small.
- Average wave power at the shoreline is estimated to change by +/-5% on average, and up to +/- 30% at some locations.
- Boat wakes are considered minor offering up less than 5% of the total wave energy.



Natural Boundary Change

- A natural boundary is formed by these key elements: Presence of Water, Character of the Shoreline and the Action of Water.
- Therefore it is not level. It varies up to 2.5 meters (8') for Cowichan Lake.
- It you change one of the key elements it will alter the natural boundary.
- Example: presence of water changes due climate change or due to a weir.



"natural boundary" means the visible high water mark of any lake, river, stream or other body of water where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the body of water a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself; LAND ACT [RSBC 1996] CHAPTER 245



Assessing/Modelling the Changes

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Impacts Table – Raised Weir Only

Property Address:		EXAMPLE								
P	Potential Impact	Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir		Legend			
Flooding	Will the proposed raised weir increase the probability of flooding	Change in return period or annual exceedance probability (AEP) of flooding at the primary residence. (Number in brackets provides the	50-year Return50-year ReturnPeriod Flood 2%Period Flood 2%AEP (1 floodAEP (1 flood		No significant change	Grey	N/A Above Provincial Floodplain Level			
	at the primary residence?1	average number of times a flood is expected to be exceeded over any given 50-year period)	average over 50 years)	average over 50 years)		No Colour	Below Provincial Floodplain Level			
	Will raised weir result in additional	Is any portion of the ground elevation within the			X	Blue	No			
nundation	property title boundary?	crest elevation?			Ŷ	Orange	Yes			
						Grey	< 0.5 m			
		What is the average Horizontal Distance between				Blue	0.5 m to 2 m			
Change of Natural E	Boundary	Present Natural Boundary (PNB) & Estimated			4 m	Green	2 to 5 m			
									Yellow	5 to 10 m
						Orange	> 10m			
Shoreline Protectio	n Structures	Is shoreline structure located between PNB &	PNB &		Y	Blue	No			
(e.g., retaining walls	s)	depending on its foundation and construction.			•	Orange	Yes			
		What is the vulnerability of vegetation to change in				Blue	Low			
Changes in Shorelir	ne/Riparian Vegetation	water level & wave energy? If high, vegetation type may change (ie: to more			Low	Yellow	Moderate			
		water tolerant species).				Orange	High			
Rinarian Access	Potential loss of lake access	Would the EFNB location result in having to access			Νο	Blue	No			
		lake across neighbouring private property? ²		1		Orange	Yes			
	Change in access to dock					Grey	– N/A – No Dock			
Dock Access	structures during recreational	What is the change in days when lake level is below the dock access elevation?	104 days 79 days		t is the change in days when lake level is below 104 days 79 days 20% fewer da	e change in days when lake level is below 104 days 79 days 20% fewer days	20% fewer days	Blue	<10% fewer days	
	season.					Orange	>10% fewer days			
	Change in useable beach days	What is the change in days when beach usable	104 days	70 days	20%	Blue	<10% fewer days			
	during recreational season	(more than 3 m wide)?	104 uays	19 uays	fewer days	Orange	>10% fewer days			

2. Neighbouring property does not include the lake bottom property owned by Mosaic Forest Management.

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Potential Impact: Flooding

Will the proposed raised weir increase the probability of flooding at the primary residence?

Example:

	Will the proposed raised weir increase the probability of	Change in return period or annual exceedance probability (AEP) of flooding at the primary residence.	50-year Return Period Flood 2% AEP (1 flood	~50-year Return Period Flood 2% AEP (1 flood		Grey	N/A Above Provincial Floodplain Level
looaing	flooding at the primary residence? ¹	(Number in brackets provides the average number of times a flood is expected to be exceeded over any given 50-year period)	occurs on average over 50 years)	occurs on average over 50 years)	No Significant Change	No Colour	Below Provincial Floodplain Level

NOTE: Flooding is considered to occur when lake level exceeds the lowest ground elevation at of the primary residence (i.e.: foundation level)

Flood Assessment Results – Weir Only

	Frequency of Flood Event						
Scenario	Mean Annual	Return Period Flood					
	Flood	20-year	50-year	100-year	200-year		
Peak Lake Level Existing Weir	164.2 m	165.3	165.5	165.7	165.9		
Change in Peak Lake Level with Proposed Raised Weir	+0.06m (2.5")	+0.03m (1.2")	+0.02m (0.8")	0.00 m	0.00 m		
Total number of p	properties wher	e the primary re	esidence could b	e flooded ^{1,2}			
Existing Weir	25	127	153	175	203		
Proposed Raised Weir	31	127	153	175	203		
Change in Number of Properties	6	0	0	0	0		

Notes:

1. Primary residence considered to be flooded when the peak flood lake level is at or above the minimum ground elevation (i.e., touching the foundation) at the primary residence.

2. The number of properties shown is cumulative and includes the number of properties from lower/more frequent flood events.

3. Modelled water level accuracy is +/- 0.05 m. WL changes less than 0.05 m considered insignificant.



Increases in peak water levels are projected to occur whether or not the proposed raised weir is implemented. There are likely to be larger changes in peak water levels on Cowichan Lake as a result of climate change than as a result of the proposed raised weir. (page 4-2 Appendix G)

Potential Impact: Inundation

Will a raised weir result in additional water being stored within the property title boundary?

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir	L	egend
Is any portion of the ground elevation within the property title			V	Blue	No
boundary below the proposed weir crest elevation?			T	Orange	Yes

- \succ 319 properties store water today at the existing weir crest elevation.
- > Water will be stored for spring/summer on an additional 136 shoreline properties.

Potential Impact: Change of Natural Boundary

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir	L	egend
				Grey	< 0.5 m
What is the average Horizontal				Blue	0.5 m to 2 m
Distance between Present Natural Boundary & Estimated Euture			4 m	Green	2 to 5 m
Natural Boundary?				Yellow	5 to 10 m
				Orange	> 10m

The change in water levels due to the proposed weir is expected to cause a change in the natural boundary at most locations around the lake.

Horizontal Distance between PNB and EFNB	< 3 m	3 m to 5 m	5 m to 10 m	>10 m
# of Properties	814	26	23	13
Note: Natural Boundary shifts between 0 to 0.39 m v	ertically and up to 32 m horizontally	,		

Potential Impact: Shoreline Protection Structures (e.g., retaining walls)

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir	L	egend
Is shoreline structure located between Present Natural Boundary &				Blue	No
Estimated Future Natural Boundary? If yes, it may be susceptible to erosion depending on its foundation and construction.			Y	Orange	Yes

- 50 properties have structures within their property boundary that <u>may</u> be impacted by shifting of the Natural Boundary.
- > A detailed analysis of the quality, age, purpose and foundation stability was not performed.

Potential Impact: Changes in Shoreline/Riparian Vegetation

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir		L	.egend
What is the vulnerability of					Blue	Low
wave energy?			Low		Yellow	Moderate
If high, vegetation type may change (i.e. to more water tolerant species).					Orange	High

Vulnerability of vegetation to changes due to proposed raised weir	Low	Moderate	High
# of Properties	696	168	13



High change areas are typically low lying areas such as tributaries and islands.

Potential Impact: Riparian Access

Loss of access to the lake

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir		Legend
Would the Estimated Future Natural Boundary location result in having to			No	Blue	No
access lake across neighbouring private property?			INO	Orange	Yes

> No properties are expected to lose riparian access (loss of lake access).

Potential Impact: Dock Access

Change in access to dock structures during recreational season.

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir		Legend
What is the change in days when lake level is below the dock access elevation?	104 days	79 days	20% fewer days	Grey	– N/A – No Dock
				Blue	<10% fewer days
				Orange	>10% fewer days

> 462 properties do not have docks.

- \succ 190 properties will see less than 1 day of change.
- > 225 properties will see more than 1 day of change.



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Potential Impact: Beach Use

Change in useable beach days during recreational season (Apr to Oct)

As part of the Cowichan WUP, full enjoyment of lakeshore beach was considered when the beach is more than 3 m wide

Index	Existing Weir	Proposed Weir	Difference Between Existing & Proposed Weir	Legend	
What is the change in days when	104 dovo	70 dovo	20%	Blue	<10% fewer days
beach usable (more than 3 m wide)?	104 days	79 days	fewer days	Orange	>10% fewer days

307 → 10% re shoreline properties during recreat

reduction in beach use days of

during recreation season

148 shoreline properties

 \rightarrow **40** to **45%** b

reduction in beach use days of

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during recreation season

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Impacts Table – Raised Weir Only

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Change in access to dock What is the change in days when lake level is below 20%	Blue	No			
Change in access to dock What is the change in days when lake level is below 20%	Oranç	ige Yes			
What is the change in days when lake level is below 20%	Grey	– N/A – No Dock			
Dock Access structures during recreational the dock access elevation? 104 days 79 days fewer days	Blue	<10% fewer days			
season.	Oranç	ige >10% fewer days			
Reach Use Change in useable beach days What is the change in days when beach usable 104 days 70 days 20%	Blue	<10% fewer days			
during recreational season (more than 3 m wide)?	Oranç	lge >10% fewer days			

2. Neighbouring property does not include the lake bottom property owned by Mosaic Forest Management.

What if we do Nothing?

Lake levels will drop more frequently below historical low water levels

- Cowichan River flows cannot be maintained.
- Loss of fish and habitat in the Lake and River
- Impact to navigation
- Grounded docks.
- Exposure of sediments. Changing vegetation.

Peak water levels are projected to increase whether or not the proposed raised weir is implemented.

• There are likely to be larger changes in peak water levels on Cowichan Lake as a result of climate change than as a result of the proposed raised weir.

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Key Outcomes/Summary

- Each property is very unique. Potential impacts are property and owner dependant. Some will find value in having higher water levels in the summer.
- Water levels remain within previously experienced ranges. Length of time at various level are changing.
- Up to 6 additional residences may experience flooding with the new weir.
 Modelled a 6cm (2.5") increase in peak levels.
- Inundation (volume of water stored on property) will increase (logical given the whole concept is to store water).
- Climate change will moderate impacts over time.

- Even without a new weir, there will be more occurrences of flooding (due to warmer wetter winters, less snow pack, more intense inflows)
- The 'do nothing' scenario has significant impact to future environmental flows and low lake levels.
- With the vast amount of data, modelling tools, science, and technology we are now able to understand potential impacts.
- We have an opportunity to ADAPT to climate change.