2019 Cowichan Lake Pumping
Weekly Report #2
September 8 – 13, 2019

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Down to Earth Biology

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1 INTRODUCTION

This report describes the environmental monitoring observations and lamprey survey/salvage efforts implemented during the second week of pumping from September 8 until September 14, 2019. Cowichan Lake lamprey salvage efforts, as per the *SARA* permit for the Cowichan Lake Pump-Out Project (the Project), focused on nine sensitive sites determined by Fisheries and Ocean Canada (DFO) based on previous studies on the lamprey population and additional sites at the confluence of major streams with the lake.

Environmental monitoring requirements are provided in greater detail in the *Environment Monitoring Plan for the Pump Out of Lake Cowichan during Drought Conditions* [1] (EMP) including monitoring of water quality, fish and fish habitat, aquatic resources, riparian vegetation, and wildlife.

Table 1. Site visit summary

Date (dd/mm/yy)	Sites Inspected	Lead QEP	Monitoring Activities
10/09/19	Cowichan River Lake Cowichan	Leo Chira, R.P.Bio.	- Inspected the weir and pumps. - Collected in-situ water quality data from river. - Inspected the 9 potential lamprey salvage sites as per DFO.
11/09/19	Catalyst weir Cowichan River Cowichan Lake	Leo Chira, R.P.Bio.	- Inspected the weir and pumps. - Collected in-situ water quality data from river. - Inspected 3 additional lamprey salvage sites.
12/09/19	Catalyst weir Cowichan River Cowichan Lake	Leo Chira, R.P.Bio.	- Downloaded water temperature data. - Collected in-situ water quality data from river. - Inspected the weir and pumps and observed pump fish screen cleaning.

2 MONITORING

Monitoring of the weir operations and fish/fish habitat sites are conducted in accordance with the EMP for the project at a frequency that allows identification of noticeable changes in fish habitat to inform any salvage activities that would be needed to prevent stranding of lamprey within the littoral zone of Cowichan Lake and that verifies fish are not at risk of being impinged on the pump screens. Based on recent field surveys that concluded Cowichan lamprey was absent at historical rearing sites, i.e. the nine sampling sites included in the SARA permit, additional sites along the shoreline were inspected for potential lamprey habitat.

[1] LGL Limited. 2016. Environmental Management Plan – Supplementing Cowichan River Flows During Drought Conditions by Pumping Water from Cowichan Lake.

2.1 WEIR OPERATIONS

During the ongoing pumping operations, the number of pumps operating this week has varied between 14 and 15, in order to maintain a relatively constant instream flow in Cowichan River. Most of the remaining pumps were ready to be operated if needed in the event of a pump failure or some other pumping issues.

No significant issues were recorded at the weir. North Pacific Diver Inc conducted cleaning of the pump fish screens. One pump was found to be non-operational during the week and another pump was brought online to ensure sufficient flow was provided. A remotely operated vehicle (ROV) inspected and recorded a video of the screens prior to cleanup operations beginning. The main component of debris on the screens was identified as the Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive aquatic species in Cowichan Lake and other lakes from the region. The EM was present for the cleaning of the screens on September 12, 2019. As most or all of the debris on the pump screen were organic (e.g. algae, aquatic plants), the cleaning procedures did not visually increase the amount of sediments downstream from the pump outlets. The parking lot adjacent to the weir and boat launch is a noticeable source of sediments entering the lake during large rainfall events, as observed on September 12th.

The weekly checklist for the pumps is provided in Table 2.

Table 2. Weekly pump-out checklist for Cowichan Lake based on observations from Aug. 29, Sep. 3 and Sep. 6, 2019.

Item	Good condition	Needs work	Notes
Fish screens clear	X		Screens were cleaned on Sep 12, 2019.
No debris around pump floats	X		No large woody debris.
Pump discharge piping intact	X		No damage to pump discharge points determined.
No excess pump noise	X		All pumps are electric.
Pump tethers acceptable	X		
No sediment entrainment	X		No visible discharge of sediments from lake into the river. Cleaning of the screens did not increase the amount of sedimentation downstream from the weir.
Pumps in acceptable water depth	X		
Pump discharge is controlled	X		14 to 15 pumps worked concurrently during this monitoring period.
No environmental hazards	X		

2.2 WATER QUALITY

In-situ water quality sampling was conducted in the river and lake during pumping operations using a calibrated WTW 3410 multi-meter. Surface water sampling took place near the river staff gauge (downstream) and at the lake boat ramp upstream of the weir (Table 3).

Table 3. Weekly in-situ water quality variables above and below the Cowichan Lake weir.

Variable	Sep 10	Sep 11	Sep 12
Temperature (°C)			
Above weir (lake site)	20.5	20.8	20.3
Below weir (river site)	20.1	20.8	20.0
Dissolved oxygen (mg/L)			
Above weir (lake site)	8.66	9.02	9.15
Below weir (river site)	8.60	8.90	9.03

On August 28, 2019, two HOBO V2 model temperature loggers were installed at the two sample sites to monitor temperature variations continuously, at 15 minute intervals. Temperature data were downloaded on September 12, 2019. Temperature data indicates a clear diurnal pattern in the littoral zone of the lake and river, and the water in the lake was, in general, warmer than the water in the river at the monitoring locations. Minimum/maximum temperature values in the lake and river for the period of August 28 – September 12 were 20.4°C/23.0°C and 20.3°C /22.7°C, respectively.

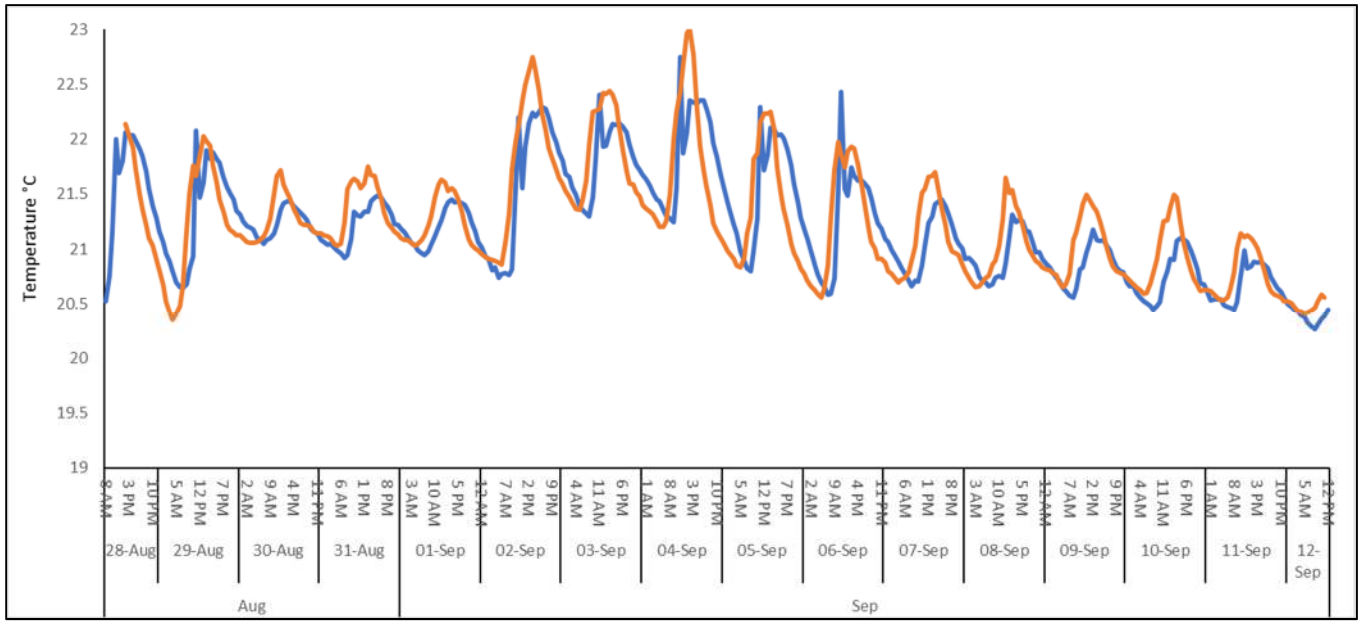

Figure 1. Hourly average temperature recorded in Cowichan Lake (orange) and Cowichan River (blue) from August 28 to September 12, 2019.

2.3 FISH AND FISH HABITAT

The pump setup was inspected visually to ensure the fish screens function properly and the risk for fish impingement remains low. An underwater inspection of the fish screens using an ROV as well as screen cleaning activities were completed on September 12, 2019. Based on the ROV video, discussions with the divers operating the ROV and cleaning the screens, and regular visual inspection, fish impingement has not been documented on any of the pump screens installed at the weir since the pump-out project began (August 29, 2018).

Table 4. Fish impingement observations at the end-of-pipe fish screen on pump intakes in Cowichan Lake.

Date	Reason	Observations
10/09/19	Installation	14 pumps operating, pump screens partially blocked; no impingement visible.
11/09/19	Operations	15 pumps operating (15th pump started at 11 pm), pump screens partially blocked; no impingement visible.
12/09/19	Operations	15 pumps operating; debris accumulated on screens is being removed; little to no risk for fish impingement especially on the unused pumps.

Assessment of the previously determined sites where Cowichan Lake lamprey were observed (free swimming forms and ammocoetes) – as per DFO and BC Conservation Foundation (BCCF), continued on September 10-11, 2019 during this reporting period. As no precipitation was recorded prior to these site assessments, the creeks at the predetermined lamprey sites remained dry and the lake water level continued to drop. Rainfall began on September 12, 2019 and lake levels have shown an increase as a result.

The predetermined lamprey sites were sampled using the digging method. Lamprey larvae were found below the water level (in the substrate) in an isolated pool of approximately 6 m in diameter and 0.5 m deep located near Nixon Creek. Based on water characteristics (D/O=5.50 mg/l; 66.2% saturation; T=19.7°C), potential risk of injury to fish during the salvage procedures, rainfall forecast, and water temperature in the lake (T=22.5°C), it was decided for the time being the lamprey were is suitable habitat and were not at risk of stranding. They were therefore not salvaged. As the water level in this pool is likely influenced by the lake water level, the pool will be monitored on a weekly basis to ensure it remains an appropriate habitat to resident lamprey larvae.

As lamprey larvae were not observed in any of the remaining eight predetermined sites, the salvage and habitat monitoring efforts were shifted toward other lake tributaries that had not yet been investigated. On September 11, 2019, the confluences of McKay and Little Shaw creek with the lake were inspected.

No flow was observed in Little Shaw Creek and its habitat at the lake confluence was considered poor for lamprey rearing, i.e. compacted cobbles and shallow layer of sand. This area will not be surveyed any further.

McKay Creek had surface flow under the North Shore Road bridge, though the water goes subsurface approximately 100 m upstream from the lake shoreline. Based on observations of the shoreline at other sites, it is likely the confluence area of McKay Creek and Cowichan Lake was dry prior to pumping

commencing. Lamprey larvae were found in a dry side-channel of McKay Creek, approximately 7 m away from the lake waterline. Digging in this site found the groundwater to be approximately 5 cm below the surface. A total of 19 lamprey individuals raging from 20 mm to 100 mm were salvaged from an area of approximately 0.5 m^2. No mortalities were recorded during the salvage process and all individuals were released in a nearby area of the lake characterised by small gravels, large sand, and organics. Sampling continued upstream in the dewatered channel until groundwater was approximately >0.25 m below the surface. Lamprey were not found in any upstream areas.

The stranding risk for free swimming lamprey forms remained low during the pumping operations – Table 6. No free swimming forms were observed during the site assessments.

Table 5. Cowichan lamprey salvage and stranding observations at nine sites around Cowichan Lake.

Site	Aug 28, 2019 (pre-pumping)	Sep 10, 2019 (during pumping)
Meade Creek (N)	Good lamprey habitat – small gravels and organics. No risk for stranding dur to steep lake banks. No swimming lamprey observed.	Sampled for lamprey larvae – none found. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.
Miracle Creek	Poor lamprey habitat – compact or organics dominated. Low risk for stranding – gently sloped banks; no isolated pools. No swimming lamprey observed.	Sampled for lamprey larvae – none found. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.
Sutton Creek	Poor lamprey habitat – compact or organics dominated. Low risk for stranding – gently slopped or steep lake banks. No swimming lamprey observed.	Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish. Area not sampled for lamprey larvae.
Robertson Creek	Good lamprey habitat – small gravels and organics. Little risk for stranding – steep banks, one lake area that may become isolated. No swimming lamprey observed.	Sampled for lamprey larvae in areas where they were previously observed – none found. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.
Utility Creek	Poor lamprey habitat – compact or organics dominated. Low risk for stranding due to gentle slope; no isolated pools. No swimming lamprey observed.	Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish. Area not sampled for larvae.
Hawes Bay	Sub-optimal/poor lamprey habitat– sand/organics and cobbles dominated. Low risk for stranding due to gentle slope; no isolated pools. No swimming lamprey observed.	Stranded three spine stickleback (*Gasterosteus aculeatusadults*) observed on the fine sand beaches at this location. Sampled for lamprey larvae – none found. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.
Shaw Creek	Good lamprey habitat on the lake shoreline, small gravel and organics. Low risk for stranding in a pool near the confluence with Shaw Creek. No swimming lamprey observed.	Sampled for lamprey larvae in areas where they were previously observed along the shoreline and pool at risk for isolation but still connected – none found. The pool receives water from Shaw Creek at its upstream end. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.

Site	Aug 28, 2019 (pre-pumping)	Sep 10, 2019 (during pumping)
Nixon Creek	Good lamprey habitat on the lake shoreline, small gravel and organics. Low risk for stranding, steep banks. No swimming lamprey observed.	Sampled for lamprey larvae in areas where they were previously observed. Lamprey found in an isolated pool. The pool has good rearing habitat and it is at low risk for drying out; habitat was not disturbed, and salvage will occur as needed. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.
Nixon Float House	Mostly poor and suboptimal lamprey habitat on the lake shoreline near and behind the float house – organics dominated. Good lamprey habitat found closer to Nixon Creek. No risk for stranding – steep banks. No swimming lamprey observed.	Sampled for lamprey larvae – none found. Receding water line did not expose different habitat type nor created isolated pools or increased risk for stranding fish.

2.4 AQUATIC RESOURCES AND WILDLIFE OBSERVATIONS

Monitoring of the riparian vegetation, aquatic plants, and erosion/bank stability issues was also conducted during the monitoring of the nine sites along the Cowichan Lake shoreline. Sites were photo-documented for reference.

No notable wildlife sightings were recorded during this reporting period.

Riparian vegetation along the lake shoreline continued to be exposed to drier conditions than typical; however, no significant signs of stress or die-off in trees or shrubs were observed to date.

Aquatic plants at Utility and Miracle creeks were completely exposed to air prior to pumping beginning. Stress in plants has been observed at the two locations. The area of emerged aquatic plants at Robertson Creek remained small during this period.

Photographs of a selection of sites inspected are provided in Section 3 below.

3 PHOTOS

Photo 1. Looking west at the Cowichan Lake shoreline near Nixon Creek. Aug 29, 2019.

Photo 2. Looking west at the Cowichan Lake shoreline near Nixon Creek. Sep 10, 2019.

Photo 3. Looking east at the Cowichan Lake shoreline near Nixon Creek. Aug 29, 2019.

Photo 4. Looking east at the Cowichan Lake shoreline near Nixon Creek. Sep 10, 2019.

Photo 5. Isolated pool on the lake shoreline near Nixon Creek. Sep 3, 2019.

Photo 6. Isolated pool on the lake shoreline near Nixon Creek. Found to contain lamprey. Sep 10, 2019.

Photo 7. Looking southwest at the lake shoreline near the Nixon Creek float house. Aug 29, 2019.

Photo 8. Looking southwest at the lake shoreline near the Nixon Creek float house. Sep 3, 2019.

Photo 9. Looking east at the lake shoreline near Shaw Creek. Aug 28, 2019.

Photo 10. Looking east at the lake shoreline near Shaw Creek. Sep 3, 2019.

Photo 11. Looking west at the lake shoreline near Robertson Creek. Sep 3, 2019.

Photo 12. Looking west at the lake shoreline near Robertson Creek. Sep 10, 2019.

Photo 13. Looking south at the vegetated lake shoreline near Robertson Creek. Aug 28, 2019.

Photo 14. Looking south at the vegetated lake shoreline near Robertson Creek. Sep 10, 2019.

Photo 15. Looking north at the lake shoreline near Meade Creek. Aug 28, 2019.

Photo 16. Looking north at the lake shoreline near Meade Creek. Sep 10, 2019.

Photo 17. Looking east at the lake shoreline near Utility Creek. Aug 28, 2019.

Photo 18. Looking west at the lake shoreline near Utility Creek. Sep 10, 2019.

Photo 19. Looking west at the lake shoreline - mud flats and riparian vegetation near Miracle Creek. Aug 28, 2019.

Photo 20. Looking west at the lake shoreline - mud flats and riparian vegetation near Miracle Creek. Sep 10, 2019.

Photo 21. Looking west at the lake shoreline near Sutton Creek. Sep 6, 2019.

Photo 22. Looking west at the lake shoreline near Sutton Creek. Sep 10, 2019.

Photo 23. Looking east at the lake shoreline near Hawse Creek. Aug 28, 2019.

Photo 24. Looking east at the lake shoreline near Hawse Creek. Sep 10, 2019.

Photo 25. Looking west at the lake shoreline near Little Shaw Creek. Sep 11, 2019.

Photo 26. Looking south at the confluence area of McKay Creek and Cowichan Lake. Lamprey salvaged from area beside bucket. Sept. 11, 2019.

Photo 27. Looking north at the confluence area of McKay Creek and Cowichan Lake. Lamprey salvaged from wetted area in foreground. Dark soil represents areas inspected by digging. Sept. 11, 2019

Photo 28. Lamprey salvaged from McKay Creek area. Sept. 11, 2019

4 REPORT LIMITATIONS

This report was prepared exclusively for Catalyst Paper Corporation. The quality of information, conclusions and estimates contained herein is consistent with the level of effort expended and is based on: i) information available at the time of preparation; ii) data collected by EDI Environmental Consulting Inc. and/or supplied by outside sources; and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used only by Catalyst Paper Corporation. Any other use or reliance on this report by any third party is at that party's sole risk.