

**REPORT TO REGIONAL PARKS COMMITTEE
MEETING OF WEDNESDAY, JUNE 25, 2025**

SUBJECT Elk Lake Oxygenation System Update

ISSUE SUMMARY

To update the Regional Parks Committee on the operation of the oxygenation system in Elk/Beaver Lake Regional Park.

BACKGROUND

The Board-approved 2020 Elk/Beaver Lake Watershed Management Plan outlines a comprehensive initiative to improve water quality in Elk Lake. The initiative prioritizes:

- Reducing phosphorus runoff from surrounding land to limit nutrient pollution.
- Restoring streams and riparian habitats to enhance natural filtration.
- Implementing an oxygenation system to improve lake health and mitigate algae blooms.
- Engaging landowners and community stewards in best management practices.

Cyanobacteria (commonly known as blue-green algae) are naturally occurring aquatic organisms that can multiply very quickly under favourable conditions, such as warm temperatures, high nutrient concentrations and stable conditions. These blooms can occur in a variety of colours, including blue-green, green, brown, blue, white and red. Phosphorus is the key nutrient limiting algal growth in the majority of BC lakes. Increased concentrations of nutrients often lead to increased algal production and increased risk of a bloom forming. Evidence suggests that climate warming favours cyanobacteria, as warmer lake temperatures are known to accelerate blue-green algae growth. As the air warms, the atmosphere will also have a greater capacity to hold water, leading to more intense rainfalls and increased surface runoff. The increased spread of invasive species, such as carp, which are known to disturb the bottom sediments of lakes and re-suspend nutrients, also contributes to the rise in blue-green algae blooms due to changes in the food web structure.

Water quality issues in Elk/Beaver Lake have negatively impacted ecological, cultural and recreational values of the regional park since the 1980s. Elevated phosphorus levels in the lake have contributed to frequent blue-green algae blooms that threaten the health of the lake, the health of park visitors and the overall visitor experience. Details about water quality are available in the Elk/Beaver Lake Watershed Management Plan, approved by the CRD Board in 2020.

Most of the phosphorus comes from lake bottom sediments that have accumulated over decades and is released back into the water column under low oxygen conditions, a process known as internal phosphorus loading. In 2019, the Capital Regional District (CRD) Board carried a staff recommendation to remediate the lake, and in 2020, the Board committed partial funding for remediation, supplemented by a \$750,000 provincial grant from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

A hypolimnion (deep-water) direct oxygenation injection system was selected, designed and constructed in Elk Lake and in November 2023 the system was operationalized, and fully commissioned in March 2024. The objectives of the oxygenation system include:

1. Eliminate deep-water oxygen depletion (anoxia).
2. Decrease internal phosphorus loading.
3. Maintain suitable cold-water fish native habitat below 15°C.
4. Reduce frequency and duration of blue-green algae blooms.

The oxygenation system diffuses high-purity oxygen into the deepest part of the lake to help reduce oxygen depletion, which keeps most of the phosphorus bound in the lake bottom sediments. Oxygen injection is expected to improve fish habitat and reduce the amount of phosphorus available to blue-green algae in the lake. The oxygenation system only targets the deep-water sources of phosphorus and is not expected to have any impact on shallow-water sources or external inputs.

IMPLEMENTATION UPDATE

Staff engaged experts to evaluate the oxygenation system's effectiveness, assess water quality objectives and provide recommendations moving forward. The Elk Lake Oxygenation System 2024 Annual Report details the first year of oxygenation operation and evaluates data against the water quality objectives for Elk Lake. The review compared water quality data before (2019-2023) and after (2024) the system was installed. While some data has been collected in 2025, it has not yet been compiled and analyzed. When comparing 2024 results to pre-oxygenation conditions, results have indicated an improvement in lake health, including:

1. Deep-water oxygen levels improved in 2024, with a shorter anoxia period (2 months versus 5 months in previous years).
2. Total phosphorus in deep water was reduced by 80% in 2024 compared to previous years.
3. Average deep-water temperatures increased in summer 2024 (12.5°C) compared to previous levels (8°C); however, they did not exceed 15°C to maintain optimal native fish habitat.
4. Blue-green algae blooms continued to occur and were longer lasting than in previous years.

Water quality improved significantly in 2024; however, blue-green algae blooms persisted throughout the year. This was likely due in part to environmental conditions (heavy rainfall in July and August, warm temperatures and stable wind conditions), which were ideal growing conditions for blue-green algae. In addition, blue-green algae bloom conditions in 2025 across the region and province have been some of the worst on record. Specific to Elk Lake oxygenation, some of these worsening conditions were expected temporarily after system installation due to the stabilization of the various sources of phosphorus in the lake. Overall, findings highlight the need to continue addressing all nutrient sources impacting lake health through the operation of the oxygenation system and actions outlined in the Elk/Beaver Lake Watershed Management Plan.

While early 2025 conditions appear to show an increase in blue-green algae blooms, it is not uncommon for Elk Lake to experience spring blooms (e.g., 2021). Unfortunately, the persistent presence of blue-green algae blooms continues to disrupt lake activities. On May 25, 2025, the IRONMAN 70.3 Victoria event was affected, leading to the cancellation of the 1.9 km swimming portion of the race. This decision was made due to elevated algae levels in Elk Lake, raising concerns about potential health risks for competitors.

Preliminary analysis in 2025 indicates that water quality improvements observed in 2024 have persisted this year, which aligns with our expectations. A wholesome evaluation of the data to assess the continued impact of the oxygenation system will occur by the end of the year, after the

water has turned over in the fall. As of the beginning of June, the deep-water remains oxygenated (not anoxic) and total phosphorus levels are well below historical averages. However, external sources of phosphorus and weather-related influences (such as elevated precipitation in March and warm days with stable winds in April and early May) may continue to stimulate algal blooms.

Staff will continue to monitor water quality, track changes over time and inform the optimization of the oxygen system. Ongoing water quality monitoring is critical to guiding system operation, evaluating effects on Beaver Lake and assessing key actions in the watershed management plan. Performance monitoring in the coming years will determine if further remediation is needed for Beaver Lake.

The oxygenation system worked as expected in its first year, and CRD staff, with assistance from consultants, continue to optimize the system to increase efficiency and reduce future operating costs.

IMPLICATIONS

Environmental Implications

Improvements to the water quality of Elk/Beaver Lake benefit diverse ecological values in the regional park, including the provision of critical habitat for the Pacific Coast population of western painted turtle, federally threatened under the *Species at Risk Act*. The lake also provides important habitat for many native aquatic and riparian species downstream, including coho salmon and coastal cutthroat trout in the Colquitz River.

Climate Implications

The presence of blue-green algae is expected to increase across the globe in response to climate change. Increased temperatures and drought, followed by heavy rainfall events that carry nutrients from the land into nearby water bodies, support optimal conditions for blooms and will continue to affect lake health and pose threats to human and pet health. Continued actions to reduce external sources of nutrients through the implementation of the watershed management plan should be prioritized to adapt to climate change.

Financial Implications

The CRD is grateful for the Province of BC's \$750,000 contribution to facilitate the purchase of the \$1.6 million oxygenation system. Annual costs to maintain the system include the following, with expected increases due to inflation and tariffs:

Expense Category	2024 Costs	2025 Anticipated Costs
Electricity	\$60,000	\$60,000
System maintenance	\$20,000	\$40,000
Water quality monitoring	\$35,000	\$30,000
Expert consultation	\$20,000	\$15,000
Staff time	\$30,000	\$30,000
TOTAL	\$165,000	\$175,000

Intergovernmental Implications

From 2016 to 2019, the CRD led an intergovernmental working group to coordinate lake remediation efforts. CRD staff continue to collaborate with government partners to support water quality objectives, particularly in the implementation of the Elk/Beaver Lake Watershed Management Plan. Since installing the system, staff have provided support and resources to several interested parties across Canada to contribute to improved understanding of water quality issues and remediation options.

Service Delivery Implications

CRD staff oversee the water quality monitoring program, including its implementation, operational management and the maintenance of the system's services. They are also responsible for issuing public alerts when blue-green algae blooms are detected in parks, along with providing educational resources about blue-green algae through the CRD website and public signage. While this report does not directly affect service delivery, it highlights ongoing efforts to enhance system efficiency and advance the implementation of the watershed management plan.

Social Implications

Blue-green algae blooms continue to affect recreational values in and around the lake. The disruption of large, permitted events such as the IRONMAN 70.3 Victoria is an example of why the work to implement the watershed management plan is critical. The oxygenation system and implementation of the watershed management plan are anticipated to continue to improve water quality outcomes for the lake, thereby improving recreational values. Local experts and community groups, like the Beaver Elk Environmental Stewards and Victoria Golden Rods and Reels Fishing and Social Club, have played a key role in these efforts. Staff meet regularly with local stewards to share updates and knowledge.

CONCLUSION

After just over one year of operation, the oxygenation system improved deep-water oxygen levels, reduced phosphorus and maintained optimal water temperatures; however, blooms persisted throughout the year and into 2025 due to climate-related impacts and the continued stabilization of the various nutrient sources within the lake. Staff will continue to operate the oxygenation system, coordinate water quality monitoring and implement actions in the Elk/Beaver Lake Watershed Management Plan to reduce internal and external sources of nutrients that contribute to blue-green algae blooms in the lake. Staff will report to the Board annually on system performance and water quality progress.

RECOMMENDATION

There is no recommendation. This report is for information only.

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ATTACHMENT

Presentation: Elk Lake Oxygenation System Update