Elk/Beaver Lake Watershed Management Plan

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Capital Regional District | Parks & Environmental Services, Regional Parks

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EXECUTIVE SUMMARY

A healthy and vibrant community depends on healthy ecosystems. In an effort to improve water quality and support recreational, cultural, social and environmental values across the region, the Capital Regional District (CRD) has led the development of a watershed management plan for the Elk/Beaver Lake watershed.

Water quality degradation has been reported in Elk/Beaver Lake for decades. Intensive research, data collection and analysis has improved our understanding of lake issues and supports ongoing decision making to improve water quality at the lake. In 2013, an intergovernmental group was formed by the Province to address the lake issues, and at the direction of the CRD Board in 2016, staff formed the Elk/Beaver Lake Initiative to chair and coordinate actions with local government and interest groups. The priorities of the Elk/Beaver Lake Initiative are to:

- reduce the frequency and toxicity of blue-green algae
- improve fish habitat
- manage invasive weed growth.

With the overall goal of improving water quality in Elk/Beaver Lake, this watershed management plan addresses these priorities by tackling the elevated nutrient levels in the lake that contribute to these issues. Recommendations are outlined to reduce total phosphorus entering the lake by improving land management practices within the watershed, improving watershed structure and function, and improving lake health and function.

In addition, the watershed management plan outlines various actions to reduce nutrient inputs into the lake from the surrounding watershed, with the highest priority actions being to:

- improve rural/urban land management practices to reduce and manage the source of phosphorus inputs into the watershed
- improve agricultural land use practices to reduce and manage nutrient use
- restore and enhance stream and watershed function in Haliburton Brook and O'Donnell Creek
- manage and reduce growth of invasive Eurasian milfoil.

An implementation plan, performance metrics and long-term monitoring recommendations are also presented. Partnership and collaboration with government agencies is also important to ensure the long-term sustainability of the plan and guide future improvement of water quality in the lake and its many environmental, social, recreational, cultural and economic values.

ACKNOWLEDGEMENTS

Many individuals, landowners, interest groups, experts, and government agencies have put countless hours into better understanding, assessing and restoring water quality at Elk/Beaver Lake. These contributions of time, energy, and resources have been fundamental in understanding the lake issues, increasing public awareness and supporting informed decision making to improve water quality in the lake. Through collaboration, passion, vision and determination, this watershed management plan has been developed in partnership with many individuals, agencies and groups to support, protect and restore the many values of the lake and surrounding watershed.

The CRD acknowledges that Elk/Beaver Lake and the surrounding watershed are located on the ancestral lands of the Lək̓ʷəŋən and W̱SÁNEĆ Nations. The support and context they have provided for the history of the land and current interest and vision for the region is a valuable contribution to this plan. An intergovernmental working group has also been critical to providing guidance and support for collaborative decision making to improve water quality in a complex, multi-jurisdictional lake, particularly the District of Saanich, which significantly supported this process. A huge amount of gratitude goes to the community members and volunteer stewardship groups that have continued to care for the future of Elk/Beaver Lake and have dedicated their time and energy to support this initiative. Contributions of funding and in-kind support have supported the success of this initiative from a variety of grantors, funders and partners.

This document aims to acknowledge all key contributors and partners that supported the Elk/Beaver Lake Initiative within the Partnerships section of this document. Any omissions were unintentional.

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1. INTRODUCTION

Elk/Beaver Lake is the most visited Regional Park, valued for its many benefits at local, regional, provincial and national scales. Water quality issues at Elk/Beaver Lake were formally identified in the 1960s and have continued to decline, having significant impacts on the environment, social, cultural and recreational values of the lake and surrounding lands. At the direction of the Capital Regional District (CRD) Board, the Elk/Beaver Lake Initiative was established in 2016, driven by community concern and supported by an intergovernmental working group to improve water quality at the lake. The priority actions identified by the Elk/Beaver Lake Initiative include reducing blue-green algae (also known as cyanobacteria) blooms, managing invasive aquatic plant growth and improving fish habitat, all related to the overall water quality of the lake.

1.1 Background

Work to date has confirmed that the primary cause of lake issues is the elevated nutrient levels in the lake. Approximately 30% of these nutrients come from run-off, groundwater and air particles (dust) that enter the lake from the surrounding land, known as the external nutrient load. The remaining 70% of nutrients are accumulated in bottom sediment and recycled back into the lake, known as the internal nutrient load. From 2016-2019, staff worked with government and community partners to develop two complementary plans to address the internal and external nutrient loads in the lake and improve water qualities. This watershed management plan directly addresses external nutrient loads, while an in-lake remediation plan is underway to address the internal nutrient load.

1.2 Purpose, Scope and Timeframe

The purpose of the watershed management plan is to identify goals, objectives, recommended actions and an implementation plan to improve water quality in Elk/Beaver Lake.

The scope of this plan is geographically focused to Elk/Beaver Lake and the surrounding sub-watershed that drains into the lake. The scope of recommended actions within the plan is focused on reducing the external nutrient load in the lake. The internal nutrient load issue is addressed through a separate in-lake remediation plan and will not be specifically addressed within this document. The in-lake remediation process is guided by CRD staff, expert consultants and intergovernmental agencies. On September 11, 2019, staff brought forward a report and business case to the CRD Board outlining the environmental, recreational, community and economic values of the lake (over $10 million annually) and a recommendation to remediate the lake. The CRD Board approved the recommendation to move ahead with the in-lake remediation of Elk/Beaver Lake, subject to receiving at least 50% capital grant funds for the project.

During the public consultation process, a number of ideas and suggestions were brought forward for consideration within the plan. Some ideas and suggestions, however, were excluded if they did not fall within the scope of the plan. Recommended actions within this plan include active, on-the-ground restoration activities, in addition to actions relating to public outreach, education and community-led stewardship.

The timeframe of this management plan guides actions for at least the next 10 years (2020–2030). Following 2030, the plan should be reviewed and revised, as necessary.

1.3 Approach

The watershed management plan is one component of a multi-pronged, holistic approach to improve water quality in Elk/Beaver Lake. The watershed management plan addresses the land use activities and practices within the watershed that contribute to an ongoing, external nutrient load. Through a coordinated and parallel process, the in-lake remediation plan identifies actions to manage elevated nutrients accumulated in the lake sediments to reduce the internal nutrient load. This community-driven, collaborative approach will address immediate health and environmental concerns, while making a long-term, sustainable plan to address the source of the water quality issues within the watershed.

Given known constraints within the watershed, ensuring the success of this plan requires that it is sustainable, achievable, informed by science and supported by the agencies, community members, landowners and stakeholders needed to implement it. The plan includes a summary of our current understanding of lake issues, leading techniques and best management practices to support measurable objectives, a robust monitoring plan to assess the effectiveness of the plan and an adaptive management framework, essential to supporting continuous learning through an iterative, decision-making process.

1.4 Partnerships

A number of partnerships were critical to the development of this plan, as indicated in the Acknowledgements section. Table 1-1 below identifies the agencies, governments, community groups, landowners, funders and individuals for their vital contribution to this plan and the health and enjoyment of Elk/Beaver Lake.

Table 1-1 Elk/Beaver Lake Initiative Partners

Government
• Capital Regional District • District of Saanich • District of Central Saanich • Island Health (also known as Vancouver Island Health Authority) • BC Ministry of Environment and Climate Change Strategy • BC Ministry of Forests Lands and Natural Resource Operations & Rural Development • Transport Canada • BC Ministry of Transportation and Infrastructure • Fisheries and Oceans Canada • Peninsula and Area Agricultural Commission • Saanich Environment & Natural Areas Advisory Committee
First Nations
• Lək'ʷəŋən Nations: Esquimalt and Songhees Nation • W̱SÁNEĆ Nations: Pauquachin, Tsartlip, Tsawout, Tseycum
Non-Governmental Organizations/Community groups
• Colquitz Watershed Stewardship Coalition (also known as Colquitz Coalition) • Victoria Golden Rods and Reels Fishing and Social Club • Victoria Rowing Society, Rowing Canada Aviron, and Victoria City Rowing Club • University of Victoria Vikes: University of Victoria Varsity Athletics • BC Lake Stewardship Society • Beaver Elk Environmental Stewards • Habitat Acquisition Trust • Haliburton Brook Stewardship Coalition • Urban Biodiversity Enhancement and Restoration Group (UBER) at Haliburton Watershed • Victoria Natural History Society (birding) • Elk Beaver Lake Equestrian Society • Retriever Club • Haig-Brown Fly Fishing Association • World Fisheries Trust • Royal Oak Burial Park • Elk/Beaver Lake Recreational Advisory Group • Peninsula Streams Society • Amalgamated Conservation Society • South Vancouver Island Anglers Coalition

Table 1-1, cont'd

Academic Partners
• University of Victoria Engineering • University of Victoria Restoration of Natural Systems • University of Victoria Environmental Law Centre • Simon Fraser University Restoration Program • Camosun College Environmental Technology Program • Vancouver Island University Resource Management Program
Experts
• Richard Nordin, PhD • Ken Ashley, PhD • Purnima Govindarajulu, PhD • James Miskelly, Natural Resources Canada • Ian Bruce, Peninsula Streams • Christian Englestoft, MSc and Kristiina Ovaska, PhD • Gertrud Nurnberg PhD • Bruce LaZerte, PhD • Patrick Lucey and Cori Barraclough, Aqua-Tex Scientific Consulting Ltd • Northwest Hydraulic Consultants Ltd.
Agriculture
• Haliburton Organic Farm • Arabian Horse Farm • Hobby farms
Funding Contributors
• Canadian Wildlife Federation • BC Wildlife Federation • Habitat Conservation Trust Foundation • Freshwater Fisheries Society of BC • Victoria Fish and Game Protective Association • Community to Community Forum (C2C) – Union of BC Municipalities • District of Saanich (in-kind) • Victoria Golden Rods and Reels Fishing and Social Club (In-kind) • Peninsula Streams Society (in-kind) • Victoria Rowing Society, Rowing Canada, and Victoria City Rowing Club (in-kind)
Key Community Champions
• Mick Collins (Victoria Golden Rods and Reels Fishing and Social Club) • Robert McConnell (Victoria Golden Rods and Reels Fishing and Social Club) • Jamie Disbrow (Beaver Elk Environmental Stewards)

1.4.1 Intergovernmental Working Group

An intergovernmental working group was formed in 2014 by the Ministry of Environment and Climate Change Strategy (ENV) to address increasing concern for water quality in Elk/Beaver Lake. In 2016, the CRD established the Elk/Beaver Lake Initiative and coordinated the working group's efforts to improve water quality. The intergovernmental working group supports the Elk/Beaver Lake Initiative by providing guidance and support for in-lake remedial recommendations, participating in decision making, supporting the securement of funds, and helping to guide future adaptive management. Membership of the intergovernmental working group include ENV, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), Island Health, the District of Saanich and the CRD. After December 2019, the intergovernmental working group was formally decommissioned, however, all partner agencies are available to support the Elk/Beaver Lake Initiative, as needed.

1.4.2 First Nations

The CRD acknowledges that Elk/Beaver Lake and the surrounding watershed are located on the ancestral lands of the Lək̓ʷəŋən and W̱SÁNEĆ peoples for thousands of years. As caretakers and stewards of the land, First Nations play an important part in providing insight on current values and the values of the land pre-settlement, and are important partners moving forward with this plan. Continued consultation and collaboration with First Nations will be supported throughout the implementation of this plan.

1.4.3 Community Groups

Community support and engagement has been a vital component of driving and coordinating actions to improve water quality at Elk/Beaver Lake. Partnerships with the University of Victoria Civil Engineering and Restoration of Natural Systems programs have provided valuable project planning that have contributed to improvements to stormwater management within the watershed surrounding Elk/Beaver Lake. Numerous expert scientists have also provided expertise that has led to the selection of lake and watershed improvement options.

Numerous community groups and volunteers have contributed to aquatic weed monitoring, water quality monitoring, invasive plant removal, and riparian restoration efforts. Volunteer participation is a critical component to ongoing riparian area enhancement. The enjoyment of recreation activities, such as rowing, hiking, swimming and fishing have driven the objectives of the Elk/Beaver Lake Initiative and this watershed management plan. Communications and collaboration with local interest groups, lake users and stakeholders are ongoing.

1.4.4 Private Landowners

Private landowners that live within the watershed surrounding Elk/Beaver Lake are a critical component to ensuring the success of this plan. Landowner support and participation have already contributed to external nutrient reduction and better stewardship of the watershed as a whole. Building partnerships and

providing support and resources to landowners, to help shift current behaviours and land management practices, will make a significant impact on the efficacy of the plan.

1.5 Public Engagement and Plan Development

Public engagement was a key part of developing the watershed management plan for Elk/Beaver Lake to address external sources of nutrients. This plan was developed with an effort to involve the intergovernmental working group, First Nations, private landowners, park visitors and interest groups in our region through a public engagement process. The planning process involved a multi-phased approach to gather available data, identify key issues, share ideas on appropriate solutions and develop a plan to address those issues. Following the initial public engagement phase, the plan was developed, reviewed, revised and finalized for endorsement by various levels of government, field experts, stakeholders, landowners and community groups.

For a complete summary of the public consultation process, see Appendix A.

1.6 Vision, Goals, Objectives and Outcomes

The following vision, goals, objectives and outcomes for the watershed were developed and informed by the public consultation process.

Vision: The vision expresses the desired end state; a vision for where one wants to be in 15-20 years.

> *The vision for Elk/Beaver Lake watershed is to have a healthy and diverse lake ecosystem that supports environmental values, safe recreation and community activities for generations to come.*

Goal: Succeeding the vision, the following goal was identified for Elk/Beaver Lake watershed.

> *The primary goal is to improve water quality in Elk/Beaver Lake*

Objectives: The objectives were developed to specifically address the primary goal of improving water quality, specifically addressing the external nutrient load from phosphorus:

1. *Improve land management practices within the watershed to reduce total phosphorus entering the lake.*
2. Improve watershed structure and function to reduce total phosphorus entering the lake.
3. *Improve lake health and function to reduce total phosphorus within the lake.*

Outcomes: The anticipated outcomes of this watershed management plan include:

- *Restored habitat for native aquatic species*
- *Reduced growth of Eurasian milfoil*
- *Reduced frequency of blue-green algae blooms*
- *Improved community awareness and understanding of watershed stewardship*

1.7 Jurisdiction

The Elk/Beaver Lake watershed falls within multiple jurisdictions, as outlined in Figure 1-1.

Those jurisdictions include the following, with associated responsibilities identified as they relate to the Elk/Beaver Lake Initiative.

Jurisdiction	Responsibilities
District of Saanich	Responsible for planning regulations and bylaw enforcement for residential properties in the watershed are within the jurisdiction of the Saanich
ENV	Responsible for the effective protection, management and conservation of BC's water, land, air and living resources
FLNRORD	Manages and monitors fisheries within British Columbia
Island Health (AKA Vancouver Island Health Authority)	Provides guidance and expertise on water quality issues impacting human health, such as toxic blue-green algae blooms
Transport Canada	Regulates water surface activities on Elk/Beaver Lake
CRD Regional Parks	Manages Elk/Beaver Lake Regional Park

The CRD also works collaboratively with Island Health, and ENV to facilitate lake water quality monitoring, and the detection and public communication of blue-green algae toxins in the lake.

Additional jurisdictional responsibilities are held by the Ministry of Agriculture. This ministry provides tools and information to support farmers and growers to ensure sustainable and environmentally friendly use of these resources. Significant agricultural land use takes place in the Elk/Beaver Lake watershed and provincial legislation is important to protecting soil, water, air and biodiversity in the agricultural sector. The provincial Agricultural Land Commission is an independent administrative tribunal dedicated to preserving agricultural land and encouraging farming in British Columbia. The Agricultural Land Commission specifies land use permitted within the Agricultural Land Reserve, which covers a significant portion of the Elk/Beaver Lake watershed.

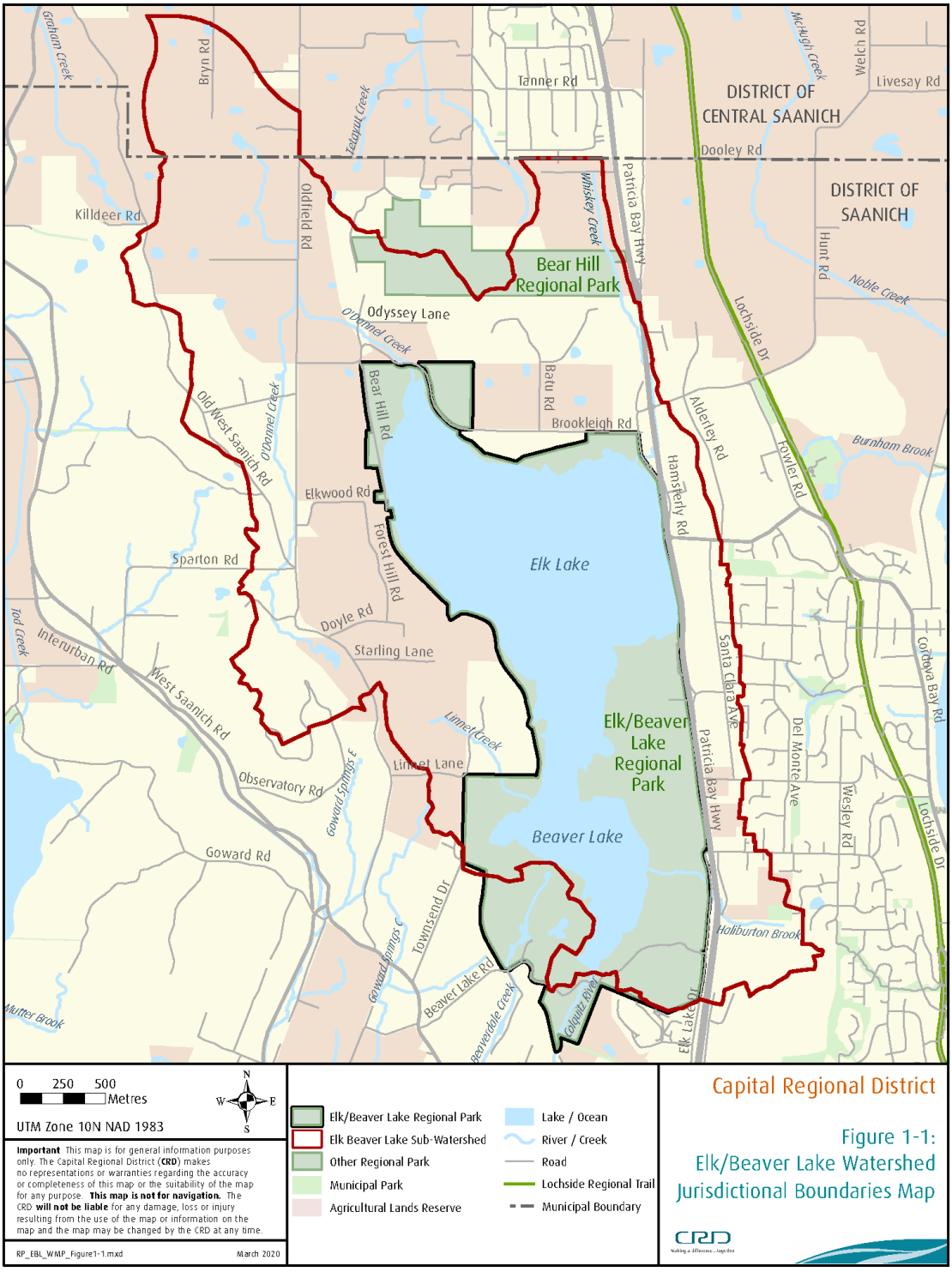

Figure 1-1: Elk/Beaver Lake Watershed Jurisdictional Boundaries

1.8 Policy

Key legislation, policy and bylaws that impact and/or guide activities within the Elk/Beaver Lake watershed are as follows:

District of Saanich: Watercourse Bylaw, Zoning Bylaw, Deposit of Fill Bylaw, Tree Preservation Bylaw, Subdivision Bylaw, and Official Community Plan policies.

- Capital Regional District: Elk/Beaver Lake Regional Park Management Plan (Bylaw No.3698; CRD 2010), Regional Parks Regulation Bylaw (4225), and Septic Maintenance Bylaw (3470).
- Agricultural Land Commission: The *Agricultural Land Commission Act* and associated regulations.
- Ministry of Agriculture: *Code of Practice for Agricultural Environmental Management* regulates land use and impacts of the environment.
- BC Provincial Legislation: *Environmental Management Act, Water Protection Act, Riparian Areas Protection Act, Wildlife Act* and *Water Sustainability Act*.
- Federal Legislation: *Fisheries Act, Canada Wildlife Act* and *Species at Risk Act*.

For more information on these policies and regulations, please see Appendix C – Policy & Regulation.

Additional reports and strategies that guide or support recommendations within this plan include:

- Ministry of Environment and Climate Change Strategy: Water Quality Objectives and Water Quality Attainment Report. (McKean, 1992; Ministry of Environment, 1996)
- Capital Region District: CRD Regional Climate Action Strategy (2017), Regional Parks Strategic Plan (2012), Regional Canada Goose Management Strategy (2012)

2. ELK/BEAVER LAKE AND WATERSHED

The Elk/Beaver Lake sub-watershed is the headwaters for the Colquitz River system, which flows through the District of Saanich and into the ocean at Portage Inlet. Elk/Beaver Lake is composed of two basins, Elk and Beaver, separated by a shallow inter-lake channel. The 2.24 km^2 combined lake area receives water from a 7.82 km^2 upstream sub-watershed drainage area. Water flows into Elk/Beaver Lake from 25 drainage tributaries, but the primary inflows are from O'Donnell Creek, Hamsterly Creek, Haliburton Brook and Linnet Creek. A comprehensive understanding of the historic and current conditions and trends of water quality is critical to the development of a watershed management plan. This section provides a summary of our understanding of the watershed and water quality issues in Elk/Beaver Lake.

2.1 Land Use Summary

Historic and current land use impacts the quality of the surface waters within a given watershed. Land use describes a category of usage, such as urban/rural residential, agricultural, and forested, often associated with the zoning of the land. Land use can be valuable in better understanding the type of land management practices and activities that occur on the land, such as the application of fertilizers in rural areas, animal manure storage on agricultural lands and the paving of roads or parking lots in urban areas. Land cover provides useful information of the physical state of the environment at a particular time, often using aerial imagery of a region.

Water quality in Elk/Beaver Lake has been affected by human activities for at least the past 150 years (Groeneveld, 2002). Prior to colonization, the Indigenous people of this territory managed the lands in such a way as to provide for many of their cultural, sustenance and economic needs. The disturbed meadows on the east side of the park represent a high-quality native meadow complex that were historically farmed. This area was not originally forested, partly due to the clay soils, and likely partly due to Indigenous land management. The first Euro-Canadian settlers described this area as a prairie (Pearson, 1981). Today, there are many remnants of the original prairie, including pockets of diverse native meadow, a few original Garry oak trees, and many vernal pools.

In the late 1800s, land use changed significantly and included forestry, agriculture, urbanization, and increasing recreational uses, which have all influenced the water quality in Elk/Beaver Lake in different ways. The surface area and depth of the lake was significantly altered between 1873 and 1879 by the construction of three dams to supply drinking water to the City of Victoria until 1914 and to the Saanich Peninsula until 1977. The construction of these dams has resulted in the lake surface area increasing by 21% (from 1.84-2.24 km^2) and the shoreline perimeter increasing by 19% (Groeneveld, 2002), flooding surrounding lands. The Patricia Bay Highway (BC-17) was constructed in the 1950s and is located directly adjacent to the east of the lakeshore. The construction of the highway and shoreline trail may have resulted in the disappearance of many small, natural drainages around the lake (Groeneveld, 2002).

The first signs of water quality concerns in the lake were identified in 1968 during provincial water quality monitoring, and the lake was concluded to be highly eutrophic (high in nutrients) by 1972. A paleo-limnological study indicates that the rate that sediment was moving into the lake was increasing even before 1850 and increased exponentially after that, until at least 2000 (Groeneveld, 2002). In natural systems, lakes become more eutrophic over time through natural processes over hundreds of years. However, in urban areas, such as Elk/Beaver Lake, human-related activities sped up this process. This accelerated process of sedimentation and subsequent eutrophication of the lake is a common consequence of land clearing, water impoundment (damming), agricultural activities, and increasing impervious surfaces, all of which have occurred in the Elk/Beaver Lake watershed, most intensely since the 1950s.

The majority of the watershed is privately owned, with the exception of Elk/Beaver Lake Regional Park, which surrounds the perimeter of the lake. Aside from Elk/Beaver Lake Regional Park, zoning within the watershed is primarily Rural (A-1) indicating 2ha lots. There is also higher density, single family zoning (RS-12) on the east side of Patricia Bay Highway (BC-17). There are a number of lots zoned Commercial (C-6; C-2, C1C) on the northeast side of the lake and east of BC-17 (District of Saanich, 2015). There are also a small number of properties zoned as Public (P-1) within the watershed as well.

The majority of residential properties to the north and west of the lake, and just east of BC-17, reside outside the Urban Containment Boundary. This boundary identifies the division between the urban area to the south-east of Saanich and the rural area to the north-west. As a result, properties outside the Urban Containment Boundary have septic systems and fields to manage human waste, while properties within the boundary are on sewage systems. There are currently no commercial forestry or large industrial agricultural activities occurring in the watershed. Land cover in the watershed, as demonstrated in Figure 2-1 is primarily tree cover, lake and pond, agricultural fields and grass, shrub, bare ground and exposed rock. There is also a network of urban area (buildings, roads, and parking lots) and pockets of riparian and wetland areas scattered throughout the watershed.

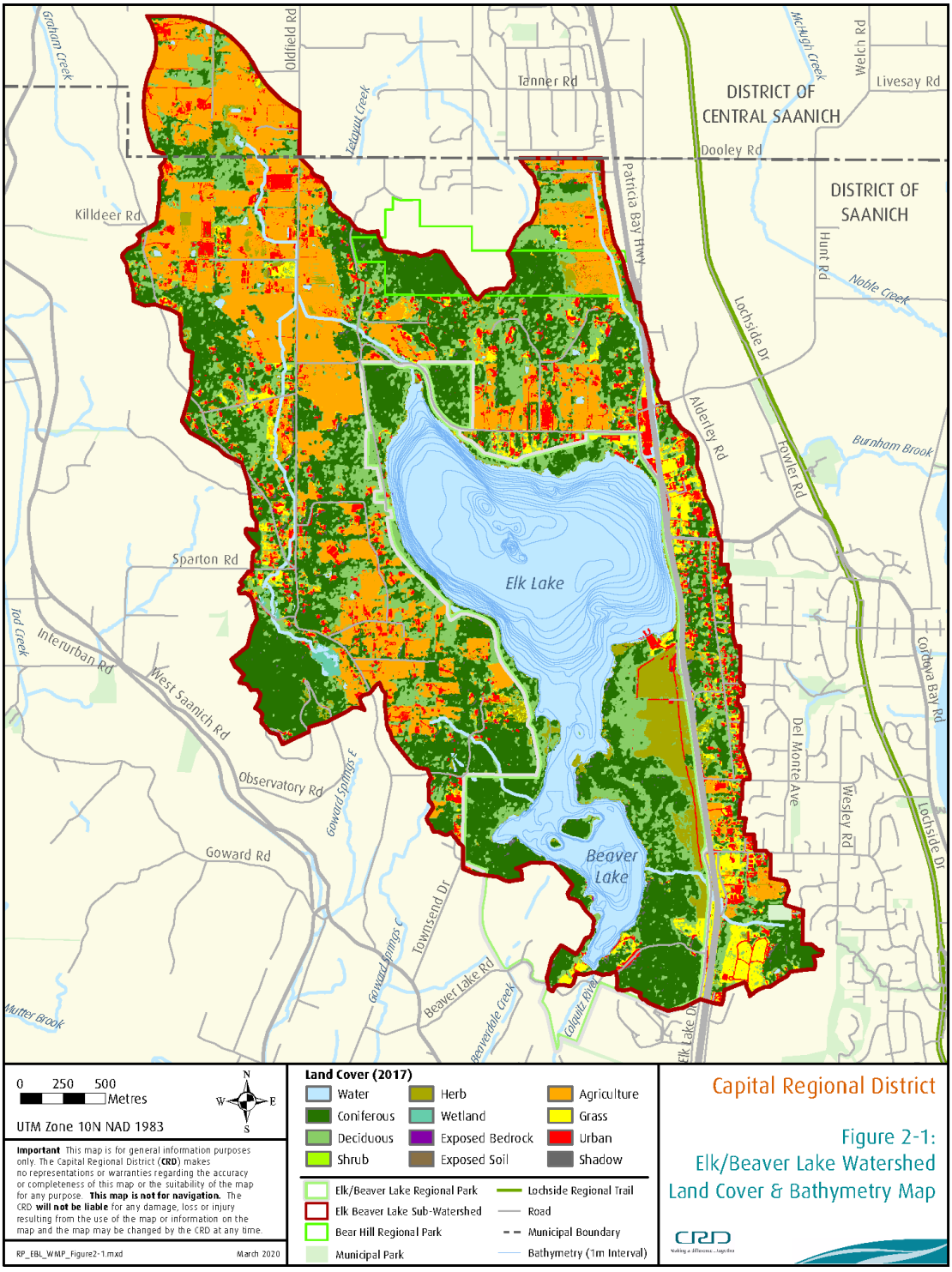

Figure 2-1: Elk/Beaver Lake Watershed Land Cover Map (2017)

2.2 Lake and Watershed Values

Elk/Beaver Lake and surrounding watershed provide significant environmental, cultural, social and economic values to the region and its residents. Some of these values are intangible and cannot be quantified, while others provide significant economic benefit to the region. A more detailed summary of the values provided by Elk/Beaver Lake can be found in the Elk Beaver Lake Business Case (CRD, 2019).

2.2.1 Cultural Values

Elk/Beaver Lake and surrounding Saanich Peninsula have been inhabited and taken care of by the Lək'ʷəŋən and W̱SÁNEĆ peoples for thousands of years. The area is still used for hunting, fishing and collecting plants for food, medicine and ceremonial purposes. The Indigenous people of this territory managed the lands in such a way as to provide for many of their cultural, sustenance and economic needs.

2.2.2 Social Values

Elk/Beaver Lake Regional Park is the only park designated as a recreation park in all of CRD Regional Parks system (CRD, 2012). This means that the park is managed to support a variety of recreational activities, and the management of the natural environment is focused toward the enjoyment of park users. The park is the most heavily used regional park, and a focal point for multiple-use outdoor recreation, with an estimated 1.57 million visits in 2018. Although the national rowing team is expected to relocate, the lake is home to numerous competitive and recreational rowing teams and will continue to support other significant rowing clubs. The lakes are also the site of an annual national triathlon and other sporting events. The park also hosts many day camps and nature programs that educate and benefit citizens year-round. Elk/Beaver Lake supports the largest freshwater fishery on Vancouver Island with 15,000-18,000 angler days per year. The lake and surrounding park is a popular destination for hiking, walking, equestrian activities, youth camping opportunities, dog-walking, swimming, water skiing, canoeing, kayaking and more. The park offers opportunities for social interactions, team building, community events and fitness. Elk/Beaver Lake provides opportunities for many outdoor experiences, activities and events, and is managed to accommodate a variety of shoreline and in-lake recreational activities.

Elk/Beaver Lake also provides significant benefits to CRD residents and visitors by supporting increased mental well-being. Positive experiences and interactions in nature are closely linked with improved mental and physical health. This lake and surrounding watershed supports a connected, vibrant and healthy community.

2.2.3 Environmental Values

The Elk/Beaver Lake watershed is located within the Coastal Douglas-fir moist maritime (CDF-mm) biogeoclimatic zone. It is composed of sensitive ecosystems, including older forest mixed conifer and deciduous, older second growth forest (mixed and coniferous), dry-open woodland and wetland (swamp) habitat that support a diversity of species. Provincially, red-listed ecological communities include: Western Red cedar/Indian-plum (*Thuja plicata/Oemleria cerasiformis*), Grand Fir/Three-leaved Foamflower (*Abies*

grandis/Tiarella trifoliate), Douglas-fir/Dull Oregon-grape (*Pseudotsuga menziesii/Mahonia nervosa*) and Grand Fir/Dull Oregon-grape (*Abies grandis/Mahonia nervosa*). A number of wildlife trees have been designated within this watershed, as well, that are important in supporting biodiversity. These natural areas provide habitat for a diversity of plants and animals in an otherwise degraded and fragmented urban area.

Natural Garry oak (*Quercus garryana*) woodlands and associated ecosystems are among the most endangered in Canada. Less than 5% of the natural ecosystems in southwest British Columbia remain, and over 100 species of plants, animals, reptiles, birds and insects are officially listed as "at risk", due to the degradation and disappearance of these ecosystems. Shallow vernal pools form on the heavy clay soils and support a unique flora, including rare plants. The disturbed meadow habitat on the east side of Elk/Beaver Lake Regional Park provides a rare opportunity to restore important Garry oak prairie habitat for future generations. These meadows have a very complex history and have been altered significantly in recent history, demonstrating a unique example of some of the most endangered habitats in the CRD. Two rare plant species are known to occur in the open meadows on the east side of Elk Lake basin: Needle-leaved Navarretia (*Navarretia intertexta*, provincially blue-listed) and Graceful Cinquefoil (*Potentilla gracilis var. gracilis*, provincially red-listed species). These meadows are also suspected to be a historical site for federally endangered Rosy Owl-clover (*Orthocarpus bracteosus*) under the *Species at Risk Act*, which was collected at Patricia Bay Highway (BC-17) in 1954.

Species at Risk, including critical habitat for western painted turtles (*Chrysemys picta bellii*), a federally designated species-at-risk and the only remaining species of native turtle on Vancouver Island, live in this watershed for year-round habitat, including nesting grounds. (Canada G. , 2018). There is also critical habitat identified for the Barn Owl (*Tyto alba*) and Batwing Vinyl Lichen (*Leptogium platinum*). Occurrences of the Green Heron (*Butorides virescens*), provincially blue-listed species, have also been identified along shorelines in Beaver Lake and the channel. The lake provides ecosystem services, such as stormwater management, water filtration, and provision of aquatic and riparian habitat for many species in the lake and downstream.

The Elk/Beaver Lake watershed further supports environmental values downstream within one of the largest watersheds in the CRD, the Colquitz River watershed. Elk/Beaver Lake drains water into the Colquitz River and plays an important role in flood mitigation, nutrient cycling, and providing important habitat for species downstream. The Colquitz River has a native fish habitat for Coho salmon (*Oncorhynchus kisutch)* and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*). A number of environmental values are indicated in Figure 2-2.

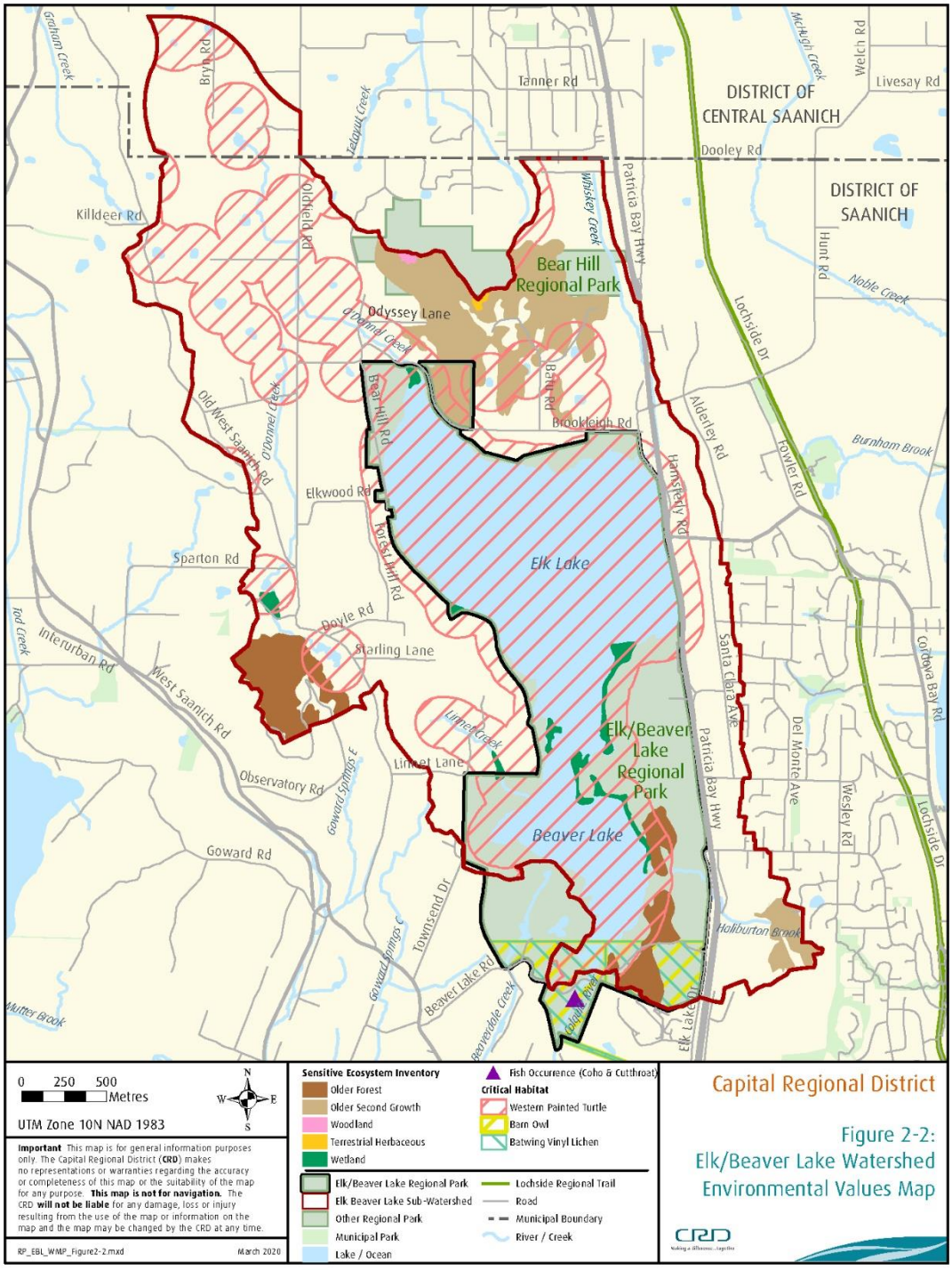

Figure 2-2: Map of Environmental Values in Elk/Beaver Lake Watershed

2.2.4 Economic Values

The economic value of Elk/Beaver Lake is approximated from best available information, and does not account for intangible social, aesthetic, cultural, health benefits and environmental services that are difficult to monetarily quantify. The following Table 2-1 summarizes all available data on sources of economic value.

Table 2-1 Annual Economic Value of Elk/Beaver Lake

Sources of Economic Value		Annual Value
Recreation	Rowing	$2.80 million*
	Fishing	$2.35 million
	Triathlon	$5 million
Leases & Permits		$15,300
Total Annual Economic Value		**$10.2 million**

* Excludes the value of the National Rowing Center ($3.4 million), as it is expected to relocate in near future.

2.3 Lake and Watershed Issues

Deterioration of the aquatic environment at Elk/Beaver Lake was formally identified in 1972 and has been well documented since the 1980s (Nordin, 2015). Multiple stressors on the lake have impacted the health and function of the ecosystem, biodiversity and ecosystem services, which have further deleterious implications for the social, cultural and economic values of the lake.

Poor water quality in Elk/Beaver Lake has led to the following key issues that have been identified as priorities within the lake:

- Blue-green algae (cyanobacteria)
- Invasive plants (Eurasian milfoil)
- Poor fish habitat

2.3.1 Blue-Green Algae

Elk/Beaver Lake experiences frequent blue-green algae (also known as cyanobacteria) blooms throughout the year. These native, naturally occurring blue-green algae are responsible for life as we know it on earth, by providing oxygen in our atmosphere. In high abundance; however, blue-green algae produce a visible blue-green scum on the surface of water that may become toxic. In Elk Lake basin, blooms typically occur over the winter months from November-March. Blooms in Beaver Lake have historically occurred from August-September; however, in 2018 and 2019, blooms have continued in Beaver Lake throughout winter, as well. Some of the common blue-green algae species in Elk/Beaver Lake (*Microcystis, Aphanizomenon*, and *Anabaena*) have the potential to produce cyanotoxins, which are dangerous to human health.

Ingesting water with cyanotoxins may cause a range of symptoms, including headaches, abdominal pain, damage to liver and brain tissue in humans, and can lead to liver damage or death in dogs and other small mammals. Scientists have also uncovered a possible link between Parkinson's Disease and Amyotrophic Lateral Sclerosis with neurotoxins found in blue-green algae (Costanza L. Vallerga, 2020). The CRD works closely with Island Health to issue advisories and warning signage for the public to avoid recreational use of the lake when testing confirms the presence of cyanotoxins in concentrations exceeding guidelines for water contact. In 2019/2020, significant efforts were made, in collaboration with government partners, to improve public communication about the blooms and risk to public health.

In the Elk Lake basin, a thermocline forms during the summer, separating warm surface waters from cooler deep waters. At the surface, photosynthesis and atmospheric oxygen-exchange occurs and maintains a high level of dissolved oxygen. In deep waters below the thermocline, water becomes very low in oxygen (hypoxic), as it is isolated from oxygenated surface waters. Decomposers like bacteria found in benthic habitat in sediments use any available oxygen to break down organic materials, further reducing available oxygen. In low oxygen conditions, phosphorus is released (p-release) from sediments into the deep lake waters. As surface waters cool in the fall, the thermocline dissolves and the deep and surface waters mix. This allows the phosphorus in the deep water to become available at surface waters and support rapid growth of blue-green algae.

In the Beaver Lake basin, a strong thermocline does not form during the summer. Instead, deep and shallow waters mix readily under windy conditions and nutrients are immediately available to promote blue-green algae blooms. This allows for blooms to occur throughout the summer and into the fall. Following rapid growth of both blue-green algae and aquatic plants during the summer and fall, decomposition of these organic materials further contributes to excessive nutrients in the sediments. This high level of biological activity also reduces dissolved oxygen levels, perpetuating water quality issues in the lake.

2.3.2 Invasive Plants (Eurasian water-milfoil)

Eurasian water-milfoil, referred to as milfoil, is a non-native aquatic plant that grows abundantly in Elk/Beaver Lake. Under high phosphorus conditions, milfoil grows particularly well and outcompetes other native species. Eurasian water-milfoil is very aggressive and once introduced to a waterbody will displace native aquatic vegetation in a couple of years. The extensive coverage and dominance of this species is the result of high nutrient levels and ongoing disturbance (boat propellers, weed harvester) that favour its rapid growth. Not only does milfoil thrive in elevated phosphorus conditions, this invader also further contributes to the nutrient issues in the lake. As the plant dies back in the fall, it begins to decompose and contribute phosphorus back into the lake sediments and water column, compounding the nutrient issue.

2.3.3 Poor Fish Habitat

As a result of high nutrient levels and low oxygen levels in the lake, the community of organisms that live in the lake are under increased stress. The current conditions support a phytoplankton community that is dominated by blue-green algae. The zooplankton and benthic community in Elk/Beaver Lake is also reduced in abundance and diversity, as a result of poor food availability, low oxygen conditions and increased predation by invasive fish. These environmental conditions further impact fish, reptile and amphibian habitat. In particular, fish habitat has been significantly impacted for those fish that prefer deep, cold, oxygenated waters. As deep waters have become hypoxic (low in oxygen) or anoxic (no available oxygen) in Elk/Beaver Lake, fish are forced to inhabit shallower, warmer habitat where they can access sufficient oxygen. This is well documented in a fish inventory study (Hemmera Envirochem, 2017), where no fish were captured in depths greater than 12 m in Elk Lake, likely as a result of deep-water, anoxic conditions.

2.4 Eutrophication

Water quality issues identified at Elk/Beaver Lake are primarily the result of high levels of nutrients in the lake, also known as eutrophication. Through a process of lake ageing, water bodies fill with sediments and become enriched in nutrients over time. At Elk/Beaver Lake, this natural process has been accelerated by human-related activities in and around the lake that increase the amount of nutrients that enter the lake and trap nutrients within the lake (damming). Phosphorus, in particular, is considered to be the most important factor impacting water quality. Eutrophic lakes are those lakes that are highly productive. In urban areas, these highly productive lakes are also associated with excessive aquatic plant growth, poor water clarity, reduced oxygen levels, deteriorated aquatic habitat, low biodiversity and frequent blue-green algae blooms. The source of excessive nutrients in a lake is often a combination of internal and external nutrient loading.

2.4.1 External Nutrient Sources (from the watershed)

In Elk/Beaver Lake, it is estimated that between 11-29% of total phosphorus in the lake water is attributed to external sources of nutrients (Nordin, 2015; Nurnberg, 2016). This source of nutrients is carried by water, sediments and dust particles from external sources within the Elk/Beaver Lake watershed and deposited into the lake. The sources of external nutrients in Elk/Beaver Lake come largely from land management practices and activities in rural, residential, urban, agricultural pasture and cropland, wetlands, streams and some open grass lands (prairie). The movement of nutrients (particularly phosphorus) continues to occur naturally in some areas, flowing from the watershed into tributaries and making its way into Elk/Beaver Lake downstream. However, in areas that are heavily impacted by humans, higher levels of nutrients enter the watershed and make their way into the lake. Nutrient inputs vary across the landscape, depending on land use, management practices and activities, soil acidity and permeability, impervious surfaces, proximity to transport by streams, creeks and groundwater, and ecosystem function and health.

Increasing urbanization, particularly in areas near marine and freshwater shorelines, has significantly shifted landscapes from natural areas to agricultural, suburban, and urban land use that have accelerated sources and delivery rates of nutrients and sediments into aquatic ecosystems. The main sources of excess phosphorus in urban and rural environments are fertilizers, manure, and human waste, but other sources also play a role in contributing the nutrient inputs within the watershed. (Goonetilleke, 2019; Hobbie, et al., 2017). These key sources that contribute to water quality issues in Elk/Beaver Lake are summarized below:

- Fertilizers: Phosphorus is one of the critical nutrients needed to support for plant growth and one of the three major nutrients found in most fertilizers, along with nitrogen and potassium. Although adding phosphorus to the soil can improve your home lawn and garden, or agricultural crop productivity, adding too much and too often can lead to excess phosphorus run-off into nearby streams, groundwater and may build-up on soils. Fertilized soils, as well as livestock operations, are also vulnerable to nutrient losses to the air. Management of agricultural phosphorus has been in effect for decades (Stackpoole, Stets, & and Sprague, 2019). The *Fertilizers Act* and Regulations require that all regulated fertilizer and supplement products must be safe for humans, plants, animals, and the environment. Regulated products include farm fertilizers, micronutrients, lawn and garden products (R.S.C, 1985). While regulation of fertilizer use has been greatly improved, fertilizer use still impacts water quality in nearby aquatic environments. In Elk/Beaver Lake watershed, we expect that significant nutrient inputs originate from residential and agricultural lands where fertilizers are often used to support lawn and crop growth. Addressing this issue, by shifting behaviours and supporting landowner stewardship, will make a significant impact on overall nutrient inputs in the watershed.
- Compost: Compost retains a large volume of water, thus helping to prevent or reduce erosion, run-off and establish vegetation. Composting can improve downstream water quality by retaining pollutants, such as heavy metals, nitrogen, phosphorus, oil and grease, fuels, herbicides, and pesticides. Nutrients and hydrocarbons adsorbed and/or trapped by compost are decomposed by naturally occurring microorganisms, improving soil structure and nutrient content, which reduces the need for chemical fertilizers. However, the storage and management of compost is important to ensure it is not contributing to nutrient levels downstream.
- Pet Waste (Manure): Animal waste is one of the many seemingly small sources of nutrients that can lead to significant issues for water quality. Dog, horse and other farm animal waste is rich in nitrogen and phosphorus, and when it makes its way into storm drains and local streams, it may contribute significantly to nutrient issues in the lake. In a recent study with high urban density, household nutrient inputs from pet (dog) waste contributed up to 76% of total phosphorus inputs and 28% of total nitrogen inputs into a local water body (Hobbie, et al., 2017). Although currently, we expect dog and horse waste has a lower relative impact on water quality compared to other inputs in Elk/Beaver Lake, the relative importance of pet waste is likely increasing, as use in the regional park and density in the surrounding watershed increases. Currently, CRD Regional Parks has signage indicating the importance

of dog waste pick-up throughout Elk/Beaver Regional Park and complementary dog waste bags are provided at high use areas. There are a number of designated trails for horse riding in the regional park, and all riders are required to keep manure to trail edges.

- Septic: Septic systems containing human waste contain a high degree of phosphorus and nitrogen. Estimates of phosphorus contribution from septic was initially estimated to account for up to 21% of the total annual external phosphorus load (Nurnberg & LaZerte, 2016; Nordin, 2015); however, general septic system models have been found to overestimate the actual phosphorus contribution. It is expected, that in the case that septic systems are maintained and cared for, very little phosphorus would reach the lake through infiltration, due to the low mobility of phosphorus in local soils and septic field set-backs of at least 30 m (Hodgins, 2016). If septic systems are not well maintained, phosphorous may reach surface or sub-surface waters and enter into nearby streams and creeks through run-off. Actions to improve septic maintenance practices and reduce transport of septic nutrients by run-off could significantly reduce inputs from this source.
- House Cleaners: Federal regulations are in place to protect Canada's environment from the release of phosphorus from certain products that could contribute to the over-fertilization of freshwater ecosystems, and the growth of harmful algae blooms that are proliferating in Canada's lakes and rivers (Canada E. , 2011). The regulations apply to the manufacturers and importers of laundry detergents, household dishwashing compounds (including hand dishwashing soap and automatic dishwashing detergents) and household cleaners. Bans on phosphorus-containing detergents have strongly reduced sanitary sewer phosphorus inputs from cities to surface waters. We anticipate that this source has minimal inputs into the Elk/Beaver Lake watershed, however, improving awareness of this potential source of watershed pollution is worthwhile to support more natural house cleaning products.
- Hyper-abundant Wildlife (Canada Geese): Non-migratory Canada geese were introduced in the 1960s and 70s and are now an ongoing concern in the regional district. Large populations of these geese contribute to heath, economic and environmental issues affecting municipalities, parks, farmers, businesses, health agencies and airport authorities. A number of studies have shown that the presence of birds in high densities in the catchment of lakes and ponds has an impact on nutrient levels in the lake. The impact that Canada geese may have on total phosphorus in Elk/Beaver Lake likely varies seasonally with rainfall and changes in population and distribution. Populations residing within the beach areas of the regional park would have the greatest impact on water quality, including both nutrient inputs and *E.coli* contamination. Estimates of nutrient loads from birds suggested that they contributed 2-4% of the total external phosphorus load in the lake (Nordin, 2015; McKean, 1992; Nurnberg & LaZerte, 2016).

  We expect that relative input of phosphorus from geese is relatively low compared to inputs from other sources. However, without addressing this source, populations of geese are expected to increase and continue to impact water quality in the lake. Proactive efforts to address this increasing concern

would remediate future ongoing water quality issues at the lake, particularly as it relates to *E.coli* and human health concerns. Currently, the CRD is guided by the *Regional Canada Goose Management Strategy* (CRD, 2012) and practices, including goose waste removal and hazing practices to reduce resident population. Land uses within the watershed, and associated phosphorus sources that contribute to the nutrient load, are summarized in Table 2-2.

Table 2-2: Land Cover and Associated Phosphorus Sources within Elk/Beaver Lake Watershed

Land cover	Common phosphorus sources
Urban and Rural residential (buildings, roads, parking lots)	• Fertilizers • Pet waste • Septic • Cleaners • Compost
Agricultural (pastures, crop fields)	• Manure • Inorganic fertilizer
Parks and Natural areas (forest, wetland, streams and meadows)	• Hyper-abundant and invasive wildlife • Pet waste

2.4.2 External Nutrient Transport

Nutrients are carried from their source into the lake by run-off, groundwater (infiltration) and dust particles (atmospheric deposition). In similar urban/rural watersheds, studies have shown that phosphorus enters surface waters primarily through run-off, rather than atmosphere deposition or groundwater infiltration (Hobbie, et al., 2017). Groundwater is expected to contribute lower levels of phosphorus into the lake, due to the low mobility, and high retention of phosphorus in sediment. Increased amounts of impervious surfaces (not allowing liquids to pass through) within the watershed also reduces infiltration and increases impacts or run-off in more urban environments. Impervious surfaces enable phosphorus to move across the large areas easily, by preventing retention of phosphorus in vegetation and preventing infiltration of phosphorus by soil sorption and biotic uptake. Phosphorus therefore becomes cut off from natural ecosystem processes, resulting in increased phosphorus levels in streams and storm drains. (Hobbie, et al., 2017). Atmospheric deposition carries nutrients from rain and dust that is picked up by winds and evaporation from the land and deposited into the lake. External phosphorus loads from the atmosphere is estimated at about 17% (Nurnberg & LaZerte, 2016), however, this source is challenging to quantify (Goonetilleke, 2019).

In Elk/Beaver Lake, it is estimated that run-off is the primary mechanism of transport, carrying nutrients across partially and fully impervious surfaces, through stormwater drains, ditches, creeks and streams until it makes its way to the lake. Run-off from O'Donnell Creek and other ephemeral creeks are estimated to make up to 58% of annual external nutrient load (Nurnberg & LaZerte, 2016; McKean, 1992). Three major

streams contribute the majority of nutrients in the watershed, largely from run-off: Haliburton, O'Donnell and Hamsterly.

- O'Donnell Creek: This creek is the major inflow to the lake, supplying a significant proportion of the water (and some nutrients) to the lake. This creek was the subject of a major restoration effort in the 1990s by the Golden Rods and Reels Society and local landowners. The watershed is made up of mostly agricultural lands, including a number of small operation farmland (less than 5 ha) and low-density rural residential lots. Spatial data acquired from the National Hydrologic Network indicate that portions of the creek have been diverted from their natural course into roadside drainage ditches to accommodate the subdivision of lands into low-density residential and small agricultural parcels. Tributaries of O'Donnell Creek, and the creek itself, drain a land area totalling 2.6 km^2.
- Haliburton Brook: Haliburton Brook is a non-fish bearing first order stream, which begins in a forested area of the Royal Oak Burial Park (Cordova Bay) and runs a total length of approximately 841 m above-ground with approximately 200 m flowing in pipes under the highway and road, eventually flowing into Beaver Lake within the Elk/Beaver Lake Regional Park (Saanich GIS Mapping 2012). Haliburton Brook and the Haliburton Watershed are divided by the Patricia Bay Highway, separating the upper and lower reaches of Haliburton watershed. The upper watershed has been modified for farming, and later for urban development, and the lower watershed is largely within the CRD regional park lands, previously also farmland. There is significant evidence of stream degradation, due to channeling and ditching of streams that diverted water away from natural habitats and wetland were filled. Tributaries to Haliburton Brook, and the brook itself, drain a land area totalling 0.75 km^2, mostly collecting water from highway run-off and drainage from Royal Oak Burial Park and a medium-density residential area east of the Patricia Bay Highway.
- Hamsterly Creek (Whiskey Creek): This creek flows into the northeastern part of Elk Lake basin and has been subject to significant channeling and ditching. Run-off from urbanized landscape and impervious surfaces have degraded the watershed, reducing nutrient cycling and uptake in plants and soil. Water flow is quite low in this creek and is expected to contribute relatively low phosphorus inputs, as well.
- Linnet Creek: Linnet Creek originates on the southwest side of Elk Lake and flows southeast to Beaver Lake. The main stem of the creek flows from a low-density residential area, and through forested lands before entering the northwest corner of Beaver Lake. The small tributaries and Linnet Creek collect run-off from a land area of approximately 56,500 m^2 (~0.057 km^2). Very minimal inflow of water and nutrients have been reported for this creek.

Water and nutrients from Elk/Beaver Lake are exported primarily from the lake at Colquitz River, flowing over a dam at the south end of Beaver Lake. The Colquitz River collects water from numerous tributaries throughout the District of Saanich, as well as Central Saanich, and enters the ocean at Portage Inlet. Water quality in Elk/Beaver Lake is critical to ensuring the health of the downstream ecosystems and habitats:

- Colquitz River Outflow: Water from Elk Lake flows south into Beaver Lake where a dam controls downstream flows to the Colquitz River. The crest of the dam spillway is at 60.54 m (McKean, 1992), slightly below the elevation of the surrounding shoreline (70 m). Most of the year, the well-mixed water in Elk and Beaver Lake basins is carried out of the lake via outflows to the Colquitz River, along with the concentration of nutrients and other substances in the water. Due to minimal mixing between the hypolimnion (deeper waters) and the epilimnion (shallow waters) in the summer, only water and any nutrients from the epilimnion exit the lake.

2.4.3 In-lake Nutrient Sources

There are a number of nutrient sources within the lake that also contribute to the water quality issues and can be addressed through active management. These sources include:

- Internal Nutrient Loading: In Elk/Beaver Lake, it is estimated that between 71-89% of total phosphorus in the lake water comes from internal nutrient sources (Nordin, 2015; Nurnberg, 2016). Internal nutrient loading occurs when the nutrients in the bottom sediments of the lake are recycled back into the water column. The nutrients in lake sediments accumulate over time and are a direct function of the amount of external nutrients deposited into the lake from the surrounding watershed. This accumulation of phosphorus in lake sediments is a natural process, but it has been significantly accelerated by human activities in and around the lake. Nutrients locked in the lake sediments are released into the water column by a variety of mechanisms and environmental conditions. The dominant driver for the release of phosphorus from sediments is low oxygen levels at the sediment-water interface. Under low oxygen conditions, phosphorus is released from the sediment and made available in the water column. Under high oxygen conditions, phosphorus remains bound to the sediment. As previously described, the internal nutrient load issue is addressed through a separate in-lake remediation plan and will not be specifically addressed within this plan.
- Non-native Fish: In 2017, a fish inventory was conducted to characterize the overall fish community in Elk/Beaver Lake. After employing a variety of sampling techniques at multiple sites around the lake, no native fish species were captured or observed. A total of 732 fish were captured, including yellow perch (55%), largemouth bass (12%) and pumpkinseed (11%), followed by smaller numbers of bullhead, common carp, smallmouth bass and rainbow trout. The abundance of non-native fish in Elk/Beaver Lake is detrimental to the health of the overall lake ecosystem, because it upsets the food-web, reduces biodiversity, and contributes to poor water quality. Yellow perch, for example, consume native zooplankton and benthic organisms. Largemouth bass are aggressive predators of desirable recreation fish, such as rainbow trout, that are annually stocked in the lake by the Province. Common carp consume benthic invertebrates and desirable aquatic plants, facilitating the growth of nuisance plants, such as Eurasian water-milfoil. Carp are also known to root around in bottom sediments causing declines in native aquatic vegetation and increases in water turbidity. This foraging behaviour of many non-native fish, particularly carp, stirs up lake-bottom sediments and contributes to nutrient release

from sediments in the lake, in a process known as bioturbation. In the case of Elk/Beaver Lake, the presence of carp likely supports the rapid growth of invasive Eurasian milfoil, which thrives in disturbed environments. Efforts to reduce the population of invasive fish, particularly common carp would be beneficial in improving water clarity, reducing nutrient inputs and restoring natural aquatic plant communities in the lake system (Przemyslaw G. Bajer, 2015).

- Invasive plants: Excessive growth of submerged invasive aquatic plants has become a nuisance in Elk/Beaver Lake, impacting the ecological health of the ecosystem and associated recreation values. An aquatic plant survey conducted in 2016 found 11 aquatic plant species (compared to 60 species in a previous survey conducted in 1985). Native whorled water-milfoil (*Myriophyllum verticillatum*) and invasive Eurasian water-milfoil (*Myriophyllum spicatum*) were the most dominant, accounting for more than 95% of aquatic plants. These plants grow very long strands (1-3 m long) and float just under the lake surface in a thick mat. The rapid growth of Eurasian water-milfoil is related to nutrient issues in the lake. This invasive species grows aggressively in the summer, and in the fall decomposes and contributes to nutrient levels in the sediment, later available for release into the water column. The extent of milfoil growth during the summer is significant, covering a total of 106.84 ha (30.6%) and contributing between 55-150 tonnes of dry weight the surface area (Vadeboncoeur, 2019), as indicated in Figure 2-3. While these invasive species are expected to support some nutrient uptake in the lake, shifting to native aquatic plants would be more beneficial for supporting native habitat and less eutrophic conditions in the lake.

  The CRD has harvested invasive aquatic plants annually from Elk/Beaver Lake since 1979, using a mechanical weed harvester (with the exception of a few years). A new weed harvester was purchased in 2016. Staff have reported that, on average, 300-450 tonnes (wet weight) of aquatic weeds are removed from Elk/Beaver Lake each year. The weed harvester improves the recreational values of the lake by clearing surface plant material for boats, rowers and swimmers. However, the weed harvester is not an effective treatment to fully remove the plant material and reduce the environmental impacts to the overall lake health, water quality and wildlife habitat.

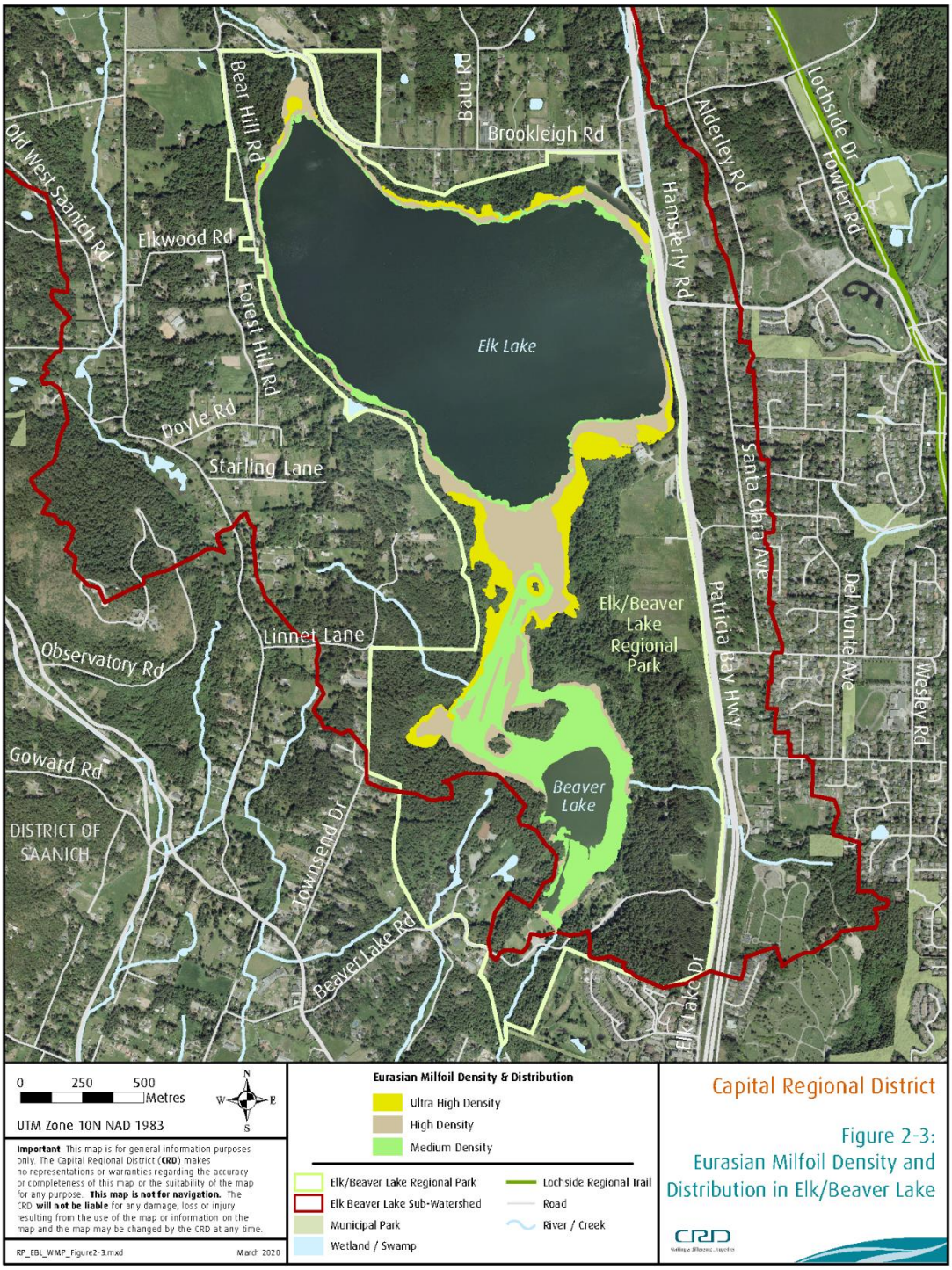

Figure 2-3: Eurasian Milfoil Density and Distribution in Elk/Beaver Lake

The above polygon colours correspond with density classifications (yellow = ultra-high; beige = high; green = medium)

2.5 Environmental Stressors

A number of stressors indirectly contribute to the water quality issues in Elk/Beaver Lake. The following factors have been identified as putting significant stress of water quality and nutrient loading issues in the lake.

- Residence Time: Residence time of a lake is calculated by the amount of time water spends in a lake, before being flushed downstream. A long residence time can put added stress on the lake system, as nutrients and water move very slowly through the system. Dams trap sediments that would otherwise be flushed downstream, and cause nutrients to settle in the lake sediment more readily and increase internal nutrient loading. The approximate seven-year residence time of Elk/Beaver Lake is a significant driver of high nutrient levels and elevated lake productivity, largely a response to the three dams constructed on the lake.
- Anoxia: Low oxygen (hypoxia) or no oxygen (anoxia) conditions in a lake can further exacerbate existing water quality issues. In Elk Lake basin, the deeper waters are severely hypoxic throughout the summer and fall. Typically, hypoxia starts as soon as the lake stratifies in the spring, indicating a high sediment oxygen demand from accumulated organic substances. Stratification of the water column reduces mixing in the summer months, and oxygen depletion is quite severe. This anoxia impacts habitat for native species (cutthroat trout) and also causes the release of phosphorus from the sediments. In Beaver Lake basin, low oxygen conditions can occur throughout the year. High levels of decomposition of organic material have significantly increased the sediment oxygen demand, leading to hypoxic and, occasionally, anoxic conditions. Due to the shallow depth of Beaver Lake, winds can cause mixing throughout the basin and introduce more oxygen, seasonally.
- Climate Change: Predicted changes in the climate are expected to further stress the lake environment and compound nutrient issues. Increasing temperatures and longer growing seasons will improve growing conditions for invasive plants and blue-green algae. Heavier winter rains are also expected to cause increased stream erosion and flooding and contribute higher levels of nutrients into the lake.

3. WATERSHED MANAGEMENT ACTIONS

3.1 Implementation

The implementation of this plan requires collaboration and coordination among government and community partners. In particular, agencies that have jurisdiction for land use within the Elk/Beaver Lake watershed have direct responsibility for coordinating, facilitating and/or implementing the recommended actions, including District of Saanich, Central Saanich and regional parks (CRD). Each recommended action is phased in over time and identifies which agency is involved, and how, to ensure the successful implementation of that action. Private landowners will play an essential function in applying the recommended actions on their own properties. Funding to support this plan is currently limited and will require cost-sharing approaches, creative partnerships and successful grant applications to solicit necessary funds to support the phased implementation plan.

3.2 Prioritization

The recommended actions have been prioritized based on our understanding of key sources of phosphorus and how phosphorus moves throughout the Elk/Beaver Lake watershed. Maintaining the ecological function and structure of important natural areas are a critical component to watershed management and reducing nutrient inputs. Healthy ecosystems support effective nutrient cycling, infiltration, flood and sediment control. Following our understanding of the nutrient transport, the creeks and associated watersheds that contribute the greatest phosphorus into the lake are Haliburton, O'Donnell and Hamsterly Creek. These major inflows will be prioritized.

3.3 Recommended Actions

The following actions have been associated with each watershed objective. A summary of all recommended actions can be found in Appendix E. Detailed descriptions of the actions, timelines and implementation plan follow below:

Objective 1: Improve land management practices within the watershed to reduce total phosphorus entering the lake.

This objective specifically aims to reduce phosphorus sources within the watershed that contribute to elevated phosphorus levels within the lake. Landowners and land managers can significantly improve water quality by changing their current practices and support a healthier watershed, with the following actions:

ACTION 1.a: Improve rural/urban land management practices to reduce and manage the source of phosphorus inputs into the watershed.

Responsibility	Local landowners, Districts of Saanich and Central Saanich, CRD
Primary Focus	Lands within Haliburton, O'Donnell & Hamsterly sub-watersheds
Priority	High
Timeframe	2020-2022
Performance Indicator	Contact 90% of landowners within Elk/Beaver Lake Watershed

- *Landowners:* to adopt best management practices for rural and urban landowners. See Appendix D for best management practices for rural and urban landowners. Primary recommendations include:
    - Use fertilizers wisely
    - Pick up pet waste
    - Care for and maintain your septic system
    - Conserve water
    - Use landscaping practices that reduce erosion and run-off
    - Reduce use of high phosphorus house products
    - Maintain healthy lawn practices
- *Districts of Saanich and Central Saanich:*
    - Maintain daylighted (open-air) vegetated streams and ditches along roadsides and keep storm drains clear of organic matter to support improved stormwater management.
    - Contact local landowners, stewardship groups and knowledge holders to share information about the importance of phosphorus use reduction and best management practices for reducing run-off of phosphorus into the watershed.
- *CRD:* to improve public access to resources on the importance of nutrient reduction and management within the watershed and impacts to the overall health of the lake system.

ACTION 1.b: Improve agricultural land use practices to reduce and manage nutrient use.

Responsibility	Local farmers, Districts of Saanich and Central Saanich
Primary Focus	Farmlands within Elk/Beaver Lake watershed (priority for new and small operation farmers (>5 hectares)
Priority	High
Timeframe	2020-2025
Performance Indicator	Contact 90% of farmers within watershed

- *Farmers*: to comply with Code of Practice for Agricultural Environmental Management & adopt Nutrient Management Plan, as needed (over 5 ha, nutrients applied to land, and nutrient levels test high). Farmers to enroll in Environmental Farm Plan. See Appendix D for additional resources on beneficial management practices for agricultural lands. Primary recommendations include:
    - Use fertilize wisely
    - Store manure appropriately
    - Conserve and effectively manage water use
    - Manage livestock activity
    - Reduce soil erosion
    - Vegetative buffers
- *Districts of Saanich/Central Saanich:*
    - Improve public awareness of provincial compliance requirements with Code of Practice for Agricultural Environmental Management and adopt Nutrient Management Plan, as needed (over 5 ha, nutrients applied to land, and nutrient levels test high).
    - Support landowners to enroll in Provincial Environmental Farm Plan to complement and enhance existing stewardship practices. Adopt beneficial management practices for optimum farming practices that minimize input of nutrients to nearby streams and riparian habitat.

ACTION 1.c: Ensure proper function of septic and sewerage systems to reduce phosphorus inputs.

Responsibility	Landowners and CRD
Primary Focus	Landowners with septic systems
Priority	Moderate
Timeframe	2020-2022
Performance Indicator	Ensure 85% compliance with Septic System Bylaw 3479

- *Landowners:* Ensure compliance with septic bylaws and adopt practices that support a healthy septic system. Further information on the septic maintenance bylaw can be found in Appendix A, and septic system care and maintenance can be found in Appendix D.
- *CRD:* Continue providing educational resources to local residents on effective system care and educate about compliance requirements for Bylaw 3470. Provide incentives for landowners to support septic system function and maintenance to ensure compliance with CRD bylaw.

ACTION 1.d: Reduce waste input from non-native Canada goose population.

Responsibility	CRD
Primary Focus	High goose activity areas (Eagle, Beaver and Hamsterly beaches)
Priority	Moderate
Timeframe	2020-2030
Performance Indicator	Reduction of resident Canada goose population at Elk/Beaver Lake Regional Park

- *CRD:* Continue to work with federal and provincial partners to adopt practices within the Elk/Beaver Lake Regional Park that will discourage hyper-abundance of resident, non-native Canada goose population. Recommended approaches, as identified the *Regional Canada Goose Management Strategy* (CRD, 2012) include waste removal, habitat modification, hazing/scaring, and population control (egg addling). More information on the strategy can be found in Appendix A.

ACTION 1.e: Reduce waste from dogs and horses on park trails.

Responsibility	Park users, CRD
Primary Focus	Horse trails and high dog-use areas (Eagle, Beaver and Hamsterly Beaches)
Priority	Low-moderate
Timeframe	2020-2030
Performance Indicator	Continued enforcement and outreach efforts throughout the regional park

- *Park Users:* Maintain compliance with the Parks Regulation Bylaw (No.4225). Dog walkers are encouraged to carry dog waste bags and pick up after their pets and properly dispose of waste. Horseback riders are encouraged to dismount and move waste into vegetation buffers off of main trails.
- *CRD*: Provide improved information to park users along trail system and at major contact points for reducing animal waste on the trail. CRD bylaw officers will continue to issue warnings and enforce the Parks Regulation Bylaw (No.4225) that requires a person, with care and control of a dog in a regional park, must immediately remove any faeces deposited by that dog (8.1.d). CRD to investigate options to encourage horseback riders to pick up and dispose of horse waste within the park.

OBJECTIVE 2: Improve watershed structure and function to reduce total phosphorus entering the lake.

This objective specifically aims to increase the ability of the watershed to mitigate the impacts of nutrient loading before nutrients reach the lake. Improving watershed function, structure and health will increase nutrient uptake in soils and vegetation, while supporting improved habitat for native species. Landowners

and land managers can make a significant impact on water quality by restoring native habitat with the following actions:

ACTION 2.a: Restore and enhance stream and watershed function (Haliburton Brook).

Responsibility	Landowners, stewardship groups, CRD, and District of Saanich
Primary Focus	Haliburton Brook and watershed
Priority	High
Timeframe	2020-2024
Performance Indicator	60% of stream habitat restored

- *All:* work collaboratively to restore habitat and function of stream from upper watershed (east of Highway-17) to the lower watershed (west of Highway-17) to establish a series of functional wetland and stream habitat to reduce sediment erosion and increase nutrient uptake. Creating and maintaining wetland habitat would reduce erosion, support natural flooding, manage run-off from the highway and improve buffering capacity of the environment to take up phosphorus. Wetlands would also provide important habitat for waterfowl and shorebirds, stopover habitat for migratory birds, breeding and foraging habitat for frogs and toads, and foraging habitat for bats, breeding and foraging habitat for aquatic insects, and drinking water for all wildlife.
- *CRD:* In lower watershed (west of BC-17) support efforts to improve Haliburton Brook function and create wetland habitat.
    - Recommended stream restoration activities include bank stabilization and de-compaction, invasive plant removal, native riparian plantings, and alleviate stream blockages that inhibit fish passage.
    - Recommended wetland enhancement activities include creating bioswales and wetland habitat to support natural flooding, slow water movement and increase infiltration at the Haliburton Field. (see map – red)
- *District of Saanich:* In upper watershed (east of BC-17), support community efforts to restore ecological function of the stream and surrounding watershed.
    - Support landowner and community efforts to improve stream and riparian habitat (wetland creation, stream restoration and stabilization)
    - Collaborate with Ministry of Transport and Infrastructure to improve watershed function along highway (BC-17) through native plantings, raingardens and vegetation buffers.
- *Landowners:* support stream restoration efforts and opportunities to participate in public workshops to adopt best management practices and restoration techniques for stream habitat. For example, enroll in the Streamkeepers workshops provided by the Pacific Streamkeepers Federation (Taccogna, 1995). Further resources on best management practices for stream restoration is found in Appendix D.

ACTION 2.b: restore and enhance stream and watershed function (O'Donnell Creek).

Responsibility	Landowners, Stewardship Groups, CRD, Districts of Saanich & Central Saanich
Primary Focus	O'Donnell Creek and watershed
Priority	High
Timeframe	2024-2026
Performance Indicator	60% of stream habitat restored

- *All:* Restore stream and watershed function to reduce erosion and increase nutrient uptake.
- *CRD*: Support efforts to improve stream function for water filtration, retention and improve habitat quality within CRD regional park boundary.
    - Alleviate stream blockages that inhibit fish passage and plant native vegetation along length of stream within park.
    - Install bioswales at inflow site to reduce sedimentation and increase infiltration before entering the lake. (see map – red)
- *Districts of Saanich/Central Saanich*: Support community and landowner efforts outside of the regional park boundary to restore ecological function and structure of the stream.
- *Landowners (particularly farmers) and Stewardship Groups:* initiate stream restoration projects along O'Donnell Creek by stabilizing and enhancing streamside with native plantings, and installation of raingardens and bioswales, where appropriate. Learn more about stream restoration and opportunities to participate in public workshops to learn and adopt best management practices and restoration techniques for stream habitat. For example, enroll in the Streamkeepers workshops, provided by the Pacific Streamkeepers Federation (Taccogna, 1995). Further resources on best management practices for stream restoration is found in Appendix D.

ACTION 2.c: Restore and enhance stream and watershed function (Hamsterly Creek).

Responsibility	Landowners, Stewardship Groups, CRD and District of Saanich
Primary Focus	Hamsterly Creek and watershed
Priority	Moderate-high
Timeframe	2026-2028
Performance Indicator	60% of stream habitat restored

- *All:* Restore stream and watershed function to reduce erosion and increase nutrient uptake.
- *CRD*: Support efforts to improve stream function in water filtration, retention and improve habitat quality.
    - Alleviate stream blockages that inhibit fish passage and plant native plants along length of stream within park.
    - Install bioswales or settling ponds at inflow site to reduce sedimentation and increase infiltration before entering the lake (see map – red)
- *District of Saanich*: Support community efforts along stream outside of regional park boundary to restore ecological function and structure of the stream.
- *Landowners and Stewardship groups:* Support stream restoration projects through stabilizing and enhancing streamside with native plantings, installation of raingardens and bioswales, where appropriate. Learn more about stream restoration and opportunities to participate in public workshops to learn best management practices and restoration techniques for stream habitat, for example the Streamkeepers workshops, provided by the Pacific Streamkeepers Federation (Taccogna, 1995). Further resources on best management practices for stream restoration is found in Appendix D.

ACTION 2.d: Restore and enhance riparian habitat along lake shoreline.

Responsibility	CRD
Primary Focus	Overflow sites on perimeter of lake, adjacent to paved parking lots and highly compacted soils (impervious surfaces)
Priority	low-moderate
Timeframe	2024-2028
Performance Indicator	Reduced overflow flooding at priority sites and support seasonal flooding where feasible

- *CRD:* enhance and restore riparian habitat at critical areas along the perimeter of the lake where overflow occurs. This activity reduces flooding and increases infiltration and nutrient uptake at the lakeshore.
    - Create bioswales and/or raingardens along Hamsterly Beach and Beaver Beach shoreline (see map – purple)
    - De-compact and revegetate riparian habitat along Orchian Wall (see map - purple)
    - Where feasible, support natural floodplains to allow seasonal flooding.

Further resources on bioswale and raingarden design can be found in Appendix D.

ACTION 2.e: Maintain ecological function of sensitive ecosystems and ecological communities (forest, woodland and prairie habitat).

Responsibility	CRD
Primary Focus	Sensitive ecosystems and important ecological communities (Garry Oak Meadow and coastal-Douglas fir habitat)
Priority	Moderate
Timeframe	2020-2024
Performance Indicator	Restored native habitat in target area (60%)

- *CRD*: Support natural areas restoration in sensitive and rare ecological communities.
    - Support Garry oak meadow restoration on the east side of Elk/Beaver Regional Park, adjacent to the Patricia Bay Highway, BC-17 (see map). This area totals approximately 11 acres. In addition to planting Garry oak trees, native herbaceous plants can be introduced that are well suited to site conditions, including flowering plants, such as common camas, Fool's onion (*Triteleia hyacinthina*), chocolate lily (*Fritillari affinis*), chickweed monkey-flower (*Mimulus alsinoides*), and many other provincially endangered species. (see map)
    - Improve water infiltration by reducing ditching, as well as trail creation and braiding within park boundaries to reduce soil compaction throughout park. This will slow movement of water across the watershed and increase nutrient infiltration before it reaches the lake.
    - Support restoration of forest and woodland habitat through planting of native tree and shrub species to support improved nutrient uptake, support urban forest canopy and reduce flooding. These actions should be focused on areas of historically forested habitat (in open field areas south of Haliburton Creek) and should be coordinated with removal of high priority terrestrial invasive plants.

OBJECTIVE 3: Improve lake health and function to reduce total phosphorus within the lake.

This objective specifically aims to improve the overall health and function of the lake ecosystem. Improving the structure and function of the lake will help to shift the trophic status to being less eutrophic (mesotrophic) and will better support native habitat and species. Sources of nutrients within the lake will be reduced and nutrient uptake will be increased. Landowners and land managers can make a significant impact on water quality by restoring native habitat within the lake with the following actions:

ACTION 3.a: Restore and enhance shallow water habitat.

Responsibility	CRD, Stewardship groups
Primary Focus	Shallow water zones (< 3 m depth), adjacent to Orchian wall, and in Beaver Lake basin
Priority	Low-moderate
Timeframe	2026-2030
Performance Indicator	60% of shallow water habitat restored

- *CRD*: Enhance shallow water (littoral) habitat zones by establishing native vegetation and supporting (where feasible) natural floodplains. This activity increases nutrient uptake, prevents shoreline erosion and provides habitat for amphibians, turtles, young fish, and zooplankton (see map – yellow). Floating vegetation islands and buffers may be used to support native habitat and shade out non-native plant species. Efforts to first remove invasive plants in the lake should be prioritized before establishing native plants.

ACTION 3.b: Reduce non-native fish populations.

Responsibility	CRD, stewardship groups, fisher-people
Primary Focus	Non-native fish species (Common Carp, Yellow Perch)
Priority	Low-moderate
Timeframe	2020-2030
Performance Indicator	Reduction of invasive and non-native fish population (30% reduction in biomass)

- *CRD:* Support provincial efforts to enhance the recreational fishery and community efforts to harvest and remove non-native/invasive fish species. Recommendations include providing the public with resources on non-native fish and the impact of non-native fish on environmental, cultural and recreational values within the lake.
- *Stewardship groups and fisher-people*: Catch and remove any non-native fish caught in Elk/Beaver Lake. Support building awareness of the importance of removing non-native fish from the lake.

ACTION 3.c: Manage and reduce growth of invasive Eurasian milfoil population.

Responsibility	CRD
Primary Focus	Shallow water habitats (< 6 m depth)
Priority	Moderate-high
Timeframe	Ongoing (2020-2030)
Performance Indicator	70% of Eurasian milfoil biomass removed

- *CRD*: Continue efforts to reduce population on invasive plants in Elk/Beaver Lake.
    - Continue harvesting Eurasian milfoil with weed harvester to remove at least 400 tonnes of biomass annually. This approach removes the surface portion of the plant up to 2 m deep. The biomass should continue to be collected from surface waters and along the beach to reduce re-infestation from cuttings. This approach reduces impacts to recreation, such as rowing, swimming and fishing, however, it does not reduce the milfoil population over time and does not support efforts to improve water quality.
    - Harvested plant material should be removed from the lake, dried and disposed of to ensure minimal likelihood of re-infestation. Any fragments produced during plant harvest, should be raked and removed from the shoreline. The dried biomass should be re-located to an area further from the lake (ideally outside of the watershed) to reduce potential nutrient loading back into the lake.
    - Investigate and consider adopting an additional approach to meaningful reduction of Eurasian milfoil. Appropriate strategies for sustained population reduction include manual removal by trained divers, or rototilling technologies. Significant consideration should be made for timing of these approaches and protection for Western Painted Turtle critical habitat.

ACTION 3.d: Reduce incidences of new invasive species introductions and growth.

Responsibility	CRD, park users
Primary Focus	Park users operating vessels (boats, canoes, kayaks, rowing shells) in the lake
Priority	Low-moderate
Timeframe	2020-2030
Performance Indicator	No new occurrences of invasive species in lake

- *CRD*: Provide public educational materials and resources to lake users about the impacts of invasive species and their introduction into freshwater environments. CRD to endorse provincial efforts to reduce invasive species introductions into the lake, such as the Clean-Drain-Dry campaign for boat, paddles and fishing gear cleaning practices before and after lake use. Signage posted at primary lake access points (point ramps and docks).

The following map, Figure 3-1 illustrates the locations of recommended restoration activities.

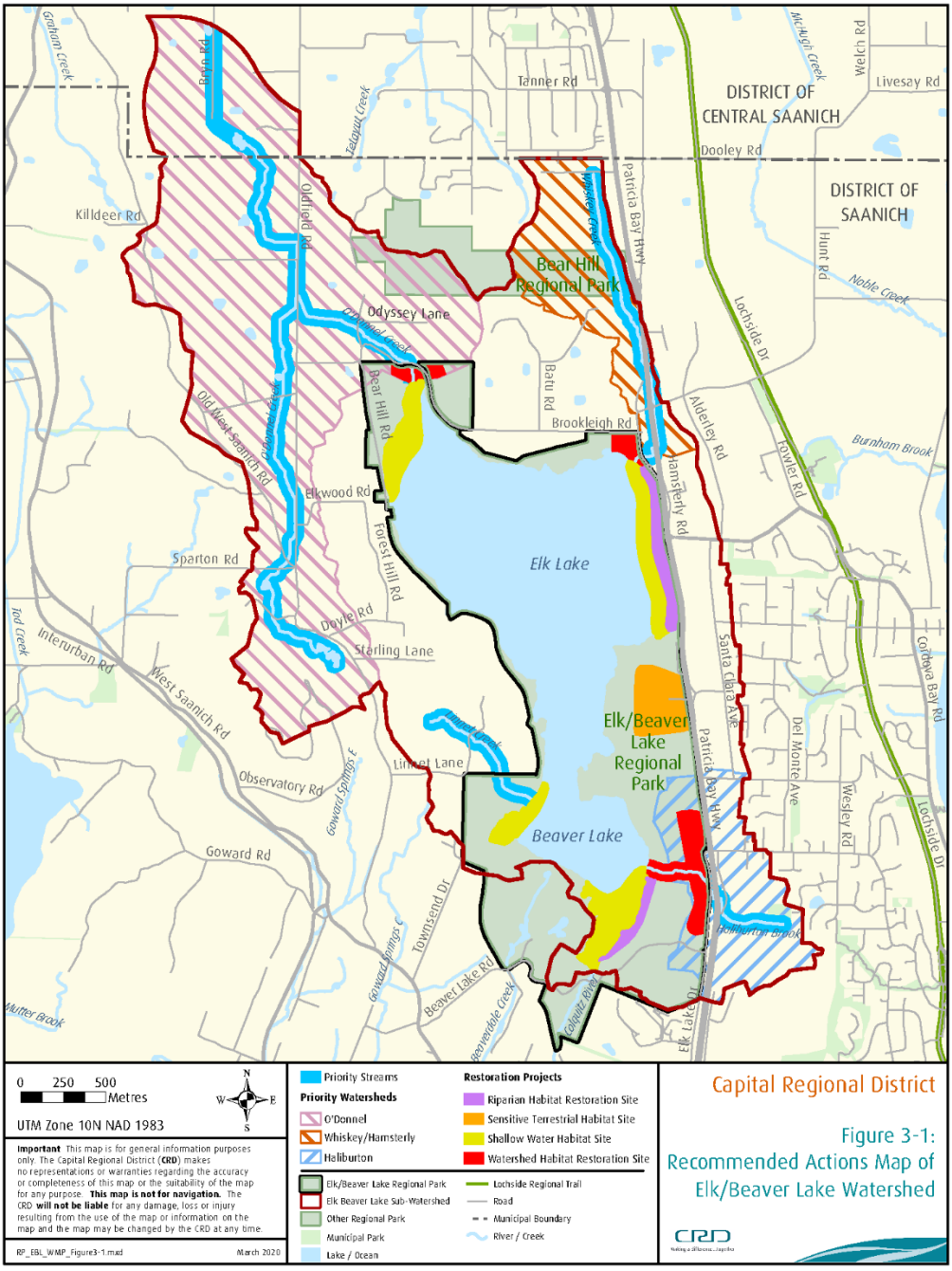

Figure 3-1: Recommended Actions Map of Elk/Beaver Lake Watershed

(red – stream restoration; purple – riparian restoration; orange – Garry Oak restoration; yellow – littoral restoration)

3.4 Performance Indicators

Identifying key performance indicators are an important component of any plan to ensure the recommended actions are successfully addressing the objectives and goals and achieves the long-term vision. The following indicators will be used to assess whether the goal, objectives and recommended actions are implemented and achieved. These indicators will be monitored, as defined in the Monitoring Program (Appendix F) and progress will be assessed fully in 2030.

3.4.1 Primary Goal

In order to assess the overall goal of improving water quality in Elk/Beaver Lake, the water quality will be monitored and evaluated against Water Quality Objectives established by the ENV. McKean (1992) identified these objectives for two water uses (primary contact water recreation, and aquatic life) for Elk/Beaver Lake.

These performance indicators include:

- Reduce year-round total phosphorus concentrations to 5-15 ug/L to support aquatic life and lake recreation.
- Temperature shall not exceed a maximum of 15°C in the hypolimnion layer of the lake.
- Dissolved oxygen shall not be less than a summer minimum of 5 mg/L 1 m above the sediment in the lake.
- Chlorophyll-A shall have a mean summer range of 1.5-2.5 ug/L.
- Secchi depth, an indication of water clarity, must exceed 1.9 m.
- Phytoplankton community shall not be dominated by blue-green algae (cyanobacteria). The number of blue-green algae shall not exceed 50% of the cells/mL in discrete samples collected at the surface. These samples shall be collected from May-August.

3.4.2 Outcomes

Through the completion of the recommended actions, the following outcomes will be measured as an indication of overall success of the plan, summarized in Table 3-1.

Table 3-1: Anticipated Outcomes and Associated Performance Indicators

Goal	Performance indicator
Restore habitat for aquatic native species	• Reduce population/biomass of non-native fish • Increase biodiversity of zooplankton and invertebrate species
Reduce growth of Eurasian milfoil	• Reduce areal coverage invasive milfoil by at least 50%
Reduce frequency of blue-green algae blooms	• Reduce number of blue-green algae visible bloom days (50% after 3 years and 75% after 8 years)
Build community awareness and understanding of watershed stewardship	• Increase number of landowners engaged in implementation of recommended actions

3.4.3 Objectives and Recommended Actions

The objectives specifically focus on distinct components of nutrient transport to reduce the external nutrient load:

1. Improve land management practices within the watershed to reduce total phosphorus entering the lake.
2. Improve watershed structure and function to reduce total phosphorus entering the lake.
3. Improve lake health and function to reduce total phosphorus within the lake.

Measuring the transport of external inputs of phosphorus throughout the watershed from various non-point sources can be very challenging. In order to effectively measure the success of meeting the objectives of this plan, the reduction of total phosphorus inputs into Elk/Beaver Lake will be used as a performance indicator.

The success of the recommended actions within the Elk/Beaver Lake Watershed Management Plan will be evaluated against the performance indicators identified for each recommended action described in the previous section.

3.5 Monitoring Program

Ongoing data collection, as defined in the monitoring program, will be conducted to monitor success in achieving the water quality performance indicators. After external phosphorus loads are reduced, water quality improvements to facilitate long-term shifts in blue-green algae abundance, invasive plant growth and habitat quality typically take at least five years to become established (Jeppesen, 2005).

Outreach efforts with local landowners should be reassessed to ensure behavioural changes to reduce nutrient inputs are maintained over time.

The following metrics in Table 3-2 should be monitored in the lake for the next 10 years, at the following frequencies (at minimum). A detailed monitoring plan for 2020 has been summarized in Appendix F and should be revisited annually to make any necessary revisions.

Monitoring will be led by CRD in 2020, but will need to be conducted collaboratively by stewardship groups, and responsible government agencies moving forward.

Table 3-2: Monitoring Program for Elk/Beaver Lake

Metric	Frequency
Total lake nutrients (phosphorus, nitrogen)	Monthly (2020-2024), annually (2024-2030)
Total nutrient input and export to/from lake	Monthly (2020-2024), annually (2024-2030)
Total lake dissolved oxygen	Monthly (2020-2024), annually (2024-2030)
Chlorophyll-A	Summer-time, monthly (2020-2030)
Lake temperature	Monthly (2020-2024), annually (2024-2030)
Lake pH	Monthly (2020-2024), annually (2024-2030)
Water clarity (secchi disk)	Monthly (2020-2024), annually (2024-2030)
Blue-green algae abundance/diversity	Annually (2020-2030)
Blue-green algae bloom frequency	Compile annually
Eurasian milfoil coverage and biomass	2025, 2030
Fish Inventory	2025, 2030
Benthic invertebrate abundance/diversity	2025, 2030
Zooplankton abundance/diversity	2025, 2030
Number of engaged landowners	Compile annually

4 MANAGEMENT CONSIDERATIONS

4.1 Species at Risk and Critical Habitat

The implementation of this plan is important to improving water quality in the lake, however, a number of species at risk and critical habitat have been identified within this watershed that need careful consideration. Special consideration for the timing and implementation of actions must be made for those species and their associated habitat to ensure their protection and support their recovery—in particular, critical habitat for the Western painted turtle (*Chrysemys picta bellii*), that resides within the lake and must be considered before any actions are taken within their known critical habitat.

4.2 Adaptive Management

Adaptive management is a framework that provides the rationale and data to support science-based decision making in light of uncertainty. Adaptive management of the Elk/Beaver Lake watershed ensures comprehensive, effective solutions are achieved to restore water quality, lake health and the ecosystems and values they support in the community.

Adaptive management is incorporated into the plan by the regular monitoring of performance indicators. This framework allows for the ability to revisit and revise current strategies to effectively respond to new information on how the lake is responding to the recommended actions and meeting the objectives. This allows the flexibility to make informed decisions in a timely manner. This framework is bounded by the goal, objectives and outcomes, a defined monitoring program and established performance indicators.

4.3 Challenges

A number of challenges have been identified that should be considered and acknowledged throughout the implementation of the plan:

- Managing expectations: Reducing nutrient loads has repeatedly proven to be the most effective approach to sustained control of blue-green algae blooms; however, it may take decades to be effective. (M.A. Burford (Griffith University), 2019).
- Coordination and collaboration: This plan requires coordination and collaboration across jurisdictions, community groups and landowners. To ensure the effective implementation of this plan, strong communication between these groups is critical.
- Limited resources: Significant resources and funds are required to implement this plan effectively. Working collaboratively, identifying appropriate grants and identifying cost-sharing opportunities are important to the success of this plan.

- Monitoring success: Historic sources of phosphorus can be stored in sediments throughout the watershed and move across the watershed over time, serving as a continual nutrient source. This effect may initially mask the effects of conservation efforts to improve water quality through reductions in nutrient inputs to surface waters. (Stackpoole, Stets, & and Sprague, 2019)
- Changing behaviour: Knowledge of the linkages between management practices in the watershed and downstream ecosystems can be improved by outreach and education efforts; however, shifting behaviour is challenging and requires long-term investment. (Hobbie, et al., 2017)

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APPENDICES

Appendix A – Public Engagement Process Summary

Appendix B – Policy & Regulation

Appendix C – Best Management Practices

Appendix D – Summary of Recommended Actions in Elk/Beaver Lake Watershed

Appendix E – Elk/Beaver Lake Water Quality Monitoring Program

APPENDIX A – PUBLIC ENGAGEMENT PROCESS SUMMARY

PHASE 1: Build public awareness: to engage both broad and targeted audiences in the development of this plan, multiple opportunities for the public to become informed and engaged were provided. Key partners and collaborators were also identified and engaged during this process.

- *Broad Outreach*
    - Online website development and updates
    - Public Open House
- *Targeted Outreach (presentations & meetings)*
    - Saanich Environment & Natural Areas Advisory Committee
    - Beaver/Elk Environmental Stewards
    - Intergovernmental working group
    - Local landowners
    - Victoria Golden Rods & Reels
    - Peninsula and Area Agricultural Commission
    - Gorge Waterway Initiative
    - CRD Naturalist volunteer presentations
    - Local experts
- *Outcome*
    - Improved public awareness
    - Summary of public vision, goals and objectives

PHASE 2: Engage and consult on the plan: formal opportunities to share information about Elk/Beaver Lake and water quality concerns were provided during this phase. Public workshops and one-on-one meetings allowed discussion and problem solving. The draft vision, goals and objectives were reviewed, revised and validated during this phase and the outcomes were used to inform the development of the plan.

- *Broad Outreach:*
    - Public Workshop #1 – September 17 (7:30-9:30pm)
    - Public Workshop #2 – September 26 (7:30-9:30pm)
    - Public Workshop #3 – October 3 (7:30-9:30pm)
- *Outcome*
    - Vision, goals, objectives and action items were drafted and reviewed by all participants to inform the content of the plan.

PHASE 3: Develop and finalize the plan: The plan was drafted by staff and reviewed before it was finalized. Interest groups, government agencies and field experts were approached and consulted on the outcomes of the plan for final review before broad public review online.

- *Targeted Outreach:*
    - Workshop participants
    - Intergovernmental working Group
    - First Nations: Lək'ʷəŋən and W̱SÁNEĆ Nations
    - Saanich Environment & Natural Areas Advisory Committee
    - Peninsula and Area Agricultural Commission
    - Biologist Experts

Broad Outreach: The broader public was engaged through an online survey to provide feedback on the plan and make any suggestions or additions. The plan was made public in February for public review and all survey comments and public input were consolidated and reviewed to make any necessary amendments to the plan.

Public Participation Process

The Capital Regional District (CRD) has developed a draft management plan for the Elk/Beaver Lake Watershed. The purpose of the Elk/Beaver Lake Watershed Management Plan is to identify goals, objectives, recommended actions and an implementation plan to improve water quality in Elk/Beaver Lake. Initial public input was conducted in 2019 to gather information to assist in drafting the watershed management plan of this lake. A follow-up engagement process was conducted in 2020 to obtain feedback on the draft watershed management plan.

Online Response Form

The purpose of this report is to summarize the opinions expressed by the public through an online response form on the draft Elk/Beaver Lake Watershed Management Plan (Appendix I). The response form was available online from February 11-27, 2020. The response form entailed seven questions to allow respondents to offer feedback about the Elk/Beaver Lake Watershed Management Plan key sections. Six of the questions were quantitative using a five-point Likert scale ranging from "very satisfied" to "not satisfied" as response options. The last question was qualitative, offering respondents the opportunity to provide additional comments to the draft management plan. All of the questions were optional.

Rationale for Online Response Form

It is important to acknowledge that the aim of the response form was to offer an easy to access venue for the public to provide comments and share their desires for the Elk/Beaver Lake watershed. The information obtained through this participation tool is not intended to be representative of the whole population of the island or the CRD. Hence, the data reported in this document will not be generalized to the broader population.

The response form was used to ensure that the expectations and any concerns of participants engaged in the Elk/Beaver Lake Watershed Management Plan process are documented and considered. The information retrieved through this participatory tool will complement the insights provided through other public participation opportunities conducted in 2019 and 2020. The data in this report should, therefore, be interpreted as part of the overall public participation process outcomes undertaken to develop the Elk/Beaver Lake Watershed Management Plan.

Results

On February 11, 2020, the CRD released the Elk/Beaver Lake Watershed Management Plan for public review. The same day the project webpage was updated, a media release came out and advertising was provided in different venues throughout the public review period.

A total of 89 online response forms were received by midnight of February 27, 2020, for which results are reported below. Of those response forms, 69 questionnaires were completed and another 20 partially filled out. As some of the surveys were not completed, response rate varied by question.

Vision Statement

Participants were asked to rate their satisfaction about the following vision statement: "*The vision for Elk/Beaver Lake watershed is to have a healthy and diverse lake ecosystem that supports natural values, safe recreation and community activities for generations to come.*" Most respondents were very satisfied (n=21; 24%) to satisfied (n=30; 34%) about the vision statement proposed for Elk/Beaver Lake Watershed, with another third being moderately satisfied (n=26; 30%). Only a few respondents were slightly satisfied (n=8; 9%) to not satisfied (n=1; 1%) with the vision proposed.

Management Goal

When asked about the goal proposed for the Elk/Beaver watershed in the draft management plan, respondents were very satisfied (n=30; 34%) to satisfied (n=28; 32%) about the vision statement proposed for Elk/Beaver Lake Watershed. Only few respondents were moderately satisfied (n=10; 11%), slightly satisfied (n=7; 8%) or not satisfied (n=2; 2%) with the goal proposed.

Objectives

More than half of respondents were very satisfied (n=23; 26%) to satisfied (n=34; 39%) with the objectives proposed in the draft management plan, with fewer being moderately satisfied (n=12; 14%), slightly satisfied (n=4; 5%) or not satisfied (n=2; 5%)

Outcomes

Once again, more than half of respondents were very satisfied (n=24; 27%) to satisfied (n=27; 31%) with the objectives proposed in the draft management plan, with fewer being moderately satisfied (n=11; 13%), slightly satisfied (n=3; 3%) or not satisfied (n=1; 1%)

Recommended Actions

Respondents to the survey were very satisfied (n=10; 11%) to satisfied (n=37; 42%) with the proposed management actions, with fewer being moderately satisfied (n=11; 13%), slightly satisfied (n=5; 6%) or not satisfied (n=3; 3%)

Additional Comments

The last question of the survey allowed respondents to provide additional comments about the draft management plan for the Elk/Beaver Lake watershed. The main theme emerging from the 44 qualitative comments provided by respondents was appreciation for this plan and its content (n=12; 27%), followed by the request of enforcing waste management through improvement of sewage treatment and removal of animal waste from the park (n=11; 25%). Other key themes mentioned by respondents were around implementing nutrients removal (n= 9; 20%), speeding up the plan timeline (n=6; 14%) and focussing on the oxygenation of the lake (n=5; 11%). Eradicate invasive species, managing human activities in the park, concerns for funding and the role of CRD Regional Parks department in the management of the lake were also mentioned, yet each of those themes provided less than 5% of the qualitative comments.

Elk/Beaver Watershed Initiative Feedback Survey

The purpose of this comment form is to collect feedback on the draft Elk/Beaver Lake watershed management plan, which aims to address elevated nutrients in the watershed that contribute to poor water quality in Elk/Beaver Lake. The CRD drafted the plan following public consultation and in collaboration with other government agencies and community partners. Read more >>

Comments received by midnight February 27, 2020 will be used to inform regional parks management decisions and to finalize a draft plan for review and approval by the CRD Board.

Comments may be summarized and shared publicly with the CRD Board, CRD Committees and Commissions, as part of the plan's review process and may appear in information provided on the CRD's website. Please do not provide any information that could identify yourself or others in your responses. No individuals will be identified and no comments will be attributed to any individual in any reports or communications resulting from this survey.

Note: Each page of the feedback form will timeout after 30 minutes. Please do not use the back/forward buttons on your browser, but rather use the buttons at the bottom of the page and ensure you **click the 'finish' button at the end of the form,** even if you have not answered all of the questions.

1.*Enter your postal code_____

This information will allow us to understand whether respondents are located within the watershed boundary.

Proposed Vision

The vision for Elk/Beaver Lake watershed is to have a healthy and diverse lake ecosystem that supports natural values, safe recreation and community activities for generations to come.

2. Overall, how satisfied are you with the proposed vision of the draft watershed management plan?

- Very satisfied
- Satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied

Proposed Goal

The primary goal of the watershed management plan is to improve water quality in Elk/Beaver Lake.

3. Overall, how satisfied are you with the proposed goal of the draft watershed management plan?

- Very satisfied
- Satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied

Proposed Objectives

Objectives were identified to improve water quality in Elk/Beaver Lake watershed. These objectives include the following:

- Improve land management practices within the watershed to reduce total phosphorus entering the lake.
- Improve watershed structure and function to reduce total phosphorus entering the lake.
- Improve lake health and function to reduce total phosphorus within the lake.

4. Overall, how satisfied are you with the proposed objectives of the draft watershed management plan?

- Very satisfied
- Satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied

Proposed Outcomes

The proposed outcomes of the watershed management plan include:

- Restored habitat for native aquatic species.
- Reduced growth of Eurasian milfoil.
- Reduced frequency of blue-green algae blooms.
- Improved community awareness and understanding of watershed stewardship.

5. Overall, how satisfied are you with the proposed outcomes of the draft watershed management plan?

- Very satisfied
- Satisfied
- Moderately satisfied
- Slightly satisfied
- Not Satisfied

Proposed Recommended Actions

A series of actions have been identified as priorities under each objective. For a detailed description of the action, timeline and implementation plan please review pages (37- 48) within the draft watershed management plan.

6. Overall, how satisfied are you with the proposed recommended actions of the draft watershed management plan?

- Very satisfied
- Satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied

7. Do you have any specific comments you want to make to improve the draft watershed management plan?

Thank you for taking the survey.

APPENDIX B – POLICY & REGULATION

Key legislation, policy and bylaws that impact and/or guide activities within the Elk/Beaver Lake watershed are as follows:

District of Saanich

The District of Saanich bylaws apply to all private lands within the Elk/Beaver Lake watershed.

Relevant bylaws are as follows:

- The **Watercourse Bylaw** prohibits activities which might pollute a watercourse or change water flows. Violations of this bylaw could include allowing, or failure to exclude, livestock entering a watercourse, or allowing high nutrient substances, such as soil fill, manure, or grey-water to wash into a watercourse.
- The **Zoning Bylaw** establishes a minimum setback of 7.5 m for buildings and structures from the natural boundary of a watercourse.
- The **Deposit of Fill Bylaw** prohibits the deposit of fill within 15 m of the centre line of designated watercourses.
- The **Tree Preservation Bylaw** prohibits the removal of trees within 15 m of the natural boundary of streams, and trees within a floodplain.
- **Streamside Development Permit Area** establishes setbacks to protect and enhance riparian habitat buffers.
- The **Subdivision Bylaw** requires all new development to protect downstream habitat and water quality, by providing drainage structures, both during and after development, to decrease the speed and volume of stormwater run-off, while at the same time improving run-off water quality. This means that best management practices, such as sediment ponds and silt fencing should be properly maintained to prevent discharges from disturbed soils into downstream habitat and drainages.
- The **District of Saanich Climate Change Adaptation Plan** (Saanich 2020) identified sectors for which climate impacts and adaptation were developed.

Relevant policies outlined within the official community plan are as follows:

- **Policy 5.1.1.8***:* Support efforts of farm operators and other agencies to enhance farmland and increase crop yield, by improving water supply and undertaking drainage improvements and improving soil capabilities, while considering environmental impact.
- **Policy 5.1.1.9***:* Encourage environmentally sound agricultural practices by promoting the BC Environmental Farm Program Local Initiatives.

- Policy 5.1.1.19: Encourage the development of a Property Assessment policy that primarily supports local food production, and does not inadvertently result in ecological degradation

Capital Regional District

Relevant CRD plans, strategies and bylaws include the following:

- The Elk/Beaver Lake (and Bear Hill) Regional Parks Management Plan (Bylaw No.3698; CRD 2010) amended previous bylaws which govern management in Elk/Beaver Lake Regional Park.
- Regional Climate Action Strategy: Supports community-focused climate mitigation and adaptation through 2021. At the community level, the Regional Climate Action Strategy guides the CRD's services to support community-focused climate mitigation and adaptation action over the next five years. The strategy aligns with federal, provincial and regional initiatives, to ensure a coordinated approach that identifies all opportunities and maximizes region-wide benefits. (CRD, 2017)
- Capital Regional District Parks Regulation Bylaw No.1, 2018 (Bylaw No.4225): This bylaw governs the use of regional parks and trails. In particular, it governs how animals in the regional park should be managed by their owners.
- Septic Maintenance Bylaw: Ensuring septic systems are well maintained will help protect our local water quality. The bylaw requires owners with Type 1 systems to have their septic tank pumped out at least once every five years. Five years is intended to be a maximum time frame. Some systems need more frequent pumping depending on the size of the tank and the conditions in the home. Owners of Type 2 or Type 3 systems (often package treatment plants) are required to maintain their system according to the maintenance plan for the system, and ensure it is maintained by an Authorized Person at least once per calendar year. Owners should ensure their Authorized Person completes a Certification of Maintenance and sends it in to the CRD. Owners should keep a copy of this form, however, as proof of service.
- Regional Canada Goose Management Strategy: A steering committee of stakeholders has developed a Regional Canada Goose Management Strategy that provides guidance on controlling the population of resident Canada geese in the regional district. The objectives of the Regional Canada Goose Management Strategy are:
    - To reduce the damage to agricultural crops by Canada geese that results in economic losses to farmers;
    - To develop a knowledge base for the CRD and its member municipalities, federal and provincial agencies, First Nations, Vancouver Island farmers and non-government environmental organizations on Canada geese population management methods;
    - To reduce Canada geese impacts on parks and recreational areas in the regional district.

Agricultural Land Commission

- *Agricultural Land Commission Act* and associated Regulations: The *Agricultural Land Commission Act* and Agricultural Land Reserve regulations are the legislative framework for the establishment, administration, and procedures of BC's agricultural land preservation program. The *Agricultural Land Commission Act* is a high-level statute that sets out principles and broad rules for the protection of agricultural land in BC. The *Agricultural Land Commission Act* takes precedence over, but does not replace, other legislation and bylaws that may apply to the land. Local and regional governments, as well as other provincial agencies, are expected to plan in accordance with the provincial policy of preserving agricultural land

BC Provincial Government

The ENV works together with FLNRORD, Ministry of Health, Ministry of Agriculture, and other provincial agencies to manage and protect water in BC.

- *Water Sustainability Act*: Was brought into force on February 29, 2016 to ensure a sustainable supply of fresh, clean water that meets the needs of BC residents today and in the future.
- *Water Protection Act*: Protects BC's water by reconfirming the Province's ownership of surface and groundwater, clearly defining limits for bulk water removal, and prohibiting the large-scale diversion of water between major provincial watersheds and/or to locations outside of BC.
- *Environmental Management Act*: Regulates industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation. *Environmental Management Act* provides the authority for introducing wastes into the environment, while protecting public health and the environment. The *Environmental Management Act* enables the use of permits, regulations and codes of practice to authorize discharges to the environment and enforcement options, such as administrative penalties, orders and fines to encourage compliance. Guidelines and objectives for water quality are developed under the *Environmental Management Act.*
    - Code of Practice for Agricultural Environmental Management: On February 28, 2019, a new regulation called the Code of Practice for Agricultural Environmental Management came into effect. The new Code of Practice for Agricultural Environmental Management applies to all agricultural operations in BC, from small hobby farms to large commercial operations that are rearing and keeping livestock or poultry, or growing and harvesting agricultural products.
    - Organic Matter Recycling Regulation of B.C.: Governs the construction and operation of compost facilities, and the production, distribution, storage, sale and use of biosolids and compost. It provides guidance for local governments and compost and biosolids producers, on how to use organic material, while protecting soil quality and drinking water sources.

- *Riparian Areas Protection Act*: Protects riparian areas, while facilitating urban development that embraces high standards of environmental stewardship. The *Riparian Areas Protection Act* calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that a Qualified Environmental Professional conducts a science-based assessment of proposed activities.
- *BC Wildlife Act*: Management of wildlife in Canada is shared by the federal, provincial, and territorial governments. The provincial act ensures conservation and management of wildlife populations and habitat, issuing licences and permits for fishing, game hunting, and trapping, guidelines for safe angling and trapping and outfitting policies

Government of Canada

- *Wildlife Act*: Management of wildlife in Canada is shared by the federal, provincial, and territorial governments. Federal responsibility includes protection and management of migratory birds, as well as nationally significant wildlife habitat, and responsibilities for endangered species, control of international trade in endangered species, research on wildlife issues of national importance, and international wildlife treaties and issues.
- *Fisheries Act*: Protects our fish and fish habitat for future generations. This includes protections against the harmful alteration, disruption, and destruction of fish habitat, and protecting biodiversity and addressing urgent threats to conservation and fisheries.
- *Species at Risk Act*: The purposes of the *Species at Risk Act* are to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species that are extirpated (no longer exist in the wild in Canada), endangered, or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened. A series of measures applicable across Canada provides the means to accomplish these goals. Some of these measures establish how governments, organizations, and individuals in Canada work together, while others implement a species assessment process to ensure the protection and recovery of species. Some measures provide for sanctions for offences under the *Species at Risk Act.*

APPENDIX C – BEST MANAGEMENT PRACTICES

Best management practices describe ways to manage your land and activities to mitigate pollution of surface and groundwater near you. These practices are usually simple and low tech and benefit your household and land in many ways.

Urban/Rural Landowners

Best Management Practices: The following practices are generally recommended for residential homeowners in urban, sub-urban and rural landscapes. For further information regarding the implementation of these practices, consult an expert or review the resources provided below.

- Use fertilizers wisely
    - Reduce use of commercial and inorganic fertilizers.
    - Apply at the right time and in the right amounts. If more fertilizer is applied than the grass can utilize, it can wash into nearby streams and lakes.
    - Get a soil test to see what your soil needs.
    - Fertilizer with slow release nitrogen is better for the environment.
- Pick up pet waste
    - Pick up pet waste from your yard on a daily basis.
    - Carry disposable bags, while walking your dog to pick up and dispose of waste in the garbage.
- Care for and maintain your septic system
    - Check function of system annually.
    - Have tank pumped out regularly (every two-fiver years).
    - Make sure your system has an effluent filter to reduce the amount of solids entering your drain-field.
- Conserve water
    - Reduce overall water consumption.
    - Collect and conserve with rain barrels, use soaker hoses and drip irrigation.
    - Plant native species that require less water.
- Use landscaping practices that reduce erosion and run-off
    - Protect soil by planting native groundcover vegetation.
    - Use pervious surfaces as ground cover to support infiltration. Roofs, driveways, patios, and other impermeable surfaces force a large amount of water to quickly run off into storm drains, ditches, and waterways. Permeable surfaces allow rainwater to seep into the ground. They can include grass swales, gardens, forests, as well as special paving materials, called permeable pavers.

- Restore and maintain forest cover, wetlands, ponds, riparian areas.
- Create raingardens. A rain garden is a planted depression in the yard that absorbs rainwater from hard surfaces. It contains native grasses, wildflowers, and shrubs that thrive in wet conditions.
- Reduce nutrient inputs from yard waste by storing compost heaps away from riparian habitat. The use compost blankets, filter socks or a compost filter berm can help retain sediment and reduce erosion.

- Reduce use of high-phosphorus house products
  - Look for alternative cleaning products (laundry detergent, dish-washing soaps and detergents, and household cleaners) that have low phosphate components.
  - Do not pour household chemicals (particularly those containing phosphates), such as paint or oil onto the yard or directly into storm drains. Dispose of chemicals appropriately, according to local waste disposal guidelines.
- Maintain a healthy lawn
  - The best way to support your watershed is by planting native groundcover vegetation, rather than a non-native species.
  - If you have a lawn, maintain longer grass (6-8 cm in length) to support a healthier lawn by absorbing more water and nutrients, leading to improved root and soil structure.
  - Aerate the soil to create small holes, loosen the soil, and remove thatch (dead grass) to allow water, nutrients, and oxygen reach the root system.
  - Reduce foot traffic during wet periods, compacted soils decrease the ability of roots to grow. Consider foot paths or stepping-stones in high-traffic areas.
  - Reduce watering, a healthy lawn does not require much water. It only needs 2-3 cm (1 inch) per week, either by rainfall or watering.
  - Use compost, instead of fertilizer. Compost is considered a soil amendment and contains limited nutrients. Organic matter will improve the drainage and aeration of clay soil and help sandy soil hold water and nutrients.

Homeowners Stewardship Resources

- Environmental Best Management Practices for Urban and Rural Land Development (Section 8: Pollution Prevention and Management): This document provides information to support developers, landowners and local government to protect the environment and human health and safety by ensuring clean and safe water, land and air; and maintain and restore the ecological diversity of fish and wildlife species and their habitats. (Ministry of Water, 2004)

- CRD Environmental Sustainability a Homeowner's Guide to Outdoor Water Use: This booklet, prepared by CRD Environmental Sustainability Department, offers information, tips and techniques for wise outdoor water use. These simple techniques will help you use water more efficiently and save money. They will also help your garden flourish, as about 70-80% of all plant problems are related to incorrect watering. Follow this guide, and you will cut down on your costs, maintenance time and effort and, most importantly, conserve our precious water resource. (CRD, 2011)
- BC Stewardship Guide (Stewardship Options): This book helps landowners identify natural features on their property and provides both practical and legal options for private stewardship. Part One provides hands-on suggestions for identifying, retaining and restoring wildlife and fish habitat. Part Two describes legal options and current tax incentives available to private landowners to protect that habitat. Private land stewardship is essential to conserve BC's unique biological diversity and maintain fish and wildlife populations. There are many rewards for land stewards, such as personal enjoyment, a better quality of life, creating economic opportunities, and the chance to leave a living legacy for future generations. (Penn, 1996)
- Rural Landowners Stewardship Guide (for Ontario Landscape): The overriding goal of the Rural Landowner Stewardship Guide is to protect and enhance the quality of our natural environment – both groundwater and surface water, such as streams, rivers, ravines, creeks, wetlands and lakes, and the natural landscape features that support these ecosystems. (Caldwell, 2013)
- Gardening with Native Plants: Creating a naturescape (native plant garden) on your land is part of the solution to habitat loss. The actions of many individual landowners can make a big difference for wildlife in our region. This guide shows how showy native plants in your garden can also save you time and money; forget about watering, artificial fertilizers, and toxic pesticides. Because native plants have evolved in this climate for countless generations, they attract local songbirds and insect pollinators. The various plants in this guide fit into any type of garden setting. (Trust, 2017)
- Landowner Guide to Protecting Water Quality in the Kawarthas: The tips provided in this handbook are intended to help you identify sources of nutrients, such as phosphorus and nitrogen, while providing information on best management practices for your property. At the same time, we believe that these practices have the potential to improve your property value, enhance personal enjoyment of our urban, shoreline, and rural environments, and contribute to healthier lifestyles. (Conservation, 2013)

Additional Restoration Resources

- The Streamkeepers Handbook: The Streamkeepers Program has been developed in response to the concerns of the many volunteers working on stream enhancement projects. In spite of volunteer efforts and government regulations, development pressures from our expanding population continue to threaten our aquatic habitats. Everyone, from residents to land developers, foresters, and farmers, needs to become aware of how important good watershed practices are to the long-term protection of our environment. (Taccogna, 1995)

- Raingarden Handbook for Western Washington: This handbook will guide you through the following stages: plan, build, plant, and maintain. The handbook is written for conditions specific to western Washington, including appropriate plant selections and sizing recommendations based on regional soils and rainfall patterns. (Hinman, 2013).
- Building a Rain Garden (CRD): This guide provides general principles for building a raingarden in the CRD. (CRD, 2019)

Agricultural Landowners

There are significant resources available to farmers within BC that guide nutrient management practices. Landowners are encouraged to:

- Comply requirements with Code of Practice for Agricultural Environmental Management and adopt Nutrient Management Plan, as needed (over 5 ha, nutrients applied to land, nutrient levels test high)
- Consider enrolling in the provincial Environmental Farm Plan to complement and enhance existing stewardship practices. Adopt beneficial management practices for optimum farming practices that minimize input of nutrients to nearby streams and riparian habitat. (Partnerships, 2020)

The following practices are generally recommended for landowners that manage agricultural landscapes. This is a summary of the key practices to consider, but is not exhaustive:

- Fertilize Wisely: Effectively manage use and application of fertilizers, ensure nutrients are available to meet crop needs, while reducing nutrient run-off.
- Store manure appropriately: Ensure manure is stored and contained effectively, with appropriate set-back from riparian habitat.
- Conserve and effectively manage water use
    - Consider use of bioswales and Keyline design landscape practices to manage water flow.
    - Increasing irrigation efficiency can reduce non-point source pollution of ground and surface waters.
- Manage activity of livestock: Use appropriate fencing set-backs and grazing practices to lessen the water quality impacts (e.g., reduce erosion potential).
- Reduce soil erosion: Use vegetation strips to increase nutrient uptake and prevent potential pollutants from running off into surface waters.
    - Plant winter cover crops.
    - Leave harvested plant materials on the soil surfaces.
    - Use vegetation buffers.
    - Minimize soil compaction.

For additional information regarding the implementation of these practices, consult an expert or review the resources provided below.

Resources

Watershed Stewardship Guide for Agriculture: This guide is designed for all agricultural producers – from ranchers to greenhouse growers. Farmers are key to ensuring protection for aquatic environments. The stewardship principles discussed within this guide enable farmers to improve their operations and enhance the quality of their local environment. (Nener, Heinonen, Derksen, & John, 1997)

Beneficial Management Practices Program: Producers who develop and have a completed and current Environmental Farm Plan may be eligible to apply for cost-shared incentives through the Canadian Agricultural Partnership Beneficial Management Practices Program to implement actions identified in their on-farm environmental action plans.

APPENDIX D – SUMMARY OF RECOMMENDED ACTIONS IN ELK/BEAVER LAKE WATERSHED

Objective	Action	Performance Indicator	Timeframe	Lead Responsibility	Primary focus
1. Improve land management practices within the watershed to reduce total phosphorus entering the lake	1.a. Improve rural/urban land management practices to reduce and manage the source of phosphorus inputs into the watershed.	Contact 90% of landowners within Elk/Beaver Lake Watershed	2020-2022	Local landowners, Districts of Saanich and Central Saanich, CRD	Lands within Haliburton, O'Donnell & Hamsterly sub-watersheds
	1.b. Improve agricultural land use practices to reduce and manage nutrient use.	Contact 90% of farmers within watershed	2020-2025	Local farmers, Districts of Saanich and Central Saanich	Farmlands within Elk/Beaver Lake watershed [priority for new and small operation farmers (>5 ha)]
	1.c. Ensure proper function of septic and sewerage systems to reduce phosphorus inputs	Ensure 85% compliance with Septic System Bylaw 3479	2020-2024	Landowners, CRD	Landowners with septic systems
	1.d. Reduce waste input from non-native Canada goose population	Reduction of resident Canada goose population at Elk/Beaver Lake Regional Park	2020-2030	CRD	High goose activity areas (Eagle, Beaver and Hamsterly beaches)
	1.e. Reduce waste from dogs and horses on park trails	Improve educational materials within park and improve waste disposal opportunities	2020-2030	Park users, CRD	Elk/Beaver Lake Regional Park (trail system, park system)

Summary of Recommended Actions in Elk/Beaver Lake Watershed, cont'd

Objective	Action	Performance Indicator	Timeframe	Lead Responsibility	Primary focus
2. Improve watershed structure and function to reduce total phosphorus entering the lake	2.a. Restore and enhance stream and watershed function (Haliburton Brook)	60% of stream habitat restored	2020-2024	Landowners, stewardship groups, CRD, District of Saanich	Haliburton Brook and watershed
	2.b. Restore and enhance stream and watershed function (O'Donnell Creek)	60% of stream habitat restored	2024-2026	Landowners, stewardship groups, CRD, Districts of Saanich and Central Saanich	O'Donnell Creek and watershed
	2.c. Restore and enhance stream and watershed function (Hamsterly Creek)	60% of stream habitat restored	2026-2028	Landowners, stewardship groups, CRD, District of Saanich	Hamsterly Creek and watershed
	2.d. Restore and enhance riparian habitat along shoreline	Reduced overflow flooding at priority sites	2024-2028	CRD	Overflow sites on perimeter of lake, adjacent to paved parking lots and highly compacted soils (impervious surfaces)
	2.e. Maintain ecological function of sensitive ecosystems and ecological communities (forest, woodland and prairie habitat)	Restored native habitat in target area (60%)	2020-2024	CRD	Sensitive ecosystems and important ecological communities (Garry Oak Meadow)

Summary of Recommended Actions in Elk/Beaver Lake Watershed, cont'd

Objective	Action	Performance Indicator	Timeframe	Lead Responsibility	Primary focus
3. Improve lake health and function to reduce total phosphorus within the lake	3.a. restore and enhance shallow water habitat	60% of shallow water habitat restored	2026-2030	CRD, stewardship groups	Shallow water zones (< 3 m depth), adjacent to Orchian wall, and in Beaver Lake basin
	3.b. Reduce non-native fish populations	Reduction of invasive and non-native fish population (30% reduction in biomass)	2020-2030	CRD, stewardship groups, fisher-people	Non-native fish species (Common Carp, Yellow Perch)
	3.c. Manage and reduce growth of invasive Eurasian milfoil population	80% of Eurasian milfoil biomass removed	2020-2030	CRD	Shallow water habitats (< 6 m depth)
	3.d. Reduce incidences of new invasive species introductions and growth	No new occurrences of invasive species in lake	2020-2030	CRD, park-users	Park users operating vessels (boats, canoes, kayaks, rowing shells) in the lake

APPENDIX E – ELK/BEAVER LAKE WATER QUALITY MONITORING PROGRAM

1. Background

The Elk/Beaver Lake Initiative was established by the CRD in 2015 to address the long history of water quality issues at Elk/Beaver Lake. Since the 1980s, research has indicated significant eutrophication of the lake (high nutrient loading), causing harmful algal blooms, deterioration of aquatic habitat and increased growth of invasive weeds. Data was collected in 2016 and 2017 to improve our understanding of lake dynamics and support decision making for remedial actions to improve in-lake conditions.

2. Purpose

This monitoring plan will guide monitoring activities in 2019 to determine the onset of stratification in the spring, and turnover in the fall, to support the development of an in-lake remediation plan, including system design and operations. CRD also wants to gather baseline data that will be used to evaluate and assess the success and monitor any impacts on in-lake remediation.

3. Goals

The goals of the water quality monitoring program:

- To better understand current water quality issues at Elk/Beaver Lake.
- Provide a baseline of water quality conditions to support development of in-lake remediation master plan.
- Monitor changes in water quality through time and in response to future active management, in-lake remediation systems and watershed management at Elk/Beaver Lake.
- Assess compliance with existing regulations and guidelines

4. Water Quality Objectives

a. Addressed by Monitoring Plan

	Objectives	Source
I.	Maintain Chlorophyll-A mean summer range of 1.5-2.5 ug/L.	McKean 1992
II.	Reduce year-round total phosphorus concentrations 5-15 ug/L to support aquatic life and lake recreation.	Water Quality Objectives (ENV)
III.	Maintain deep water temperatures below 15°C in the hypolimnion to support aquatic life.	McKean 1992
IV.	Improve year-round dissolved oxygen concentrations >5 mg/L at 1 m above lake bottom.	McKean 1992
V.	Improve water clarity to no less than 1.9 m Secchi depth year-round.	McKean 1992
VI.	Shift the phytoplankton community composition such that blue-green algae make up no more than 50% of the cells/mL.	Nordin 2015

b. Additional Initiative Objectives, addressed and monitored separately:

Objectives	
I.	Reduce number of blue-green algae visible bloom days (50% after three years and 75% after eight years).
II.	Reduced number of beach closure days recorded as response to blue-green algae blooms.
III.	Reduce year-round total blue-green algae and related toxins to 100,000 cells/mL (microcystins < 20 ug/L).
IV.	Reduce areal coverage invasive milfoil by at least 50%.
V.	Reduce total hours spent operating weed harvester by at least 50%.
VI.	Improve water quality for native fish species.

5. In-Lake Water Sampling Plan

Water Quality Parameters

a. <u>Physical Parameters</u>

- Dissolved Oxygen
- Temperature
- pH
- Conductivity
- Water Clarity

b. Chemical Samples

- Total Phosphorus
- Ortho-phosphorus
- Total Nitrogen, Nitrite, Nitrate, ammonia
- Dissolved Organic Carbon

c. Biological Samples

- Chlorophyll-A
- Phytoplankton tow
- Zooplankton tow

Data Collection

- Collect physical profile data every metre, every four weeks (except February-April, collect every two weeks), and weekly from April-June for oxygen depletion rate analysis.
- Collect chemical data at surface (0.5 m) and at depth, every four weeks (except February-April, every two weeks).
- Collect total phosphorus and orthophosphate every metre below the thermocline, from May-October.
- Collect biological samples at surface (Chlorophyll-A, phytoplankton) with integrated tube sampler, below surface (zooplankton), May-August, every four weeks.
- Sediment samples in Beaver Lake: Repeat sampling by Groenveld in 2002 in Elk Lake. Sampling to be conducted as soon as possible.

Sampling locations

- ELK-2 is the traditional sample point used by the ENV and is located over the deep location in the north end of the Elk basin. (17 m)
- BVL-1 is the deepest part of Beaver basin and is most typically the sample point in Beaver Lake. (7 m)

Location	Surface Surveys: Epilimnion	Deep Surveys: Hypolimnion
Elk Lake (ELK-2)	1 m (from surface)	15-18 m (or 1 m from bottom)
Beaver Lake (BVL-1)	1 m (from surface)	5-8 m (or 1 m from bottom)

6. Stormwater (SW) Sampling

Water Quality Parameters

a. Physical Parameters

- Dissolved Oxygen
- Temperature
- pH
- Conductivity
- Water Clarity

b. Chemical Samples

- Total Phosphorus
- Ortho-phosphorus
- Total Nitrogen, Nitrite, Nitrate, ammonia
- Dissolved Organic Carbon
- Dissolved metals

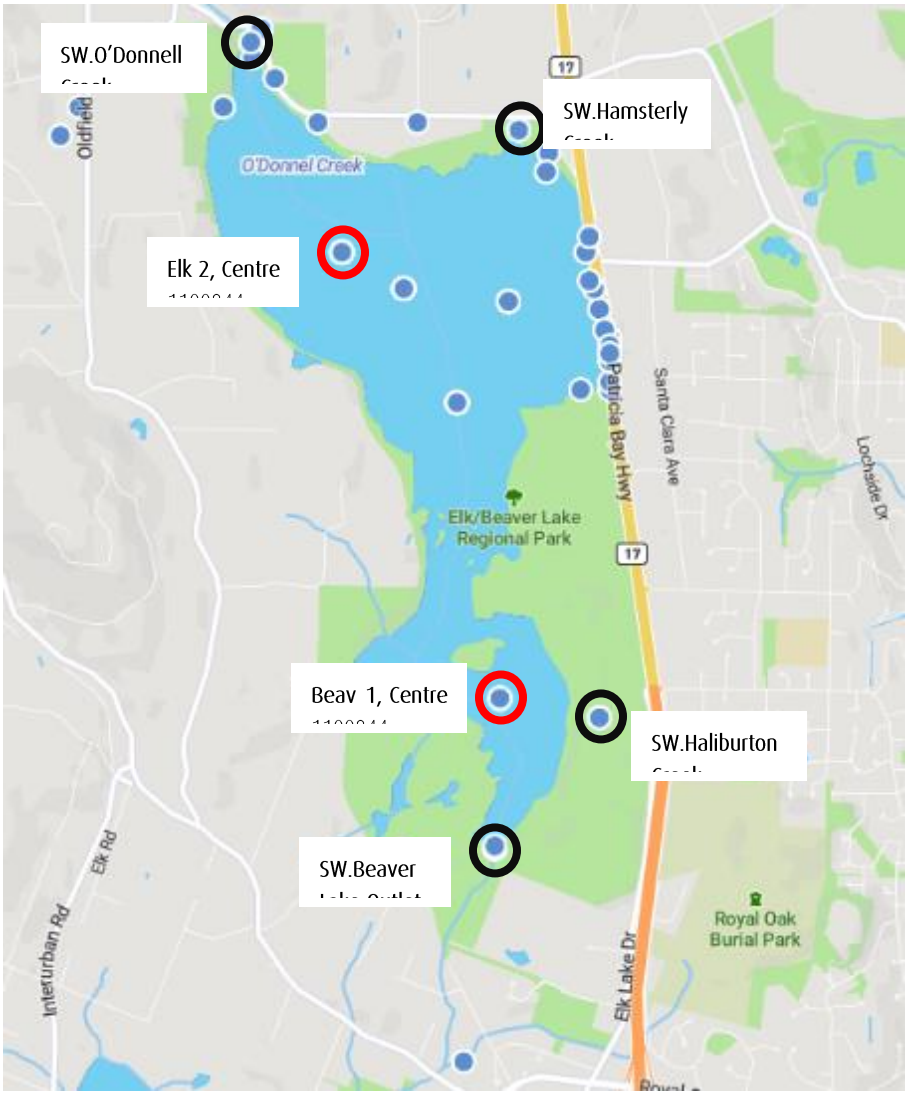
Data Collection

- All parameters every four weeks (August-October)

Sampling Locations

a. Inflow: O'Donnell Creek, Haliburton, Hamsterly
b. Outflow: Sampling the head of Colquitz River to monitor outflows

Sampling Map



Monthly Sampling (chemical/physical)

- Number of locations: 2
- Number of samples per location: 2 (surface and deep)
- Frequency: once/month

Increased Frequency Sampling (2x month)

- Number of locations: 2
- Number of samples per location: 2 (surface and deep)
- Frequency: twice/month

Monthly Hypoliminion Sampling (sampling below thermocline to bottom)

- Number of locations: 2
- Number of samples per locations: varies by month (Elk: average 8.5; Beaver 2.5)
- Parameters: Orthophosphate and Total Phosphorus ($22/sample)
- Frequency: once/monthly

Technical Definitions and descriptions:

- **Thermocline** is where temperature change is >1^{0}C/m.
- **Statification** in spring (Februry to mid-April) indicates when to turn an aeration/oxygenation system on.
- **Trophic status** is used to describe a lake's level of productivity, depending on nutrients available for plant growth. Measured with water clarity (secchi disc depth); Chlorophyll-A (algal pigments); and phosphorus concentration (limiting nutrient for nitrogen fixing algae)

Trophic Status	Chl-*a*(µg/L) growing season mean (Jun-Sept)	Secchi (m) growing season mean (Jun-Sept)	TP (µg/L) at spring overturn	TN (mg/L) at spring overturn
Oligotrophic	0-2	>6	1-10	<0.10
Mesotrophic	2-5	3-6	10-20	0.10-0.50
Eutrophic	>5	<3	>20	>0.50

- **Temperature:** Temperature can affect the life cycles and survival of organisms (including algae) and the ability of the water to hold oxygen. By building a vertical profile of temperature, we will be able to make inferences about lake mixing patterns, identify timing and location of thermal stratification (thermocline).

- Dissolved Oxygen: Dissolved oxygen, or oxygen present in the water, can also impact the type of aquatic life a water body can support. Low levels of dissolved oxygen can kill sensitive organisms and are generally undesirable, as they can indicate that organic matter is decomposing in the water column (i.e., after an algal bloom dies).
- pH: Predict conditions when bloom may occur.
- Total Phosphorus: Total phosphorous in early spring will be an indication of biological productivity in summer.
- Spring Overturn Phosphorus: The best method of monitoring long-term trends in phosphorus loading. Phosphorus in early spring (while lake is mixed) indicator of what the biological productivity in the summer might be, as it is a reasonable representation of the summer nutrient supply.
- Orthophosphate: Bioavailable phosphorus.
- Total Nitrogen: Organic N + ammonia + nitrate + nitrite.
- Water Clarity: A Secchi disk is a black and white checkered disk that is lowered into the water column to measure water clarity. As one of the oldest formalized methods of measuring water clarity, taking Secchi depth allows comparisons of current and historic water clarity measurements.
- Dissolved Organic Carbon: In general, organic carbon compounds are a result of decomposition processes from dead organic matter, such as plants or marine organisms. Moreover, dissolved carbon is an indicator of organic loadings in streams, as well as supporting terrestrial processing (e.g., within soil, forests, and wetlands) of organic matter.
- Conductivity: This is an indicator of the concentration of dissolved electrolyte ions in the water. Significant increases in conductivity may be an indicator that polluting discharges have entered the water (good indicator of land disturbance). This is dependent on temp and salinity, as well as water flow and water level changes.