Cultus Lake
Looking at a Lake in Transition

April 2020

Prepared by:
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FRASER VALLEY WATERSHEDS COALITION

Fraser Basin Council

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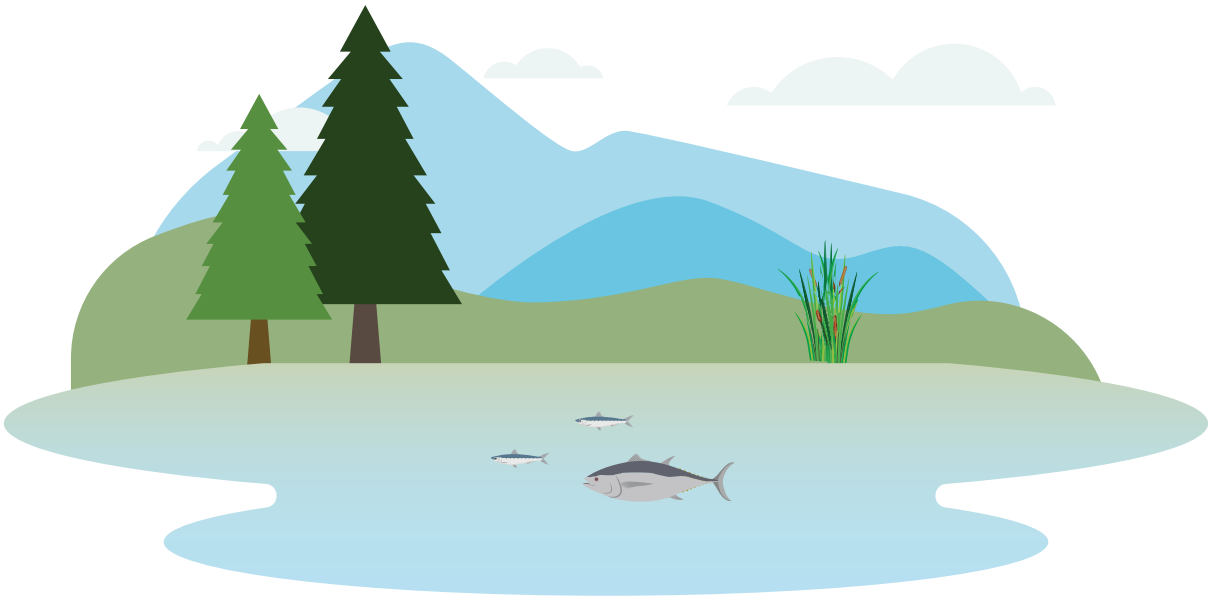
Cultus Lake – A Lake in Transition

A primer on water quality for a bellwether of environmental change in the Fraser Valley – and opportunities for collaboration on regional environmental stewardship



Note: Early in 2020, with funds from the Canada Nature Fund for Species at Risk (CNFASAR), the Fraser Watersheds Coalition (FVWC) joined Fraser Basin Council (FBC) in a partnership to convene a Cultus Lake Summit in March 2020, with FBC facilitating the event. Unexpectedly, the event could not proceed due to the COVID-19 pandemic. Until a similar event can be safely convened, FBC and FVWC opted to provide interested parties with this primer that outlines the issues affecting Cultus Lake, British Columbia, and its ecosystem services.

Introduction

Nestled in the Cascade foothills in the Fraser Valley just an hour from Vancouver, Cultus Lake is one of the Lower Mainland's most beautiful and popular lakes – rightly earning the title "jewel of the Fraser Valley." However, its sunny future may be clouded by cultural eutrophication.

- Excess loading of nitrogen and phosphorus in the lake water as a result of human activities in recent decades has pushed the lake into the early stages of cultural eutrophication – a process that threatens water quality and the viability of the lake for people, and critically, the aquatic ecosystem. There is an urgent need to address the factors that lead to eutrophication in order to preserve the critical habitat that is home to two vulnerable species, the Cultus Lake Pygmy Sculpin and the Cultus Lake Sockeye Salmon.
- Other limiting factors that confront these two species and the Cultus Lake aquatic ecosystem include the their natural predators, ongoing impacts of climate change on lake function that intensify eutrophication, and invasive species like smallmouth bass and Eurasian watermilfoil whose impacts on the overall lake ecosystem are not yet fully understood.
- Cultural eutrophication threatens many lake-derived ecosystem services that provide significant cultural, economic, recreational and health values to surrounding communities. Some actions are planned to reduce the influx of excess nutrients and to manage invasive species, but studies indicate much more must be done. There is excellent potential to build on these efforts, with collaborative relationships among interested parties to develop new programs in the short- and long-term. The Fraser Basin Council and Fraser Valley Watersheds Coalition are focused on developing those relationships in non-adversarial, facilitated settings to review current knowledge, identify data gaps and outline the next steps to benefit the Cultus Lake aquatic ecosystem.

This document reviews key challenges and research findings, and some actions planned to protect the lake's water quality. The goal is to provide interested participants with an understanding of the challenges facing Cultus Lake, and to engage them in exploring what actions to take to preserve its ecosystem. We hope to inspire ongoing participation and collaboration to seek and implement effective, timely and sustainable solutions to the issues identified.

- **A history of collaboration:** Since 2007, FBC has facilitated the Cultus Lake Aquatic Stewardship Strategy (CLASS) in its goal to promote active stewardship in a non-adversarial manner; FVWC supports this valuable work. A network of local citizens, groups and governments, CLASS educates the public about cultural eutrophication in Cultus Lake, the potential impacts on its aquatic ecosystem, and other lake health issues. With CLASS, FBC obtained funding in 2013 from the Fraser Salmon and Watersheds Program (FSWP) and the Canadian Wildlife Federation (CWF) Endangered Species Fund, to support our partner, Fisheries and Oceans Canada's (DFO) Lakes Research Program at the Cultus Lake Salmon Research Laboratory, and allied academic partners to apply an environmental science lens on issues at Cultus Lake, with a study identifying the sources and nutrient loadings to the lake (Putt 2014; Putt et al. 2019). This effort has greatly expanded our knowledge of what stresses this valued ecosystem. CLASS and FBC have leveraged this focus to advance support for key initiatives promoting lake stewardship, including a new septic effluent treatment facility, management of pikeminnow, E. watermilfoil and other invasive species. With Cultus Lake Park Board, CLASS purchased hydro-acoustic software used by DFO technicians to map out lake bottom types, and the spread of Eurasian watermilfoil in the lake.

The Value of Cultus Lake

Cultus Lake is a unique place, providing significant ecosystem services and values including recreation and esthetics, water supply, fisheries, research opportunities, cultural and historical significance, to an array of local and regional interests. Its aquatic ecosystem is under stress from the influx of nutrients (nitrogen and phosphorus), climate change and other pressures.

To sustain the Cultus Lake ecosystem and its services, we must better understand and vigorously respond to the factors leading to its stress, which are largely human-induced and range from the local watershed to regional airshed influences. As such, Cultus Lake provides important insight into the primary drivers of environmental change and aquatic ecosystem degradation across watersheds in the Fraser Valley.

- **Critical Habitat for Species at Risk:** The lake is critical habitat for the diverse flora and fauna that depend on it, in particular two endemic fish species, the Cultus Lake pygmy sculpin (SARA, threatened, COSEWIC, endangered), and Cultus Lake sockeye salmon (COSEWIC, endangered), both of which are unique to the lake and are recognized as being under threat primarily from changing lake habitat conditions, along with other stressors, including climate change and invasive predators.
- **Cultus Lake Pygmy Sculpin (Cottus aleuticus; Coastrange Sculpin, Cultus population):** Endemic to Cultus Lake, the pygmy sculpin has a unique evolutionary lineage distinct from the common Coastrange Sculpin (Cottus aleuticus), a species that typically inhabits creeks and rivers. Evolved to use the lake water column as its critical habitat, the Pygmy Sculpin feeds on zooplankton in mid-depth waters, quite a feat for fish that lack a swim bladder, as they must swim constantly to stay buoyant. Other unique adaptations to its lake habitat include its dwarf body size, lower bone density, high levels of buoyant sub-surface fat, and enlarged sensory pores on the head that likely help it find plankton in the deeper water column. Visual observations and seasonal trapping indicate the Cultus Pygmy Sculpin spends much time in deep water close to lake sediments, rising in the water column to feed. This fish is highly vulnerable to predatory and invasive species. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recently reassessed the Cultus Pygmy Sculpin as endangered, largely due to its limited habitat range and evidence of declining water quality in its critical habitat, identified by DFO's Lakes Research Program. However, more information is needed to fully understand how water quality and other changes further threaten the Cultus Pygmy Sculpin.
- **Cultus Lake Sockeye Salmon:** Cultus Lake Sockeye Salmon are also genetically unique and endemic to the lake. Unlike most sockeye that spawn in streams and rivers, the Cultus Lake population spawns exclusively in the lake. It is among the latest of Fraser River Sockeye Salmon complex to spawn, obliging its young to develop faster. Unlike most Sockeye Salmon fry, they school and move into deeper waters immediately after swimming up from the gravel, likely an adaptation to its many predators in the lake. Studied since the 1920s, this population has dropped precipitously since the 1970s, and continues to face exploitation in other salmon fisheries. It also faces stresses from native predators in the lake and elsewhere, from invasive Smallmouth Bass (Micropterus dolomieu), invasive Eurasian watermilfoil (Myriophyllum spicatum) that impacts spawning areas, climate change, and decreasing oxygen levels in deep water due to nutrient loading.
- **A Bellwether of Regional Environmental and Aquatic Ecosystem Change:** The nutrient impacts at Cultus Lake and more recent invasive species problems provide insight into similar impacts in other freshwater bodies of the Fraser Valley and adjacent montane valleys. Measures to improve nutrient management in soil, water and air – which will reduce nutrient inputs into Cultus Lake from both run-off and significant atmospheric deposition – have beneficial implications for Fraser Valley agricultural sectors, (which generate an astounding $3.1 billion into the provincial economy, Regional Snapshot Series: Agricultural Economy in the Fraser Valley Regional District, 2017), for air quality and human health, and ecosystem health in watersheds in the region. Steps to reduce nutrient loading and invasive species transport at Cultus Lake and elsewhere throughout southern British Columbia will help protect regional aquatic ecosystems, and the ecosystem services benefiting residents, visitors and regional governments.
- **Ts'elxweyeqw Traditional Land:** The lake is in the ancestral, unceded territory of the nearby Soowahlie First Nation and the Ts'elxweyeqw Tribe of the Stö:lō, and has been for millennia. Their cultural imprint endures in the names of Chilliwack, Cultus and Sweltzer Creek, and the lake continues to be an important gathering place for annual canoe races for Indigenous youth and communities. The Ts'elxwéyeqw remind us that respect for nature is woven in their core values: these highlight collaboration, caring for neighbours, youth and future generations, preserving cultural aspects including traditional foods, sustainable resource management, and harmony with and respect for the environment. The Ts'elxweyeqw perspective is this: S'ólh témexw te íkw' eló. Xólhmet te mekw'stám ít kwelát. – This is our land. We have to look after everything that belongs to us.
- **Residential Communities:** In the past century, many newcomers made Cultus Lake their home. The lake now has an estimated 1,400 permanent residents (BC Stats, 2016) to date.

- **Recreation Destination:** Tourism is a significant economic driver for Cultus Lake, with recreational values high both on the lake and within its watershed. Its close proximity as a Lower Mainland recreation destination attracts more than 2 million visitors annually (FVRD, 2011). Cultus Lake Provincial Park saw 747,486 visitors generating $1 million for the province in camping fees alone (BC Parks 2019 statistics), while the regional Cultus Lake Park draws an estimated one million visitors a year. Overall, tourists inject more than an estimated $27 million into local attractions and services at Cultus and the area (FVRD, 2010). (Note: a new FVRD recreation study will be released this year, 2020.)

Cultus Lake and its Ecosystem Services at Risk

A series of studies, including the one below, conducted by Fisheries and Oceans Canada's Lakes Research Program and government and academic partners, demonstrate that Cultus Lake is in an oligo-mesotrophic phase – its water quality has substantially degraded from its natural state, the result of significant nutrient loading from human sources. Left unabated, cumulative nutrient loads threaten the critical habitat and persistence of Cultus Lake's two endemic species at risk (Coastrange sculpin, Cultus population; Cultus Lake sockeye salmon), along with diverse lake-derived ecosystem services. Lake water quality models predict that without nutrient management, Cultus Lake will likely become mesotropic in 25 years, a significant trophic status change in the lake's ecology that is likely to affect its ecosystem services.

Eutrophication forcings on a peri-urban lake ecosystem: Context for integrated watershed to airshed management
(Putt, MacIsaac, Herunter, Cooper, Selbie, 2019)

Water Quality: Lake trophic states refer to thresholds in the level of nutrients, in particular nitrogen (N) and phosphorus (P), and associated productivity of algae and plants. In balance with their natural ecosystem state, N and P are critical nutrients that support aquatic ecosystems. When in excess in any given lake, N and P can significantly transform biological community composition and functioning (i.e. rates of biological productivity), which in turn affect lake ecosystem services. The defined lake trophic states are:

- **Oligotrophic or nutrient-poor** lakes have clear water, few aquatic plants, and ample levels of dissolved oxygen to provide a healthy and stable habitat for fish like trout and salmon.
- **Mesotrophic** waters can remain clear, but have increased levels of nutrients and aquatic plants; clouding of water from algae may be seen under the surface. Some lake areas may have seasonally-reduced levels of oxygen. The water column may or may not be habitable for fish during certain times of the year.
- **Eutrophic or nutrient-rich** waters have abundant plants and algae blooms, and often murky water. As plants and algae die, the decaying process consumes oxygen leaving the water hypoxic (i.e. oxygen poor) to anoxic (i.e. no oxygen), with uninhabitable zones for aquatic life, potentially leading to reduced aquatic biodiversity, fish death and even extirpation. Invasive species suited to low oxygen levels may easily outcompete stressed native inhabitants.
- **Cultural eutrophication** of lakes refers to their artificial enrichment by human-sourced nutrients (i.e. runoff, septic leachate, atmospheric deposition), the associated degradation of water quality and increases in algal growth. Excess nitrogen and phosphorus applied to the land builds up in soils and may be delivered to the lake as runoff, or transported in air (i.e. dust, phase transformation) and deposited directly on to aquatic ecosystems or their watersheds.

Nutrient Loading in Cultus Lake: Building upon historical work within the system, recent studies by DFO's Lakes Research Program and their partners have identified and quantified multiple anthropogenic sources of loadings of nutrients into Cultus Lake. These sources are:

- Atmospheric deposition from the nutrient-contaminated regional airshed;
- Septic leachate and treated effluent from within watershed sources;
- Agricultural run-off from Columbia Valley and its contaminated aquifer;
- Watershed runoff, surface and groundwater;
- Gull guano (from birds that seasonally feed nearby and roost on the lake).

Table 1. The annual total nitrogen and phosphorus loads to Cultus Lake are shown here. Totals for subwatersheds include surface water and groundwater; the total for septic leaching includes Columbia Valley, International Ridge and North Cultus septic areas. Lake outflow exports via Sweltzer Creek are also shown. (Source: Putt et al, 2019)

	Average Annual Load (kg/year)	
Source	**Total Phosphorus (P)**	**Total Nitrogen (N)**
Vedder Mountain (surface and groundwater runoff)	221 (8.1%)	5,978 (11.8%)
International Ridge	305 (11.1%)	7,310 (14.4%)
Smith Falls	209 (7.6%)	2,923 (5.8%)
Columbia Valley	724 (26.4%)	20,643 (40.7%)
Atmospheric Deposition to lake surface wet & dry	124 (4.5%)	8,673 (17.1%)
Migratory Gulls	614 (22.4%)	476 (0.9%)
Septic leaching (total)	523 (19.1%)	4,557 (9.0%)
Sockeye carcasses	23 (0.8%)	191 (0.4%)
Total Load	**2,744 kg/year**	**50,751 kg/year**
Sweltzer Creek Export	-1,258	-21,952
% Retention	54.2%	56.7%

The "tailpipe effect": Fraser Valley Airshed Influences on Cultus Lake and Downwind Aquatic Ecosystems

While there are multiple sources of excess nutrients loaded to Cultus Lake each year, Putt et al. (2019) estimated that atmospheric deposits of N and P are the largest single source of nutrient loading into Cultus, cumulatively responsible for 63% of total N and 42% of total P loadings, annually.

The Cultus Lake watershed sits along the southeastern edge of the lower Fraser River airshed, a geography that forms a funnel, and which appears to capture and concentrate emissions and particulates emanating from urban and agricultural landscapes from Vancouver and Whatcom County to Chilliwack. Nitrogen and phosphorus are deposited on the land and water systems in the Fraser Valley and adjacent montane valleys, including the one occupied by Cultus Lake, impacting their ecology.

The research estimates up to 66% of N and 70% of P in the Cultus Lake watershed runoff is ultimately sourced via deposition from the nutrient-laden regional airshed of the region. This indicates, with western to eastern Fraser Valley scientific evidence, that atmospheric deposition of nutrients and other pollutants has a far-reaching influence, impacting aquatic ecosystems beyond the Cultus Lake watershed.

As such, Cultus Lake is a model ecosystem that is a bellwether of the key aquatic ecosystem drivers within the region, promoting a focal point for monitoring and policy within other watersheds.

Local and Regional Risks of Cultural Eutrophication

Due to the regional distribution of airborne nutrients, Cultus Lake can be seen as a bellwether of excess nutrient impacts on Fraser Valley ecosystems upwind from urban and farming centres.

- Elevated atmospheric deposits of nutrients recorded throughout the Lower Mainland indicate the Cultus study's observations are of broader concern, as urban and agricultural emissions are likely impacting highly valuable aquatic ecosystems across the region.
- Continued eutrophication is expected to negatively impact the ecology of Cultus Lake and its many lake-derived ecosystem services, affecting tourism and impairing local economies. Increased algal and plant growth and associated decreases in water clarity and aesthetics could reduce recreational use, degrade habits, and alter food webs that would severely impair fish persistence and fisheries.

Impact on Vulnerable Species at Risk

The lake serves as critical habitat for two endangered species, the Coastrange Sculpin, Cultus population (Cottus aleuticus), which completes its life history within the lake, and the Cultus Lake Sockeye Salmon (Oncorhynchus nerka), which uses the lake for adult spawning and juvenile rearing. Water quality degradation is known to increase the risk of extinction for both species, with eutrophication having the potential to disrupt physical, biological and chemical aspects of their freshwater habitat. Almost a century of research shows eutrophication-related seasonal deep water oxygen depletion has more than doubled in Cultus Lake since the 1930s, and both species at risk rely significantly on deep, oxygen-rich and benthic habitats to complete critical life functions.

Past, current and future projected nutrient levels in Cultus Lake.

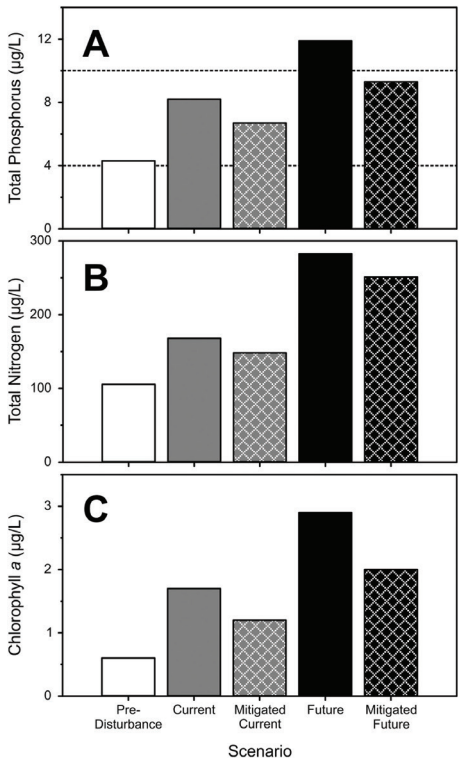


Figure 1: Cultus Lake model results for current epilimnetic water quality parameters A) total phosphorus (TP), B) total nitrogen (TN), and C) chlorophyll-a (grey bars), relative to those prior to significant human influence (white bars), and predicted under an expert-informed future development scenario 25 years in the future (black bars). Also shown, are estimated lake responses to realistic mitigation of current within-watershed nutrient sources (grey bars with hash marks), and the future development scenario with the same mitigations applied (black bars with hash marks). Dotted reference lines in Panel A indicate the Canadian Council of Ministers of Environment thresholds for phosphorus-inferred aquatic system trophic status (lower – ultra-oligotrophy-oligotrophy threshold (4 µg/L TP); upper - oligotrophy-mesotrophy threshold (10 µg/L TP)).

Reducing Nutrient Loading to Cultus Lake

Lake eutrophication is a reversible phenomenon. Reduction of nutrient sources can elicit near-complete water quality recovery in regional systems where local sources comprise the bulk of the loadings (for example, Lake Washington). In particular, a focus on abating phosphorus will lead to the greatest reversals in lake habitat degradation and improve water quality (Putt et al. 2019).

- Lake models indicate reducing loads from the Cultus watershed's three local nutrient sources that are reasonably achievable in the short term (reduced septic -100%, agriculture -50% and gull -45%) will moderately improve water quality in Cultus Lake. This necessary action will slow but not stop lake water quality degradation.
- The two largest sources of nutrients to the lake, direct atmospheric deposition and sub-watershed runoff (heavily influenced by atmospheric deposition), can be mitigated only through longer-term, broader regional nutrient management, beyond the scope of local watershed abatement strategies. Regional phosphorus deposition from the atmosphere, which largely arises from atmospheric transport of particles, most likely arises from soil disturbance and wind erosion on upwind agricultural lands. The hypothesis is that this source may be at least partially mitigated through agricultural soil and waste management (i.e. low tillage, dosed manure application, cover crops, reduction of barn exhausts), which could substantially reduce atmospheric P loading to the regional airshed and aquatic ecosystems.
- An integrated landscape-to-airshed nutrient management approach inclusive and respectful of stakeholders, governments, Indigenous communities and their individual and shared values, will be essential to reduce airshed phosphorus deposition, and to halt or reverse eutrophication trends at Cultus Lake and across the region. Failure to do so could result in significant impacts on cultural and socioeconomic values, lake-derived ecosystem services, and the lake's species at risk.

Nutrients in the Fraser Valley

Nitrogen, phosphorus and other elements crucial for biological metabolic processes cycle through natural ecosystems and generally stay in a sustainable balance, changing the trophic states of aquatic ecosystems (i.e. lakes) very slowly over thousands or even millions of years. However, human activities bring a substantial influx of nutrients that cannot be absorbed by natural systems in a sustainable way – the sharp nutrient increase greatly accelerates changes and rapidly pushes natural systems out of balance (i.e. cultural eutrophication). This human-sourced stress rapidly accelerates the natural progression of trophic state change, hence the term cultural eutrophication. We see the result of these nutrients in the Fraser Valley as algae-clogged streams and sloughs, oxygen-depleted waters limiting fish survival, and hazy skies in the summer. The following two studies calculated budgets for nitrogen (N) and phosphorus (P) for the Fraser Valley (not including atmospheric losses for P) – how much is imported, how much flows out, and what remains. The reviewers conclude that while there are some steps taken to reduce nutrient loss, our systems are poor at recapturing nitrogen and phosphorus efficiently, a common problem seen globally. The studies offer a high level context on the nutrient story in the Fraser Valley.

Phosphorus flows in a peri-urban region with intensive food production: A case study, Bittman, Sheppard, Poon and Hunt (2016)
How efficient is modern peri-urban nitrogen cycling: A case study (Bittman, Sheppard, Poon & Hunt, 2017)

Excess nutrients associated with human activity in the Lower Mainland are derived from several sources. In the Fraser Valley we import nutrients in the form of:

- imported foods (including livestock for consumption) for humans and our pets;
- feed for livestock, which in turn becomes manure;
- fertilizers for crops, forests, nurseries, gardens, lawns and golf courses;
- soaps, toiletries, detergents, industrial products;
- fuels for households, buildings, and marine, air and land transportation.

Crops and other plants take up some N and P, but not enough can be reabsorbed by the ecosystem or recycled sustainably. Excess nitrogen and phosphorus escaping into ecosystems results in polluted air, and polluted water that can become hypoxic or oxygen deprived. Nutrients are lost through:

- runoff into local streams, sloughs, lakes, aquifers and ultimately the Fraser River;
- septic effluent seeping into water ways and ultimately the Fraser River;
- soils – P accumulates in soils, at times leading to soil toxicity, and cannot easily be extracted;
- solid and organic waste that is sequestered in landfills;
- air dissipation, through ammonia (NH_3), nitrogen oxides (NOx) and other gaseous compounds.

Values of nitrogen & phosphorus in the Fraser Valley (Bittman et al., 2017; Bittman et al., 2019)

Source	Annual Influx	Annual Efflux	Per Person Import	Net Annual Import
Nitrogen	41,200 tonnes	32,200 tonnes	3.3 kilograms	9,000 tonnes
Phosphorus	8,560 tonnes	976 tonnes	3.2 kilograms	7,584 tonnes

- Of the 41,200 tonnes of nitrogen that the region imports annually, almost none is returned to the regions of origin. An estimated 32,200t goes into the Fraser River and the ocean as sewage effluent; 10,300t dissipates into the atmosphere; and 9,000t of what is used in agriculture seeps into local waterways.
- Excess P in peri-urban regions (areas outside main urban centres) like the Fraser Valley is an issue globally, while at the same time there is global depletion of mined supplies of phosphorus. Annually, 8,560 tonnes of phosphorus are imported into the lower Fraser Valley. Of that, 976t are exported as food goods or solid waste; regional watersheds retain 7,584t; and another 1,500t is lost to landfills where it is no longer accessible as a crop nutrient.

Evolving farm practices and emerging technologies may mitigate phosphorus imbalances. However, current waste management policies (composting, exporting biosolids to range land) also do little to recapture P or return it to regions that originally produced the feed and food we import. Solutions are needed to reduce or stop environmental degradation, and to protect imperiled food security here and around the planet.

Works in progress

The current trajectory toward eutrophication is not inevitable. We can halt and even reverse its progress, if we work together to reduce the regional nutrient load to create a sustainable environment. In fact, there is significant momentum on which to build. Various jurisdictions have begun or plan actions to reduce nutrient loading into Cultus Lake and regional ecosystems. Some examples are:

- **Ongoing DFO Lakes Research Program: Monitoring and Research** includes monthly physical, chemical and biological monitoring of the lake ecosystem (2009 to present); multiple sub-annual hydro-acoustic and trawl surveys for juvenile Sockeye Salmon; species at risk monitoring and research on the Cultus Lake Pygmy Sculpin, its ecology and threats to persistence; providing the science for federal listing process of Sockeye Salmon. Predictive lake modeling of climate change impacts and interactions is ongoing. Much of this research builds upon a unique history of federal research on Cultus Lake and its Sockeye Salmon, dating to the 1920s (origins of the modern Cultus Lake Salmon Research Laboratory).
- **Water quality monitoring.** Cultus Lake Aquatic Stewardship Strategy (CLASS) began Secchi disc readings in 2019 to monitor lake water clarity changes associated with changing trophic states. Readings ranged from 3.8m (July) to 10m (September); this data goes to the BC Lake Stewardship Society for its province-wide climate change and eutrophication research on lakes. Readings continue in 2020.

- **Agricultural Environmental Management Code of Practice.** New 2019 provincial agricultural waste regulations are driving innovation. The dairy sector, for example, is testing a BC-made dewatering centrifugal technology to extract 40-60% of the phosphorus from raw dairy manure. The intent is to reduce local P build-up in soil and ease its transport off the farm. (*BC-made Nutrient Management Tool offers Dairy Farmers New Solution:* bit.ly/3bu4mcp). Manures may also be reconsidered for use in berry fields, instead of importing phosphorus. Poultry feeds are modified to reduce phosphorus in waste; researchers test cover crops to protect soils from winter winds.
- **Cultus Lake Liquid Waste Treatment Facility.** The FVRD and Cultus Lake Park approved plans in 2018 for a new wastewater treatment facility for the lake community with Class A+ level technology that can remove more than 90% of N and P from septic waste. Treated effluent currently piped into the lake will be diverted into the ground for further attenuation. BC Parks is expected to link into the new system as its septic facility ages out. A new facility at the lake's south end must also have Class A+ standards. FVRD recognizes "the value of Cultus Lake and the importance of protecting this sensitive environment with long-term solutions to ensure its sustainability." (https://www.fvrd.ca/EN/main/services/sewer-septic/projects/cultus-lake-sewer-upgrade.html)
- **Organic waste diversion.** Gulls deposit phosphorus, a powerful driver of eutrophication, in their feces in and around the lake. In May 2019 the City of Chilliwack began covering organic wastes at Bailey landfill, and in 2020, the City and Fraser Valley Regional District expanded compostable waste diversion from landfills. Reducing these nearby food sources may reduce the number of gulls that roost on Cultus Lake overnight in winter months, but this remains to be seen.
- **Invasive smallmouth bass.** Fisheries and Oceans Canada (CNF-ASAR) provided the Ministry of Environment and Climate Change a four-year grant to research and potentially eradicate Smallmouth Bass, a significant predator of Cultus Lake juvenile Sockeye Salmon and possibly Cultus Lake Pygmy Sculpin. An annual harvest and fishing derby help reduce another predator, the pikeminnow. CLASS provides support to these efforts.
- **Invasive mussels.** The Fraser Valley Invasive Species Society conducted zebra and quagga mussel larvae monitoring in 2019 and resumes the water testing this year. The BC Invasive Species Council promotes its Invasive-Wise Marina program in the community and to boaters to prevent their introduction.
- **Invasive Plants.** Cultus Lake Park Board (CLPB) and FVRD tested benthic mats to reduce Eurasian watermilfoil in 2017. CLPB continues to use benthic mats to reduce invasive milfoil at the north end of the lake, the outlet, used seasonally by Sockeye Salmon.

Next Steps – Enhancing Collaboration on Cultus Lake

Cultus Lake faces increased nutrient loading from sources in its watershed and from the wider Fraser Valley region, with the potential to rapidly degrade lake water quality if not actively managed. The factors are complex and multifaceted, and require a multi-dimensional, science-based and collaborative response as we take our next steps.

However, clear sources can and need to be addressed, and have been defined for Cultus Lake. It's vital that those who can contribute to the reduction of nutrient loading to Cultus and the region – biologists, soil and nutrient management and air quality specialists, representatives from First Nations, local governments, regional ministry offices, agricultural and community groups – have a clear understanding of regional nutrient management practices, new approaches on the horizon, and how these impact Cultus Lake and nearby watersheds.

Collaborative relationships are needed to share information, identify knowledge gaps, and develop appropriate responses for Cultus and Fraser ecosystems and communities.

Consider what's at stake.

- Cultus Lake is highly valued – and vulnerable. If nutrient loading and water quality degradation remains unabated, the result could be significant environmental, economic, recreational and cultural losses for the region.
- Consider future generations. It is our collective responsibility to ensure continued and sustainable biodiversity in the lake and a clean, healing environment for people today and tomorrow. As the Ts'elxweyeqw understand, Xólhmet te mekw'stám ít kwelát – "We have to look after everything that looks after, and sustains, us."
- The postponed summit drew keen interest from experts in diverse sectors and disciplines who were eager to learn the latest information on water quality in Cultus Lake and to share their ideas to support its recovery. This primer and the accompanying technical document prepared by the scheduled keynote presenter, Dr. Daniel Selbie, Fisheries and Oceans Canada, Science Branch, Lakes Research Program, will go to interested groups to inspire participation in a future summit, once permitted to do so.
- Building on its history at Cultus Lake, FBC continues to explore potential partnerships and collaborative work to address the causes of cultural eutrophication in a timely manner. FBC seeks partners to engage in inclusive, non-adversarial participation at a safe table for mutually beneficial collaboration. Next steps may include in-person or remote discussions to identify practical on the ground measures.

Opportunities to Be Involved

Everyone who lives, works or plays near Cultus Lake has a role to play in its future. We invite you to learn about opportunities to be involved. For more on this initiative at **www.fraserbasin.bc.ca/fvr.html**

To receive updates and more information, please contact us at:

- Natashia Cox, Fraser Valley Watersheds Coalition, Program Director, natashia@fvwc.ca
- Christina Toth, FBC assistant regional manager, ctoth@fraserbasin.bc.ca

Fraser Basin Council

Fraser Basin Council (FBC) is a charitable non-profit organization that brings people together to advance sustainability in the Fraser River Basin and throughout British Columbia.

Fraser Valley Watersheds Coalition

Fraser Valley Watersheds Coalition (FVWC) is a registered charity that believes healthy watersheds provide the foundation for healthy communities. FVWC connects local stewardship groups, senior governments, local governments, First Nations and residents interested in working towards healthy watersheds in the Fraser Valley Regional District. Contact: Natashia Cox, FVWC program director, ncox@fvwc.ca

Canada Nature Fund for Aquatic Species at Risk (CNFASAR) is part of Canada's Nature Initiative launched in May 2018 to provide $55 million over five years to support projects that help recover aquatic species at risk, through targeted activities that address priority threats and places. The program is funded through Fisheries and Oceans Canada, which safeguards and manages Canada's fisheries, oceans and freshwater resources.

Appendix A – Supporting studies

Eutrophication forcings on a peri-urban lake ecosystem: Context for integrated watershed to airshed management (Putt, MacIsaac, Herunter, Cooper, Selbie, 2019)

How efficient is modern peri-urban nitrogen cycling: A case study Bittman, Sheppard, Poon and Hunt (2017)

Phosphorus flows in a peri-urban region with intensive food production: A case study, Bittman, Sheppard, Poon and Hunt (2016)

http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2020/2020_011-eng.html (Summary on Cultus Lake Sockeye Salmon Recovery Potential Assessment, DFO 2020)

http://www.rmbel.info/primer/lake-trophic-states-2/ (Lake tropic definitions)

Acronyms

CLPB – Cultus Lake Park Board

CNFASAR – Canada Nature Fund for Aquatic Species at Risk

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

DFO – Fisheries and Oceans Canada

FBC – Fraser Basin Council

FVRD – Fraser Valley Regional District

FVWC – Fraser Valley Watersheds Coalition

SARA – Species At Risk Act

Cover photo: Chilliwack River Hatchery (Department of Fisheries & Oceans Canada) display tank of live juvenile salmon and steelhead, at the 2019 Cultus Lake Pikeminnow Derby – Christina Toth photo.

FRASER VALLEY WATERSHEDS COALITION

Fraser Basin Council

Canada