

FINAL REPORT:

Hatzic Lake Management Plan

PREPARED FOR:

BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
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www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

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1. INTRODUCTION

In March 2019, the BC Ministry of Forest, Lands, Natural Resource Operation and Rural Development (FLNRORD) entered into a partnership agreement with the Fraser Valley Regional District (FVRD) to provide funding for the development of a management plan for Hatzic Lake with cross-government (local, provincial, federal and First Nations) and community input. The intent of the management plan is to achieve a healthy, functioning lake ecosystem.

In July 2019, Clear Course Consulting Ltd. was retained to facilitate engagement and to develop a management plan for Hatzic Lake. The plan was developed through a comprehensive background review of existing documentation along with agency, partner, and community engagement. Through this review, several issues were identified, the causes for those issues were explored, and a vision for Hatzic Lake was developed. This management plan reflects what was learned through this process in an Action Plan that aims to achieve the vision for Hatzic Lake.

Goals

The goals of the management plan are to:

1. identify the desired conditions of Hatzic Lake;
2. clearly define the issues affecting the health of Hatzic Lake;
3. compile a single reference for data collection, analysis and reporting on the system to date;
4. develop pathways to solving issues in the short- and long-term;
5. define legislated responsibilities for tackling the issues identified; and
6. develop a process to work collaboratively among decision-makers, stakeholders, agencies, and other interested parties.

About Hatzic Lake

The Hatzic Lake watershed is a complex system with a variety of interrelated issues. The geographic scope of the plan includes Hatzic Lake and downstream through Lower Hatzic Slough to the Fraser River (referred to as the Hatzic Lake catchment). It also includes consideration of the primary tributaries feeding into Hatzic Lake—such as (but not limited to) Upper Hatzic Slough, Legace Creek, and Chilqua Slough—and, specifically, how these tributaries affect the health of the Hatzic Lake ecosystem. It is well understood that upstream watershed activities have the

potential to affect the lake; those activities have been identified and included. Specific actions related to upstream habitats were not explored within the scope of this plan.

Hatzic Lake is an oxbow lake that adjoins the Fraser River to its south and is located on the east side of Mission, BC, within the Fraser Valley Regional District (FVRD) and the Traditional Territories of the Leq'á:mel and Semá:th First Nations. Located near the centre of the lake is Hatzic Island, a densely populated, low-lying land mass that is approximately 2.6 km in length and is accessed by road from the southwest end of the lake. Both Hatzic Island and Hatzic Prairie lie within the Fraser River floodplain (Golder, 2006) and are susceptible to localized flooding (FVRD, 2006). At the north end of Hatzic Lake there are three farming communities, Hatzic Prairie, Durieu, and McConnell Creek that together form part of the Hatzic Valley and the lake's catchment area. Also, located at the south end of the lake are industrial lands including a log sort along the Lower Hatzic Slough.

Over the past 100 years, many issues have impacted Hatzic Lake, including residential, arable, and industrial land development, extreme weather events, water level management of the lake, the introduction of invasive species, and climate change. Furthermore, as Hatzic Lake is an oxbow lake that has evolved from the meandering of the Fraser River, and its natural tendency—in the absence of human intervention—is to eventually fill with sediment and more closely represent a wetland. This succession is exasperated by sediment deposition occurring from upper watershed erosion mobilized by heavy rain.

A detailed description of the background of Hatzic Lake has been presented in a number of documents, including: Magwood, 2005; FVRD, 2006; Associated Engineering, 1992; Urban Systems, 2019; and Drinnan, 1975. Summaries of these reports, as well as other documents important to the development of the Action Plan, are presented in further detail in Appendix A.

2. ISSUES & CAUSES

As identified during the background review and engagement, the top nine issues that are directly related to the health of Hatzic Lake are:

1. Lake Volume
2. Sedimentation
3. Water Quality
4. Threatened Valued Species (including species at risk)
5. Invasive Species
6. Indigenous Land & Resource Management
7. Recreation
8. Natural Resource Development (e.g., agriculture, mining, and forestry)
9. Governance

This section discusses the causes associated with these top issues and how they directly impact the health of Hatzic Lake.

The Action Plan (refer to Section 3) identifies actions that address each of these issues in an effort to meet the vision statement for Hatzic Lake:

Hatzic Lake is a healthy ecosystem that sustains valued species, resists invasive species, and supports cultural, recreational, and sustainable uses.

ISSUE 1: Lake Volume

Hydrologically, the Hatzic Lake watershed is a complex interaction of overland flow from upstream mountainous areas, groundwater influence connected into large aquifers, and tidal and backwater effects from the Fraser River. The hydrological interactions can be challenging to manage due to land-use constraints that can exasperate negative effects from seasonal high-water, drought, and floods. Land-use constraints include urban development, agriculture, and transportation corridors such as highways and railways.

Since 1948, the Dewdney Area Improvement District (DAID) (which operated as the Dewdney Diking District until the Improvement District was formed in 1972) has been managing water levels for flood protection through the operation of a pump station located between Hatzic Lake and the Fraser River. For the past several years, DAID has expanded their water management role to support recreational use on the lake throughout the summer. This is enabled through a

short-term use water license authorized by the Province. Appendix H shows Hatzic Lake during high and low water periods, demonstrating the variability in lake volume.

The following is a summary of causes of fluctuating lake volume in Hatzic Lake.

Table 1 – Causes of fluctuating lake volume in Hatzic Lake

Cause	Description
a) Flood	Hatzic Lake is protected from flooding from the Fraser River by an extensive diking network, flood gates, and pump stations. This infrastructure is managed by the Dewdney Area Improvement District (DAID). An excellent description of the flood protection system is provided in the <i>Operational Manual – Hatzic Lake Slide Gates</i> (LECL, 2014). Since the installation of the flood protection system in the late 1940’s, there has been no significant flooding from the Fraser River (Bendle, 2018). However, Hatzic Lake and Hatzic Prairie residents have experienced flooding due to large precipitation events and seasonal run-off impacting homes and properties.
b) Drought	According to the <i>Strategic Climate Risk Assessment for BC</i> (MOECCS, 2019c), future seasonal water shortages resulting in drought is considered a moderate-high risk event with a high likelihood of occurrence in any given year. This will result in extreme consequences, including effects on drinking water quality, ecosystem health, community water supply, and risk to water-dependent industries such as agriculture. Drought response is initiated through various government agencies, technical working groups, and regional drought teams (MOECCS, 2018). The low water and high temperatures seen in 2018 at Hatzic Lake had consequences for recreational use and resulted in fish die-offs (including federally listed species-at-risk, white sturgeon, <i>Acipenser transmontanus</i>) and subsequent algae blooms had negative implications for human health. Plants, such as flowering rush (<i>Butomus umbellatus</i>), can thrive in warm water and are not susceptible to periodic drying, though they cannot survive without being periodically inundated. Dense stands of invasive aquatic plants, such as Eurasian watermilfoil (<i>Myriophyllum spicatum</i>), can affect water quality during periods of drought by creating hypoxic conditions from die-off (Shultz & Dibble, 2012). In addition, low water levels encourage concentrations of invasive plant species that, in turn, support habitats beneficial to invasive fish (e.g., pumpkinseed, black crappie, largemouth bass, carp, and brown bullhead). This further displaces native fish such as salmon and trout (Madrone, 2018).
c) Managing water for recreational use	Hatzic Lake water levels are managed at the Fraser River Dike where the flood control infrastructure consists of flap valves, pump stations, and slide gates. For 2018 and 2019, FVRD was issued a Short-term Use permit by FLNRORD (under the <i>Water Sustainability Act</i>) and appointed DAID as the authorized operator of this infrastructure for the purpose of retaining water at the flood gates. The primary function of the flood control infrastructure is to protect upstream property, transportation corridors, and other valuable assets from flooding. More recently, this infrastructure has been used to maintain lake levels in the summer for recreational activity by closing the slide gates and using pumps to move water out of Hatzic Slough into the Fraser River. This restricts the interchange of tidally influenced water from the Fraser River into Hatzic Lake. This is thought to maintain clarity for aesthetic purposes. Refer to Urban Systems, 2020, for a complete description of how water levels are managed.

ISSUE 2: Sedimentation

Sedimentation is an ongoing process of erosion, transportation, and deposition of material into a waterbody. This is a natural process that can be negatively accelerated through anthropogenic (human-caused) activities and can increase during periods of heavy precipitation. Sedimentation in a water catchment, like Hatzic Lake, can accelerate the successional process of transforming an oxbow lake into a wetland. Sedimentation increases flood risk by reducing volume capacity of the lake resulting in overtopping of banks and inundation of land, properties, and homes. The following is a summary of causes of sedimentation in Hatzic Lake.

Table 2 – Causes of sedimentation in Hatzic Lake

Cause	Description
a) Natural Erosion	The steep-sloped south coast mountains, such as the those in the upper Hatzic Lake watershed, can be extremely unstable and cause natural failures such as bedrock slides, rock falls, embankment failures, and debris slumps and flows.
b) Accelerated erosion due to anthropogenic activities (e.g., forestry, agriculture, and transportation)	Natural erosion processes can be accelerated due to anthropogenic activities such as forestry, mining, agriculture, recreational activities, and other human interventions. For example, road building for forestry, linear developments (e.g., highways and powerlines), and recreational use can cause destabilizations that lead to slumps, slides, and failures which then increase the mobilization of upstream sediments to the lower watershed. In addition, the removal of streamside (riparian) vegetation for agriculture and urban development can further accelerate localized erosion and increase the susceptibility of failure during high flows. Dense, single species stands—such as infestations of invasive flowering rush—can contribute to sedimentation by reducing flow and increasing sediment accretion around plant roots.

ISSUE 3: Water Quality

Water quality is a measure of the health of an aquatic ecosystem. Good water quality supports the ecological and biological processes on which species depend. To evaluate the health of a system, water quality monitoring is used to understand biological communities, physical characteristics, and chemical properties of a water body.

Poor water quality can be identified when one or more parameters fall outside the normal range of expected results. Provincial guidelines outline the appropriate range of water quality parameters for the protection of aquatic life (MOECCS, 2019a) and for recreational use (MOECCS, 2019b), both of which apply to Hatzic Lake. When water quality parameters are outside of their normal range, e.g., excess nitrogen or phosphorus, this can create ideal conditions for plants to colonize and thrive, including invasive species. Accelerated annual plant growth, which is seen

with prolific species like flowering rush, results in an excess of biomass decomposition in the fall and can further negatively affect water quality. When water quality is considered poor, aquatic conditions are less suitable for native fish species such as salmon and sturgeon. This allows non-native invasive fish species to flourish as they are generally more tolerant of poor water quality parameters, including high temperatures and lower oxygen levels. It also creates conditions conducive to algal blooms (e.g., cyanobacteria or blue green algae) which can negatively affect recreational use and impact human, pet, and livestock health. The following is a summary of causes of poor water quality in Hatzic Lake.

Table 3 – Causes of poor water quality in Hatzic Lake

Cause	Description
a) Extended periods of hot and dry weather	Many of the streams and rivers in coastal BC are cold water systems originating from snow melt and ground water (which is generally cooler than surface water). Cold water is more oxygenated than warm water and necessary for many of the life stages of native fish and amphibians. Hot and dry summers exacerbate water quality issues with a reduction in cool freshwater inputs causing warming waters.
b) Restricted Fraser River flows entering Hatzic Lake	The interchange of water from the Fraser River into Hatzic Lake is an important contributor of cool, turbid water that will create better water quality conditions (i.e., cooler) for native species such as salmon and sturgeon (Urban Systems, 2020). It also creates conditions which can limit the growth of invasive species, such as Eurasian watermilfoil, by reducing light penetration to the root systems (Madrone, 2018).
c) Point source pollution	Point source pollution enters Hatzic Lake from existing storm drains, run-off pipes, drainage channels, and residential drainage. These are known, direct, end-of-pipe sources that contribute to water quality declines by introducing a variety of contaminants, including fertilizers, pathogens, chemicals, and other contaminants. These known end-of-pipe sources can be identified, monitored, and assessed to ensure they are not contributing to declining water quality.
d) Non-point source pollution	Non-point source pollution originates from different sources over time and is associated with a range of land development activities. This type of pollution can be considered a “wicked problem”, as defined by Rittle and Webber (1973), because it is difficult to define the actual problem; there isn’t one specific action responsible for the impact; there are no clear pathways to resolve the issue; management is cross-jurisdictional; and, there are no tested solutions. In the case of Hatzic Lake, non-point source pollution is caused by activities such as urbanization, agriculture, stormwater, septic systems, forestry, and atmospheric deposition (BCMELP, 1999). Shallow ground water and improperly installed or maintained septic fields may also be a significant cause of amounts of nitrate in the system (George, 1983; Magwood, 2004; FVRD, 2006).
e) Loss of riparian habitat	Riparian areas provide several important benefits to aquatic fish habitat, including the supply of nutrients, contributing fish habitat, shoreline stabilization, maintaining stable thermal regimes through cover, and intercepting sediment (Naiman et al., 2000; Richardson, 2004). As with many residential lakeshores, the removal and alteration of natural riparian areas is extensive throughout Hatzic Lake catchment.

Cause	Description
f) Invasive aquatic species	Single species stands of invasive aquatic plants—that thrive in poor quality water—can spread rapidly and increase organic decomposition. They also cause, or contribute towards: increased nutrient levels; decreased oxygen levels in the water; eutrophication; increased water temperatures as dense stands reduce water flows; increase accretion; and, increased suspended solids in the water column.

ISSUE 4: Threatened Valued Species

Valued species at Hatzic Lake include all fish and wildlife species of importance to residents, visitors, land managers and Indigenous communities. There are a variety of valued species at Hatzic Lake, including birds, amphibians, and fish. Valued species include species-at-risk such as White Sturgeon (*Acipenser transmontanus*) and species under review for being at risk such as Pacific Salmon (*Onchorhynchus sp.*). The federal *Species at Risk Act* (SARA) identifies and develops strategies to protect fish and wildlife species that are at risk of becoming extinct, endangered, or extirpated.

Although plant species composition is well-documented at Hatzic Lake and there has been some effort to identify fish species (Urban Systems, 2020), species composition and population density has not been explicitly confirmed.

It is recognized that some invasive fish species are valued for recreational and subsistence fishing; however, this component of use has not been addressed in the plan.

The following is a summary of causes of the decline of valued species at Hatzic Lake.

Table 4 – Causes of the decline of valued species at Hatzic Lake

Cause	Description
a) Habitat destruction and alteration	Habitat for valued species is the physical conditions required to fulfill their life stage processes, including water quality. This habitat can be negatively affected by a number of pathways, including outright destruction (e.g., infilling), alteration (e.g., importing sand for beaches), and disruption (e.g., blocking migration routes).
b) Invasive Species	Both aquatic and terrestrial invasive plants and animals have a detrimental effect on valued species by altering habitat, predation and by outcompeting for limited habitat and food resources.
c) Lack of current species data	A thorough native and invasive aquatic plant inventory has been completed for the lake, including regular inventories of invasive flowering rush. Undertaking complete non-plant species inventories are technically complex and expensive. In systems like Hatzic Lake, assumptions have been made about species composition based on provincial data, anecdotal data, and local knowledge. These uncertainties can negatively affect valued species management.

Invasive species include both plants and animals that are not native to the region and have been primarily introduced inadvertently through vectors such as horticultural and pet trade and boat ballasts. Invasive plants can spread rapidly, invading ecosystems with no natural predators while displacing and out-competing native plants and animals. Risks from invasive species have been summarized succinctly by the Sea-to-Sky Invasive Species Council:

“Second only to habitat loss, invasive plants and animals have been identified as the most significant threat to biodiversity. Invasive plants can alter water flow and lead to erosion or a reduction in available water, create and increase fire hazards, damage roads and other built structures, contain substances that are toxic to humans and animals, and reduce crop yields.” (SSISC, 2015)

Aquatic invasive species management, including inventorying invasive plant and animal populations, can be complex and expensive. Water quality, water levels, phenology, regulated control measures, inventorying and monitoring, public education, and the legislated responsibilities of governing agencies are all important factors in preventing the spread and coordinating the control and removal of invasive species. Several problematic aquatic invasive species are thriving at Hatzic Lake, including flowering rush, Eurasian watermilfoil, bullfrogs (*Lithobates catesbeianus*), and several species of non-native fish, such as black crappie (*Pomoxis nigromaculatus*), pumpkinseed (*Lepomis gibbosus*) and large-mouth bass (*Micropterus salmoides*). Flowering rush is a candidate for eradication province-wide and a high priority for the Province to manage in Hatzic Lake, therefore, additional information has been provided in Appendix F. The following is a summary of causes of the colonization of invasive species at Hatzic Lake.

Table 5 – Causes of the colonization of invasive species at Hatzic Lake

Cause	Description
a) Ideal water conditions for invasive species colonization	Hatzic Lake is showing signs of natural and anthropogenic eutrophication (i.e., increased lake productivity due to higher input of nutrients) and the potential for internal nutrient loading (Thomson, 2020). These nutrient inputs can originate from sources such as high numbers of waterfowl, septic systems, and fertilizers. Similar to fertilizing a garden, this nutrient rich eutrophic condition allows for strong plant establishment and prolific spread, especially for certain invasive species such as flowering rush. Unfortunately, Hatzic Lake provides ideal habitats and water quality conditions for invasive species colonization.
b) Lack of public awareness	As with many invasive species, the lack of public awareness is a key vector for distribution of invasive plants. Inadvertent transfer through recreational use can help spread the reproductive parts within a system and from one lake to another. Some plants are introduced unintentionally by gardeners who may not know that many invasive plants do

Cause	Description
	not have natural predators or pathogens and they can spread very quickly. Some invasive plants are still sold in local nurseries.
c) Recreational and residential use	Aquatic invasive species, such as flowering rush and Eurasian watermilfoil, are easily propagated from plant fragments. Motorized boats can cut plant fragments when they are operated in heavily infested areas and waves, created by the vessels, and can dislodge entire plants from the substrate. These dislodged plants and plant fragments can establish new local populations or can be transported easily to another waterbody. Motorboats and wave action can also disturb sediments that re-mobilize excessive nutrients, degrade water quality, and increase the amount of nutrients available for invasive species.

ISSUE 6: Indigenous Land & Resource Management

Indigenous People are intrinsically connected to their Traditional Territories. For Indigenous People, the land shapes language, culture, and self-identity while also providing the necessities for life. Hatzic Lake watershed is within the ancestral lands and shared Traditional Territories of several Indigenous communities.

First Nations need to be meaningfully engaged in order to honour Aboriginal Title. Furthermore, in 2019, the Province of British Columbia formalized a path that works towards reconciliation by passing legislation to implement the *Declaration on the Rights of Indigenous People Act* building on the United Nations Declaration on the Rights of Indigenous People (UNDRIP). To participate in reconciliation and recognize Aboriginal Title, it is imperative that the Indigenous communities are included in lake management under the framework of free, prior, and informed consent.

Leq'á:mel and Semá:th First Nations have been actively participating in Hatzic Lake management as part of the project team. These government-to-government relationships are being strengthened and prioritized and will lead to a beneficial and collaborative approach to lake management. The following is a summary of Indigenous land and resource management challenges.

Table 6 – Indigenous land and resource management challenges

Cause	Description
a) Restricted/limited access	There are currently restrictions on access to land within Traditional Territories by locked gates and entry refusal without an escort. This is essentially blocking access to land First Nations have the right to access.
b) Limited integration into the planning	Indigenous communities have been engaged in this planning process for Hatzic Lake watershed since 2018. Future planning processes for Hatzic Lake watershed requires ongoing and meaningful free, prior and informed consent with all Indigenous communities where their jurisdictional boundaries overlap with Hatzic Lake.

c) Lack of awareness	There is a lack of understanding by some about the difference between Traditional Territory and First Nation reserve lands, as well as the legislated rights of Indigenous People.
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ISSUE 7: Recreation

Recreational activities are an important consideration for Hatzic Lake, especially for local area residents. There are also economic considerations at Hatzic Lake, including Camp Luther that operates camps for children on the shores of the lake. Recreational activities include fishing, boating, kayaking, canoeing, paddle-boarding, and swimming. No areas of the lake have restricted use; however, day-users have limited shoreline access or no public boat ramp access. The following is a summary of causes of limits to recreational enjoyment at Hatzic Lake.

Table 7 – Causes of limits to recreational enjoyment to Hatzic Lake

Cause	Description
a) Invasive Species	Invasive species can impact water visibility and reduce the natural occurrence and abundance of native aquatic and terrestrial species. For example, Eurasian watermilfoil can form dense mats that adversely impact recreational activities such as boating, water-skiing, paddle-boarding, kayaking, and swimming. Flowering rush can form dense stands on shorelines that negatively impacts shoreline access. Invasive aquatic species can also alter ecosystem composition and displace native species, in turn, affecting fishing and other harvesting activities.
b) Water levels	Many lake activities, such as boating and non-motorized water sports, require stable water levels. Hatzic Lake is prone to both low water and flooding. Low water can impact water quality as it provides a favourable environment for algal blooms and concentrations of toxins. Flooding also impacts beaches and waterfronts by restricting access and damaging infrastructure.
c) Water Quality	Recreational enjoyment of Hatzic Lake can be severely impacted by water quality. While algal blooms are a naturally occurring event and not necessarily harmful to human health, some algal blooms, such as cyanobacteria blooms (blue-green algae), are a public safety concern and can result in water body closures (which has occurred at Hatzic Lake). Algal blooms also affect lake esthetics as they can change lake colour and smell. Nutrient inputs from upstream agriculture and sewer discharge contribute towards decreased water quality and impacts on recreational use.
d) Safety	A wide array of recreational users enjoy Hatzic Lake for activities such as water-skiing, fishing, and general boating. Unfortunately, motorized water sports can conflict with non-motorized lake activities and can result in bodily harm or death. This risk increases when the area for recreation use decreases (e.g., low water levels, watermilfoil) and there is poor visibility caused by invasive species.

ISSUE 8: Natural Resource Development

Natural resources are considered products that can be produced from the manipulation of the natural environment—including land and water that is suitable for industries such as agriculture, mining, forestry, and hydroelectric operations (Black et al., 2020). These types of resource developments are important drivers of economic viability of communities; however, these activities can cause a variety of impacts within the watershed. The following is a summary of causes of impacts due to natural resource development.

Table 8 – Causes of impacts due to natural resource development

Cause	Description
a) Habitat destruction and alteration	Habitat destruction and alteration, resulting from resource development, can negatively affect Hatzic Lake through pathways including outright destruction (e.g., blasting and road building), alteration (e.g., cutting forests for crop plantations), and disruption (e.g., ditching). This destruction, alteration, and disruption can increase susceptibility to secondary effects including bank destabilization caused by increased sedimentation downstream.
b) Negative effects on water quality	Run-off from the natural resource development sites can cause point and non-point source pollution affecting downstream habitat (refer to Issue 3: Water Quality).

ISSUE 9: Governance

There are several local government boundaries that divide the Hatzic Lake catchment, including two areas within Fraser Valley Regional District (Electoral Area F and Electoral Area G) and an area within the District of Mission. In addition, there are overlapping legislations governing both land and aquatic habitat. For example, Hatzic Lake is considered a public waterway and is therefore governed by provincial legislation. Authority to manage lake levels has been appointed to DAID; they are also responsible for “dyking and drainage of the land and the construction, acquisition, maintenance and operation of works for those purposes and all things incidental thereto” (BC Gazette, 1972). Species are managed by the federal government and riparian areas fall within local government jurisdiction. Linear corridors, including railways and highways, have their own right-of-way and jurisdictional rights within Hatzic Lake drainage. The Hatzic Lake catchment is also within the Traditional Territory of several First Nations.

Over the past several years, the FVRD has developed numerous strategies and policy documents with direct links to many of the areas addressed in this management plan. This includes environmental stewardship, flood and water quality management, and recreation planning. Appendix C summarizes applicable FVRD documents that have relevance to this management

plan and Appendix D summarizes applicable provincial and federal oversight for Hatzic Lake. The following is a summary of challenges with governance.

Table 9 – Challenges with governance

Cause	Description
<p>a) Multiple land managers with potentially conflicting mandates and no single over-arching governing body.</p>	<p>With regards to governance, Hatzic Lake is a complex system. To adequately address all the issues outlined in this report it would require significant resources, including funding, staff time and expertise, specialized consultants, and capital investment. This can be challenging to manage for any one level of government given the overlapping, multi-jurisdictional boundaries. Implementation of initiatives can be further slowed by bureaucratic processes (e.g., permitting) and conflicting mandates.</p>

3. ACTION PLAN

This Action Plan identifies actions that address the nine issues impacting the health of Hatzic Lake (refer to Section 2). Actions were developed based on recommendations by subject matter experts, community feedback, legislation, best management practices, and research. Actions are categorized by implementation timeline, i.e., quick wins, short-term, and long-term actions. Although many of the actions identified are complex, they are intended to be implementable. Reviewing and determining the feasibility, appropriateness, and priority of the actions that are recommended in this management plan is an iterative and collaborative process. Further work is required to ensure the timing and assigned responsibilities are appropriate and that there are clear benchmarks to gauge project success. The lead for each action item may change depending on available funding and priorities. New issues and actions may arise over time and should be considered by the lead organizations (with input from the community, if appropriate) and incorporated into the Action Plan.

Vision Statement

Hatzic Lake is a healthy ecosystem that sustains valued species, resists invasive species and supports cultural, recreational, and sustainable uses.

Action Plan Key

Lead	AGRI	BC Ministry of Agriculture	FVRD	Fraser Valley Regional District	
Abbreviations:	DAID	Dewdney Area Improvement District	HLIS	Hatzic Lake Improvement Society	
	DFO	Fisheries & Oceans Canada	LN	Leq'á:mel First Nation	
	ENV	BC Ministry of Environment & Climate Change Strategy	NGO	Non-government organization/community group with support from government agencies	
	ENV-IS	ENV Invasive Species (Non-Plants)	SN	Semà:th First Nation	
	ENV-W	ENV Water Quality			
	FH	Fraser Health			
	FLNRORD	BC Ministry of Forestry, Lands, Natural Resource Operations & Rural Development			
	FLNRORD-F	FLNRORD Forest Stewardship			
	FLNRORD-FS	FLNRORD Resource Management Fish			
	FLNRORD-IP	FLNRORD Invasive Plants			
	FLNRORD-W	FLNRORD Water Authorizations			
	Complexity:	Simple - little to moderate amount of planning, collaboration, and coordination; Complex - significant planning, collaboration, and coordination			
	Estimated Cost:	\$ - Less than \$1,000; \$\$ - \$1,000-\$10,000; \$\$\$ - \$10,000-\$100,000; \$\$\$\$ - more than \$100,000			
	Status:	NS - Not Started; U - Underway; P - Postponed; CX - Cancelled; C - Completed			

Actions	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance				
QUICK WINS Simple solution, implemented within 12 months													
1. Educate the community and the public on invasive species within the area and how to report invasive species to the Province using mobile apps like Report-a-Weed BC and Report Invasives.					X					FLNRORD-IP ENV-IS	Simple	\$	U
2. Provide information to community and the public about environmental reporting resources, including Conservation Officer Service's RAPP Line (1-877-952-7277), DFO's Observe Record Report Line (1-800-465-4336), and Environment and Climate Change Canada's (ECCCs) Pollution Emergencies Line (1-800-663-3456).			X	X	X	X	X		X	ENV-IS	Simple	\$	U
3. Identify and train a local lead to support interested residents in managing flowering rush in areas adjacent to private docks where the function of the dock is obstructed by invasive vegetation. This could be accomplished through Indigenous partnerships or local stewardship. Management would include identification, in-stream permitting, removal methods, proper disposal, and monitoring to reduce the risk of spread as described in the <i>Manual Treatment Guidelines for Control of Flowering Rush on Hatzic Lake</i> : https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/guidance-resources/2019_floweringrush_weedalert_hatzicmanualtreatmentguidelines.pdf .			X	X	X		X			FNNRORD-IP	Simple	\$	NS
4. Distribute existing FLNRORD flowering rush educational materials regionally to educate local and regional residents about the risks of the plant and how to reduce new infestations. Information could be shared through existing social media channels (e.g., NGO, FVRD channels) and traditional print media. Appropriate materials for distribution currently exist and are suitable to Hatzic Lake.			X	X	X		X			FLNRORD-IP	Simple	\$	U
5. Develop and distribute Eurasian watermilfoil education materials to educate about the ways to manage and reduce its spread. Information could be shared through existing social media channels (e.g., NGO, FVRD channels) and traditional print media.			X	X	X		X			FLNRORD-IP	Simple	\$	U
6. To reduce Eurasian watermilfoil, local community groups, such as the Hatzic Lake Improvement Society, could oversee the permitting and manual removal of watermilfoil from select priority areas, including docks and popular swimming areas. Because this is a specialized and potentially expensive task, provincial managers should provide support including advice, funding, and implementation, where appropriate. Once harvesting is started, it should be continued for management to be effective; permits and funding should be secured for a sustained approach. Select targeting of high priority areas may be more effective than tackling the whole lake (Madrone, 2018) and smaller targeted areas will allow for proper handling and disposal of flowering rush. Monitor the effectiveness of removal, modify work plans as needed, and, if reasonable, expand efforts to include the installation of benthic barriers (Madrone, 2018). This could be implemented as a phased approach.			X	X	X		X			NGO	Simple	\$\$	NS

Actions	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance				
7. Continue partnering with local First Nations to develop local stewardship, capacity, and expertise in invasive species management.					X	X			X	FLNRORD-IP ENV-IS	Simple	\$-\$-\$	U
8. Complete an inventory of end-of-pipe outlets and discharge pipes outlets at Hatzic Lake.			X	X	X		X			FLNRORD to confirm lead	Simple	\$	NS
9. Leverage the existing public education campaign to increase understanding that there are direct connections from storm drains into fish habitat, including Hatzic Lake. For example, activities such as draining hot tubs should be done slowly overland rather than directly into the storm drain system.			X	X			X			NGO	Simple	\$	NS
10. Complete a streambank and lakeshore bank assessment to inform a restoration plan aimed at reducing localized erosion and non-point source pollution (e.g., sedimentation in the lower watershed).	X	X	X	X						NGO	Simple	\$-\$-\$	NS
11. Restore riparian habitats throughout the watershed by planting native riparian vegetation. Where beaver activity is an issue, restoration should include beaver deterrents (e.g., wire mesh protection). This effort should include education about beavers, including appropriate control measures, and address incorrect assumptions, e.g., beaver populations can be controlled by simply removing vegetation (i.e., their source of food).			X	X		X				Residents	Simple	\$-\$-\$	NS
12. Clearly define DAID’s responsibilities, as per Letters Patent, to clarify what is in scope and out of scope when there is flooding not associated with the Fraser River. The Letters Patent is very detailed in allocating boundaries; however, it is lacking in detail regarding specific responsibilities. The Letters Patent states that DAID is responsible for “diking and drainage of the land and the construction, acquisition, maintenance and operation of works for those purposes and all things incidental thereto” (BC Gazette, 1972) within DAID’s boundary that includes Hatzic Lake and Hatzic Prairie (refer to <i>Appendix G – Dewdney Area Improvement District Boundary</i>). Once responsibility is clearly defined, a complete review of the annual operating funds should be completed to ensure funding levels are appropriate to meet DAID’s commitments. This review should form the basis of a Memorandum of Understanding outlining areas of responsibility between DAID, FVRD, FLNRORD-W and others (e.g., Indigenous communities) and align with any new Service Area boundary, as recommended in Action No. 41.	X						X		X	DAID	Simple	\$-\$-\$	NS
13. Ensure FVRD and DAID are represented in regional flood management and emergency preparedness planning.	X								X	FVRD, DAID	Simple	\$	NS
14. Continue the development of effective and accessible aquatic invasive plant treatment methods, including those for flowering rush and Eurasian watermilfoil. Methods may include, but should not be limited to, suction dredging, manual and machine excavation, substrate barriers, aquatic herbicides, and biocontrol development.					X					FLNRORD-IP	Complex	\$\$\$	U

Actions <i>What can be done to address the issues so that the vision can be achieved?</i>	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance				
15. Adopt a Memorandum of Understanding between all applicable managing agencies and groups (with a mandate to protect Hatzic Lake) to agree to the actions and responsibilities outlined in this Action Plan. Although the implementation timeline, lead, complexity, and cost has been suggested for each action, the partners should review the Action Plan periodically (e.g., every 12 months) to ensure the actions are being implemented and are addressing the key nine issues.									X	All	Complex	\$	NS
16. On September 26, 2019, the FVRD hosted a Farmer Engagement Session for Hatzic Prairie residents to discuss the importance of sustainable and efficient farming practices in Hatzic Prairie and the surrounding area. Additional farmer engagement should be initiated to encourage two-way dialogue between local government, AGRI, residents, and Hatzic Prairie farmers.			X	X					X	FVRD	Simple	\$	NS
17. Identify a lead for the Hatzic Lake Management Plan that will oversee the implementation, monitoring, reporting, and ongoing updates to the plan.									X	FLNRORD	Simple	\$	NS
SHORT-TERM ACTIONS <i>Implemented within 1-3 years</i>													
18. Implement an integrated pest management approach to contain and reduce the flowering rush population in the Hatzic water system.				X	X					FLNRORD-IP	Simple	\$\$\$	U
19. Develop a Hatzic Lake Traditional Use Plan that addresses how Indigenous land and resource management should be incorporated within future lake initiatives.									X	LN, SN	Complex	\$\$	U
20. Partner with Indigenous communities to develop educational information boards around the lake that help educate visitors and residents about the cultural history and traditional use of the lake and its species, or an equivalent as guided by First Nation communities.				X	X				X	FVRD	Simple	\$\$	NS
21. Continue to develop tools to determine appropriate actions to address sedimentation. These may include sediment modeling, placement of additional sediment traps, and ongoing maintenance of existing and proposed traps (NHC, 2005).		X							X	FVRD to confirm lead	Complex	\$\$-\$\$\$	NS
22. Through effective engagement, work directly with lake users to develop a management strategy for motorized lake use that would identify slow zones, swimming areas, and environmentally sensitive areas. During the engagement workshop, it was noted that it was extremely important for Hatzic Lake residents to be able to have unrestricted motorized access to the lake. However, it was also noted there was value in reinstalling speed restrictions in high-use areas to ensure safe access for swimmers and to reduce wake effects.	X			X	X				X	NGO	Simple	\$\$	NS

Actions

What can be done to address the issues so that the vision can be achieved?

Issues

Actions	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt.	7. Recreation	8. Natural Resource	9. Governance				
23. Implement the following flood gate management actions:													
a) Encourage Fraser River water to mix with Hatzic Slough upstream of the flood gates as much as possible during summer months (Urban Systems, 2020).	X		X	X	X					FLNRO-W DAID	Simple	\$	NS
b) Develop thresholds for managing water levels anticipated during summer storms.	X		X		X					FLNRO-W DAID	Simple	\$\$	NS
c) Lobby for a Short-term Use Approval water licence based on flow conditions rather than fixed dates.	X		X		X					DAID	Simple	\$	NS
a) Ensure slide gate/pump station operations manuals (AE, 2014 and LECL, 2014) address recommendations outlined in Urban Systems' report (2020). Operations should be based on environmental conditions and informed by data as opposed to operator judgement. The manual should include specific methods for operation to facilitate knowledge transfer. This should include specific data collection methods and data access requirements and be required through the Short-term Use Approval water licence.	X		X		X					FLNRORD-W	Simple	\$\$	NS
d) Ensure Hatzic Flood Protection Infrastructure is managed to prevent flooding, meet water quality objectives as defined by provincial and federal legislation (e.g., managing gates during periods of fish migration) (Urban Systems, 2020), and be completed in a manner that avoids or mitigates the harmful alteration, disruption, or destruction of fish and fish habitat and/or fish fatalities (Fisheries Act, 1985).	X		X	X		X			X	FLNRORD-W	Simple	\$	NS
e) In late summer, avoid releasing water too quickly from the lake through the flood gates to ensure fish and fish habitats are protected from potential stranding and to reduce flow and the spread of invasive plant propagules downstream. This should be included in the Short-term Use Approval water licence as an approved rate of release with acceptable water level decreases within designated time periods. This should be data driven and monitored. This will also mitigate the spread of flowering rush reproductive parts as a slow draw down will reduce water velocities and a quick flushing effect.	X		X		X					FLNRORD-W DAID	Simple	\$\$	NS
f) Define maximum allowable water elevations at the slide gates to better manage flood events (Urban Systems, 2020).	X		X		X					FLNRORD-W	Simple	\$\$- \$\$\$	NS
g) Automate data collection systems at slide gates and pump stations to ensure accurate and reliable data. Consider upgrading to real-time remote access which will reduce reliance on manual data collection and management and enable access to data by all management partners. This should be required through the Short-term Use Approval water licence.	X		X		X					FLNRORD-W DAID	Complex	\$\$- \$\$\$	NS

Actions <i>What can be done to address the issues so that the vision can be achieved?</i>	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance				
24. Create a workplan and funding strategy to update floodplain management, including an evaluation of risk for flooding by the Fraser River and increased sea levels, as data from Fraser Basin Council becomes available (Urban Systems, 2019). Other pertinent recommendations included in the 2019 Urban Systems report include: understanding the impact of design storms during non-controlled periods and hydrologic-hydraulic modeling for flood and storm scenarios. This work may be eligible for funding through the Union of BC Municipality's Community Emergency Preparedness Fund.	X							X	X	DAID	Complex	\$\$- \$\$\$	NS
25. Develop a Regional Drought Plan as per MOECCS, 2018. The plan could be created for the entirety of the FVRD or specific areas (e.g., Area F) and/or focus on land-use (e.g., agriculture or recreational area impacts). The plan would define the area(s) and roles/responsibilities, plus identify the priority stream watch list, assessment criteria and response protocols, data management, a communication plan, and training requirements.	X						X	X	X	FVRD	Complex	\$\$	U
26. Establish and implement water conservation strategies and water use reduction targets. Build these strategies and targets into water restriction communications and enforcement.	X		X						X	FVRD	Complex	\$\$	U
27. For residents upstream of Hatzic Lake, field saturation level data should be shared with DAID to assess the impacts of raised lake levels on agricultural practices in the fall (e.g., damage to soil during harvesting and impacts to winter cover crops).	X		X							Farmers	Complex	\$\$- \$\$\$	NS
28. Continue weekly water quality monitoring in partnership with the BC Lake Stewardship Society, Hatzic Lake Improvement Society, and MOECCS. This data can be used to understand the magnitude of water quality imbalance (e.g., excessive nutrients) and support the development of an action plan to mitigate poor water quality.			X							ENV-W	Complex	\$\$-\$\$	U
29. Expand water quality monitoring to other locations, including upstream tributaries. This expansion will help identify which streams are primarily responsible for negative effects on water quality.			X							ENV-W	Simple	\$\$	NS
30. Categorize the wide range of applicable planning initiatives underway by various levels of government, NGO's, and academic institutions to leverage limited resources for regional initiatives that address non-point source pollution. Certain components of non-point source pollution are extremely challenging to plan for and mitigate. For example, atmospheric deposition in the form of forest fire-related particulate may affect Hatzic Lake water quality; however, planning for this at a local level is unlikely to result in any meaningful change. It is important for residents, local governments, and agencies to be aware of initiatives underway that have relevance locally, regionally, and beyond (e.g., BC Climate Change Risk Assessment prepared by MOECCS (2019)). Federal, provincial, and local governments need to continue to work together to ensure there is an understanding of initiatives underway that have wide-ranging effects.			X						X	FVRD	Simple	\$\$-\$\$	NS

Actions <i>What can be done to address the issues so that the vision can be achieved?</i>	Issues									Lead	Complexity	Estimated Cost	Status	
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance					
31. Develop public education that communicates to landowners the benefits of restoring riparian vegetation (including appropriate beaver deterrent strategies). To ensure more widespread implementation, information should clearly demonstrate how landowners will benefit (e.g., erosion control and the reduction of invasive species) instead of presenting material that is intrinsically “good for the environment”. This could be completed by an NGO with funding support from AGRI.			X	X	X					NGO	Simple	\$\$	NS	
32. Ensure the 2019 Riparian Areas Protection Regulation is being adhered to in development permit areas and within 30 m of the highwater mark of Hatzic Lake and the surrounding waterways. This could be linked to a public education campaign informing lakeshore and streamside residents of their legislated responsibilities in protecting riparian areas. Also, explore inclusion of riparian protections within local bylaws.			X	X	X					FVRD	Simple	\$\$	NS	
33. The FVRD has developed educational materials related to best practices for a healthy septic system. Distribute these materials annually to residents and business owners on Hatzic Island to inform them of the risks and best practices associated with septic fields.			X							FVRD	Simple	\$	NS	
34. Discuss the potential for a municipal sewer connection between the FVRD, the District of Mission, and Hatzic Island residents. In the past, residents opted out of a sewer connection; however, this should be revisited because leaking septic can be a significant source of pollution impacting environmental and human health. The next step could involve a project feasibility study that outlines the project phases, risks, and estimated short- and long-term costs.			X	X					X	Residents	Complex	\$\$- \$\$\$	NS	
35. Engage farmers and encourage the use of ARDCorp free support for environmental farm planning (www.ardcorp.ca) and work with AGRI Planning Advisors to focus efforts and leverage existing resources, where possible. Provide educational opportunities for best management practices considering many onsite drainage ditches have direct connectivity to the Hatzic Lake catchment. Provide education around jurisdictional authority for water management (e.g., roadside storm drainage ditches are the responsibility of MOTI and are not designed to assist with agricultural drainage). This will ultimately benefit the environment by reducing nutrient loading and eutrophic effects on downstream waterways, as well as being less expensive for farmers (Geesing, 2019).			X	X					X	AGRI	Simple	\$	NS	
36. Develop an Agricultural Area Plan for Hatzic Prairie. Agricultural Area Plans identify agricultural issues of community concern in a defined farming area and find practical action-based solutions through community consultation. They are an effective tool for addressing agriculture issues in a region and help develop relationships between farmers and municipal planners as they plan for the future of agricultural lands in the region. These plans are initiated by farming stakeholders and local government within a defined farming area and are often supported by a professional agrologist, the Agricultural Land Commission, and AGRI. Plans are typically funded by a combination of local and regional government in partnership with the Investment Agriculture Foundation of BC.			X	X					X	X	FVRD	Complex	\$\$	NS

Actions <i>What can be done to address the issues so that the vision can be achieved?</i>	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt.	7. Recreation	8. Natural Resource	9. Governance				
37. Initiate an Agricultural Area Committee for Hatzic Prairie. Agricultural Area Committees are advisory groups primarily composed of volunteer representatives from the agricultural community. They are initiated by local or regional government bodies to identify and address broad and day-to-day agricultural issues. Agricultural Area Committees often have non-voting members and committee members from AGRI and the Agricultural Land Commission and may have appointed non-voting local government staff members to provide logistical and coordination support and, at times, funding through annual government budget allocations. A committee can help clarify priorities and information and champion projects for farmers in a defined land-use area.			X	X				X	X	FVRD	Complex	\$\$	NS
38. Explore the formation of a non-government organization for Hatzic Prairie, e.g., a Farmers' Institute, or the expansion of an existing Institute to include Hatzic Prairie (e.g., McConnell Creek Farmer's Institute). BC Farmers' Institutes strive to serve the needs of the local agricultural community, meeting regularly to identify and address issues of interest and concern to local farms and agricultural stakeholders. Members also sit on committees in the wider community, advocating for farmers' interests at community, municipal, provincial, and federal levels. They create community connections by offering regular workshops, farm tours, professional development opportunities, farmers' markets, and social events that benefit farmers, agricultural partners, and the local community. They are simple to implement but require ongoing community commitment.								X	X	Farmers	Simple	\$	NS
39. Complete effectiveness monitoring and maintenance for the flowering rush containment system that was installed in summer 2020. Review the effectiveness of the system within one year of operation and modify, as necessary.					X					FLNRORD-IP	Complex	\$\$	U
40. Encourage intercommunity/industry collaboration between different lake users for successful implementation of this Action Plan. This includes building relationships between Hatzic Island residents and the agricultural community. This could be achieved through an annual or biannual facilitated meeting of watershed constituents.	X	X	X	X	X	X	X		X	All	Complex	\$\$	NS
LONG-TERM ACTIONS <i>Implemented within 4-10 years</i>													
41. It would be advantageous for the FVRD to establish a Service Area (SA) to better serve Hatzic Lake residents. The process to develop a SA should be initiated as soon as possible and begin with a comprehensive assessment of what services would be provided and what the potential implications are for residents. This should be tied closely to reviewing and confirming responsibilities in DAID's Letters Patent (Action No. 12). This review will determine specific roles for the FVRD and how those roles differ and complement DAID's service responsibilities. This review will also incorporate potential effects of Hatzic Lake operations on upstream residents.									X	FVRD	Complex	\$\$\$	NS

Actions <i>What can be done to address the issues so that the vision can be achieved?</i>	Issues									Lead	Complexity	Estimated Cost	Status
	1. Lake Volume	2. Sedimentation	3. Water Quality	4. Valued Species	5. Invasive Species	6. Ind. Land/Res. Mgt	7. Recreation	8. Natural Resource	9. Governance				
42. Conduct a non-plant species assessment at Hatzic Lake (e.g., fish, amphibians, reptiles, birds, and mammals) to determine native and invasive fish and amphibian abundance. This will inform management decisions for valued species. Maximize opportunities to gather this data through existing initiatives, such as Resilient Waters, North American Breeding Bird Survey, and local bioblitz, or in partnership with academic institutions.				X	X					ENV-IS	Complex	\$\$- \$\$\$	NS
43. Once downstream populations of flowering rush are contained, reduce all Hatzic Lake flowering rush populations.					X					FLNRORD-IP	Complex	\$- \$\$\$	U
44. Develop a watershed stability map and complete a geotechnical assessment that identifies high hazard areas for rockfall, landslide, and mass erosion in the upper Hatzic watershed. This should include failing slopes and potential mass instabilities where protective land-use policies (e.g., within forestry industry) can be implemented or adapted to reduce sediment inputs. An influx of sediment into the lower watershed, including Hatzic Lake, can be considered non-point source pollution. This would also identify candidates for stabilization and/or restoration (e.g., road cuts) using traditional and bioengineering techniques to reduce sediment inputs.	X	X	X	X			X	X		FLNRORD-FS	Complex	\$\$\$	NS
45. Establish a working relationship with upper Hatzic watershed forestry industry and the FVRD to assess sedimentation of the upstream watercourses of Hatzic Lake.	X	X	X	X				X	X	FLNRORD-FS	Simple	\$	NS
46. Assess and monitor Canadian Pacific Railway (CP) infrastructure to ensure it meets regulatory requirements. Updating the crossing to a clear span bridge was identified as a priority project in the <i>Hatzic Prairie Drainage Study</i> (AE, 1992) and acknowledged as an impediment to passing 1:100-year flood flow which significantly increases flood risk for Hatzic Island residents (Urban Systems, 2019). Given this would be a large capital investment with significant logistical challenges, this should be approached as a collaborative effort between governments, First Nations, CP rail, and stakeholders. Reducing flood risk at Hatzic Island will benefit not only residents but reduce environmental effects (e.g., inundated septic) and the spread of invasive species.	X		X	X						LN	Complex	\$\$\$\$	U

4. IMPLEMENTATION AND MONITORING

Implementation and monitoring of the actions recommended in the Hatzic Lake Management Action Plan are to be administered by each lead organization. With action items ranging in level of complexity, it is important that each lead organization establish appropriate performance indicators to measure project progression and completion.

Reviewing and determining the feasibility, appropriateness, and priority of the actions that are recommended in this management plan is an iterative and collaborative process. Although the implementation timeline, complexity, and cost has been suggested for each action, the lead organizations should review the Action Plan periodically (e.g., every 12 months) to ensure the actions are being implemented and are addressing the key nine issues. New issues and actions may arise over time and should be considered, with input from the community, if appropriate, and incorporated into the Action Plan.

Funding

Implementing the recommended action items will require significant funding. Table 10 provides a summary of a selection of grant programs that are well suited to this work.

Table 10 – Funding Opportunities

Organization	Program	Eligibility*	More Information
Government of Canada	Climate Action and Awareness Fund / Climate Action Fund	Not-for-profit and non-governmental organizations, university or academic institutions, Indigenous organizations	https://www.canada.ca/en/environment-climate-change/campaigns/climate-action-fund.html
	Habitat Stewardship Program for Species at Risk	Non-governmental organizations, community groups, Indigenous organizations and communities, individuals, private corporations and businesses, educational institutions, provincial, territorial and municipal governments, provincial Crown corporations	https://www.canada.ca/en/environment-climate-change/services/environmental-funding/programs/habitat-stewardship-species-at-risk.html
	EcoAction Community Funding Program	Not-for-profit and non-governmental groups and organizations	https://www.canada.ca/en/environment-climate-change/services/environmental-funding/ecoaction-community-program.html
	BC Salmon Restoration and Innovation Fund [DFO]	Indigenous groups, commercial enterprises, universities and academics, industry associations, other organizations such as research institutions and stewardship groups	https://www.dfo-mpo.gc.ca/fisheries-peches/initiatives/fish-fund-bc-fonds-peche-cb/projects-projets-eng.html

Organization	Program	Eligibility*	More Information
Habitat Conservation Trust Foundation	Habitat Conservation Trust Fund	Provincial government agencies, First Nations, local governments, community and conservation groups, Universities and colleges, and individuals	https://hctf.ca/apply-for-funding/
Investment Agriculture Foundation of BC	Agriculture Area Planning Program – <i>relaunching in spring 2021</i>	Local government – other eligible applicants will be confirmed in spring 2021	https://iafbc.ca/other-programs/
Pacific Salmon Foundation	Community Salmon Program	Volunteer based group/ organization or not-for-profit	https://www.psf.ca/what-we-do/community-salmon-program
Union of BC Municipalities (UBCM)	Community Emergency Preparedness Fund: Flood Risk Assessment, Mapping & Mitigation Planning	All BC local governments (municipalities and regional districts) and all BC First Nations (bands and Treaty First Nations)	https://www.ubcm.ca/EN/main/funding/lgps/community-emergency-preparedness-fund/flood-risk-assessment-mapping-mitigation-planning.html
	Community Emergency Preparedness Fund: Structural Flood Mitigation	All BC local governments (municipalities and regional districts) and all BC First Nations (bands and Treaty First Nations)	https://www.ubcm.ca/EN/main/funding/lgps/community-emergency-preparedness-fund/structural-flood-mitigation.html

*Other Eligibility criteria may apply to grant program. Refer to links in More Information for details.

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6. APPENDICES

Appendix A – Relevant Strategic Reports & Technical Assessment Documents – Detailed Review

Document (by date)	Area of Focus	Summary	Document Highlights
1. Hatzic Dam – Fish Passage Assessment (Urban Systems, 2020)	Fish Passage	This report evaluates the existing flow control structure and pump stations and assesses fish passage effectiveness.	<p>Recommendations include:</p> <ol style="list-style-type: none"> Fish passage should be prioritized during the salmon spawning migration period, as well as during the migratory period for spawning trout and steelhead (September to February for salmon and March/April for steelhead and trout). Conduct a fish inventory assessment on Hatzic Lake to better understand the resident fish species that utilize Hatzic Lake. Explore options to better facilitate fish passage based on this inventory. Closing the slide gates to minimize turbidity in Hatzic Lake must not occur at the expense of fish passage. Water from the Fraser River, although higher in turbidity, may actually reduce the algal blooms experienced during the summer months in Hatzic Lake. To better assess the impact of the dam operation on fish passage, monitoring and reporting of the operational conditions should be improved. The pumping system should not operate when water levels at the outfall are insufficient as this will likely cause injury and/or mortality of fish. When slide gates need to stay closed, consider alternate fish passage provisions (i.e., fish ladder for upstream passage, fry capture and release for juvenile out migration). Flood protection levels should be defined by FLNRORD and understood and adhered to by all stakeholders.
2. Columbia Basin Cooperative Weed Management Area. (CBCWMA, 2019)	Invasive Species	This document highlights the interconnectedness of aquatic systems and the capacity for sound organizations to work together to control and eliminate flowering rush.	<p>This report includes Hatzic Lake as a priority area for management in British Columbia. Specific actions for controlling flowering rush include:</p> <ul style="list-style-type: none"> Education for horticulturalists, homeowners, recreationalists, law makers, public Continued ongoing surveys Contain and control
3. Hatzic Lake Flood Risk Assessment. (Urban Systems, 2019)	Flood	The purpose of this report is to update the hydrologic analysis and conclusions from the 2006 Golder report using a proposed summer lake level of 2.5 m.a.s.l.	<p>The start and end dates of the managed level in the lake result in a significant difference in the design flows. These dates influence both the downstream boundary condition and the magnitude of the potential incoming flow. At this time, it is recommended that the lake level be raised only during the months of July, August and September, but ultimately governed by the water level in the Fraser River and not using fixed dates.</p> <p>Recommendations include:</p> <ul style="list-style-type: none"> Further study is recommended to investigate the impact of design storms on the lake during the non-controlled period, as well as the possibility of dredging, outfall upgrades, or other strategies to reduce the flood risk throughout the year. It is also recommended that a more detailed dual hydrologic-hydraulic model be developed that will allow testing of a wider variety of design storm and flood scenarios, as well as explore flood peaks and durations in more detail. This will assist in future development of a longer-term lake level management strategy. CPR culverts are a significant impediment to passing flood flows and the capacity should be improved. Guidelines for lake residents to assist in the identification, treatment, containment, and disposal of flowering rush at Hatzic Lake.
4. Manual Treatment Guidelines for Control of Flowering Rush, Hatzic Lake (FLNRORD, 2019)	Invasive Species	Manual control guidelines for flowering rush.	<ul style="list-style-type: none"> Guidelines for lake residents to assist in the identification, treatment, containment, and disposal of flowering rush at Hatzic Lake.
5. Development of Best Strategies for the Control of <i>Butomus umbrellatus</i> L. (Flowering Rush) in Alberta (Cahoon, 2018)	Invasive Species	A student thesis is a comprehensive review of the phenology and cytotype of flowering rush in Alberta. It also examines the effect of cytotype on propagation	<ul style="list-style-type: none"> Despite the substantial removal of <i>B. umbrellatus</i> from one test area, there was substantial growth immediately following treatments. This regrowth was either from missed plant material during removal or from plants dispersing from outside of the plots into the cleared area. Due to the sheer mass of the rhizome mat, it is more likely the regrowth was the result of rhizome fragments left in the substrate. At the second test area, removal was more manageable and produced more significant results likely due to the smaller population of flowering rush.

Document (by date)	Area of Focus	Summary	Document Highlights
		means, and tests different control methods in two infested Alberta lakes.	<ul style="list-style-type: none"> Considering that treatments resulted in very little long-term reduction of <i>B. umbellatus</i>, annual treatments may be necessary at heavily infested sites. Therefore, it will be very important to consider hours of labour involved in each of the control methods. Removal of eight 4m² plots at Lake Isle took 16 hours with five people, while installing the benthic barriers required approximately five hours, which included initial cutting back and removal of leaf material from four plots. Benthic barriers provide the most time and cost-efficient method of controlling growth and may represent the control method with the most rapid effects. Benthic barriers have been used successfully in controlling Eurasian watermilfoil (Laitala <i>et al.</i>, 2012, Shaw <i>et al.</i>, 2016).
6. Hatzic Island Discussion Paper (Bendle, 2018)	Land-use Planning	This discussion paper identifies each of the key areas of concern for land use planning on Hatzic Island and recommendations for addressing these concerns.	<ul style="list-style-type: none"> Areas of concern addressed in the paper include development constraints, planning policies and regulations, non-conforming development, any bylaw enforcement. In conclusion: As part of any policy bringing the non-conforming development into conformity, the delivery of a community water system and community sewer system are important considerations. Concerns associated with the existing and future development on Hatzic Island require active solutions that will likely require the cooperation of multiple government agencies to commit to investing in Hatzic Island. What is needed is a discussion focusing on different approaches to managing land use and development on Hatzic Island and the support of active solutions.
7. Provincial Containment Strategy, <i>Butomus umbellatus</i> (Flowering rush) (FLNRORD, 2015)	Invasive Species	This report summaries the extent of flowering rush at Hatzic Lake and the recommended measures to contain the spread of the plant.	<p>Containment measures include:</p> <ul style="list-style-type: none"> Physical containment Public Education and Outreach Targeted Surveys Exploring Treatment Options
8. Environmental Assessment for Hatzic Slough Sediment Management and Flood Mitigation (LECL, 2015a)	Sedimentation, Flood	The specific objectives of this study are to identify fish and wildlife resources and determine what environmental impacts the project will pose during construction and future operation. The significance of these impacts is evaluated to determine mitigating measures and recommendations.	<ul style="list-style-type: none"> The frequency and severity of flooding is expected to continue and increase as sediment infilling reduces capacity and conveyance of Legacy Creek, Hatzic Slough and Hatzic Lake. The sediment accumulation in Hatzic Slough and Legacy Creek reduces conveyance and drainage potential for areas upstream. Sediment accumulation in Hatzic Slough is expected to continue due to abundant sediment sources in the high relief northern portion of the watershed. Past deforestation practices in this portion to the watershed results in frequent slope destabilisations and debris torrents during rain events. The sediments that transported from these high relief regions of the watershed are deposited in the low-lying portions of the watershed. Sandy sediment aggradation primarily occurs in the slow flowing Hatzic Slough, the southern portion of Legacy Creek and Hatzic Lake. Legislative oversight: <ul style="list-style-type: none"> Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery unless it has been authorized by DFO. Serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat. Any works in or about a watercourse require, at minimum, notification to the Ministry of Environment. For some projects, an Approval under Section 9 of the <i>Water Act</i> may be required from the MOECCS. Under the <i>Navigation Protection Act</i> works which include anything, whether temporary or permanent, that is made by humans, and that is in, on, over, under, through or across any navigable water in Canada. This includes the dumping of fill or the excavation of materials from the bed of navigable waters. The <i>ALC Act</i> defines the regulations for the protection of lands designated as Agricultural Land Reserve. Among other policies the <i>ALC Act</i> regulates the non-farm usage of ALR properties, including soil removal and fill placement. Additional legislation governing these types of activities is administered by Fraser Valley Regional District (local government) and the Provincial Diking Authority (<i>Dike Maintenance Act</i>).
9. Changes in and about Hatzic Slough – Sand Recovery Station Construction and Dredging (LECL, 2015b)	Sedimentation	An environmental monitoring report that involves the construction of eleven sand recovery stations and subsequent dredging works at nine of the stations within Hatzic Slough.	<p>Dredging is a sensitive process in which there can be extremely negative effects downstream if not done in a careful manner. Any future dredging works are to be monitored full-time.</p> <p>Recommendations include:</p> <ol style="list-style-type: none"> Replanting during the spring window. A watering plan should be implemented for the summer months. Japanese knotweed is a voracious growing invasive plant. Despite best efforts to remove it, it is already re-growing at Station D and it is likely that it will return to Station B. An Invasive Species Management Plan is required. The wetlands identified along the banks of Hatzic Slough require protection as habitat for the western toad (<i>Bufo boreas</i>) that is protected under Schedule 1 of the <i>Species At Risk Act</i>. An alternate method involving the dredging of material in Hatzic Slough is recommended to reduce the impact of sand along the bank and may include vacuum trucks.
10. Hatzic Region Hydrology and	Flood, Water Quality,	This report examines the hydrology and watershed	<ul style="list-style-type: none"> Historical forest practices have resulted in numerous landslides and excessive sediment delivered to valley-bottom streams. This issue is primarily a result of extensive rural and agricultural private land development. While sediment supply should decline at

Document (by date)	Area of Focus	Summary	Document Highlights
Watershed Stability Assessment (Millard <i>et al.</i> , 2013)	Landslide, Sedimentation, Forestry	stability of the Hatzic region in the Chilliwack Forest District.	<p>some point in the future as chronic sediment sources stabilize and historical forest practices are avoided, the elevated ECA levels are likely to be a permanent feature of these watersheds and may increase with further rural development.</p> <ul style="list-style-type: none"> • Successful management of watershed issues in the Hatzic region must include rural land management in addition to forest management. • In addition, gravel removal will be required on an ongoing basis, albeit at a reduced rate once the historical forestry-related landslides stabilize.
11. Hatzic Valley Watershed Strategy (FVRD, 2006)	Water Quality, Land Use Planning	This strategy guides and informs community and land use planners and decision makers within the Hatzic Valley, as well as guides the community toward practical and achievable solutions for stewardship of watershed resources.	<ul style="list-style-type: none"> • Advisory in nature, this document will initiate a process for collaboration with all stakeholders toward a watershed strategy that integrates diverse objectives, which include flood protection, habitat enhancement, public education, recreational use, and the protection of surface and groundwater quality. For this purpose, stakeholders include government agencies, crown corporations, local residents, and rate payers' groups. • Another barrier to implementation and the development of watershed plans under Regional District direction is the lack of funding for such initiatives over the long term, based on a smaller population base and a much larger area of responsibility, then that found in a municipal setting.
12. Flood Damage Recovery Plan Lagace Creek, Hatzic Valley (NHC, 2005)	Flood	This report quantifies the effects of two high-magnitude precipitation events on Lagace Creek and included a Flood Damage Recovery Plan and rationale in order to secure Provincial Emergency Program (PEP) funding for recovery works.	<ul style="list-style-type: none"> • Page ii - "We have also provided options for a longer-term sediment management strategy. Elements of this strategy would include installation of another sediment trap in the upper reaches of the system, regular maintenance of the sediment traps, and regular excavations of sandy sediments from Reach 2 of Lagace Creek. The annual long-term maintenance budget could be as high as \$100,000 per year. We have also provided options for a longer-term sediment management strategy. Elements of this strategy would include installation of another sediment trap in the upper reaches of the system, regular maintenance of the sediment traps, and regular excavations of sandy sediments from Reach 2 of Lagace Creek. The annual long-term maintenance budget could be as high as \$100,000 per year."
13. Magwood Thesis – Hatzic Valley (Magwood, 2004)	Water Quality	A student thesis designed to determine the quality of drinking water in a rural watershed, to investigate the links between groundwater, surface water and land use, and to compare the results with resident perceptions.	<p>Observations and conclusions include:</p> <ul style="list-style-type: none"> • Land use impacts on surface water quality – These results show that the land use in the Hatzic Valley influences the water quality in the streams that run through the valley. The impact of agriculture on nitrate levels was only seen locally whereas significant correlations between temperature and conductivity and amount of agricultural or forested land were seen throughout the watershed, suggesting that there are cumulative impacts from the changing land use, which is increasingly agricultural as one moves downstream. • Hatzic Island is the main area of concern. The density of septic systems and proximity of wells to septic systems in the subdivisions on the island are a cause for concern. Steps should be taken to consider a new source of drinking water for this area especially for those living in the subdivisions.
14. Preliminary Debris Flow Hazard Assessment of Field, Carratt, Eng, McNab and Dale Creeks, Hatzic Valley (BGCE, 2004)	Debris Flow	Report assesses the risk of further debris flow activity on five creeks; quantifies the risk to the existing homes on creek fans; suggests whether or not the risk of debris flow impacts on the homes has increased following 2003 flows; and recommends appropriate solutions to reduce the risk of loss of life, injury or structural damage.	<p>Report recommends the following studies:</p> <ol style="list-style-type: none"> a. A detailed study of debris flow hazards and risks on the eastern slopes of Hatzic Valley between Dewdney and Cascade Creek. This study should include as a minimum the following creeks (from North to South): Field Creek, Garratt Creek, Eng Creek, McNab Creek, Saporano Creek, Pattison Creek, North and South Herford Creek, Dale Creek, and Storey Creek. Buildings exist in the debris flow runoff zones of the above creeks. The costs of such detailed studies per creek would range between \$ 35,000 and \$ 70,000. The deliverables would include a set of comprehensive reports in which the magnitude and frequency of debris flows is determined, the design magnitudes calculated for each creek and the debris flow hazard modelled. A set of conceptual designs for debris flow mitigation alternatives could be presented and costed for each creek. Based on this work, local authorities could make decisions on how to manage debris flow risk in Hatzic Valley. b. The discontinued Level 1 Watershed Study should be completed and reviewed by an expert on forestry-related landslides and debris flows. c. A detailed forest road stability assessment should be initiated in which all forest roads in the upper watersheds of the above creeks are visited by qualified personnel and prescriptions are made to deactivate those road portions that pose the highest risk for failure; d. A Coastal Watershed Assessment Procedure (CWAP) should be conducted and peer reviewed for all study watersheds and adjacent smaller drainages with downstream resources. e. Slope stability experts should scrutinize all future logging plans in the study area watersheds and nearby creeks. f. The bedrock failure in the upper watershed of Pattison Creek is investigated by a bedrock landslide specialist with reference to potential catastrophic failure and transformation into a rock avalanche, which could destroy development downstream.

Document (by date)	Area of Focus	Summary	Document Highlights
15. Study of Flood Proofing Barriers in Lower Mainland Fish Bearing Streams (Thomson & Associates, 1999)	Flood, Fish Habitat	This study examines two classes of flood control structures: pump stations and flood boxes. Support for concerns about fish passage through controlled devices like flood boxes, and manual flow control structures.	<p>g. A long-term management plan should be compiled on how to address recurrent debris flows and continuous streambed aggradation.</p> <p>h. A hydroclimatic threshold for debris flow initiation should be developed for specific locations in the Fraser Valley, which could be used to develop an early warning system (i.e., a landslide advisory that can be issued over the radio or by calling residents in hazardous areas).</p> <p>i. A public meeting should be held to advise affected and interested residents of the findings of this study.</p> <p>j. Seek public input to any further hazard management strategies.</p> <p>k. This report should be distributed to the Fraser Valley Regional District, the Department of Fisheries and Oceans as well as the Ministry of Water, Land and Air Protection, Water Management Branch at their Surrey office.</p> <p>l. Ensure that all site-specific mitigation measures are incorporated into any land development approvals (building permits etc.) that are issued in the mapped hazard areas.</p> <p>m. Consider the implementation of a hydroclimatic threshold advance warning system to alert residents when conditions become ripe during which debris flow initiation is likely.</p> <p>n. If the decision is made not to proceed with further study, it is recommended that periodic monitoring of the subject watersheds and channels be conducted to identify instabilities or channel changes that may warrant further public advisory or reconsideration of debris flow structures.</p>
16. Hatzic Prairie Drainage Study (AE, 1992)	Flood	This report is focused on developing a plan to reduce flood damages and channel instability in Hatzic Prairie (i.e., the Hatzic Lake watershed).	<ul style="list-style-type: none"> • It is well recognized that significant amounts of fish habitat have been alienated in the lower mainland due to the ongoing flood proofing initiative of the last century. Areas that were once used by anadromous fish for rearing are now largely isolated from the Fraser River, its tributaries and many other smaller watersheds. Fish access to several important rivers and wetland areas is now impeded or controlled by dikes, pump houses, hydraulically operated flood boxes, and manual flow control structures. Although many of these structures have been designed and are operated to allow for fish migration, there is a growing belief that fish passage through and past these structures is far more impeded than previously believed. • While the valley bottom represents a floodplain ecosystem that was naturally subjected to inundation by high stage flows before major flood protection works were constructed on the Fraser and its tributary streams, flood protection initiatives aim to maintain a drainage system that will allow continued use of the rich floodplain land area for agriculture and rural habitation. About 70,000 hectares of valley bottom land is under cultivation on over 5,000 farms in the Lower Fraser Valley, which combined generate over half of the province's farm production revenues. More than half of the BC population lives in the Lower Mainland and an unknown number are protected from annual Fraser River flooding by the dyking system. • In 1992, Dewdney Area Improvement District contracted Associated Engineering (1992) to analyze the flooding issue and make recommendations to alleviate flooding problems. The study's recommendations concerning the pump house and flood box configuration that are relevant to this report are as follows: <ul style="list-style-type: none"> • increase pumping capacity from 48,000 USGPM to 114,000 USGPM, a 138 % increase; • install a fish-friendly submersible vacuum pump complete with inclined and hinged screen in front of the lead pump, similar to the arrangement at the Matsqui Slough pumping station; • provide only coarse trash rack screens on the remaining pump intakes and flood boxes; • increase flood box area from 14.4 square metres to 28.8 square metres, a 100% increase; • install side mounted flap gates on the discharge ends of the flood boxes. <p>At the time of this study, none of the above infrastructure recommendations had been installed or built.</p> <ul style="list-style-type: none"> • The Department of Fisheries' involvement with the operation of the pumping station has been minimal. Associated Engineering (1992) reported that Fisheries, in commenting on the proposed pumping station and in particular on the screening of pump intakes, "demanded approach velocities that can be as low as 0.15 m./sec, resulting in very large screen structures", and that Fisheries suggested they might "levy a tax on the operating municipality based on the fish loss due to pumping stations and its economic impact in the fishing industry." Local DFO staff have had no dealings of note with the station or operators in the last 5 years [43]. However, DFO now requires that future pumps installed at this facility must be fish friendly. <ul style="list-style-type: none"> • In an effort to mitigate the risk of flooding, there would be no appreciable benefit to the drainage system capacity by dredging the lake. However, this would enhance the recreational use of the lake in summer. • The greatest prevention for flooding would be to increase the pumping capacity from 6 cubic metres per sec. (cms) to 14.4 cms. Additionally, by lowering the water level in the Lower Hatzic Slough and lake levels down to elevation 1.8 metres compared with the current setting of 2.44 metres. • This lower lake level would, however, have a negative impact on recreational use of Hatzic Lake. • Dredging Hatzic Lake by removing 1,700,00 cubic metres of material was estimated to cost approximately \$12,000,000-\$21,000,000 in 1992.

Document (by date)	Area of Focus	Summary	Document Highlights
17. Hatzic Lake Summer Water Level Controls (Envirowest, 1991b)	Water Levels, Water Quality, Fish Passage, Introduced Species	A summary of concerns that should be considered before a proposed water level barrier is designed.	<p>Observations included:</p> <ol style="list-style-type: none"> 1. Milfoil: Yearly drops in water levels which expose mudflats in Hatzic Lake serve as a natural control for submerged vegetation, such as milfoil (<i>Myriophyllum spp.</i>), that would otherwise inhabit nearshore areas. Mudflat exposure deters the proliferation of submerged vegetation in the lake. If water levels are controlled in late summer, submerged vegetation will colonize these nearshore areas and decrease the recreational value of the lake for boaters in the future. 2. Water level: Water below the proposed barrier would remain at Fraser River levels during this period. Holding the lake at a defined level may help to alleviate any high temperature problems that the lake undergoes as a result of shallow water in the summer. The only concern, albeit a minor one, would be to ensure that a contingency plan for summer floods be formulated in case of heavy rains in August. 3. Fish passage: <ul style="list-style-type: none"> • Coho Salmon – Adults migrate late in the season and over a prolonged period, often moving upstream when the first rains increase river flow in the fall. Spawning takes place from October to March. Hatching occurs in early spring. Fry emerge from early March to late July. In late March or April of the year following their emergence most fry migrate to the sea • Chum Salmon – Chum salmon begin to arrive at, the mouth of some streams in September, and arrival on the spawning grounds varies from September to early January. Hatching occurs from late December to February. Emergence occurs in late April to early May. The fry move immediately downstream to estuarine waters. The proposed barrier should have little effect on the downstream or upstream migration of salmonid species during the proposed detention period.
18. Hatzic Prairie Study: Pattison Creek Catchment (Golder, 1991)	Sedimentation	This report looks at existing and potential problems of the sediment generated within the Pattison Creek catchment and provides mitigation measures.	<ul style="list-style-type: none"> • As the prime source of supply within the basin is related to forest access road construction, some rehabilitation can be undertaken to reduce the possibility of further failures and generation of sediment. These works relate primarily to control of water and include the construction, or improvement, of water bars (to prevent the concentration of flow down the roads) and the installation of culverts. However, the existing slide scars are now so large, and the exposure of erodible materials so great, that sediment will continue to be generated. There is no economic means of mitigating this situation. As the trees on the upper reforested slopes grow, the severity of the runoff will be decreased with some marginal benefit to basin stability. • Future logging practices must avoid creating slope instability which results in long-term problems for neighbouring areas.
19. A Biophysical Assessment of Hatzic Lake Tributaries with Reference to Fisheries Enhancement Opportunities (George, 1983)	Water Quality, Fish Habitat	A brief biophysical assessment of Hatzic Lake was completed in mid-August 1982. The main objective was to identify potential for enhancement of resident trout stocks and to determine the lake's capability of supporting a fishery.	<p>Report recommends:</p> <ul style="list-style-type: none"> • Investigations should include improvement of faulty septic tanks, the practicality of waste collection and treatment, the restriction of livestock access to streams or lake waters, or even limit additional population increases. • Before suggested enhancement-projects are considered (e.g., fry stocking, obstruction removal), the problem of pump induced smolt and kelt mortality must be resolved. • Existing juvenile cutthroat habitat must be preserved, and dredging should be kept to a minimum, particularly in natural areas.
20. A Brief Review of the Water Quality of Hatzic Lake with Respect to Future Land-use Planning (Drinnan, 1975)	Water Quality	A brief review of the existing water quality information on Hatzic Lake, located in the lower Fraser River Valley was done. While the data was insufficient for definite conclusions to be made, it was suggested that the waters of Hatzic Lake were either in a eutrophic or near eutrophic state. It was not possible to determine the cause or source of the factors involved, but several were considered possible, including faulty septic disposal systems and runoff from agricultural areas.	<ul style="list-style-type: none"> • Page 9 – Findings indicate several factors suggest that intensive land use may not be desirable. These factors include: <ol style="list-style-type: none"> a. Problems associated with flooding b. Poor soil drainage; and c. Eutrophication problems (leading to "problems in the form of algal blooms and excessive weed growth. Intensive land use...may accelerate these effects, creating a situation in which the lake may become aesthetically and recreationally less attractive.")

Appendix B – Additional Documentation – List

Document (by date)	Area of Focus	Summary
1. Hatzic Prairie Flood Mitigation Infrastructure (Landtec, 2015)	Flood, Sedimentation, Dredging	This report outlines key issues and concerns for the low-lying areas of the Hatzic Lake Watershed associated with the removal of sand in Hatzic Slough.
2. Hatzic Lake Slide Gates Operations Manual (LECL, 2014)	Operating Instructions	User manual.
3. Hatzic Lake Pump Station Design (AE, 2013)	Infrastructure	Pump station design drawings.
4. Fish Passage Assessments – Lower Fraser Watershed Group (MEC, 2012)	Fish Passage	A report detailing the results of fish passage assessments within watersheds in the Chilliwack Forest District conducted in the fall of 2011 on behalf of BC Timber Sales.
5. Structural Assessment Hatzic Lake Pump Station Inspection (AE, 2012)	Infrastructure	This report includes findings for a visual inspection of the Hatzic Slough pump station, discharge pipes and floodbox.
6. Overview Geotechnical Hazard Assessment – Electoral Area F (Hatzic Valley), Fraser Valley Regional District (Qcd, 2008)	Geotechnical Hazard	A report on geotechnical hazards in the FVRD's Electoral Area F that will guide future land planning and development and inform emergency response planning.
7. Hydrologic Analysis – Late Summer Lake Level Assessment for Hatzic Lake (Golder, 2006)	Flood, Water Levels	This hydrologic analysis reviews the potential risk of flooding in Hatzic Lake if late summer lake levels are altered (i.e., raised to between 2.1 to 2.3 m.a.s.l.).
8. Hatzic Pump Station Upgrade Strategic Plan (Golder, 2003)	Infrastructure	This strategic plan addresses upgrades to the Hatzic pump station and considers fisheries issues within the watershed, conceptual designs for pump station upgrades, and the associated costs and advantages of each upgrade.
9. Hatzic Valley Sensitive Habitat Inventory and Mapping Project (FVRD, 2002)	Habitat Inventory, Mapping	Watercourse mapping and inventory study completed for selected sections of the Hatzic Valley, BC in 2001-2002.
10. Terrain Classification, Terrain Stability, and Sediment Potential of Durieu Ridge Map Area (DMA, 1995)	Geotechnical Hazard, Mapping	This report discusses the methods and results of a terrain stability assessment and mapping program.
11. Fish Species List for the Hatzic Prairie Watershed (Envirowest, 1991a)	Fish Habitat	A list of fish species (recorded and suspected) that have been identified within the Hatzic Prairie Watershed.
12. Catalogue of Salmon Streams and Spawning Escapements (Mission-Harrison) (Hancock & Marshall, 1985)	Habitat Inventory	A catalogue of salmon-bearing streams and spawning escapements within Statistical Area 29, in Mission/Harrison, completed by the Department of Fisheries and Oceans for the Salmonid Enhancement Program.
13. Review of Outlet Conditions at Hatzic Lake (MOECCS, 1983)	Infrastructure, Fish Habitat	This study looks at the hydrology of the watershed that drains into Hatzic Lake to determine the amount of runoff that could be expected from design storms and the effectiveness of the outlet works in discharging the storm runoff.
14. Hatzic Prairie Land Use and Drainage Study (AGRI, 1980)	Water Levels	A land use and water management inventory of the Hatzic Lake area in an effort to identify costs for future improvement work.
15. Legace Creek Flooding Preliminary Report (McPherson, 1980)	Flood	A report that assesses the impact of the 1979 flood when Legace Creek breached a gravel berm, damaged farms, and deposited gravel and debris on farmlands.
16. Physical Characteristics and Water Quality of Hatzic Lake (Cook & Smith, 1976)	Water Quality	This report comprises an assessment of available information concerning the physical characteristics and water quality of Hatzic Lake. The report formed a portion of the information required for the Hatzic Lake Land Use Plan (since replaced). The defined land use planning or study area included all the shoreland of Hatzic Lake as well as Hatzic Island.
17. A Brief Review of the Water Quality of Hatzic Lake with Respect to Future Land-use Planning (Drinnan, 1975)	Water Quality	A brief review of the existing water quality information on Hatzic Lake.

Appendix C – Applicable FVRD Plans, Strategies and Policies

Plan/Strategy/Policy: [Official Community Plan Hatzic Valley, Electoral Area F \(2010\)](#)

Summary Description: Establishes the vision, objectives, goals and priorities for how the FVRD will grow and evolve Area F in the future.

Relevance to Management Plan:

- Vision: Hatzic Valley is a vital community in a healthy environment where liveability is fostered by: quiet and peace of rural life; connection to nature; clean and abundant water; engagement in civic life; preserving rural and agricultural roots; and, protecting the unique landscape of the Valley.
- OCP Objective 1: Protect ground and surface water and maintain hydrological functions.
- OCP Objective 2: Responsibly steward the environment.
- OCP Objective 3: Respect geological and hydrological processes, reduce hazards where feasible, and avoid unacceptable risks to people and property.
- OCP Objective 7: Encourage a range of rural land uses, supported by appropriate servicing levels, that sustain the community and environment.

Hazard & Risk Management:

- 8.2.7 [Emergency Management] The Regional District should work with the Dewdney Area Improvement District on an ongoing basis to review and confirm flood level triggers for emergency response actions and communication protocols for reporting water levels and dike conditions.
- 8.2.8 [Emergency Management] As opportunities arise, the Regional District will seek external funding to undertake a comprehensive quantitative flood risk assessment of the Fraser River floodplain within and adjacent to the Plan area to: a. better understand flood scenarios, paths and profiles; economic loss and various flood stages; the duration of inundation; and, b. inform and guide the responsible authorities in the major investment in dike upgrades that are required.
- 8.2.10 [Advocacy] Significant upgrades to flood protection works require major contributions from provincial and federal governments. Normally, senior governments should pay costs of capital improvements and the local community should pay costs for ongoing operation and maintenance.

Habitat:

- 9.3.8 [Avoiding and Mitigating Impacts] The Responsible Authorities are encouraged to consider the upgrade of the Hatzic Pump Station to improve fish passage as a priority action for habitat restoration.

Ground & Surface Water:

- 10.1.1 [Other Risks] The potential for negative impacts to groundwater and soil from ground-based disposal of sewage will be a primary consideration in land use planning.
- 10.1.9 [Other Risks] The Regional District will work in partnership with provincial authorities and the Hatzic Valley farming community to identify agricultural practices that minimize potential for groundwater contamination while supporting viable farm operations.

Watersheds Draining to Hatzic Lake: Policies 11.1.1 to 11.1.10

Riparian Areas Development Permit Area 2-F

Plan/Strategy/Policy: [Official Community Plan Hatzic Valley, Electoral Area G \(2010\)](#)

Summary Description: Establishes the vision, objectives, goals and priorities for how the FVRD will grow and evolve Area G in the future.

Relevance to Management Plan:

- Vision: To maintain the rural character and lifestyle of our agricultural and rural-residential community in an environmentally sustainable manner while providing opportunities for outdoor recreational activities.
- OCP Objective 2: Preserve fish, wildlife and water resources.
- OCP Objective 3: Encourage sustainable development and environmental stewardship.
- OCP Objective 5: Safeguard human health.
- OCP Objective 7: Protect people and development from natural hazards.

Local Area Policies - Hatzic Island - Services:

- 7.1.2 [Water Supply] The Regional District will undertake a study to assess the feasibility of providing a public sewage disposal system to Hatzic Island and canvas the Hatzic Island community to gauge interest in establishing a Service Area.

- 7.1.3 [Water Supply] The Regional District will liaise with the District of Mission regarding the potential to develop for Hatzic Island a community sewage collection system which connects to the District of Mission sanitary sewer.
- 7.1.4 [Water Supply] If there is community interest in establishing a public sewage disposal system for Hatzic Island, the Regional District will seek funding support from senior governments.
- 7.1.5 [Water Supply] The Regional District will continue to investigate the feasibility and costs of providing a public water system to Hatzic Island, including connection to the Abbotsford-Mission Water and Sewer Commission system. Liaison with Abbotsford-Mission Water and Sewer Commission to determine feasibility and potential impacts on the water supply is an essential part of this investigation.

Local Area Policies - Hatzic Island - Lake Access:

- 7.2.1 The Regional Board encourages the efforts of the Dewdney Area Improvement District to maintain summer water levels in Hatzic Lake that are suitable for recreation provided that:
 - a) there is no increase in the risk or consequence of flooding;
 - b) there is no negative impact on habitat and fish passage between the Fraser River and the Hatzic system is not impeded;
 - c) the works are designed and supervised by a qualified hydraulic engineer; and,
 - d) all necessary Federal, Provincial and local approvals are obtained.

Infrastructure & Services:

- 8.2.3 [Sewage Disposal] Where it is not possible to develop a conventional septic field to serve development of a use permitted in the zoning bylaw on an existing lot, other innovative on-site disposal systems including package treatment plants that meet the requirements and regulations governing sewage disposal may be accepted by the Fraser Health Authority or the Ministry of Environment.
- 8.2.7 [Sewage Disposal] Holding tanks for sewage shall not be supported.
- 8.3.5 [Drinking Water] The Regional District should canvas the Hatzic Island community to determine whether there is interest in establishing a community water supply for the Island.

Biological Diversity:

- 12.3.8 [Avoidance and Mitigation of Environmental Impacts] The Regional District encourages the stewardship initiatives of responsible community groups and will support them as resources permit, primarily through in-kind contributions.
- 12.3.9 [Avoidance and Mitigation of Environmental Impacts] The Responsible Authorities are encouraged to consider the upgrade of the Hatzic Pump Station to improve fish passage as a priority action for habitat restoration.

Ground and Surface Water:

- 13.1.1 [Groundwater] The Regional District will investigate the feasibility of providing community sanitary sewer service to Hatzic Island to address the risk of groundwater contamination from onsite sewage disposal.

Plan/Strategy/Policy: [Regional Growth Strategy \(2014 Draft 1\)](#)

Summary Description: Comprises 8 growth management goals that the FVRD will focus on over the next 20 to 30 years. Draft 2 scheduled for release by early 2021.

Relevance to Management Plan:

- Vision: The Fraser Valley Regional District will be a network of vibrant, distinct, and sustainable communities that accept responsibly managed growth while being committed to protecting the land resources and the natural environment to ensure that a high quality of life is accessible to all.
- Goal 5: Protect the natural environment and promote environmental stewardship.
- Goal 6: Protect and manage rural and recreational lands.
- Goal 8: Manage water, energy resources and waste responsibly.

Plan/Strategy/Policy: [FVRD Board Strategic Plan \(2014-2018\)](#)

Summary Description: Plan has expired. Strategic planning to recommence in October 2020.

Relevance to Management Plan:

- Priorities include: Waste Management, Water Quality, Flood Protection and *Management*, and Outdoor Recreation

Plan/Strategy/Policy: [Fraser Valley Adaptation Strategies Update: BC Agriculture & Climate Change Regional Adaptation Strategies \(2015\)](#)

Summary Description: The adaptation plan outlines the priority impact areas, and a series of strategies to increase the resilience of the Fraser Valley agriculture sector in a changing climate.

Relevance to Management Plan:

- Strategy 2.2: Identify, pilot & evaluate mechanisms to reduce runoff onto & off agricultural lands
- Strategy 3.2: Coordinate sector, commodity & individual producer flood risk responses & planning
- Strategy 4.2: Increase research and information transfer regarding pest lifecycles, identification and management
 - Action 4.2D: Support local governments to improve weed and invasive species management on public lands (including ditch maintenance)

Plan/Strategy/Policy: [Outdoor Recreation and Tourism Infrastructure Management Plan \(2020 - In development\)](#)

Summary Description: To be completed in spring 2020. Phase 1: Quantify the value outdoor recreation brings to the region. Data collected from over 150 different locations. Phase 2: Management plan with the FVRD separated into recreation areas with localized details about activities, challenges and opportunities, and recommendations.

Relevance to Management Plan:

- There is an opportunity for the Hatzic Lake Management Plan and the Outdoor Recreation and Tourism Infrastructure Management Plan to be aligned in its actions, specifically recreational access to and use of Hatzic Lake.

Plan/Strategy/Policy: [Outdoor Recreation & Tourism in the FVRD - Regional Snapshot Series: Parks and Recreation \(2012\)](#)

Summary Description:

Relevance to Management Plan:

- Minimizing Impact, Maximizing Experience: While the benefits of using parks and recreation areas far outweigh the negatives, it is still important to consider the potentially negative impacts that can occur with improper use. Common problems include the spread of invasive species, illegal dumping, and damage to vegetation and soil caused by going off-trail.

Plan/Strategy/Policy: [FVRD First Nations Relations](#)

Summary Description: FVRD comprises 30 bands and numerous urban and rural reserves

Relevance to Management Plan:

- Vision: Shaping the Future of the FVRD by sharing knowledge, resources, and culture as respectful partners in planning.
- Core Values include: Collaboration - Working together to solve common problems with creative solutions.

Appendix D – Applicable Local, Provincial and Federal Acts, Regulations and Policies

	Policy/Act/Regulation	Summary Description
LOCAL	Dewdney Area Improvement District (DAID) Letters Patent	Since 1972, DAID has been responsible, under Letters Patent (Lieutenant Governor in Council, 1972), for the diking and drainage within DAID's boundary and the construction, acquisition, maintenance and operation of works required to fulfill their legislated responsibility (BC Gazette, 1972).
	<u>District of Mission Official Community Plan (OCP) (2018)</u>	This policy represents the community's vision for the future and describes how and where residential, commercial, industrial, agricultural and other types of development will occur. The OCP guides the provision of necessary road, water, sewer and other infrastructure, and includes policies concerning environmental, economic and community health and well-being.
	Fraser Valley Regional District policies	Refer to <i>Appendix C – Applicable FVRD Plans, Strategies and Policies</i> for a list of applicable policies.
PROVINCIAL	<u>Agricultural Land Commission Act (2002)</u>	This Act defines the regulations for the protection of lands designated as Agricultural Land Reserve. Among other policies, the <i>ALC Act</i> regulates the non-farm usage of ALR properties, including soil removal and fill placement. For any non-farm usage on ALR properties, notification must be made to the Agricultural Land Commission.
	<u>Dike Maintenance Act (1996)</u>	The province is committed to maintaining the safety and integrity of dikes while preventing detrimental effects on river processes and other parties. The purpose of this Act is to provide the provincial Inspector of Dikes with statutory authority to approve construction and design of new dikes.
	<u>Drinking Water Protection Act (2001)</u>	This Act covers all water systems other than single-family dwellings (and systems excluded through the regulation). The Act sets out certain requirements for drinking water operators and suppliers to ensure the provision of safe drinking water to their customers.
	<u>Environment Management Act (2003)</u>	This Act regulates industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation. The Act provides the authority for introducing wastes into the environment, while protecting public health and the environment.
	<u>Fish Protection Act (1997)</u>	This Act was developed to ensure that fish and fish habitat are sustained for present and future generations. It aims to balance the needs of fish with the needs of people, to the benefit of both.
	<u>Freshwater Strategy for British Columbia (1999)</u>	This document provides an overview of the future direction of water management in BC. The strategy: outlines some of the key challenges in water management, identifies the principles which will guide decisions, presents the ministry strategic goals and the linkages to the freshwater strategy, discusses the freshwater strategic goals, and describes the initiatives developed to accomplish those goals, the accomplishments to date in each initiative or program and the priority actions to be completed over the next three years.
	<u>Flood Hazard Area Land Use Management Guidelines (2004)</u>	This document provides guidelines intended to help local governments, land-use managers and approving officers develop and implement land-use management plans and make subdivision approval decisions for flood hazard areas.
	<u>Forest and Range Practices Act (2002)</u>	This Act outlines how all forest and range practices and resource-based activities are to be conducted on Crown land in BC, while ensuring protection of everything in and on them, such as plants, animals and ecosystems.
	<u>Local Government Act (2004)</u>	This Act is the primary legislation for the FVRD and DAID improvement district, setting out the framework for structure and operations, as well as the main powers and responsibilities.
	<u>Railway Act (1996) and Railway and Safety Act (2004)</u>	The <i>Railway Act</i> provides authority for the establishment and statutory governance of railways operating solely within the province and falling under provincial jurisdiction, including common carrier, industrial and commuter railways. Whereas, the <i>Railway Safety Act</i> provides authority for the Province to adopt the technical regulations, rules and standards of the federal Railway Safety Act, thereby harmonizing the rail safety regime in BC with federal legislation.

	Policy/Act/Regulation	Summary Description
PROVINCIAL	<u>Riparian Areas Protection Regulation</u> (amended 2019)	<p>The purpose of the regulation is to protect the many and varied features, functions and conditions that are vital for maintaining stream health and productivity, including:</p> <ul style="list-style-type: none"> • Sources of large organic debris, such as fallen trees and tree roots; • Areas for stream channel migration; • Vegetative cover to help moderate water temperature; • Provision of food, nutrients and organic matter to the stream; • Stream bank stabilization; and • Buffers for streams from excessive silt and surface run-off pollution.
	<u>Sewerage System Regulation</u> (amended 2018)	This regulation, under the <i>Public Health Act</i> , covers holding tanks for sewage effluent or onsite sewage systems that: process a sewage flow of less than 22,700 litres per day; serve single-family systems or duplexes; and serve different buildings on a single parcel of land.
	<u>Transportation Act</u> (2004)	This Act deals with public works related to transportation, as well as the planning, design, holding, construction, use, operation, alteration, maintenance, repair, rehabilitation and closing of provincial highways.
	<u>Water Sustainability Act</u> (2016)	This Act is designed to provide expanded tools to help ensure that water will remain clean and secure for future generations of British Columbians, as well as to ensure the maintenance of healthy ecosystems in general.
	<u>Wildlife Act</u> (1996)	This Act defines wildlife as all native and some non-native amphibians, reptiles, birds, mammals that live in BC. For some provisions of the Act, the definition includes fish, and other BC legislation defines some insects and plants as wildlife.
FEDERAL	<u>Canadian Navigable Waters Act</u>	Under the <i>Navigable Waters Act</i> , works which include anything, whether temporary or permanent, that is made by humans, and that is in, on, over, under, through or across any navigable water in Canada. This includes the dumping of fill or the excavation of materials from the bed of navigable waters.
	<u>Fisheries Act</u> (1985)	Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the <i>Fisheries Act</i> , no person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery unless it has been authorized by DFO. Serious harm to fish includes the death of fish or any permanent alteration to, or destruction of, fish habitat.
	<u>Migratory Bird Convention Act</u> (1994)	The purpose of this Act is to implement the Convention by protecting and conserving migratory birds — as populations and individual birds — and their nests. Specifically, no person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.
	<u>Species at Risk Act</u> (2002)	The purposes of this Act are to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened.

Appendix E – Roles and responsibilities of agencies and groups with Hatzic Lake oversight

Abbrev.	Agency/Group (alphabetical)	Role and Responsibility	
AGRI	BC Ministry of Agriculture	AGRI is responsible for the production, marketing, processing, and merchandising of agricultural products and food, and for providing financial and educational resources to agronomic producers. They are also responsible for invasive insects related to agriculture.	
MOECCS	BC Ministry of Environment and Climate Change Strategy	MOECCS is responsible for the effective protection, management and conservation of BC's water, land, air and living resources, and oversee and provide resources for the lake water quality program. They also manage point source and agricultural pollution impacting Hatzic Lake. The MOECCS, in partnership with the BC Lake Stewardship Society (BCLSS), initiated a long-term water quality monitoring program at Hatzic Lake in 2019. MOECCS is also responsible for invasive animals, amphibians and invertebrate management and regulation (including fish).	
FLNRORD	BC Ministry of Forestry, Lands, Natural Resource Operations and Rural Development	FLNRORD is responsible for the stewardship of Crown land and natural resources, and for the protection of BC's archaeological and heritage resources. At Hatzic Lake, FLNRORD is responsible for permitting for activities in and around water, including licensing for the operation of the flood gate and pumps, riparian and aquatic habitat protection, fish, wildlife and invasive plant and forest insect management and regulation.	
FLNRORD-FS FLNRORD-IP FLNRORD-W	FLNRORD Forest Stewardship FLNRORD Invasive Plants FLNRORD Water	} Specific branches that are identified in the Action Plan include Forest Stewardship Branch, Invasive Species Branch, and Water Branch.	
DAID	Dewdney Area Improvement District		DAID is responsible, under Letters Patent (Lieutenant Governor in Council, 1972), for the "dyking and drainage of the land and the construction, acquisition, maintenance and operation of works for those purposes and all things incidental thereto" (BC Gazette, 1972). Unlike a municipality or regional district, DAID may only provide the services authorized in their Letters Patent. Currently, DAID has been managing water levels for both flood protection and recreation purposes. Funding for DAID is provided through a tax levy on landowners within the DAID's boundary (refer to <i>Appendix G – Dewdney Area Improvement District Boundary</i>).
ECCC	Environment and Climate Change Canada		ECCC is a federal government agency responsible for informing Canadians about protecting and conserving our natural heritage, and ensuring a clean, safe and sustainable environment for present and future generations.
DFO	Fisheries and Oceans Canada	DFO is the federal government department responsible for safeguarding Canadian waters and managing Canada's fisheries, oceans, and freshwater resources. At Hatzic Lake, DFO is responsible for projects affecting fisheries such as Pacific salmon, permitting for instream project and restoration activities, as well as issues resulting in the unacceptable harmful alteration, disruption or destruction (HADD) of fish habitat.	
FH	Fraser Health	FH is responsible for the delivery of hospital and community-based health services to more than 1.8 million people. These services include testing for and responding to the contamination of the water in Hatzic Lake (e.g., testing for <i>Escherichia coli</i> (E. coli) and cyanobacteria), regulating small water systems and permitting septic systems.	
FVRD	Fraser Valley Regional District	The FVRD is the local government for the unincorporated area of Hatzic Lake and is responsible for land use planning on Hatzic Island and parts of Hatzic Lake area. They have also assisted FLNRORD with invasive species management projects. The FVRD cannot provide the services authorized under DAID's Letters Patent within assigned boundary of the improvement district.	
HLIS	Hatzic Lake Improvement Society	HLIS is a registered non-profit society and a member of the BC Lake Stewardship Society (BCLSS). With BCLSS and provincial funding, HLIS coordinates sampling programs at Hatzic Lake to guide future initiatives. The group lobbies and works with government to manage invasive species and pollution (run-off), obtains and manages grants to help implement projects, and continues lake monitoring to determine where best to focus their efforts.	
LN	Leq'á:mel First Nation	Hatzic Lake is located within the Traditional Territory of Leq'á:mel First Nation and they are an active participant in managing and implementing the actions identified by the group.	
SN	Semà:th First Nation	Hatzic Lake is within the Traditional Territory of Semà:th First Nation and they are an active participant in the working group.	

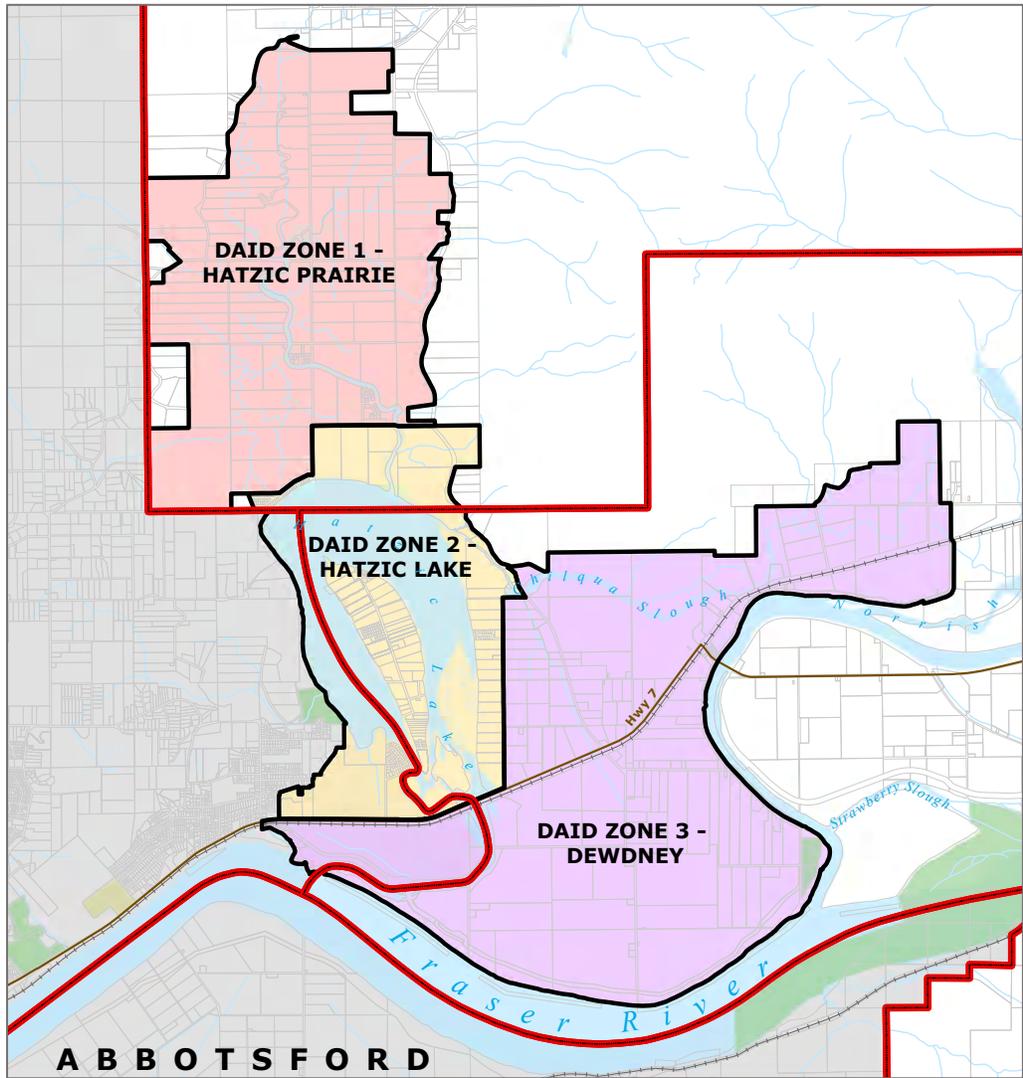
In 1978, botanists collected the first specimen of flowering rush (*Butomus umbellatus*) at the south and north ends of Hatzic Lake, the first documented collections of this species in British Columbia. Flowering rush is now recognized as a highly invasive aquatic plant in North America, capable of causing significant damage to aquatic ecosystems and culturally significant areas, and impacting recreational, agricultural, and industrial uses. It is a high priority for containment in the Pacific Northwest and eradication in the province of BC, with only four impacted waterbodies known. In 2012, the Province's new Invasive Plant Early Detection Rapid Response Program, coordinated through the BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), identified containment and eradication of the Hatzic Lake flowering rush population as key to preventing species establishment and impacts province wide. Since that time, FLNRORD has:

- developed survey and sample collection protocols for aquatic invasive species in BC;
- mapped and monitored changes to the flowering rush population in Hatzic Lake and adjoining sloughs (ongoing);
- completed annual targeted surveillance for flowering rush in adjacent waterbodies and waterbodies with associated uses province-wide (ongoing);
- established federal and provincial permitting processes for the treatment of aquatic invasive plants (ongoing);
- worked with manufacturers to establish herbicide registrations for the control of aquatic invasive plants in BC, including flowering rush (in progress);
- trialled multiple mechanical and chemical treatment methods for controlling flowering rush and other aquatic invasive plants (ongoing);
- installed containment barriers to prevent the spread of reproductive flowering rush plant parts downstream;
- developed flowering rush biological control agents to regulate plant population growth through targeted herbivory (ongoing); and
- engaged with all levels of government, First Nations, and other stakeholders to share information.

Flowering rush is a relatively new invader to BC and remains a candidate for province-wide eradication. The Hatzic Lake population is the largest infestation of four affected waterbodies in the province.

Extensive studies and reports have been completed on the Hatzic region, including Hatzic Lake, Hatzic Slough and upstream through Hatzic Prairie, and McConnell Creek. As such, a comprehensive watershed description has not been included in this report. An annotated bibliography has been provided in Appendix B which outlines the most relevant studies applicable to this plan. Appendix C provides a list of additional documents that were reviewed to inform this plan.

Figure 1 – Dewdney Area Improvement District Boundary



Appendix H – Hatzic Lake During Periods of High and Low Water

The extent of the water levels in the lake during high water and unmanaged low water levels are illustrated in Figures 2 and 3, respectively.

Figure 2 – High Water Levels, Hatzic Lake, May 24, 2017 (Map data: Google, Maxar Technologies)

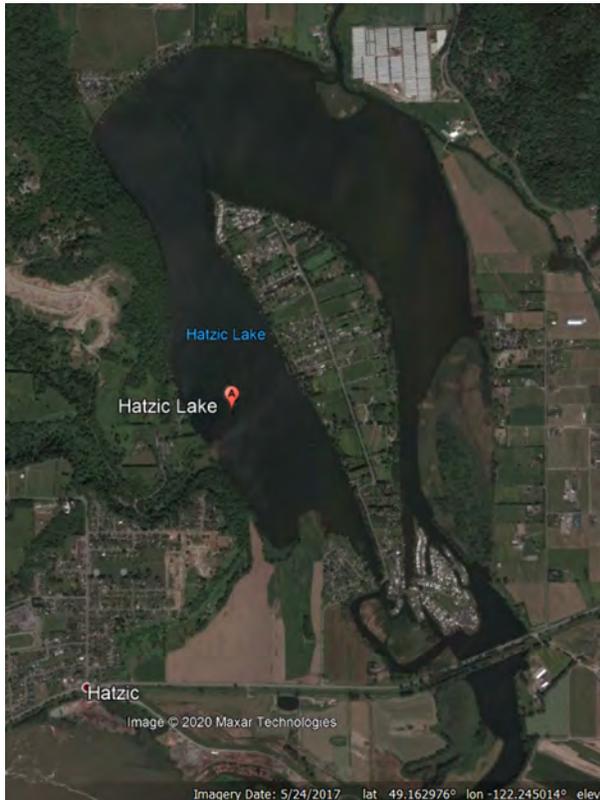
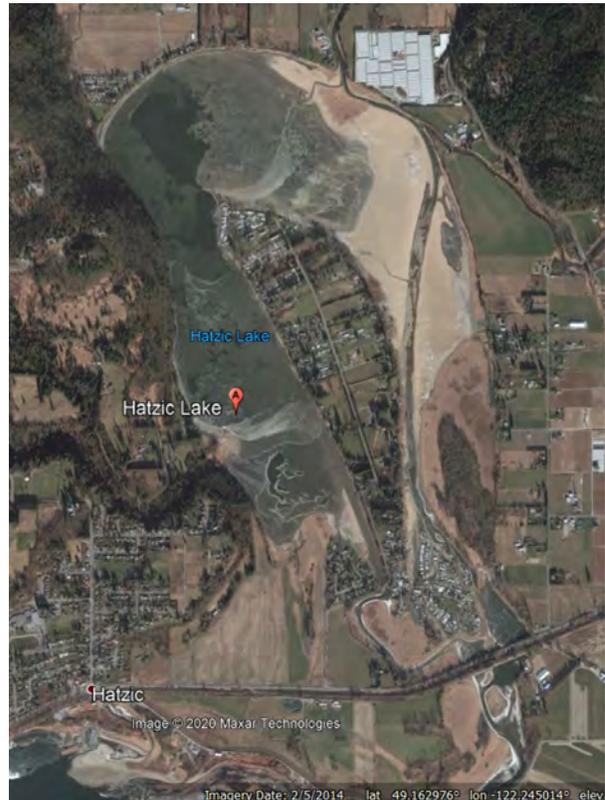


Figure 3 – Low Water Levels, Hatzic Lake, Feb 5, 2014 (Map data: Google, Maxar Technologies)



This management plan was developed through a systematic process to ensure government priorities and community needs are represented appropriately. The process was as follows:

1. **Background Review:** A comprehensive review of the extensive work completed on the Hatzic Lake watershed to date.
2. **Agency, Stakeholder, and First Nation Engagement:** Engagement comprised of one-on-one meetings, group meetings, and ongoing communications. The purpose of initial engagement was to formalize the project scope, inform the community engagement, and garner agency input into the process and deliverables.
3. **Community Engagement:** This step included one-on-one interviews, email newsletters, an online survey, and a community workshop. The purpose of the engagement was to inform the community of the project and issues at Hatzic Lake, create an understanding of community perspective, identify any gaps in understanding, and collectively identify solutions for those issues.
4. **Develop a Vision:** A vision statement was developed for the project through dialogue and engagement. The vision statement identifies the long-term goal of the project.
5. **Identify Key Issues:** An important component of the project was to identify and define the key issues affecting Hatzic Lake. This was especially important because many issues in the Hatzic Lake catchment are interrelated.
6. **Action Plan:** Actions were developed based on recommendations by subject matter experts, community feedback, legislation, best management practices, and research. Actions are categorized according to timeline, complexity, and estimated cost. Although many of the actions identified are complex, they are intended to be implementable. Implementation of the actions are intended to occur over a 10-year timeline. The responsibility for implementation may depend on available funding and government priorities.

Community, stakeholder, agency, and First Nation engagement were integral to the process of developing the Hatzic Lake Management Plan. Understanding historical lake use and issues, while capturing feedback and priorities, has helped inform the Issues & Causes and Action Plan sections of the management plan.

We recognize that there are often conflicting uses and opinions and we have attempted to balance these differences through a comprehensive action-based plan. At the core of the Action Plan is collaboration between residents, government, non-government organizations, First

Nations, and industry groups. It is essential that all groups work together to navigate the simple and complex work required to restore the health of Hatzic Lake.

For more details on engagement, refer to the report, *Hatzic Lake Management Plan – Engagement Plan Results* (Clear Course, 2020).
