VICTOR LAKE RIPARIAN ASSESSMENT

Mountain Metis Community Association and Mighty Peace Watershed Alliance

Mighty Peace Watershed Alliance
September 23, 2024

Executive Summary

Ongoing community concerns and identified issues about Victor Lake prompted Mountain Metis Community Association to raise some of these issues with the Mighty Peace Watershed Alliance and to work collaboratively on addressing them. The riparian assessment process and scientific approaches learnt during this project puts another tool in MMCA's toolbox for stewarding Victor Lake and its watershed. Results from the completed riparian assessment will provide a baseline for ongoing management effort. This objective of this project is to understand the condition of the riparian zone around Victor Lake and what effect this may be having on the lake ecosystem and water quality.

The methods selected for this riparian assessment project reflect a wholistic approach to watershed management which involves both Traditional Knowledge and Western Science, empirical data and community understanding. The community story relates the community's history of the lake, how it has changed, human impacts and uses of the lake, importance to the community and the relationship between the community and lake. Watershed characterization will be completed using geospatial, physical and biological s including geology, land cover, land use, size and geography of the watershed as well as lake features and biota. With the intent to identify potential problems, the most heavily impacted segment of shoreline was selected as the polygon for the riparian assessment. Based on MMCA's existing knowledge, a survey was conducted whereby several muskrat burrows and beaver lodges were visited and visual inspection was completed.

MMCA has long used Victor Lake and environs for meeting, camping and trading as well as subsistence activities. Current use involves living around the like and stewardship efforts but there has been a sharp decline in subsistence and traditional uses due to concerns about the lake.

No invasive species were identified but vigorous growth of native species dominated by pondweed (*Potamogeton* spp.) indicate a healthy and functioning littoral zone. The lake has fluctuated just over 2 metres in the last 50 years with and average lake level of 1117.24 metres above sea level. Water quality monitoring indicates good water. The Riparian Assessment produced a Functional at Risk rating based on a vegetative rating 72.7%, a soils/hydrology rating of 63.3% and an overall rating of 68.3%.

It is recommended that rodent activity is monitored via visual inspection into the future. Collaboration with the Municipal District of Greenview to address the airstrip, recreational use, public toilets, boat launches and potential contamination from the highway.

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Background

The Mountain Metis are descendants of Iroquois and European fur traders who traveled west with the North West Company and Hudson's Bay Company during the early 18th century. The Mountain Metis identity emerged as a result of Scottish and French bloodlines intermingling with Iroquois, Sekani, Chippewa and Beaver tribes. These fur trader families settled in the Athabasca Valley and homesteaded the region for over a century until the Jasper Exodus. In the early 1900's, an Order in Council was passed by the Government of Canada in order to create Jasper National Park. The Mountain Metis families were forcefully evicted from the area by government officials who sealed their guns, leaving them with no means of survival. They eventually re-settled in areas of west-central Alberta, including Edson, Robb, Marlboro, Hinton and Grande Cache. Today, Mountain Metis members continue their close connection with the land and follow traditional practices such as hunting, fishing, and plant harvesting. They are known as the horseback people who guide and outfit in the Canadian Rockies, as did their Ancestors.[1]

Many of the Mountain Metis live around Victor Lake and are stewards of this area and its water resources. Ongoing community concerns and identified issues prompted Mountain Metis Community Association to raise some of these issues with the Mighty Peace Watershed Alliance and to work collaboratively on addressing them.

The Mighty Peace Watershed Alliance (MPWA) is the official Watershed Planning and Advisory Council for the Peace/Slave River Basin. It is a multi-sector, not-for-profit society committed to planning for an ecologically healthy watershed while ensuring environmental, economic and social sustainability. The Alliance includes stakeholders and representatives of communities that use consensus, adaptive management, and innovation to understand and promote living within the watershed. [2]

During the spring of 2024, Mountain Metis Community Association (MMCA) and MPWA had several discussions around ongoing projects, water quality, watershed issues and potential projects. Out of these conversations an invitation was issued from MMCA to MPWA to work together on a Victor Lake riparian assessment. The intent of this was to provide an assessment of Victor Lake and to provide exposure for MMCA community members to riparian assessments. The riparian assessment process and scientific approaches learnt during this project puts another tool in MMCA's toolbox for stewarding Victor Lake and its

[1] Retrieved from the Mountain Metis Facebook page on August 20, 2024. https://www.facebook.com/mountainmetis/about_details

[2] Retrieved from https://mightypeacewatershedalliance.org/ on August 20,2024.

watershed. Results from the completed riparian assessment will provide a baseline for ongoing management efforts.

Objective

This objective of this project is to understand the condition of the riparian zone around Victor Lake and what effect this may be having on the lake ecosystem and water quality. Additionally, increased beaver and muskrat presence and activity, as noted by MMCA, will be examined. This project will help establish a baseline for the riparian zone on Victor Lake that allows for follow-up assessments to monitor change in the riparian zone and by extension the conditions of Victor Lake itself.

Methods and Approach

The methods selected for this project reflect a wholistic approach to watershed management which involves both Traditional Knowledge and Western Science, empirical data and community understanding. Human interaction with Victor Lake and its adjacent water bodies is as important as any chemical or physical parameter that we can measure when assessing the function and condition of Victor Lake.

Community Story

The community story will relate the community's history of the lake, how it has changed, human impacts and uses of the lake, importance to the community and the relationship between the community and lake. MMCA had community members, including an elder, attend this workshop to provide the community perspective and knowledge. Additionally, members of MMCA shared knowledge and the community story in advance of this workshop and that knowledge was also used to help learn the community story.

Watershed Characterization

Watershed characterization will be completed using geospatial data. This exercise will provide insight into land uses in the Victor Lake watershed and the impact that they are having on the lake ecosystem and water quality. Characteristics are determined by many factors including geology, land cover, land use, size and geography of the watershed as well as lake features.

Geography

MPWA has completed land use analysis in the process of creating a Source Water map for the community of Grande Cache and this map report (Appendix A) was referenced for watershed information such as infrastructure, community and land use.

Aerial Imagery

A search was conducted for historical air photos of Victor Lake in the Government of Alberta Air Photo Library (https://www.alberta.ca/ordering-air-photo-products) and then these photos were purchased. Both Bing maps (www.maps.bing.ca) and Google maps (www.maps.google.ca) were accessed to see current satellite imagery.

Bathymetry

Bathymetric data was accessed from the Alberta Geological Survey website (Lake Bathymetry Data | Alberta Geological Survey (aer.ca)). This geospatial data was then accessed using ArcGIS. Additionally, a Government of Alberta map was used that had previously been obtained from the now defunct Atlas of Alberta Lakes.

Hydrology

Discharge from Victor Lake was estimated using the Alberta Flow Estimation Tool for Ungauged Watersheds (https://afetuw.alberta.ca). The watershed was delineated using the Watershed Delineation tool and setting the pour point at the northeast end of Victor Lake in the channel that flows to Grande Cache Lake. Lake Levels were downloaded from Alberta River Basins (www.rivers.alberta) by selecting Victor Lake under the Environmental Data tab.

Water quality

Lake water quality data was obtained from the Alberta Lake Management Society website (www.alms.ca) in the form summer and winter LakeKeepers reports.

Fish Community

To obtain a record of fish presence, data from the Fisheries and Wildlife Management Information System was downloaded (https://www.alberta.ca/access-fwmis-data). A polygon was selected that included all of the lake and the proximal portions of tributaries.

Management

There was one plan that was identified as specific to Victor Lake. This Source Water Protection Plan (Associated Engineering Alberta Ltd., 2015) was briefly reviewed, was undertaken as this is a specific management plan for the Victor Lake watershed. On January 1, 2019, the Town of Grande Cache dissolved and became a hamlet in the Municipal District of Greenview. Although we were unable to locate this plan on the Municipal District of Greenview website (https://mdgreenview.ab.ca/communities/grande-cache/), it is downloadable from file:///C:/Users/User/Downloads/Grande%20Cache%20source%20water%20protection%20plan.pdf or https://mightypeacewatershedalliance.org/resources/ .

Riparian Assessment

All field work was based on the procedure laid out by Cows and Fish in their Alberta Lentic Wetland Health Assessment (Survey) User Manual (https://cowsandfish.org/health-assessment-and-inventory-forms/). The riparian assessment conducted also included a modified littoral component.

Aquatic Rodent survey

Concerns about the level of beaver (*Castor canadensis*) and muskrat (*Ondata zibethicus*) activity was addressed by a preliminary survey of their activity in the Victor Lake vicinity. This was not a rigorous study due to the level of effort required for such a study but an initial reconnaissance to determine next steps. Beaver lodges, muskrat holes and evidence of rodent activity were visited on foot and an assessment of the activity and potential inference for population were completed.

Results

Community story

MMCA members and/or ancestors have used the Victor Lake area for as back as the memory of the community reaches. However, the creation Jasper National Park and the subsequent eviction radically changed how and when they use the area. The last families left Jasper National Park circa 1906. Even before the eviction, Victor Lake was a critical meeting area and waypoint for trade, travel and gatherings. After the eviction, MMCA presence became more continuous in the Victor Lake area and the number of residents increased.

Although, À la Pêche Lake was preferred for fishing with harvested species including Bull Trout (*Salvelinus confluentus*) and Dolly Varden (*Salvelinus malma*), Elders note that historically whitefish (probably *Prosopium willliamsoni*), Suckers (*Catostomus* spp.) and Arctic Grayling (*Thymallus arcticus*) were harvested from Victor Lake. It was a place with many berries such as Saskatoon (*Amelanchier alnifolia*), and a place where beaver (*Castor canadensis*) and muskrats (*Ondatra zibethicus*) were harvested for pelts

A rise in lake levels resulted in morphological changes that include the inundation of the peninsula at the south end of the lake and several islands that used to be farmland.

Concerns around the connectivity of the aquifers and the lake, the movement of animals between the aquifer and lake and impacts of the aquifer on lake health were identified by community members.

Current concerns include: the impact of the airstrip and highway primarily through surface run off and aerial deposition of sediments and other contaminants from these corridors; the increase in tourism and recreational use of the lake; the lack of public toilets at the lake; the increase of aquatic vegetation and the loss of riparian and upland vegetation; the channel between Victor Lake and Grand Cache Lake and the level control structure.

The following snippets capture some of the MMCA perspective on Victor Lake:

- No longer the same lake
- People from Victor Lake go to Grande Cache Lake to swim

During the 3 days of this workshop, several comments arose regarding the tragic drowning deaths that have occurred in Victor Lake. This seems to impart a sullen tone on the collective perception of the lake amongst MMCA members.

This project involved getting youth involved in stewardship of their lands and introducing them to environmental science work. Knowledge was relayed by elders and community members and the youth involved in this also contributed to the process and are critical to the community story for MMCA about Victor Lake. These people, their conversations, their knowledge and their action with regards to their lake will be critical in defining the future of the lake and how we manage it (Figure 1).

Figure 1. Photograph of MMCA members doing the riparian assessment.

Watershed Characterization

Watershed Characterization was completed as a desktop exercise by pulling together various data and analyzing it. The following sections were presented at the workshop July 22 as the first component of the riparian assessment.

Geography

Victor Lake is located near the hamlet of Grande Cache in the Smoky /Wapiti sub-watershed of the Peace Watershed (Figure 2) and is the Water Survey Canada Sub-Basin 07GA. Waters from Victor Lake flow towards the Little Smoky River and eventually into the Peace River.

Aerial Imagery

Historical air photos that capture the area of interest were identified and the two best photos were from 1975 and 1983. Accessing this satellite imagery allows a visual assessment of changed in lake shape and extent over the last 5 decades (Figure 3). The most distinct change that was noticed, is the straightening and expansion of the channel from Victor Lake to Grande Cache Lake between the years of 1975 and 1983.

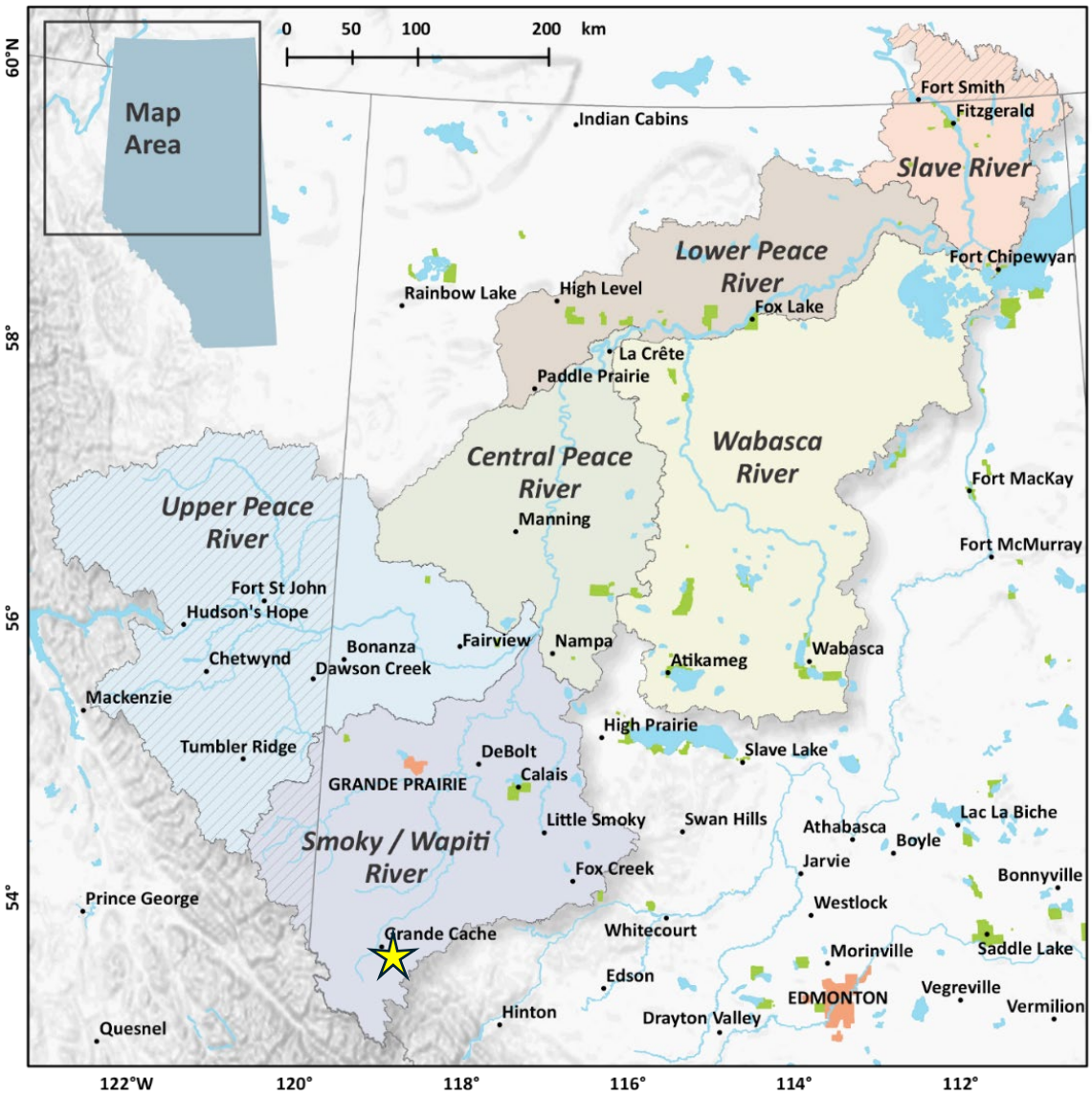


Figure 2. Map of the Peace and Slave Watersheds with Victor Lake identified (yellow star).

Figure 3. Aerial photos of Victor Lake from 1975 (on the left), 1983 (in the middle) and Bing satellite image accessed in 2024 (on the right).

The land cover breakdown reflects characteristics of the Montaine zone (Figure 4) in which the lake is found with primarily forest cover and sparse wetlands due to the steepness of the grade which encourages quick drainage(Alberta Tourism, 2015). This Rocky Mountain Natural Region ecozone has warm air masses that move through them and create a unique mix of flora and fauna. Only a portion of Grande Cache lies within the Victor Lake watershed and so the residential land use is mix of the eastern edge of the hamlet of Grande Cache and the Victor Lake Co-op on the southern edge of the lake. The high percentage of No Defined Human Footprint area in the lake watershed indicates that watershed function is probably good. It also highlights the importance of point sources of pollutions and localized land use in affecting lake function as well the importance of riparian zone function in maintaining lake quality.

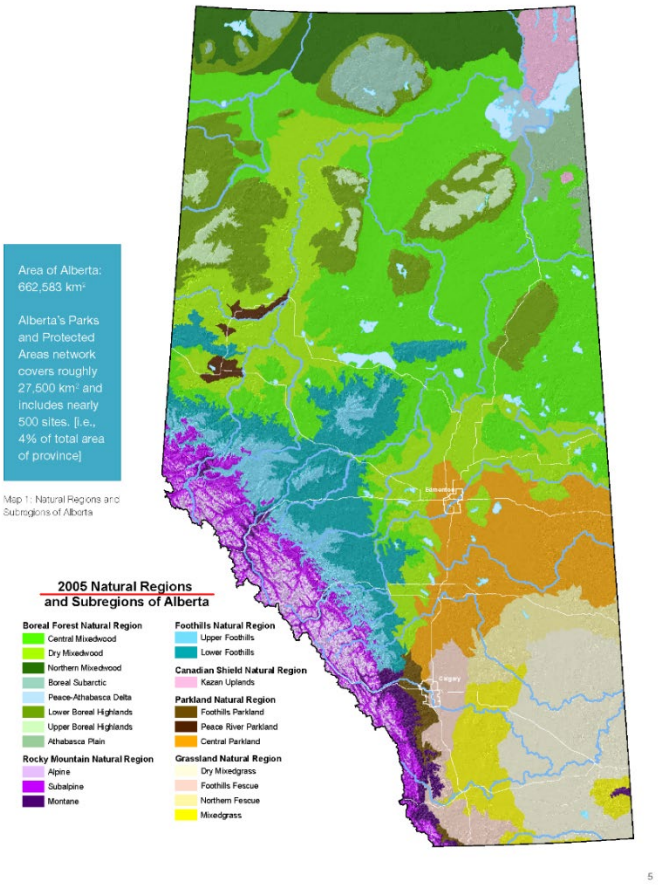


Figure 4. Subregion map of Alberta. Extracted form Alberta Parks. 2015. Natural Regions and Subregions of Alberta. A Framework for Alberta's Parks.

Bathymetry

The primary basin of Victor Lake is approximately 22 m deep and is located in the northeastern portion of the lake (Figure 5). At the west of the lake there is deeper enclave separated from the main portion of the lake by a shallower ridge. Although not really a distinct second basin it may be separated enough to have different characteristics. The surface area of the lake is 72.47 ha.

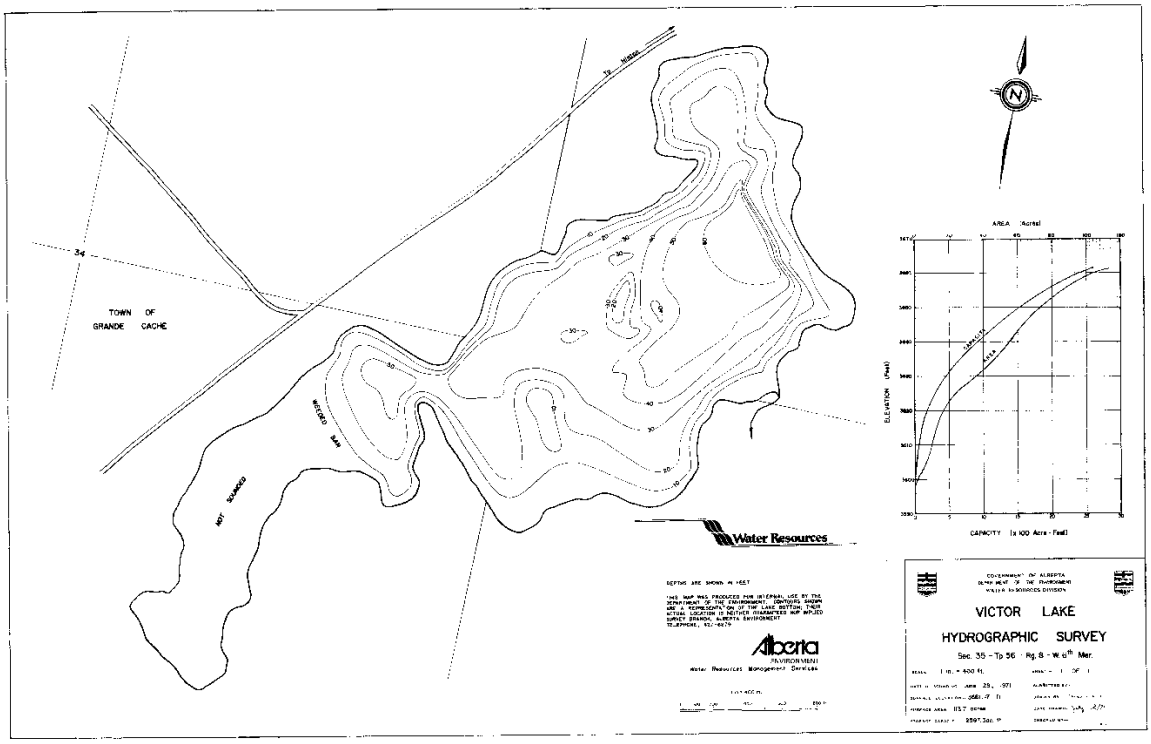


Figure 5. Bathymetric map of Victor Lake. Credit: Government of Alberta.

Hydrology

Victor Lake's surface area of 72.47 ha and watershed surface area of 997.81 ha results in a Watershed to Lake ration of 13.8:1. Lakes with smaller ratios are more dependent on a smaller surface are to contribute runoff and maintain lake levels. It is more dependent on the water yield of the smaller watershed and accordingly changes in land use could have a proportionally larger effect on lake hydrology. The lake has fluctuated just over 2 metres between the lowest level (1115.78 m) and the highest level (1118.00 m) recorded between the years of 1968 and 2023 (Figure 6). The average lake level for this time period was 1117.24 m.

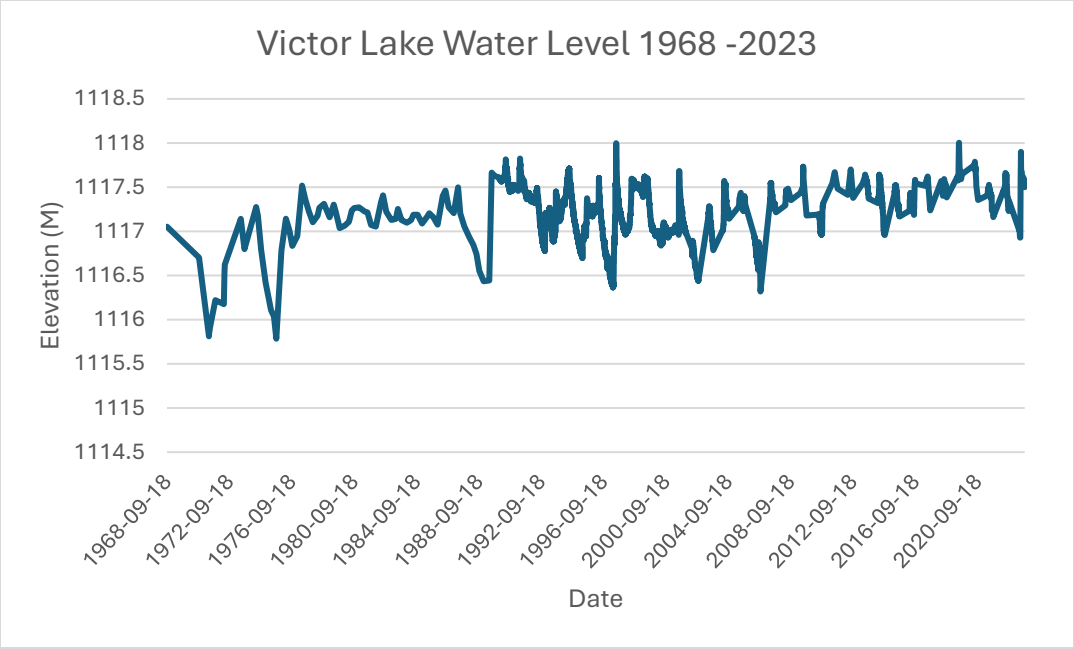


Figure 6. Graph of Victor Lake water levels from 1968 to 2023. Data obtained from Alberta River Basins.

The Alberta Flow Estimation Tool For Ungauged Watersheds was used to estimate flows through the channel from Victor Lake to Grande Cache Lake (Figure 7).

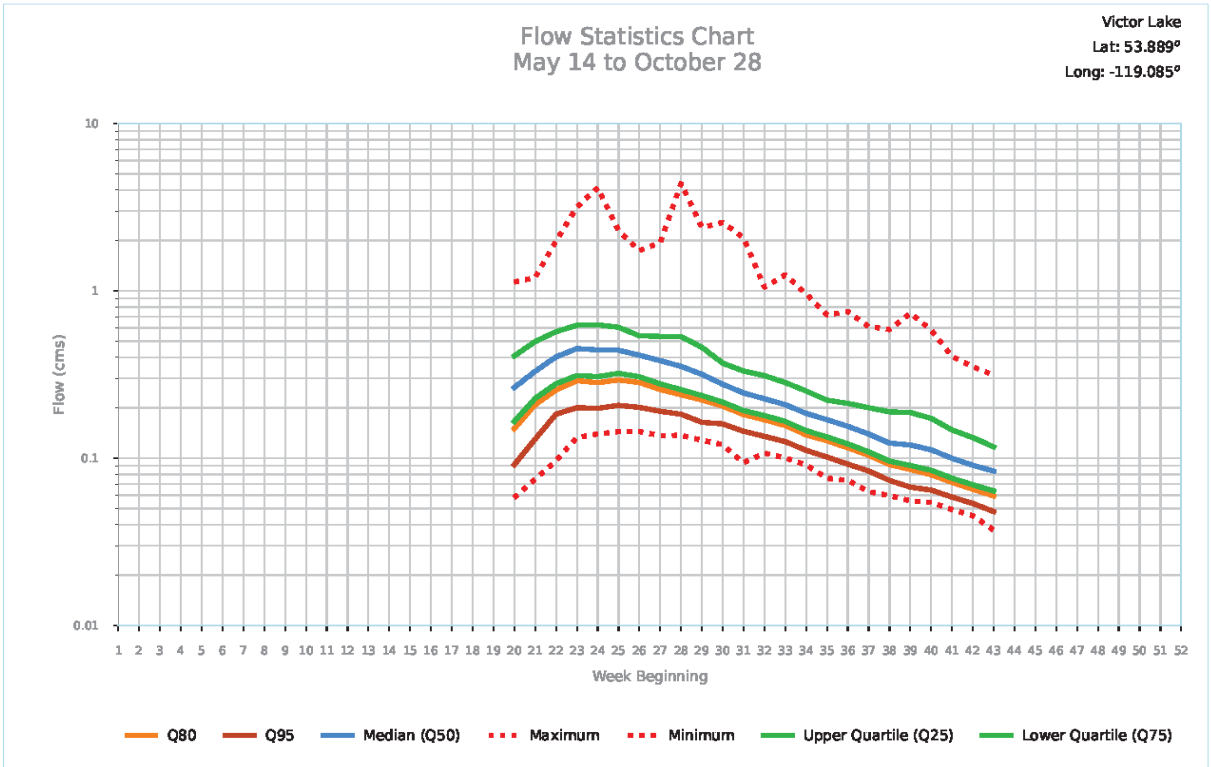


Figure 7. Flow Statistic Chart for Victor Lake produced by Alberta Flow Estimation Tool For Ungauged Watersheds.

Water levels have remained relatively constant since 1975, which coincides with verbal reports that the construction of the channel and level control structure between Victor Lake and Grande Cache Lake occurred around this time. A search of Government of Alberta licence only yielded Grande Cache's Licence to Divert and Use Water (Licence No. 09498). This Licence is for withdrawal from both Victor Lake and Grande Cache Lake but the only potential reference to the channel between the lakes (Figure 8) is "diversion ditch" and nothing is mentioned about the control structure that is present (Figure 9). MMCA communities identified large changes in water levels as the Grande Cache community was establishing (incorporation 1966) and this aligns well with level fluctuations seen prior to 1976 when the lake entered a period of more consistent levels.

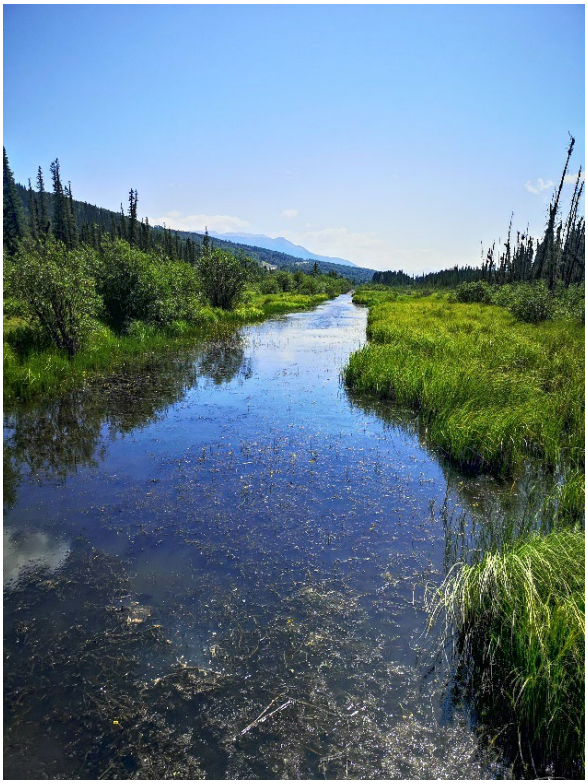


Figure 8. Photo of the channel between Victor Lake and Grande Cache Lake.

Water quality

Although multiple years of sampling in both the summer and winter season occurred, just the Summer LakeKeepers 2022 report(Sinn & Peter, 2023) will be reviewed here as representative of the sampling events. Victor Lake is an oligotrophic lake, meaning that is has low productivity and is generally the water is not green but clear. Readings for Average Surface Total Phosphorous of 4.2 µg/L, Average Surface Total Kjeldahl Nitrogen of 0.6 µg/L, Average Surface Chlorophyll-a of 1.8 µg/L and a euphotic depth of 9.2 m all indicate an oligiotrophic (limited nutrient) status[3]. The nitrogen and phosphorous values reflect a low availability of nutrients in the water column that is available for aquatic vegetation. Chlorophyll is measurement of aquatic vegetation presence in the water column, and this is also low. Euphotic depth refers to the depth to which sunlight penetrates the water column and is available to plants. This is a measure of how clear the water in a lake is and Victor Lake has very clear water, meaning that there is little in the way of sediment or algae that is obstructing transparency.

[3] Water indicators – Lake trophic status | Alberta.ca https://www.alberta.ca/water-indicators-lake-trophic-status

Victor Lake has a smaller watershed to lake surface ratios (13.8:1) and this typically correlates with better water quality simply because there is less watershed area from which runoff can collect contaminants. For instance, this can result in lower nutrient loadings, which aligns well with the oligotrophic status of this lake. However, the lake watershed effects on water quality depend on many variables including area, land cover, land use, watershed chemistry and watershed transport capacity (Fraterrigo & Downing, 2008).

Figure 9. Photograph of control structure in channel between Victor Lake and Grande Cache Lake taken from the north bank on July 23, 2024

The control structure in the channel appears to contain creosote and there may other preservatives present. Very possibly, the structure may have in the past or may still be releasing contaminants into the water. No analysis was completed to determine if contaminants are leaching out of the control structure.

Fish community

Fish Community can be an indicator of lake health due to population responses to anthropogenic activities on the landscape(Jacobson et al., 2017). The Fish and Wildlife Internet Mapping Tool returned the following list of species for Victor Lake: Brook Trout (*Salvelinus fontinalis*), Burbot (*Lota lota*), Longnose Sucker (*Catostomus Catostomus*), Pearl Dace (*Margariscus margarita),* Rainbow Trout (*Oncorhynchus mykiss*) and White Sucker (*Catostomus commersoni*). Both Brook Trout and Rainbow Trout were introduced. Although no age-class assessment or recruitment study was completed, this assemblage of species is consistent with this habitat (see (Joynt & Sullivan, 2003)). The presence of multiple pairs of Osprey (*Pandion haliaetus*) and a pair of Bald Eagle (*Avis prede*) while completing the riparian survey lends anecdotal support to a healthy fish population.

Management

The Source Water Protection Plan – Victor Lake and Grande Cache(Associated Engineering, 2015) is water management plan focussed specifically on Victor Lake, and the connected Grande Cache Lake, as the source water body for Grande Cache. Maintaining good water quality is the ultimate goal of a source water protection in order to reduce the likelihood of drinking water contamination. Although there is not complete alignment between the risks identified by the plan and concerns identified by the community members it is very similar. For instance, the plan ranks transportation as the highest risk, followed by wastewater systems. Development and recreational use were ranked lower in the plan but are identified a major concern by MMCA. Many of the recommendations of the plan align with management action that MMCA indicated they would like to see take place. Some specific examples of recommendations that are identified in both are the Highway 40 drainage assessment and upgrades, reclaiming the airstrip within 30 m of the high-water mark, installing washroom facilities at Victor Lake and monitoring of lake water quality. MPWA strongly encourages MMCA and the MD of Greenview to work collaboratively on these items for the improved management of Victor Lake to support a resilient, functioning lake ecosystem.

The MD of Greenview has also created a wetland on the west side of Victor Lake to help provide extra runoff filtration, however it is not located in the main path of runoff from the highway (Figure 10). Thus, its ability to prevent contaminant delivery to the lake is limited.

Figure 10. Map of Victor Lake, the created wetland (in yellow) and the location of the highway.

Riparian Assessment

Polygon selection

With the intent to identify potential problems, the most heavily impacted segment of shoreline was selected as the polygon for the riparian assessment (Figure 11). This area is defined by activities such as boat (kayak, canoe) launching, angling, dog walking, OHV use and general recreation (Figure 38). The riparian assessment score for this area will reflect the most degraded portion of the riparian zone around the lake. Corner points were established on this polygon to capture some of the littoral zone.

Figure 11. Location of Riparian assessment of Victor Lake is shown in red.

Littoral zone

A scan of the littoral zone was completed using waders in the littoral zone at both ends of the polygon as the polygon corner points were established and also at a path/launching area. Additionally, the littoral zone was examined from the shore along the full polygon length. This scan was to look for invasive weeds and to assess aquatic vegetation. This area was not used in calculating the riparian assessment score.

No invasive species were identified but vigorous growth of native species dominated by pondweed (*Potamogeton* spp.) (Figure 12 & Figure 39) with the presence of a few emergent plants such as Water

Figure 12. Photograph of polygon littoral zone with vigorous native aquatic vegetation.

Figure 13. Photograph of Water smartweed in polygon littoral zone.

smartweed (*Persicaria amphibia*) (Figure 13) indicate a healthy and functioning littoral zone.

Vegetative Cover

A transect approach was taken for the vegetative cover assessment. The polygon was traversed and as a group the percentage of vegetative cover was estimated using a running tally. This polygon was well vegetated with 85 – 90% of the area vegetated (Figure 40).

Invasive species

No invasive species were found in the riparian zone, either on land or in the water.

Disturbance-increaser species

There were a few species present that can indicate disturbance including common dandelion (*Taraxacum officinale*), yellow sweet clover (*Melilotus officinalis*) and common plantain (*Plantago major).* However, the area covered by these species was estimated at just 2% of the polygon.

Preferred Tree and Shrub establishment

The polygon had a low score in this category reflecting a well-established mature stand of woody vegetation. 3% of the area was estimated to have preferred tree and shrub establishment.

Browse Utilization of Preferred Trees and Shrubs

No ungulate browsing was identified and accordingly none of the available second year and older leaders were browsed.

Live Woody Vegetation Removal Other than Browsing

There was some beaver activity removing live woody vegetation and some of anthropogenic removal. With an estimated 11% of woody vegetation removed, this polygon fell into the light category

Human Alteration of Polygon Vegetation

Alteration exists primarily in the form of the road and trails, which constitute about 13% of the polygon.

Physical site altered by human activity

Site alterations consisted again of the road and trails used to access the shore. In this polygon it was estimated to be 13%, however the severity was scored as severe due to the permanent nature of the alteration and the lack of vegetation on the altered area.

Human caused bare ground

As above, approximately 13 % of the site was bare ground on the road and trails.

Degree of artificial change of water level

Both the control structure in the channel between the two lakes and the water intake for the Town of Grande Cache were considered in assessing this. The control structure in the channel provides some stabilization of low levels, whereas the intake has the potential to draw down lake levels. Overall, lake levels do not exhibit excessively large fluctuations, and the shoreline did not have bare ground or the presence of species that prefer disturbance suggesting that lake levels are not fluctuating a lot.

Polygon trend

The overall trend has been identified as static to degrading. There has been no major alteration of the riparian zone since the establishment of the road and trails, however this area is experiencing an increase in use.

Overflow structure

Currently, the ownership and management of the control structure in the channel between the two lakes is not well understood and no licence for it was found. Maintaining water levels for the Town of Grande Cache is assumed to be the reason for the control structure.

Even should this structure be removed, the effect on Victor Lake water levels would probably be minimal as the surface elevation of Victor Lake and Grande Cache generally vary by only a few centimetres.

Shoreline rock

The shoreline has a lot of cobbles and those areas where cobbles are not present tend to be well vegetated.

Vegetation use by animals

Only moderate beaver and muskrat activity were identified within the polygon during this assessment.

Susceptibility of parent materials to erosion

Soils in the polygon are the product of weathering of Rocky Mountain stone (plus the addition of organic faction from decomposition) yield soils that more resistant to erosion than soils that are primarily clay in composition (Cows and fish, 2023). Plentiful cobbles also reduce the susceptibility to erosion and results in this category being rated as low.

Percent of shoreline accessible to large animals

There is no grazing of livestock that occurs here.

Percent of tree and shrub cover on the polygon that is decadent

Less than 1% of the canopy is estimated to be decadent (dead or dying).

Primary Land Use Sector

Recreation is the primary land use here. While conducting the assessment, dog-walking, kayaking and angling in the polygon were all observed (Figure 38). People were riding dirt bikes in the adjacent area while the assessment was taking place, but not in the riparian zone polygon.

Table 1. Estimated land use percentage for the polygon and adjacent area.

Land use	Percentage of polygon with this land use	Percentage of adjacent area with this land use
No Land Use Apparent	80	20
Recreation	10	20
Roads	10	60

Rating Calculation

Calculating the final riparian health assessment score involves summing the actual scores (Table 2) and then dividing by the possible scores (Table 3). Overall, this stretch of riparian zone is "Functional At Risk" or "Healthy, but with Problems". The vegetation component scored higher, 72.7% than the soils/hydrology component, 68.37%. It is important to bear in mind that this is the most impacted stretch of riparian zone on Victor Lake and as such it is to be expected that a large portion of the riparian zone for the whole lake would be classified as "Proper Functioning Condition" or "Healthy".

Table 2. Riparian question scores.

Riparian questions	Actual Score	Possible Score
Vegetative cover of the polygon	4	6
Invasive plant species canopy cover	3	3
Invasive plant species density distribution	3	3
Disturbance-increaser undesirable herbaceous species	3	3
Preferred tree and shrub establishment and regeneration	2	6
Browse utilization of preferred trees and shrubs	3	3
Woody vegetation removal other than browsing	2	3
Human alteration of polygon vegetation	4	6
Vegetation Subtotal	24	33
Percent of polygon physical site altered by human activity	8	12
Severity of human-caused alteration of polygon physical site	0	3
Human caused bare ground	2	6

Degree of artificial change of water level	9	9
Soil/Hydrology sub-total	19	30
Overall Polygon Total	43	63

Table 3. Final ratings for polygon riparian health.

	Actual Score	Possible Score	Percentage
Vegetation rating	24	33	72.7
Soil/Hydrology rating	19	30	63.3
Overall	43	63	68.3

Aquatic rodent survey

MMCA has placed several wildlife cams in the vicinity of beaver lodges and in areas where beaver and/or muskrat activity has been observed. Additionally, they have used drones to conduct an aerial survey of portions the aquatic environment around Victor Lake and the channel. Beavers are ecosystem engineers and work to modify water levels to their benefit, which can result in greater water fluctuation levels or in some cases stabilization levels. From the northern shore of Victor Lake where the riparian survey was conducted only two beaver lodges were identified.

With MMCA's existing knowledge, the survey involved visiting several muskrat burrows, primarily in the channel (magenta in Figure 14), and beaver lodges, in the power pond (red in Figure 14).

At each location, evidence of fresh activity was assessed such as fresh cuttings in front of beaver lodge (Figure 15). Muskrats are known to primarily consume herbaceous vegetation and beaver are known to primarily consume woody vegetation(Eder, 2011).

To understand the beaver and muskrat population in this area better, it suggested to continue with this form of survey to develop on understanding of the population trend.

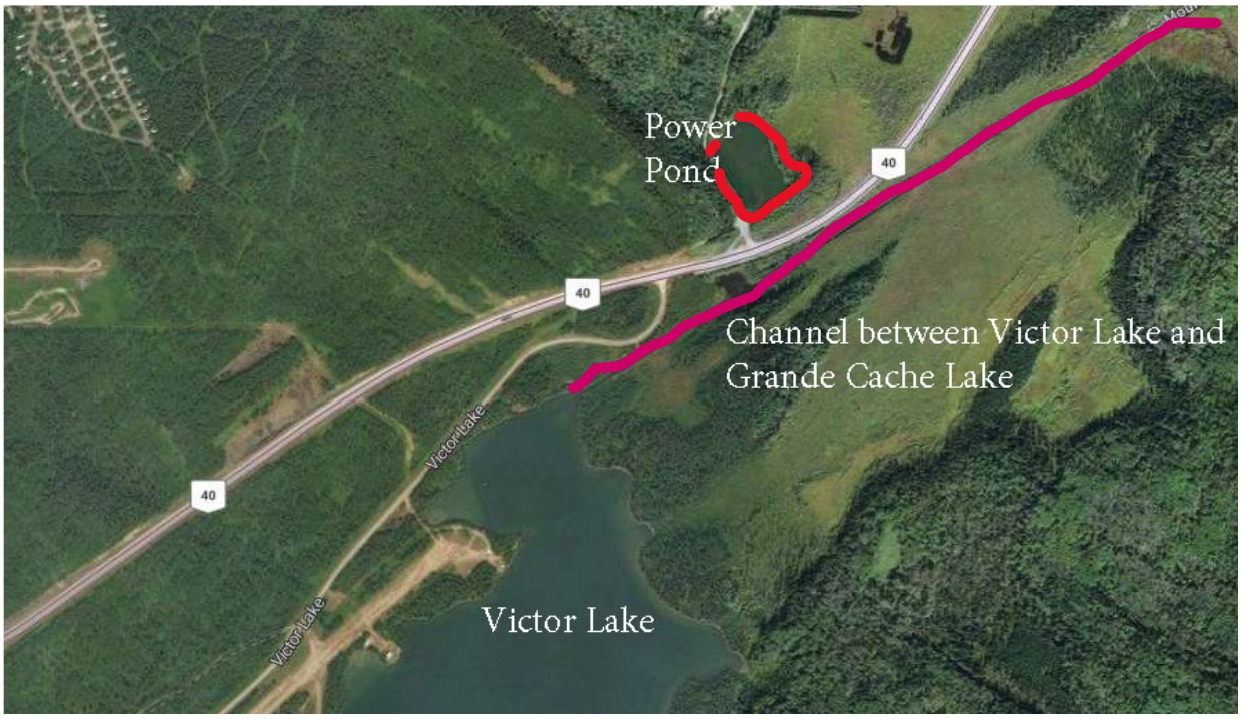


Figure 14. Map of Victor Lake, channel between Victor Lake (fuscia) and Grande Cache Lake and Power Pond (red).

Figure 15. Photograph in front of a beaver lodge on the Power Pond with fresh branches in front of it.

Conclusion

The riparian assessment indicates that the most impacted section of riparian zone on Victor Lake is functional but at risk. Overall, the riparian zone is assumed to be in good condition due to the lack of disturbance identified in most of it. Water quality monitoring indicates that the water quality is good. The presence of fish-eating birds, the lack of invasive species, and fulsome native vegetation are also very positive for the state of the lake ecosystem.

Hazards to the Victor Lake ecosystem that were documented during the assessment include the airfield, increasing recreation at the lake, contaminants from Highway 40 and the control structure in the channel between to the two lakes.

As all of these are identified as hazards in the Source Water Protection Plan, the recommendation is to work collaboratively with the MD of Greenview to address them. Reclamation of part or all of the airstrip would improve the buffer for the lake. Victor Lake offers great recreational opportunities, but this activity should be managed to sustain it into the future. Major transportation corridors, such as Highway 40, also pose a potential risk to lake ecosystems and any proactive review of drainage from the highway and spill response would be highly beneficial. It is recommended to identify the owner of the control structure, commission a study to understand what effect it is having, and if feasible to remove it.

A functioning and ”healthy” Victor Lake ecosystem will be able to maintain its processes, be resilient to disturbance and support the community and community values. Proactive management to maintain or improve the lake ecosystem is the most efficient and effective approach to ensuring Victor Lake retains its function and value to the community. The above recommendations follow this approach and should serve to increase those involved in lake stewardship.

Appendix A – Source Water map

Source Water map for Victor and Grande Cache Lake created by Mighty Peace Watershed Alliance and the Government of Alberta.

Victor Lake Watershed

Grande Cache Waterworks System

The information contained in this document is provided on an "as is" basis with no guarantees of completeness, accuracy, usefulness or timeliness. This document has been created using available information and should be considered a work in progress. Details on communities serviced, facilities used for treating and transporting potable water and users need to be verified. Users of this information should bear this in mind.

AUTHORIZATION APPROVAL

Water Source: Victor Lake

Authorization ID: 720

System Name: Grande Cache Waterworks System

Municipality: Municipal District of Greenview No. 16

Water Source Type: Surface Water

Regulating Agency: Alberta Environment and Parks

Water Act File:

Approval Holder: Hamlet of Grande Cache

SOURCE WATER WATERSHED

Victor Lake and Grande Cache Lake are Grande Caches drinking water sources.

Grande Cache is a hamlet within the Municipal District of Greenview No. 16. It is located on Highway 40 approximately 145 kilometres northwest of Hinton and 435 kilometres west of Edmonton.

Victor Lake and Grande Cache Lake watershed includes all the land that surrounds drainage lines flowing into the lake to make a watershed of approximately 997.81 ha for Victor Lake and 3357.886138 ha for Grande Cache Lake.. It is part of the Smoky River Sub-Basin within the Peace River Watershed.

Residents from Grande Cache and surrounding communities rely on the drinking water source.

COMMUNITIES SERVICED

TOWN	NA
HAMLET	Grande Cache
VILLAGE	NA
LOCALITY / SUBDIVISION	Joachim, Victor Lake and Susa Creek
FIRST NATION / METIS	NA

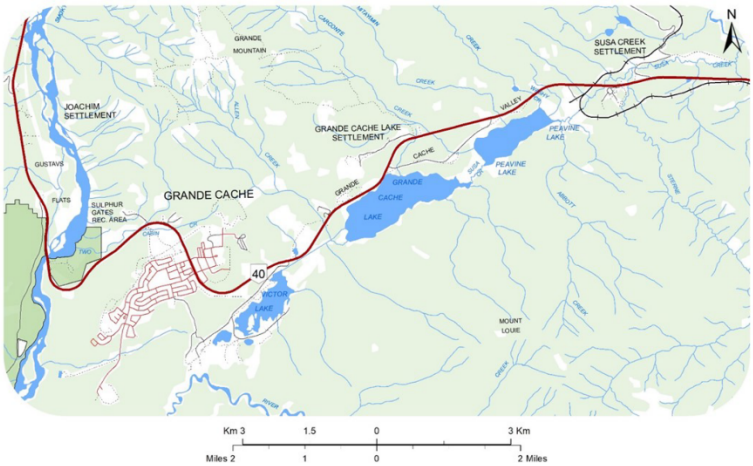
MAP OF WATERSHED

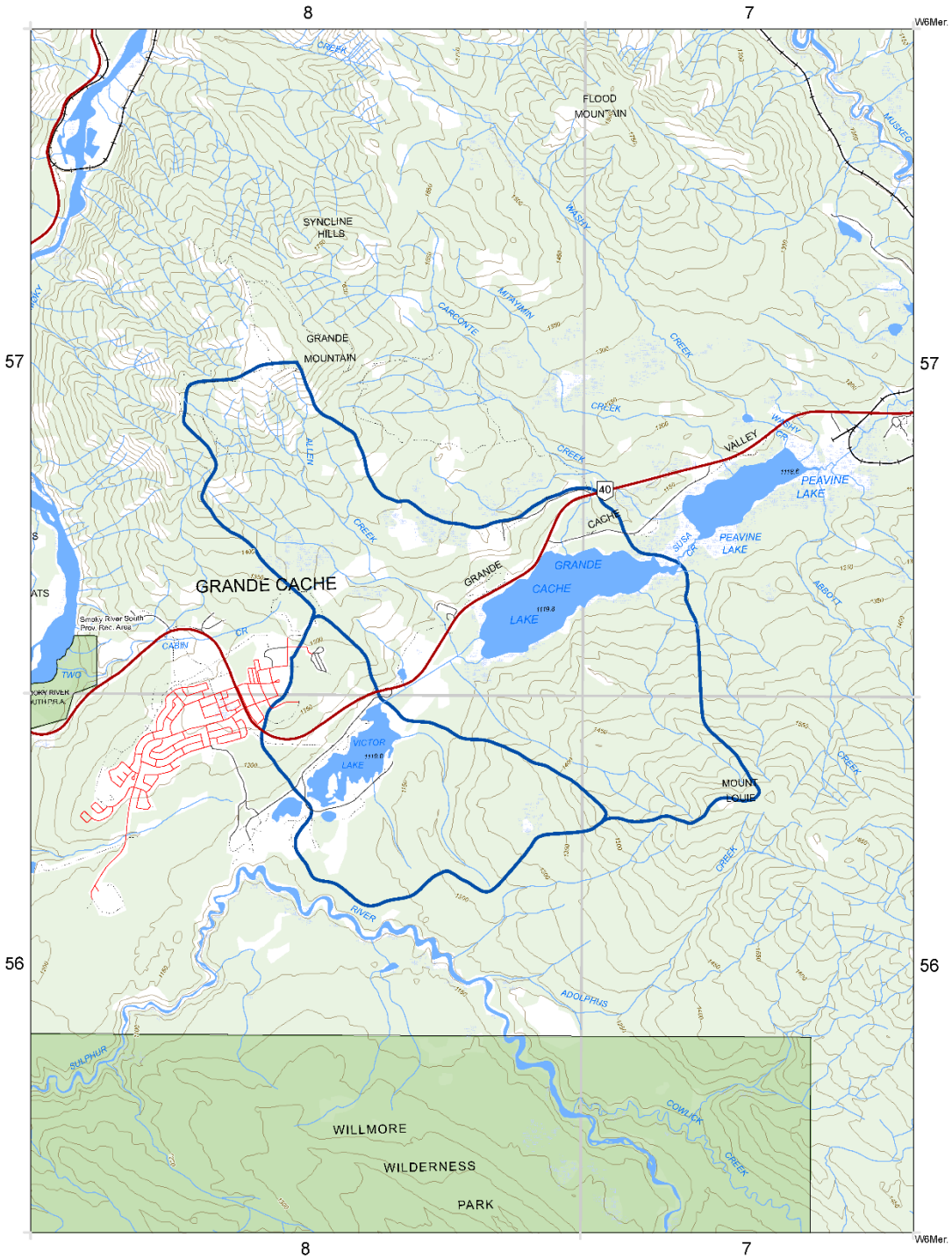
Click here to View Watershed in Google Maps

FACILITIES

- Surface Water Intake
- Water Treatment Plant – Class II
- Water Distribution System - Class I
- Treated Water Reservoir

RESIDENTIAL AREAS SERVICED





Victor Lake & Grande Cache Lake Watershed

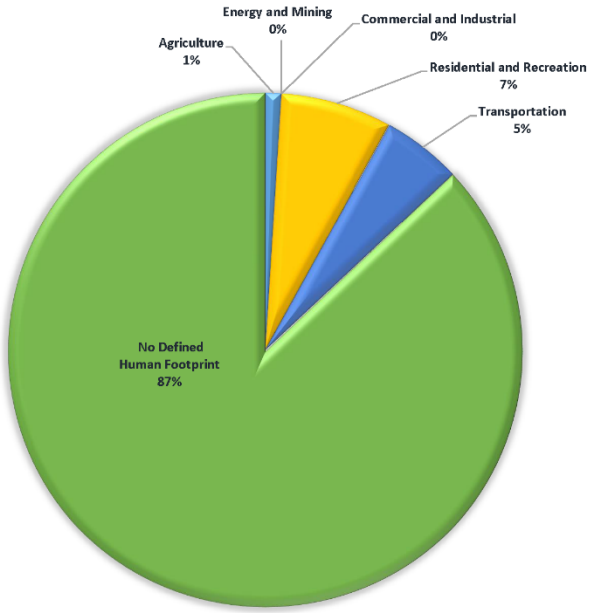
Km 3 1.5 0 3 Km
Miles 2 1 0 2 Miles

Drinking Water Intake Upstream Watershed
Highway - Paved
Paved Road
Gravel Road
Unimproved Road
Contour Index 50m
Wetland
Forested Area

Alberta Environment and Parks

CUMULATIVE EFFECTS OF HUMAN FOOTPRINT

Percentage of Human Footprint by Category



	Human Footprint Total (Ha)	Human Footprint % of Watershed
Agriculture	**11.13**	**1.1**
Cultivation (Crop/Pasture/Bare Ground)	**11.13**	**1.1**
Rough Pasture	11.13	1.1
Commercial and Industrial	**0.97**	**0.1**
Industrial Site Rural	**0.97**	**0.1**
Unknown Facility	0.97	0.1
Energy and Mining	**3.95**	**0.4**
Seismic Line	**3.95**	**0.4**
Trail	3.95	0.4
Residential and Recreation	**70.03**	**7.0**
Other Disturbed Vegetation	**8.45**	**0.8**
Golf Course	6.50	0.7
Recreation	1.95	0.2
Rural (Residential/Industrial)	**61.58**	**6.2**
Country Residence	24.92	2.5
Rural Residence	0.76	0.1
Urban Industrial	35.90	3.6
Transportation	**47.16**	**4.7**
Road - Hard Surface	**15.71**	**1.6**
2 Lane Gravel Road	10.50	1.1
2 Lane Paved Road	0.58	0.1
3 Lane Paved Road	3.33	0.3
Unimproved Road	1.30	0.1
Road - Vegetated Verge	**31.45**	**3.2**
Vegetated Road Edge	31.45	3.2
No Defined Human Footprint	**864.56**	**86.6**
Grand Total	**997.81**	**100.0**

Human Footprint data was used to produce maps, tables and charts:
ABMI Human Footprint Inventory: *Wall-to-Wall Human Footprint Inventory*. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020.

Victor Lake Watershed

Human Footprint Inventory (HFI)

Km 1 0.5 0 1 Km

Miles 0.5 0.25 0 0.5 Miles

Drinking Water Watershed

HFI Inventory

Road

Other Disturbed Vegetation

Industrial Site Rural

Rural (Residential/Industrial)

Seismic Line

Cultivation (Crop/Pasture/Bare Ground)

No Defined Human Footprint

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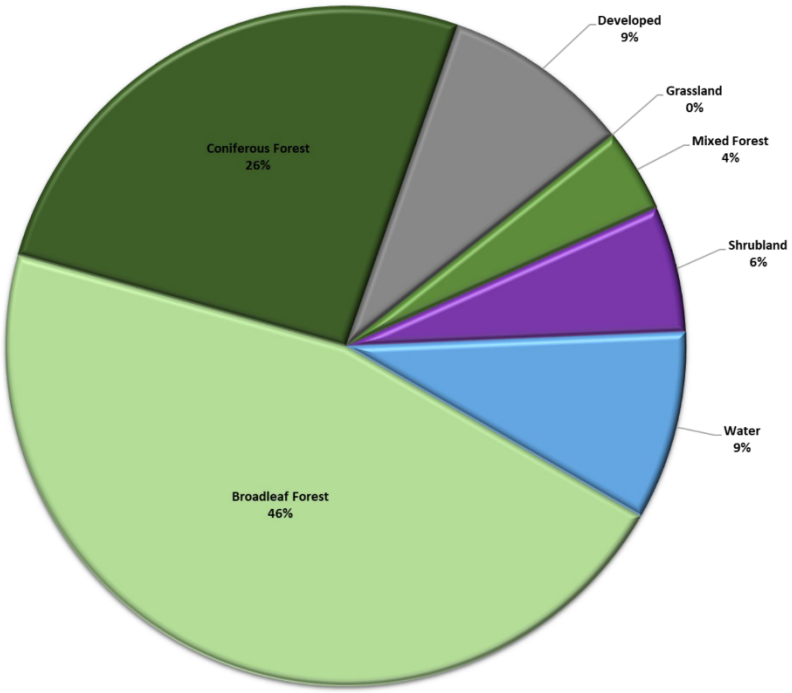
ABMI Human Footprint Inventory: Wall-to-Wall Human Footprint Inventory 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020.

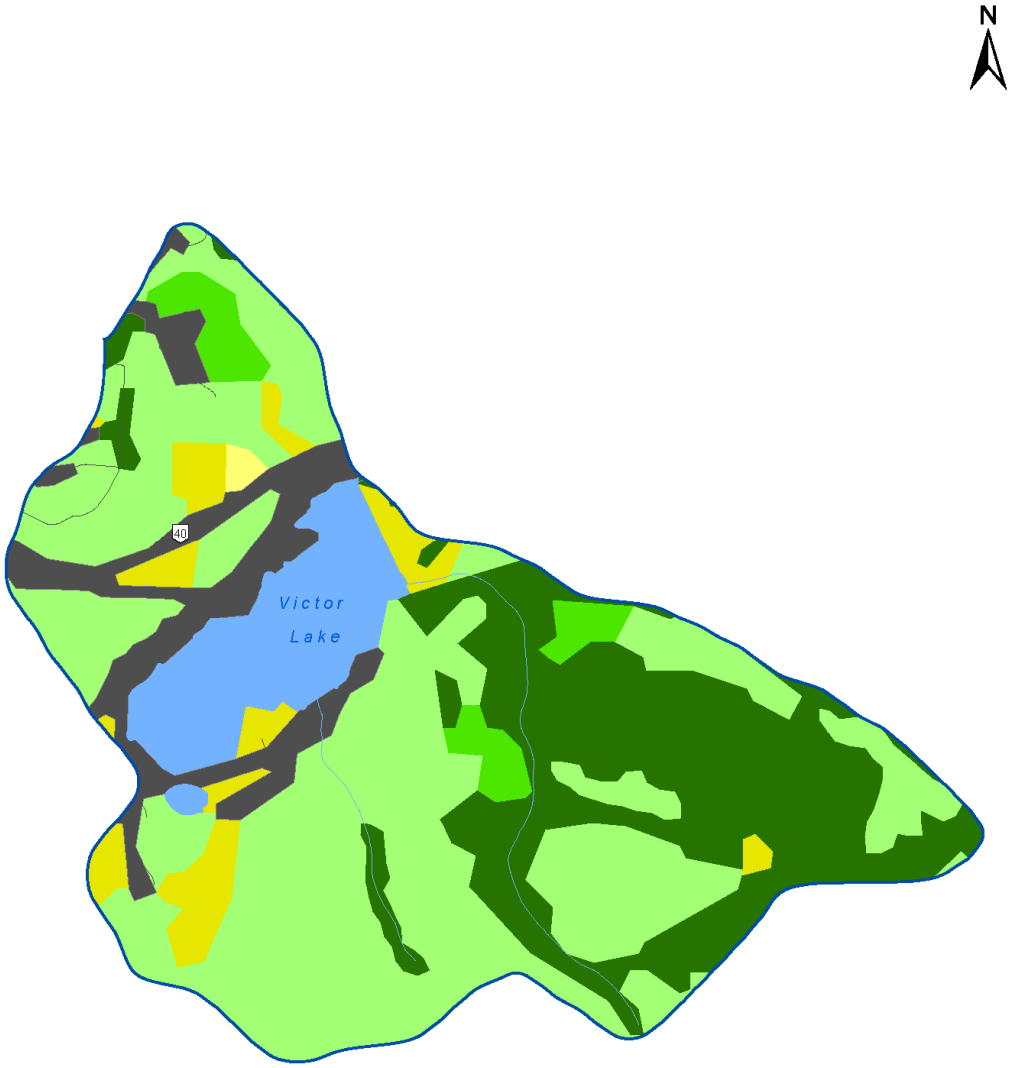
LAND COVER CLASSIFICATION

Percentage of Land Cover within Watershed



Land Cover Class	Total Area (HA)	Percentage of Watershed
Agriculture	0.00	0%
Broadleaf Forest	463.25	46%
Coniferous Forest	253.95	26%
Developed	93.43	9%
Exposed Land	0.00	0%
Grassland	3.30	0%
Mixed Forest	35.21	4%
Rock/Rubble	0.00	0%
Shrubland	59.83	6%
Snow/Ice	0.00	0%
Water	88.84	9%
Grand Total	**997.81**	**100%**

Land Cover data used to produce maps, tables and charts.
ABMI wall-to-wall Land Cover circa 2000, Version 2.1: ABMI Remote Sensing Group, August 2012.
ABMI (Alberta Human Footprint Monitoring Program).



Victor Lake Watershed
Land Cover

Km 1 0.5 0 1 Km
Miles 0.5 0.25 0 0.5 Miles

Access
Drinking Water Watershed

Land Cover
Developed
Water

Coniferous Forest
Mixed Forest
Broadleaf Forest

Shrubland
Grassland

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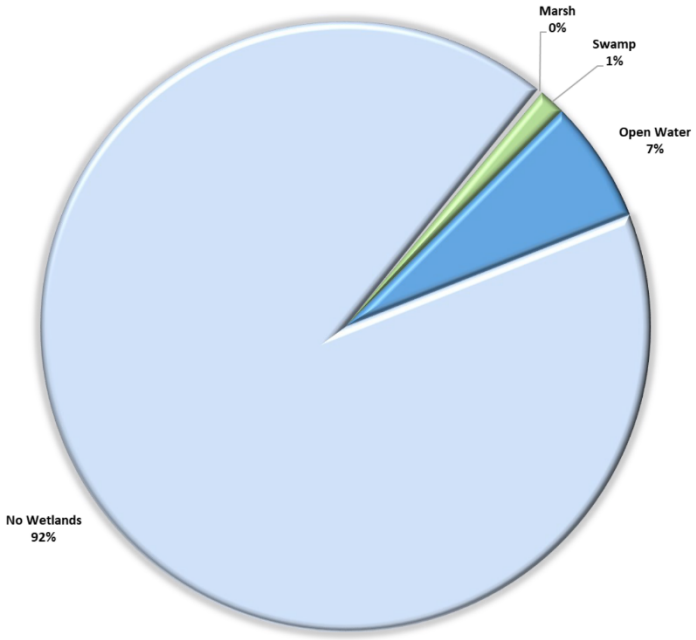
ABMI wall-to-wall Land Cover circa 2000, Version 2.1:
ABMI (Alberta Human Footprint Monitoring Program)
Remote Sensing Group, August 2012

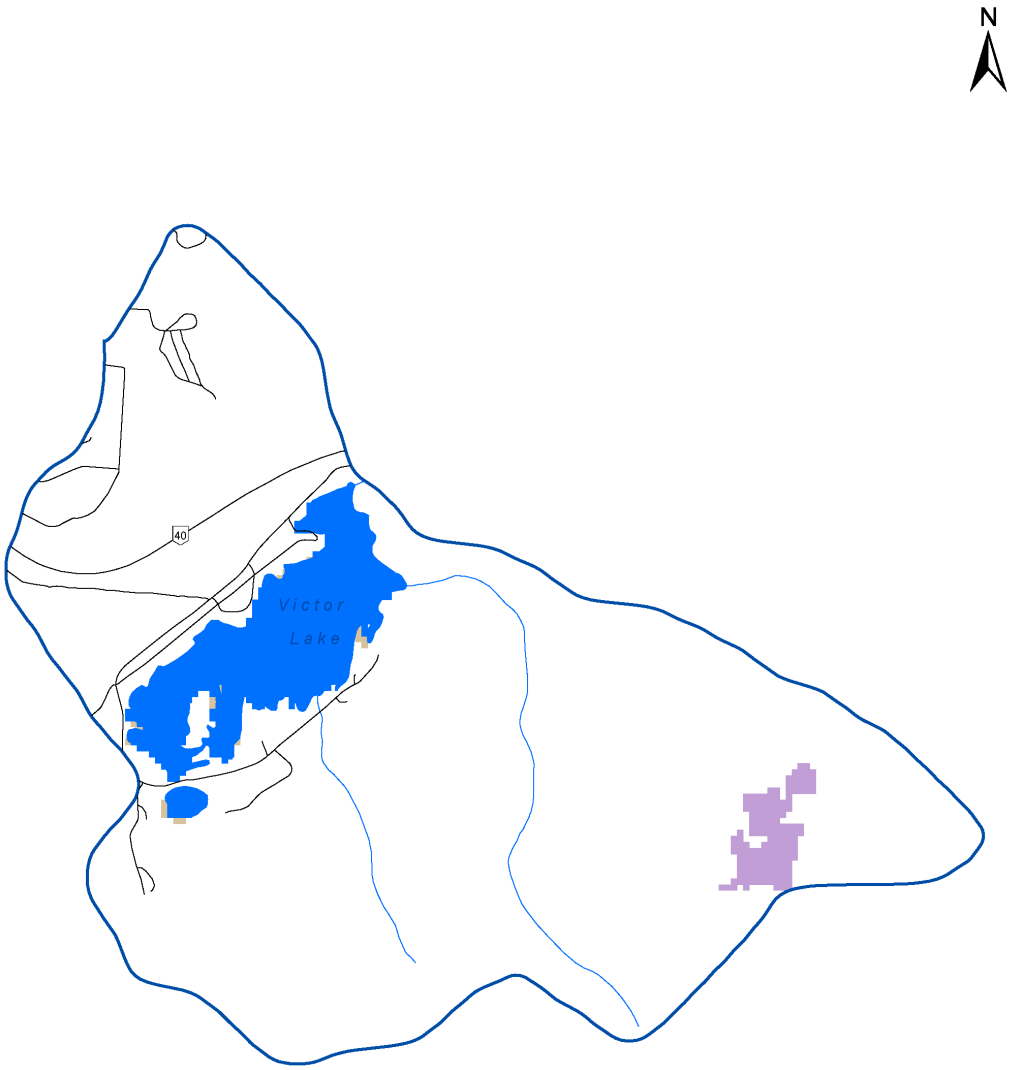
WETLANDS CLASSIFICATION

Percentage of Wetlands by Category



	Area (ha)	% of wetlands within watershed
Bog	0.0	0%
Fen	0.0	0%
Marsh	2.7	0%
Swamp	14.1	1%
Open Water	64.9	7%
No Wetlands	916.1	92%
Grand Total	**997.8**	**100%**

Wetlands data used to produce maps, tables and charts.
The Alberta Merged Wetland Inventory depicts wetlands within the province of Alberta, Canada for the period 1998 to 2015 classified to the five major classes in the Canadian Wetland Classification System (CWCS). These five major classes include bog, fen, marsh, swamp and shallow open water. For the purposes of this inventory, shallow open water includes all open water.



Victor Lake Watershed

Wetlands

Km 1 0.5 0 1 Km

Miles 0.5 0.25 0 0.5 Miles

Drinking Water Watershed

Wetlands Class

Open Water

Swamp

Bog

Fen

Marsh

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The Alberta Merged Wetland Inventory depicts wetlands within the province of Alberta, Canada for the period 1998 to 2015 classified to the five major classes in the Canadian Wetland Classification System (CWCS). These five major classes include bog, fen, marsh, swamp and shallow open water. For the purposes of this inventory, shallow open water includes all open water.

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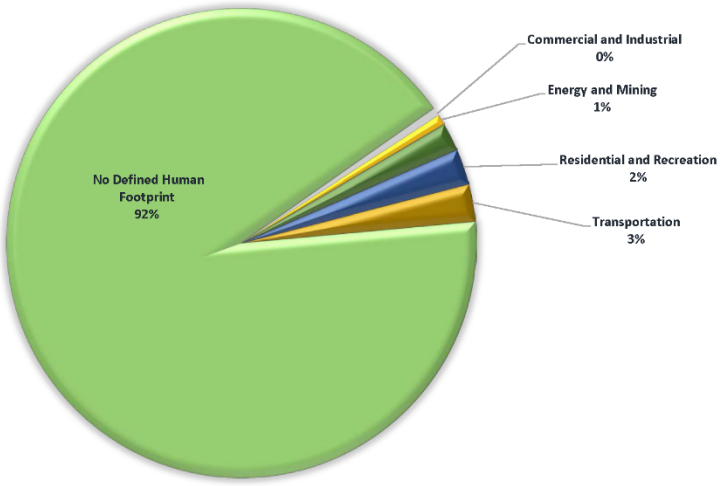
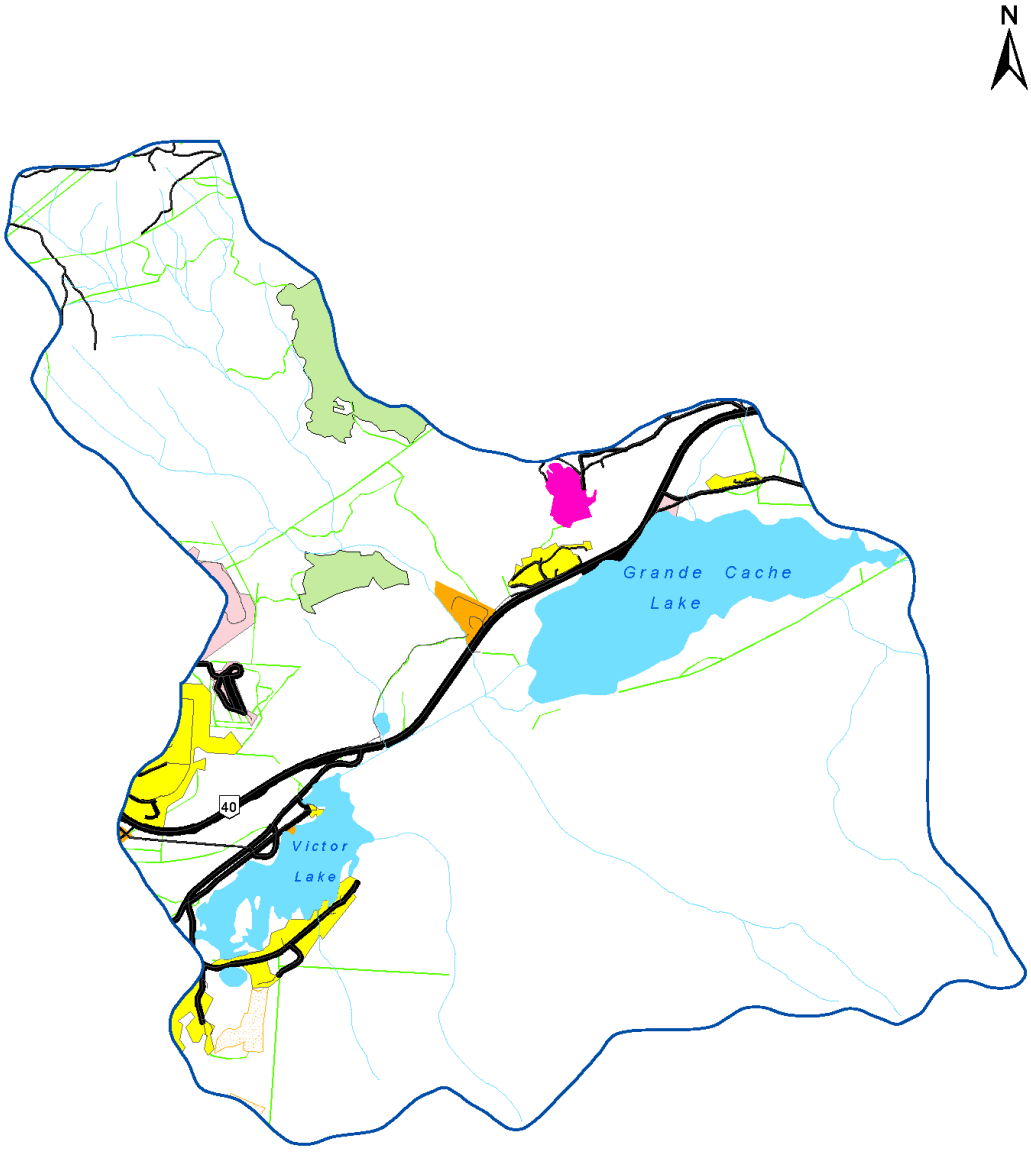
CUMULATIVE EFFECTS OF HUMAN FOOTPRINT

Percentage of Human Footprint by Category



	Human Footprint Total (Ha)	% of Human Footprint in Watershed
Agriculture	**11.13**	**0.3%**
Cultivation (Crop/Pasture/Bare Ground)	**11.13**	**0.3%**
Rough Pasture	11.13	0.3%
Commercial and Industrial	**10.46**	**0.3%**
Industrial Site Rural	**10.46**	**0.3%**
Unknown Facility	10.46	0.3%
Energy and Mining	**25.87**	**0.8%**
Mine Site	**11.77**	**0.4%**
Gravel/Sand Pit	11.77	0.4%
Seismic Line	**14.10**	**0.4%**
Conventional Seismic	3.09	0.1%
Trail	11.01	0.3%
Forestry	**70.88**	**2.1%**
Cut Blocks	**70.88**	**2.1%**
Harvested Area	70.88	2.1%
Residential and Recreation	**91.61**	**2.7%**
Other Disturbed Vegetation	**17.20**	**0.5%**
Golf Course	13.73	0.4%
Recreation	3.47	0.1%
Rural (Residential/Industrial)	**74.41**	**2.2%**
Country Residence	37.75	1.1%
Rural Residence	0.76	0.0%
Urban Industrial	35.90	1.1%
Transportation	**94.00**	**2.8%**
Road - Hard Surface	**32.63**	**1.0%**
1 Lane Gravel Road	2.82	0.1%
2 Lane Paved Road	3.86	0.1%
2 Lane Undivided Paved Road	4.59	0.1%
2 Lane Unpaved Road	10.80	0.3%
3 Lane Paved Road	3.47	0.1%
Truck Trail	3.46	0.1%
Unclassified Road	1.23	0.0%
Unimproved Road	2.40	0.1%
Road - Vegetated Verge	**61.37**	**1.8%**
Vegetated Road Edge	61.37	1.8%
No Defined Human Footprint	**3,053.94**	**90.9%**
Grand Total	**3,357.89**	**100.0%**

Human Footprint data was used to produce maps, tables and charts:
ABMI Human Footprint Inventory: *Wall-to-Wall Human Footprint Inventory*. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020.



Grande Cache Lake Watershed

Human Footprint Inventory (HFI)

Km 1 0.5 0 1 Km

Miles 0.5 0.25 0 0.5 Miles

Drinking Water Watershed

HFI Inventory

Road

Mine Site

Other Disturbed Vegetation

Industrial Site Rural

Rural (Residential/Industrial)

Seismic Line

Cultivation (Crop/Pasture/Bare Ground)

Cut Blocks

No Defined Human Footprint

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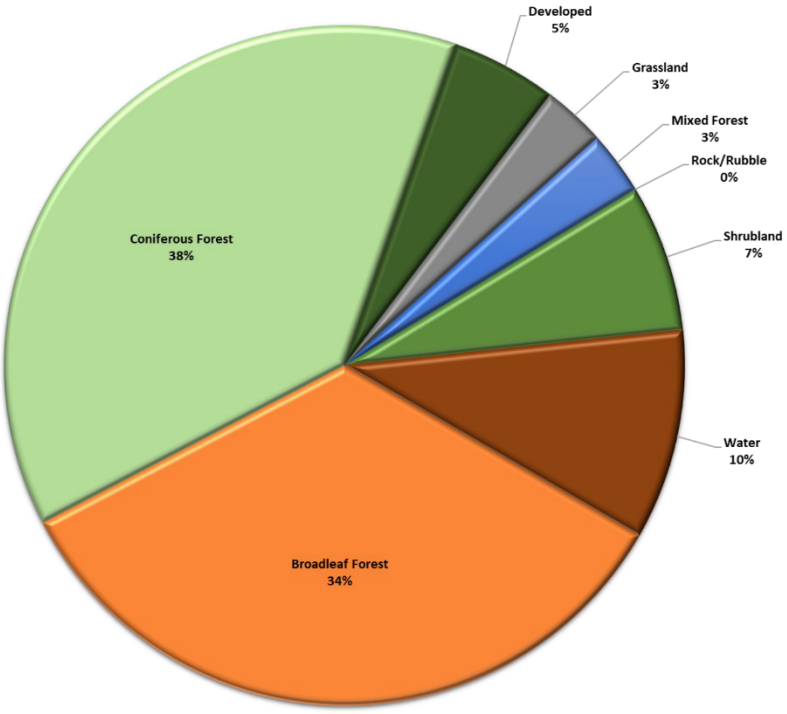
ABMI Human Footprint Inventory: Wall-to-Wall Human Footprint Inventory 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020.

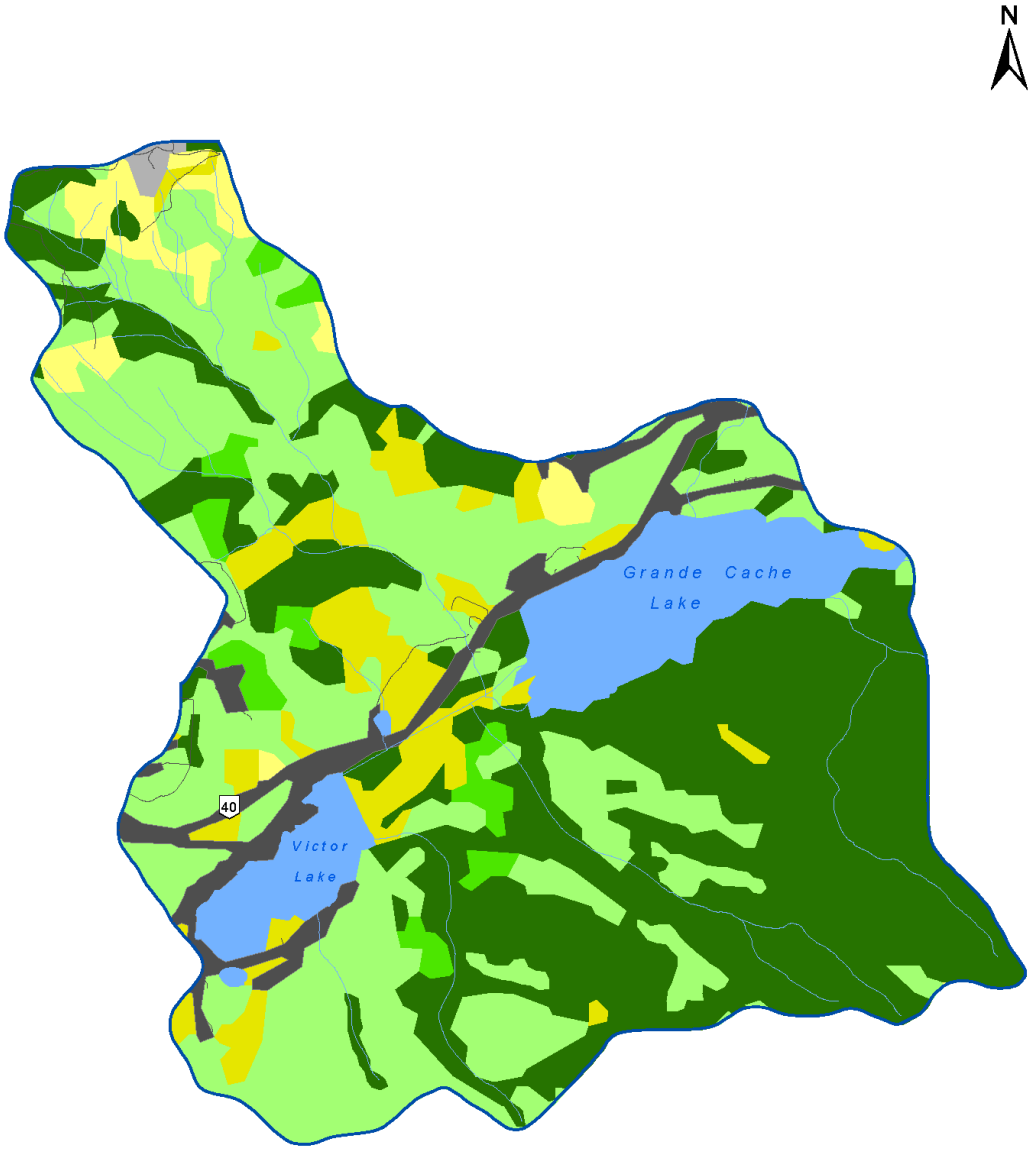
LAND COVER CLASSIFICATION

Percentage of Land Cover within Watershed



Land Cover Class	Total Area (HA)	Percentage of Water-shed
Agriculture	0.00	0%
Broadleaf Forest	1,147.54	34%
Coniferous Forest	1,278.34	38%
Developed	173.44	5%
Exposed Land	0	0%
Grassland	102.04	3%
Mixed Forest	91.79	3%
Rock/Rubble	10.73	0%
Shrubland	239.43	7%
Water	314.57	10%
Grand Total	**3,357.89**	**100%**

Land Cover data used to produce maps, tables and charts.
ABMI wall-to-wall Land Cover circa 2000, Version 2.1: ABMI Remote Sensing Group, August 2012.
ABMI (Alberta Human Footprint Monitoring Program).



Grande Cache Lake Watershed

Land Cover

Km 1 0.5 0 1 Km

Miles 0.5 0.25 0 0.5 Miles

Access
Drinking Water Watershed

Land Cover
Developed
Water

Coniferous Forest
Mixed Forest
Broadleaf Forest

Shrubland
Grassland
Rock/Rubble

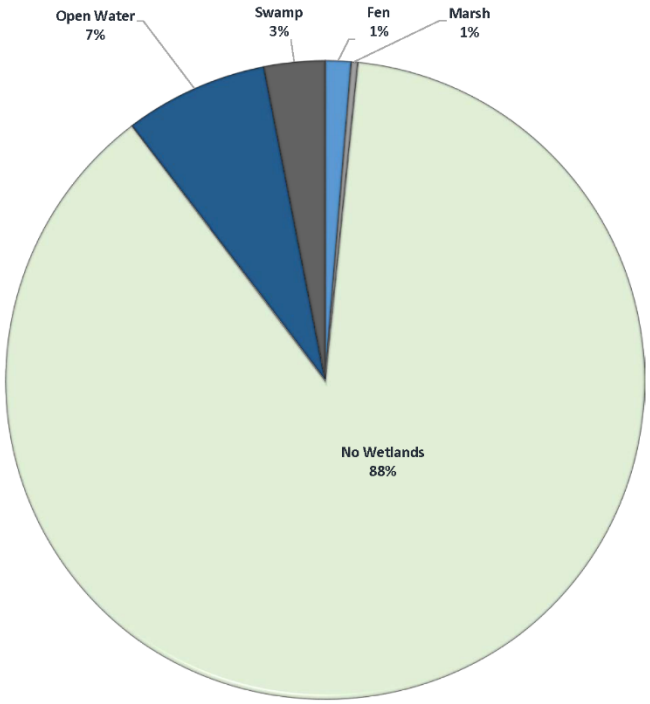
Prepared by Environment and Parks, Northwest Geospatial Field Unit - 2022

ABMI wall-to-wall Land Cover circa 2000, Version 2.1:
ABMI (Alberta Human Footprint Monitoring Program)
Remote Sensing Group, August 2012

Alberta Environment and Parks

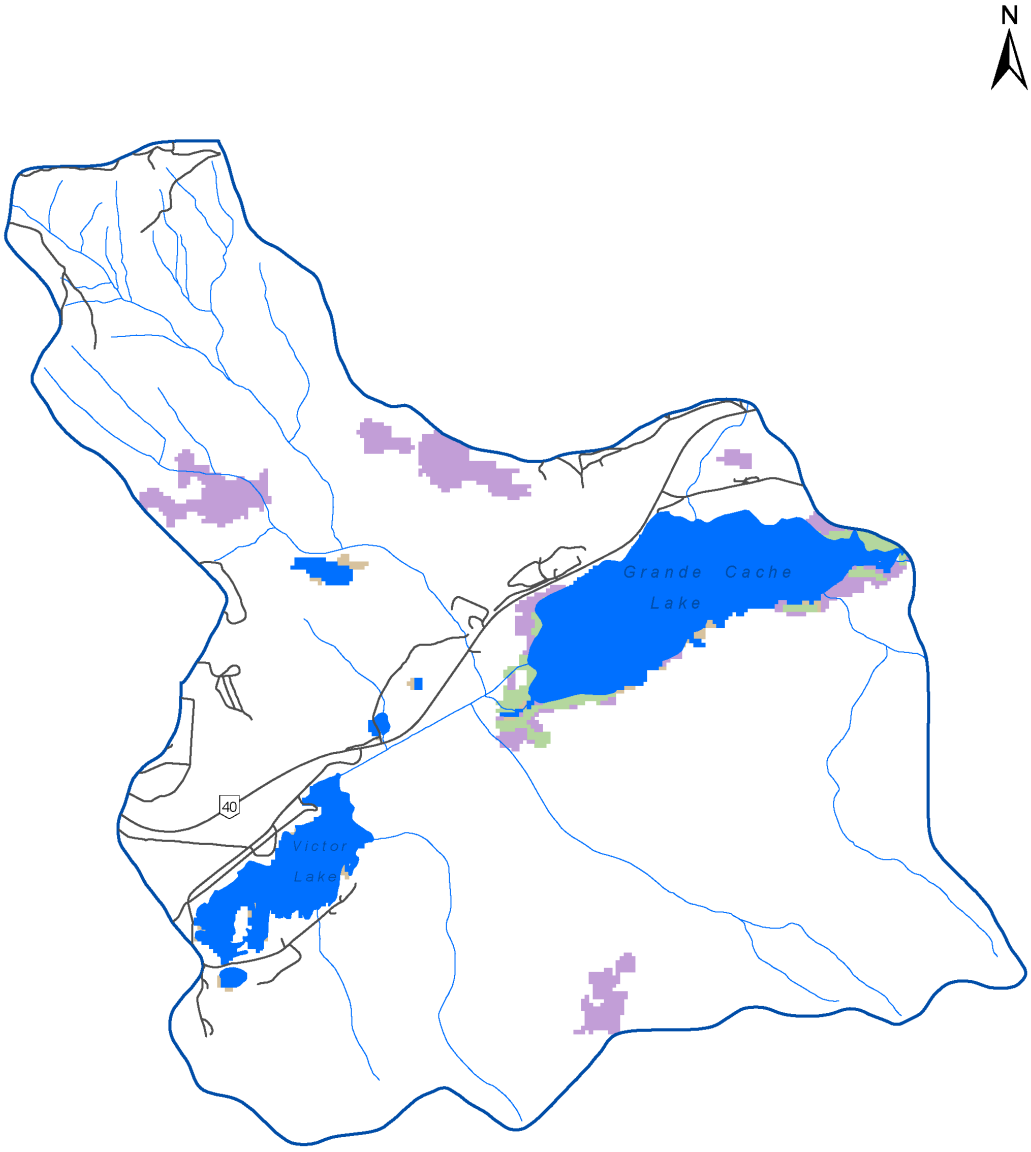
WETLANDS CLASSIFICATION

Percentage of Wetlands within Watershed



Wetlands Class	Area (ha)	% of wetlands within watershed
Bog	0.00	0%
Fen	43.68	1%
Marsh	11.34	1%
Open Water	243.63	7%
Swamp	103.59	3%
No Wetlands	2,955.65	88%
Grand Total	**3,357.89**	**100%**

Wetlands data used to produce maps, tables and charts.
The Alberta Merged Wetland Inventory depicts wetlands within the province of Alberta, Canada for the period 1998 to 2015 classified to the five major classes in the Canadian Wetland Classification System (CWCS). These five major classes include bog, fen, marsh , swamp and shallow open water. For the purposes of this inventory, shallow open water includes all open water.



Grande Cache Lake Watershed

Wetlands

Km 1 0.5 0 1 Km

Miles 0.5 0.25 0 0.5 Miles

Access

Drinking Water Watershed

Wetlands Class

Open Water

Swamp

Bog

Fen

Marsh

Prepared by Environment and Parks, Northwest Geospatial Field Unit - 2022

The Alberta Merged Wetland Inventory depicts wetlands within the province of Alberta, Canada for the period 1998 to 2015 classified to the five major classes in the Canadian Wetland Classification System (CWCS). These five major classes include bog, fen, marsh, swamp and shallow open water. For the purposes of this inventory, shallow open water includes all open water.

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Appendix B – Table of Coordinates

Table 4. Corner point and photo coordinates.

Corner point	Northing	Easting	Distance from water's edge	Notes
Northeast	53.8870276	-119.0863248	8 m	Water depth 83 cm
Southeast	53.8868336	-119.0866115	15 m	On trail headed down to shore
Northwest	53.8871985,	-119.088195	5.5 m	Water depth 92 cm
Southwest	53.887052	-119.088246	12.5 m	Middle of road
Path down to water at east end	53.886841	-119.086676	N/A	Figure 19 & Figure 39
Path down to water east of garbage bin	53.886994	-119.087792	N/A	Figure 17
Path down to lake at west end	53.887090	-119.08836	N/A	Figure 23

Appendix C - Photographs

Figure 16. Photograph of truck parked on road that is in the riparian polygon.

Figure 17. Path down to lake east of garbage bin.

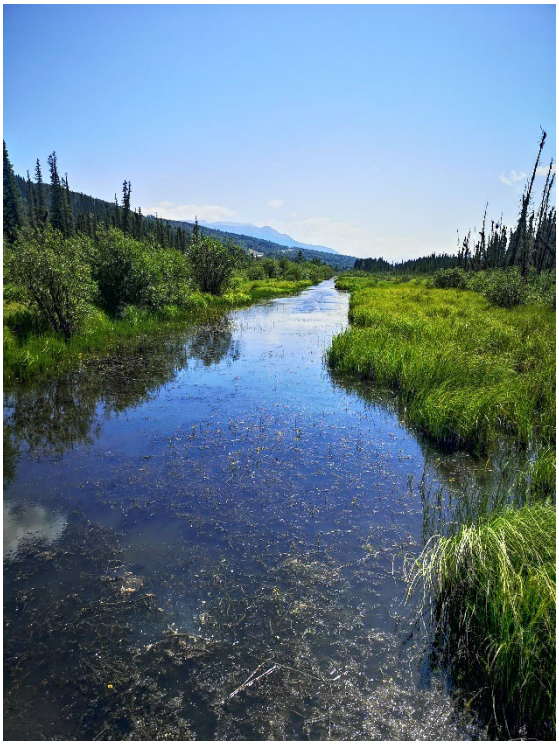

Figure 18. Photograph of the channel between Victor Lake and Grande Cache Lake.

Figure 19. Path down to water at east end of polygon.

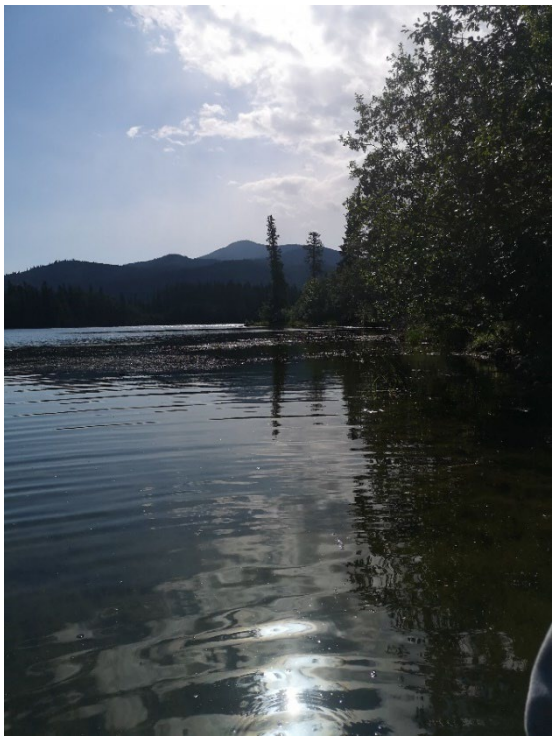

Figure 20. Photo east from northwest corner point.

Figure 21. Path down to lake west of garbage bin.

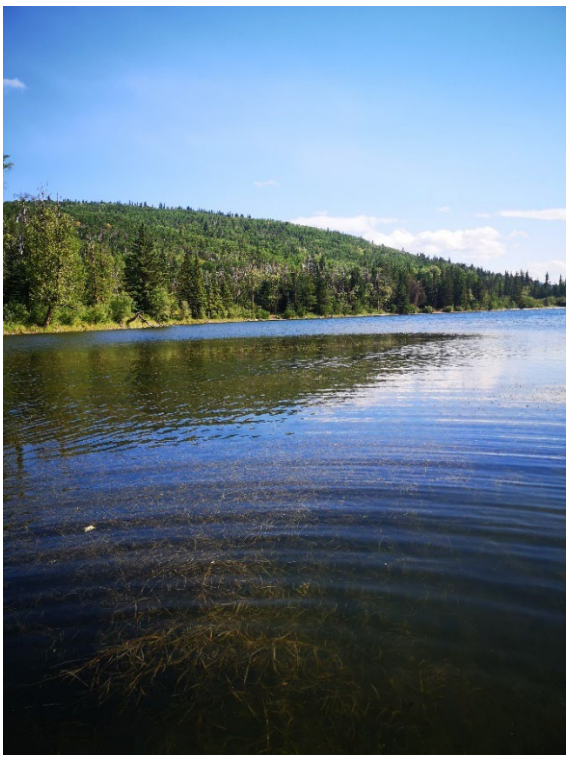

Figure 22. Photo north from northwest corner point.

Figure 23. Path down to lake at west end of polygon.

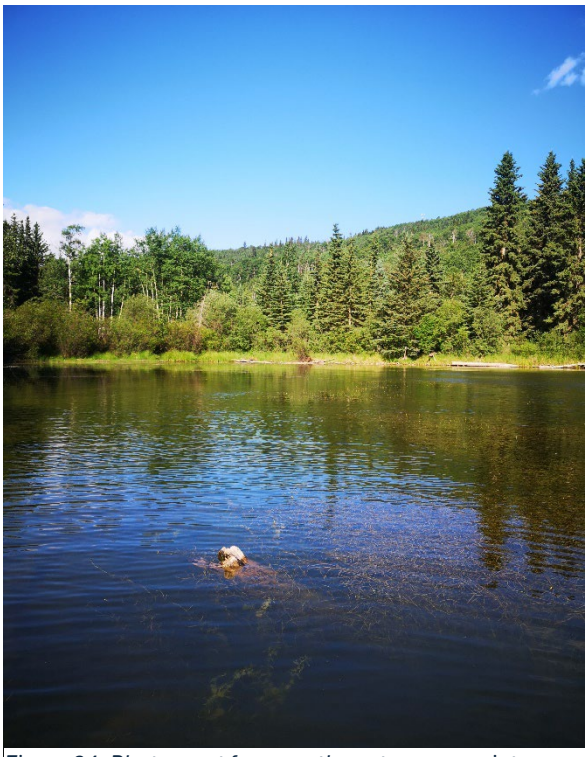

Figure 24. Photo west from northwest corner point.

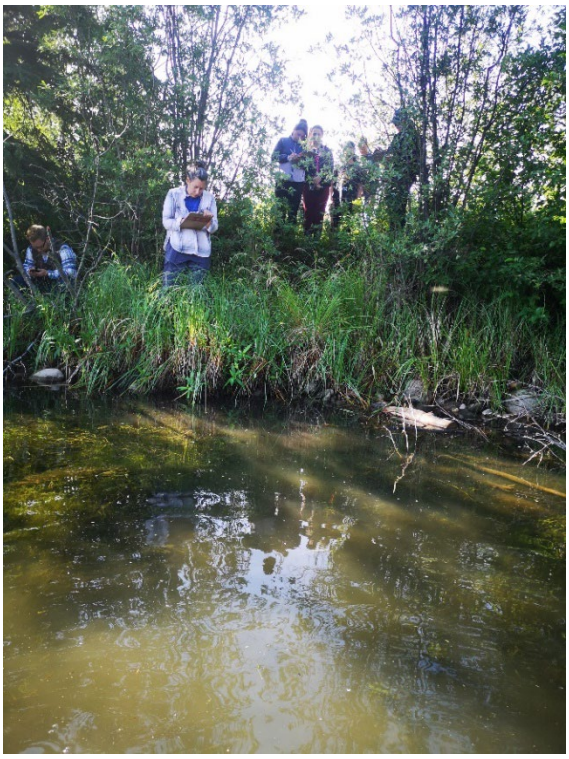

Figure 25. Photo south from northwest corner point.

Figure 26. Photo west from southwest corner point.

Figure 27. Photo north from southwest corner point.

Figure 28. Photo east from southwest corner point.

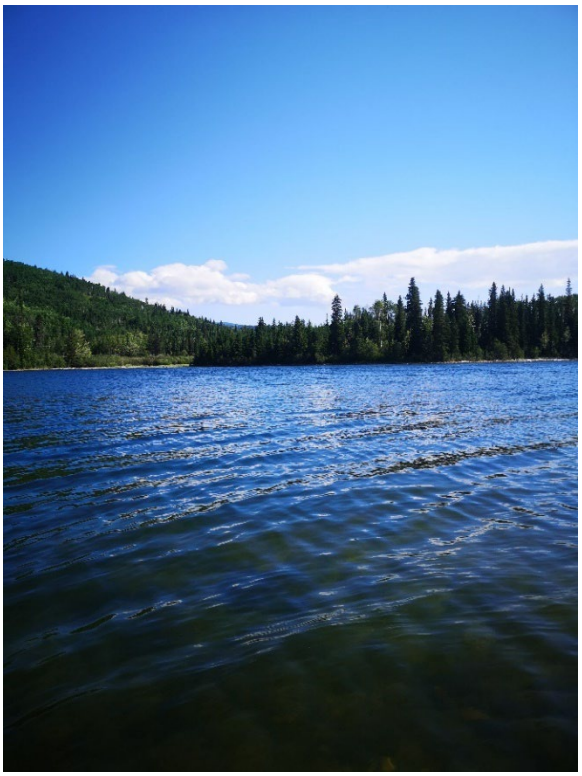

Figure 29. Photo north from northeast corner point.

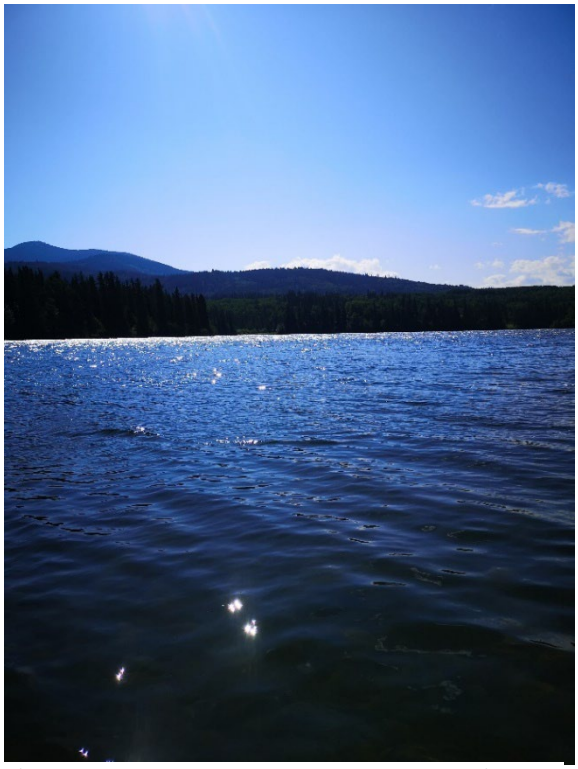

Figure 30. Photo east from northeast corner point.

Figure 31. Photo south from southwest corner point.

Figure 32. Photo east from southeast corner point.

Figure 33. Photo north from southeast corner point.

Figure 34. Photo south from northeast corner point.

Figure 35. Photo west from northeast corner point.

Figure 36. Photo south from southeast corner point.

Figure 37. Photo west from southeast corner point.

Figure 38. Aerial view of recreational use in riparian zone polygon.

Figure 39. Aerial view of east end of riparian zone polygon.

Figure 40. Aerial view of vegetative cover in large portions of the riparian zone polygon.

References

Alberta Tourism, P. and R. (2015). *Alberta Parks. 2015. Natural Regions and Subregions of Alberta. A Framework for Alberta's Parks*.

Associated Engineering. (2015). *Town of Grande Cache Source Water Protection Plan: Victor Lake and Grande Cache Lake*.

Cows and fish. (2023). *Alberta Lentic Wetland Health Assessment (Survey) User Manual*. 31. https://cowsandfish.org/health-assessment-and-inventory-forms/

Eder, T. K. G. (2011). *Mammals of Canada*. Lone Pine Publishing.

Fraterrigo, J. M., & Downing, J. A. (2008). The influence of land use on lake nutrients varies with watershed transport capacity. *Ecosystems*, *11*(7), 1021–1034. https://doi.org/10.1007/S10021-008-9176-6/METRICS

Jacobson, P. C., Hansen, G. J. A., Bethke, B. J., & Cross, T. K. (2017). Disentangling the effects of a century of eutrophication and climate warming on freshwater lake fish assemblages. *PLOS ONE*, *12*(8), e0182667. https://doi.org/10.1371/journal.pone.0182667

Joynt, A., & Sullivan, M. (2003). *Fishes of Alberta*. Lone Pine Publishing.

Sinn, C., & Peter, B. (2023). Summer LakeKeepers 2022. In *Spatial Data Science: With Applications in R*. CRC Press. https://doi.org/10.1201/9780429459016