



Whiteswan Lake Foreshore Integrated Management Plan FINAL



Prepared for:

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EXECUTIVE SUMMARY

A Foreshore Integrated Management Plan (FIMP) for Whiteswan Lake was completed by Masse Environmental Consultants Ltd in 2020. The objective of this project was to conduct a detailed inventory of the foreshore of Whiteswan Lake, and identify foreshore habitat values, habitat sensitivities, and impacts from existing foreshore developments. The information presented in this report will provide guidance to governments and developers on future lake foreshore developments while sustaining healthy aquatic and riparian ecosystems.

Whiteswan Lake is a 378 ha montane lake nestled within the Kootenay Ranges of the Rocky Mountains in a mainly east-west orientation, approximately 30 km southeast of Canal Flats, BC. The lake is located within the Whiteswan Lake Provincial Park, which was created in 1978 with the primary focus to protect the underrepresented Dry Cool Montane Spruce (MSdk) biogeoclimatic subzone ecosystem while maintaining a recreational destination for outdoor opportunities. The lake has been managed as a monoculture rainbow trout fishery since the 1960s and there are concerns of hybridization of the introduced rainbow trout with the native westslope cutthroat trout downstream of the lake, which prompted management actions. The area has significant cultural values to First Nations as it provided a geographical link between the Columbia Valley and the Elk Valley and the prairies, and was used as a marshalling point, hunting camp and was also used for religious and social events.

Field surveys were conducted on September 4 and 5, 2020, to inventory and describe the land use, shoreline modifications and biophysical attributes along 12.9 km of lake foreshore. More than half of the shoreline was in natural condition (59%, 7.6 km), while the remainder was disturbed (41%, 5.3 km). The Whiteswan Lake Forest Service Road was the most significant anthropogenic alteration of the foreshore as it runs along the entire south side of the lake over a distance of ~5.1 km (39% of the foreshore). Other alterations included cabins and residences at the east end of the lake, boat launches, docks, a retaining wall and 1 groyne. Agricultural use, also at the east end of the lake, resulted in removal of some riparian vegetation. Other impacts included disturbance to the lake bed by motor boats disrupting submergent vegetation within the shallow littoral zones at both ends of the lake and an ATV track on the foreshore at the east end of the lake.

Five zones of sensitivity (ZOS) were identified within Whiteswan Lake including: wetlands, wide shallow littoral zones, stream mouths, shore spawning habitat and a riparian cottonwood band. High value wildlife habitat was identified within the floodplain at the east end of the lake, with abundant wildlife signs observed, including ungulate and waterfowl tracks and browse. A stick nest was observed on a cottonwood tree in this area. Multiple wetland polygons were identified within the littoral zone, including the Blue-listed bulrush Deep Marsh ecological community (BC CDC 2012), contributing to the biodiversity of the area.

SUGGESTED CITATION

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1 INTRODUCTION

Masse Environmental Consultants Ltd. was retained by Living Lakes Canada to complete a Foreshore Integrated Management Plan (FIMP) for Whiteswan Lake in 2020. The FIMP methodology was developed to assess the impacts of foreshore developments on lakes across British Columbia, providing a standardized method (Schleppe et al 2020). The purpose of the FIMP is to identify lake foreshore habitat values, habitat sensitivities and impacts from foreshore developments. The FIMP process can also be repeated and used to determine the rate of change along a lake foreshore. This information provides guidance to land managers during foreshore development, while sustaining healthy aquatic and riparian ecosystems.

Whiteswan Lake is located within Whiteswan Lake Provincial Park, ~ 30 km southeast of Canal Flats, BC (Figure 1), and is a popular destination for outdoor recreationists and anglers. The lake has been managed as a monoculture rainbow trout (*Oncorhynchus mykiss*) fishery since the 1960s and there are concerns of hybridization of the introduced rainbow trout with the native westslope cutthroat trout (*Oncorhynchus clarki lewisi*) downstream of the lake (McPherson and Robinson 2013). Development pressures include heavy recreational use, campgrounds, cabins and residences at the east end of the lake and the Whiteswan Lake Forest Service Road (FSR) which runs along the entire south side of the lake. The area surrounding the park is part of the Kootenay Region working forest and the FSR sees regular industrial traffic including logging trucks. The Whiteswan Lake area has a high cultural significance for First Nations.

2 BACKGROUND

Whiteswan Lake Provincial Park was created in 1978 and includes Whiteswan Lake and Alces Lake, and surrounding area, as well as Lussier Hot Springs along the Lussier River. The primary purpose of the park was to protect remnants of the forest ecosystem Dry Cool Montane Spruce (MSdk) biogeoclimatic subzone which is under-represented within the Southern Park Ranges Ecosection (B.C. Parks 2003). The secondary role was to maintain a recreational destination for outdoor opportunities oriented to a forested mountain lake setting and to protect the Lussier Hotsprings. The park encompasses an area of 1994 ha with approximately 1% zoned for intensive recreation (26 ha) and the remaining 99% (1968 ha) zoned as Natural Environment with the objective to protect scenic values and to provide recreation opportunities in a largely undisturbed natural environment.

2.1 Setting

Whiteswan Lake is a 378 ha montane lake nestled within the Kootenay Ranges of the Rocky Mountains (Table 1) in a mainly east-west orientation (Figure 1). It is headwatered by Alces (Moose) Lake (30.1 ha), which drains east into Whiteswan Lake through a ~ 1.2 km channel linking the two lakes. The channel is dry for most of the year with flows suspected to be mostly subsurface (Jeff Burrows, pers. comm.). There are four main tributaries to Whiteswan Lake including Cave Creek and Birch Creek that drain south near the midpoint of the north shore, and Home Basin Creek and Inlet Creek that drain into the east end of the lake. The outflow of the lake is Outlet Creek which is located at the northeast corner of the lake and

flows north for ~ 2 km into the White River. The land northeast of the lake broadens into a wide floodplain valley with flat terrain. A waterfall, 3 m in height, located 2.3 km downstream of Whiteswan Lake prevents fish from the White River from migrating into the lake through Outlet Creek. There is no hydrological gauging of Whiteswan Lake.

Table 1. Whiteswan Lake physical characteristics (Habitat Wizard).

Parameter	Amount
Elevation	1143 m
Surface Area	378 ha
Drainage	~ 70 km ²
Maximum Depth	19.3 m
Mean Depth	13 m
Average Width	860 m
Foreshore Perimeter	12.9 km

2.2 Biogeoclimatic Characteristics

Whiteswan lake is situated within the Dry Cool Montane Spruce (MSdk) biogeoclimatic subzone, which occurs at low to mid elevations in the Columbia River valley and its tributaries (MacKillop et al. 2018). The climate is broadly characterized by dry, cold winters and dry, warm summers. The east-west orientation of the lake creates contrasting warm and cool aspects and associated vegetation communities along the north and south shorelines. South facing aspects feature dry Douglas-fir (*Pseudotsuga menziessi*) and lodgepole pine (*Pinus contorta*) dominated forests with shrubby understories. North-facing aspects have more mixed conifer forests that include hybrid white spruce (*Picea* sp.) and subalpine fir (*Abies lasiocarpa*) along with some western larch (*Larix occidentalis*) and western redcedar (*Thuja plicata*). Cottonwood (*Populus trichocarpa*) floodplain and wetland ecosystems occur on level terrain at the east and west ends of the lake. The MSdk experiences frequent mixed-severity fires.

2.3 Cultural Significance

Cultural heritage values are significant in Whiteswan Lake Provincial Park. The Ktunaxa (Kootenai) and Kinbasket people intensively used Whiteswan Lake because its geographical location provided a strategic link between the Columbia Valley and the Elk Valley and the prairies; and served as a marshalling point for journeys between these areas. Whiteswan Lake was an important seasonal hunting camp for the Ktunaxa people and their use of the area dates back at least 5,000 years. It was also used as a staging area for religious and social events. Numerous archeological and traditional use sites are present within the park (B.C. Parks 2003).

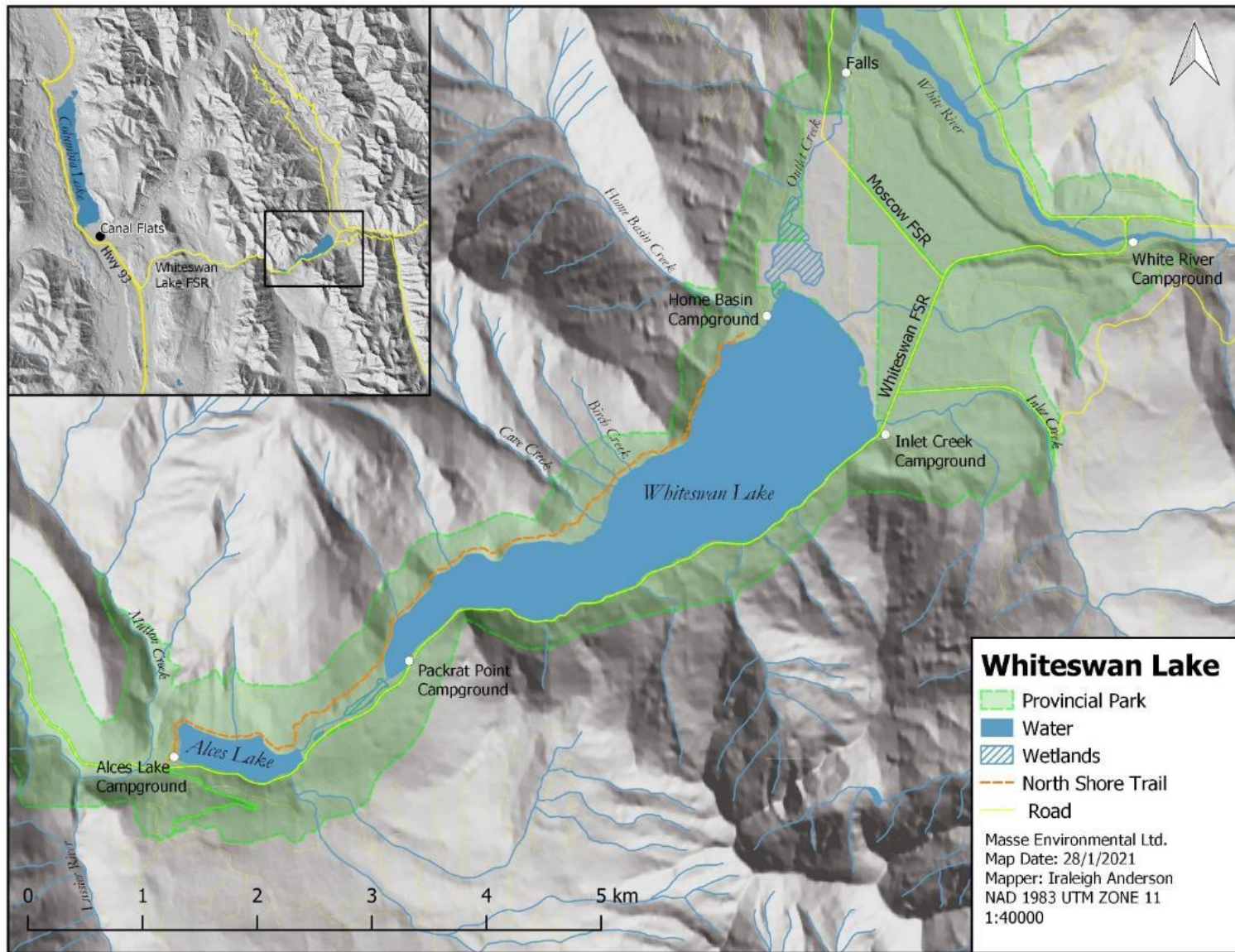


Figure 1. Whiteswan Lake location map.

2.4 Recreational and Residential Use

Whiteswan Lake is a popular destination for recreationists attracting many angling enthusiasts, generally averaging 10,000 angler days annually (Heidt and Lamson 2012). The fishery at Whiteswan Lake has been reported as one of the highest quality rainbow trout fishery in the East Kootenays (B.C. Parks 2003). There is also a popular ice fishery on Whiteswan Lake, however there is no recent angler use information other than an average of 3,137 angler days annually from 1969 to 1992 (Heidt and Lamson 2012). More recent anecdotal information in 2012-2013 indicated continued high use (McPherson and Robinson 2013).

Other recreational opportunities within the park include camping, hiking, canoeing, boating, swimming, and cycling. There are 3 campgrounds along the Whiteswan Lake foreshore: Packrat Point with 16 sites, Inlet Creek with 16 sites and Home Basin with 37 sites, which includes a swimming beach. There are two additional campgrounds in close proximity at Alces Lake (28 sites) and at White River (17 sites). Boat accessible and walk-in campsites are also available approximately halfway on the north shore of the lake at the Cave Creek Campground, which has 6 graveled tent pads, 5 picnic tables, 2 pit toilets, several fire rings, and food storage lockers. A hiking trail (North Shore Trail) runs along the north shore of the lake extending from the Alces Lake campground east to the Home Basin campground and provides access to the Cave Creek campground.

Three boat launches are located on Whiteswan Lake including two concrete boat launches at Home Basin and Packrat Point and one gravel boat launch at Inlet Creek. There are no restrictions for power boats on Whiteswan Lake, but recreational towing, such as waterskiing, is not permitted.

There are several privately owned District Lots with residences and cabins at the east end of the lake (Table 2). The flat terrain at this end of the lake is also conducive to rural and agricultural development with several agricultural fields still in use.

Table 2. District lots located at east end of Whiteswan Lake and zoning designation.

PID / District Lot	Ownership	Zone	Designation*
DL 16280	Crown	A-1	OSRT
016-441-125	Private	A-1	RR
015-379-701	Private	A-1	RR
016-452-127	Private	A-1	RR

*OSRT: Open Space Recreation and Trails; RR: Rural Resource.

2.5 Fisheries

Whiteswan Lake has been managed for a recreational fishery since the 1930's, with stocking of rainbow trout, a non-native species to the area, beginning in 1931. The lake was treated with toxaphene to eliminate the presence of "undesirable" native species such as longnose sucker (*Catostomus catostomus*), mountain whitefish (*Prosopium williamsoni*), and northern pikeminnow (*Ptychocheilus oregonensis*) in 1959 and 1961 (McPherson and Robinson 2013), in order to create a rainbow trout monoculture (Tepper 2006). Further management actions included flow diversion from Mutton Creek into Alces Lake to improve flushing rate and water quality in 1972 (Bell and Martin 1985); construction of a spawning channel connecting Alces Lake and Whiteswan Lake in 1979; improvements to spawning habitat in Outlet Creek in 1979 (Heidt 2008); and habitat restoration in Inlet Creek to improve rearing and spawning habitat in 1998 and 1999 (Agra 2000a, 2000b). Active use of the spawning channel and diversion of Mutton Creek into Alces Lake were discontinued in 2009 due to relatively poor productivity and maintenance requirements of the channel including the control of beaver activity (McPherson and Robinson 2013). These collaborative efforts led to the creation of a naturalized rainbow trout population and a regionally significant fishery. Most of the rainbow trout spawning, which happens in May and June, occurs in Inlet Creek and Outlet Creek, as well as small tributaries along the lake such as Cave Creek (Lamson et al. 2014). In addition, significant shore spawning has been reported along sections of the shoreline with upwellings/springs such as around Cave Creek and Birch Creek (Kevin Heidt, pers. comm.), two sections along the south shore at the east end of the lake, and west of Outlet Creek (see maps in Appendix 1 for exact locations). Other small pockets of shore spawning were reported throughout the lake for example near the Packrat boat launch.

Concerns of hybridization of naturalized rainbow trout in Whiteswan Lake with the native westslope cutthroat trout residing in the White River and beyond, led to the development of a Fisheries Management Plan in 2013 (McPherson and Robinson 2013). Westslope cutthroat trout is a federally and provincially listed species of Special Concern and hybridization with rainbow trout has been identified as the leading cause for its decline, with genetically pure populations occurring in only 8 to 20% of its native range (Lamson 2019). The two main objectives of the plan were to: 1) reduce risks to native westslope cutthroat trout populations downstream of the park caused by the non-native, naturalized rainbow trout emigrating from Whiteswan Lake; and, 2) maintain high quality recreational angling opportunities in Whiteswan Lake and Alces Lake. Much of the rainbow trout spawning occurs in Outlet Creek and observations of adult fish below the waterfall raised concerns of rainbow trout migrating into the White River. This led to the construction of a barrier upstream of Moscow FSR (which accesses the Home Basin Campground) in 2015 (NHC 2016) and further upgrades and improvements in 2019 (Jeff Burrows, pers. comm.; Photo 1). The barrier was designed to prevent adult and juvenile rainbow trout outmigration.

Management recommendations that have been implemented to date include:

- Construction of the barrier on Outlet Creek to prevent outmigration of adult and juvenile rainbow trout into the White River and beyond to reduce the potential for hybridization of westslope cutthroat trout.

- Promote fishing of rainbow trout in Outlet Creek downstream of the waterfall from April 1 to July 31, with up to 5 daily catch, and release of all other species.
- Continue management of Whiteswan Lake as a rainbow trout fishery with open fishing all year round and up to 5 rainbow trout daily catch.
- Continue monitoring of the fishery with yearly creel surveys.
- Discontinue rainbow trout stocking in Whiteswan Lake as the naturalized population is self sufficient and able to reproduce.
- Continue stocking of rainbow trout in Alces Lake as it is isolated from downstream habitat.



Photo 1. Outlet Creek barrier after it was refurbished in 2019 (Photo Lamson 2019).

2.6 Wildlife

2.6.1 Mammals

Mammals reported to occur within the Whiteswan Lake Provincial Park include bighorn sheep (*Ovis canadensis*), moose (*Alces alces*), elk (*Cervus elaphus*), deer (*Odocoileus sp.*), grizzly (*Ursus arctos horribilis*) and black bears (*Ursus americanus*; BC Parks 2003). Whiteswan Lake and the nearby White River valley are designated winter range for moose (Ungulate Winter Range unit #U-4-008). Abundant elk and deer tracks were observed along the eastern foreshore of the lake.

2.6.2 Birds

The citizen science application eBird (2021) lists 38 completed bird checklists at the Whiteswan Provincial Park hotspot (mapped at the northeast end of Whiteswan Lake). Twelve species are included as incidental observations in wildlife species inventory (WSI) datasets (BC CDC 2021b). Numerous waterfowl are known to use Whiteswan Lake; commonly observed species at this location include: Canada Goose

(*Branta canadensis*), American Coot (*Fulica americana*), Common Goldeneye (*Bucephala clangula*), Hooded Merganser (*Lophodytes cucullatus*), Mallard (*Anas platyrhynchos*), Eared Grebe (*Podiceps nigricollis*), Bufflehead (*Bucephala albeola*), Common Merganser (*Mergus merganser*), Green Winged Teal (*Anas carolinensis*), Lesser Scaup (*Aythya affinis*), Red Necked Grebe (*Podiceps grisegena*), Barrow's Goldeneye (*Bucephala islandica*), Gadwall (*Mareca strepera*), American Widgeon (*Mareca americana*), and Blue Winged Teal (*Anas discors*). Black-necked Stilt (*Himantopus mexicanus*) were observed in the wetland at the east end of the lake in April of 2020 (Bruce MacDonald, pers. comm.), which is a rare occurrence in British Columbia (BC CDC 1995).

A large stick nest was observed in a cottonwood at the east end of the lake during field surveys on September 5, 2020 (Photo 13). The nest was unoccupied at the time of observation but appeared to be that of a bald eagle. A live bald eagle was observed perching on the treed shoreline at the west end of the lake (Photo 19).

2.6.3 Reptiles and Amphibians

Columbia spotted frog (*Rana luteiventris*), long-toed salamander (*Ambystoma macrodactylum*), and Oregon spotted frog (*Rana pretiosa*) are reported within the vicinity of Whiteswan Lake (BC CDC 2021b). Western toad (*Anaxyrus boreas*) toadlets were observed in the wetland at the inlet stream on the west end of the lake during field surveys on September 5, 2020 (Photo 20).

2.7 Species and Ecosystems at Risk

Species at risk (SAR) and ecological communities are tracked provincially (Red- and Blue-listed) by the BC Conservation Data Centre (CDC), and federally (designated as 'Special Concern', 'Threatened', 'Endangered', 'Extirpated' or 'Extinct') by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Legal protection for species and their habitats in Canada is enacted through the *Species at Risk Act* (SARA) based on research and recommendations from COSEWIC. The BC Species and Ecosystems Explorer (BC CDC 2021a) was queried to generate a list of potentially occurring at-risk taxa and ecological communities in the study area using the following criteria:

- BC Conservation Status: Red (Extirpated, Endangered, or Threatened) OR Blue (Special Concern)
- COSEWIC Status: Extinct OR Extirpated OR Endangered OR Threatened OR Special Concern
- Area of Interest: User Defined Polygon (Whiteswan Provincial Park boundary)

The CDC iMap tool (BC CDC 2021b) was used to further query the CDC data for publicly available wildlife species occurrence records within an area defined by the approximate boundary of Whiteswan Lake including a ~5 km buffer area.

Results from the BC Species and Ecosystems Explorer query were filtered to remove unranked taxa (either federally or provincially Red- or Blue- listed), redundancies where both populations and taxa are listed (e.g., western painted turtle) and multiple taxonomic level classifications (e.g., wolverine), and highly unlikely species to occur due to known habitat availability and distributions (e.g., white sturgeon),

yielding 130 taxa with provincial and/or federal at-risk conservation rankings with potential occurrence in Whiteswan Lake Provincial Park (BC CDC 2021a; Appendix 3). The list included 4 amphibians, 48 birds, 6 fish, 23 insects, 5 lichens, 10 mammals, 19 molluscs, 13 plants, and 2 reptiles.

Species at risk confirmed in the vicinity of Whiteswan Lake include Common Nighthawk (*Chordeiles minor*; SARA Schedule 1 - Endangered; eBird 2020), Williamson's Sapsucker (*Sphyrapicus thyroideus*; SARA Schedule 1 - Endangered; Campbell *et al.* 2000), Winter Wren (*Troglodytes hiemalis*; BC CDC 2021b), and Western toad (SARA Schedule 1 – Special Concern). Incidental observations of Oregon spotted frog (BC Red-listed, SARA Schedule 1 - Endangered) in the wetland between Alces and Whiteswan Lakes and near Inlet Creek have been reported (BC CDC 2021b), although this may have been misidentified since this species is known only from the Fraser Valley near Vancouver BC (COSEWIC 2011).

Critical habitat for whitebark pine (*Pinus albicaulis*) (BC blue-listed, SARA Schedule 1 - Endangered) overlaps Whiteswan Lake Provincial Park and is expected to be found at higher elevations (BC CDC 2021b). Mapped critical habitat for American badger (BC Red listed, SARA Schedule 1 – Endangered) in the East Kootenay Trench lies 3 km west of Alces Lake (BC CDC 2021b).

Eight provincially at-risk ecological communities potentially occur in Whiteswan Provincial Park (Appendix 4; BC CDC 2021a). These include 5 terrestrial ecosystems and 3 wetland ecosystems. The Blue-listed bulrush (*Schoenoplectus acutus*) Deep Marsh ecological community (BC CDC 2012) was observed during field surveys in September 2020 along the eastern shoreline of Whiteswan Lake (Photo 6).

3 METHODS

The foreshore inventory and assessment of Whiteswan Lake followed standard methodology presented in the Foreshore Integrated Management Planning Methods (FIMP; Schleppe et al 2020). The Foreshore Inventory and Mapping (FIM) methods developed by Schleppe and Mason (2009) were revised by the technical committee in 2020 and replaced with FIMP. The FIMP includes three main components:

1. Foreshore Inventory and Mapping,
2. Foreshore Habitat Sensitivity Index, and
3. Foreshore Development Guide.

This report presents the results and findings of the first two components. The Foreshore Development Guide is provided in Appendix 6.

3.1 Foreshore Inventory and Mapping

3.1.1 Background Review

A background review was completed to gain a better understanding of the ecological and land use context of the Whiteswan Lake area. Existing information was collected from the following resources:

- BC Parks
- BC Conservation Data Centre (BC CDC)
- EcoCat
- iMap BC/ Habitat Wizard
- Wildlife Species Inventory
- E-flora BC/E-fauna BC/E-Bird
- iNaturalist
- British Columbia Wildlife Survey Inventory data
- Regional District of East Kootenays (RDCK) Official Community Plans (OCP) and Zoning Plans

3.1.2 Field Surveys

Field surveys were conducted on September 4 and 5, 2020, to inventory and describe the land use, shoreline modifications and biophysical attributes along the lake foreshore. The survey team consisted of Sylvie Masse, MSc, RPBio, Tyson Ehlers, BSF, RPBio and Ico de Zwart, PhD, RPBio. Weather conditions were ideal for the surveys with warm temperatures and clear skies. Winds from the west picked up in the afternoon and were generally calm in the morning. The entire foreshore was surveyed from a motorboat travelling at a slow speed 20-30 m from the shoreline.

The shoreline was delineated into segments in the office prior to the field surveys based on ortho imagery and TRIM (Terrain Resource Information Management) topographical information and further refined in the field. A Garmin GPS unit was used to mark the adjusted segment breaks as necessary and georeference any features. The tracking function was also used to record the route travelled. Representative geo-referenced photos were taken for each segment with an Olympus TG-6 camera. A geo-referenced video was recorded for the entire shoreline using a gimbal stabilised iPhone SE using the Timestamp application. Additional field observations, such as wildlife and habitat features, were recorded on field sheets. The maximum depth of the littoral zone was measured by determining the depth of light penetration using a secchi disk.

3.1.3 Data Analysis

Field data were entered into an MS Excel spreadsheet. Mapping and GIS was completed using QGIS. TRIM streamline was modified for stream mouths that did not match with TRIM based on field observations and ortho-imagery. JPEG photographs and geo-referenced videos of the foreshore are provided as attachments to this report. Biophysical attributes of the foreshore are presented in tabular format and graphs were created to represent percentage of each category for the entire lake foreshore (see Section 4, results).

Categories selected include:

- Percent of natural and disturbed shoreline;
- Percent of natural and disturbed shorelines for each shore type category;
- Percent of natural and disturbed shorelines for each land use category;
- Substrate type;
- Aquatic vegetation and littoral zone;
- Shoreline modification; and
- Level of impact.

All results are presented on the Foreshore Inventory Maps in Appendix 1 and in the Segment Summaries in Appendix 2.

3.2 Foreshore Habitat Sensitivity Index

A Foreshore Habitat Sensitivity Index (FHSI) is an analytical framework used to determine the habitat value or environmental sensitivity of a shoreline segment. The output of the analysis assigns one of five potential “Ecological Ranks” to segments (e.g., Very High, High, Moderate, Low, and Very Low). The FHSI is calculated using a combination of criteria that are field derived and from the literature. Scores assigned to each criterion (Table 3) are tallied for a single habitat segment to determine the Ecological Rank. The rank represents the sensitivity of the shoreline to changes from land use or proposed shoreline activities. In general, ranks will be higher for segments that are natural or have sensitive habitat features than for segments that are disturbed.

The FHSI analysis was developed as follows. Foreshore habitat is comprised of littoral, foreshore, and terrestrial components, each of which have attributes that are measured in FIM. Modifications and disturbances were incorporated into the index as negative values. Modifications may also alter biophysical attributes (i.e riparian vegetation, substrates), which should be reflected by lower ratings for these attributes. The initial ratings and weightings were based on the FIM methods document (Schleppe et al. 2020). Several iterations were completed with different weightings and with or without specific attributes until the FHSI calculated for each segment was consistent with the professional opinion of the team’s biologists. The ratings and weighting used for each attribute are presented in Table 3. The rationale for the weighting of each criteria is provided in Table 4 and the rationale for including additional criteria is provided in Table 5.

Table 3. Summary of criteria and ratings used to calculate the FHSI.

Criteria	% of FHSI	% Within Category	Logic	Uses Weighted FIM Data	Value Categories
FIM					
Shore type	20	25.0	Sum (% shore type _i * value _i) * Maximum Score	Y	Stream Mouth = Wetland (1) > Gravel Beach = Rocky Shore (.8) > Sand Beach = Cliff /Bluff (0.5), Other (0.3)
Substrate	10	12.5	Sum (% substrate * value _i) * Maximum Score	Y	Cobble (1) > Gravel (1) > Boulder = Organic = Mud = Marl (0.8), Fines = Sands (0.5) > Bedrock (0.3)
% Natural	10	12.5	% of segment * Maximum Score		% of segment
Aquatic vegetation	10	12.5	% * Maximum Score		Presence
Overhanging vegetation	7	8.8	% of segment * Maximum Score		% of segment
Large woody debris /km	3	3.8	rating * Maximum Score		>15 LWD (1); 10-15 LWD (0.8); 5-10 LWD (0.6); 0-5 LWD (0.4) 0 LWD (0)
B1 vegetation width and type	13	16.3	Width rating x Class rating x Maximum Score		Width: < 20 m (1) < 15 to 20 m (0.8) < 10 to 15 m (0.6) < 5 to 10 m (0.4) 0 to 5 m (0.2)
B2 vegetation width and type	7	8.8			Class: Wetland = Broadleaf = Shrubs (1) > Coniferous Forest = Mixed Forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row Crops (0.3) > Exposed Soil (0.05)
Subtotal	80				
Fish					
Littoral width	10	66.7	rating * Maximum Score		>50m (1) >10 to 50 m (0.5) <10 m (0)
Known shore spawning	5	33.3	Class rating x Maximum Score		Class: Present = 1, Absent = 0
Subtotal	15				
Ecosystem					
Floodplain	5	100	Class rating x Maximum Score		Class: Present = 1, Absent = 0
Subtotal	5				
Total	100				
Modifications					
% Road modified	-5		% of segment * Maximum Score		% of segment
% Erosion protection	-5		% of segment * Maximum Score		% of segment
Boat launches/km			# boat launches/km * -0.1		Presence
Groynes/km			# groynes/km * -0.1		Presence
Docks/km			# docks/km * -0.1		Presence
Subtotal	-10				

Table 4. Rationale for values assigned to FHSI criteria.

Criteria	Value Categories	Rationale
FIM		
Shore type	Stream Mouth = Wetland (1) > Gravel Beach = Rocky Shore (.8) > Sand Beach = Cliff /Bluff (0.5), Other (0.3)	Values are based on habitat quality and sensitivity to disturbance. Streams and wetlands provide high value habitat for a wide variety of species and are extremely sensitive to disturbance. Gravel beach and rocky shores can provide spawning and rearing habitat and are easily modified by development.
Substrate	Cobble (1) > Gravel (1) > Boulder = Organic = Mud = Marl (0.8), Fines = Sands (0.5) > Bedrock (0.3)	Substrates provide habitat, cover, and potential spawning habitat. Coarse substrates provide stable habitat. Organic mud and marl substrates are often highly productive. Fines, sands, and bedrock are considered to provide lower quality habitat as these substrates have no interstitial spaces.
% Natural	% of segment	% of the segment that has already been disturbed.
Aquatic vegetation	Presence	Aquatic vegetation is sensitive to disturbance, contributes to aquatic productivity, provides high quality habitat.
Overhanging vegetation	% of segment	Overhanging vegetation provides shade and cover, and contributes leaf and insect drop.
Large woody debris /km	>15 LWD (1); 10-15 LWD (0.8); 5-10 LWD (0.6); 0-5 LWD (0.4) 0 LWD (0)	Woody debris provides cover/rearing for fish, and provides additional substrate for periphyton/benthic invertebrates
B1/B2 vegetation width and type	Width: < 20 m (1) < 15 to 20 m (0.8) < 10 to 15 m (0.6) < 5 to 10 m (0.4) 0 to 5 m (0.2)	Riparian vegetation represents the interface of the aquatic and terrestrial environment and contributes to shoreline stability.
	Class: Wetland = Broadleaf = Shrubs (1) > Coniferous Forest = Mixed Forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row Crops (0.3) > Exposed Soil (0.05)	Wetland, shrub and broadleaf vegetation generally provides the greatest habitat diversity and value for most species.
Littoral width	>50m (1) >10 to 50 m (0.5) <10 m (0)	Littoral habitat contributes to aquatic productivity and is sensitive to disturbance.
Known shore spawning	Class: Present = 1, Absent = 0	Shore spawning locations represent areas where sensitive life stages of fish occur.
Floodplain	Class: Present = 1, Absent = 0	Floodplains provides high quality habitat and are highly productive.

The FHSI is heavily weighted towards attributes that are collected as part of the FIM for the following reasons:

- FIM attributes (shore type, substrate, disturbance and vegetation) can be consistently collected in the field.
- FIM attributes represent habitat potential and sensitivity to disturbance.
- FIM attributes do not require any additional species or site-specific information that may or may not be available.

Table 5. The rationale for criteria that was added to develop the FHSI is summarised below:

Littoral width	Littoral areas are highly productive, provide areas where aquatic vegetation becomes established, provide habitat and cover for small fish, and are sensitive to disturbance.
Shore spawning	Areas of known rainbow trout shore spawning were added as the lake is managed as a rainbow trout fishery. Spawning areas were provided by FLNRORD staff.
Floodplain	A floodplain criteria was added as the riparian vegetation criteria did not adequately account for the ecological value of the riparian habitat in floodplain areas at the east and west ends of the lake.

We chose not to include additional site-specific fish, wildlife, plant, or aquatic criteria in developing the FHSI for the following reasons:

- Fish criteria (rearing habitat, staging, migration corridors) are based on FIM attributes (substrate, proximity to stream mouths) that are already included in the index as part of the FIM criteria.
- Site specific observations made during the FIM fieldwork represent one-off observations that may not adequately identify sensitive habitat over multiple seasons or years, and
- There was little existing information on site specific sensitivities available from other sources, and the lack of any observation does not imply that it is absent.

Additional attributes can be added and/or relative weightings adjusted if the FHSI does not adequately represent foreshore sensitivity, or if new site-specific information becomes available.

3.3 Ecological Ranks

After the FHSI values for each segment were calculated, segments were assigned a five class ranking system with categories including Very Low, Low, Moderate, High and Very High (Table 6). We elected to adjust the ranking based on the review of the distribution of the FHSI scores (Figure 6), so that segments that scored >64 were ranked as Very High, otherwise the two wetland segments (Segments 2 and 12) with scores >82 overwhelmed other segments that should also have a ranking of Very High. Logical score breaks were used for the other ranks, based on the difference between the minimum possible score value of 12 and the score of 64, which resulted in equal increments of 13.

Table 6. Five class ranking system based on FHSI scores.

Rank	Rank Range
Very High	>64
High	51 - 64
Medium	38 - 51
Low	25 - 38
Very Low	<25

4 RESULTS

The foreshore is defined as the area from the edge of the pelagic regions (or limnetic/open water areas) of the lake to an area up to 50 m past the high water mark (HWM) in the upland/riparian zone (Schleppe et al 2020). This includes the upland, foreshore and littoral zones. The upland zone consists of the

terrestrial environment above the HWM, the foreshore zone consists of the area between the approximate low water mark (LWM) and the HWM, and the littoral zone consists of the area below the LWM to a point where light penetration to the bottom of the lake no longer occurs (Schleppe et al. 2020). The lake level was ~ 0.7 m below the normal high water mark as determined in the field, and the lake appears to fluctuate ~ 1.1 m between the high and low water marks. The depth of light penetration was 11.5 m as measured with a secchi disk on September 4, 2020.

4.1 Natural vs. Disturbed Shoreline

The foreshore of Whiteswan Lake had a total length of 12.9 km and was divided into 22 segments ranging in length between 166 m and 1.5 km (Appendix 2). The total length of shoreline considered disturbed was 5.3 km (41.1%), while the total length of natural shoreline was 7.6 km (58.9%; Table 7).

Table 7. Amount of natural and disturbed shoreline.

Attribute	Total (m)	Percent (%)
Natural	7580.9	58.9
Disturbed	5282.6	41.1
Total	12863.5	100.0

4.2 Shore Type

The predominant shore types consisted of gravel and rocky shores with 5.6 km (43.6%) and 4.6 km (36.1%) respectively (Table 8; Figure 2). The remainder consisted of cliff/bluff (1.5 km; 11.7%) and wetlands (1.1 km; 8.7%). Steeper shorelines were generally located along the north and south shores of the lake, as the lower gradient shorelines were located within the floodplain at the east and west ends of the lake. The greatest percentage of disturbed shoreline was found along rocky (21.4 %) and gravel (15.2%) shorelines.

Table 8. Shore type along the Whiteswan Lake foreshore and relative amounts.

Shore Type	Total (m)	Percent (%)	Natural (%)	Disturbed (%)
Cliff/Bluff	1504.3	11.7	9.4	2.3
Gravel	5604.2	43.6	28.4	15.2
Rocky Shore	4637.7	36.1	14.7	21.4
Wetland	1117.3	8.7	6.5	2.2
Total	12863.5	100.0	58.9	41.1

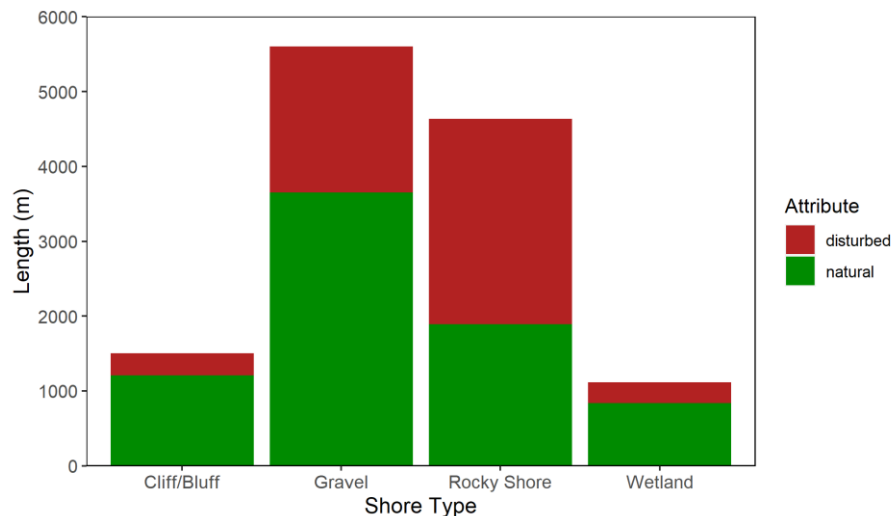


Figure 2. Shore types along the Whiteswan Lake foreshore relative to the amount of natural and disturbed foreshore.

4.3 Land Use

The predominant land use along the foreshore of Whiteswan Lake was transportation with the Whiteswan Lake FSR running along the entire south shore of the lake (4.9 km; 38.2%; Table 9; Figure 3). Most of the land surrounding the lake has been designated as park; however since it is transected by the FSR along the entire south side of the lake, the relative value of the park land use decreased (4.4 km; 33.9%). Other land uses include rural (2.0 km; 15.4%) and recreation (1.6 km; 12.5%). As expected, the greatest percentage of disturbed shoreline was associated with the transportation land use (Figure 3).

Table 9. Land use along the Whiteswan Lake foreshore and relative amounts.

Land Use	Total (m)	Percent (%)	Natural (%)	Disturbed (%)
Park	4360.0	33.9	33.6	0.3
Recreation	1604.5	12.5	9.9	2.6
Rural	1985.2	15.4	11.1	4.3
Transportation	4913.8	38.2	4.4	33.8
Total	12863.5	100	59	41

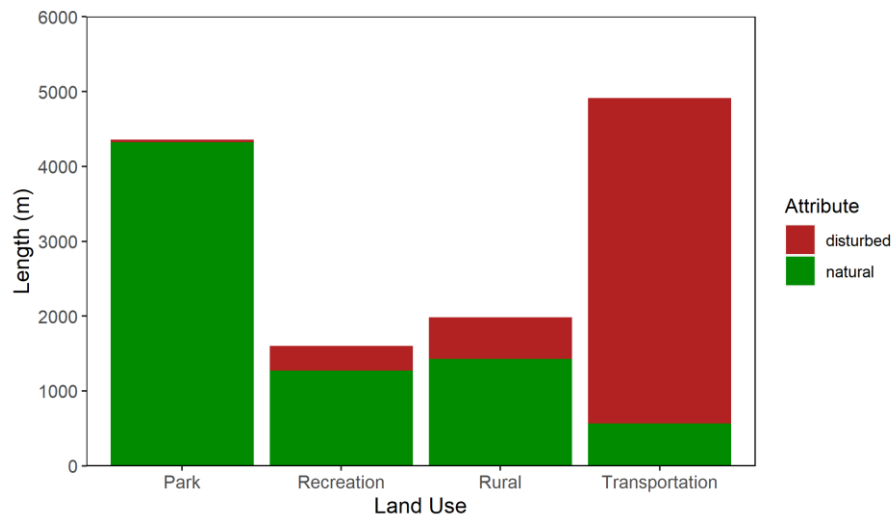


Figure 3. Land use along the Whiteswan Lake foreshore relative to the amount of natural and disturbed foreshore.

4.4 Substrate Type

The substrate type usually consists of a mixture of various size particles within each shore type. A gravel shore type for example would have a greater percentage of gravel than large cobbles and a rocky shore would have a greater percentage of larger substrate. The predominant foreshore substrate consisted of cobbles (44.7%) followed by boulder (20.9%) and gravel (17.0%; Table 10; Figure 4). Fine substrate including marl, and mud were more abundant within the floodplain littoral zones at the east and west ends of the lake.

Table 10. Substrate type along the Whiteswan Lake foreshore and relative percentage.

Substrate	Percent (%)
Marl	2.4
Mud	10.9
Organics	0.8
Fines	0.0
Sand	0.9
Gravel	17.0
Cobble	44.7
Boulder	20.9
Bedrock	2.4
Total	100

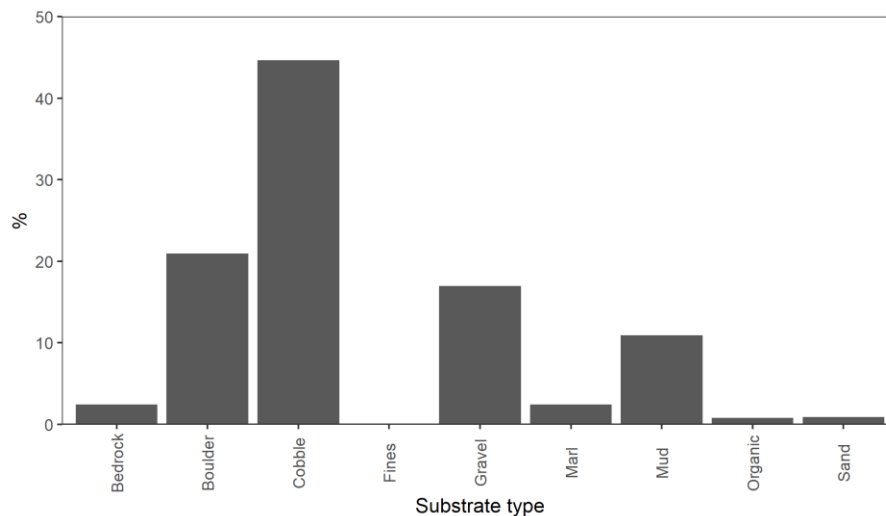


Figure 4. Substrate type along the Whiteswan Lake foreshore.

4.5 Aquatic Vegetation, Wetlands and Littoral Zone

Aquatic vegetation was present throughout the littoral zone of Whiteswan Lake with variable cover. The littoral zone varied from narrow in some sections with a minimum width of 5 m along the steeper shores (>60%) to very wide with a maximum width of 450 m along the low gradient shores (<5%). The east and west ends of the lake were relatively shallow within the floodplains and littoral zones were wide and extended the entire width of the lake (Segments 1 to 3, and 11 to 16). These areas were unique as the substrate was predominantly made up of marl, which is a substrate composed of a combination of loose clay, precipitated calcium carbonate, mollusk/invertebrate shells and other materials (Schleppe 2020). Submergent vegetation within the marl was patchy ranging from dense to sparse (Photo 2). As more fines were mixed in with the marl, the submergent vegetation cover appeared to increase. The dominant aquatic vegetation species in these areas included Stonewort (*Chara* sp.; Photo 3) and slender-leaved pondweed (*Stuckenia filiformis*). A review of ortho-imagery over several years indicated that vegetation density also varied from year to year.

Wetlands were located at both the east and west ends of the lake within the floodplain with more level terrain (Segments 2, 12, 13 and 14) and contained substantial amounts of emergent vegetation as well as submergent vegetation. The wetland located at the west end of the lake was dominated by Canada bluejoint (*Calamagrostis canadensis*) and beaked sedge (*Carex utriculata*; Photo 4). The wetlands to the east (Photos 5 to 7) were dominated by soft-stemmed bulrush (*Shoenoplectus tabernaemontani*); and the foreshore had abundant spike-rush (*Eleocharis* cf. *palustris*; Photo 8) and sandbar willows (*Salix exigua*).

Large woody debris within the littoral zone was most abundant in Segments 4 to 11 and 15 to 20 with the number of pieces ranging from 6 to 105. The foreshore area along Segments 16 to 20 had less large woody debris pieces due to the impacts of the FSR and removal of trees along the shoreline.



Photo 2. Patchy submergent vegetation at west end of lake in marl substrate (Segment 1 in background).

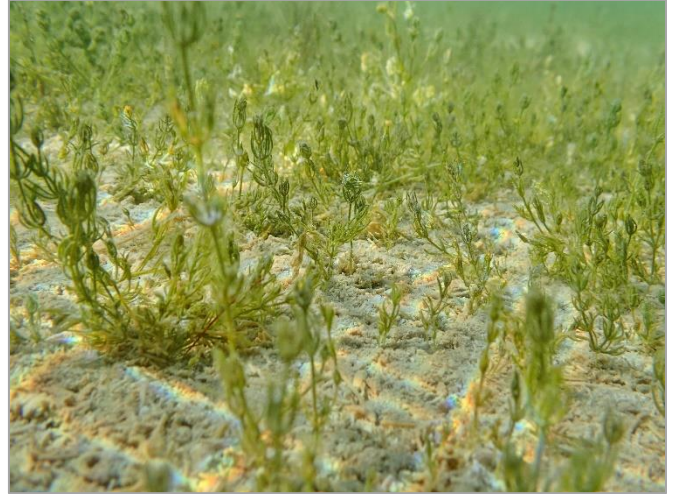


Photo 3. Stonewort growing in marl substrate (*Chara* sp.).



Photo 4. Wetland at west end of lake with stream mouth (Segment 2).



Photo 5. Wetland at the mouth of Outlet Creek (Segment 12).

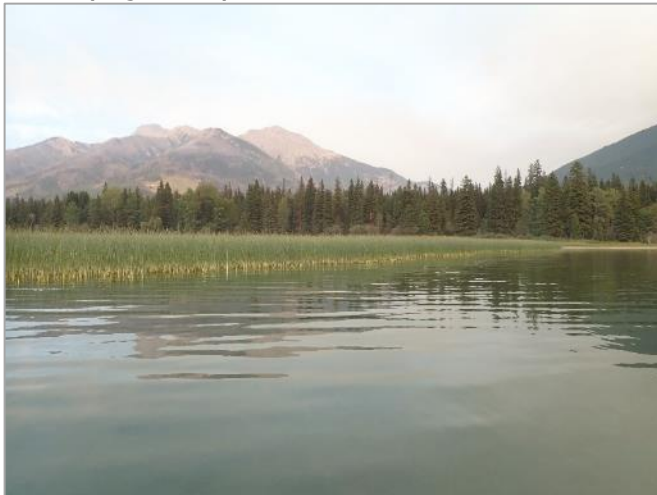


Photo 6. Bulrush wetland in littoral zone at east end of lake (Segment 14).



Photo 7. Spike-rush along foreshore at east end of lake (Segment 14).

4.6 Riparian Characteristics

The majority of the riparian vegetation along the foreshore of Whiteswan Lake was a mixture of coniferous (32.4%; Photo 8), shrubs (35%, Photo 9) and mixed forests (14.4%; Photo 10 and 11). Along the sections disturbed by the Whiteswan Lake FSR there were areas of exposed soils (9.2%; Photo 12), shrubs and herbs/grasses (8.9%). The riparian vegetation in the floodplains at the east and west ends of the lake had three vegetation bands with a B1 herbaceous layer within the foreshore area, a B2 shrub layer and a B3 mainly broadleaf forest layer (Segments 2, 13 to 15). The area to the east was dominated by mature cottonwood trees. Overhanging vegetation was present throughout except for areas that were denuded along the Whiteswan Lake FSR.



Photo 8. Coniferous forest with narrow B1 layer (Segment 4).



Photo 9. Shrub layer along Whiteswan Lake FSR.



Photo 10. Mixed forest near Cave Creek (Segment 7).



Photo 11. Mixed forest dominated by black cottonwood (Segment 13). Note wetland in the forefront, a B1 herb/grass layer, a B2 shrub layer and a B3 mainly broadleaf forest layer.



Photo 12. Section of exposed soils along Whiteswan Lake FSR and coniferous forest in the background (Segment 17).

4.7 Wildlife and Wildlife Habitat Features

Wildlife and wildlife habitat features observed during the survey included:

- Snags were present throughout and were most abundant in Segments 7 to 11. Snags recorded in Segments 18 to 20 were mostly uphill of the road.
- The area within the eastern floodplain (Segment 13) was dominated by mature black cottonwood forest which provides high value habitat to wildlife, especially for birds and cavity nesters. A stick nest was observed in one of the large cottonwood trees (Photo 13). Multiple snags were also present (Photo 14).
- Abundant wildlife signs were observed along Segments 13 to 15. This included heavy browse on sandbar willows, ungulate and waterfowl tracks (Photo 15 and 16).
- South facing rocky outcrops may provide habitat for reptile species (Photo 17).
- Waterfowl observed on the lake included Common Merganser (Photo 18), American Wigeon, Mallard, Bufflehead and Canada Goose.
- Bald eagle observed perching in mature tree in Segment 21 (Photo 19).
- Western toad observed in wetland at west end of lake (Segment 2; Photo 20).



Photo 13. Stick nest at east end of lake in cottonwood tree (Segment 13).



Photo 14. Snags at east end of lake (Segment 14).



Photo 15. Abundant wildlife tracks at east end of lake (Segment 15).



Photo 16. Sandbar willows browsed by wildlife (Segment 13).



Photo 17. South facing rocky outcrop (Segment 5).



Photo 18. Common Merganser on rock along foreshore (Segment 5).



Photo 19. Bald Eagle perched in tree (Segment 19).



Photo 20. Western toad in wetland at the west end of lake (Segment 2).

4.8 Shoreline Modifications

The most widespread shoreline modification was the Whiteswan Lake FSR which runs along the entire south shore of the lake for ~5.1 km (39%; Segments 1, and 16 to 22). The proximity of the road to the shoreline varied throughout with the most significant riparian buffer retained along Segment 19 (Photo 21-22). The Home Basin campground located at the northeast end of the lake provides access to recreationist to the foreshore with multiple access paths (Photo 25). Other shoreline modifications included 3 boat launches (Photo 23 and 24), 3 docks (Photo 26), 2 retaining walls (Photo 27) and 1 groyne (Photo 28). Riparian vegetation removal was also observed at the east end of the lake where agricultural fields were created (Photo 29).

Impacts from the use of motor boats was most prominent in the shallow littoral zones at either end of the lake with disturbance of the littoral substrate from propellers dragging along the bottom which may be affecting aquatic vegetation growth in some areas (Photo 30). ATV tracks were also observed on the foreshore at the east end of the lake (Photo 31), which may have gained access through the agricultural fields.

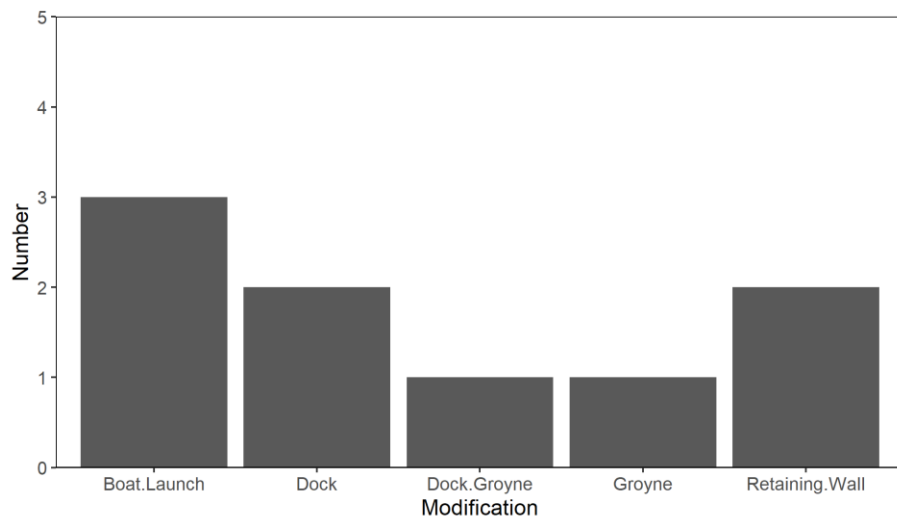


Figure 5. Foreshore modifications in Whiteswan Lake.



Photo 21. Riparian buffer retained along FSR (Segment 19).



Photo 22. Narrow riparian buffer along FSR mainly consisting of shrubs (Segment 20).

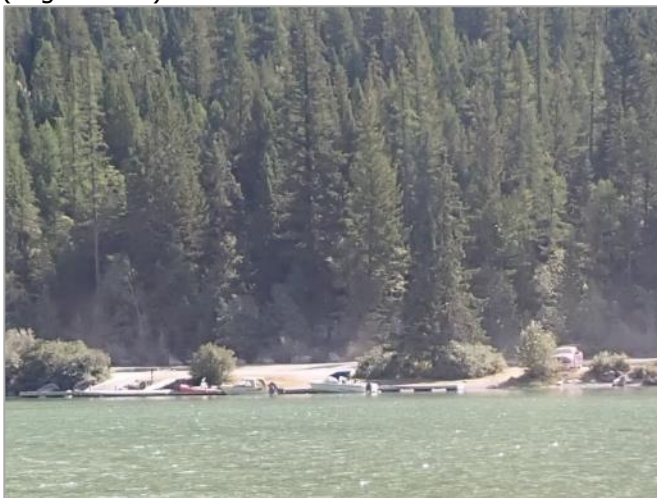


Photo 23. Boat launch and dock at Packrat Point (Segment 1).



Photo 24. Boat launch at Home Basin Campground (Segment 11).



Photo 25. Home Basin Campground with access paths to the waterfront (Segment 11).



Photo 26. Example of dock groyne and cabins (Segment 13).



Photo 27. Retaining wall and residences (Segment 13).



Photo 28. Rock groyne (Segment 13).



Photo 29. Agricultural field within lake foreshore (Segment 14).



Photo 30. Example of impact of motor boats on lake substrate (Segment 3).



Photo 31. ATV tracks on foreshore (Segment 14).

4.9 Level of Impact

Segments rated with a high level of impact were located along the Whiteswan Lake FSR (Segments 1, 16 to 18, and 20 to 22) totalling 4.0 km (30.7%) of the foreshore (Table 11). The FSR was constructed adjacent to the shoreline for most of its length, except along Segment 19 where the road was set back and a narrow riparian buffer was maintained. Otherwise, most of the remaining riparian vegetation along these sections consists of shrubs and herbs/grasses with some sections of exposed soils.

Moderate levels of impacts were located along Segments 11, 13, 14 and 19, totalling 3.3 km (25.6%). Developments along these segments (except for Segment 19) included the Home Basin Campground, recreational developments, and agricultural fields.

Most of the north shore of Whiteswan Lake and Segment 15, which consists mainly of the mouth of Inlet Creek, totalling 3.8 km (29.7%) are undeveloped with no impacts. Low impact segments totalling 1.8 km (13.9%) included the Cave Creek campground (Segment 7), access to foreshore from the North Shore Trail (Segment 10), removal of riparian vegetation along the wetland (Segment 12) and a portion of Segment 2 impacted by the FSR.

Table 11. Summary of score rating for each segment.

Level of Impact	Shoreline Length (m)	Shoreline %	Segments
High	3953.3	30.7	1, 16, 17, 18, 20, 21, 22
Medium	3291.7	25.6	11, 13, 14, 19
Low	1793.8	13.9	2, 7, 10, 12
None	3824.6	29.73	3, 4, 5, 6, 8, 9, 15

4.10 Foreshore Habitat Sensitivity Index

A summary of FHSI scoring is provided in Table 12, and in Figure 6. A detailed table of the FSHI data and calculations is provided in Appendix 5. Individual segments were assigned an ecological rank of Very Low, Low, Medium, High, and Very High, based on their FHSI score. Most of the shoreline had an ecological rank of Medium (36%), followed by Very High (27%), Low (21%), High (13%) and Very Low (2%).

Very High ecological ranks were assigned to Segments 2, 3, and 11 to 15. This includes the east and west end of the lake. Segments 2 and 11 to 15 scored high values for their wide littoral zones, substrate type, presence of wetlands and riparian vegetation. Most of the developments on the lake, other than the Whiteswan Lake FSR, has occurred in Segments 13 to 15 and include cabins and residences, a campground, two docks, one groyne, agricultural fields, and boat launch. Segment 3 is located next to the wetland and has significant amounts of shrubs overhanging the lake and shallow littoral zone. Segment 11 includes the Home Basin Campground.

High ecological ranks were assigned to Segments 7, 8 and 10. These segments are located on the north side of the lake. Segments 7 and 8 are located next to Cave Creek, Birch Creek and two unnamed tributaries draining south into the lake, which have significant amounts of gravel along the foreshore and have been identified as areas for shore spawning. Most of Segment 10 has a wide littoral zone.

Segments assigned an ecological rank of Medium (Segments 4 to 6, and 9) are located along the north shore of the lake where there has been little disturbance. Segment 16 is located near the Inlet Creek outlet with wide littoral zone and abundant submergent vegetation and has been impacted by the FSR and a gravel boat launch. Segments 18 and 19, which were also assigned a value of Medium are located on the south shore of the lake where the road has been set back from the lake and a riparian buffer has been maintained. Shore spawning has been identified along these two segments.

All segments with an ecological rank of Low (Segments 1, 17, 20, and 22) are affected by the Whiteswan Lake FSR. Segment 1 also has a parking area, boat launch and public dock.

Segment 21 was assigned a Very Low ecological rank and has been significantly affected by the FSR. This is primarily a cliff/bluff that had to be blasted to accommodate the FSR and the lake was partially infilled with angular riprap.

Table 12. Summary of score rating for each segment.

Rating	Range	Shoreline Length (m)	Shoreline %	Segments
Very High	>64	3530.8	27.4	2, 3, 11, 12, 13, 14, 15
High	51-64	2037.9	13.2	7, 8, 10
Medium	38-51	4248.2	35.7	4, 5, 6, 9, 16, 18, 19
Low	25-38	2747.7	21.4	1, 17, 20, 22
Very Low	<25	298.9	2.3	21

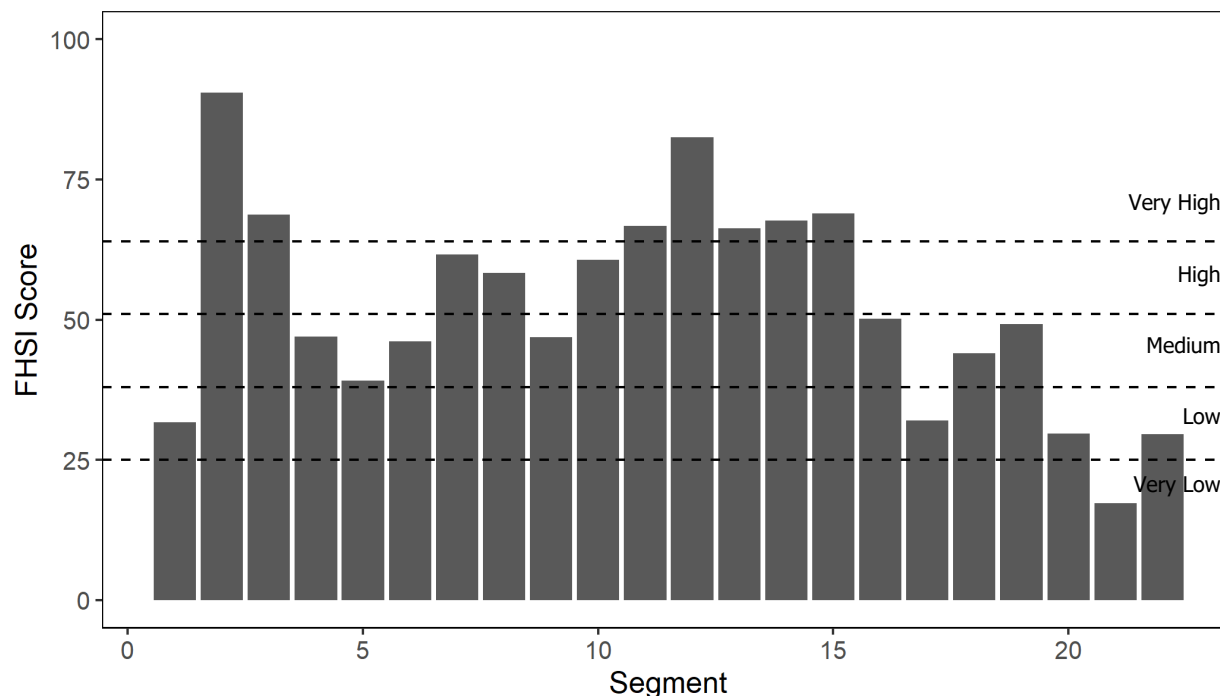


Figure 6. Plot of FHSI scores for each segment based on the criteria used in Table 3.

4.11 Zones of Sensitivity

Zones of Sensitivity (ZOS) are defined as specific areas that are identified as important habitats for either species or general ecosystem function (Schleppe et al 2020). Five ZOS were identified during the FIM surveys and background review and are described below.

- Shore Spawning** – Known rainbow trout shore spawning areas were identified in Segments 7, 8, 11, 17 and 18 by FLNRORD (Kevin Heidt, pers. comm.) and were mapped as polygons (Appendix 1). Rainbow trout shore spawning habitat is important to the long-term viability of the Whiteswan Lake fishery. The combined number of shoal redds would exceed individual tributary counts with the exception of Outlet Creek, with the most important shore spawning area located around Cave Creek (Segment 7), where abundant gravel is present. These areas have gravel substrates and are reported to have groundwater upwellings or springs that keep the gravels clean and allow the eggs to be oxygenated.
- Submerged Vegetation** - Submerged vegetation contributes to lake primary productivity, provides habitat for fish, and is sensitive to disturbance. Submerged vegetation is present throughout the shallow littoral areas at the east (Segments 11 – 16) and west ends (Segments 1-3) of the lake. The density of vegetation varies throughout these areas from dense to sparse. This may relate to differences in the underlying substrate, although there were signs that very shallow littoral areas had been impacted by boat propellers which may reduce or prevent vegetation from establishing. For the purposes of mapping the zone of sensitivity, the entire shallow littoral areas were mapped as polygons.

- **Stream Mouths** - Stream mouths provide a source of nutrients to the lake and are key staging areas for both adult spawners and emergent fry/juveniles. The riparian zones around streams also provide high value wildlife habitat. Most of the rainbow trout spawning occurs in Inlet Creek and Outlet Creek, as well as small tributaries along the lake such as Cave Creek and potentially in Home Basin Creek and Birch Creek. A 100 m polygon on either side of the stream mouths was used for streams that provide spawning habitat and a 50 m polygon was used for non fish bearing streams. Polygons were not defined for streams that did not have a defined channel at the mouth or discharged directly into the lake through a culvert along the FSR.
- **Cottonwood Riparian** – Black cottonwood riparian ecosystems provide important habitat for a wide range of plant and wildlife species. As the trees mature and decay, they offer important habitat for cavity nesters and are often used by raptors for roosting, nesting and foraging. Black cottonwood riparian ecosystems have been ranked by the BC Conservation Data Centre amongst the rarest plant community in the province. Reduced to fragments, the remaining stands are considered endangered. The cottonwood riparian ecosystem is located along Segment 13 and is mapped as a polygon.
- **Wetlands** - Wetlands are areas of high productivity, provide key habitat for fish, birds and other wildlife, and protect the shoreline from wind/wave erosion. Wetland polygons are located at the west (Segment 2) and east ends of the lake (Segments 12-14) within the shallow littoral areas.

5 DISCUSSION

Most of the disturbances to the foreshore of Whiteswan Lake are related to the Whiteswan Lake FSR which runs along the entire south shore of the lake for ~ 5.1 km and affecting 39% of the shoreline. The north shore of the lake is mostly undisturbed, other than the Cave Creek campground which is only accessible by either boat or foot via the North Shore Trail. Alterations other than the FSR are concentrated at the east end of the lake (Segments 11 to 14) within the floodplain and include the waterfront Home Basin Campground, and privately owned lots. Foreshore alterations comprise cabins and residences, boat launches, docks, a retaining wall and 1 groyne. This area was also conducive to the development of agricultural fields which has resulted in the loss of some riparian vegetation. Other impacts include disturbance to the lake bed by motor boats disrupting submergent vegetation within the shallow littoral zones at both ends of the lake.

High value wildlife habitat was identified within the floodplain at the east end of the lake (Segments 12 to 15), with abundant wildlife signs observed, including ungulate and waterfowl tracks and browse. The floodplain extends to the White River and is likely used as a connectivity corridor for wildlife between the river and Whiteswan Lake. The riparian vegetation band dominated by mature black cottonwood trees, ~40 to 70 m wide maintained along ~650 m of the foreshore along Segment 13, is considered an important ecological feature. Black cottonwood riparian ecosystems have been ranked by the BC Conservation Data Centre amongst the rarest plant community in the province. Reduced to fragments, the remaining stands are considered endangered (MELP 1997). These forests provide important wildlife habitat especially for birds and cavity nesters. A stick nest was observed on a cottonwood tree in this

area. In addition, multiple wetland polygons were identified within the littoral zone, including the Blue-listed bulrush (*Schoenoplectus acutus*) Deep Marsh ecological community (BC CDC 2012), contributing to the biodiversity of this area.

Whiteswan Lake is managed as a rainbow trout fishery and attracts many recreationists and anglers. Even though rainbow trout are not native to this area, they have become naturalized and self-sustaining. Most of the spawning occurs in Inlet Creek and Outlet Creek, however shore spawning has also been reported in Segments 7, 8, 11 and 17-19 and contributes to the overall success of the rainbow trout population. Concerns of hybridization with the native westslope cutthroat trout downstream of the waterfall in Outlet Creek and in the White River drainage prompted the construction of a barrier on Outlet Creek to limit downstream migration of juvenile and adults and appears to be effective, although monitoring is ongoing.

Large portions of the foreshore of Whiteswan Lake (~81.4%) are located within Whiteswan Lake Provincial Park and further development is unlikely. The east end of the lake (Segments 12 to 15) contains various sensitive habitats, such as wetlands, mature cottonwood riparian habitat and extensive littoral zones. The land along this area is privately owned, and future development may be expected. Further development in this area should take potential impacts on sensitive environmental features into consideration.

6 RECOMMENDATIONS

The inclusion of Whiteswan Lake into the Whiteswan Lake Provincial Park has contributed to the protection of a large portion of the lake foreshore, as no additional developments are permitted within the park. The most sensitive habitats are located at the east and west ends of the lake within the floodplains. Zones of Sensitivity (ZOS), which include areas that are identified as important habitats, have been designated for wetlands, the wide shallow littoral zones at the east and west ends of the lake (Segments 2, and 12 to 15), most stream mouths, shore spawning habitat and the riparian cottonwood band at the east end of the lake (Segment 13), and are mapped as polygons (Appendix 1). ZOS were not assigned to all stream mouths, as some did not have a defined channel or discharged directly into the lake via a culvert along the FSR. Streams that provide spawning habitat, such as Outlet Creek, Inlet Creek and Cave Creek, were assigned a wider stream mouth buffer of 100 m in order to allow for fish staging.

Many of the ZOS features located at the east end of the lake (Segments 12 to 15) are surrounded by privately owned land and some future development may be expected. The east end of the lake (Segments 12 to 15) should be designated as sensitive habitat and any future developments should consider the sensitivity of this area. The wetland at the west end of the lake (Segment 2) should also be designated as sensitive habitat with no developments permitted. These areas should be considered as conservation zones due to their sensitivity and ecological importance. Designation of conservation zones along privately owned lands (Segments 13 and 14) will require consultation with landowners.

The following recommendations should be considered:

- Protect designated zones of sensitivity (ZOS) including wetlands, stream mouths that provide staging and rearing habitat for fish bearing streams, shore spawning habitat, shallow littoral zones at the east and west ends of the lake, and riparian cottonwood within the floodplain at the east end of the lake.
- Consider designation of conservation areas at the east (Segment 2) and west ends of the lake (Segments 12 to 15). Landowner acceptance would be required for segments next to privately owned land (Segments 13 and 14).
- Limit use of power boats within the shallow littoral zones at the east and west ends of the lake to reduce disturbance to shallow littoral areas. Since docks are present at either end, use of power boats in these areas cannot be prohibited, however, educational information should be posted at strategic locations to inform users of the sensitivity of these areas.
- Ensure road maintenance practices on the Whiteswan FSR minimise disturbance to the foreshore. Where possible, grading and/or snow removal should be directed towards the upland side of the road.
- Any future developments should be carefully designed with the assistance of a Qualified Environmental Practitioner.

7 REFERENCES

- [Agra] Agra Earth and Environmental Ltd. 2000a. Routine monitoring of 1998 Inlet Creek restoration structure. Consultant report prepared for Crestbrook Forest Industries Ltd.
- [Agra] Agra Earth and Environmental Ltd. 2000b. As-built report of Inlet Creek restoration prescriptions. Consultant report prepared for Crestbrook Forest Industries Ltd.
- [BC CDC] B.C. Conservation Data Centre. 1995. Species Summary: *Himantopus mexicanus*. B.C. Ministry of Environment. <https://a100.gov.bc.ca/pub/eswp/> (accessed Feb 12, 2021).
- [BC CDC] B.C. Conservation Data Centre. 2016. Conservation Status Report: *Rana pretiosa*. B.C. Minist. of Environment. Available: <https://a100.gov.bc.ca/pub/eswp/> (accessed Feb 18, 2021).
- [BC CDC] B.C. Conservation Data Centre. 2021a. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed 2021-02-12). Search criteria: Animals OR Plants OR Lichens OR Macrofungi AND BC Conservation Status: Red (Extirpated, Endangered, or Threatened) OR Blue (Special Concern) AND COSEWIC Status: Extinct OR Extirpated OR Endangered OR Threatened OR Special Concern AND Area Of Interest: User Defined Polygon
- [BC CDC] B.C. Conservation Data Centre. 2021b. CDC iMap [web application]. Victoria, British Columbia, Canada. Available: <http://maps.gov.bc.ca/ess/sv/cdc/> (accessed 2020-01-12).
- B.C. Parks. 2003. Whiteswan Lake Provincial Park - Purpose Statement and Zoning Plan.
- Bell, J. and A. Chirico. 2007. Whiteswan Lake Creek or Outlet Creek Field Report. Prepared by BC Ministry of Environment. 5 pp.
- Bell, J.M. and A.D. Martin. 1985. Rainbow trout fry production from the Whiteswan Lake spawning channel in 1984. BC Ministry of Environment, Fisheries Branch, Kootenay Region.
- Burrows, J. 2021. Personal Communications. Senior Fish Biologist, Ministry of Forests, Lands, Natural Resource Operations and Rural Development.
- Campbell, R.W., A.R. Norris, M.L. Funk and K.V. Kimm. 2000. British Columbia nest record scheme: 45th annual report – 1999 nesting season. Wildlife report No. 6. Wild Bird Trust of British Columbia, West Vancouver, B.C. 26 p.
- COSEWIC. 2011. COSEWIC assessment and status report on the Oregon Spotted Frog *Rana pretiosa* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 47 pp.

- eBird. 2021. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: <http://www.ebird.org>. (Accessed: January 29, 2021).
- Heidt, K.D. and H.M. Lamson. 2012. Fisheries Field Report – Region 4 Small Lakes Assessment – Whiteswan Lake. Report prepared by the BC Ministry of Forests, Lands and Natural Resource Operations, Fish and Wildlife Branch, Fisheries Program – Kootenay Lake. 14 pp.
- Lamson, H.M. 2019. Evaluation of Current Westslope Cutthroat Trout Hybridization Levels in the Upper Kootenay Drainage – Final Report. Report prepared for Fish and Wildlife Compensation Program. 27 pp.
- Lamson, H.M., Evans, V. and S. Whyte. 2014. Kootenay Region 2014 Small Lake Assessments. Report prepared by the Ministry of Forests, Lands and Natural Resource Operations, Fish and Wildlife Branch. 102 pp.
- McPherson, S.M. and M.D. Robinson. 2013. Whiteswan Lake Provincial Park Fisheries Management Plan. Prepared by Lotic Environmental Ltd. for the Ministry of Forests, Lands and Natural Resource Operations. 90 pp.
- [MELP] Ministry of Environment, Lands and Parks. 1997. Cottonwood Riparian Ecosystems of the Southern Interior. Brochure funding provided by Forest Renewal BC.
- [NHC] Northwest Hydraulic Consultants Ltd. 2016. Outlet Creek Fish Barrier Construction Completion Report. Report prepared for Ministry of Forests, Lands and Natural Resource Operations, Cranbrook, B.C. 5 pp.
- Schleppe, J. and B. Mason. 2009. Standard Methods for Completion of Foreshore Inventory and Mapping Projects. Prepared by: Ecoscape Environmental Consultants Ltd. and the Community Mapping Network. 37 pp.
- Schleppe, J.S., McPherson, S., Porto, L., and B. Mason. 2020. Foreshore Integrated Management Plan Methods. Prepared for Living Lakes Canada. Prepared by Ecoscape Environmental Consultants Ltd., Lotic Environmental Ltd., Wood Environment and Infrastructure Solutions, and BC Community Mapping Network. Report prepared for Living Lake Canada. 81 pp.
- Tepper, H. 2006. Kootenay Fisheries Field Report – Whiteswan Lake. BC Ministry of Environment, Fisheries Branch, Cranbrook BC.

APPENDIX 1. WHITESWAN LAKE FORESHORE INVENTORY MAPS

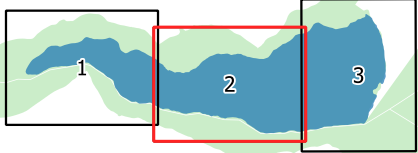


Whiteswan Lake Foreshore Inventory and Mapping Mapsheet 2 of 3

- Dock
- Boat Launch
- Campground
- Shoreline Modification
- FISS Record (Rainbow Trout)
- Shoreline Segment Break
- BC Freshwater Atlas Streams
- 2020 Mapped Streams
- North Shore Trail
- Roads
- Contour (20 m)
- Provincial Park Boundary
- Cadastral Boundaries
- BC Freshwater Atlas Wetlands
- Foreshore Habitat Sensitivity Index
 - Very High
 - High
 - Medium
 - Low and Very Low
- Zones of Sensitivity
 - Submergent Vegetation
 - Wetland
 - Cottonwood Riparian
 - Creek Mouth
 - Shoal Spawning
- 2020 Wildlife Observation - Nest

0 100 200 meters

1:6000 NAD83 UTM Zone 11
March 29, 2021
Living Lakes Canada
Masse Environmental Consultants Ltd.



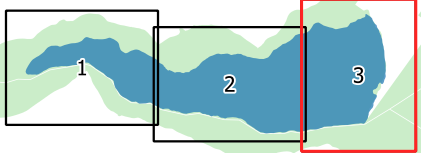


Whiteswan Lake Foreshore Inventory and Mapping Mapsheet 3 of 3

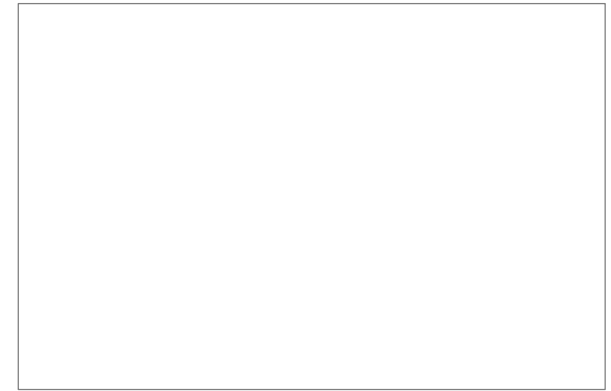
- Dock
- Boat Launch
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 - Cottonwood Riparian
 - Creek Mouth
 - Shoal Spawning
- 2020 Wildlife Observation - Nest

0 100 200 meters

1:6000 NAD83 UTM Zone 11
March 29, 2021
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APPENDIX 2. WHITESWAN LAKE SEGMENT SUMMARIES



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
166	Rocky Shore	Roadway	Low <5%	Recreation	High >50%	No	100	0	Roadway, parking area and boat launch.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	20	70	10	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
30	0	0	0	0	40	20	10	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Exposed Soil	Sparse	Sparse (<10%)	Sparse (<10%)	Patchy	5	5	Patchy shrubs along foreshore.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Sparse (<10%)	Abundant (>50%)	Continuous	15	Campground present within this band.

Wildlife habitat

Veteran	Snags	Comment
No	No	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
8	8	0	0	Wide >50m	1	100	0	0	0	0	0	0	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	1	0	0	1	100	50



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
368	Wetland	Roadway	Low <5%	Park	Low <10%	No	5	95	Wetland.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	0	0	5	95	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
20	80	0	0	0	0	0	0	0	None 0%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	95	0	0	5	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Natural Wetland	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Continuous	35	100	Includes stream mouth and wetland vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Shrubs	Tall Shrubs	Abundant (>50%)	Sparse (<10%)	Patchy	25	B3 band present.

Wildlife habitat

Veteran	Snags	Comment
No	No	Bald eagle sighting.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
100	20	80	0	Wide >50m	2	100	0	0	0	0	0	0	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	5	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
536	Rocky Shore	None	Medium 5-20%	Park	None	No	0	100	Undisturbed forshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	100	0	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
15	0	0	0	0	0	35	50	0	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Tall Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	10	100	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	40	Some aspen and cottonwood present.

Wildlife habitat

Veteran	Snags	Comment
No	5 to 25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
50	40	10	0	Wide >50m	7	100	0	0	0	0	0	0	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
880	Rocky Shore	None	Steep 20-60%	Park	None	No	0	100	Undisturbed forshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	95	5	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	30	65	5	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Abundant (>50%)	Medium (10-50%)	Continuous	5	40	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	45	

Wildlife habitat

Veteran	Snags	Comment
No	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
10	5	5	0	Narrow <10m	22	10	0	0	0	0	0	35	50	5

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
259	Cliff/Bluff	None	Very Steep >60%	Park	None	No	0	100	Undisturbed forshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
80	20	0	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	30	50	20	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Sparse (<10%)	Medium (10-50%)	Continuous	5	20	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Sparse (<10%)	Medium (10-50%)	Continuous	45	Drier site, bedrock dominated.

Wildlife habitat

Veteran	Snags	Comment
No	5 to 25	Merganser and loon sighting.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Narrow <10m	6	0	0	0	0	0	0	30	50	20

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
474	Rocky Shore	None	Steep 20-60%	Park	None	No	0	100	Undisturbed forshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	100	0	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	20	80	0	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	5	40	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	45	

Wildlife habitat

Veteran	Snags	Comment
No	5 to 25	Mergenser on rock.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Narrow <10m	10	0	0	0	0	0	0	30	60	10

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
796	Gravel	Other	Low <5%	Recreation	Low <10%	No	5	95	Includes Cave Creek campground.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	90	0	10	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	80	20	0	0	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	10	40	0

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	40	

Wildlife habitat

Veteran	Snags	Comment
No	>25	

Aquatic Vegetation

Littoral Zone														
Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
20	20	0	0	Medium 10-50m	105	0	0	0	60	10	20	10	0	0

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
482	Gravel	None	Medium 5-20%	Park	None	No	0	100	Includes Birch Creek.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	5	90	0	5	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	10	30	60	0	0	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	3	40	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	47	

Wildlife habitat

Veteran	Snags	Comment
No	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
10	10	0	0	Medium 10-50m	53	0	0	0	60	10	15	15	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
946	Cliff/Bluff	None	Very Steep >60%	Park	None	No	0	100	Cliff/bluff at west and rocky at east

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
60	30	10	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	5	35	40	20	None 0%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	3	40	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	47	

Wildlife habitat

Veteran	Snags	Comment
No	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Medium 10-50m	13	0	0	0	10	0	0	10	40	40

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
415	Gravel	None	Medium 5-20%	Park	Low <10%	No	5	95	Undisturbed forshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	20	80	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	10	40	50	0	0	Low 0-25%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	3	40	Undisturbed vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	47	

Wildlife habitat

Veteran	Snags	Comment
No	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
40	40	0	0	Wide >50m	21	10	0	0	50	0	20	20	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
642	Gravel	None	Low <5%	Recreation	Medium 10-50%	No	20	80	Includes Home Basin Campground

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	95	0	5	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	80	20	0	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	5	40	0

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Abundant (>50%)	Continuous	45	

Wildlife habitat

Veteran	Snags	Comment
5 to 25	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
60	60	0	0	Wide >50m	2	40	30	0	10	0	20	0	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
1	0	0	0	1	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
214	Wetland	None	Low <5%	Rural	Low <10%	No	10	90	Wetland.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	0	0	10	90	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
50	50	0	0	0	0	0	0	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	100	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Natural Wetland	Tall Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	40	75	Includes lake outlet and wetland vegetation.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Mixed Forest	Mature Forest	Medium (10-50%)	Medium (10-50%)	Patchy	10	Tree layer removed on east side of stream.

Wildlife habitat

Veteran	Snags	Comment
No	No	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
100	40	100	0	Wide >50m	0	95	0	0	0	0	0	5	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
988	Gravel	Other	Low <5%	Rural	Medium 10-50%	Yes	30	70	Residential development and wetland present.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	80	0	0	20	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	50	0	0	0	0	50	0	0	High >75%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	100	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	15	10	Bullrush polygon in littoral zone.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Shrubs	Tall Shrubs	Abundant (>50%)	Medium (10-50%)	Continuous	10	Ungulate browse. B3 band present.

Wildlife habitat

Veteran	Snags	Comment
>25	5 to 25	Abundant wildlife including waterfowl and heavy bro

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
60	30	30	0	Wide >50m	2	60	0	0	0	0	0	40	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
1	1	1	1	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
535	Wetland	Other	Low <5%	Rural	Medium 10-50%	Yes	45	55	Agricultural field and wetland present.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	0	20	0	80	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	90	0	0	5	5	0	0	0	High >75%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
50	0	0	0	0	0	0	0	0	50	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Natural Wetland	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Continuous	15	20	Bullrush polygon in littoral zone.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Shrubs	Low Shrubs	Medium (10-50%)	Sparse (<10%)	Patchy	5	Includes agricultural fields. B3 band present.

Wildlife habitat

Veteran	Snags	Comment
>25	5 to 25	Deer/Elk tracks.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
80	80	80	0	Wide >50m	2	30	40	0	20	0	0	10	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
248	Stream Mouth	None	Low <5%	Rural	None	No	0	100	Includes Inlet Creek.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	30	0	70	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	10	40	0	0	30	20	0	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	100	0	0	0	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Medium (10-50%)	Sparse (<10%)	Patchy	10	70	Includes stream mouth.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Shrubs	Tall Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	15	Disturbance from stream flooding. B3 band present.

Wildlife habitat

Veteran	Snags	Comment
No	5 to 25	Abundant wildlife: ducks, elk and deer.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
45	10	35	0	Wide >50m	0	20	0	10	20	40	10	0	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	0	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
345	Gravel	Roadway	Steep 20-60%	Transportation	High >50%	No	100	0	Includes road and Inlet Creek campground.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	100	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	10	80	10	0	High >75%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	5	90	Narrow band of shrubs present.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	30	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
5 to 25	<5	Osprey sighting.

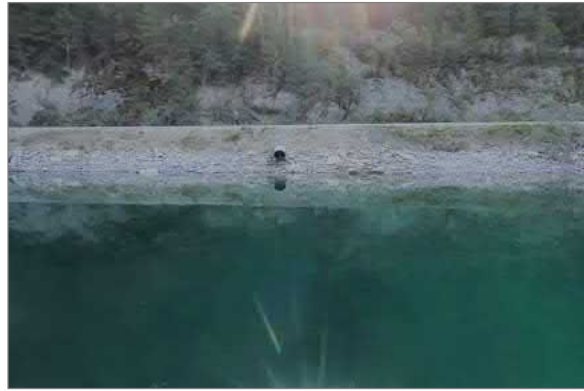
Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
90	90	0	0	Wide >50m	15	20	0	0	40	0	20	20	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	1	100	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
723	Rocky Shore	Roadway	Very Steep >60%	Transportation	High >50%	No	100	0	Includes road.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	100	0	0	0	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	90	10	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Exposed Soil	Grass/Herb	Sparse (<10%)	None	Patchy	3	0	Road is next to lake foreshore with exposed soils.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Sparse (<10%)	Medium (10-50%)	Continuous	32	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
5 to 25	5 to 25	Eagle sighting.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
10	10	0	0	Narrow <10m	12	0	0	0	10	0	10	80	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	10



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
562	Gravel	Roadway	Steep 20-60%	Transportation	High >50%	No	100	0	Road set back slightly with shrubs along foreshore.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	100	0	0	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	10	90	0	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	5	80	Road set back with narrow band of shrubs.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	30	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
>25	>25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
30	30	0	0	Narrow <10m	87	0	0	0	30	0	0	70	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
1127	Gravel	Roadway	Steep 20-60%	Transportation	Medium 10-50%	No	50	50	Road set back with riparian buffer.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	100	0	0	0	0

Fisheries

Shore Spawn
Yes

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	10	90	0	0	Low 0-25%	Smooth

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Coniferous	Mature Forest	Abundant (>50%)	Medium (10-50%)	Continuous	5	90	Road set back with riparian buffer

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Medium (10-50%)	Medium (10-50%)	Continuous	30	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
>25	>25	Eagle perched on tree.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
30	30	0	0	Narrow <10m	54	0	0	0	40	0	20	40	0	0

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	0



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
1516	Rocky Shore	Roadway	Steep 20-60%	Transportation	High >50%	No	100	0	Includes road infill.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	90	10	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	20	50	30	0	Low 0-25%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	3	80	Narrow band of shrubs present.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Sparse (<10%)	Medium (10-50%)	Continuous	32	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
5 to 25	>25	Eagle sighting.

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Narrow <10m	46	0	0	0	0	0	30	30	30	10

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	90



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
299	Cliff/Bluff	Roadway	Very Steep >60%	Transportation	High >50%	No	100	0	Includes road infill.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
75	25	0	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	30	60	10	Low 0-25%	Blast Rock

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Exposed Soil	Low Shrubs	Medium (10-50%)	None	Patchy	2	10	Exposed soils and riprap along foreshore.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Mature Forest	Sparse (<10%)	Medium (10-50%)	Continuous	33	Blast cliff.

Wildlife habitat

Veteran	Snags	Comment
<5	5 to 25	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Narrow <10m	5	0	0	0	0	0	0	0	50	50

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	100



General

Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Comment
343	Rocky Shore	Roadway	Steep 20-60%	Transportation	High >50%	No	100	0	Includes road infill.

Shore Type (%)

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	100	0	0	0	0	0

Fisheries

Shore Spawn
No

Foreshore Substrate (%)

Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddness	Shape
0	0	0	0	0	0	40	60	0	Low 0-25%	Angular

Land Use (%)

Agriculture	Commercial	Conservation	Forestry	Industrial	Institution	Multi-family	Natural	Park	Rural	Single Family	Transportation	Urban Park	Utility
0	0	0	0	0	0	0	0	0	0	0	100	0	0

Vegetation Band 1

Class	Stage	Shrubq	Tree	Distribution	Width	Overhang	Comment
Shrubs	Low Shrubs	Abundant (>50%)	Sparse (<10%)	Continuous	5	80	Narrow band of shrubs present.

Vegetation Band 2

Class	Stage	Shrub cover	Tree cover	Distribution	Width	Comment
Coniferous	Young Forest	Sparse (<10%)	Medium (10-50%)	Continuous	30	Road width removed.

Wildlife habitat

Veteran	Snags	Comment
<5	<5	

Aquatic Vegetation

Aquatic Vegetation	Submerget Vegetation	Emergent Vegetation	Floating Vegetation	Width	LWD	Marl	Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	0	Narrow <10m	18	0	0	0	0	0	0	40	50	10

Littoral Zone

Shoreline Modifications

Retaining Walls	Docks	Dock Groynes	Groynes	Boat Launches	% Road modified	% Erosion Protection
0	0	0	0	0	100	80

APPENDIX 3. SPECIES AT RISK

Appendix 3. Species at risk with potential occurrence in Whiteswan Lake Provincial Park (BC CDC 2021a).

Scientific Name	English Name	Class	BC List ¹	COSEWIC ²	SARA Status ²
<i>Anaxyrus boreas</i>	Western Toad	amphibians	Yellow	Special Concern	Special Concern
<i>Ascaphus montanus</i>	Rocky Mountain Tailed Frog	amphibians	Blue	Threatened	Threatened
<i>Lithobates pipiens</i>	Northern Leopard Frog	amphibians	Red	Endangered	Endangered
<i>Plethodon idahoensis</i>	Coeur d'Alene Salamander	amphibians	Yellow	Special Concern	Special Concern
<i>Accipiter gentilis atricapillus</i>	Northern Goshawk, atricapillus subspecies	birds	Blue	Not at Risk	
<i>Aechmophorus occidentalis</i>	Western Grebe	birds	Red	Special Concern	Special Concern
<i>Ardea herodias herodias</i>	Great Blue Heron, herodias subspecies	birds	Blue		
<i>Asio flammeus</i>	Short-eared Owl	birds	Blue	Special Concern	Special Concern
<i>Athene cunicularia</i>	Burrowing Owl	birds	Red	Endangered	Endangered
<i>Bartramia longicauda</i>	Upland Sandpiper	birds	Red		
<i>Botaurus lentiginosus</i>	American Bittern	birds	Blue		
<i>Buteo lagopus</i>	Rough-legged Hawk	birds	Blue	Not at Risk	
<i>Buteo platypterus</i>	Broad-winged Hawk	birds	Blue		
<i>Buteo swainsoni</i>	Swainson's Hawk	birds	Red		
<i>Butorides virescens</i>	Green Heron	birds	Blue		
<i>Calcarius pictus</i>	Smith's Longspur	birds	Blue		
<i>Chondestes grammacus</i>	Lark Sparrow	birds	Blue		
<i>Chordeiles minor</i>	Common Nighthawk	birds	Yellow	Special Concern	Threatened
<i>Coccythraustes vespertinus</i>	Evening Grosbeak	birds	Yellow	Special Concern	Special Concern
<i>Contopus cooperi</i>	Olive-sided Flycatcher	birds	Blue	Special Concern	Threatened
<i>Coturnicops noveboracensis</i>	Yellow Rail	birds	Red	Special Concern	Special Concern
<i>Cygnus columbianus</i>	Tundra Swan	birds	Blue		
<i>Cypseloides niger</i>	Black Swift	birds	Blue	Endangered	Endangered
<i>Dolichonyx oryzivorus</i>	Bobolink	birds	Blue	Threatened	Threatened
<i>Euphagus carolinus</i>	Rusty Blackbird	birds	Blue	Special Concern	Special Concern
<i>Falco mexicanus</i>	Prairie Falcon	birds	Red	Not at Risk	
<i>Falco peregrinus anatum</i>	Peregrine Falcon, anatum subspecies	birds	Red	Not at Risk	Special Concern
<i>Hirundo rustica</i>	Barn Swallow	birds	Blue	Threatened	Threatened
<i>Hydroprogne caspia</i>	Caspian Tern	birds	Blue	Not at Risk	
<i>Icteria virens</i>	Yellow-breasted Chat	birds	Red	Endangered	Endangered
<i>Larus californicus</i>	California Gull	birds	Blue		
<i>Limnodromus griseus</i>	Short-billed Dowitcher	birds	Blue		
<i>Limosa haemastica</i>	Hudsonian Godwit	birds	Red	Threatened	
<i>Megascops kennicottii macfarlanei</i>	Western Screech-Owl, macfarlanei subspecies	birds	Blue	Threatened	Threatened
<i>Melanerpes lewis</i>	Lewis's Woodpecker	birds	Blue	Threatened	Threatened
<i>Melanitta perspicillata</i>	Surf Scoter	birds	Blue		

Scientific Name	English Name	Class	BC List ¹	COSEWIC ²	SARA Status ²
<i>Numenius americanus</i>	Long-billed Curlew	birds	Blue	Special Concern	Special Concern
<i>Nycticorax nycticorax</i>	Black-crowned Night-heron	birds	Red		
<i>Oreoscoptes montanus</i>	Sage Thrasher	birds	Red	Endangered	Endangered
<i>Patagioenas fasciata</i>	Band-tailed Pigeon	birds	Blue	Special Concern	Special Concern
<i>Pelecanus erythrorhynchos</i>	American White Pelican	birds	Red	Not at Risk	
<i>Phalacrocorax auritus</i>	Double-crested Cormorant	birds	Blue	Not at Risk	
<i>Phalaropus lobatus</i>	Red-necked Phalarope	birds	Blue	Special Concern	
<i>Pluvialis dominica</i>	American Golden-Plover	birds	Blue		
<i>Podiceps nigricollis</i>	Eared Grebe	birds	Blue		
<i>Psiloscoops flammeolus</i>	Flammulated Owl	birds	Blue	Special Concern	Special Concern
<i>Recurvirostra americana</i>	American Avocet	birds	Blue		
<i>Setophaga castanea</i>	Bay-breasted Warbler	birds	Red		
<i>Setophaga tigrina</i>	Cape May Warbler	birds	Blue		
<i>Setophaga virens</i>	Black-throated Green Warbler	birds	Blue		
<i>Sphyrapicus thyroideus</i>	Williamson's Sapsucker	birds	Blue	Endangered	Endangered
<i>Tympanuchus phasianellus columbianus</i>	Sharp-tailed Grouse, columbianus subspecies	birds	Blue		
<i>Catostomus platyrhynchus</i>	Mountain Sucker	fishes	Blue	Special Concern	Special Concern
<i>Cottus confusus</i>	Shorthead Sculpin	fishes	Blue	Special Concern	Special Concern
<i>Cottus sp. 9</i>	Rocky Mountain Sculpin	fishes	Red	Special Concern	Special Concern
<i>Oncorhynchus clarkii lewisi</i>	Cutthroat Trout, lewisi subspecies	fishes	Blue	Special Concern	Special Concern
<i>Rhinichthys umatilla</i>	Umatilla Dace	fishes	Red	Threatened	
<i>Salvelinus confluentus</i>	Bull Trout	fishes	Blue	Special Concern	
<i>Argia vivida</i>	Vivid Dancer	insects	Blue	Special Concern	Special Concern
<i>Boloria alberta</i>	Albert's Fritillary	insects	Blue		
<i>Cicindela hirticollis</i>	Hairy-necked Tiger Beetle	insects	Blue		
<i>Colias meadii</i>	Mead's Sulphur	insects	Blue		
<i>Cupido comyntas</i>	Eastern Tailed Blue	insects	Blue		
<i>Danaus plexippus</i>	Monarch	insects	Red	Endangered	Special Concern
<i>Epargyreus clarus clarus</i>	Silver-spotted Skipper, clarus subspecies	insects	Blue		
<i>Euphydryas gillettii</i>	Gillette's Checkerspot	insects	Blue		
<i>Euptoieta claudia</i>	Variegated Fritillary	insects	Blue		
<i>Hesperia nevada</i>	Nevada Skipper	insects	Blue		
<i>Libellula pulchella</i>	Twelve-spotted Skimmer	insects	Blue		
<i>Lycaena dione</i>	Dione Copper	insects	Red		

Scientific Name	English Name	Class	BC List ¹	COSEWIC ²	SARA Status ²
<i>Lycaena hyllus</i>	Bronze Copper	insects	Blue		
<i>Oeneis jutta chermocki</i>	Jutta Arctic, chermocki subspecies	insects	Blue		
<i>Ophiogomphus occidentis</i>	Sinuous Snaketail	insects	Blue		
<i>Papilio machaon dodi</i>	Old World Swallowtail, dodi subspecies	insects	Red		
<i>Phanogomphus graslinellus</i>	Pronghorn Clubtail	insects	Blue		
<i>Polites themistocles themistocles</i>	Tawny-edged Skipper, themistocles subspecies	insects	Blue		
<i>Pyrgus communis</i>	Checkered Skipper	insects	Blue		
<i>Somatochlora forcipata</i>	Forcipate Emerald	insects	Blue		
<i>Speyeria aphrodite manitoba</i>	Aphrodite Fritillary, manitoba subspecies	insects	Blue		
<i>Speyeria aphrodite whitehousei</i>	Aphrodite Fritillary, whitehousei subspecies	insects	Blue		
<i>Speyeria mormonia eurynome</i>	Mormon Fritillary, eurynome subspecies	insects	Red		
<i>Cladonia luteoalba</i>	lemon pixie	lichens	Blue		
<i>Collema bachmanianum</i>	Caesar's tarpaper	lichens	Blue		
<i>Evernia divaricata</i>	mountain oakmoss	lichens	Blue		
<i>Leptogium cyanescens</i>	blue-blue vinyl	lichens	Red		
<i>Nephroma isidiosum</i>	pebbled paw	lichens	Blue		
<i>Gulo gulo luscus</i>	Wolverine, luscus subspecies	mammals	Blue	Special Concern	Special Concern
<i>Myodes gapperi galei</i>	Southern Red-backed Vole, galei subspecies	mammals	Blue		
<i>Myotis lucifugus</i>	Little Brown Myotis	mammals	Yellow	Endangered	Endangered
<i>Neotamias minimus oreocetes</i>	Least Chipmunk, oreocetes subspecies	mammals	Blue		
<i>Neotamias minimus selkirki</i>	Least Chipmunk, selkirki subspecies	mammals	Red		
<i>Neotamias ruficaudus ruficaudus</i>	Red-tailed Chipmunk, ruficaudus subspecies	mammals	Red		
<i>Oreamnos americanus</i>	Mountain Goat	mammals	Blue		
<i>Ovis canadensis</i>	Bighorn Sheep	mammals	Blue		
<i>Taxidea taxus</i>	American Badger	mammals	Red	Endangered	Endangered
<i>Ursus arctos</i>	Grizzly Bear	mammals	Blue	Special Concern	Special Concern
<i>Anguispira kochi</i>	Banded Tigersnail	molluscs	Blue	Not at Risk	
<i>Cryptomastix mullani</i>	Coeur d'Alene Oregonian	molluscs	Blue		
<i>Galba bulimoides</i>	Prairie Fossaria	molluscs	Blue		
<i>Galba dalli</i>	Dusky Fossaria	molluscs	Blue		
<i>Gastrocopta holzingeri</i>	Lambda Snaggletooth	molluscs	Red		
<i>Gyraulus crista</i>	Star Gyro	molluscs	Blue		
<i>Hemphillia camelus</i>	Pale Jumping-slug	molluscs	Blue		

Scientific Name	English Name	Class	BC List ¹	COSEWIC ²	SARA Status ²
<i>Kootenaia burkei</i>	Pygmy Slug	molluscs	Blue	Special Concern	Special Concern
<i>Magnipelta mycophaga</i>	Magnum Mantleslug	molluscs	Blue	Special Concern	Special Concern
<i>Oreohelix subrudis</i>	Subalpine Mountain snail	molluscs	Blue		
<i>Physella columbiana</i>	Rotund Physa	molluscs	Red		
<i>Sphaerium occidentale</i>	Herrington Fingernail clam	molluscs	Blue		
<i>Sphaerium striatinum</i>	Striated Fingernailclam	molluscs	Blue		
<i>Stagnicola caperata</i>	Wrinkled Marshsnail	molluscs	Blue		
<i>Stagnicola traski</i>	Widelip Pondsnaail	molluscs	Blue		
<i>Valvata humeralis</i>	Glossy Valvata	molluscs	Red		
<i>Valvata tricarinata</i>	Threeridge Valvata	molluscs	Red		
<i>Vertigo elatior</i>	Tapered Vertigo	molluscs	Red		
<i>Zacoleus idahoensis</i>	Sheathed Slug	molluscs	Blue	Special Concern	Special Concern
<i>Arnica louiseana</i>	Lake Louise arnica	plants	Blue		
<i>Botrychium campestre</i> var. <i>lineare</i>	Linear-leaf moonwort	plants	Blue		
<i>Botrychium michiganense</i>	Michigan moonwort	plants	Blue		
<i>Botrychium pallidum</i>	pale moonwort	plants	Red		
<i>Braya humilis</i> ssp. <i>maccallae</i>	McCalla's dwarf braya	plants	Blue		
<i>Drosera linearis</i>	slender-leaf sundew	plants	Blue		
<i>Graphephorum wolfii</i>	Wolf's trisetum	plants	Blue		
<i>Pellaea glabella</i> ssp. <i>occidentalis</i>	western dwarf cliffbrake	plants	Red		
<i>Pinus albicaulis</i>	whitebark pine	plants	Blue	Endangered	Endangered
<i>Pinus flexilis</i>	limber pine	plants	Blue	Endangered	
<i>Potentilla glaucophylla</i> var. <i>perdissecta</i>	diverse-leaved cinquefoil	plants	Blue		
<i>Potentilla ovina</i> var. <i>decurrens</i>	sheep cinquefoil	plants	Blue		
<i>Pterygoneurum kozlovii</i>	alkaline wing-nerved moss	plants	Blue	Threatened	Threatened
<i>Charina bottae</i>	Northern Rubber Boa	reptiles	Yellow	Special Concern	Special Concern
<i>Chrysemys picta</i>	Painted Turtle	reptiles	Blue	Special Concern	Special Concern

¹Red = Species that is at risk of being lost (extirpated, endangered or threatened) within British Columbia. Blue = Species considered to be of special concern within British Columbia. ²Endangered = Facing imminent extirpation or extinction. Threatened = Likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction. Special concern = May become a threatened or an endangered species because of a combination of biological characteristics and identified threats. Information sources: British Columbia Conservation Data Centre, BC Species and Ecosystem Explorer, and references therein.

APPENDIX 4. AT-RISK ECOLOGICAL COMMUNITIES

Appendix 4. At-risk ecological communities with potential occurrence in Whiteswan Lake Provincial Park (BC CDC 2021a).

Scientific Name	English Name	Ecosystem Group	BC List
Amelanchier alnifolia - Shepherdia canadensis - Juniperus communis	saskatoon - soopolallie - common juniper	Terrestrial Realm - Grassland Group (G): Grassland Brushland Class (Gb)	Blue
Betula nana / Carex aquatilis	scrub birch / water sedge	Wetland Realm - Peatland Group: Fen Wetland Class (Wf)	Blue
Carex lasiocarpa / Drepanocladus aduncus	slender sedge / common hook-moss	Wetland Realm - Peatland Group: Fen Wetland Class (Wf)	Blue
Deschampsia cespitosa Community	tufted hairgrass Community	Terrestrial Realm - Grassland Group (G): Alkaline/Saline Meadow Class (Ga)	Red
Festuca campestris - (Pseudoroegneria spicata) - Achillea borealis - Cladonia spp.	rough fescue - (bluebunch wheatgrass) - yarrow - clad lichens	Terrestrial Realm - Grassland Group (G): Grassland Class (Gg)	Red
Puccinellia nuttalliana - Hordeum jubatum	Nuttall's alkaligrass - foxtail barley	Terrestrial Realm - Grassland Group (G): Alkaline/Saline Meadow Class (Ga)	Red
Salix drummondiana / Calamagrostis canadensis	Drummond's willow / bluejoint reedgrass	Terrestrial Realm - Flood Group (F): Low Bench Flood Class (Fl)	Blue
Schoenoplectus acutus Deep Marsh	hard-stemmed bulrush Deep Marsh	Wetland Realm - Mineral Wetland Group: Marsh Wetland Class (Wm)	Blue

APPENDIX 5. FORESHORE HABITAT SENSITIVITY INDEX DATA AND CALCULATIONS

Appendix 5. Foreshore Habitat Sensitivity Index data and calculations.

Segment Number	Segment Length (m)	Biophysical						Riparian			Fisheries		Wildlife	Modifications					Segment Number	Biophysical	Riparian	Fisheries	Ecosystem	Modifications	FHSI	FHSI Rank				
		Percent Natural	Shore Type	Substrate	Aquatic Vegetation	Overhanging Vegetation	Large Woody Debris	Riparian Band Width # 1	Riparian Band Width # 2	Riparian Band Width # 3	Littoral Habitat	Shore Spawning	Floodplain	Road	Erosion Protection	Dock	Groyne	Boat Launch												
1	166.1	0.0	15.4	9.2	0.8	0.4	1.2	0.1	3.4	0.0	10.0	0.0	0.0	-5.0	-2.5	-0.6	0.0	-0.6	1	<div></div>	26.9	<div></div>	3.5	<div></div>	10.0	0.0	<div></div>	-8.7	31.7	Low
2	367.8	9.5	20.0	8.0	10.0	7.0	1.2	13.0	7.0	0.0	10.0	0.0	5.0	-0.3	0.0	0.0	0.0	0.0	2	<div></div>	55.7	<div></div>	20.0	<div></div>	10.0	5.0	<div></div>	-0.3	90.5	Very High
3	535.9	10.0	16.0	8.7	5.0	7.0	1.2	5.2	5.6	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	<div></div>	47.9	<div></div>	10.8	<div></div>	10.0	0.0	<div></div>	0.0	68.7	Very High
4	879.7	10.0	16.0	8.4	1.0	2.8	1.2	2.1	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	<div></div>	39.4	<div></div>	7.7	<div></div>	0.0	0.0	<div></div>	0.0	47.0	Medium
5	259.2	10.0	11.2	7.6	0.0	1.4	1.2	2.1	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	<div></div>	31.4	<div></div>	7.7	<div></div>	0.0	0.0	<div></div>	0.0	39.1	Medium
6	474.4	10.0	16.0	8.4	0.0	2.8	1.2	2.1	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	<div></div>	38.4	<div></div>	7.7	<div></div>	0.0	0.0	<div></div>	0.0	46.1	Medium
7	796.5	9.5	16.4	10.0	2.0	2.8	1.2	4.2	5.6	0.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	7	<div></div>	41.9	<div></div>	9.8	<div></div>	10.0	0.0	<div></div>	0.0	61.7	High
8	481.6	10.0	16.2	9.5	1.0	2.8	1.2	2.1	5.6	0.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	8	<div></div>	40.7	<div></div>	7.7	<div></div>	10.0	0.0	<div></div>	0.0	58.4	High
9	946.2	10.0	12.4	7.8	0.0	2.8	1.2	2.1	5.6	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	<div></div>	34.2	<div></div>	7.7	<div></div>	5.0	0.0	<div></div>	0.0	46.9	Medium
10	415.2	9.5	16.0	9.5	4.0	2.8	1.2	2.1	5.6	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	<div></div>	43.0	<div></div>	7.7	<div></div>	10.0	0.0	<div></div>	0.0	60.7	High
11	641.9	8.0	16.2	10.0	6.0	2.8	1.2	2.1	5.6	0.0	10.0	5.0	0.0	0.0	0.0	0.0	0.0	-0.2	11	<div></div>	44.2	<div></div>	7.7	<div></div>	15.0	0.0	<div></div>	-0.2	66.7	Very High
12	214.3	9.0	20.0	8.0	10.0	5.3	0.0	13.0	2.2	0.0	10.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	12	<div></div>	52.3	<div></div>	15.2	<div></div>	10.0	5.0	<div></div>	0.0	82.5	Very High
13	988.0	7.0	16.8	9.0	6.0	0.7	0.0	7.8	2.8	1.4	10.0	0.0	5.0	0.0	0.0	-0.1	-0.1	0.0	13	<div></div>	39.5	<div></div>	12.0	<div></div>	10.0	5.0	<div></div>	-0.2	66.3	Very High
14	535.2	5.5	18.0	8.0	8.0	1.4	1.2	7.8	1.4	1.4	10.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	14	<div></div>	42.1	<div></div>	10.6	<div></div>	10.0	5.0	<div></div>	0.0	67.7	Very High
15	247.7	10.0	18.8	9.0	4.5	4.9	1.2	5.2	4.2	1.1	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15	<div></div>	48.4	<div></div>	10.5	<div></div>	10.0	0.0	<div></div>	0.0	68.9	Very High
16	344.6	0.0	16.0	9.8	9.0	6.3	1.2	2.6	5.6	0.0	5.0	0.0	0.0	-5.0	0.0	0.0	0.0	-0.3	16	<div></div>	42.3	<div></div>	8.2	<div></div>	5.0	0.0	<div></div>	-5.3	50.2	Medium
17	722.6	0.0	16.0	9.8	1.0	0.0	0.0	0.1	5.6	0.0	0.0	5.0	0.0	-5.0	-0.5	0.0	0.0	0.0	17	<div></div>	26.8	<div></div>	5.7	<div></div>	5.0	0.0	<div></div>	-5.5	32.0	Low
18	562.1	0.0	16.0	10.0	3.0	5.6	1.2	2.6	5.6	0.0	0.0	5.0	0.0	-5.0	0.0	0.0	0.0	0.0	18	<div></div>	35.8	<div></div>	8.2	<div></div>	5.0	0.0	<div></div>	-5.0	44.0	Medium
19	1126.6	5.0	16.0	10.0	3.0	6.3	1.2	2.1	5.6	0.0	0.0	5.0	0.0	-5.0	0.0	0.0	0.0	0.0	19	<div></div>	41.5	<div></div>	7.7	<div></div>	5.0	0.0	<div></div>	-5.0	49.2	Medium
20	1516.3	0.0	16.0	9.4	0.0	5.6	0.0	2.6	5.6	0.0	0.0	0.0	0.0	-5.0	-4.5	0.0	0.0	0.0	20	<div></div>	31.0	<div></div>	8.2	<div></div>	0.0	0.0	<div></div>	-9.5	29.7	Low
21	298.9	0.0	11.5	8.1	0.0	0.7	1.2	0.1	5.6	0.0	0.0	0.0	0.0	-5.0	-5.0	0.0	0.0	0.0	21	<div></div>	21.5	<div></div>	5.7	<div></div>	0.0	0.0	<div></div>	-10.0	17.2	Very Low
22	342.7	0.0	16.0	8.8	0.0	5.6	0.0	2.6	5.6	0.0	0.0	0.0	0.0	-5.0	-4.0	0.0	0.0	0.0	22	<div></div>	30.4	<div></div>	8.2	<div></div>	0.0	0.0	<div></div>	-9.0	29.6	Low
																				Max Possible	60	20	15	5	-10	100.0				
																				Max Observed	55.7	20.0	15.0	5.0	-10.0	90.5				
																				Min Observed	21.5	3.5	0.0	0.0	0.0	17.2				
																				Ranking Break Rationale		Modified Breaks *								
																				Max FHSI score	90.5	64								
																				Min FHSI score	17.2	12								
																				Difference	73.2	52								
																				Breaks	14.6	13								
																					Max Score	Length (m)	%							
																				Very Low	25	298.9	2.3							
																				Low	38	2747.7	21.4							
																				Medium	51	4592.7	35.7							
																				High	64	1693.2	13.2							
																				Very High	100	3530.9	27.4							
																				Total		12863.5	100.0							

*Note: Based on the review of score distribution, segments that scored >64 were ranked as Very High, otherwise the two wetland segments (Segments 2 and 12) with scores >82 would overwhelm other segments that should also have a ranking of Very High. Logical score breaks were used for the other ranks, based on the difference between the minimum possible score value of 12 and the score of 64, which resulted in equal increments of 13.

APPENDIX 6. WHITESWAN LAKE FORESHORE DEVELOPMENT GUIDE