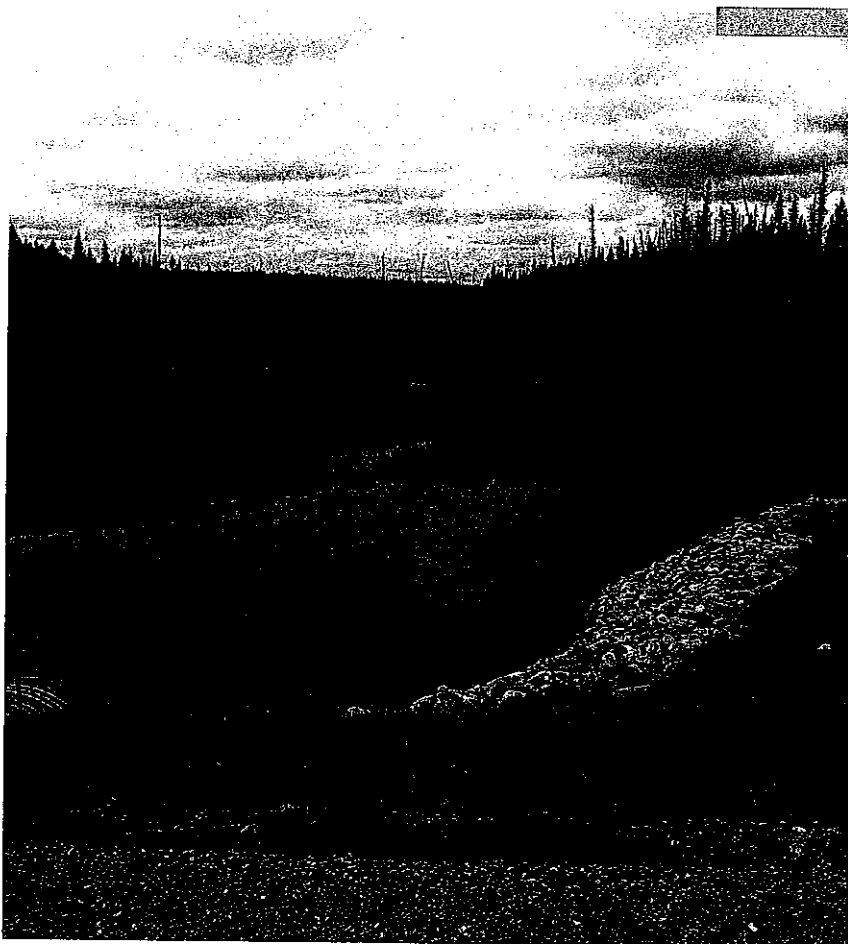




Environmental and Carrying Capacity Study

Resort Village of Candle Lake



December 2014

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Table of Contents

1.0	Introduction.....	1
2.0	Scope of Work.....	2
3.0	Environmental Conditions	3
3.1	Topography	3
3.2	Climate.....	3
3.3	Geology and Soils.....	3
3.4	Vegetation	5
3.5	Surface Water	6
3.6	Groundwater	6
3.7	Wetlands.....	6
3.8	Fish and Fish Habitat.....	12
3.9	Wildlife and Habitat.....	15
3.10	Species at Risk	15
4.0	Land Use and Development.....	16
4.1	Land Use	16
4.2	Infrastructure	16
4.2.1	Wastewater Lagoons	16
4.2.2	Roads.....	17
4.2.3	Marinas and Boat Launches.....	17
4.3	Potential Sources of Contamination	19
4.3.1	Federal Contaminated Sites Database.....	20
4.3.2	Other Potential Sources of Contamination.....	20
4.4	Existing Land Use Policies and Regulations	20
4.5	Regulations Relating to Marina Development	24
5.0	Candle Lake Water Quality Review	26
5.1	Historical Water Quality Analysis.....	26
5.1.1	Tributaries to Candle Lake	26
5.1.2	Candle Lake	27
5.2	2014 Water Quality Analysis.....	28
5.2.1	Tributaries to Candle Lake	28
5.2.2	Candle Lake	32

5.2.3	2014 Water Quality Conclusions.....	33
6.0	Carrying Capacity and Lake Classification.....	34
6.1	Carrying Capacity	34
6.1.1	Recreational Carrying Capacity of the Lake.....	34
6.2	Lake Classification.....	35
7.0	Lakeshore Development Guidelines.....	39
7.1	Introduction.....	39
7.2	Purpose	39
7.3	Guiding Principles.....	40
7.4	Policies and Guidelines.....	40
7.4.1	Site Development Policies.....	40
7.4.2	Site Development Guidelines	42
7.4.3	Vegetation.....	43
7.4.4	Buildings	43
7.4.5	Public Access Policies	44
7.4.6	Hazard Protection Guidelines	44
7.4.7	Infrastructure Policies	44
7.4.8	Infrastructure Guidelines	44
7.4.9	Water Systems.....	45
7.4.10	Stormwater Management Systems.....	45
7.4.11	Land Use Policies	45
7.4.12	Education Policies.....	45
7.5	Implementation	45
7.5.1	Zoning	Error! Bookmark not defined.
7.5.2	Co-operation with Other Agencies.....	45
7.5.3	Education.....	46
8.0	Recommendations	47
9.0	References	49

Appendix A Lake Classification

1.0 Introduction

The Resort Village of Candle Lake is located along the southern and western shores of Candle Lake and is a premier destination resort located approximately 80 km northeast of the City of Prince Albert, in central Saskatchewan. With a permanent population of 765 (2011 census) and a summer seasonal population of approximately 6,463, the Resort Village offers a full range of services and amenities for approximately 7,228 people. It is noted that the population estimate should be considered on the conservative side as the estimate was derived using a multiplier of 2.5 people per residence and/or RV site. There are approximately 2,316 properties, including 127 commercial properties, with approximately 90% of the residential properties being seasonal. There is also an increasing attraction for lake and resort living in this area. The relatively close proximity to Saskatoon and other larger centres to the south make Candle Lake a desirable option for camping, boating, fishing and swimming. Hiking, biking and golf also take place along the shores of the lake.

Candle Lake is a large lake which covers an area of 13,234 ha. The lake contains a number of sport fish species including northern pike, walleye, yellow perch, burbot, and lake whitefish, as well as non-sport fish species such as white sucker, cisco, longnose sucker and shorthead redhorse. A few large lake sturgeon have been reportedly caught in Candle Lake which verifies that, at some point in history, they were able to find their way upstream from the Saskatchewan River. The level of Candle Lake is regulated by a four-bay 3.1 m high concrete dam which was constructed in 1979 and is operated by the Saskatchewan Water Security Agency. Candle Lake discharges into the Torch River which, in turn, discharges to the Saskatchewan River.

Due to the popularity of this area, the Resort Village is facing development pressure with several development applications currently under consideration. The Resort Village recognizes the need to strengthen the economic base of the area by creating a positive environment for sustainable business development, particularly as it relates to tourism and outdoor recreation as well as residential development, while also respecting the natural environment.

As a result of development pressure, the Resort Village has retained Urban Systems to conduct this Environmental and Carrying Capacity Study to identify potential development issues related to Candle Lake.

The primary objective of this study is to assess the current carrying capacity of the lake and provide recommendations to guide future development surrounding Candle Lake to achieve a balance between economic factors and the preservation of the natural environment, which is the key attractant for visitors and residents alike.

3.0 Environmental Conditions

3.1 Topography

Candle Lake is located just south of the Canadian Shield in the Wapawekka Hills Upland, a rolling morainic till plain with elevations ranging from 480 to 590 metres above sea level. The undulating and hummocky terrain of the Candle Lake area was formed during the last glaciation (Judd-Henrey, *et al.*, 2006).

The Candle Lake area occupies the Whiteswan Plain and Emma Lake Upland landscape areas of the Mid-Boreal Upland ecoregion. In most of Saskatchewan, the uplands have a gentle slope and drain northeastward via the North Saskatchewan River. The terrain of the Mid-Boreal Upland ecoregion is comprised of level plateaus, hilly glacial till plains and steep sloping and eroded escarpments (Ecological Framework of Canada, 2014a).

The June 2014 site visit confirmed that the topography of the Candle Lake area is hummocky with minor variances in elevation.

3.2 Climate

The Mid-Boreal Upland ecoregion is classified as having a predominantly subhumid mid-boreal ecoclimate. This area is sensitive to the influence of climate change on the natural water cycle (Judd-Henrey *et al.*, 2008). The climate has predominantly short, cool summers and cold winters. The mean annual temperature ranges from -1°C to 1°C. The mean summer temperature ranges from 13°C to 15.5°C and the mean winter temperature ranges from -13.5°C to -16°C. The mean annual precipitation ranges 400 to 550 mm (University of Saskatchewan, 2008a).

3.3 Geology and Soils

The Mid-Boreal Upland consists, for the most part, of Cretaceous shales, and are covered entirely by kettled to dissected, deep, loamy to clayey-textured glacial till, lacustrine deposits, and inclusions of coarse, fluvio-glacial deposits. Associated with rougher morainal deposits are a large number of small lakes, ponds, and sloughs occupying shallow depressions. Permafrost is very rare and found only in peatlands. Well-drained Gray Luvisolic soils are dominant in the region. Significant inclusions are peaty-phase Gleysols and Mesisols that occupy poorly drained depressions. Dystric Brunisols occur on droughty, sandy sites (University of Saskatchewan, 2008b).

The geology of Candle Lake is classified as Flm Mk4 which indicates that the soils are a loam-clay loam with a morainal mode of deposition, and a knoll and kettle surface form (Acton, D.F., *et al.*, 1990).

The Canadian Land Inventory (CLI) has detailed soil reports for many areas of Canada including the Candle Lake area. This mapping was reviewed and a description of the soil types within the Candle Lake area is presented in Table 3.1 (CLI, 2013).

Table 3.1 – CLI Soils Description

Association	Map Unit	Parent Material
Horizontal fen - Meadow	Fh - Mw	Mesic to humic sedge peat 40 to 180 cm, or more, thick. Variable textured, glacial and recent deposits of poorly drained depressional areas. Meadow vegetation.
Bittern Lake	Bt2: fl/Ga3:St3	Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Very stony land.
Arbow	Aw:/	Variable textured, glacial and recent deposits of poorly drained depressional areas, black spruce vegetation. Loamy texture.
Arbow – Flat Bog	Aw:/ - Bf	Variable textured, glacial and recent deposits of poorly drained depressional areas, black spruce vegetation. Loamy texture. Fibric moss peat overlying mesic peat of sedge, moss or forest origin, 60 to 180 cm or more thick.
Flat Bog – Horizontal Fen	Bf - Fh	Fibric moss peat overlying mesic peat of sedge, moss or forest origin, 60 to 180 cm or more thick. Mesic to humic sedge peat 40 to 180 cm, or more, thick.
Bittern Lake	Bt5: fl - /s	Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Fine sandy loam – loamy sand.
Flat Bog - Pine	Bf – Pn7	Fibric moss peat overlying mesic peat of sedge, moss or forest origin, 60 to 180 cm or more thick. Coarse textured, weakly to non-calcareous, sandy glaciolacustrine deposits, some of which have been re-worked by wind.
Bittern Lake – Flat Bog - Pine	Bt5: fl-/s Bf – Pn7: s/Gd2:St3	Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Fine sandy loam – loamy sand. Fibric moss peat overlying mesic peat of sedge, moss or forest origin, 60 to 180 cm or more thick. Coarse textured, weakly to non-calcareous, sandy glaciolacustrine deposits, some of which have been re-worked by wind. Very stony land.
Pine	Pn7:s /Sr3	Coarse textured, weakly to non-calcareous, sandy glaciolacustrine deposits, some of which have been re-worked by wind. Sandy soils. Fluvial-lacustrine plain.
Waltville	Wv1:s/ / Ga3	Medium to moderately fine textured, moderately calcareous glacial till. Sandy loam. Knob and kettle till plain.
Bittern Lake	Bt3:fl/Ga3-4:St3	Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Fine sandy loam. Knob and kettle till plain. Very stony land.
Flat Bog-Stream Fen-Bittern Lake	Bf-Fs- Bt5:/s	Fibric moss peat overlying mesic peat of sedge, moss or forest origin, 60 to 180 cm or more thick. Mesic to humic sedge peat 40 to 80 cm or

Association	Map Unit	Parent Material
		more thick. Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Loamy sand.
Bittern Lake-Pine-Stream Fen	Bt2:fl-s- Pn7:s – Fs/Gd3:St3	Medium to moderately fine textured, moderately calcareous glacial till overlain by coarse to moderately coarse, well-sorted sandy materials. Fine sandy loam – loamy sand. Coarse textured, weakly to non-calcareous, sandy glaciolacustrine deposits, some of which have been re-worked by wind. Mesic to humic sedge peat 40 to 80 cm or more thick. Dissected till plain. Very stony land.
Stream Fen-Meadow	Fs-Mw	Mesic to humic sedge peat 40 to 80 cm or more thick. Variable textured, glacial and recent deposits of poorly drained depressional areas. Meadow vegetation.

As indicated in the table above, many of the soils surrounding Candle Lake are indicative of shallow groundwater, wetlands, bogs and/or fen habitats.

3.4 Vegetation

The Mid-Boreal Upland ecoregion forms part of the continuous mid-boreal mixed coniferous and deciduous forest that encompasses the area from northwestern Ontario to the foothills of the Rocky Mountains. The overstory vegetation consists of medium to tall, closed stands of trembling aspen and balsam poplar with white and black spruce, and balsam fir occurring in late successional stages. A diverse understory of shrubs and herbs occur in areas of deciduous stands. Coniferous stands are typically associated with feathermoss. Cold and poorly drained fens and bogs are comprised of tamarack and black spruce (Ecological Framework of Canada, 2014b).

At a discontinued Environment Canada atmospheric monitoring site located in the vicinity of Candle Lake (53°59'N, 105°07'W), the habitat is described as being boggy with small pockets of standing water. The area is relatively flat and the primary overstory vegetation consists of black spruce with lesser amounts of larch. The water table is generally near the surface and the understory vegetation consists mostly of moss and Labrador tea (Environment Canada, 2013).

The site visit conducted by Urban Systems on June 17 to 19, 2014 confirmed that vegetation in the Candle Lake area generally consisted of:

- Black spruce dominated lowlands with lesser amounts of balsam poplar, willow and aspen;
- Drier upland sites with jackpine, larch, willow, alder, aspen and balsam poplar; and
- Riparian areas containing willow, balsam poplar, alder and spruce.

3.5 Surface Water

The Candle Lake drainage basin encompasses an area of 1,625 km² and is comprised of numerous rivers, creeks and springs. The hummocky terrain also contains numerous wetlands including: marshlands, bogs, and muskeg. Streams that flow into Candle Lake include: Hannin Creek, Whitefish River, Ice House Creek (located between Hannin Creek and Clearsand Creek), Clearsand Creek, and Fisher Creek. The transition from boreal forest to agriculture occurs along the watershed boundary just south of Candle Lake.

Candle Lake occupies an area of 13,234 ha. The level of Candle Lake is regulated by a 3.1 m concrete dam, constructed in 1978-1979 and operated by the Saskatchewan Water Security Agency. Candle Lake discharges into the Torch River, which is a tributary of the Saskatchewan River. The lake has a sandy bottom with few aquatic weeds and a maximum depth of approximately 18.5 m.

The water levels of Candle Lake have been controlled at the outlet to the Torch River since 1938. The water levels on Candle Lake are generally controlled to accommodate recreational activities and to prevent flooding in low lying areas during periods of high precipitation (Judd-Henrey, *et al.*, 2006).

As part of an assessment of ground and surface water conditions in the Candle Lake area (Judd-Henrey *et al.*, 2008), it was noted that drought conditions had contributed to a 0.2 metre drop in the water level of Candle Lake between 2000 and 2003. The interaction of groundwater and surface water was examined during the study and it was noted that some of the streams within the study area are largely groundwater fed.

3.6 Groundwater

As part of an assessment of groundwater conditions in the Candle Lake area, it was observed that some of the aquifers are situated close to the surface and may have connectivity to surface water (Judd-Henrey, *et al.*, 2008). The groundwater analysis showed that most shallow samples were high in bicarbonate (alkalinity). In general, the groundwater is high in calcium, sodium and potassium.

A search of the Saskatchewan Energy and Resources Well Data web page indicated that there are 101 groundwater wells within the Candle Lake municipal boundaries (Saskatchewan Energy and Resources, 2014).

During the June 2014 site visit, it was evident that the groundwater table was very high in areas around Candle Lake (particularly to the west of Candle Lake). Numerous wetlands, bogs and fens are present and groundwater pumping (de-watering) was ongoing in some of the subdivisions on the western shores of Candle Lake.

3.7 Wetlands

The Resort Village of Candle Lake is located in an area with numerous wetland ecosystems, including bogs, fens, marshes and shallow open water wetlands. A particularly large wetland complex, likely a fen, was observed to the west of Highway 265. This wetland appears to be hydrologically connected to Fisher

Creek and Torch Lake. A recently developed campground (still under construction) was evident within this wetland complex. In addition, groundwater issues were observed in and around local developments to the east of Highway 265 (between the Highway and the western shoreline of Candle Lake).

Wetlands are land saturated with water long enough to promote the formation of water-altered soils, the growth of water-tolerant vegetation and various kinds of biological activity. Specifically, wetlands may only have water present (above the ground) for very short periods of time per year, or even less frequently. Wetlands instead are defined by their soils and water-dependent plant species such as cattails, rushes, sedges, and other species adapted to water saturation. Wetlands are productive ecosystems that play an important role in sustaining healthy watersheds by (Alberta Government, 2013):

- Protecting water quality;
- Providing water storage and infiltration;
- Providing wildlife habitat; and
- Sustaining biodiversity.

A wide array of waterfowl and shorebirds were observed during the June 2014 site visit. Although these species will undoubtedly utilize Candle Lake and its shoreline areas, the adjacent wetlands will also provide important breeding and foraging areas.

A summary of applicable wetland legislation and best practices for Saskatchewan is included below:

Saskatchewan Wetland Policy

The Saskatchewan Wetland Policy, adopted in 1995, was prepared by the Saskatchewan Wetland Conservation Corporation. The policy statement is "The Government of Saskatchewan believes in the sustainable management of wetlands to maintain the multiple benefits they provide, now and into the future."

The policy deals with general objectives and principles. However, it does not deal with specific management strategies. The Policy defines what wetlands are, identifies the causes of wetland loss and the benefits of wetlands in Saskatchewan. Under this policy, a wetland is defined to include both the wet basin and an area of transitional lands between the water body and adjacent upland. The transitional lands are a minimum of 10 metres adjacent to the area covered by water at the water body's normal full supply level.

The specific objectives of the policy include:

- To encourage sustainable management of wetlands on public and private lands to maintain their functions and benefits;
- To conserve wetlands that are essential to maintain critical wetland species or wetland functions; and
- To restore or rehabilitate degraded wetland ecosystems where previous destruction or alteration has resulted in a significant loss of wetland functions of benefits.

The Policy also identifies next steps to be taken, which include the participation and advice of stakeholders and these five key objectives:

- To increase awareness of the benefits of wetlands;
- To increase wetland monitoring;
- To coordinate government policies and programs to improve wetland management;
- To develop land-use planning guidelines for wetland management; and
- To encourage landowners to maintain wetlands.

Water Management Framework

The Saskatchewan Water Framework was drafted in January, 1999, and was developed beginning in 1994 by a Water Management Working Group as an integrated water management strategy. The framework includes a vision and principles, as well as nine goals, 16 objectives and 58 recommended actions. While this framework relates to water management in general, there are goals and objectives that are application to wetlands.

The Vision of this framework is: **Safe and reliable water supplies within healthy and diverse aquatic ecosystems.** The following six principles form the foundation of the Water Management Framework:

- Stewardship;
- Partnership;
- Integrated management;
- Value of water;
- Sustainable development; and
- Best Practice.

The nine goals of the Water Management Framework include:

- Healthy aquatic and riparian ecosystems and drinking water sources;
- Safe and sustainable aquifers;
- Protection of wetlands and effective control of drainage;
- Access to a safe and reliable supply of drinking water;
- Sustainable economic development;
- Adequate water infrastructure;
- Protection from flood, drought and climate change;
- Integrated water management; and
- Meaningful public awareness and involvement.

The 16 objectives of Water Management Framework include:

- Maintain, restore and protect the habitat of aquatic and riparian ecosystems and drinking water sources;
- Minimize contamination of waterbodies;
- Protect aquifers from depletion and contamination;
- Foster wetlands retention and orderly drainage, in accordance with regulations and public policy;
- Enhance safety of municipal and domestic drinking water supplies;
- Promote water developments with broad public benefits;
- Promote economic diversification and stability through sustainable use of water and related land resources;
- Prevent bulk export of water;
- Establish innovative approaches for financing costs of developing, operating, maintaining and upgrading infrastructure;
- Plan developments in consideration of the potential effects of flood, drought and climate change;
- Clearly define and fully integrate agency mandates and activities related to water;
- Manage water on a watershed basis;
- Recognize Aboriginal peoples' interests;
- Adequate monitoring and research of water resources;
- Enhance public awareness and involvement in water management planning and decision-making; and
- Recognize the intrinsic and economic value of water and cost of its management.

Managing Saskatchewan Wetlands - A Landowner's Guide

The landowners guide to Saskatchewan Wetlands is intended for use by landowners whose property contains wetlands. The intent of the guide is to:

- Promote an understanding and appreciation of the value of Saskatchewan wetlands;
- Foster the sustainable management of prairie land and water resources; and
- Provide practical information to landowners on wetland management issues.

The Landowners guide is a comprehensive guide that outlines the following information:

- What are wetlands? Wetland resources, wetland types and wetland functions.
- The three steps in wetland management planning:
 - i. Initiating a management plan;

- ii. Conducting a wetland inventory; and
- iii. Defining values, objectives and goals.
- Conserving wetlands for future generations.

The Federal Policy on Wetland Conservation

The objective of the Federal Government with respect to wetland conservation is to:

Promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future.

Goals:

- Maintenance of the functions and values;
- No net loss of wetland functions;
- Enhancement and rehabilitation;
- Recognition of wetland functions;
- Securement of wetlands;
- Recognition of sound, sustainable management practices; and
- Utilization of wetlands.

Guiding Principles:

- Wetland conservation is dependent on the incorporation of environmental objectives into the economic decision-making process, as recommended by the (Brundtland) World Commission on Environment and Development, the CCREM National Task Force on Environment and Economy, the Federal-Provincial Agriculture Committee on Environmental Sustainability, and the Sustaining Wetlands Forum.
- Wetlands and wetland functions are inextricably linked to their surroundings, particularly aquatic ecosystems, and therefore wetland conservation must be pursued in the context of an integrated systems approach to environmental conservation and sustainable development.
- On-going development and refinement of scientific knowledge and expertise in Canada is fundamental to the achievement of wetland conservation. Wetland conservation can only be achieved through a coordinated, cooperative approach involving all levels of government and the public, including landowners, non-government organizations, and the private sector.
- The Federal Government will play a major role in advocating and achieving wetland conservation, while respecting the jurisdiction of the provinces and territories and the rights of individual landowners.
- In consultation and cooperation with native institutions and representatives in Canada, the Federal Government will promote a cooperative approach to wetland conservation for lands and waters held by the Federal Government for native peoples.

- A basic change in the attitude and perceptions of Canadians regarding wetlands, through communication and education programs, is a vital prerequisite of wetland conservation.
- Canada has a special responsibility to provide leadership in international wetland conservation efforts, through the management of transboundary resources such as water and wildlife in North America, encouragement of global wetland conservation, and active participation in international treaties, conventions and forums.

Strategies:

1. **Developing Public Awareness** - *The Federal Government will promote public awareness and understanding of the wetland resource in Canada and actively encourage participation of the Canadian public, including landowners, non-government organizations, aboriginal governments and institutions, and the private sector, in wetland conservation.*
2. **Managing Wetlands on Federal Lands and Waters and in Other Federal Programs** - *The Federal Government will develop exemplary practices in support of wetland conservation and sustainable wetland use to be incorporated in the design and implementation of federal programs and in the management of federal lands and waters.*
3. **Promoting Wetland Conservation in Federal Protected Areas** - *The Federal Government will continue to manage the use of National Parks, National Wildlife Areas, Migratory Bird Sanctuaries, National Capital Commission lands and other federal areas established for ecosystem conservation purposes so as to sustain their wetland functions and natural processes.*
4. **Enhancing Cooperation** - *The Federal Government will continue to be a partner in cooperative activities and agreements with the provinces and territories and non- government agencies to advance wetland conservation.*
5. **Conserving Wetlands of Significance to Canadians** - *The Federal Government will participate in and promote the establishment of a systematic and coordinated national network of secured wetlands to be achieved in cooperation with provincial and territorial governments and other stakeholders. Such an approach will lead to a comprehensive network of secured sites or complexes of exemplary and strategically important wetlands of significance to Canadians, together representing the full range of wetland functions and types.*
6. **Ensuring a Sound Scientific Basis for Policy** - *The Federal Government will support and promote the development of expertise for a sound technical and scientific basis for wetland observation, ensuring that the information necessary for making decisions regarding wetlands is accessible to planners, managers, regulators, and other decision-makers at all levels.*
7. **Promoting International Actions** - *The Federal Government will promote conservation and sustainable use of wetlands internationally, and encourage the involvement of other nations and international organizations in wetland conservation efforts.*

3.8 Fish and Fish Habitat

Candle Lake contains a number of fish species including northern pike, walleye, yellow perch, burbot, lake whitefish, white sucker, longnose sucker and shorthead redhorse. A few large lake sturgeon have been reportedly caught in Candle Lake which verifies that, at some point in history, they were able to find their way upstream from the Saskatchewan River. Candle Lake has a well-regarded fishery for northern pike and walleye, as well as a small commercial fishery for lake whitefish. Torch Lake is known to contain important spawning habitat for northern pike, although any of the shallow bay areas with aquatic vegetation within the main body of Candle Lake are also likely to support northern pike spawning. Walleye prefer spawning along exposed rocky shorelines, or over gravelly areas within tributary streams. Fisher Creek, in particular, is a known spawning area for walleye during the early spring. Riparian vegetation along the lakeshore was observed to be variable throughout the developed areas of the lake and completely intact in undeveloped areas along the north and east shorelines. Developed areas of the lake ranged between very well vegetated and totally cleared of vegetation, although many lakefront homes maintained at least some riparian vegetation.

The fish population of Candle Lake has been assessed by the Saskatchewan Ministry of Environment in 1961, 1971, 1976, 1981, 1987, 1992, 1997, 2002, 2007, and most recently in 2012. A summary of the 2012 *Saskatchewan Ministry of Environment Fishery Stock Assessment (Draft)* is provided below (Hlasny, R. 2012).

Saskatchewan Ministry of Environment Fishery Stock Assessment (Draft) – 2012

Candle Lake is assessed by the Saskatchewan Ministry of Environment every 5 years to determine the health and abundance of the sport-fish population. On September 5, 6, 7, 11 and 12, 2012, a total of 1,080 m of gillnet was set in 18 different locations around Candle Lake at depths ranging between 3 and 16 m. Test net results for walleye and northern pike indicated that both species are in good health in terms of numbers and individual fish size. Yellow perch were present but no “angling-sized” perch were netted. Lake whitefish and burbot were found in good numbers. Forage species such as cisco and white sucker have remained consistent.

Angler surveys conducted over the past 9 years indicated that the catch per unit effort (CPUE) has been consistent indicating that fishing is as good at present as it has been in the past.

Another test netting of Candle Lake will be undertaken in 2017 to keep an updated inventory on Candle Lake. Given the rapid seasonal human population growth at Candle Lake, as evidenced by the amount of newer subdivisions and RV sites, it may become a necessity to see a further reduction to the present catch limit of three walleye per day.

Benthic Invertebrates

A summary of the 2008 *Biodiversity and adult flight periods of mayflies (Ephemeroptera) inhabiting Candle Lake, Saskatchewan*. Blue Jay (in press) by Parker, D. et al. is provided below.

Benthic Invertebrates are very important to the health of fish populations within Candle Lake as they are the predominant food source for many of the baitfish species within the lake, as well as an important food

source for sportfish species such as walleye and northern pike, particularly during the juvenile phase of their life cycles.

Saskatchewan Environment retained the services of Aqua Tax Consulting to survey the aquatic macroinvertebrates found in Candle Lake during the ice-free seasons of 2001 and 2002. A total of three sites were selected for the collection of aquatic macroinvertebrates. The sampling sites included: a rocky, exposed shoreline near Onechassa Subdivision (Site A), a sheltered bay behind a bulrush bed near the Sandy Bay Campground (Site B) and wetland-type habitat near the North Subdivision (Site C). The exact location of these sites is shown on Figure 3.1. At each site dip net samples were taken every 2 to 3 weeks during the open water season. All aquatic insects collected were taken back to the lab where they were identified and, in some cases, raised from larvae to adults.

At Site C, 15 floating traps were deployed to collect aquatic macroinvertebrates as they hatched from the water. Samples were collected from the traps three times a week and counted to determine what species are hatching at what time of year and in what densities.

Additional benthic sampling was conducted using an Ekman dredge at different depths throughout the lake to determine which species, and at what densities, were inhabiting the deeper areas of the lake.

A total of 244 different species of aquatic macroinvertebrates were identified during this inventory on Candle Lake. The list below provides a general list of the aquatic macroinvertebrates that were identified (Parker, D.R., et al., 2008):

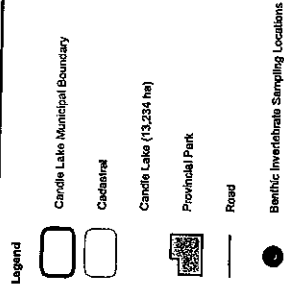
- Horsehair worms
- Snails and limpets
- Scuds and crayfish
- Caddisflies
- Two-winged flies (Diptera)
- Dixidae
- Snail-killing flies
- Leeches
- Freshwater clams
- Mayflies
- Beetles
- Mosquitoes
- Horseflies and deerflies
- Crane flies

The diverse array of aquatic macroinvertebrates found in Candle Lake could be used for future water quality studies as changes in the densities of aquatic macroinvertebrate communities can be used as an indicator of water quality and ecosystem health.

Resort Village Of Candle Lake

Candle Lake Environmental Study

Benthic Invertebrate Sampling Locations Figure 3.1

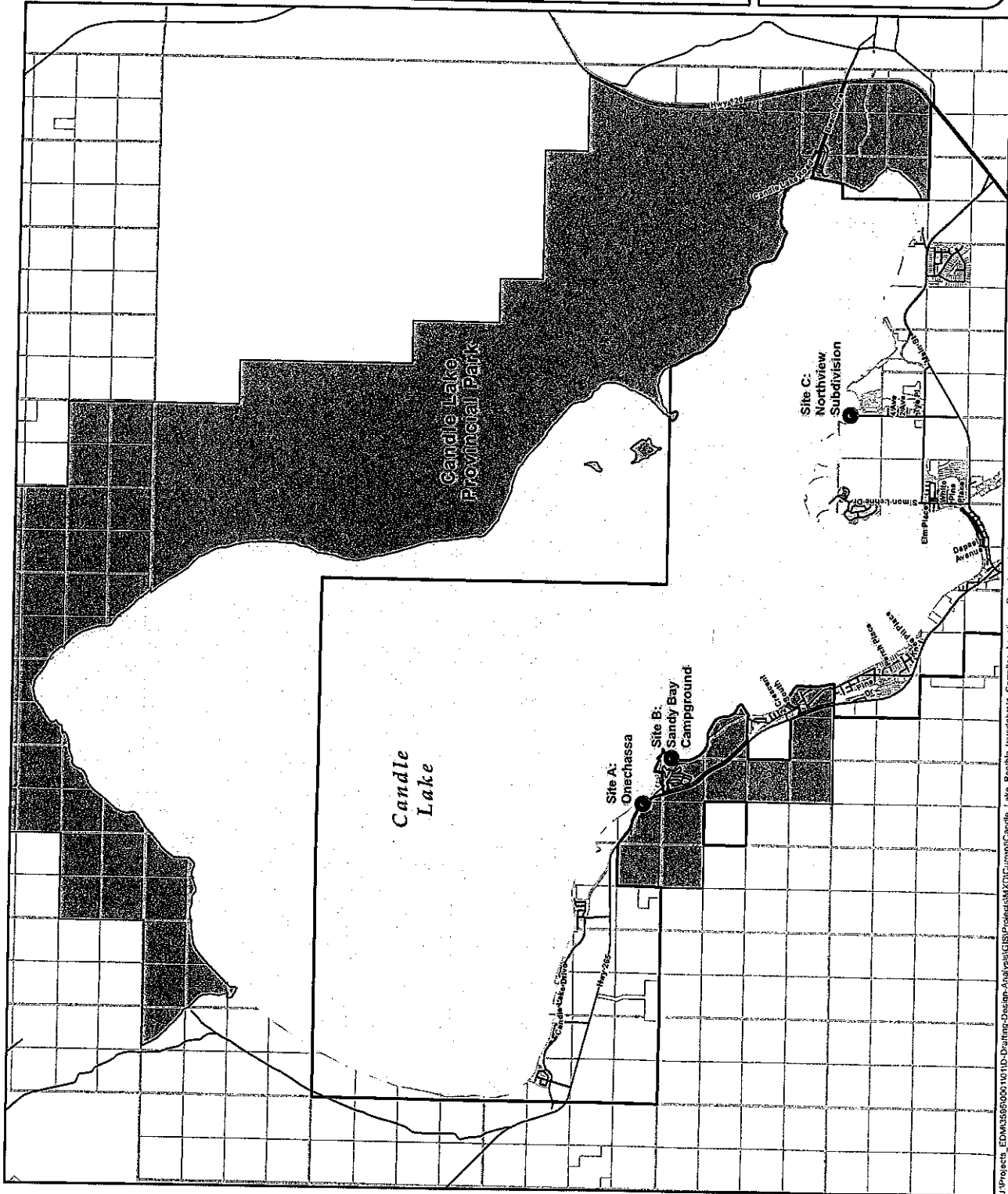


Notes:

Scale: 1:70,000
NAD 1983 CSRS UTM Zone 13N
Data Sources:
- Candle Lake from GeoBase, August 2014
- Park, road and cadastral data from Province of Saskatchewan, Jan. 2013

Project #: 3955.0001.01
Author: CR
Checked:
Status:
Revision: A
Date: 2014 / 12 / 2

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3.9 Wildlife and Habitat

Candle Lake is noted for its abundance of wildlife. Characteristic wildlife includes moose, white-tailed deer, elk, black bear, timber wolf, lynx, snowshoe hare, red fox, beaver, and muskrat. Bird species include common loon, red-tailed hawk and neotropical migrants, as well as numerous species of waterfowl (University of Saskatchewan, 2008c).

The June 2014 site visit yielded numerous wildlife sightings within the Resort Village of Candle Lake including red fox, lesser yellowlegs (shorebird), numerous species of waterfowl and several white-tailed deer.

3.10 Species at Risk

The Saskatchewan Conservation Data Centre is responsible for tracking, evaluating and categorizing species according to their ecological status Saskatchewan. A search of the online Conservation Data Centre interactive map resulted in a number of masked rare and endangered species occurrences in the vicinity of Candle Lake. The majority of these species at risk occurrences are plant species, many of which occur in wetland habitats. The two animal species at risk occurrences include woodland caribou and barred owl. A brief description of each species is provided below.

Woodland Caribou (Boreal Population)

The Boreal Population of woodland caribou inhabits a huge area of Canada stretching from the Mackenzie Mountains in the Yukon Territory to southern Labrador in the east. Woodland caribou use mature and old-growth coniferous forests that contain large quantities of terrestrial and arboreal lichens. These forests are generally associated with marshes, bogs, lakes and rivers. Woodland caribou often show a preference for peatlands and they generally avoid clear-cuts, shrub-rich habitat and aspen-poplar dominated sites. The most common tree species in preferred habitats are black spruce, white spruce and larch (tamarack). This species is designated as Threatened by COSEWIC and is listed on Schedule 1 of the federal Species at Risk Act (SARA). Provincially, the woodland caribou is listed as "Threatened".

Habitat destruction, hunting, disturbance by humans (including construction of roads and pipelines), and predation have all contributed to the decline of woodland caribou. Forestry practices, as well as the spread of mining and agriculture have resulted in the loss, alteration and fragmentation of important caribou habitat (SARA, 2014). Critical habitat for the woodland caribou has been mapped in Saskatchewan and is situated approximately 30 km to the west of Candle Lake in Prince Albert National Park.

Barred Owl

The barred owl inhabits dense woodland, swamps, wooded river valleys, marshes and meadows. Barred owls generally require expansive forests with large mature trees that provide cavities suitable for security and nesting. Barred owls usually nest 7 to 8 m above the ground and may nest within either living or dead trees. Trees with suitable cavity for nesting are typically at least 51 cm in diameter (BC Species Explorer, 2014).

The barred owl is not listed on the SARA and has no status under COSEWIC. The barred owl is provincially ranked as a species of "least concern".

4.0 Land Use and Development

4.1 Land Use

The Resort Village of Candle Lake was incorporated in 1977. As of 2005, the Resort Village of Candle Lake had an estimated permanent population of 765 and a total summer seasonal population of 6,463. It should be noted that the seasonal population could be much higher as this number is an estimate based on the number of seasonal residences and RV sites multiplied by an assumed average of 2.5 people per residence/RV site. Candle Lake Provincial Park, which includes approximately 300 campsites, also encompasses nearly 50% of the shoreline adjacent to the Resort Village and covers a total area of 7,874 ha. Commercial fishing and trapping in the area dates back to 1912; people were permanently settling in the area in the 1920s; and tourism began to develop in the late 1940s. Agricultural activities are common throughout the broader ecoregion (University of Regina, 2014).

There are also adjacent subdivisions in the Regional Municipality (RM) of Paddockwood and the Regional Municipality (RM) of Torch River. The RM of Torch River only has one development in proximity to Candle Lake and that is the Ponderosa Lodge which has 6 guest rooms in the main lodge, a four-plex with three-2 bedroom suites and one-1 bedroom suite. The RM of Paddockwood has several subdivision sites including: Cranberry Creek (80 lots), Aspen Ridge (62 lots), Torch Light Garden (1 house and 69 campsites), and Evergreen Estates (unknown but anticipated to be a large development).

4.2 Infrastructure

4.2.1 WASTEWATER LAGOONS

The Resort Village intends to conduct an analysis of the available remaining lagoon capacity in the community. However, a meaningful investigation cannot be completed until more detailed records become available. Given that only a small minority of property owners at Candle Lake live at their homes year-round, the volume of wastewater generated by the community during any given year is extremely difficult to estimate. Factors that influence wastewater generation include the frequency with which seasonal residents visit their homes/cabins, the number of people that reside in each dwelling unit, and the water consumption habits at each home. In addition, the volume of wastewater generated by the campground and cabin rental facilities is dependent on usage/vacancy rates, which at the time of preparing this report, were not submitted to the Resort Village of Candle Lake.

As such, the only accurate means of assessing the frequency and volume of wastewater being transferred to the lagoons for treatment and disposal is via the records that are kept by the local septic truck haulers. However, it is understood that there is no requirement to maintain and submit such records.

It is recommended that the Resort Village require these businesses to keep detailed records of the homes, cabins, parks, and businesses they service, the amount of wastewater they collect from each customer, and the volume of wastewater that they release into the lagoons. These records would ideally be submitted at least monthly so that the Village can gain a better perspective of the severity of the

seasonal loading on the lagoon. This information can be used to accurately assess the available capacity in the lagoon, as well as provide information that can be used to help optimize the time and duration of treated effluent release events.

In addition to the above recommendations, it is also suggested that the Resort Village consider charging user fees for the septic haulers to access the lagoons. Currently, there is a lagoon fee as part of a base tax of \$50 per property. It may be necessary to supplement the lagoon fee with a user fee for septic haulers. The requirement for such user fees could be included in an overall taxation review study that would be intended to help the Resort Village set aside sufficient funds to construct, operate, and maintain Village infrastructure with reduced reliance on the availability of government funding programs.

4.2.2 ROADS

Road classification, using the National Road Network (NRN) dataset, was completed and is a good starting point to understand the road network in the Resort Village. The NRN is a national organization that captures and classifies data using a Canada-wide standard. Local classifications, volumes and design standards will not reflect accurately with the NRN dataset and will require the local municipality to collect data to reflect local goals and priorities. There are four road classifications that are categorized based on a variety of factors. Traffic volumes typically govern the road cross section for a particular corridor based on operational constraints. As a municipality experiences growth and development, additional classifications are developed to capture unique road elements based on the adjacent land uses. Table 4.1 summarizes the road classification including the local context for the Resort Village based on TAC (Transportation Association of Canada) standards. Figure 4.1 indicates the road infrastructure in Candle Lake.

Table 4.1 – Rural Road Vehicle Classification

	Local	Collectors	Arterials	Freeway
Typical operating speed (km/h)	50	60	80	100
Typical traffic volume (Average Daily)	Less than 1,000	Less than 5,000	Less than 12,000	Greater than 8,000
Local Context	Simon Lehne	Main Street	N/A	N/A








4.2.3 MARINAS AND BOAT LAUNCHES

During the June 2014 site visit, numerous marinas and small private moorages were noted. Based on a review of available information, only 3 marinas on Candle Lake have been registered or approved by the Ministry of Environment (this does not include those on private land), although there are at least 10 known to currently exist on Candle Lake and an additional two are proposed. Only a few official boat launches were noted but several "rough" launches were observed. Table 4.2 indicates the marinas including capacity that were identified through discussions with Candle Lake Council.

Resort Village Of Candle Lake

Candle Lake Environmental Study

Road Network Map
Figure 4.1

- Legend**
-  Candle Lake Municipal Boundary
 -  Road Class
 -  Expressway / Highway
 -  Collector
 -  Local / Street
 -  Allway / Lane
 -  Resource / Recreation

Notes:

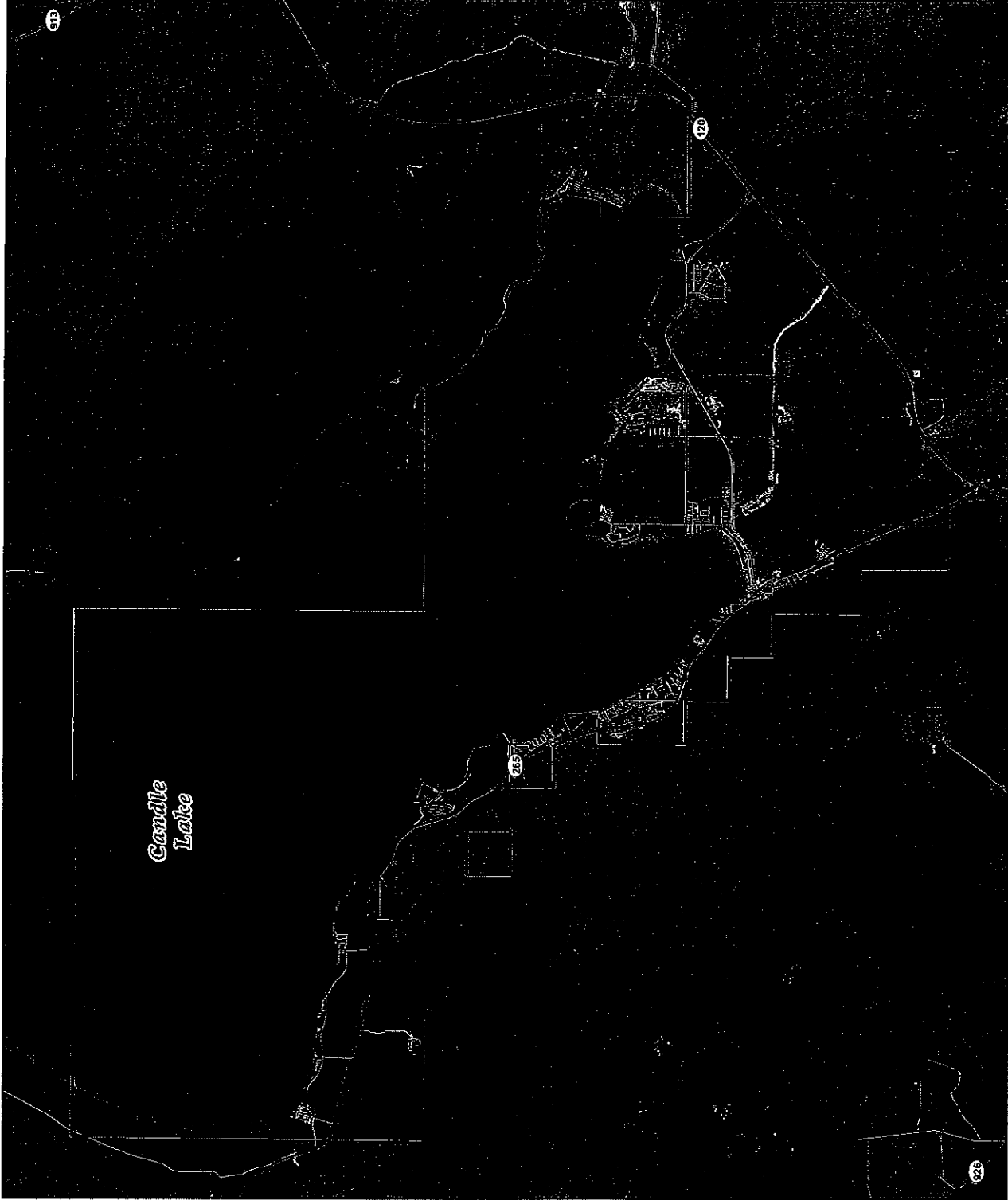
Scale: 1:70,000
(When scaled at 11x17")

Coordinate System:
NAD 1983 CSRS UTM Zone 13N

Data Sources:
- Road data provided by www.geobase.ca.
- Imagery provided by ESRI.

Project #: 3595.0001.01
Author: JWCOR
Checked: RM
Status:
Revision: B
Date: 2014/12/2

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This information should be confirmed as the number of marinas identified for Candle Lake vary depending on the source of information. Craig Guidinger, Regional Lands Manager at the Ministry of Environment, indicated that the Ministry had a record of 34 docks and 3 marinas on Candle Lake (marinas on private land are not included in the Ministry's records). Mr. Guidinger noted that these numbers are unrealistically low and the only way to get a really accurate number would be to physically count them.

Table 4.2 – Marina Capacity on Candle Lake

	Marina	Boat Capacity
1	Golf Course	150
2	Nobles Point	100
3	Enchanted Harbour	40
4	Island View	50
5	Clearsand	40
6	Birchview (van Impe)	100
7	Knogler's Harbour View	30
8	Hansen's Haven	25
9	North View	45
10	Onechassa	19
	TOTAL	594

Candle Lake is noted to be short on boat storage space and marina slips. There are two proposed marinas currently under consideration on Candle Lake. Preliminary details of these proposed developments are included below:

- Evergreen Estates – 150 boat slips, services, parking and covered storage; and
- Unnamed marina – 100 boat slips, storage and parking.

Based on the assumption of one boat per dock (on the 34 registered docks) plus the number of marina slips in Table 4.2, there is a minimum of 628 boats regularly using Candle Lake. This does not include any boats parked off-shore (such as in boat storage/parking facilities) or day users that stay in the provincial campgrounds or picnic areas, or non-registered, private docks. More investigation would be required to more accurately determine the number of boats that regularly use Candle Lake.

4.3 Potential Sources of Contamination

Concerns have been raised about the water quality in Candle Lake based on boat use and adjacent land use. Available information was reviewed to determine any recorded contaminated sites within the Candle Lake area.

4.3.1 *FEDERAL CONTAMINATED SITES DATABASE*

A search of the Treasury Board of Canada's Federal Contaminated Sites Inventory was conducted on July 18, 2014. A total of 2 known contaminated sites within the Candle Lake area were noted. However, both of these sites have been remediated and do not appear to be a threat to water quality within Candle Lake.

The first of these sites is entitled the "Candle Lake RCMP Patrol Cabin Site" and is situated on Berensein Road. A historical review was conducted at this site and it was determined that no further assessment was necessary.

The second site is located on Lakeview Road and is a former Environment Canada hydrometric station. The site was remediated to remove any elemental mercury that may have contaminated the soil at this location.

4.3.2 *OTHER POTENTIAL SOURCES OF CONTAMINATION*

The potential sources of contamination and/or erosion and sedimentation observed in the Candle Lake area are listed in Table 4.4.

Table 4.4 – Potential Sources of Contamination In the Candle Lake Area

Source	Contaminants
Marinas, boat launches and private docks	Hydrocarbons, sedimentation
ATV use in proximity to the lake	Hydrocarbons, sedimentation
Fuel/Service Stations	Hydrocarbons
Roads/ditches	Run-off of hydrocarbons, heavy metals and bacteriological compounds
Landfills	Leaching of hydrocarbons, heavy metals and bacteriological compounds
Septic tanks and sewage lagoons	Accidental release of heavy metals and bacteriological compounds

While each of the above sources of potential contamination noted in Table 4.3 may not have a significant impact on water quality, the cumulative effect of all of these types of land uses may eventually affect the water quality of Candle Lake.

4.4 Existing Land Use Policies and Regulations

Note: We were not able to source a copy of the current Basic Planning Statement. It is not available on the Resort Village website nor is it available from Municipal Relations, Community Planning. The Resort Village has advised that we only need to be concerned with the Draft OCP as outlined below.

North Central Lake Lands District Official Community Plan

This District Official Community Plan (the Plan) was developed to guide development in the North Central Lake Lands for the next 25 to 30 years and forms a partnership between the Regional Municipality of Paddockwood No. 520, the District of Lakeland No. 521, and the Resort Village of Candle Lake in ensuring that development remains consistent with the objectives and goals outlined in the Plan. The Plan forms policy that addresses most land use and development scenarios that will appear in the area including municipal and environmental reserve, agricultural lands, natural or heritage property, residential, commercial and industrial lands. It outlines general planning goals and objectives for the region as a whole, while also providing for interface areas where municipalities will work together when considering development potential (i.e. Regional Municipality of Paddockwood/Resort Village of Candle Lake Interface Region). Also included in the Plan are policies that are specific to each participating municipality, if applicable.

A District Official Community Plan, such as the North Central Lake Lands District Official Community Plan, provides participating municipalities with the ability to weigh their decision making criteria against objectives and goals that are set by representatives from each of the participating municipalities. This holistic approach to planning allows municipalities with limited capacity or resources to pool their collective knowledge and experience and garner an increased ability to self-regulate land use and development. By setting District-wide objectives, the participating municipalities are able to develop economies of scale in improving road and municipal infrastructure, financing growth, gauging and regulating development, and accommodating resource and forestry development.

Summary of the role of a District Planning Board:

Once the Plan is approved by the Ministry, the District Planning Board will serve as an advisory body for the member municipalities, where each participating municipality will forward matters relating to items such as subdivision, industrial and commercial site control, minor variances, phased municipal reserve dedication, permitting other uses of Municipal Reserve dedication, concept plans considerations, and other land use considerations that may have causational circumstances in the surrounding region. Ultimately, the individual municipalities will be the final decision makers under this process.

Participating municipalities will be able to function in autonomy through the implementation of guidelines and regulations outlined in their respective bylaws and municipal policies; however, benefit from the increased capacity of the District Board and their advisory role by providing a mechanism to weigh decisions on the minds of representatives from each of the participating municipalities before being considered by the provincial Ministry in Regina. This framework allows for each municipality to operate within their own development standards and guidelines, while providing an opportunity to have land use and developmental decisions grounded on the collective goals and objectives identified in the Plan.

Candle Lake Zoning Bylaw

Candle Lake has a Zoning Bylaw that was developed in the 1970's, which has since seen a number of amendments to address changing land use and developments in the area. Although these amendments have addressed shifts in land use in the Resort Village of Candle Lake, it is important that the Zoning Bylaw be reflective of overarching policy (i.e. North Central Lake Lands District Official Community Plan)

to direct development in a manner that is consistent with the goals and objectives identified by the community and surrounding District.

A new Zoning Bylaw would include updated development standards that speak to goals and objectives identified in the Plan and include a number of land uses that may not have been considered or included in previous Zoning Bylaw amendments.

Lakeshore Development Guidelines:

Choice of building material and location of developments are two of many considerations when pursuing recreational development along natural shorelines. Shorelines are protected by the Environmental Management and Protection Act, 2002 (EMPA). Under Section 36(1) of the EMPA, any person planning work near a water body must contact the Ministry of Environment to:

- Alter the bed, bank, or boundary of a water body or water course;
- Remove or add material to a bed, bank, or boundary of a water body or water course;
- Remove vegetation from a bed, bank, or boundary of a water body or water course;
- Municipal development permits are required for any lot development;
- Alteration permits are required from the DFO and Ministry of Environment if development is on or within 5 metres of a lake bed; and
- A Temporary Use permit is required from the Municipality for any use of Environmental or Municipal Reserve land.

Approvals are required from the Department of Fisheries and Oceans (DFO) for work in or abutting water from municipalities for all development.

Candle Lake Development Application Process

The current Candle Lake development process is summarized below:

1. The developer is encouraged to host an open house to provide for public comment and feedback.
2. An application must be made to the Ministry of Municipal Relations (MMR) for Subdivision Application.
3. MMR reviews subdivision application for consistency with municipal policies and bylaws, and an approved subdivision process; following up with the Municipality to receive their comments.
4. If no serious concerns are identified, the Subdivision Application is approved.
5. A Servicing Agreement is entered into between the developer and the Municipality (includes any infrastructure upgrades and servicing fees).
6. A deposit is used to rectify infrastructure deficiencies and, if none are found, it is returned.

This is an appropriate development application process; however, through the adoption of the District OCP, the Resort Village of Candle Lake is provided with increased decision making capacity by being a part of the District Board. Through this mechanism, participating Municipalities can discuss opinions and

concerns with unique development application to share experiences and discuss considerations with others who could provide advice on how they had dealt with similar situations. This provides an additional layer of decision making within the Region before the development applications are forwarded to the Ministry of Municipal Affairs. Here the Minister gathers feedback from the Municipality and ensures consistency with the District OCP to weigh decisions of the suitability of a development in effected community. Although the Resort Village is able to provide comment on a development application, much of the decision lies in the hands of the Ministry.

If the Resort Village of Candle Lake chose to hire or retain a professional planner on staff, the Municipality would be provided with decision making authority, removing the Ministry from making the final decision on development applications. This would provide the Resort Village of Candle Lake with authority over development decisions like subdivision, industrial and commercial site control, and the adoption of Concept Plans, while providing the opportunity to develop a Public Notice Policy that reflects the framework outlined in the *Planning and Development Act, 2007*. In addition to this, by retaining a professional planner or having one on staff, the Resort Village could introduce a fee schedule with regards to development permit applications and processes to cover the administrative costs associated with the review of development permit applications.

Moving Forward with the District Official Community Plan

With the adoption of the District OCP, the Resort Village of Candle Lake has been provided new jurisdiction over the control and management of their lands, which will require policy updates and amendment to ensure that development processes and policies are consistent with the goals and objectives identified in the District OCP. For instance, property set back requirements for sewage treatment and disposal will have to be maintained as outlined in the OCP which could require an amendment to the Candle Lake Zoning Bylaw.

It is recommended that Candle Lake consider developing or amending policy to address the District Goals outlined in **Section 2** of the District OCP. Those goals are as follows:

2.1 Environmental Consideration

- a. Conserve aquatic and terrestrial ecological resources in the District;
- b. Use the natural resources in the District in a manner that is environmental, social and economically sustainable;
- c. Conserve valuable agricultural lands for agricultural land use; and
- d. Provide ongoing opportunities for the public to appreciate water and land resources and aesthetic values of the District.

2.2 Physical and economic Development

- a. Ensure physical development reflects market conditions and public needs, while maintaining consistency with the financial capabilities and needs for resource conservation.
- b. To strengthen the economic base of the District by creating a positive environment for:
 - i. Sustainable business development, specifically tourism and outdoor recreation; and

- ii. Residential development subject to area-specific objectives.
- 2.3 Community Development and Infrastructure
 - a. To promote the development of services to meet the needs of the residents, businesses and visitors; and
 - b. To evaluate and maintain vehicular and pedestrian traffic and develop appropriate roads and walkways.
- 2.4 Senior Government Interests and Involvement
 - a. To obtain the support and assistance of government in areas where this Plan is consistent with federal and provincial interests; and
 - b. To support and compliment provincial interests where that interest has been made known to the Municipality.
- 2.5 Inter-Jurisdictional Cooperation
 - a. Maintain communications with adjacent municipalities and First Nations to ensure development plans do not jeopardize adjacent land uses or plans; and
 - b. Consider joint service operations with other municipal and First Nation governments.

Candle Lake-Specific Policies under the District OCP

7.1 Commercial Land Use and Development

Objective 3: To encourage the enhancement and expansion of a commercial centre in the Resort Village of Candle Lake, and further:

- a. To encourage commercial developments to locate within the commercial centre (except for home-based business, home-based occupations, golf courses and marinas); and
- b. To explore an outdoor mall within the commercial centre.

Section 22.1 Resort Village of Candle Lake Objectives

- 3. To accommodate boating facilities for desired types and levels of lake use and to support and encourage responsible management of boating and other water-based activities.

4.5 Regulations Relating to Marina Development

Saskatchewan Water Security Agency

The Water Security Agency is the provincial organization responsible for reviewing aquatic habitat alterations for the protection of aquatic ecosystems and human health. Any work within water, or on the bed, bank and boundary area of a waterbody is subject to the Environmental Management and Protection Act and requires an Aquatic Habitat Protection Permit from the Water Security Agency. Specifically, the development of marinas, boat launches, breakwaters, docks and waterlines all require an Aquatic Habitat Protection Permit.

Transport Canada's Navigation Protection Act

Transport Canada's Navigation Protection Act came into effect in April 2014 and replaced the Navigable Waters Protection Act. The end result is that many projects within aquatic environments no longer trigger this Act as it only applies to water bodies on the List of Scheduled Waters (Candle Lake is not listed). However, there is a clause in the Navigation Protection Act that allows owners of non-scheduled navigable waters to ask for a review under the Navigation Protection Act. The Minister may accept or refuse an opt-in request.

Fisheries and Oceans Canada

Fisheries and Oceans Canada provides an online self-assessment process that determines whether or not a project in or near a water body requires a Request for Review application to be prepared and submitted. This self-assessment provides a list of the types of water bodies and project activities where a Request for Review is not required. As Candle Lake is a productive, fish-bearing waterbody, it is likely that most projects located below the visible high water mark of Candle Lake should submit a Request for Review application to Fisheries and Oceans Canada prior to construction. Some applicable notable exceptions include:

- All new construction, repair or rebuild of a floating, cantilever or post dock.
- All dock removal activities.
- All construction or repairs of boat launches, provided that no new fill is to be placed below the high water mark.
- Repairs to existing piers or wharfs, provided that there is no increase in footprint below the high water mark.

5.0 Candle Lake Water Quality Review

The Resort Village of Candle Lake is aware of public concerns about the potential effects on water quality in Candle Lake due to the lakeshore development and boat use on the lake. To determine potential impacts, historical water quality data for Candle Lake and the tributaries to the lake were examined. In addition, a sampling event was performed in June 2014 by Urban Systems staff to provide baseline water quality data to help monitor the potential impacts of the lakeshore development and boat use in the future.

Water quality data from the lake and its tributaries were compared to the Saskatchewan Surface Water Quality Objectives (Water Security Agency, 2006) and the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines (CCME, 2014). As fisheries and recreation are the most common uses for Candle Lake, the data were compared to provincial objectives and federal guidelines for both the protection of aquatic life and for recreational use. The assessment of water quality in Candle Lake was based on the most stringent guideline available. It is important to note that both the provincial objectives and federal guidelines have no legal standing and serve as a guide for issuing permits, licences and orders and for maintaining designated water uses.

5.1 Historical Water Quality Analysis

Historical water quality data were available for the 16 sampling locations in and around Candle Lake from 1993 to 1994, 2002, and 2008 to 2010.

5.1.1 *TRIBUTARIES TO CANDLE LAKE*

Various inflows to Candle Lake including Hannin Creek, Fisher Creek, Clearsand Creek, the outlet of Bay Lake and the Whitefish River have been examined for potential impacts on Candle Lake. There were only three parameters that did not meet the surface water quality objectives and guidelines. On one day in 2009, the measured dissolved oxygen in Hannin Creek (5.6 mg/L, July 2009) was below the Saskatchewan Water Quality Objective of 6.5 mg/L for cold water biota in later life stages. It was not expected that this low value would have significant impact on the lake when the other water sources remained above water quality objective levels. It is important to note that the Hannin Creek data set for dissolved oxygen was limited to two data points only. The total iron level in Fisher Creek in July 2001 of 2.8 mg/L was higher than the Water Quality Objective of 0.3 mg/L but with only one total iron measurement taken from all the inputs to the lake (and no corresponding dissolved iron concentration), it is not possible to comment on whether this value is typical of the source water or whether it could be a function elevated flows through freshet or a precipitation event. All of the dissolved fluoride readings for the source waters were at or slightly above the CCME guideline of 0.12 mg/L for the protection of aquatic life. With several inputs to the lake showing concentrations above the guideline for fluoride, it is suggested that these fluoride levels may be typical of the area. *E. coli* levels in the source waters never approached guideline levels. In general, the historical source water quality for Candle met objective and guidelines levels, but it should be noted that the data set was limited.

5.1.2 CANDLE LAKE

Water quality in Candle Lake has been monitored periodically since 1993 from depths ranging from the surface to depths of 17 m. Most of the historical data for the lake has been taken in February/March and in July/August. Further information about lake dynamics would be required to determine the presence of a thermocline and the timing for turn-over to occur and the potential impacts on the data set. Based on the limited available data set, there was no indication of water quality changes from surface to depths of 18 m. Looking at the lake as a whole, dissolved oxygen levels were measured at 2.0 mg/L in February 2008 but readings taken a half hour later were much higher (13.7 mg/L) suggesting that further information regarding the sampling methods and sample handling procedures would be required to comment on this difference. On three of the eight occasions when total silver was tested, the detection limits for the samples were above the Saskatchewan Surface Water Quality Objective but on the other occasions, when the detection limit was lower, the silver levels were found to be below objective levels. It is reasonable to assume that if the appropriate detection limits were used for the other three samples that the values would also have been below the guideline. All fluoride levels in the lake were at or slightly above CCME guideline levels which is consistent with the source waters indicating that there may be a natural source of fluoride in the area. In terms of recreational use of the lake, *E. coli* levels in the lake have, historically, never approached guideline levels. All of the remaining water quality parameters met the objective and guideline levels suggesting that Candle Lake would be suitable for recreational purposes and the aquatic life is likely not at risk in the lake due to water quality.

Historically, Candle Lake has been monitored at the shoreline and at various depths in the lake. In the limited data set, there was no indication of major differences in water quality of the shoreline compared to the depths of the lake.

Based on the historical average total phosphorus (55 µg/L), total nitrogen (630 µg/L), chlorophyll a (0.63 µg/L) concentration and Secchi disk depth (6.1 m) in the lake, the trophic status of the lake would be difficult to confirm. The total phosphorus and nitrogen concentrations and the Secchi disk depth would suggest a mesotrophic lake while the chlorophyll a data would indicate an oligotrophic lake. Table 5.1 indicates the ranges for trophic status in lakes.

Table 5.1 – Trophic Status in Lakes

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Description	Low productivity Clear water Low Nutrients Low algal growth	Intermediate productivity Clear water Medium nutrient levels Aquatic plants	High productivity Clear to murky water High nutrients Abundant aquatic plants / algae
Total Phosphorus (µg/L)			
Mean	8	27	84
Range	3 – 18	11 – 96	16 – 390
Total Nitrogen (µg/L)			
Mean	660	750	1,900
Range	310 – 11,600	360 – 1,400	390 – 6,100
Chlorophyll a (µg/L)			
Mean	1.7	4.7	14
Range	0.4 – 4.5	3 – 11	2.7 – 7.8
Secchi Depth (m)			
Mean	9.9	4.2	2.4
Range	5.4 – 28	1.5 – 8.1	0.8 – 7.0

In general, the water quality has met the Saskatchewan Water Quality Objectives and CCME guidelines with only minor exceptions suggesting that aquatic life will not be adversely affected by the lake water. Both the Saskatchewan and the CCME recreational guidelines were met in the lake. There was also no indication of water quality deteriorating over time in Candle Lake, however, further monitoring would be required to confirm the consistent water quality.

5.2 2014 Water Quality Analysis

To provide background water quality levels for Candle Lake and its inputs, Urban System conducted a sampling event on June 17th and 18th, 2014. The same sampling locations as the historical work were used. All samples were taken upstream of road crossings to minimize the influence of the roads on the water quality results.

5.2.1 TRIBUTARIES TO CANDLE LAKE

Several tributaries to Candle Lake including Scout Creek (Photo 5.1), Hannin Creek (Photo 5.2), Clearsand Creek (Photo 5.3), Fisher Creek (Photo 5.4), and United Church Camp (no photo) were sampled for water quality in 2014. In addition, the outlet to Candle Lake, the Torch River (Photo 5.5), was also sampled for water quality in 2014. All provincial objectives and federal water quality guidelines were met for each input to the lake. The historical data showed total iron and dissolved fluoride concentrations

that were above guidelines but concentrations in all inputs in 2014 were below objective and guideline concentrations. Dissolved oxygen levels were not measured in 2014. The *E. coli* concentrations in Hannin Creek and United Church were slightly elevated compared to the other inputs and the lake levels but were below the Saskatchewan Objective single sample maximum of 400 MPN/100 mL. Further monitoring, including periods of spring freshet, would be beneficial to observe the water quality of the lake inputs at various times of the year.

Photo 5.1 – Scout Creek



Photo 5.2 – Hannin Creek



Photo 5.3 – Clearsand Creek



Photo 5.4 – Fisher Creek (at Inlet to Candle Lake)

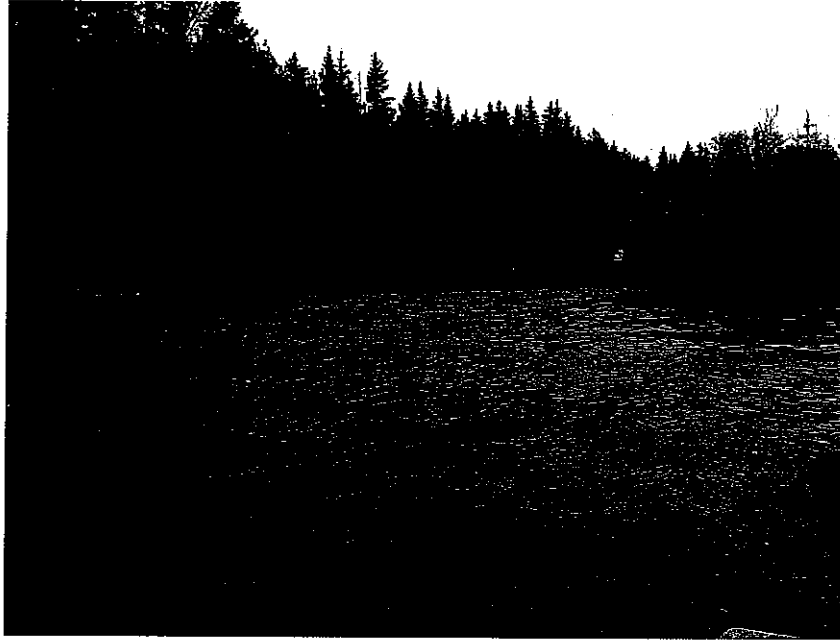


Photo 5.5 – Torch River



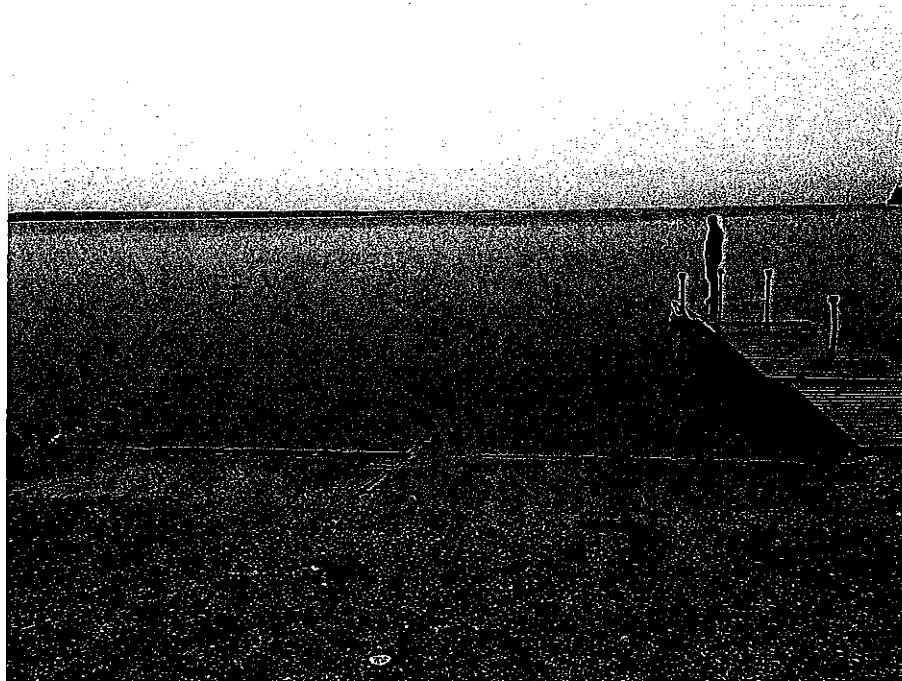
5.2.2 CANDLE LAKE

Water quality samples were taken from the middle of the lake from the surface and from a depth of 16 m [(1 m above the bottom in approximately 17 m of water) (Photo 5.6)]. There were no occasions when the water quality at either depth did not meet objective and guideline levels. The surface and depth sample did not appear to vary substantially based on depth. Further information on the conditions of the lake including thermocline depth would be required to comment on the mixing in the lake.

To determine possible anthropogenic influence on the lake, the water at the 17 m depth was analyzed for caffeine. Sampling was limited for caffeine due to the high costs associated with the analysis. As caffeine is not a compound produced by agriculture or industry, it is a good measure of the potential human influence on the lake. The lake was found to have measureable amounts (0.0282 µg/L) of caffeine. While the presence of caffeine indicates human influence on the lake, it is unclear whether the presence of caffeine could be explained by direct input in the lake (coffee grounds being discarded in and around the lake) or whether by indirect methods (excreted by humans and entering the lake through the sewage lagoons or leaking septic tanks). Further work on the presence of caffeine in the lake is recommended to determine if wastewater is entering the lake system.

Based on the June 2014 total phosphorus (<200 µg/L), total nitrogen (< 540 µg/L) and the chlorophyll a (0.86 µg/L) concentrations in the lake, the trophic status of the lake would be oligotrophic. Secchi depth, total coliforms, faecal coliforms and *E. coli* were not measured within Candle Lake as part of the 2014 sampling event.

Photo 5.6 – Candle Lake Water Sampling



5.2.3 2014 WATER QUALITY CONCLUSIONS

Overall, the historical water quality of Candle Lake and the various inputs to the lake only showed a few occurrences that were above the recommended levels. Based on the limited data set, there is no indication of any parameters increasing over time to affect water quality for the protection of aquatic life or for recreational use of Candle Lake.

Based on the 2014 sampling event, Candle Lake and the tributaries to the lake met the water quality objectives and guidelines. It is important to note that one sampling event is a 'snap-shot' on water quality and may not be indicative of long term water quality. Government funding can no longer be relied upon for water quality monitoring; however, this is an important consideration in the stewardship of the lake. Therefore, continued monitoring of the lake would be recommended to determine whether the lakeshore development and boating on the lake are affecting water quality.

Analyses for hydrocarbons (PAHs, LEPH, HEPH) was not conducted during the 2014 sampling event. The rationale behind the exclusion of hydrocarbons from the sampling was due to the fact that hydrocarbons tend to be absorbed into the sediments quite quickly, and thus would not likely be detected in a water sample (Nagy, E. *et al.*, 1984). In addition, the cost associated with laboratory analyses for hydrocarbons is very high.

6.0 Carrying Capacity and Lake Classification

The three main objectives of the Environmental and Carrying Capacity Study are to:

- Determine an appropriate carrying capacity for the lake,
- Classify Candle Lake, and
- Develop Lakeshore Development Guidelines.

6.1 Carrying Capacity

The concept of carrying capacity is founded in the biological sciences and is defined generally as "the population of organisms that can be sustained considering the resources available in the ecosystem in which they reside." This concept was further applied to terrestrial recreation resource management in areas such as national parks and campgrounds as well as to aquatic environments such as lakes. Recreational carrying capacity is defined as "the amount of development and activity a body of water can handle before it starts to deteriorate." Determining the optimum use level for a lake is a complex process, which varies from lake to lake and according to the perceptions of users.

The traditional concept of carrying capacity did not consider user perception or user values. Therefore, carrying capacity should include an element of perception or values from area users and managers, who add the human component to carrying capacity (Shelby and Heberlein, 1986).

As a result of user perception, carrying capacity determination is never purely objective (Bosley, 2005). Most carrying capacity conflicts do not revolve around resource questions, but more so around questions of values. In other words, time and effort is spent on collecting data about the physical environment when the conflict is essentially human-based and is unlikely to be resolved by biological information. Therefore, it is important to break the concept of carrying capacity into two parts: the resource component and the values-based component. It is important to note that the idea of "optimum" carrying capacity revolves around the question of values, which are usually determined through a census of users and are articulated in management objectives. This is beyond the scope of this study.

For the purposes of the Environmental and Carrying Capacity Study, the carrying capacity of Candle Lake has been defined based on the measures of environmental change (biophysical/ecological characteristics of Candle Lake including the fisheries resources in Section 3.0 and water quality in Section 5.0). In the absence of primary research (user surveys or watercraft census) to gather the values/perceptions of the users of Candle Lake, existing literature was reviewed to gain an understanding of general parameters used to assess boating capacity on similar lake environments.

6.1.1 *RECREATIONAL CARRYING CAPACITY OF THE LAKE*

The recreational carrying capacity of Candle Lake was determined by examining the boating carrying capacity of the lake as this is the simplest measure of lake use. Due to the budget and time constraints of the project, additional carrying capacity parameters such as user surveys and boat counting were not

performed. The boating carrying capacity was estimated based on a literature review and the following assumptions:

- All marinas/docks on the lake have a combined capacity of 628 boats.
- A 100 m buffer from the shore was removed from the useable area calculation for the lake resulting in a usable area of 12,459 ha.
- Jaakson et al. (1990) developed suggested densities for their study area in North-Central Saskatchewan ranging from 0.04 km²/boat for paddling boats to 0.08 km²/boat for waterskiing boats. As a worst-case scenario, the higher density of 0.08 km²/boat was used.

Based on the usable surface area of the lake being 125 km² (12,459 ha) and an estimated boating density of 0.08 km²/boat, Candle Lake could support approximately 1,560 boats. According to recent estimates, the number of boats on the lake could be 628 based on the capacity of the various marinas and docks on the lake. It should be noted that this number may not account for additional private docks that are not registered with the Ministry or day use in the lake which may significantly increase the number of boats on the lake during peak times. Boat counting during peak periods would be required to confirm the number of boats operating on the lake. By this calculation, the lake may be able to support more boats, but these numbers do not account for public perception on the appropriate number of boats operating safely on the lake at any given time.

6.2 Lake Classification

In the absence of a formal lake classification system for Saskatchewan, Candle Lake was assessed using a system developed for the Thompson Nicola Regional District (TNRD) in the interior of British Columbia. This system was developed based on the perceived need for direction in the management of lakeside development to maintain a diversity of lakes for recreation, settlement and commercial use. The classification system was developed based on an inventory of the available information on 220 lakes in the TNRD as selected by the Planning Department of the Regional District. Information was gathered on land status, Canada Land Inventory ratings and biophysical characteristics of the lakes. This information was supplemented by a Lake User Survey consisting of four segments: Public Lake User Survey, Cottage Owner Survey, Resort Owner Survey and Resort Patron Survey. With the exception of a Lake User Survey, a similar process for information gathering has been used for the Candle Lake Environmental and Carrying Capacity Study.

The Lake Classification System developed for the TNRD resulted in the following classes of lakes – each with their own definition, criteria (including exceptions), and management guidelines:

- **Wilderness Lakes** - those lakes with no development, and generally no motorized access although rudimentary access may exist; however, there is an absence of near shore logging.
- **Natural Environment Lakes** - those lakes with negligible development, limited near shore logging and access; significant sportfish values, waterfowl and ungulate capabilities;
- **General Use Lakes** - those lakes that are generally used for public recreation, with some private development;

- **Development Lakes** - those lakes that can withstand a variety of uses including extensive public recreation and private development;
- **Critical Lakes** - those lakes which are at a critical point in their evolution and should have no further development;
- **Special Case Lakes** - those lakes that require special management guidelines.

Background information pertinent to these classifications is provided in Appendix A – (Lake Classifications).

Table 6.1 outlines the criteria for this classification and the applicability to Candle Lake. Adaptations have been made to the criteria based on current water quality guidelines, available information/data for Candle Lake, and applicability of the criteria to Candle Lake.

Table 6.1 – Classification Criteria

Criteria	Application to Candle Lake
1. The lake or shoreline has a dominant Canada Land Inventory (CLI) Recreation Capability rating of 1, 2 and 3, and the lake has an area greater than 100 hectares and a mean depth greater than 5 metres.	The shoreline of Candle Lake has 4 pockets of Class 1 and 2 ¹ lands but is almost entirely classified as Class 3 ² . There is one small area at the north end of the lake that is Class 4 and 5 ³ . At 13,234 ha, Candle Lake is significantly larger than 100 ha. Candle Lake has a mean depth of 8.4 metres.
2. Private cottage lots, whether owned or leased, may constitute less than 35% of the perimeter of the lake on lakes under 800 hectares and 50% of the perimeter on lakes over 800 hectares, providing that there is still over 0.67 units per hectare of water surface ⁴ .	Based on air photo interpretation, approximately 13% of the shoreline of Candle Lake is developed.
3. The following water quality criteria must be met, based on the maximum of whichever measurements are available: a) mean summer chlorophyll a is less than 5 µg/L; b) secchi disk readings are greater than 3	Water quality for Candle Lake: a) Mean summer chlorophyll a was 0.86 µg/L in 2014 and 0.63 µg/L historically. b) Historically, all secchi disk readings (12) were greater than 3 meters. Secchi disk readings not taken in 2014. However, water clarity

¹ Class 1 and 2 lands have a natural capability to engender and sustain high to very high total annual use for one or more intensive recreational activities.

² Class 3 lands have a natural capability to engender and sustain moderately high total annual use for intensive or moderately intensive activities.

³ Class 4 and 5 lands have a natural capability to engender and sustain moderate to moderately low total annual use for dispersed activities.

⁴ Existing units per hectare have not been calculated at this point as information from other municipal governments is required and was not readily available. However, it is expected that the units per hectare for Candle Lake are well below this at the present time.

Criteria	Application to Candle Lake
<p>metres;</p> <p>c) water quality meets the appropriate provincial/federal water quality objectives and guidelines.</p>	<p>appeared good and secchi disk readings would likely have been greater than 3 m as well.</p> <p>c) With only minor exceptions, the Saskatchewan Objectives and the CCME guidelines were met for the protection of aquatic life and for recreation, both historically and in 2014 in the lake.</p>
<p>4. The lakeshore does not consist of steep slopes or soils which are unsuitable for nutrient removal from sewage effluent.</p>	<p>The majority of the Candle Lake shoreline does not consist of steep slopes or unstable soils.</p>

Based on these categories, **Candle Lake would be classified as a Development Lake.** The definition of a Development Lake is as follows:

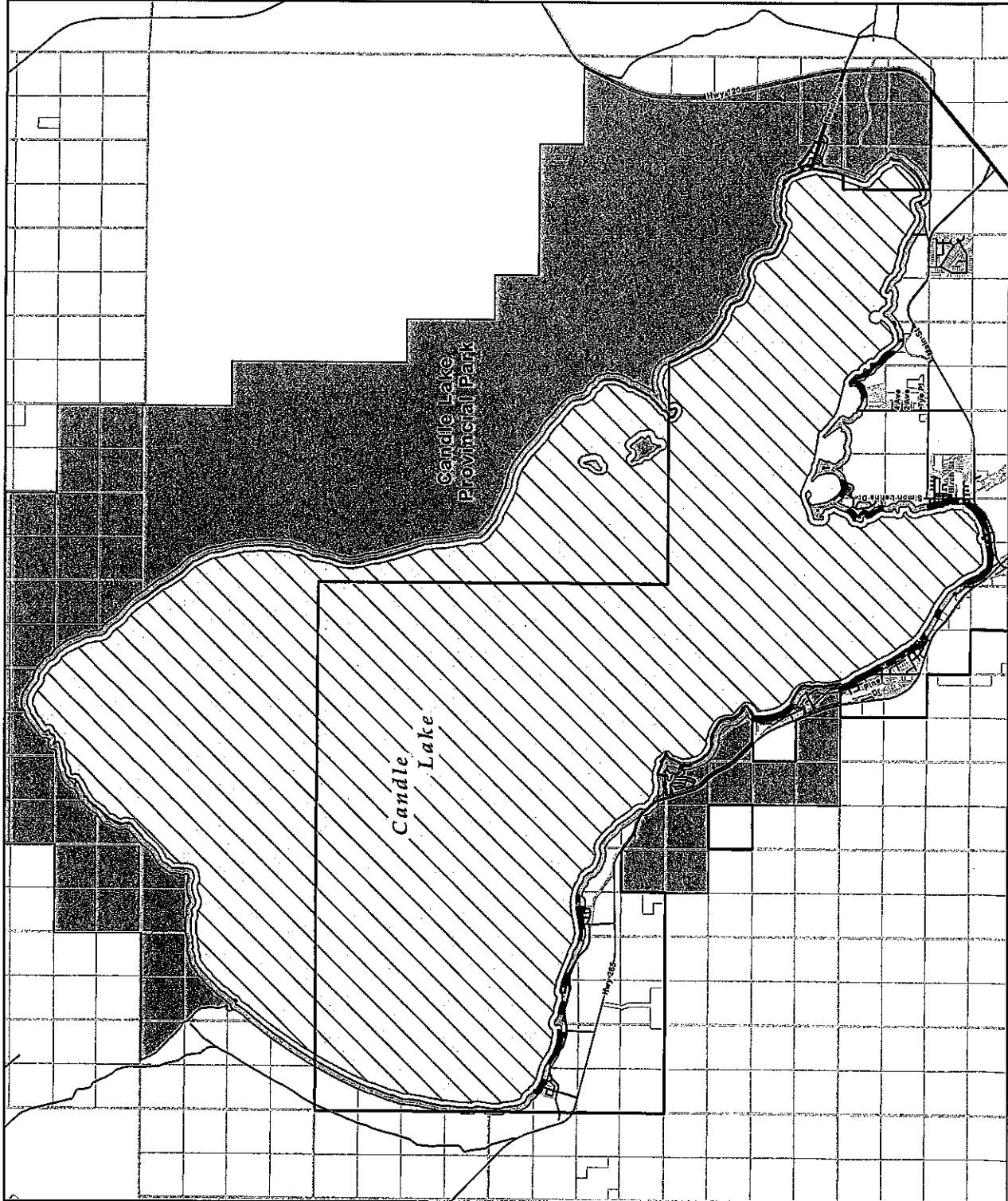
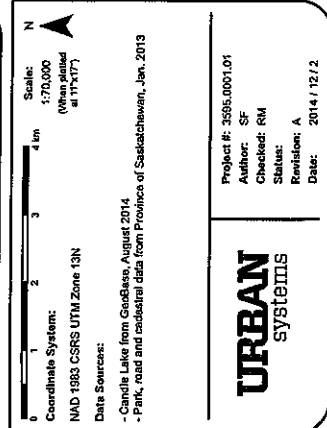
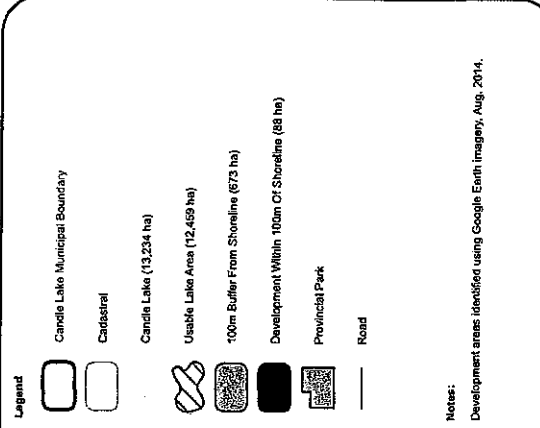
Those lakes capable of supporting a high level of mixed uses such as cottaging, outdoor recreation and agriculture. Conservation of the natural environment is also an important objective.

Figure 6.1 indicates the usable area of the lake as well as the 100 m buffer from the shoreline.

Resort Village Of Candle Lake

Candle Lake Environmental Study

Usable Lake Area & Shoreline Development Figure 6.1



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7.0 Lakeshore Development Guidelines

7.1 Introduction

The Lakeshore Development Guidelines in this section are based on a system developed for the Thompson Nicola Regional District (TNRD) in the interior of British Columbia as described in Section 6.2 of this report.

These Lakeshore Development Guidelines for Candle Lake were prepared in response to the current, and anticipated increase of, residential and commercial development within the Resort Village. Lakeshores and uplands areas are recognized as both extremely valuable assets and environmentally sensitive areas requiring careful development and ongoing management. These areas also encompass multiple interests including forestry, agriculture, tourism, First Nations, various government agencies, the land development industry, community associations, environmental organizations and other interest groups.

These Lakeshore Development Guidelines are intended to improve the ability of the Resort Village of Candle Lake to handle the growing development pressure on Candle Lake and other surrounding water bodies while retaining the sensitive natural features that draw people to the area for recreational purposes.

As discussed in Section 6.2 of this report, Candle Lake has been classified as a **Development Lake**. Development Lakes can typically accommodate 0.67 units/ha of water surface area and have an allowable percentage of shoreline development of up to 50% (for lakes over 800 ha). As previously noted, existing units per hectare have not been calculated at this point as information from other municipal governments is required and was not readily available. However, it is expected that the units per hectare for Candle Lake are well below 0.67 units/ha of water surface area at the present time.

7.2 Purpose

The purpose of the Lakeshore Development Guidelines is to ensure that lake resources at Candle Lake will be available for the use and enjoyment of future generations. This will be achieved through high quality development that preserves the integrity of the shoreline and upland areas and maintains the environmental attributes of the lake. These Lakeshore Development Guidelines should **apply to the entire Resort Village of Candle Lake landbase** as all wetlands, groundwater springs, creeks and lakes (which are predominant throughout the area) are hydraulically connected.

The guidelines should therefore be viewed as a baseline of standards that, to a degree, are considered flexible providing development proponents can demonstrate that policy objectives will be achieved. In particular, qualified professionals engaged in larger scale multiple lot developments may propose guideline alternatives or variations providing that acceptable development standards are achieved to the satisfaction of the Resort Village of Candle Lake. The guidelines are not intended to conflict with existing provincial or federal policy regulations. Where this may occur, the guidelines should be superseded.

7.3 Guiding Principles

1. **Protect the Environmental Quality of Candle Lake and Surrounding Waterbodies including Wetlands** – The Resort Village of Candle Lake recognizes the environmental value of Candle Lake and surrounding waterbodies and intends to protect the riparian, aesthetic and water quality components.
2. **Promote a Collaborative Approach** – The Resort Village of Candle Lake is committed to an appropriate and balanced level of development that will benefit all stakeholders including the developed community, lake users, senior government agencies and First Nations.
3. **Develop and Implement Clear and Appropriate Policies** – By creating clear policies and guidelines, the Resort Village of Candle Lake will avoid confusion and misunderstandings that can negatively impact Candle Lake.
4. **Protect Lake Users and Development from Hazardous Conditions** – Steep slopes, unstable soils, wildfires and floods can threaten development, impact the environment and compromise safety. Measures will be implemented to minimize exposure to hazardous conditions.
5. **Maintain and Selectively Enhance Public Access** – Candle Lake is a public resource and public access shall be maintained and enhanced where possible, provided that the environmental values of the lake and lakeshore are not compromised in doing so.
6. **Promote Sustainable Lake Management Practices through a Stewardship and Awareness Program** – Understanding the importance of Candle Lake and ways to preserve it from detrimental development impacts will be important to the ongoing stewardship of this valuable resource. The Resort Village of Candle Lake shall promote awareness of lakeshore-friendly practices and water quality preservation.
7. **Ensure Consistency with Other Planning Documents** – Including the Saskatchewan Ministry of Municipal Affairs Planning Handbook.
8. **Encourage Economic Development and Diversification** – High quality development represents economic growth opportunities for the Resort Village of Candle Lake including construction, employment, tourism and trade for existing businesses and service centres.

7.4 Policies and Guidelines

7.4.1 SITE DEVELOPMENT POLICIES

- .1 Shorelines shall be maintained in a predominantly natural state with tree cover and ground vegetation as development occurs.
- .2 Where new development sites lack existing tree cover and understory, a development plan including restoration of the shoreland shall be required that promotes appropriate native plant varieties.
- .3 Development shall retain and conserve natural features including wetlands, rock outcrops, streams, islands, emergent aquatic vegetation, and other features contributing to the natural character of the site and surrounding area.

- .4 Development shall minimize site disturbance during construction including the implementation of erosion and sediment control measures.
- .5 Development shall be designed at a level of density and site coverage compatible with the physical capabilities of the shoreland and water body.
- .6 The location of new shoreland subdivisions shall be assessed on the basis of site suitability, environment, and socio-economic impacts in the context of the entire lake, streams and wetlands.
- .7 Site selection and development shall consider the impacts and compatibility with existing and future land use and resource activities.
- .8 Infill development will be encouraged as an extension of existing development, where feasible.
- .9 Linear waterfront development (consisting of individual dwellings situated along the shoreline) and back lot development (consisting of individual dwellings within the lakeshore designation without water frontage) are both considered acceptable residential development forms.
- .10 Cluster designs shall be encouraged and density bonusing may be considered in conjunction with higher servicing standards and site conservation initiatives where applicable.
- .11 Private roads accessing shoreland lots are to be designed with aesthetic considerations in mind including minimal tree removal, unobtrusive cuts and fills, alignments that follow contours, and other design elements resulting in road construction that is well suited to the landscape and maintains visual qualities.
- .12 Nutrient input from outside sources (i.e. resource use, sewage disposal, erosion and sedimentation, etc.) shall be recognized as a contributing factor to lake water quality and collaborative initiatives to minimize non-point pollution shall be pursued.
- .13 The development proponent shall submit all plans and drawings necessary to accurately represent the extent of site changes including but not limited to building locations, roads and parking, site servicing, grading, stormwater management and vegetation removal. The Resort Village of Candle Lake may request supplementary drawings and reports as needed to determine development impacts.
- .14 Development shall incorporate best management practices as identified in:
 - a) Department of Fisheries and Oceans, Land Development Guidelines for the Protection of Aquatic Habitat.
 - b) Managing Saskatchewan Wetlands - A Landowner's Guide
 - c) Saskatchewan Ministry of Environment – A Guide to Managing Community Wildfire Risk
- .15 Wildfire management shall be considered at the planning stage for subdivisions including escape plans, fuel management, water supply and hydrant systems.
- .16 Wildlife movement corridors and sensitive habitat areas shall be identified and accommodated at the planning stage of development.
- .17 A storm drainage management plan shall be prepared for lakeside subdivisions and potentially include detention ponds, cut-off ditches and the establishment of new wetland areas.

7.4.2 SITE DEVELOPMENT GUIDELINES

- .1 Minimize paved and other hard surface areas and use permeable paving materials that allow for precipitation to filter into the ground.
- .2 Use shrubs or water bars to redirect site drainage to avoid direct and rapid flow of surface drainage to the lake and/or streams.
- .3 All road or path stream crossings should be perpendicular to the flow direction.
- .4 Surface drainage should be managed so as to avoid direct discharge into the lake and to maximize stormwater detention.
- .5 Avoid the use of retaining walls below the high water mark and introduce more natural landscape features including rocks and plantings set into a stable slope (2:1 maximum).
- .6 Avoid creation of an artificial sand beach.
- .7 Avoid dredging or filling when constructing a dock, deck or other shoreline structures.
- .8 Avoid development in areas susceptible to erodible soils and steep slopes.
- .9 Environmentally sensitive areas within the Resort Village shall be recognized to protect environmental values. These may include portions of wildlife habitat, semi-enclosed marsh/wetland or shallow water bodies draining into or from the lake, steep slopes, old-growth forest areas, lands prone to flooding and lands designated for recreation or conservation.
- .10 Areas designated as environmentally sensitive shall remain undeveloped and undisturbed which prohibits grading, excavating, filling and/or construction of roadways, driveways, parking areas or structures.
- .11 Development should not be considered for any island.
- .12 Road layout shall be aligned to conform to natural grades as much as possible.
- .13 A 15 m minimum setback should be required from the high water mark (natural boundary) on all streams, lakes and waterbodies. Setback areas shall remain in a natural condition to provide shoreline protection and protection and food sources for fish and wildlife. Natural drainage courses shall be preserved as close as possible to their natural location and appearance.
- .14 Site works development shall not be permitted on slopes in excess of 20% unless a geotechnical review confirms suitability. Slopes shall be measured over a horizontal distance inland of 45 m/150 ft. from the shoreline of Candle Lake and other waterbodies.
- .15 Topsoil removed during construction should be conserved for use on areas requiring vegetation or landscaping.
- .16 Construct and continuously maintain sediment ponds, silt fences, filtration facilities, run-off diversions, and other works as required, to protect creeks, watercourses and lakes from siltation.
- .17 Inspect silt fences during, and immediately after, prolonged rainfall. If undercutting is observed, immediately repair fence.

- .18 Existing agricultural land use may require that fencing, cattle guards, and other measures be included in site development to mitigate potential land use conflicts.

7.4.3 VEGETATION

- .1 Carefully prune or limb trees and shrubs instead of removing them to open up views to the water.
- .2 Leave a 15 m riparian setback from a lake (measured from the high water mark) along the shoreline where native vegetation is retained.
- .3 Within the front yard/riparian setback, the natural landscape shall be retained except for 30% of the lot frontage which may be cleared to create unobstructed lake views and access. Where trees and understorey have been removed, native landscape materials should be introduced and allowed to re-establish so as to create a contiguous buffer.
- .4 Use temporary fencing or flagging around trees and natural areas to avoid construction damage.
- .5 To retain trees adjacent to construction, avoid any excavation or digging within the dripline of the tree.
- .6 Remove aquatic plants only where they seriously interfere with recreational use of water and then clear only the smallest possible area.
- .7 For steep slopes greater than 20%, existing vegetation should be substantially retained on all slope faces.
- .8 Hazard trees (trees which are leaning or in danger of falling) should be pruned or removed where necessary from the property.
- .9 Exposed slopes caused by site grading should be reseeded as soon as possible.
- .10 Maximize the retention of mature trees.
- .11 When selecting plant material to be introduced to the site, preference should be given to native species. In addition, consideration should be given to fire resistance.

7.4.4 BUILDINGS

- .1 All development including residences, accessory structures and landscaping/fencing should be located outside of the setback area.
- .2 Building height should be measured from the average finished ground level of the profile of the building facing the lake to the highest point of the roof. Maximum height shall be 2 storeys for residential and 3 storeys for commercial development.
- .3 Minimize the structure profile facing the water.
- .4 Select building materials that are natural or have a natural appearance that blends into the surroundings. Material selection should also consider combustibility as a wildfire precaution.
- .5 Avoid excessive shoreline structures that are visible from the lake to minimize visual clutter of the shoreland.
- .6 Locate accessory structures behind the main building and or existing vegetation to screen views of the structure from the water.

- .7 On steeply sloping sites (+20%), the proposed building shall step down the hillside.
- .8 Parking areas should not be visible from the lake.
- .9 To maintain a balance of natural and built form, the maximum cumulative width of shoreline structures, including all docks, storage sheds, decks and gazebos and boathouses should be no more than 25% of the lot's water frontage.
- .10 The height of shoreland buildings should be appropriate to the lake setting including background setting, slope, tree cover and buffer. High visual impact development will generally not be permitted.

7.4.5 PUBLIC ACCESS POLICIES

- .1 Development design shall consider all existing public land and water-based recreation activities such that new development will minimize the impact on existing activities.
- .2 Subdivisions shall be designed to incorporate public trails and walkways near the lake edge, but in a manner that will have a low environmental impact on riparian vegetation and the waterbody.
- .3 Public use of resort facilities, particularly recreational and docking facilities, is encouraged.
- .4 Shared docking/marina facilities, boat launches and common waterfront access areas shall be encouraged.
- .5 Non-waterfront residential subdivisions shall provide access to the water and opportunities for communal boat moorage.

7.4.6 HAZARD PROTECTION GUIDELINES

- .1 Proposed development within steep slope areas (i.e. greater than 20%), unstable soils, or similar hazards will require review by an appropriately qualified professional engineer experienced in geotechnical engineering. If the proposed development is feasible pending implementation of remedial measures recommended by the professional engineer, these measures will be required as a condition of development approval.

7.4.7 INFRASTRUCTURE POLICIES

- .1 All new development shall be served by appropriately designed, constructed and maintained stormwater systems.

7.4.8 INFRASTRUCTURE GUIDELINES

- .1 On-site holding tanks must be installed according to Resort Village of Candle Lake Bylaws and/or Saskatchewan Health Regulations.
- .2 Proper on-going maintenance of septic holding tanks is strongly encouraged.

7.4.9 WATER SYSTEMS

- .1 All new development must prove the availability of a sustainable potable water supply which meets the criteria set by the appropriate authorities.
- .2 Developments comprising two (2) or more parcels should be served by community water systems. These systems must be approved by the Saskatchewan Ministry of Environment.
- .3 The Saskatchewan Water Security Agency encourages fire flow compliance with the fire survey requirements of insurers.

7.4.10 STORMWATER MANAGEMENT SYSTEMS

- .1 Stormwater management plans are to be prepared for all new development to deal with the cumulative impacts of run-off. The stormwater plan will ensure run-off resulting from new development is minimized and retained on-site wherever possible.

7.4.11 LAND USE POLICIES

- .1 Development in lakeside areas will recognize the need to accommodate and co-exist with multiple use of lands surrounding lakes. Development plans shall be compatible with existing uses and make necessary provisions for buffering, fencing, screening, scale, open space, setback and other measures that can maximize compatibility with development.
- .2 Heritage sites shall be protected through the development process such that any historically significant buildings, structures, features or areas identified shall be preserved.

7.4.12 EDUCATION POLICIES

- .1 Citizen participation in retaining or improving lake resource values shall be encouraged individually or through the formation of a lake association(s).

7.5 Implementation

The Resort Village of Candle Lake has the authority to regulate lakeshore development. The Ministry of Government Relations will not approve lakeshore development that is not consistent with the Resort Village of Candle Lake Lakeshore Development Guidelines or the Official Community Plan.

7.5.1 CO-OPERATION WITH OTHER AGENCIES

Inherent in the lakeshore development process is extensive co-operation with other public agencies. Key examples of these agencies, and specific areas of required co-operation, are as follows:

- Saskatchewan Ministry of Government Relations
- Saskatchewan Ministry of Environment

- Saskatchewan Water Security Agency– water licensing; approval of foreshore works below the high water mark
- Fisheries and Oceans Canada –Fisheries Protection Program for works below the high water mark of a waterbody.

The Resort Village of Candle Lake will work with these and other agencies throughout the development process, including during rezoning, subdivision and building permit activities. These agencies will assist the Resort Village in implementing the various guidelines set out in the previous section.

7.5.2 EDUCATION

Education of property owners in lakeshore areas is critical so that development projects are properly designed, constructed and maintained. The Resort Village of Candle Lake should develop an environmental stewardship program to educate residents on the ecological values of lakes, streams and wetlands to encourage protection of these resources.

8.0 Recommendations

The Resort Village of Candle Lake is an outdoor mecca with numerous summer and winter recreational opportunities. At the heart of these recreational opportunities is Candle Lake itself. The following recommendations are provided to promote calculated and sustainable growth within the Resort Village:

Environmental Protection

- Consider developing or amending policy to address the District Goals outlined in Section 2 of the North Central Lake Lands District OCP as well as the Lakeshore Development Guidelines.
- Develop policies or guidelines regarding private moorage/marina construction and boat launches.
- Conduct a wetland inventory and classification of all wetlands within the Resort Village boundaries.
- Prepare a wetland plan for the Resort Village defining the values, objectives and goals for wetland conservation including specific management strategies regarding wetlands in the Resort Village boundaries.
- Consider a bylaw and/or awareness program to prevent/discourage the operation of ATV's or other motorized vehicles within waterbodies (i.e. Candle Lake, wetlands, streams, etc.).
- As a part of development approvals or maintenance activities, ensure tree and vegetation clearing is conducted during the period of September 1st to April 15th to avoid impacting nesting birds and to maintain compliance with the federal Migratory Birds Convention Act.
- Develop a long-term water quality monitoring program on Candle Lake and its tributaries to determine if water quality is in fact being degraded over time.
- Further work on the presence of caffeine in the lake is recommended to determine if wastewater is entering the lake system.

Lake Carrying Capacity

- Conduct additional research to calculate a Candle Lake-specific recreational carrying capacity including:
 - Conducting a Candle Lake user survey. Engage Candle Lake residents, recreational users, seasonal property owners, etc. in a survey to gather the values/perceptions of the users of Candle Lake. This will provide important values-based information to the concept of carrying capacity.
 - Conducting a watercraft census in order to learn about the peak level of recreational use, the types of use, and the mix of public and private access and moorage. This should be conducted at various times during the boating season. The number of boats on the lake should be counted, the type of boat and the boat's approximate speed (stationary, wake, no wake or wake-producing speed). A census at several points in time will provide the most accurate picture of actual usage.

Infrastructure

- Require septic haulers to keep detailed records of the homes, cabins, parks, and businesses they service, the amount of wastewater they collect from each customer, and the volume of wastewater that they release into the lagoons. These records would ideally be submitted at least monthly so that the Village can gain a better perspective of the severity of the seasonal loading on the lagoon. This information can be used to accurately assess the available capacity in the lagoon, as well as provide information that can be used to help optimize the time and duration of treated effluent release events.
- Consider charging user fees for the septic haulers to access the lagoons. The requirement for such user fees could be included in an overall taxation review study that would be intended to help the Resort Village set aside sufficient funds to construct, operate, and maintain Village infrastructure with reduced reliance on the availability of government funding programs.
- Conduct traffic count studies within the Village to more accurately assess road usage. This work would be most beneficial on peak usage periods (i.e. long weekends during the summer months).

Fire/Wildfire Considerations

- Consider undertaking a Fire Capacity, Preparedness, and Response Review to assess the community's ability to provide municipal fire protection services. The study could also include an assessment of the available forest-fire fighting provisions and any upgrades that may be required to the system to meet the guidelines of the Water Security Agency and the needs of the community.

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APPENDIX A

Lake Classifications

APPENDIX C – LAKE CLASSIFICATION METHODOLOGY

The TNRD Lakes Classification System is based upon the TNRD Lake Study Policy Statement prepared in 1991. The following section is extracted directly from the 1991 Lake Study Policy Statement and outlines the methodology used to determine the Lake Classification System.

METHODOLOGY for 1991 Lakes Classification System

Design of Original Study

The concept of the original Lake Study was developed in the mid-1970s, the result of the perceived need for direction in management of lakeside development to maintain a diversity of lakes for recreation, settlement and commercial use.

The Lake Study began in mid May of 1978 with a meeting of the Lake Study Steering Committee. This committee had representatives from various agencies, including B.C. Fish and Wildlife Branch, B.C. Forest Service Recreation Division, B.C. Pollution Control Branch, B.C. Lands Management Branch, South Central Health Unit and Fisheries and Oceans Canada. At the first meeting it was decided that an inventory of the information available be assembled as a preliminary step to the study. The previously mentioned agencies were consulted as well as the B.C. Water Rights Branch, B.C. Parks Branch and Ducks Unlimited (Canada).

Under consideration were 220 lakes selected by the Planning Department of the Thompson-Nicola Regional District. These were generally lakes over 16 hectares in area, but the list included some smaller lakes and excluded some larger lakes. The initial inventory was conducted with the intent of choosing several lakes for which there was good information available for more detailed study. Information was gathered on land status, Canada Land Inventory ratings and biophysical characteristics of the basic list of lakes. This process revealed that much information was available on a number of lakes within the Regional District. Lake studies from other areas of the Province were also reviewed.

Initially, the study was to be directed at only a few lakes to provide a baseline against which the merits of development proposals might be measured. This approach was abandoned in June 1978 in favour of two new studies - a Lake User questionnaire and a Lake Classification system - which appeared to have more practical application.

The Lake User Survey was the first priority due to the time required for calculations and interpretations. The survey consisted of four segments; the Public Lake User Survey, the Cottage Owner Survey, the Resort Owner Survey and Resort Patron Survey. The Public Lake User Survey was undertaken first, on Canada Day, July 1, and work on all segments proceeded through 1978.

Also in 1978, data gathering, interpretations and discussions resulted in the formulation of a preliminary Lake Classification System. The lake classification process was refined during the summer. In September the Lake Classification System was presented and discussed at a combined meeting of the Steering Committee and the Technical Planning Committee. At a second meeting the classification of specific lakes commenced. Steering Committee members and various agencies were invited to send in their submissions on the classification of various lakes.

Original Criteria Used

In designating General Use and Development Lakes, criteria for water quality and suitability for development were derived primarily from Proposed Guidelines for Control of Development of Lakeshore Property (Ableson, 1978), from the Ontario Lake Planning Guidelines (Ontario, 1977), and from personal communications with B.C. Fish and Wildlife staff. The standards from Ableson have their origins in the worldwide lake eutrophication studies which took place as part of the International Biological Program. These studies indicated that the sensitivity of a lake to eutrophication is dependent upon its level of productivity. Mean summer chlorophyll *a* content is the most accurate measure of the productivity of a lake, which in turn reflects the nutrient content of the lake. This approach was particularly useful in selecting an initial listing of Critical Lakes - those which are in advanced stages of eutrophication. This listing has been considerably expanded as a result of sampling information provided by Environmental Protection Branch of B.C. Ministry of Environment, Lands and Parks.

The use of Canada Land Inventory (C.L.I.) Capabilities in the study is modelled after the Red Deer Regional Planning Commission's Regional Lake Perspective (RDRPC, 1976). Sport fish capability was not available for the Thompson-Nicola Regional District so the recommendations of the Lake Development and Access section of the Fisheries Management Plan, (Cartwright, 1978) were used. Ducks Unlimited (Canada) has made more detailed surveys of some areas for Waterfowl Capability, so their capability ratings were also utilized. Because C.L.I. ratings tend to be generalized over extensive areas there has been frequent consultation with B.C. Fish and Wildlife Branch for more local, refined information in the interior. The classification system

attempts to avoid placing recreational subdivisions on lakes with high (i.e. 1, 2 or 3) C.L.I. ratings for ungulates or waterfowl. Where it is judged that extensive development may degrade a sport fishery there are similar restrictions.

Carrying capacity standards (allowable percentage perimeter development and hectares per user unit) have been influenced by those of Ableson (1978) and those which have been adopted by the Okanagan-Similkameen Regional District. However, these have been modified as a result of data compiled in the Lake Study and the Lake User Survey.

The allowable hectares (acres) of water surface per user unit ratio is used specifically as a measure against lake surface crowding and to help maintain a quality recreational experience for the lake surface users. The need for such a ratio has been demonstrated by the results of the Lake User Survey, which showed that a high percentage of interfering activities was perceived by lake users. For these reasons a "user unit" has been established as a flexible guideline for each classification of lake.

Each use, (each cottage lot whether vacant or developed, campsite, picnic site, Forestry Service recreation site, Special Use Permit, fishing camp cabin or fishing camp campsite) within one-half kilometre of the lake is assigned a "user unit" value of one. (Where the number of campsites or picnic sites is difficult to determine, such as in Forest Service recreation sites, the number of parking spaces or the average level of summer use shall be used.) The surface area of the lake is then divided by the number of "user units" to determine the "user unit ratio" (see Ableson, 1978, for details of calculations).

The allowable percentage perimeter development standard is intended to ensure a relatively natural visual landscape for lake users. It has been assumed from the results of the Lake User Survey that lake users highly value the natural surroundings as a major element of the lake's environment. At the public hearings held in early 1977, the desire to leave a moderate to large (50-80%) portion of the lakeshore in its natural state was commonly expressed. A survey conducted at four lakes (Tunkwa, Leighton, Stake and McConnell) within the Regional District by the Recreation Section of B.C. Forest Service (Lake User Study, 1978) revealed that the natural landscape of the lakes and their surroundings was the second major attraction (next to fishing) of those interviewed. The use of the allowable percentage perimeter development standard will serve to accommodate public access, ensure that lakes will never reach the state of having the total shoreline under intensive development, and reinforce the safeguards for the lake ecosystem noted by Ableson.

The following criteria are used in measuring shoreline or perimeter development: all private and Crown lease lots and Special Use permits to 8 hectares in size are measured by actual lake frontage or 90 metres per lot (whichever is less); commercial, industrial, parks, campsites and Forest Service recreation sites are measured by actual lake frontage; and lots greater than 8 hectares, vacant Crown land and land held under grazing lease, licence or permit are not counted as development. Both the "user unit ratio" and the "percentage perimeter development" should be used in determining whether or not additional development may be permitted on a lake.

Results of the Lake User questionnaire pointed out a wish for a conservative approach to setting limits on shoreline development. Lake users had an underlying wish to retain, insofar as possible, the appearance of a natural shoreline environment. The recommendation of a 100 metre buffer zone in which no logging may occur was derived following an examination of a number of other studies. The Red Deer Regional Lake Perspective (1976) calls for a 1.6 kilometre buffer zone. The Lake User questionnaire showed a concern by lake users about the effect of possible logging upon viewing areas. Initially, it was judged that a minimum buffer zone of 100 metres would ensure that a relatively natural visual landscape would remain after logging.

Requiring a minimum buffer zone of 100 metres ensures a relatively natural visual landscape for lake users. The 100 metre buffer zone, within which no logging is recommended, would also help safeguard the lake against the effects of erosion, fluctuation in water levels, pollution with wood debris, nutrient loading, and siltation of eggs or the micro-organisms which support rearing fish. The buffer zone will also maintain nesting hole sites for tree or snag nesting ducks and other birds, and provide a shelterbelt for wintering ungulates.

Current Update

There is now (1991) no rigid policy on logging in the vicinity of lakes, rather this is decided, within each Timber Supply Area, on a lake-by-lake basis by a consultative committee representing a broad range of agency and public interests. For those lakes which have not been classified for Visual Quality Objectives (see Ministry of Forests "Lakeshore Harvesting Guidelines", 1991), a 200 metre flexible "leave strip" buffer zone around lakes has been informally agreed upon until appropriate classifications have been collectively determined in order to preserve values associated with unclassified lakes and their riparian zone.

For the relatively few lakes which have been classified for Visual Quality Objectives, more appropriate lakeshore logging guidelines are recognized. This system has allowed for placement of several lakes in the Wilderness Lakes category.

In addition to those lakes recognized as water storage sites and classed as Special Case Lakes in the 1984 study, three new sources have expanded that listing. Ducks Unlimited has provided a listing of those lakes which support waterfowl enhancement projects. Parks Branch of the Ministry of Environment, Lands and Parks has identified the lakes which are foreseen to have an exceptionally high recreation demand as a result of completion of the Coquihalla Highway. The Archaeology Branch of the Ministry of Tourism and Minister Responsible for Culture has provided access to mapping of lakes with known native cultural sites.

Unfortunately, the Lake Classification Committee has been inoperative since 1984, so no further formal classifications have been made in the General Use and Development lakes categories. However, recommendations pertaining to subdivision development have been obtained from agencies on request.

The overall approach in the 1991 update relied on the following information gathering processes:

- Regional District staff interview for operational level feedback;
- discussion with major government and non-government agencies;
- an inter-agency ad hoc meeting to share information;
- request to twenty-three regional districts concerning other related policy statements, nine of which responded that they had developed some form of policy guidelines;
- a press release and media interviews resulted in some public input; letters and other materials submitted were reviewed.

A special emphasis was placed on lakes opened up for easier access by the Coquihalla Highways.

A special technical review was undertaken by sub-consultant Ira Withler (biologist and zoologist), and a recreational use overview was carried out by sub-consultant Debbie Clarke of Forecon Consulting. Particular emphasis was placed on lake carrying capacities.



Neither budget nor timeframe was available for public hearings or for questionnaires. However, this does not preclude the need for special hearings on particular lake shoreland development proposals which may arise from time to time.