

LAC LA BICHE

Watershed Management Plan

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Executive Summary

Lac La Biche County has partnered with Alberta Environment and other stakeholders to develop and implement a watershed management plan for the Lac La Biche watershed. This plan strives to balance environmental, community and economic issues with government legislation for the protection and management of water resources.

The Lac La Biche Watershed Management Plan (WMP) will aid Alberta Environment make water resource decisions in the Lac La Biche planning area under the *Water Act* and the *Environmental Protection and Enhancement Act*. The plan will also assist the municipality as well as neighboring municipalities and resource managers to make informed water management and land use decisions as well as provide information to the public. The WMP addresses sustainability of Lac La Biche Lake in terms of water quality, shoreline development, sedimentation and groundwater. The plan also addresses guidelines and a total overall plan for: economic development, fisheries management, community health, agricultural management, commercial endeavors and industrial development.

A Watershed Advisory Committee (WAC) has been created to oversee the development and implementation of the Lac La Biche WMP. The objectives of the WAC include the (a) development and approval of Lac La Biche WMP to augment existing land use, area structure and municipal development plans, (b) sewage, stormwater and other wastewater (e.g. industrial effluents) management options to reduce the impact on the watershed, (c) encourage low-impact alternatives for new subdivision and cottage developments to reduce potential impacts on the watershed, (d) achieve effective stewardship and management of agricultural lands including riparian areas within agricultural lands, to contribute to improved water quality and watershed health, (e) improve watershed health by restoring altered or drained natural wetlands and protecting existing wetlands, and (f) manage all other land uses, including industrial development, recreational areas and golf courses, to minimize the impacts to Lac La Biche watershed. These issues are discussed in detail within the plan including recommendations on their resolution.

The WMP addresses issues pertaining to water quality (primarily elevated concentrations of total phosphorus, total nitrogen, and bacteria), water quantity, riparian areas and wetlands, and wildlife. For each of these issues, the plan provides short-term and long-term recommendations as well as a barometer for the successful implementation of these recommendations, i.e., a performance measure.

Lac La Biche County will review planning documents and the Land Use Bylaw and incorporate the recommendations within the WMP. The plan includes specific public outreach, activities, newsletters, initiatives and education programs which are essential to the success of the plan.

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1.0 Introduction

Lac La Biche is the 7th largest lake in Alberta, with a surface area of about 234 km² (Mitchell and Prepas, 1990). It is located about 220 kilometers northeast of Edmonton, AB (Figure 1) and is a provincial tourist destination and a recognized biologically-significant area for bird life. Lac La Biche has a natural outlet into the La Biche River and is part of the Athabasca River watershed, which joins with the Peace River and flows to the Arctic Ocean via the Mackenzie River system.

The lake is divided into an east and west basin. Sir Winston Churchill Provincial Park is located on Big Island and is connected to the south shore of the east basin by a causeway. The lake has a history of water management concerns, mainly related to urban, industrial, agricultural and recreational development, as well as periodic flooding of lands in low-lying areas. Lac La Biche is a source of water for agriculture, forestry, oil and gas, commercial fishing, recreation/tourism and domestic and municipal users.

Sewage management, protecting the drinking water source and human development issues within the Lac La Biche watershed have made watershed management planning a priority for Lac La Biche County (formally known as Lakeland County and the Town of Lac La Biche). The County has partnered with Alberta Environment and several other stakeholders to develop and implement a watershed management plan for the Lac La Biche Watershed. This plan strives to balance environmental, community and economic issues with government legislation for the protection and management of water resources. Alberta Environment has regulatory responsibility for allocating water and protecting the aquatic environment (under the *Water Act*) and for controlling wastewater releases into the environment (under the *Environmental Protection and Enhancement Act*). The department is also responsible for approving the Terms of Reference for watershed management plans, as outlined in the *Framework for Water Management Planning*. The Terms of Reference was sent to Alberta Environment on February 06, 2007, and approved on February 12, 2007.

A Watershed Advisory Committee (WAC) has been created to oversee the Watershed Management Plan. The WAC is composed of representatives from Lac La Biche County Council, Lac La Biche County, County of Athabasca No. 12, Aspen Regional Health Authority, Sustainable Resource Development (Public Lands; Fish and Wildlife), Alberta Environment, Community Development Parks and Protected Areas, First Nations, Industry (Alberta-Pacific Forest Industries Inc.), Non-Government Agencies (Ducks Unlimited Canada and the Alberta Conservation Association) and public members from the County. Other stakeholders in the watershed include: commercial fishermen, sport fishermen, recreational cottagers, agriculture, tourism operators, private landowners, leaseholders (Crown land) and the petroleum and natural gas industry.

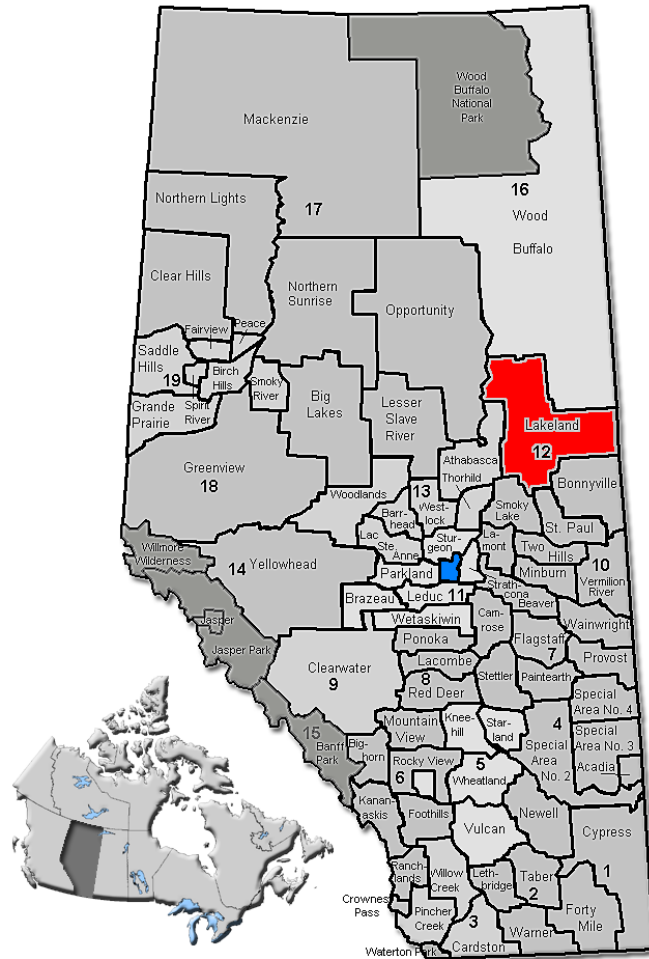


Figure 1. Location of Lac La Biche County (red). City of Edmonton is shown in blue (map adapted from http://en.wikipedia.org/wiki/Lakeland_County,_Alberta).

1.1 Objectives of the Lac La Biche Watershed Advisory Committee

The Watershed Advisory Committee generated the following objectives:

- Develop, obtain approval for and implement the Lac La Biche Watershed Management Plan, which should augment existing Land Use, Area Structure and Municipal Development Plans.
- Encourage implementation of sewage, stormwater and other wastewater (e.g. industrial effluents) best management practices (BMPs) to improve watershed health within the Lac La Biche watershed.
- Encourage implementation of low-impact alternatives for new subdivision and cottage developments to reduce potential impacts on the watershed.

- Encourage effective stewardship and management of agricultural lands including riparian areas within agricultural lands, to contribute to improved water quality and watershed health. This may be facilitated by establishing partnerships with Cows and Fish, the Alberta Conservation Association and other riparian stewardship groups.
- Collaborate with local landowners and watershed residents to improve watershed health by restoring altered or drained natural wetlands and protecting existing wetlands.
- Manage all other land uses, including industrial development, recreational areas and golf courses, to minimize the impacts to Lac La Biche watershed.
- Increase public awareness and engagement of land stewardship by knowledge and information exchange on the impacts of land use/development practices on water quality and habitat.

1.2 Scope of the Watershed Management Plan

The planning area is outlined in Figure 2. The plan addresses the issues and concerns identified in the Terms of Reference, such as water quality and riparian health, sewage management, human development issues and wildlife conservation and protection.

1.3 Goals and Objectives of the Watershed Management Plan

The Lac La Biche Watershed Management Plan will help Alberta Environment make water resource decisions in the Lac La Biche planning area under the *Water Act* and the *Environmental Protection and Enhancement Act*. The resulting plan will also assist Lac la Biche County, the County of Athabasca and other resource managers to make informed water management and land use decisions, and it will provide information to the public. The *Framework for Water Management Planning* is used to guide the plan. Water management issues in the watershed were identified through a consultative process.

The Watershed Management Plan addresses the sustainability¹ of the lake in terms of water quality, shoreline development, sedimentation and groundwater. Additionally, the guidelines and total overall plan for: economic development, fisheries management, community health, agricultural management, commercial endeavors and industrial development are also addressed by this plan.

¹ Sustainability implies capability to be maintained indefinitely; integrates the environment, the economy and the social system to be maintained perpetually in a healthy state.

1.4 Authority

Human activities that affect the health of any watershed in Alberta are governed by a variety of Acts and Regulations (Table 1). The authority of these Acts and Regulations, when properly implemented and enforced, will support the Lac La Biche Watershed Management Plan goals.

Table 1. Legislation and policy involving water and watershed management in Alberta.

Legislation/policy	Description
Federal <i>Fisheries Act</i> - Department of Fisheries and Oceans Canada (DFO)	Regulates and enforces on harmful alteration, disruption and destruction of fish habitat in Section 35.
Provincial <i>Water Act</i> – Alberta Environment (AENV)	Governs the diversion, allocation and use of water. Regulates and enforces actions that affect water and water use management, the aquatic environment, fish habitat protection practices, in-stream construction practices, storm water management.
Provincial <i>Environmental Protection and Enhancement Act (EPEA)</i> – AENV	Management of contaminated sites, storage tanks, landfill management practices, hazardous waste management practices and enforcement.
Provincial <i>Agricultural Operations Practices Act (AOPA)</i> – Natural Resources Conservation Board (NRCB)	Regulates and enforces on confined feedlot operation and environment standards for livestock operations.
Provincial <i>Municipal Government Act (MGA)</i> – Municipal Affairs	Provides municipalities with authorities to regulate water on municipal lands, management of private land to control non-point sources, and authority to ensure that land use practices are compatible with the protection of aquatic environment.
Provincial <i>Public Lands Act</i> - Sustainable Resource Development (SRD)	Regulates and enforces on activities that affect Crown-owned beds and shores of water bodies and some Crown-owned uplands that may affect nearby water bodies.
Provincial <i>Safety Codes Act</i> - Municipal Affairs	Regulates and enforces septic system management practices, including installation of septic field and other subsurface disposal systems.
<i>Regional Health Authorities Act</i> – Alberta Health	RHA have the mandate to promote and protect the health of the population in the region and may respond to concerns that may adversely affect surface and groundwater.
<i>Wildlife Act</i> - SRD	Regulates and enforces on protection of wetland-dependent and wetland-associated wildlife, and endangered species (including plants).
Provincial <i>Parks Act & Wilderness Areas, Ecological Reserve and Natural Areas Act</i> – SRD and Community Development	Both Acts can be used to minimize the harmful effects of land use activities on water quality and aquatic resources in and adjacent to parks and other protected areas.
Federal <i>Navigable Waters Protection Act</i> - DFO	Protects the public's right of navigation in Canadian waters, by prohibiting the building, placing or maintaining of any work whatsoever in, on, over, under, through or across any such navigable water, without the authorization of the Minister of Fisheries and Ocean Canada
Provincial Wetlands Policy (expected 2009)	This policy will be used to protect wetlands and mitigate losses through a No-Net-Loss policy.

Land Use Bylaws (Municipal)	The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map.
Area Structure Plans (Municipal)	Adopted by Council as a bylaw pursuant to the Municipal Government Act that provides a framework for future subdivisions, development, and other land use practices of an area, usually surrounding a lake.
Municipal Development Plans	The plan adopted by Council as a municipal development plan pursuant to the Municipal Government Act.

Municipal development plans, area structure plans and other planning documents in the Lac La Biche watershed:

- *Lac La Biche County Municipal Development Plan*
- *Lac La Biche County Land Use Bylaws*
- *Lac La Biche Area Structure Plan*
- *Lac La Biche West Area Structure Plan*
- *Village of Plamondon General Municipal Plan-1992*
- *Village of Plamondon Landuse Bylaw #92-151*
- *Lakeview Estates Area Structure Plan (1996)*
- *Former Town of Lac La Biche Land Use Bylaw (1999)*
- *Birkhill Subdivision Area Structure Plan (2003)*
- *Riparian Setback Matrix Model (2007)*
- *Red Deer Brook Area Structure Plan (2008)*

1.5 Public Consultation

Regular communications are integral to the successful planning and creation of a publicly-valued watershed management plan that is of benefit and value to the affected stakeholders and the public. The communication strategy is designed to convey timely and accurate information to the public and to facilitate identification of community issues and concerns. The WMP is committed to the principles of open and visible communication and access to relevant information that fosters trust, credibility and integrity.

Information was disseminated to the public through fact sheets, workshops, displays, feature stories, mail outs, newsletters, news releases, ads and presentations to groups, and the public's ideas, issues and concerns were solicited through workshops, review of planning documents at open houses or public meetings, and via the county website.

1.6 Linkages with Regional Strategies

Regional strategies provide direction for natural resource and environmental management over large areas of the province. Development of a regional strategy (such as an Integrated Watershed Management Plan for the Lower Athabasca basin) in the area affected by this plan is not expected for several years. The nearest regional strategy is the Lakeland Sub-Regional Integrated Resource Plan to the south. The Lac La Biche Watershed Management Plan is an initiative that addresses specific water management issues with respect to the Lac La Biche Watershed. This plan will be considered in the development of a regional strategy, and it will be reviewed once such a regional strategy is complete, to ensure consistency between both plans.

1.7 Existing Licenses and Commitments

Licenses have been issued for surface water withdrawal from the Lac La Biche Watershed. Licensed water uses include: agricultural including irrigation, industrial including cooling, oilfield injection, wood processing, aggregate washing, residential and municipal water supply. Under the plan, existing licenses for water withdrawal will be respected. This means that water conservation objectives will not be imposed on any existing licenses, unless there is a provision to do so or the licensee agrees to do so. A significant adverse impact on the aquatic environment (*Water Act*, S.55(2)) may be a specific reason where a WCO may be applied to an existing license. Alternatively, incentives may be developed to encourage existing users to reduce their current water use.

1.8 Timeline and Schedule for Review

Table 2. Development and implementation of the Lac La Biche Water Management Plan.

Plan formulation	
1. Draft the watershed management plan.	April - June 2008
2. Public review and First Nations consultation of draft watershed management plan.	June - December 2008
3. Finalization of watershed management plan and submission to Alberta Environment for Approval	May 2009
Implementation, evaluation and monitoring	
1. Plan Implementation, monitoring and 5-year incremental plan review.	2010

2.0 Planning Area

The planning area is located within Lac La Biche County and the County of Athabasca No. 12 and includes the Hamlet of Lac La Biche. The area includes the entire Lac La Biche watershed, including

the Owl River subwatershed (Figure 1). Together, they cover about 4,330 square kilometers (km^2): the Owl River, with a drainage area of about 3,080 km^2 and the immediate drainage basin of the lake with about 1,250 km^2 .

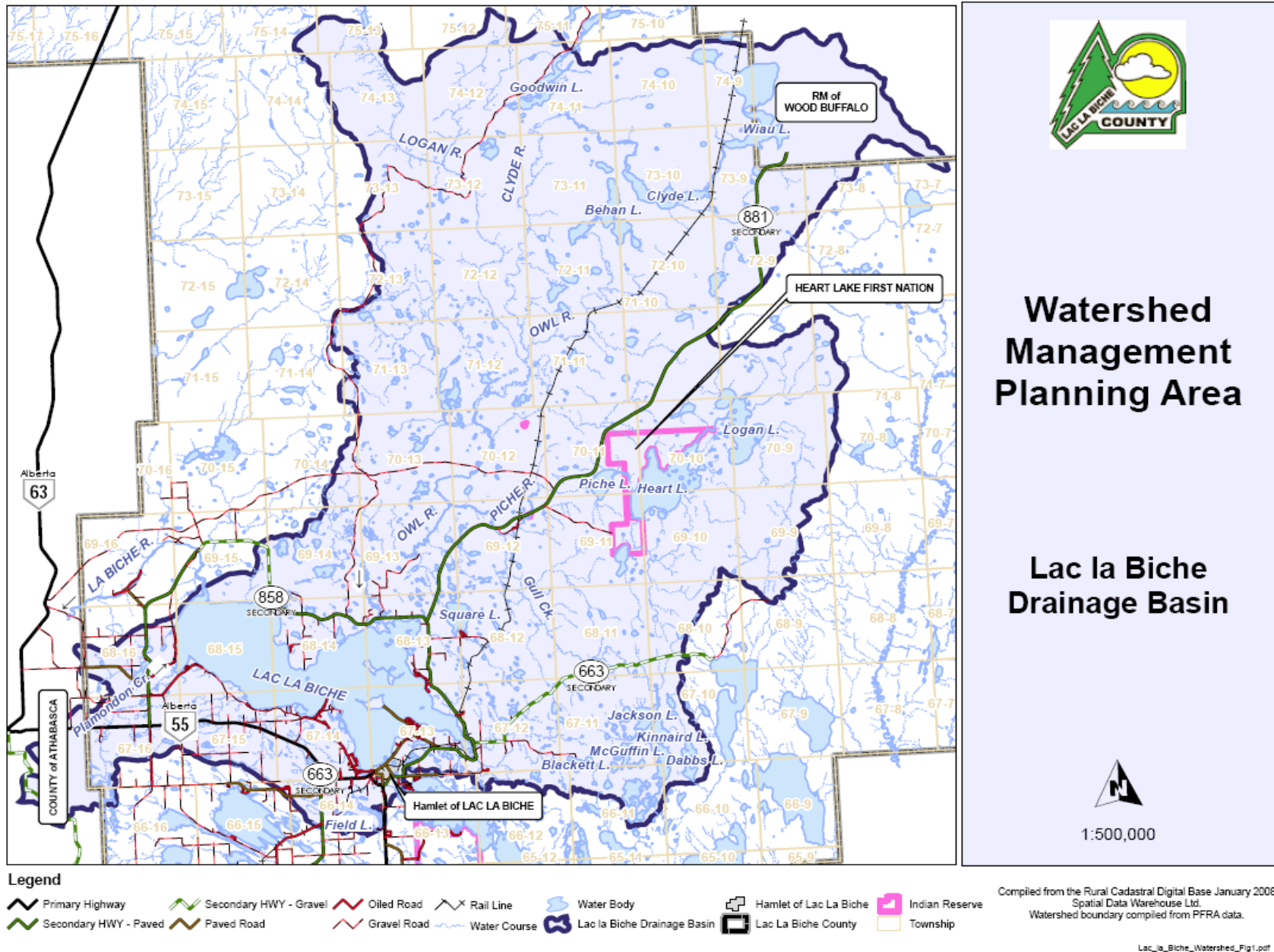


Figure 2. The Lac La Biche watershed planning area.

3.0 Watershed Management Plan Implementation and Accountability

This management plan will not succeed until its recommendations are implemented, and it will not be effective unless the tasks identified are performed and an accountability process is established and adhered to. For the purposes of this plan, “Short-Term Recommendations” will be completed within three years of implementation, while “Long-Term Recommendations” will likely take more than three years to complete. Improved coordination and partnership with provincial and municipal government departments will be realized through the implementation of this plan. Councils, planners and administration from Lac La Biche County and the provincial government must publicly endorse, support and enforce this plan in order to ensure its success.

Short-Term Recommendations

- As a Watershed Stewardship Group partner under the Provincial Water Strategy, the Lac La Biche Watershed Advisory Committee should register as a non-profit society for additional funding opportunities.
- Develop and implement partnership agreement(s) with provincial, federal and local government agencies and conservation groups to assist with the implementation of the Lac La Biche Watershed Plan.
- Maintain ongoing communication and collaboration with non-profit environmental groups, community groups, landowners and agriculture producers to address the issues identified in the plan.
- Finalize an annual action plan budget by November of each year.

Long-Term Recommendations

- The Lac La Biche Watershed Advisory Committee should provide an annual progress report on implementation of the Watershed Management Plan, to the local governments, the public, all stakeholders and Alberta Environment.
- A comprehensive review of the plan should be conducted at minimum intervals of five years or as is otherwise deemed appropriate or necessary.
- The Lac La Biche Watershed Advisory Committee should participate in any future watershed management planning that may be proposed for the Lac la Biche Watershed under the Provincial Water Strategy.

Performance Measures

- The Lac La Biche Watershed Advisory Committee is registered as a non-profit society.
- Annual progress reports are completed and presented to the respective municipal governments, stakeholders and Alberta Environment.
- Minimum of one public open house is held per year to keep the public aware and involved with the WAC’s activities.
- Partnerships and collaboration with other resource agencies.

- Number of completed reviews and revisions of the plan.
- Lac La Biche Watershed Advisory Committee representation on a future Lac La Biche Water Planning and Advisory Council.

4.0 Watershed Issues and Their Resolution

4.1 Water Quality

Water quality in Lac La Biche and the surrounding watershed has been monitored periodically since 1965 and continuously from 2001-2007. Primary parameters of concern for humans and livestock are total phosphorus (TP), total nitrogen (TN) and bacteria. A map showing the locations of the Lac la Biche inflows can be found in Appendix A.

TP (often the most limiting nutrient in aquatic ecosystems) along with TN are essential macro-nutrients in aquatic ecosystems. Excessive quantities of TN and TP can cause eutrophication, which is characterized by excessive growth of algae and plants in response to the high nutrient levels. The overabundance of plant matter can cause oxygen depletion in the water column when this organic matter decays. Decreased levels of oxygen can result in suffocation of fish and other aquatic organisms. Algal blooms may include toxin-producing blue-green algae (i.e., *Microcystis* spp.). The input of nutrients into aquatic systems can occur naturally, but large amounts of nutrients typically originate from human sources, including sewage wastes, urban run-off carrying residential use fertilizers and agricultural operations.

Fecal coliform bacteria are of concern, particular from a human health perspective. Fecal coliforms include the genera that originate from human feces, such as *Escherichia*, as well as genera that are not of fecal origin, such as *Enterobacter* spp., *Klebsiella* spp. and *Citrobacter* spp. When levels are elevated, there may be an elevated risk of waterborne gastroenteritis. The presence of these bacteria in aquatic environments may indicate that the water has been contaminated with the fecal material of humans or animals, e.g., cattle, sheep, etc. (Health Canada, 2006). Fecal coliform bacteria can enter aquatic systems through direct discharge of waste from mammals and birds, from agricultural and storm runoff and from untreated human sewage. CCME Guidelines for Recreation and Esthetics are 1,000 CFU/100 mL fecal coliforms and 200 CFU/100 mL *E. coli*; for Irrigation Water they are 1,000 CFU/100 mL fecal coliforms and 100 CFU/100 mL *E. coli* (CFU = colony forming units).

4.1.1 Lac La Biche

TP concentrations in the west and east basins of Lac La Biche have ranged from 31-256 µg/L and have been similar in both basins over the past 20 years (mean annual concentrations of

100-105 µg/L) (Rawles, 2007). Based on these TP concentrations, Lac La Biche is considered eutrophic, or highly productive. Rising concentrations of TP in the surface water throughout the spring and summer suggest that TP is released from the bottom sediments and is then mixed into the surface water. The TP loading to Lac La Biche from sources external to the lake was estimated to be 37,866 kg/year, or 0.16 g/m² of the lake surface (Alberta Environment, 1984).

TN concentrations ranged from 560-1,800 µg/L and have been similar in both basins over the past 20 years (mean annual concentrations of 903-937 µg/L); however, mean lake TN concentrations have increased over the past two decades, averaging 832 µg/L in the 1980s and 1,143 µg/L in the 2000s (a 37% increase) (Rawles, 2007). The cause of increasing TN concentrations in the lake remains unknown, although it is known that phytoplankton and bacteria contribute to the amount of dissolved inorganic nitrogen content in the water column, and decomposition of aquatic organisms adds both dissolved organic and particulate organic nitrogen to water; while sewage runoff, erosion, and watershed disturbances can increase particulate inorganic nitrogen levels in water. There is no nitrogen budget for Lac La Biche.

Data on bacterial concentrations at various locations in the Lac La Biche watershed have been collected since 2003. These data address concentrations of total coliform bacteria and more specifically *Escherichia coli* Escherich, which is a fecal coliform bacterium. In the west basin, both total coliform and *E. coli* concentrations have exceeded CCME Recreation and Esthetics Guidelines and Irrigation Water Guidelines (CCME, 2007) at various locations on several occasions (e.g., Plamondon White Sands, Mission Beach and Bayview Beach). These concentrations frequently approached or exceeded 1,000 CFU/100 mL (Rawles, 2007). Similarly, in the east basin, total coliform and *E. coli* concentrations have also exceeded CCME Recreation and Esthetics and Irrigation Water Guidelines at various locations on several occasions (e.g., McArthur Park, Golden Sands and Red Deer Brook). Here, concentrations ranged from 600-1,000 CFU/100 mL (Rawles, 2007).

4.1.2 Owl River

Owl River is a tributary of Lac La Biche that flows through the community of Owl River prior to entering the lake at the north shore of the east basin. TP concentrations in this tributary have been among the lowest of any of the tributaries flowing into Lac La Biche (Big Bay 2, Inflows 1, 8 and 16). Mean annual concentrations have ranged from 144 µg/L in 2004 to 297 µg/L in 2003, for a mean concentration from 2003-2006 of 190 µg/L (Rawles, 2007). This is considerably higher than the mean concentration of TP in Lac La Biche (100-105 µg/L).

TN concentrations ranged from 798-2,630 µg/L throughout the year and averaged 1,231 µg/L from 2003-2006. Generally, TN concentrations in Owl River are lower than those of the other inflows into the east basin of Lac La Biche (Big Bay 2, Inflows 1, 8 and 16) (Rawles, 2007). TN concentrations generally remain constant or show small increases from May-October but can vary considerably among years.

Neither fecal coliform nor *E. coli* concentrations exceeded CCME Recreation and Esthetics Water Guidelines or the Irrigation Water Guidelines from 2003-2006. Concentrations were always below 100 CFU/100 mL and often as low as 10 CFU/100 mL from May-September. These concentrations were intermediate compared to bacterial concentrations of the other inflows into the east basin of Lac La Biche (McArthur Park, Red Deer Brook and Golden Sands) (Rawles, 2007).

4.1.3 Red Deer Brook

Red Deer Brook is a stream that flows from Field Lake through a wetland complex into Lac La Biche on the south shore of the east basin. Since 1983, treated effluent from the Hamlet of Lac La Biche has been discharged into Field Lake.

TP concentrations in Red Deer Brook ranged from 214-3,171 µg/L and averaged 1,010 µg/L from 2003-2006 (Rawles, 2007). Compared to the other inflows into the east basin of Lac La Biche (golf course 3a, legion inflow 3d, inflows 5 and 6), Red Deer Brook has among the highest concentrations of TN, on occasion spiking over 2,500 µg/L. These elevated concentrations may be linked to the release of treated wastewater into Field Lake, which is the source for Red Deer Brook. There is considerable interannual variation in TP concentrations in this water body.

TN concentrations in Red Deer Brook were generally similar to those of other inflows into the east basin of Lac la Biche, ranging from 1,641-5,750 µg/L and averaging 2,831 µg/L; however, they are substantially higher than those in Owl River and Lac La Biche (1,231 µg/L and 903-937 µg/L, respectively).

Fecal coliform and *E. coli* concentrations were below CCME Recreation and Esthetics Water Guidelines and the Irrigation Water Guidelines in 2003 but occasionally exceeded the CCME Irrigation Water Guidelines thereafter, and particularly in 2006, when *E. coli* and fecal coliform concentrations frequently exceeded 500 CFU/100 mL (Rawles, 2007). These concentrations are similar to those found in the east and west basins of Lac La Biche, but they are substantially higher than those found in Owl River (Rawles, 2007).

Short-Term Recommendations

- Continue the water quality monitoring program for Lac La Biche and its major inflows, particularly for TP, TN, and coliform bacteria.
- Develop water quality indicators. Water quality improvement will be seen over time as riparian restoration efforts are implemented.
- Ensure the Riparian Setback Matrix Model is used and enforced for all new developments.
- Identify point-source and non-point sources of pollution and remediate them.
- Complete a nutrient loadings study on the Owl River and Red Deer Brook.
- Education and awareness programs and incentives aimed at encouraging people to maintain and/or upgrade their septic systems (those that still use a septic system).

Long-Term Recommendations

- Monitor concentrations of TP, TN, and fecal bacteria in the inflow from the wastewater treatment facility into Field Lake and reduce nutrient and bacterial concentrations to minimize impacts on receiving waters. Revise the monitoring program based on long-term results.
- Develop nitrogen budgets for Lac La Biche and all major inflows and tributaries.

Performance Measures

- Annual surface quality testing and reporting to measure parameters such as nutrients, bacteria and other parameters of interest to water quality.
- Decreases in the concentrations of total fecal bacteria and *E. coli* below CCME Recreation and Esthetics and/or Irrigation Water Guidelines.
- Reduced nutrient loading.
- Development of water quality indicators.

Enabling Legislation and Policy

- *Water Act*;
- *Environmental Protection and Enhancement Act*;
- *Safety Codes Act*; and
- *Regional Health Authorities Act*.

4.2 Water Quantity

The Lac La Biche water level was recorded sporadically in 1930, 1931 and 1932, and has been monitored regularly since 1933 (Figure 3). Water levels have fluctuated considerably, ranging from a minimum water level of 542.62 m a.s.l. (above sea level) in 1992 to a maximum of 545.0 m a.s.l. in 1960. The mean water level from 1930-2006 was 543.32 m a.s.l.

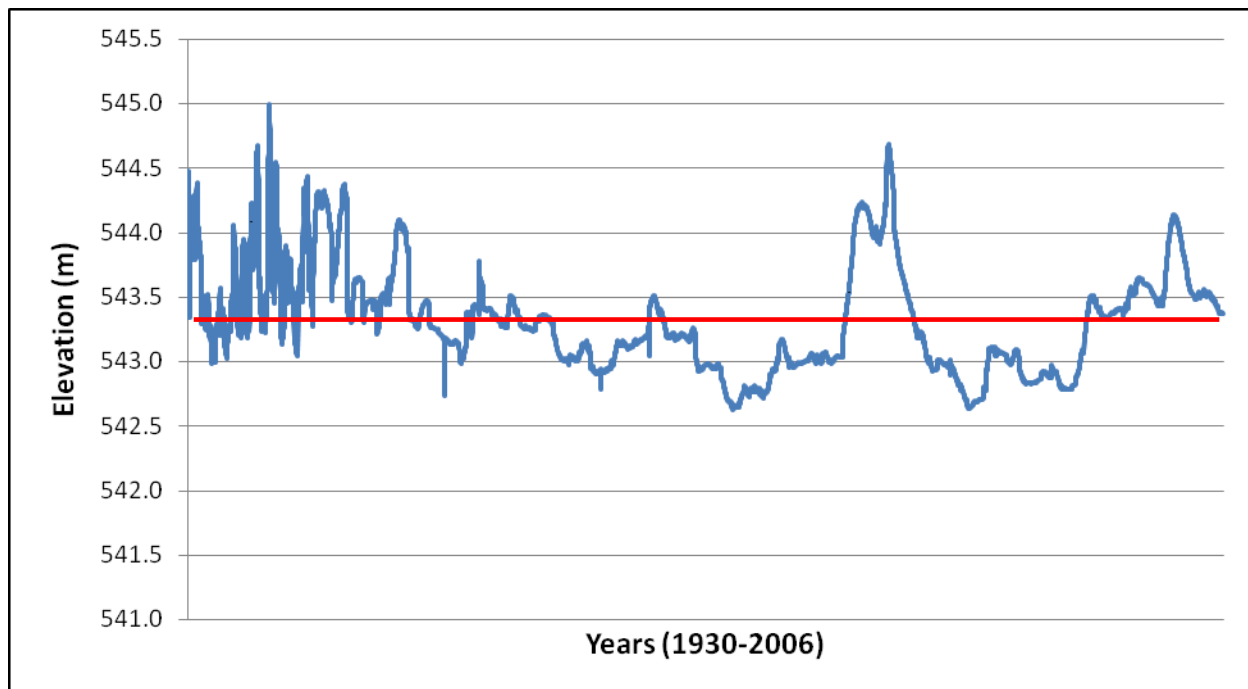


Figure 3. Water levels fluctuations in Lac La Biche from 1930-2006 (mean water level indicated by the red line; Environment Canada, 2006).

Water level fluctuations have resulted in considerable changes to the lake's area and capacity (Figure 4) and have caused both flooding and lake access problems. Sudden storms occur fairly frequently on Lac La Biche. The water level at the east end of the lake can increase by as much as 0.3 m during storms. In spring, ice jams and floods are common along the east shore of the east basin (Mitchell and Prepas, 1990).

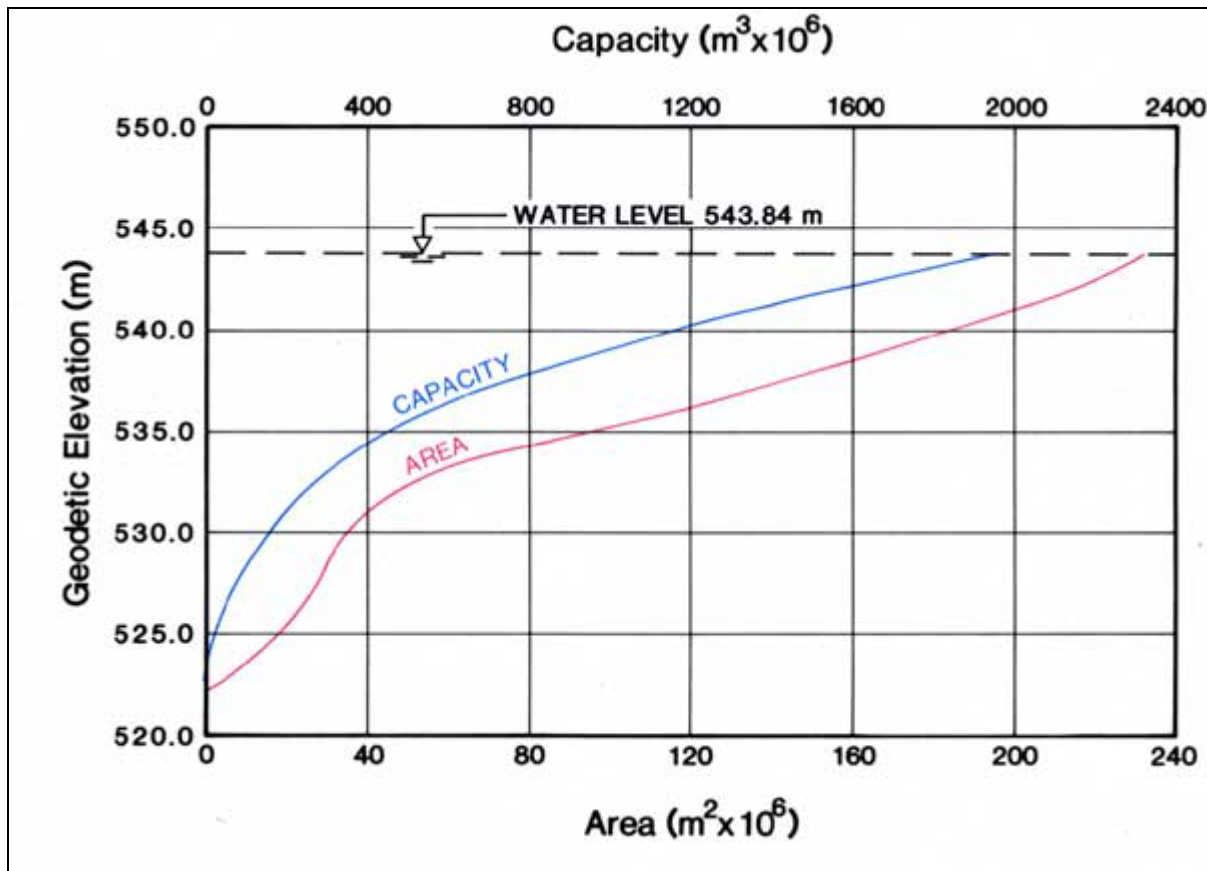


Figure 4. Changes of lake capacity and area due to water level fluctuations in Lac La Biche. Water level shown here is geodetic water level on the date of sounding, 1960 (Alberta Environment, no date).

An estimated water balance has shown that the largest input into Lac La Biche is the Owl River (draining an area of 3364 km²), followed by groundwater (Table 3). Work on groundwater in the Cold Lake-Beaver River region has shown that steady-state flows of groundwater from the Empress geological formation flows from two directions towards Lac la Biche (White and Prather, 2004). Further study on the connectivity of lower layers may better determine the relative contribution of these groundwater sources to the lake.

The water budget completed for Lac la Biche in 2003 (Table 3) emphasizes the importance of the Owl River to this lake but also emphasizes the importance of groundwater sources in the overall water budget.

Table 3. Estimated water balance for Lac la Biche in 2003 (adapted from Schindler et al., 2004).

Source	Input (%)	Output (%)
Owl River	62	
Precipitation	12	
Other Inflow	3	
Groundwater	23	
Evaporation		47
La Biche River		22
Lake storage		32

Short-Term Recommendations

- Continue monitoring of water levels in Lac La Biche.
- Undertake necessary field surveys on La Biche River to determine natural spill elevation for Lac La Biche.
- Develop a groundwater quality testing program and assess groundwater and surface water interactions, particularly in areas of extensive agricultural and forestry operations adjacent to Lac La Biche and its major tributaries.
- Develop a water conservation objective (WCO)² for Lac La Biche. To define a WCO it will be necessary to identify the water volume required for human use (including existing consumptive and non-consumptive uses), lake levels and water quality needed to protect the aquatic environment. The intent for establishing a WCO for Lac La Biche is to ensure that over-allocations do not occur in the future, as has been seen in the South Saskatchewan River Basin. Oil and gas expansion in the area has been rapid, and we need to ensure that lake levels are not adversely affected by intensive surface or groundwater extraction. To date, the amount of water required for human use (including consumptive and non-consumptive uses), to protect lake levels and for protection of the aquatic environment to ensure healthy aquatic ecosystems has not been identified. This would assist in meeting all of the goals and objectives outlined in this plan, as water quantity affects water quality, riparian areas, wetlands, fisheries, waterfowl and wildlife.

Long-Term Recommendations

² The *Water Act* defines a WCO (Sect. 1(1)(hhh)) as, "...the amount and quality of water... necessary for the:

- protection of a natural water body or its aquatic environment, or any part of them,
- protection of tourism, recreational, transportation or waste assimilation uses of water; or
- management of fish or wildlife,

and may include water necessary for the rate of flow of water or water level requirements.

- Groundwater mapping should be performed to determine important discharge and recharge areas in proximity to Lac la Biche and its major tributaries.
- Land use and development decisions could be based around the sensitivity of the groundwater source to contamination from point and non-point sources of pollution within the watershed.

Performance Measures

- Water Availability Study.
- WCO.
- Annual groundwater quality testing and reporting to measure parameters such as nutrients, bacteria and other parameters of interest to groundwater quality.
- Development of groundwater quality indicators.

Enabling Legislation and Policy

- *Water Act*;
- *Environmental Protection and Enhancement Act*;
- *Safety Codes Act*; and
- *Regional Health Authorities Act*.

4.3 Riparian Areas and Wetlands

Riparian zones and wetlands act as buffers, protecting water quality and attenuating floods. Contaminants are adsorbed onto sediments, assimilated by vegetation and transformed by soil microbes into less harmful forms (Klapproth and Johnson, 2000). They have long been proven effective in reducing nutrients, sediments and other anthropogenic pollutants that enter surface waters via overland and subsurface flow (Klapproth and Johnson, 2000; Lee and Smyth, 2003; Mayer et al., 2006).

In 2007, Lac La Biche County in cooperation with Aquality Environmental Consulting Ltd. completed the Riparian Setback Matrix Model (RSMM) in order to address the growing need to protect the riparian areas within the county. The RSMM creates unique, scientifically defensible development setbacks based on slope, height of bank, depth to groundwater and vegetation. The RSMM was made policy (PS-033) and adopted into the Municipal Development Plan (Bylaw #07-006) on July 10, 2007.

4.3.1 Lac La Biche

Riparian areas and wetlands and the ecological goods and services that they provide are under growing threat from increasing development pressures in the Lac La Biche Watershed. A

riparian health assessment of the Lac La Biche shoreline was completed in 2002 (ARHMP, 2003 and ARHMP, 2004). The assessment revealed that only 31% of riparian areas were healthy, with the remaining areas shown to be unhealthy or having problems. A second riparian health assessment via aerial videography found that the majority (70%) of riparian zones were healthy, with only 10% and 20% of riparian zones defined as moderately impaired and highly impaired, respectively (Mills, 2005). Since 2005, there have been no other riparian health assessments completed.

4.3.2 Owl River

A riparian health inventory was undertaken in 2002 by Cows and Fish. A riparian inventory is more detailed than an assessment and includes an investigation of vegetation, soil and hydrology. Thirteen sites along the river were inventoried, and it was found that 31% were healthy, 61% were healthy but had problems and 8% were classified as unhealthy (ARHMP, 2003).

4.3.3 Red Deer Brook

Red Deer Brook is a wetland complex that flows from Field Lake into Lac La Biche. Since 1983, treated effluent from the Hamlet of Lac La Biche has been discharged into Field Lake. Water quality studies conducted by Alberta Environment and Aquality in 1998-99 and 2006, respectively, have shown that Red Deer Brook and its wetlands are vitally important for nutrient reduction between Field Lake and Lac La Biche; White and Prather (2004) reported a nutrient reduction of 92%. An Economic Valuation study by Kimmel and Olewiler (2007), Simon Fraser University, concluded that the present value of Red Deer Brook is \$16,662,000. The conservation of Red Deer Brook produces a social net gain of \$8,365 per acre (Lakeland County Watershed Program, 2006). In 2008, the RSMM was used to determine setback distances from the wetland complex for the Red Deer Brook Area Structure Plan.

Short-Term Recommendations

- Partner with Cows and Fish to construct a riparian restoration demonstration site on the shores of Lac La Biche. Install signs and have other educational material available on site.
- Install educational signs on walking paths and public shoreline areas to educate tourists and property owners alike about the importance of riparian areas.
- Ensure that the RSMM is used on all lakes, rivers and creeks within the Lac La Biche watershed where there is proposed development.
- Identify riparian areas and wetlands that are of significant importance to wildlife and/or waterfowl.

- Partner with Ducks Unlimited Canada to complete a drained wetland inventory and develop a plan with targets for restoration.

Long-Term Recommendations

- Collaborate with land owners, Cows and Fish and Ducks Unlimited Canada to restore or enhance lost/impaired riparian and wetland areas.
- Develop/enhance a riparian area management module to incorporate into the local school curriculum.
- Develop and implement a riparian area management public awareness program.
- Develop and implement a program to compensate landowners/producers for restoring key riparian and wetland areas.
- Enact bylaws prohibiting the operation of quads, snowmobiles and other off-road vehicles within the riparian areas of the Lac La Biche watershed.

Performance Measures

- A Riparian Demonstration Site, located in key area of watershed that is also easily accessible for public educational purposes.
- Municipal legislation in place for existing and future developments to protect, maintain and enhance riparian areas and wetlands and protect critical wildlife/waterfowl/fish habitat within the Lac La Biche watershed.
- Remediation, reclamation and enhancement of existing impaired riparian areas and wetlands.
- Improvement of riparian health as determined by riparian health surveys.
- Development/enhancement of riparian education modules in local schools.
- Development and implementation of a public education program regarding riparian areas.
- Municipal legislation in place to prohibit the operation of quads, snowmobiles and other off-road vehicles within the riparian areas of the Lac La Biche watershed.
- Improved water quality in Lac La Biche, Owl River and Red Deer Brook.

Enabling Legislation and Policy

- *Water Act;*
- *Municipal Government Act;*
- *Fisheries Act;*
- *Public Lands Act;*
- *Wildlife Act;*
- *Provincial Parks Act and Wilderness Areas, Ecological Reserves and Natural Areas Act;*
- *Provincial Wetlands Policy;* and
- Municipal land use bylaws, area structure plans and development plans.

4.4 Fisheries, Waterfowl and Wildlife

Riparian areas and wetlands are valuable wildlife, waterfowl and plant habitat. They provide nesting sites for several bird species, reptiles and amphibians and mammals. Although riparian areas make up only a small fraction of the landscape, they are disproportionately important to fish and wildlife, recreation, agriculture and society in general. As much as 80% of Alberta's wildlife relies in whole or in part on riparian areas to survive (Cows and Fish, 2006).

4.4.1 Species at Risk

The Lac La Biche area is home to three species that are listed in the *Species at Risk Act*. These are the yellow rail, the woodland caribou and the Monarch butterfly. The yellow rail (*Coturnicops noveboracensis* Gmelin) and the Monarch butterfly (*Danaus plexippus* L.) are listed as "Special Concern" and the woodland caribou boreal population (*Rangifer tarandus caribou* L.) is listed as "Threatened" (COSEWIC, 2008).

The yellow rail breeds in large, wet meadows or shallow marshes with sedges and grasses. On its wintering grounds, it is found in salt marsh, rice fields and damp meadows. Little is known about the foraging behavior of the yellow rail, but it is known to feed on freshwater snails, insects (especially aquatic insects), small crustaceans and seeds (during the fall and winter). The most important threat to yellow rail is the loss of wetland habitat on the bird's breeding grounds (Bookhout, 1995).

Monarch butterfly females lay eggs on the underside of leaves. Emerging caterpillars forage on leaves and flowers. Adult butterflies make massive migrations from August-October, often flying thousands of kilometers south to hibernate along the California coast and in central Mexico. A few overwinter along the Gulf coast or south Atlantic coast. Its habitat encompasses many open areas, including fields, meadows, marshes and roadsides. The destruction of its wintering sites, migration corridors and principal breeding areas threaten this species the most (Opler et al., 2006).

The various subspecies of caribou display a wide range of size. Generally the subspecies inhabiting the more southerly latitudes are larger than their northern cousins. Caribou are known to travel distances greater than any other terrestrial mammal, traversing often more than 5,000 km/year, with extensive migrations in spring and fall. Spring migration leads the caribou off the winter range back to calving grounds. Use of traditional calving grounds is the basis by which caribou herds are defined. They have a nearly circumpolar distribution, inhabiting arctic tundra, subarctic and boreal forest regions. They are primarily grazing herbivores, feeding on willow and birch leaves, mushrooms, cotton grass, sedges and numerous

other herbs and shrubs. Lichens are an important component of the diet, especially over the winter months, but they are not eaten exclusively. Humans have heavily hunted this species for centuries. Natural resource exploration, e.g., oil, gas, timber and minerals, are the most serious threats to woodland caribou habitat (Nowak and Paradiso, 1983).

4.4.2 Fisheries

The fish species in Lac La Biche are walleye (*Sander vitreus* Mitchill), northern pike (*Esox lucius* L.), lake whitefish (*Coregonus clupeaformis* Mitchill), cisco (*Coregonus* spp.), yellow perch (*Perca flavescens* Mitchill), burbot (*Lota lota* L.), white sucker (*Catostomus commersonii* Lacépède), longnose sucker (*Catostomus catostomus* Forster), spottail shiner (*Notropis hudsonius* Clinton), brook stickleback (*Culaea inconstans* Kirtland) and Iowa darter (*Etheostoma exile* Girard). The lake is managed for sport, domestic and commercial fisheries, but catch data are available only for the commercial fishery. Records of the commercial catch have been kept since 1942 (Alberta Recreation, Parks and Wildlife, 1976). The most important commercial fisheries species are cisco, lake whitefish and northern pike; however, the fishery has been erratic due to changes in market demand, overfishing, variable year-class strength and occasional die-offs.

4.4.3 Waterfowl and Birds

Many species of waterfowl and birds live and/or reproduce in riparian areas and wetlands, including geese, swans, American white pelicans, double-crested cormorants, herring gulls, ring-billed gulls, great blue herons, common terns, black terns, Forster's terns, red-necked grebes and eared grebes. The lake is also important as a nesting and reproduction area for bald eagles, osprey and great gray owls.

The lake was first designated a Bird Sanctuary in 1920 by the Government of Canada and became a Provincial Wildlife Sanctuary following the passing of Alberta Natural Resources Act in 1930. Subsequently, Lac La Biche was designated an Important Birds Area (IBA) as part of an international program spearheaded by Birdlife International, and it is part of the Natural Legacy 2000 program. The primary Canadian lead partners are the Canadian Nature Federation and Bird Studies Canada (BSC). The provincial lead partner is the Federation of Alberta Naturalists (FAN). The lake was nominated as an IBA site because of its large numbers of nesting California Gulls and Western Grebes. All islands within the lake are designated as natural areas by Alberta

Environment, and one is designated as a provincial park (Sir Winston Churchill Provincial Park, since 1965).

There are 17 important waterfowl production and loafing areas on Lac La Biche. The habitat potential on these sites varies from year to year depending on water levels fluctuations. These sites and the species commonly found at each site are listed below (Alberta Municipal Affairs, 1982).

Islands

- Pelican Island - cormorants and gulls
- Birch Island and narrows - ducks, herons, shorebirds, eagles, pelicans, gulls, terns
- Black Fox Island - mergansers, cormorants, grebes, gulls, terns, loons, shorebirds, pelicans
- Island northwest of Black Fox Island - nesting pelicans, herons, cormorants, gulls and loafing mergansers, ducks, terns, gulls and pelicans
- Long Island - grebes, ducks, loons, herons, shorebirds
- Current Island - pelicans, cormorants, gulls, terns, grebes, ducks, herons
- Red Fox Island - ducks, pelicans, gulls
- Island southwest of Red Fox Island - ducks, pelicans, gulls
- Cucumber Island - pelicans, cormorants, gulls, grebes
- Sir Winston Churchill Provincial Park - gulls, shorebirds, mergansers, ducks, loons, osprey

Shallow bays

- Squirrely's Bay - ducks, osprey, gulls, shorebirds
- Mission Bay - coots, shorebirds, terns, grebes, osprey, ducks, herons and nesting western grebes
- Big Bay - grebes, herons
- McArthur Beach - loafing area for gulls
- Plamondon Bay - shorebirds
- Owl River delta - swans, pelicans, terns, ducks, gulls, coots, loons, grebes
- Owl River bay - grebes, ducks, herons, pelicans, osprey, terns, shorebirds, gulls, geese

4.4.4 Wildlife

In addition, riparian zones provide habitat for reptiles and amphibians, e.g., the wood frog, the boreal chorus frog and the Canada toad, and safe corridors for several species of large mammals, including moose, white-tailed deer, mule deer, coyotes, wolves and black bears, and small mammals, including beaver, muskrat, mink, weasels, squirrels and mice (Wenger, 1999).

NatureWatch has initiated a FrogWatch program across Canada, including in the Lac La Biche area, to monitor the health of riparian, wetland, and aquatic ecosystems. Frogs and toads can be used as indicator species, because they are vulnerable to changes in their habitat. Tracking changes in the geographic range, the beginning and ending of the calling season and the population of frogs and toads will assist in understanding changes occurring in the environment.

Short-Term Recommendations

- Designate all the islands on the lake as provincial park land or ecological reserves to ensure that the islands are protected from hunting and disturbance as required by their designation as a Migratory Bird Sanctuary.
- Limit boat speed and/or distance to islands.
- Educate the public about the importance of maintaining aquatic and riparian vegetation using fact sheets and interpretive signs in the watershed, which explain the link between wildlife populations and habitat preservation.

Long-Term Recommendations

- Identify critical wildlife corridors, habitats and breeding areas.
- Collaborate with land owners, Cows and Fish and Ducks Unlimited Canada to restore or enhance lost/impaired riparian and wetland areas.
- Stream surveys should be completed to determine if any other critical fish habitat areas exist in the Lac La Biche tributaries.
- Identify critical wildlife habitat and ensure protection of contributing lands via conservation easements or other methods.
- Develop and implement a wildlife management plan, e.g., for fish, waterfowl and amphibian populations.

Performance Measures

- Development and implementation of a basin specific wildlife management plan for Lac la Biche, e.g., for fish, waterfowl and amphibian populations.
- Increase in amounts and health of aquatic and riparian vegetation.
- Increase in wildlife habitat.

- Increased wildlife populations.

Enabling Legislation and Policy

- *Water Act*;
- *Municipal Government Act*;
- *Fisheries Act*;
- *Public Lands Act*;
- Municipal District, Hamlet and Summer Village Land Use Bylaws;
- Area Structure Plan; and
- Municipal Development Plan.

5.0 Conclusions

Throughout this management plan, the recommendation regarding public outreach and education appears in many different sections. This should be the primary focus for the WAC and is essential to the success of this plan. The committee should continue with planning outreach activities and sending out newsletters and other suggested initiatives. These efforts will generate public support for the plan and will greatly assist in the implementation of the recommendations contained herein. This will lead to measurable improvements in the health and functionality of the Lac La Biche watershed.

Lac La Biche County and partner municipalities in the watershed planning area should review their existing planning documents and land use bylaws and incorporate the recommendations listed in this Watershed Management Plan. An Inter-Municipal Development Plan between all parties involved should be considered. There are many tools available for protection of critical riparian and wetland areas, including Conservation Easements, Environmental Reserves, Protective Notations, purchasing land or land trades may be utilized to acquire critical habitat lands.

Appropriate enforcement measures will also be a vital component of the implementation of this plan. Individuals choosing to ignore environmental protection tools, such as best management practices, bylaws and guidelines, must be made aware of the importance of changing their perspectives and increasing their awareness of environmental issues in the Lac La Biche watershed. Thoughtful and creative use of the tools recommended in this plan can bring about a marked improvement in the water quality in Lac La Biche and its tributaries and in the general overall ecological health and functionality of the entire watershed.

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7.0 Glossary

BSC – Bird Studies Canada aims advance the understanding, appreciation and conservation of wild birds and their habitats, in Canada and elsewhere, through studies that engage the skills, enthusiasm and support of its members, volunteers and the interested public.

CCME – The Canadian Council of Ministers of the Environment is made up of environment ministers from federal, provincial and territorial governments and works to promote the cooperation and coordination of inter-jurisdictional issues, such as waste management, air pollution and toxic chemicals. CCME members propose nationally-consistent environmental standards and objectives to achieve a high level of environmental quality across the country.

CFU – Colony forming units, pertaining to bacterial concentrations

Drainage basin – An extent of land where water from precipitation or snow melt drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. Also known as a “watershed”.

Eutrophication – The natural and/or anthropogenic processes by which the nutrient content of natural waters is increased, generally resulting in an increase of biotic productivity and biomass

IBA – The Important Birds Area (IBA) Program is a global effort to identify and conserve areas that are vital to birds and other biodiversity.

Riparian area – The interface between land and a water body. Plant communities along the water body margins are called riparian vegetation, characterized by water-loving plants. Riparian zones are significant in ecology, environmental management and civil engineering due to their role in soil conservation, their biodiversity and the influence they have on aquatic ecosystems.

RSMM – The Riparian Setback Matrix Model is a scientifically-based, legally defensible model that allows municipalities to take adequate precautions to prevent the most common forms of pollution of water bodies and wetlands from various types of developments.

establishing arbitrary setbacks.

TN – Total nitrogen

TP – Total phosphorus

WAC – Watershed Advisory Committee

Watershed – see “drainage basin”.

WCO – Water conservation objective

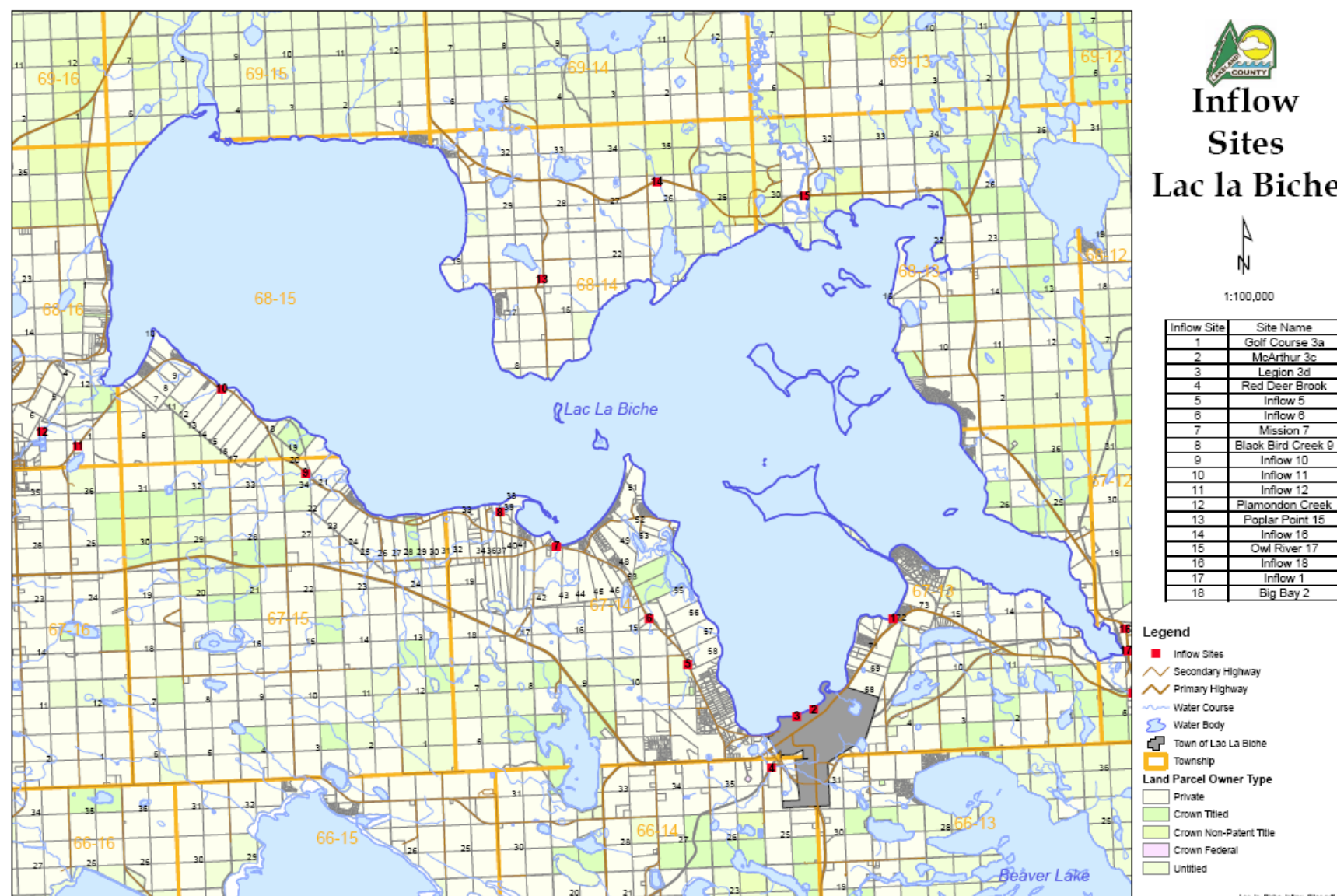
Wetland – Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment. The Canadian Wetland Classification recognizes five distinct classes of wetlands: bogs, fens, marshes, swamps and shallow open waters.

WMP – Water management plan

µg – microgram, 1×10^{-6} grams, or one millionth of a gram.

Appendix A

Lac La Biche Inflow Sampling Locations



Appendix B

Lac La Biche Watershed Management Plan Terms of Reference

Appendix C

Record of First Nations Consultation

First Nation/Metis settlement	Address	Telephone	Notes
Beaver Lake Cree Nation	P.O. Box 960, Lac La Biche, Alberta, T0A 2C0	(780) 623-4549	<p>Contacted Dec. 17, 2008, re. council meeting</p> <p>left message with Priscilla 09 January</p> <p>Further contact with Beaver Cree Nation was not responded to.</p>
Heart Lake First Nation	P.O. Box 447, Lac La Biche, Alberta, T0A 2C0	(780) 623-2130	<p>contacted Betty Kennedy (EA for Chief and Council); discussed opportunities for engagement. John Flemming from the Tribe will be at the LLB WMP meeting on the 13th, so some consultation can be made there. Will make follow up to Sonny Nest at Tribal Council (780-481-3363) to get put on agenda.</p> <p>Spoke with Sonny Nest of the Treaty 6 council (environmental advisor for Treaty 6); he advises both Beaver and Heart Lake councils</p> <p>set up meeting for Monday, January 19th at 1pm with Sonny at the tribal council offices here in town (17630 103 Ave); we missed the meeting dates for January with the band councils</p> <p>J. White and presentation to Sonny Nest January 19 at 1:00 PM for 2 hours. Sonny offered a letter of support for the plan which was never received.</p>

Edward Obichon from Heart Lake First Nation was chosen to be a First Nations representative for the Watershed Advisory Committee. He was sent all of the meeting notices/packages but did not make it to any of the meetings. Packages were sent out via letter post by either Krystle Fedoretz or Melissa Mucha for the following meeting dates: February 21, 2007, March 14, 2007 (a call was also made to Edward as a reminder), January 10, 2008, September 30, 2008, March 26, 2009. County staff also met with Jill Norris who was part of the Heart Lake Consultation Office.

Kikino Metis Settlement	General Delivery, Kikino, Alberta, T0A 2C0	(780) 623-7868	<p>- call Jan. 06 to set up meeting time/date with Loretta, will get about 1 hr. to present WMP, council meets every Tuesday - sent WMP via e-mail on Dec. 17, 2008 (kiadmin@telus.net)</p> <p>- called on January 07, spoke with Joanie (Loretta away), who left message for Loretta</p> <p>- spoke with Loretta on January 08, she will speak with council re. open time slot on January 20</p> <p>- received e-mail from Loretta on January 09, indicating that no time slot open on January 13 council meeting, but openings on January 20 and 27 council meetings; I replied via e-mail on January 12 asking for inclusion on January 20 council meeting and asking for details re. meeting place and specific time</p> <p>- re-sent e-mail on January 15 requesting specifics on inclusion in council meeting on January 20 - had not heard anything from Loretta</p> <p>- Loretta e-mailed on January 15, indicating that Council had meeting in Edmonton on January 20 and would not be able to meet with Aquality to discuss LLB WMP until sometime in February.</p>
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Further contact with Kikino was not responded to.

Buffalo Lake Metis Settlement	Box 16, Caslan, Alberta, T0A 0R0	(780) 689-2170	meeting scheduled for January 20th at 1pm; 30-45 minutes long, at the council office; waiting on travel directions to the office from Cindy MacDonald
			J. White and K. Fedoretz presentation to Buffalo Lake Metis Settlement Council made on January 20, 2009. A letter of support for the plan was requested, but never received.
