

Fort McMurray #468 First Nation **STATE OF THE GREGOIRE LAKE WATERSHED**

**Phase 1: Preliminary Technical
Assessment & Framework for a
Watershed Management Initiative**

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FORT MCMURRAY #468 FIRST NATION

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Executive Summary

In response to community concerns of declining watershed health, Fort McMurray #468 First Nation (FMFN468) has spearheaded the development of a preliminary (Phase 1) 'State of the Watershed' report for the Gregoire Lake watershed (GLW). This report brings together existing information on the landscape and land use, water quantity and quality, and ecological function, describes and assesses the current state of the watershed where possible, and identifies data gaps that should be filled to complete our understanding of the health of the watershed. It is intended to serve as a starting point in terms of data gathering and an assessment of watershed health that will be built upon through collaborative and coordinated efforts with the larger watershed community. It is also intended to set the stage for a collaborative GLW Management Initiative that will ideally lead to the development of a watershed management plan in the future.

OVERVIEW OF THE WATERSHED

The GLW is located in northeastern Alberta, approximately 35 km south of Fort McMurray and within the Regional Municipality of Wood Buffalo (RMWB), and is situated within the larger Clearwater River subwatershed of the Athabasca River watershed. The drainage basin comprises an area of approximately 232 km² and is about nine times the size of Gregoire Lake, which comprises an area of approximately 26 km². Gregoire Lake is generally shallow with a maximum depth of just over 7 m.

The watershed is located in the Boreal Forest Natural Region and is characterized by extensive wetlands (43% watershed coverage) – the majority of which are peatlands – interspersed with upland forests (36% watershed coverage), which provide habitat for a wide range of wildlife and vegetation. Over 30 waterbodies (lake, ponds, and reservoirs) and 180 watercourses of varying size and disturbance are located in the watershed, which support a variety of fish. A prominent feature of the GLW is the large north-facing escarpment in the transition area between the relatively level plains and Gregoire Lake in the northern portion and the Stony Mountain uplands in the southern portion.

The watershed has long been home to Indigenous people, with European settlers entering the region in the 18th century. Today, the watershed is sparsely populated and home to approximately 1,183 people. The primary residential communities – which include Fort McMurray #468 First Nation and the Hamlets of Anzac and Gregoire Lake Estates – are located adjacent to Gregoire Lake. Gregoire Lake Provincial Park is located on the northwestern shore of the lake. The central and southern portions of the watershed are generally remote with very limited road access, and Stony Mountain Wildland Provincial Park overlaps with the southern portion of the watershed.

Land use in the GLW consists of residential uses, institutional, commercial and industrial uses including oil sands extraction, parks and protected areas, recreational uses including fishing, hunting, and trapping, and Indigenous uses. Gregoire Lake is the most widely used recreational lake in the Regional Municipality of Wood Buffalo. The increasing human settlement and industrial footprint and recreational uses are considered the greatest pressures on the watershed. In addition, concerns of sewage inputs to the lake and waste dumping are prevalent.

PRELIMINARY FINDINGS & RECOMMENDATIONS

Landscape & Land Use

Overall, natural land cover in the GLW is considered generally fair based on the landscape composition and level of disturbance as of 2015; however, information on wetlands and riparian health in the watershed is lacking. There are also some concerns about the functioning of the various culverts south of the lake and the weir structure at the outlet of the lake; information on the status of these is also lacking. The watershed is generally subject to low to moderate anthropogenic pressures, with the exception of the expanding anthropogenic footprint driven by commercial and industrial development, including linear disturbance, which presents a higher pressure. Planned and future *in situ* oil sands developments within the watershed will further increase these pressures. There is an insufficient level of information currently available to characterize the pressures associated with recreational uses.

Recommendations include:

- Source additional wetland data and incorporate into the assessment, with associated ground-truthing for verification, to provide a more accurate estimate of wetland area and classification.
- Complete riparian health assessments and associated ground-truthing for the watershed, especially for Gregoire Lake and Surmont Creek, to determine the level of riparian area impairment.
- Assess the status of culverts around the lake and the weir structure to characterize existing issues and determine the appropriate courses of action – Alberta Environment and Parks (AEP) should be engaged to undertake any assessments and develop corrective actions.
- Connect with AEP and recreational groups (e.g., McMurray Sno-drifters) to determine what type of information may be available in terms of recreational uses and/or how this information can be appropriately captured.

Surface Water Quality

Gregoire Lake was the focus of the assessment based on data availability and budgetary and time constraints. Surface water quality in Gregoire Lake is considered generally healthy and has been fairly stable over the past three decades. However, some parameters have occasionally exceeded provincial and/or federal guidelines, and the available data suggests some potential emerging trends although data gaps present challenges to confirmation.

Total dissolved solid concentrations have increased in more recent years, coinciding with increases in calcium, sodium, chloride, sulphate, and magnesium concentrations. This may indicate anthropogenic source inputs of sodium chloride into Gregoire Lake. Fluoride concentrations have exceeded guidelines in the past but there are data gaps for more recent years. Available metals data is limited to the 2014-2017 time period. Iron, manganese, and arsenic concentrations exceeded guidelines in September 2015 but have otherwise been below guidelines, suggesting an anomalous event in the fall of 2015.

Clarity in the lake has generally decreased since 1989 but data gaps in more recent years makes it difficult to confirm any trends. Total phosphorus levels have been generally stable since 1989, and the trophic state of Gregoire Lake appears stable. However, chlorophyll-a concentrations have general been higher in more recent years, which may explain the potential declines in clarity, but several data gaps make it difficult to confirm any



definite trends. All reported concentrations of nitrate and nitrite since 1989 were well below provincial guidelines for the protection of aquatic life. However, increased concentrations of nitrate have been reported in more recent years relative to previous years but this may be a function of differences in seasonal sampling in more recent years.

Exceedances in fecal coliforms have been reported along the beaches of Gregoire Lake Provincial Park prior to 1994. However, there is no readily available long-term dataset and no recent data to characterize existing conditions.

Lake profiles indicate that dissolved oxygen (DO) concentrations do not meet provincial guidelines in the bottom 1 to 2.5 m of the lake during summer and winter, but concentrations were usually sufficient in the surface waters of the lake, and during winter stratification to minimize the risk of winterkill; this is quite standard for shallow Alberta lakes (Mitchell & Prepas, 1990). However, lake profiles have not been updated since 2000, and there is no readily available dissolved oxygen or temperature datasets.

Recommendations include:

- Continue monitoring parameters exhibiting potential changes or trends, or lacking a robust dataset, and complete further analysis (e.g., trend analysis) where appropriate to better characterize potential changes that may be indicative of degrading water quality.
- Investigate potential source inputs of sodium and chloride inputs to Gregoire Lake.
- Metals data is limited to the 2014-2017 time period and it is recommended that the Nexen Lakes Water Quality Program Monitoring dataset (2000 to 2013) is obtained for a more fulsome assessment of these metrics. In addition, future phases of this work should consider the inclusion of additional metals beyond the four included in this report.
- Expand current monitoring activities to include field temperature and DO measurements; if this is already being done, the dataset should be obtained for inclusion in the assessment.
- Complete sampling for fecal coliforms given the high recreational value of Gregoire Lake and the concerns about septic/sewage inputs.
- Given that climate-change related temperature changes may lead to stronger or weaker thermal stratification, update lake profiles to continue monitoring of lake stratification.
- Future phases of this work should consider the inclusion of organic indicators, such as PAHs and naphthenic acids, for a better understanding of the potential impacts of oil sands operations on the lake.
- Implement a sampling program that encompasses watercourses that drain into Gregoire Lake as well as several additional lakes that are spatially representative of the watershed.
- Further investigate the status of and responsibility for the decommissioned sewage lagoon in the watershed, adjacent to Milton's Creek and southwest of Gregoire Lake given concerns about past spillover events and potential source inputs to adjacent water features.
- Given ongoing concerns about the potential for septic/sewage inputs into the lake, the RMWB should consider completing an inventory of all related infrastructure in the watershed through the use of a survey that aims to: create an inventory of systems in place; assess the septic maintenance practices of homeowners to better understand potential conditions; and identify opportunities to improve septic system practices in the watershed.

Surface Water Quantity

In the absence of sufficient site-specific hydrological information for the GLW, hydrological modeling was completed to better understand the hydrology of the watershed. The model confirmed that streamflow is low during the winter months and increases quickly in the spring, coinciding with the onset of snowmelt. Streamflow displays episodic rises following summer precipitation events. Minimum flows and lake levels typically occur before the onset of spring snowmelt. Streamflow variability is dampened by Gregoire Lake, with less severe high flows and greater low flows downstream of the lake. Although there was insufficient data to complete an assessment of streamflow and lake level, information provided by the hydrological model in terms of streamflow and lake level should serve as a monitoring tool for the future.

The effects of climate change on streamflow and lake levels were also evaluated under two future scenarios for 2011-2100, modest changes and more extreme changes. The selected climate change scenarios projected increases in annual air temperatures, increases in annual precipitation, and increases in potential evapotranspiration (greater than precipitation increases). The hydrological model projects that these changes will lead to a higher but more variable peak snowpack and earlier seasonal snow disappearance. Annual low flows and water level were projected to increase due to warmer air temperatures, but summer flows were projected to decrease slightly due to earlier snowmelt and higher evapotranspiration rates. Peak and average flows and water level were projected to increase under climate change scenarios due to higher precipitation and more rapid snowmelt.

Historical observations of water levels from Gregoire Lake were used to estimate lake storage curves for this system. However, due to the absence of recent bathymetry data, the storage curves devised can only be considered approximate and a fulsome assessment could not be completed at this time.

From a hydrologic water balance perspective, drinking water systems are not a significant source or drain on the watershed as they are sourced currently outside of the GLW and are expected to continue to be.

Recommendations include:

- Complete a bathymetric survey for Gregoire Lake to update lake storage curves, and characterize lake sedimentation rates and potential changes to the lake environment over time.
- Given significant changes to both the weir structure and water levels on Gregoire Lake due to these weir changes, develop a comprehensive record of all historical weir changes and update the water level data to a single datum to account for changes in the weir crest height and other flow impediments (i.e., large beaver dams or diversions) at the outlet.
- Given that long-term streamflow records are a major data gap for the watershed, collect streamflow measurements over a range of flows at the lake outlet (Gregoire River) and Surmont Creek from the spring through late fall in order to derive stage-discharge curves and ultimately streamflow records at these locations.
- Once a sufficient level of data has been collected, construct a water balance for Gregoire Lake to improve the knowledge on process-understanding in the lake and assist in prioritizing future conservation or restoration efforts.



Groundwater Quality

Groundwater quality was not assessed due to a lack of readily available data and time and budgetary constraints. To be able to assess this indicator in future phases of this work, the following is recommended:

- Obtain relevant groundwater chemistry data from individual oil sands operators within and adjacent to the GLW, where possible.
- Determine if there is groundwater chemistry data available for the now inactive Anzac monitoring stations.
- Explore potential opportunities to work with AEP or the current Oil Sands Monitoring (OSM) program to expand the scope of current groundwater chemistry monitoring activities in the region to enable the collection of data relevant to the GLW.

Groundwater Quantity

Groundwater quantity was not assessed due to a lack of readily available data and time and budgetary constraints. To be able to assess groundwater levels in future phases of this work, the following is recommended:

- Obtain groundwater level data relevant to the GLW from local oil sands operators, where possible.
- Explore potential opportunities to work with AEP or the OSM program to expand the scope of current groundwater level monitoring activities in the region to enable the collection of data relevant to the GLW.
- Characterize groundwater extraction pressures using groundwater well data for the GLW from using the Alberta Water Well Information Database and groundwater allocation data from *Water Act* approvals.

Biotic Community

No fulsome assessments were completed at this time due to a lack of readily available data and budgetary and time constraints; however, fish and fish habitat, fish health, benthic macroinvertebrates, woodland caribou, and macrophyte community were explored in terms of potential approaches and available data to inform future decision making in the use of biotic indicators for the GLW and associated data collection.

The Fish Sustainability Index (FSI) for walleye in Gregoire Lake was determined to be 'moderate risk' in 2017, up from 'very low risk' in 2012 and habitat protection need for the species in the lake is considered high. The FSI for northern pike in the lake was determined to be 'high risk' in both 2012 and 2017. Habitat protection need for northern pike in the lake is considered moderate while habitat protection need in the lakes upstream of Surmont Creek in the southern portion of the GLW is considered very high. There is limited available information on the status of fish populations in other lakes and watercourses in the GLW. There is also limited information on the status of Arctic grayling and its habitat in the GLW. In addition, information on fish communities in the watershed and potential changes in them is lacking.

Fish passage issues for the weir channel and the reconstructed naturalized channel outlet for Gregoire Lake have been identified; however, information on actual fish movements in these channels is lacking.

Mercury concentrations in northern pike, and walleye from Gregoire Lake were sampled in the past as part of the RAMP. Mercury concentrations in walleye and northern pike were found to exceed Health Canada guidelines for subsistence fishers in both 2002 and 2007 but not in 2012. Comparisons with historical regional data indicated that these concentrations fall within the range of mercury concentrations observed in this region of Alberta, and the results suggest low potential risk to fish health. No further tissue sampling has been complete since, although Evans and Talbot (2012) recommend that fish in Gregoire Lake should continue to be monitored for mercury concentrations because of the lake's proximity to and downwind location from Fort McMurray's industrial development.

There is both historical and more recent data available for the macroinvertebrate community in Gregoire Lake that can be used to assess this indicator in future phases of this work.

Alberta Environment surveyed the macrophyte community within Gregoire Lake in 1981. Vegetation was predominantly located along the western shore and the shallow area near Anzac at the southeastern portion of the lake, adjacent to human settlement areas. No known surveys have been completed since.

The East Side Athabasca River (ESAR) woodland caribou range extends into the northern and southern portions of the GLW. Although level of lands disturbance/habitat suitability has been modeled for the ESAR range, habitat suitability within the GLW has not been quantified. It is likely that based on the disturbance extent within the entire ESAR range and the disturbance extent in the GLW (based on the preliminary assessment of the landscape indicators), the threshold of 65% of undisturbed habitat for self-sustaining populations of woodland caribou in the GLW has been exceeded. However, modeling of suitable habitat and levels of disturbance based on current conditions within the GLW would be required to confirm this.

Recommendations to assess biotic community indicators in the future include:

- Collect and review non-publically available information from AEP and local industry (and that were not available for review during the preparation of this report) to synthesize all available information on fish and fish habitat in the GLW, where possible.
- Partner with AEP to: better understand what data collection activities are currently being undertaken within the wider GLW and what is planned; and monitor changes in the fish community in Gregoire Lake if this is not already being done as this can serve as an important indicator of lake health. A partnership approach would also enable the integration of local and Indigenous knowledge.
- Consider undertaking fish community inventories on lakes and tributaries in the GLW for which there is no fish or fish habitat information available. Local and Indigenous knowledge should also be collected to support information gathering for these features.
- Work with AEP to complete fish movement studies for the weir and naturalize outlet channel to better characterize existing issues and identify necessary corrective actions.
- Explore opportunities to complete additional fish tissue sampling for mercury in Gregoire Lake with the OSM program.
- Work with AEP to begin documenting incidences of fish deformities, erosions, lesions and tumours during Fall Index Netting on Gregoire Lake if this is not already being done; if it request this information



and associated data collection methods as this could then be used to build a larger community-based monitoring program (e.g., documentation by fishers).

- Assess the most recent RAMP data for the benthic macroinvertebrate community in Gregoire Lake relative to previously collected baseline data available to characterize any potential changes in community composition, which may be indicative of changes in watershed health. If further investigation is considered warranted, benthic sampling can be undertaken during future surface water sampling events to support ongoing data collection and monitoring.
- Complete a macrophyte community survey in Gregoire Lake and assess for changes relative to the previously completed survey. This work can be done during other field data collection in the lake (e.g., bathymetric survey, surface water quality sampling).
- A disturbance modeling exercise using the disturbance and biophysical habitat criteria outlined in Environment Canada (2011) could be completed to characterize caribou habitat potential in the GLW.

ADDITIONAL CONSIDERATIONS

In addition to the recommendations specifically related to the various indicators and associated data gaps, there are some important additional considerations in the context of watershed management planning processes, including: data collaboration and management; future engagement considerations; strategic opportunities; opportunities for community-based monitoring to support local stewardship and empowerment; and a management framework to guide future efforts. Suggestions and recommendations in the areas are provided in the report, as well as a preliminary framework for a watershed management plan.

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