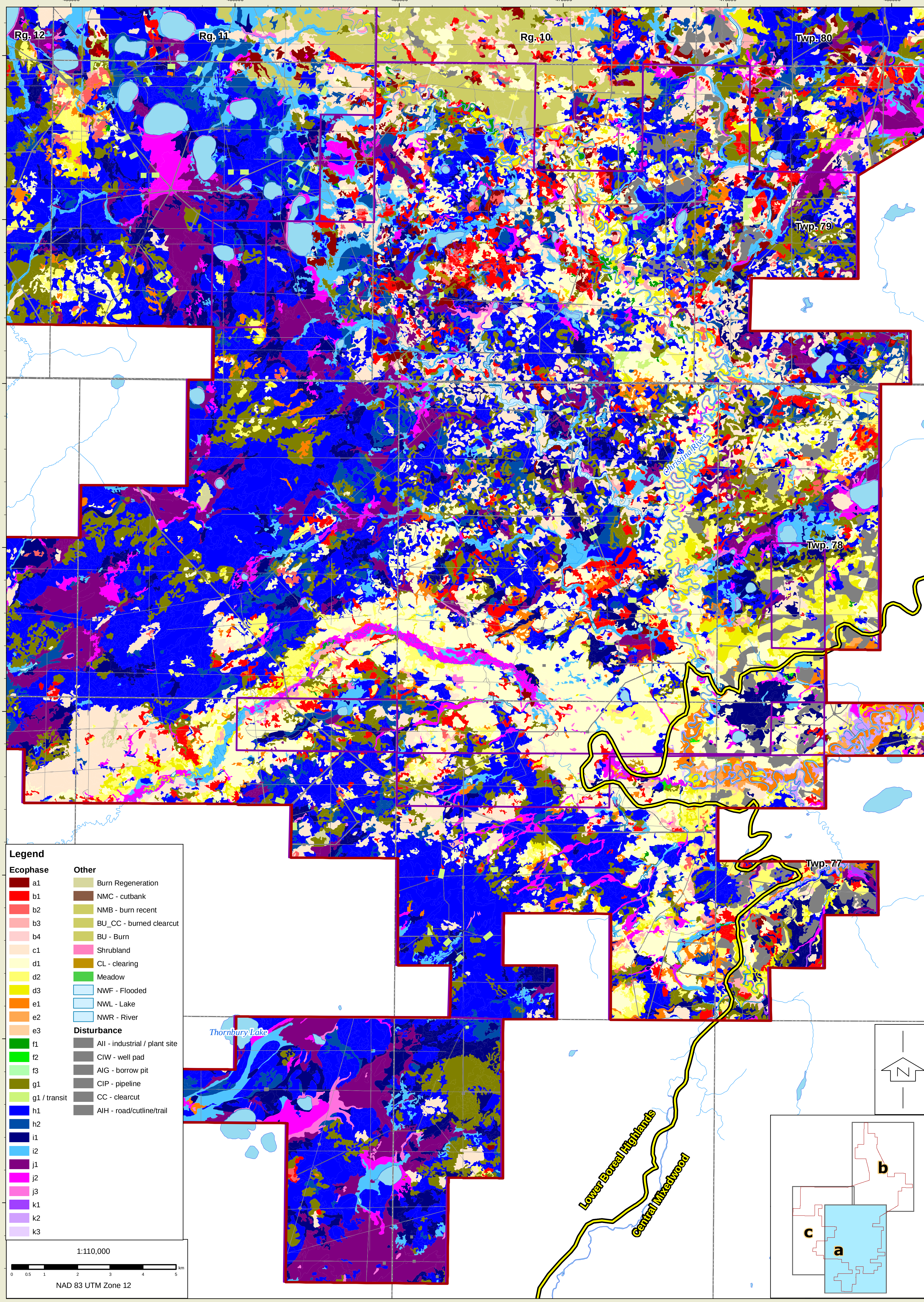

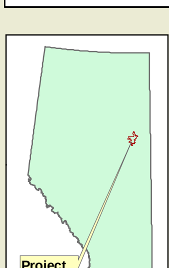

Legend

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- North American Vegetation LSA
- North American Lease
- Natural Subregions
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Title:

ELC CLOSURE SCENARIO IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved: LM/PB	Revision Date: July 9, 2007
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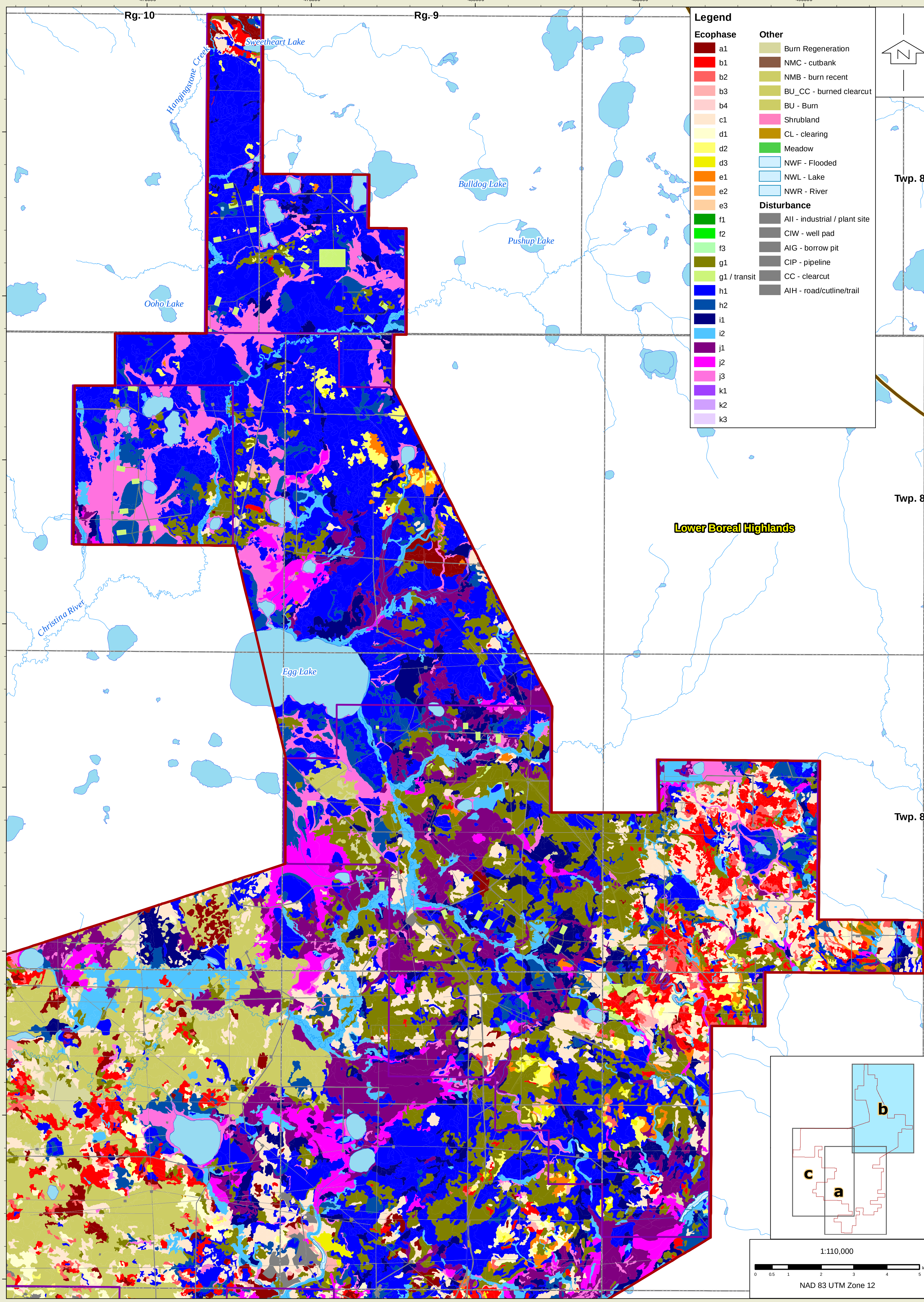

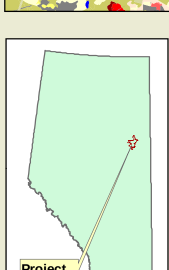

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- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Title:

ELC CLOSURE SCENARIO IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
LM/PB	July 9, 2007

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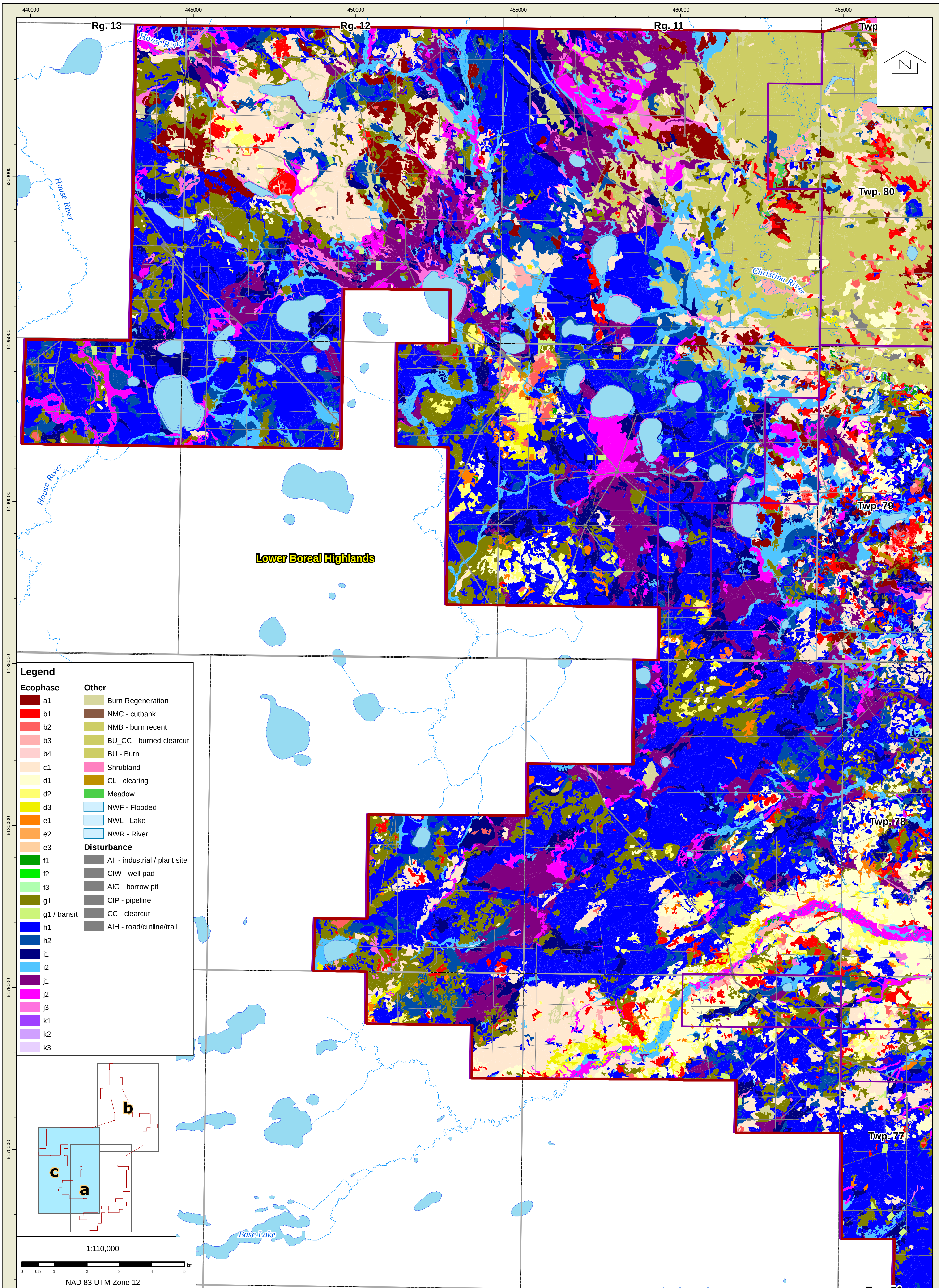

Legend

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- North American Vegetation LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Title:

ELC CLOSURE SCENARIO IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
LM/PB	July 9, 2007	
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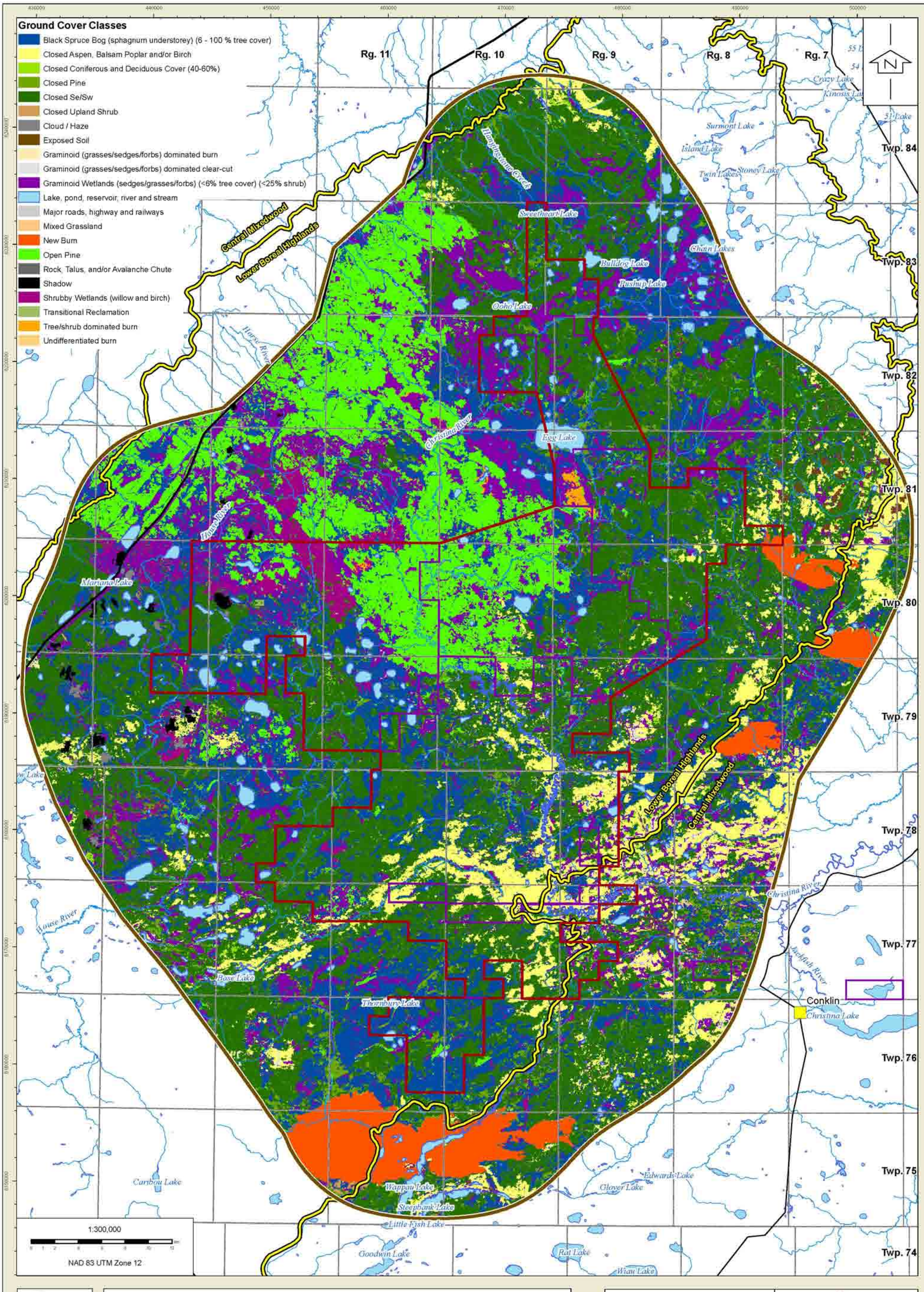

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DISTRIBUTION OF GROUND COVER CLASSES IN THE RSA AT CLOSURE

NORTH AMERICAN OIL SANDS CORPORATION

Approved: LM/PB	Revision Date: July 9, 2007
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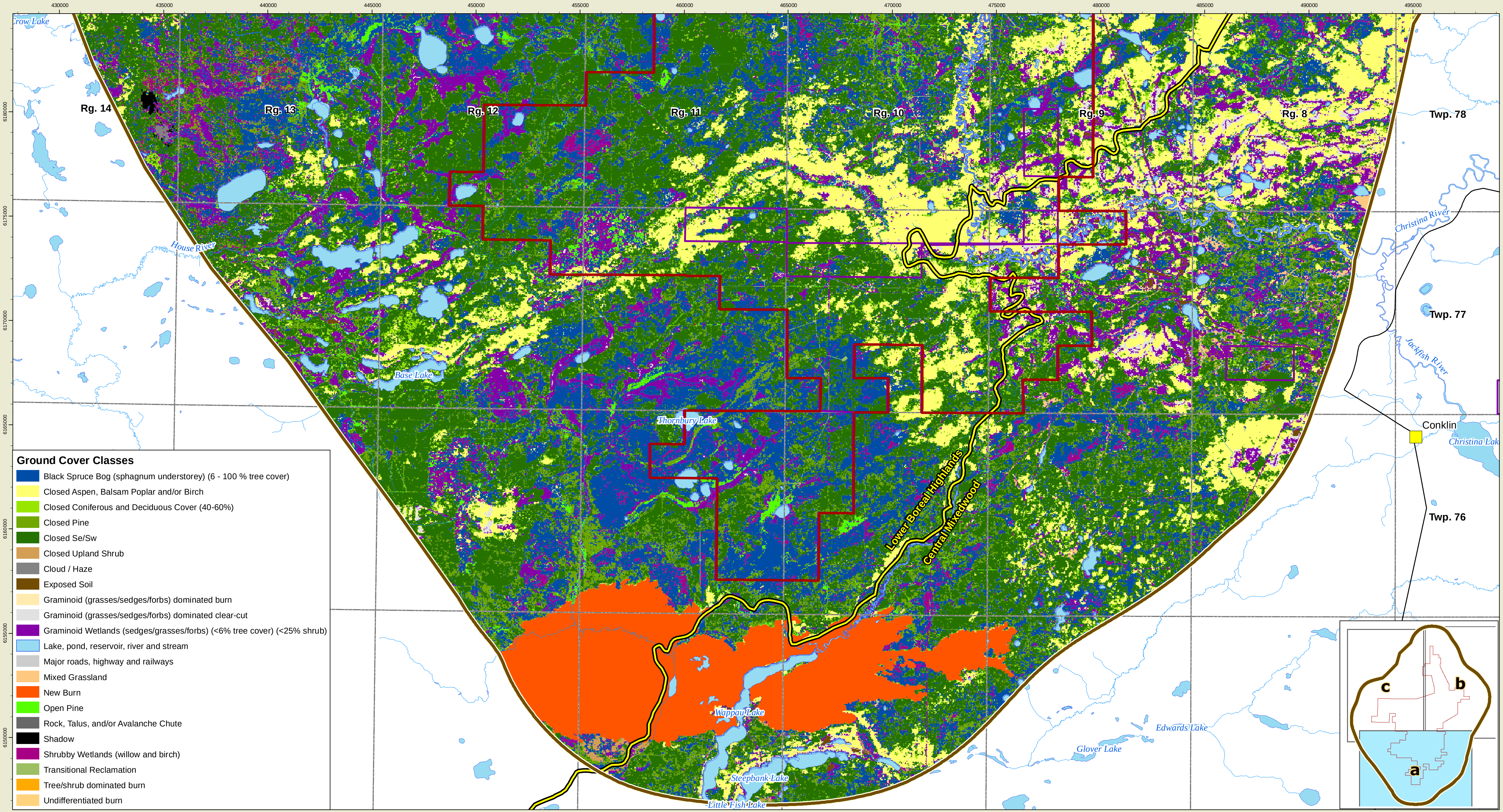

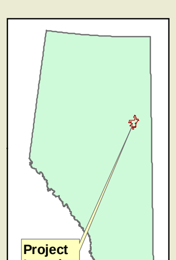

Legend

- North American Vegetation RSA
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Title:

DISTRIBUTION OF GROUND COVER CLASSES IN THE RSA AT CLOSURE

NORTH AMERICAN OIL SANDS CORPORATION

Approved: LM/PB	Revision Date: July 9, 2007	
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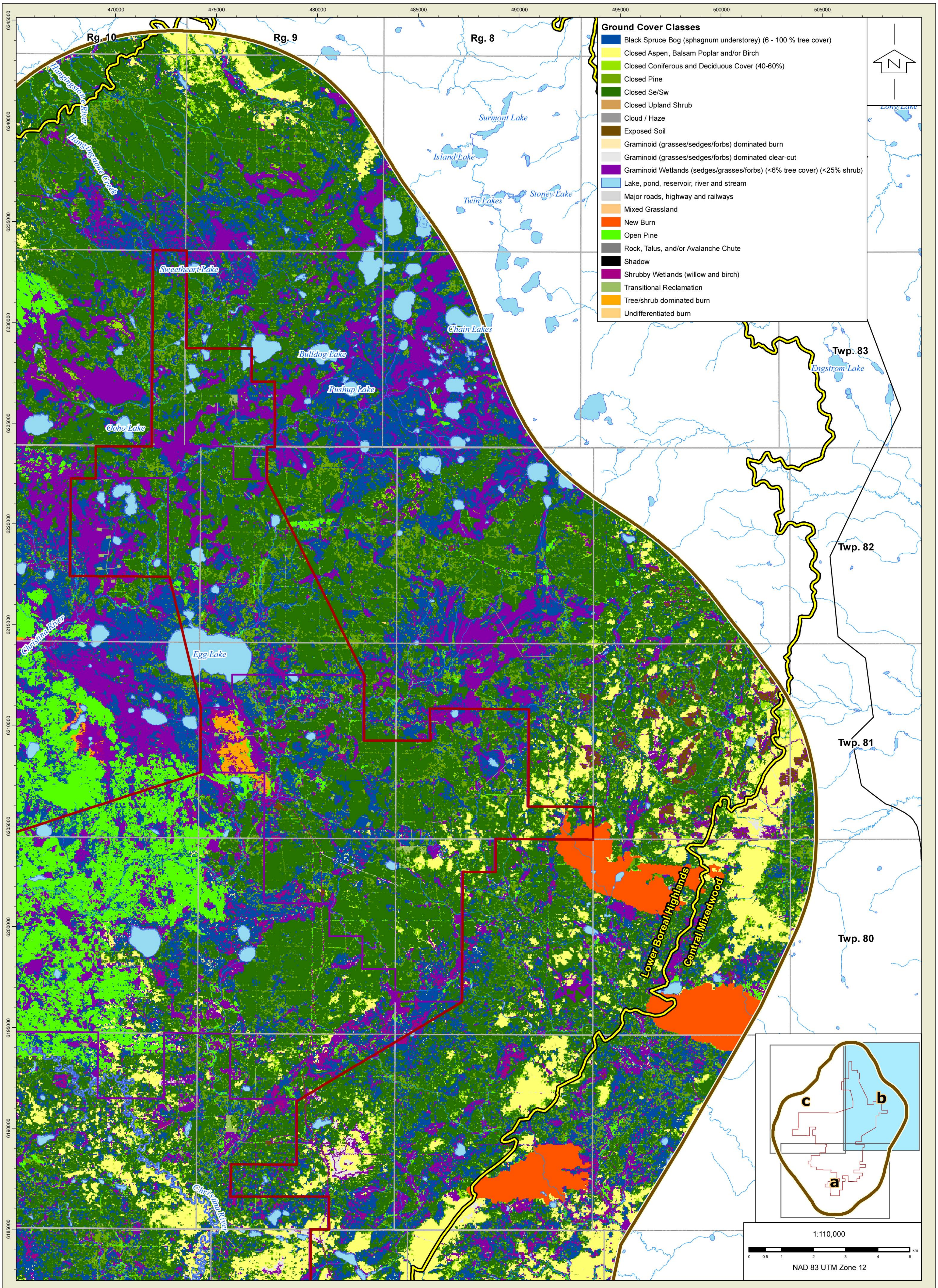

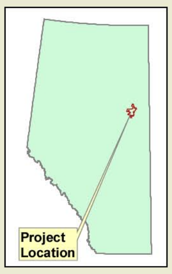

Legend

- North American Vegetation RSA
- North American Vegetation LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
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- Twp. Rg. Lines

Title:

DISTRIBUTION OF GROUND COVER CLASSES IN THE RSA AT CLOSURE

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
LM/PB	July 9, 2007	
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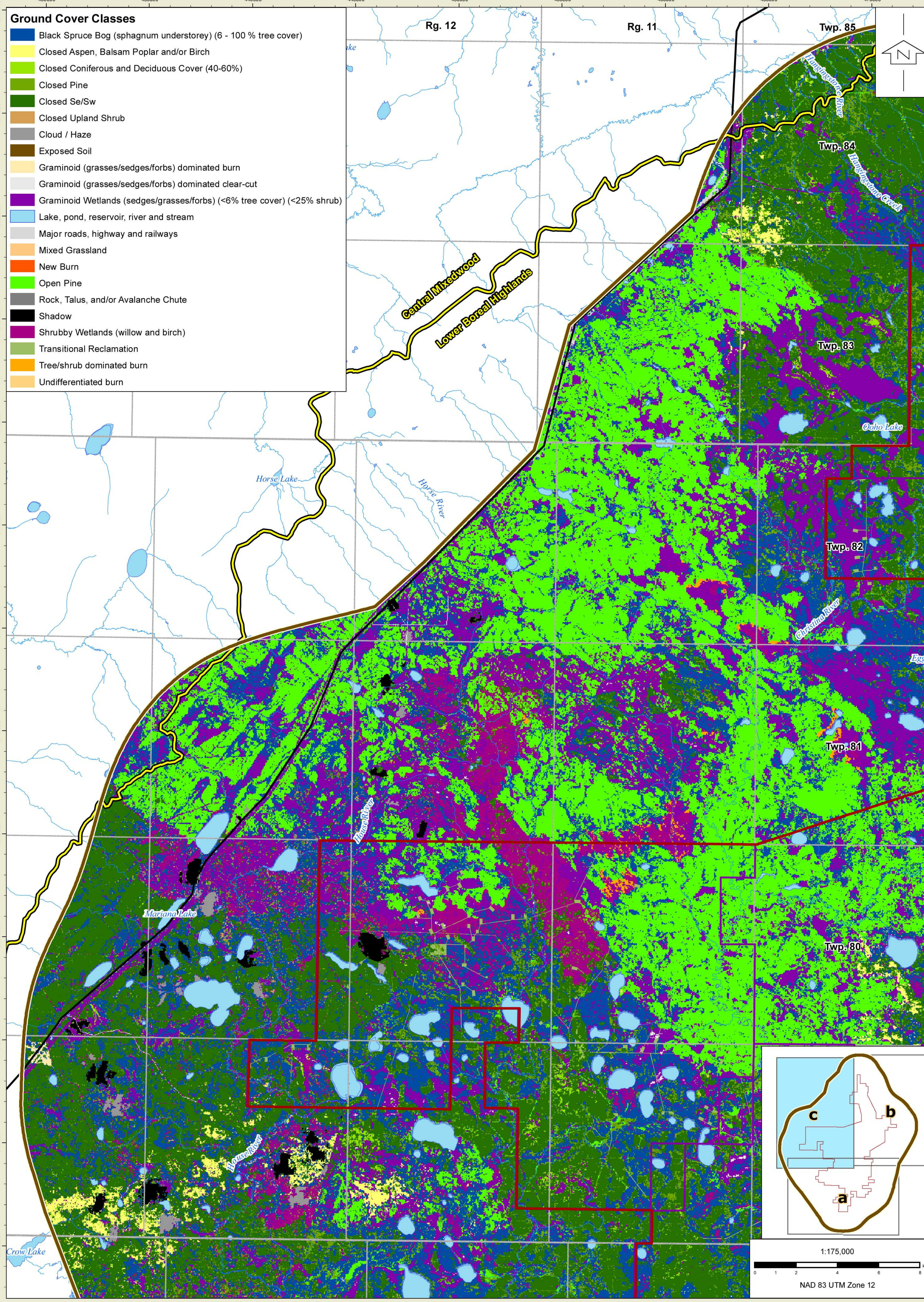

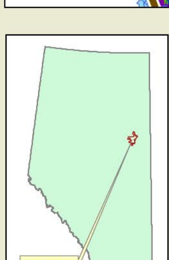

Legend

- North American Vegetation RSA
- North American Vegetation LSA
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- Major Road (Hwy. 63)
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Title:

DISTRIBUTION OF GROUND COVER CLASSES IN THE RSA AT CLOSURE

NORTH AMERICAN OIL SANDS CORPORATION

Approved: LM/PB		Revision Date: July 9, 2007
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10.7 Cumulative Effects Assessment

A cumulative effects assessment (CEA) considers the impacts of the Project with other existing, approved, planned and potential projects in the region that overlap temporally and spatially. These projects are listed in Volume 2, Section 1 and include other planned or existing oil and gas facilities, forest harvesting, recreational activity and road construction (possible connector highway and bypass between Highway 63 and Highway 881).

At the time of this assessment, there were no publicly announced future oil sands developments identified in the RSA. Future industrial activities within the RSA are predicted to include exploration for oil and gas, seismic activity and forest harvesting, however, quantitative details (or footprints) of these future activities and associated developments are not available to North American. As such a qualitative CEA was conducted for vegetation.

For the purposes of the cumulative effects assessment, the following assumptions have been made:

- Vegetation mitigation, and reclamation methods for the planned and proposed projects will be similar to those identified by North American;
- End land use targets for the planned and proposed projects will be similar to North American's; and
- Coordination of site developments, through integrated land management, is a successful form of mitigation.

Based on these assumptions, potential impacts and mitigation measures in the cumulative case are anticipated to be similar to those discussed in the application case. Therefore, the residual cumulative impact rating to vegetation, at closure, is predicted to be low as in the application case. The confidence of the CEA predictions is lowered by the uncertainty of future project timing and details.

10.8 Follow-up and Monitoring

North American is supportive of the Alberta Biodiversity Monitoring Program and will facilitate monitoring under this program within the project area. As much of the project area is located on wetland ecosite phases, North American will also work with other developers, local stakeholders and the government on developing wetland initiatives.

North American is working cooperatively with industry and stakeholders on an integrated land management strategy. As part of this cooperation, Al-Pac will be providing updated Forest Management plans for the area. With consultation, clearing for development of the Project will be coordinated with annual allowable cuts and Al-Pac's quotas within the Timber Management Unit.

North American will introduce a weed management and control program for the Project.

10.9 Summary

The LSA and RSA associated with the Project were assessed for impacts via vegetation removal and alterations in hydrology on rare species, potential rare plant habitat, rare plant communities, communities with limited distributions, old-growth forests, wetlands, traditional and medicinal plants, forest productivity and forest merchantability.

The majority of the LSA is located in the Lower Boreal Highlands Subregion of the Boreal Forest Natural Region, with the remainder located in the Central Mixedwood Subregion. Eighty percent of the LSA is forested (having 6% or greater total tree cover). Lowland wetland vegetation comprises 54% of the LSA, with terrestrial vegetation comprising 34%. Five percent of the LSA was classified as old-growth forest. Ten rare vascular plant species and three rare non-vascular plant species were observed in the LSA.

The proposed development will have a low impact on wetlands. Portions of disturbed wetlands will be reclaimed to upland ecosite phase g1, and a “g1-transition” ecosite phase. Pipelines and power lines will be reclaimed to pre-disturbance wetland ecosite phases, whereas access roads will be reclaimed to a g1 ecosite phase. Well sites and CPFs on peatlands will have portions reclaimed to both an upland (g1) and to a “g1-transition” ecosite phase. The Project development will result in the removal of 1% of the wetlands in the LSA. The effect of vegetation removal on these habitats is predicted to be low.

It is anticipated that construction and operation of the Project will not impact or change the drainage patterns in the LSA and therefore have little impact on vegetation. Any resulting changes in water table elevation could initiate changes in plant community composition, structure and ecosystem function. With the use of appropriate hydrological reclamation and mitigation options (including avoidance, culverts, diversion channels and effective water use), impacts of hydrological changes on vegetation will be low.

Removal of vegetation is expected to have a low impact on rare plant species. Hydrological impacts are anticipated to have no impact (Volume 3 Section 5) and therefore hydrological impacts on rare plant species are judged to be low. A high percentage of potential rare plant habitats are composed of wetland ecosite phases. A reduction in the total area of wetlands in the LSA would reduce the amount of high and moderate potential rare plant habitat. The environmental impact for high and moderate potential rare plant habitat is low. Low potential rare plant habitat will increase and the environmental impact is anticipated to be low. The environmental impact on very low potential rare plant habitat will be low. One rare community was found in the LSA. As it was not within the footprint, there is no environmental impact anticipated.

Five communities with limited distribution occur in the LSA, two of these communities have wet soils and could be negatively affected by changes in hydrology. However, alterations to hydrology are expected to be negligible, and therefore environmental impact to these communities is anticipated to be low. The community of limited distribution most affected by vegetation removal is classified as f1 horsetail – white spruce ecosite phase which is not common in the LSA. Reclamation of this community is possible over the medium-term. The environmental impact of vegetation removal on these communities is expected to be low.

The impact of vegetation removal on timber resources and old-growth forest is predicted to be low. Productive and merchantable lands will be reclaimed to an equivalent capability at closure. The impact of development on old-growth stands will be long-term but low in magnitude. The environmental impact for productive forests, merchantable lands and old-growth forests is anticipated to be low.

Removal of vegetation and alterations to hydrology are predicted to have a low impact on traditional and medicinal plants. Indicator species assessed are found in upland communities, which will be reclaimed to upland sites with similar baseline conditions.

The contribution of the Project to cumulative effects for PAI is predicted to be low.

Table 10.9-1 Summary of Potential Impacts on Vegetation in the LSA

	Parameter	Direction	Extent	Magnitude	Duration	Frequency of Occurrence	Permanence	Level of Confidence	Final Impact Rating
Ecological Units	Vegetation Removal on terrestrial ecosite phases	Positive	Regional	Negligible	Medium-term	Isolated	Reversible in medium-term	Medium	Low
	Vegetation Removal on wetland ecosite phases	Negative	Subregional	Negligible	Long-term	Isolated	Irreversible	Medium	Low
	Alterations in hydrology on terrestrial ecosite phases	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No impact
	Alterations in hydrology on wetland ecosite phases	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in medium-term	Medium	Low
Rare Plants	Removal of Vegetation	Neutral (& Negative)	Subregional	Low	Medium-term (& Long-term)	Isolated	Reversible in medium-term (& Irreversible)	Medium	Low
	Alterations in hydrology	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in medium-term	Medium	Low
Potential Rare Plant Habitat	Removal of High Potential Rare Plant Habitat	Negative	Subregional	Negligible	Long-term	Isolated	Irreversible	Low	Low
	Removal of Moderate Potential Rare Upland Plant Habitat	Negative	Subregional	Negligible	Medium-term (& Long-term)	Isolated	Reversible in medium-term (& Irreversible)	Low	Low
	Removal of Moderate Potential Rare Wetland Plant Habitat	Negative	Subregional	Negligible	Long-term	Isolated	Irreversible	Low	Low
	Removal of Low Potential Rare Plant Habitat	Positive	Subregional	Negligible	Medium-term (& Long-term)	Isolated	Reversible in medium-term (& Irreversible)	Medium	Low
	Removal of Very Low Potential Rare Plant Habitat	Neutral	Subregional	Negligible	Medium-term	Isolated	Reversible in medium-term	Medium	Low
	Alterations in hydrology	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in medium-term	Medium	Low
Rare Communities	Removal of Vegetation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No impact
	Alterations in hydrology	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No impact
Communities of Limited	Removal of Vegetation	Neutral	Subregional	Negligible	Medium-term	Isolated	Reversible in medium-term	Medium	Low

	Parameter	Direction	Extent	Magnitude	Duration	Frequency of Occurrence	Permanence	Level of Confidence	Final Impact Rating
Distribution	Alterations in hydrology	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in medium-term	Medium	Low
Wetlands and Peatlands	Removal of Vegetation	Negative	Subregional	Negligible	Long-term	Isolated	Irreversible	Low	Low
	Alterations in hydrology	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in long-term	Low	Low
Productive Forests	Removal of Vegetation	Positive	Subregional	Negligible	Medium-term	Isolated	Reversible in medium-term	Medium	Low
Forest Merchantability	Removal of Vegetation	Positive	Subregional	Low	Medium-term	Isolated	Reversible in medium-term	Medium	Low
Old Growth Forests	Removal of Vegetation	Negative	Subregional	Negligible	Long-term	Isolated	Reversible in long-term	Medium	Low
Traditional and Medicinal Plants	Removal of Vegetation on Cranberry Habitat	Positive	Subregional	Negligible	Short-term	Isolated	Reversible in short-term	High	Low
	Alterations in hydrology on Cranberry Habitat	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in long-term	Low	Low
	Removal of Vegetation on Blueberry Habitat	Positive	Subregional	Negligible	Long-term	Isolated	Reversible in short-term	Medium	Low
	Alterations in hydrology on Blueberry Habitat	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in long-term	Low	Low
	Removal of Vegetation on Strawberry Habitat	Positive	Subregional	Negligible	Short-term	Isolated	Reversible in short-term	High	Low
	Alterations in hydrology on Strawberry Habitat	Neutral	Subregional	Negligible	Medium-term	Continuous	Reversible in long-term	Low	Low

n/a - not applicable

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11 WILDLIFE

11.1 Introduction

This section presents the baseline and impact assessment of wildlife resources for the proposed Project. Existing regional information was reviewed for the Project and field studies were conducted in 2006 and 2007 to assist in quantifying and describing baseline wildlife conditions within the wildlife study areas selected for the assessment. In addition to field studies conducted for the Project, wildlife data from other regional projects were reviewed and/or utilized.

This section of the EIA has been prepared in accordance with the requirements prescribed under the *Alberta Environmental Protection and Enhancement Act* (EPEA) and the final terms of reference (TOR) for the Project (AENV, 2006).

11.2 Study Areas

11.2.1 Local Study Area

Site selection for the Project footprint began in 2005 and has continued as the Project design has evolved. Soil and vegetation sampling was initiated in 2005 based on preliminary geological results and the North American land holdings at the time. Preliminary facility placements were based on:

- Maximizing resource recovery;
- Terrain (i.e., upland locations were preferred as were locations with minimal change in topography, thereby reducing need for cut and fill); and
- Avoiding open water bodies and defined water course channels (having defined bed and bank material).

Initial geological resource mapping, as defined in 2006, was used to further refine the 2006 vegetation study design and to establish the vegetation LSA boundaries. The same LSA was considered for the wildlife assessment since the wildlife assessment is dependant on vegetation. North American acquired over 50 townships of Alberta Vegetation Inventory/Ecological Land Classification (AVI/ELC) data for the Project to map vegetation in all lease areas. As the LSA was being defined, the development of the Project footprint was still in preliminary stages. Plans for utility rights-of-way (ROWs) connecting North American's leases were conceptual; the precise location of the ROWs was not defined. Therefore, vegetation on lands between the leases was also mapped.

The lease boundary and interconnecting lands encompass almost 16 townships of land. Consideration was given to decreasing the LSA size in order to reduce the dilution effect on assessed impacts of such a large LSA; however, insufficient engineering was available to eliminate any of these lands from potential development.

Since the initial selection of the LSA, North American has continued to refine the footprint layout based on a constraints mapping approach to avoid sensitive areas within the lease boundaries. North American made modifications to the footprint layout based on information acquired from the geological data collection, hydrogeological data, aquatics, and soils and vegetation surveys conducted in 2005 and 2006 combined with the AVI/ELC mapping and survey imagery (i.e., still photography images, aerial video, line scans and LIDAR, including topography).

As the Project footprint was further refined, several changes were made. North American examined each development area to determine the best well trajectories, giving consideration to variability in oil/water contact, reservoir quality and character differences in the channels. Options for well pair placements in the channel trends considered non-reservoir shale plugs and various types of potential thief zones. Two SAGD pads were moved outside of the North American lease lands; however, well trajectories were designed to drain the resources from within the leases. Engineering and hydrogeologic assessment resulted in several source water and water disposal wells being located outside of the North American leases. In addition, the ROWs interconnecting the hubs were defined, some of which extended between North American leases. The refined Project footprint was used to assess impacts related to the Project.

The evolution of the Project footprint, following completion of the field programs, has resulted in small portions of the Project footprint occurring outside of the vegetation and wildlife LSA boundary. The initial developments of Leismer Commercial, Leismer Expansion and Corner hubs are entirely within the LSA. The small portions of infrastructure that are outside of the LSA are more conceptual in nature and are associated with future development. The implications of the small portions of the footprint being outside of the LSA were not considered to affect the overall evaluation of wildlife impacts. In addition, it is anticipated that the overall Project footprint will be further refined, based on additional geological, biophysical and construction/reclamation information. Prior to construction, pre-development assessments (PDAs) will be conducted on the CPFs and SAGD pads to evaluate potential impacts and to develop conservation and reclamation (C&R) Plans for each site (Figure 11.2-1).

11.2.2 Regional Study Area

A wildlife RSA has been delineated to evaluate potential effects of the Project that may occur beyond the LSA (Figure 11.2-1) and focussed on species with large home ranges (i.e., black bear, moose, and woodland caribou). The RSA incorporates:

- Regional industrial developments and ecological variables that have the potential to interact cumulatively;
- Existing, approved, and planned land uses such as forestry, industrial, and natural areas;
- An area that is sufficient in size to assess the cumulative impacts for wildlife species that are known to occupy large home range areas (black bears, moose and woodland caribou); and
- Lands that Al-Pac is harvesting for forestry resources, based on a Forest Management Agreement (FMA).

Two RSAs were used: one was delineated for black bears and moose and a separate RSA was delineated for woodland caribou (Caribou RSA).

The RSA was designated based on a region of influence (ROI). Moose home ranges are known to vary among individuals and regions; however, they seldom exceed 5 km to 10 km in width (LeResche and Rausch, 1974). Therefore, an 11 km radius from the LSA boundary was used to determine the ROI. The RSA for black bears and moose is 474,702 ha (4,747 km^2). The boundary was extended to the edge of highway 63 where the 11 km boundary was close to that feature. Given the ecological interrelationships among vegetation, wildlife and biodiversity, this RSA was used in the assessment process for all of these disciplines.

The caribou RSA is 360,767.5 ha (3,608 km^2; Figure 11.2-1). It contains approximately 85% of the Egg-Pony caribou herd range and a small portion of the Wiau caribou herd range. It is partially bound on the southeast by Conklin, and on the west by Highway 63. It is large enough to support and assess the Project effects and the regional cumulative effects of caribou in this area. It was fine-scale, empirically derived caribou habitat model that was estimable across the entire extent of the caribou RSA.

Projects within these RSAs include Whitesands In-situ Project, Petro-Canada Meadow Creek, JACOS Hangingstone and Connacher Great Divide. These projects have been previously assessed and therefore are included in the baseline.

11.2.3 Temporal Boundaries

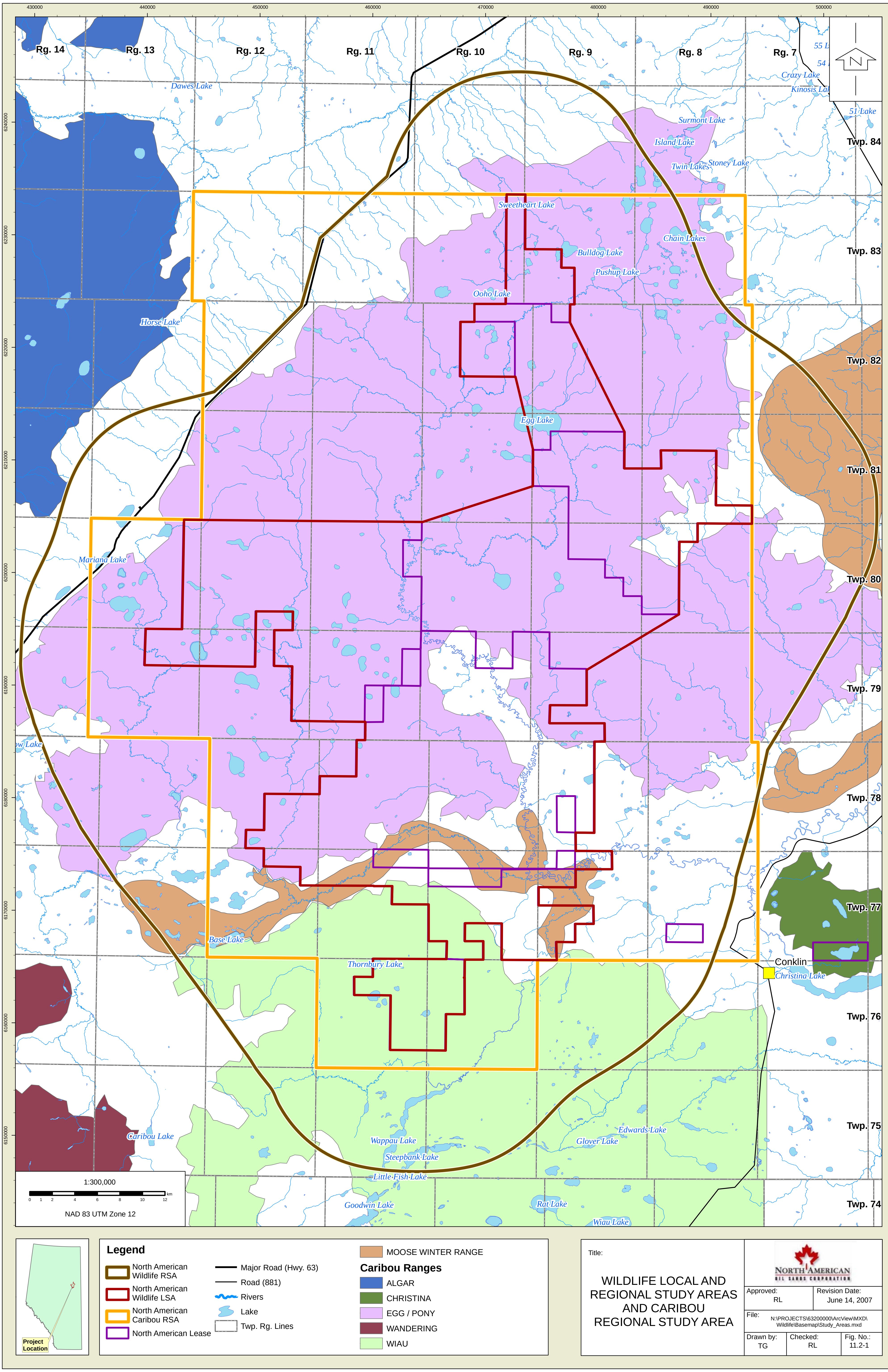
The temporal scope of the EIA reflects the timing and nature of Project phases as well as information available on other proposed projects. Project and cumulative project effects are assessed for the construction, operations, decommissioning and reclamation, and closure phases of the Project. Each phase is assessed at the peak of Project activity. The timing of phases for the Project is:

- Construction – 2008 through 2016
- Operations – 2010 through 2050
- Decommissioning and reclamation – progressive with final decommissioning in 2051 through 2053
- Closure – 2053

Baseline scenario refers to the conditions (existing and approved projects) present in the LSA and RSA as of March 1 2007. The application scenario uses a maximum disturbance case, which assumes that all components of the Project are fully developed and operational at the same time. This conservative, worst-case approach adds a safety margin to the assessment. The closure scenario assumes all facilities have been decommissioned and reclamation activities have been completed.

The temporal boundary for closure for the wildlife assessment extends 70 years beyond the life of the Project. This time frame is anticipated to achieve merchantable timber after reclamation, assuming natural successional trajectories of the various ecosite phases. Reclamation of the facilities will utilize a progressive reclamation approach; as facilities are abandoned, they will be reclaimed. It is expected that, where appropriate, Reclamation Certificates would be issued prior to forest stands reaching merchantable criteria. As Project development is phased over many years, reclamation will be undertaken during the life of Project operation.

Cumulative effects include planned projects that have not yet received approval and include those that were publicly disclosed as of March 1, 2007.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6230000
6220000
6210000
6200000
6190000
6180000
6170000
6160000
6150000
Dawes Lake
Surmont Lake
Island Lake
Twin Lakes
Stoney Lake
Crazy Lake
51 Lake
Sweetheart Lake
Chain Lakes
Bulldog Lake
Pushup Lake
Ooho Lake
Horse Lake
Egg Lake
Mariana Lake
Base Lake
Thornbury Lake
Conklin
Christina Lake
Caribou Lake
Wappau Lake
Steepbank Lake
Edwards Lake
Glover Lake
Little Fish Lake
Goodwin Lake
Rat Lake
Wiau Lake
1:300,000
0 1 2 4 6 8 10 12 km
NAD 83 UTM Zone 12
Project Location
Legend
North American Wildlife RSA
North American Wildlife LSA
North American Caribou RSA
North American Lease
Major Road (Hwy. 63)
Road (881)
Rivers
Lake
Twp. Rg. Lines
MOOSE WINTER RANGE
Caribou Ranges
ALGAR
CHRISTINA
EGG / PONY
WANDERING
WIAU
Title:
WILDLIFE LOCAL AND REGIONAL STUDY AREAS AND CARIBOU REGIONAL STUDY AREA
NORTH AMERICAN OIL SANDS CORPORATION
Approved: RL
Revision Date: June 14, 2007
File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Basemap\Study_Areas.mxd
Drawn by: TG
Checked: RL
Fig. No.: 11.2-1

11.3 Issues and Assessment Criteria

Wildlife issues identified for the detailed assessment follow the TOR (AENV 2006). These issues are consistent with those identified in the Regional Sustainable Development Strategy (RSDS) for the Athabasca Oil Sands area (AENV 1999) and other EIAs produced for relevant oil sands SAGD projects (e.g., Gulf Surmont In-situ Oil Sands Project, OPTI Long Lake Project, Nexen/OPTI Long Lake South Project, MEG Energy Corp. Christina Lake Regional Project, Petro-Canada Meadow Creek Project).

Potential issues of the Project that may affect wildlife include:

- Impacts to habitat availability resulting from habitat loss and alteration as well as reduced habitat effectiveness;
- Impacts to habitat connectivity caused by barriers to wildlife movements; and
- Impacts to wildlife populations resulting from increased levels of direct and indirect mortality risks associated with project developments and activities.

These potential issues are discussed in more detail in the following sections.

11.3.1 Wildlife Habitat Availability

The Project will result in direct loss of habitat, as well as reduced habitat effectiveness adjacent to facilities. Developments such as wellpads, roads, and Project infrastructure will reduce wildlife habitat availability for many wildlife species. Direct habitat loss results from the physical clearing of vegetation and soils. Indirect habitat loss is often referred to as reduced habitat effectiveness. This means that while habitats directly adjacent to infrastructure and roads may provide the life requisites for a certain species (e.g., feeding areas, hiding cover), the human use associated with these developments may deter some species from using these habitats.

11.3.2 Habitat Connectivity

SAGD projects involve development of infrastructure and facilities, including roads, seismic, above and below ground pipelines and electrical power lines. Many of these developments create linear habitat disturbances that fragment the landscape and may reduce habitat connectivity (Fahrig, 1997). Linear developments may impede movements of wildlife along corridors between seasonal ranges, between foraging and cover habitats and restrict long-distance dispersal of individuals (Jalkotzy et al., 1997, Forman et al., 2003). Impediments to wildlife movement can result in population declines or local extirpations (Jalkotzy et al., 1997, Forman et al., 2003).

11.3.3 Mortality Risk

Wildlife populations fluctuate with changes to growth rates (fecundity and mortality), immigration, and emigration (Krebs, 2001). Project related developments and activities may negatively impact wildlife populations by affecting any one of these factors. In particular, the Project may impact wildlife populations by directly and or indirectly increasing the risk of wildlife mortality (factors that contribute to animal mortality).

Direct project-related mortality may result from a number of factors. Direct mortality occurs primarily during habitat clearing or collisions with Project equipment and vehicles. Habitat clearing poses a direct risk to wildlife as a result of possible destruction of nests, dens or hibernacula of hibernating species. Also, Project-related direct mortality can result from legal and illegal hunting by Project personnel and destruction of problem wildlife as a result of encounters or attraction to human activities and facilities. Hunting by Project personnel during any phase of the Project will be discouraged, and North American employees and contractors will be prohibited from carrying firearms when working on Project sites. Therefore, mortality related to hunting by Project personnel is not considered a risk in this assessment.

Indirect Project-related mortality risk associated with Project developments can result from changes to habitat characteristics that increase access for hunters, poachers and in some cases predators. This can also occur from reductions in the amount of undisturbed habitat. Typically, most hunting and trapping occurs near roads or other points of access such as seismic cut-lines. Increases in linear corridors consequently increases the amount of area easily accessible to hunters, trappers and predators (Schallenberger, 1980; Cole et al., 1997; Hayes et al., 2002; Westworth 2002; Forman et al., 2003). This is particularly problematic for caribou, where an increase in linear features can increase the predation pressure by wolves, negatively affecting the caribou population (James and Stuart-Smith, 2000; James et al., 2004; Alberta Woodland Caribou Recovery Team, 2005). Increased access can also be a significant issue for other hunted species such as moose and black bears.

Indirect mortality can also manifest itself through increased stress levels. Activities such as the presence of humans, noise from seismic, vehicles, and industrial operations can potentially displace animals from key habitats and force them to use less than optimum habitats (e.g., Wielgus and Bunnell, 1994). Increased stress levels can also have implications on reproductive success (Wasser, 1999; Phillips and Alldredge, 2000; Shively et al., 2005).

11.4 Methods

11.4.1 Field Surveys

The purpose of the baseline surveys was to provide current information on species presence, distribution and habitat use within the LSA. In addition, surveys helped to identify important wildlife habitats and seasonal uses for some species and to provide information used for habitat suitability model validation (Appendix 11A). The surveys conducted were determined based on consultation with ASRD and to meet the TOR for the Project (AENV, 2006). Specifically, surveys were designed to gather baseline information on indicator species and species at risk.

The baseline assessment for the Project consisted of six different wildlife surveys, conducted in 2006 and 2007. Each survey had a specific emphasis on a different suite of wildlife species:

- Scat collection program – provided precise information on habitat use by wolf, moose and caribou and provided information on the potential effects of human disturbance on wildlife health (preliminary findings only);
- Winter track count survey – provided information on presence, relative abundance, distribution and habitat use of upland gamebirds (i.e., grouse and ptarmigan), small mammals (i.e., red squirrel and snowshoe hare), furbearers (i.e., weasel, marten, fisher, wolverine, lynx, red fox, coyote and wolf) and ungulates (i.e., deer, moose and caribou);
- Bat survey – gathered information on the presence of bats in the LSA;
- Barred owl survey: gathered information on presence and distribution of barred owls and other species of owls within the LSA;

- Breeding bird survey – gathered information on the relative abundance of, and habitat use by, birds in the LSA; and

- Canadian toad survey: gathered information on the abundance of, distribution of and habitat use by Canadian toads in the LSA.

Wildlife field surveys including those listed above were conducted in the Corner and Leismer areas of the wildlife LSA. Field surveys were not conducted in the South Leismer, Thornbury and Hangingstone areas of the LSA based on a decision made in consultation with ASRD for the following reasons:

- North American is proactively conducting a long term study to assess and monitor the effects of the Project on wolf, moose and caribou within and beyond the wildlife LSA (section 11.4.1.2); and

- To focus other wildlife surveys within areas of the LSA that would be initially developed by North American (the Corner and Leismer areas).

Data-sharing agreements with other operators and projects (Nexen/OPTI Long Lake South Project and the Nexen Cottonwood Project) allowed opportunity to gather additional baseline data from surveys conducted in the RSA. The approaches used in these surveys are consistent with the methods used by North American for field surveys in the LSA. Data was gathered from the following field surveys conducted in the RSA:

- Winter tracking survey (rationale provided previously); and

- Breeding bird survey (rationale provided previously).

11.4.1.1 Scat Detection Survey

North American initiated a long term study in 2006 to monitor change in the abundance, distribution and physiological health of wolf, moose and caribou within the LSA and in a control area (added in 2007). Of particular concern are caribou, which are primarily found within distinct ranges in northern Alberta (Dzus, 2001; Alberta Woodland Caribou Recovery Team, 2005). The East Side Athabasca River (ESAR) Caribou Range is located within the RSA and overlaps two of the sub-ranges, primarily the Egg-Pony as well as part of the Wiau (Figure 11.4-1). This study is being conducted by Dr. Samuel Wasser of the Center for Conservation Biology at the University of Washington.

The assessments employ a comprehensive, non-invasive program for monitoring population health. The measures include: a physiological health panel that can be acquired non-invasively from stress, reproductive and nutrition hormones in the scat of these species (Wasser et al., 2004). Positive identification of species, sex, individual identities and population estimates may be acquired from DNA in those same samples (Wasser et al., 2004). Scat locations were marked by GPS, to gather habitat use information and to determine the spatial distribution of scat samples and disturbances. In addition, the scat locations were used to develop an empirical habitat model (resource selection model; Manly et al., 2002; Lele and Keim, 2006) for caribou.

Scat samples were collected between January and March in both 2006 and 2007, using specially trained scat detection dogs. These dogs were able to locate samples from all three species at considerable distances, even if covered by snow. The dog team (consisting of a dog, handler and trained orienteer) surveyed predetermined blocks, which were selected from an 8 km by 8 km square grid in and just outside of the LSA (Figure 11.4-1). Within the grid, a smaller grid (5 km by

5 km) was placed in the best possible habitat for the target species. Transects were walked within the grid with the dogs off-leash to increase the search area covered (Wasser et al., 2004). During the 2006 and 2007 field program, 40 squares were surveyed within the LSA. In 2007, an additional eight survey squares were sampled northeast of the LSA in a control area.

The following physiological measures are being assessed to partition the various pressures impacting these indicator species:

- Cortisol concentrations: This is an adrenal hormone secreted in response to many external stressors. Elevated cortisol metabolites in feces could reflect stress impacts, such as those resulting from noise and other increases in human activities, starvation or chemical exposure.
- Thyroid hormone secretion: This is reduced in response to nutritional stress. Animals reduce thyroid hormone under nutritional stress to reduce metabolism, making their body more efficient at storing energy. Low thyroid hormone levels thus reflect nutritional stress, implying reduced food availability.
- Reproductive hormones: These are testosterone in males and estrogen and progesterone in females. These hormones reflect changes in reproductive health that could be resulting from stress or toxin-related hormone disruption. If stress-related reproductive suppression is occurring, the reproductive hormones of both males and females will be lower than expected at each reproductive stage. If toxin exposure is impacting this system, the interdependencies of each of the above hormones to one another will be low, but also more erratic and coincident with equally erratic profiles in cortisol and thyroid hormones.

Monitoring changes in these parameters in wolf, moose and caribou populations over time will provide a high probability of quickly detecting impacts, allowing them to be mitigated before they become irreconcilable.

The scat detection survey and associated research is an ongoing monitoring program. Preliminary results are provided from hormone and scat-location analysis. Final analysis and assessment from further research will be provided at a future date.

11.4.1.2 Winter Track Count Survey

Winter tracking surveys were conducted in February 2006 for three projects: North American Kai Kos Dehseh Project, Nexen Cottonwood Project and Nexen/OPTI Long Lake South Project. Data from these surveys were combined to create a regional dataset (Figure 11.4-2). The winter tracking surveys were conducted using linear transects to determine winter habitat use, presence, and distribution of wildlife in the LSA. Winter tracking was conducted using Finnish Triangles (Hogmander and Penttinen, 1996). This sampling protocol is used by the Alberta Biodiversity Monitoring Initiative, and by researchers at the University of Alberta (Bayne 2006, pers. com.; Nielsen et al., 2006). Each Finnish triangle was 2 km per side for a total length of 6 km. The triangles were positioned to obtain a representative sample of each ecosite phase. Each triangle was sampled once during the winter season.

Winter tracking data from the three projects was pooled and resulted in a total distance sampled of 157.8 km (Table 11.4-1). A total of 18 ecosite phases were sampled with the distance surveyed ranging from 0.1–30.7 km (average 8.3 km) for each ecosite phase. Criteria defined by Beckingham and Archibald (1996) were used to describe ecosite phases found within the LSA.

All wildlife tracks intercepting the transect line were counted and recorded in 25 m intervals. If locations had more than one snowshoe hare or red squirrel track (e.g., runs) and the number of individual tracks could not be determined, five tracks were recorded for snowshoe hare runs and three tracks were recorded for red squirrel runs. Tree and shrub species cover was also recorded in every 25 m interval, which aided in verifying the mapped ecosite phase. Snow depth was recorded every 100 m, which was used to determine if wildlife distribution was affected by snow depth (further details follow).

Tracking commenced within 48 hours of a fresh snow fall (greater than 5 cm), allowing time for tracks to accumulate. This increased the probability of detecting tracks, especially for uncommon, wide-ranging species, such as fisher and lynx (Raine, 1983; Squires et al., 2004). Tracking occurred over a period of several days and, therefore, a standardized index of track abundance was used to examine the number of tracks observed per kilometre per day (i.e., tracks/km/d) for each species. This standardized index of track abundance has been used in other tracking studies and inventory standards (e.g., Raine, 1983; British Columbia Ministry of Environment, Lands and Parks, 1998).

Snow depth can affect the distribution of some wildlife species. The distribution of deer, for example, can be restricted if snow depths exceed 30 cm to 40 cm (Sabine et al., 2001). Similarly, snow depths in excess of 70 cm might restrict moose movements (Schwab and Pitt, 1991). Snow depth was measured to the nearest centimetre every 100 m along each tracking transect to determine if it affected the distribution of some wildlife species within the LSA. A generalized linear model (GLM) statistical analysis was used to determine if snow depth, in combination with habitat, was a significant factor in the distribution of deer and moose.

Table 11.4-1 Winter Track Count Sampling Effort by Ecosite Phase

Ecosite Phase	Distance Sampled (km)	Percentage of Total Distance Sampled (%)	Ecosite Phase Percent Area in LSA (%)
Ecosite Phases			
a1 – bearberry Pj	0.1	0.1	1.7
b1 – blueberry Pj-Aw (Bw)	12.6	8.0	2.8
b2 – blueberry Aw	2.5	1.6	0.7
b3 – blueberry Sw-Pj	0.2	0.1	0.4
c1 – Labrador tea-mesic Pj-Sb	11.6	7.4	8.0
d1 – low-bush cranberry Aw	21.3	13.5	5.7
d2 – low-bush cranberry Aw-Sw-Sb	9.5	6.0	2.4
d3 – low-bush cranberry Sw	3.5	2.2	0.9
e1 – fern Sw	0.1	0.1	1.1
f1 – horsetail Sw	0.1	0.1	0.1
g1 – Labrador tea-hygric Sb-Pj	30.7	19.5	9.8
h1 – treed bog	20.0	12.7	25.9
h2 – shrubby bog	5.4	3.4	4.3
i1 – treed poor fen	7.4	4.7	5.4
i2 – shrubby poor fen	8.8	5.6	5.0
j1 – treed rich fen	3.8	2.4	7.4
j2 – shrubby rich fen	10.2	6.5	3.1
j3 – graminoid rich fen	3.2	2.0	2.5

Ecosite Phase	Distance Sampled (km)	Percentage of Total Distance Sampled (%)	Ecosite Phase Percent Area in LSA (%)
Other			
Other – AIG, AIH, CC, CIW, CL, SR, NWL, NWR	6.8	4.3	12.8
Total	**157.8**	**100.0**	**100.0**

AIG – gravel pits, borrow pits

AIH – permanent highways, rights-of-way, railroads, dam sites

CC- clearcut

CIW – wellsites

CL – clearing

SR – shrubby riparian

NWL – lake and ponds subject to seasonal thaw

NWR – rivers

11.4.1.3 Bat Survey

Two bat surveys were conducted in the LSA (July 30–August 4 and August 14–16, 2006) to determine the presence, sex, age, reproductive status and size of bats or bat groups. Two methods were used to detect bats: mist netting (physically capturing bats) and using the AnaBat II Bat Detector (Detector) (identifying bats through their echolocation calls) with Compact Flash Zero Crossings Analysis Interface Module (CF ZCAIM; Titley Electronics). Mist nets were placed at four locations at four different sites along cutlines, overgrown trails and over streams between old-growth forests (roosting habitat) and wet areas such as streams, bogs and marshes (foraging habitat) (Figure 11.4-3). To survey during peak bat activity, mist nets were set up shortly after dusk and dismantled between 0200–0300 hours (British Columbia Ministry of Environment, Lands and Parks, 1998). The total mist netting effort was 141 net-hours (a single net set up for one hour equals one net-hour). The nets ranged from 1.8 m to 6.1 m in height and 6 m to 12 m in width.

To decrease stress and the probability of injury to bats, nets were monitored constantly and bats were removed quickly after capture (CCAC, 2006, website). Individual bats were placed into cloth bags and held for an hour to allow food to clear the digestive tract for a more accurate weight measurement during processing. Data collected on individual bats and net locations was based on protocols developed for bat surveys in Alberta (Vonhof, 2000).

Measurements of the captured bats included species identification, sex, reproductive status, age (according to juvenile/adult characteristics), weight (using a digital scale) and forearm length (using calipers) (British Columbia Ministry of Environment, Lands and Parks, 1998). Bats were released immediately following processing.

Bat detectors were used to identify bats to species by their echolocation calls. Use of the Detector helps provide information on species that typically would not be captured by mist netting, especially bats that forage high up in the forest canopy (British Columbia Ministry of Environment, Lands and Parks, 1998). The Detector is able to distinguish between foraging versus navigating activity (i.e., feeding buzzes versus navigation passes), which gives more information regarding bat behaviour at a site. A Detector was set up in the vicinity of the nets each night to compare netting success versus activity levels recorded. Digital recording files were analyzed to determine species and activity levels within the area. To differentiate among species, all sonogram data were visualized and a measured call slope was necessary to differentiate similar species on a frequency-time display using Analook version 4.9j (Corben, 2004). The minimum frequency and call slope (of the main body of the bat call) were used, along with overall call shape and pattern of calls to determine species categories. A set of criteria established by Patriquin and Barclay (2003) were used for discriminating between background noise and calls.

11.4.1.4 Barred Owl Survey

A survey specifically targeting barred owls was conducted in the LSA from May 17–25, 2006. Other owl species, if detected, were also recorded. Stations were located approximately 1,600 m apart, as recommended by Takats et al. (2001), to maximize coverage of the survey area and minimize the chance of surveying the same owls twice. Fifty-one stations were surveyed and, with a listening radius of 800 m, a total of 6% of the LSA was surveyed (Figure 11.4-4).

Surveys commenced one half hour after sunset and ended at approximately 3:00 a.m. At each station, observers remained silent for two minutes to allow their initial disturbance to subside and to listen for owls already calling. Johnny Stewart Power Pro Convert-A-Callers™ were used to broadcast recordings of owl calls. The recording consisted of 30 seconds of calling followed by one minute of silence for each of three species of owl (boreal owl, great gray owl and barred owl). The playback ended with two minutes of silence. This protocol follows the established survey methodology outlined by the Guidelines for Nocturnal Owl Monitoring in North America (Takats et al., 2001) and the Alberta Wildlife Animal Care Committee Class Protocol #006 (ASRD, 2005a, Internet site). It is not necessary to broadcast calls of all species of owls that may be present, since it has been observed that most species will respond to various owl calls. The order of broadcast calls was as follows: boreal owl, great gray owl and barred owl. The calls of the boreal owl were broadcast first since small owl species may not call if larger owl species are calling in the area.

If an owl or owls were detected, their location was obtained by either direct observation or through triangulation. Triangulation involved obtaining compass bearings and distance estimates for an owl from two separate locations approximately 500 m apart.

11.4.1.5 Breeding Bird Survey

The breeding bird survey focused on songbird or passerine species, but it included all bird species detected during the survey. A modified fixed-radius point count sampling procedure was used with a detection radius of 50 m and the centre point located at least 100 m from a stand edge (British Columbia Ministry of Lands, Environment and Parks 1999). Birds were identified from the centre of the fixed radius plot by sight or sound for a period of 10 minutes. The distance to each bird, sex (if possible) and behaviour were recorded. In addition, observations of birds greater than 50 m away and birds seen or heard before or after the census period were recorded as incidentals.

The breeding bird survey for the Project was conducted from June 20 to 28, 2006, which is within the period of peak breeding activity for birds in this region of Alberta. An additional survey was conducted for the Cottonwood project and these data were combined with the Project data. These surveys were conducted during optimal weather conditions (minimal wind and precipitation) and during the early morning period (half hour before sunrise to 10:00 hours), which is the peak activity period for most species of birds (Bibby et al., 2000). A total of 200 census plots were established within 18 ecosite phases (Table 11.4-2 and Figure 11.4-5).

The data were analyzed by both ecosite phase and by broad habitat type classification. For broad habitat type classification, ecosite phases were grouped since small differences in vegetation composition within the shrub and herb layers may not affect habitat use by specific species. Ecosite phases were grouped into nine habitat types using similarities in tree, shrub and herbaceous cover (Table 11.4-2).

The survey data were used to calculate the number of territorial males per 40 ha (Franzreb, 1981). Territorial males are easier to observe and distinguish than their female counterparts due to their conspicuous breeding colours and singing behaviour to attract mates and defend an exclusive territory (Franzreb, 1981). Each territorial male is assumed to represent a breeding pair.

Table 11.4-2 Habitat Classification Used for the Breeding Bird Survey

Habitat Type	Boreal Highlands Ecosite Phases	Number of Sites Surveyed	Total Sites Surveyed
Jack pine	a1	4	4
Coniferous	b3	0	51
	c1	15	
	d3	2	
	e1	3	
	f1	3	
	g1	28	
Deciduous	b2	4	33
	d1	29	
Mixedwood	b1	15	29
	d2	14	
Treed black spruce	h1	26	36
	i1	10	
Shrubby black spruce	h2	9	14
	i2	5	
Treed fen	j1	14	14
Shrub fen	j2/SR	7	7
Graminoid fen and marsh	j3	12	12
Total		**200**	**200**

11.4.1.6 Canadian Toad Survey

Male Canadian toads emit a loud distinct call during the breeding season, which is easily detected. This allows for easy systematic sampling of Canadian toads over a relatively large area. The call of the Canadian toad can be heard up to 1,000 m and therefore, survey points were stratified 1,000 m apart. The Canadian toad survey was conducted June 9 to 10, 2006 within the LSA. A total of 32 survey points were established and sampled during the survey. Based on the 1,000 m listening radius, 5.5% of the LSA was surveyed (Figure 11.4-6). Surveying began one half hour after sunset and ended between 02:30 a.m. and 03:30 a.m. If toads were detected and handled for identification purposes, guidelines for handling of toads were strictly adhered to (Alberta Wildlife Care Committee Class Protocol #003; ASRD 2005b, Internet site).

11.4.1.7 Species at Risk

There are three designations of species at risk (SAR) including species listed federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2007) as Endangered, Threatened or Special Concern, those listed on Schedules 1, 2 and 3 of the *Species at Risk Act*

(SARA 2007, Internet site) and those listed in Alberta as At Risk, May be at Risk or Sensitive (ASRD, 2006).

Information on several SAR was gathered during specific surveys (e.g., Canadian toad), as well as incidentally for the other SAR during all other wildlife surveys.

11.4.2 Habitat Suitability Modelling

Habitat suitability index (HSI) modelling provides the assessment tool for describing impacts resulting from habitat loss and decreased habitat effectiveness (US Fish and Wildlife Service 1980, 1981). The models presented in this report were adapted and modified (where necessary) from the models provided in DCEL (2005) (Appendix 11A). HSI modelling was applied only to indicator species to focus the assessment. These species are considered most vulnerable to Project effects and are species of concern for stakeholders and regional management strategies. Within the Athabasca Oil Sands area, the RSDS was created to provide a framework for balancing development with environmental protection. In October 2000, a multi-stakeholder committee CEMA (2005, Internet site), developed a list of key indicator species and prioritized them into three groups with the highest management priority placed in Group 1. In this assessment, some species within priority Groups 1 and 2 were considered as indicators with consideration also given to species identified through ASRD consultation and species identified as species at risk (Section 11.4.1.7). In this assessment, a total of 14 indicator species or groups of species were selected including:

- Canadian toad;
- Northern goshawk;
- Great gray owl;
- Barred owl;
- Boreal owl;
- Mixedwood forest bird community;
- Old growth forest bird community;
- Beaver;
- Muskrat;
- Fisher;
- Lynx;
- Black bear;
- Moose; and
- Woodland caribou.

All of these indicator species were evaluated in the LSA, while three species with large home ranges were evaluated in the RSA. A larger, more regional scale is required to fully assess the impacts of the Project for wide-ranging species. These include:

- Black bear;
- Moose; and
- Caribou.

The study area for caribou is smaller than the RSA, and is 360,767.5 ha (3,608 km^2). It contains approximately 85% the Egg-Pony caribou herd range and a small portion of the Wiau caribou herd range in northeast Alberta. This caribou study area provided fine-scale habitat mapping using a resource selection probability function (Lele and Keim, 2006).

11.4.2.1 Habitat Availability

Habitat availability reflects an area's capability to support a species. Measures of habitat availability consider both habitat suitability and habitat effectiveness (Gibeau, 2000). Habitat suitability refers to an area's potential to support a species given its biophysical characteristics (US Fish and Wildlife Service 1980, 1981). Habitat effectiveness refers to the willingness or ability, of a species to use habitat that is identified as suitable (Gibeau, 1998). Thus, regardless of the suitability of an area, a species may be unwilling to use the habitat due to factors such as its proximity to human disturbance.

11.4.2.2 Habitat Suitability and Resource Selection Functions

The HSI models estimate the suitability of habitat for a species by relating structural and spatial variables of the habitat (e.g., vegetation and soils) to species-specific requirements (e.g., food and cover). A suitability index (SI) value, ranging from 0 to 1 was assigned to each structural or spatial variable. A value of 0 represents unsuitable habitat and a value of 1 represents optimal habitat. Selection of variables for the models was based on species-specific knowledge using a combination of literature review and expert opinion (US Fish and Wildlife Service 1980, 1981). The final model combines the individual relationships for each structural or spatial variable of the habitat in a mathematical equation. The construction of this equation considers the relative importance of each variable to the species. The result of the model provides an HSI (from 0 to 1) for each habitat polygon (or portion thereof). The HSI value is considered to be low (> 0 to 0.333), moderate (0.334 to 0.666) or high (0.667 to 1.00).

The Resource Selection Function (RSF – Manly et al., 2002) and the Resource Selection Probability Function (RSPF – Lele and Keim, 2006) are functions that compute the probability (or relative probability if RSF is used) that a particular resource, as characterized by a combination of environmental variables, will be used by an individual animal. Resource selection was estimated for caribou in the caribou RSA using these empirical model functions, readily available GIS data, and winter caribou scat-locations collected from trained detection dogs (section 11.4.1.1). Unlike expert and literature-based HSI models, these RSFs and RSPFs use empirical data to derive the probability of habitat use, which is considerably less subjective, and is specific to the ecoregion and area of interest. As with the HSI models, values for low, moderate and high follow a similar scale (values are probabilities of occurrence): low (>0.05-0.3), moderate (>0.31-0.65), and high (0.66-1.00).

11.4.2.3 Habitat Effectiveness

Habitat in close proximity to land-use activities may have lower habitat effectiveness than comparable habitat in remote locations, which is referred to as a region of influence (ROI). Within the ROI, a species may be unable or unwilling to use an area as a result of the disturbance, despite the area having high habitat suitability. The size and shape of the ROI is dependent on the sensitivity of the species to the activity, the intensity and duration of the activity and the topography and vegetation surrounding the activity. Consequently, ROIs are variable among species and areas and they must be selected based on the species sensitivity to various disturbances and on knowledge of the topography and vegetation in the area. To consider habitat effectiveness in a determination of habitat availability, disturbance coefficients ranging between 0 and 1 were applied to the HSI values from the habitat suitability models. The lower the coefficient, the more the habitat suitability adjacent to the disturbance will be reduced. Consequently, habitat considered suitable based on its biophysical characteristics, may be considered unsuitable if it occurs within the ROI. The ROI for each species is provided in Appendix 11A.

11.4.2.4 Calculation of Habitat Availability

The amount of habitat available, measured as high, moderate or low suitability habitat units (HU), is a function of the area of each habitat type multiplied by the overall HSI value for each habitat type. HSI values consider both the suitability and effectiveness of the habitat for each species. The HU are described as the following:

$$HU = \Sigma(HSI_i \times A_i)$$

where,

HSI_i = the habitat suitability index for habitat type polygon *i*

A_i = the area of that polygon

Similarly, the calculation for the RSF/RSPF is:

$$HU = \Sigma(RSF_i \times A_i)$$

where,

RSF_i = the probability of resource use in polygon *i*

A_i = the area of that polygon

In this assessment, habitat availability was estimated for each indicator species for baseline, application and closure. The specific model mechanics for each indicator species are provided in Appendix 11A.

11.4.3 Habitat Connectivity

A loss in habitat connectivity occurs when contiguous tracts of habitat become divided into smaller isolated tracts of habitat (Noss and Csuti, 1997). Wildlife need to be able to move across the landscape in order to access basic life requisites as food, water and shelter, to maintain genetic flow between populations, and in order to colonize new habitats (Noss et al., 1996; Chepko-Sade and Haplin, 1987).

Moose and caribou were selected as indicator species to assess Project-specific impacts on habitat connectivity in the LSA. These species were selected because of their relatively large home ranges, their ability to make long-distance movements, and because of their importance to local and regional stakeholders.

The effect of the Project on habitat connectivity for moose and caribou was assessed in a qualitative approach. A qualitative assessment approach was necessary to maintain a practical assessment in the absence of data for how caribou and moose use landscape features for movement and dispersal. This qualitative assessment was conducted in the following sequence:

1. Areas of contiguous tracts of moderate and high quality baseline habitats were predicted across the LSA (using habitat models, regional caribou herd boundaries, and ungulate winter ranges). This enabled depiction of the areas in the LSA where moose and caribou were most likely to occur.

2. The prospective locations of Project developments, which are potential barriers to animal movements, were superimposed above the predicted moose and caribou habitats in the LSA. The intersections of these two layers represent areas of the greatest potential risk to moose and caribou movements resulting from Project development.

3. The intersections areas (between proposed pipelines, roads, and infrastructure with areas most likely to have animal presence) were then identified. These areas of intersection serve as a planning tool for mitigation and for evaluating the impact of the Project on animal movements. Based on these intersection areas, a qualitative discussion on the potential of the Project to impact moose and caribou movements is provided.

The development of Project-related above-ground pipelines, infrastructure and roads are potential barriers to moose and caribou movements. Above-ground pipelines present the greatest potential barrier to animal movement as they are often impassable without adequate measures of mitigation (Jalkotzy et al., 1997 provides a review; Boreal Caribou Committee, 2001). Road and trail developments from the Project present a partial barrier to movement, particularly if they are often frequented by human influences (Forman et al., 2003).

11.4.4 Mortality Risk

11.4.4.1 Direct Mortality Analysis

Direct mortality risk from the Project was assessed for the Canadian toad, black bear, moose and caribou. These species were chosen for risk assessment because estimates of direct mortality could be made for these species based on their habitat requirements or available data on mortality (i.e., road mortality information).

Direct mortality risk for Canadian toad was estimated as the predicted loss of over-wintering habitat resulting from the Project. Using GIS, impacts to over-wintering habitat were estimated based on both ecosite phase mapping and soils information gathered for the Project.

For black bear, moose and caribou, direct mortality risk was based on the last five years of accident reports recorded along Highway 881 from Lac La Biche to Highway 63 and recorded along Highway 63 from Plamondon to Fort McMurray. The correlation of traffic volumes to roadkilled wildlife was used to assess potential road-kills with projected traffic volume estimates for the Project.

11.4.4.2 Indirect Mortality Analysis

The indirect effects of the Project on mortality risk for black bear, moose, and caribou was assessed in a qualitative approach. In this approach, Project-related factors that are most likely to indirectly affect these indicator species were considered, including:

- Exposure of these species to increased levels of anthropogenic disturbances (stresses) that may occur during Project development and or during regular maintenance and operational activities of associated infrastructure;
- Increased exposure of these species to increased illegal and legal hunting harvest resulting from human access that is provided by Project development; and
- Potential to expose these species to increased levels of predation by displacing them from habitats that provide security from predators and or by attracting predators to prey species through Project developments.

In the assessment, a qualitative discussion on the potential indirect mortality risks associated with the Project development and activities is provided separately for each of the indicator species.

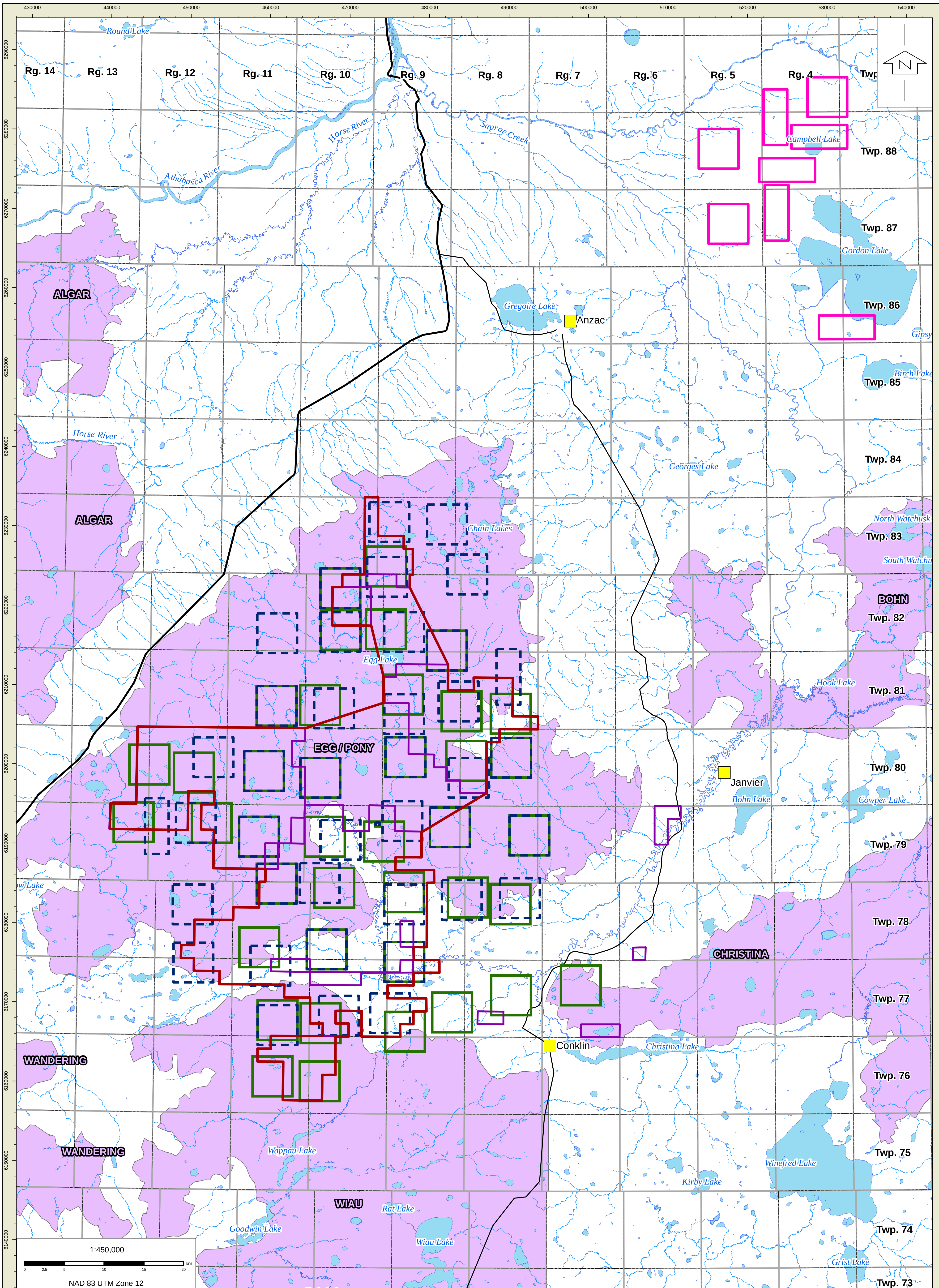
A qualitative approach was necessary because available data on the regions caribou, moose, and black bear populations is not adequate to support a quantitative assessment (e.g., population modelling). This same conclusion was assessed for caribou populations in this area by McLoughlin et al. (2003).

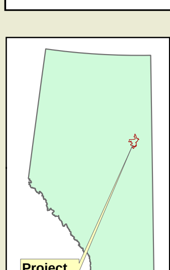
11.4.5 Impact Assessment Criteria

The impact assessment criteria used for the wildlife assessment have been modified from the methods provided in Volume 2, Section 1. These modifications are wildlife specific and reflect the issues pertaining to this discipline and the specific methods needed to accurately identify Project impacts on wildlife (Table 11.4-3).

Table 11.4-3 Assessment Criteria used to Predict Potential Impacts Associated with the Project

Parameter	Rating	Criteria
Direction of Impact	Positive	Net benefit or gain to indicators or wildlife habitat.
	Neutral	Benefits and losses are balanced.
	Negative	Net loss or detriment to indicators or wildlife habitat.
Extent of Impact	Local	Impact to indicators or wildlife habitat confined to the area directly disturbed by project facilities.
	Sub-regional	Impact to indicators or wildlife habitat extends beyond area of direct disturbance but is limited to the LSA.
	Regional	Impact to indicators or wildlife habitat extends beyond the LSA but is limited to the RSA.
	Extra-regional	Impact to indicators or wildlife habitat extends beyond the RSA.
Magnitude of Impact	Negligible	No discernable impact to indicators or wildlife habitat.
	Low	Disturbance to indicators or wildlife habitat predicted to cause no detectable changes greater than that observed in natural variation.
	Medium	Disturbance to indicators or wildlife habitat predicted to cause a detectable change greater than that observed in natural variation.
	High	Disturbance predicted to cause a detectable change to indicators or wildlife habitat great enough to impair recovery.
Duration of Impact	Short term	Impact to indicators or wildlife habitat that occurs for less than one year.
	Medium term	Impact to indicators or wildlife habitat that occurs for one year or longer but less than ten years.
	Long term	Impact to indicators or wildlife habitat that occurs for ten years or longer.
Frequency of Occurrence of Impact	Isolated	Impact to indicators or wildlife habitat that occurs during a specified period.
	Occasional	Impact to indicators or wildlife habitat that occurs intermittently and sporadically over assessment period.
	Regular	Impact to indicators or wildlife habitat that occurs regularly over assessment period.
	Continuous	Impact to indicators wildlife habitat that occurs continually over assessment period.
Permanence of Impact	Reversible in short term	Impact to indicators or wildlife habitat that can be reversed in less than one year.
	Reversible in medium term	Impact to indicators or wildlife habitat that can be reversed in one year or more, but less than ten years.
	Reversible in long term	Impact to indicators or wildlife habitat that can be reversed in ten years or more.
	Irreversible	Impact to indicators or wildlife habitat that is permanent.
Prediction Confidence	Low	Assessment based on poor understanding of cause-effect relationships and poor quality data (e.g., historical data source, using data from elsewhere, data incomplete, etc).
	Moderate	Assessment based on good understanding of cause-effect relationships and poor quality data (e.g., historical data source, using data from elsewhere, data incomplete, etc); or poorly understood cause-effect relationships using high quality data.
	High	Assessment based on good understanding of cause-effect relationships and high quality data.
Environmental Impact	No impact	Impacts to indicators or wildlife habitat are not predicted to occur.
	Low impact	Measurable change in the parameter that is not discernable from natural variability and no predicted measurable change in the indicator species' population.
	Moderate impact	Measurable change in the parameter that is at or above levels of natural variability and with potential for measurable change in the indicator species' population during the life of the Project but expected to recover after reclamation.
	High impact	Measurable change in the parameter that is above levels of natural variability that potentially threatens the long term viability of the indicator species’ population.





Legend

North American Wildlife LSA	Major Road (Hwy. 63)	2006 Survey 5x5km Grid
North American Lease	Road (881)	2007 Survey 5x5km Grid
	Rivers	2007 Control 5x5km Grid
	Lake	Caribou Ranges
	Twp. Rg. Lines	

Title:

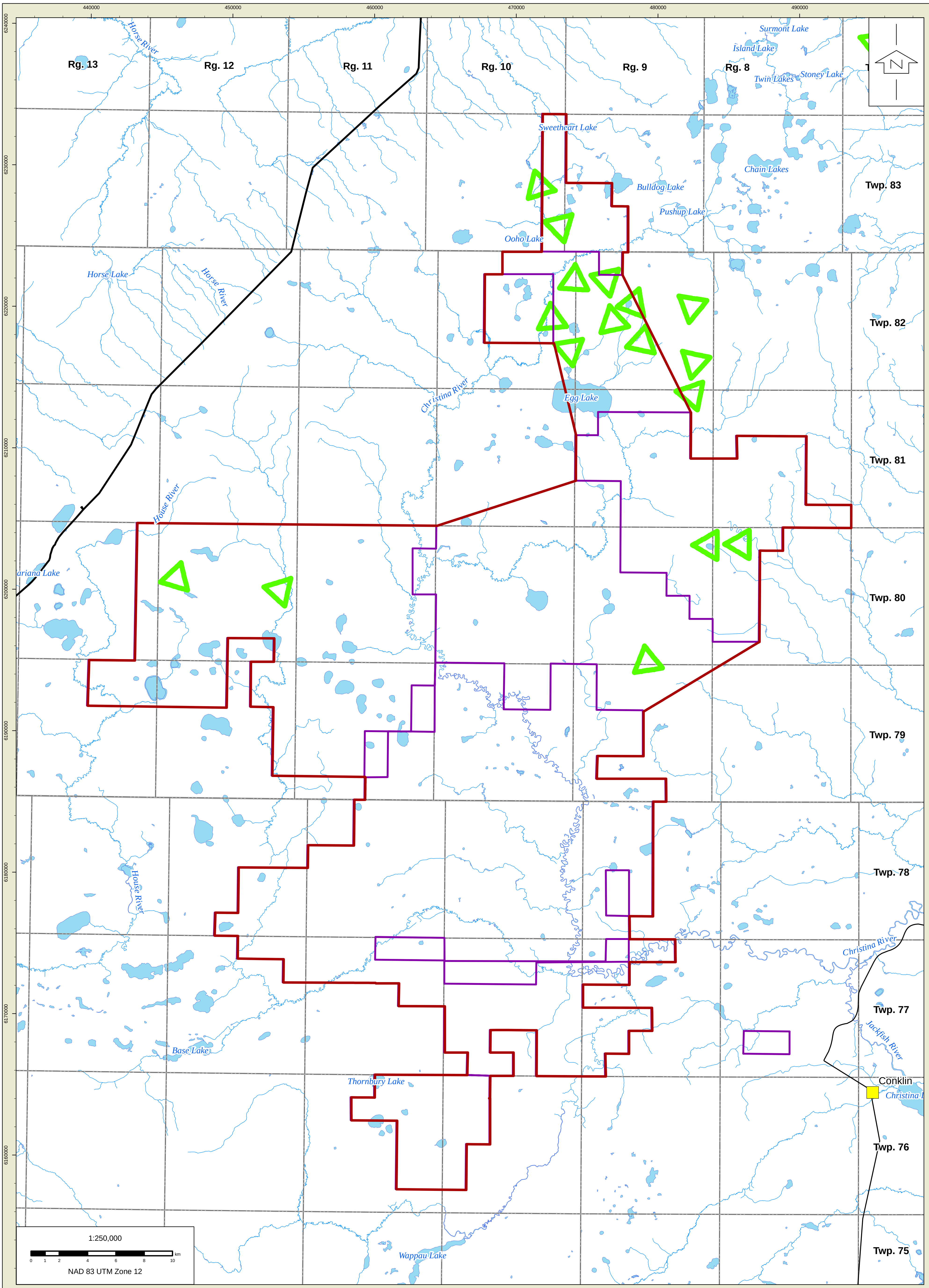
DISTRIBUTION OF SCAT DETECTION SURVEY SQUARES

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Surveys\Scat_Detection_Survey_Squares.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	11.4-1



Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines
- Winter Tracking Survey Transects

Title:

DISTRIBUTION OF WINTER TRACKING SURVEY TRANSECTS

NORTH AMERICAN OIL SANDS CORPORATION

Approved: RL	Revision Date: June 14, 2007
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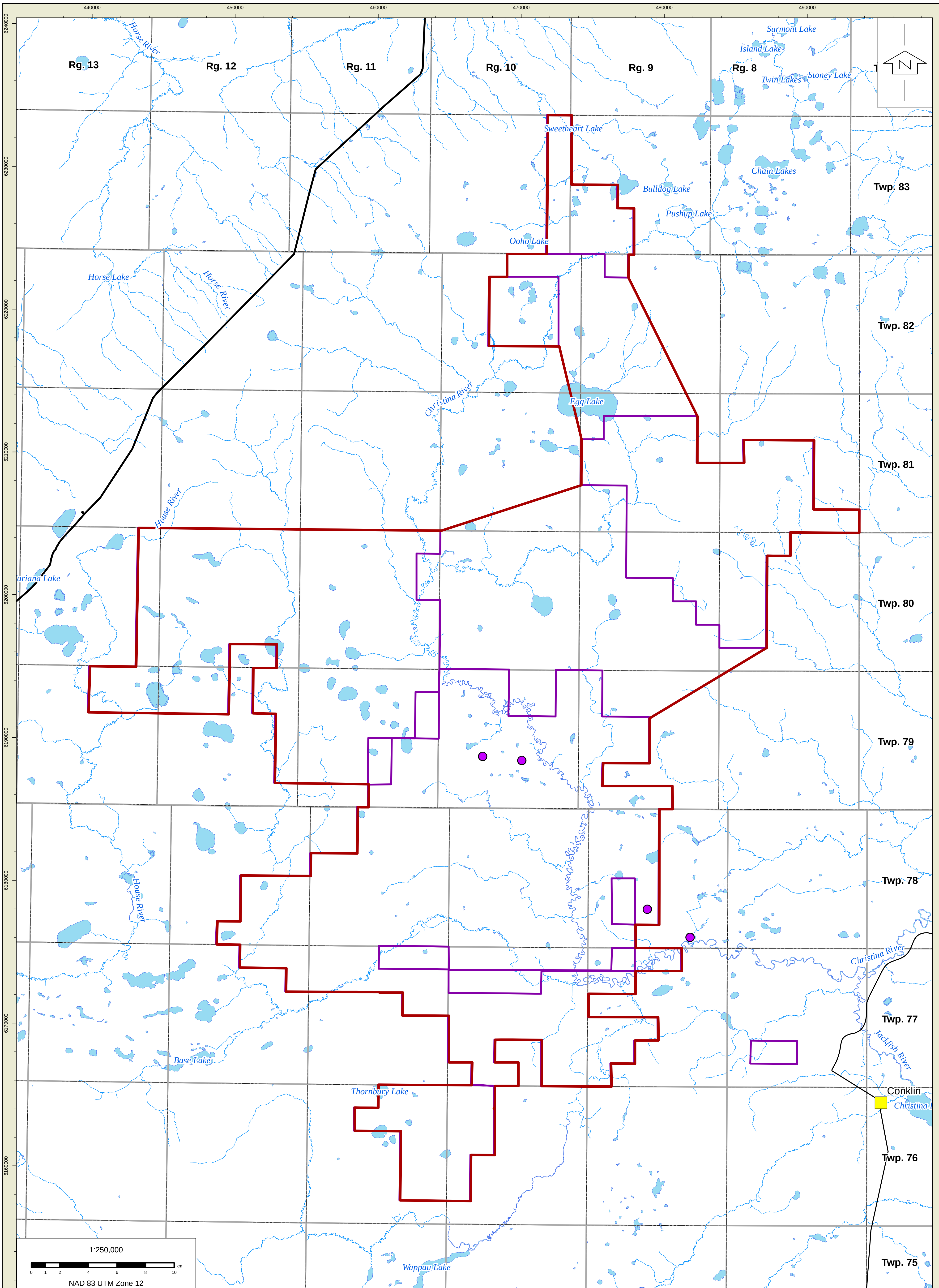
Drawn by:	Checked:	Fig. No.:
TG	RL	11.4-2



Project Location

Legend

- Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines
- Bat Survey Locations

Title:

DISTRIBUTION OF BAT SURVEY LOCATIONS

NORTH AMERICAN OIL SANDS CORPORATION

Approved: RL	Revision Date: June 14, 2007
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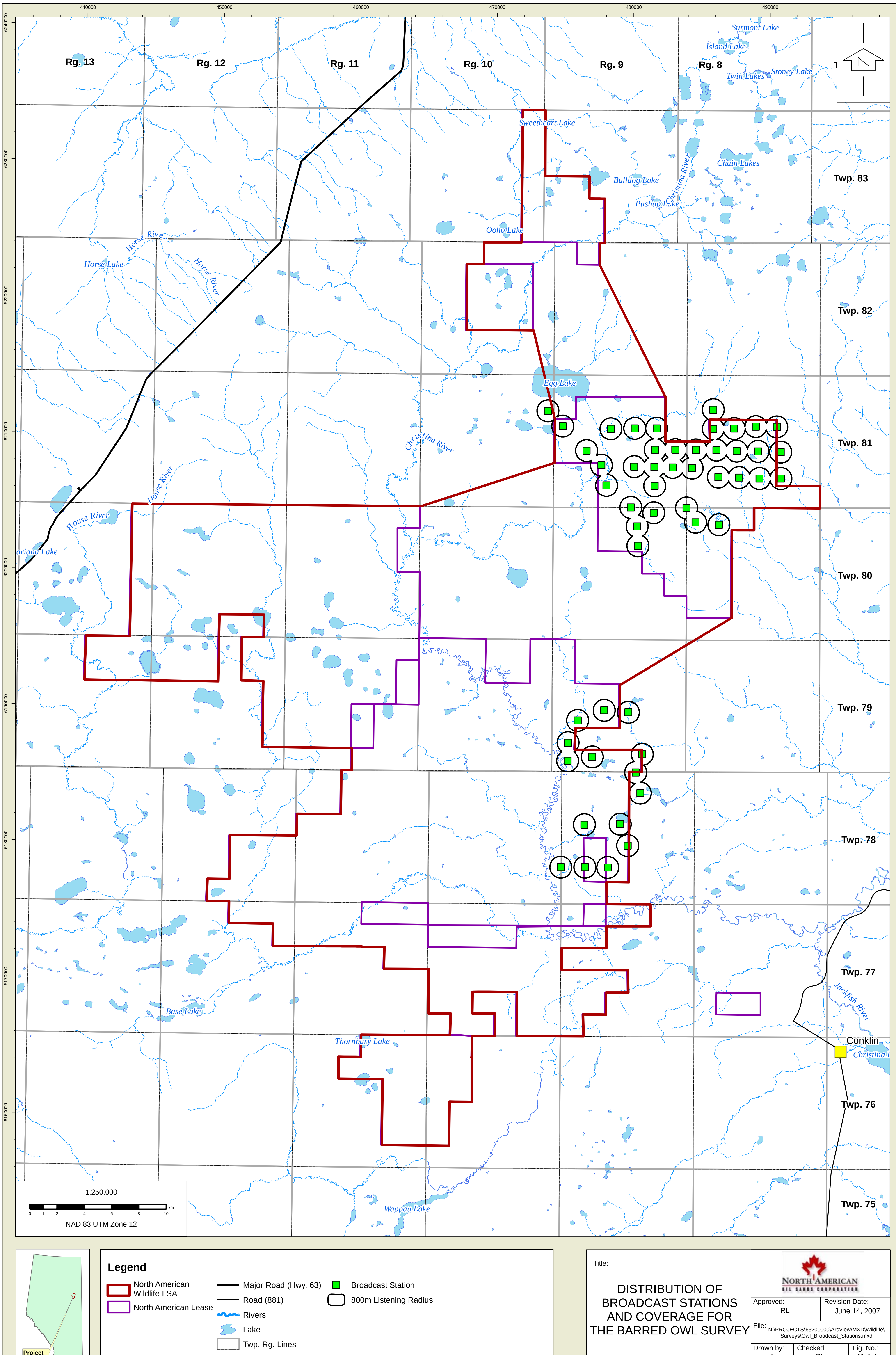


Title:

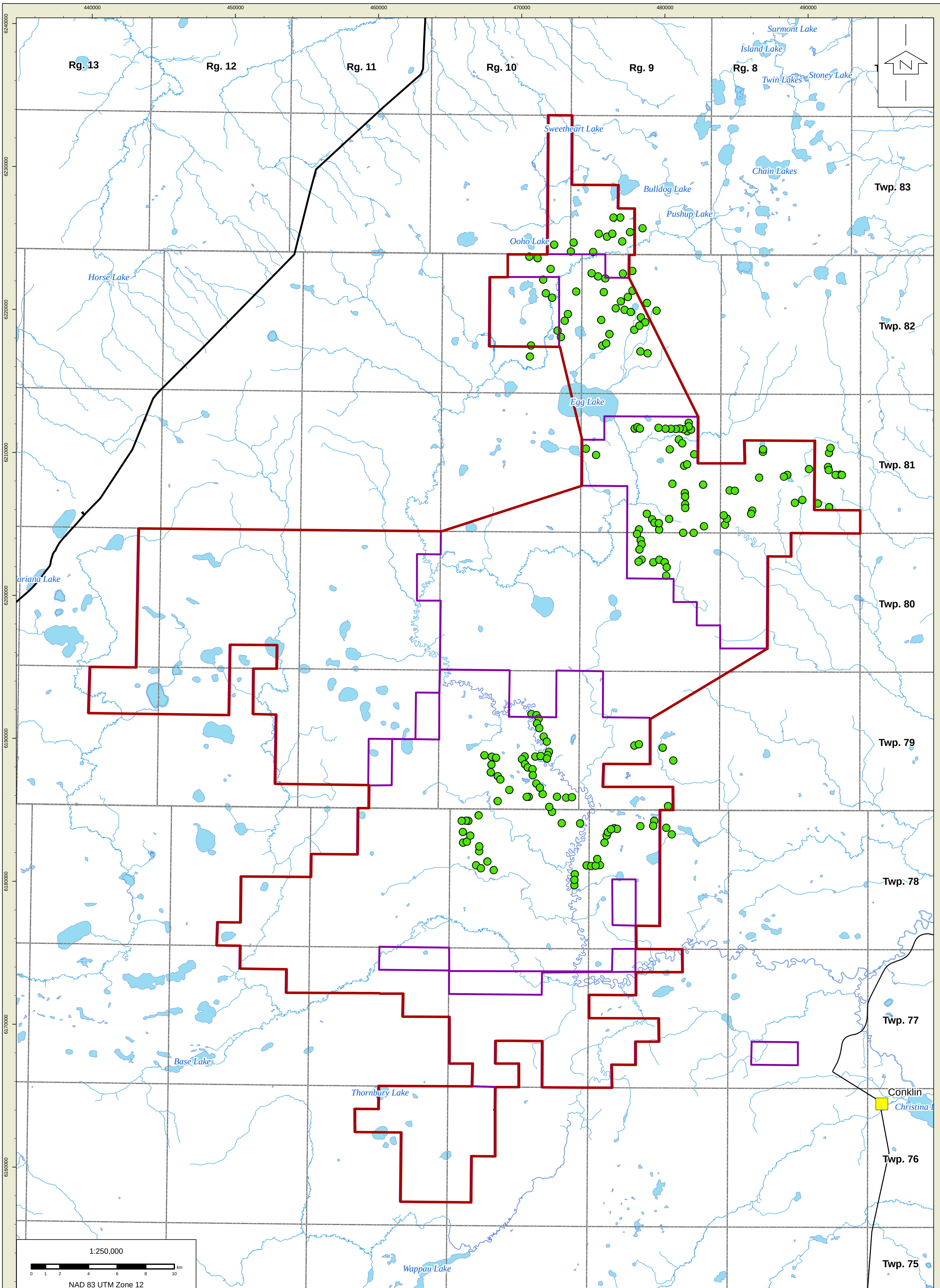
DISTRIBUTION OF BROADCAST STATIONS AND COVERAGE FOR THE BARRED OWL SURVEY

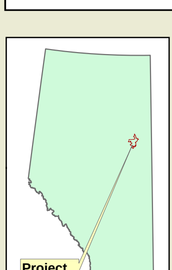
NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Surveys\Owl_Broadcast_Stations.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	11.4-4





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines
- Breeding Bird Survey Location

Title:

DISTRIBUTION OF BREEDING BIRD SURVEY POINTS

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
RL	June 14, 2007	
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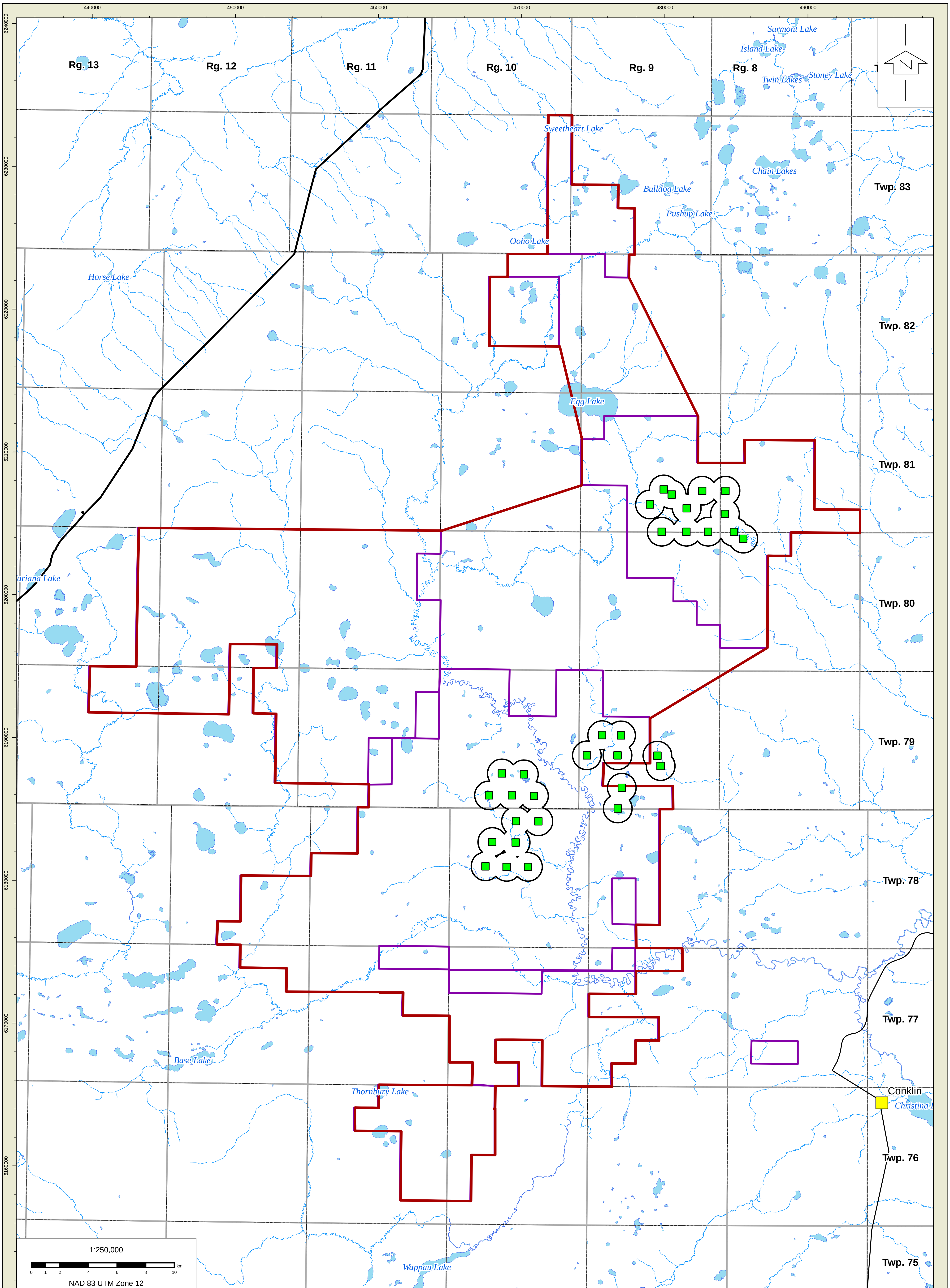
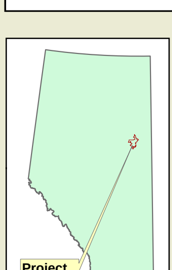
Drawn by: TG	Checked: RL	Fig. No.: 11.4-5





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines
- Survey Station
- 1000m Listening Radius

Title:

DISTRIBUTION OF STATIONS AND COVERAGE FOR THE CANADIAN TOAD SURVEY POINTS

NORTH AMERICAN OIL SANDS CORPORATION

Approved: RL	Revision Date: June 14, 2007
File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Surveys\Toad_Broadcast_Stations.mxd	

Drawn by:	Checked:	Fig. No.:
TG	RL	11.4-6

11.5 Existing Conditions

11.5.1 Scat Detection Survey

In 2006, 1,243 scat samples consisting of 90 wolf, 495 moose and 658 caribou were collected (Table 11.5-1, Figure 11.5-1). In 2007, 1,162 scat samples consisting of 145 wolf, 353 moose and 606 caribou were collected in the LSA and 14 moose and 44 caribou were collected in the control area (Table 11.5-1, Figure 11.5-1). Sampling in the control area was limited due to high snow depths in 2007. Comparison of the 2006 and 2007 data suggest the species-specific distributions and proportions to be fairly similar across years. Most notable is the consistent avoidance of high disturbance areas by wolves across both years.

Wolf scats were less common than both moose and caribou and accounted for less than 15% of the total scat collected (Table 11.5-1). The greatest number of wolf scat (41%) was detected on anthropogenic features (e.g., cutlines, linear features, secondary roads). Within natural habitats, wolf scat was most common in the h1 (8%) ecosite phase although differences between habitats that were used and those that were not were low.

Moose scat was collected from 15 ecosite phases in both 2006 and 2007 with the greatest number found in the j1 (13%) and i2 (11%) ecosite phases with high numbers also found on anthropogenic features. Low numbers of scat were found in b1, b2, d3 and h2 ecosite phases. Higher numbers of moose scat were found in habitats with higher cover of preferred browse species such as willow (e.g., fens). The four ecosite phases with the lowest scat densities generally have limited cover of preferred browse species (i.e., pine dominated habitats and shrubby bogs).

Caribou were the most common species detected in both 2006 and 2007 (Table 11.5-1). The LSA falls within the ESAR caribou range (Figure 11.5-1). The greatest number of scat was collected from the h1 (23%) ecosite phase with moderate numbers collected from all other lowland ecosite phases and on anthropogenic features. Caribou scat was rarely found in upland ecosite phases, although scat was collected from pine habitats that often have lichen ground cover (a1, c1 and g1).

The 2006 scat samples have been analyzed for all parameters except for microsatellite DNA used to establish individual identities. Those latter analyses are ongoing. The 2007 samples are currently being analyzed for the above-mentioned hormones and DNA.

Results from the hormone analyses of the 2006 samples are shown in Figure 11.5-2, Figure 11.5-3, Figure 11.5-4 and Figure 11.5-5. Several things are important to aid in the interpretation of these graphs:

- Hormone concentrations were log transformed to these dependent variables normally distributed. Thus, the values plotted are the log of the actual values;
- Cortisol (abbreviated as B) is the adrenal hormone and is expected to become elevated in response to a wide variety of stressors, including disturbance stress. It is also elevated in response to nutritional stress, as this causes mobilization of glucose for energy and increased foraging behaviour; and
- Thyroid hormone (abbreviated as T3) is expected to decline in response to nutritional stress. This lowers the animal's metabolism, causing efficient use of available energy.

Thus, a stress signal would be reflected by a rise in cortisol, coincident with an outside disturbance. A nutritional stress signal would be reflected by a reduction in T3, coupled with a rise in B, coincident with a relevant outside disturbance.

These data were analyzed by field session with the four sessions corresponding with development activity as follows: Drilling development was initiated during session 1 and peaked during session 3. Activity declined dramatically during session 4, as nearly all developers had ceased activity. Thus, disturbance stress was expected to increase from sessions 1–3, peak during session 3 and then drop off in session 4.

Figure 11.5-2 shows the overall change in cortisol (logB) and thyroid hormone (logT3) across sessions. These two hormones responded as predicted to stressors across sessions. Cortisol levels progressively increased, peaking in session 3 and then dropping off in session 4. Thyroid hormone showed the opposite trend.

The above relation between session and logB is statistically significant overall when entered into a general linear model predicting log B from species, session, and the interaction between species and session. For Species, $F = 239.4$, $p < 0.0001$, df =1; session, $F = 37.3$, $p < 0.001$, df = 3; Species X session, $F = 24.0$, $p < 0.0001$, df = 5. The same is true for prediction logT3 in the overall model: Species, $F = 138$, $p < 0.0001$, df = 1; session, $F = 2.21$, $p < 0.02$, df = 3; Species X session, $F = 11.93$, $p < 0.0001$, df = 5. These results suggest that development activities in 2006 were stressful for the animals and that this stress also showed a pronounced nutritional stress signal. However, the animals appeared to recover from those stressors when development activities terminated. Future comparisons in subsequent years will be crucial to evaluate whether recovery persists following continued development activities in the area.

The caribou signal (Figure 11.5-1) is most consistent to the overall data (Figure 11.5-2). Both log B and log T3 were significantly correlated with session in the caribou ($F = 23.0$, $p < 0.001$ for log B; $F = 7.61$, $p < 0.0001$ for log T3, df = 3). The North American leases were divided into disturbed (relatively high development activity) and undisturbed (relatively low activity) areas. When the disturbance variable (U,D) is added into the general linear model predicting these two hormones, the impact of developed land alone is not a significant predictor of log B, but is significant as an interaction with session ($F = 4.17$, $p < 0.006$). This infers that the stress effect of human activities is heightened when they occur on developed versus undeveloped land in the caribou. In other words, the stress response is most severe during the activity peak in session 3 in high disturbance landscapes. Similar results were obtained for predicting T3. However, in this case, landscape disturbance was significant as a main effect ($F = 15.12$, $p < 0.0001$); nutritional stress was highest in disturbance relative to non-disturbance areas, regardless of session, for the caribou.

The moose signal (Figure 11.5-4) shows a similar pattern as the caribou for T3. However, its stress pattern (logB) is more erratic, being highest in sessions 2 and 4. Both log B and log T3 were significantly correlated with session ($F = 3.03$, $p < 0.03$ for log B; $F=64.0$, $p < 0.0001$ for log T3). When the landscape disturbance variable (U,D) is added into the general linear model predicting these two hormones, U,D is not a significant predictor of log B, but is a significant predictor of T3, both as a main effect ($F = 17.08$, $p < 0.0001$) and as an interaction with session ($F = 3.8$, $p < 0.01$). This is tentatively interpreted to mean that nutritional stress may always be highest in disturbed relative to non-disturbed landscapes for the moose. However, these impacts were still exacerbated by temporal patterns in development activities.

As previously mentioned, the wolf appeared to most strongly avoid areas of high human use (Figure 11.5-1). While the sample size was low in 2006, both log B and log T3 were significantly correlated with session ($F= 7.3$, $p < 0.0003$ for log B; $F=4.0$, $p < 0.05$ for log T3, df = 3; Figure 11.5-5). The logB response by session was very similar to the overall pattern shown in

Figure 11.5-2, as well as to the caribou pattern (Figure 11.5-3), peaking in session 3 and then falling off sharply in session 4. However, the T3 pattern was somewhat unique, showing a fairly consistent decline with session, through session 4. One tentative interpretation of these latter results is that it takes the predator longer to recover nutritionally from the development activities, even though its stress response is appropriately dampened.

In summary, based on the analyses to date, development activities in 2006 did appear to be associated with physiological stress in the animals and particularly with nutritional stress. While these patterns differed somewhat across species, all species showed a fairly consistent pattern of greatest stress associated with greatest activity. All species also appeared to recover from that stress when development activities terminated (session 4) during the first year of study, with the possible exception of nutritional recovery in wolves. Future comparisons in subsequent years will be crucial to evaluate whether recovery persists following continued development activities in the area. Data from the control populations in 2007 should also be important to our interpretation of these results.

Table 11.5-1 Scat Distribution by Ecosite Phase within the LSA

	Wolf			Moose			Caribou		
	2006	**2007**	**%**	**2006**	**2007**	**%**	**2006**	**2007**	**%**
a1	0	0	0	16	5	2	13	14	2
b1	2	4	3	3	7	1	5	1	0
b2	0	0	0	2	4	1	0	0	0
c1	2	4	3	13	7	2	19	22	3
d1	5	7	5	45	31	9	3	1	0
d2	0	0	0	9	6	2	0	0	0
d3	0	1	0	4	1	1	0	0	0
g1	3	8	5	18	12	3	29	42	5
h1	7	12	8	36	39	9	141	160	23
h2	3	1	2	9	4	1	24	50	6
i1	9	4	6	43	31	8	51	46	7
i2	1	6	3	48	46	11	44	23	5
j1	4	4	3	73	44	13	62	84	11
j2	0	1	0	32	20	6	57	10	5
j3	2	4	3	13	12	3	93	18	8
Other									
Anthropogenic	45	51	41	62	27	10	68	72	11
Wetlands	0	12	5	4	1	1	12	6	1
Burn	7	1	3	58	9	8	19	17	3
Blank	0	25	11	7	70	9	18	84	8
Total	**90**	**145**	**100**	**495**	**376**	**100**	**658**	**650**	**100**

11.5.2 Winter Track Count Survey

A total of 16 species or species groups (e.g., grouse and deer) were detected. The highest species diversity was recorded in the d1, g1 and h1 ecosite phases (12 species; Table 11.5-1). The lowest species diversity was detected in the f1 (no species), b1 (one species) and e1 (one species) ecosite phases. In the following sections the results of the winter track count survey are provided by species guild (upland gamebirds, small mammals, furbearers, ungulates).

11.5.2.1 Upland Gamebirds

Four species of upland game birds potentially occur in the region: ruffed grouse, spruce grouse, sharp-tailed grouse and willow ptarmigan. With the exception of the ptarmigan, the three species of grouse tracks are difficult to distinguish and were recorded as grouse. Ptarmigan tracks were not observed during this survey.

A mean density of 0.3 tracks/km/day was recorded over 27 ecosite phases (Table 11.5-1). Within ecosite phases where grouse tracks were detected, the mean track densities varied from 0.03 tracks/km/day to 1.1 tracks/km/day with the highest mean densities recorded in b3, d2, c1 and b1 ecosite phases.

11.5.2.2 Small Mammals

Snowshoe hares accounted for the largest number of observations during the surveys, with an overall mean track density of 3.8 tracks/km/day (Table 11.5-1). Snowshoe hares were present in 15 of the 27 ecosite phases sampled. The highest mean track densities were observed in the c1 (13.8 tracks/km/day), a1 (9.7 tracks/km/day) and j3 (8.2 tracks/km/day) ecosite phases. For ecosites where hares were observed, the lowest mean track densities were observed in the d1 (0.4 tracks/km/day) and i2 (0.8 tracks/km/day) ecosite phase.

Table 11.5-2 Mean Track Densities for each Wildlife Species or Group by Ecosite Phase from Combined Surveys

Ecosite Phase	Mean track densities (tracks/km/day)															
	Grouse	Red Squirrel	Snow-shoe Hare	Weasel	Mink	Marten	Fisher	Otter	Muskrat	Lynx	Fox	Coyote	Wolf	Deer	Moose	Caribou
a1			9.7 ±9.7													
b1	0.6 ±0.2	6.9 ±0.9	6.4 ±1.4			0.04 ±0.03	0.2 ±0.1			0.02 ±0.02	0.04 ±0.03	0.5 ±0.2	0.3 ±0.1	0.3 ±0.1	0.3 ±0.9	
b2	0.1 ±0.1	2.5 ±1.2	1.1 ±0.6										0.08 ±0.08		0.3 ±0.2	
b3	1.1 ±1.1															
b4																
c1	0.7 ±0.2	0.9 ±0.2	13.8 ±2.1	0.05 ±0.05						0.09 ±0.05		0.04 ±0.04	0.1 ±0.07	0.3 ±0.1	0.03 ±0.03	
d1	0.2 ±0.1	4.1 ±0.6	0.4 ±0.2			0.3 ±0.1	0.2 ±0.08			0.02 ±0.02	0.08 ±0.06	0.07 ±0.04	0.1 ±0.06	0.5 ±0.1	0.3 ±0.08	0.07 ±0.04
d2	0.8 ±0.2	2.8 ±0.6	3.5 ±0.8	0.1 ±0.1		0.7 ±0.2	0.08 ±0.04			0.04 ±0.03		0.1 ±0.04	0.02 ±0.02	0.2 ±0.09	0.4 ±0.2	
d3	0.1 ±0.1	13.3 ±3.0	1.2 ±1.0	0.7 ±0.5		0.6 ±0.4	0.4 ±0.3					0.2 ±0.1	0.3 ±0.3	0.8 ±0.4	0.1 ±0.1	0.1 ±0.1
e1												2.2 ±2.2				
e2																
e3																
f1																
f2																
f3																
g1	0.3 ±0.1	2.6 ±0.3	4.6 ±0.5		0.01 ±0.01	0.3 ±0.1	0.01 ±0.01			0.06 ±0.03		0.2 ±0.05	0.05 ±0.03	0.1 ±0.06	0.1 ±0.05	0.07 ±0.04
h1	0.07 ±0.05	0.6 ±0.2	3.3 ±0.8	0.07 ±0.03		0.04 ±0.03		0.03 ±0.02		0.1 ±0.05		0.06 ±0.06	0.03 ±0.02	0.01 ±0.01	0.2 ±0.07	0.2 ±0.1
h2		0.3 ±0.2	3.1 ±1.4			0.3 ±0.1					0.05 ±0.05	0.2 ±0.1	0.05 ±0.05	0.5 ±0.3		
I1	0.06 ±0.04	2.6 ±0.6	1.4 ±0.5			0.1 ±0.1		0.09 ±0.06				0.1 ±0.1	0.1 ±0.1		0.2 ±0.08	0.2 ±0.09
I2	0.03 ±0.03	2.0 ±0.7	0.8 ±0.2	0.4 ±0.3	0.04 ±0.04	0.02 ±0.02			0.1 ±0.07			0.2 ±0.8	0.09 ±0.06	2.4 ±0.6		0.07 ±0.05
j1		1.7 ±0.9	2.8 ±1.4										0.1 ±0.1		0.1 ±0.1	0.3 ±0.2
j2	0.2 ±0.1	4.6 ±0.9	1.7 ±0.6		0.04 ±0.04					0.02 ±0.02	0.04 ±0.04	0.2 ±0.1	0.07 ±0.07	0.03 ±0.03	0.2 ±0.1	0.3 ±0.3
j3	0.4 ±0.3	7.0 ±2.6	8.2 ±3.2		0.1 ±0.1	0.3 ±0.2									0.3 ±0.2	
k1																
k2																
k3																
l1																
Mean	**0.3 ±0.03**	**3.2 ±0.2**	**3.8 ±0.3**	**0.06 ±0.02**	**0.01 ±0.005**	**0.2 ±0.03**	**0.05 ±0.02**	**0.008 ±0.004**	**0.006 ±0.004**	**0.04 ±0.01**	**0.02 ±0.009**	**0.2 ±0.02**	**0.09 ±0.02**	**0.3 ±0.05**	**0.2 ±0.03**	**0.09 ±0.03**

Red squirrels were the second most common small mammal species detected during the surveys, with an overall mean track density of 3.2 tracks/km/day (Table 11.5-1). Red squirrels were observed in 14 of 27 ecosite phases, with densities ranging from 0.3 tracks/km/day in the h2 ecosite phase to 13.3 tracks/km/day in the d3 ecosite phase. Track densities were highest in the d3, j3 and b1 ecosite phases. Although red squirrels were detected in deciduous ecosite phases (i.e., b2 and d1), spruce understories were common in these types, providing habitat for red squirrels.

11.5.2.3 Furbearers

Several weasel species were detected during winter tracking surveys. These included short-tailed weasel, least weasel, mink, marten, fisher and river otter. Short-tailed and least weasel tracks were not recorded to species, rather grouped into the broad category weasel. These species are sexually dimorphic, meaning the size of female short-tailed and male least weasels overlap, making it difficult to distinguish between species (Rezendes, 1999).

Weasel tracks were detected in 5 of 27 ecosite phases, with the highest mean track densities in d3 (0.7 tracks/km/day) and i2 (0.4 tracks/km/day) ecosite phases (Table 11.5-1). Where observed, low track densities were recorded in the c1, d2 and h1 ecosite phases. Marten were detected in 10 of 27 ecosite phases, with mean track densities ranging from a low of ≤ 0.04 tracks/km/day in the i2, h1 and b1 ecosite phases to 0.7 tracks/km/day in the d2 ecosite phase (Table 11.5-1). Fishers were detected in five ecosite phases, with mean track densities ranging from 0.08 tracks/km/day in the d2 ecosite phase to 0.4 tracks/km/day in the d3 ecosite phase. Mink were detected in four ecosite phases with densities ranging from 0.01 tracks/km/day in the g1 ecosite phase to 0.1 tracks/km/day in the j3 ecosite phase. River otter were detected in two ecosite phases, with densities ranging from 0.03 tracks/km/day in the h1 ecosite phase to 0.1 tracks/km/day in the i1 ecosite phase. These two species were detected near aquatic habitats.

Lynx were detected in 7 ecosite phases, with the highest mean track densities recorded in h1, c1 and g1 ecosite phases (Table 11.5-1). High track densities of snowshoe hares were also detected in these ecosite phases, indicating that hares, being the primary prey for lynx, are likely the cause of the greater lynx track densities observed (Krebs et al., 2001). As a result, there was a moderate and significant correlation between lynx track densities and snowshoe hare track densities (log-transformed, $r = 0.57$, $P < 0.01$, $F = 12.3$, d.f. = 26).

Fox tracks were detected in four ecosite phases, with the highest mean densities recorded in the d1 ecosite phase (0.08 tracks/km/day); Table 11.5-1). As with other furbearers, overall track density was low (0.02 tracks/km/day), and with such few tracks found, inferences with regard to habitat use cannot be made.

Coyote tracks were detected in 12 ecosite phases, with the highest mean densities recorded in the e1 ecosite phase (2.2 tracks/km/day) and in the b1 ecosite phase (0.5 tracks/km/day; Table 11.5-1). As with other medium-large furbearers, overall track density was low (0.2 tracks/km/day).

Wolf tracks were observed during the surveys within 13 ecosite phases, with mean track densities ranging from < 0.03 tracks/km/day in the d2 and h1 ecosite phases to 0.3 tracks/km/day in the b1 and d3 ecosite phase (Table 11.5-1). Wolf tracks were frequently observed on trails with packed snow during winter tracking, and incidentally along cutlines and other linear corridors during various other field surveys. This is in agreement with scat data, were 41% of wolf scat was detected on anthropogenic features (e.g., cutlines) despite their existence on only a small proportion of the overall landscape.

11.5.2.4 Ungulates

Tracks of deer, moose and caribou were detected during the winter tracking survey. Deer tracks were detected in 10 ecosite phases, with the highest mean track density recorded in the i2 ecosite phase (2.4 tracks/km/day; Table 11.5-1).

Moose tracks were detected in 12 ecosite phases, with the highest mean density recorded in the d2 ecosite phase (0.4 tracks/km/day; Table 11.5-1). Mean track densities across all ecosite phases were also low (0.2 track/km/day). Data from the scat survey showed that moose were relatively common in the lowland ecosite phases (h1, i1, i2, j1, j2 and j3) and less common in the upland ecosite phases with the exception of the d1 ecosite phase. These ecosite phases are abundant in woody browse species such as willow.

Caribou tracks were detected in eight ecosite phases with the highest mean densities recorded in the j1 and j2 ecosite phases (0.3 tracks/km/day; Table 11.5-1). Densities in d3 and h1 (0.2 tracks/km/day) and i1 ecosite phases (0.1 tracks/km/day) were also relatively high. Scat data for caribou was highest within the h1 ecosite phase (23%), with moderate numbers collected from all other lowland ecosite phases. Low numbers of scat were collected in the upland ecosite phases. This is consistent with the known habitat use of caribou in northern Alberta (Dzus, 2001).

11.5.2.5 Snow Cover in the LSA

Data for snow depth came from the winter tracking surveys conducted in 2006 for the Nexen Long Lake South and Cottonwood projects and the Project. During the winter tracking surveys, snow depth varied from 9.0–69.0 cm, with an average depth of 31.1 cm (Table 11.5-2). Ecosite phase g1 had the lowest snow depth, and it differed from ecosite phases b1, d1, h1, i1, i2, j1 and j2 (ANOVA, $P < 0.03\text{-}0.001$, Tukey’s multiple comparison). Ecosite phase i2 had the greatest snow depth, and differed from ecosite phases c1, d2, d3, and g1 (ANOVA, $P < 0.02\text{-}0.001$, Tukey’s multiple comparison).

Both deer and moose distribution have been found to be affected by snow depth. Deer movements are restricted in areas where snow depths exceed 30 cm to 40 cm (Wallmo and Gill, 1971). In 2006, 12 ecosite phases surveyed had average depths exceeding 30 cm. A GLM was performed to assess the relative importance of snow depth and habitat (of each variable as well as the interactive effects). The interactive effect of habitat and snow depth was the top model (i.e., best predictor; Akaike’s Information Criterion) of deer occurrence. Deer also had strong selection for habitats with snow depths of ≤ 20 cm (Ivlev’s Index) and used habitats with snow depths > 40 cm less than their availability (avoidance). This is consistent with the findings from other studies (Wallmo and Gill 1971).

Snow depths of 70 cm restrict the distribution of moose (Coady, 1974). The maximum snow depth recorded during the tracking surveys was 69.0 cm and the average snow depth was considerably less than 70 cm. As with deer, a GLM was performed to assess the relative importance of snow depth and habitat (of each variable as well as the interactive effects). Snow depth + ecosite phase was the top model (i.e., best predictor; Akaike’s Information Criterion) of moose occurrence. Moose selected habitats with snow depths between 30 cm and 50 cm, and used habitats with snow depths < 20 cm less than their availability. This is likely due to the fact that moose are exploiting habitats with low snow interception cover, such as willow fens, habitats that are generally unavailable to deer. This is also supported by the fact that deer selected habitats with snow depths less than 30 cm.

Table 11.5-3 Average Snow Depth Recorded within the LSA for all Winter Tracking Surveys

Ecosite Phase	Snow Depth (cm)
a1	37.0 ± 0.0
b1	33.1 ± 0.7
b2	31.9 ± 1.7
b3	21.0 ± 1.0
c1	29.6 ± 0.7
d1	33.1 ± 0.6
d2	29.3 ± 1.0
d3	28.3 ± 1.3
f1	30.0 ± 0.0
g1	28.0 ± 0.5
h1	31.9 ± 0.6
h2	30.3 ± 0.9
i1	32.0 ± 0.9
i2	34.7 ± 0.8
j1	33.6 ± 0.9
j2	31.4 ± 0.8
j3	31.3 ± 1.3
Average	31.1 ± 0.2

11.5.3 Bat Survey

No bats were captured within the LSA during the bat survey. At the mist netting locations, bats were observed flying over early in the evening (i.e., immediately after sunset) indicating that while no bats were caught in the net, it is possible that a roost was located near the netting locations.

Analyses of the AnaBat recordings indicated that several bat species were detected in the area (Table 11.5-4; Figure 11.5-6). Several little brown bats were detected at the sites, along with one red bat. Bat detectors and recordings of echolocation calls cannot distinguish big brown bats from silver-haired bats. Big brown bats were not captured during the survey and little information is available on the distribution of this species in the region. The majority of low-frequency bat passes recorded with the AnaBat detector were likely silver-haired bats.

Of the four bat species listed as species at risk (northern long-eared bat, silver-haired bat, red bat and hoary bat), only the red bat was detected with certainty in the LSA (Figure 11.5-6). The other passes recorded could either be big brown bats or silver-haired.

Table 11.5-4 Bat Species Detected with Anabat II Detector

Date	Big Brown/Silver-Haired	Little Brown Bat	Red	Unidentified[1]
July 30, 2006	2	4		
August 1, 2006	3	8	1	3
Total Detected	**5**	**12**	**1**	**3**

1 Calls too poor in quality to identify confidently.

11.5.4 Barred Owl Survey

Four barred owls in one ecosite phase were detected during the 2006 survey (Table 11.5-6, Figure 11.5-7). Seven other owl species were detected in four ecosite phases (this excludes the clear cut habitat type) (Table 3.2-7 and Figure 11.5-7). Four species were observed during the formal survey: the barred owl, boreal owl, northern pygmy owl and great horned owl. Two owls were detected incidentally, with one great gray owl detected on route to the study area, and a barred owl during the bat survey.

Four barred owls were detected during the 2006 survey, all within the c1 ecosite phase (Table 11.5-5, Figure 11.5-7). Six other owls including one boreal owl, two great horned owls and three pygmy owls were observed during the survey. An additional barred owl was incidentally observed in a d1 ecosite phase during the bat survey. A great gray owl was incidentally observed on route to the study area.

Table 11.5-5 Owl Species Observed by Ecosite Phase and Habitat Use from the 2006 Survey

Ecosite Phase	Barred Owl	Boreal Owl	Great Gray Owl	Great Horned Owl	Northern Pygmy Owl	Total
b2				2		2
c1	4	1				5
CC			1		1	2
d1	1				1	2
g1					1	1
Total	**5**	**1**	**1**	**2**	**3**	**12**

11.5.5 Breeding Bird Survey

11.5.5.1 Breeding Bird Density among Habitat Types

During the breeding bird survey, 49 bird species were observed in 17 different ecosite phases. The highest density of birds was observed in the j2 ecosite phase (240.2 territories/40 ha; Table 15.5-8). The f1 ecosite phase had the lowest density of birds with 17.0 territories/40 ha. Within the generic habitat classifications, bird density ranged from 59.4 territories/40 ha in the graminoid fen habitat type to 240.2 territories/40 ha in the shrub fen habitat type.

Forty-nine species of birds were detected during the breeding bird survey with an average individual species density ranging from 0.3 territories/40 ha to 13.0 territories/40 ha (Appendix 11C, Table 11C-1). The five species with the highest average densities included:

- Dark-eyed junco (13.0 territories/40 ha);
- Yellow-rumped warbler (12.2 territories/40 ha);
- Chipping sparrow (9.2 territories/40 ha);
- Ruby-crowned kinglet (6.4 territories/40 ha); and
- Ovenbird (6.1 pairs/40 ha).

Five bird species identified as SAR were detected (Figure 11.5-8) including:

- Least flycatcher (1.0 territories/40 ha, ecosite phases a1, g1, h1 and j1), detected on four occasions in the LSA;
- Brown creeper (2.0 territories/40 ha, ecosite phases b1, b2, d1, d2, d3 and i1), detected on eight occasions in the LSA;
- Bay-breasted warbler (0.3 territories/40 ha, ecosite phase d1), detected on one occasion in the LSA;
- Common yellowthroat (0.3 territories/40 ha, ecosite phase j2), detected on one occasion in the LSA; and
- Western tanager (0.6 territories/40 ha, ecosite phases d2 and g1), detected on two occasions in the LSA.

11.5.5.2 Breeding Bird Diversity and Species Composition

Breeding bird diversity varied considerably within habitat types. Diversity was highest in the j2 ecosite phase (15.7) with high diversity also observed in the d1 (13.5), i1 (12.2) and g1 (10.8) ecosite phases (Table 11.5-6). The lowest diversity was observed in the f1 (1.0) and e1 (4.0) ecosite phases.

Table 11.5-6 Density and Diversity Index of Birds within each Habitat Type

Habitat Class	Ecosite Phase	Sites Surveyed	Density (Territories/40 ha)		Diversity Index	
Jack Pine	a1	4	101.9	101.9	5.7	5.7
Coniferous	b3	0	0.0	88.9	0.0	16.4
	c1	15	84.9		8.1	
	d3	2	152.9		4.8	
	e1	3	67.9		4.0	
	f1	3	17.0		1.0	
	g1	28	85.5		10.8	
Deciduous	b2	4	101.9	92.6	4.8	13.5
	d1	29	105.4		13.4	
Mixedwood	b1	15	67.9	89.6	10.4	12.5
	d2	14	112.8		9.6	
Treed black spruce	h1	26	88.2	97.7	9.5	13.4
	i1	10	122.3		12.2	
Shrubby black spruce	h2	9	118.9	134.7	7.5	11.0
	i2	5	163.1		7.7	
Treed fen	j1	14	163.8	163.8	10.0	10.0
Shrub fen	j2	7	240.2	240.2	15.7	15.7
Graminoid fen and marsh	j3	12	59.4	59.4	8.5	8.5

11.5.6 Canadian Toad Survey

No Canadian toads were detected during the survey in 2006. Canadian toad distribution is restricted by hibernating and breeding habitat. Hibernating habitat consists of sandy soils (those generally found in ecosite phases a1, b1, b2, b3, b4 and c1) where the toads can easily move below the frost line in winter (Garcia pers. comm., cited in Westworth, 2002). This type of habitat may not occur in sufficient quantity to support Canadian toads in the LSA, although not all the LSA was surveyed.

Canadian toads are widespread in the Athabasca Oils Sands Region (Hamilton et al., 1998). Canadian toads were not observed during baseline surveys for OPTI Long Lake (OPTI, 2000) or Cottonwood (conducted in 2006) but were frequently observed within the Long Lake South Project LSA in 2005 (Nexen/OPTI, 2006) and within the Surmont LSA in 1998 (Gulf, 2001). Canadian toads may also have a discontinuous distribution, and occur at low densities in this region, hence the variation in delectability (Roberts et al., 1979; Westworth, 2002).

11.5.7 Species at Risk

A total of 53 species potentially occurring in the LSA were identified as SAR. These include two species of amphibian, one species of reptile, 42 species of birds and eight species of mammals (Table 11.5-7).

Table 11.5-7 Species at Risk Potentially Occurring in the LSA including Provincial and Federal Status

Common Name	Provincial[1]	Federal (COSEWIC)[1]	Federal (SARA)[1]	Detected in LSA
Amphibians and Reptiles				
Canadian toad	May be at risk	Not at risk		N
Western toad	Sensitive	Special concern	Schedule 1	Y
Red-sided garter snake	Sensitive			N
Birds				
Pied-billed grebe	Sensitive			N
Western grebe	Sensitive			N
Horned grebe	Sensitive			N
American white pelican	Sensitive	Not at risk		N
American bittern	Sensitive			N
Great blue heron	Sensitive			N
Green-winged teal	Sensitive			N
Northern pintail	Sensitive			N
Lesser scaup	Sensitive			N
White-winged scoter	Sensitive			N
Turkey Vulture	Sensitive			N
Osprey	Sensitive			N
Bald eagle	Sensitive	Not at risk		N
Northern harrier	Sensitive	Not at risk		N
Northern goshawk	Sensitive	Not at risk		N
Broad-winged hawk	Sensitive			N
Peregrine falcon	At risk	Special concern	Schedule 1	N
Sharp-tailed grouse	Sensitive			N
Yellow rail	Undetermined	Special concern	Schedule 1	N
Sora	Sensitive			N
Sandhill crane	Sensitive			N
Black tern	Sensitive	Not at risk		N
Northern hawk owl	Sensitive	Not at risk		N
Barred owl	Sensitive			Y
Great gray owl	Sensitive	Not at risk		Y
Short-eared owl	May be at risk	Special concern	Schedule 3	N
Northern pygmy owl	Sensitive			Y
Common nighthawk	Sensitive	Threatened		N
Black-backed woodpecker	Sensitive			Y
Pileated woodpecker	Sensitive			Y
Least flycatcher	Sensitive			Y
Eastern phoebe	Sensitive			N
Barn swallow	Sensitive			N
Brown creeper	Sensitive			Y
Cape May warbler	Sensitive			N
Black-throated green warbler	Sensitive			N
Bay-breasted warbler	Sensitive			N
Common yellowthroat	Sensitive			Y
Canada warbler	Sensitive			N
Western tanager	Sensitive			Y
Rusty blackbird	Sensitive	Special concern	No schedule	N
Baltimore oriole	Sensitive			N

Common Name	Provincial[1]	Federal (COSEWIC)[1]	Federal (SARA)[1]	Detected in LSA
Mammals				
Northern long-eared bat	May be at risk			N
Silver-haired bat	Sensitive			N
Red bat	Sensitive			Y
Hoary bat	Sensitive			N
Fisher	Sensitive			Y
Wolverine	May be at risk	Special concern	No schedule	N
Canada lynx	Sensitive	Not at risk		Y
Woodland caribou	At risk	Threatened	Schedule 1	Y

1 Status definitions are provided in Appendix 11B.
Sources: ASRD (2006), COSEWIC (2007), SARA (2007, Internet site).

11.5.7.1 Amphibians and Reptiles

The Canadian toad, western toad and red-sided garter snake occur in the region. As mentioned in Section 11.5.6, Canadian toads were not detected within the LSA. One western toad was detected in the LSA in a cutblock during the barred owl survey (Table 11.5-7; Figure 11.5-8). Red-sided garter snakes are found throughout Alberta; however, none were observed within the LSA.

11.5.7.2 Birds

A total of 42 species of birds, identified as SAR, potentially occur in the region. Habitat is limited for some of these species within the LSA and they are not likely to occur. Species that have not been observed in the LSA and which are rare in the region include the American white pelican, white-winged scoter and peregrine falcon.

Although not observed in the LSA, habitat is available for the pied-billed grebe, horned grebe and western grebe, green-winged teal, northern pintail, lesser scaup and black tern. Habitat is present for the wading birds including the American bittern, great blue heron, yellow rail, sora and sandhill crane although none of these species were detected in the LSA.

Six raptor species and five owl species identified as SAR potentially occur in the region. Habitat exists for all raptor and owl species except the peregrine falcon which requires cliffs for nesting (Semenchuk, 1992). Of the remaining species, three owl species were detected. Four barred owls were detected during the barred owl survey, and one additional barred owl was detected during the bat survey (Table 11.5-7 and Figure 11.5-7). One great gray owl was detected during the barred owl survey while driving to site (Figure 11.5-8). Three northern pygmy owls were detected during the barred owl survey (Figure 11.5-7). None of the other raptor or owl SAR were detected in the LSA.

Sharp-tailed grouse and common nighthawk occur in the region. Sharp-tailed grouse are found sporadically throughout the boreal forest in farmlands, open woodlands, muskeg and bogs (Semenchuk, 1992). Sharp-tailed grouse are frequently observed in habitat burned by the Mariana Lakes and House River fires (Lauzon, pers. comm.). No sharp-tailed grouse were observed during any surveys conducted for the Project (Table 11.5-7). Although there is habitat available for the common nighthawk, none were observed in the LSA.

Two species of woodpecker are identified as SAR: the pileated woodpecker and the black-backed woodpecker (Table 11.5-7). Pileated woodpeckers prefer older forests, particularly deciduous or mixedwood, with large trees for nesting. Black-backed woodpeckers prefer mixedwood or coniferous forests and nest in burns, logged areas, windfalls or other openings such as bogs, swamps and lakeshores (Salt and Salt, 1976; Semenchuk, 1992). Neither species was detected in the LSA.

Twelve songbird species identified as SAR potentially occur in the region (Table 11.5-7). The bay-breasted warbler, brown creeper, common yellowthroat, least flycatcher and western tanager were detected during the breeding bird survey (Figure 11.5-8). Habitat exists within the LSA for all 12 bird species. Given their distribution in the region, they are all expected to occur within the LSA as well.

11.5.7.3 Mammals

Seven mammal species potentially occurring in the LSA were identified as SAR. With the exception of the bat species already discussed earlier, all three remaining species (fisher, lynx and caribou) were detected during surveys (Table 11.5-7). However, fishers were only detected in the RSA, not in the LSA (Figure 11.5-9). Although not observed in the LSA, the silver-haired bat, northern long-eared bat and hoary bat have been observed in the region (Caceres and Pybus, 1997) and suitable habitat, consisting of old growth forests, occurs in the LSA. Wolverines were not detected in the LSA but have been detected in the region including the JACOS study area and tracks were observed south of the LSA in 2007 (Lauzon 2007, pers. comm.).

In Alberta, woodland caribou are listed as Threatened under Alberta's Wildlife Act and by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2002, 2007). Woodland caribou populations are declining in Alberta and the proximate causes for these declines are the combined effects of human and natural disturbance (e.g., wildfires, logging, road construction, seismic lines), hunting, poaching and predation primarily by wolves as well as black bears (Edmonds, 1988; Ferguson and Gauthier, 1992; Gray, 1999; Dzus, 2001; Alberta Woodland Caribou Recovery Team, 2005). Accurate estimates of caribou population size, however, are currently not available. This is due to the difficulty in conducting standard population census techniques (e.g., aerial census; Dzus 2001, Alberta Woodland Caribou Recovery Team 2005, Dzus 2006, pers. comm.). However, trends in survivorship have been analysed and this indicates that most of the monitored caribou herds in Alberta are declining (Dzus, 2001; McLoughlin et al., 2003; Alberta Woodland Caribou Recovery Team, 2005).

The LSA and RSA occur in the East Side Athabasca River (ESAR) caribou range (Figure 11.2-1). More specifically, the LSA and RSA overlap the Egg-Pony and Wiau caribou herds (Figure 11.2-1). It is estimated that the caribou population in the ESAR range have declined by more than 40% from 1993 to 2002 (McLoughlin et al., 2003, Alberta Woodland Caribou Recovery Team, 2005). Caribou on the ESAR are declining at an average rate of approximately 4% per year (McLoughlin et al., 2003, Alberta Woodland Caribou Recovery Team 2005). McLoughlin et al., (2003) concluded that calf recruitment rates are too low to prevent caribou population declines. Adult female survivorship however, has remained similar to past studies (Fuller and Keith, 1981; Edmonds, 1988; Stuart-Smith et al., 1997; McLoughlin et al., 2003). Caribou were detected during the winter tracking survey (Figure 11.5-9) and during the scat program (Figure 11.5-1).

11.5.8 Habitat Suitability Modeling and Supply

11.5.8.1 Canadian Toad

Habitat Model Description

The Canadian toad has highly specific habitat requirements that include various types of wetlands for breeding; upland deciduous dominated habitats for foraging; and sandy sites, most often dominated by jack pine, for hibernation. The model is based on a combination of breeding, foraging and hibernating habitat. Since each component is a life requisite of the Canadian toad, the habitat model assesses each habitat component separately. However, habitat for Canadian toads is optimal when all three critical habitat parameters occur within 1,000 m of each other (Garcia et al., 2004). For example, upland habitats that are more than 1,000 m from a wetland are considered unsuitable for Canadian toads.

Baseline Habitat Availability

The Canadian toad habitat model predicts that 17.3% of the LSA has high suitability for toads (25,126.3 ha), 8.6% has moderate suitability (12,443.2 ha), 43.4% has low suitability (63,106.4 ha) and 30.7% is not suitable (44,673.3 ha) (Figure 11.5-10).

11.5.8.2 Northern Goshawk

Habitat Model Description

Northern goshawks occur throughout the northern hemisphere. Nesting is in areas of mature and old-growth mixed and deciduous forests with high canopy closure. Foraging takes place in similar habitats and at forest edges where a greater diversity of prey are available. Habitat suitability is reduced near human disturbances and nesting is less successful near forest edges. The HSI model used here combines nesting and foraging requirements and was adapted from the model by Schaffer et al. (1999), which was developed for use in the boreal forest of Alberta and in the Foothills Model Forest area near Hinton, Alberta. Additional model parameters and model structure were also incorporated from a northern British Columbia model by Mahon et al. (2003).

Baseline Habitat Availability

The northern goshawk habitat model predicts that 2.4% of the LSA has high suitability for goshawks (3,480.2 ha), 8.3% has moderate suitability (12,068.8 ha), 24.2% has low suitability (35,205.7 ha) and 65.1% is not suitable (94,594.5 ha) (Figure 11.5-11).

11.5.8.3 Great Gray Owl

Habitat Model Description

The great gray owl has complex habitat requirements. Nesting sites are located near suitable foraging habitats preferred by their primary prey species, the meadow vole. Meadow voles prefer moist habitats with high graminoid cover and low shrub cover. Nesting habitat consists of mature and old growth deciduous dominated forests with high canopy cover. In addition, habitat suitability is reduced near human disturbances.

Baseline Habitat Availability

The great gray owl habitat model predicts that 22.7% of the LSA is highly suitable habitat for great gray owls (32,997.0 ha), 51.2% is moderately suitable habitat (74,476.1 ha), 22.1% has low suitability (32,176.4 ha) and 3.9% is not suitable (5,699.7 ha) (Figure 11.5-12).

11.5.8.4 Barred Owl

Habitat Model Description

This model is based on Olsen et al. (1999) which was developed for west-central Alberta. Barred owls primarily inhabit mature and old mixed woods and coniferous forests, especially in the boreal forest (Godfrey, 1986; Boxall and Stepney, 1982; Dunbar et al., 1991; Van Ael, 1996; Mazur, 1997; Mazur et al., 1998; Mazur and James, 2000). The persistence of barred owls is dependent upon mature and old growth forests. These stands provide the reproductive habitat, namely large diameter dead trees for nesting.

Baseline Habitat Availability

The barred owl habitat model predicts that 0.2% of the LSA is highly suitable habitat for barred owls (289.9 ha), 2.4% is moderately suitable habitat (3,539.2 ha), 0.3% has low suitability (378.5 ha) and 97.1% is not suitable (141,141.6 ha) (Figure 11.5-13).

11.5.8.5 Boreal Owl

Habitat Model Description

This model is based on the boreal owl model developed by Heinrich et al., (1999) for the Foothills model forest of west-central Alberta. The boreal owl lives and breeds in dense boreal/taiga conifer forests. They primarily nest in abandoned nest cavities of pileated woodpeckers, which occur in large diameter deciduous trees, snags and conifer snags. Boreal owls are thus limited to mature and old growth forest stands that provide the required reproductive habitat.

Baseline Habitat Availability

The boreal owl habitat model predicts that 0.6% of the LSA is highly suitable habitat for boreal owls (942.5 ha), 0.1% is moderately suitable habitat (161.4 ha), 0.3% has low suitability (384.6 ha) and 99% is not suitable (143,860.6 ha) (Figure 11.5-14).

11.5.8.6 Mixedwood Forest Bird Community

Habitat Model Description

Mixedwood forests have a high ecological importance because they support a high diversity of wildlife species. Mixedwood forests are characterized by a diversity of tree species and complex structure, including multi-layered tree and shrub canopies. This diversity provides habitat for a wide range of bird species.

For the mixedwood forest bird community, an area analysis was conducted to determine the availability of mixedwood forest habitat within the LSA. For this analysis, ecosite phases b1, b3, d2, e2, and f2 for the BM and ecosite phases b1 and d2 for the LBH were considered mixedwood forest habitat highly suitable for the mixedwood forest bird community. All other habitats were considered unsuitable.

Baseline Habitat Availability

The analysis identified 7,688.0 ha of mixedwood forest in the LSA, representing 5.3% of the LSA (Figure 11.5-15).

11.5.8.7 Old Growth Forest Bird Community

Habitat Model Description

Old growth forests represent a community based on stand age and successional stage as opposed to a specific habitat type. Compared to young or mature forests, old growth forests typically have greater species richness and they support a higher number of rare species (Stelfox, 1995; Timoney, 1998). Several bird species considered species at risk in Alberta occur in old growth forests, including the bay-breasted warbler, black-throated green warbler, Cape May warbler, western tanager and pileated woodpecker (ASRD, 2006).

Deciduous and mixedwood forests (i.e., b1, b2, b3, d1, d2, e1, e2, f1, and f2 ecosite phases for the Boreal Mixedwood Natural Subregion, BM), and b1, b2, d1, d2, and e1 ecosite phases for the Lower Boreal Highlands Natural Subregion, LBH) greater than 100 years old are considered old growth. Coniferous forests (i.e., a1, b4, c1, d3, e3, f3, g1, h1, i1, j1 and k1 ecosite phases for the BM, and a1, b3, c1, d3, f1, g1, h1, i1 and j1 ecosite phases for the LBH) greater than 120 years old are considered old growth. All stands that did not meet the above stand age and successional stage criteria were considered unsuitable (i.e., not old growth forests).

Baseline Habitat Availability

The analysis identified 7,718.3 ha of old growth forest in the LSA, representing 5.3% of the LSA (Figure 11.5-16).

11.5.8.8 Beaver

Habitat Model Description

Beavers inhabit low-gradient rivers and streams and a wide variety of lentic habitats such as lakes, ponds and marshes. They require deep water with stable shorelines in forested areas (Jenkins and Busher, 1979; Muller-Schwarze and Sun, 2003). A high interspersion of water and shallow banks with adjacent terrestrial deciduous vegetation provides optimal habitat (Jenkins and Busher, 1979; Muller-Schwarze and Sun, 2003). Within the wildlife LSA, all stream and shoreline banks are considered suitable for beavers.

Baseline Habitat Availability

The beaver habitat model predicts that 2.8% of the LSA is highly suitable for beavers (4,111.2 ha), 3.8% is moderately suitable (5,537.7 ha), 9.4% has low suitability (13,631.8 ha) and 84.0% is unsuitable (122,068.5.0 ha) (Figure 11.5-17).

11.5.8.9 Muskrat

Habitat Model Description

Muskrats are amphibious rodents that spend the majority of their time in water (Banfield, 1974; Allen and Hoffman, 1984; Boutin and Birkenholz, 1987). While somewhat flexible in their habitat requirements, muskrats need a permanent water source and a protected site for rearing their young (Boutin and Birkenholz, 1987). This protected site can be in the form of a floating lodge constructed of vegetation or bank dens (Boutin and Birkenholz, 1987).

Muskrat densities are dependent upon the amount of interspersion between water and emergent vegetation (Weller, 1978; Proulx and Gilbert, 1983; Boutin and Birkenholz, 1987). Muskrat densities fluctuate with changing water levels and ideal muskrat habitat occurs where there is an equal ratio of open water to emergent vegetation. Muskrat densities are highest in habitats that have a high density of emergent aquatic vegetation that are boarded by terrestrial herbaceous vegetation (Errington, 1963).

Baseline Habitat Availability

The muskrat habitat model predicts that 0.7% of the LSA is highly suitable for muskrats (968.4 ha) for herbaceous wetlands and 1.0% of the LSA is considered highly suitable for muskrats (1,524.8) in riverine environments (Figure 11.5-18). In total, 1.7% of the LSA (2,493.2 ha) is highly suitable muskrat habitat.

11.5.8.10 Fisher

Habitat Model Description

Fishers inhabit dense mature coniferous and mixed forests with diverse prey availability and high canopy closure (Powell, 1993; Powell and Zielinski, 1994). They prefer continuous or near continuous forest tracts with the fewest non-forest openings. Such forest cover provides thermal cover and den sites for fishers, while woody debris and understorey vegetation support an adequate prey base.

Baseline Habitat Availability

The fisher habitat model predicts that 27.4% of the LSA is highly suitable for fishers (39,781.6 ha), 60.3% is moderately suitable (87,595.7 ha), 7.4% is low suitability (10,818.8 ha) and 4.9% is not suitable (7,153.2 ha) (Figure 11.5-19).

11.5.8.11 Lynx

Habitat Model Description

Lynx inhabit the northern forests across much of Canada and Alaska and parts of the northern United States (Forsyth 1985). Lynx are associated with various aged forests and structural stages, interspersed with lowland habitat and dense shrubby understoreys (McCord and Cardoza, 1992). They require mature forests with downed logs for denning, thermal cover and security habitat. They also require minimal human disturbance (Koehler and Aubry, 1994). Lynx prey mainly on snowshoe hares, but will take a variety of alternative avian and mammalian prey when hare populations decline (Saunders, 1963; Soper, 1964; van Zyll de Jong, 1966; Nellis et al., 1972; Brand et al., 1976; Currie and Robertson, 1992).

Baseline Habitat Availability

The habitat model predicts that 53.8% of the LSA is highly suitable habitat for lynx (78,218.9 ha), 38.6% includes moderately suitable habitat (56,151.4 ha), 6.2% has low suitability (9,028.0 ha) and 1.3% is not suitable (1,951.0 ha) (Figure 11.5-20).

11.5.8.12 Black Bear

Habitat Model Description

Black bears inhabit a variety of forest types and seral stages and require large areas to meet their nutritional needs (Smith 1993). High quality bear habitat is considered to be an area with habitat interspersion that provides food close to cover. Habitat use by black bears is influenced by the seasonal availability of food, cover and by denning requirements.

Baseline Habitat Availability

The model predicts that 7.9% of the LSA includes highly suitable habitat for black bear (11,519.4 ha), 64.5% includes moderately suitable habitat (93,711.7 ha), 26.3% has low suitability (38,167.2 ha) and 1.3% is not suitable (1,951.0 ha) (Figure 11.5-21). In the RSA, the habitat model predicts that there is 8.2% of highly suitable for black bear (39,084.8 ha), 70.6% is moderately suitable (335,043.9 ha), 20.8% has low suitability (98,657.1 ha) and 0.4% is not considered suitable (1,916.3 ha, Figure 11.5-22).

11.5.8.13 Moose

Habitat Model Description

Moose occupy a variety of deciduous and coniferous habitats within the boreal forest. Their summer diet consists largely of tree and shrub leaves and aquatic plants, while their winter diet consists exclusively of woody deciduous browse. Moose forage in deciduous and aquatic habitats such as shrublands, regenerating burns, young forests and lake margins. They seek thermal and security cover in mature mixedwood and conifer habitats. Riparian areas are important to moose as stable habitat within climax forests (Geist, 1975). Moose undertake daily and seasonal movements dictated by their requirements for food (abundant preferred browse), calving (isolated mesic sites), shelter from snow and extreme temperatures (mature conifer and mixedwood forest) and predator avoidance (Thompson and Stewart, 1997). Therefore, interspersion of these seasonal components (combination of young and old forests providing food and cover) is key to productive moose habitat.

Baseline Habitat Availability

The moose model predicts that 19.7% of the LSA includes highly suitable habitat for moose (28,611.8 ha), 61.3% is moderately suitable (89,124.0 ha), 17.7% has low suitability (25,662.5 ha) and 1,951.0 ha is unsuitable (1.3%) (Figure 11.5-23). In the RSA, the habitat model predicts that 47.7% is highly suitable for moose (226,230.1 ha), 35.4% is moderately suitable (168,252.1 ha), 16.5% has low suitability (78,303.7 ha) and 0.4% is not considered suitable (1,916.3 ha, Figure 11.5-24).

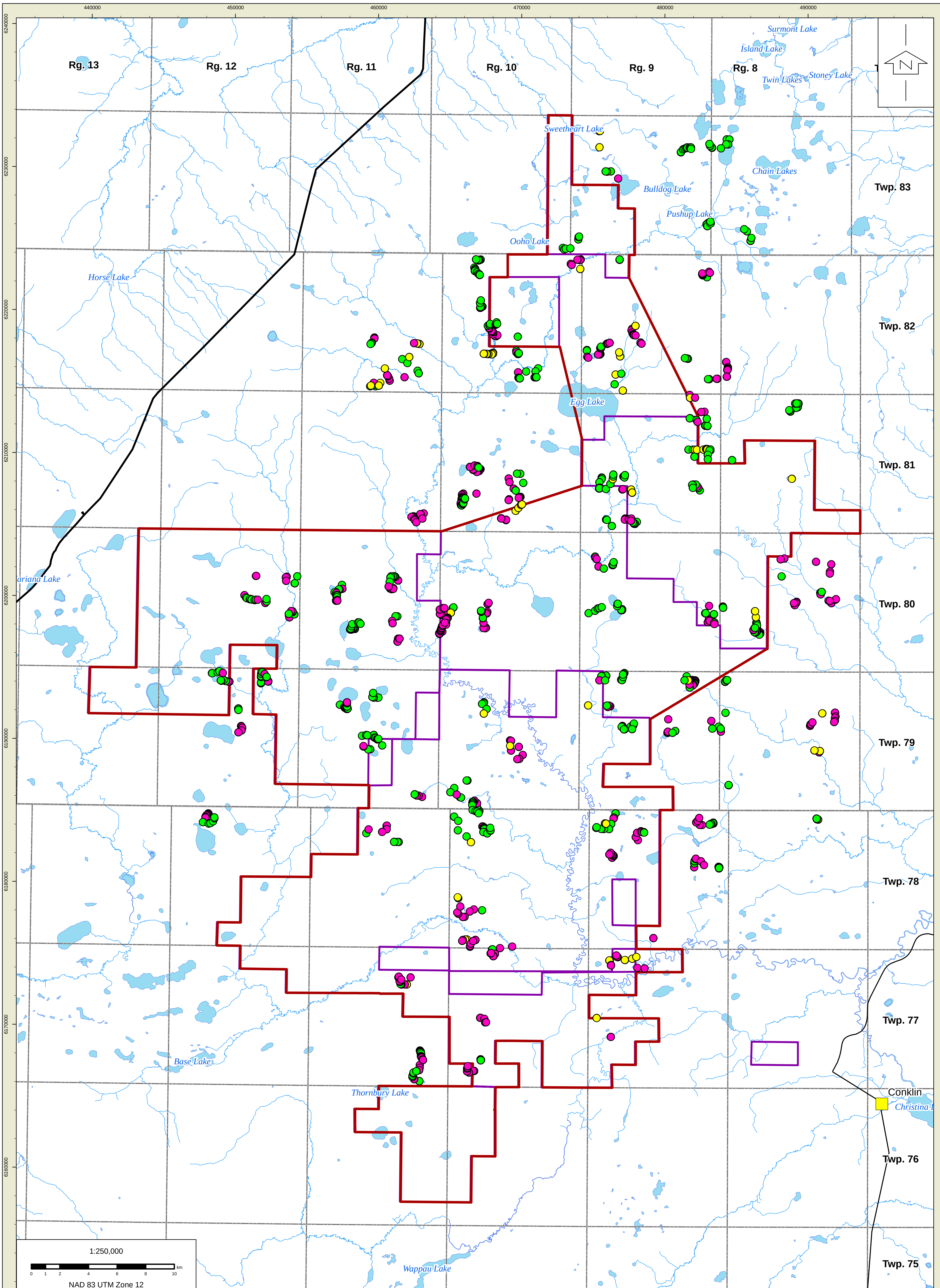
11.5.8.14 Woodland Caribou

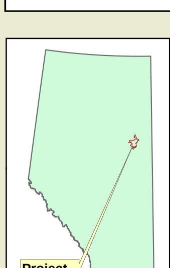
Habitat Model Description

A RSPF was developed for caribou using the data collected as part of the scat collection program. The detailed methods for the development of the RSPF and mechanics are outlined in Appendix 11A. Caribou in the boreal forest typically occur at low density in bog and fen habitat types and they have a requirement for large, undisturbed landscapes. Terrestrial lichens constitute the majority of the winter diet of caribou in Alberta (Thomas et al., 1996; Dzus, 2001). Arboreal lichens are also consumed by caribou and arboreal lichens become very important when there is deep snow or when a crust makes it difficult for caribou to access terrestrial lichens (Simpson et al., 1985). During the summer, the diet of caribou is more varied and aside from terrestrial lichens, they have been known to forage on shrubs, grasses, sedges, horsetails and forbs (Boertje, 1984; Bergerud, 1972). Caribou typically occupy large wetland complexes year-round (Stuart-Smith et al., 1997; Dzus, 2001).

Baseline Habitat Availability

The caribou habitat model predicts that 38.2% of the LSA has high suitability for caribou (55,594.9 ha), 30.3% has moderate suitability (44,011.1 ha), 20.7% has low suitability (30,088.3 ha) and 10.8% is not suitable (15,634.0 ha) (Figure 11.5-25). In the caribou RSA, the habitat model predicts that 38.6% is highly suitable for caribou (139,444.1 ha), 29.1% is moderately suitable (105,091.5 ha), 21.5% has low suitability (77,548.5 ha) and 10.7% is not considered suitable (38,683.4 ha, Figure 11.5-26).





Legend

North American Wildlife LSA

North American Lease

Major Road (Hwy. 63)

Road (881)

Rivers

Lake

Twp. Rg. Lines

Scat Locations

SPECIES

Caribou

Moose

Wolf

Title:

SCAT LOCATIONS FOR WOLF, MOOSE AND CARIBOU

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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TG	RL	11.5-1

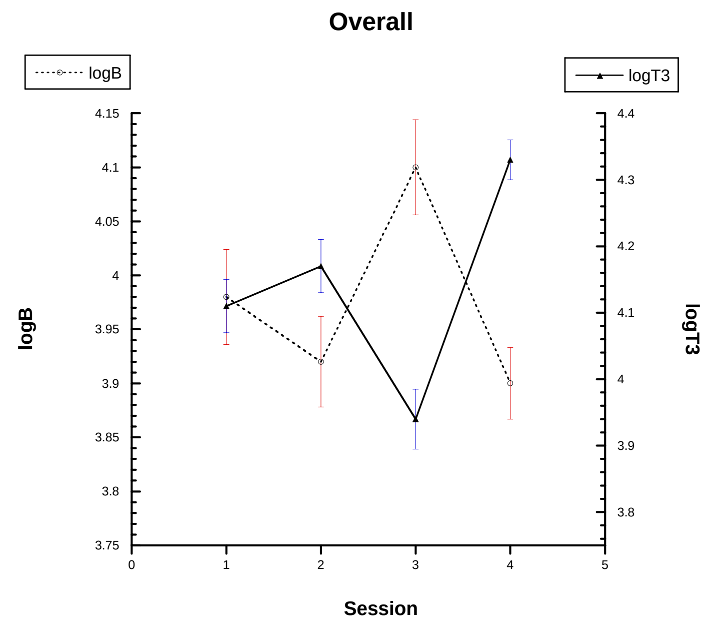


Figure 11.5-2 Overall Change in Cortisol (logB) and Thyroid Hormone (logT3) Across Sessions

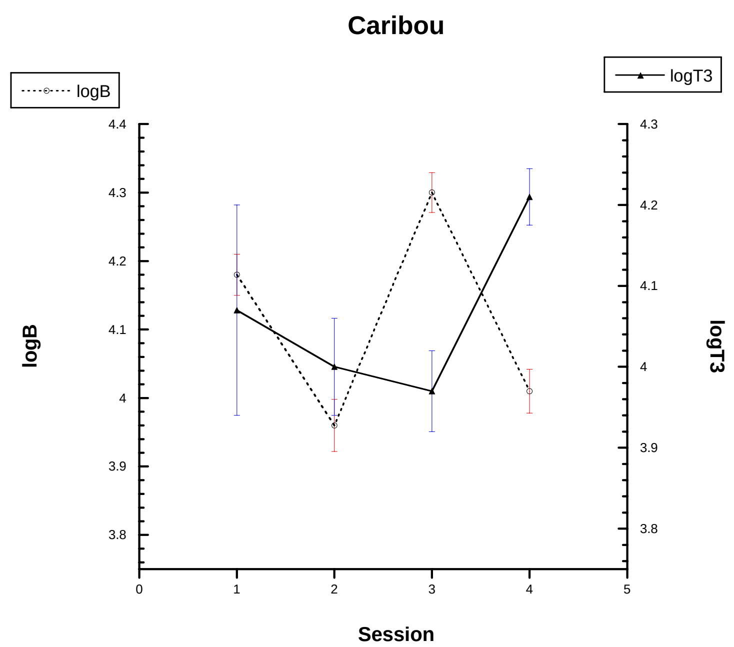


Figure 11.5-3 Changes in Caribou Cortisol (logB) and Thyroid Hormone (logT3) Across Sessions

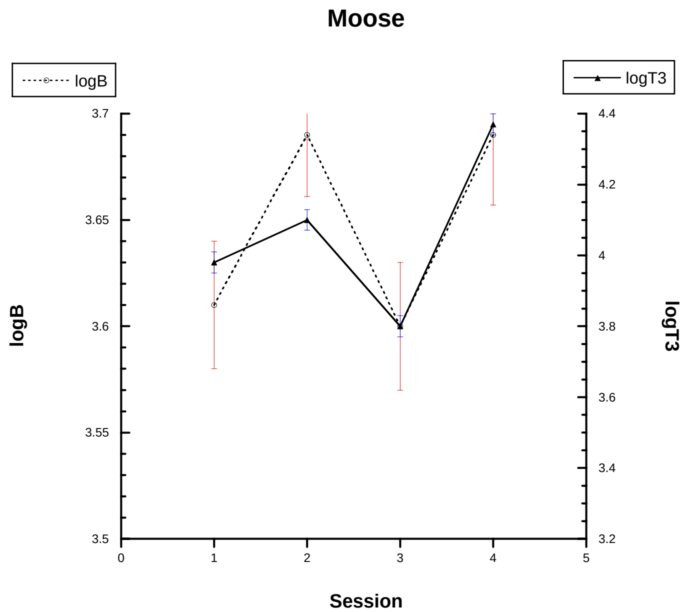


Figure 11.5-4 Changes in Moose Cortisol (logB) and Thyroid Hormone (logT3) Across Sessions

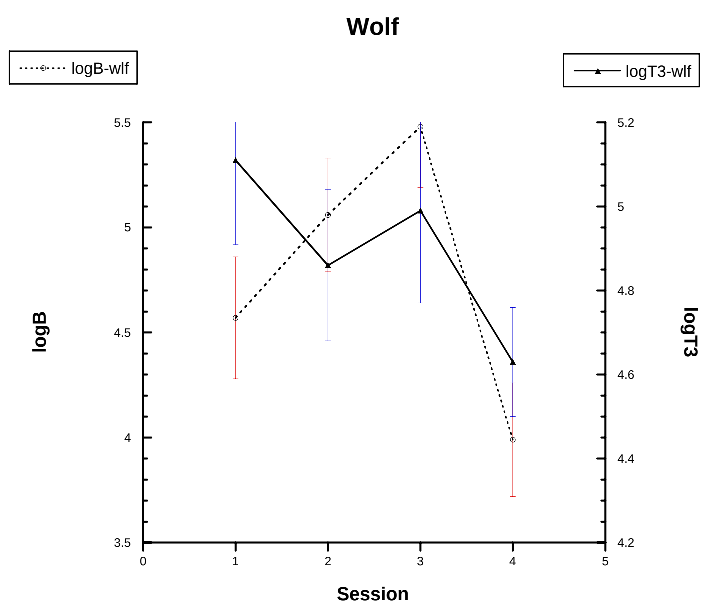
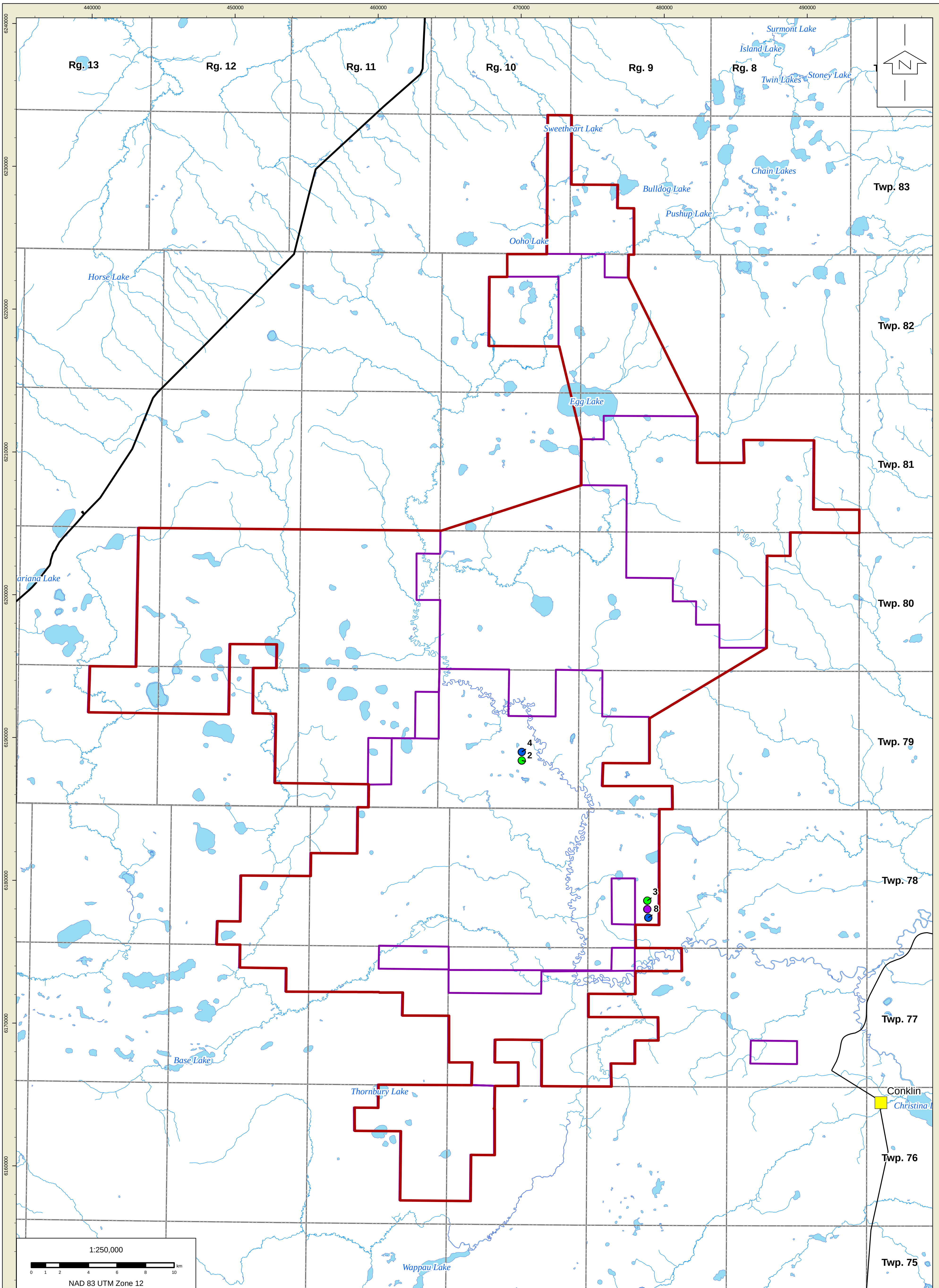
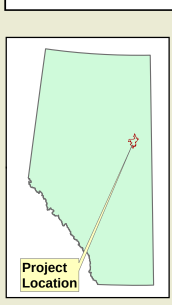


Figure 11.5-5 Changes in wolf cortisol (logB) and thyroid hormone (logT3) across sessions





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Bat Species Recorded

- Big Brown / Silver-haired bats
- Little Brown Bats
- Red Bats

Title:

BAT SPECIES RECORDED WITH THE ANABAT DETECTOR

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Surveys\Bat_Species_Recorded.mxd

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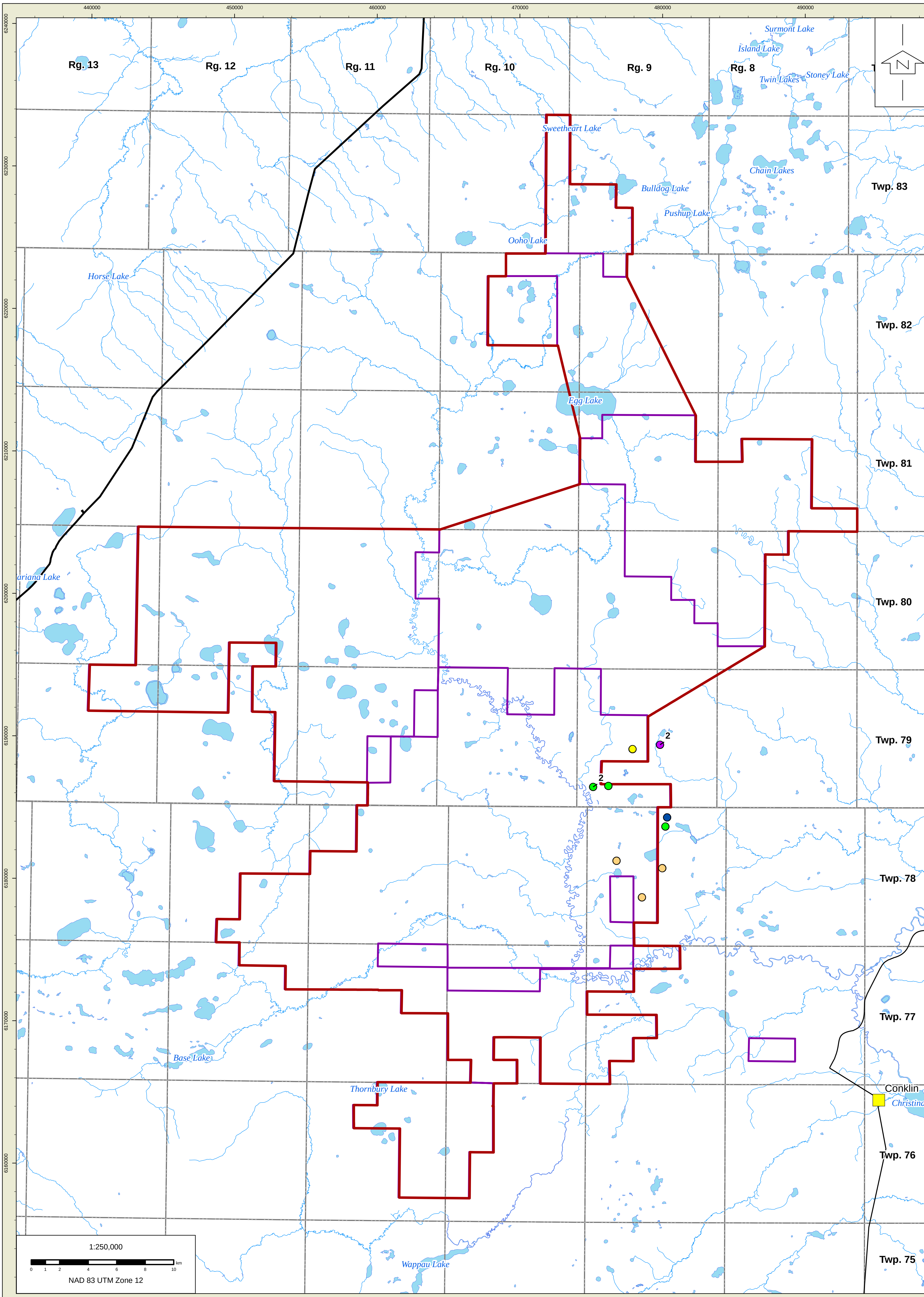

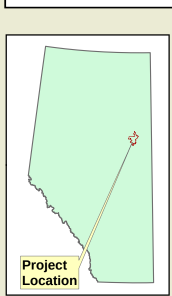

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Owl Species Detected

- Barred owl
- Boreal owl
- Great gray owl
- Great horned owl
- Northern pygmy owl

Title:

OWL SPECIES DETECTED DURING 2006 BARRED OWL SURVEY

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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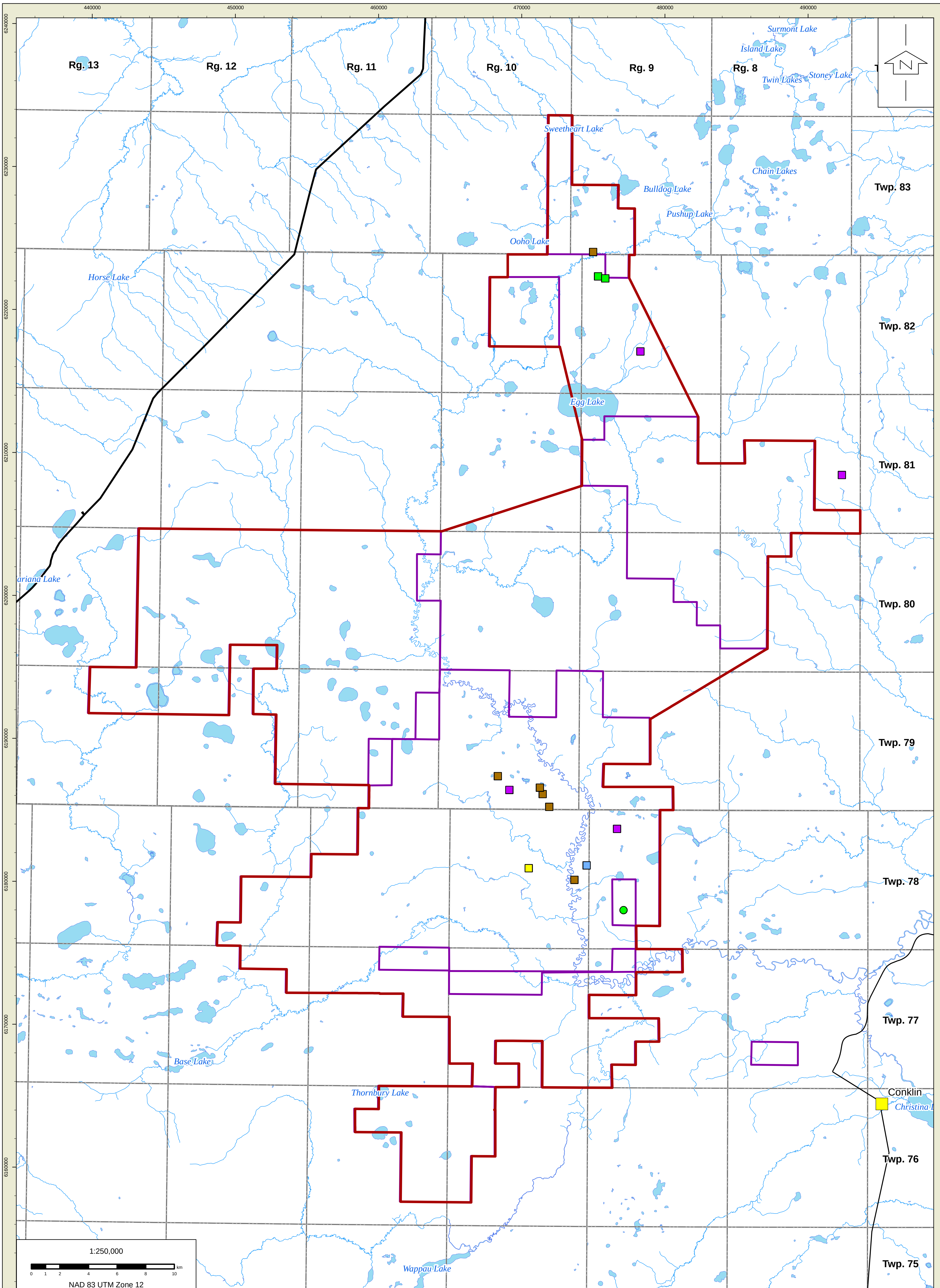

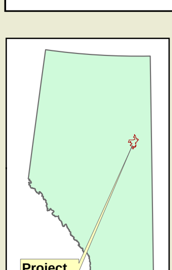

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Species at Risk Detected

- Bay-breasted warbler
- Brown creeper
- Common yellowthroat
- Least flycatcher
- Western tanager
- Western toad

Title:

SPECIES AT RISK DETECTED - AMPHIBIANS AND BIRDS

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Surveys\Risk_Amphibians_Birds.mxd

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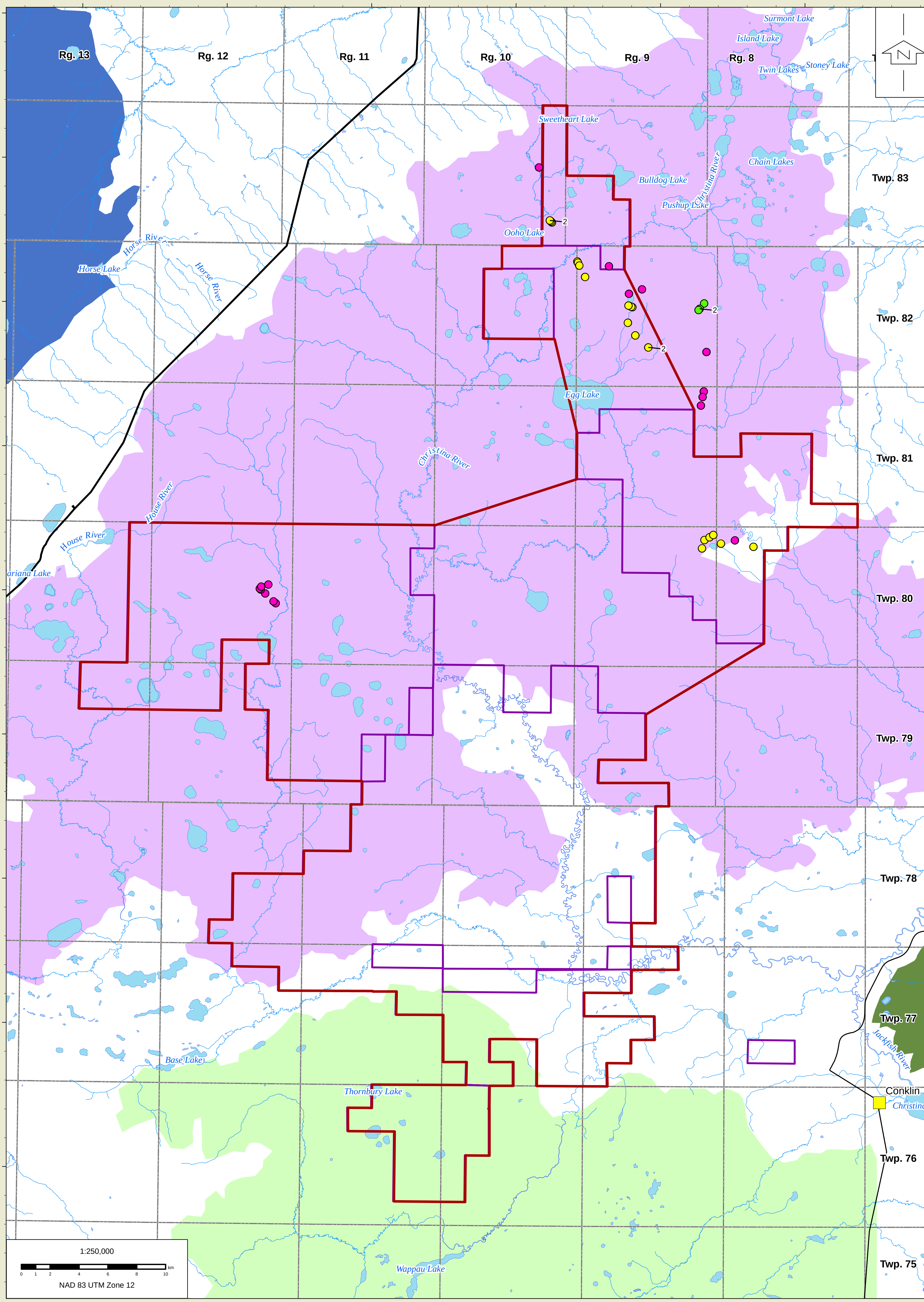

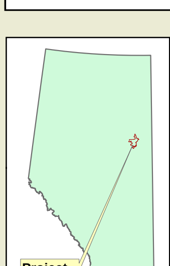

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Species at Risk Detected

- Caribou
- Fisher
- Lynx

Caribou Ranges

- ALGAR
- CHRISTINA
- EGG / PONY
- WANDERING
- WIAU

Title:

SPECIES AT RISK DETECTED - CARIBOU, FISHER AND LYNX

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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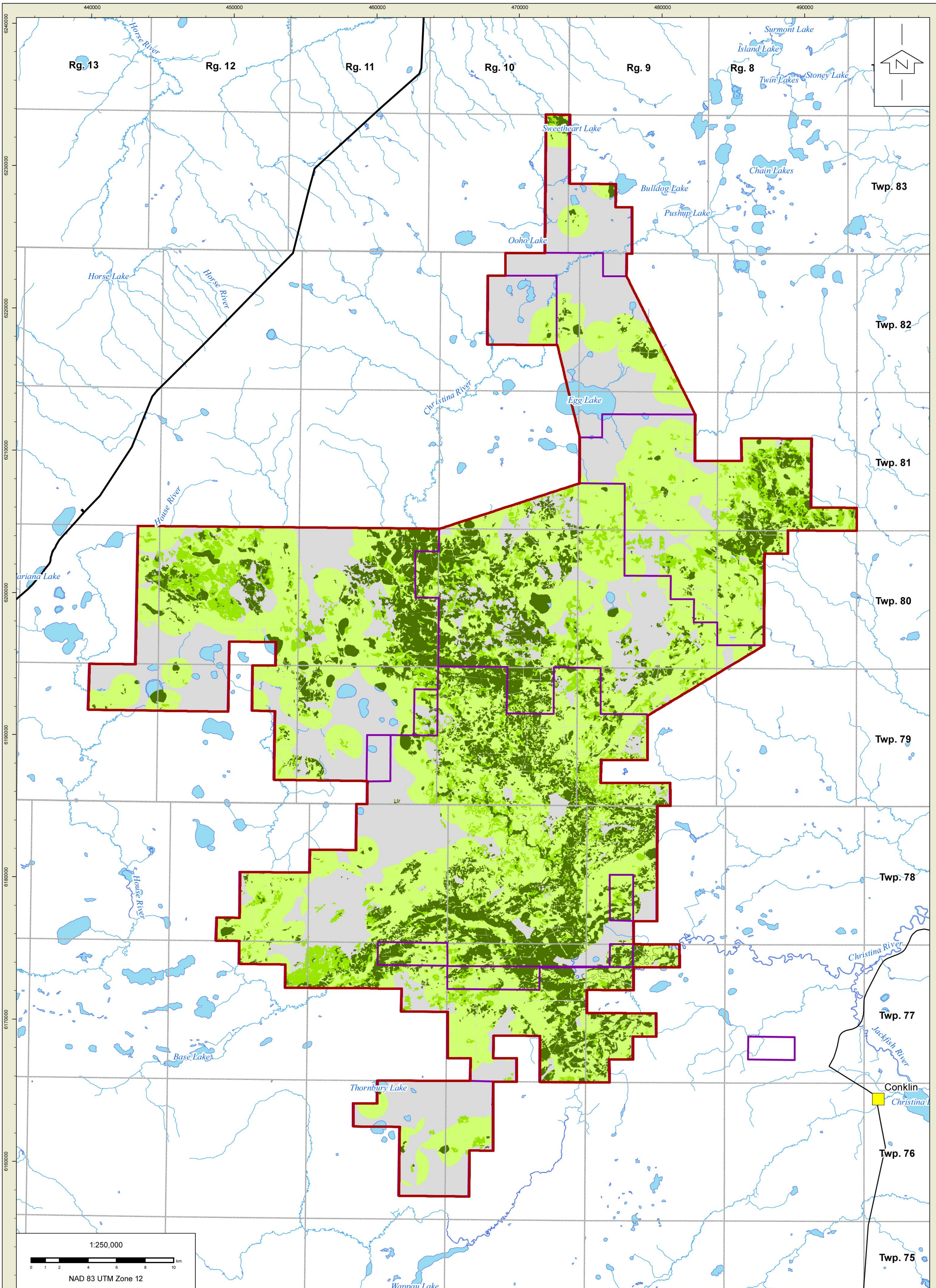

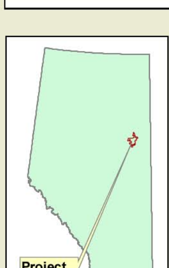

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR CANADIAN TOAD AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
RL	June 14, 2007	
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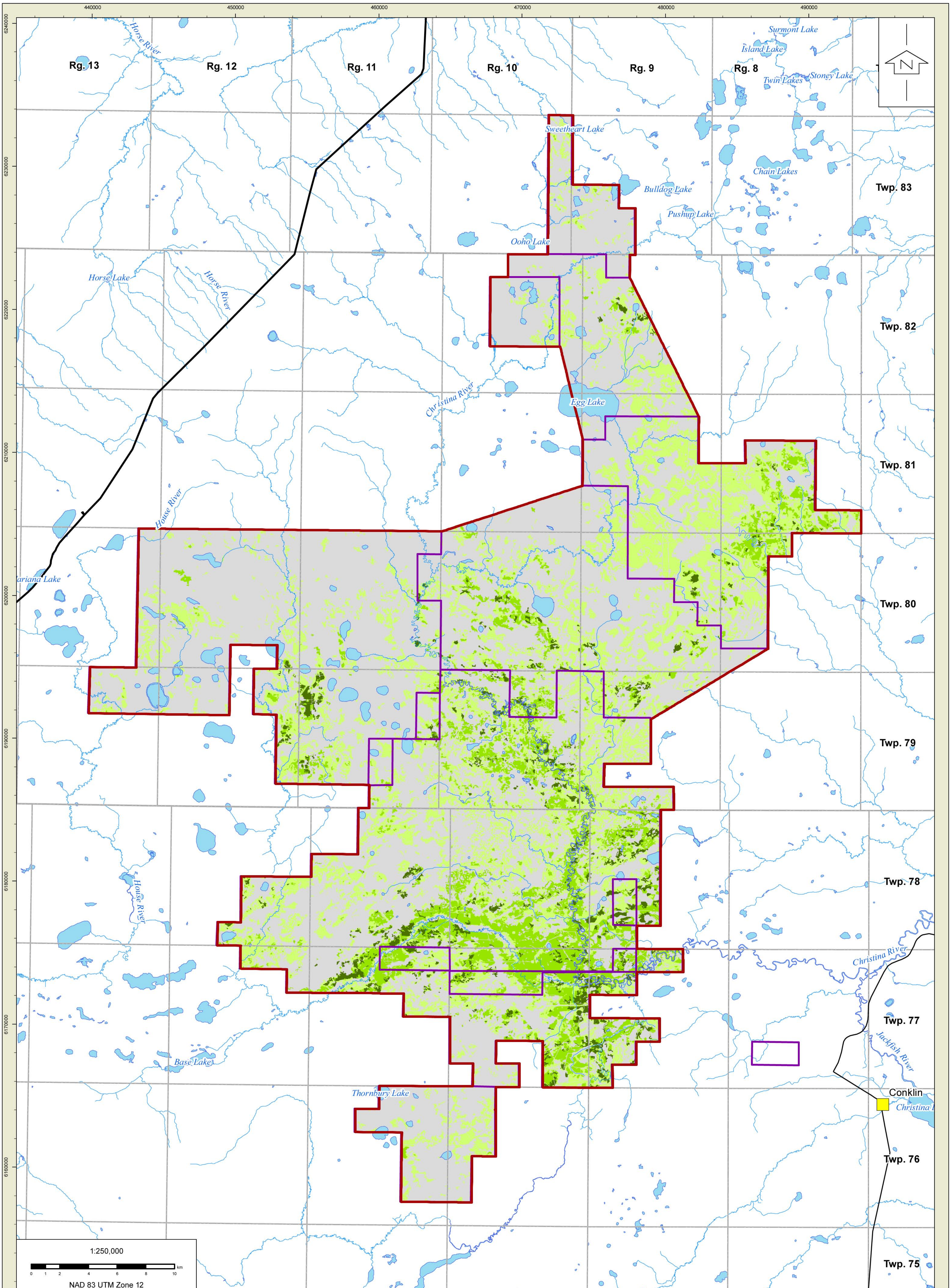

Project Location

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR NORTHERN GOSHAWK AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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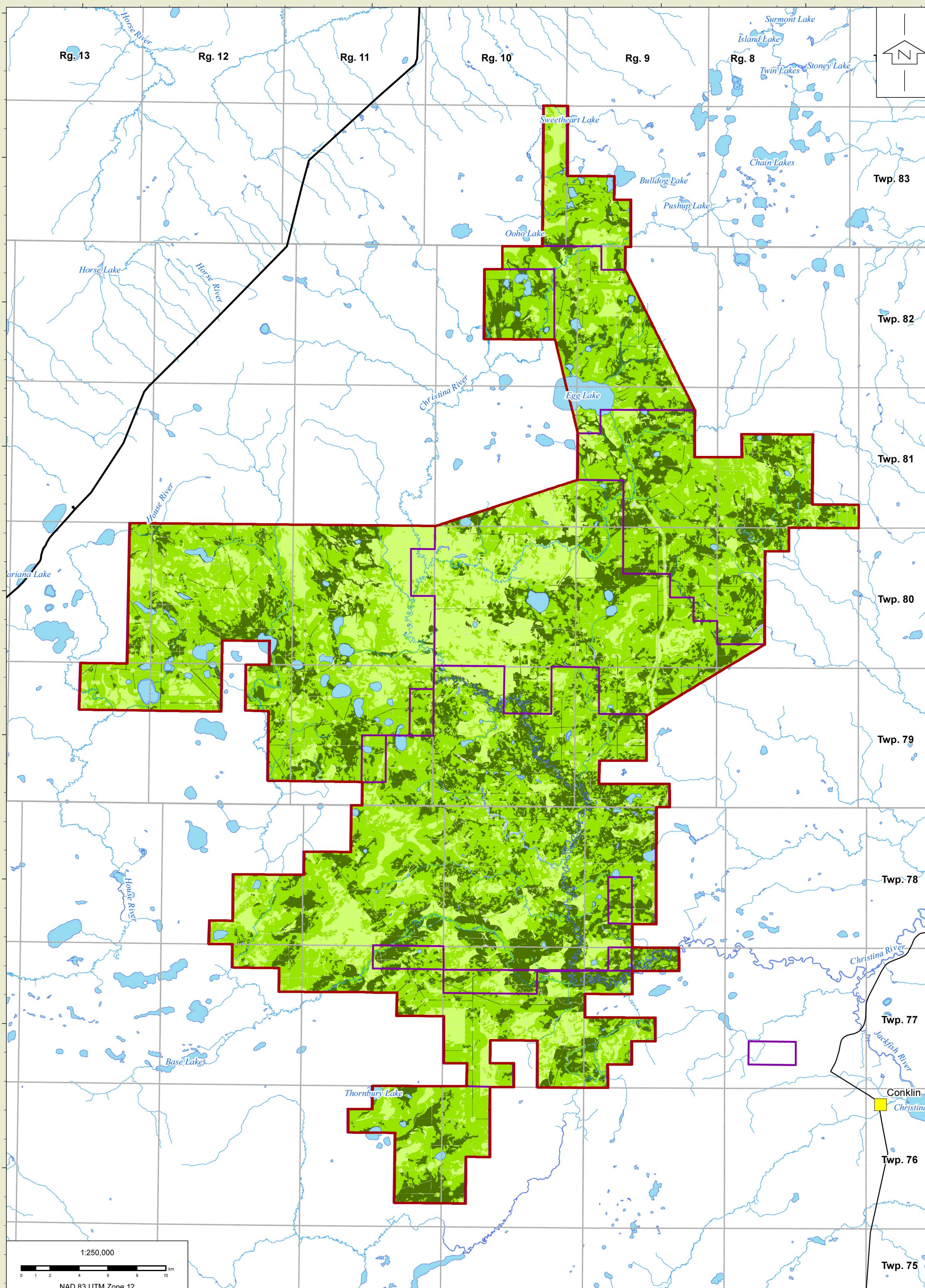

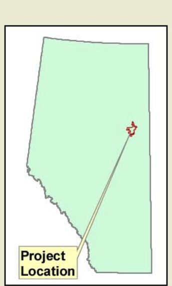

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR GREAT GRAY OWL AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\GreatGrayOwl_p1.mxd

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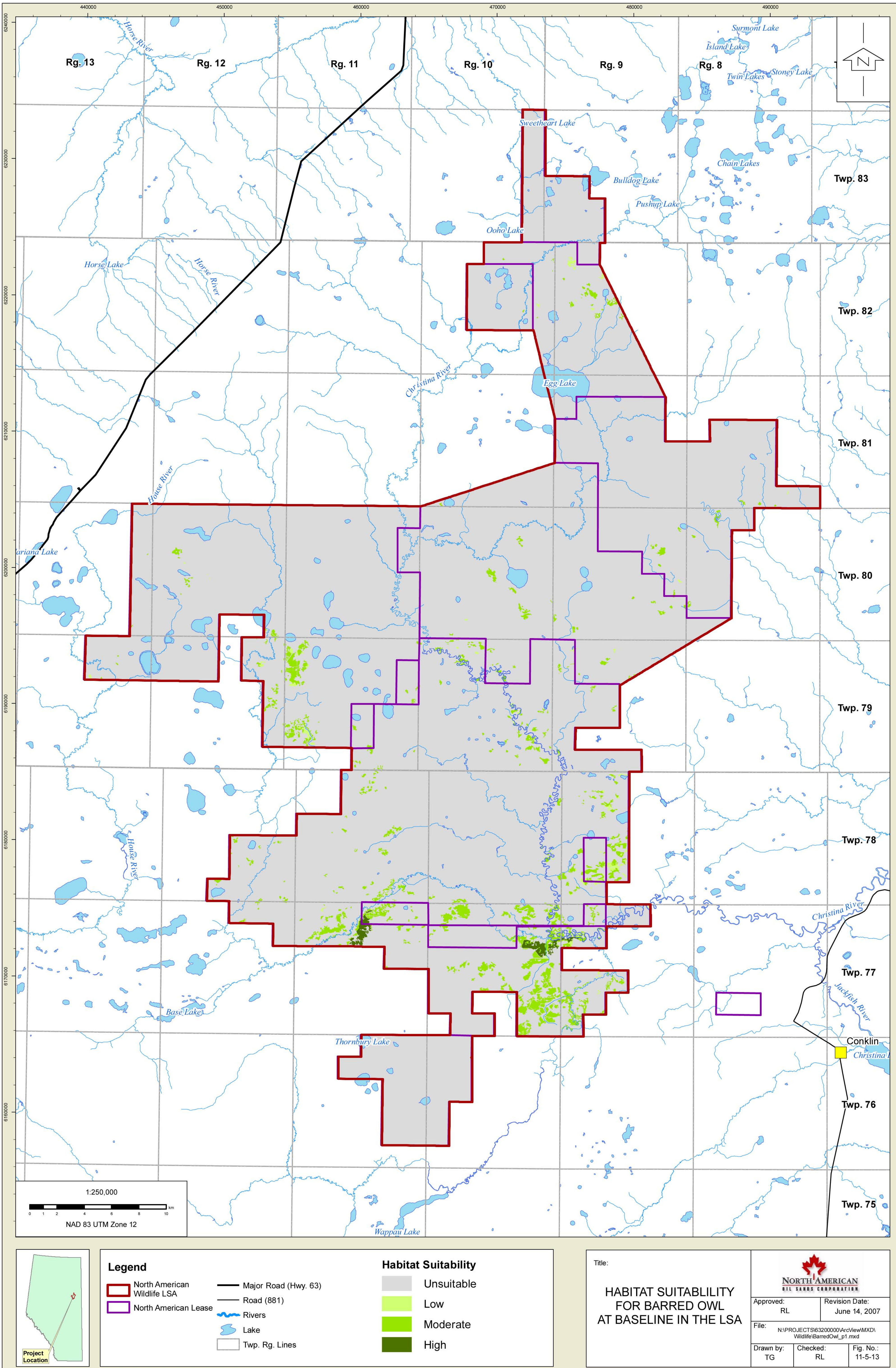
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Rg. 12
Rg. 11
Rg. 10
Rg. 9
Rg. 8
Twp. 83
Twp. 82
Twp. 81
Twp. 80
Twp. 79
Twp. 78
Twp. 77
Twp. 76
Twp. 75
Horse River
Surmont Lake
Island Lake
Twin Lakes
Stoney Lake
Sweetheart Lake
Chain Lakes
Bulldog Lake
Pushup Lake
Ooho Lake
Horse Lake
Egg Lake
Christina River
Base Lake
Thornbury Lake
Wappau Lake
Jackfish River
Conklin
1:250,000
NAD 83 UTM Zone 12
Project Location
Legend
North American Wildlife LSA
North American Lease
Major Road (Hwy. 63)
Road (881)
Rivers
Lake
Twp. Rg. Lines
Habitat Suitability
Unsuitable
Low
Moderate
High
Title:
HABITAT SUITABLILITY FOR BARRED OWL AT BASELINE IN THE LSA
NORTH AMERICAN OIL SANDS CORPORATION
Approved: RL
Revision Date: June 14, 2007
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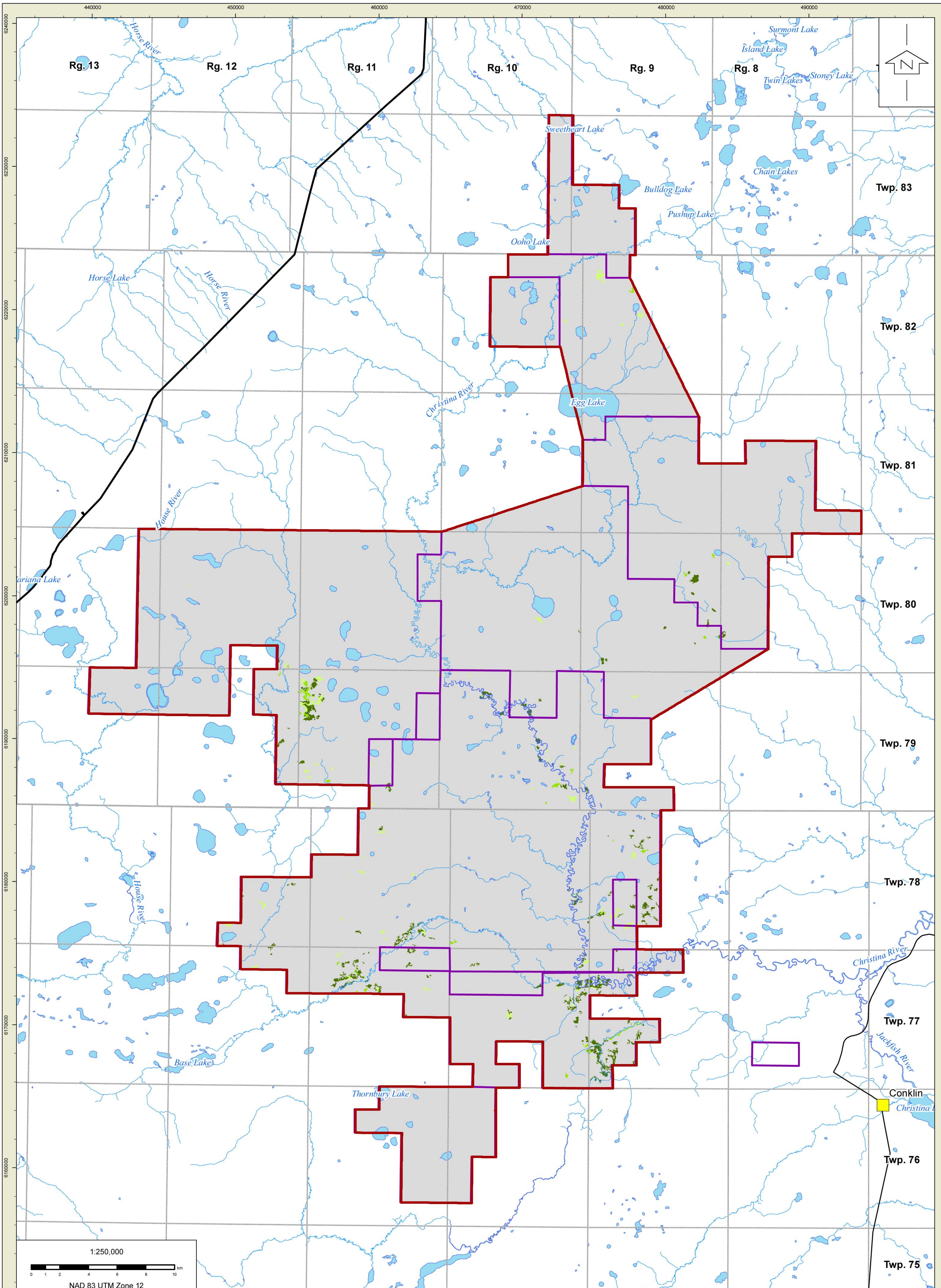
Fig. No.: 11-5-13



Project Location

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABLILITY FOR BOREAL OWL AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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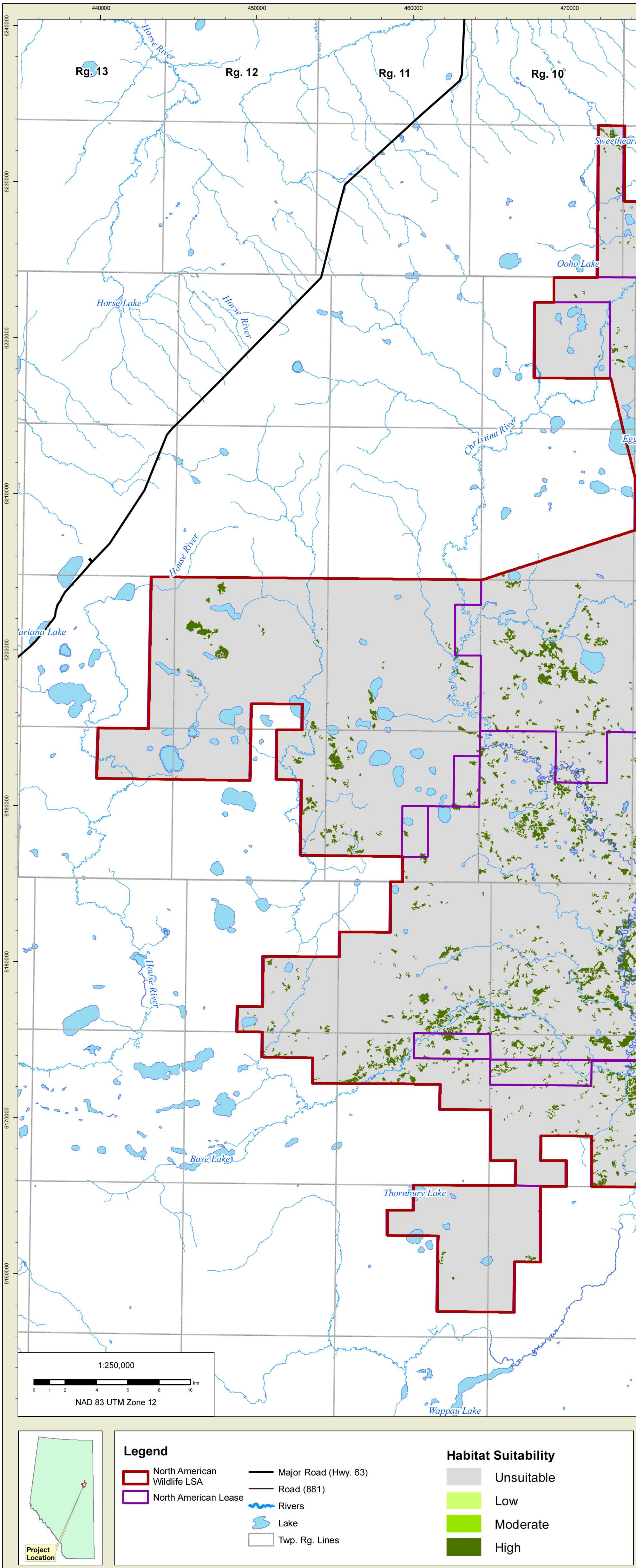

Title:

HABITAT SUITABILITY FOR MIXEDWOOD FOREST BIRD COMMUNITY AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\MixedwoodForestBird_p1.mxd

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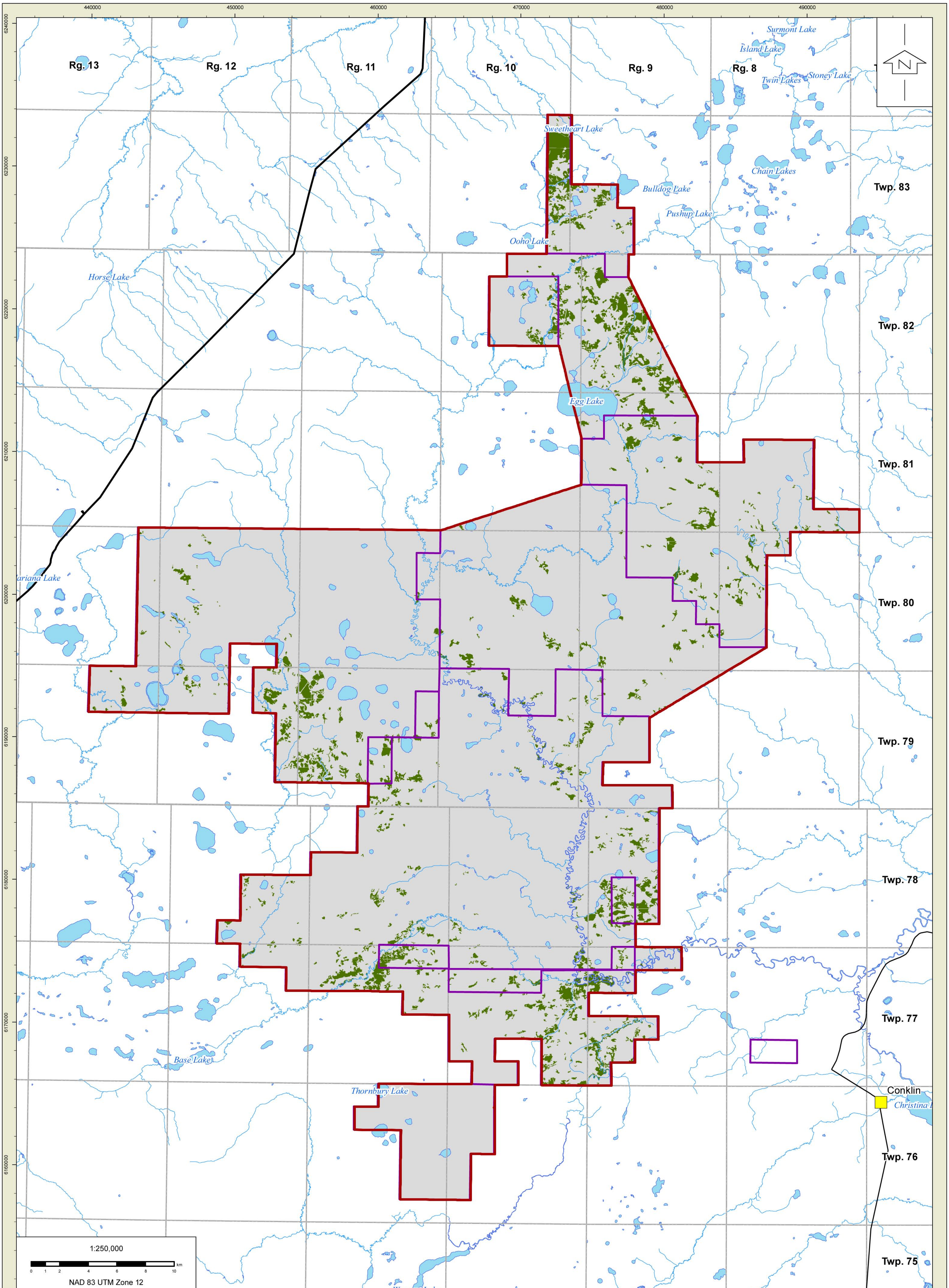

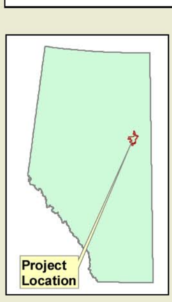

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR OLD GROWTH FOREST BIRD COMMUNITY AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved: RL	Revision Date: June 14, 2007	
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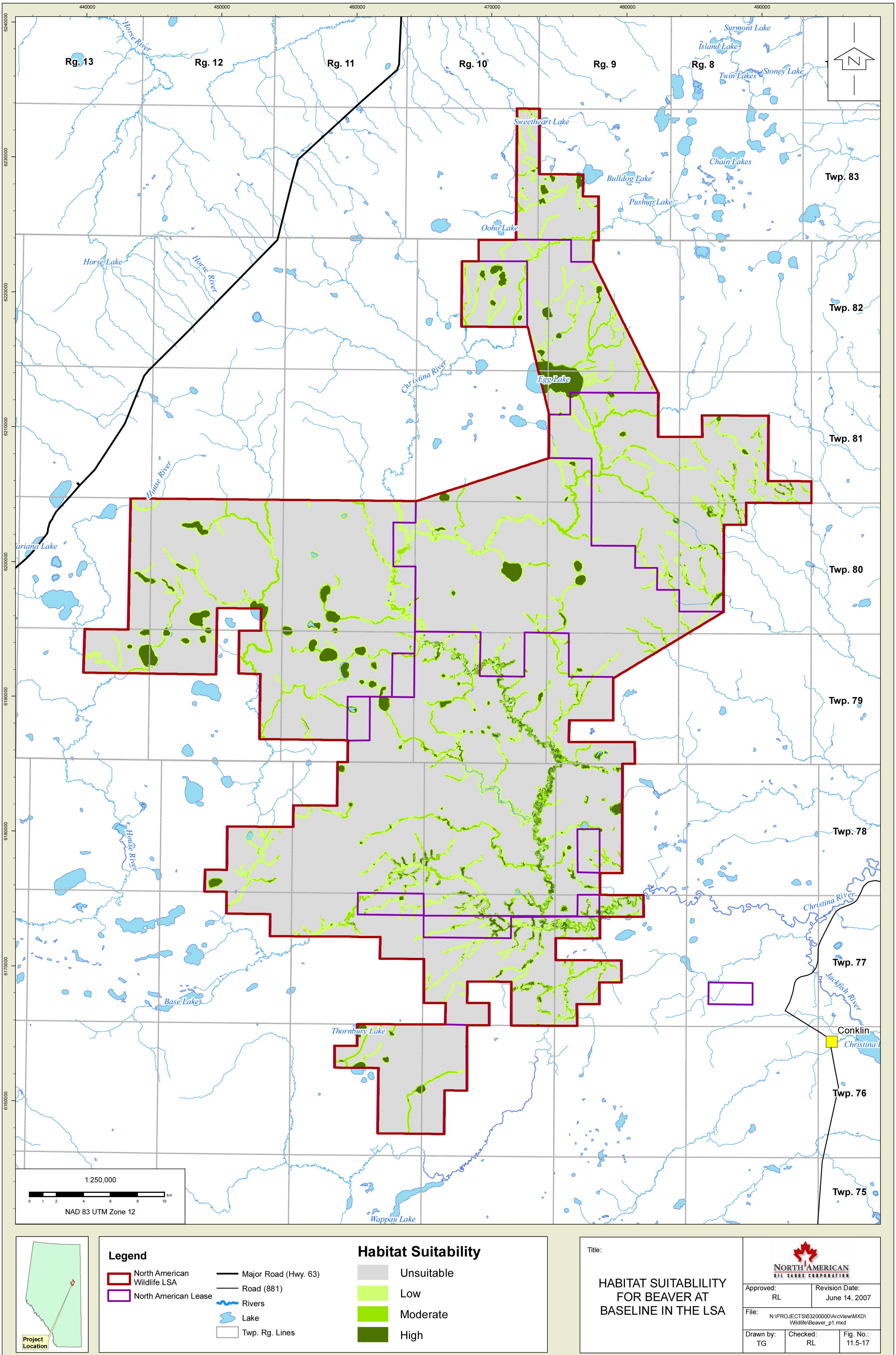

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Twp. 79
Twp. 78
Twp. 77
Twp. 76
Twp. 75
Horse River
Surmont Lake
Island Lake
Twin Lakes
Stoney Lake
Sweetheart Lake
Chain Lakes
Bulldog Lake
Pushup Lake
Ooho Lake
Horse Lake
Christina River
Egg Lake
Mariana Lake
Jackfish River
Conklin
Christina L
Base Lake
Thornbury Lake
Wappau Lake
1:250,000
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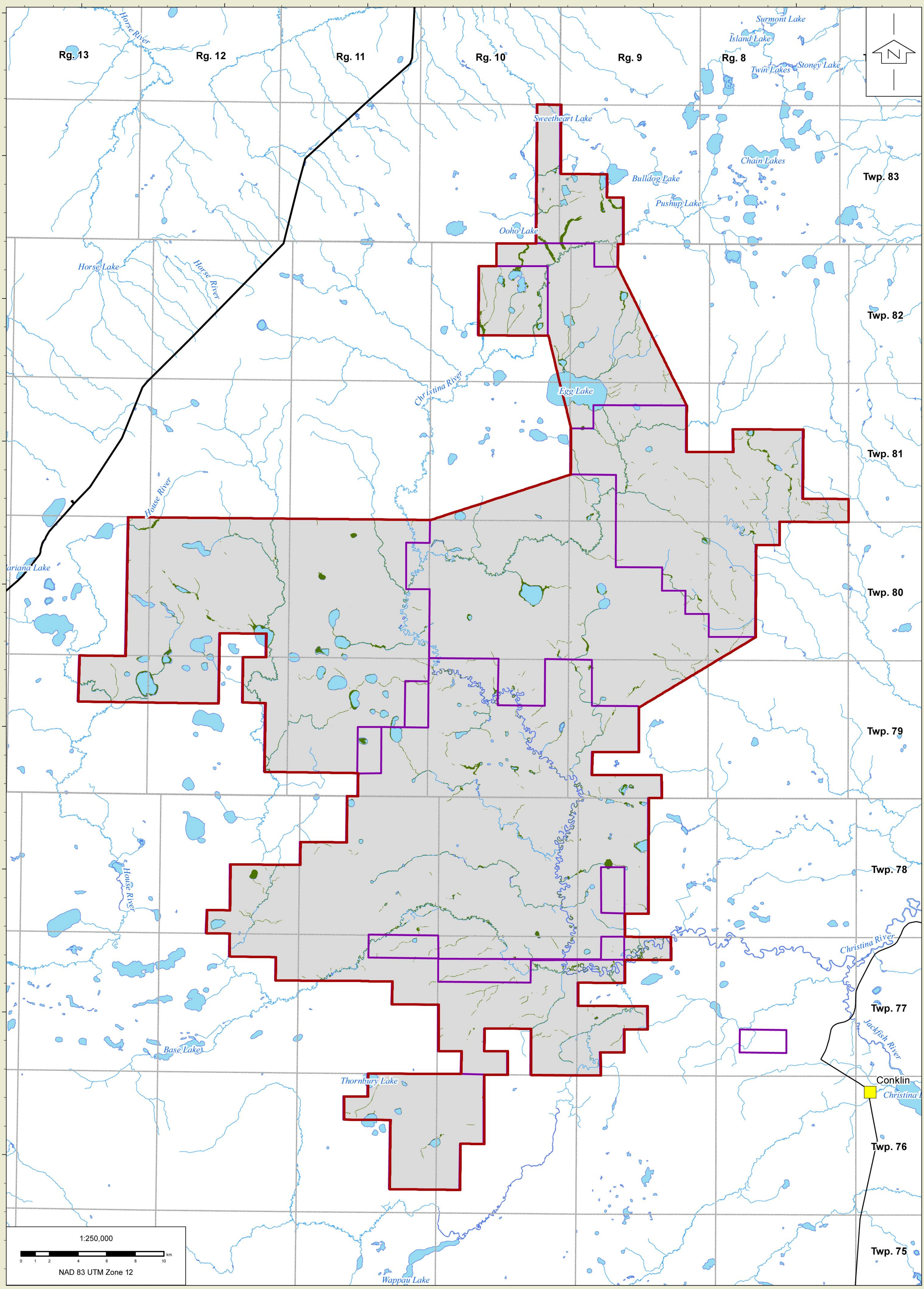
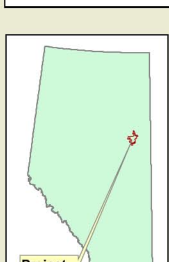
km
NAD 83 UTM Zone 12
Project Location
Legend
North American Wildlife LSA
North American Lease
Major Road (Hwy. 63)
Road (881)
Rivers
Lake
Twp. Rg. Lines
Habitat Suitability
Unsuitable
Low
Moderate
High
Title:
HABITAT SUITABLILITY FOR BEAVER AT BASELINE IN THE LSA
NORTH AMERICAN OIL SANDS CORPORATION
Approved: RL
Revision Date: June 14, 2007
File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\Beaver_p1.mxd
Drawn by: TG
Checked: RL
Fig. No.: 11.5-17





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

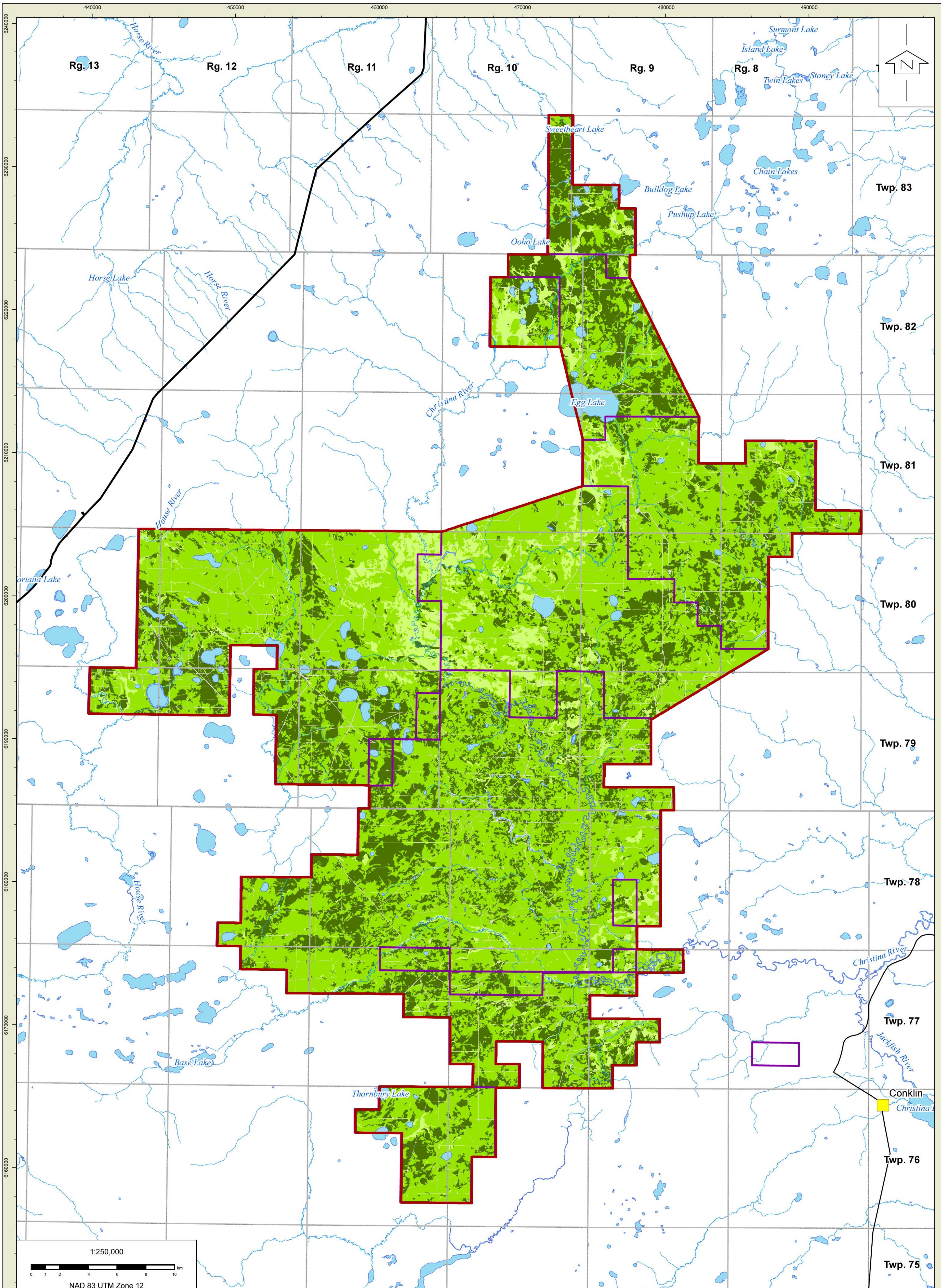
HABITAT SUITABILITY
FOR MUSKRAT
AT BASELINE IN THE LSA

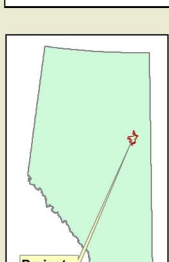
NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\CombinedMuskrat_p1.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	11.5-18





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

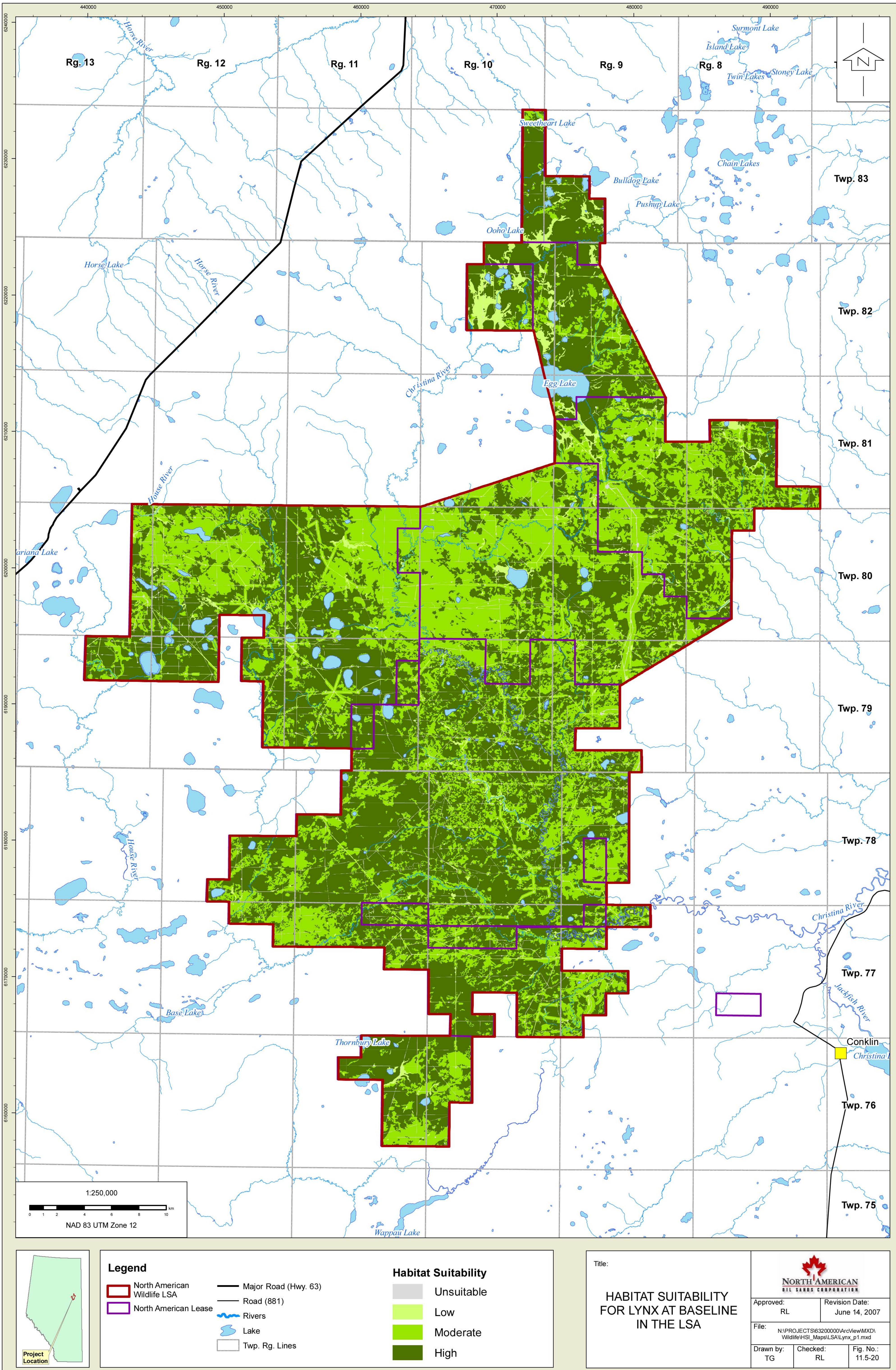
- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR FISHER AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:	
RL	June 14, 2007	
File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\Fisher_p1.mxd		
Drawn by: TG	Checked: RL	Fig. No.: 11.5-19



Title:

HABITAT SUITABILITY FOR LYNX AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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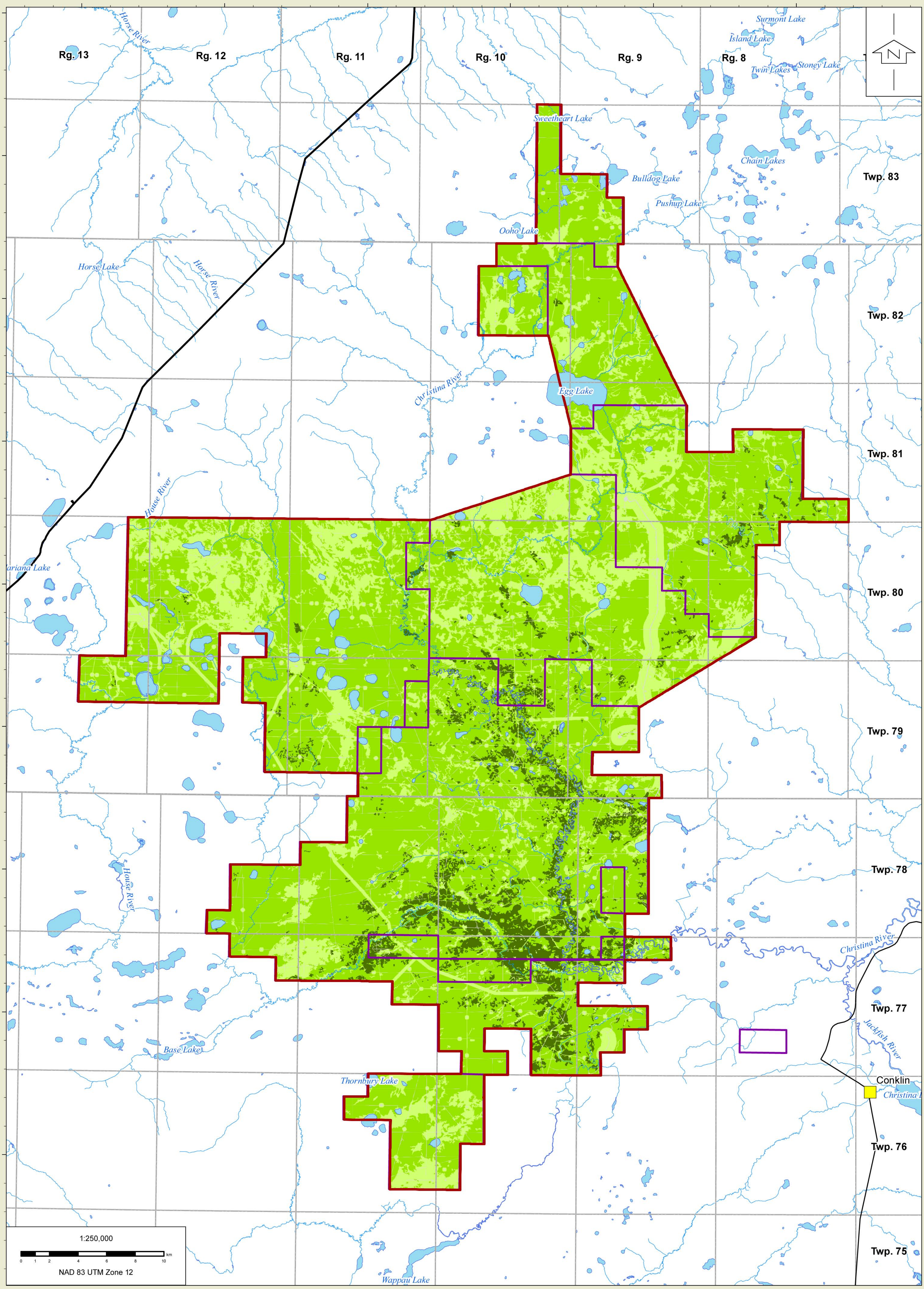
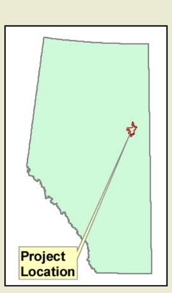
TG	RL	11.5-20





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABLILITY FOR BLACK BEAR AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\BlackBear_p1.mxd

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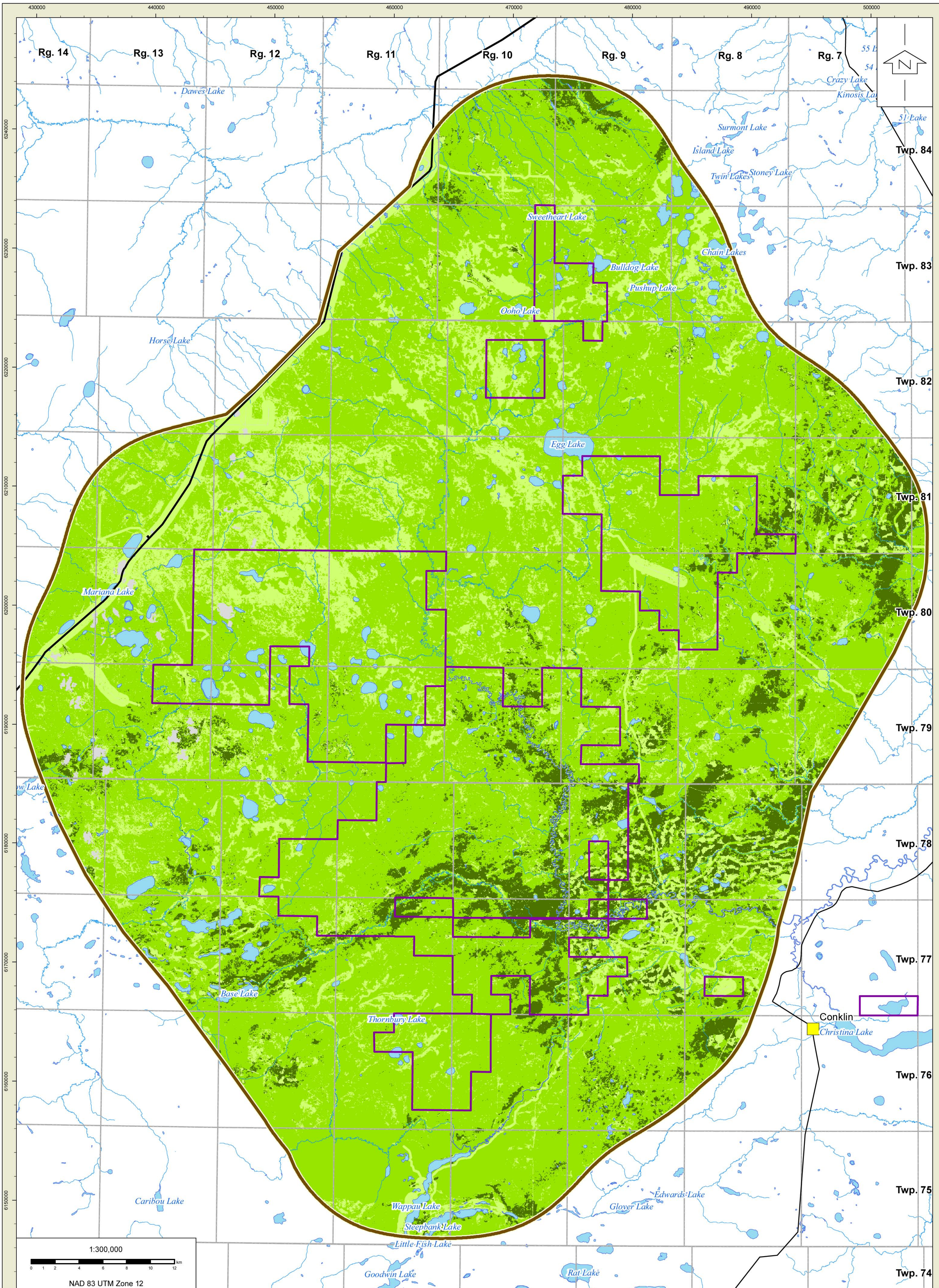
TG	RL	11.5-21



Legend

- North American Wildlife RSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

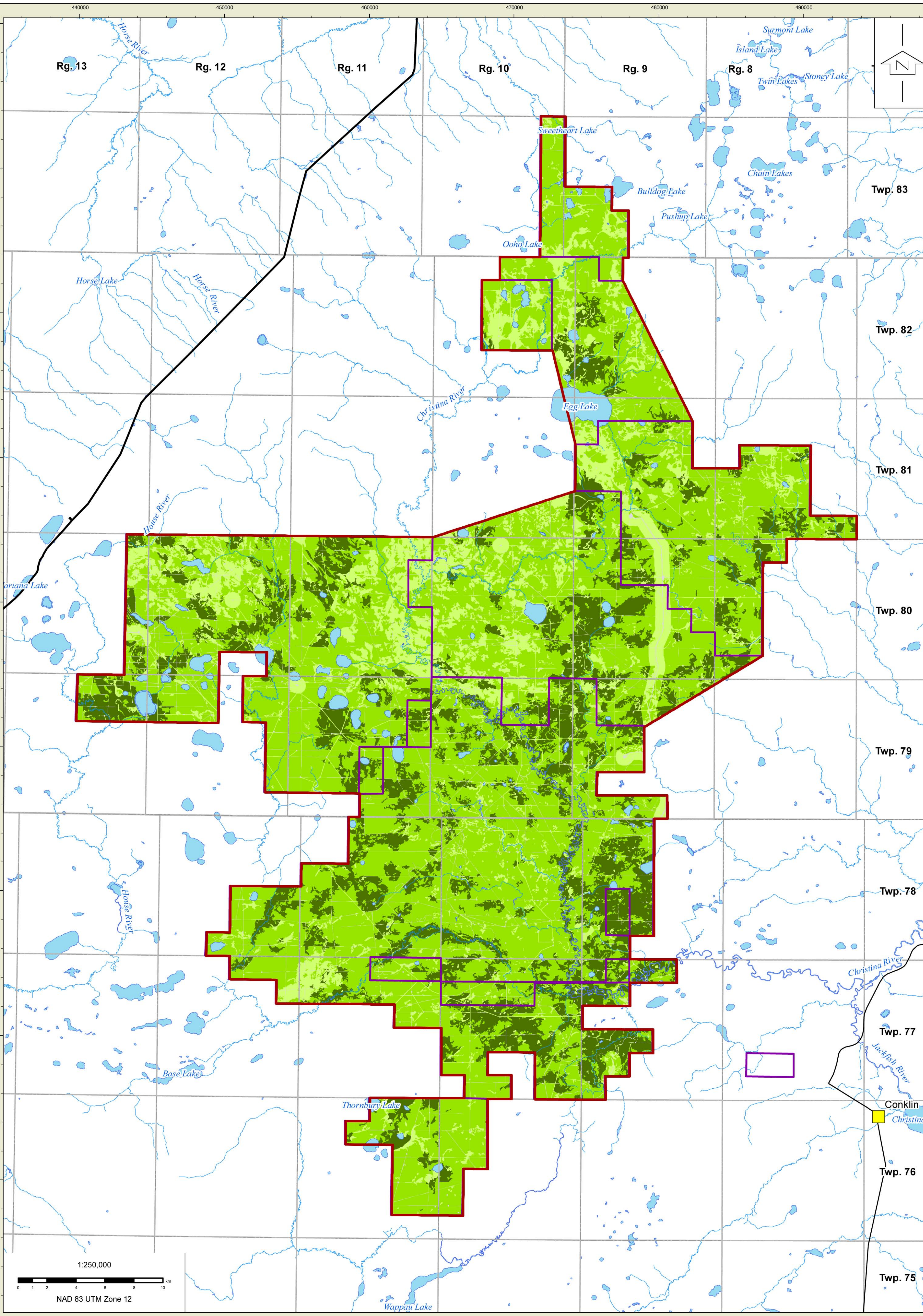
HABITAT SUITABILITY FOR BLACK BEAR AT BASELINE IN THE RSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\RSA\BlackBear_p1.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	11.5-22



Project Location

Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

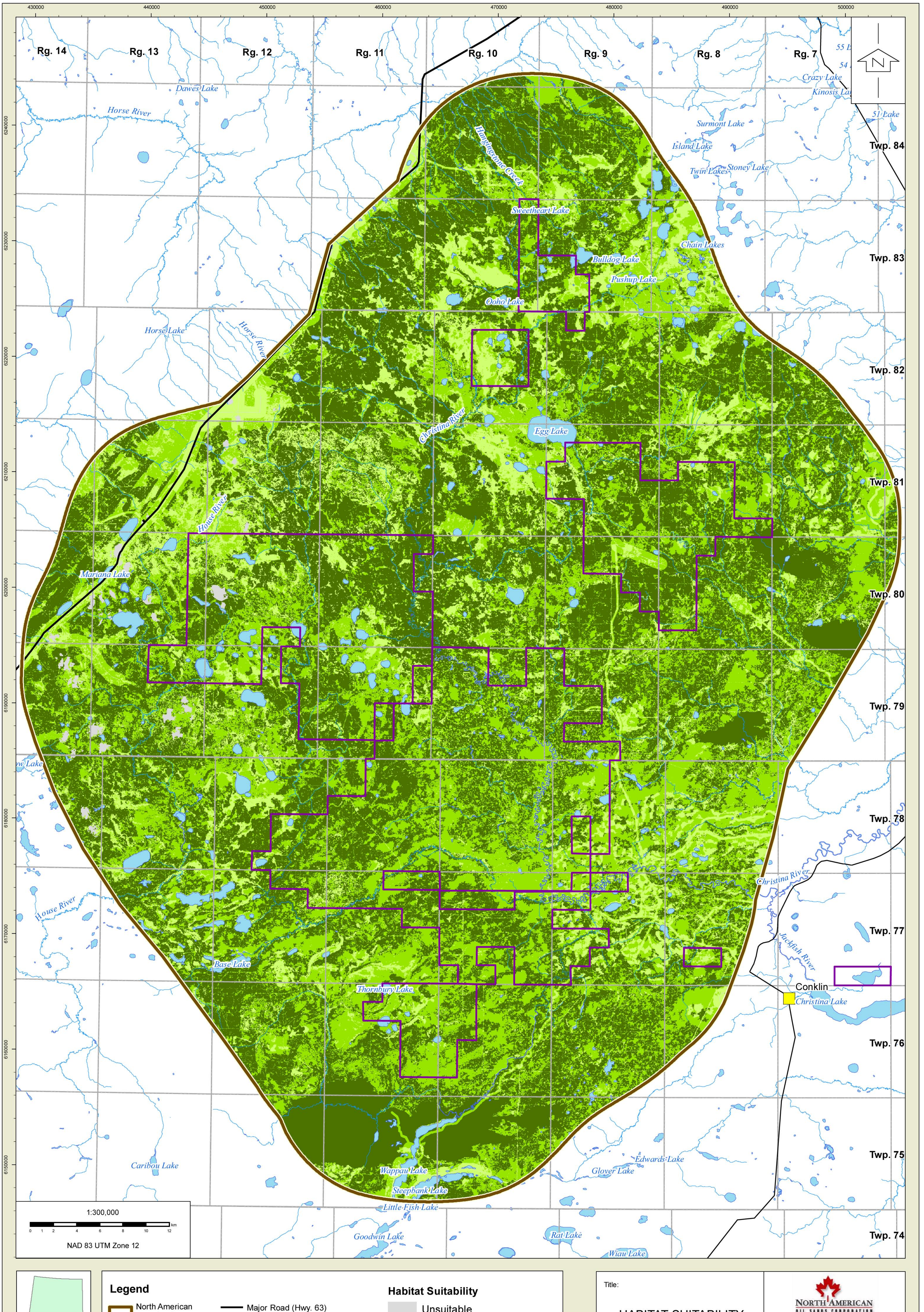
HABITAT SUITABILITY FOR MOOSE AT BASELINE IN THE LSA

North American Oil Sands Corporation

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\Moose_p1.mxd

Drawn by:	Checked:	Fig. No.:
TG	RL	11.5-23



Legend

- North American Wildlife RSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR MOOSE AT BASELINE IN THE RSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved: RL	Revision Date: June 14, 2007
File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\RSA\Moose_p1.mxd	

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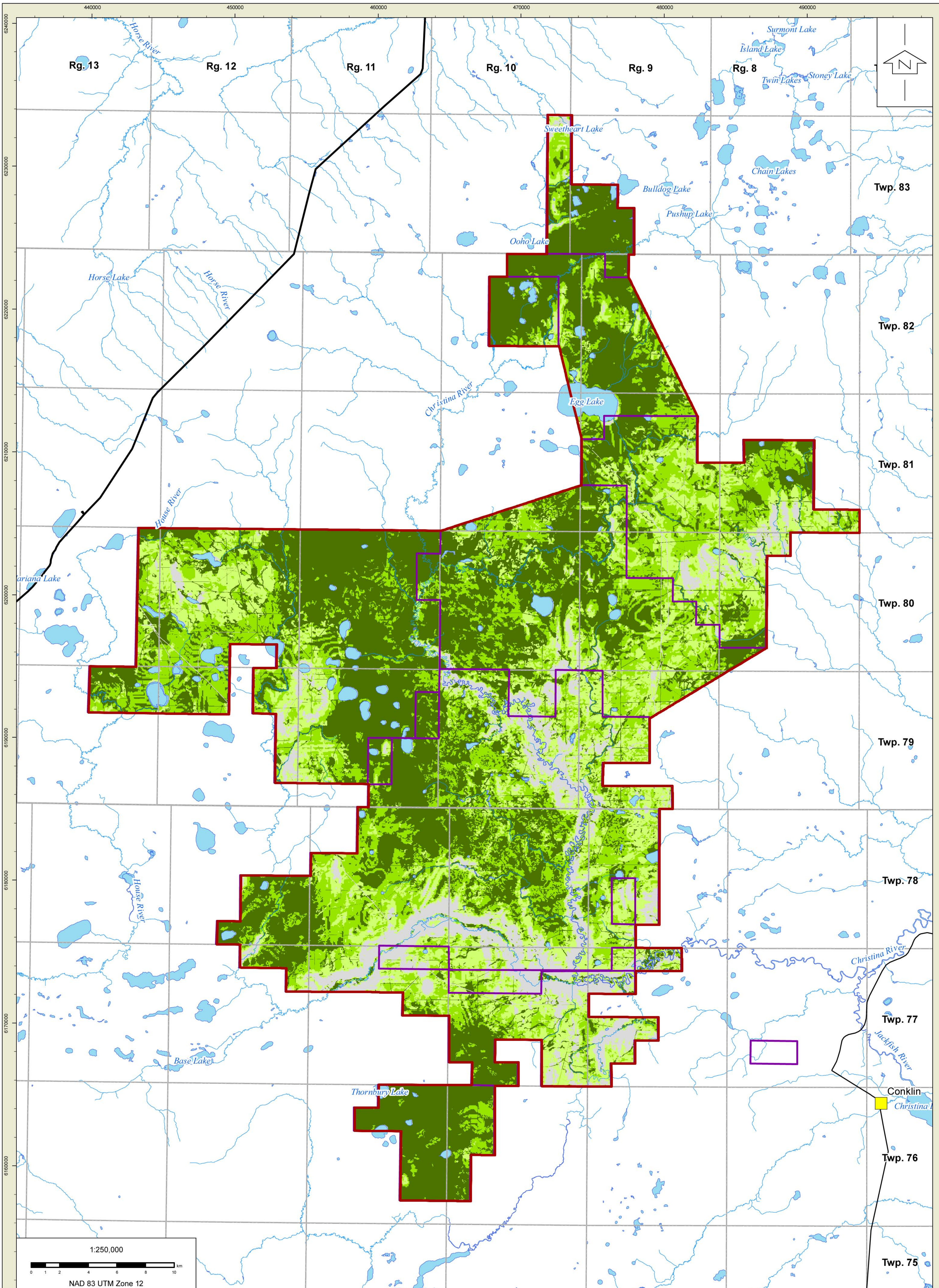
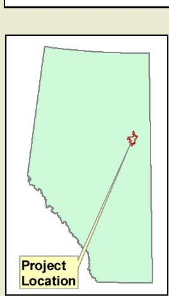
TG	RL	11.5-24





Legend

- North American Wildlife LSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR WOODLAND CARIBOU AT BASELINE IN THE LSA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

File: N:\PROJECTS\63200000\ArcView\MXD\Wildlife\HSI_Maps\LSA\Caribou_p1.mxd

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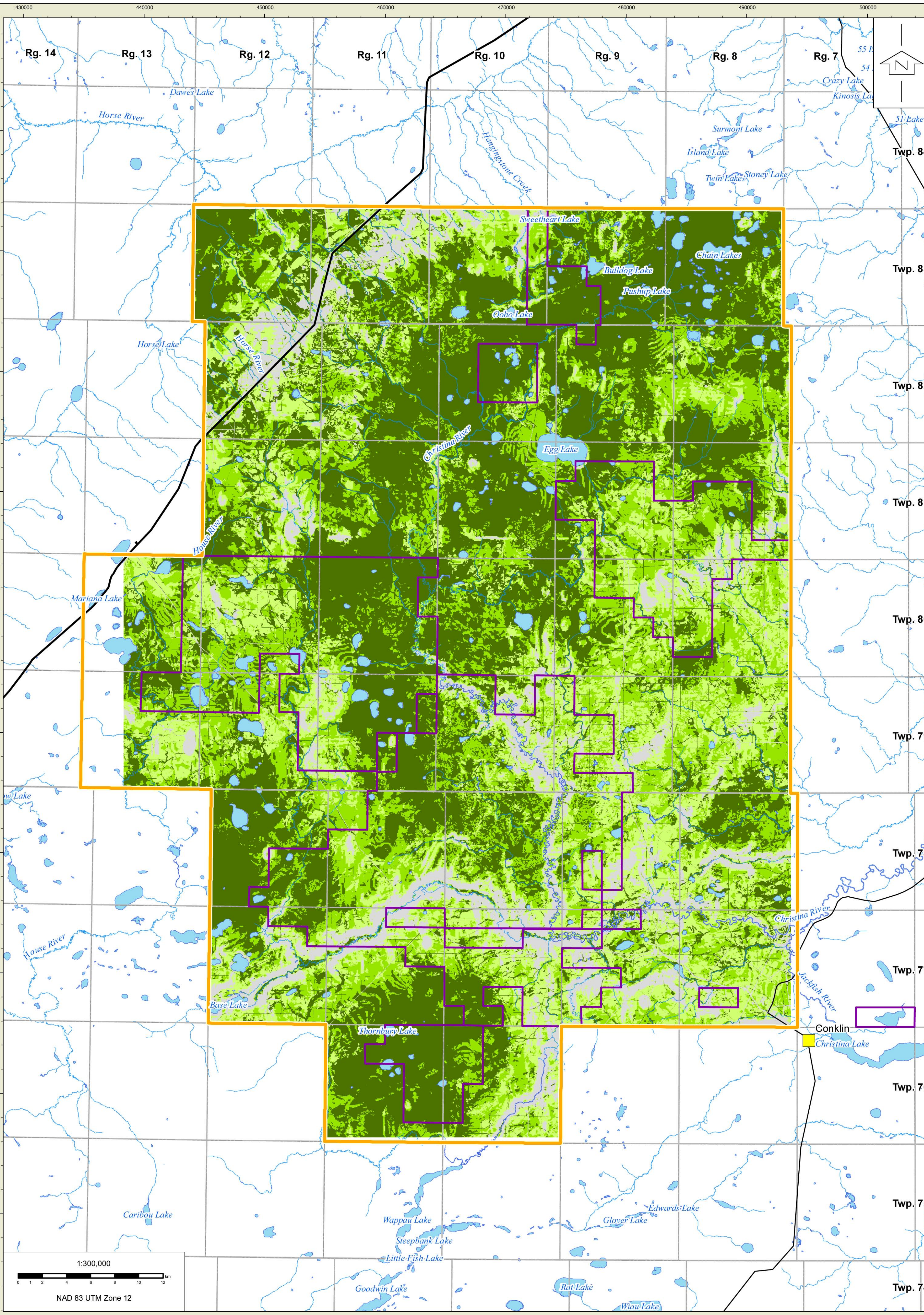

Legend

- North American Caribou RSA
- North American Lease
- Major Road (Hwy. 63)
- Road (881)
- Rivers
- Lake
- Twp. Rg. Lines

Habitat Suitability

- Unsuitable
- Low
- Moderate
- High

Title:

HABITAT SUITABILITY FOR WOODLAND CARIBOU AT BASELINE IN THE CARIBOU REGIONAL STUDY AREA

NORTH AMERICAN OIL SANDS CORPORATION

Approved:	Revision Date:
RL	June 14, 2007

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Drawn by:	Checked:	Fig. No.:
TG	RL	11.5-26

11.6 Impact Assessment and Mitigative Measures

11.6.1 Habitat Availability and Reduced Habitat Effectiveness

Impacts to habitat availability for each indicator are sub-regional in extent, except for black bear, moose and caribou. For all indicator species, the permanence of the impact is reversible after Project closure.

11.6.2 Mitigation

In order to reduce impacts to habitat availability and habitat effectiveness, North American will implement the following mitigation measures:

- Optimize the Project footprint;
- Integrate the Project developments with other existing and/or proposed land use activities in the area to minimize new disturbance, density of linear features and cumulative habitat loss, including the use of existing access or utility corridors where practicable;
- Optimize linear corridor widths;
- Avoid clearing from May 1 through August 15 to avoid potential nesting of migratory birds or conduct survey to determine their presence, to meet the requirements of the *Migratory Birds Convention Act*;
- Incorporate plans for replacement, at reclamation, of sandy upland habitats in proximity to aquatic habitats will be considered for Canadian toads;
- Maintain drainage patterns through the installation of culverts and other surface and subsurface flow maintenance measures;
- Implement dust control measures on access roads as needed;
- Prohibit pets from the lease;
- Provide environmental supervision during all critical phases (e.g., clearing, constructing water crossings);
- Implement appropriate erosion control measures;
- Conduct progressive reclamation where applicable throughout the Project development, including the return of equivalent soil capability;
- Reclaim corridors that are no longer needed;
- Use certified native vegetation species in reclamation; and
- Limit off-road access on new disturbances, were practicable, by rolling back debris near the intersection of linear disturbances.

11.6.2.1 Canadian Toad

Potential Impacts

Canadian toads have very specific habitat requirements including sandy terrestrial habitats for winter hibernation, wetlands for breeding and upland aspen-dominated habitats for foraging during summer. Impacts associated with clearing activities will primarily affect the availability of foraging habitat and winter hibernating habitat.

Residual Impacts

Habitat clearing required for the Project at application is predicted to result in a 2.2% loss (989.5 HU) in habitat availability for Canadian toad, most of which is within highly suitable habitat (Table 11.6-1, Figure 11.6-1). Surveys conducted within the LSA did not detect the presence of Canadian toads within areas proposed for initial development of Project facilities. Impacts during application are expected to be restricted to the LSA and may result from the direct removal of habitat. The magnitude of the effect is considered as medium, given the amount of habitat area that will be impacted by project developments in the LSA (2.2%). For reclamation, plans to incorporate the replacement of sandy upland habitats in proximity to aquatic habitats will be considered. Reclamation recommendations are based partly on successes seen at Suncor where Canadian toads have re-colonized wetlands and terrestrial habitats within their reclaimed development areas (McDonald and Paquin, 2004; Ednie, 2005). At closure and following final reclamation, available habitat for Canadian toad is predicted to be recovered to baseline conditions (Table 11.6-1, Figure 11.6-2).

Table 11.6-1 Summary of Project Impacts on Canadian Toad Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for Canadian toad in the LSA (HU)	44,088.4	43,098.9	44,175.0
Change in habitat availability due to the Project relative to baseline		-989.5 (-2.2%)	86.61 (0.2%)
Change to high quality habitat availability due to the Project relative to baseline		-509.38 (-2.2%)	63.7 (0.3%)
Environmental impact attributable to the Project		Moderate	Negligible

11.6.2.2 Northern Goshawk

Potential Impacts

Goshawks are considered an old and mature forest obligate species due to their requirements for these structural stages to meet their nesting and foraging requirements. Approximately 2.4% of the LSA is considered high-quality habitat for goshawks suitable for nesting. Clearing of mature or old growth forests will negatively affect goshawks by removing nesting and foraging habitat.

Residual Impacts

Clearing at application is predicted to result in a 5.2% loss of HU for the northern goshawk (Table 11.6-2, Figure 11.6-3). The losses are incurred primarily in high and moderately suitable habitats. Impacts at application will be long term, local and medium in magnitude. The overall environmental impact is considered moderate. While this analysis is based on change in the total amount of habitat units, goshawks are associated with habitat patch integrity and are sensitive to habitat fragmentation.

At closure, suitable habitat for the goshawks approaches baseline conditions, with a slight loss of 1.5% predicted in comparison to baseline conditions (Table 11.6-2, Figure 11.6-4).

Table 11.6-2 Summary of Project Impacts on Northern Goshawk Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for northern goshawk in the LSA (HU)	10,922.6	10,355.6	10,630.2
Change in habitat availability due to the Project relative to baseline		-567.0 (-5.2%)	-292.51 (-2.7%)
Change to high quality habitat availability due to the Project relative to baseline		-199.3 (-7.4%)	-61.2 (-2.3%)
Environmental impact attributable to the Project		Moderate	Low

11.6.2.3 Great Gray Owl

Potential Impacts

Great gray owls have specific habitat requirements that include open graminoid habitats for foraging located near suitable nesting habitat consisting of deciduous dominated mature or old growth forests. Approximately 35% of the LSA is considered high-quality habitat for the great gray owl. Clearing of mature or old growth forests will negatively affect owls by removing nesting habitat, but fragmentation of forests may increase hunting opportunities for this species, since ROW are maintained to graminoid cover, which is a preferred habitat for their prey, the meadow vole.

Residual Impacts

Clearing at application is predicted to result in a 4.0% loss of HU for the great gray owl (Table 11.6-3, Figure 11.6-5). The losses are incurred primarily in high and moderate suitability habitat. The expected change in habitat availability may not cause a detectable change. The overall environmental impact is considered low.

At closure, suitable habitat for the great gray owl is nearly at baseline conditions, with a slight loss of only 0.02% predicted in comparison to baseline conditions (Table 11.6-3, Figure 11.6-6).

Table 11.6-3 Summary of Project Impacts on Great Gray Owl Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for great gray owl in the LSA (HU)	71,075.6	68,205.7	71,061.7
Change in habitat availability due to the Project relative to baseline		-2,869.9 (-4.0%)	-13.9 (-0. 02%)
Change to high quality habitat availability due to the Project relative to baseline		-1,344.2 (-5.2%)	-507.1 (-1.9%)
Environmental impact attributable to the Project		Low	Negligible

11.6.2.4 Barred Owl

Potential Impacts

Barred owls have specific habitat requirements, as they are associated with old growth forests. The clearing of old growth forests may reduce potential nesting habitat and increased fragmentation may reduce the functional habitat due to increased disturbance.

Residual Impacts

Clearing at application is predicted to result in a 1.8% loss of HU for the barred owl (Table 11.6-4, Figure 11.6-7). The losses are incurred primarily in highly suitable habitat. The overall environmental impact is considered low. While this analysis is based on change in the total amount of habitat units, barred owls are associated with habitat patch integrity and are sensitive to habitat fragmentation. At closure, suitable habitats for the barred owl will stay the same as application. (Table 11.6-4, Figure 11.6-8). Reclaimed habitat will be at a young structural stage and will require many decades to reach old growth to reach optimal suitability for barred owls.

Table 11.6-4 Summary of Project Impacts on Barred Owl Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for barred owl in the LSA (HU)	2,078.9	2,041.6	2,041.6
Change in habitat availability due to the Project relative to baseline		-37.3 (-1.8%)	-37.3 (-1.8%)
Change to high quality habitat availability due to the Project relative to baseline		-9.2 (-4.3%)	-9.2 (-4.3%)
Environmental impact attributable to the Project		Low	Low

11.6.2.5 Boreal Owl

Potential Impacts

Boreal owls are linked to old growth forests and are sensitive to disturbance. Habitat clearing may result in a decrease in nesting habitat for boreal owls and increased fragmentation may affect the integrity of certain habitat patches.

Residual Impacts

Clearing at application is predicted to result in a 1.4% loss of HU for the boreal owl (Table 11.6-5, Figure 11.6-9). The losses are incurred primarily in highly suitable habitat. The overall environmental impact is considered low. While this analysis is based on change in the total amount of habitat units, boreal owls are associated with habitat patch integrity and are very sensitive to habitat fragmentation.

At closure, suitable habitat for the barred owl remains the same as baseline conditions (Table 11.6-5, Figure 11.6-10). Reclaimed habitat will be at a young structural stage and will require many decades to reach old growth.

Table 11.6-5 Summary of Project Impacts on Boreal Owl Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for boreal owl in the LSA (HU)	1,057.1	1,042.7	1,042.7
Change in habitat availability due to the Project relative to baseline		-14.4 (-1.4%)	-14.4 (-1.4%)
Change to high quality habitat availability due to the Project relative to baseline		-7.0 (-0.8%)	-7.0 (-0.8%)
Environmental impact attributable to the Project		Low	Low

11.6.2.6 Mixedwood Forest Bird Community

Potential Impacts

The mixedwood forest community has high ecological importance due to its ability to support a high diversity of vegetation and wildlife species, including birds. Project impacts to the mixedwood forest bird community will result primarily from clearing.

Residual Impacts

Of the highly suitable habitat available to mixedwood forest birds at baseline, 200.1 ha is predicted to be lost due to Project development, which represents a 2.6% loss of total HU (Table 11.6-6, Figure 11.6-11). This is considered a low overall environmental impact.

At closure and following final reclamation, available habitat for mixedwood forest birds is predicted to be recovered to near baseline conditions, with only a 0.2% loss from baseline (Table 11.6-6, Figure 11.6-12).

Table 11.6-6 Summary of Project Impacts on Mixedwood Forest Bird Community Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for mixedwood forest birds in the LSA (HU)	7,688.0	7,487.9	7,700.0
Change in habitat availability due to the Project relative to baseline		-200.1 (-2.6%)	12.1 0.2%
Change to high quality habitat availability due to the Project relative to baseline		-200.1 (-2.6%)	12.1 0.2%
Environmental impact attributable to the Project		Low	Negligible

11.6.2.7 Old Growth Forest Bird Community

Potential Impacts

Old growth forests provide habitat for a diverse assortment of species including several bird species considered species at risk in Alberta (e.g., pileated woodpecker, Cape May warbler and western tanager). Habitat clearing may result in a decrease of habitat for old growth specialist species, as well as fragmentation, which may compromise patch integrity.

Residual Impacts

Of the highly suitable habitat available to old growth forest birds at baseline, 127.6 ha is predicted to be lost due to Project development, which represents a 1.7% loss of HU (Table 11.6-7, Figure 11.6-13). While this analysis is based on change in the total amount of habitat units, some species associated with old growth forests are associated with habitat patch integrity and are very sensitive to habitat fragmentation. While the quantified impact based on total change in habitat units is estimated to be of low magnitude, the functional capability for old growth forest habitat at baseline or application to support potential interior forest old growth species is uncertain.

At closure, and following final reclamation, available habitat for old growth forest birds remains at a loss of 1.6% from baseline. Reclaimed habitat will be at a young structural stage and will require many decades to reach old growth. Consequently, the impacts at closure remain low in magnitude (Table 11.6-7, Figure 11.6-14).

Table 11.6-7 Summary of Project Impacts on Old Growth Forest Bird Community Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for mixedwood forest birds in the LSA (HU)	7,718.3	7,590.7	7,590.7
Change in habitat availability due to the Project relative to baseline		-127.60 (-1.7%)	-127.6 (-1.7%)
Change to high quality habitat availability due to the Project relative to baseline		-127.60 (-1.7%)	-127.6 (-1.7%)
Environmental impact attributable to the Project		Low	Low

11.6.2.8 Beaver

Potential Impacts

Beaver are an aquatic mammal dependant on the woody plant species available in terrestrial habitats for food supply and building material. Potential impacts to beaver will result from clearing of terrestrial habitats as well as alteration of wetlands.

Residual Impacts

The Project is predicted to result in a decrease of 19.4 HU (0.2%) (Table 11.6-8, Figure 11.6-15). The majority of this loss will occur in moderate suitability habitat (8.3 HU or 0.4%), followed by low suitability habitat (7.9 HU or 0.4%) and highly suitable habitat (3.2 HU or 0.1%). These impacts will result from the clearing of terrestrial habitats (e.g., d1). Impacts at application will be long term, local in extent and low in magnitude and may not cause a measurable change greater than that observed in natural variation. These impacts are considered to be low in magnitude, long term in duration and the overall impact is considered low.

At closure, nearly all of the beaver habitat will be reclaimed, with an overall loss remaining of 0.4 HU (0.01%; Table 11.6-8, Figure 11.6-16). This is considered a negligible impact.

Table 11.6-8 Summary of Project Impacts on Beaver Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	Application	Closure
Habitat availability for beaver in the LSA (HU)	7,923.9	7,904.5	7,923.5
Change in habitat availability due to the Project relative to baseline		-19.4 (-0.2%)	-0.4 (-0.01%)
Change to high quality habitat availability due to the Project relative to baseline		-3.2 (-0.1%)	-0.1 (-0.003%)
Environmental impact attributable to the Project		Low	Negligible

11.6.2.9 Muskrat

Potential Impacts

Muskrats are an aquatic mammal dependent upon marshes and waterbodies with emergent vegetation. Muskrat populations and habitat are most influenced by alterations in water levels, which affects their ability to occupy an area year-round and determines the amount of emergent vegetation that is available for food.

Residual Impacts

The Project is predicted to result in a decrease of 5.2 HU (0.2%) (Table 11.6-9, Figure 11.6-17). All of this loss will occur in high suitability habitat (no low or moderate habitats were identified). These impacts are considered to be low in magnitude, long term in duration and the overall impact is considered low.

At closure, muskrat habitat will partially be reclaimed, with an overall loss remaining of 3.5 HU (0.1%) (Figure 11.6-18). The impact rating will not change from application and is considered a low impact.

Table 11.6-9 Summary of Project Impacts on Muskrat Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	Application	Closure
Habitat availability for muskrat in the LSA (HU)	2,493.2	2,488.0	2,489.6
Change in habitat availability due to the Project relative to baseline		-5.2 (-0.2%)	-3.5 (-0.1%)
Change to high quality habitat availability due to the Project relative to baseline		-5.2 (-0.2%)	-3.5 (-0.1%)
Environmental impact attributable to the Project		Low	Low

11.6.2.10 Fisher

Potential Impacts

Fishers typically occur in continuous or near continuous forest habitat that has few large non-forest openings. Fishers are particularly sensitive to habitat change such as logging and road development. Approximately 27% of the LSA is considered highly suitable habitat for fishers. Potential impacts to fisher include the clearing of vegetation and habitat fragmentation as a result of an increase in linear features.

Residual Impacts

At application, the Project is predicted to result in a loss of 2.0% (1,613.0 HU) of the habitat available for fisher (Table 11.6-10, Figure 11.6-19). These impacts will be long term, local in extent and low in magnitude. Fishers are very sensitive to habitat loss and fragmentation and need large tracks of contiguous, mature forest (Powell and Zielinski, 1994; Badry et al., 1997). The overall environmental impact is considered low with regard to direct habitat loss. However, increased fragmentation as a result of an increase of linear features is likely to have more of an affect with regard to fisher persistence than direct habitat loss. Nielsen et al. (2006) found a negative association of fisher occurrence and road density in northern Alberta. However, the magnitude of the impacts of road density on fisher is uncertain.

At closure, most of the suitable habitat for fisher will be recovered, though there will be a loss of 0.3% relative to baseline conditions (Table 11.6-10, Figure 11.6-20). This is considered a negligible impact.

Table 11.6-10 Summary of Project Impacts on Fisher Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for fisher in the LSA (HU)	80,251.2	78,638.1	80,036.7
Change in habitat availability due to the Project relative to baseline		-1613.0 (-2.0%)	-214.4 (0.3%)
Change to high quality habitat availability due to the Project relative to baseline		-670.0 (-2.3%)	-670.0 (-2.3%)
Environmental impact attributable to the Project		Low	Negligible

11.6.2.11 Lynx

Potential Impacts

Lynx habitat includes old or climax boreal forest with a dense understorey of shrubs and debris (e.g., windfall, deadfall). Habitat use by lynx is closely associated with the distribution of their primary prey, snowshoe hare. Approximately 54% of the LSA is considered highly suitable habitat for lynx. Lynx tend to be sensitive to habitat alteration and human developments and may alter their movement patterns in response to these activities (Mowat et al., 1999). Potential impacts to lynx habitat and populations include habitat clearing as well as habitat fragmentation as a result of an increase in linear features.

Residual Impacts

At application, there will be an overall predicted decrease of 2,359.1 HU (2.6%; Table 11.6-11, Figure 11.6-21). This will primarily occur in highly suitable habitat, with a predicted decline of 2,756.5 HU (4.6%) from baseline conditions. Moderate suitability habitat is expected to increase by 361.4 HU (1.1%) and low suitability habitat is also expected to increase by 1.5 HU (2.5%). These changes in habitat availability are likely due to reduced habitat effectiveness by reducing habitat quality adjacent to linear features and infrastructure down a step (e.g., high to moderate). These impacts are considered medium in magnitude, long term in duration and overall a moderate impact with regard to direct habitat loss.

Lynx populations in the boreal forest are dependent upon snowshoe hares (Koehler and Aubry 1994, Boutin et al., 1995, Mowat et al., 1999, Krebs et al., 2001). Lynx populations are limited by prey availability, trapping and habitat loss (Todd, 1985; Westworth, 2002). While declines in the snowshoe hare population will largely determine the population of lynx, recent research in northern Alberta has found a negative association with road density and lynx occurrence (Nielsen et al., 2006). At baseline in the LSA, road density is at or near what Nielsen et al. (2006) has defined as reference conditions (approximately 0.024 km/km^2). At application, road density increases significantly to 0.24 km/km^2 and the probability of lynx occurrence declines by approximately 10%. This would be considered a moderate impact on lynx and can be confirmed by information collected by the Alberta Biodiversity Monitoring Initiative (Nielsen et al., 2006).

At closure, lynx habitat in the LSA is predicted to mostly recover, with slight decrease in overall habitat units (-88.7 HU or 0.1%; Table 11.6-11, Figure 11.6-22). This is considered a negligible impact with regard to habitat availability.

Table 11.6-11 Summary of Project Impacts on Lynx Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for lynx in the LSA (HU)	92,401.6	90,042.6	92,312.9
Change in habitat availability due to the Project relative to baseline		-2,359.0 (-2.6%)	-88.7 (-0.1%)
Change to high quality habitat availability due to the Project relative to baseline		-2,756.5 (-4.6%)	-443.4 (-0.7%)
Environmental impact attributable to the Project		Moderate	Negligible

11.6.2.12 Black Bear

Potential Impacts

Suitable bear habitat is considered to be an area with habitat interspersion that provides food close to cover. Approximately 7.9% and 8.2% of the LSA and RSA consists of high quality black bear habitat. Increased access may be more significant to the black bear population than impacts of relatively small habitat alteration and loss. Project development will include increases in human activity and sensory disturbance.

Residual Impacts

In the LSA, the Project development is predicted to result in a 5.7% total loss of habitat units for black bear (Table 11.6-12, Figure 11.6-23). Most of this loss occurs in high (11.1%) and moderate (8.9%) suitability habitats. These impacts are considered to be medium in magnitude, long term in duration and overall a moderate impact. This may cause black bears to avoid sections of the LSA near roads (Gunson, 1993), though the Project may also attract bears (e.g., human foods). At closure, habitat for black bears will recover to near baseline levels, with a loss of 103.8 HU or 0.2 % (Table 11.6-12, Figure 11.6-24).

In the RSA, the Project is predicted to result in a 2.0% loss of HU for black bear (Table 11.6-13, Figure 11.6-25). Most of the loss occurs in low suitability habitats. Since black bears have large annual home ranges, impacts on habitats localized in the LSA may not affect bears since their range will extend into the RSA. Impacts on black bear habitat availability during application will be long term and low in magnitude. The overall environmental impact is considered low.

Table 11.6-12 Summary of Project Impacts on Black Bear Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for black bear in the LSA (HU)	55,296.1	52,139.4	55,192.3
Change in habitat availability due to the Project relative to baseline		-3,156.7 (-5.7%)	-103.8 (-0.2%)
Change to high quality habitat availability due to the Project relative to baseline		-887.6 (-11.3%)	-231.2 (-2.9%)
Environmental impact attributable to the Project		Moderate	Negligible

Table 11.6-13 Summary of Project Impacts on Black Bear Habitat Availability in the RSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for black bear in the LSA (HU)	195,491.4	191,580.3	195,491.4
Change in habitat availability due to the Project relative to baseline		-3,911.1 (-2.0%)	1,649.5 (0.8%)
Change to high quality habitat availability due to the Project relative to baseline		-933.2 (-3.5%)	0.0 0.0%
Environmental impact attributable to the Project		Low	Negligible

11.6.2.13 Moose

Potential Impacts

Moose require a combination of young and old forest, but primarily young forests that provide deciduous browse. Approximately 19.7% and 47.7% of the LSA and RSA consists of high quality moose habitat. Any landscape disturbance that converts forest to younger age classes may improve habitat for moose, providing hunting pressure and other factors are managed (Rempel et al., 1997). Development of the Project can be expected to remove moose habitat, though clearing will also increase edge habitat that will be attractive to moose.

Residual Impacts

The Project is predicted to result in an overall decrease of 3,427.0 HU (5.1%; Table 11.6-14, Figure 11.6-26). This will occur primarily in highly suitable habitat, where 1,727.8 HU (7.0% of high HU) are predicted to be lost, by both clearing and functional habitat loss. Moderate quality habitats also experience a decline by a similar magnitude as highly suitable habitat (2,431.2 HU or 6.5% or moderate habitats). There will also be an increase in low suitability habitat by 732.0 HU (0.9% of low quality habitats). This increase in low suitability habitat is due to both clearing reduced habitat effectiveness by converting high and moderate habitats to low quality.

This impact is considered of medium magnitude and long term in duration with an overall moderate impact. It is unclear at this point whether or not the Project with cause either a slight decline or a slight increase in the local moose population. Rempel et al. (1997) found that if landscape disturbance (logging and fire) occurred concurrently without hunter access, the moose density would increase. Similarly, these authors found that if disturbance occurs with hunter access, the moose density declined. Without landscape disturbance, regardless of the level of hunter access, moose densities remained similar. Disturbance, whether it is in the form of forest harvest or the creation of ROW, has the potential for increasing forage for moose. Increased moose densities on caribou range, however, may facilitate a decline of caribou (Alberta Woodland Caribou Recovery Team, 2005; James et al., 2004).

In the RSA, the Project is predicted to result in an overall decrease of 5,154.0 HU (1.9%; Table 11.6-15, Figure 11.6-27). This will occur in low suitable habitat, where 471.4 HU (3.7% of low quality) are predicted to be lost. These impacts are considered low in magnitude, long term in duration and overall a low impact.

At closure, suitable habitat for moose will be mostly recovered in the LSA (Table 11.6-15, Figure 11.6-28). There will be a loss of 435.4 HU or 0.7% at closure, a negligible impact.

Table 11.6-14 Summary of Project Impacts on Moose Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for moose in the LSA (HU)	67,446.6	64,019.6	67,011.1
Change in habitat availability due to the Project relative to baseline		- 3,427.0 (-5.1%)	-435.4 (-0.7%)
Change to high quality habitat availability due to the Project relative to baseline		-1727.9 (-7.0%)	-721.7 -2.9%
Environmental impact attributable to the Project		Moderate	Negligible

Table 11.6-15 Summary of Project Impacts on Moose Habitat Availability in the RSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for moose in the LSA (HU)	276,521.8	271,367.8	275,908.6
Change in habitat availability due to the Project relative to baseline		-5,154.0 (-1.9%)	-613.3 (-0.2%)
Change to high quality habitat availability due to the Project relative to baseline		5,359.9 2.7%	-1,197.8 -0.6%
Environmental impact attributable to the Project		Low	Negligible

11.6.2.14 Woodland Caribou

Potential Impacts

Caribou are considered to be sensitive to the effects of logging and oil and gas exploration and development, from both direct and indirect effects (Dzus, 2001; Alberta Woodland Caribou Recovery Team, 2005). Instead of direct habitat loss, the emphasis recently has focused on changes in habitat condition, particularly the proliferation of linear corridors and resultant ecological interactions with caribou's main predator, the wolf and the role of other ungulate prey species such as deer and moose in supporting a wolf population (Dzus, 2001, Alberta Woodland Caribou Recovery Team, 2005; James et al., 2004). Factors such as disturbance reduced habitat effectiveness and direct habitat loss may be less important than the impacts of predation and its interaction with the infrastructure of seismic lines and roads that accompany oil/gas exploration and development (Alberta Woodland Caribou Recovery Team 2005, James et al., 2004).

Residual Impacts

The Project is predicted to result in an overall decrease of 2,514.1 HU (3.3%; Table 11.6-16, Figure 11.6-29). This will occur primarily in highly suitable habitat, where 5,092.3 HU (10.6% of high quality) are predicted to be lost, by both clearing and functional habitat loss.

The impact of habitat loss is considered medium in magnitude and long term in duration. The overall impact in the LSA with regard to habitat availability in the LSA is considered moderate.

In the caribou regional study area, the Project is predicted to result in an overall decrease of 3,933.2 HU (1.9%; Table 11.7-17, Figure 11.6-30). This will occur in the high and moderate suitability habitats, where 2,763.4 HU (2.8%) and 1,851.8 HU (1.8%) are predicted to be lost, respectively. In terms of habitat loss, these impacts are considered low in magnitude, long term in duration and overall a low impact.

At closure, suitable habitat for the caribou will be nearly recovered, resulting in an overall loss of 567.3 HU (0.8%) in the LSA (Table 11.6-16, Figure 11.6-31). In the caribou regional study area, it is also expected that caribou habitat will be mostly recovered with a 0.8% loss (1484.7 HU; Table 11.6-17, Figure 11.6-32).

Table 11.6-16 Summary of Project Impacts on Woodland Caribou Habitat Availability in the LSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for caribou in the LSA (HU)	75,204.0	72,689.9	75,771.2
Change in habitat availability due to the Project relative to baseline		-2,514.1 (-3.3%)	-567.3 (-0.8%)
Change to high quality habitat availability due to the Project relative to baseline		5,092.3 (-10.6%)	-779.0 (-1.6%)
Environmental impact attributable to the Project		Moderate	Negligible

Table 11.6-17 Summary of Project Impacts on Woodland Caribou Habitat Availability in the RSA

	Project Specific Impacts		
	Baseline	**Application**	**Closure**
Habitat availability for caribou in the RSA (HU)	191,978.6	186,996.4	190,493.9
Change in habitat availability due to the Project relative to baseline		-4,982.2 (-2.6%)	-1484.7 (-0.8%)
Change to high quality habitat availability due to the Project relative to baseline		115,515.3 (-4.8%)	-842.1 (-0.7%)
Environmental impact attributable to the Project		Low	Negligible

11.6.3 Habitat Connectivity

11.6.3.1 Mitigation

In order to reduce impacts to habitat connectivity, North American will implement the following mitigation measures:

- Provide wildlife crossing points through the use of natural terrain features;
- Install above-ground pipeline crossing structures for wildlife where natural terrain features are not suitable for below pipe movements; and
- Locate wellpads at least 100 m from waterbodies (including creeks) where practicable.

11.6.3.2 Potential Impacts

Habitat fragmentation might lead to the loss of habitat connectivity, which occurs when large, contiguous tracts of habitat are divided into smaller, isolated patches (Noss and Csuti, 1997). Large blocks of habitat in the landscape that are exclusive of major human disturbances and infrastructure are extremely important to the persistence of many species (Noss et al., 1996). Wildlife must be able to move freely between these large blocks for various life requirements, and to maintain genetic flow between populations (Noss et al., 1996). These movement areas are referred to as linkage zones (Servheen et al., 2001). Linkages between habitats can occur on a coarse landscape level or on a fine-scale, site-specific basis. Within the LSA, the greatest barriers to wildlife movements are above-ground pipelines and infrastructure. Roads present a partial barrier, but they are permeable to many wildlife species (Forman et al., 2003).

11.6.3.3 Residual Impacts

Woodland Caribou

At baseline, there are four general hypothetical habitat connectivity areas (Figure 11.6-33). These habitat connectivity areas link both high quality habitats and the adjacent caribou herds (Figure 11.6-33). At application, there are five areas of aboveground pipeline that pose a potential barrier to caribou movements within and to high quality habitats and adjacent ranges (Figure 11.6-34). If properly mitigated with crossing structures, impacts are predicted to be low for caribou with regard to habitat connectivity.

Moose

At baseline, there are four general hypothetical habitat connectivity areas (Figure 11.6-35). These habitat connectivity areas link both high quality habitats and the critical moose winter ranges (Figure 11.6-35). At application, there are five areas of aboveground pipeline that pose a potential barrier to moose movements within and to high quality habitats and adjacent winter ranges (Figure 11.6-36). These are similar to those of caribou. If properly mitigated with crossing structures, impacts are predicted to be low for moose with regard to habitat connectivity.

11.6.4 Direct Mortality Risk

11.6.4.1 Mitigation

In order to reduce the potential of direct mortality, North American will implement the following mitigation measures:

- No fuel will be stored within 100 m of a watercourse or waterbody;
- Speed restrictions will be implemented on access roads to reduce risks of wildlife mortality;
- Wildlife cautionary signage will be erected on access roads;

- Fuel and chemical spill contingency and response plans will be implemented;
- Continuous management of food waste will be implemented;
- Wildlife will not be harassed or fed to prevent habituation;
- Employees and contractors will be prohibited from hunting, fishing or carrying firearms within the lease;
- Employees and contractors will take a bear awareness and avoidance training program;
- Pets will not be allowed on the lease;
- Vegetation control program will be developed to discourage roadside foraging by wildlife;
- Waste disposal sites will be provided, and wastewater storage areas and runoff control structures will be monitored and maintained to prevent contamination of surface waters;
- Potential nesting of migratory birds will be protected by avoiding clearing from May 1 through August 15 or conducting surveys to determine their presence, which will meet the requirements of the *Migratory Birds Convention Act*; and
- Clearing and development activity in the defined ungulate winter range area (as shown on Figure 11.2-1) will be avoided during the period from January 15 to April 30. This will avoid disruption of key caribou and moose wintering habitat and meet the requirements of Alberta Fish and Wildlife for the management of ungulate winter ranges.

11.6.4.2 Wildlife Health

Regarding wildlife health, based on the results from the air and water quality impact assessments (Volume 2, Section 2 and Volume 3, Section 7), no acute or chronic effects on animal health are expected from the Project.

11.6.4.3 Canadian Toad

Potential Impacts

Direct mortality of Canadian toads may result from road mortality, winter clearing of hibernating habitat, destruction of wetlands and from impacts to water quality. However, it is anticipated that the primary risk of direct mortality will result from clearing activities that are expected to occur during fall and winter when toads are hibernating.

To determine the potential affect of winter clearing on hibernating Canadian toads, an assessment of the loss of winter habitat was determined. However, since there is no information on the densities and distributions of hibernating toads in relation to the availability of hibernating habitat, an estimation of the loss of winter habitat provides an indirect look into the potential mortalities that could occur.

The presence of Canadian toads within the LSA is undetermined. A toad survey was conducted June 9–10, 2006 but no toads were detected. Therefore, the direct mortality assessment is a worst case scenario, assuming that suitable habitat within the LSA is being used. There exists a high degree of uncertainty whether or not Canadian toads are present in the LSA.