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**REPORT ON**

# WILDLIFE BASELINE CONDITIONS FOR SHELL'S PROPOSED MUSKEG RIVER MINE PROJECT

**Submitted to:**

**Shell Canada Limited**
**400 - 4 Avenue SW**
**Calgary, AB T2P 2H5**

**December 1997**

# ABSTRACT

From March through August 1997, surveys were conducted to determine the relative use of different vegetation communities by wildlife species inhabiting the Shell Canada Limited Muskeg River Mine development area.

Winter track count and early summer browse/pellet group count surveys indicted that the relative abundance of moose and deer was low compared to other areas of northern Alberta. Within vegetation communities, no difference in habitat use could be detected, but at the landscape level, ungulates utilized riparian areas significantly more than escarpment and upland communities. Although the Alsands area on Lease 13 contained abundant balsam poplar, preferred browse material (e.g., red osier dogwood, willow) was relatively uncommon, a condition which may have caused limited use of this area by moose.

Winter track count data suggested that the relative abundance of most furbearers (except red squirrels and snowshoe hares) was low in the Local Study Area (LSA). Red squirrels were more abundant in closed conifer dominated habitats and showed limited use of bogs and fens. Snowshoe hares preferred closed white spruce and mixedwood community types, and tended to limit their use of riparian and open habitats. However, at the landscape level, both snowshoe hares and red squirrels appeared to select communities associated with riparian zones and escarpments over upland habitats. Tracks were detected for coyotes, fishers, martens, weasels, minks, and river otters. Coyotes, fishers, martens, and weasels were more strongly associated with closed conifer and mixedwood habitats than relatively open community types such as bogs and fens. Mink and otter tracks were only observed along the Muskeg River. No tracks for wolves, foxes, lynx, or wolverines were recorded. The abundance of beavers and muskrats was also low, a condition which may be associated with the limited amount of suitable habitat. The winter track count survey also indicated that the density of grouse was low, and that these birds preferred open and closed aspen communities.

Species richness and diversity of small mammals was highest in riparian habitat, followed by wetlands, and coniferous and mixedwood habitats. In contrast, relative abundance of small mammals, which was greatest in mixedwood habitat, was largely due to the number of masked shrews present.

Spring and late summer waterfowl surveys indicated that abundance and brood production was low compared to nearby waterbodies such as Kearl Lake. Although the small ponds within the Lease 13 area probably represent important staging areas for migrating waterfowl, poor quality nesting and brood-rearing habitat likely caused the low numbers of ducklings observed in the area. A summer breeding bird survey detected 67 species in the area. Although species diversity was moderate, the low relative abundance of species may be due to the limited amount and size of quality breeding habitat areas.

# ABSTRACT

In general, the results of studies in the Alsands area indicated that the reclamation sites represent marginal habitat for small mammals, ungulates, and waterfowl. Since these herbivores provide the prey base for many predator species, this area would also be unsuitable for carnivorous furbearers and raptors inhabiting the LSA.

Results indicated that many of the wildlife species occupying the LSA were strongly associated with riparian habitats.



**Key Words:** ecosystem-based management, environmental baseline, moose, furbearers, grouse, oil sands, raptors, small mammals, breeding birds, waterfowl.

# ACKNOWLEDGMENTS

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Field work was conducted by Tony Calverley, Janice Cursons, Kelly Gurski, Cameron Jackson, Sheldon Kowalchuk, Rob Olson, Michael Raine, Jason Sharpe and Terry York. Assistance for investigations of the Alsands area was provided by Carl Surrendi and Debbie Mahoney of Fort McKay Environmental Services. Database management services were provided by Chris Ramsay, while quality control/quality assurance was conducted by Lorne Gould. Data analysis was performed by John Virgl. Report writing was conducted by John Virgl, with assistance from Tony Calverley, Cameron Jackson, Michael Raine and Jason Sharp. The report was edited for content by Marilyn Collard, Lorne Gould, John Gulley, Derek Melton and Michael Raine. Technical editing was performed by Barbara McCord. Typing was done by Maureen Myers.

# EXECUTIVE SUMMARY

This document reports on the findings from wildlife surveys carried out from March through August 1997, on and adjacent to Shell Canada Limited's (Shell) Muskeg River Mine development area in support of an Environmental Impact Assessment (EIA). Studies were conducted within the mine development area, or Local Study area (LSA), as well as other portions of Lease 13. The studies were designed to augment and complement previous studies conducted within Lease 13 in support of the Aurora EIA, the Alsands development and other regional studies. Objectives of the studies were to: 1) determine the relative use of different vegetation communities (i.e., habitats) by ungulates, small mammals, furbearers, waterfowl, upland game birds, breeding birds and raptors; 2) determine if the Muskeg River and Jackpine Creek drainages are used preferentially by wildlife species at the landscape level; and 3) determine the suitability of the Alsands area for ungulates, small mammals and waterfowl. The data collected were then used to complete this environmental baseline report for the Muskeg River Mine area.

Winter track counts completed on a limited area of Lease 13 indicted that the relative abundance of moose and deer was low relative to other areas of northern Alberta. This agrees with the results of aerial surveys conducted in the past that determined overall moose densities in the area to range from 0.09-0.10 moose per $km^2$. Spring pellet group counts determined that moose utilized riparian areas more than escarpment and upland areas.

Winter track count data suggest that the relative abundance of most furbearers (except red squirrels and snowshoe hares) was low in the Lease 13 area. Red squirrels were more abundant in closed conifer dominated habitats (5.7 tracks/km-track-day). Snowshoe hares preferred closed white spruce and mixedwood community types (22.4 tracks/km-track-day) and tended to limit the use of riparian and open habitats (0.65-2.3 tracks/km-track-day). However, at the landscape level, both snowshoe hares and red squirrels appeared to select communities associated with riparian zones and escarpments over upland habitats.

Tracks were detected for coyotes, fishers, martens, weasels, minks and river otters. Coyotes, fishers, martens and weasels were more strongly associated with closed conifer and mixedwood habitats than relatively open community types such as bogs and fens. Track counts for coyotes, fishers and martens (pooled), and weasels in the Lease 13 area were 0.10, 1.26 and 1.12 tracks/km-track-day, respectively. Mink and otter tracks were only observed along the Muskeg River (0.03 and 0.01 tracks/km-track-day, respectively). No tracks for wolves, foxes, lynx, or wolverines were recorded during the study. However, tracks from a pack of seven wolves were observed by non-survey personnel in the Lease 13 area. The abundance of grouse, beavers and muskrats was also low, which may be associated with the limited amount of suitable habitat. Total track counts for grouse species in the Lease 13 area was 1.71 tracks/km-track-day. Analysis indicated that grouse significantly preferred open and closed aspen communities.

## EXECUTIVE SUMMARY

A total of 106 individuals representing eight species of small mammals were captured in the LSA. Masked shrews constituted 44%, and red-backed voles constituted 34% of the total number of animals captured. The remaining species (arctic shrew, pygmy shrew, bog lemming, jumping mouse, least chipmunk and meadow vole) each accounted for less than 4% of the total sample. Species richness and diversity of small mammals was highest in riparian habitat, followed by wetlands, and coniferous and mixedwood habitats, although the difference was not statistically significant. In contrast, relative abundance was greatest in mixedwood habitat, a finding which was largely due to the number of masked shrews captured in this community type. The presence of a relatively abundant and diverse small mammal community in riparian habitat would likely provide abundant food for several predator species. Low relative abundance, species richness and diversity also suggested that the Alsands regeneration sites represented marginal habitat for small mammals.

A total of 17 species of waterfowl were observed during spring and late summer surveys. Mallards were the most abundant. Other species that were moderately abundant included blue- and green-winged teal, buffleheads and ringed-neck ducks. However, compared to other areas in the region (e.g., Kearl Lake within the Aurora Mine LSA), abundance and brood production of waterfowl in the Lease 13 area was low. Although the small ponds and lakes within the LSA are probably used as staging areas for migrating waterfowl, poor quality nesting and brood-rearing habitat likely result in low juvenile recruitment in the area. Similarly, the Alsands reclamation sites were observed to support low numbers of waterfowl and low brood production in late summer.

A breeding bird survey detected 67 species in the Lease 13 area. Although species diversity was moderate, the relative abundance of species was low, likely due to the limited amount and size of quality breeding habitats. For example, 60% of the bird species recorded had less than 6 detections. In addition, species diversity and richness were significantly greater in the wetlands dominated community types than in upland dominated vegetation. These results are contrary to other studies of species-habitat associations. Generally, those studies found that species abundance, richness and diversity were greater in upland hardwood and mixedwood habitats than softwood community types associated with bog-fen complexes. One explanatory hypothesis for the results found during the 1997 surveys is related to the distribution, size, and amount of upland habitat patches within the Lease 13 area. Upland habitat was represented by a small number of small-sized patches (islands) interspersed among a relatively large wetland complex. The degree of fragmentation of upland habitat may have been too large to support the rich and diverse bird assemblages commonly observed in similar but less fragmented habitat.

The results of studies in the Alsands area suggest that the various habitats in the area represent marginal habitat for small mammals, ungulates and waterfowl. Since these species provide the prey base for many predator species, this vegetation would also be unsuitable for carnivorous furbearers and raptors inhabiting the reclamation area.

Overall results of the field surveys indicated that many of the wildlife species occupying the Lease 13 area were associated with riparian habitats. Current empirical and theoretical investigations have also stressed the importance of riverine and stream habitats to species diversity and persistence at the landscape level.

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# 1. INTRODUCTION

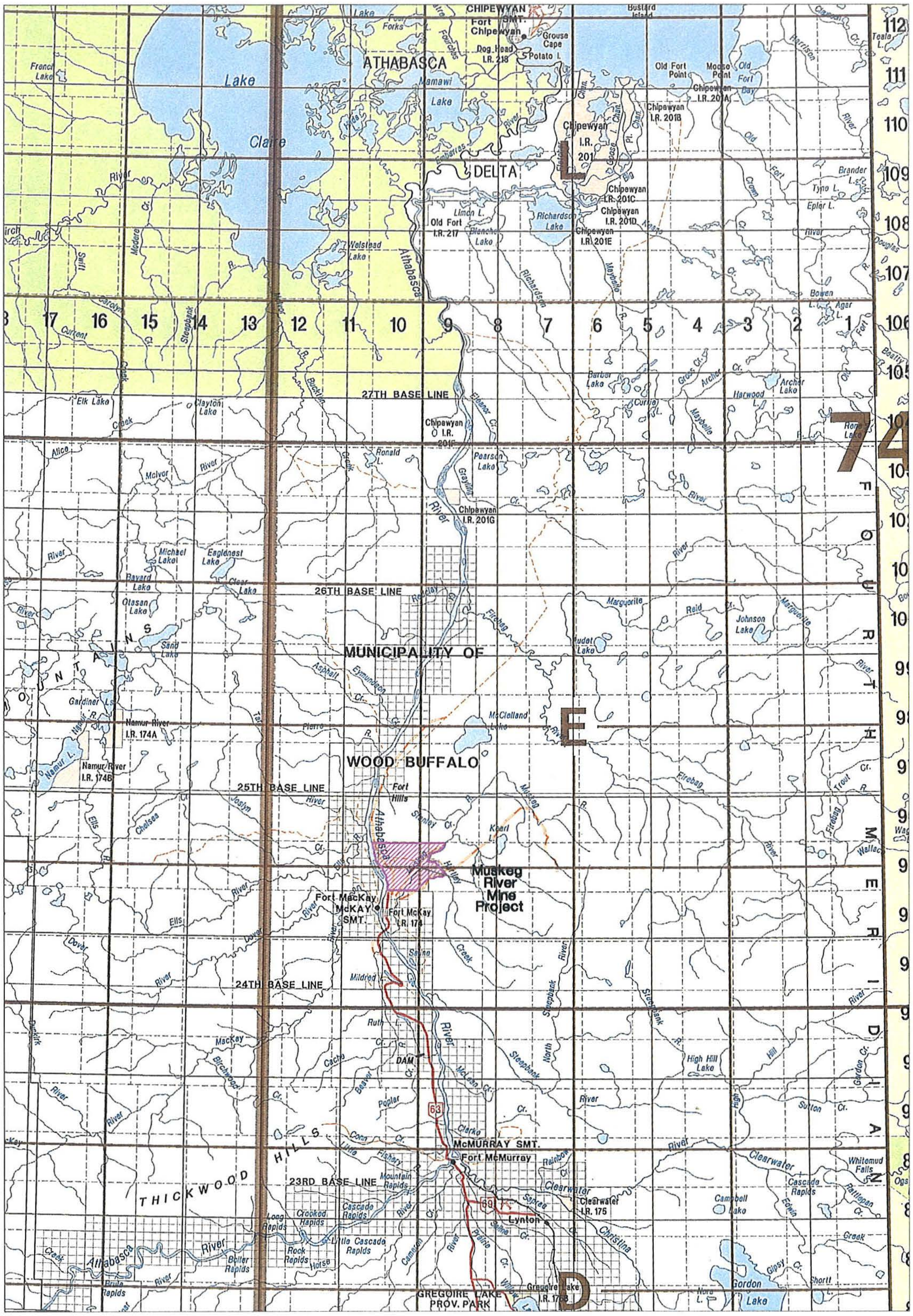
Shell Canada Limited (Shell) is currently planning for an oil sands development of mining operations on the west half of Lease 13 (west of the Muskeg River). This development is known as the Muskeg River Mine. The area is located approximately 75 km north of Fort McMurray and on the east side of the Athabasca River (Figure 1.1). As part of an Environmental Impact Assessment (EIA) for the project, Shell is required to assess the impacts of further development on wildlife (i.e., mammals, birds, amphibians and reptiles). Baseline information concerning these wildlife groups is required for impact assessment, mitigation planning, closure design and monitoring recommendations.

During the past two decades, several baseline studies have been carried out on or near Lease 13:

- the wildlife component of the Alsands EIA (1978);
- the Alberta Oil sands Environmental Research Program (AOSERP) from 1975 to 1984;
- the Other Six Leases Operations (OSLO) baseline inventory; and
- wildlife surveys conducted by Westworth (1996), Fort McKay Environmental Services (1996) and wildlife habitat modelling conducted by AXYS (1996a) in support of an EIA for the Aurora Mine (BOVAR 1996).

Information collected for the Alsands EIA included resource surveys in 1973 on Lease 13 (Shell 1975). A number of Syncrude documents are also available from this period (e.g., Renewable Resources Consulting Services 1972, Penner 1976). Studies have also been conducted as part of EIAs for other industrial activities in the region, including those for the OSLO project. Alberta Fish and Wildlife has also conducted moose surveys within the region during 1993-94 (cited in Westworth 1996).

Most of the data collected and/or discussed during the AOSERP program was of a regional nature, or was focused on sites that did not include Lease 13. Reviews of wildlife populations and habitat requirements included those for insectivorous animals (Ealey et al. 1979), small mammals (Green 1979), terrestrial birds (Francis and Lumbis 1979), waterfowl (Hennan and Munson 1979), amphibians and reptiles (Roberts et al. 1979) and black bears (Penner et al. 1980). Surveys and research studies included aerial surveys and winter track counts for aquatic mammals (Searing 1979), a woodland caribou study in the Birch Mountains (Fuller and Keith 1980), a moose study in the Fort Hills area (Nowlin 1978), a black bear study that was prematurely ended (Blair Rippen, pers. comm.) and a wolf study (Penner 1976). Aerial surveys for moose were also conducted within Lease 13 by Salter et al. (1986) and Eccles and Duncan (1988).

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**REFERENCE**

SCANNED IMAGE OF ALBERTA ENVIRONMENTAL PROTECTION PROVINCIAL BASE MAP 1997, ORIGINAL SCALE 1:1,000,000

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SHELL CANADA LIMITED

**LOCATION OF SHELL LEASE 13 WEST WITHIN NORTHEASTERN ALBERTA**

| | | |
|---|---|---|
| 6 NOV 97 | FIGURE 1.1 | DRAWN BY: TM/VS |

Previous studies in the area are of interest from a pre-disturbance, historical perspective, but more recent information is required to assess current baseline conditions in the area comprising Lease 13. Recent wildlife surveys conducted as part of the Aurora Mine EIA assessed much of the lands within Lease 13. These surveys included winter track count and moose surveys (Westworth 1996) beaver and muskrat surveys (Fort McKay Environmental Services 1996) and raptor surveys (AXYS 1996b). Wildlife habitat modelling for selected species (AXYS 1996a) and baseline descriptions were also completed for the Aurora EIA (BOVAR 1996).

The only area not surveyed during the Aurora EIA is the area that lies between the Muskeg River, Jackpine Creek and the southern boundary of Lease 13 (Figure 1-2). This area is semicircular in shape and occupies some 40 $km^2$. This area became the focus for most of the 1997 wildlife studies as it represented a data gap. However, for studies not conducted during the Aurora EIA (e.g., winter owl surveys, songbird surveys), the entire lease was used as the sampling area. The site of the former Alsands project was also investigated during the summer of 1996. The Alsands area had been cleared, drained in a series of large ditches, then left to revegetate naturally when the project was closed. The area was certified in 1982, when a reclamation certificate (No. 5474) was issued to Shell Canada Resources Limited. A relatively dense cover of aspen, poplar, willow and tamarack has regenerated on this site and there have been recent reports of abundant wildlife (C. Surrendi, pers. comm.). Therefore, a limited field program was conducted to assess the wildlife use of this area.

The scope of the proposed Shell oil sands development became more focused during the course of the field studies such that the project footprint was restricted to the west side of Lease 13. As the baseline data collection program was structured to complete data collection for the entire lease, this definition of the project did not compromise the baseline program.

For this study, Shell has adopted an ecosystem-based management approach for assessing the impact of the development on wildlife in the development area. Species, and the communities formed by species assemblages, are tightly coupled with the characteristics of particular habitats (i.e., plant communities and physical attributes). It is the interaction among habitat types and wildlife communities that produces the type of ecosystem present in the environment. Consequently, linking habitat type with species associations is fundamental to forming an ecosystem-based management plan.

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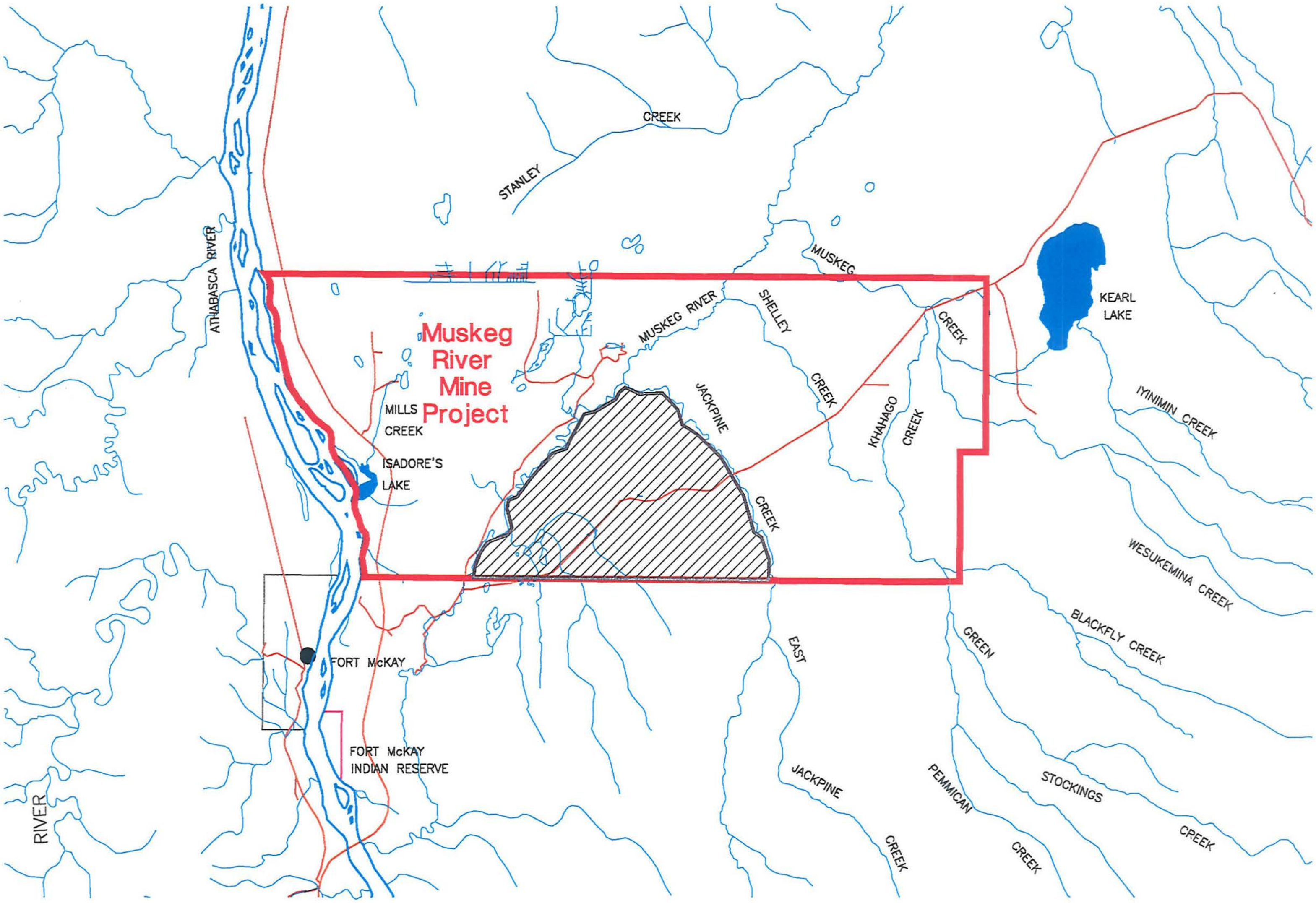


**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

Golder Associates

SHELL CANADA LIMITED

**AREA OF MUSKEG RIVER MINE PROJECT NOT SURVEYED BY AURORA MINE EIA STUDIES**

| | | |
|---|---|---|
| 1 DEC 97 | Figure 1.2 | DRAWN BY: RFM/VS |

Oil sands development activities can affect wildlife species and communities through direct loss of habitat, fragmentation of habitat, changes to habitat characteristics, disturbance, direct mortality and increased access to remote areas. Obtaining baseline information on the habitat requirements of species is essential for determining the impact of the development on wildlife. Predicting the influence of the development on population size is more difficult as other factors such as natural and human predation and disease also contribute to changes in population size. Therefore, it is Shell's intention to use baseline data collected from this and other studies to determine species-habitat associations, and not to focus the EIA on impacts to wildlife populations.

As it is nearly impossible to study all species within an area, species representative of public and scientific values can be chosen for management purposes. Species selected in this fashion are known as Management Indicator Species (MIS) (Salwasser and Unkel 1981), Valued Ecosystem Components (VECs) (Sadar 1994), key species and other terms. They will be termed Key Indicator Resources (KIRs) for the purposes of this EIA, following the terminology of the Aurora EIA (BOVAR 1996a). Species chosen as KIRs for the Aurora Mine EIA were selected based on a scoring of species:

- political importance (endangered status);
- commercial and subsistence economic importance;
- non-consumptive importance; and
- ecological importance (BOVAR 1996).

Rather than repeat this process, the Muskeg Mine study included a review of the selection process and adopted the KIRs of the Aurora Mine EIA for the Shell EIA. Following review of this list by Alberta Environmental Protection (AEP) personnel, two additional KIRs were selected: the western tanager and the pileated woodpecker. Table 1-1 shows reasons KIRs were chosen, in addition to representing their respective species groups. Full details of the KIR selection process are found in BOVAR (1996).

**Table 1-1 Key Indicator Resources and the Selection Rationale**

| KIR | Selection Rationale |
|---|---|
| moose | economic importance, early successional species |
| red-backed vole | importance in food chain |
| snowshoe hare | importance in food chain |
| black bear | economic importance, carnivore |
| beaver | economic importance, semi-aquatic habits |
| fisher | use of late seral stages, economic importance, carnivore |
| dabbling ducks | importance in food chain, economic and recreational importance |
| ruffed grouse | economic and recreational importance |
| Cape May warbler | use of white spruce forests, neotropical migrant |
| western tanager | use of open forest mixedwood, neotropical migrant |
| pileated woodpecker | use of late seral stages, large diameter trees and snags |
| great gray owl | raptor, use of wetlands |

This report compiles information from several independent field studies in the LSA and compares the results with previous studies in Lease 13 and other investigations in similar ecosystems and community types. Field studies for the Shell EIA included:

- winter track counts, snow depth surveys and a winter owl survey (Golder 1997a);
- spring ungulate fecal pellet group count and browse use/availability surveys;
- spring and summer waterfowl surveys;
- spring raptor nest survey;
- spring breeding bird surveys; and
- late summer small mammal survey.

In addition, the results from the above surveys were integrated with results of wildlife surveys (i.e., fecal pellet group/browse, small mammal and waterfowl) conducted on the former Alsands footprint by Fort McKay Environmental Services. This information was then used to develop mitigation measures and to assess impacts of the Shell project on wildlife.

The studies conducted on Lease 13 for both the Aurora and Muskeg River Mine EIAs are summarized in Table 1-2.

The results of the literature review and field programs will be presented and discussed using the following wildlife assemblages:

- Ungulates
- Terrestrial Furbearers
- Semi-aquatic Furbearers
- Small Mammals
- Waterfowl
- Upland Game Birds
- Breeding Birds
- Raptors
- Reptiles and Amphibians

Emphasis will be placed on KIRs within each assemblage where appropriate. Each wildlife group and/or KIR is discussed in terms of its status and distribution, habitat associations, habitat modelling results (for KIRs only) and factors that act to limit their populations.

**Table 1-2 Field Studies Conducted on Lease 13 for the Aurora and Muskeg River Mine EIAs**

| KIR | Aerial Survey | Track Count | Owl Survey | Breeding Bird | Browse | Small Mammal | Alsands |
|---|---|---|---|---|---|---|---|
| moose | a | a,b | | | b | | b |
| red-backed vole | | | | | | b | b |
| snowshoe hare | | a,b | | | | | |
| black bear | | | | | | | |
| beaver | c | | | | | | |
| fisher | | a,b | | | | | |
| dabbling ducks | b | b | | | | | b |
| ruffed grouse | | a,b | | | | | |
| Cape May warbler | | b | | b | | | |
| western tanager | | | | b | | | |
| pileated woodpecker | | | | b | | | |
| great gray owl | b,d | | b | | | | |

a = Westworth 1996
b = Golder 1997a and this report
c = Fort McKay Environmental Services 1996
d = AXYS 1996b

# 2. OBJECTIVES

The principal objective of this report is to provide baseline wildlife data for the Muskeg River Mine area. Field work was focused on areas and species groups not sampled for the Aurora Mine EIA. The data were used to provide knowledge of the value of vegetation-community associations as wildlife habitat for the project KIRs. A secondary objective was to assess the use of the Muskeg River and Jackpine Creek valleys as habitat by wildlife. Specific objectives of the field programs were to determine:

- the relative abundance and vegetation community use by ungulates during winter and early summer;
- the relative abundance and vegetation community use by furbearers during the winter;
- the relative use of the Muskeg River and Jackpine Creek valleys by ungulates and furbearers;
- the relative abundance, species richness, species diversity and species-habitat associations for small mammals during late summer;
- the status of breeding and migrating waterfowl species;
- the relative abundance, species richness, species diversity and species-vegetation community assemblages for breeding birds; and
- the relative abundance of, and vegetation community use by, great gray owls, boreal owls and ruffed grouse.

# 3. STUDY AREAS

## 3.1 LOCAL

The Local Study Area (LSA) was determined by the outer boundaries of Lease 13 West and a 0.5 km buffer around the project footprint (Figure 3.1). A buffer of 0.5 km was selected for the LSA as it met the maximum zone of disturbance (0.5 km) for wildlife used in the Aurora Mine EIA (BOVAR 1996) and this assessment. This buffer did not extend a full 500 m to the north of Lease 13, however, as Syncrude intends to develop the area right to within several hundred metres of the edge of Lease 13. The LSAs were identical for soils, vegetation, ELCs and wildlife.

Study areas for the various field campaigns differed depending on whether similar surveys had been conducted within the Lease 13 area, and on decisions regarding the final development design. The project footprint, and hence the LSA, was not finalized until October 1997.

All of Lease 13 was the focus of the owl and songbird surveys since such studies had not been done within the Lease, and since at the project planning stages the entire lease was included in development plans. The area of Lease 13 not surveyed during the Aurora EIA lies between the Muskeg River, Jackpine Creek and the southern boundary of Lease 13. This 40 $km^2$ area was the focus for pellet group and browse surveys and waterfowl/raptor surveys. The western portions of Lease 13, where the initial development is proposed to occur, was the focus for small mammal trapping surveys. Finally, the site of the former Alsands project was the study area for pellet group and browse surveys and, small mammal and waterfowl surveys conducted in conjunction with Fort McKay Environmental Services.

### 3.1.1 Vegetation Community Types Sampled

For all wildlife studies, except winter track count surveys, vegetation community types were classified according to Beckingham and Archibald (1996). Beckingham and Archibald described 54 plant community types (e.g., a1.1: jack pine/bearberry/lichen) which are grouped into 25 ecosite phases (e.g., a1: lichen jack pine), which in turn are grouped into 12 ecosites (e.g. a: lichen). While Golder determined the plant community type for each field data collection point, it was necessary to conduct the statistical analyses at the ecophase, the ecosite, or sometimes a broader classification to meet minimum sample size criteria. For the purposes of

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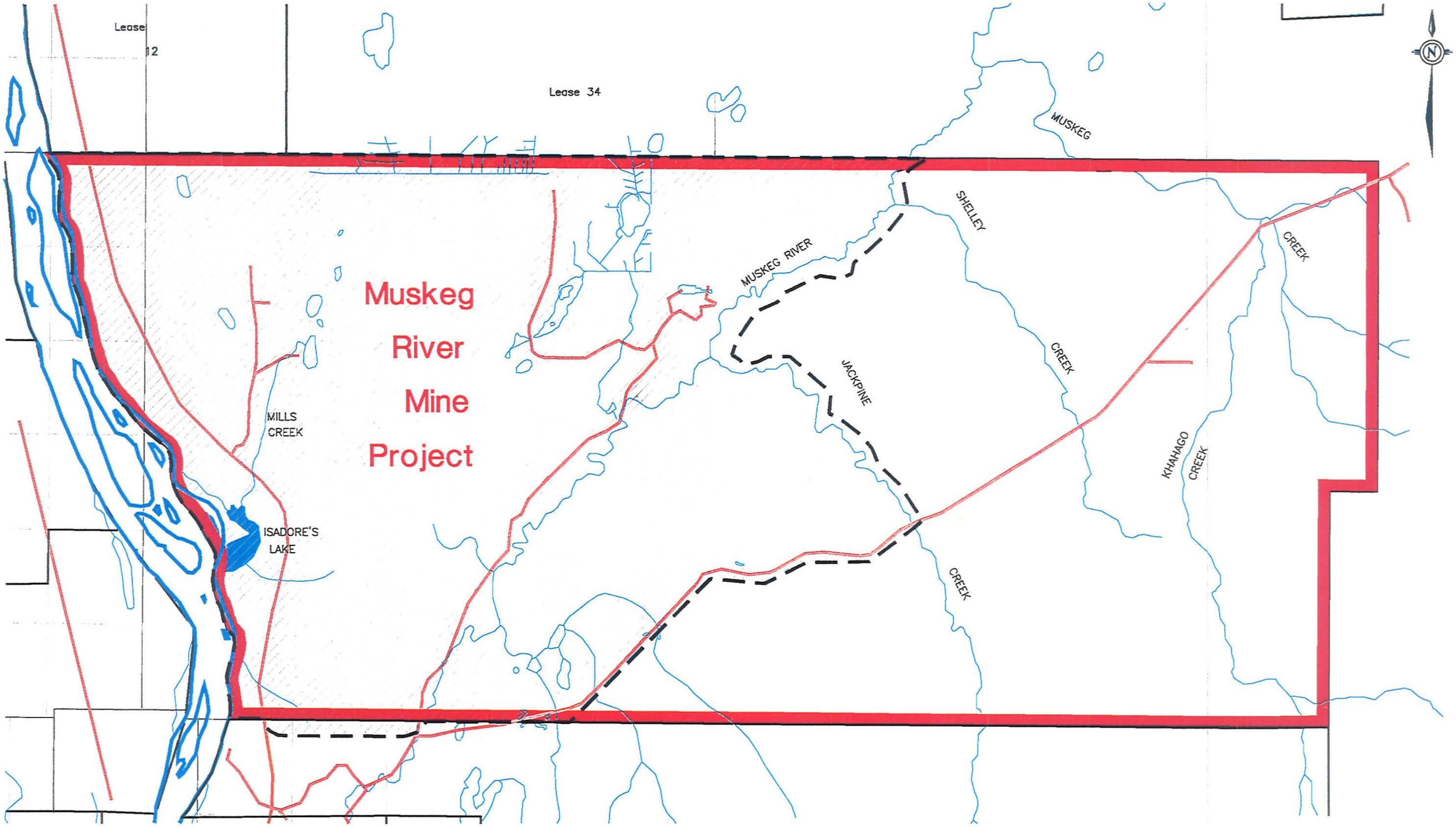


**REFERENCE**
DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

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SCALE 1:100,000

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**LOCAL STUDY AREA**

| 1 DEC 97 | Figure 3.1 | DRAWN BY: DC |
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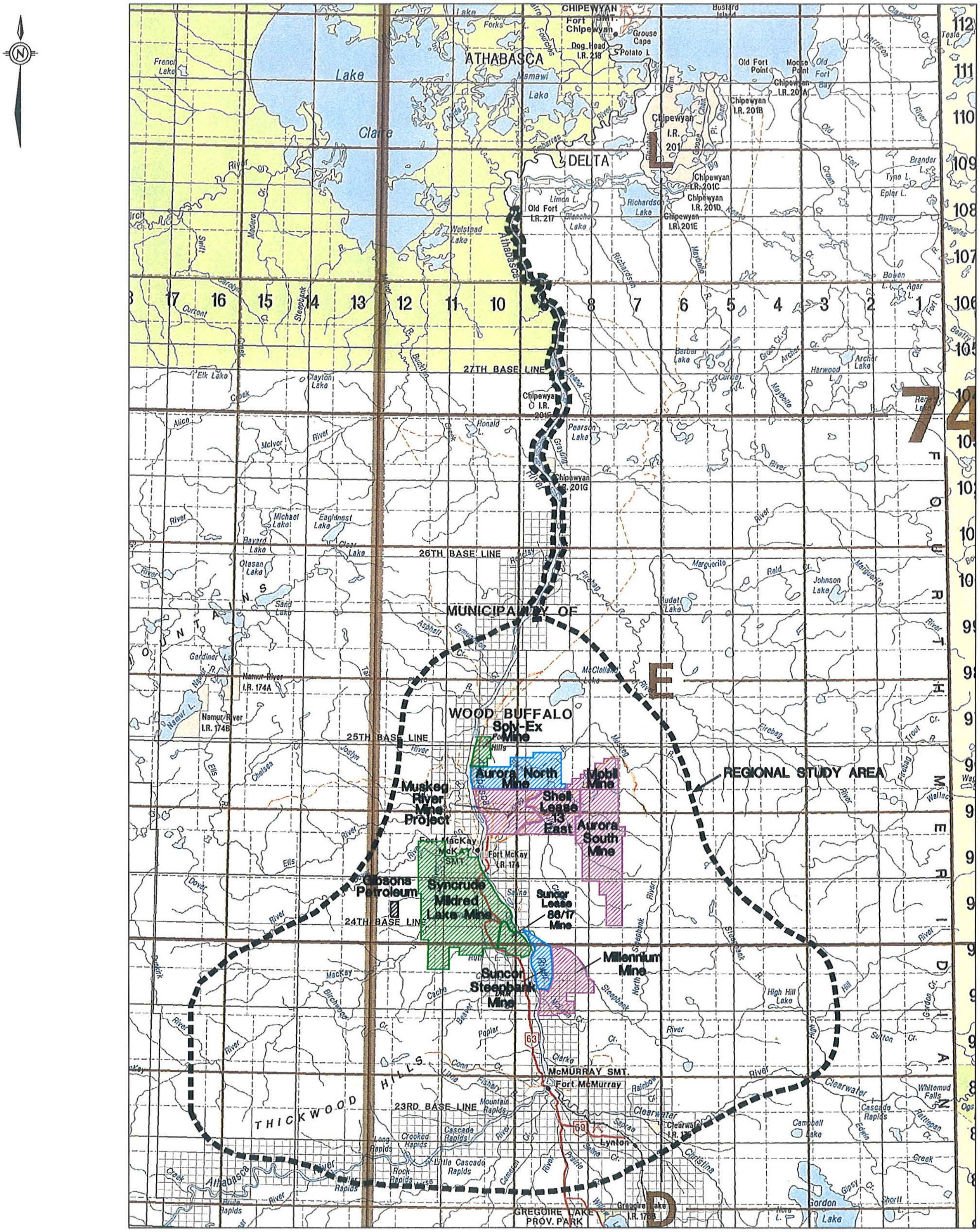
this report, the term "vegetation community type" refers to any of the above (i.e., plant community type, ecophase, ecosite, or broader grouping). For the winter track count study, vegetation communities were classified by canopy cover because the ecosystem mapping system of Beckingham and Archibald (1996) requires a description of the herb and bryophyte layers in the forest, which is not possible during the winter. Two additional vegetation community types, not listed by Beckingham and Archibald (1996), were described during wildlife studies: a riparian shrub zone and balsam poplar regeneration. Riparian shrub community types were present as narrow communities along creeks and rivers. Shrub species were predominantly river alder and willow. While this type most closely resembles Beckingham and Archibald's willow/sedge/golden moss plant community type (k2.2), no real equivalent to this vegetation community type was recorded by them. Therefore, the river alder/willow assemblage was included as a new plant community type. Similarly, the balsam poplar regeneration found within the Alsands reclamation area was not described by Beckingham and Archibald, so was also included as a new plant community type.

### 3.1.2 Landscape

Three landform types were investigated at the landscape level. The first landform type was designated as escarpment. Escarpments were not common in the Lease 13 area due to the low relief surrounding the Muskeg River and Jackpine Creek. The escarpment of the Athabasca River was not sampled during the wildlife field program. The second landform type was termed riparian and was composed of those vegetation community types adjacent to the creeks and rivers of the LSA. The third landform type, designated as upland, was composed of the remaining land area of the LSA, including wetlands.

## 3.2 REGIONAL

A Regional Study Area (RSA) for wildlife was selected to correspond with the RSA for vegetation and ELCs (see Golder 1997c and d; Figure 3-2). The boundaries for the RSA were developed in consultation with Shell Canada Limited, Syncrude Canada Limited, Suncor Energy Inc. and other stakeholders, and considered a number of biophysical criteria, including watershed boundaries, ecological boundaries (based on ecological land classification criteria) and the regional airshed (based on existing air emission and deposition data). In total, the RSA encompassed 1,051,411 ha.

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SCALE 1:1,250,000 (Approx.)

**REFERENCE**

SCANNED IMAGE OF ALBERTA ENVIRONMENTAL PROTECTION PROVINCIAL BASE MAP 1997, ORIGINAL SCALE 1:1,000,000

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**REGIONAL STUDY AREA**

| | | |
|---|---|---|
| 1 DEC 97 | Figure 3.2 | DRAWN BY: TM |

# 4. METHODS

For all wildlife studies, a literature review was incorporated to augment the information available on wildlife species and communities. Information from the literature was also used to compare and contrast results of other studies with the patterns obtained from this study. Some KIRs (e.g., the black bear) were not studied in the field while others (e.g., the ruffed grouse and pileated woodpecker) were studied incidentally to studies of other species.

## 4.1 WINTER TRACK COUNT SURVEYS

Winter track counts were conducted on March 13-14, 1997 (Figure 4-1). Detailed methodology is provided in Golder (1997a).

## 4.2 UNGULATE SUMMER BROWSE AND PELLET GROUP SURVEY

### 4.2.1 Field Methods

Browse and pellet group surveys were conducted May 21-31, 1997. Air photos were used to identify landform and vegetation community types for sampling. Two parallel transects, 100 m in length and separated by a minimum distance of 10 m, were established within each sampling site. Each transect contained five sampling stations, spaced at 25 m intervals. Sampling stations were circular with a diameter of 5 m. Each transect was located at least 200 m from any road, and 10 m from habitat margins (to limit possible edge effects). A total of 78 paired transects were surveyed during the study (Figure 4-2).

For each sampling station, all potential browse species were identified and an estimate of percent cover (amount of browse available) was recorded. Plants were inspected for recent browsing activity and the proportion of material browsed (percent browsed) was estimated.

Ungulate pellet groups, defined as an association of six or more pellets, were counted within a 2 m strip along each transect (1 m on each side of the transect). Pellet groups were identified by species (i.e., moose or deer). Density of pellet groups was expressed as the mean (± 1 Standard Error; SE) of the number of pellet groups observed per 400 $m^2$ (i.e., number per area of paired transect).

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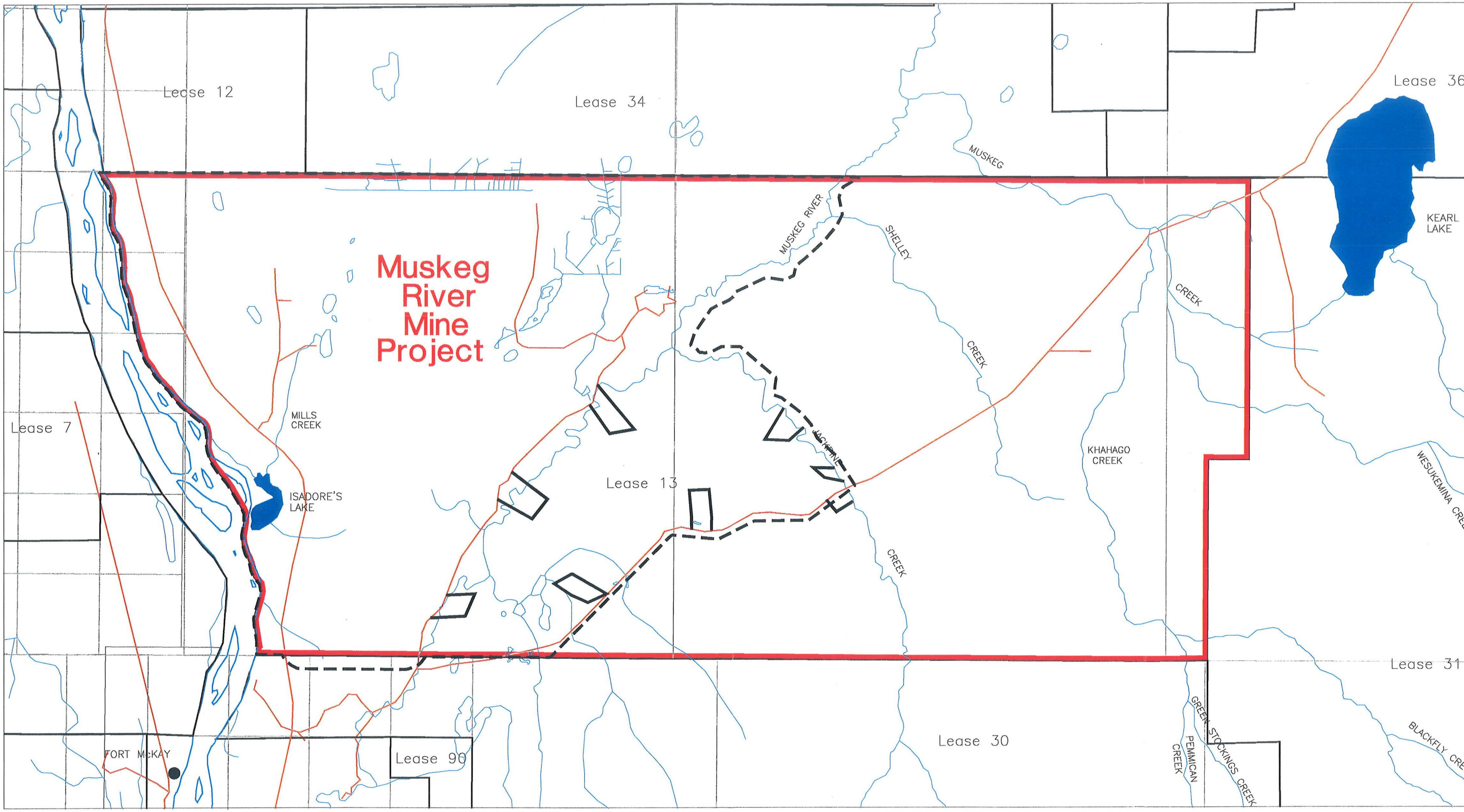


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**LEGEND**

TRACKING SURVEY TRANSECTS

**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 741
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

Golder Associates

SHELL CANADA LIMITED

**LOCATIONS OF TRACK SURVEY TRANSECTS CONDUCTED ON SHELL LEASE 13 MARCH 13-14, 1997**

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| 1 DEC 1997 | Figure 4.1 | DRAWN BY: TM/RFM/VS |

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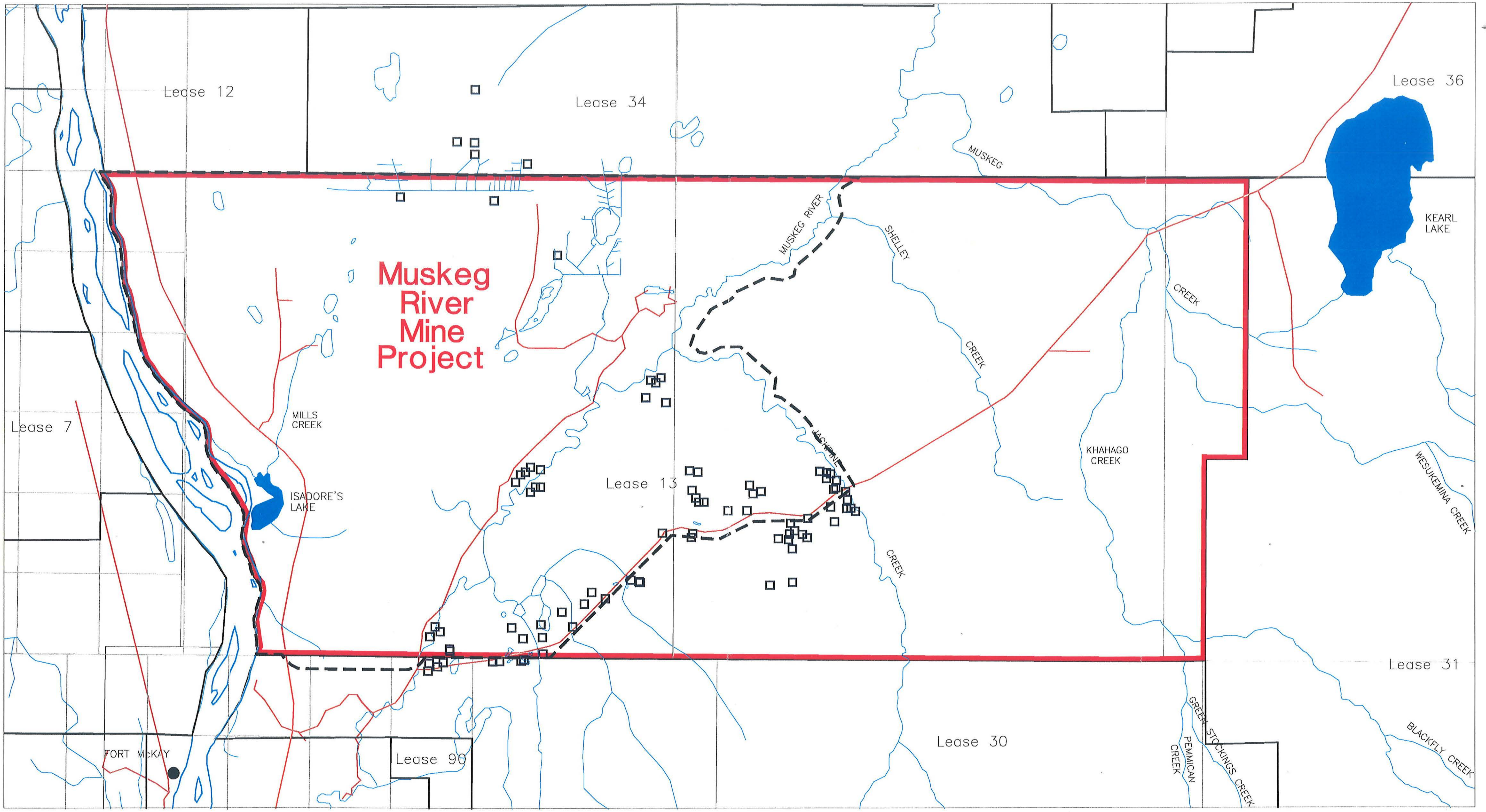


0 1000 2000 3000 40000 5000m

SCALE 1:75,000

**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

**LEGEND**

□ UNGULATE BROWSE AND PELLET GROUP SURVEY LOCATIONS

Golder Associates

SHELL CANADA LIMITED

LOCATIONS OF UNGULATE BROWSE AND PELLET GROUP SURVEYS CONDUCTED ON SHELL LEASE 13 MAY 9-31 1997

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| 1 DEC 1997 | Figure 4.2 | DRAWN BY: TM/VS |

### 4.2.2 Statistical Analysis

Analysis of variance (ANOVA) was used to determine if the availability of browse material (percent browse) differed among landform or vegetation community types. Data were subjected to the arcsine transformation before statistical analysis (Zar 1984).

Observed and expected frequencies of habitat use were calculated from the average proportion of plant material browsed and available, respectively, within sampling stations along each transect. Hence, browse availability and use were used as an index of habitat (landform or vegetation community type) use. The Chi-square ($\chi^2$) goodness-of-fit test, with Yates correction, was used to analyze the effect of habitat type on browse availability and use. Subsequent to obtaining a significant result, Bonferroni 95% confidence intervals were constructed to determine which habitats were preferred, used in proportion to availability or avoided (Byers et al. 1984).

Two separate analyses were performed on the following habitat associations. The first analysis compared browse use and availability among the three landforms (escarpment, riparian, upland). The second analysis tested for habitat use at a smaller scale. The upland was separated into nine vegetation community types. Although the upland contained 16 vegetation community types, only those types with three or more replicates were included in the analysis. Similarly, the escarpment landform contained two vegetation community types, but only one was included in the analysis. The riparian landform was designated as one vegetation community type.

A non-parametric one-way analysis of variance (Kruskal-Wallis, $\chi^2$ approximation) was used to test for differences in the density of moose or deer fecal pellet groups among landform types. Density represents the number of fecal pellet groups observed per 400 $m^2$ (the combined area of transects sampled in each replicate). Due to the limited number of observations for each vegetation community type, no analysis could be performed to test for differences in pellet group density at this habitat scale.

## 4.3 SMALL MAMMAL SURVEY

### 4.3.1 Field Methods

The small mammal trapping survey was conducted August 25-31, 1997. The study area was the LSA. Within the LSA, suitable discrete vegetation classes (upland coniferous, upland mixedwood, coniferous wetlands, riparian and regenerating vegetation on the Alsands area) were chosen using air photos. Each class was sampled in triplicate (see Table 4-1 for vegetation community type classification; Figure 4-3 for transect locations).

Adjacent transects were separated by a minimum distance of 200 m. Transects were placed at least 10 m from the edge of a polygon and 20 m from the nearest active road. Fourteen of the 15 transects had eight stations, placed 13 m apart, while one transect had seven stations. Three snap traps and one live trap were set at each station. Each transect also had one pitfall trap set at station 3. Different trap types were used as different species have a variable susceptibility to being caught in each trap type. Trap lines were run for three nights, generating 99 potential trap nights (i.e., 4 traps x 8 stations x 3 nights = 96 trap nights + 3 pit fall trap nights = total of 99 trap nights) for most transects. Traps that were sprung but contained no individual were subtracted from the total number of potential trap nights for each transect.

All 15 transects were set during the day and checked the following day. To equalize sampling time for each trap, transects were checked in the same sequence that they were set. Animals captured in live traps were identified, temporarily marked by pelage clipping and released. The remaining individuals were placed in bags, identified by transect and frozen on dry ice for shipment to the Provincial Museum in Edmonton for determination or confirmation of species, age (i.e., juvenile, adult), sex, weight and reproductive condition.

### 4.3.2 Statistical Analysis

Species richness was calculated as the mean number of different species recorded within each vegetation class (habitat). Species diversity was estimated using the Shannon-Wiener index, which emphasizes rare species in the community (Krebs 1989). The relative abundance of small mammals in each habitat was expressed as the average number captured per 100 trap nights.

A non-parametric one-way ANOVA (Kruskal-Wallis test) was used to test for the effect of vegetation class on relative abundance, species richness and species diversity.

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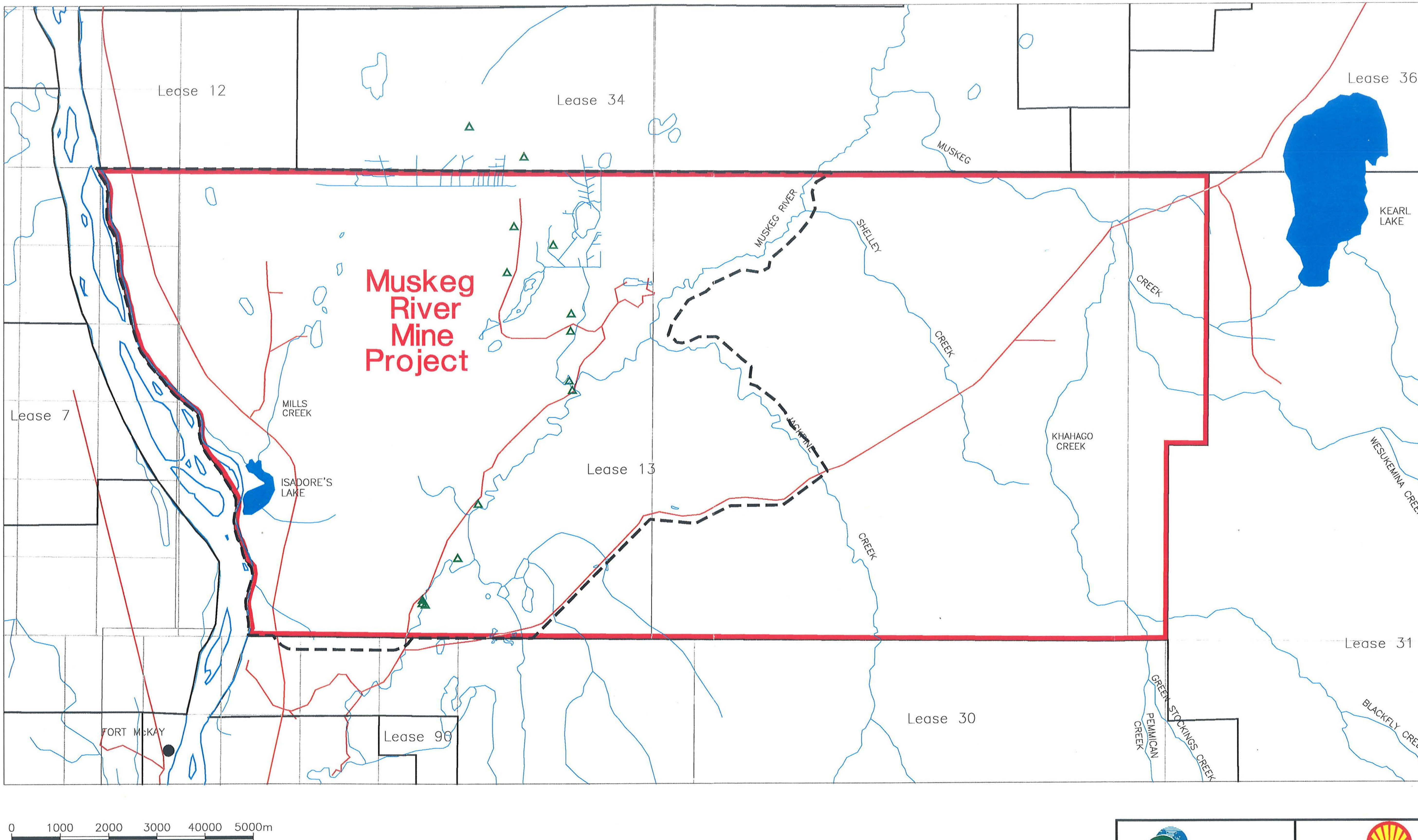


**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

**LEGEND**

△ SMALL MAMMAL SURVEY LOCATIONS

Golder Associates

SHELL CANADA LIMITED

LOCATIONS OF SMALL MAMMAL SURVEYS CONDUCTED ON SHELL LEASE 13 AUGUST 25-31 1997

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|---|---|---|
| 1 DEC 1997 | Figure 4.3 | DRAWN BY: TM/RFM/VS |

**Table 4-1 Number of Small Mammal Trapline Replicates per Vegetation Community Type**

| Vegetation Community | Vegetation Class | Plant Community Type[a] | Community Type Code[b] | Number of Transects |
|---|---|---|---|---|
| riparian willow | Riparian | Aw-Sw/beaked willow | n/a | 3 |
| low-bush cranberry | Upland Mixedwood | Aw-Sw/beaked willow; Aw-Sw/blueberry-green alder | d2.6; b3.2 | 3 |
| poor fen | Upland Wetland | Sb-Lt/dwarf birch/sedge/peat moss | j1.1 | 3 |
| Labrador tea-mesic | Upland Coniferous | Pj-Sb/Labrador tea/feather moss; Pj/blueberry/lichen; Pj-Aw/blueberry/Labrador tea | c1.1; a1.2; b1.3 | 3 |
| balsam poplar regeneration | Alsands Reclamation | Pb-Aw regeneration | n/a | 3 |

[a] Aw = trembling aspen
Sw = white spruce
Sb = black spruce
Lt = larch (tamarack)
Pb = balsam poplar

[b] From Beckingham and Archibald (1996)

## 4.4 WATERFOWL SURVEYS

### 4.4.1 Field Methods

Waterfowl investigations consisted of two aerial surveys and one ground survey. Aerial surveys were conducted in the spring (May 17, 1997) and late summer (August 28, 1997), using a Jet Ranger helicopter at speeds from 130 - 160 km/h, approximately 100 m above ground level but lower when conditions allowed.

Aerial surveys were flown with a minimum of one observer on each side of the aircraft. The front seat observer recorded birds in front of and on the left side of the helicopter while the second observer recorded all species sighted on the right side of the helicopter. In the late summer survey, two observers sat on the left side of the helicopter. Communication among the observers ensured that birds were not counted twice.

Wetlands surveyed during the first aerial survey included the Muskeg River, Jackpine Creek and a group of permanent and semi-permanent wetlands that are numbered and labelled (Figure 4-4). Observed waterfowl were recorded according to their breeding status. Birds were recorded as lone drakes (LD), flocked drakes (FD), pairs (P), groups (G) and hens (H). For most species, estimating the total number of individuals involved the following assumptions and calculations. The number of lone drakes was multiplied by 2 because it was assumed that the hen was on the nest. The number of flocked drakes was also multiplied by 2 because these birds were assumed to have mated earlier in the breeding season. These assumptions and calculations were not used to estimate the number of redhead, scaup, ring-necked and ruddy ducks as the sex ratio in these species is typically male biased (Dale Caswell, CWS Winnipeg, pers. comm).

On May 31, 1997, ground surveys of 11 wetlands were conducted (Figure 4-4). These wetlands were accessible from the main road, and had also been previously surveyed from the air. The survey began at 8:00 a.m. and concluded at 1:08 p.m. MDT. There was no cloud cover evident when the surveys began, but as the day progressed cloud cover increased to approximately 25%. Winds were calm throughout the survey period.

Ground surveys were conducted by walking to the wetlands and observing any waterfowl on the water. Binoculars and spotting scopes were used to make a positive visual identification of the different species and breeding status (i.e., LD, G, H). For those wetlands that had abundant emergent vegetation (i.e., cattails or bulrushes), the periphery was also checked to locate individuals residing in the vegetation. Care was taken to ensure that the birds were not flushed between wetlands and counted more than once.

In late summer (August 28), the second aerial survey was conducted. All water bodies within Lease 13 were censused, including the drainage canals within the former Alsands site.

No statistical analysis was conducted on the waterfowl data.

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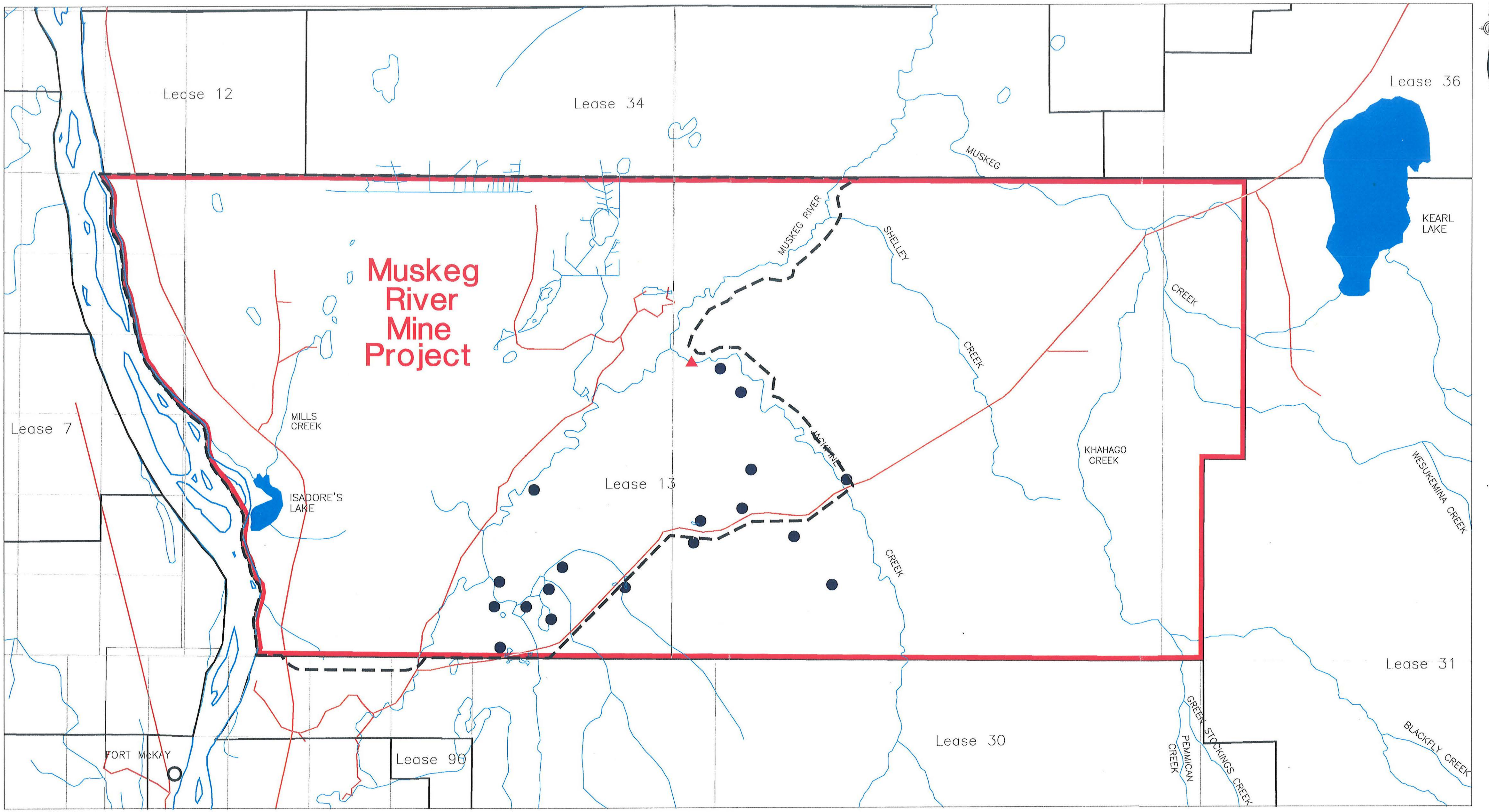


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**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

**LEGEND**

● WATER BODIES SURVEYED

▲ RAPTOR NEST

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SHELL CANADA LIMITED

LOCATIONS OF WATERFOWL GROUND SURVEYS CONDUCTED ON SHELL LEASE 13 MAY 31, 1997

| 1 DEC 1997 | Figure 4.4 | DRAWN BY: TM/RFM/VS |
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# 4.5 BREEDING BIRD SURVEY

## 4.5.1 Field Methods

Breeding bird surveys were conducted using standard point-count methods. Point counts were conducted from June 10-15, 1997. For each vegetation community type, 2-5 point-count stations were established in a linear orientation. These stations were spaced 250 m apart to avoid sampling the same birds twice. Additionally, point counts were conducted at least 50 m from the edge of the habitat to ensure that birds inhabiting other habitats than the one being surveyed were not counted. The location of each point-count station was referenced using the global positioning system (GPS).

Observations were divided into those less than 50 m from the observer and those greater than 50 m away, but still within the particular habitat. Only those observations within 50 m have been utilized in the analysis of the data; those within 50 m to 100 m have been utilized for species presence/absence data within the Lease 13 area. Due to the low number of detections for many species, point counts were pooled into their respective vegetation community types. A total of 15 vegetation community types were sampled at 126 sites (Table 4-2; Figure 4-5).

**Table 4-2 Number of Breeding Bird Point Counts for Each Vegetation Community Type in the Lease 13 Study Area**

| Vegetation Community Type | Number of Point Counts |
|---|---|
| Jack pine/Aspen (b1) | 5 |
| Aspen/White spruce (b3) | 5 |
| White spruce/Jack pine (b4) | 1 |
| Aspen dominated (d1) | 16 |
| Aspen/White spruce (d2) | 17 |
| White spruce dominated (d3) | 2 |
| White spruce/Balsam fir (e3) | 1 |
| Black spruce/Jack pine (g1) | 5 |
| White spruce/Black spruce (h1) | 11 |
| Closed Black spruce bog (i1) | 17 |
| Closed Black spruce/Tamarack-fen (j1) | 10 |
| Open Black spruce/Tamarack-fen (j2) | 2 |
| Open Tamarack-fen (k1) | 13 |
| Shrubby fen (k2) | 3 |
| Riparian | 18 |

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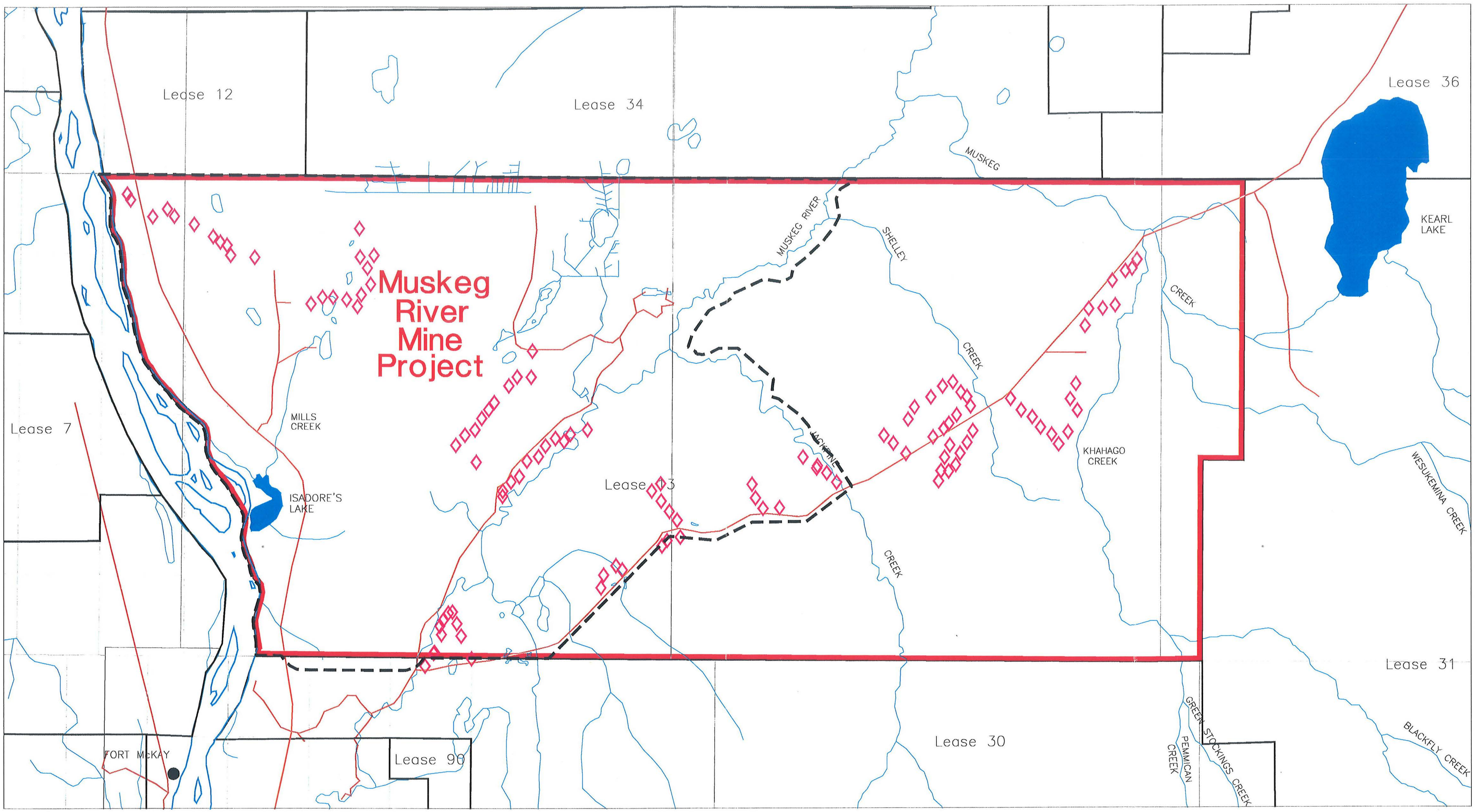


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SCALE 1:75,000

**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

**LEGEND**

◇ SURVEY SITES

Golder Associates

SHELL CANADA LIMITED

LOCATIONS OF BREEDING BIRD SURVEYS CONDUCTED ON SHELL LEASE 13 JUNE 10-15 1997

| | | |
|---|---|---|
| 1 DEC 1997 | Figure 4.5 | DRAWN BY: TM/RFM/VS |

Surveys began approximately a half-hour before sunrise and continued until approximately 10:00 a.m. Sampling began 1 minute after the observer arrived at the station to allow the birds to settle after the observer's approach. All birds observed or heard within a 10 minute sampling period were recorded. Observations were divided into those recorded in the first three minutes of the survey and those in the remaining seven minutes. This allows comparison and exchange of data with the North American Breeding Bird Survey. Surveys were not conducted during high winds (e.g., Beaufort Scale >5; trees in leaf sway) or inclement weather, which would reduce the likelihood of identifying species.

Species flying through or above the canopy were also recorded; however, these observations have not been included in the analysis. The movements of the identified species were carefully monitored to minimize the probability of recounting the birds within the same or adjacent plot.

### 4.5.2 Statistical Analysis

All bird species detected in the Lease 13 area were used in the analysis of species diversity and richness. The Shannon-Weiner index was used to calculate species diversity for each vegetation community type. Non-parametric analysis of variance (Kruskal-Wallis, $\chi^2$ approximation) was used to compare species diversity or richness among vegetation community types.

#### Classification of Bird and Habitat Communities

Two-way indicator species analysis (TWINSPAN) was performed to classify bird species and habitat communities (i.e., vegetation community types). To avoid the confounding effects of extremely uncommon species, bird species detected in >10% of all habitats (31 species) were analyzed. In addition, to give equal weight to common and uncommon species, data were standardized by dividing the number of detections for a species in a given habitat by the maximum number of detections for that species. Subsequently, the transformed data (i.e., relative frequency, %), were then ranked according to the following categories: "-" = 0%, "1" = >0% to 10%, "2" = >10% to 20%, "3" = >20% to 30%, "4" = >30% to 50%, "5" = >50% to 70% and "6" = >70%. Thus, each species received a rank based on the relative frequency of occurrence within each habitat type.

Based on the ranked data, TWINSPAN divides species and habitat types into smaller groups. Divisions among species groups is based on the dissimilarity of species preferences for vegetation community types, while separation of vegetation communities is a result of the dissimilarity in bird species abundance. A two-way ordered table is generated, showing the grouping of similar vegetation community types across the horizontal axis. In addition, the grouping of bird species with similar habitat preferences is depicted along the vertical axis.

Using the ranked abundance data, relative abundance of each of the 31 species was compared among community types using a Kruskal-Wallis test.

# 4.6 RAPTOR SURVEYS

## 4.6.1 Hawks, Eagles and Falcons

### 4.6.1.1 Field Methods

A survey for raptor nests was conducted concurrently during the first aerial waterfowl survey. Attention was focused on the peripheral areas surrounding wetlands. Observed nests were located on a map of the Lease 13 area.

## 4.6.2 Owls

### 4.6.2.1 Field Methods

Owl surveys were conducted during the evenings of March 31-April 3, 1997. Methods are provided in Golder (1997a). Sample locations are shown in Figure 4-6.

# 4.7 HABITAT SUITABILITY MODELLING

Habitat Suitability Index (HSI) models were used to assess the baseline habitat conditions for KIRs in the Local and RSAs Golder (1998). Models were adapted from AXYS (1996a), Westworth (1996) and, in some cases, were developed by Golder. A brief description of the HSI process follows and a more full account is provided in Golder (1998). Detailed model descriptions are found in the above mentioned reports.

### Theory and Use Of HSI Models

HSI models are analytical tools for determining the relative potential of an area to support individuals (or populations) of a wildlife species. They are frequently used to quantify potential habitat losses and gains for wildlife species as a result of various land use activities. HSI models were initially developed by wildlife managers in the United States in the 1970s when the focus for wildlife management shifted from monitoring individuals to monitoring habitat. Concurrently, the use of computer technology was

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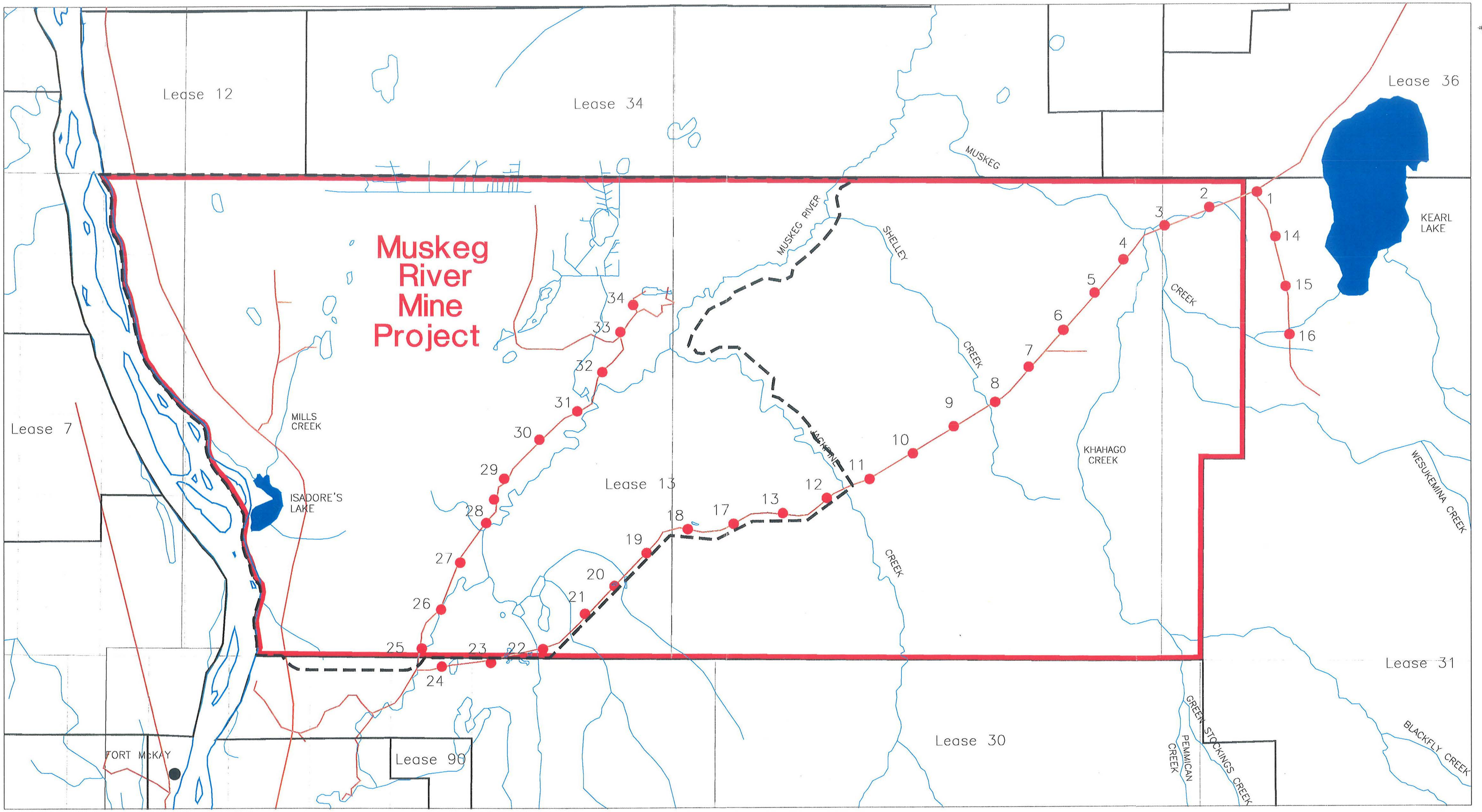


0 1000 2000 3000 40000 5000m
SCALE 1:75,000

**REFERENCE**
DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

**LEGEND**
● OWL SURVEY LOCATIONS
22

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**LOCATION OF OWL SURVEY SITES SAMPLED ON SHELL LEASE 13 MARCH 31 TO APRIL 3, 1997**

| 1 DEC 1997 | Figure 4.6 | DRAWN BY: TM/RFM/VS |
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expanding to allow managers to apply habitat concepts in much larger areas. By the early 1980s, a standard set of protocols for the development and use of HSI models had been published (U.S. Fish and Wildlife Service 1981). Although largely ignored in Canada until the late 1980s, an environmentally conscious public pushed the need for habitat information to the forefront of many company planning processes. Today, many EIAs use HSI modelling to determine the potential impacts of project activities on wildlife resources.

## Background

HSI models evaluate the potential of an area to support a wildlife species, based on a number of known or assumed relationships between elements of habitat structure and their ability to support a species' biological needs (e.g., food, cover, reproduction). These relationships are then combined mathematically into models. They are referred to as index models because the rating they provide is a relative value ranging from 0 to 1, where 0 indicates that an area is unsuitable and 1 indicates optimum suitability. Often, HSI values for each habitat type are multiplied by the area (ha) of the habitat type or area under consideration to determine the number of habitat units (HU) for each wildlife species. HSI models are not capable of providing information about abundance and other demographic characteristics of wildlife populations and cannot be used as a substitute for population data. They are appropriate, however, for the following purposes:

- determining a ranking of the capability of a single habitat area to support various wildlife species, such that management plans can reflect the needs of wildlife in the area, or so a baseline status of wildlife habitat is known before habitat modifications;
- comparing different habitat types or areas to determine where various wildlife species are most likely to be affected by land management activities, or to plan for areas that are highest priority for protection; and
- comparing the same area at different times by predicting changes to the habitat structure as a result of industrial activity and/or natural succession.

# 5. RESULTS AND DISCUSSION

## 5.1 UNGULATES

### 5.1.1 Moose

#### Status and Distribution

Several aerial and winter track count surveys have been conducted in the oil sands area of northeastern Alberta in the last 25 years. Early estimates of moose density were $0.09/km^2$ for the Lease 13 area (Shell 1975), and $0.31/km^2$ for the larger Alsands area (Bibaud and Archer 1973). Current estimates for the Lease 12, 13 and 34 (Aurora North) areas were approximately $0.10/km^2$ (Westworth 1996), indicating that moose populations in the Lease 13 area have remained low and relatively stable. Low moose densities may reflect the shortage of preferred winter habitat (deciduous and mixedwood forest) in the area (BOVAR 1996). Prime moose habitat with minimal hunting mortality, such as the Peace Athabasca Delta, can support moose populations of 0.4 to 1 moose/$km^2$ (Telfer 1984).

Locations of moose observations during aerial surveys within and adjacent to Lease 13 in 1985-1986 and 1988-1996 are presented in Figures 5-1 and 5-2, respectively. The majority of moose observations within Lease 13 have been made in, or close to, watercourses. Relatively few moose observations were recorded in the uplands of Shell 13 West.

#### Habitat

Analysis of the browse data collected in this study indicated that the average percent browse available to ungulates was significantly different among vegetation community types ($F_{15,70} = 13.31$, $P < 0.01$). However, the variation in browse availability among habitats did not result in a statistical difference in the use of different vegetation communities ($\chi^2 = 4.74$, $P > 0.50$). Ungulates tended to browse in each habitat in proportion to the amount of plant material available (Table 5-1). Although some habitats appeared to be preferred (e.g., riparian, trembling aspen - d1), and avoided (e.g., fens - k2), the lack of statistical significance was likely due to the limited number of browse observations and the large number of habitats analyzed.

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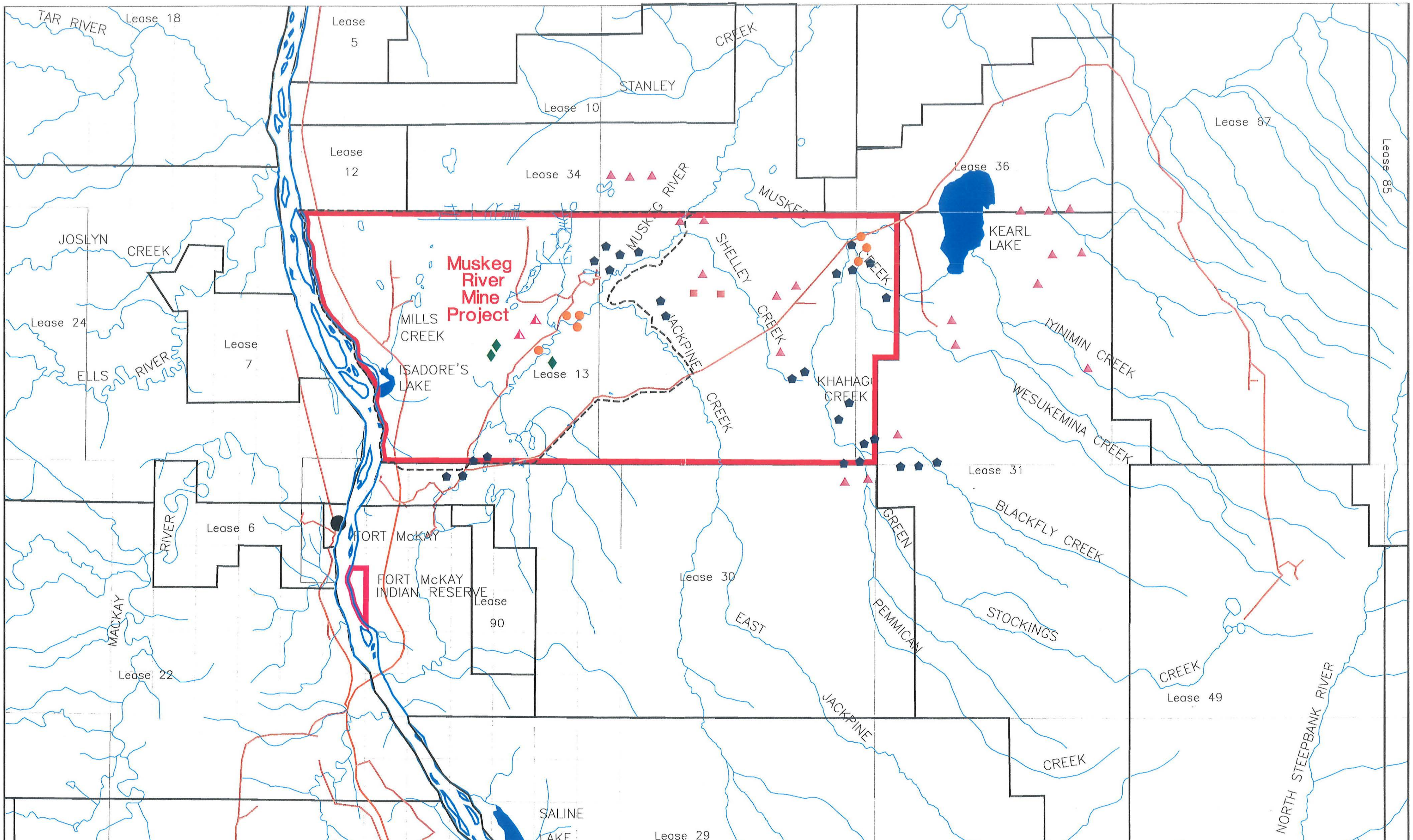


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SCALE 1:150,000

**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I 84A AND 84H FROM RESOURCE DATA DIVISION ALBERTA ENVIRONMENTAL PROTECTION, 1997.

ADAPTED FROM BOVAR ENVIRONMENTAL, 1996
SOURCE: SALTER ET. AL. 1986; OSLO 1988

**LEGEND**

- ● MOOSE OBSERVED DURING BEAVER/MUSKRAT AERIAL SURVEYS, OCT. 1985
- ▲ MOOSE OBSERVED DURING TRANSECT SURVEYS, DEC. 1985
- ■ MOOSE OBSERVED DURING FERRY FLIGHTS OR FROM THE GROUND, DEC. 1985
- ⬟ MOOSE OBSERVED DURING AERIAL TRANSECT SURVEYS, FEB. 1986
- ◆ MOOSE OBSERVED DURING FERRY FLIGHTS OR FROM THE GROUND, FEB. 1986
- △ WHITE-TAILED DEER OBSERVED DURING AERIAL TRANSECT SURVEYS, DEC. 1985

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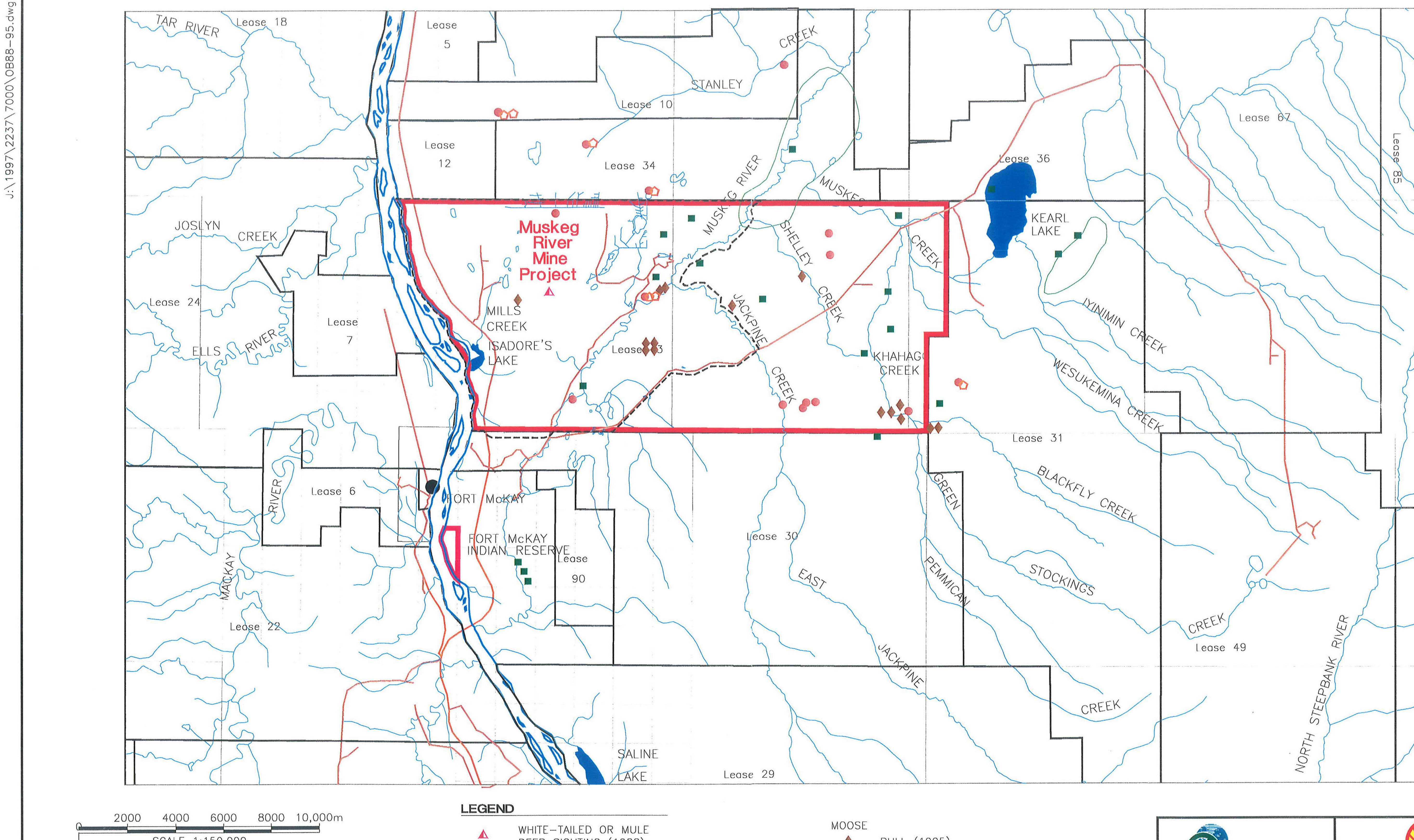
**UNGULATE OBSERVATIONS ON THE LOCAL STUDY AREA 1985-1986**

| 1 DEC 1997 | Figure 5.1 | DRAWN BY: TM |
|---|---|---|




## LEGEND

WHITE-TAILED OR MULE DEER SIGHTING (1988)

MOOSE SIGHTING (1988)

MOOSE TRACK CONCENTRATION (1988)

MOOSE

BULL (1995)

COW (1995)

CALF (1995)

## REFERENCE

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

ADAPTED FROM BOVAR ENVIRONMENTAL, 1996
SOURCE: ECCLES AND DUNCAN 1988; WESTWORTH 1995

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**UNGULATE OBSERVATIONS ON THE LOCAL STUDY AREA 1988 AND 1995**

| 1 DEC 1997 | Figure 5.2 | DRAWN BY: TM |
|---|---|---|

Availability of browse was greatest in the k2 vegetation community, followed by Alsands poplar regeneration sites, riparian, d1, and b2 vegetation communities (Table 5-1). Except for k2, these habitats contain preferred browse material such as willow, red-osier dogwood and Saskatoon berry, and also provided good cover. Such attributes provide quality habitat for ungulates. Although k2 (shrubby rich fen ) had a large amount of plant material available, most of the shrubs (cinquefoil and bog birch) were not preferred forage and likely received limited use by ungulates.

### Table 5-1 Mean Browse Available and Expected and Observed Proportion of Browse Used by Ungulates Among Vegetation Community Types

| Vegetation Community[a] | N | Percent Browse Available | Expected Proportion Used | Observed Proportion Used |
|---|---|---|---|---|
| b3 (blueberry Aw-Sw) | 3 | 8.5 | 0.031 | 0.000 |
| riparian shrub (red osier-willow) | 12 | 15.6 | 0.224 | 0.517 |
| a1 (lichen Pj) | 6 | 8.6 | 0.062 | 0.005 |
| b1 (blueberry Pj-Aw) | 9 | 8.9 | 0.096 | 0.123 |
| b2 (blueberry Aw(Bw)) | 9 | 10.5 | 0.113 | 0.103 |
| c1 (Labrador tea Pj-Sb) | 3 | 4.2 | 0.015 | 0.000 |
| d1 (low-bush cranberry Aw) | 8 | 11.2 | 0.107 | 0.222 |
| d2 (low-bush cranberry Aw-Sw) | 5 | 6.7 | 0.040 | 0.008 |
| g1 (Labrador tea Sb-Pj) | 4 | 7.2 | 0.039 | 0.000 |
| i1 (treed bog) | 8 | 8.6 | 0.082 | 0.005 |
| k2 (shrubby rich fen) | 4 | 40.0 | 0.191 | 0.017 |
| balsam poplar regeneration | 8 | 15.9 | 1.104 | 0.600 |

[a] From Beckingham and Archibald 1996.
N = Number of replicates for each vegetation community type.

Winter track count and fecal pellet surveys confirmed the presence of moose as the dominant ungulate species in the Lease 13 area. However, the frequency of moose tracks and pellet groups detected among vegetation community types was too low to warrant statistical analysis. Of the moose tracks observed, the greatest number was recorded in the closed mixedwood forest (7 tracks/km-track day), and closed mixedwood white spruce-dominated forest (6 tracks/km-track-day). Moose tracks were also observed in closed white spruce, riparian and aspen-dominated habitats.

Previous studies in the oil sands area confirmed the selection of deciduous forest, mixedwood forest and riparian areas by moose. Alsands (1978) and Westworth (1979, 1980, 1996) found moose were most often associated with aspen and mixedwood forests during the winter. During aerial surveys, Westworth (1979) found that 67% of moose observations occurred in deciduous and mixedwood habitat. A later study by Skinner and Westworth (1981), using both aerial and winter track count surveys, also showed that moose preferred riparian shrub areas.

## Habitat Modelling

AXYS (1996a) compiled habitat suitability ratings for moose within the Syncrude LSA and RSA. Within the LSA, aspen-dominated and edge communities were identified as prime habitat. These habitat types accounted for 8% of the LSA. A further 30% of the LSA was identified as moderate quality habitat. At the regional scale, 17% of the area was identified as high quality habitat and 40% was moderate. Similar to the analysis at the local level, prime habitat was associated with deciduous forest stands.

The model used by AXYS was used for this study. It is described in Golder (1998); background details are found in AXYS (1996a). A total of 4,679 HUs occur within the Shell LSA. Of these, 20% were classified as low quality, 32% as moderate quality and 48% as high quality habitat.

## Landform Types

To assess habitat preference at a larger spatial scale (i.e., all of Lease 13), vegetation community types were clustered into escarpment, upland or riparian landform types. Results indicated that the availability of browse material was highest in riparian and upland habitats and lowest in habitats associated with escarpments (Table 5-2), but analysis indicated that the difference was not statistically significant ($F_{2,83}$ = 1.80, $P$ = 0.17). Small sample sizes for escarpment and riparian landform types likely contributed to the lack of significance.

### Table 5-2 Mean Browse Available and Expected and Observed Proportion of Browse Used by Ungulates Among Landform Types

| Landform | N | Percent Browse Available | Expected Proportion Used | Observed Proportion Used[(a)] | Selection[(b)] |
|---|---|---|---|---|---|
| Escarpment | 4 | 7.3 | 0.029 | 0.000 (0.000 - 0.000) | avoided[(a)] |
| Riparian | 12 | 15.6 | 0.187 | 0.511 (0.058 - 0.964) | neutral |
| Upland | 70 | 13.0 | 0.784 | 0.489 (0.036 - 0.942) | neutral |

(a) = Numbers in brackets indicate 95% confidence intervals
(b) = significant at $\alpha$=0.05
N = Number of replicates for each landform

Based on availability of browse material, analysis indicated that there was an overall tendency for ungulates to limit browsing activity in escarpment and upland habitat, and to prefer riparian habitat ($\chi^2$ = 7.29, $df$ = 2, $P$ < 0.05). Thus, ungulates selected riparian habitat over escarpment and upland habitats for browsing activity. However, the generated 95% confidence intervals suggested that only escarpments were avoided, and vegetation in riparian and upland habitats was browsed in proportion to the availability (Table 5-2).

Similar to the browse study, results of the pellet group surveys indicated that the relative use of riparian habitat by moose was greater than upland and escarpment habitats (Table 5-3). The density of moose pellet groups was significantly higher in riparian habitat than upland habitat ($\chi^2$= 6.26, *df* = 2, *P* = 0.04). Although the mean density of moose pellet groups in riparian habitat was greater than in escarpments, the combination of low number of replicates and high variation resulted in no detectable difference between these two habitats (Table 5-3).

**Table 5-3 Mean (± 1 SE) Density of Moose and Deer Pellet Groups Among Landform Types**

| Landform | N | Moose | Deer |
|---|---|---|---|
| | | (Number of Pellet Groups/400 m²) | |
| Escarpment | 4 | 0.25 ± 0.25 | 0.00 |
| Riparian | 12 | 0.50 ± 0.29 | 0.25 ± 0.18 |
| Upland | 62 | 0.10 ± 0.06 | 0.03 ± 0.03 |

N = Number of replicates for each landform

Riparian areas typically exhibit a high diversity of shrub species, some or all of which may be favoured as browse by ungulates. At the habitat level, upland vegetation community types, such as aspen and mixedwood forests, may provide similar diversity and abundance of preferred browse species to riparian areas. However, the aggregation of all upland vegetation community types into one landform type resulted in overall poorer browse habitat for ungulates than the riparian landform. Browse and fecal pellet studies indicated that relative use of the riparian landform was greater than for the upland landform. Therefore, at the landscape level, riparian areas appeared to represent prime habitat for moose in the LSA.

In previous studies, moose were shown to prefer browsing in riparian areas, particularly when the surrounding upland areas consisted of peatland or conifer habitat (Westworth 1980). Riparian areas also provide moose (as well as other ungulates) with quality habitat for calving (Cederlund et al. 1987). High and variable density of vegetation cover within riparian habitats decreases the risk of predation on calves.

In addition to providing quality forage and calving habitat for moose, riparian areas also serve as travel corridors for ungulates (Brewster 1988). Travel corridors can be important for seasonal migration between habitats as well as facilitating dispersal of individuals across the landscape. Westworth (1980, 1996) showed that moose often use riparian habitats for foraging and travel routes during seasonal shifts in habitat use. AOSERP studies (Hauge and Keith 1981), using radio-telemetry, found that many moose (62%) made seasonal, short range movements in response to changing snow conditions. These moose moved an average of 6 km to winter range when snow conditions became thick and soft in December - January. Thirty-eight percent of the radio-collared moose made greater movements (i.e., more than 20 km) between summer ranges in the Birch

Mountains and/or the Muskeg Mountain area and winter ranges near the Fort Hills and the Athabasca River. Movements along or parallel to the Athabasca River valley were not evident.

### Limiting Factors

Moose populations are essentially limited by predation (human or natural) and competition for resources (Messier 1994). Habitat selection by moose is a function of food availability and quality, and cover from predators. The two major causes of moose mortality are predation by wolves and humans (Hauge and Keith 1978). Wolf presence in the LSA is thought to be low due to low prey abundance (BOVAR 1996). Human hunter access, conversely, has increased and could partially account for low moose numbers (BOVAR 1996). Increased access and cutting of the forest has also resulted in the range expansion of white-tailed deer. White-tailed deer are known carriers of brainworm, a parasitic nematode. Although the parasite is benign in deer, it is fatal in moose and caribou (Anderson and Strelive 1968). However, the presence of this mortality agent in the moose population of the Lease 13 area is currently unknown.

## 5.1.2 Deer and Other Ungulates

### Status and Distribution

Mule deer are traditional residents of the western boreal forest and are most frequently associated with cleared or disturbed habitat. Populations are generally small and localized. At one time white-tailed deer were not found in the oil sands area. Recent changes to access and creation of open habitat for this species has resulted in a northern range expansion (BOVAR 1996). Both mule deer (Alsands 1978) and white-tailed deer (Westworth 1980) have been observed during aerial surveys. Westworth (1996) was able to estimate white-tailed deer populations on the Lease 12, 13 and 34 areas at $0.08/km^2$.

Woodland caribou, and possibly elk, were residents of the oil sands area in the past. Caribou exist at low densities 60 km northwest of the Aurora Mine site, while elk are restricted to the Athabasca River south of Fort McMurray (BOVAR 1996).

### Habitat

Deer browse could not be differentiated from moose browse during the browse study. It is expected that the majority of the browse recorded was due to moose as the number of deer appeared extremely low in the area (i.e., no deer tracks were detected during the winter track count survey, and fecal pellet observations were too few to warrant analysis among vegetation community types).

The majority of deer tracks in Leases 12, 13 and 34 were found in cleared peatlands and aspen forest (Westworth 1996). Westworth (1980) also noted the presence of deer in regenerating areas. It is expected, therefore, that any deer present in the LSA should be found primarily in early regenerating or open stands with abundant deciduous browse.

### Landform Types

Deer, like moose, preferred riparian areas over upland and escarpment landforms. Analysis indicated that the average density of deer pellet groups was statistically higher in riparian habitat than escarpment and upland habitats ($\chi^2$ = 6.26, *df* =2, *P* = 0.04; Table 5.3). Like moose, deer benefit from abundant browse and cover along watercourses, and may use them as travel corridors during seasonal or dispersal movements (Brewster 1988).

### Limiting Factors

Deer are essentially limited by the availability of suitable habitat, winter conditions (snowfall and temperature) and predation (natural and human). Activities that produce early regenerative stands will likely benefit deer populations by increasing food availability. Therefore, the production of regeneration habitat in Lease 13 and surrounding areas will likely be associated with an increase in deer abundance. However, the increase in abundance may be limited by mortality from wolves and hunters.

# 5.2 TERRESTRIAL FURBEARERS

## 5.2.1 Coyotes, Wolves and Foxes

### Status and Distribution

Coyotes, wolves and foxes are all found in the boreal forest. Previous studies have found the coyote to be the most abundant large carnivore in the oil sands area. Track densities during winter track count surveys have ranged from a low of 0.09 tracks/km-track-day (Westworth 1996) in the Lease 12, 13 and 34 areas, to a high of 0.29 tracks/ km-track-day (Alsands 1978) for the general Syncrude Lease area. Winter track counts within Lease 13 in March 1997 recorded 0.10 tracks/km-track day. Coyotes appear to be common, but present in low densities.

Previously, wolves in the LSA belonged to the Muskeg River pack, estimated to contain 9-13 animals with a home range of 1289-1779 km$^2$ (Fuller and Keith 1980). Due to the low population size and large home range, low track densities were previously recorded. Track densities range from 0.01 tracks/km-track-day for the Lease 88 and 89 area (Skinner and Westworth 1981), to 0.05 tracks/km-track-day for the Lease 12, 13 and 34 area (Westworth 1996). Earlier estimates of density for the Lease 17 and 22 area were 1 wolf/100 km$^2$ (Westworth 1979). While no wolf tracks were recorded in Lease 13 during March 1997 track surveys, an incidental observation was made of the tracks of 7 wolves. Wolves may be considered present, but uncommon in the Lease 13 area. A study in northeastern Alberta estimated wolf density at 11.1 wolves/1000 $km^2$ (Fuller and Keith 1980).

Foxes, like wolves, are present in the oil sands area at low densities. Track densities range from 0.01 tracks/km-track-day in the Lease 12, 13 and 34 area (Westworth 1996), to 0.08 tracks/km-track-day in the Lease 88 and 89 area (Skinner and Westworth 1981). No fox tracks were recorded during the 1997 field work. Foxes may be considered uncommon in the oil sands area.

## Habitat

Coyotes are generalist predators that tend to prefer cleared and agricultural fringe sites, while avoiding densely forested areas (Boyd 1977). Previous studies found a preference for riparian white spruce areas and cleared peatlands (Skinner and Westworth 1981; Westworth 1996). The 1997 track count survey indicated that coyote tracks were most often detected in closed balsam poplar forest (0.83 tracks/km-track-day), riparian shrub areas (0.22 tracks/km-track-day) and closed white spruce (0.29 tracks/km-track-day). No tracks were recorded in black spruce bogs or tamarack fens.

Wolves also tend to prefer open areas, avoiding heavy conifer cover in winter (Penner 1976). No wolf tracks were encountered along the study transects during the winter track count survey. However, during the owl survey, two wolves were sighted crossing the road 50 km east of Muskeg Creek. Examination of the site showed seven sets of wolf tracks in a white spruce/trembling aspen forest type.

Red foxes, like coyotes and wolves, prefer semi-open country, and are more commonly found in grassland regions (Banfield 1987). Previous studies have discovered tracks in jack pine and riparian white spruce areas (Skinner and Westworth 1981), and near garbage dumps (Alsands 1978). No red fox tracks or observations were recorded during the Lease 13 winter track count survey.

## Landform Types

Riparian areas can provide habitat and movement corridors for all three species of canids. Generalists, like coyotes and foxes, prefer to concentrate foraging activities in habitats that provide a wide array of potential food items (e.g., insects, berries, plants, small mammals; Bekoff 1977). The high structural diversity of riparian zones is typically associated with such foraging opportunities. Although no fox tracks were recorded during this study, results suggested that coyotes tended to exploit habitats associated with riparian and escarpment landforms.

Wolf movement is often concentrated along rivers and paths and landforms such as escarpments (Penner 1976). Although wolves will use riparian habitat for hunting and travelling during winter, hunting success of wolves is likely greater in upland habitat. High snow accumulation in riparian, and other open areas, would make travel for deer and moose difficult and cause them to use closed conifer and mixedwood communities with less snow (see Section 4.2). These habitats would also have a less dense shrub layer and increase the chance of wolves sighting and capturing prey. In fragmented landscapes, streams and rivers (e.g., Muskeg and Athabasca rivers) may provide safe travel corridors for wolves searching for moose and deer in patchy habitat.

### Limiting Factors

Canids in the area are limited by the presence of open habitat, food resources, competition and human disturbance. Wolf density is tied directly to the ungulate density (Messier 1994). Moose and deer density in the oil sands area is fairly low, resulting in low wolf numbers. Although coyotes are more general in their diet, their densities have been shown to fluctuate in response to changes in snowshoe hare and microtine rodent populations (Nellis and Keith 1976; Todd 1978). Red foxes will also prey on hares and rodents, but have not shown a dependence on either species.

Although there is little niche overlap among foxes, wolves and coyotes, species interactions do occur. Wolves may kill coyotes within their territory (Fuller and Keith 1981). Of greater significance for the three species is the influence of anthropogenic disturbance on populations. Coyotes and foxes are expected to respond favourably to small-scale disturbances that create open or edge habitat. Wolves, however, tend to avoid areas disturbed by humans. Complete loss of habitat, such as that caused by oil sands development, is expected to reduce the number of canids in the immediate area.

## 5.2.2 Terrestrial Mustelids: Wolverines, Fishers, Martens and Weasels

### Status and Distribution

Wolverines, due to their solitary nature and large home range (100-900 $km^2$: Banci 1994), are considered to be the most uncommon carnivore in the oil sands area. Skinner and Westworth (1981) found a track density of 0.005 tracks/km-track-day for the Lease 88 and 89 area. No tracks were observed for the Aurora EIA (Westworth 1996). No wolverine tracks were observed in the March 1997 studies in Lease 13. Estimated population density for the Lease 17 area was calculated to be 0.08 animals/100 $km^2$ (Westworth 1979).

Fishers, although relatively more numerous, are similarly considered uncommon in the area. Track densities for the Lease 12, 13 and 34 area were 0.02 tracks/km-track-day (Westworth 1996). A density of 0.43

fishers/100 km$^2$, based on trapping data was estimated for the Fort McMurray area (Westworth 1979).

Westworth (1979) classified martens as scarce in the Lease 17 area. Recently, Westworth (1996) reported that track densities for the Lease 12, 13 and 34 areas were 0.15 tracks/km-track-day, suggesting a possible resurgence of martens in the area. After combining fisher and marten tracks, a total of 1.26 tracks/km-track-day was recorded in the Lease 13 area for this study. This high number may be indicative of the continued resurgence of marten, but caution should be used in interpreting these numbers due to small sample size (total of 78 track-days of effort).

Weasels are the most common carnivores in the oil sands area. Ermines are considered abundant and least weasels uncommon, although the inability to distinguish the species based on tracks makes this speculative. Combined track densities for the two species were 1.14 tracks/km-track-day for the Lease 88 and 89 areas, and 1.22 tracks/km-track-day for the Lease 12, 13 and 34 areas (Westworth 1996). A track density of 1.12 tracks/km-track-day in the Lease 13 area was recorded in 1997.

### Habitat

Wolverines are thought to prefer undisturbed areas of coniferous forest (Pasitschniak-Arts and Larivière 1995). No tracks were found during the 1997 winter track count survey. Due to the short duration of the survey and the large size of a wolverine's home range, occasional use of Lease 13 by wolverines cannot be discounted, although recent wildlife surveys within the oil sands area have failed to record the species.

Martens and fishers are thought to prefer middle to late stage coniferous forests (Buskirk and Ruggiero 1994; Powell and Zielinski 1994). Inventory work on Lease 12, 13 and 34 (Westworth 1996) showed that fisher tracks were found in greatest frequency in riparian balsam poplar forest Chapin et al. (1997) found no significant difference in stand site selection by marten in Maine. For this study, track count observations for martens and fishers were pooled. Chi-square analysis suggested that martens and fishers showed some degree of selection for the various community types during winter ($\chi^2$= 18.21, $df$ = 9, $P < 0.03$). Closed aspen and mixed coniferous stands were used relatively more than peatland and fen habitats.

### Habitat Modelling

Habitat suitability indices for fishers were calculated by AXYS (1996a) for the Syncrude LSAs and RSAs. Highly suitable habitat was found in 13% of the RSA, primarily in deciduous and mixedwood vegetation community types. Moderate habitat, including peatland, mixedwood, mixed conifer, white spruce, jack pine and wetland types, was found in 69% of the LSA. Marginal habitat was found in 6% of the Syncrude LSA, and consisted of wetland, peatland and disturbed/herb-grass vegetation community types.

Golder (1998) used the AXYS (1996a) model to map habitat suitability for fishers for the Local and RSAs . A total of 4,798 HUs were mapped for the LSA. Of these, 46% were high quality habitat, 49% were moderate quality habitat and 5% were low quality habitat.

The ermine and least weasel prefer riparian, deciduous and early successional habitats, due in part to the abundance of small mammal prey usually found in these areas (Banfield 1987). Contradictory results were found in previous track count surveys. Westworth (1982) found the majority of tracks in black spruce muskeg, riparian white spruce and mixedwood areas. Westworth (1996) found a preference for open tamarack/bog-birch, black spruce/tamarack and cleared peatlands in the Lease 12, 13 and 34 areas. The Lease 13 winter track count data found a preference for closed mixedwood-white spruce-dominant (7.77 tracks/km-track-day). More tracks were observed in this community than expected by chance alone ($\chi^2$= 86.14, $df$ = 7, $P$ < 0.01). Closed balsam poplar and closed aspen (pooled, 0.47 tracks/km-track-day), and mixed coniferous-balsam fir-dominant forests (0 tracks/km-track-day) were underused.

## Landform Types

Riparian areas typically provide good habitat for several species of small mammals, and subsequently are favoured by weasel species. Indeed, for this study, the relative use of riparian by weasels was significantly greater than vegetation communities associated with uplands and escarpments ($\chi^2$ = 50.96, $df$ = 2, $P$ < 0.01). The number of tracks per km-track day for riparian, upland and escarpment landforms was 3.07, 0.75 and 0.32, respectively. Wolverines, fishers and martens are expected to occasionally forage in riparian areas, although mature coniferous forest is considered prime habitat. Analysis at the landform level suggested that martens and fishers used all three landforms in proportion to availability ($\chi^2$ = 0.05, $df$ = 2, $P$ > 0.50). Riparian areas, however, must still be recognized as potential dispersal corridors, particularly in disturbed landscapes.

## Limiting Factors

The prime limiting factor for all mustelid species is the availability of suitable habitat (quality den sites and food resources). The larger mustelids (wolverines, fishers and martens) rely on middle to late stage coniferous forests (Pasitschniak-Arts and Larivière 1995). Further, wolverines are thought to be particularly sensitive to human disturbance, avoiding disturbed areas if possible (Banci 1994). However, predation on weasels can also be a significant mortality agent and subsequently, limit population size. All mustelid species in the oil sands area are trapped for their fur. Martens and fishers are relatively easy to trap and have been extirpated from other areas due to over-trapping.

### 5.2.3 Lynx

#### Status and Distribution

Lynx are not considered abundant in the oil sands area. The animals typically have large home ranges (8.3-51.0 $km^2$ (Koehler and Aubry 1994)), making detection within the boundaries of a particular study area difficult. Penner (1976) found a density of 0.002 tracks/km-track-day in Lease 17 in 1976. A higher than expected density of 0.06 tracks/km-track-day was found in Leases 88 and 89 in 1980-1981 (Skinner and Westworth 1981). No previous observations were made in Lease 13 (Shell 1975), and no lynx tracks were recorded during this study.

#### Habitat

No lynx tracks were recorded as part of the 1997 Lease 13 winter track count survey. Previous observations were made in black spruce muskeg (Skinner and Westworth 1981) and in black spruce (Penner 1976). Lynx are thought to prefer dense climax boreal forest, although their distribution is tied to that of their most common food, the snowshoe hare (Skinner and Westworth 1981).

#### Landform Types

Lynx are believed to show no preference or avoidance for upland or riparian areas, and are expected to use both as they are encountered. Riparian habitat, however, may provide suitable travel routes for dispersing individuals or animals expanding their home range.

#### Limiting Factors

Although lynx will take other food items, they are considered obligate consumers of snowshoe hares. Hares and lynx exhibit a nine-to-11 year population cycle, featuring significant peaks and troughs (Boutin et al. 1995). Large changes in population size from year to year may help explain the large differences in track count study results in the oil sands area. Beyond habitat and food availability, lynx presence is also influenced by human activity and trapping pressure. Lynx prefer large areas of remote wilderness, and tend to avoid contact with humans (Koehler and Aubry 1994).

### 5.2.4 Black Bears

#### Status and Distribution

Black bears are relatively common in the oil sands area, with populations remaining fairly stable from year to year. Fuller and Keith (1977) estimated bear density to be 25-50/100 $km^2$. Young and Ruff (1982) provided a lower estimate of bear density (18-25/100 $km^2$), based on habitat availability and densities recorded previously for the Cold Lake, Alberta area.

### Habitat

Since black bears hibernate during the winter, no tracks were expected or recorded during the Lease 13 winter track count. Bears are omnivores, and rely on a variety of foods. Food and shrub diversity is generally higher in deciduous stands or recently disturbed areas. For this reason, bears are most often found in aspen or mixedwood stands (Banfield 1987).

### Habitat Modelling

Habitat suitability indices for black bears were calculated by AXYS (1996a), for the Syncrude LSA and RSA. They found that 15% of the Syncrude LSA (mainly trembling aspen and mixedwood) provided prime habitat for black bears. A further 47% of the area (trembling aspen/white spruce, white spruce and jack pine/black spruce) provided moderate habitat, while 32% (mainly willow shrub lands and bogs and fens) provided marginal habitat.

The Shell LSA and RSA were mapped for black bear habitat suitability using the AXYS (1996a) model Golder (1998). A total of 3,809 HUs were mapped for the LSA. Of these 51% were mapped as high quality habitat, 28% was moderate quality habitat and 21% was low quality habitat.

### Landform Types

Black bears use many different areas throughout the year. Horsetails, grasses and sedges, and aspen buds are important spring foods, while berries and nuts are important before hibernation (Rogers et al. 1987). Availability of these foods is quite often highest in riparian areas so bears can be expected to use riparian zones to a high degree. Riparian habitat may also facilitate dispersal and provide cover for individuals moving among habitats in search of food, particularly in disturbed landscapes.

### Limiting Factors

Black bears are limited by the availability of den sites and food, and by intraspecific and human predation. Construction of new roads into the area could lead to an eventual increase in hunting pressure if access is not controlled. Black bears can also become habituated to garbage and handouts, which often results in the eventual destruction of such "nuisance" animals.

## 5.3 SEMI-AQUATIC FURBEARERS

### 5.3.1 Muskrats and Beavers

#### Status and Distribution

Beavers are large aquatic rodents found throughout the boreal forest and parkland region. Penner (1976) estimated beaver density in the Lease 17 region to be 1.9 animals/km$^2$. Beaver density on the east side of the Athabasca River is thought to be lower, due to less favourable habitat. Westworth (1981) recorded 0.11 colonies/km$^2$ during an aerial survey of the Lease 88 and 89 areas. Based on an estimate of 6.3 beavers/lodge (Searing 1979), this would yield an estimate of 0.69 beavers/km$^2$. Surveys within the Aurora Mine LSA determined a density of 0.09 colonies and food caches per km$^2$ (Fort McKay Environment Services 1996). Half the active beaver lodges recorded during that study were found within the Alsands reclamation site. Drainage canals were constructed during site abandonment and beavers have since occupied these canals to feed on the aspen, alder and willow shrubs that have regenerated on the site. This site, with a density of 0.57 lodges and food caches per km$^2$, represents some of the best beaver habitat in the LSA. Syncrude, however, recently (fall 1997) drained some of these canals in preparation for their Aurora North development activities.

Muskrats are smaller aquatic rodents, common in marshes and other waterbodies throughout the parkland and boreal forest region (Banfield 1987). Two separate areas in Lease 17 were found to have densities of 2.5 muskrats/ha and 0.3 muskrats/ha. Density of muskrats on the east side of the Athabasca River is thought to be lower, due to poorer quality habitat. During an aerial survey of Leases 88 and 89, Westworth (1981) recorded 0.03 muskrat houses/km$^2$. However, no muskrat houses or pushups were observed during a November 1995 study of the Aurora Mine area (Fort McKay Environment Services Ltd. 1996).

#### Habitat

Beavers prefer relatively deep waterbodies near stands of early deciduous vegetation. Preferred food includes aspen, birch and willow (Banfield 1987). The Lease 13 area is dominated by conifer bogs, and provides generally poor habitat. Beavers are expected along the margins of the Muskeg River, Jackpine Creek and in marshy areas near aspen stands.

Muskrats also prefer waterbodies with relatively deep water. Good muskrat habitat is provided by waterbodies (most often marshes) with a well-developed zone of emergent plants, which are used for food and lodge construction (Banfield 1987). Wetlands in the Lease 13 area are generally shrubby bogs rather then marshes. For this reason, Lease 13 is thought to be poor quality habitat for muskrats.

Muskrat houses and pushups recorded during past studies (Eccles and Duncan 1988) are shown in Figure 5-3. Most have been found in the Kearl Lake and Green Stocking Creek areas to the east of the LSA. No muskrat houses or pushups have been recorded west of the Muskeg River.

### Habitat Modelling

A beaver habitat model modified from Westworth (1996) was used to map habitat suitability for the Local and RSAs (Golder 1998). A total of 1,424 HUs was determined to occur within the LSA. Of these, the vast majority (91%) were high quality habitat. Eight percent was classified as moderate quality habitat and only 1% was classified as low quality habitat.

### Landform Types

Riparian areas are critical to beaver and muskrat populations. Upland areas are used occasionally for dispersal. Loss of riparian areas will effectively reduce beaver and muskrat populations.

### Limiting Factors

Beaver and muskrat populations are limited by the availability of habitat and food, and by predation. Beavers are preyed on most often by wolves, while muskrats are preyed on most often by minks. Both beavers and muskrats are trapped for their fur.

## 5.3.2 Minks and River Otters

### Status and Distribution

Minks are considered common along watercourses in the oil sands area. Pelts collected in the Fort McMurray area for the years 1970-1975 were twice the provincial average (Westworth 1979). Track count densities have ranged from 0.1 tracks/km-track-day on Leases 17, 88 and 89 (Penner 1976; Skinner and Westworth 1981) to 0.22 tracks/km-track-day for Leases 12, 13 and 34 (Westworth 1996). However, only 0.03 tracks/km-track-day were recorded for minks during the winter track count survey in this study.

Current and historic local abundance of river otters in the oil sands area is low. Westworth (1979) estimated otter density for the Lease 17 area to be 0.17/100 $km^2$. Track count densities ranged from 0.01 tracks/km-track-day (Skinner and Westworth 1981) on the Leases 88 and 89 area to 0.02 tracks/km-track-day (Westworth 1996) on the Lease 12, 13 and 34 area. For this study, the relative abundance of river otters in the Lease 13 area was estimated at 0.01 tracks/km-track day.

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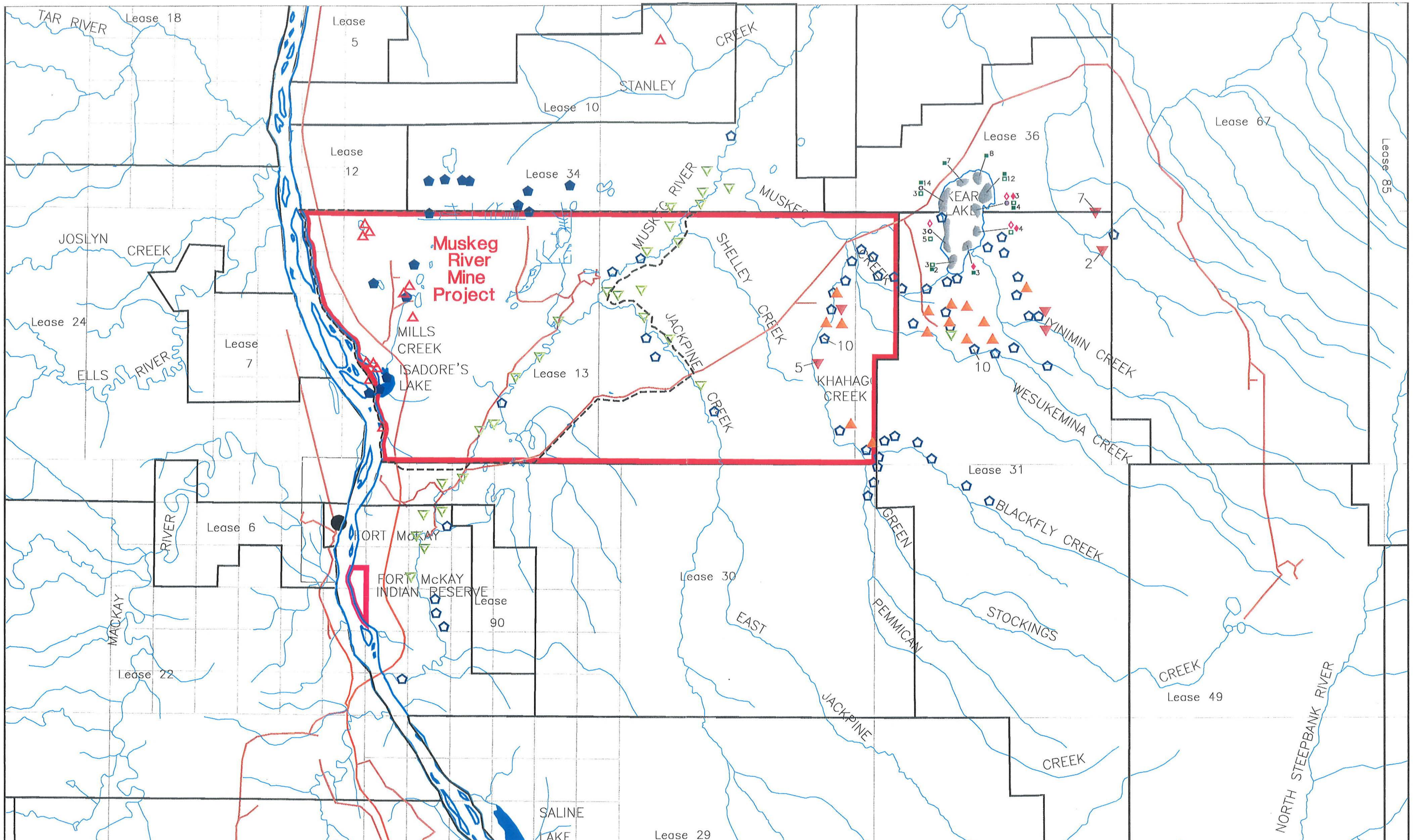


0 2000 4000 6000 8000 10,000m

SCALE 1:150,000

**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

ADAPTED FROM BOVAR ENVIRONMENTAL, 1996
SOURCE: SALTER AND DUNCAN 1986; ECCLES AND DUNCAN
1988; FORT MCKAY ENVIRONMENTAL SERVICES 1996.

**LEGEND**

- INACTIVE BEAVER LODGE AND FOOD CACHE (1986)
- ACTIVE BEAVER LODGE AND FOOD CACHE (1986)
- ACTIVE BEAVER LODGE (1986)
- BEAVER FOOD CACHE (1986)
- INACTIVE BEAVER LODGE (1986)
- MUSKRAT HOUSE (1986)
- INACTIVE MUSKRAT HOUSE (1988)
- ACTIVE MUSKRAT HOUSE (1988)
- INACTIVE MUSKRAT PUSHUP (1988)
- ACTIVE MUSKRAT PUSHUP (1988)
- INACTIVE BEAVER LODGE (1988)
- ACTIVE BEAVER LODGE (1986)

Golder Associates

SHELL CANADA LIMITED

**MUSKRAT AND BEAVER STRUCTURES ON THE LOCAL STUDY AREA IN 1986, 1988 AND 1996**

| | | |
|---|---|---|
| 1 DEC 1997 | Figure 5.3 | DRAWN BY: TM |

### Habitat

Minks are semi-aquatic carnivores that hunt in and along watercourses. They are found most commonly along stream banks, lakeshores, forest edges and large marshes (Banfield 1987). Previous studies have found that most tracks were within riparian shrub and riparian white spruce communities (Skinner and Westworth 1981; Westworth 1996). The only tracks recorded in the Lease 13 area were along the Muskeg River. The track frequency in the riparian shrub zone was 0.22 tracks/km-track-day.

River otters are aquatic carnivores that feed almost exclusively on fish in streams and lakes. Tracks are most frequently encountered along the shores of deep lakes, rivers and large marshes (Banfield 1987). Previous studies have recorded tracks along the Muskeg and Athabasca rivers (Alsands 1978; Skinner and Westworth 1981; Westworth 1996). Tracks in the Lease 13 area were limited to the bank of the Muskeg River. The track frequency within the riparian shrub zone was 0.11 tracks/km-track-day.

### Landform Types

Minks and river otters rely on riparian zones almost exclusively. Riparian zones represent prime habitat for foraging for minks and otters. In addition, riparian habitats provide optimum (i.e., good cover and available food) travel routes for dispersal and movement of individuals between populations. As previously mentioned, no mink or river otter tracks were observed in habitats associated with upland or escarpment vegetation communities. However, upland areas may be used during dispersal or for travelling between streams and rivers.

### Limiting Factors

Minks and river otters are limited by the presence of suitable habitat, predation, food resources and trapping. Preservation of riparian areas and maintenance of water quality should ensure persistent populations of mink and river otter.

## 5.4 SMALL MAMMALS

Several species of small mammals are found in the Lease 13 area (Table 5-4). Food items for these different species include insects, plant shoots and roots, seeds, nuts and fruits. Most species, except the porcupine and woodchuck, have home ranges of less than 1 ha. They occupy a wide array of habitat types, and while some can persist in many habitats, others have more specific habitat requirements (Table 5-4). The following results present general information on trap success, species captured in the Lease 13 area, and estimates of relative abundance, species richness and diversity among the different vegetation communities sampled. The discussion is then focused on a few key species.

A total of 106 individuals were captured during 1347 trap nights (corrected for sprung traps). This resulted in a trap success of approximately 8%, which is similar to the trap success (10%) obtained by Golder Associates during a recent small mammal survey in north-central Saskatchewan for Weyerhaeuser Canada (Golder 1997b). Eight species of small mammals were captured in the Lease 13 area. One individual red-backed vole representing the dark phase morph was also captured (Table 5-5). Masked shrews constituted 44% of the total, while red-backed voles and meadow voles represented 34% and 10% of the total sample, respectively. The remaining species (arctic shrew, pygmy shrew, bog lemming, jumping mouse and least chipmunk) each constituted less than 4% of the total number of individuals caught. Other species, such as the northern flying squirrel, woodchuck and porcupine, were precluded from capture due to their large body size relative to the size of the traps.

Analysis indicated no significant difference in relative abundance, species richness, or species diversity among the habitat types sampled (largest $\chi^2$ of the three tests $< 5.98$, $df = 4$, $P > 0.19$). However, given the low number of sites sampled for each vegetation community (N = 3), the statistical power for detecting a significant difference was also low. The general trend suggests that Alsands reclamation community had the lowest abundance, richness and diversity of small mammal species (Table 5-5). In contrast, the mixedwood habitat contained the greatest relative abundance of individuals, which was largely associated with the high number of masked shrews captured. As expected, the riparian habitat had the greatest richness and diversity of small mammals in the LSA (Table 5-5). Doyle (1990) also found greater species richness in riparian areas than in adjacent upland habitats. Conifer and wetlands vegetation types were similar with respect to small mammal community structure and composition.

## Table 5-4 Small Mammal Food and Habitat Preference, and Home Range Size

| Species | Food | Habitat | Home Range |
|---|---|---|---|
| Arctic shrew | Insectivore | Forested and non-forested areas; bogs, marshes and grassy clearings. Tree climbers, can tolerate drier conditions than most other shrews. | 0.04 ha |
| Masked shrew | Insectivore; also eats small mammals | Margins of moist fields, bogs and marshes. Moist or dry woods, requires litter and high humidity. | 0.04-0.1 ha |
| Pygmy shrew | Insectivore | Wooded areas, bogs and wet meadows. Prefers clearings within forests. Uncommon. | -- |
| Short-tailed shrew | Insectivore; also eats worms and small vertebrates | Hardwood forests and areas of high humidity. Requires loose humus. | 0.5 ha |
| Water shrew | Insectivore; also fish and larval amphibians | Streams, lakes and ponds with adequate bank cover. Favours fast-flowing streams in dense climax conifer forests. | Within 20-60 m of shoreline |
| Red-backed vole | Herbivore; mycorrhizal fungi important in diet | Coniferous and mixed hardwoods. Moist areas. Low tolerance for dry conditions. | 0.01-0.5 ha |
| Bog lemming | Herbivore, mainly grass and sedges; mycorrhizal fungi | Wet forested areas, bogs and wetlands. Uncommon. | 0.08-0.2 ha |
| Heather vole | Herbivore | Dry, open pine/spruce stands. Shrubs near forest edge, open grassy areas. | 0.08 ha |
| Meadow vole | Herbivore; grasses and sedges | Clearings, wet meadows. Grass cover essential. Avoids deep forests and dry grasslands. | 0.1-0.3 ha |
| Deer mouse | Granivore; also herbs and insects | Broad habitat tolerance; disturbed areas, dry land habitat. Not usually found in wet areas. | 0.5-2.0 ha |
| Meadow jumping mouse | Granivore; also herbs and insects | Grasslands, meadows, clearings and forest edges. Damp meadows favoured. Uncommon. | 0.2-1.1 ha |
| Least chipmunk | Granivore; also herbs and invertebrates | Prefers clearings, forest edges, disturbed areas. | 0.1 ha |
| Woodchuck | Herbivore | Mixedwood, pastures. Rare in climax forests and glades. | 2.4 ha |
| Northern flying squirrel | Omnivore; lichens, seeds, fruits, nuts, insects and eggs | Coniferous forests, not found in disturbed areas. | 0.8-1.2 ha |
| Porcupine | Herbivore; winter diet of bark and tree buds | Deciduous and mixedwood forests. Uncommon in conifer stands. | 13.0-14.5 ha |

Source: Adler 1988; Banfield 1987; Forsyth 1985; Peles and Barrett 1996; Wrigley 1986

**Table 5-5 Number of Individuals Captured, Mean Relative Abundance, Species Richness and Diversity Among Vegetation Community Types**

| | Vegetation Community Type[(a)] | | | | |
|---|---|---|---|---|---|
| **Species** | **AL** | **M** | **R** | **UC** | **W** |
| arctic shrew | -- | -- | -- | -- | 3 |
| red back vole, black phase | -- | -- | -- | 1 | -- |
| bog lemming | -- | -- | 1 | -- | -- |
| jumping mouse | -- | -- | 4 | -- | -- |
| least chipmunk | -- | -- | 1 | -- | -- |
| masked shrew | 4 | 21 | 11 | 66 | 5 |
| meadow vole | 1 | 1 | 2 | 1 | 6 |
| pygmy shrew | -- | 2 | -- | -- | -- |
| red-backed vole | 2 | 5 | 10 | 8 | 11 |
| Mean relative abundance (total number captured/100 trap nights) | 2.1 | 5.9 | 3.3 | 2.8 | 2.7 |
| Mean species richness | 1.3 | 2.3 | 3.7 | 2.3 | 3.0 |
| Mean species diversity | 0.21 | 0.58 | 1.13 | 0.60 | 0.80 |

(a) AL = Alsands area, M = mixedwood, R = riparian, UC = coniferous, W = wetlands.

## 5.4.1 Red-Backed Voles

### Status and Distribution

The red-backed vole is one of the most common and abundant small rodents found throughout most of the forested areas of Alberta (Smith 1993). In northern Alberta, red-backed voles occupy a variety of boreal habitats, using both ground and shrub layers for food and cover (AXYS 1996a). The red-backed vole is a diurnal species that remains active throughout the year with regular cyclic fluctuations in population numbers occurring every 4 to 5 years (Green 1979). Summer 1977 population density estimates for the red-backed vole in mixedwood habitat ranged from 9.3 to 19.1 animals/ha (Westworth 1979). In 1980, Westworth and Skinner estimated red-backed vole populations varied between 8.6 and 19.7 animals/ha within the Syncrude Mildred Lake leases (AXYS 1996a).

### Habitat

The presence of aspen and mixed white spruce-jack pine communities in the Lease 13 area provides prime habitat for red-backed voles (AXYS 1996a). Green (1980) also described balsam poplar, aspen and jack pine communities as providing high quality habitats for the red-backed vole. In the LSA, abundance of red-backed voles was greatest in wetlands, riparian and coniferous habitats (Table 5-5). These habitats were associated with moderate to high levels of structural and compositional variation on the ground. Such habitats generally have abundant food and cover, and a relatively stable micro-climate that provides prime habitat for small mammals, including red-backed voles (Carey and Johnson 1995).

### Habitat Modelling

Habitat modelling was conducted for the Muskeg River Mine area using the model outlined in Golder (1998), adapted from AXYS (1996a). Of the 5,469 HUs mapped for the LSA, the majority (77%) was of moderate quality.

### Landform Types

As mentioned above, the abundance of red-backed voles was strongly associated with wetlands and riparian habitats, which is likely a function of available food and cover within these vegetation community types. Wetlands and riparian habitats also serve as refuges and movement corridors during dispersal (Dickson and Williamson 1988; Gibbs 1993). The elimination of these habitat types, particularly in disturbed landscapes, often increases the risk of predation for dispersing individuals and can slow down the recolonization rate of suitable habitat patches, or isolate local populations. As local populations become small and isolated, the probability of temporary local extinction events increases (Hanski 1996).

### Limiting Factors

The distribution of the red-backed vole is affected by the amount of cover provided by vegetation, debris and litter, water availability and interspecific competition (Green 1979). Red-backed voles are important prey species for several carnivores and raptors. The association with vegetation, debris and litter has been attributed to protection from these predators (Green 1979; AXYS 1996a). Water availability is important because of the vole's relatively high daily intake of water. Although the red-backed vole and meadow vole are able to persist in grassland or forested areas, red-backed voles are superior competitors in forested areas while meadow voles outcompete red-backed voles for resources in grassland habitats (Green 1979).

## 5.4.2 Meadow Voles, Deer Mice and Other Small Rodents

### Status and Distribution

Meadow voles exhibit a diurnal activity pattern and cyclical patterns in population density every 3 to 4 years (Green 1979). Up to 30 meadow voles/ha have been recorded in disturbed areas, but population estimates in undisturbed areas were not recorded for this species (Westworth 1979). Between 1979 and 1983, meadow vole numbers ranged from 16.7 to 121.1 animals/ha within cleared and revegetated areas on the Syncrude leases (AXYS 1996a).

Deer mice are nocturnal and exhibit annual changes in abundance, but no cyclic fluctuations in density (Gliwicz 1992). In 1977, estimates of deer mouse density varied from 2.5 to 6.5 animals/ha in the Lease 17 area (Westworth 1979). No deer mice were collected from the Lease 13 area in the present study. As well, no estimates of population density for the heather vole, bog lemming and jumping mouse were obtained in 1977 (Westworth 1979).

### Habitat

The meadow vole is most commonly found in moist habitats with dense grass or sedge ground cover and in sites dominated by willow scrub or tamarack forest (Green 1979, 1980). Wetlands habitat had the highest abundance of meadow voles in the LSA, but the relative abundance of this small mammal was generally low throughout the area (Table 5-5).

The deer mouse is frequently found in dense shrub communities and open aspen-dominated forests with dense shrub understories (Green 1979). Balsam poplar forest and young successional areas are optimum habitats for deer mice, jack pine and aspen forests are moderately good habitat, and older successional, black spruce, willow shrub and tamarack communities represent marginal habitats (Green 1980). No deer mice were captured in the Shell LSA in 1997.

### Landform Types

The 1997 trapping program was not designed to investigate the use of landforms by small mammals. However, three species were found to be unique to riparian areas: the bog lemming, jumping mouse and least chipmunk. However, few individuals of these species were captured during this study (Table 5-5).

### Limiting Factors

Meadow vole populations are influenced by the density of ground cover and structure of the canopy, soil moisture and composition, and interspecific competition (Green 1979). Densities of meadow vole populations are directly related to the amounts of vegetation cover. Abrupt changes in the amount of cover, which influences predation risk, often lead to rapid changes in local abundance of meadow voles (Green 1979, 1980). Soil moisture and composition indirectly influence meadow vole abundance by influencing vegetation. Interspecific competition for resources occurs primarily with red-backed voles and likely restricts meadow voles to grassland habitats (Green 1979). Meadow voles are a major prey species of furbearers and raptors, which also limits population size. In addition, because meadow voles are considered a pest in agricultural and forest areas, due to herbivory and tree girdling, numbers are sometimes limited by human control activities (Green 1978, 1979, 1980).

### 5.4.3 Shrews

#### Status and Distribution

Shrews are active year-round and throughout the day and night, with peaks of activity at dusk and dawn (Ealey et al. 1979). In 1977, the masked shrew density was 4 to 17 animals/ha in the Syncrude Mildred Lake area (Westworth 1979). Several arctic shrews were also trapped but no population estimate was calculated. The abundance of the water shrew was not determined, but was thought to be common in suitable habitat (Westworth 1979). Alternatively, based on the limited supply of suitable habitat, the dusky shrew was presumed to be scarce (Westworth 1979).

#### Habitat

Moist, cool areas associated with dense ground cover represent prime habitat for shrews. Examples of such habitat are bushy grasslands, semi-dry marshes, deciduous and coniferous forests, alder-willow thickets and margins of lakes, bogs and streams (Banfield 1987; Ealey et al. 1979; Smith 1993). The majority of small mammals captured in the Shell LSA were masked shrews (Table 5-5). The relative abundance of masked shrews was highest in mixedwood and riparian habitats. Similar numbers of masked shrews were captured in the Alsands, conifer and wetlands community types. Three arctic shrews were captured in wetlands and two pygmy shrews were captured in mixedwood habitat.

#### Landform Types

The 1997 trapping program was not designed to investigate the use of landforms by small mammals. Masked shrews, however, were abundant in riparian habitats which may be linked to greater food and cover, and higher relative humidity associated with these vegetation communities. Although wetlands may also provide good ground-level structural diversity (food and cover), the relative humidity may be lower, due to less overstory cover, than in riparian habitats. Water shrews, although not captured during 1997 field work, can be expected to occur in riparian areas.

#### Limiting Factors

Humidity may be an important factor limiting the abundance and distribution of shrews. Shrews typically occupy habitats where the air is saturated with water vapour and tend to avoid dry sites (Ealey et al. 1979). Local food abundance and predation risk are also factors that affect shrew population size.

### 5.4.4 Snowshoe Hares and Red Squirrels

#### Status and Distribution

Snowshoe hares are common throughout the oil sands area, and usually provide the majority of observations during track count surveys. Populations of snowshoe hares generally fluctuate on a nine-to-11-year cycle, leading to large variations in track count data from year to year (Boutin et al. 1995). Figures from years near the trough of the population cycle display track densities of 2.94 tracks/km-track-day (Syncrude 1973) and 3.53 tracks/km-track-day (Westworth 1996). In years of peak populations, densities can be 8-10 times higher. For example, Skinner and Westworth (1981) estimated track count frequencies at 21.15 tracks/km-track-day, and this study produced estimates of 22.36 tracks/km-track-day.

Red squirrel observations from track counts in the oil sands area are usually second only to snowshoe hares. Early surveys of Lease 17 (Alsands 1978) and Leases 88 and 89 (Skinner and Westworth 1981) yielded densities of 2.33 and 2.08 tracks/km-track-day, respectively. An estimate of 1.19 squirrels/ha, based upon a midden study in Lease 17, was made by Penner (1976). A more recent track count survey yielded a density of 0.63 tracks/km-track-day (Westworth 1996), suggesting a drop in squirrel numbers. However, during this study, a density of 5.65 tracks/km-track-day was recorded in Lease 13 area.

#### Habitat

Snowshoe hares are most often found in areas with a well developed shrub layer. Observations made at the peak of the snowshoe hare cycle were most often made in riparian white spruce, mixedwood, and black spruce muskeg areas (Skinner and Westworth 1981), all areas with a prominent shrub component. For the current study, analysis indicated that habitat use by snowshoe hares was significantly different ($\chi^2$= 1454.87, df = 14, P < 0.01). Based on the expected distribution among habitats, relatively more tracks were observed in closed white spruce forest (95 tracks/km-track-day). Other habitats with a greater than expected frequency of tracks included closed mixed conifer-black spruce dominant (40 tracks/km track-day), closed black spruce bog (37 tracks/km track-day) and closed mixedwood (45 tracks/km track-day). In contrast, hares limited the use of wetland-shrub complexes (1.93 tracks/km track-day), riparian shrub zones (11.97 tracks/km track-day), open aspen forests (8.70 tracks/km track-day) and closed aspen forests (5.58 tracks/km track-day).

#### Habitat Modelling

Habitat suitability indices for snowshoe hare were calculated by AXYS (1996a) for the Syncrude LSAs and RSAs. Highly suitable hare habitat in the RSA was divided among several vegetation community types (peatlands, deciduous, white spruce, mixedwood and wetland/shrub), and accounted for 37% of the area.. Moderate habitat was found in 18% of the RSA, and was divided amongst peatlands, mixedwood and conifer forests. Marginal habitat types, including pine, wetland, peatland and disturbed/grass-herb, accounted for 8% of the LSA.

Snowshoe hare habitat modelling was conducted for the Shell LSA and RSA using a model adapted from AXYS (1996a) (see Golder 1998). A total of 5320 HUs was mapped for the LSA. Of these, 29% represented high quality habitat, 65% moderate and 6% low.

Red squirrels rely on conifer cones for the majority of their food supply, and are subsequently found in conifer-dominated forests. Earlier studies found that red squirrels were most often found in upland white spruce and riparian white spruce areas (Alsands 1978; Skinner and Westworth 1981; Westworth 1996). Red squirrels in the Lease 13 winter track count survey showed a similar, significant preference for these habitat types ($\chi^2$ = 1546.74, $df = 11$, $P < 0.01$). The highest frequency of tracks was found in closed white spruce (36 tracks/km-track-day) and closed mixedwood-white spruce-dominant (55 tracks/km-track-day) habitats. Vegetation communities that were avoided included open and closed black spruce bog (pooled = 2.30 tracks/km track-day), open aspen (1.54 tracks/km track-day) and closed aspen (0.65 tracks/km track-day).

## Landform Types

Riparian shrub and riparian white spruce areas can provide important alternative habitat for snowshoe hares and red squirrels, particularly in areas where there is substantial loss of suitable upland habitat. Riparian areas may also be used as dispersal corridors, especially in highly fragmented landscapes. Animals with low vagility (ability to disperse long distances in open habitat), such as snowshoe hares and red squirrels, may depend on riparian areas to maintain gene flow between local populations in fragmented landscapes. For both snowshoe hares and red squirrels, analysis indicated a significant difference in the relative use of riparian, escarpment and upland vegetation communities ($\chi^2 > 439.00$, $df = 2$, $P < 0.01$). Based on the availability of these three landform types, track count data indicated snowshoe hares and red squirrels preferentially used riparian and escarpment communities, while limiting the use of upland areas. Although upland communities represent quality habitats for survival and reproduction at the habitat level for both species, riparian areas and escarpments may represent movement corridors at the landform level.

## Limiting Factors

Populations of red squirrels and snowshoe hares are limited by the availability of habitat, food and predation. Major predators of snowshoe hares are lynxes, coyotes and fishers. Major predators of red squirrels are fishers and martens.

# 5.5 WATERFOWL

Waterfowl in the LSA can be categorized as dabblers or divers. Dabbling ducks feed on aquatic insects and plant material on the surface and within the first 20-30 cm of the water column. Diving ducks, in contrast, forage deeper in the water column, thus enabling them to exploit different food resources than dabblers.

### Status and Distribution

Seventeen species of waterbirds were observed during the aerial and ground surveys. In contrast, 81 species of waterbirds were recorded in the Aurora LSA, which included Lease 13 (BOVAR 1996). The difference was likely due to the presence of three large lakes to the east of Lease 13 and the lack of significant staging and breeding areas in Lease 13. Mallards were the most abundant waterfowl species recorded during aerial surveys in 1997. Other species observed in relatively large numbers were ring-necked ducks, blue- and green-winged teals and buffleheads (Table 5.6). Although the number of birds observed during the spring aerial survey was greater than for the ground survey (2-3 times), the difference across species was quite consistent (i.e., the most abundant species detected during the aerial survey were also most abundant during the ground survey) so the results of both surveys were combined (Table 5-6).

The 2-3 fold difference in the number of birds observed during the aerial survey and the ground survey conducted 14 days later, may be due to two reasons. The first is that the aerial survey may have been more effective at detecting birds than the ground survey used in this study. A second possibility is that many of the birds from the first survey were migrating through to other more suitable nesting locations

Results from the August aerial survey indicated that the number of broods in the Lease 13 area (both east and west) was low (Table 5-7). Broods were observed only for mallards, blue-winged teals and buffleheads. These results suggest that nesting success in the area is poor, or that many of the species observed during spring surveys do not nest in the LSA.

### Habitat

The migration of these birds through the LSA may be an indication that the nesting habitat is limited or insufficient to meet the requirements of many species. The lack of suitable nesting habitat for both ground nesting and over-water nesting species may be the main reason for the low density of waterfowl in the LSA. Most of the wetlands did not have much emergent vegetation, which is required for over-water nesting species for nest construction as well as shelter. Although the density of waterfowl on the LSA was relatively low, observations indicated that the wetlands do support breeding populations, and provide a staging area for migrating waterfowl.

### Table 5-6 Estimated Number of Individuals From Spring Aerial and Ground Surveys

| | Breeding Status | | | | | |
|---|---|---|---|---|---|---|
| **Waterbird** | **LD** | **LH** | **FD** | **P** | **GB** | **Estimated Number** |
| Mallard | 14 | 0 | 13 | 2 | 0 | 58 |
| Gadwall | 0 | 0 | 0 | 0 | 6 | 6 |
| American Wigeon | 3 | 0 | 0 | 1 | 0 | 8 |
| Green-winged Teal | 2 | 0 | 7 | 0 | 9 | 27 |
| Blue-winged Teal | 1 | 0 | 0 | 1 | 0 | 4 |
| Northern Shoveler | 1 | 0 | 0 | 1 | 0 | 4 |
| Lesser Scaup | 2 | 0 | 0 | 1 | 0 | 4 |
| Ring-necked Duck | 6 | 1 | 2 | 12 | 0 | 45 |
| Common Goldeneye | 1 | 0 | 0 | 1 | 12 | 4 |
| Bufflehead | 6 | 0 | 0 | 5 | 0 | 22 |
| Redhead | | | | | | NR |
| Canada Goose | | | | | | NR |
| American Coot | | | | | | NR |
| Common Loon | | | | | | 2 |
| Western Grebe | | | | | | NR |
| Common Snipe | | | | | | NR |
| Yellowlegs species | | | | | | NR |
| | | | | | | |
| Total | 36 | 1 | 22 | 24 | 27 | 184 |

LD=Lone drake, LH=Lone hen, FD=Flocked drake, P=Pair, GB=Grouped bird, NR=not recorded

### Table 5-7 Estimated Number of Individuals from Autumn Aerial Survey

| Species | Individuals | Brood | Estimated Number |
|---|---|---|---|
| Mallard | 54 | 32 | 86 |
| Blue-winged Teal | 17 | 6 | 23 |
| Redhead | 2 | 0 | 2 |
| Bufflehead | 18 | 7 | 25 |
| Unknown Dabblers | 4 | 0 | 4 |
| Western Grebe | 1 | 0 | 1 |
| Sandhill Crane | 4 | 0 | 4 |
| Common Snipe | 2 | 0 | 2 |
| Yellowlegs species | 5 | 0 | 5 |
| Total | 107 | 45 | 152 |

## Habitat Modelling

A habitat model for dabbling ducks (Westworth 1996) was adapted to map habitat suitability for the LSAs and RSAs (Golder 1998).

### Landform Types

The results from the spring and late summer aerial surveys suggested that the preferred wetlands choice for most waterfowl were non-flowing waterbodies, especially permanent natural (e.g., beaver ponds and natural basins) and artificial (e.g., borrow pits) wetlands. Few observations of waterfowl were recorded for the Muskeg River and Jackpine Creek. though the Muskeg River had a higher abundance of waterfowl than Jackpine Creek. The difference may be due to the faster current of Jackpine Creek, which would be unsuitable for staging birds, or for raising young.

### Limiting Factors

Waterfowl populations are primarily limited by the availability of suitable nesting and brood-rearing habitat. Nesting success is a function of duck density, predator density and cover from exposure to predators and weather. For ducks that nest in upland habitat, suitable nesting habitat must have adequate cover (e.g., grass and shrub habitat). In addition, ponds with abundant emergent vegetation (providing cover from predators) must be adjacent to nesting habitat for successful rearing of broods. For ducks that nest over water, nesting and brood-rearing success will depend partially on cover from emergent vegetation. Cavity nesters, such as common goldeneyes and buffleheads, depend on large-diameter snags near slow-moving streams or ponds.

# 5.6 UPLAND GAME BIRDS

Three species of upland game birds potentially occur in the Lease 13 LSA; spruce, ruffed and sharp-tailed grouse. Willow ptarmigan may also be found infrequently in the area. However, due to the difficulty involved in identifying grouse tracks to species, all three species were combined for analysis, and the discussion focuses on the ruffed grouse that was chosen as a KIR.

## 5.6.1 Ruffed Grouse

### Status and Distribution

The ruffed grouse is common throughout the deciduous and mixedwood forests of North America. They are year-round residents, and are considered the second most abundant upland game bird in the Athabasca region after the spruce grouse (Francis and Lumbis 1979). Ruffed grouse density in northeastern Alberta ranges from 0.02 individuals/km$^2$ in poor quality aspen/jack pine and young black spruce habitat, to 0.32 and 0.46 grouse/km$^2$ in aspen and bottomland willow habitat (Francis and Lumbis 1979). Grouse track observations were made during the Lease 13 winter track count survey. An average of 1.71 grouse tracks per km-track-day were recorded in the Lease 13 area.

### Habitat

Ruffed grouse distribution is tied to deciduous and mixedwood forest, particularly those seral stages that possess a well-developed shrub component (Bergerud and Gratson 1988). Young grouse feed almost exclusively on insects, but forage on plant matter as they mature (Ehrlich et al. 1988). Adults feed on berries and sedges during the summer, fruiting shrubs in the fall and buds, twigs and catkins in the winter (Edminster 1954). Berry-producing shrubs and forbs are typically more abundant in deciduous and mixedwood stands. In addition to providing forage, deciduous stands are also used for cover during and after the breeding season.

During March 1997, grouse tracks were found more often than expected ($\chi^2 = 160.65$, $df = 9$, $P < 0.01$) in open (6.17 tracks/km-track day) and closed (3.77 tracks/km-track day) aspen forest. Fewer tracks than expected were found in riparian shrub-dominant (0.11 tracks/km-track day), closed mixedwood (0.38 tracks/km-track day) and closed mixed coniferous-black spruce-dominant (0.27 tracks/km-track day) ecotypes.

AXYS (1996a) developed a habitat suitability model for the ruffed grouse, based on habitat and forage preferences. Highly suitable grouse habitat was considered to occur in stands with a high percentage of deciduous trees, with diameter at breast heights (dbh's) of 15 cm or greater, and a canopy closure of between 70 and 80%. Shrub densities of 51-70%, particularly of favoured shrubs (aspen willow and berry producers) were identified as important in the understory.

### Habitat Modelling

AXYS (1996a) found that 17% of the area (consisting of mixedwood and deciduous forest vegetation community types) consisted of highly suitable habitat. A further 3% (white spruce type) contained moderate habitat and 43% (peatland, jack pine and mixed conifer forest, wetlands and disturbed/herb grass types) consisted of marginal habitat.

The AXYS (1996a) ruffed grouse model was adapted for use in this EIA (Golder 1998).

### Landform Types

At the landscape level, winter track count data indicated that upland vegetation communities were significantly preferred by grouse ($\chi^2 = 17.33$, $df = 2$, $P < 0.01$). Although grouse limited the use of escarpments and riparian habitats during the winter, riparian areas may become important secondary habitat when prime upland habitat is not available. Riparian areas may also provide travel corridors for grouse, particularly when upland habitat is lost or extremely fragmented.

### Limiting Factors

Ruffed grouse are common throughout the boreal forest and parkland of Canada, and are typically limited by habitat availability and predation. Ruffed grouse are preyed on by northern goshawks and other birds of prey, and by a variety of carnivores including wolves, coyotes, foxes, lynx, fishers and martens. Grouse populations are subject to periodic and drastic fluctuations, the cause of which is poorly understood (Godfrey 1986). Ruffed grouse are also hunted within the oil sands area.

## 5.7 BREEDING BIRDS

### Status and Distribution

The boreal forest of Canada has one of the highest diversities of breeding birds north of Mexico (Robbins et al. 1986). Approximately 72% of the total vertebrate fauna of the mixedwood boreal forest of western and northern Canada consists of avian species (Semenchuk 1992). A total of 252 avian species has been recorded in the western boreal forest (Semenchuk 1992). Thus, the boreal forest represents an important ecosystem for sustaining breeding populations of North American birds. Such diversity is a result of the wide variety of niches available to breeding birds in the boreal forest.

The majority of the birds found in the Lease 13 LSA are migrants many of which winter south of the continental United States. Over the past few decades, many migrant populations have been declining. Because the mixedwood zone in North America represents important breeding habitat for birds, it is necessary to determine habitat-species associations (Titterington et al. 1979; Robbins et al. 1989a; Semenchuk 1992). Habitat loss in the tropics has also been suggested as a contributing factor in the decline of neotropical migrant populations (Askins et al. 1990; Diamond 1991; Hagan and Johnston 1992; Askins 1993; Petit et al. 1995). In addition, several other potential mortality factors such as collisions with vehicles and windows of buildings, and increased predation from domestic cats are potentially responsible for declining populations. It has also been suggested that species with the most marked declines require large areas of mature forest cover for breeding and wintering (Robbins et al. 1989b). Because successful breeding is critical to the survival of a species, habitat loss in the breeding grounds (e.g., boreal forest) is a concern.

## Habitat

Bird species abundance, richness and diversity depends on many environmental factors and the scale at which a bird community is considered. Some species of birds have general habitat requirements that allow them to exploit many different types of habitats (e.g., yellow-rumped warbler, Tennessee warbler, gray jay). These generalist species are capable of using more marginal habitat if preferred habitat is in short supply (Askins and Philbrick 1987; Villard and Taylor 1994). For example, if human-related or natural disturbance causes a decrease in local habitat availability, generalist species are often able to emigrate into other habitats and maintain population persistence within the landscape.

In contrast, bird species with specialized habitat requirements (e.g., Cape May warbler, Connecticut warbler) are less able to use alternate habitat types (Villard and Taylor 1994). These specialized species, although under less competition for resources from other species within their preferred habitat, are less able to adapt their behaviour to a changing environment. Specialized species tend to occur only in specific habitat types, and if disturbance alters those preferred habitats, those species will be negatively affected at the stand level. If disturbance occurs over a very large spatial scale, these specialized species may become locally or regionally extirpated. The maintenance of habitat heterogeneity at the landscape level is, therefore, critical in the conservation of species richness and diversity.

In the LSA, a total of 67 species were detected in 125 point counts (Table 5-8, Figure 4-5). Over 60% of the species recorded had less than six detections, suggesting that, although diversity was high, the relative abundance of species was quite moderate. Only 50 species were assigned to a specific vegetation community and thus were used in the analysis of species diversity and richness. Of these, only 31 species were recorded in > 10% of the vegetation communities sampled. Therefore, classification of bird species and vegetation community types was based on 31 bird species and 15 vegetation community types.

## Classification of Birds and Vegetation Community Types

Bird use of vegetation communities was classified along an ecological gradient of upland black spruce, closed and open black spruce/tamarack fens and bogs, and upland trembling aspen, white spruce and mixedwood

## Table 5-8 Number of Detections for Bird Species Recorded in the Lease 13 Study Area That Could be Assigned to a Vegetation Community

| Species | Number of detections | Species | Number of Detections |
|---|---|---|---|
| Tennessee warbler | 54 | Black-capped chickadee | 3 |
| Gray jay | 33 | Greater yellowlegs | 3 |
| Ovenbird | 32 | Swamp sparrow | 3 |
| Chipping sparrow | 30 | Western tanager | 3 |
| Yellow-rumped warbler | 28 | Bay-breasted warbler | 2 |
| Ruby-crowned kinglet | 23 | Connecticut warbler | 2 |
| Palm warbler | 22 | Hairy woodpecker | 2 |
| Black and white warbler | 19 | Northern flicker | 2 |
| Magnolia warbler | 15 | Philadelphia vireo | 2 |
| Alder flycatcher | 13 | Rose-breasted grosbeak | 2 |
| Dark-eyed junco | 12 | Solitary vireo | 2 |
| Swainson's thrush | 11 | Black-backed woodpecker | 1 |
| Hermit thrush | 10 | Canada warbler | 1 |
| LeConte's sparrow | 9 | Common yellowthroat | 1 |
| White-throated sparrow | 8 | Evening grosbeak | 1 |
| Least flycatcher | 7 | Lincoln's sparrow | 1 |
| American redstart | 6 | Mourning warbler | 1 |
| Cedar waxwing | 6 | Olive-sided flycatcher | 1 |
| Common snipe | 6 | Pileated woodpecker | 1 |
| Boreal chickadee | 5 | Ruffed grouse | 1 |
| Cape May warbler | 5 | Spotted sandpiper | 1 |
| Northern waterthrush | 5 | Wilson's warbler | 1 |
| Orange-crowned warbler | 5 | Winter wren | 1 |
| Red-eyed vireo | 5 | White-winged crossbill | 1 |
| Yellow-bellied flycatcher | 5 | Yellow warbler | 1 |

stands using TWINSPAN (Table 5-9). Three broad bird-vegetation community groupings were derived:

- A - mixed softwood and closed black spruce bogs;
- B - late successional wetlands (fens, riparian areas); and
- C - upland hardwood, softwood and mixedwood stands.

Bird species strongly associated with Community Type A included the ruby-crowned kinglet, yellow-rumped warbler (group 1) and common snipe and yellow-bellied flycatcher (group 2; Table 5-9). The relative abundance of all four species was significantly greater in Community Type A than Types B and C (Table 5-10). Other species classified in the group 2 assemblage and associated with Community Type A included the magnolia warbler, chipping sparrow and palm warbler. However, these species were also strongly correlated with vegetation communities that constituted Community Type B (Table 5-10).

Community Type B was primarily composed of wetlands vegetation communities (fens and riparian areas). However, based on the bird-vegetation community associations, a mixed trembling aspen/white spruce vegetation community was also placed into this community type. The presence of the Cape May warbler in this vegetation community, riparian and the white spruce/balsam fir communities (Type C) vegetation communities suggests that these stands were likely in the later stages of succession. Community Type B was strongly associated with bird species from group 3 (e.g., black and white warbler, alder flycatcher) and several species from group 2 (e.g., Swainson's thrush, chipping sparrow, palm warbler). Based on relative abundance, the black and white warbler and Swainson's thrush showed a significant preference for this community type (Table 5-10).

The third community type (Type C) was composed entirely of upland vegetation communities. Three of the vegetation communities (WSJP, WS and WSBF) had fewer than 2 point counts recorded, and subsequently, very few birds were detected in these stands (Table 4-2). The remaining three vegetation communities (JPTA, TA and TAWS) were associated with bird species classified in group 4 (Tennessee warbler, ovenbird, Connecticut warbler and rose-breasted grosbeak). However, many of these species were similarly distributed among community Types A and B, which resulted in no significant difference in relative abundance among community types (Table 5-10).

## Table 5-9 TWINSPAN Analysis for Breeding Birds

| | A | | | | B | | | | | C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMMUNITY TYPE | BLACK SPRUCE/JACK PINE | WHITE SPRUCE/BLACK SPRUCE | CLOSED BLACK SPRUCE BOG | CLOSED BLACK SPRUCE/TAMARACK | TREMBLING ASPEN/WHITE SPRUCE | OPEN TAMARAK FEN | RIPARIAN | OPEN BLACK SPRUCE/TAMARACK FEN | SHRUBBY FEN | JACK PINE/TREMBLING ASPEN | TREMBLING ASPEN | TREMBLING ASPEN/WHITE SPRUCE | WHITE SPRUCE/JACK PINE | WHITE SPRUCE | WHITE SPRUCE/BALSAM FIR |
| *GROUP 1* | | | | | | | | | | | | | | | |
| Ruby-crowned kinglet | 5 | 4 | 6 | 4 | - | 4 | 2 | - | - | - | 2 | 2 | - | - | - |
| Yellow-rumped warbler | 5 | 6 | 5 | 5 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | - | 2 | - | - |
| *GROUP 2* | | | | | | | | | | | | | | | |
| Boreal chickadee | - | 6 | 6 | - | - | - | 5 | - | - | - | - | - | - | - | - |
| Common snipe | - | 3 | 6 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| Yellow-bellied flycatcher | 5 | 6 | 5 | 5 | - | - | - | - | - | - | - | - | - | - | - |
| Cedar waxwing | - | - | 6 | 4 | 5 | - | - | - | - | - | - | - | - | - | - |
| Dark-eyed junco | - | 3 | 6 | 4 | - | 6 | - | - | - | - | - | - | - | - | - |
| Greater yellowlegs | - | - | - | 6 | - | - | - | - | 5 | - | - | - | - | - | - |
| Magnolia warbler | 6 | 6 | - | 5 | 4 | 5 | 5 | 4 | 4 | - | - | - | - | - | - |
| American redstart | - | 5 | 5 | - | - | 6 | 6 | - | - | - | - | - | - | - | - |
| LeConte's sparrow | - | - | 5 | 3 | 3 | 6 | - | - | 3 | - | - | - | - | - | - |
| Swamp sparrow | - | - | - | 6 | - | 6 | 6 | - | - | - | - | - | - | - | - |
| Swainson's thrush | - | - | - | - | 5 | 6 | 6 | 3 | 3 | - | - | - | - | - | - |
| Chipping sparrow | - | 5 | 6 | 6 | 5 | 6 | 6 | 3 | 6 | - | 4 | - | - | - | - |
| Palm warbler | - | 3 | 6 | 4 | 2 | 6 | 2 | 2 | 2 | - | - | 2 | - | - | - |
| *GROUP 3* | | | | | | | | | | | | | | | |
| Alder flycatcher | - | - | 5 | 3 | 3 | 3 | 6 | - | - | - | 4 | - | - | - | - |
| Black and white warbler | - | - | - | - | 6 | 4 | 6 | - | 4 | - | 5 | - | - | - | - |
| Cape May warbler | - | - | - | - | 4 | - | 6 | - | - | - | - | - | - | - | 4 |
| White-throated sparrow | - | - | - | 5 | - | 5 | 6 | - | - | - | - | 4 | - | - | - |
| *GROUP 4* | | | | | | | | | | | | | | | |
| Hermit thrush | 4 | 4 | - | - | 6 | 5 | - | - | - | - | 6 | - | - | - | - |
| Tennessee warbler | - | 6 | 4 | 5 | 6 | 6 | 6 | - | - | 4 | 4 | 4 | - | 2 | 2 |
| Blackburnian warbler | - | - | - | - | - | - | 6 | - | - | - | 6 | - | - | - | - |
| Northern flicker | - | - | - | - | 6 | - | - | - | - | - | 6 | - | - | - | - |
| Ovenbird | - | 1 | 1 | - | 4 | - | 2 | - | 1 | 1 | 6 | 1 | - | - | - |
| Solitary vireo | - | - | - | - | - | 6 | - | - | - | 6 | - | - | - | - | - |
| Connecticut warbler | - | - | - | - | - | - | - | - | - | - | 6 | 6 | - | - | - |
| Orange-crowned warbler | - | - | 6 | - | - | - | - | - | 5 | - | - | 5 | - | - | 5 |
| Rose-breasted grosbeak | - | - | - | - | - | - | - | - | - | 6 | 6 | - | - | - | - |
| Red-eyed vireo | - | 3 | - | - | - | - | - | - | - | - | 6 | - | - | - | - |
| *GROUP 5* | | | | | | | | | | | | | | | |
| Gray jay | 6 | 5 | 6 | 5 | 4 | 6 | 5 | 3 | - | 4 | - | 3 | 3 | 3 | 4 |
| Least flycatcher | - | - | 6 | 4 | - | - | 4 | - | - | - | 5 | - | - | - | - |

**Table 5-10 Comparison of Species Relative Abundance, Richness and Diversity (mean ± 1 SE) Among Vegetation Community Types**

| Species | Type A | Type B | Type C |
|---|---|---|---|
| Ruby-crowned kinglet | **4.8 ± 0.5** | 1.2 ± 0.8 | 0.7 ± 0.4 |
| Yellow-rumped warbler | **5.3 ± 0.3** | 2.2 ± 0.2 | 1.0 ± 0.5 |
| Boreal chickadee | 3.0 ± 1.7 | 1.0 ± 1.0 | 0.0 ± 0.0 |
| Common snipe | **3.0 ± 1.3** | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Yellow-bellied flycatcher | **5.3 ± 0.3** | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Cedar waxwing | 2.5 ± 1.5 | 1.0 ± 1.0 | 0.0 ± 0.0 |
| Dark-eyed junco | 3.3 ± 1.3 | 1.2 ± 1.2 | 0.0 ± 0.0 |
| Greater yellowlegs | 1.5 ± 1.5 | 1.0 ± 1.0 | 0.0 ± 0.0 |
| Magnolia warbler | **4.3 ± 1.4** | **4.4 ± 0.2** | 0.0 ± 0.0 |
| American redstart | 2.5 ± 1.4 | 2.4 ± 1.5 | 0.0 ± 0.0 |
| LeConte's sparrow | 2.0 ± 1.2 | 2.4 ± 1.1 | 0.0 ± 0.0 |
| Swamp sparrow | 1.5 ± 1.5 | 2.4 ± 1.5 | 0.0 ± 0.0 |
| Swainson's thrush | 0.0 ± 0.0 | 4.6 ± 0.7 | 0.0 ± 0.0 |
| Chipping sparrow | **4.3 ± 1.4** | **5.2 ± 0.6** | 0.7 ± 0.7 |
| Palm warbler | **3.3 ± 1.3** | **2.8 ± 0.8** | 0.3 ± 0.3 |
| Alder flycatcher | 2.0 ± 1.2 | 2.4 ± 1.1 | 0.7 ± 0.7 |
| Black and white warbler | 1.5 ± 1.5 | **4.0 ± 1.1** | 0.8 ± 0.8 |
| Cape May warbler | 0.0 ± 0.0 | 2.0 ± 1.3 | 0.7 ± 0.7 |
| White-throated sparrow | 1.3 ± 1.3 | 2.2 ± 1.4 | 0.7 ± 0.7 |
| Hermit thrush | 2.0 ± 1.2 | 2.2 ± 1.4 | 1.0 ± 1.0 |
| Tennessee warbler | 3.8 ± 1.3 | 3.6 ± 1.5 | 2.7 ± 0.7 |
| Bay-breasted warbler | 0.0 ± 0.0 | 1.2 ±1.2 | 1.0 ± 1.0 |
| Northern flicker | 0.0 ± 0.0 | 1.2 ± 1.2 | 1.0 ± 1.0 |
| Ovenbird | 0.5 ± 0.3 | 1.4 ± 0.8 | 1.3 ± 1.0 |
| Solitary vireo | 0.0 ± 0.0 | 1.2 ± 1.2 | 1.0 ± 1.0 |
| Connecticut warbler | 0.0 ± 0.0 | 0.0 ± 0.0 | 2.0 ± 1.3 |
| Orange-crowned warbler | 1.5 ± 1.5 | 1.0 ± 1.0 | 1.7 ± 1.1 |
| Rose-breasted grosbeak | 0.0 ± 0.0 | 0.0 ± 0.0 | 2.0 ± 1.3 |
| Red-eyed vireo | 0.8 ± 0.8 | 0.0 ± 0.0 | 1.0 ± 1.0 |
| Gray jay | **5.5 ± 0.3** | 3.6 ± 1.0 | 2.8 ± 0.6 |
| Least flycatcher | 2.5 ± 1.5 | 0.8 ± 0.8 | 0.8 ± 0.8 |
| Species richness | **14.5 ± 3.0** | **16.0 ± 3.2** | 6.3 ± 2.0 |
| Species diversity | **2.4 ± 0.3** | **2.5 ± 0.2** | 1.5 ± 0.3 |

Numbers in Bold are Significantly different ($P < 0.05$) from Non-bold Numbers.

Overall, the majority of bird species were associated with wetlands vegetation communities in bird community Types A and B. In no case was the relative abundance of a species in community Type C greater than Type A or B. In addition, species diversity and richness were significantly greater in the wetlands-dominated community types than in the upland-dominated community type (Table 5-10). These results are contrary to other studies of species-habitat associations. Generally, studies have found that species abundance, richness and diversity was greater in upland hardwood and mixedwood habitats than softwood communities associated with bog-fen complexes (Niemi and Hanowski 1984; Morgan and Freedman 1986; Westworth and Telfer 1993; Scheick et al. 1995). One explanation for the results in this study is related to the distribution, size and number of upland habitat patches within the Lease 13 LSA. Upland habitat was represented by a small number of small-sized patches (islands) interspersed among a relatively large wetlands complex. The degree of fragmentation of upland habitat may have been too large to support the rich and diverse bird assemblages observed in similar but less fragmented habitat (Tilman et al. 1994).

## Landform Types

The breeding bird surveys were not specifically designed to investigate bird use of landforms. However, high species abundance, richness and diversity in the riparian communities of the Lease 13 LSA were consistent with other studies. Habitats supporting structurally diverse shrub communities, such as riparian forests, are typically associated with rich and diverse bird assemblages (Gates and Giffen 1991; Westworth 1996). Similar results can be expected at the landscape level. The Athabasca River, west of the LSA, is a substantial river system in northeastern Alberta, and likely serves as an important travel corridor for a large number of avian species, particularly during migration. In addition to providing breeding habitat, riparian and forest habitats adjacent to the Athabasca River may be important staging areas for species migrating to more northern latitudes.

Disturbance to adjacent upland habitat removes previously established corridors for migration and dispersal. Such disturbance makes current riparian reserves important as movement corridors for both adult and juvenile birds. Machtans et al. (1996) showed that birds will travel through riparian zones more frequently than adjacent stands that have been disturbed. In areas where there is significant disturbance, riparian corridors may be the only mechanism for the exchange of individuals between populations as well as dispersal across the landscape.

## Limiting Factors

Like most vertebrates, breeding birds are limited by factors influencing habitat availability and suitability. Loss of habitat translates to a reduction in population size, which may decrease the richness and diversity of the local bird community. Disturbance typically alters habitat suitability by changing food resources, predation risk and intra- and interspecific competition. However, as previously mentioned, responses to disturbance are species-specific and depend on the adaptability (i.e., generalist vs specialist) of species.

Isolation of particular habitats through disturbance is known as fragmentation. Typically, most disturbances, both natural and human-induced, change pre-disturbance communities to early seral stages. The result is the fragmentation of mature habitat and the creation of patches of early seral stage forest. Generally, old growth specialist species, like many of the wood warblers, incur negative effects while early seral stage specialists, such as most of the sparrows, benefit from disturbance. Thus, there is a perpetual dynamic between forest succession (which may be viewed as a source of fragmentation) and the bird species associated with changing habitats.

### 5.7.1 Cape May Warbler

#### Status and Distribution

Based on the number of detections during surveys, the number of Cape May warblers in the LSAs appears to be low (Table 5-9). Although the distribution of breeding pairs ranges from northeastern British Columbia to Newfoundland and Maine, local abundance can also vary between relatively uncommon and common (PÖYRY 1992). During winter, the species inhabits forests of southern Florida and the Caribbean islands.

#### Habitat

Prime habitat for Cape May warblers consists of late stage coniferous stands with good canopy closure. Mature white spruce is preferred for nesting sites, but these birds will also nest in balsam fir, black spruce and tamarack (PÖYRY 1992). In the Suncor lease study, Westworth (1996b) found that Cape May warblers were associated with closed mixedwood and white spruce stands. In the Lease 13 LSA, Cape May warblers were detected in wet areas associated with mature spruce and mixedwood stands. Although there is no relative shortage of bog and fen habitat in the Lease 13 area, the availability of stands with dense conifer cover is limited.

#### Habitat Modelling

Based on a habitat suitability index model used for the Syncrude lease, AXYS (1996a) found that only 1% of the LSA was prime habitat (closed white spruce), 45% was moderate (jack pine-black spruce, black spruce), and 48% was marginal (aspen, mixedwood). Similarly, at the regional scale, 3% of the area was rated prime habitat, 49% was moderate and 46% was marginal.

The AXYS (1996a) model was adapted for use in this EIA (Golder 1998).

### Limiting factors

The key factor limiting population size of Cape May warblers is likely the availability of prime habitat. Although there appears to be enough moderate habitat to support a larger population of Cape May warblers than is currently present, estimates of demographic variables, such as juvenile recruitment and adult survival, for the different vegetation community types are not known. Other factors, like food availability and predation may be influencing all habitats equally. For example, if food resources are temporarily low across the entire landscape, then suitability with respect to food abundance would be similar among all habitats. In addition, small populations are sensitive to random environmental and demographic fluctuations, particularly in environments where the availability of prime habitat is low (Hanski 1996; Pulliam 1996). In other words, the low abundance of Cape May warblers may be a result of the interaction among population size, temporal fluctuations in environmental conditions and supply of prime habitat.

## 5.7.2 Western Tanager

### Status and Distribution

The western tanager is a summer resident of the boreal, interior and coastal forests of British Columbia, Alberta and Saskatchewan. Winters are spent in Mexico and Costa Rica (Ehrlich et al. 1988). Although restricted to particular habitat types, it is common throughout most of its range. Western tanagers were recorded by Westworth (1996) as part of a breeding bird survey conducted in the Suncor LSA.

### Habitat

The diet of western tanagers consists of approximately 80% insects and 20% fruits (Bent 1958). Insects are caught on the wing or gleaned from foliage (Ehrlich et al. 1988). Cup nests are constructed in coniferous, and rarely, deciduous trees (Godfrey 1986). Suitable foraging and nesting habitat typically is found in open coniferous and mixedwood forests (Godfrey 1986).

This species is widely distributed but uncommon throughout most of northern Alberta. The western tanager prefers open mixedwood forest or pure conifer boreal forests (Peterson 1961), but is occasionally found in pure deciduous stands in Alberta (Semenchuk 1992). It consumes both insects and berries (Peterson 1961; Semenchuk 1992). In the western national parks western tanagers are generally found in montane pine or aspen forests (Holroyd and Van Tighem 1983). They nest high in the canopy of trees with near-horizontal branches, up to 15 m (Semenchuk 1992). They usually feed in the higher portions of trees or among bushes, but will also catch insects aerially.

Western tanagers were recorded in four habitat types on the Suncor LSA during 1995 (Westworth 1996). The majority of records were made in mixedwood and coniferous vegetation communities with an estimated density of 0.18 individuals/ha. Western tanagers were also recorded in habitats dominated by aspen (0.06/ha) and jack pine (densities negligible). In the Lease 13 LSA in 1997, three western tanagers were detected in vegetation communities associated with riparian habitat.

### Habitat Modelling

A habitat model for the western tanager was created for this EIA (Golder 1998). This model was created using the results of a literature review and expert judgement. The model has not been reviewed by a species expert or regulatory staff by the end of 1997.

### Landform Types

Western tanagers use white spruce stands. These are often associated with riparian areas. As stated above, the only observations made for tanagers in this study were in riparian zones.

### Limiting Factors

Western tanagers are preyed on by a variety of animals. In their northern breeding ranges, tanager nests are sometimes parasitized by brown headed cowbirds (Bent 1958; Skutch 1989). Young are preyed upon by various Corvid (crow family) species (Skutch 1989). Adult tanagers are preyed on by a variety of raptorial birds. Bent (1958) recorded an incidence of predation by a sharp-shinned hawk, while Skutch (1989) lists screech owls, long-eared owls and short-eared owls as potential predators.

While parasitism and predation certainly occur, western tanagers may also be limited by the availability of suitable habitat. An estimated 56% of the RSA is composed of peatlands, wetlands and disturbed or sparsely vegetated areas (BOVAR 1996), all habitats considered unsuitable for western tanagers. The remaining 44% is divided among coniferous, deciduous and mixedwood communities of various seral stages, some of which should provide suitable habitat for breeding western tanagers.

## 5.7.3 Pileated Woodpecker

### Status and Distribution

The pileated woodpecker is widely distributed across North America and in Alberta is found mainly in the boreal forest, Foothills and Rocky Mountain regions (Semenchuk 1992). During the winter periods, this species can be found farther south and east of these areas, but is not usually found in agricultural areas. Currently, the population in Alberta is considered stable (Semenchuk 1992). Pileated woodpeckers have been previously recorded in the oil sands region of northeastern Alberta, with observations in 14.3% of the terrestrial point counts (or 0.14 mean individuals per count) in the Suncor Lease area (Westworth 1996).

Pileated woodpeckers are year-round residents and defend their territory throughout the year (Bull and Meslow 1988). There is strong site fidelity to home range as the pair will occupy the same home range for many years, provided adequate resources are available (Bull and Jackson 1995). In areas with high densities of suitable foraging and nesting habitat, home range size will be smaller than in areas with fewer resources (Renken and Wiggers 1989).

## Habitat

Pileated woodpeckers require mature to old growth, dense-canopied forests, particularly mixed and deciduous woods, for nesting, roosting and foraging. Unlike other woodpeckers, this species rarely occurs in burns (Semenchuk 1992). Due to their large body size and since they are primary cavity nesters, pileated woodpeckers require large-diameter snags to construct nesting and roosting cavities. This species usually excavates standing snags and decayed trees of >20 cm dbh (Bull 1987; Harestad and Keisker 1989; Renken and Wiggers 1989; Bull and Jackson 1995).

Pileated woodpeckers typically excavate a new nest within the same nesting territory each year and line the nest with wood chips (Semenchuk 1992). Three to four eggs are laid and are incubated by both sexes for approximately 18 days. After hatching, the young are fed by both parents and fledge within 22-26 days (Semenchuk 1992).

This species also excavates roosting cavities, which are important for protection against thermal extremes and predators and are most often used at night and during inclement weather (Bull and Jackson 1995). Roosting cavities differ from nesting cavities in that they are most often located in rotting trees and snags that are easily excavated, whereas nesting cavities are often located in partially decayed or live trees. Roosting trees often have several entrance holes excavated that are connected by a continuous hollow chamber within the rotting tree, allowing for escape from predators.

Pileated woodpeckers forage primarily on carpenter ants and wood-boring beetle larvae, but will feed on fruits and nuts when available (Hoyt 1957; Bull and Jackson 1995). Diet is dependent on food availability rather than food preference (Bull et al. 1986). Foraging substrates consist of decaying large diameter woody debris such as downed logs and stumps, as well as standing dead snags (Mannan 1984; Millar 1992). Foraging areas are often within mature or old stands that contain a large volume of coarse woody debris and dense understory vegetation. This species has also been known to forage in younger stands if suitable nest trees are available within the home range (Bull and Meslow 1988).

Population density in an area is related to the density of large-diameter snags that provide nesting and foraging substrate (Renken and Wiggers 1989). With high volumes of stumps and logs available to house insects, more individuals per unit area will be able to obtain adequate food with little interference. A dense canopy closure with high basal area allows pileated woodpeckers to better avoid predators and also provide suitable micro-habitat for insect production.

#### Habitat Modelling

A habitat model, adapted from Golder (1997b), was used for this EIA (Golder 1998).

#### Landform Types

The breeding bird survey was not designed to look at landform use by birds. However, it is likely that pileated woodpeckers frequent riparian areas where large, mature to old growth trees (e.g., white spruce/mixedwood) are often found.

#### Limiting Factors

Due to the specialized habitat requirements of this species, their distribution is limited by the availability of large-diameter coarse woody debris found in mature forested areas. The Manitoba Forestry Wildlife Management Project (1994) considered that contiguous blocks of habitat for at least three pairs of woodpeckers should be preserved if maintenance of pileated woodpeckers is desired. This translates to minimum area of 750 ha.

## 5.8 RAPTORS

### 5.8.1 Hawks, Eagles and Falcons

One raptor nest was located during the waterfowl aerial survey (Figure 4-4) and was determined to be inactive. During the course of other field investigations, some incidental sightings of red-tailed hawks were recorded, but generally, observations of diurnal raptors were rare in the LSA. Similar results were obtained for the Aurora mine area study. In that study, seven bald eagles, five northern harriers and six red-tailed hawks were observed during a two-day survey (AXYS 1996b).

### 5.8.2 Owls

Thirty-four census stations were visited (Figure 4-6). Although the surveys were conducted within the suggested period for such work, spring weather conditions at the time of the survey were not ideal. Spring snowstorms with snow, blowing snow and high winds were common during the survey period. These conditions limit the range of the song playback tapes for calling owls and hinder the surveyor's ability to hear or see the responding owls (Smith 1987).

Over the course of the sampling period, seven boreal owls responded to the song playback tapes. Six owls were heard from stations situated in closed mixedwood stands and one from a station in a closed trembling aspen stand. However, the boreal owls that responded were approximately 200-500 m from the census stations, making the exact location difficult to determine.

One great horned owl vocalization was also recorded. The census station for this observation was a black spruce-dominant stand with jack pine and trembling aspen comprising secondary species.

## 5.8.3 Great Gray Owl

### Status and Distribution

The great gray owl is a year-round resident of the boreal forest in North America and Eurasia. Although widespread, it is considered uncommon throughout its range and was formerly listed as vulnerable by COSEWIC (1997) and by Alberta Environmental Protection, Fish and Wildlife Division (AEP 1996). Great gray owls have been documented in the oil sands area. Three owls were sighted in 1988 in the Aurora area (BOVAR 1996). Four owls were sighted on or near the Lease 13 area before the winter track count surveys (Golder 1997a). The two owls identified on the study site were located near Shelley and Jackpine creeks.

Great gray owls primarily prey on small mammals and their populations are tied to the populations of their prey (Duncan 1992).

### Habitat

Great gray owls rely on relatively open habitat. Owls breed and hunt in open coniferous, deciduous and mixedwood forests, interspersed with muskegs, marshes and wet meadows (Semenchuk 1992). The availability of nest sites and foraging habitat appears to be critical for great gray owls (Nero 1980; Mikkola 1983). They nest on old hawk and raven nests, or on the top of broken snags or stumps (Duncan 1992). The owls hunt from perches. Foraging habitats include moist forest openings and open herbaceous forests (Anderson 1987). Bogs and clear cuts are also hunted by great gray owls (Nero 1980).

### Habitat Modelling

AXYS (1996a) derived a habitat model for the great gray owl, based on breeding and foraging preferences. High quality breeding habitat was identified as mature, primarily deciduous stands of trees, with canopy closures in excess of 35%. Great gray owls do not build their own nests, but rely on old hawk and raven nests, most often found in poplar and trembling aspen stands (AXYS 1996a).

The foraging habitat index included a component for shrub density (which is thought to decrease hunting success) and two components related to favoured prey of the great gray owl. Microtine rodents (particularly *Microtus* spp.) are favoured almost to the exclusion of other prey. Prime vole habitat was identified with high graminoid ground cover and high soil moisture (AXYS 1996a).

AXYS (1996a) concluded that 24% of the Syncrude RSA comprised high quality habitat for great gray owls. The prime habitat was for the most part associated with edge habitats adjacent to fens. Moderate habitat was divided among disturbed herb/grass, peatland and wetlands vegetation community types and comprised 23% of the Syncrude RSA. Marginal habitat made up the remainder and was divided among deciduous, mixedwood, jack pine, white spruce and mixed coniferous types.

The AXYS (1996a) model was used for this study (Golder 1998).

### Landform Types

No data concerning the use of landforms by great gray owls was obtained from the literature, other than that they frequent bogs and fens (Duncan 1994). Due to the open grassy areas found along the margins of some stream types and the high rodent populations usually found in such areas, riparian zones must also be considered good habitat for great gray owls.

### Limiting Factors

Great gray owls are limited by availability and competition for suitable nesting and foraging habitat and by predation. Great gray owls rely on abandoned stick nests, usually constructed by hawks or ravens. Open, abandoned nests of this type are also favoured by great horned owls and other owls and raptors, who may compete with the great gray owls (Voous 1988). Competition with other owl species for microtine rodents also occurs, but is likely only limiting for great gray owls when the rodents are at low points in the population cycle (Mikkola 1983).

As adults, great gray owls are occasionally preyed on by great horned owls and lynx (Duncan 1987). Juveniles are preyed upon by northern goshawks, great horned owls and occasionally red-tailed hawks (Duncan 1987; Bull et al. 1988; Bull and Henjum 1990).

## 5.9 REPTILES AND AMPHIBIANS

The wood frog, Canadian toad and the striped chorus frog are likely present on the LSA (Roberts et al. 1979). The red-sided garter snake may also be present; records for this species include observations at Kearl Lake to the east and the Birch Mountains (Roberts et al. 1979). No studies of reptiles and amphibians were conducted in 1997. Amphibian species can be good biodiversity indicators (e.g., Heyer et al. 1994) and may also be sensitive receptors for wildlife health issues.

## 5.10 VULNERABLE, THREATENED AND ENDANGERED SPECIES

Species with vulnerable, threatened or endangered status according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1997) or listed on the Province's blue or red list (AEP 1996) that may occur within the LSA are provided as described in the following sections.

### 5.10.1 Birds

Red-listed bird species that may occur within the LSA are the peregrine falcon and the whooping crane. These species are also listed as endangered by COSEWIC (1997). The peregrine falcon was not observed during 1997 field surveys, but is known to nest in the Fort Chipewyan-Lake Athabasca area (Munson et al. 1980). The whooping crane only nests in Wood Buffalo National Park and was observed migrating within Lease 17 in small numbers in 1973-75.

Blue-listed bird species that potentially occur within the LSA include the bay-breasted warbler, black-throated green warbler, Cape May warbler, ferruginous hawk and the short-eared owl. COSEWIC (1997) considers the short-eared owl to be vulnerable but does not list the other blue-listed species. It should be noted that the blue list in Alberta is not a threatened species list; rather, it suggests species that may be at risk of extirpation in the province.

The bay-breasted warbler is blue-listed by AEP (1996) due to its dependency on old growth habitats and its unknown population status. The black-throated green warbler has similar old growth habitat requirements to the bay-breasted warbler. Both species were considered in this EIA to be represented by the Cape May warbler and the pileated woodpecker.

The ferruginous hawk is currently recovering in Alberta and may soon be placed on the yellow list (AEP 1996).

The status of the Cape May warbler, a KIR for this EIA, is discussed in Section 5.7. It is listed by AEP (1996) due to its dependency on old growth forests for breeding and its neotropical migratory habits. Habitat on its wintering grounds is under development pressures.

Two short eared owls were observed by AXYS (1996) within the Aurora LSA during a 1995 survey. Golder Associates (1997a) did not record any during a late winter owl survey. AEP (1996) states that the irruptive nature of the population of short-eared owls makes them a difficult species to monitor.

### 5.10.2 Mammals

The wolverine is considered at risk by the Province (blue-listed) and vulnerable by COSEWIC. AEP (1996) estimates that up to 1000 wolverines may occur within the province. No wolverine tracks were observed during 1996 (Westworth 1996) or 1997 (Golder 1997a) winter track count studies. Woodland caribou are listed as vulnerable by COSEWIC and blue-listed by the Alberta. However, no woodland caribou are known to reside within the LSA.

### 5.10.3 Amphibians

No COSEWIC-listed species of amphibians occur within the LSA. However, the Canadian toad, blue-listed by Alberta, does likely occur within the LSA.

## 5.11 INTRODUCED SPECIES

The wood bison is an introduced species that was present in the area before increased colonization of the area by man. Wood bison are currently found in the area as a part of a Syncrude Canada Ltd. research project at their Mildred Lake Site.

# 6. ALSANDS STUDY AREA

The Alsands study area deserves special mention as it represents a 13-year-old development area within Lease 13 that was left to reclaim naturally. The area has been described in previous reports (Fort McKay 1996). Studies were conducted in this area in August 1997 to determine if, as thought previously (Fort McKay 1996), the successional habitat interspersed with drainage canals represented good wildlife habitat. However, the number of sites sampled, sampling regime and sampling period was low. Therefore, the limited extent, intensity and duration of these studies must be considered when interpreting results. Results for 1997 studies are presented in this report and in a report from Fort McKay Environment Services Ltd. (1997).

Results of the browse study indicated that, although there was an abundance of available browse material in the balsam poplar regeneration sites, ungulate use of this habitat type was limited. The predominant plant species, balsam poplar and trembling aspen, are not preferred browse material for moose and deer. Preferred browse species, such as willow and red osier dogwood, were uncommon in this reclaimed habitat type. Although this habitat may provide ungulates with an alternative food source when other food items become unavailable, the low abundance of preferred browse species is the probable explanation for limited ungulate use of balsam poplar regeneration sites.

Only three species of small mammal were captured in the Alsands reclamation sites (masked shrew, meadow vole and red-backed vole). Compared with other vegetation types sampled, this habitat had the lowest estimates for relative abundance, species richness and species diversity. Although the difference in these variables among habitats was not significant, the statistical power for detecting a significant effect was also low. Only three sites from each vegetation community were sampled and consequently, the results must be considered cautiously. However, given the minimal amount of structural variation on the ground (i.e., limited food and cover) in these regeneration sites, the trend in the data is probably real. Limited ground-level structural diversity is typically associated with marginal habitat for small mammals (Green 1980).

Drainage canals constructed prior to abandonment of the Alsands project have created good beaver habitat (Fort McKay 1996). Beavers feed upon the aspen, alder and willow shrubs that have regenerated on the site. The Alsands site, with a density of 0.57 lodges and food caches per $km^2$, represents some of the best beaver habitat in the LSA.

The late summer waterfowl survey indicated that the Alsands area did not have a great number of adult ducks or broods. A total of 24 adults and seven young were observed. This represented some 22% and 16% of all adults and young, respectively, observed within Lease 13 (both east and west) during the survey. No winter track counts or breeding bird surveys were conducted within the Alsands area in 1997.

# 7. BIODIVERSITY

It has been suggested that management for biodiversity should be the fundamental goal for management of public and private lands and that a 'no net loss' of biodiversity should be an objective for resource managers (Noss and Cooperrider 1994). While the suitability of biodiversity as being a worthwhile subject for study is easy to recognize, how to study it is another matter. As Egler (1977) states:

"ecosystems are not only more complex than we think, but more complex than we can think"

As biodiversity is such an important issue it is important that it be well defined. This is particularly true for an EIA for activities on a relatively large land base where there is a large potential to impact biodiversity. Biodiversity has been defined in many ways. It should be thought of as more than just species richness in an area. It can include spatial and temporal diversity of plant and/or animal communities at the landscape level, structural diversity at the community level, species diversity, and genetic diversity. One widely used definition of biodiversity is from Noss and Cooperrider (1994):

"the variety of life and its processes; it includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting."

A description of biodiversity must include reference to the scale at which the diversity is being described (Kananaugh and Iacobelli 1993). Noss and Cooperrider (1994) state that there are 4 levels of biodiversity that must be considered:

- landscapes (regional);
- communities (e.g., ELC units);
- species; and
- genes.

In addition, each scale of biodiversity can be described in terms of its composition, structure and function (Table 7-1). Composition can refer to the number and kind of species in an area, the genetic make up of a population and the variety of habitat types within a landscape. Structure can refer to the vertical and horizontal layering of a forest, the abundance and distribution of snags and deadfall, or the distribution of forest patches across a landscape. Function refers to the climatic, geological, hydrological, ecological, and evolutionary processes that occur within each scale of biodiversity.

**Table 7-1 Potential Biodiversity Indicators for the Muskeg River Mine Project**

| | Composition | Structure | Function |
|---|---|---|---|
| Landscape | • ELC unit abundance and distribution | • patch size<br>• patch shape connectivity | • natural disturbance regimes |
| Community | • relative abundance, frequency, richness and diversity of species | • snag density<br>• canopy cover | • nutrient cycling rates<br>• predation rates |
| Species | • abundance<br>• density | • population structure<br>• range | • population dynamics<br>• life history |
| Gene | • allelic diversity<br>• presence of rare alleles | • heterozygosity<br>• polymorphism | • inbreeding depression<br>• gene flow |

As biodiversity is such a complex issue, indicators should be used to measure it. Table 7-1 presents some possible biodiversity indicators at each of the four levels and three components of biodiversity. A manager need not study all 12 cells within this matrix. Rather, if biodiversity can be assessed at the landscape and community levels, and for composition and structure, then it can be reasonably assumed that biodiversity for all 12 cells is accounted for (P. Duinker, pers. comm., Lakehead University). These four cells that should be measured are shaded in Table 7-1. Each of the four levels of biodiversity are described further below.

## 7.1 LANDSCAPE LEVEL BIODIVERSITY

Biodiversity at the landscape level refers to the pattern of vegetation and wildlife species communities distributed across the landscape (Noss and Cooperrider 1994). Rowe (1993) argues that landforms are the key to ecosystems and hence, to biodiversity; hence the need to use a geographical context when describing ecosystems. One must look at landforms, soils, air, and climate in addition to living organisms. Together, they are more important than their sums.

The use of landscape units as a framework for the setting of landscape level biodiversity objectives is considered by Kananaugh and Iacobelli (1993) to be the best ecological framework for the conservation of biodiversity. Such landscape units are enduring features of the earth's surface, versus the more ephemeral biotic features such as forest cover or vertebrate species. The ELC developed for the Project uses a combination of terrain, soils, vegetation and moisture regime features to map landscape units.

### 7.1.1 Fragmentation

One ecological principle that should be considered at the landscape level is the effect of fragmentation on ecosystems. Fragmentation refers to the process of dividing a large contiguous habitat into a number of smaller units. This has the result of increasing the amount of edge in the habitat, decreasing the amounts of habitat interior and increasing the distance between habitat patches.

### 7.1.2 Movement Corridors

The blockage of wildlife movement corridors is becoming an ever increasing concern amongst the public and conservation biologists. Soule (1991) defined a conservation (wildlife) corridor as a "linear landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat". With increasing development pressure and fragmentation of wildlife habitat, species are often confined to such patches of habitat or 'habitat islands'. The objective in planning for conservation corridors is to allow for sufficient movement between habitat islands such that a species can persist in the region.

If the project does create a barrier(s) to movement, it could result in: (1) decreased gene flow between segments of a population, (2) preclusion of movement to critical habitat such as summer range, winter range, denning areas, etc., or (3) localized extinctions due to restricted movement. Any of these conditions would result in reduced biodiversity within the region.

Good surrogates for measuring biodiversity at the landscape level include ELC unit abundance and distribution (for composition) and ELC patch size, shape and connectivity (for structure: Table 7-1).

## 7.2 COMMUNITY LEVEL BIODIVERSITY

Biodiversity must also be considered at the community level; one cannot rely on landscape level biodiversity alone. A community refers to all the organisms, including plants, wildlife, insects and microbes that live together in an area and interact together. For example, a single ecosection patch can be considered to be a community. Diversity within a patch can include structural measures, such as abundance and density of standing dead trees or woody debris, or age class diversity; compositional measures, such as species richness; and functional measures, such as the intensity of disturbance events (Noss 1995). Management at the community level means paying attention to ecological processes such as fire and hydrological and nutrient cycling (Noss and Cooperrider 1994).

Good surrogates for measuring biodiversity at the community level include the relative abundance, frequency, richness and diversity of species within ELC units (for composition) and HSI variables that are important for the KIRs for the LSA (e.g., snag density and canopy cover - for structure: Table 7-1).

## 7.3 SPECIES LEVEL BIODIVERSITY

Species diversity is what most people think of when they think of biodiversity (Noss and Cooperrider 1994). While most vertebrates on the earth have been identified, many if not most invertebrates, microbes and bacteria have yet to be discovered. Un-named organisms may outnumber named species by an order of magnitude.

Single species management has long been the goal of most wildlife agencies. In general, high profile species that are valued by society or by a specific segment of society such as hunters were managed to ensure that viable populations were maintained or enhanced. Single species have also been selected as management indicator species, whereby the health of a number of species with similar habitat requirements is thought to be represented by one species. Another concept used by managers is that of a keystone species, which is a species that plays an integral, if not controlling, role in an ecosystem (Paine 1966). Thus, by managing for or monitoring a single species, the health of an ecosystem can be maintained. At the species level of biodiversity, measures of demographic integrity, such as abundance, and sex ratio and age distribution are considered important.

# 7.4 APPROACH USED TO MEASURE WILDLIFE BIODIVERSITY

Biodiversity for wildlife was assessed using all four cells shaded in Table 7-1. A discussion of landscape level indicators and structural components at the community level is provided in the ELC report (Golder 1997d). The remainder of this section focuses on composition at the community level.

A habitat based approach was used to quantify baseline species composition at the community level. Vegetation communities were rated as to their species richness based on the number of species found within a unit relative to other units (see Appendix II). The vegetation classification used for mapping at the RSA level (Golder 1997c) was used for this evaluation. A Richness Index was developed, as follows:

$$\text{Richness Index} = \frac{\text{(number of species in community)}}{\text{(maximum number in any community)}}$$

This was done in order to allow for a comparison of the rankings with HSI scores which also range from 0 - 1.0 (Golder 1998). Final richness indices are provided in Table 7-2.

**Table 7-2 Wildlife Richness Numbers and Indices for Vegetation Communities**

| Vegetation Community | Richness | | | | | |
|---|---|---|---|---|---|---|
| | Mammal | | Bird | | Amphibian/ Reptile | |
| | N | Index | N | Index | N | Index |
| open water | 8 | 0.29 | 63 | 0.56 | 0 | 0.00 |
| jack pine forest | 21 | 0.75 | 48 | 0.43 | 2 | 0.50 |
| mixedwood forest | 27 | 0.96 | 81 | 0.72 | 2 | 0.50 |
| black and white spruce forest | 25 | 0.89 | 57 | 0.51 | 2 | 0.50 |
| aspen (poplar) forest | 20 | 0.71 | 67 | 0.60 | 2 | 0.50 |
| graminoid fen/shrubby fen | 16 | 0.57 | 70 | 0.63 | 4 | 1.00 |
| riparian | 18 | 0.64 | 97 | 0.87 | 4 | 1.00 |
| marsh | 10 | 0.36 | 78 | 0.70 | 4 | 1.00 |
| wooded fen/bog | 28 | 1.00 | 112 | 1.00 | 4 | 1.00 |
| disturbed areas | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |

These ratings were then multiplied by the number of hectares available for each vegetation community within the LSA to arrive at final Habitat Unit (HU) scores for biodiversity, (Golder 1998). A total of 7,516 mammal, 7,293 bird and 8,531 reptile and amphibian HUs were mapped for the LSA (Golder 1998) as shown in Table 7-3.

**Table 7-3 Wildlife Biodiversity Habitat Units Within the RSA**

## Table 7-3 Wildlife Biodiversity Habitat Units Within the RSA

| Vegetation Community | Mammal | Bird | Reptile/Amphibian |
|---|---|---|---|
| Open Water | 51 | 100 | 0 |
| Jack Pine Forest | 769 | 439 | 513 |
| Mixedwood Forest | 240 | 180 | 125 |
| Black and White Spruce Forest | 535 | 305 | 300 |
| Aspen (Poplar) Forest | 1,180 | 988 | 826 |
| Graminoid/Shrubby Fen | 1,925 | 2,106 | 3,369 |
| Riparian | 950 | 1,280 | 1,478 |
| Marsh | 30 | 59 | 85 |
| Wooded Fen/Bog | 1,836 | 1,836 | 1,836 |
| Disturbed Areas | 0 | 0 | 0 |
| **Total** | **7,516** | **7,293** | **8,531** |

# 8. CLOSURE

We trust this report presents the information you require. Should any portion of the report require clarification, please contact the undersigned.

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# APPENDIX I

# SPECIES LISTS

| Common Name | Scientific Name |
|---|---|
| **BIRD SPECIES** | |
| **Gaviiformes** | |
| Common loon | *Gavia immer* |
| **Podicipediformes** | |
| Pied-billed grebe | *Podilymbus podiceps* |
| Horned grebe | *Podiceps auritus* |
| Red-necked grebe | *Podiceps grisegena* |
| **Pelecaniformes** | |
| White pelican | *Pelecanus erythrorhynchos* |
| Double crested cormorant | *Phalacrocorax auritis* |
| **Ciconiformes** | |
| Ammerican bittern | *Botaurus lentiginosus* |
| Great blue heron | *Ardea herodias* |
| **Anseriformes** | |
| Tundra swan | *Cygnus columbianus* |
| Trumpeter swan | *Cygnus buccinator* |
| Greater white-fronted goose | *Anser albifrons* |
| Snow goose | *Chen caerulescens* |
| Ross's goose | *Chen rossii barnacle goose* |
| Canada goose | *Branta canadensis* |
| Green-winged teal | *Anas crecca* |
| Mallard | *Anas platyrhynchos* |
| Northern pintail | *Anas acuta* |
| Blue-winged teal | *Anas acuta* |
| Cinnamon teal | *Anas cyanoptera* |
| Northern shoveler | *Anas clypeata* |
| Gadwall | *Anas strepera* |
| American widgeon | *Anas americana* |
| Canvasback | *Aythya valisineria* |
| Redhead | *Aythya americana* |
| Ring-necked duck | *Aythya collaris* |
| Greater scaup | *Aythya marila* |
| Lesser scaup | *Aythya affinis* |
| Common goldeneye | *Bucephala clangula* |
| Bufflehead | *Bucephala albeola* |
| Hooded merganser | *Lophodytes cuculatus* |
| Common merganser | *Mergus merganser* |
| Red-breasted merganser | *Mergus serrator* |

| Common Name | Scientific Name |
|---|---|
| Rudy duck | *Oxyura jamaicensis* |
| **Falconiformes** | |
| Osprey | *Pandion haliaetus* |
| Bald eagle | *Haliaeetuus leucocephalus* |
| Northern harrier | *Circus cyaneus* |
| Sharp-shinned hawk | *Accipiter striatus* |
| Cooper's hawk | *Accipiter cooperi* |
| Golden eagle | *Aquila chrysaetos* |
| Northern goshawk | *Accipiter gentilis* |
| Broad-winged hawk | *Buteo platypterus* |
| Swainson's hawk | *Buteo swainsoni* |
| Red-tailed hawk | *Buteo jamaicensis* |
| Rough-legged hawk | *Buteo lagopus* |
| American kestrel | *Falco sparverius* |
| Pigeon hawk (merlin) | *Falco columarius* |
| Peregrine falcon | *Falco peregrinus* |
| **Galliformes** | |
| Spruce grouse | *Dendragapus canadensis* |
| Sharp-tailed grouse | *Pedioecetes phasianellus* |
| Willow ptarmigan | *Lagopus lagopus* |
| Ruffed grouse | *Bonasa umbellus* |
| **Gruiformes** | |
| Sora rail | *Porzana carolina* |
| American coot | *Fulica americana* |
| Sandhill crane | *Grus canadensis* |
| Whooping crane | *Grus americana* |
| **Charadriiformes** | |
| Black-bellied plover | *Pluvialis squatarola* |
| Lesser golden plover | *Pluvialis dominica* |
| Semipalmated plover | *Charadrius semipalmatus* |
| Killdeer | *Charadrius vociferus* |
| Greater yellowlegs | *Tringa melanoleuca* |
| Lesser yellowlegs | *Tringa flavipes* |
| Solitary sandpiper | *Tringa solitaria* |
| Spotted sandpiper | *Actitis macularia* |
| Whimbrel | *Numenius phaeopus* |
| Hudsonian godwit | *Limosa haemastica* |
| Sanderling | *Calidris alba* |
| Semipalmated sandpiper | *Calidris pusilla* |

| Common Name | Scientific Name |
|---|---|
| Western sandpiper | *Calidris mauri* |
| Least sandpiper | *Calidris minutilla* |
| White-rumped sandpiper | *Calidris fuscicollis* |
| Baird's sandpiper | *Calidris bairdii* |
| Pectoral sandpiper | *Calidris melanotos* |
| Short-billed dowitcher | *Limnodromus griseus* |
| Long-billed dowitcher | *Limnodromus scolopaceus* |
| Common snipe | *Capella gallinago* |
| Wilson's phalarope | *Phalaropus tricolor* |
| Bonaparte's gull | *Larus philadelphia* |
| Ring-billed gull | *Larus delawarensis* |
| Herring gull | *Larus argentatus* |
| California gull | *Larus californicus* |
| Franklin's gull | *Larus pipixcan* |
| Common tern | *Sterna hirundo* |
| Black tern | *Chlidonias niger* |
| **Strigiformes** | |
| Great horned owl | *Bubo virginianus* |
| Snowy owl | *Nyctea scandiaca* |
| Northern hawk-owl | *Surnia ulula* |
| Long-eared owl | *Asio flammeus* |
| Boreal owl | *Aegolius funereus* |
| Great gray owl | *Strix nebulosa* |
| Barred owl | *Strix varia* |
| **Caprimulgiformes** | |
| Common nighthawk | *Chordeiles minor* |
| **Coraciiformes** | |
| Belted kingfisher | *Ceryle alcyon* |
| **Piciformes** | |
| Yellow bellied sapsucker | *Sphyrapicus varius* |
| Downy woodpecker | *Picoides pubescens* |
| Hairy woodpecker | *Picoides villosus* |
| Northern three-toed woodpecker | *Picoides tridactylus* |
| Black-backed woodpecker | *Picoides arcticus* |
| Northern flicker | *Colaptes auratus* |
| Pileated woodpecker | *Dryocopus pileatus* |
| **Passeriformes** | |

| Common Name | Scientific Name |
|---|---|
| Olive-sided flycatcher | *Nuttalornis borealis* |
| Western wood peewee | *Contopus sordidulus* |
| Yellow-bellied flycatcher | *Empidonax flaviventris* |
| Alder flycatcher | *Empidonax alnorum* |
| Least flycatcher | *Empidonax minimus* |
| Eastern kingbird | *Tyrannus tyrannus* |
| Bank swallow | *Riparia riparia* |
| Barn swallow | *Hirundo rustica* |
| Tree swallow | *Iridoprocne bicolor* |
| | |
| Gray jay | *Perisoreus canadensis* |
| Blue jay | *Cyanocitta cristata* |
| Black-billed magpie | *Pica pica* |
| American crow | *Corvus brachyrhynchos* |
| Common raven | *Corvus corax* |
| | |
| Black-capped chickadee | *Parus atricapillus* |
| Boreal chickadee | *Parus hudsonicus* |
| Red-breasted nuthatch | *Sitta canadensis* |
| Brown creeper | *Certhia familiaris* |
| | |
| Winter wren | *Troglodytes troglodytes* |
| Marsh wren | *Cistothorus palustris* |
| | |
| Golden-crowned kinglet | *Regulus satrapa* |
| Ruby-crowned kinglet | *Regulus calendula* |
| Veery | *Catharus fuscescens* |
| Swainsons thrush | *Catharus ustulatus* |
| Hermit thrus | *Catharus guttatus* |
| American robin | *Turdus migratorius* |
| | |
| Bohemian waxwing | *Bombycilla garrulus* |
| Cedar waxwing | *Bombycilla cedorum* |
| | |
| Solitary vireo | *Vireo solitarius* |
| Warbling vireo | *Vireo gilvus* |
| Philadelphia vireo | *Vireo philadelphicus* |
| Red eyed vireo | *Vireo olivaceous* |
| Tennessee warbler | *Vermivora peregrina* |
| Orange-crowned warbler | *Vermivora celata* |
| Yellow warbler | *Dendroica petechia* |
| Magnolia warbler | *Dendroica magnolia* |
| Cape may warbler | *Dendroica tigrina* |
| Yellow-rumped warbler | *Dendroica coronata* |
| Palm warbler | *Dendroica palmarum* |
| Black-throated green warbler | *Dendroica virens* |

| Common Name | Scientific Name |
| --- | --- |
| Bay-breasted warbler | *Dendroica castanea* |
| Blackpoll warbler | *Dendroica striata* |
| American redstart | *Stenophaga ruticilla* |
| Ovenbird | *Seiurus aurocapillus* |
| Northern waterthrush | *Seiurus noveboracensis* |
| Common yellowthroat | *Dendroica coronata* |
| Canada warbler | *Wilsonia canadensis* |
| Wilson's warbler | *Wilsonia pusilla* |
| | |
| Western tanager | *Piranga ludoviciana* |
| | |
| Rose-beaked grosbeak | *Pheucticus ludovicianus* |
| | |
| American tree swallow | *Spinzella arborea* |
| Chipping swallow | *Spinzella passerina* |
| Clay-colored sparrow | *Spinzella pallida* |
| Savannah sparrow | *Passerculus sandwichensis* |
| Leconte's sparrow | *Ammospiza leconteii* |
| Fox sparrow | *Paserella iliaca* |
| Song sparrow | *Melospiza melodia* |
| Lincoln's sparrow | *Melospiza lincolnii* |
| Swamp sparrow | *Melospiza georgiana* |
| White-throated sparrow | *Zonotrichia albicollis* |
| Dark-eyed junco | *junco hyemalis* |
| Lapland longspur | *Calarius lapponicus* |
| Snow bunting | *Plectrophenax nivalis* |
| | |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Yellow-headed blackbird | *Xanthocephalus xanthocephalus* |
| Brewer's blackbird | *Euphagus cyanocephalus* |
| Common grackle | *Quiscalus quiscula* |
| | |
| Brown-headed cowbird | *Molothrus ater* |
| | |
| Northern oriole | *Icterus galbula* |
| Pine grosbeak | *Pinicola enucleator* |
| Purple finch | *Carpodacus purpureus* |
| Red crossbill | *Loxia curvirostra* |
| White-winged crossbill | *Loxia leucoptera* |
| Common redpoll | *Carduelis flammea* |
| Pine siskin | *Carduelis pinus* |
| Evening grosbeak | *Coccothraustes vespertinus* |

## MAMMALS

**Insectivora**

| | |
| --- | --- |
| Masked shrew | *Sorex cinereus* |

| Common Name | Scientific Name |
|---|---|
| Wandering shrew | *Sorex vagrans* |
| Water shrew | *Sorex palustris* |
| Arctic shrew | *Sorex arcticus* |
| Pygmy shrew | *Sorex hoyi* |
| **Chiroptera** | |
| Little brown bat | *Myotis lucifugus* |
| Silver-haired bat | *Lasionycteris noctivagans* |
| Big brown bat | *Eptesicus fuscus* |
| Hoary bat | *lasiurus cinereus* |
| Keen myotis | *Myotis keeni* |
| **Lagomorpha** | |
| Snowshoe hare | *Lepus americanus* |
| **Rodenita** | |
| Woodchuck | *Marmota monax* |
| Least chipmunk | *Tamius minimus* |
| Red squirrel | *Tamiasciurius hudsonicus* |
| Northern flying squirrel | *Glaucomys sabrinus* |
| Beaver | *Castor canadensis* |
| Deer mouse | *Peromyscus maniculatus* |
| Red-backed vole | *Clethrionomys gapperi* |
| Heather vole | *Phenacomys intermedius* |
| Meadow vole | *Microtus pennsylvanicus* |
| Muskrat | *Ondatra zibethicus* |
| Meadow jumping mouse | *Zapus hudsonicus* |
| Porcupine | *Erethizon dorsatum* |
| **Carnivora** | |
| Coyote | *Canis latrans* |
| Wolf | *Canis lupus* |
| Red fox | *Vulpes vulpes* |
| Black bear | *Ursus americanus* |
| Marten | *Martes americana* |
| Fisher | *Martes pennanti* |
| Ermine | *Mustela erminea* |
| Least weasel | *Mustela nivalis* |
| River otter | *Lutra canadensis* |
| Mink | *Mustela vison* |

| Common Name | Scientific Name |
|---|---|
| Wolverine | *Gulo gulo* |
| Lynx | *Lynx canadensis* |
| **Artiodactyla** | |
| Mule deer | *Odocoileus hemionus* |
| White-tailed deer | *Odocoileus viginianus* |
| Moose | *Alces alces* |
| Woodland caribou | *Caribou tarandus* |
| Bison | *Bison bison* |
| **Salientia** | |
| Canadian toad | *Bufo hemiophrys* |
| Western toad | *Bufo boreas* |
| Boreal chorus frog | *Pseudacris triseriata* |
| Wood frog | *Rana sylvatica* |
| **Squamata** | |
| Common garter snake | *Thamnophis sirtalis* |

Source: Bovar 1996(a)

# APPENDIX II

# SPECIES USE OF VEGETATION COMMUNITIES

**Table 1. Potential and Observed use of Vegetation Communities by Bird Species**

| Common Name | open water | jack pine forest | mixed wood forest | black and white spruce forest | aspen (poplar) forest | graminoid fen/shrubby | riparian | marsh | wooded fens or bogs | Paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| red-throated loon | x | | | | | | | | | |
| arctic loon | x | | | | | | | | | |
| common loon | x | | | | | | P | | | |
| pied-billed grebe | x | | | | | | P | x | | |
| horned grebe | x | | | | | | P | x | P | |
| red-necked grebe | x | | | | | | P | x | | |
| eared grebe | x | | | | | | | x | | |
| western grebe | x | | | | | | | | | |
| American white pelican | x | | | | | | P | | | |
| double-crested cormorant | x | | | | | | P | x | | |
| American bittern | | | | | | x | P | x | P | |
| great blue heron | x | | x | x | P | x | P | x | | P |
| great egret | x | | | | | x | | x | | |
| tundra swan | x | | | | | | | | | |
| trumpeter swan | x | | | | | | | | | |
| goose | x | | | | | | | | | |
| snow goose | x | | | | | | | | | |
| Ross' goose | x | | | | | | | | | |
| Canada goose | x | | | | | | P | | P | |
| wood duck | x | | | | | x | | x | | |
| green-winged teal | x | | | | | x | P | x | P | |
| American black duck | x | | | | | x | | x | | |
| mallard | x | | | | x | x | P | x | P | x |
| northern pintail | x | | | | | x | P | x | P | |
| blue-winged teal | x | | | | | x | P | x | P | |
| cinnamon teal | x | | | | | x | | x | | |
| northern shoveler | x | | | | | x | P | x | P | |
| gadwall | x | | | | | x | P | x | P | |
| Eurasian wigeon | x | | | | | x | | x | | |
| American wigeon | x | | | | | x | P | x | P | |
| canvasback | x | | | | | x | P | x | P | |
| redhead | x | | | | | x | P | x | P | |
| ring-necked duck | x | | | | | x | P | x | P | |
| greater scaup | x | | | | | x | | x | | |
| lesser scaup | x | | | | | x | P | x | P | |
| harlequin duck | | | | | | | | | | |
| oldsquaw | x | | | | | | | | | |
| surf scoter | x | | | | | x | | x | | |
| white-winged scoter | x | | | | | x | | x | | |
| common goldeneye | x | | | | P | x | P | x | | P |
| Barrow's goldeneye | x | | | | | x | | x | | |
| bufflehead | x | | | | x | x | P | x | | x |
| hooded merganser | x | | | | | x | P | x | P | |
| common merganser | x | | | | | x | P | x | | |
| red-breasted merganser | x | | | | | x | P | x | | |
| ruddy duck | x | | | | | | P | x | P | |
| osprey | x | | | | | | P | | P | |
| bald eagle | x | | | | x | | P | | | x |
| northern harrier | | | | | | x | P | x | P | |
| sharp-shinned hawk | | P | P | P | P | | | | x | P |
| Cooper's hawk | | | | | | | | | | |
| northern goshawk | | | P | | | | | | | |
| broad-winged hawk | | | x | | P | | | | P | P |
| Swainson's hawk | | | | | | | | | | |
| red-tailed hawk | | P | P | P | P | | | | | P |
| rough-legged hawk | | x | | | | | | | | |
| golden eagle | | | | | | | | | P | |
| American kestrel | | | x | | P | | P | | | P |
| merlin | | | | | | | P | | P | |
| peregrine falcon | x | | | | | | P | x | P | |
| gyrfalcon | | x | | | | | | | | |
| spruce grouse | | P | P | P | | | | | P | |
| willow ptarmigan | | x | | | | | | | | |
| ruffed grouse | | | P | | P | | | | | P |

X. indicates species observed on Lease 13.
P. indicates species potentially on Lease 13.

**Table 1. Potential and Observed use of Vegetation Communities by Bird Species**

| Common Name | open water | jack pine forest | mixed wood forest | black and white spruce forest | aspen (poplar) forest | graminoid fen/shrubby | riparian | marsh | wooded fens or bogs | Paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| sharp-tailed grouse | | | | | | | P | | P | |
| sora | | | | | X | x | P | x | P | X |
| American coot | x | | | | | x | P | x | P | |
| sandhill crane | | | | | | x | P | x | P | |
| whooping crane | | | | | | | | | | |
| black-bellied plover | | | | | | | | | | |
| lesser golden plover | | | | | | | | | | |
| semipalmated plover | | | | | | | P | | | |
| killdeer | | | | | | | P | | P | |
| American avocet | x | | | | | | | x | | |
| greater yellowlegs | | | | | | x | | x | y | |
| lesser yellowlegs | | | | | | x | | x | P | |
| solitary sandpiper | | | | | | x | P | x | P | |
| willet | | | | | | | | x | | |
| spotted sandpiper | | | | | | | P | x | x | |
| upland sandpiper | | | | | | | | | | |
| whimbrel | | | | | | | | | | |
| hudsonian godwit | | | | | | | | | | |
| marbled godwit | | | | | | | P | | x | |
| ruddy turnstone | | | | | | | | | | |
| sanderling | | | | | | | | | | |
| semipalmated sandpiper | | | | | | | | | | |
| western sandpiper | | | | | | | | | | |
| least sandpiper | | | | | | | P | | P | |
| white-rumped sandpiper | | | | | | | | | | |
| Baird's sandpiper | | | | | | | | | | |
| pectoral sandpiper | | | | | | | | | | |
| dunlin | | | | | | | | | | |
| stilt sandpiper | | | | | | | | | | |
| buff-breasted sandpiper | | | | | | | | | | |
| short-billed dowitcher | | | | | | | | | P | |
| long-billed dowitcher | | | | | | | | | | |
| common snipe | | | x | x | x | x | | x | y | x |
| Wilson's phalarope | x | | | | | x | P | x | P | |
| red-necked phalarope | x | | | | | x | | x | | |
| red phalarope | x | | | | | x | | x | | |
| Franklin's gull | x | | | | | x | P | x | P | |
| Bonaparte's gull | x | | | | | x | P | x | P | |
| mew gull | x | | | | | | P | x | | |
| ring-billed gull | x | | | | | | P | x | | |
| California gull | x | | | | | | P | x | | |
| herring gull | x | | | | | | P | x | | |
| Iceland gull | x | | | | | | | x | | |
| glaucous gull | x | | | | | | | x | | |
| Caspian tern | x | | | | | | | | | |
| common tern | x | | | | | x | P | x | P | |
| arctic tern | x | | | | | | | x | | |
| black tern | x | | | | | x | P | x | P | |
| rock dove | | | | | | | | | | |
| mourning dove | | x | | | | | | | | |
| great-horned owl | | P | P | P | P | | P | | P | P |
| snowy owl | | x | | | | | | | | |
| northern hawk owl | | P | P | | | x | | | P | |
| barred owl | | | | | | | | | | |
| great gray owl | | P | P | P | P | x | P | | P | P |
| long-eared owl | | | | | | | | | | |
| short-eared owl | | | | | | x | | x | | |
| boreal owl | | | x | P | | | | | P | |
| common nighthawk | | | | | | | | | | |
| belted kingfisher | | | | | | x | P | x | P | |
| yellow-bellied sapsucker | | | P | x | P | | | | | P |
| downy woodpecker | | | P | | P | | | | | P |
| hairy woodpecker | | P | P | P | P | | | | | P |
| three-toed woodpecker | | P | P | P | | | | | x | |

X. indicates species observed on Lease 13.
P. indicates species potentially on Lease 13.

**Table 1. Potential and Observed use of Vegetation Communities by Bird Species**

| Common Name | open water | jack pine forest | mixed wood forest | black and white spruce forest | aspen (poplar) forest | graminoid fen/shrubby | riparian | marsh | wooded fens or bogs | Paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| black-backed woodpecker | | P | P | P | | | | | x | |
| northern flicker | | P | x | x | P | | | | | P |
| pileated woodpecker | | | P | x | P | | | | | P |
| olive-sided flycatcher | | P | x | | | x | P | | P | |
| great-crested flycatcher | | | x | | P | | | | | P |
| western wood-pewee | | P | P | x | P | x | P | x | P | P |
| yellow-bellied flycatcher | | P | x | x | x | | | | x | x |
| alder flycatcher | | | x | x | x | | P | | x | x |
| least flycatcher | | | x | x | x | | | | x | x |
| eastern phoebe | | | P | | P | x | P | | P | P |
| Say's phoebe | | | | | | | P | | | |
| eastern kingbird | | | x | | P | x | P | | P | P |
| horned lark | | | | | P | | | | | P |
| tree swallow | | | x | | P | x | P | x | P | P |
| bank swallow | | | | | | | P | x | | |
| cliff swallow | | | | | | | P | x | | |
| barn swallow | | | | | | | P | x | | |
| gray jay | | P | x | x | x | | | | x | x |
| blue jay | | | P | | P | | | | | P |
| black-billed magpie | | P | x | | P | | P | | | P |
| American crow | | P | x | x | P | | | | P | P |
| common raven | | P | x | P | x | | P | | P | x |
| black-capped chickadee | | | P | | P | | | | | P |
| boreal chickadee | | P | P | x | | | P | | x | |
| red-breasted nuthatch | | P | P | x | | | | | x | |
| brown creeper | | P | P | P | | | | | | |
| house wren | | x | | | | | | | | |
| winter wren | | P | x | P | | | | | x | |
| marsh wren | | | | | | x | P | x | P | |
| golden-crowned kinglet | | P | x | P | | | | | | |
| ruby-crowned kinglet | | P | x | x | x | | | | x | x |
| mountain bluebird | | | x | | P | | | | P | P |
| veery | | | | | | | | | | |
| gray-cheeked thrush | | | | | | | | | | |
| Swainson's thrush | | | x | x | x | | P | | x | x |
| hermit thrush | | P | x | x | x | | | | x | x |
| American robin | | | x | P | | | P | | | |
| northern mockingbird | | x | | | | | | | | |
| brown thrasher | | x | | | | | | | | |
| American pipit | | | | | | | | | P | |
| Bohemian waxwing | | P | x | P | | | P | | | |
| cedar waxwing | | | x | x | P | | P | | x | P |
| northern shrike | | | | | | | | | | |
| European starling | | | x | | P | | | | | P |
| solitary vireo | | | x | | | | | | x | |
| warbling vireo | | | P | | P | | | | | P |
| Philadelphia vireo | | | x | | x | | | | x | x |
| red-eyed vireo | | | x | x | x | | P | | | x |
| Tennessee warbler | | | x | x | x | x | P | x | x | x |
| orange-crowned warbler | | | x | | P | | P | | x | P |
| yellow warbler | | | | | | x | P | | x | |
| magnolia warbler | | P | x | x | x | | P | | y | x |
| Cape May warbler | | | x | P | | | | | | |
| yellow-rumped warbler | | P | x | x | x | | | | y | x |
| warbler | | P | x | P | | | | | | |
| palm warbler | | | x | x | x | x | | | x | x |
| bay-breasted warbler | | | | P | x | | | | P | x |
| blackpoll warbler | | | x | P | | | | | x | |
| black-and-white warbler | | | x | x | x | | P | | P | x |
| American redstart | | | x | x | P | | P | | x | P |
| ovenbird | | | x | x | x | | | | x | x |
| northern waterthrush | | | x | x | | x | P | x | X | |
| Connecticut warbler | | | x | x | x | | | | x | x |
| mourning warbler | | | x | | P | | | | | P |

X. indicates species observed on Lease 13.
P. indicates species potentially on Lease 13.

**Table 1. Potential and Observed use of Vegetation Communities by Bird Species**

| Common Name | open water | jack pine forest | mixed wood forest | black and white spruce forest | aspen (poplar) forest | graminoid fen/shrubby | riparian | marsh | wooded fens or bogs | Paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| common yellowthroat | | | x | x | | x | P | x | P | |
| Wilson's warbler | | | x | | | | P | | P | |
| Canada warbler | | | x | | x | | P | | P | x |
| western tanager | | | x | | x | | | | x | x |
| rose-breasted grosbeak | | | x | x | x | | | | | x |
| indigo bunting | | x | | | | | | | | |
| American tree sparrow | | | | | | | P | | P | |
| chipping sparrow | | | x | x | x | | | | x | x |
| clay-colored sparrow | | | | | | x | P | | P | |
| vesper sparrow | | | | | | | | | P | |
| savannah sparrow | | | | | | x | | x | P | |
| LeConte's sparrow | | | x | | | x | | x | x | |
| sharp-tailed sparrow | | | | | | x | P | x | P | |
| fox sparrow | | | | | | | P | | P | |
| song sparrow | | | | | | x | P | x | P | |
| Lincoln's sparrow | | | | | | x | P | x | P | |
| swamp sparrow | | | | | | x | P | x | x | |
| white-throated sparrow | | P | x | x | x | | P | | x | x |
| white-crowned sparrow | | | | | | | P | | P | |
| Harris' sparrow | | x | | | | | | | | |
| dark-eyed junco | | P | P | x | | | | | x | |
| Lapland longspur | | x | | | | | | | | |
| Smith's longspur | | x | | | | | | | | |
| snow bunting | | x | | | | | | | | |
| bobolink | | x | | | | | | | | |
| red-winged blackbird | | | | | x | x | P | x | P | x |
| western meadowlark | | x | | | | | | | | |
| yellow-headed blackbird | | | | | | x | P | x | P | |
| rusty blackbird | | | | | | x | P | | P | |
| Brewer's blackbird | | | | | P | x | P | | P | P |
| common grackle | | | | | | x | P | | P | |
| brown-headed cowbird | | | | | | x | | | | |
| northern oriole | | | | | | | | | | |
| pine grosbeak | | | | | | | | | | |
| purple finch | | | P | P | P | | | | | P |
| red crossbill | | P | P | P | P | | | | | P |
| white-winged crossbill | | | P | x | x | | | | x | x |
| common redpoll | | | x | x | P | | | | P | P |
| hoary redpoll | | x | | | | | | | | |
| pine siskin | | P | P | P | x | | | | x | x |
| American goldfinch | | | | | | | | | | |
| evening grosbeak | | | P | P | P | | | | x | P |
| house sparrow | | | | | | | | | | |
| Species Richness | 63 | 48 | 81 | 57 | 67 | 70 | 97 | 78 | 112 | 67 |
| Richness Index | 0.23 | 0.00 | 0.52 | 0.14 | 0.30 | 0.34 | 0.77 | 0.47 | 1.00 | 0.30 |

X. indicates species observed on Lease 13.
P. indicates species potentially on Lease 13.

**Table 2 Potential and Observed use of Vegetation Communities by Mammal Species**

| common name | open water | jack pine | mixedwood forest | black and white spruce | aspen and poplar forest | graminoid fen/shrubby fen | riparian | marsh | wooded fen/bog | paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| masked shrew | | Y | Y | Y | Y | | | | x | Y |
| dusky shrew | | | | Y | | | y | | Y | |
| water shrew | | | | | | y | y | x | | |
| arctic shrew | | | Y | | Y | | | | Y | Y |
| pygmy shrew | | Y | Y | Y | Y | | | | Y | Y |
| little brown bat | Y | | | | | Y | Y | x | | |
| northern long-eared bat | Y | Y | Y | Y | Y | Y | Y | x | Y | Y |
| silver-haired bat | Y | | Y | | Y | Y | Y | x | | Y |
| big brown bat | Y | | | | | Y | Y | x | | |
| hoary bat | Y | Y | Y | Y | Y | Y | Y | x | x | Y |
| snowshoe hare | | Y | Y | Y | x | | | | Y | x |
| least chipmunk | | Y | Y | Y | x | | | | | x |
| woodchuck | | | Y | | | | | | | |
| red squirrel | | Y | Y | Y | | | | | Y | |
| northern flying squirrel | | Y | Y | Y | | | | | Y | |
| beaver | x | | | | | x | Y | x | | |
| deer mouse | | Y | Y | Y | Y | | | | | Y |
| southern red-backed vole | | Y | x | Y | Y | | | | Y | Y |
| heather vole | | Y | | | | | Y | | Y | |
| meadow vole | | | Y | | Y | Y | Y | | Y | |
| muskrat | x | | | | | x | Y | x | Y | |
| northern bog lemming | | | | x | | x | Y | | Y | |
| meadow jumping mouse | | | | | | x | Y | | Y | |
| porcupine | | | Y | | Y | | | | | Y |
| coyote | | Y | Y | Y | Y | | Y | | Y | Y |
| gray wolf | | Y | Y | Y | Y | | | | Y | Y |
| red fox | | Y | Y | Y | Y | | Y | | Y | Y |
| black bear | | Y | Y | Y | Y | | | | Y | Y |
| marten | | Y | | Y | | x | | | x | |
| fisher | | Y | | Y | | x | | | x | |
| ermine | | Y | Y | Y | | | | | Y | |
| least weasel | | Y | Y | Y | | | | | Y | |
| mink | | | | x | | x | Y | x | Y | |
| wolverine | | Y | x | Y | | | | | x | |
| striped skunk | | | Y | Y | Y | | | | | Y |
| river otter | x | | | | | x | Y | x | Y | |
| canada lynx | | Y | Y | Y | | | | | Y | |
| mule deer | | | Y | | Y | | | | | Y |
| white-tailed deer | | | Y | | Y | | | | | Y |
| moose | | | Y | Y | Y | x | Y | | Y | Y |
| | | | | | | | | | | |
| Species Richness | 8 | 21 | 27 | 25 | 20 | 16 | 18 | 10 | 28 | 19 |
| Richness Index | 0.00 | 0.65 | 0.95 | 0.85 | 0.60 | 0.40 | 0.50 | 0.10 | 1.00 | 0.55 |

x indicates species observed on Lease 13
Y indicates species potentially on Lease 13

## Table 3 Potential and Observed use of Vegetation Communities by Amphibian and Reptile Species

| Common Name | open water | jack pine forest | mixedwood forest | black and white spruce forest | aspen (poplar) forest | fen | riparian | marsh | treed bog (black spruce) | paper birch forest |
|---|---|---|---|---|---|---|---|---|---|---|
| Canadian toad | | x | x | x | x | x | P | x | P | x |
| stripped chorus frog | | | | | | x | P | x | P | |
| wood frog | | | | | | x | P | x | P | |
| red-sided garter snake | | x | x | x | x | x | P | x | x | x |
| | | | | | | | | | | |
| **Species Richness** | 0 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 2 |
| **Richness Index** | 0.00 | 0.50 | 0.50 | 0.50 | 0.50 | 1.00 | 1.00 | 1.00 | 1.00 | 0.50 |

x indicates species observed on Lease 13
P indicates species potentially on Lease 13