

H:\198\_514\MAPS\FIGURES\011\_WILDLIFE\FIGURE\_11.5-01\_LANDSCAPE-SCALE\_WILDLIFE\_HABITAT\_CONNECTIVITY.mxd

**Legend**


- North American Upgrader Wildlife RSA
- North American Upgrader Wildlife LSA
- Alberta Natural Subregion
- Alberta Natural Area
- Waterbody - Permanent
- Waterbody - Recurring
- River / Stream
- ➔ Possible Regional Movements
- ➔ Likely Wildlife Movement Corridor

**Snow Track Observations**

- Coyote
- Deer ssp.
- Moose

Title:

## LANDSCAPE - SCALE WILDLIFE HABITAT CONNECTIVITY

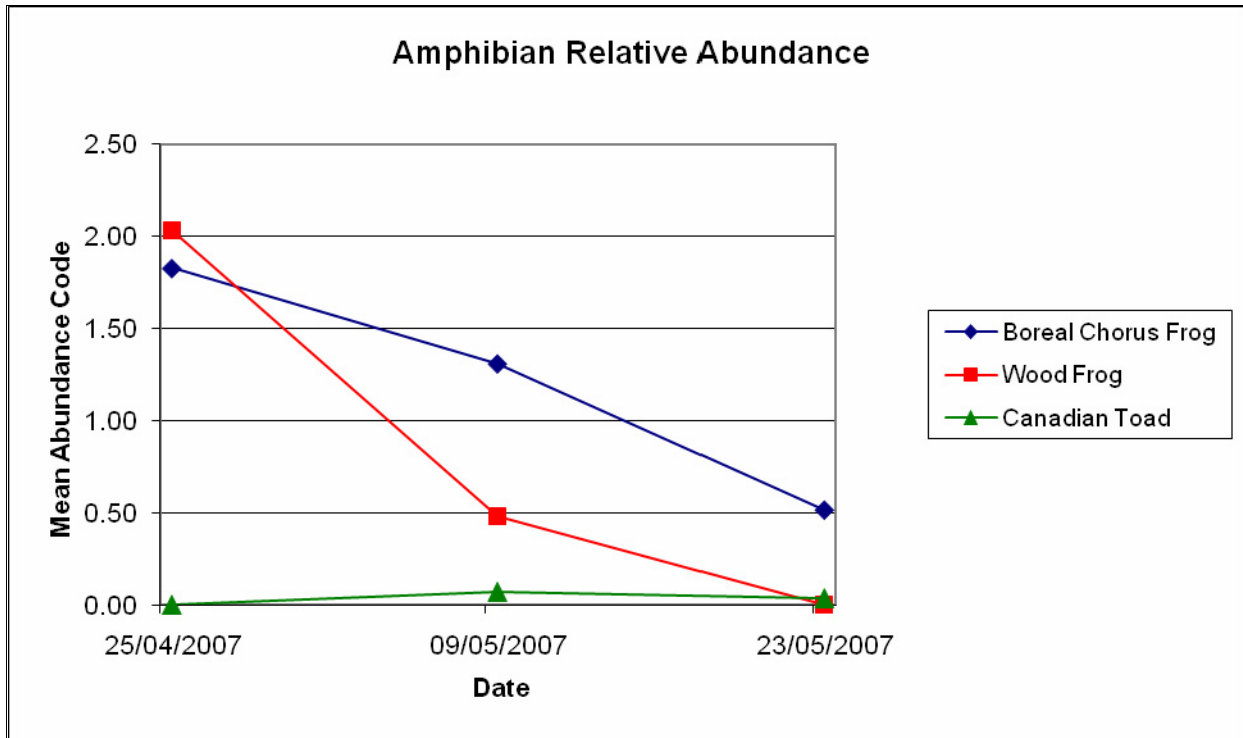


Approved: **BE**      Revision Date: **Nov. 24, 2007**

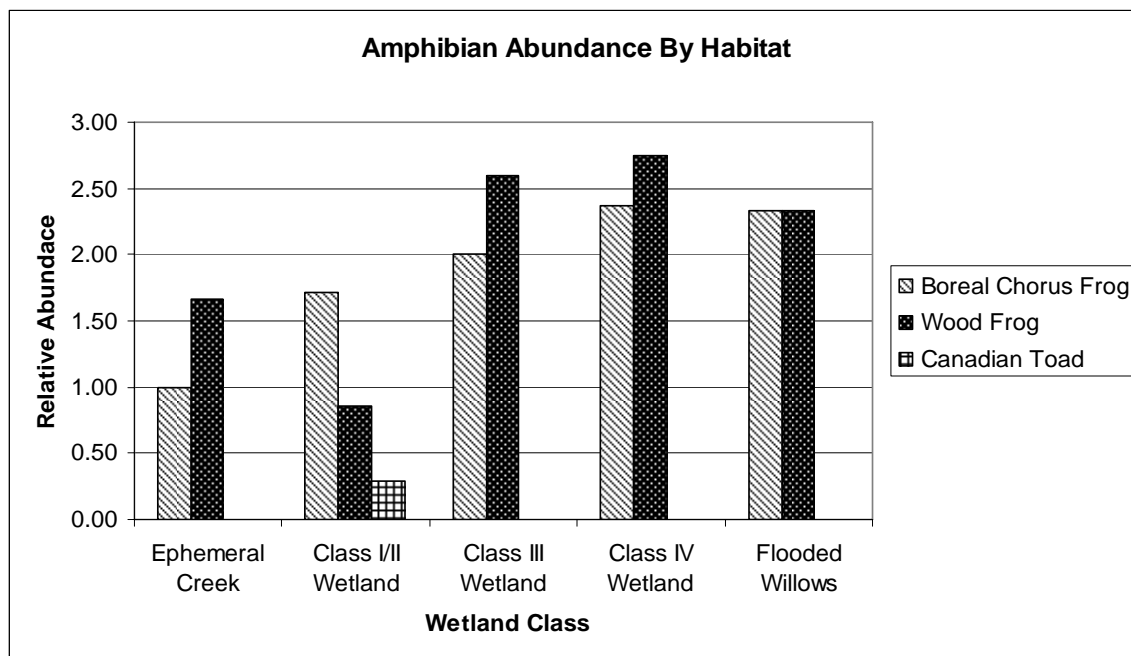
File: FIGURE\_11.5-01\_LANDSCAPE-SCALE\_WILDLIFE\_HABITAT\_CONNECTIVITY.mxd

Drawn by: **TR**      Checked: **JD**      Fig. No.: **11.5-1**

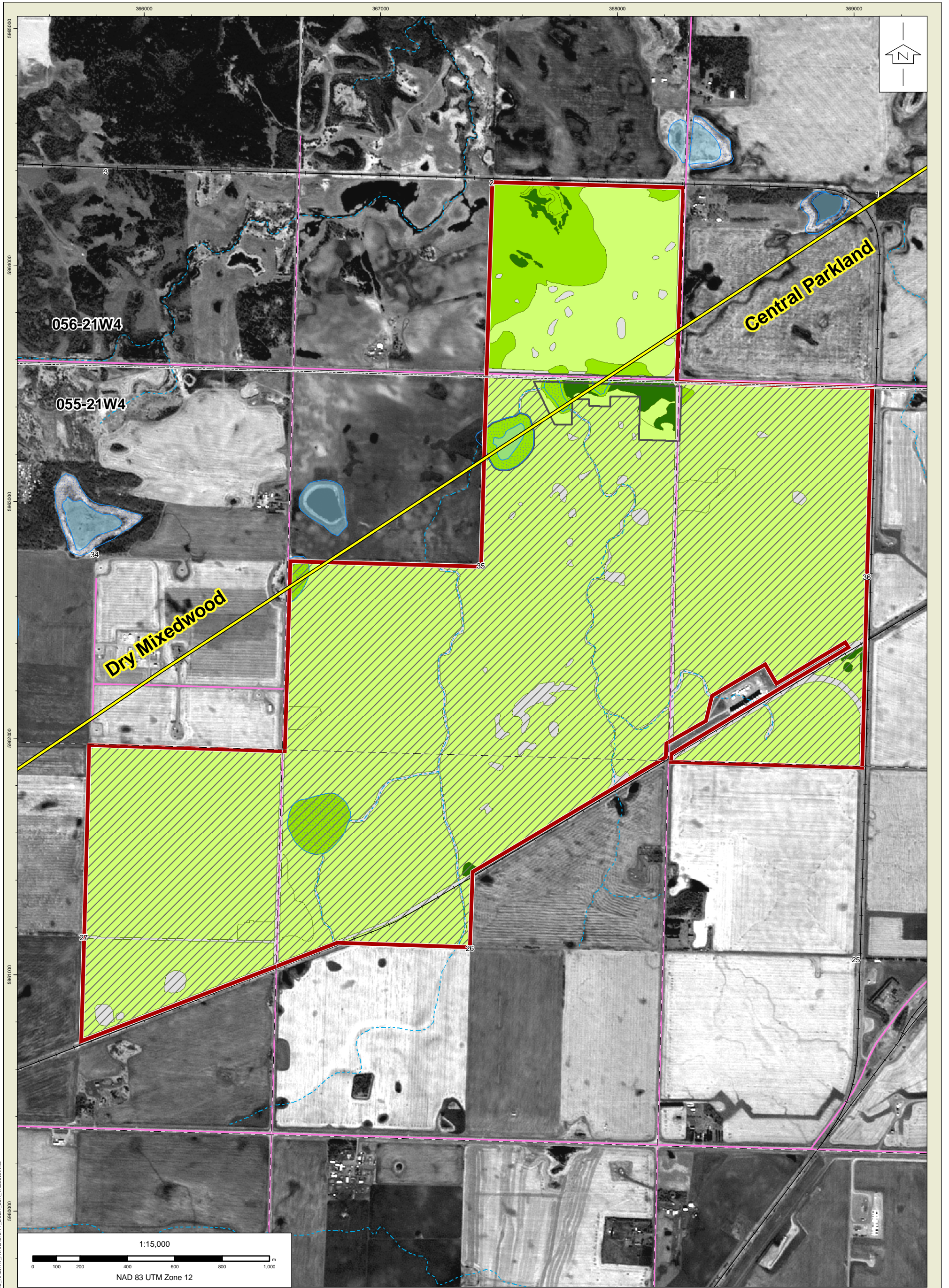
**Figure 11.5-2 Relative Abundance and Activity of Amphibians**



**Figure 11.5-3 Amphibian Abundance by Habitat**





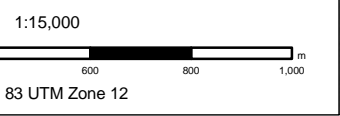


**Central Parkland**

**Dry Mixedwood**

056-21W4

055-21W4



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring
- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

- Nil
- Low
- Moderate
- High

Title:

**AVAILABILITY OF DEER HABITAT WITHIN THE LOCAL STUDY AREA**



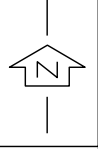
Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-04_BAS_HABITAT_AVAILABILITY_DEER_LSA_TABLOID.mxd	
Drawn by: JC	Checked: JD
Fig. No.: <b>11.5-4</b>	

I:\8198\_514\MAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-04\_BAS\_HABITAT\_AVAILABILITY\_DEER\_LSA\_TABLOID.mxd

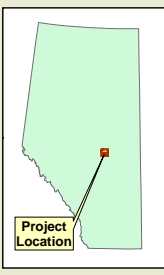
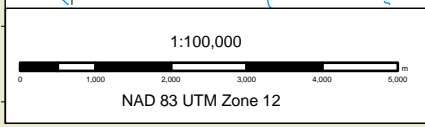
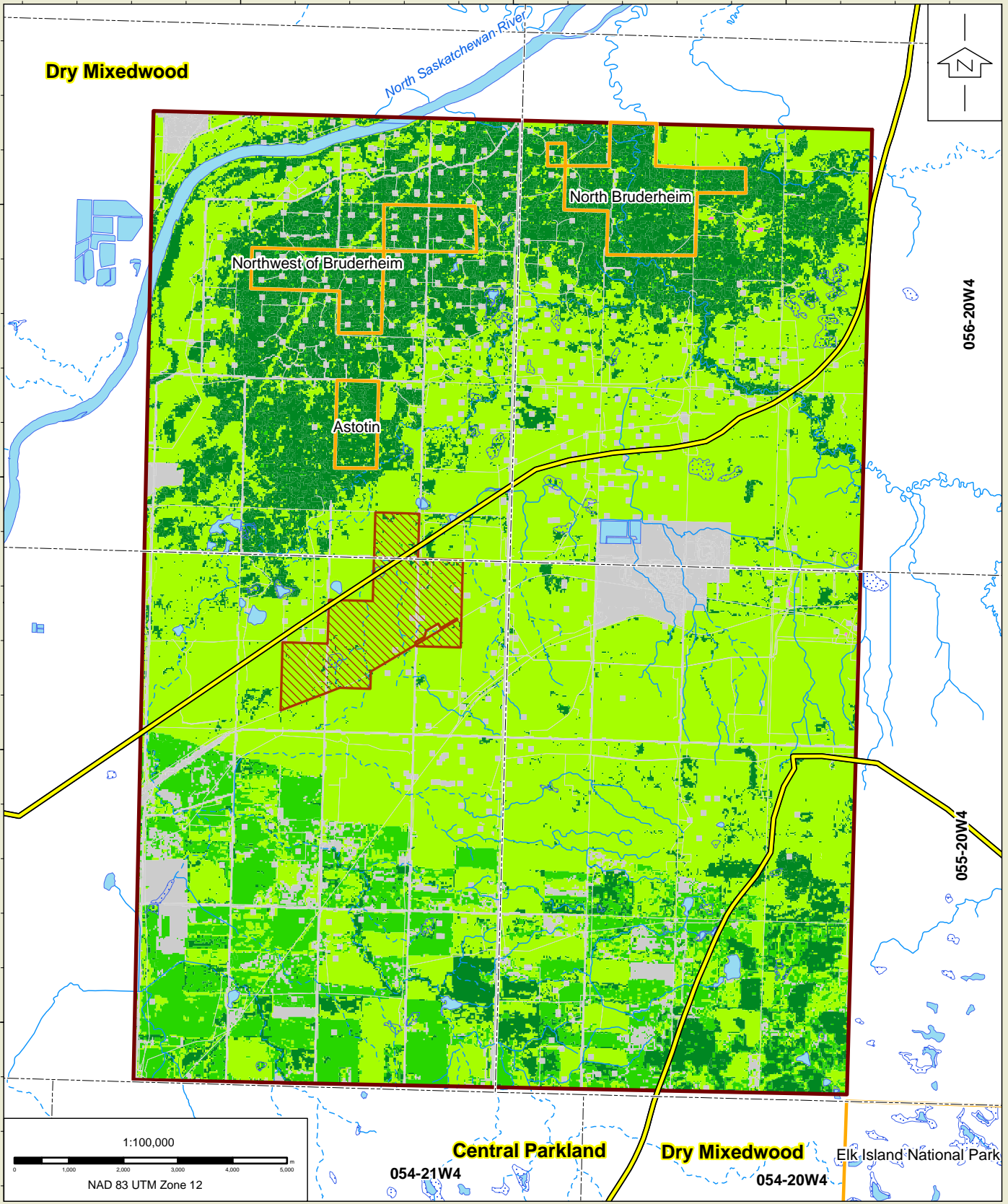


365000 370000 375000

**Dry Mixedwood**



5970000  
5965000  
5960000  
5955000



Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Areas
	Alberta Natural Subregions
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

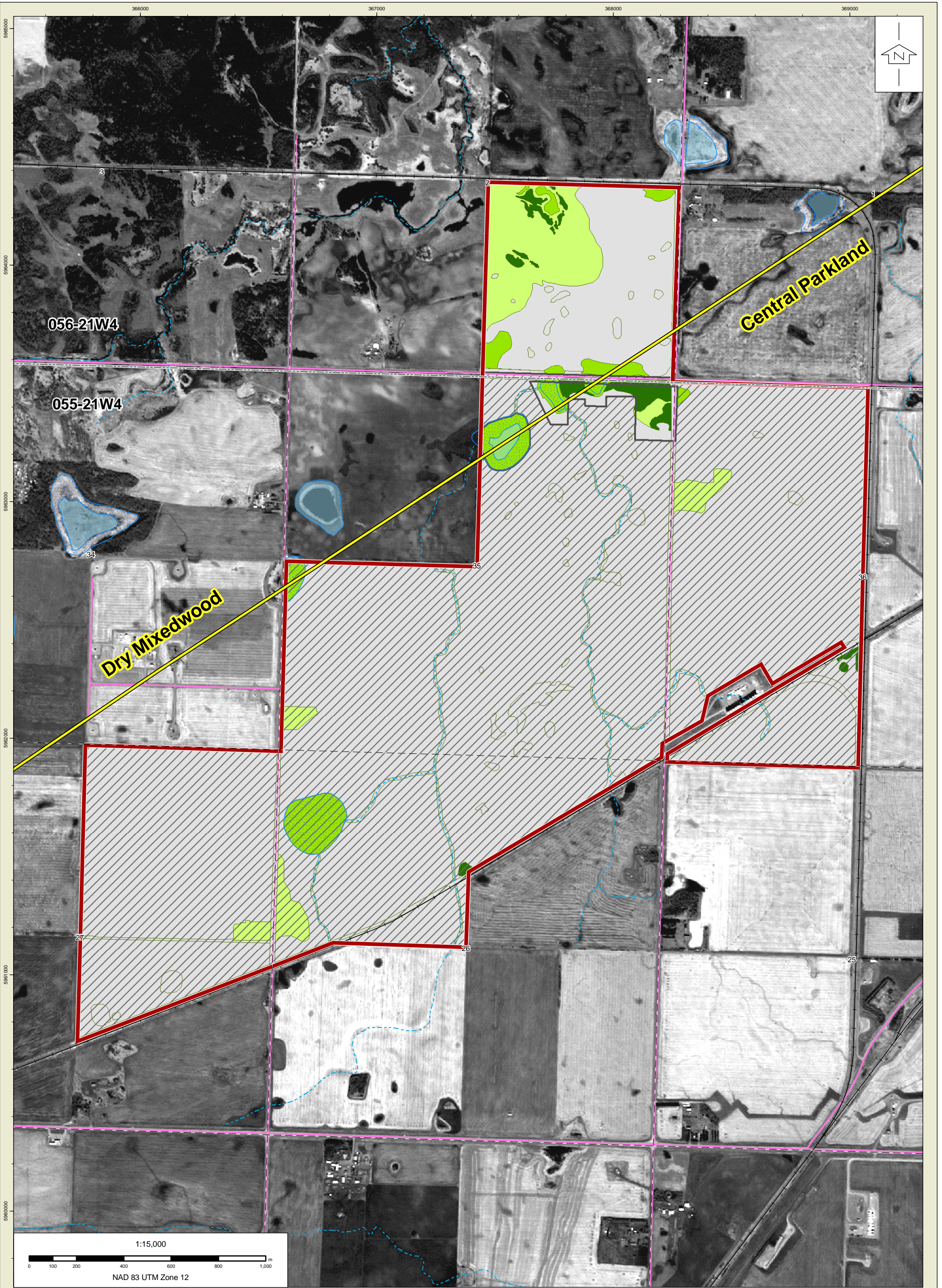
Title:

**AVAILABILITY OF DEER HABITAT WITHIN THE REGIONAL STUDY AREA**

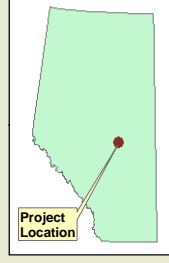
Approved: <b>BE</b>	Revision Date: <b>Oct 24, 2007</b>
File: FIGURE_11.5-05_BAS_HABITAT_AVAILABILITY_DEER_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-5</b>	

HP198\_514\WP\FIGURES\01\_WILDLIFE\FIGURE\_11.5-05\_BAS\_HABITAT\_AVAILABILITY\_DEER\_RSA.mxd





I:\8198\_514\MAPS\FIGURES\011\_WILDLIFE\Figure\_11.5-06\_BAS\_HABITAT\_AVAILABILITY\_MOOSE\_LSA\_TABLOID.mxd



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring
- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

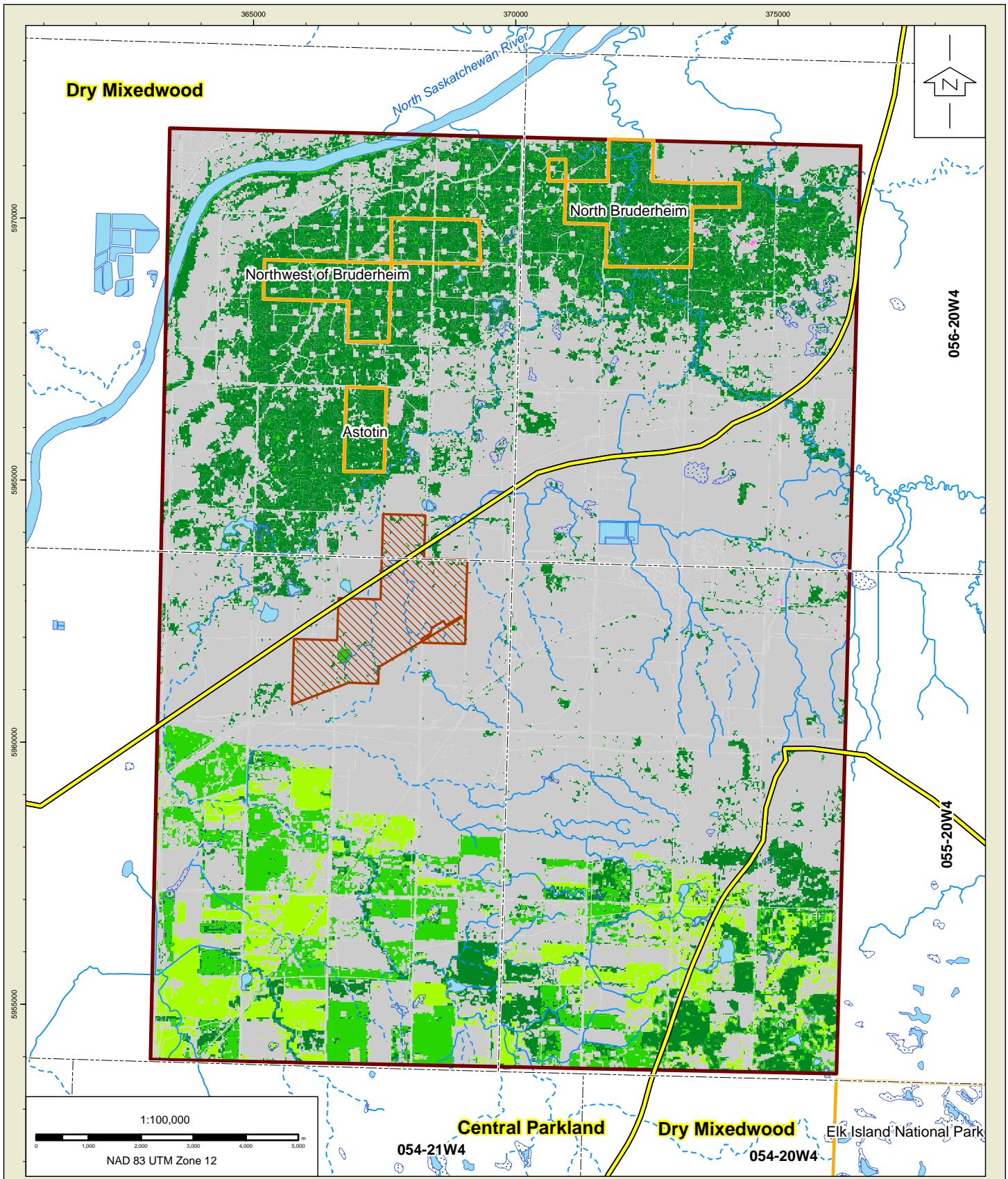
- Nil
- Low
- Moderate
- High

Title:

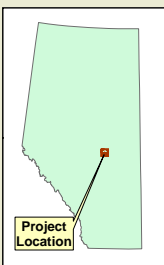
**AVAILABILITY OF MOOSE HABITAT WITHIN THE LOCAL STUDY AREA**

Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-06_BAS_HABITAT_AVAILABILITY_MOOSE_LSA_TABLOID.mxd	
Drawn by: JC	Checked: JD
Fig. No.: <b>11.5-6</b>	





H:\198\_514\MAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-07\_BAS\_HABITAT\_AVAILABILITY\_MOOSE\_RSA.mxd



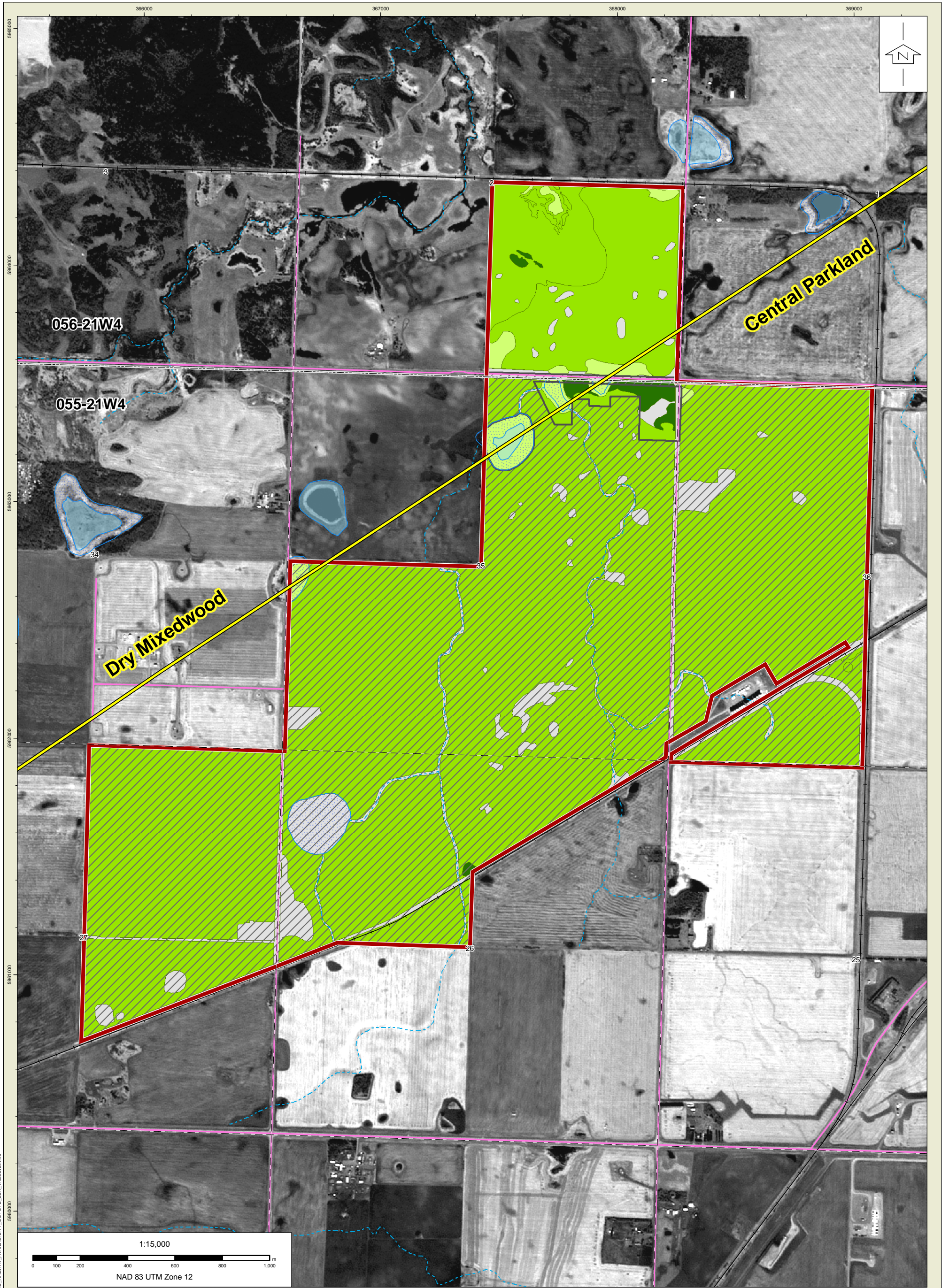
Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Areas
	Alberta Natural Subregions
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

Title:

**AVAILABILITY OF MOOSE HABITAT WITHIN THE REGIONAL STUDY AREA**

Approved: <b>BE</b>	Revision Date: <b>Oct 24, 2007</b>
File: FIGURE_11.5-07_BAS_HABITAT_AVAILABILITY_MOOSE_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-7</b>	





**Central Parkland**

**Dry Mixedwood**

056-21W4

055-21W4



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring

- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

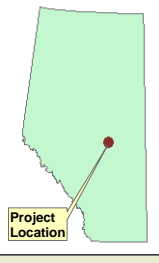
- Nil
- Low
- Moderate
- High

Title:  
**AVAILABILITY OF COYOTE HABITAT WITHIN THE LOCAL STUDY AREA**

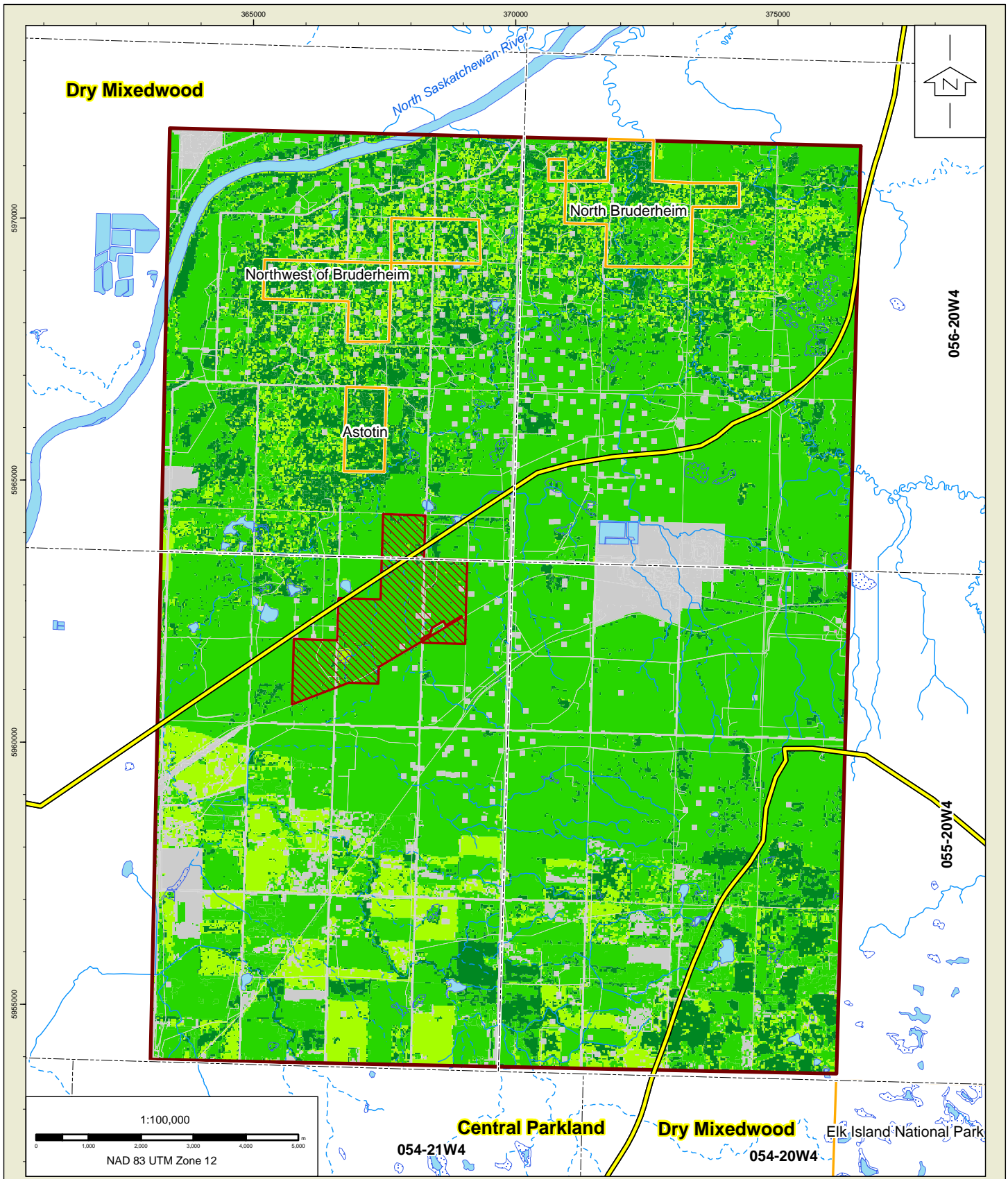


Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-08_BAS_HABITAT_AVAILABILITY_COYOTE_LSA_TABLOID.mxd	
Drawn by: JC	Checked: JD
Fig. No.: <b>11.5-8</b>	

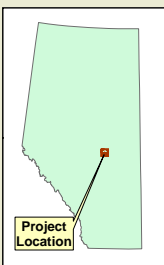
I:\8198\_514\MAPS\FIGURES\011\_WILDLIFE\FIGURE\_11.5-08\_BAS\_HABITAT\_AVAILABILITY\_COYOTE\_LSA\_TABLOID.mxd







H:\198\_514\NAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-09\_BAS\_HABITAT\_AVAILABILITY\_COYOTE\_RSA.mxd



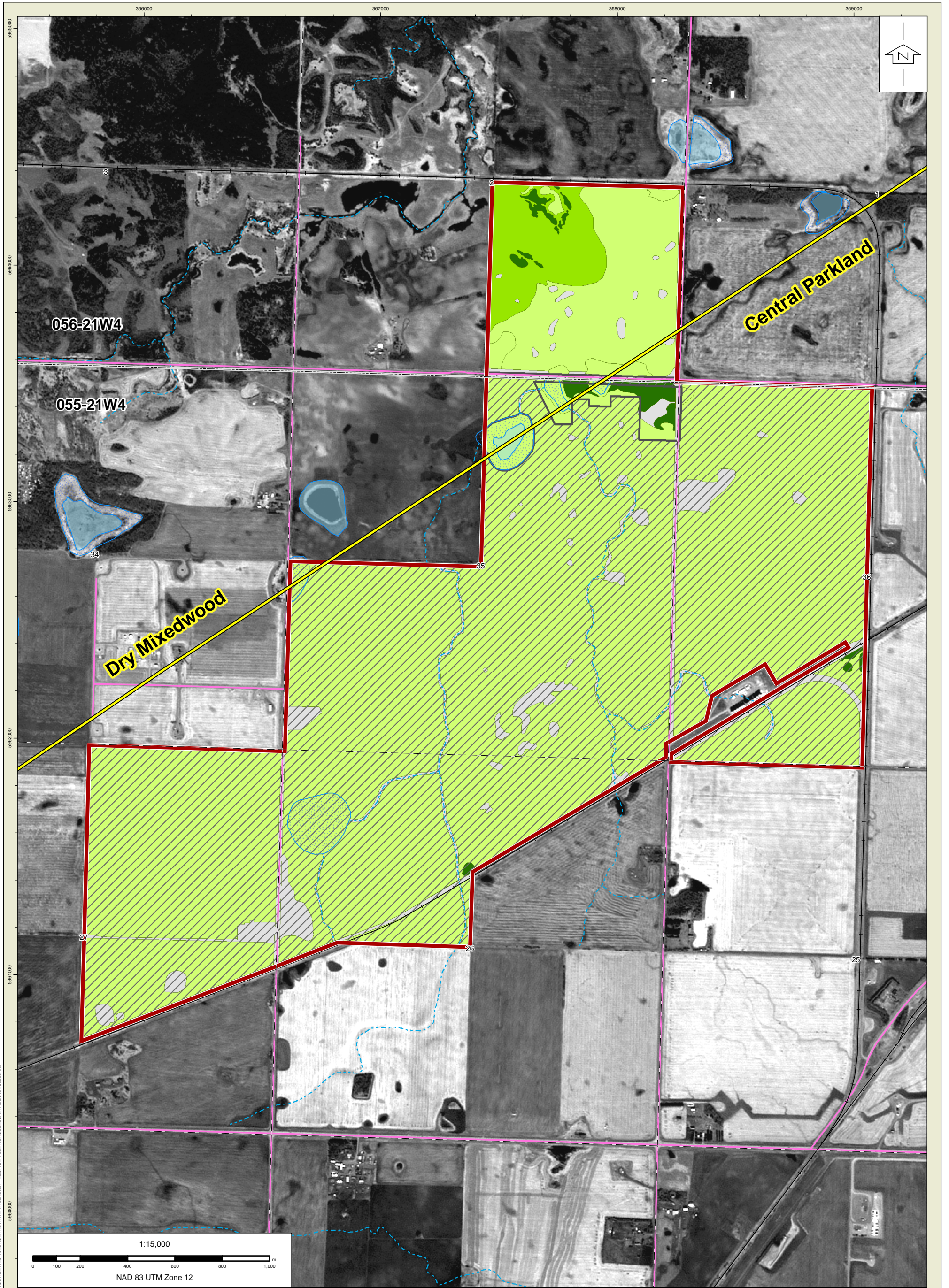
Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Area
	Alberta Natural Subregion
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

Title:

**AVAILABILITY OF COYOTE HABITAT WITHIN THE REGIONAL STUDY AREA**

Approved: <b>BE</b>	Revision Date: <b>Oct 24, 2007</b>
File: FIGURE_11.5-09_BAS_HABITAT_AVAILABILITY_COYOTE_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-9</b>	





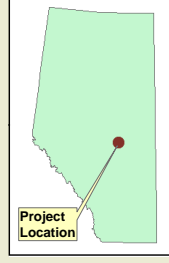
**Central Parkland**

**Dry Mixedwood**

056-21W4

055-21W4

1:15,000  
0 100 200 400 600 800 1,000 m  
NAD 83 UTM Zone 12



**Legend**

- North American Upgrader LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring
- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

- Nil
- Low
- Moderate
- High

Title:  
**AVAILABILITY OF LONG-TAILED WEASEL HABITAT WITHIN THE LOCAL STUDY AREA**



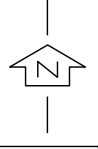
Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-10_BAS_HABITAT_AVAILABILITY_LONG_TAIL_WEASEL_LSA_TABLOID.mxd	
Drawn by: JC	Checked: JD
	Fig. No.: <b>11.5-10</b>

I:\8198\_014\MAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-10\_BAS\_HABITAT\_AVAILABILITY\_LONG\_TAIL\_WEASEL\_LSA\_TABLOID\_SIZE.mxd

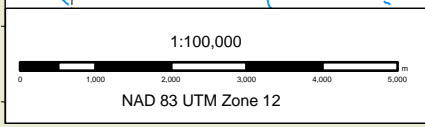
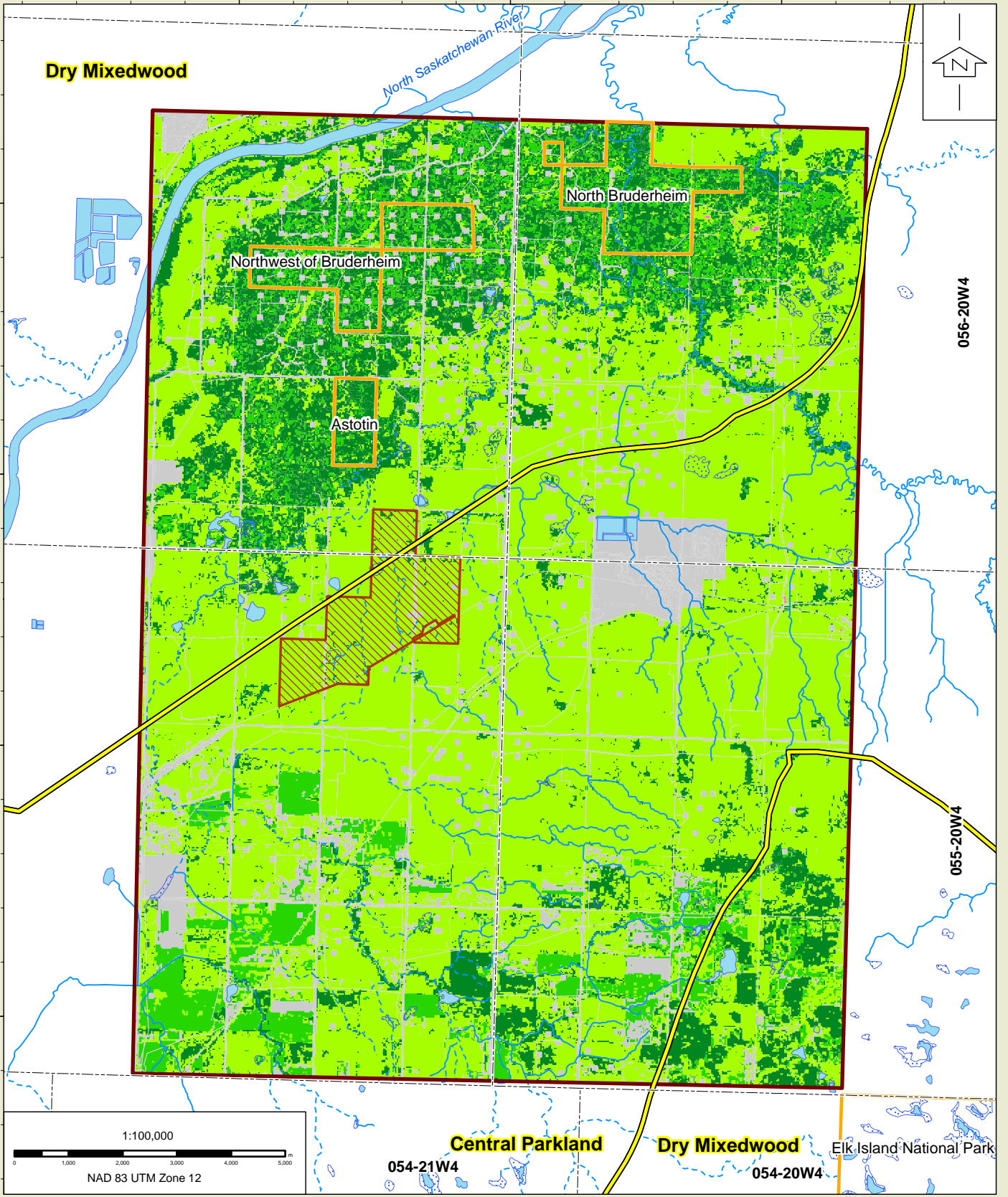


365000 370000 375000

**Dry Mixedwood**

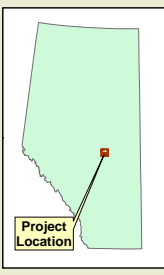


5970000  
5965000  
5960000  
5955000



**Central Parkland** **Dry Mixedwood** Elk Island National Park  
054-21W4 054-20W4

H:\198\_514\NA\PS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-11\_BAS\_HABITAT\_AVAILABILITY\_LONG\_TAIL\_WEASEL\_RSA.mxd



Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Areas
	Alberta Natural Subregions
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

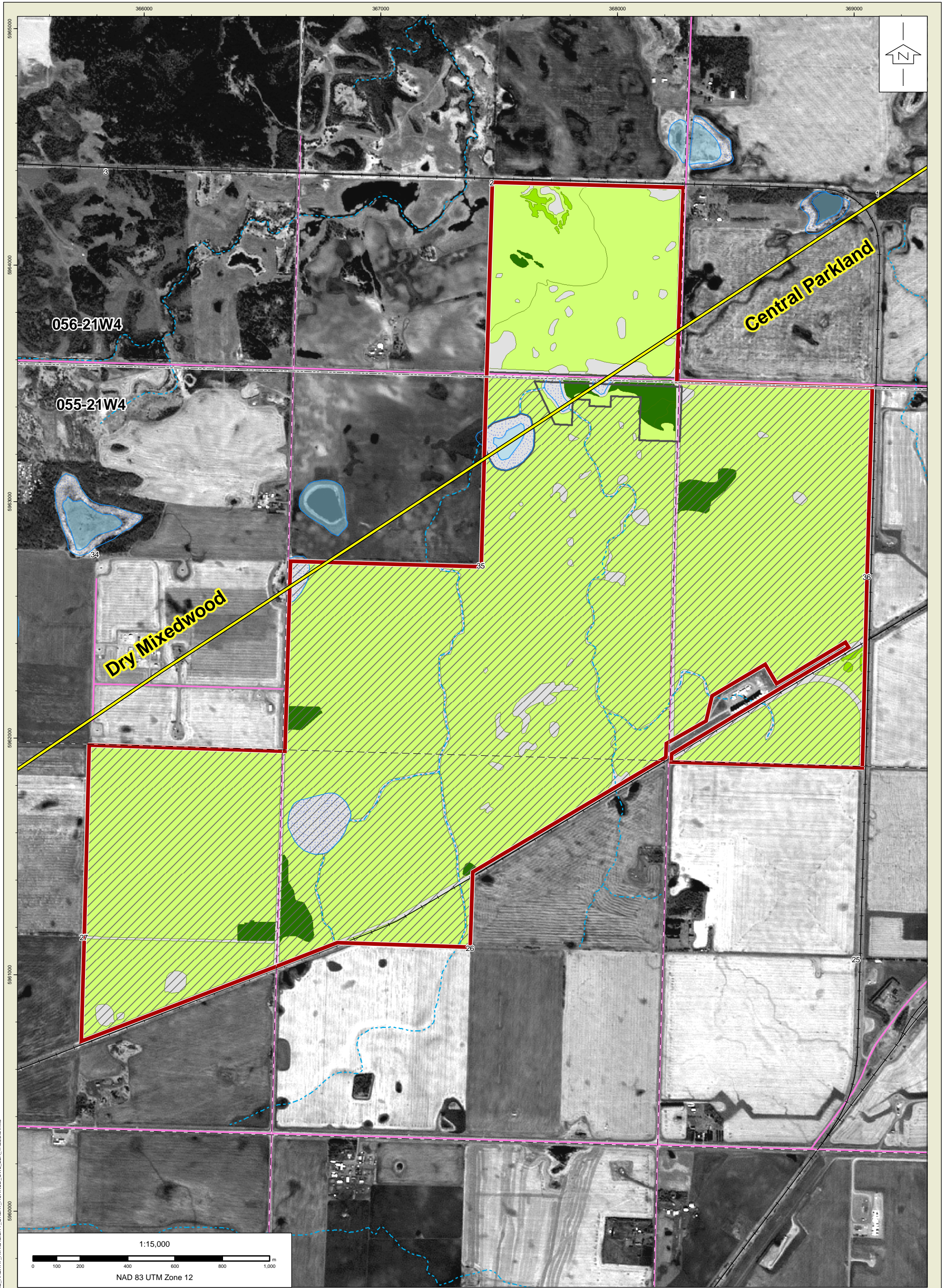
Title:

**AVAILABILITY OF LONG-TAILED WEASEL HABITAT WITHIN THE REGIONAL STUDY AREA**

**NORTH AMERICAN OIL SANDS CORPORATION**

Approved: <b>BE</b>	Revision Date: <b>Oct 24, 2007</b>
File: FIGURE_11.5-11_BAS_HABITAT_AVAILABILITY_LONG_TAIL_WEASEL_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-11</b>	



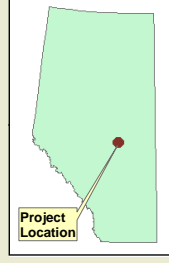


**Central Parkland**

**Dry Mixedwood**

056-21W4

055-21W4



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Natural Subregion
- Waterbody**
- Permanent
- Recurring

- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

- Nil
- Low
- Moderate
- High

Title:  
**AVAILABILITY OF GREAT HORNED OWL BREEDING HABITAT WITHIN THE LOCAL STUDY AREA**



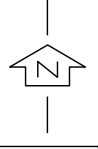
Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-12_BAS_HABITAT_AVAILABILITY_GREAT_HORNED_OWL_LSA_TABLOID.mxd	
Drawn by: LZ	Checked: JD
Fig. No.: <b>11.5-12</b>	

I:\6198\_514\MAPS\FIGURES\011\_WILDLIFE\FIGURE\_11.5-12\_BAS\_HABITAT\_AVAILABILITY\_GREAT\_HORNED\_OWL\_LSA\_TABLOID.mxd

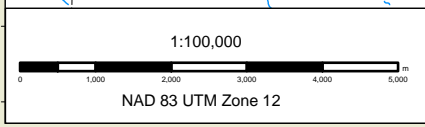
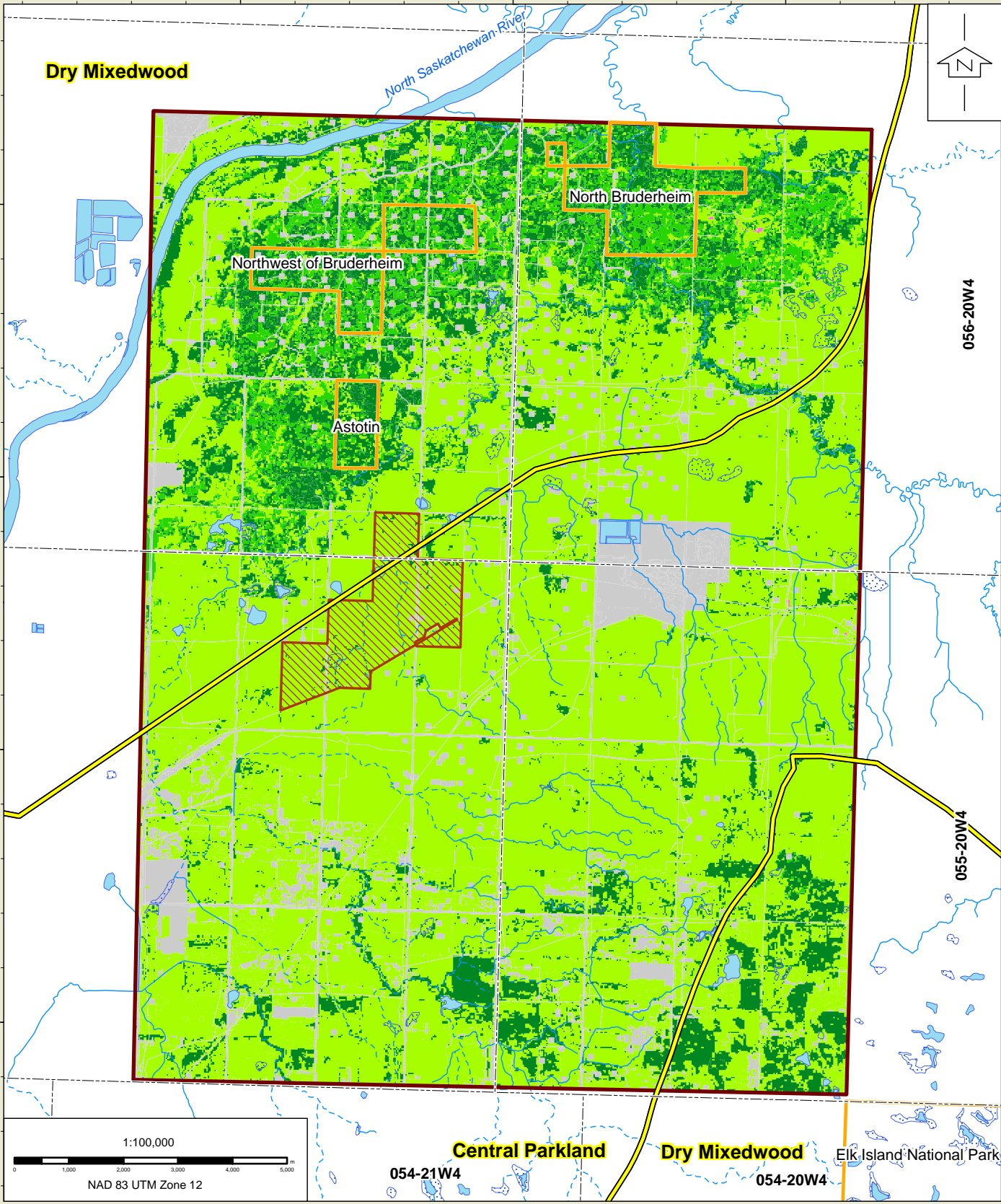


365000 370000 375000

**Dry Mixedwood**



5970000  
5965000  
5960000  
5955000

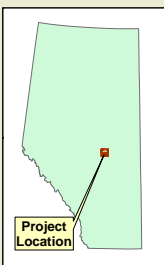


**Central Parkland**

**Dry Mixedwood**

Elk Island National Park

H:\198\_514\WA\PS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-13\_BAS\_HABITAT\_AVAILABILITY\_GREAT\_HORNED\_OWL\_RSA.mxd



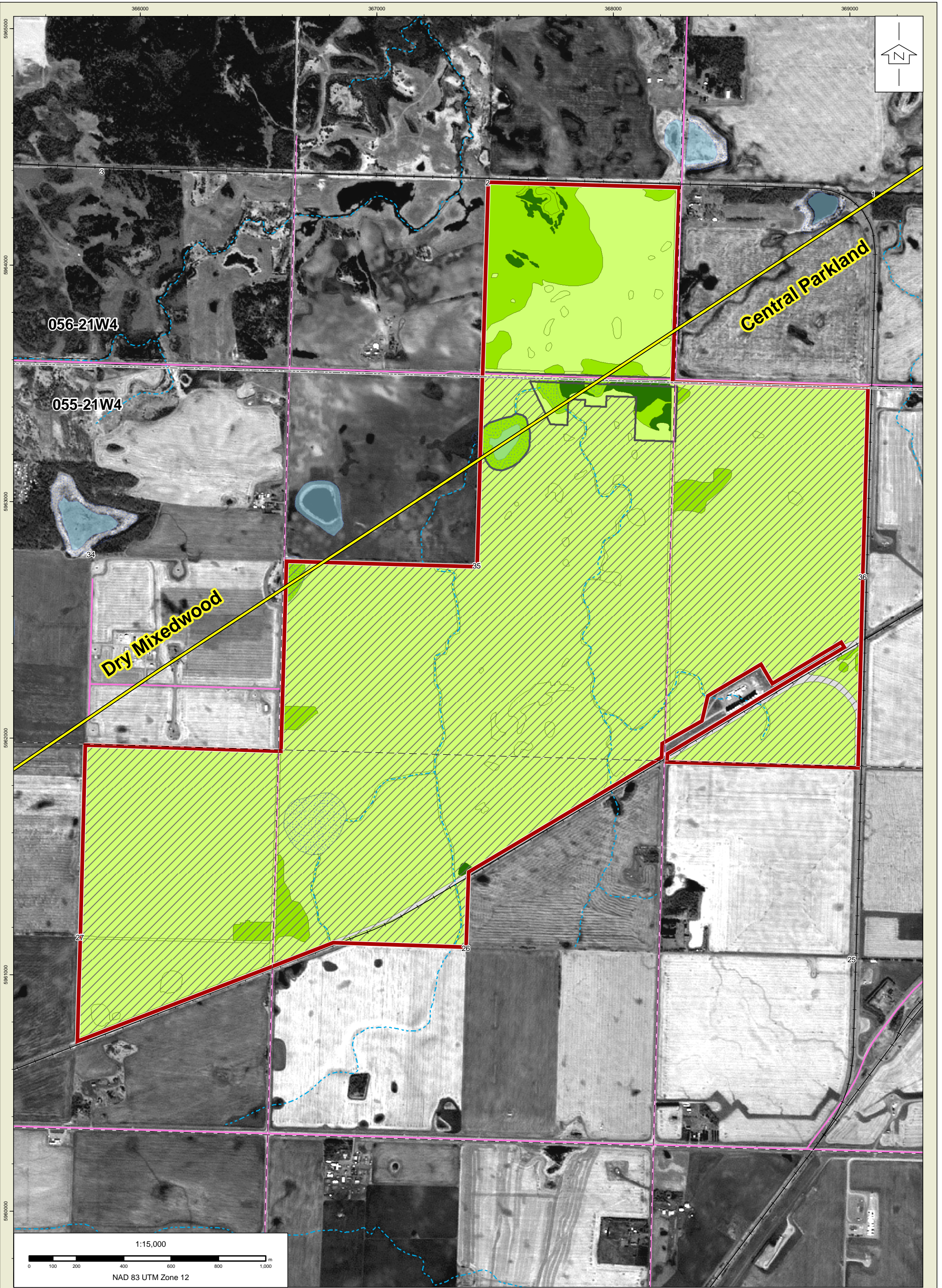
Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Area
	Alberta Natural Subregion
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

Title:

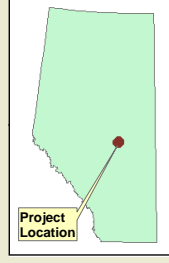
**AVAILABILITY OF GREAT HORNED OWL HABITAT WITHIN THE REGIONAL STUDY AREA**

Approved: <b>BE</b>	Revision Date: <b>Nov. 24, 2007</b>
File: FIGURE_11.5-13_BAS_HABITAT_AVAILABILITY_GREAT_HORNED_OWL_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-13</b>	





I:\6198\_514\MAPS\FIGURES\011\_WILDLIFE\FIGURE\_11.5-14\_BAS\_HABITAT\_AVAILABILITY\_SONGBIRD\_LSA\_TABLOID.mxd



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring
- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

- Nil
- Low
- Moderate
- High

Title:

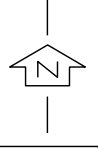
**AVAILABILITY OF  
SONGBIRD HABITAT  
WITHIN THE  
LOCAL STUDY AREA**

Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-14_BAS_HABITAT_AVAILABILITY_SONGBIRD_LSA_TABLOID.mxd	
Drawn by: LZ	Checked: JD
Fig. No.: <b>11.5-14</b>	

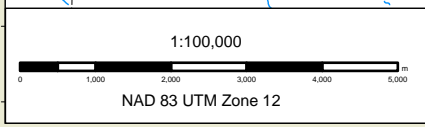
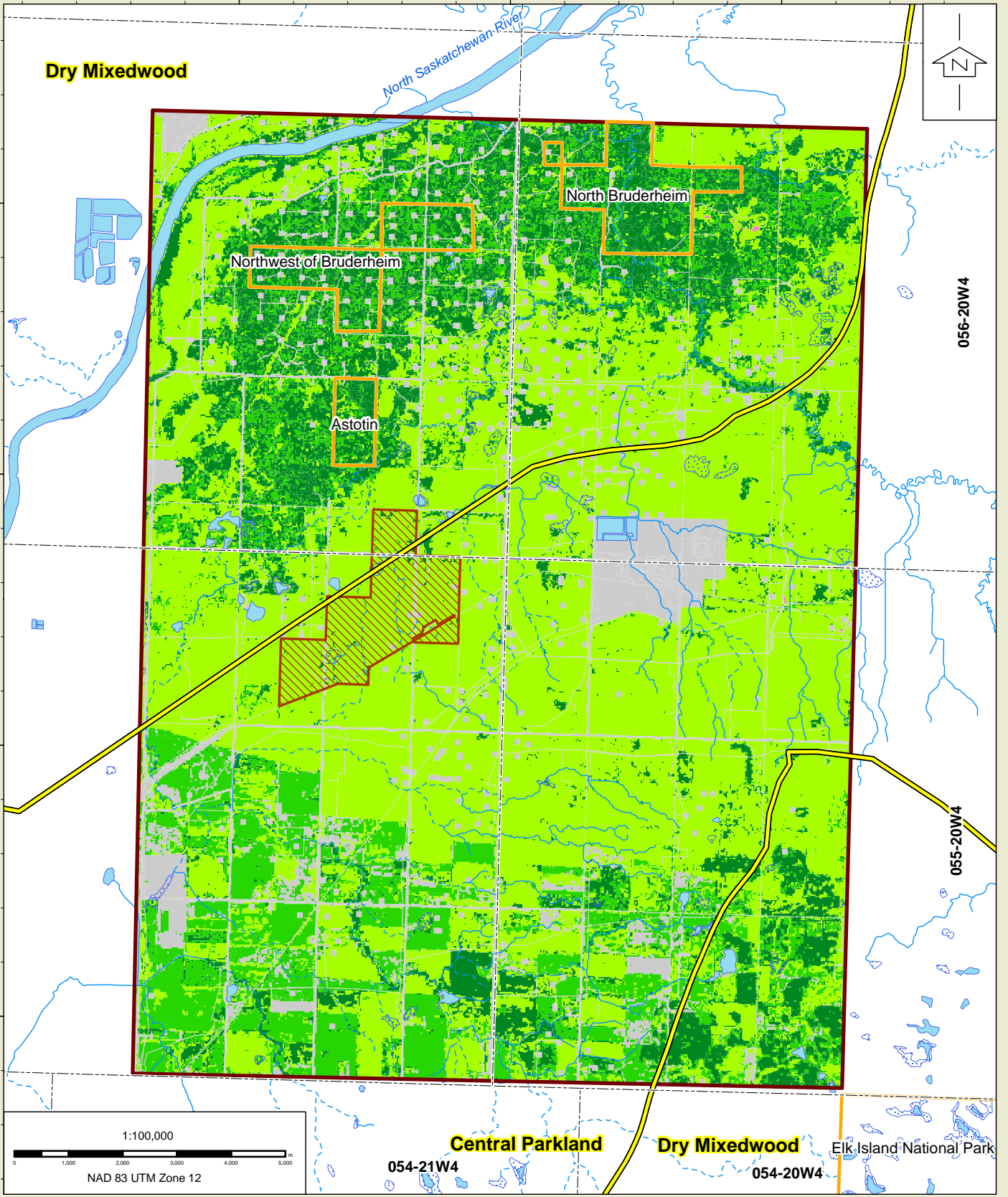


365000 370000 375000

**Dry Mixedwood**



5970000  
5965000  
5960000  
5955000



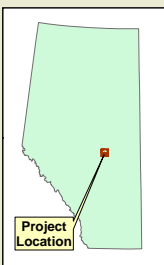
**Central Parkland**

**Dry Mixedwood**

Elk Island National Park

054-21W4

054-20W4



Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Area
	Alberta Natural Subregion
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

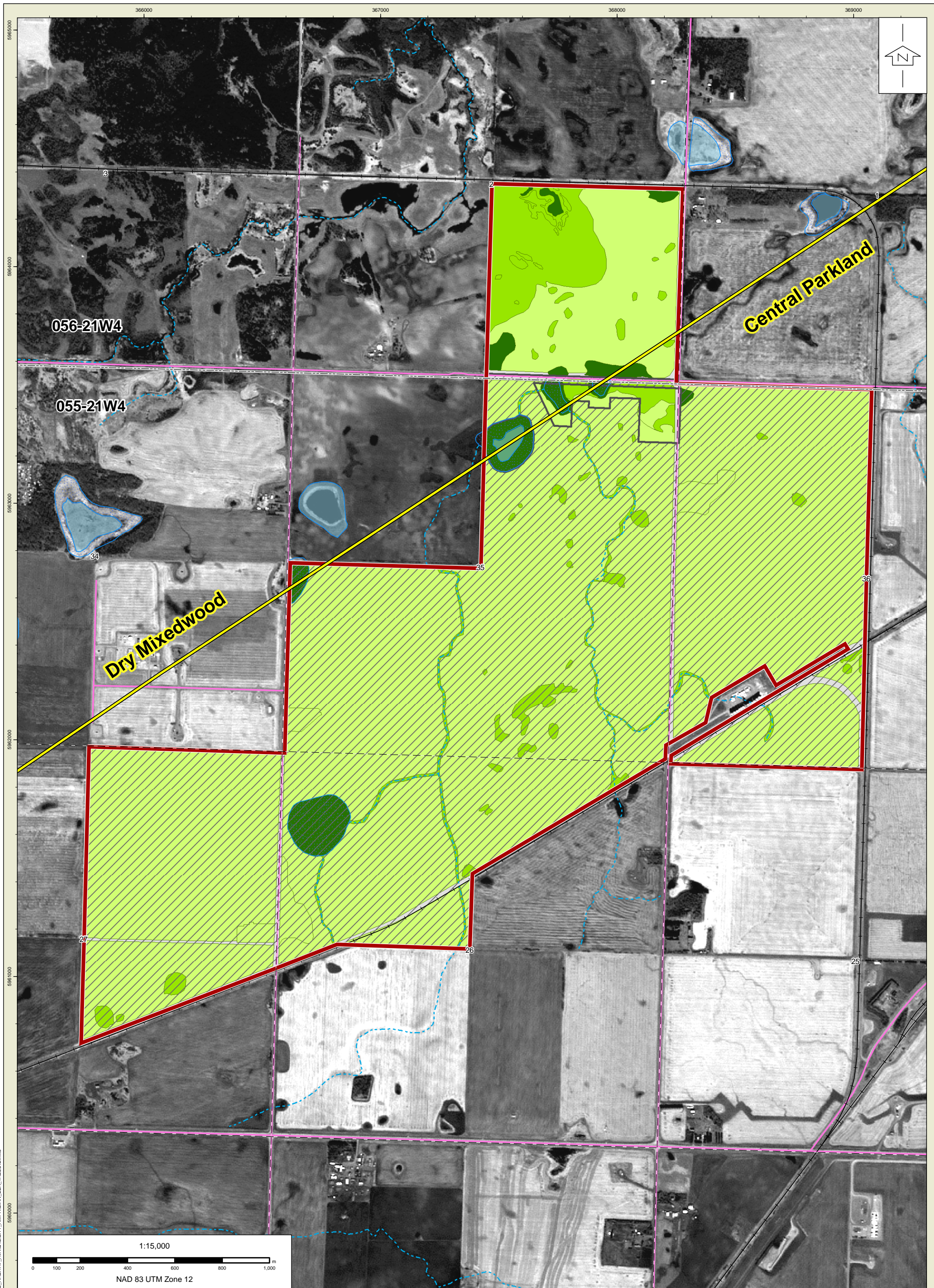
Title:

**AVAILABILITY OF SONGBIRD HABITAT WITHIN THE REGIONAL STUDY AREA**

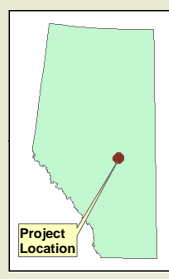
Approved: <b>BE</b>	Revision Date: <b>Nov. 24, 2007</b>
File: FIGURE_11.5-15_BAS_HABITAT_AVAILABILITY_SONGBIRD_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-15</b>	

H:\198\_514\NAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-15\_BAS\_HABITAT\_AVAILABILITY\_SONGBIRD\_RSA.mxd





I:\6198\_514\MAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-16\_BAS\_HABITAT\_AVAILABILITY\_AMPHIBIAN\_LSA\_TABLOID.mxd



**Legend**

- North American Upgrader Wildlife LSA
- Project Footprint
- Alberta Natural Subregion
- Waterbody**
- Permanent
- Recurring
- Stream - Permanent
- Stream - Intermittent
- Alberta Township / Range
- ATS Section Line
- Road
- Railway

**Habitat Availability**

- Nil
- Low
- Moderate
- High

Title:

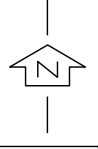
**AVAILABILITY OF AMPHIBIAN HABITAT WITHIN THE LOCAL STUDY AREA**

Approved: BE	Revision Date: Nov.18, 2007
File: FIGURE_11.5-1A_BAS_HABITAT_AVAILABILITY_AMPHIBIAN_LSA_TABLOID.mxd	
Drawn by: LZ	Checked: JD
Fig. No.: <b>11.5-16</b>	

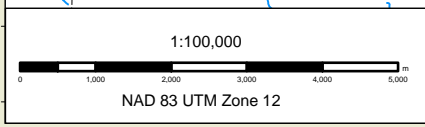
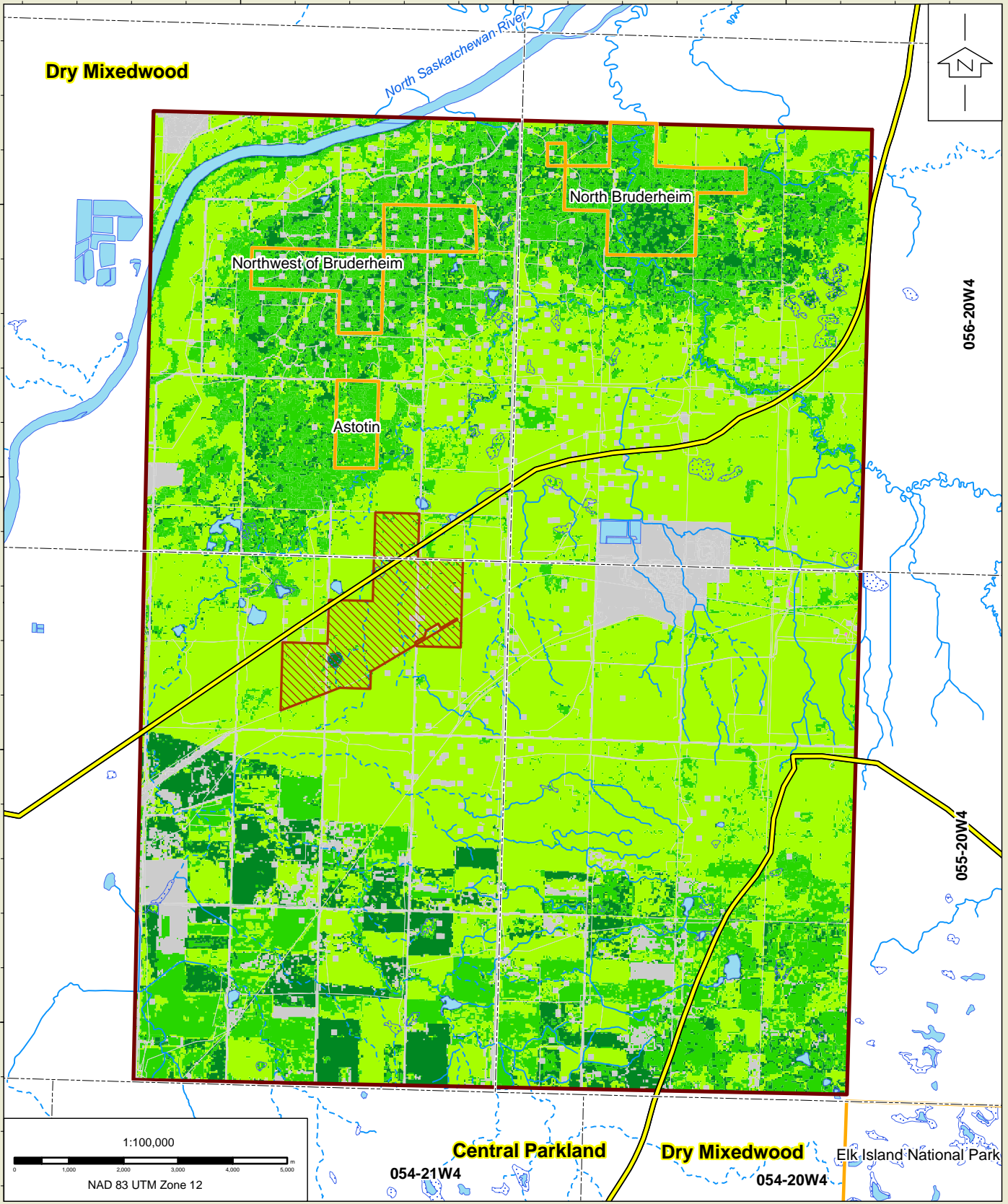


365000 370000 375000

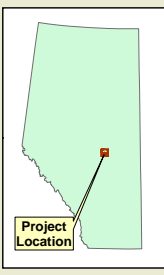
**Dry Mixedwood**



5970000  
5965000  
5960000  
5955000



H:\198\_514\NAPS\FIGURES\01\_WILDLIFE\FIGURE\_11.5-17\_BAS\_HABITAT\_AVAILABILITY\_AMPHIBIAN\_RSA.mxd



Legend	
	North American Upgrader Wildlife RSA
	North American Upgrader Wildlife LSA
	Natural Area
	Alberta Natural Subregion
	Alberta Township/Range
	Waterbody
	Permanent
	Recurring
	Stream - Permanent
	Stream - Intermittent
Habitat Availability	
	Nil
	Low
	Moderate
	High
	Unclassified

Title:

**AVAILABILITY OF AMPHIBIAN HABITAT WITHIN THE REGIONAL STUDY AREA**

Approved: <b>BE</b>	Revision Date: <b>Nov. 24, 2007</b>
File: FIGURE_11.5-17_BAS_HABITAT_AVAILABILITY_AMPHIBIAN_RSA.mxd	
Drawn by: <b>LZ</b>	Checked: <b>JD</b>
Fig. No.: <b>11.5-17</b>	



## 11.6 Impact Assessment and Mitigative Measures

Impacts are presented in [Table 11.8-1](#) for the species of interest, and are described below.

### 11.6.1 Sensory Disturbance of Wildlife

#### 11.6.1.1 Noise

Sensory disturbance will affect different wildlife species and communities to varying degrees ([Table 11.6-1](#) and [Appendix 11A](#)). North American will not be developing in SE 2-56-21 W4M or in the northern portion of NE 35-55-21 W4M; therefore, the development of the Project will result in minimal clearing of highly and moderately rated habitat for most key species. However, once site preparation and construction of the Project commences, the disturbance from noise and activity on the Project site is predicted to displace temporarily most of the wildlife from the retained natural habitat in SE 2-56-21 W4M and the northern portion of NE 35-55-21 W4M. It is also likely that wildlife in habitat adjacent to the LSA will be displaced temporarily due to the noise from construction activities.

Mechanical source noise levels within the Project site may exceed 75 dB during the operation phase ([Volume 2, Section 3, Figures 3.6-1 and 3.6-2](#)). However, noise levels are predicted to subside to tolerable levels (below 55 dB) at the locations of suitable wildlife habitats (300 m to 400 m from the Project site) due to distance attenuation (MPCA, 1999). It is likely that local mammalian species such as white-tailed deer and moose will habituate to the low noise levels associated with the Upgrader operation (Bashore and Bellis, 1982; Westworth et al., 1989). At the predicted noise levels, it is expected that disruption to bird ecology in the immediate vicinity of the Upgrader site will be minimal, and that habituation is likely to occur (Dafour, 1980; White and Thurow, 1985; Slabbekoorn and Peet, 2003; Tempel and Gutierrez, 2003).

Due to morphological features in the middle ear, noise tolerance in some *Fringillidae* (including finches) and *Emberizidae* (including sparrows) species is high relative to other families of birds. Most of the songbirds recorded in the LSA are members of the above families, have been shown to have high learning plasticity and can adapt to communicate within a range of conspecific frequencies when necessary (Peris and Pescador, 2004). Changes in ovenbird (*Seiurus aurocapilla*) nesting success have been noted adjacent to compressor stations operating at 75 dB to 90 dB in forested environments (Habib et al., 2007). The stations in the ovenbird study were situated in 1 ha to 2 ha clearings, and nesting success was recorded up to 200 m from the edge of the clearings. At the predicted noise levels of the Project and the distance to suitable habitat from the noise sources, the modification in bird song frequency and changes in nesting success is unlikely. At the predicted levels, habituation will likely occur for both birds and mammals.

Loud noise may hinder vocal communication between frogs during courtship (Sun and Narins, 2005). However, singing wood and boreal chorus frogs were detected adjacent to nearby plants with similar noise outputs (North West Upgrading, 2006), so that the effects on amphibians are expected to be low.

The noise associated with the Project is predicted to be localized, and while Project noise will continue as long as the Upgrader is in operation, the effect is reversible with the closure of the Project. The noise levels associated with the Project are anticipated to have no to low impact on wildlife health, behaviour or persistence (varying with species). The prediction confidence in this evaluation is high, based on published data regarding noise and the effects on wildlife, and because of the comprehensive noise models applied for the Project ([Volume 2, Section 3](#)).



### 11.6.1.2 Light

The assessment of the effects of artificial light on wildlife is a relatively new process. Other than the effects of lighted structures and their attraction to birds, little literature is currently available for review. Artificial light has the potential to cause changes in circadian rhythms, disrupt hormone cycles, cause behavioral change and alter the balance between predators and prey (Rich and Longcore, 2006). The instruments used to measure the effects of artificial lighting for the Project are not sensitive enough to measure all light that is detectable for some wildlife. However, qualitative predictions on the ways in which light may affect wildlife can be judged based on the species in the region, the findings in the literature and the results of regional surveys near existing developments.

**Table 11.6-1 Summary of Potential Effects of Sensory Disturbance on Key Species**

Species	Potential Effects
White-tailed deer	White-tailed deer are tolerant of human activity and constant noise (Bashore and Bellis, 1982; Pattie and Hoffman, 1990; Smith, 1993). While white-tailed deer will likely vacate the construction zone, they are also likely to use green areas on the Project site, as well as habitat remaining around the Upgrader once construction has been completed. The effect of light on deer is unknown, but given the human tolerance level of white-tailed deer, they are likely to habituate to greater ambient nocturnal light. However, increased light may also increase predation pressure, thus causing deer to avoid more illuminated areas.
Coyote	Coyotes are human tolerant, but will vacate the immediate area of the construction zone (Pattie and Hoffman, 1990; Smith, 1993). Coyotes will likely return to areas near the LSA once the Project is operational, especially in the preserved habitat at the northern end of the LSA. The effect of light on coyotes is unknown. Greater ambient nocturnal light may allow for better detection of prey at night, but a decrease in nocturnal prey activity due to greater levels of illuminance may actually cause a decrease in successful hunts (Beier, 2006).
Moose	Moose may return to the immediate area after a period of habituation to plant noise (Westworth et al., 1989), but since habitat suitability in the immediate vicinity of the LSA is considered to be low, the occurrence of moose will remain unlikely. Due to the low occurrence of moose in the LSA, the effect of an increase in ambient light is unlikely to have a measurable effect on moose.
Long-tailed Weasel	Due to the attenuation of noise levels with increasing distance from the Project, the behaviour and presence of long-tailed weasels is unlikely to be affected in nearby suitable habitat during the operation phase. Construction activity adjacent to suitable habitat may cause a temporary decrease in long-tailed weasel occurrence. An increase in ambient nocturnal illuminance may cause a decrease in prey activity, as well as weasel activity due to increased predatory risk (Beier, 2006).
Great horned owl	The foraging range of great horned owls in fragmented landscapes is approximately 1,500 ha (Houston et al., 1998). Owls have been shown to be relatively tolerant of loud noise (Tempel and Gutierrez, 2003). However, if auditory hunting is being interfered with near the construction site, the home range of a local great horned owl would allow for hunting away from the disturbance. Attenuation of noise levels during the operation phase is unlikely to affect owl behaviour. Greater ambient nocturnal light may allow for better detection of prey at night, but a decrease in nocturnal prey activity due to greater levels of illuminance may actually cause a decrease in successful hunts (Beier, 2006).



Species	Potential Effects
Songbirds	Many species of songbirds use songs and calls to delineate territories and call in mates, as well as during courtship. However, noise levels of the Project during the operation phase are not expected to be above levels that will disrupt or interfere with songbird communications (Dafour, 1980; Slabbekoorn and Peet, 2003). Songbird territorial and breeding communications were detected adjacent to fully operational plants (as described in North West Upgrading, 2006) at similar rates as those found during the Project baseline surveys. It is expected that if there is a disruption due to noise levels during construction, it will be a short-term effect.
Amphibian Community	During the breeding season (April-May), increased noise levels associated with plant construction may alter or inhibit communication between individual frogs (Sun and Narins, 2005). Pairing of males and females may be affected in the immediate construction area; however, singing frogs have been detected adjacent to nearby plants in operation (Degussa's Gibbons Hydrogen Peroxide Plant and Agrium's Redwater Fertilizer Plant) (North West Upgrading, 2006). It is expected that if there is a disruption due to noise levels during construction, it will be a short-term effect. Potential physiological effects of increased amount of illuminance may include decreases in nocturnal foraging and courtship activity, as well as changes in hormone levels (Buchanan, 2006). The significance of these changes is unknown. As mentioned above, singing frogs have been detected adjacent to nearby plants in operation (Degussa's Gibbons Hydrogen Peroxide Plant and Agrium's Redwater Fertilizer Plant) (North West Upgrading, 2006) at levels recorded during the Project baseline surveys.

Bats, nocturnal rodents and other nocturnal mammals respond to clear moonlight conditions by a decrease in foraging, general activity and distance traveled when moving through their habitat (Beier, 2006). A decrease in overall activity and a shortening of the distance in movements are likely associated with a predation risk response (Bird et al., 2004). Limited research has shown that circadian rhythms can be disrupted when artificial light is used to mimic twilight conditions (Beier, 2006). Some species of bats have been shown to be attracted to artificial light sources such as street lights (Rydell, 2006). It is presumed that foraging is relatively more efficient due to the higher density of insect prey that is drawn to the light. Avoidance of lit areas has also been shown in other species, such as the *Myotis* spp. However, what is not known is whether they are avoiding the light, or the open spaces around the light away from cover. Low prey capture rates by big brown bats near artificial light sources have also been explained by the capture of larger prey items (Rydell, 2006). Efficient hunting of large, preferable prey that congregate near lights would require fewer hunting flights.

Molenaar et al. (2006) presented preliminary data that suggests that roadside lighting may decrease habitat suitability of grassland birds. This research showed a greater occurrence of nests in relatively darker areas, away from lights. The roadside lights in Molenaar et al. (2006) had an illuminance of 10 lux, 100 times the light of a full moonlit sky (Table 11.6-2). The ways in which lights may affect forest bird nest distribution near the Project is unknown because research on how the distribution of bird nests affected by artificial lighting is very limited. However, even within 300 m of the Project, the illuminance is predicted to be between 0.7 lux and 2.3 lux, somewhat brighter than a moonlit night, but less bright than a street light. Therefore, it is predicted that any disruption in nest site selection by birds in habitat adjacent to the Project will be negligible.

Migrating birds have been shown to be attracted to structures with lights, a factor which can lead to collisions (Gauthreaux and Besler, 2006). Collisions most likely occur where structures are masked in darkness, such as towers, guylines or lighthouses. Red lights that are constantly illuminated appear to attract more birds than white strobe lights (Gauthreaux and Besler, 2006). Active flare stacks can be a threat when birds approach the flare too closely (Gauthreaux and



Besler, 2006). The glow of light pollution associated with large cities may mask visual cues used by migratory birds (Gauthreaux and Besler, 2006). However, the haze of city lights will not impact birds in the more rural setting of the LSA.

Published research on the effects of artificial light has mostly focused on the ways in which changes between light and darkness affect wildlife. When it comes to amphibians, some research indicates that degrees of darkness may affect activity and hormone cycles (Buchanan, 2006). Activity of boreal chorus frogs is thought to be triggered by darkness, with changes in behaviour linked to differences in illuminance ranging from 0.1 lux (full moon) to 0.00001 lux (Buchanan, 2006). The instrumentation used to assess the potential light of the Project could not measure illuminance below 0.63 lux. Therefore, any increase in light at the Project site has the potential to cause changes in frog behaviour. One of the key components to the ecology of frogs is communication, and research has suggested that frogs may not sing in areas of high illuminance (Buchanan, 2006; Baker and Richardson, 2006). However, the amount of light used by Baker and Richardson (2006) to trigger effects was in the range of 52 lux to 120 lux, while the light predicted to reach the potential amphibian habitat will be below the detectable limit of 0.63 lux. If changes in frog behaviour are associated with changes in illuminance at the levels between 0.1 lux and 0.00001 lux, these changes cannot be correlated with changes in light associated with the Project, since those levels of illuminance were not measured. Frog surveys near other existing facilities (North West Upgrading, 2006), documented call rates comparable to those recorded during the Project's baseline surveys. Therefore, it may be that only significant changes in behaviour such as a cessation in singing are associated with drastic changes in illuminance as demonstrated in laboratory studies (e.g., Baker and Richardson, 2006). It may be that only subtle changes in behaviour are associated with very small changes in illuminance. Therefore, the artificial light associated with the Project is not predicted to alter frog behaviour in nearby habitats.

The light associated with the Project is predicted to be localized, and while Project illuminance will continue as long as the Project is in operation, the effect is reversible with the closure of the Project ([Appendix 11A](#)). The impact that illuminance associated with the Project will have on wildlife health, behaviour or persistence varies by species, and as such the environmental impact is rated as no impact to low impact. The prediction confidence level is considered to be moderate because the Project's illuminance levels were assessed at human detection levels ([Volume 5, Section 14](#)), and due to the paucity of published research regarding the effects of light on wildlife.

**Table 11.6-2 Illuminance Levels of Selected Sources**

Source	Illuminance (lux)
Full sunlight	103,000
Partly sunny	50,000
Operating table	18,000
Cloudy day	1,000 - 10,000
Bright office	400 - 600
Most homes	100 - 300
Lighted parking lot	10
Full moon under clear skies	0.1 - 0.3
Quarter moon	0.01 - 0.03
Clear starry sky	0.001
Overcast night sky	0.00003 - 0.0001

Source: Rich and Longcore, 2006.



### 11.6.1.3 Mitigation

Disturbance due to habitat clearing and construction will be minimized by not initiating construction during the nesting season of birds, the peak courtship period of most amphibians or the fawning periods of mammals. The necessary removal of trees or drainage of wetlands will not occur between April 15 and July 15, as recommended by Alberta Sustainable Resource Development (Follinsbee, J., pers. comm.)

During the operation phase, illuminance of non-process platforms will be switch controlled to minimize light output. Additionally, all outdoor fixtures will employ shields to minimize light pollution and achieve black sky conditions. There will be no perimeter lighting other than in gate areas. Aircraft obstruction lighting for the stack will require four levels of red lights alternating between steady red and flashing red.

### 11.6.2 Loss and/or Alteration of Wildlife Habitat

Over 85% of the LSA's land cover is currently cultivated agriculture. The agricultural lands were found to have the lowest species richness, densities and diversity of all general habitat types in the study area. In general, the wildlife habitat of the LSA is of poor quality in comparison to the RSA.

The development of the Project will require the removal of some highly and moderately rated habitat of most key species. However, most of the highly and moderately rated habitat available for most key species is located in SE 2-56-21-W4 and the northern portion of NE 35-55-21-W4. These areas will remain intact as natural areas, thus preserving habitat with the highest diversity and density of wildlife on the Project property.

Although a portion of the existing LSA habitat is to be preserved, the development of the Project will lead to an overall reduction in habitat for wildlife ([Table 11.6-3](#)). For some species, the reduction of moderately to highly ranked habitat may be up to 88%; although the high percentage can be more of a reflection on the lack of habitat at baseline. For example, the 485 ha Project footprint will require the clearing of 9.2 ha of the 14.0 ha of treed and shrubby habitat considered suitable for great horned owls. However, compared to the more densely treed regions to the north of the Property, there are very few treed areas in the LSA. Only 2.5% of the property is considered highly or moderately rated great horned owl habitat at baseline. Thus, while a large proportion of available great horned owl habitat will be lost, the property is not a regionally important source of suitable great horned owl habitat at baseline. Coyotes will see a significant decrease in moderately rated habitat, although most of the loss will be in the form of agricultural lands ([Table 11.6-3](#)). For the other key species, the reduction in highly to moderately rated habitat will be minimal in area ([Table 11.6-3](#)).

The impact of the Project on habitat availability is considered to be low. Given the size of the developmental footprint, the preservation of close to two-thirds of the important habitat is notable. Due to the preservation of suitable wildlife habitat types, decrease in species richness and diversity of the LSA will be minimal. Furthermore, habitat in which sensitive species were noted will be retained in whole or in part. The development of the Project will not lead to the direct displacement of sensitive species due to habitat loss or alteration, and therefore, the environmental impact is rated as low. The effects of habitat loss will occur throughout operations, but the effect is reversible with the closure of the Upgrader and reclamation of the site. The confidence level of predictions regarding the effects of habitat loss are considered to be high, due to the high quality of field data, GIS habitat modelling data and North American's plan to preserve examples of suitable habitat for most species found in the LSA.



**Table 11.6-3 Habitat Suitability and Availability for Baseline and Application Cases in the LSA**

Species Suitability Rating	Baseline Case		Application Case	
	Hectares	Percent of Total	Hectares Remaining	Percent Change
<b>Deer</b>				
High	5.6	1.0	4.0	-28.3
Moderate	35.5	6.3	28.7	-19.2
Low	491.9	87.6	40.1	-91.9
Nil	28.7	5.1	03.8	-86.9
Totals	561.7	100.0	76.6	-86.4
<b>Moose</b>				
High	5.6	1.0	4.0	-28.3
Moderate	16.2	2.9	9.3	-42.2
Low	27.7	4.9	20.1	-27.5
Nil	512.2	91.2	43.1	-91.6
Totals	561.7	100.0	76.6	-86.4
<b>Coyote</b>				
High	4.1	0.7	3.0	-27.0
Moderate	504.3	89.8	59.7	-88.2
Low	11.0	2.0	9.3	-15.3
Nil	42.2	7.5	4.5	-89.3
Totals	561.7	100.0	76.6	-86.4
<b>Long-tailed Weasel</b>				
High	5.6	1.0	4.0	-28.3
Moderate	19.3	89.5	19.3	0.0
Low	499.6	2.9	48.7	-90.3
Nil	37.1	6.6	4.5	-87.8
Totals	561.7	100.0	76.6	-86.4
<b>Great-horned Owl</b>				
High	12.5	2.2	3.8	-70.8
Moderate	1.5	0.3	1.0	-88.3
Low	502.8	89.5	57.8	-31.9
Nil	44.9	8.0	13.1	-69.8
Totals	561.7	100.0	76.6	-86.4
<b>Songbirds</b>				
High	5.2	0.9	4.5	-19.7
Moderate	39.2	7.0	29.0	-25.3
Low	512.4	91.2	43.1	-91.6
Nil	4.9	0.9	0.0	-100.0
Totals	561.7	100.0	76.6	-86.4
<b>Amphibians</b>				
High	16.2	2.9	9.3	-42.2
Moderate	38.8	6.9	24.8	-35.9
Low	491.9	87.6	40.1	-91.9
Nil	15.0	2.7	2.3	-84.5
Totals	561.7	100.0	76.6	-86.4

Note: The totals in this table may not add due to rounding.

### 11.6.2.1 Mitigation

In addition to the preservation of a large portion of the important habitat in the LSA, the Project will also include the creation of new or enhanced wetlands, either in SE 2-56-21 W4M or possibly



off-site to offset the loss of larger wetlands that are found within the developmental footprint. As described in [Volume 4, Section 10 - Vegetation and Wetlands](#), the size and placement of the wetland mitigation will be determined at a later date.

### 11.6.3 Wildlife Mortality

The two main causes of mortality to wildlife include habitat destruction associated with clearing, as well as vehicular collisions. The main concern would be nesting birds and animals taking cover in the woodlots and shrubby habitat. Most wildlife species are mobile and would vacate the LSA once construction of the Upgrader is initiated. However, should construction be initiated during the nesting and natal periods for wildlife, individual animals may not be able to escape. Local traffic volumes are expected to increase during the construction and operation phases of the Project. With an increase in traffic, there is the possibility that there will be an increase in vehicle-wildlife collisions.

The mortality of wildlife associated with the Project is predicted to be isolated, localized and negligible ([Appendix 11A](#)). This is because many wildlife species are mobile and would vacate the LSA once construction of the Project is initiated, and also because wildlife mortality may be relegated by scheduling construction activities away from nesting and natal periods.

Wildlife mortality events associated with increased traffic around the Project are predicted to be rare. Overall, wildlife mortality associated with the Project will not measurably affect the persistence of local wildlife populations, and as such, the environmental impact is rated as negligible. Based on the calculations of the regional transportation study (Stantec, 2007) and the results of the field surveys, the confidence level of the wildlife mortality assessment is considered to be high.

#### 11.6.3.1 Mitigation

Mortality due to habitat removal will be minimized by not initiating construction during the nesting season of birds or the natal periods of mammals. The necessary removal of trees or drainage of wetlands will not occur between April 15 and July 15, as recommended by Alberta Sustainable Resource Development (Follinsbee, J., pers. comm.).

Construction and operation of the Project will result in an increase in traffic volumes in the vicinity of the Upgrader. There is likely to be a marginal increase in vehicle-wildlife collision rates. Aside from promoting awareness of wildlife while driving in rural areas (including adherence to speed limits) for contractors and employees working at the Project, no other mitigation is warranted.

### 11.6.4 Effects of Air Emissions on Wildlife Health

The air quality evaluation is based on the full development of the Project. The Project will be a source of sulphur dioxide (SO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOC) and PM<sub>2.5</sub> emissions that result from combustion processes ([Volume 2, Section 2](#)).

Long-term exposure to the modelled values of the Project as described in [Volume 2, Section 2](#) are all below concentrations deemed critically detrimental to wildlife (Alarie et al., 1970; Theodore et al., 1971; Tabacova et al., 1985; Hayashi et al., 1987; BA Energy, 2004; Shell Canada, 2005). Air emissions associated with the Project will range beyond the extent of the wildlife LSA and RSA, and the emissions will continue as long as the Project is in operation. However, the long-term effects of emissions are not expected to affect wildlife in the LSA, either through inhalation or consumption; therefore, the environmental impact is rated as no impact. The prediction