



## **APPENDIX A**

### **ECOLOGICAL CONSIDERATIONS FOR DESIGNATED AREAS FOR PROTECTION**

#### **Considerations for Moose**

##### **Evidence of Moose Population Decline in the Alberta Oil Sands Region**

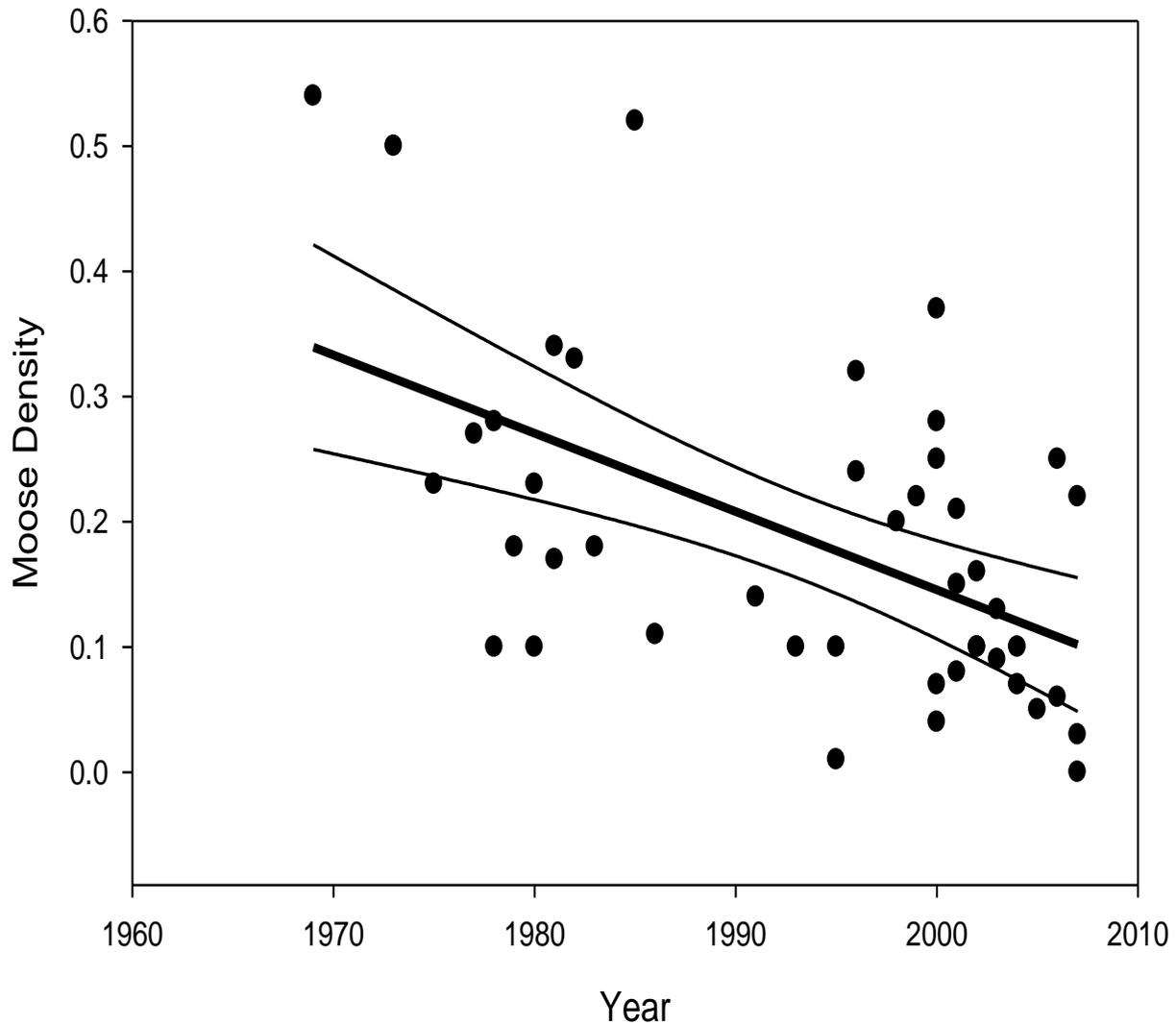
Data gleaned from aerial surveys in the region suggest that the moose population declined since the 1970s from nearly 4 moose per 10 km<sup>2</sup> to about 1 moose per 10 km<sup>2</sup> (see Figure 1). Figure 1 is based on the data provided in Suncor's Mine Dump 9 Application (Attachment 1 of the SIRs, Table 5-1, Suncor 2008). It demonstrates that moose density is declining in the region. The declining trend is statistically highly significant (Spearman rank order correlations  $r_s = -0.52$ ,  $N = 44$ ,  $p < 0.001$ ). The declining population trend is not surprising given the increasing conversion of natural land surfaces to industrial development.

The moose densities in Figure 1 help to envision the size of the area that would be needed to maintain a healthy and productive population. If we assume that the region (and the moose population) was relatively undisturbed before the 1970s, then we might expect about 4 moose per 10 km<sup>2</sup>. According to our population viability modeling (analyses conducted for other projects in the region) without wolf predation (which can likely be influenced by the amount of industrial development), we estimate that a population of 200 moose can be expected to be viable and growing while still providing a resource for hunting. A population of 200 moose would require about 500 km<sup>2</sup> of land that includes moose habitat of varying qualities and for different life-history parameters. However, given that wolf populations are healthy in the region and likely exert a substantial predation pressure on the moose populations, a much larger area, like one of several thousand square kilometers, would be required to maintain a viable population that serves as a resource for traditional (and presumably non-traditional) hunting.

##### **Moose Habitat in the Region**

Using the Alberta Ground Cover Classification data base, we mapped those vegetation communities that are preferred by moose as moose habitat, depicted in brown in Figure 2. Figure 2 shows moose habitat before any major disturbances by industrial activities. Figure 2 can be used to find potential candidate areas that could be protected from the standpoint of available moose habitat. Ground-truthing of moose habitat quality and congruence or validation with local Traditional Ecological Knowledge (TEK) would be required to evaluate any area's potential as moose habitat.

Moose Habitat was determined by calculating an affinity index. Affinity indices provide a quantitative evaluation of wildlife habit preferences based on field data that indicates relative moose occurrence in each of the AGCC vegetation classes. Details can be provided upon request.



**Figure 1: Moose densities (moose per km<sup>2</sup>) observed in various aerial surveys conducted by regulatory agencies or private industry between the years 1960 and 2008.**

The data were obtained from Suncor (2008). Where a range of dates was given we plotted the most recent year, where a range of densities was given we plotted the highest indicated density. The trend line is  $y = -0.0063x + 0.7709$ ,  $\pm$  95% confidence limits indicated by the lines above and below. The declining trend is statistically highly significant (Spearman rank order correlations  $r_s = -0.52$ ,  $N = 44$ ,  $p < 0.001$ ).

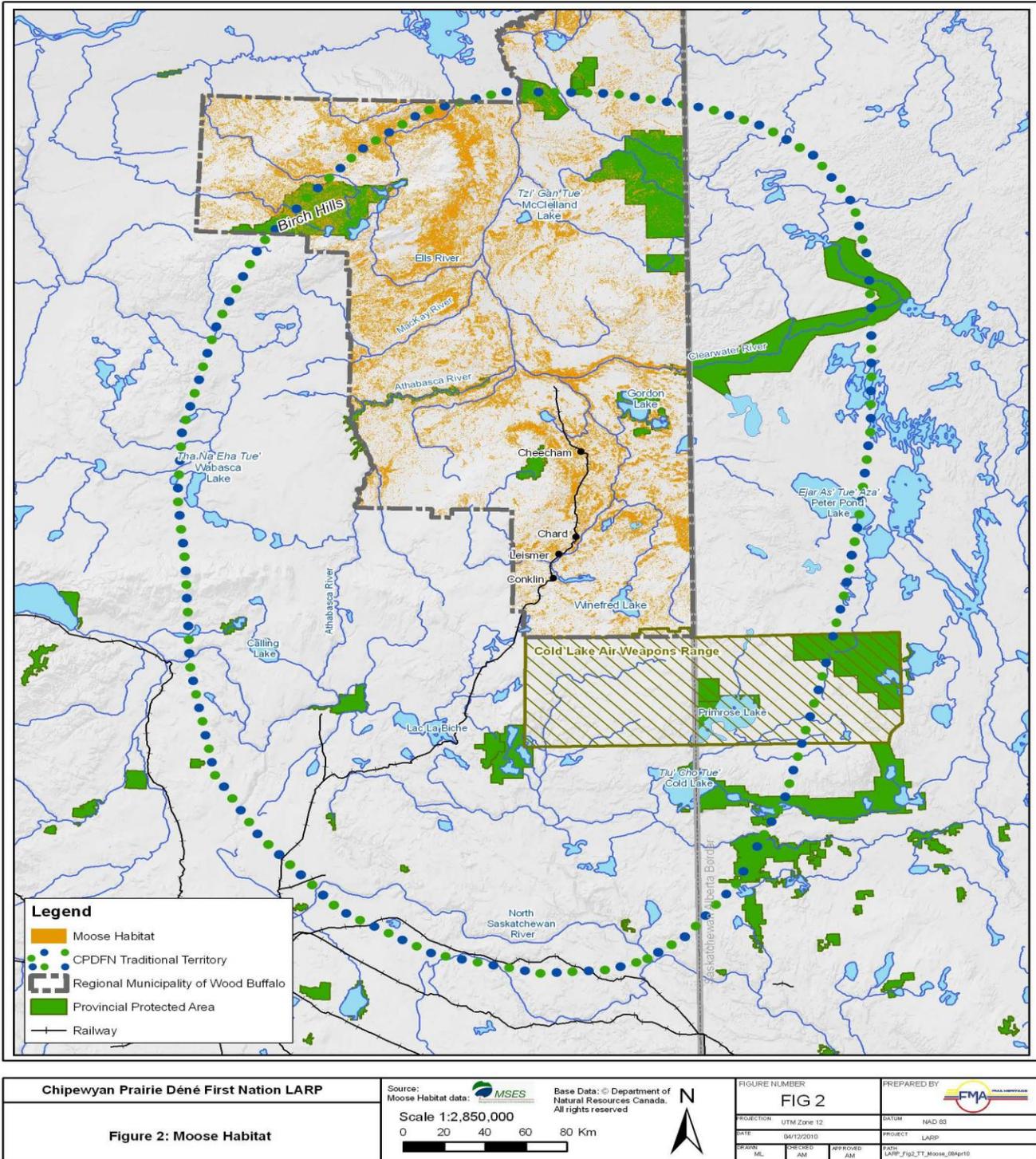


Figure 2: Moose Habitat Distribution Regional Municipality of Wood Buffalo.

## Considerations for Caribou

Designating a protected area for caribou is challenging. This is in part because of the large seasonal movements of caribou (estimates of home-range size are from 500 km<sup>2</sup> to several thousand km<sup>2</sup>). Moreover, the mapping of caribou habitat quality by means of remote sensing is difficult because the abundance and quality of lichen (main forage for caribou) is difficult to detect on satellite images. However, the coverage of terrestrial lichen and other forage for caribou was estimated based on vegetation coverage provided by the Alberta Ground Cover Classification (AGCC) (Figure 3).

In addition, discussions with members of the Chipewyan Prairie Dené First Nation (CPDFN) yielded qualitative information on the location of key Woodland caribou habitat within the CPDFN traditional land use area. These areas were roughly outlined on hardcopy Traditional Land Use mark up maps prepared by CPDFN Elders and harvesters (Figure 4).

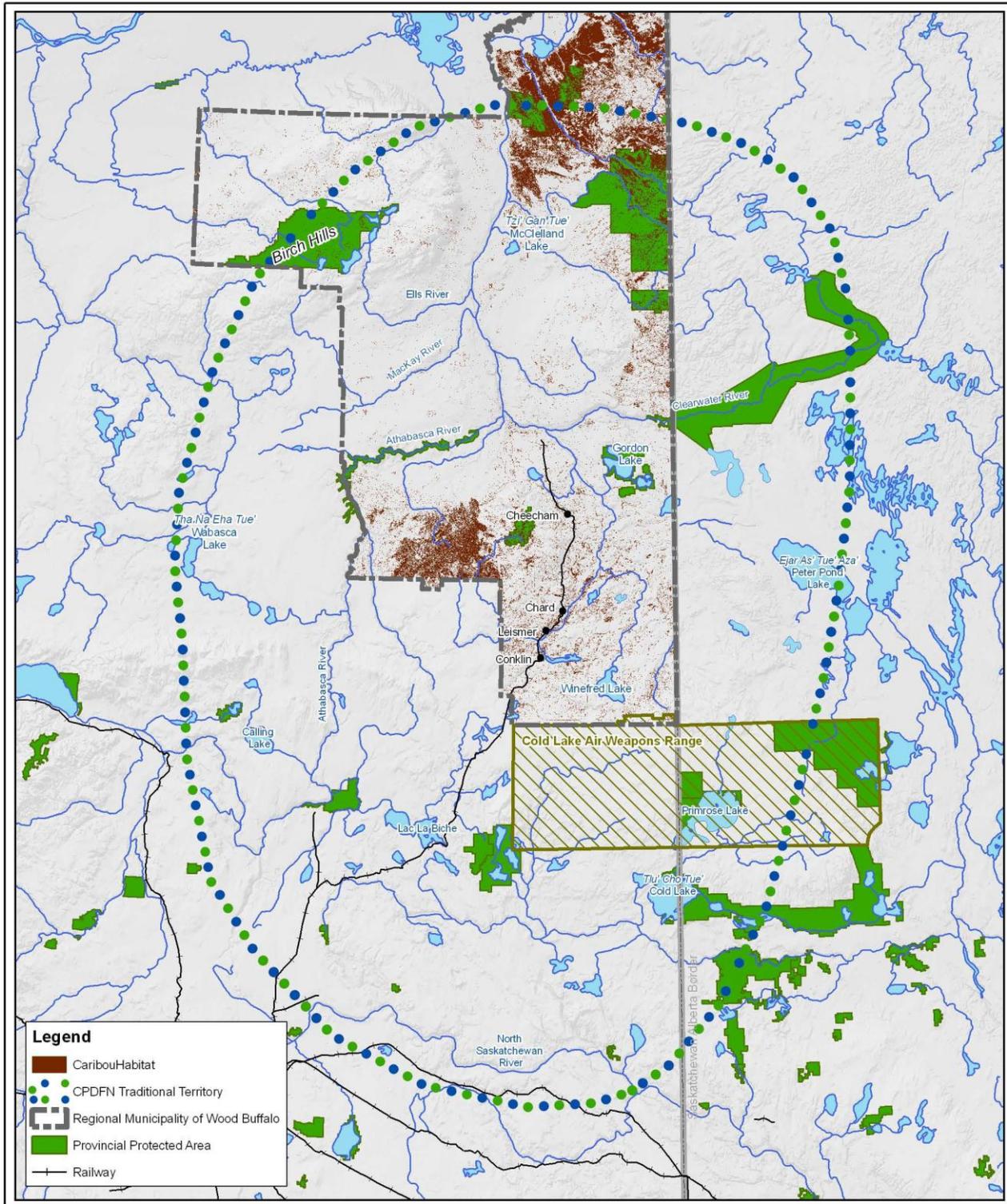
### Caribou Habitat in the Region

The availability of adequate winter forage is a critical life requisite for Woodland caribou (Nagy et al. 2004, Joly et al. 2003). In particular, terrestrial lichens are a primary food source for Woodland caribou, followed by evergreen shrubs and grasses (Bradshaw et al. 1995). Mature open black spruce forests and other needle leaf forests with a terrestrial lichen component are commonly used by Woodland caribou (Nagy et al. 2004).

We estimated the coverage of terrestrial lichen and other caribou forage species based on vegetation coverage provided by the Alberta Ground Cover Classification (AGCC). Generally, open conifer classes and undisturbed classes with a lichen or graminoid component were considered as potential caribou habitat (Nagy et al. 2004, Joly et al. 2003, Bradshaw et al. 1995). Five vegetation cover classes representing potential caribou habitat were present within the study area. Therefore, caribou habitat for the CPDFN traditional land use area is made up of the following AGCC classes:

- Class 72 – Mixed Grassland
- Class 82 – Graminoid Wetlands (sedges/grasses/forbs)
- Class 152 – Open Pine
- Class 153 – Open Engelmann Spruce/White Spruce; and
- Class 154 – Open Undifferentiated Conifer

The above-listed AGCC classes were overlaid on the areas outlined by the members of the CPDFN. There was considerable overlap of these two datasets creating a strong argument for the presence of key Woodland caribou habitat in the CPDFN traditional land use area (Figure 5).



<b>Chipewyan Prairie Déné First Nation LARP</b>  <b>Figure 3: Caribou Habitat</b>	Source: Caribou Habitat data  Base Data: © Department of Natural Resources Canada. All rights reserved.	FIGURE NUMBER <b>FIG 3</b>	PREPARED BY
	Scale 1:2,850,000 0 20 40 60 80 Km		PROJECTION UTM Zone 12 DATUM NAD 83 DATE 04/12/2010 PROJECT LARP DRAWN ML CHECKED AM APPROVED AM PATH LARP_Fig3_TT_Caribou_09Apr10

Figure 3: Caribou Habitat Distribution within Regional Municipality of Wood Buffalo

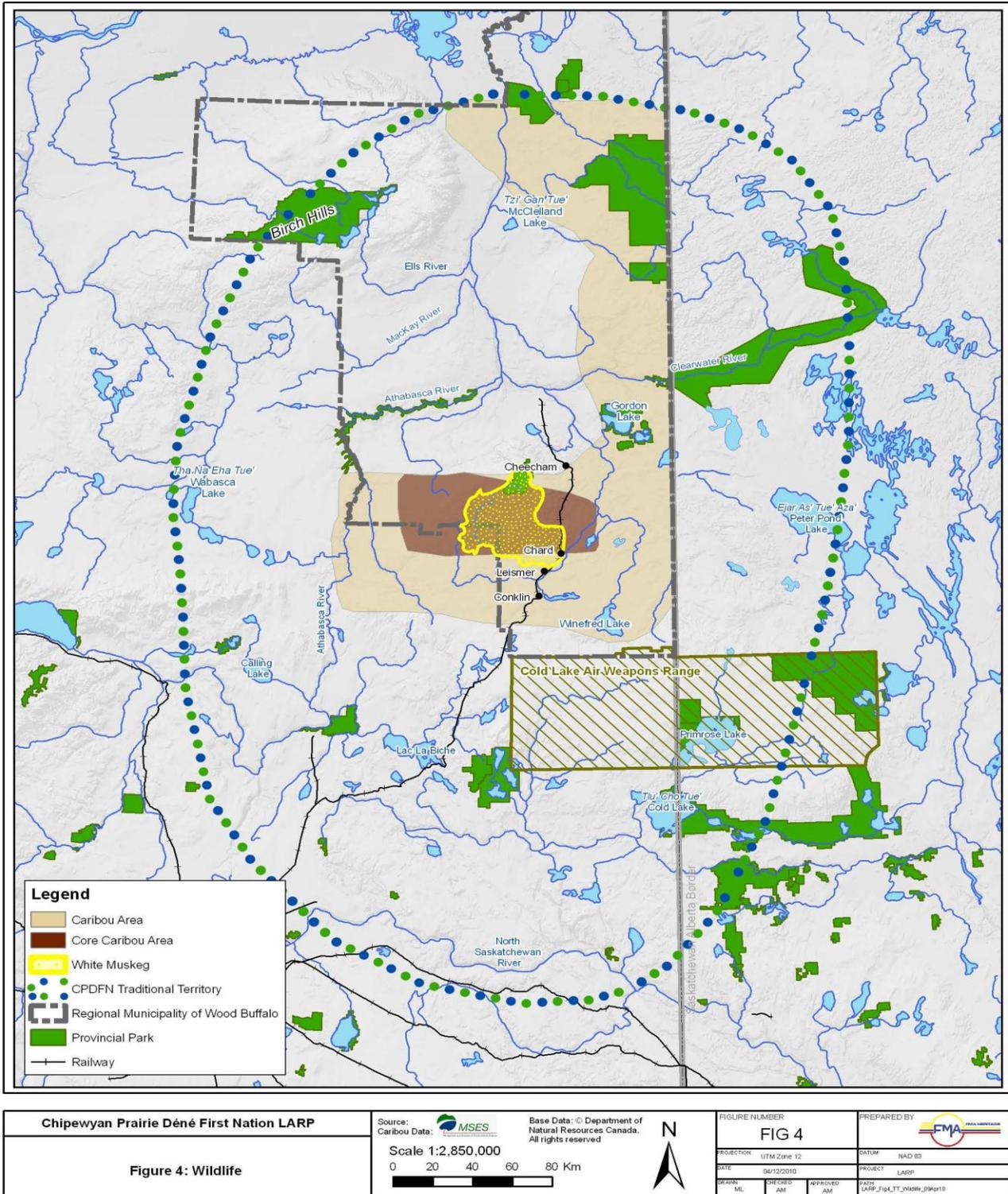


Figure 4 Caribou Habitat Distribution within CPDFN Traditional Lands (Elders/Harvesters Traditional Land Use Map)

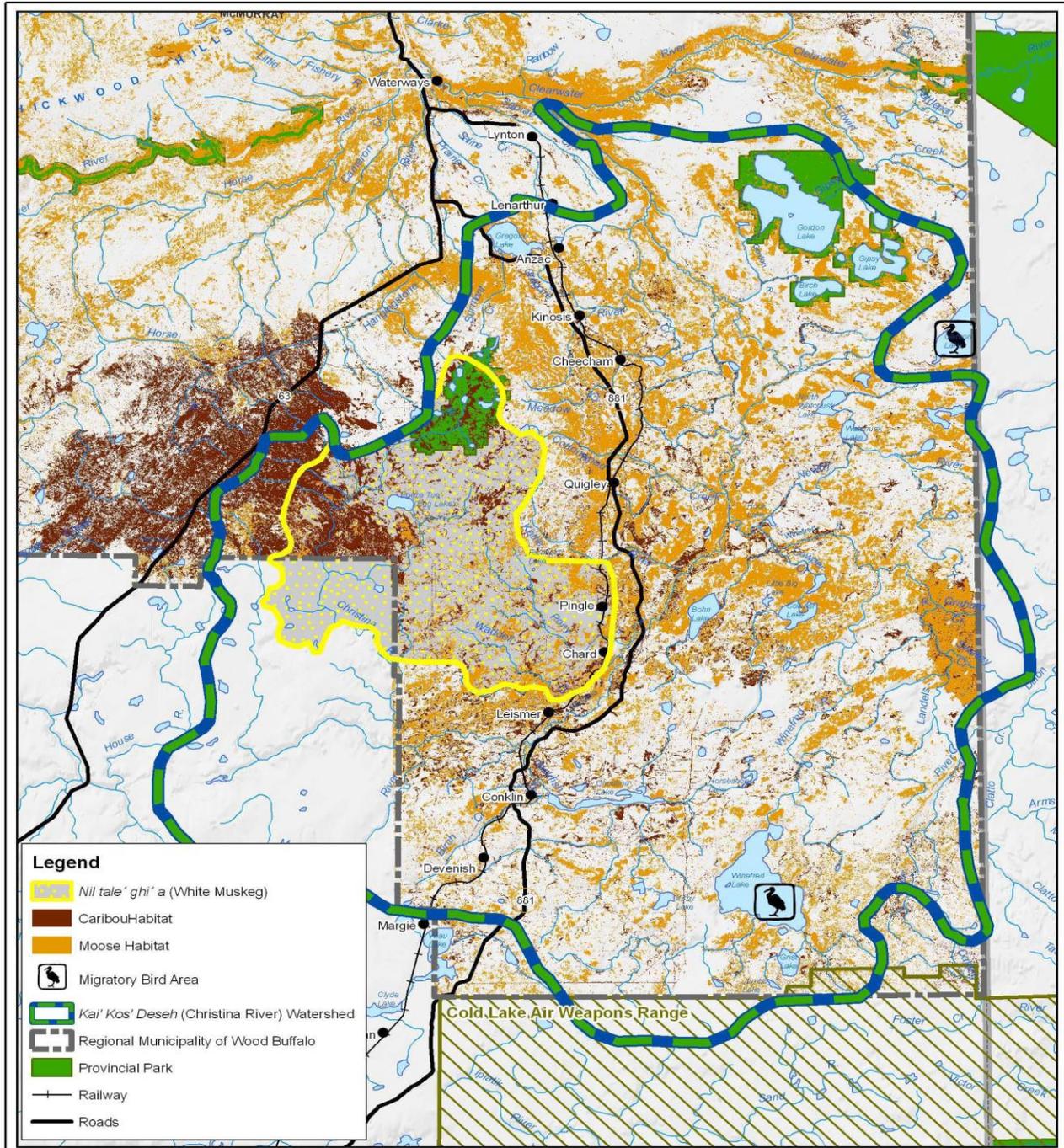


Figure 5 Moose and Caribou Habitat Distribution/Migratory Waterfowl Within Kai' Kos' Deseh/Christina River Watershed

## **Past and Current Disturbances**

Figure 6 below is based on an analysis of man-made (anthropogenic) disturbances seen on satellite images. Red areas are points that are on or within 250 metres of industrial disturbance. Numerical analyses indicate that, at the rate of disturbance experienced in the past 15 years, by the year 2020 to 2030 there will be no land left in the regional Municipality of Wood Buffalo south of Fort McMurray that is farther than 250 metres from an industrial feature.

However, there are still areas near the Saskatchewan border and between Gregoire and Egg lakes that are relatively less disturbed and more intact than other areas. The intact areas offer an opportunity for the future protection of the land cover from further industrial disturbance.

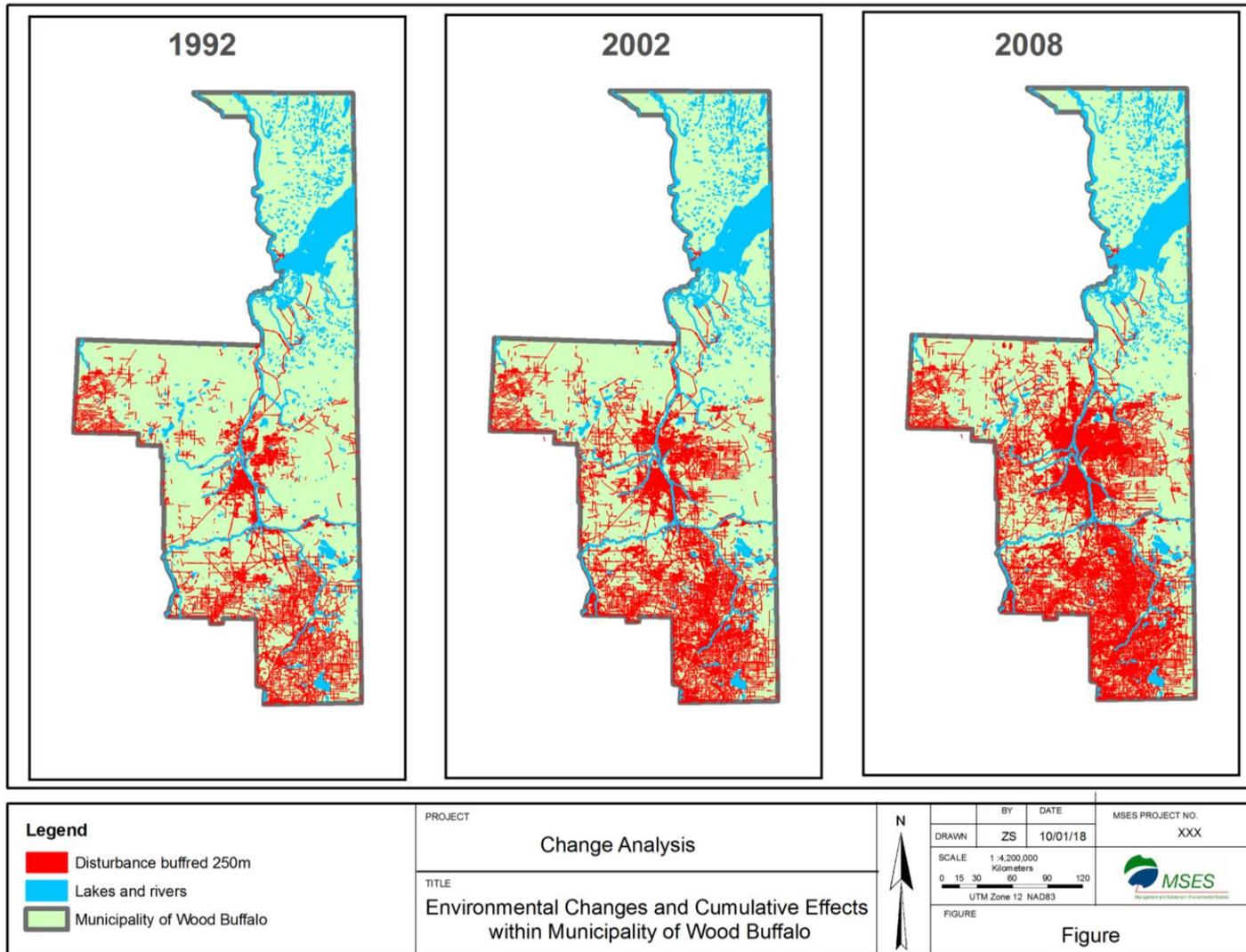


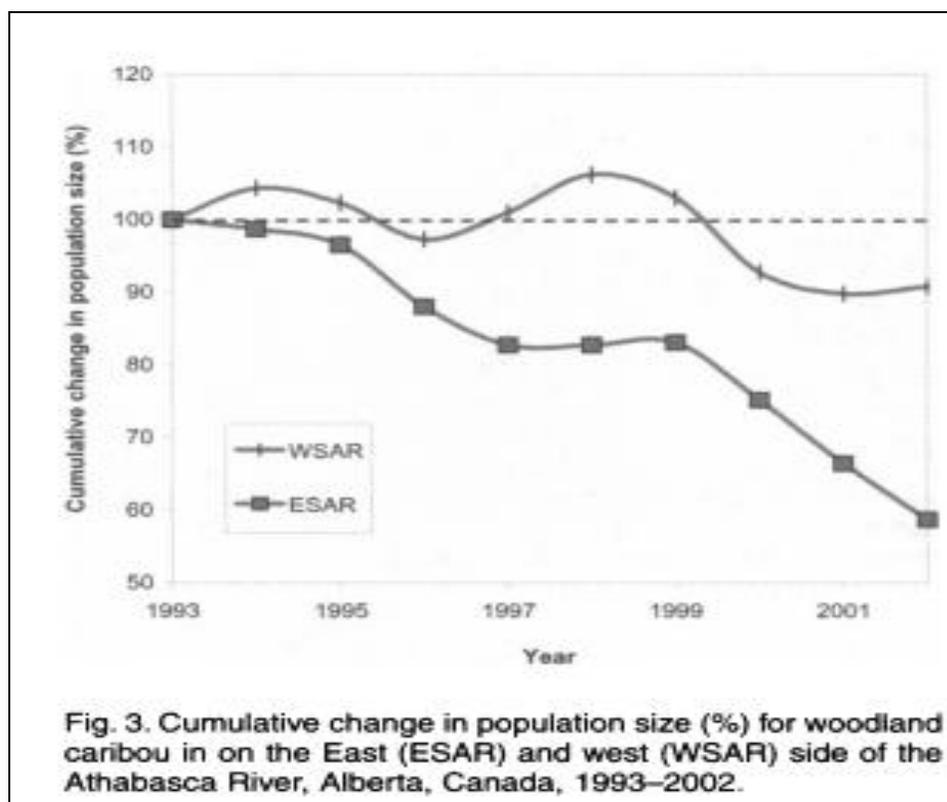
Figure 6. Progression of land cover disturbance in the Regional Municipality of Wood Buffalo between 1992 and 2008

## Bison and Caribou Populations

Bison and caribou, two historically important subsistence species, have been removed from most areas of the wider Oil Sands Region and are essentially no longer available for traditional resource use.

It is said that “Indians ... once lived bountifully on the buffalo” but that by the end of the 19<sup>th</sup> century the last wood bison were seen in the Clearwater River and the Ft. McMurray area (Gates *et al.* 1992). Although the Wood Buffalo National Park was established with the purpose of protecting the remnant population, the bison have never re-established in the region between Lake Athabasca and Cold Lake.

In that same region, the woodland caribou population is currently heavily declining (Figure 7). Figure 7 shows that the size of the caribou population in 2002 was only about 60% of its size in 1993. Since the population data has been published by the Alberta Caribou Committee in 2001, the population east of the Athabasca River has been further declining in each of the seven years when surveys were done (2002-03 was a notable exception when the population appeared to be “stable” between 2002 and 2003).



**Figure 7: Caribou Density Decline.**  
Reprinted from McLoughlin *et al.* (2003)

## **Importance of Wetlands**

Wetlands provide many benefits to wildlife and people. Wetlands are essential in maintaining the integrity and function of the ecosystem. Some benefits that wetlands provide include:

- 1) Providing nutrients and oxygen through photosynthesis -swamps and marshes are some of the most productive ecosystems rivaling the rainforest;
- 2) Can store atmospheric carbon in their vegetation and soils- peatlands store carbon that would otherwise be released to the atmosphere, destruction of peatlands could release the carbon dioxide which could affect climate conditions;
- 3) Wetlands can help spread out water over larger areas which reduces the velocity and depth of water flow through a watershed thus reducing flooding;
- 4) Store water that can recharge the groundwater supply;
- 5) Act as a natural water filter thus contributing to improving water quality;
- 6) Wetlands provide primary habitat for many species of birds, fish, mammals, insects and plants. Some of these species whose primary habitat is wetlands may be considered species of special management concern that are protected under provincial or federal legislation (Keddy 2000).

Wetlands are also important to the Aboriginal peoples because the plants and animals associated with wetlands often play key roles in sustaining traditional activities (Alberta Water Council 2008). Additional benefits to people include providing a valuable water source for livestock, educational and scientific research opportunities and providing opportunities for tourism, bird watching, hunting and fishing (Alberta Water Council 2008).

## **Protection of Wetlands**

Land use changes, drought, population growth and industrial development all contribute to the reduction of wetlands. Wetland loss in the Green Area which is represented by the forested public land in northern and western Alberta, is unknown but has likely increased due to the rapid industrial development in oil sands region (Alberta Water Council 2008). Figure 6 above shows the extent of industrial disturbance in the RMVB, supporting the view by the Alberta Water Council that wetland loss is on the increase. Our analyses of landscape disturbance indicate the urgent need for immediate protection of all wetlands in that region.

The conservation of wetlands in Alberta is supported by a variety of laws, policies, guidelines, and initiatives. The Federal Policy on Wetland Conservation is the main policy relating to wetlands on federal lands. Two key goals of this policy include:

- 1) Maintenance of the functions and values derived from wetlands, and
- 2) No net loss (NNL) of wetland functions.

All water in Alberta, including water on public and private land, is the property of the Crown under the provincial Water Act (the Act). The Act prohibits water bodies from being disturbed, drained, filled in, or altered, unless authorized by an approval from AENV.

It is unlikely that a comprehensive wetland inventory exists in the Traditional Territory of the CPDFN. It is, therefore, essential for the CPDFN to provide detailed information on wetland extent, distribution and function in order to support the NNL of wetland functions. Community members stated on a number of occasions that wetlands are being degraded. If true, then protection and compensation initiatives must take place immediately in support of the NNL policy.

## **Waterfowl**

Our search for information on flyways and staging areas specific to the CPDFN Traditional Territory did not reveal much concrete evidence. It is interesting, however, that in the early days of Oil Sands developments waterfowl research had been conducted. For example, At Gordon Lake, south of Fort McMurray, one-day counts as high as 5,600 have been documented during the spring, and estimates during fall migration of up to 100,000 ducks have been reported. (Syncrude Canada. 1973).

This indicates that Gordon Lake was of major importance for waterfowl at that time. CPDFN Elder's oral accounts suggest that Winefred Lake was of equal importance. It would be interesting to hear from the CPDFN elders whether the reported abundance of waterfowl on Gordon Lake has changed since then, and, if so, whether other lakes in the area have undergone the same changes as Gordon Lake.

Although we can't offer any concrete points of evidence for the CPDFN territory, the provincial and national big picture is interesting as it is in harmony with the concerns of the CPDFN. We have listed the concerns and policies regarding wetlands above. Specific to waterfowl, however, Ducks Unlimited Canada (DUC) shares this vision (Ducks Unlimited Canada 2010):

*“DUC is working to achieve a mosaic of natural, restored and managed landscapes capable of perpetually sustaining populations of waterfowl and other wildlife.”*

Clearly, at the current rate of development in CPDFN's territory, the maintenance of *landscapes capable of perpetually sustaining populations of waterfowl and other wildlife* is a mirage. The disturbance of wetlands must not only be stopped, it must be reversed to achieve that vision. The CPDFN community members indicated the lakes and wetlands that are important for protection. These wetland and lake complexes urgently need to be protected to achieve DUC's vision.

Moreover, DUC's conservation goals aim at restoring Canadian landscapes to support the annual life cycle needs of waterfowl at a national level. In order to achieve this, four major habitat goals have been embraced that broadly capture DUC's conservation programs:

**Goal 1: No loss of wetlands with value to waterfowl**

**Goal 2: Restore wetlands to support waterfowl**

**Goal 3: No loss of upland cover with value of waterfowl**

**Goal 4: Restore upland cover to improve habitat conditions for waterfowl**

These goals are similar to the federal wetland policies noted above, but add the need for the protection of the surrounding upland. Again, the goals to restore uplands, are in harmony with the areas surrounding lakes and wetlands, as indicated by the community.

## Rationale for Mapping Protected Areas

The descriptions below present the rationale for developing each of the layers for protection. There are four layers which are used by the CPDFN to designate protected areas that would maintain the functionality of ecological resources that are key for traditional resource use: buffers around water bodies, large intact forested landscapes, aggregations of ungulate habitat, and cultural survival areas.

### 1) Stream Levels 1, 2, and 3

The area proposed for protection within this layer includes all level 1, 2, and 3 watercourses with a 2 km buffer (1 km on either side of the watercourse) and all lakes with a 1 km buffer. The buffers are in part based on TLU information which indicates that, at a minimum, an area within 1000 m of water bodies needs to be preserved to allow for traditional resource use. In some areas such as near Winefred Lake the distance that is often used by CPDFN members is larger. Figure 8 shows areas which should be protected near waterbodies.

Generally, streams and lakes are used as travel corridors by CPDFN members. These near shore areas also support a myriad of ecological processes including habitat for species at risk as noted by Environment Canada in their submission to the hearing of the Total Jyslyn North Mine project. There are 14 nationally and internationally listed areas within the LARP boundaries, most of which would be protected by the proposed buffer surrounding waterbodies. Protection of streams and lakes and riparian habitat bordering these water bodies ensures the protection of important wildlife habitat, wildlife corridors, waterfowl staging and nesting areas, biodiversity, and other important biotic and abiotic ecosystem functions.

The layer of protection granted to all areas around water bodies is key to the establishment of a interconnected network of source habitats as Environment Canada argued in their testimony because it combines all the functions needed to help maintain regional ecosystem and traditional land use processes including:

- Wildlife corridors to allow for regional dispersal
- Setbacks from waterbodies to protect the water
- Setbacks to protect the riparian habitats
- Protecting important waterfowl habitat for both nesting and staging
- Protecting wetlands
- Protecting traditional use sites and resources

Setting aside the 1 km buffer around each waterbody will support the Federal Policy on Wetland Conservation and the provincial Water Act.

### 2) Intact Landscapes and Areas of National and International Importance

The area proposed for protection within this layer includes remaining intact expanses of boreal forest as of 2008. Intact forests are defined as areas of at least 500 km<sup>2</sup> without significant human activity (Potapov et al. 2008). In addition, these intact forest patches must be linked by a “corridor” with a width

of at least 2 km. For the purposed of this submission, intact forest was identified as an area with no visible disturbance based on landsat imagery with a 30 m resolution. Figure 9 shows areas which should be protected as part of intact forests.

Generally, increased fragmentation of the boreal forest can result in the isolation wildlife habitat patches and smaller habitat patch sizes. Use of small and isolated habitat patches becomes less likely as the energetic cost and risks associated with reaching these patches increases (Collingham et al. 2000; Laurence et al. 2002). In addition, as fragmentation increases, edge density increases (Hargis et al. 1998). Effects of human caused habitat edges on ecosystem processes of the forests include abiotic factors such as temperature and evapotranspiration, changes in vegetation and wildlife species, and influx of invasive species (Ries et al 2004). The overall effect is a reduction in habitat effectiveness making the protection of remaining intact forest a high priority.

### 3) Ungulate Habitat

The area proposed for protection within this layer includes moose, Woodland caribou, and wood bison habitat. The wood bison and the woodland caribou are threatened under the Species at Risk Act, and the moose is one of the cultural keystone species. Protection of large ungulate habitat not only directly protects traditional resources of the CPDFN but also indirectly protects species whose habitat use is encompassed within the habitat used by these species (umbrella species). Habitat loss and fragmentation is probably the most significant threat to wildlife populations (Mills 2007). The viability of a species in a landscape depends on the quantity and quality of habitat (Rutledge and Lepczyk 2002). In order to maintain the ungulate populations in the Lower Athabasca Region, remaining habitat needs to be protected. The layer of areas to be protected includes remaining large tracts of habitats suitable for these ungulates. Figure 10 shows the townships within which large aggregations of habitat still exist.

### 4) Cultural Survival Areas

The main body of this report presents the information gathered from interviews and community workshops. The CPDFN wish to protect areas which are important from an ecological point of view, including water bodies, intact landscapes, and ungulate habitat. To protect these and other culturally significant resources, the CPDFN members indicate that they require minimum survival areas. These areas include the White Muskeg, a 5 km wide corridor on either side of the Christina River, and landscapes encompassing their core traditional land use areas as shown in Figure 11.

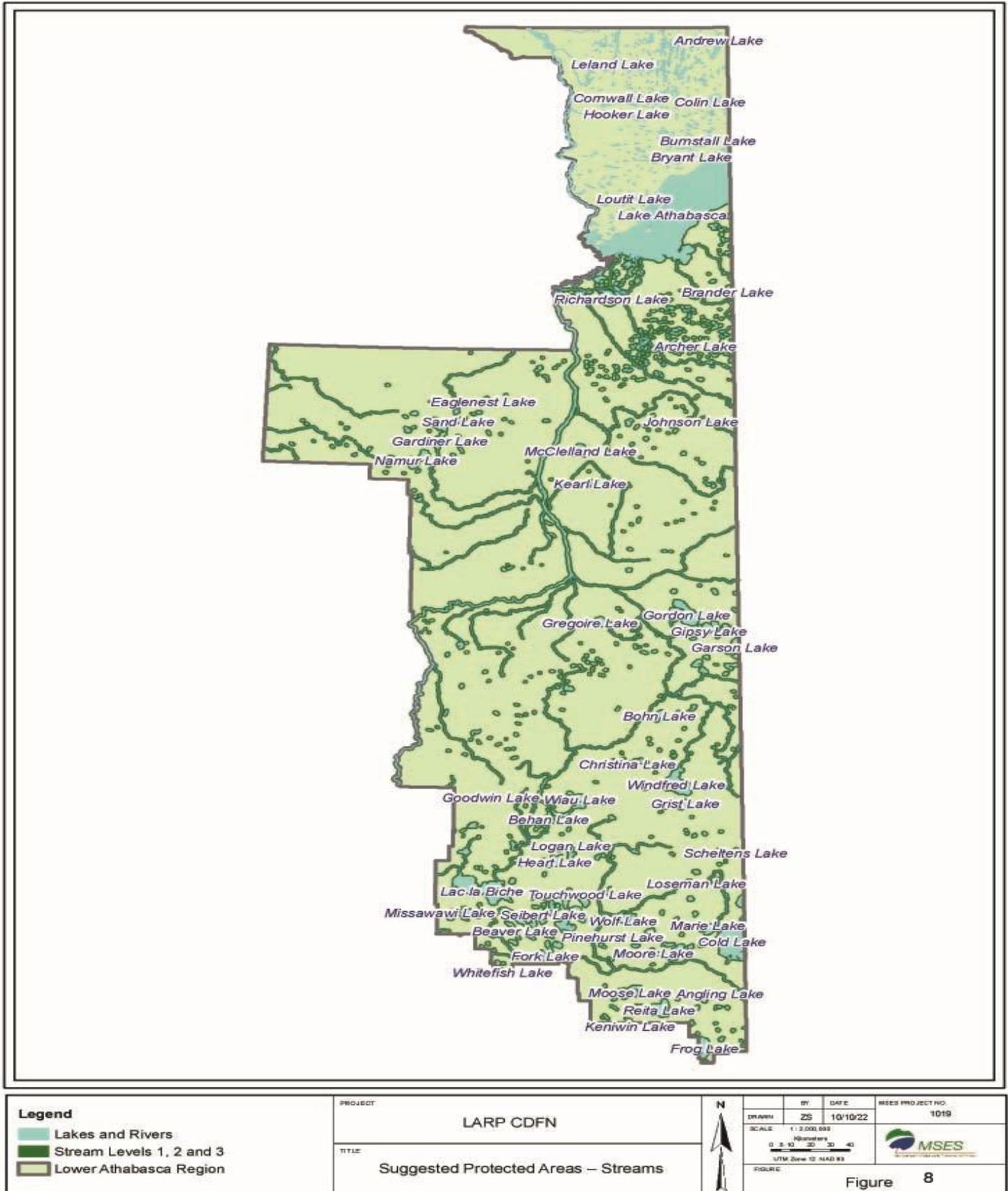
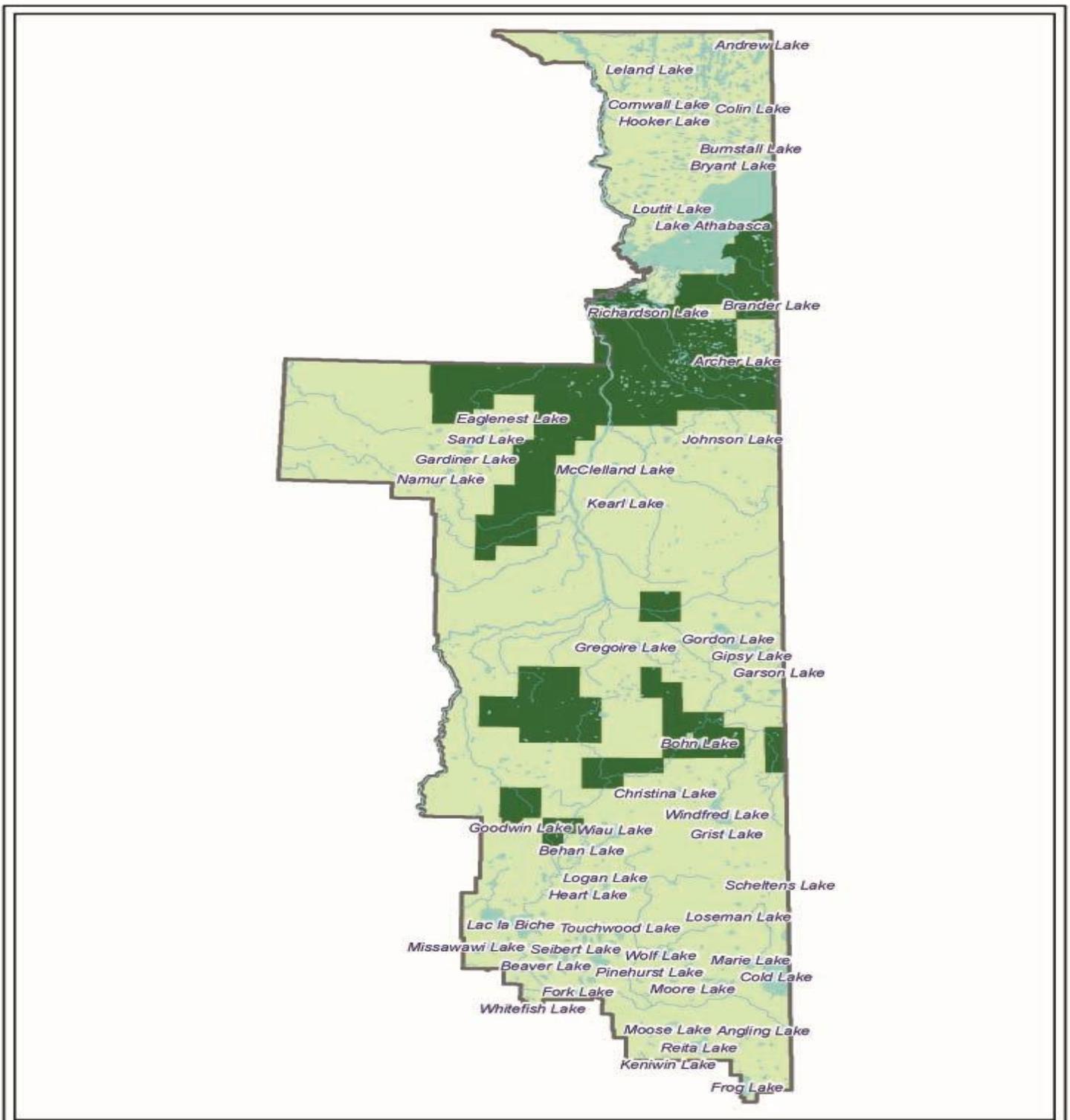
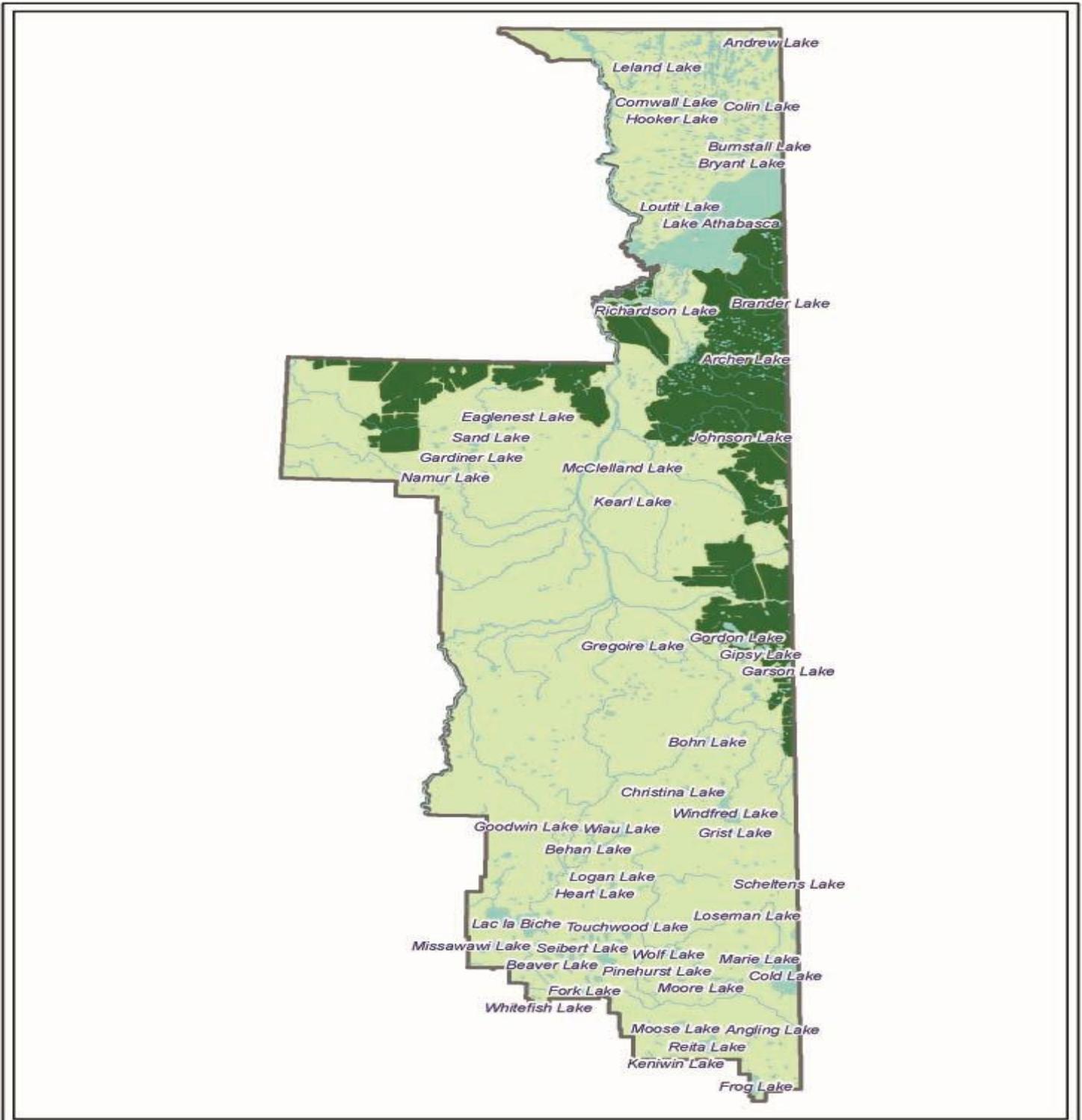


Figure 8: Buffers along Streams and around Lakes



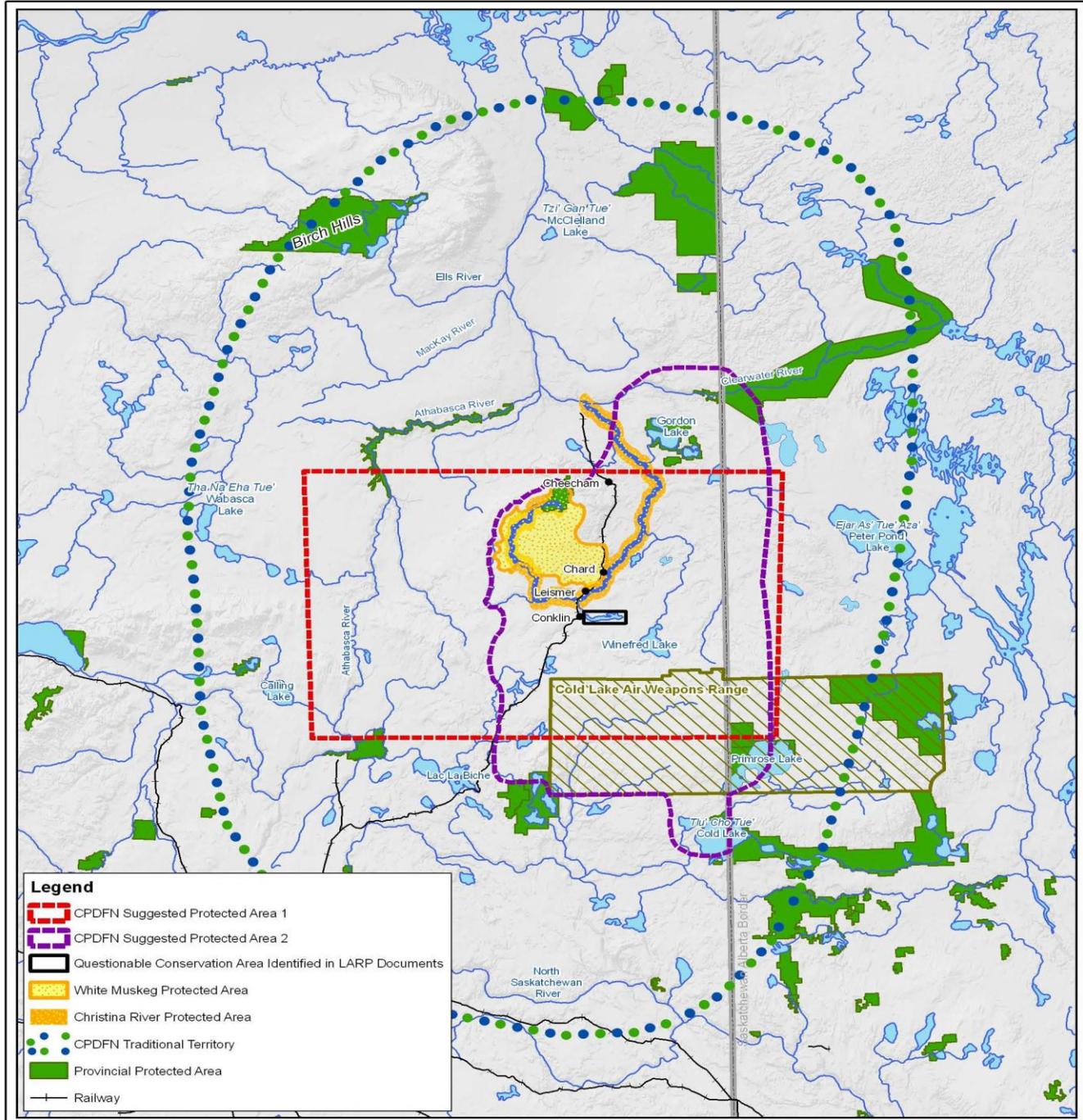
<b>Legend</b>  Lakes and Rivers  Townships with UHA*  Lower Athabasca Region <small>*UHA-Ungulate Habitat Aggregations</small>	PROJECT <p style="text-align: center;"><b>LARP CDFN</b></p>	 SCALE: 1:2,000,000 0 10 20 30 40 Kilometers UTM Zone 12 NAD 83	BY: ZS DATE: 10/10/22 MSES PROJECT NO: 1019 
	TITLE <p style="text-align: center;"><b>Suggested Protected Areas – Ungulate Habitat</b></p>		FIGURE <p style="text-align: center;"><b>Figure 9</b></p>

Figure 9: Townships Showing Ungulate Habitat Aggregations



<b>Legend</b>  Lakes and Rivers  Intact Landscapes  Lower Athabasca Region	PROJECT <p style="text-align: center;"><b>LARP CDFN</b></p>	 <table border="1" style="font-size: small;"> <tr> <td>DRAWN</td> <td>BY</td> <td>DATE</td> <td>MSES PROJECT NO.</td> </tr> <tr> <td></td> <td>ZS</td> <td>10/10/22</td> <td>1019</td> </tr> </table> <p>SCALE: 1 : 2,000,000          Kilometers            UTM Zone 12 NAD 83</p>	DRAWN	BY	DATE	MSES PROJECT NO.		ZS	10/10/22	1019
	DRAWN		BY	DATE	MSES PROJECT NO.					
	ZS	10/10/22	1019							
TITLE <p style="text-align: center;"><b>Suggested Protected Areas – Intact Landscapes</b></p>	 <p style="text-align: right;"><b>Figure 10</b></p>									

Figure 10: Intact landscapes (areas that are at least 500km<sup>2</sup> in size without any industrial disturbance).



<p><b>Chipewyan Prairie Déné First Nation LARP</b></p>	<p>Scale 1:2,850,000</p> <p>0 20 40 60 80 Km</p>	<p>FIGURE NUMBER</p> <p><b>FIG 11</b></p>	<p>PREPARED BY</p> 
<p><b>Figure 11: CPDFN Protected Areas Identified in Workshops Plus Relevant Features</b></p>	<p>Base Data: © Department of Natural Resources Canada. All rights reserved.</p>	<p>PROJECTION: UTM Zone 12</p> <p>DATE: 11/04/2010</p> <p>PROJECT: LARP</p>	<p>DATUM: NAD 83</p> <p>PATH: C:\SAA\project\12491\0105_LARP\Map\Report_Map\CPDFN_Protected_Areas_Map</p>

Figure 11: CPDFN Protected areas identified in workshops.

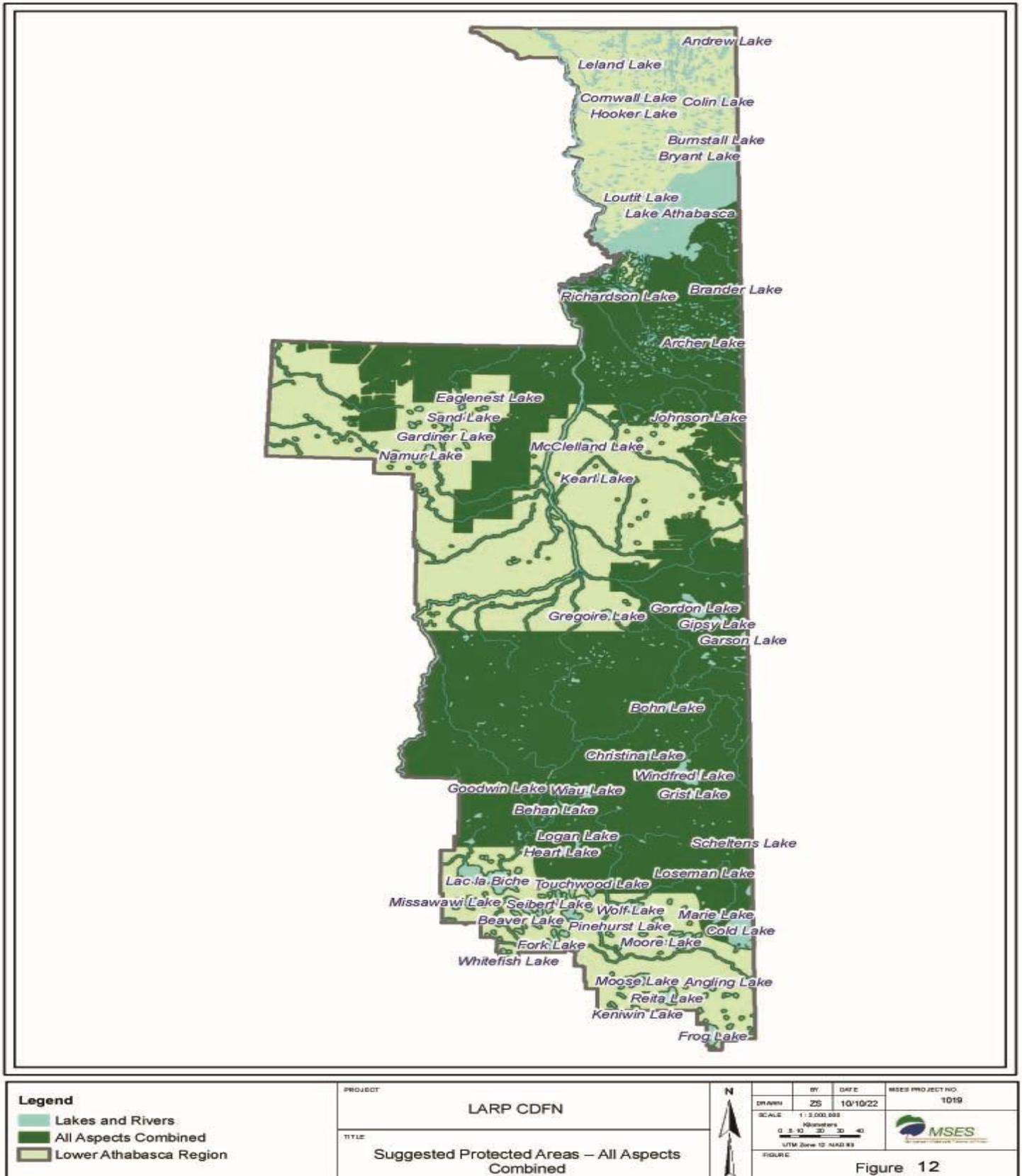


Figure 12: CPDFN Areas Proposed for Protection.

## Conclusions

Figure 12 shows the extent and locations of all lands which the CPDFN propose for protection. The LARP applies to 93,217 kilometers<sup>2</sup> of north-eastern Alberta, and together the areas proposed by the CPDFN for protection totals 53,682 km<sup>2</sup> – about 57% of the LARP area. The CPDFN are proposing protection for a considerable part of the LARP area, but as indicated in the main body of this report and, for example, Figure 3 above, it does not take in all of their traditional territory.

Further, the CPDFN proposals are for the most part consistent with recommendations made by the Lower Athabasca Regional Advisory Council (RAC) which was established in 2008 to offer advice to the provincial government regarding future resource development, land conservation objectives, regional air and water thresholds, and human development considerations in the region. The RAC submitted its report to the Government of Alberta's Land Use Secretariat in early 2010 (LARAC 2010)

The RAC examined numerous issues and the advice they offered on several of these parallel what is proposed by the CPDFN. The RAC recognized that,

“The foundation of the culture and economy of the Lower Athabasca Region is the land itself. The Lower Athabasca Region contains diverse landforms, vegetation, species and resources. Maintaining this biodiversity is essential for supporting human, plant and animal life. Maintaining the health and abundance of wildlife is also important to aboriginal peoples and communities, and the exercise of their rights.”

To achieve this outcome, the RAC advised the Government of Alberta to implement management strategies aimed at

- ensuring healthy ecosystems and processes
- conservation of land in the region
- maintenance and improvement of landscape connectivity
- reduction of the industrial footprint
- implementation of Alberta's new wetland policy
- the development and implementation of a biodiversity management framework
- increasing the capacity of mixed-use resource lands to support movement of native species and communities
- connecting conservation areas to improve their resilience to changing environmental conditions
- managing water quality and quantity to enhance and maintain ecological integrity and human health
- conservation of a regional network for the maintenance of ecological components and processes in representative and high conservation value landscapes

By taking all this advice into account, “The RAC has identified 14 per cent of the region as recommended conservation areas, to bring the total conservation area in the region up to 20 per cent. As per the terms of reference, an additional 12 per cent of lands in the region are also recommended by RAC as proposed conservation areas.” (LARAC 2010, p.26-27). If all lands identified by the RAC were made into conservation areas, about 32 percent of the region would be protected from industrial

intrusion. The RAC's advice compares very well with both the rationale for protection offered by the CPDFN and the total part of the region which would be protected.

In some ways, the CPDFN's proposals offer better protection than does the RAC scheme. The river buffers proposed by the CPDFN would connect the conservation areas that are currently proposed by RAC for the outskirts of the Rural Municipality of Wood Buffalo. The comprehensive river buffers proposed by the CPDFN would be more effective at conserving aquatic ecosystems and ecological and traditional resources that are associated with water bodies.

Caution should be exercised in associating conservation with RAC's "mixed use resources" land classification. About 50% of these areas are already disturbed and the remaining 50% exist in many small and often isolated patches. Given the current rate of development, and given that all mixed use areas are leased, these areas will be fully disturbed (with not even any patches of undisturbed land left) within the next 20-30 years. The CPDFN propose to place greater emphasis on the preservation of intact landscapes.

Finally, the need for establishing multi-use corridors is understandable, but where the Christina River is affected, this corridor must be managed tightly and strict conservation, reclamation, and restoration efforts must be established and enforced to protect the resources that are relevant for the CPDFN. This is exactly why the CPDFN propose a five kilometer buffer on either side of the Christina River.

The RAC report uses the terms "ecosystem health" and "integrity". However, there are no measurable targets or benchmarks, not even approaches concretely defined to protect ecosystem health and integrity. As it stands, the protection and re-establishment of these conditions are in the eye of the beholder. The RAC report states that, "Alberta land uses should be managed to ensure healthy ecosystems. Albertans accept the responsibility to steward our land, air, water and biodiversity so that they can be passed on to the next generation in as good or better condition." (LARAC 2010, p. 16). Under current development scenarios, mixed use areas are not sustainable, given this definition of sustainability, because no disturbance in these areas, literally none, has yet been returned to pre-disturbance conditions. In other words, the mixed use areas may eventually (in several decades, but more likely centuries) have some ecosystems with wildlife and vegetation supporting ecosystem processes, if reclamation and restoration efforts are done seriously. Nevertheless, whatever will be restored will be different from what it was before disturbance. The CPDFN do not believe that the future conditions, while different, will be as good as or better after industrial disturbance.

## Literature Cited

- Alberta Water Council. 2008. Recommendations for a new Alberta Wetland Policy. <http://www.albertawatercouncil.ca/Portals/0/pdfs/WPPT%20Policy%20web.pdf>. Accessed on March 30, 2010.
- Bradshaw, C.J., D.M. Hebert, B. Rippin, and S. Boutin. 1995. Winter peatland habitat selection by woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 73: 1567-1574.
- Collingham, Y.C. and B. Huntley. 2000. Impacts of habitat fragmentation and patch size upon migration rates. *Ecological Applications*, 10: 131-144.
- Ducks Unlimited Canada 2010. Ducks Unlimited Canada's Mission and Vision. <http://www.ducks.ca/aboutduc/who/mission.html> . Accessed on March 30, 2010.
- Gates, C., T. Chowns and H. Reynolds. 1992. Wood Buffalo at the crossroads. *In: Buffalo*, ed. by J. Foster, D. Harrison and I.S. MacLaren. Alberta Nature and Culture Series, the University of Alberta Press.
- Hargis, C.D., J.A. Bissonette, and J.L. Davis. 1998. The behaviour of landscape metrics commonly used in the study of habitat fragmentation. *Landscape Ecology* 13: 167-186.
- Joly, K., B.W. Dale, W.B. Collins, and L.G. Adams. 2003. Winter habitat use by female caribou in relation to wildland fires in interior Alaska. *Canadian Journal of Zoology*. 81: 1192-1201.
- Keddy, P.A. 2000. *Wetland Ecology: Principles and Conservation*. Cambridge University Press. Cambridge, United Kingdom.
- Lower Athabasca Regional Advisory Council (LARAC) 2010. Advice to the Government of Alberta Regarding a Vision for the Lower Athabasca Region
- Laurance, W.F., T.E. Lovejoy, H.L. Vasconcelos, E.M. Bruna, R.K. Didham, P.C. Stouffer, C. Gascon, S.G. Laurance and E. Sampaio. 2002. Ecosystem decay of Amazonian fragments: a 22 year investigation. *Conservation Biology*, 16: 605-618.
- McLoughlin, P.D., E. Dzus, B. Wynes, and S. Boutin. 2003. Declines of populations of woodland caribou. *J. Wildl. Manage.*, 64, 755-761.
- Mills, L.S. 2007. *Conservation of wildlife populations: demography, genetics, and management*. Blackwell Publishing, Oxford.
- Nagy, J.A., D. Auriat, I. Ellsworth, W. Wright, and T. Slack. 2004. Ecology of Boreal Woodland Caribou in the Lower Mackenzie Valley: Work Completed in the Inuvik Region I April 2002 to 31 March 2003. Department of Resources, Wildlife, and Economic Development, Inuvik Region, and Gwich'in Renewable Resource Board, Inuvik, NT. 63 pp.
- Potapov, P. et al. 2008. Mapping the world's forest landscapes by remote sensing. *Ecology and Society*, 13: Art.No. 51.

- RAMSAR. 2010. The Ramsar Convention on Wetlands – The Ramsar List of Wetlands of International Importance. [http://www.ramsar.org/cda/en/ramsar-documents-list/main/ramsar/1-31-218\\_4000\\_0](http://www.ramsar.org/cda/en/ramsar-documents-list/main/ramsar/1-31-218_4000_0). Accessed October 12, 2010.
- Ries L, Fletcher RJ, Battin L, Sisk TD. 2004. Ecological responses to habitat edges: mechanisms, models, an variability explained. *Annual Review of Ecology, Evolution, and Systematics* 35: 491-522.
- Rivard DH, Poitevan J, Plasse D, Carleton M, Currie DJ. 2000. Changing species richness and composition in Canadian National Parks. *Conservation Biology* 14: 1099-1109.
- Rutledge, D.T. and C.A. Lepczyk. 2002. Landscape change: Patterns, effects, and implications for adaptive management of wildlife resources. *In: J. Liu and W. Taylor, editors, Integrating Landscape Ecology into Natural Resource Management*, Cambridge University Press, pp.312-333.
- Strong, W.L., B.K. Calverley, A.J. Richard and G.R. Stewart. 1993. Characterization of Wetlands in the Settled Areas of Alberta. Alberta Environmental Protection.
- Suncor. 2008. Suncor Energy Ltd., application for approval of the Suncor Energy MD9 mine waste dump; supplemental information requests, Attachment I; submitted to the Alberta ERCB.
- Synchrude Canada. 1973. *Migratory Waterfowl and the Synchrude Tar Sands Lease: A Report*. Environmental Research Monograph 1973-3, Synchrude Canada.