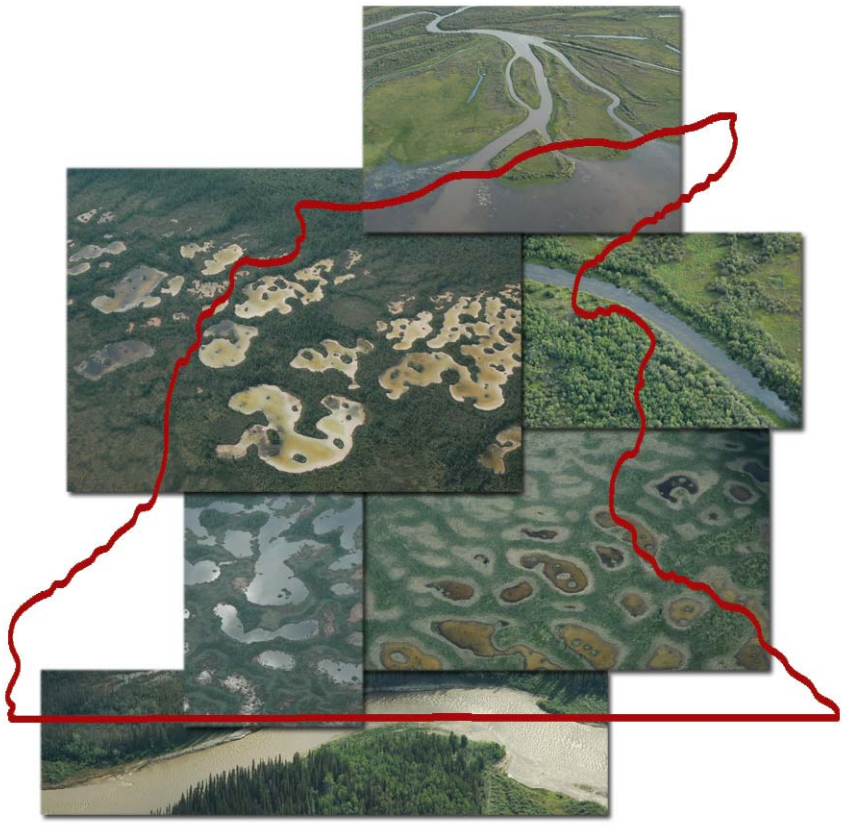
Protected Areas Strategy
Phase 1 Ecological Assessment
of the Buffalo Lake Area of Interest



Prepared by:
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March 2007

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Prepared for:

K'atl'odeeche First Nation / Protected Areas Secretariat, GNWT

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EXECUTIVE SUMMARY

Since time immemorial, Buffalo Lake, and the surrounding area, has been a significant traditional land use area for the K'atl'odeeche First Nation (KFN) of Hay River, Northwest Territories. Due to its value as a traditional hunting and trapping area, the community would like to protect the area from potential development so that future generations may utilize and enjoy the land of their ancestors. Most KFN members believe long-term protection of the area is the best route to take in achieving this goal (KFN 2006).

The Protected Areas Strategy (PAS) is a process for making decisions to protect lands using the best available knowledge, and provides an effective community-based tool for advancing culturally and ecologically significant areas towards long-term protection. The PAS outlines a series of eight steps for the planning, establishment, and management of protected areas. An integral component of the process is a detailed evaluation of the area's ecological, cultural, and economic values. The purpose of this Phase 1 Ecological Assessment is to compile, review and analyse all available ecological information related to the Buffalo Lake area. This process has included two main activities: informal interviews with local and regional experts and a thorough literature review. Existing information sources were assessed for quality, information gaps were identified, and recommendations for further research are provided.

The study area is located within the northern boreal forest and is situated in a relatively low-lying area dominated by lakes, rivers and wetlands. The study area is bounded by the Alberta / NWT border to the south and includes part of Wood Buffalo National Park (located to the east). Ecological research in the vicinity of the study area is relatively limited. The most detailed vegetation and wildlife information is provided by broad-based studies or research linked with industrial development. Information on soils is of a relatively coarse scale and the duration of hydrological records is inadequate for making environmental predictions and as a baseline for change. Disturbance regimes within the local ecosystem are understudied.

On the basis of ecological value, several options exist for the establishment of a protected area in the NWT. These include national parks and reserves, national wildlife areas, territorial natural environment parks and territorial wilderness conservation areas. Further discussion between natural science researchers, industry and other potential stakeholders needs to take place. Support for existing research programs in the Buffalo Lake area should be offered. Specifically, a comprehensive wildlife survey at the mouths of the Yates and Whitesand Rivers; surveys for rare wildlife species; a waterfowl / bird survey; and research to clearly identify inconnu spawning locations, needs to occur before an "ecologically appropriate" protected area boundary can be finalised.

1.0 INTRODUCTION

1.1 Background to the Protection of Buffalo Lake

Since time immemorial, Buffalo Lake, and the surrounding area, has been a significant traditional land use area for the K'atl'odeeche First Nation (KFN). Buffalo Lake remains an important hunting, trapping and fishing area for the KFN and provides critical habitat for moose, waterfowl and fish. The community would like to preserve the Buffalo Lake area for current youth and future generations, so that they may utilize and enjoy the land their ancestors once inhabited. Most KFN members believe long-term protection of the area is the best route to take in achieving this goal (KFN 2006a). Many KFN members have family that grew up in the Buffalo Lake area and feel it is their duty to respect the land by protecting it from development and controlling access to the area.

As outlined below, KFN has begun a process to permanently protect the western portion of Buffalo Lake under the Northwest Territories Protected Areas Strategy (NWT PAS). This process was initiated in December of 2003 when the KFN Chief and Band Council met with special representatives of Parks Canada. During the meeting, issues of common interest with respect to the Wood Buffalo National Park were discussed and protection for the whole of Buffalo Lake was discussed (KFN 2006a).

On October 8th, 2004, a preliminary meeting took place with representatives from the NWT PAS Secretariat, Dehcho First Nations (DFN), and the Canadian Parks and Wilderness Society. The NWT PAS process was explained and interest in protecting the area around Buffalo Lake, under the PAS, was expressed. On February 9th 2005, a motion was unanimously passed by the KFN Band Council, "To approve to preserve and protect the lands within the west end of the Buffalo Lake under the Protected Areas Strategy". In April 2005, a proposal to further identify areas around Buffalo Lake that the community would like to protect was accepted by the NWT PAS Secretariat. In May 2005, KFN traditional land use maps were gathered and catalogued, and a meeting was held with KFN elders to discuss overlapping issues with neighbouring First Nations. KFN elders also discussed the extension of the PAS boundary around Buffalo Lake and along the Buffalo River (KFN 2006a).

In October 2005, the KFN initiated a project to record video affidavits regarding KFN elders' traditional land use activities and occupancy in the Buffalo Lake area. The project was completed in mid-November. On November 7th, 2005, a NWT PAS Community Information Session was held at the KFN Reserve. The presentations stressed that the NWT PAS is a community-driven process to provide long-term protection for the land. As a short-term strategy, it was suggested that KFN identify areas for protection through the Dehcho Land Use Plan (DCLUP), which would provide short-term protection and flexibility while further information was being gathered and further deliberations took place. Advancing the area into the NWT PAS process would then be a longer-term goal (KFN 2006a).

Traditional knowledge mapping interviews were carried out in December 2005 with selected KFN elders. During this time, traditional knowledge information gained through previous interviews and studies was gathered and reviewed (KFN 2006a).

To ensure community awareness and support for the PAS process, a number of KFN members were interviewed during March 2006 regarding their opinions and interest in preserving and protecting the lands at the west end of Buffalo Lake through the NWT PAS (KFN 2006a). The surveys were carried out by KFN staff and were analyzed and summarized by Crosscurrent Associates Ltd. of Hay River. The results of these surveys were presented back to community members at a General Band Meeting for review and ratification on March 30th 2006.

As a result of this work, two processes have been set in place. First, through the DCLUP, the area of interest has been designated for short-term protection and is identified as DCLUP Conservation Zone 15 (DCLUPC 2006). Under the Draft Deh Cho Land Use Plan, such conservation zones include the withdrawal of all subsurface rights and the prohibition of all forms of development (excluding tourism). Second, under the Northwest Territories Protected Areas Strategy, the K'atl'odeeche First Nation has advanced the Buffalo Lake area as an Area of Interest (AI) for permanent protection (KFN 2006a).

1.2 The Purpose of an Ecological Assessment

The Protected Areas Strategy (PAS) is a process for making decisions to protect lands using the best available knowledge, and provides an effective community-based tool for advancing culturally and ecologically significant areas towards long-term protection. The PAS outlines a series of eight steps for the planning, establishment, and management of protected areas. An integral component of the process is a detailed evaluation of the area's ecological, cultural, and economic values. Findings can be used to make informed decisions on boundary locations and management strategies.

PAS (2007) indicate that "fine filter" considerations in the design of protected areas include the occurrence of rare or endangered plant and animal species, areas of high species diversity, sensitive habitats, and unique physical features that influence biological diversity. Thus by identifying existing information related to these "fine filter" considerations, this Phase 1 Ecological Assessment can be considered one of the first steps in the design of a protected area.

The goal of this Phase 1 Ecological Assessment is to begin to document the overall ecological significance of the proposed area of interest and related study area, and to identify any information gaps that hinder the PAS decision-making process. This goal was achieved by compiling, reviewing and analysing all available ecological information related to the Buffalo Lake area. This process has included two main activities: informal interviews with local and regional experts and a thorough literature review. Existing information sources were assessed for quality, information gaps were identified, and recommendations for further research are provided.

1.3 The Project Team

Crosscurrent Associates Ltd. was contracted by the K'atl'odeeche First Nation to complete this Phase 1 Ecological Assessment and Maskwa Environmental Services Ltd. acted as a sub-contractor for much of the work.

Peter Redvers, of Crosscurrent Associates Ltd., was the project supervisor.

Andrew Tofflemire, an employee of Maskwa Environmental Services Ltd., was the lead researcher and author of this report.

Richard Johnstone, also an employee of Maskwa Environmental Services Ltd., provided research assistance and GIS services to this project.

2.0 METHODOLOGY

This project followed the standard methods for conducting a literature review. Relevant documents were identified through online searches, libraries, and personal contacts. Informal interviews and personal communications with knowledgeable parties were used to acquire additional (published and unpublished) information and data. As the information was complied from the various sources, documents were reviewed and relevant information was summarised. These summaries were then compared and assessed for quality; gaps in the available information were identified and recommendations for further research (to address these gaps) were offered.

Ultimately, the establishment of a protected area serves a social desire or need to conserve the environment. The social context, historic usage, and cultural importance of an area are often tied to the ecological value people place on that particular area. As mentioned previously, members of the KFN have relied upon the Buffalo Lake area for subsistence and continue to actively harvest there. Relatively permanent features, such as cabins and grave sites, mark the landscape and thus the perception of this area as a 'special place' is retained as part of the cultural identity of the KFN. For this ecological assessment, the traditional ecological knowledge (TEK) of the KFN is most relevant and will be discussed where appropriate.

The project team would like to acknowledge the assistance of the personal contacts listed in the bibliography of this report and of a number of others who provided leads on potential information sources.

3.0 STUDY AREA

For the purposes of this report the term “area of interest” refers to the DCLUP Conservation Zone 15, while the term “study area” refers to the larger area, surrounding the Area of Interest, as indicated on Map 1. The intent of this report is to provide some of the information required by decision makers to refine the study area into a more clearly delineated “area of interest”.

3.1 Regional Overview

3.1.1 Eco-Zone and Eco-Region Description

Environment Canada (EC 2007a) has classified the nation’s landmass into eco-zones and eco-regions, thereby associating areas of similar ecosystems and habitat to facilitate natural resource management activities.

The Area of Interest (AI) for this ecological assessment is located on the eastern edge of the Taiga Plains eco-zone. Within this eco-zone, the AI is located at the eastern edge of the Hay River Lowlands eco-region. As the AI is located on the extreme eastern boundary of the eco-zone and eco-region, it is necessary to also briefly describe the area immediately adjacent to the AI, the Slave River Lowlands eco-region, because ecosystems rarely have discrete boundaries and tend to have zones of transition between two distinct areas (often termed “fuzzy boundaries”). .

The biological components of the eco-zone and eco-region classifications will be discussed in subsequent sections relating to vegetation, wildlife, and soils. Landscape units represented by the study area will also be discussed in these later sections.

3.1.1.1 The Taiga Plains Eco-Zone

This zone represents the northern edge of the boreal coniferous forest and encompasses much of the southwest and south-central parts of the Northwest Territories, northeastern British Columbia, and northern Alberta. The zone is dominated by the Mackenzie River system and includes areas to the south and west of Great Slave and Great Bear Lakes. This zone exhibits a generally cool to cold climate, with short summers and long winters. It is strongly influenced by cold arctic air masses. The terrain can be described as flat, broad lowlands with plateaus that are incised by major rivers and marked with braided channel networks. Low-lying wetlands occupy to half of this zone and much of the landscape is seasonally waterlogged, due to poor drainage resulting from permafrost and low-angle slopes (EC 2007a).

3.1.1.2 The Hay River Lowlands Eco-Region

This region is a broad, lowland plain with short, warm summers and long, cold winters. The nearly level to gently rolling topography is underlain by sporadic, discontinuous permafrost. The mean annual temperature of -2.5 °C ranges from a mean of 13 °C in the summer to -19 °C in the winter. Mean annual precipitation ranges from 350 to 450 millimetres (EC 2007a).

3.1.1.3 Slave River Lowlands Eco-Region

This eco-region (located within the Boreal Plains Eco-Zone) has a sub-humid climate with long, cold winters and short, cool summers. The eco-zone is strongly influenced by continental climatic conditions (EC 2007a). The mean annual temperature is -2 °C, with mean summer temperatures up to 13 °C and mean winter temperatures down to -17.5 °C (EC 2007a). These are typically the mildest climatic conditions in the NWT. In northern Alberta, mean annual precipitation is approximately 300 millimetres. The terrain is nearly level to gently rolling, with wetlands and peatlands covering up to half of the zone.

3.2 Boundaries of the Study Area and PAS Area of Interest

The K'atl'odeeche First Nation is seeking permanent protection of an area approximately 2,177 square kilometres in size, defined as "Conservation Zone 15 – Buffalo Lake, River and Trails" in the Final Draft of the Deh Cho Land Use Plan (KFN 2006, DCLUPC 2006). Under the final draft of the plan, no form of development is permitted in this area. A combination of cultural and ecological reasons went into the decision to seek protection for this area. This assessment, however, is focused on the ecological values of the area and is intended to provide relevant information to decision-makers. In order to allow for possible boundary adjustments, a study area with a sufficient buffer (extending beyond the conservation zone) was utilized so that areas of ecological importance that lie beyond the currently proposed boundaries, but within the general vicinity, were also considered in this assessment. Thus a comprehensive understanding of ecological systems in the Buffalo Lake area could be developed.

Initially, the conservation zone and eco-region/ecological landscape unit data layers (shapefiles) were examined visually within a Geographic Information System (GIS) to identify any obvious associations or natural boundaries that could be used as a study area for this project. The general area of interest has no obvious association with eco-region boundaries, as it falls entirely within the Hay River Lowlands eco-region (based on data from DCLUPC 2006, EC 2007a), although, as mentioned previously, a division between eco-regions and eco-zones occurs just to the east. The general area of interest includes parts of three different landscape units (discussed in Section 4.3.3), but there was no clear association between the AI and landscape units useful to defining a study area (WWF 2002). Ultimately, a study area was defined by modifying a shapefile of the Buffalo Lake watershed (WWF 2002) to better reflect both the conservation zone (the core area of interest) and the river network as represented on a digital 1:250,000 National

Topographic System basemap (Map Index: NTS 85C). The study area ultimately selected encompasses approximately 9,200 square kilometres and is located between approximately 114° 19” to 116° 28” west longitude, and 60° 00” to 60° 59” north latitude (refer to Map 1).

3.3 Surrounding or Incompatible Land Uses

As the selected study area shares the same eco-zone and eco-region class as much of the surrounding area, compiling information and research documents for this project was simplified, as it allowed some assumptions to be made. Due to the relative uniformity of the area, some of the valued ecosystem components are expected to be relatively ubiquitous throughout the study area and thus the precise location of the boundary, relative to the location of these valued ecosystem components, was less of a concern.

As the focus of this assessment is on the ecological aspects of the area, the Buffalo Lake watershed was addressed as a single ecological entity when defining the study area, and the seemingly arbitrary western boundary of Wood Buffalo National Park (WBNP), which fails to reflect natural environmental conditions (such as the shoreline or watershed of Buffalo Lake), was ignored. Thus part of the National Park is included in the study area and considered in this research. It is also recognised by Parks Canada (PC) that this boundary is disjointed from its ecological context and thus creates some management problems (McMillan et al. 2007, PC 1984).

In addition to Conservation Zone 15, the Final Draft Deh Cho Land Use Plan also refers to “Special Management Zone 32 – Big Buffalo River” where non-renewable resource development would be permitted (DCLUPC 2006). This area is included in the study area to allow for possible boundary adjustments and in recognition of the complex boundaries between Conservation Zone 15 and Special Management Zone 32; it would have been exceedingly difficult to examine the conservation zone in isolation. DCLUPC (2006) indicates that under the Interim Measures Agreement, non-exclusive geological surveys are not permitted in an area west of Buffalo Lake and north of Highway 5; this area is outside of the DCLUP Conservation Zone 15.

Example of Terrain within the Study Area Photos by GNWT / D. Downing 2005

There is currently a proposal for a lead-zinc shaft mining operation to the northeast of the study area, in the vicinity of the former Pine Point open-pit mine. Highway 5 bisects the study area from east to west and changes to a north-south direction just east of the study area. A decommissioned rail line once followed the highway eastward towards the Pine Point area (it was required to support former mining activities). Some of the surrounding and incompatible land uses mentioned above are depicted on Map 2 (shown after Page 9).

3.4 Physical Landscape of the Study Area

The study area ranges in elevation from approximately 180 to 320 metres asl, with a mean of 294 metres.[1] The terrain has a gentle northward slope in the direction of Great Slave Lake. Numerous small lakes and wetlands mark the land surface.[2]

Within and in close proximity to the AI, are a number of physical landscape features worthy of special discussion. These include Buffalo Lake, the upper and lower reaches of the Buffalo River, the Whitesand and Yates Rivers, and the Caribou Mountains.[3]

3.4.1 Buffalo Lake (Ejie Túé)

Buffalo Lake is a large, relatively shallow lake with a surface area of approximately 600 square kilometres and has an average depth of less than 9 metres. Systematic depth surveying has not been conducted in Buffalo Lake, but the western end is believed to be the deepest part of the lake (McMillan et al. 2007). Major tributaries include the Yates and Whitesand Rivers, draining into the lake from the southwest, and the (upper) Buffalo River flowing into the lake from the southeast. The only outlet from Buffalo Lake is the (lower) Buffalo River, flowing out at its northeastern end. Other lakes in the vicinity include Copp Lake, located approximately 25 kilometres east of Buffalo Lake, and Great Slave Lake, which is approximately 70 kilometres north.

3.4.2 The Upper and Lower Buffalo River (Ejie Túé Dehé)

The headwaters of the Buffalo River are located in the Caribou Mountains, to the south of the study area.

The Upper Buffalo River is approximately 60 kilometres long and flows northwestward into Buffalo Lake. At the Alberta / NWT border, the mean annual flow rate for the Upper Buffalo River has been calculated to be 21.1 cubic metres per second; comparatively, the Lower Buffalo River flows at 49.5 cubic metres per second near the Highway 5 bridge

[1] "asl" is an acronym commonly used for "above sea level".

[2] B. Decker and A. Cassidy from Forest Management, ENR provided those photos credited in this report as "GNWT / D. Downing 2005". Although these photos were captured as part of the NWT Ecological Land Classification Project and are known to have been taken within the Study Area for this EA, specific locations were not identified.

[3] Available hydrometric and water quality information will be discussed further in the hydrology section of this ecological assessment.

(Kolelj 2003, Faria 2002). Ozoray (1980) reports that the Upper Buffalo River has cut a deep valley into the escarpment of the Caribou Mountains and erosional forces are active in the area. The Lower Buffalo River is approximately 155 kilometres long, no less than 20 metres wide at any point and is at times characterized by rapids (EBA 2005a). It flows northeastward from Buffalo Lake, eventually draining into Great Slave Lake.

The river (as a whole) is also referred to as "Big Buffalo River" in the Final Draft Deh Cho Land Use Plan (DCLUPC 2006) and Soper (1942) indicates that the Upper Buffalo River was also known as the Caribou River.

3.4.3 The Whitesand and Yates Rivers

The Yates River is approximately 28 kilometres in length, while the relatively sinuous Whitesand River is approximately 45 kilometres in length.[4] Originating in the Caribou Mountains, the southern reaches of both rivers flow within incised valleys and possess small deltas, further northward at the river mouths (Ozoray 1980, GSC 1998). The Whitesand River flows at a rate of 20.9 cubic metres per second; hydrometric information is not available for the Yates River. Both the Whitesand and Yates Rivers flow generally northward into Buffalo Lake.

3.4.4 The Caribou Mountains

The Caribou Mountains are located in northern Alberta, several kilometres south of the study area. At approximately 945 metres asl (3,400 feet), these mountains are the highest land features in the vicinity of WBNP and rise to over 500 metres above the surrounding parklands (PC 1984, Soper 1942). Numerous fast-flowing streams have incised deeply to create v-shaped valleys within the mountain slopes (PC 1984). Ozoray (1980) reports the presence of groundwater springs and other groundwater discharge features in the area; at least one spring (located beneath an oxbow lake) has been identified on the northern foot of the mountains.

3.4.5 Other Features of Interest

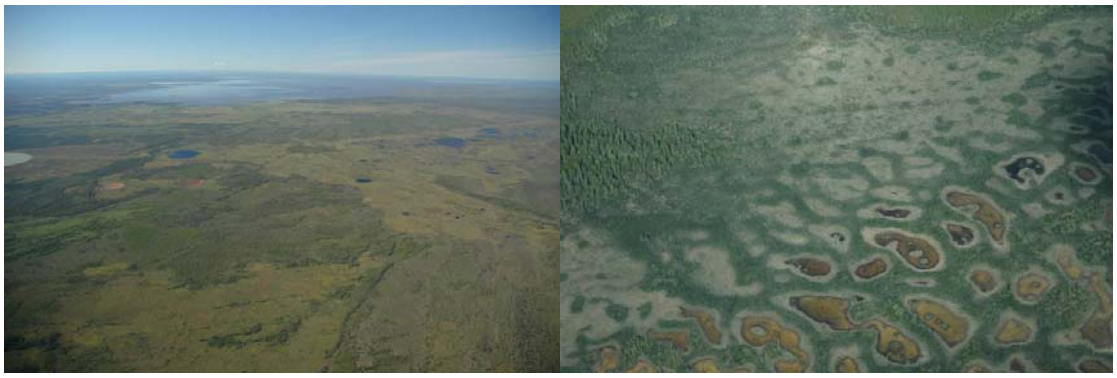
There are a number of other physical features in the area worthy of mention, although they have a less direct influence on the study area. These include the Hay River, Victoria Falls and Louise Falls to the west (both on the Hay River), karstlands with the associated sinkholes and caves to the east; and large lead-zinc deposits of commercial interest located in, and beyond, the north-eastern part of the study area. Some of the physical landscape features discussed above are depicted on Map 2; rivers and lakes within the study area are more clearly visible on Map 1 (shown after Page 7).

[4] Measurements estimated from the NTS basemaps mentioned previously.

3.5 Overview of the Biological Conditions of the General Landscape

Muskeg and other forms of low-lying wetland are a prominent characteristic of the general landscape within the study area. Black spruce is the predominant forest species, but thick patches of jack pine have become established as a dominant species in areas disturbed by fire. The local fire regime will be discussed further in the section on disturbances. Isolated microclimates have also retained pockets of other dominant tree species. Re-growth after frequent disturbances has created a relatively immature forest community at an early seral stage.

The presence of part of Canada's largest National Park within the study area is worthy of mention. Wood Buffalo National Park has been internationally recognised for its biological attributes (designated a World Heritage Site, includes a RAMSAR Wetland of International Significance, and includes a UNESCO International Biological Programme Site) (UNEP 2007, Wetlands International 2007, BSC 2007). These attributes (by virtue of proximity) are influenced by many of the same regional environmental processes as the attributes found within the study area (such as climate change, drought, fire, pest infestation, etc.) It is also possible that the study area experiences incidental occurrences and possesses potential habitat for those special attributes (ex. whooping cranes) that have led to the various ecological designations within the park.



Example of Landscape within the Study Area Photos by GNWT / D. Downing 2005

The NWT Protected Areas Strategy Ecological Working Group (PAS-EWG 2007) has prepared a draft report describing the degree to which the Buffalo Lake area is representative of the vegetation types, landscape units, and physiographic units found within the Hay River Lowlands eco-region. The results of computer modelling suggest that an area to the north and a second area to the northeast of Buffalo Lake are relatively representative of the eco-region. Including these areas as part of an Area of Interest would contribute to meeting the PAS goals of protecting biological diversity and ecological functions. The conservation value of the west end of Buffalo Lake is not as obvious in the modelling scenarios focused on "representative areas" across the entire

NWT (because in the immediate vicinity, WBNP already contributes to this goal). The value of this area is perhaps more related to the goals of the local community and a relationship to Wood Buffalo National Park, which includes the eastern half of Buffalo Lake.

4.0 ECOLOGICAL ASSESSMENT

This assessment will examine various ecological components under the following headings: terrain and soils, hydrology, disturbances, vegetation, and wildlife. Each section will be sub-divided into smaller themes of discussion. The sections will open with general information relating to the region, before moving on to more specific information about the study area, under the sub-headings. The most relevant information sources and research (past, present and future) will be assessed for quality, including discussion of bias, scope, spatial coverage in relation to the study area, and the temporal nature and current validity of the information. Based on this assessment, information gaps will be identified under each of the major headings. Following the section on wildlife, these information gaps will be summarised and recommendations will be provided to facilitate decision-making regarding any significant gaps. Scientific names will only be provided in the body of this report when discussion is focused on a particular species (such as with focal species); scientific names are also provided in Appendix A.

4.1 Terrain and Soils

4.1.1 Terrain

As mentioned previously, the study area consists of broad lowland plains with subdued relief (EC 2007a). The Caribou Mountains to the south form a plateau with valleys incised by major rivers. The geology of the area consists of sedimentary rock, such as limestone, shale and sandstone, which is typically overlain by a variety of glacial, lacustrine and alluvial deposits (EC 2007a).[5] SIGCL (1983), for example, reports the presence of limestone, shale, sandstone, and dolomite in the Pine Point area, and that all bedrock units were jointed and fractured. Braided and abandoned channels are common along the major river systems. The typically organic soils are in a state of sporadic discontunious permafrost and up to half of the area is inundated by low-lying wetlands (EC 2007a).

Eskers are relatively common east of Buffalo Lake and sink holes occur to the east, just outside of the study area (GSC 1998). As discussed previously, sinkholes are associated with the karstic landscape to the east (refer to 'Karst – by WBNP' map in Appendix B). Dune ridges are common north of Buffalo Lake (GSC 1998).

[5] Kozak and Rostad (1977) report that Buffalo Lake was under Glacial Lake McConnell.

Example of Terrain within the Study Area Photos by GNWT / D. Downing 2005

4.1.2 Soils

The region's widespread permafrost and poor drainage have created favourable conditions for the development of Cryosolic, Gleysolic, and Organic soils (EC 2007a). Environment Canada (EC 2007a) further indicates that within the Hay River Lowlands Ecoregion:

> *Surface deposits are predominantly peat-covered clayey lacustrine and glacial till on nearly level to gently rolling topography. Gleysolic and Organic soils with some Organic Cryosols are dominant in the lowlands. Luvisols are the dominant upland soils.*

For the Pine Point area, EBA (2005b) reports the primary upland soil type as Eluviated Eutric Brunisols and the primary lowland soils types as Terric Organics and Gleysols. This is consistent with BC Research (1977) which report Gleysols and Fibrisols in poorly drained areas and Eutric Brunisols and Gray Luvisols in well drained areas surrounding Pine Point.

Kozak and Rostad (1977) conducted a soil survey of the Hay River; a small portion (north of Enterprise) of this survey relates to the extreme western edge of the study area for this ecological assessment. This survey however, was focused on agricultural potential and thus has limited relevance to this ecological assessment.

Parks Canada (PC 2007) prepared a soil drainage and a soil reaction (pH) map specifically for this ecological assessment (provided in Appendix B). The soil is poorly drained to the south and east of Buffalo Lake. Imperfect drainage occurs in the south-eastern corner of the study area, while the soil is relatively well drained in the north-east and central part of the study area (PC 2007). Soil reactions vary from alkaline in the south and east, to acidic in the central part of the study area (surrounding much of Buffalo Lake). The soils along the Upper Buffalo and Whitesand Rivers appear to have a neutral reaction, while soils along the Lower Buffalo River appear to be generally alkaline (PC 2007).

As previously mentioned, four ecosystem classification plots are within the study area and basic soils information was collected at these locations (Nelson 2007). Unfortunately, the updated Northwest Territories Ecological Land Classification was not available at the time of the current ecological assessment and thus the relevant soils information could not be included in this report.

4.1.3 Landscape Units within the Study Area

The Northwest Territories Ecological Land Classification (mentioned previously) will include updated Landscape Unit information when it is released. An older version of this information is available in WWF (2002) and is depicted on Map 3:

Table 1: Landscape Units within the Study Area (refer to Map 3 on the following page).

Landscape Unit Code	Description
O/O/-/vw	*Undifferentiated organic deposits / organic cryosol / no texture / terrain very weakly broken* This landscape unit covers most of the study area and completely surrounds Buffalo Lake.
O.L/O.U/-.m/vw.w	*Mix of undifferentiated organic deposits and lacustrine deposits / combination of organic cryosol and gleysolic soil / soil medium textured / terrain very weakly or weakly broken* This landscape unit is present north and west of Buffalo Lake (in the area north of Highway 5).
L.A/R.R/f.f/vw.w	*Mix of lacustrine and alluvial deposits / regosolic soils / soils fine textured / terrain very weakly or weakly broken* A small portion of the study area, located in the north east (in the Pine Point area), is classified as this landscape unit.
L.M/U.F/f_m.f/w.w	*Mix of lacustrine and morainal deposits / combination of gleysolic and gray luvisolic soils / soils fine to medium or fine textured / terrain weakly broken* A small potion of this landscape unit occurs along the eastern edge of the study area.

4.1.4 Surficial Geology / Geomorphology

In 1983, SIGCL noted that limited geological mapping had occurred west of the Lower Buffalo River. The Geological Survey of Canada (GSC 1998) has since published a set of two maps (1906A and 1906B) depicting the surficial geology in the area; the Buffalo Lake area is represented on map 1906A at a scale of 1:250,000. These maps are apparently related to resource development in the Pine Point area.[6]

Throughout the study area, fine-grained sediments (code Lb) are present and are described by GSC (1998) as:

> *Medium-to fine-grained sand, silt and clay, massive to well laminated with scattered coarse clasts (ice rafted debris) forming blankets 1 to >5m thick over till or bedrock' generally poorly drained with extensive organic cover, eolian veneer common.… >1m thick (dominantly fen, bog/undifferentiated) organic deposits (hatch symbol) occur throughout the study area.*

Within the study area, washed till (code Tb-W) is of secondary dominance and generally occurs as small localised deposits, which can be described as follows:

> *Till with one or more of the following characteristics: 1) a discontinuous coarse lag produced through wave erosion, 2) isolated ridges of beach gravels generally <3m thick; 3) a veneer of lacustrine deposits (generally <1m thick); and 4) pockets of fine-grained lacustrine deposits up to 2m thick. Occurs as blankets >2m thick. …Generally forms a plain of limited relief but locally moulded into flutings* (GSC 1998).

Such flutings are common east of Buffalo Lake. BC Research (1977) reports that tills deposits are present along the east bank of the Lower Buffalo River and on sub-parallel ridges in the western part of the Pine Point Area.

Deltaic deposits (code Lp) are present at mouths of the Whitesand and Upper Buffalo Rivers (and the Yates River to a lesser extent) on the southern and south-eastern shore of Buffalo Lake. Abandoned and ephemeral channels are present in both areas but appear to be more extensive near the Whitesand River. Deltaic deposits are described by GSC (1998) as:

> *Clay, slit and sand coarsening upwards, 2 to 15m thick, capped by thin alluvial deposits, forming an inactive delta plain which has been incised by the present-day river. Locally sand has been extensively reworked by eolian processes.*

At the north-eastern end of Buffalo Lake "modern lake deposits" (code fL) are present. These are composed of "silt and clay, 1 – 2m thick organic rich, deposited in shallow water environments during the holocene" (GSC 1998). In the Pine Point area, to the northeast of the study area, surficial deposits range from 25 to 90 metres in thickness (SIGCL 1983).

[6] The linkage to resource development is suggested because these are an isolated set of two maps, with "mine waste" as a category of surficial cover, and are centred on the Pine Point area.

4.1.5 Adequacy of Research

At this time, the scale and extent of soil surveys is relatively limited within the study area. As with many of the other ecological components addressed within this report, the broad-based regional studies (such as EC 2007a) provided much of the information. BC Research (1977) proves relatively detailed soils and geomorphological information for the Pine Point area. The Surficial Geology Map (GSC 1998) provided invaluable information that was both current and spatially relevant to this ecological assessment. EBA (2005b) describes the dominant soil types in only a small portion of the study area for this ecological assessment.

4.1.6 Identification of Data Gaps

Nelson (2007) reports that Agriculture Canada and its partners are developing a soil coverage which includes part of the study area; it hopes to expand the scope of the coverage in the future. In the next few years, Agriculture Canada will also be updating the "Soil Landscapes of NWT", possibly to a scale of 1:500,000 or even 1:250,000. Unfortunately, the updated Northwest Territories Ecological Land Classification was not available at the time of the current ecological assessment and thus the relevant soils / detailed landscape unit information could not be included in this report (Smith et al. 2007). When forthcoming research is made available, the PAS should consider the quality and appropriateness of the data for modelling and decision making purposes. The current state of research within the study area may become greatly improved with the release of these studies and the lack of detailed soils information is the only apparent "information gap".

Although current information gaps are relatively minimal, there are potential implications within the context of "protected areas management". The limited resolution of soils data (type, presence of permafrost, pH, etc.) could make vegetation research (such as the prediction of plant distributions) problematic. An improved understanding of terrain, surface geology, and geomorphology could aid in the identification of areas of specialised wildlife habitat (such as den sites located on beach ridges and eskers, or hibernaculums in karstic areas).

4.2 Surface and Subsurface Hydrology

The surface and subsurface hydrology of the study area is influenced by permafrost and the underlying geology. SIGCL (1983) examined the hydrology of the Pine Point area, and described it as having poorly-integrated surface drainage with muskeg and swamps forming where beach ridges and longitudinal sand dunes create blockages to overland flow. Ozoray (1980) describes a hydro-geological investigation of the Steen-Whitesand River Area in northern Alberta, although much of the information has limited ecological relevance (the report provides a focused discussion of deep aquifers and water quality for industrial purposes).

Regional groundwater flow is in a northward direction towards Great Slave Lake; the Pine Point area is a region of ground water discharge with various forms of spring, seepages and phreatophytic plants (which have roots that reach the groundwater table) (SIGCL 1983).

Throughout the study area, the surface water table may be perched above a layer of permafrost, which promotes a regional overland seepage system and is reflected in extensive low-lying wetlands (EC 2007a). Parks Canada (2007) prepared a drainage map for the study area; it is included in Appendix B.

McMillan et al. (2007) refers to Buffalo Lake as shallow and warm; it is believed to be deeper at western end. McMillan et al. (2007) also report that the lake has had low water levels during the last few years. Faria (2002) indicates that within the Buffalo Lake watershed there is a "substantial lake storage" effect. Large lakes can store water temporarily and dampen the response (of a hydrograph) to runoff:

> *Lake inflow volume gets distributed over the lake area, so the time taken for water to travel through a lake between its inflow and outflow is directly proportional to lake size. Any increase in the rate of inflow to a lake, such as a spring freshet or rainstorm runoff, results in a temporary rise in lake level equal to the increase in inflow volume divided by the lake area (Faria 2002).*

In a hydrograph of the Buffalo River (at Highway 5), Faria (2002) indicates that mean annual peak flow is approximately 150 m^3/s and generally occurs with the spring freshet (between the 120^{th} and 160^{th} Julian Day). The maximum recorded peak flow was 357 m^3/s. Flow rates tend to gradually decrease over the summer and have "actually dropped to zero during winter (below the measurable limited for the gauge) for two-thirds of the years on record" (Faria 2002).

4.2.1 Water Quality and Hydrometric Monitoring Stations

In September 2005, EBA (2005a) conducted a water quality and stream assessment for a project in the Pine Point area. This assessment included 4 water quality sampling stations along the Lower Buffalo River. Samples from all four sites exceeded water quality guidelines for iron and aluminium, and three of the four sites also exceeded guidelines for

copper. Two of the stations on the Lower Buffalo River (S02 and S14) showed water quality results not typical of the natural background values for the NWT. Calcium and magnesium content is relatively high for the water in Pine Point area; boron concentrations were also found to be elevated, particularly near bore holes drilled during past industrial activities in the area (EBA 2005a). The water of the Lower Buffalo River was relatively turbid when sampled by EBA (2005a). Physical water quality parameters and river channel characteristics were also recorded for 6 sampling stations (the four stations discussed above plus two more) along the Lower Buffalo River.

Water Survey of Canada (EC 2007c) admits that "the adequacy of the network to describe hydrologic characteristics, both spatially and temporally, decreases significantly" in northern Canada. Within the study area, at one time or another, there have been a total of three hydrometric stations (in the Whitesand and Upper Buffalo River near the NWT / Alberta Border, and in the Lower Buffalo River at the Highway 5 bridge); there was also a water quality monitoring station at the Highway 5 bridge where it crosses the Lower Buffalo River (Starling 2007, EC 2007c, Kokelj 2003). No monitoring is currently taking place within the study area. Table 2 describes some of the characteristics of the former monitoring stations.

Starling (2007) reports that there was never any serious concern over water quality in the Lower Buffalo River; elevated iron and sulphur content is normal for the region. Sinkholes and sulphur rivers are present in the general area (Starling 2007).

Table 2: Characteristics of Former Monitoring Stations and Associated Rivers

Station Location	**Length of Record (yr)**	**Mean Flow (m^3/s)**	**Mean Total Flow ($10^6 m^3/yr$)**	**Basin Area (km^2)**	**Basin Yield (mm/yr)**
Buffalo R. @ Hwy 5 Bridge (Hydrometric) 60° 42' 44" N, 114° 54' 11" W	22	49.5	1,561	18,500	84.4
Buffalo R. near AB/NT Border 60° 00' 49" N, 114° 31' 32" W	4	21.1	665	4,350	153
Whitesand R. near AB/NT Border 60° 00' 17" N, 115° 34' 44" W	6	20.9	661	3,410	194
Buffalo R. @ Hwy 5 Bridge (Water Quality) 60° 42' 58" N, 114° 54' 25" W	24	N/A * Focused on 28 standard water quality parameters, recorded in late spring and fall each year from 1982 to 2005.			
Sources: Starling 2007, Kolelj 2003, Faria 2002.					

4.2.2 Adequacy of Research

Although some baseline information on hydrology exists for the Buffalo River, the reliability of this information is questionable. For some of the locations, monitoring was limited to only a few years and as more time passes without active monitoring, the value of such baseline information diminishes (historical data is now becoming dated). Due to insufficient baseline data, neither flood nor drought predictions can be made accurately for these rivers (Faria 2002).

There are relatively good water quality records for the Lower Buffalo River; however, such information is no longer being collected and thus impacts from proposed and existing developments in the Pine Point area and throughout the region may not be fully understood.

Groundwater has only been examined as part of past and proposed mining developments in the Pine Point area. Thus, any publicly available reports may have an industry bias and have primarily focused on technical and mine engineering issues.

It should be recognised that, although limited, the hydrological information available for the study area may be more than is available for other parts of the NWT.

4.2.3 Identification of Data Gaps

From a "protected areas management" perspective, there are only a few hydrological information gaps that might be of concern. The limited knowledge of physical characteristics (such as average depth, flush rate, etc.) and water quality within Buffalo Lake itself could limit the resource management or regulatory response to industrial impacts and other environmental changes. Improved knowledge of hydrometric conditions in the area could assist in the prediction of floods / drought, which in turn could be used to support other research programs (for example, predicting good/bad years to survey for amphibians) and prepare for threats from wildfire (during drought conditions).

4.3 Ecological Disturbance Regimes and Other Processes

Ecosystems are dynamic. Disturbances -- such as fire, flooding, disease and parasite infestation -- are widely recognised as natural processes occurring within the boreal forest. Anthropogenic disturbances, such as local industrial development (i.e. mining at Pine Point) and global warming, also influence the ecosystem. The frequency (recurrence intervals), magnitude, scale and influence of these disturbances vary both spatially and temporally, acting on the environment to create localised patches of differing seral stages. Resource managers and authorities often have disturbance management plans and practices to address some of these issues.

The DCLUPC (2003) recognises that disturbances actively change the landscape and that natural resources, such as merchantable timber or habitat quality, can be influenced. The dynamic nature of the ecosystem requires managers to constantly reassess conditions to ensure that the most up-to-date information is available for decision-making.

4.3.1 Fire

Wildfires are a relatively common occurrence within the boreal forest ecosystem and are recognised as one of the greatest influences on forest succession in the NWT (Decker 2007, Smith et al. 2007, McMillan et al. 2007, DCLUPC 2003). The influence of fire is not entirely destructive, however, and can improve forage quality for ungulates (Bradley and Johnson 1998). Fire is widely considered to be a naturally occurring component of ecosystems and as finite budgets necessitate only a limited response, resource managers often allow small fires in remote locations (away from human populations and other "values-at-risk") to burn unchallenged (PC 1984, McMillan et al. 2007). Parks Canada suggest that values-at-risk within the study area are relatively limited, partly due to a previous large fire in 1984 that razed much of the landscape and any associated values (McMillan et al. 2007).

The DCLUPC (2003) reports that in any given year, forest fires in the NWT vary considerably in number, distribution, and size. Between 1987 and 1997, this variation was quite dramatic (for example, the area burned annually varied from 37,000ha to more than 3 million ha). The numbers indicated by DCLUPC (2003) suggest that in the last 20 years, the Lower Buffalo River area has experienced almost twice the NWT average of forest area burned (1 percent per year versus 38 percent over 20 years):

> *The long term average number of fires is about 300 and the average area burned is about 600,000 ha, or about 1% of the forested area, per year (Bohning et al. 1997). Within the Buffalo River area, the Forestry Corp (2002) reported that 38% of the productive forest land base was burnt over the last 20 years. While this study accounted for fires prior to 2001, the possibility of future fires impacting the* [area] *… is great.* [7]

[7] Please note that the sources cited by DCLUPC (2003) were not reviewed and thus are not referenced directly in this report.

McMillan, et al. (2007) indicated that WBNP and the Government of the Northwest Territories (GNWT) have a "border zone response agreement" regarding wildfire control. Under this agreement, the first agency to respond to a fire within 20 kilometres on either side of the park boundary will retain authority over and responsibility for the management of that fire. In the Buffalo Lake area, Parks Canada is usually in charge of wildfire management; this may be attributed to WBNP having relatively greater fire fighting resources per unit of management area (whereas GNWT resources must be shared throughout the territory)(McMillan, et al. 2007).

Fire history maps for this ecological assessment have been produced by Environment and Natural Resources (ENR) of GNWT and Parks Canada. These maps are included in Appendix B. Although not provided with this report, PC (2007) also produced a "fuel type classification map" (essentially a vegetation classification merged with a fire history map).

4.3.2 Flooding / Drought

The extensive wetlands and low-lying situation of the study area, as well as regional climatic characteristics, generate local and regional fluctuations between flooding and drought conditions. Although many species in the area are adapted to such conditions, extremes can greatly influence short-term (year-to-year) success of a wildlife population (leading to variations in available habitat, reproductive success, etc.). The Lower Buffalo River, for example, is known to fluctuate quite dramatically between wet and dry years. Starling (2007), Faria (2002), and archived hydrometric records (EC 2007c) indicate that in some years the river may run almost dry, while in others, flooding can envelop the surrounding forest (Smith and Taptuna 2007). McMillan, et al. (2007) report that, over the last few years, water levels have been generally low in the Buffalo Lake area. Global warming and the associated climate changes may alter historical patterns in the area. As mentioned previously, baseline hydrological records are not extensive enough to accurately predict extreme hydrological events (Faria 2002).

4.3.3 Disease

Diseases can also represent a threat to the stability of wildlife populations and vegetation communities. Bison for example, are actively monitored in the NWT to prevent the spread of bovine tuberculosis, brucellosis, and anthrax. Within the NWT, deer mice samples have been analysed for the Hantavirus (Carrière 1999). For the most part, active monitoring of specific diseases does not occur (bison are the exception); harvesters are however encouraged to report any suspected cases.[8]

[8] The GNWT has created wildlife and fish brochures to illustrate what types of symptoms to look for in wildlife and to inform harvesters what types of wild meat are unhealthy to eat.

4.3.4 Parasite Infestation

The only major biological threat to vegetation in the area is the spruce budworm. The mountain pine beetle that has devastated much of south-western Canada, is not yet a concern in the NWT (Smith et al. 2007; Decker 2007). Other forms of parasitism include ticks and worms that affect wildlife, but these are not actively monitored by resource managers. Fau (1975) reports that whitefish from Buffalo Lake were commonly infested with nematodes known as bladderworm.

4.3.4.1 Spruce Budworm

In 1998, the responsibility for operational forest surveys was passed from the Canadian Forest Service (CFS) to the GNWT; CFS responsibility continues for areas within WBNP (Decker 2007). Between 1998 and 2003, spruce budworm (*Choristoneura fumiferana*) surveys were conducted on an annual basis. Since then GNWT has been surveying every 2 years. These surveys can take up to 2 weeks to complete (35 to 70 hours of flight time) and occur in late July to early August. Decker (2007) reports that, to his knowledge, only a single day (July 21st 2001) of surveillance has been done for spruce budworm in the Buffalo Lake area and that defoliation rates ranged from low to moderate severity. This survey covered most of Buffalo Lake except for the extreme north-east end; the only areas with significant stands of mature white spruce were at the south-east end of the lake (associated with the Upper Buffalo River).

Decker (2007) notes that the area is at relatively low risk, as the white spruce stands in the area are more than 50 kilometres from neighbouring concentrations of this species (along the Hay River), which are surveyed regularly. The southern part of the Northwest Territories has also experienced a significant decline in budworm activity since its peak in 2002. DCLUPC (2003) also reports significant concern over spruce budworm at that time. As little or no budworm activity has been suspected in the Buffalo Lake area since 2003, GNWT does not have any immediate plans for future surveys in the area. Decker (2007) also notes that the stands most at risk fall within WBNP and are thus under CFS jurisdiction.

Parks Canada (PC 2007) provided a 'Forest Health' map indicating the extent of defoliation in WBNP, as measured by the CFS in 2006 (refer to Appendix B).

4.3.5 Anthropogenic Disturbances

Anthropogenic disturbances are beginning to impact even the most pristine wilderness areas within the NWT and across Canada. The Buffalo River area, for instance, is influenced by approximately 6,000 hectares of anthropomorphic features (DCLUPC 2003). These features include highways, powerlines, power transmission towers, wildfire watch towers, cutlines, and industrial developments (such as gravel pits and the Pine Point mining area). Although only some of these may be considered permanent features (i.e. roads, powerlines, watch towers), even relatively temporary activities can involve the

removal of vegetative cover and may generate noise, pollution, and waste (which can remain in situ, such as in the case of mine tailings). Within the study area, anthropogenic features are concentrated in the northern part of the study area.

As mentioned previously, there has been some research into the impacts of climate change in the greater WNBP area (ARI 2007).[9]

4.3.6 Adequacy of Research / Identification of Data Gaps

Active monitoring of disturbances within the study area is essentially limited to fire control and assessing bison populations for disease outbreaks. Some monitoring of disturbances such as climate change and spruce budworm has been done in the past. However, in general, resource managers have limited knowledge of local disturbance regimes.

For the purposes of establishing and sustaining a protected area, managers must be cognisant of local disturbance regimes and preserve an area of adequate size to facilitate adaptation of the key ecological features. Despite the lack of specific knowledge related to disturbances within the study area, a general knowledge of the frequency, duration, and severity of a disturbance may be sufficient. Although information regarding the exact frequency and severity of wildfires, for example, may not be known, by visually examining the fire history maps produced by Parks Canada and GNWT (Appendix A), one can ascertain that the study area is of sufficient size to remain essentially intact through decades of the *typical* fire regime. This does not imply that the AI, currently under consideration by the PAS, is of sufficient size or configuration to allow the ecosystem to adapt to such disturbances. Atypical disturbances or extreme changes in historical patterns could diminish the value of a protected area and cannot be clearly understood with the current knowledge of the area.

[9] As suggested by the research descriptions for Akira Osawa in the 2002, 2001, 1999 and 1998 Aurora Research Institute Compendiums.

4.4 Vegetation

As mentioned previously, the study area is located in a generally low-lying, wetland environment. Environmental Canada (2007a) provides a concise but detailed description of the typical vegetation found within undisturbed locations of the eco-zone and eco-region.

4.4.1 Eco-Zone / Eco-Region Vegetation Characteristics

Relatively open and slow-growing conifer forests, predominantly of black spruce, are characteristic of the Taiga Plain ecozone. The often well-developed shrub / understory layer typically includes dwarf birch, Labrador tea, willow, bearberry, mosses and sedges (EC 2007a, Soper 1942, Smith et al. 2007, KFN 2006a). PC (1984) describes the Buffalo Lake area as having a "muskeg/black spruce/sphagnum" vegetation community, which is closely associated with discontinuous permafrost.

Elevated areas and the more southernly locales within the ecozone, tend to be warmer and drier, thus are capable of supporting mixed-wood forests of white and black spruce, jack pine, tamarack, white birch, trembling aspen, and balsam poplar (EC 2007a, Soper 1942). The study area is located at the southern extreme of the Taiga Plains eco-zone and some of the drier areas in the vicinity may reflect the conditions described above.

The Upper Buffalo, Yates and Whitesand Rivers are all relatively large and possess nutrient-rich alluvial fans at their mouths; such areas are often ideal for the growth of white spruce and balsam poplar (EC 2007a). Decker (2007) reports that the only significant stand of white spruce surrounding Buffalo Lake is associated with the Upper Buffalo River.

Examples of Vegetation Characteristics within the Study Area Photos by GNWT / D. Downing 2005

The sub-humid, mid-boreal eco-climate of the Hay River Lowlands, has led to the development of a characteristically closed, mixed-wood forest. Poorly drained fens and bogs support tamarack and black spruce, while the drier sites tend to have a mix of trembling aspen, balsam poplar, white and black spruce (EC 2007a).

In general, the south-eastern part of the study area is poorly drained, thus tamarack and black spruce are likely to be the dominant species, while the north-eastern part of the study area is well drained and can be assumed to support some of the species noted above for drier sites (refer to the "Soil Drainage – by WBNP" Map in Appendix B). EBA (2005b) report white and black spruce forests along the Lower Buffalo River. Mixed stands, in the north-eastern part of the study area, are predominantly bog birch with regeneration of tamarack and black spruce in low-lying areas (EBA 2005b).

4.4.2 Timber Inventories

Smith et al. (2007) and DCLUPC (2003) made reference to a timber inventory completed in 1961 in the Buffalo River area. This inventory was only recently digitized as part of a study to determine a sustainable harvest level for the area. DCLUPC (2003) suggest that the age and lack of site productivity information limits the utility of this dataset. However, Smith et al. (2007) note that after two partial updates, this is currently the best available information for the area and is of greater quality than the Landsat-based vegetation classification.[10]

Another inventory from 1994 covers a small portion of the Buffalo River area but is primarily focused on the Hay River corridor (DCLUPC 2003).

The most recent forest inventory within the study area was completed by Forestry Corporation in 2002 (*not directly referenced*); however, this report was not available for review. DCLUPC (2003) indicates that it describes the process used to determine a suitable timber harvest level for the Buffalo River area.

DCLUPC (2003) also makes reference to a 1968 study by Hirvonen (*not directly referenced*), that examined forest conditions in the Pine Point area. This research was also not available for review. The purpose of the Hirvonen study was to assess the accessible timber supply available for the development of the Pine Point Mine in relation to various routing options of the yet-to-be built railway (which ultimately followed the Mackenzie Highway route northward) (DCLUPC 2003). "Mile-to-the-inch" forest cover mapping was completed from aerial photography, and, rather then undertaking actual field sampling, previous surveys in adjacent WBNP were used to make volume estimates.

[10] Smith et al. (2007) did not provide any further details regarding this Landsat-based vegetation classification.

4.4.3 Over-Story Species

Although a variety of tree species are present within the study area, white spruce and jack pine are the most "commercially interesting" and thus research (i.e. timber inventories) has tended to focus on these species (Smith et al. 2007). Decker (2007) notes that significant white spruce stands are limited within the study area. There is the potential for a small-scale timber operation in the area, but it is limited by demand and a lack of local support for such activities. McMillan et al. (2007) also identified (jack) pine and white spruce as important in the area. Past field programs, conducted by the Environment and Natural Resources (ENR) department of the territorial government, have collected standard tree parameters (diameter at breast height, tree cores, height, species, health, condition) and some very basic site-specific information (such as soils and under-story species).

DCLUPC (2003) indicates generally low timber productivity (20 – 39%) throughout study area and moderate to high (40 – 79%) productivity northeast of Buffalo Lake, in a central area north of the lake, and in a third area west of the Lower Buffalo River near the shore of Great Slave Lake.

Fire and infestation by spruce budworm are currently the only significant threats to trees in the area. Only a single day of aerial surveying for the impact of spruce budworm was conducted in the area (July 21st 2001) and the presence of the budworm was not detected at that time, which was considered unusual (Decker 2007). Fire history maps provided by Parks Canada and ENR indicate that much of the study area has burned within the last 25 years; so a relatively early seral stage can be expected in these areas. Jack pine has become a dominant species in much of the area due to rapid invasion and establishment after fire (Smith et al. 2007, McMillan et al. 2007). The Government of the Northwest Territories (GNWT) is not currently involved in or planning any forest regeneration studies for this area (Smith et al. 2007).

EBA (2005b) reports a variety of tree species in the vicinity, such as paper birch, speckled alder, jack pine, trembling aspen, common juniper, creeping juniper, black spruce, willow, balsam poplar, red-osier dogwood, bog birch and tamarack. Parks Canada (2007) has provided a 'vegetation community' map that provides an indication of the dominant species in a particular area; the 'Ecosite Classification' map depicts various landcover types throughout part of the study area (refer to Appendix B).

4.4.4 Under-Story Species

The typical shrub and under-story species for the eco-region include dwarf birch, Labrador tea, willow, bearberry, sphagnum and other mosses, and sedges (EC 2007a, Soper 1942). A map of KFN gathering areas, produced by Green Pipe (KFN *late 1990's*), indicates that berries were traditionally collected along the north and west shore of Buffalo Lake.

In the Pine Point area, EBA (2005b, 2005c) identified the presence of a number of shrubs and herbs. These included bog birch, common bearberry, cushion mosses, haircap mosses, reindeer lichens, Canada buffalo berry, common juniper, Saskatoon berry, prickly rose, northern comandra, twinflower, northern bedstraw, rock cranberry, stair-step moss, red-stemmed feather moss, horsetail, blue-jointed reed grass, sweet gale, shrubby cinquefoil, sedges, three-leaved false solomon's seal, small bedstraw, and bulrush.

In an adjacent area of Wood Buffalo National Park, red glasswort (*Salicornia rubra*; a plant with high salt tolerance) is one of the only species to successfully establish on the salt plains (PC 1984). Individual seeds from this relatively special plant may have dispersed into and become established within study area.

4.4.5 Adequacy of Research

There has been limited vegetation research focused in the immediate vicinity of the study area. In general, broad-based regional information sources (i.e. land classifications, timber inventories, etc.) provide the majority of vegetation information available for the study area. There are, however, some localised studies associated with resource development (i.e. mining around Pine Point).

The official release of the updated Northwest Territories Ecological Land Classification is anticipated by April 2007. This classification will include detailed landscape unit descriptions and site photos for locations across the territory (Smith et al. 2007). In 2004, four Forest Ecosystem Classification plots were established within the study area for this ecological assessment to provide detailed vegetation, soils and forest measurements (Nelson 2007). As this classification is not yet available, it could not be assessed for quality or reviewed for relevant information. It is recommended that this information be reviewed before any decisions are made regarding boundary delineation for proposing the designation of a protected area.

The Forest Management Division of ENR has no future research plans specific to the PAS Ecological Assessment Study Area (Smith et al. 2007). ENR did, however, identify a general information gap related to forest growth throughout the Northwest Territories.

Due to time constraints and logistical issues, a number of less relevant information sources could not be fully considered in this report. Where possible, research abstracts were examined to provide an indication of the types of information potentially available to decision makers.

The Annual Compendiums of the Aurora Research Institute provide brief descriptions or abstracts of research activity in the Northwest Territories (ARI 2007). Past vegetation research, in the vicinity of the study area, has included:

- The examination of climate warming and carbon dynamics within boreal forest ecosystems of Wood Buffalo National Park (Primary Researcher: Osawa, A. 2003, 2001);

- An analysis of natural thinning processes in mixed species forests of Wood Buffalo National Park (Primary Researcher: Osawa, A. 2001);
- An evaluation of the effect of climate change during the past two centuries on the structure of Jack Pine forests in Wood Buffalo National Park (Primary Researcher: Osawa, A. 1999);
- The reconstruction of forest structure and function in the Canadian Taiga, Wood Buffalo National Park (Primary Researcher: Osawa, A. 1998); and
- Fire regimes in the western boreal forest and post-fire dynamics of the forest, Wood Buffalo National Park (Primary Researcher: Wein, R. 1995).

Tamerlane Ventures Inc. (2006) indicates that a number of follow-up studies (including a Rare Plant Survey) were to have been completed by EBA consultants in the Pine Point area in the summer/fall of 2006, but the reports are not yet available on the MVEIRB Public Registry and the current status or quality of this research is unknown. The MVEIRB (2007) has determined that the Developer's Assessment Report prepared by Tamerlane Ventures Inc., regarding the proposed Pine Point Pilot Project, does not conform to the Terms of Reference for the report. More specifically, in section C of the Deficiency Statement, MVEIRB (2007) identifies a need for greater consideration of any areas of "special sensitivity" (such as the presence of SARA-listed species) within the local and regional environment. Thus further vegetation and wildlife surveys in the Pine Point Area (to the northeast of the Study Area) are anticipated. BC Research (1977) includes a relatively detailed description of vegetation communities in the Pine Point area.

4.4.6 Identification of Data Gaps

General knowledge of boreal forest ecosystems and broad-scale environmental conditions (eco-zones and eco-regions) is relatively extensive. With the release of the updated NWT Ecological Land Classification, more detailed and site-specific information related to the Study Area will become available. Existing information is somewhat dated (forest inventory from 1961) and does not adequately address local processes occurring within the study area (i.e. lack of forest regeneration studies, limited monitoring of spruce budworm). Major ecological changes may occur within an area of interest, due to local processes, within the implementation timeframe of the Protected Areas Strategy. Thus the lack of such information could prove to be a cause for concern. The presence of rare species or important microclimates within the study area is relatively unknown. From a protected areas perspective, the lack of area-specific vegetation knowledge might limit understanding of ecosystem dynamics. Changes in vegetation communities and microclimates (caused by a variety of disturbances), and the impact of these changes within the ecosystem, may pass relatively unnoticed.

4.5 Wildlife

For the purposes of this ecological assessment, focal wildlife species were identified by considering national and territorial conservation status rankings, consulting with local experts, and reviewing traditional knowledge information. As the study area is relatively remote and published research documents relatively scarce, any species subject to individual study were deemed important. By considering the volume of recent research or scrutiny given to a particular species within the region, the current priorities of resource managers and regulators could be better understood.

Although more recent works have examined particular species of wildlife in the area, none are as extensive as the comprehensive faunal survey of Wood Buffalo National Park conducted by the "Dominion Government" in 1931. This field investigation was completed over several years and in all seasons, with the use of power boats, canoes, horses, dog teams, and reconnaissance aircraft (Soper 1942). The survey recorded 46 species and subspecies of mammals and 217 species of birds in the park and vicinity. Although it is recognised that the information provided by this report is quite dated and that local habitats and wildlife populations have undoubtedly changed over the last 75 years, due to natural succession and fire disturbances, the natural ecological conditions within the study area remain relatively pristine (ie. there have been no major anthropogenic disturbances in the Buffalo Lake area). Thus, the information provided by Soper (1942) can offer an impression of the ecological value of the general habitat within the study area, even if discrete habitat patches and the overall landscape have changed over time.[11] As it is a comprehensive research report, information from this source will be used as a foundation for the discussion of mammals within the study area, while more recent studies and personal communications with local experts will be incorporated to provide a more current context.

EBA (2005c) completed an initial wildlife baseline study of the Pine Point area for Tamerlane Ventures Inc., the proponent of a lead-zinc shaft mining operation in the area. This study was coordinated with and complimented other research conducted by EBA (2005a and b) on behalf of Tamerlane. Although the Pine Point area only comprises a small portion of the entire study area and EBA was forced to work within a limited timeframe, their study included plot assessments and opportunistic observations of a variety of wildlife species in a variety of habitats.

In January 2006, the KFN published a Traditional Knowledge Assessment to document some of the potential impacts of the proposed Mackenzie Gas Project (KFN 2006b). The report contains valuable data on wildlife harvesting sites, and, therefore, wildlife habitat locations, throughout the study area.

[11] It should be noted that significant landscape level changes resulted from the wildfires of the early 1980's (mentioned previously).

4.5.1 Mammals

As noted above, Soper (1942) completed surveys in the vicinity of Wood Buffalo National Park, while EBA (2005c) conducted a one-week wildlife baseline survey in the Pine Point area, from September 19th to September 25th 2005. The EBA survey focused on a much smaller area (than that of Soper 1942) and was located in the north-eastern corner of the study area for this ecological assessment. The EBA (2005c) report also recognises that "survey intensity was limited by time and season" whereas the comprehensive survey (Soper 1942) was both multi-year and conducted year-round. As mentioned previously, additional wildlife research in the Pine Point area is anticipated (Tamerlane Ventures Inc. 2006, MVEIRB 2007).

It should be noted that although the survey conducted by the Dominion Government (Soper 1942) included part of the study area (within the Park), reports were generally collected from park wardens and harvesters from the south-eastern end of the park (… "inquires were made at Chipewyan, Fitzgerald and Fort Smith…"). If K'atl'odeeche First Nation harvesters were not adequately surveyed, information may be less reliable for the Buffalo Lake area than in other areas surveyed in the park.

Soper (1942) indicates that, within WBNP, wildlife distributions were relatively uniform and suggests that the decrease in elevation from south to north partially explains this condition. This uniformity allows some assumptions to be made about the presence of wildlife within the study area and vicinity. Soper (1942) also makes a number of specific references to the upper and lower Buffalo River, Buffalo Lake, and Copps Lake (all within the study area for this ecological assessment) and identifies 5 "biological camps" along the Buffalo River (north of the border) which were used during the survey period from 1932 to 1934.

Hartop et al. (2007) report that, based on the concentration of tracks, the majority of large mammal activity during February 2006, occurred between Buffalo Lake and the Cameron Hills. More specifically, the bison control surveillance flights between February 7th and 9th 2006 recorded numerous large mammal tracks (species not specified) surrounding the west end of Buffalo Lake and to the north between the lake and the highway.

Helmer (2007) suggests that trapping in the Buffalo Lake area has declined and is now quite limited, thus current statistics on fur bearer populations (which are often gathered through ENR) are also limited.

For the purposes of this report, the following mammals are considered to be focal species: woodland (boreal) caribou, moose, wood bison, wolf, and black bear.

Carrière (1999) suggests that small mammals play a keystone role within northern boreal ecosystems because they represent major prey species for many carnivores. For this reason, small mammals and other common mammal species are included in the discussion that follows.

4.5.1.1 Woodland Caribou (threatened / sensitive)[12]

COSEWIC (2007) indicates that in 2002 the boreal population of woodland caribou (*Rangifer tarandus caribou*) was ranked as threatened throughout Canada, whereas, within the Northwest Territories, recent research has suggested that the population is sensitive (GNWT 2006). Although woodland caribou are sensitive to habitat disturbances such as seismic lines, industrial activity in the study area has been relatively limited. Dyer (1999) contends that seismic lines do not appear to pose a barrier to movement by caribou. However, James (1999) found that caribou in northeastern Alberta tended to avoid linear corridors, as wolf predation efficiency increased in these locations.

In winter, a number of woodland caribou may appear irregularly in the Copp and Buffalo Lake areas, and withdraw westward during the summer (Soper 1942). In November 1932, the animals were fairly common near the headwaters of the Buffalo River. The animals reportedly spend the summer in the highlands of the Caribou Mountains and disperse over the adjacent plains after freeze-up each year (Soper 1942). This information is consistent with recent observations and caribou appear to be present throughout much of the area (Smith et al. 2007, Helmer 2007, Johnson 2007, McMillan et al. 2007). A map of KFN (*late 1990's*) big game harvesting sites indicates the presence of caribou in locations northwest and east of Buffalo Lake. KFN (2006b) also documents a high intensity of big game harvesting at the mouths of the Yates and Whitesand River.

Interestingly, computer modelling (at a landscape scale) by Gunn et al. (2004) predicted a relatively low probability of boreal caribou occurrence in the Buffalo Lake area; a small patch of moderate to high probability was predicted in an area northwest of Buffalo Lake (apparently associated with a greater portion of spruce-lichen habitat). James (1999) notes that the selection of fen/bog habitat by caribou in northeastern Alberta reduces predation by wolves.

BC Research (1977) suggests that the woodland caribou population in the Pine Point area is relatively low and that the animals tend to inhabit the area to the south (WBNP and vicinity). Dzus (2001, p.9) indicates that woodland caribou observations and telemetry have been recorded in Alberta since 1967, and there appears to be a high concentration of animals in the Caribou Mountains and to the northwest of the area, up to the NWT / Alberta border. This information indicates woodland caribou activity immediately south of the study area, and therefore seems to suggest that woodland caribou are also present within the southern part of the study area. The Alberta government has initiated a new boreal caribou collaring program in northern Alberta, just south of the Buffalo Lake area (Helmer 2007). On bison control surveillance flights in the winter of 2005 - 2006, woodland caribou were observed north of Buffalo Lake (Hartop et al. 2007). In 1999, caribou were found in areas to the south, just outside of the study area (refer to "Moose Survey – by WBNP" map in Appendix B).

[12] All COSEWIC / NWT Status designations as reported by GNWT 2006. In some cases only the NWT status will be indicated.

Environment and Natural Resources and Parks Canada are in the early stages of a joint research program to "assess the genetic diversity and population structure of Boreal Caribou" east of the Hay River, using DNA analysis of 100 fecal samples (Johnson 2007). The research proposal for this program cites the need for baseline information and the renewed industrial interest in the Pine Point area (and the potential impacts of development) as justification for this research. This research could be used to generate a population estimate for woodland caribou in the area and to document areas of late winter occupancy. The entire study area for this ecological assessment falls within that for the proposed DNA research program. A reconnaissance survey and the collection of fecal samples are scheduled for March 2007; the reports for this project are not expected before April 2008 (population structure) and March 2009 (population estimate).

4.5.1.2 Moose (secure)

Moose (*Alces alces*) are relatively common throughout the area but are more abundant in the western half of WBNP (Soper 1942). Observations were recorded all along the Buffalo River from Great Slave Lake to south of the NWT-Alberta border. Soper (1942) reports, "[i]n no part of the park were moose subsequently seen to be so numerous as about Buffalo River and Lake." There is a pronounced eastward migration of moose from the western park sectors to the Slave River vicinity during mid-winter to spring, and as the snow melts a similar westward movement occurs (Soper 1942). No evidence of "yarding" was found, as trails generally exhibited a random pattern; concentrations of moose only occurred near highly favourable habitat. The mouths of the Yates and Whitesand Rivers are apparently areas of highly favourable habitat for moose, as high densities and frequent observations have been reported (Helmer 2007, Smith et al. 2007, KFN 2006a, 2006b). BC Research (1977) reports that moose in the area generally do not gather in concentrations over the winter months (as occurs in other areas); this only occurs during severe winters when snow depth impedes movement.

On bison control surveillance flights last winter (2005-2006), moose were observed along both sides of the Hay River between Enterprise and the border, and in the Buffalo Lake area (Hartop et al. 2007). In 1999, moose were active in areas to the south, east, and north of Buffalo Lake (refer to "Moose Survey – by WBNP" map in Appendix B). BC Research (1977) indicates that moose are present throughout the area in low densities. Fau (1975) notes that, in the fall of 1975, moose were relatively abundant along the shores of Buffalo Lake and the Buffalo River. A map of KFN (*late 1990's*) big game harvesting sites indicates the presence of moose throughout the study area, and suggests an apparent concentration in the Yates and Whitesand River area.

4.5.1.3 Wood Bison (threatened / at risk)

Wood bison (*Bos bison athabascae*) are native to an area south of Great Slave Lake (BC Research 1977). A number of plains bison (*Bos bison bison*) were trans-located into the Wood Buffalo National Park from Wainwright National Park (Alberta) beginning in 1925 (Soper 1942, Hartop et al. 2007). The local population now contains an essentially hybridised form of the animal (PC 1984). The native bison herds in and around Wood Buffalo National Park became infected with bovine tuberculosis and brucellosis when the southern animals were introduced (Hartop et al. 2007.).

The English name "Buffalo Lake" comes from the Slavey placename "*Ejie Túé*" meaning "buffalo's water". Thus, the traditional placename suggests bison have an attraction to this area. The name of the National Park also suggests that bison were common throughout the area when it was established.

With the spring thaw, the grassy, lowland plains begin to flood and the herds may move westward to higher ground in the gently rolling uplands surrounding Caribou Mountain and near Buffalo Lake (Soper 1942). Helmer (2007) indicated that Copp Lake once had a non-diseased bison population and was the source of seed animals for the Fort Providence Bison Sanctuary. The newly established herds -- including the Mackenzie herd (located within the sanctuary), the Hay-Zama herd (of north-western Alberta), and the Nahanni herd -- have all maintained relatively healthy populations (Nishi 2002).

In 1987, with the successful establishment and maintenance of disease-free bison herds in proximity to the disease-affected herds in WBNP, the GNWT implemented a program to reduce the risk of contact between diseased bison and neighbouring herds, as well as with commercial bison and cattle ranch operations in northern Alberta and the southern NWT (Gates and Gray 1992). A 'Bison Control Area' was established in which bison are actively culled. Since that time, surveillance programs have included fixed-wing aerial reconnaissance during the late winter months (December to April), interviews with local individuals and agencies travelling through the area and public participation (reporting is encouraged through the use of brochures, notices and road signs) (Nishi 2002). In 1990, the Bison Free Management Area (also known as the 'Bison Control Area') was expanded to include areas north of the provincial / territorial border, eastward to the Buffalo River and the western boundary of WBNP. The study area for this ecological assessment is located in Zone 1 of the Bison Control Area (BCA). This implies ongoing monitoring surveys and removal (killing) of any bison found in this Zone. During the survey season, Zone 1 is monitored with monthly 'semi-comprehensive' flights and an annual comprehensive survey.

Nishi (2002) reports that between 1987 and 2000, observations of bison were limited to the surveys conducted along the Mackenzie River shoreline. There were no observations or reported sightings of bison in the BCA during the 2005 – 2006 winter survey season but animals have been observed in the past. In 1999 for example, evidence of bison was found in areas to the south, east, and north of Buffalo Lake (refer to "Moose Survey – by WBNP" map in Appendix B). A map of KFN (*late 1990's*) big game harvesting sites

indicates that bison have been killed along the Yates River. Small groups of bison have been observed in the Buffalo Lake area, just south of the border (outside of the BCA) (Nishi 2002).

Hartop et al. (2007) note that the "absence of bison in the BCA should not be presumed, especially as there is a long period in the off-season when the program is not active and there is no snow to make tracks visible." With this in mind, and considering the westward migration during spring thaw (which may occur in the off-season) described by Soper (1942), it is quite probable that individual animals wander into the study area. This is further supported with statements made by Hartop et al. (2007, p.34):

> *We extended survey coverage during the semi-comprehensive and comprehensive surveys* [apparently beginning in the 1993 – 1994 season] *further into the northwest corner of WBNP, into the area north of Buffalo Lake and west of ca. 114°30'W. Although no bison were observed in this area, the addition of such coverage continues to improve our knowledge of areas along the north western park border where bison would most likely disperse.*
>
> *… Consideration should be given into extending survey routes into Alberta, west of WBNP, with respect to Hay-Zama herd movement. …there are bison in the northwest park area and there is good bison habitat in the vicinity of the Hay River near the NWT/Alberta border. This makes bison dispersal from the park and the Hay-Zama herd a distinct possibility.*

At present, few, if any, bison reside within the study area for any extended length of time. However, concerns related to disease control, the relatively high probability of individual animals entering the area for short periods of time, and the possibility of future immigration warrants addressing bison as a focal species.

4.5.1.4 Gray Wolf (secure)

Soper (1942) reported a relatively universal distribution of wolves (*Canis lupus*) throughout the park and noted activity in the Buffalo Lake area; activity was particularly intense along the Upper Buffalo River. Wardens at that time also reported a greater number of wolves in the western half of the park around Caribou Mountain and northward, and in the north-central area near Copp and Buffalo Lakes. Soper (1942) suggests that wolves appeared to be concentrated "in the region of Buffalo Lake" and the upper Buffalo River.

On bison control surveillance flights last winter (2005-2006), wolves were observed north of Buffalo Lake following woodland caribou (Hartop et al. 2007). In 1999, wolves were very active in areas to the south, east, and north of Buffalo Lake (refer to "Moose Survey – by WBNP" map in Appendix B). As mentioned previously, populations of moose and wolves are linked in a predator-prey relationship, particularly during the colder months (Bradley and Johnson 1998; Soper 1942). Bison may be a secondary prey animal for wolves (Bradley and Johnson 1998). These strong interspecific relationships

with several focal species provide sufficient justification to also treat wolf as a focal species.

4.5.1.5 Black Bear (secure)

Soper (1942, p.126) noted that "In July, 1932, trails were noted all along Buffalo River from Great Slave Lake to Buffalo Lake and, less commonly, along the upper Buffalo (Caribou) River to the forks south of the 60th parallel… Beaten trails in the woods and fresh and old spoors on the river margins were familiar daily observed features." McMillan et al. (2007) reported recent evidence of black bear (*Ursus americanus*) activity near cabins at the west end of Buffalo Lake. As the black bear is a common species throughout the boreal forest and holds a relatively dominant position within the ecosystem, treatment as a focal species is warranted.

BC Research (1977) reports that black bears were once common in the Pine Point area, before industrial development occurred. Upland forest areas provide good habitat for black bears; however, extensive areas of low-lying muskeg (which occur throughout much of the study area) do not represent good bear habitat. A map depicting KFN (*late 1990's*) big game harvesting sites indicates the presence of black bear within the study area.

4.5.1.6 Other Non-Focal Species in the Area

A map of KFN (*late 1990's*) small game harvest sites indicates the presence of beaver, muskrat, rabbit, lynx, squirrel, wolverine, wolf, fisher, otter, mink, marten, fox, and weasel within the study area. This information helps to further establish the presence of some of the species discussed below.

Mule Deer

Soper (1942) notes the relatively recent invasion (over the last few centuries) of mule deer (*Odocoileus hemionus*) into the park and reports observations along the upper Buffalo River, around Buffalo Lake, and north to Great Slave Lake. At that time, the species was fairly common in the region. Helmer (2007) reports the continued presence of this species in the area.

Bat

There are at least four species of bat known to inhabit Wood Buffalo National Park: these include the little brown myotis (*Myotis lucifugus*), the big brown bat (*Eptesicus fuscus*), western long-eared myotis (*Myotis evotis*) and the locally rare hoary bat (*Lasiurus cinereus*) (Soper 1942, PC 1984). The study area also falls in the extreme northern range of the northern long-eared myotis (*Myotis septentrionalis*) (Caceres and Pybus, 1997). Within the NWT, the little brown myotis is ranked as a sensitive species; the other

species of bat known to be present have not been evaluated and all are expected to have small local populations due to limited range (GNWT 2006).

Bats are known to hibernate deep within the karst caves located to the east, in the immediate vicinity of the study area, and it has been speculated that the karst terrain forms a major regional hibernaculum (PC 1984). Thus the study area, rich in insects (associated with the numerous wetlands), may act as an important feeding ground for these species, even if adequate winter habitat is not present.

Lynx

In the 1930s, the lynx (*Lynx candensis*) was a resident species within the park and more abundant at the western end. Soper (1942) suggests that intensive trapping pressure and other human activity at the eastern end of the park may have reduced the lynx population there. Local harvesters "…maintain that a seasonal migration occurs in December and January from the west, ostensibly originating in [the] Caribou Mountain[s] or the forested muskeg-plain immediately adjoining its base on the east and north" (Soper 1942). Lynx tend to frequent glacial moraines in this region. Helmer (2007) confirmed the continued presence of this species.

Cougar

The cougar or mountain lion (*Puma concolor*) is a naturally elusive species due to high mobility, low population densities, and a solitary tendency. Gau et al. (2001) suggest that "at minimum, transient cougars are regular visitors to northern Alberta and the Northwest Territories"; however, a warming climate could contribute to the cougar becoming established in southern part of the territory. There have been sightings within WBNP since 1962; within the Northwest Territories, 37 reliable sightings were recorded between 1983 and 2000 (Gau et al. 2001). There have been at least three observations in the vicinity of the study area: in 1992, near the NWT/Alberta border just west of the western park boundary; in 1997, near the settlement of Enterprise; and in 1999, at the extreme north-western corner of WBNP. Although its current status is unknown in the NWT, Gau et al (2001) allude to the possibility of an established resident cougar population..

Wolverine

EC (2007b) indicates that wolverine (*Gulo gulo*) is present throughout the NWT, but densities are greatest towards the south-western part of the territory. GNWT (2006) reports that this species is sensitive ("special concern" under COSEWIC) and that the current status of the species is improving. Although the species has a special designation, occurrence is not well documented within the study area and therefore it has not been deemed a focal species at this time.

Other Species

Soper (1942) observed a variety of other species in the Buffalo Lake area. These observations are summarised in Table 3 below and provide an indication of the relative diversity throughout the study area. KFN (2006b) indicates that beavers and muskrats are often harvested at the west end of Buffalo Lake.

4.5.1.7 Adequacy of Research / Identification of Data Gaps

As noted, the most extensive wildlife survey of the area was completed by Soper (1942). This information is obviously very dated but can still provide an indication of the types of wildlife and habitat in the area. Bison research is primarily concerned with the presence / absence of the species. Other wildlife research in the area is limited in extent and duration (i.e. studies in the Pine Point Area).

Although the proposed DNA study of woodland caribou fecal samples promises to provide greatly improved information on this species, the final results are years away. Other than incidental observations, limited species-specific information is available for moose, wolf, or black bear within the study area.

Table 3: Other Mammal Observations Reported by Soper (1942)

Species	Description of Location
Beaver (*Castor canadensis*)	The area has ideal habitat for beaver and the species has been observed on the Buffalo River, Buffalo Lake, Copp Lake, and along Copp Creek.
Southern Red-Backed Vole (*Clethrionomys gapperi*)	Very common with specimens collected all along the Upper and Lower Buffalo Rivers.
Northern Flying Squirrel (*Glaucomys sabrinus*)	An elusive species but one specimen was collected at mouth of Buffalo River in September 1932.
Northern River Otter (*Lontra canadensis*)	Numerous in the extreme western-central part of WBNP but are less common in the NWT then in Alberta. Helmer (2007) indicates that otter continues to be present in the area.
Snowshoe Hare (*Lupus americanus)*	These mammals were relatively common but generally more abundant in the northern and eastern parts of WBNP.
Marten (*Martes americana*)	The local population appears to periodically migrate outward from a suspected core area in the Caribou Mountains (these migrations are related to a cyclic population); more abundant near the western boundary of the park.
Striped Skunk (*Mephitis mephitis*)	Widely dispersed throughout the park; found to inhabit lowlands subject to seasonal inundation.
Woodchuck (*Mormota monax*)	Found on all along the Lower Buffalo River; this species seems to prefer glacial and gravel ridges.
Meadow Vole (*Microtus pennsylvanicus*)	Probably the most abundant small rodent; common along the Upper Buffalo River.
Least Weasel (*Mustela nivalis*)	Generally common throughout the region; one specimen was collected at the mouth of the Buffalo River.
Mink (*Mustela vison*)	Common but most abundant in western half of park; often found in small, swampy-shored lakes adjacent to Caribou Mountain and near Buffalo Lake.
Least Chipmunk (*Neotamias minimus*)	Fairly common along the Upper and Lower Buffalo Rivers.
Muskrat (*Ondatra zibethicus*)	"In July 1932 they abounded in the creeks, rivers, and marshes everywhere about Buffalo Lake. …a profusion of sign signified an unmolested and thriving population."
Deer Mouse (*Peromyscus maniculatus*)	Generally abundant; specimens collected on the Upper Buffalo River.
Masked Shrew (*Sorex cinereus*)	Widely distributed throughout the park; one specimen collected on the Buffalo River.
Red Squirrel (*Tamiasciurus hudsonicus*)	Generally common but particularly along the Upper and Lower Buffalo Rivers.
Red Fox (*Vulpes vulpes*)	One of the most common species; more abundant north of the Peace River.

4.5.2 Birds

In the north-eastern part of the study area, EBA (2005c) observed a number of bird species, including American robin, tundra swan, white-winged scoter, gray jay, common raven, spruce grouse, bohemian waxwings, whooping crane, and peregrine falcon.[13] Helmer (2007) also reported a variety of ducks ("speckled belly", lesser scaup, northern pintails, mallards) and Canada geese to be in the area around Buffalo Lake, and suggested that it was an important area for migratory birds. The bird species potentially present within the study area for this ecological assessment are listed in Appendix A.

Further research regarding the Pine Point area is anticipated; Tamerlane Ventures Inc. (2006) indicates that this work includes owl surveys and breeding bird surveys. It is not clear if incidental observations of bats have been recorded as part of the Pine Point owl survey. Bats were not mentioned in the EBA (2005c) wildlife survey report, are likely present in the area, and could be incorporated within the scope of an owl survey (as both are nocturnal flying animals).

Migratory birds are often harvested at the west end of Buffalo Lake and it has been suggested that the number of migratory birds visiting the area has declined in recent memory (KFN 2006b). A map of KFN fowl harvesting sites (KFN *late 1990's*) indicates that geese, ducks, swans, and grouse were traditionally harvested near the mouths of the Yates and Whitesand River and at the outlet flowing into the Lower Buffalo River. Ducks and geese can also be found along the southeast shore of Buffalo Lake, near the mouth of the Upper Buffalo River. The majority of bird information for the study area comes from broad-based regional sources.

4.5.2.1 Broad Bird Surveys in the Vicinity of the Study Area

The Canadian Wildlife Service (CWS) and United States Geological Survey[14] have a joint initiative to conduct Breeding Bird Surveys of 9 migration routes throughout the NWT (Machtans 2007, USGS 2007). Each route is surveyed every few years and the Little Buffalo River (route 43009) is the closest route to the study area. This route is quite distant from the study area. Charlwood (2007) has indicated that Ducks Unlimited Canada has not conducted any surveys in the area, nor do they have plans to do so in the foreseeable future.

The NWT / Nunavut Bird Checklist program is a supported by the CWS, and it maintains data from individual bird observations made by private citizens. Machtans (2007) provided database records for observations in the general vicinity of the study area; however, as the information is provided by the public, the focus tends to be around the more accessible areas such as roads and developed areas. The public nature of this program may also create some bias in the observations, as mistaken identities may be

[13] EBA (2005c) note that the whooping crane and peregrine falcon observations were likely of transitory or non-breeding individuals.
[14] This program was formerly under the mandate of the United States Fish and Wildlife Service.

more frequent and the less notable observations may not be reported. Species observed in the general vicinity of the study area are listed in Appendix A.

Whooping crane, peregrine falcon, yellow rail, and short-eared owl were deemed to be the focal avian species potentially present within the study area.

4.5.2.2 Whooping Crane (endangered / at risk)

Wood Buffalo National Park includes the only known breeding site of the endangered whooping crane (*Grus americana*) in the world (COSEWIC 2007, EC 2007b). The significance of this nesting area is highlighted by its designation as an Important Bird Area (BSC 2007), its inclusion in a larger wetland complex of international significance (designated as a Ramsar site in May 1982; Wetlands International 2007), and its role in the park becoming designated a Natural World Heritage Site (UNEP 2007).

Although the whooping crane summer range is located to the east, beyond the immediate vicinity of the study area, Parks Canada (PC 2007a, 2007b) has identified potential habitat within the study area and has suggested that the birds may be dispersing beyond their current summer range. It is also possible that individual (non-breeding) transient birds visit the area. EBA (2005c), for example, observed whooping cranes in the vicinity. Transient, non-breeding individuals are known to inhabit areas between WBNP and the Mackenzie Bison Sanctuary (far to the west, beyond the immediate vicinity of the study area) (EBA 2005c).

The Canadian Wildlife Service (CWS) conducts survey flights to monitor the recovery of the species. Between 1967 and 1996, CWS also practiced egg removal (one egg from two-egg nests) to enhance recruitment and facilitate species recovery through captive breeding and foster parenting programs. Since 1996, Parks Canada has resisted egg removal practices in an effort to minimise human interference with natural ecological processes (Boyce et al. 2005). Jones and Lacy (2004) report that captive breeding, which includes eggs brought into captivity from WBNP, has been so successful that two release projects can be maintained while ensuring a positive growth rate in the captive flock. If such reintroduction projects prove successful, this has implications for whooping crane habitat within and surrounding WBNP.

OOC (2003) predicts potential habitat for whooping cranes within the study area. This includes a small patch near Copp Lake and a relatively large habitat patch near the mouth of the Lower Buffalo River (on the east side). Another very large patch of potential whooping crane habitat occurs in the vicinity of the study area (southeast of the highway junction). A map associated with this report is provided in Appendix B.

4.5.2.3 Peregrine Falcon (threatened / sensitive)

Although the peregrine falcon (*Falco peregrinus anatum*) is probably not resident within the study area, due to a lack of nesting habitat, it has been observed in the vicinity (McMillan et al. 2007; EBA, 2005c). These falcons require high perches, which are often

associated with cliff faces, and thus may roost in the Caribou Mountains to the south of the study area. The study area may act as a hunting ground for the species.

4.5.2.4 Yellow Rail (special concern / may be at risk)

Machtans (2007) reports a number of sightings of the yellow rail (*Coturnicops noveboracensis*) in the area. This migratory species has a relatively limited distribution in the NWT and is "typically found in marshes dominated by sedge, true grasses and rushes" (EC 2007b). Wetlands are found throughout the study area; however, information on specific vegetation communities could not be assessed in this report (as timber inventories and the Landsat-based classification were not available). EBA (2005b) reports the presence of sedge, grasses and bulrushes in the Pine Point area. The current status of the species makes it a focal species; although perhaps not to the degree of the whooping crane or peregrine falcon.

4.5.2.5 Short-Eared Owl

The short-eared owl (*Asio flammeus*) is listed by GNWT (2006) as sensitive ("special concern" under COSEWIC) and was observed by EBA (2005c) in the Pine Point area.

Historically, this species has occupied most of the non-forested regions of Canada. However, within the NWT, observations suggest that this species may also breed in some taiga and boreal forest areas (GNWT 2007a). Typically the species can be found in grasslands and prairies during the summer and migrate to the southern extents of their range during the winter. Within the study area, open forest areas and wetlands may provide habitat.

4.5.2.6 Adequacy of Research / Identification of Information Gaps

There has not been any in-depth bird survey of the immediate vicinity of the study area; nor are there any immediate plans to do so. In a general wildlife survey, EBA (2005c) gathered some data on birds in the Pine Point area, but the status of owl and breeding bird surveys by EBA is unknown. The most relevant (and broadest) survey is limited to areas of public access and lacks scientific rigor (the NWT/Nunavut Bird Checklist). OOC (2003) identifies potential whooping crane habitat in the area, but the intensity of use by this and other sensitive species is unknown.

4.5.3 Fish

Inconnu (*Stenodus leucichthys*), pickerel (*Sander vitreus* a.k.a. walleye), and lake whitefish (*Coregonus clupeaformis*) are the most commonly known species in the study area (Smith and Taptuna 2007; Helmer 2007). Inconnu are the most commercially important fish in the area (Smith and Taptuna 2007). Burbot (*Lota lota*) and northern pike (*Esox lucius* a.k.a. jackfish) may also be present in the Lower Buffalo River (EBA 2005a, Fau 1975). There are no known species at risk in the area, and although there have been reports of shortjaw cisco (*Coregonus zenithicus*) in Great Slave Lake. DFO indicates that specimens would be indistinguishable from other local species without DNA analysis (Smith and Taptuna 2007).

There is no history of "fish-kills" on Buffalo Lake and it is apparently deep enough avoid completely freezing during the cold northern winter (Smith and Taptuna 2007). The water levels of the Lower Buffalo River fluctuate significantly and are known to occasionally flood neighbouring forestland while at other times are at very low levels (Smith and Taptuna 2007; Starling 2007). These fluctuations obviously have some implications for fish populations within the river, such as reducing the carrying capacity of the habitat, decreased fecundity, and increased vulnerability to competition and predation during low water levels.

Cross-jurisdictional issues affect fish management in Buffalo Lake. DFO responsibilities for fish management at the west end of Buffalo Lake are not directly linked to fisheries research or management by Parks Canada (on the east end of the lake), but any trans-boundary fish research must be approved by both agencies (Smith and Taptuna, 2007; McMillan et al. 2007). DFO has some concerns about the potential for cross-border impacts on fish populations from upstream development in Alberta.

Fisheries research in the study area has tended to focus on inconnu, so inconnu was deemed to be the only focal fish species.

4.5.3.1 Inconnu (may be at Risk)

The inconnu (*Stenodus leucichthys*) stocks in the Lower Buffalo River are an ongoing concern for the federal Department of Fisheries and Oceans (DFO) due to commercial fishing pressure on Great Slave Lake and habitat degradation related to industrial development (Smith and Taptuna 2007, GC 2007, DFO 1998). Inconnu have spawning habitat all along the Buffalo River. Due to previous over-fishing of inconnu, DFO implements a spring closure of the commercial fishery within 3 km of the mouth of Buffalo River during the inconnu spawning runs. The species is currently monitored every three years using radio tagging, floy tagging, and lethal sampling to measure basic physical parameters. According to DFO, the Whitesand River and Yates River are probable inconnu spawning locations; unfortunately, DFO currently lacks the resources (research time, funding, etc.) to pinpoint spawning locations in this area. Similarly, very little fisheries research has been done on Buffalo Lake (Smith and Taptuna, 2007).

Day and Low (1993) suggest that "…Buffalo River inconnu stocks will have a poor capacity for rapid recovery should commercial harvesting cease". The stability of this stock is influenced by a number of factors, including intra-stock population characteristics, such as cohort distribution. The report by Day and Low (1993) recommended increases in commercial closures (both in area and in duration) at the mouth of the Lower Buffalo River, continued monitoring of the stock and research to better delineate the stock, "especially of those fish which occur at the mouth of the [Lower] Buffalo River, in the river itself and in headwater streams in Buffalo Lake". The authors also pose the following questions: "Are we presently losing stocks and is the interpretation of Buffalo River inconnu sampling data flawed by our lack of knowledge on stock structure?" Apparently, these questions remain unanswered.

Fau (1975) prepared a report for Wood Buffalo National Park that included a basic fish survey. The report includes recommendations for a more consistent and comprehensive survey, as "to date our information on fish populations, age classes, distribution, etc., in Buffalo Lake is very limited". However, no follow-up research was identified during this ecological assessment.

If resources permitted, DFO would like to do more research into Alberta and carry out annual monitoring of the Buffalo River inconnu stock (Smith and Taptuna 2007).

4.5.3.2 Adequacy of Research / Identification of Data Gaps

Inconnu are only monitored on the Buffalo River every three years and research to identify spawning locations has not yet occurred. Very little is known about fish populations in Buffalo Lake.

The jurisdictional context of the study area complicates research efforts. Permission must be granted by both DFO and WBNP (Parks Canada). The proponents of research may also be reluctant to initiate studies in the area without authority over the entire system being studied (i.e. Buffalo Lake); and may be unwilling to expend budgetary dollars when such research could benefit another, non-contributing government agency.[15] Regardless of these possible complications, it is clear that there is a lack of detailed fisheries research in the Buffalo Lake area.

[15] *Personal observation of the author*.

4.5.4 Reptiles and Amphibians

Although the climate severely limits the range of reptiles and amphibians in the NWT, some species are present in the extreme south of the territory. GNWT (2006) indicates that the following species are likely present in the NWT: western toad, Canadian toad, boreal chorus frog, northern leopard frog, wood frog, long-toed salamander, terrestrial garter snake and the common red-sided garter snake. Buffalo Lake does not have a history of fish kills and apparently doesn't completely freeze during the long winter; therefore the lake bottom may provide suitable winter habitat for some of these species.

Tamerlane Ventures Inc. (2006) indicates that an amphibian survey was completed for the Pine Point area; although the report is not yet publicly available. Carrière (2007) suggests that within the study area, the only species potentially present are the wood frog (*Rana sylvatica*), boreal chorus frog (*Pseudacris maculata*), Canadian toad (*Bufo hemiophrys*), and the common red-sided garter snake (*Thamnophis sirtalis*).

4.5.4.1 Toad and Frogs

PC (1984) reports that the leopard, wood, and chorus frogs and the Canadian toad all inhabit the park.

GNWT (2007) lists the northern leopard frog as "sensitive" while COSEWIC lists the species as "special concern". EBA (2005b) notes that this species is known to occur at several sites between the border and Great Slave Lake, and may be more widely distributed than currently documented. Carrière (2007) suggests that this species is not present within the study area, as this frog in only known to occur near the Slave River.

GNWT (2007) lists the Canadian toad as "may be at risk" while COSEWIC lists the species as being of "special concern". Buffalo Lake is near the northern limit for the Canadian toad. This toad tends to remain in wetland areas for breeding, particularly ponds with mud flats (Hamilton et al. 1998). It is included on Alberta's "Red List" suggesting that the species is at risk of declining to non-viable population levels in the province. The species is not very well studied in Alberta and no wide-scale studies have been conducted.

4.5.4.2 Snakes

The 2002 Compendium of the Aurora Research Institute indicates that a survey was undertaken to assess the age structure and genetic heterogeneity of garter snake populations in the vicinity of Wood Buffalo National Park (ARI 2007). The common red-sided garter snake has adapted to the harsh winter climate by hibernating below the frost line in karst caves and crevasses; at least two snake hibernaculums have been identified (PC 1984). There are extensive karst formations just east of the study area.

4.5.4.3 Adequacy of Research / Identification of Data Gaps

Information on reptiles and amphibians within the study area is quite limited. The only research project known to have occurred in the vicinity of the study area focused on garter snakes and the status of the EBA survey in the Pine Point area is unknown.

4.5.5 Summary Comments on Available Wildlife Information

Although the presence or absence of dominant wildlife species is reasonably well known within the study area, there is limited understanding of interactions, population sizes, sex ratios, natality, mortality, and other population characteristics of these species (including the focal species). Possible use of the Buffalo Lake area by some sensitive species (such as the whooping crane, the peregrine falcon, and various species of bat, reptiles, and amphibians) has yet to be confirmed. Very limited information is available regarding the status of invasive species in the area. Formal (scientifically recorded) observations of non-focal species are often dated and may be inherently biased (such as industry-centred research). The rationale for establishing a protected area could be reinforced with greater knowledge of actual habitat usage by wildlife in general and by rare wildlife species in particular.

5.0 CONCLUSION AND RECOMMENDATIONS

The ultimate goal of this ecological assessment was to evaluate the ecological significance of the area of interest and associated study area by providing a review of the available information and by identifying information gaps or other issues that need to be addressed as a component of the overall PAS decision-making process. One of the decisions that will need to be made is the delineation of a final boundary for a Buffalo Lake Protected Area. At this time, there is insufficient ecological information to make this decision.

From an ecological perspective, the rationale for proposed protection is relatively apparent: the Buffalo Lake area is biologically diverse and may support some of the rarest species in the Northwest Territories. However, current knowledge is inadequate to make definitive judgements on the precise location / habitat usage of focal and otherwise significant wildlife species considered in this ecological assessment. Vegetation communities are generally understood but the occurrence of rare plants continues to remain undocumented.

5.1 Summary of Current and Proposed Research

When released in April 2007, the Northwest Territories Ecological Land Classification will include landscape unit descriptions and detailed vegetation, soils, and forest measurements for locations within the study area (Smith et al. 2007, Nelson 2007). The Forest Management Division of ENR has no future research plans specific to the ecological assessment study area. ENR did however identify a general information gap related to forest growth throughout the Northwest Territories.

A number of studies (including a rare plant survey) were to have been completed by EBA consultants in the Pine Point area in the summer/fall of 2006, but the current status or quality of this research is unknown.

Agriculture Canada and its partners are developing a soil coverage which includes part of the study area; it hopes to expand the scope of the coverage in the future (Nelson 2007). In the next few years, Agriculture Canada will also be updating the “Soil Landscapes of NWT”, possibly to a scale of 1:500,000 or even 1:250,000.

Active monitoring of disturbances within the study area is essentially limited to fire control and assessing bison populations for disease outbreaks. Some monitoring of disturbances such as climate change and spruce budworm has been done in the past.

Although the proposed DNA study of woodland caribou fecal samples promises to provide greatly improved information on this species, the final results are years away. Other than incidental observations, no species-specific information is gathered for moose, wolf, or black bear within the study area. The status of several wildlife studies (by EBA) in the Pine Point area is unknown. The identification of inconnu spawning locations is a priority for DFO but active research is limited by available resources. The current state of

knowledge within the study area will improve with the release of current and proposed research studies.

5.2 Summary of Data Deficiencies

There is lack of detailed soils information within the study area, although a few plots have been surveyed as part of the NWT Ecological Land Classification and as part of studies in the Pine Point area. Surface geology is mapped in relatively high detail.

From a "protected areas management" perspective, there are only a few hydrological information gaps that might be of concern: the limited knowledge of physical characteristics (such as average depth, flush rate, etc.) and water quality within Buffalo Lake itself, as well as the generally poor record of hydrometric conditions in the area. Current monitoring is not being done and knowledge of groundwater hydrology in the area tends to have an industry bias.

General knowledge of boreal forest ecosystems and broad-scale environmental conditions (eco-zones and eco-regions) is relatively extensive. Existing information is somewhat dated (i.e. the forest inventory from 1961) and does not adequately address local processes occurring within the study area (i.e. lack of forest regeneration studies, limited monitoring of spruce budworm). There has been limited vegetation research focused in the immediate vicinity of the study area. In general, broad-based regional information sources (i.e. land classifications, timber inventories, etc.) provide the majority of vegetation information available for the study area. There are, however, some localised studies associated with resource development (i.e. mining around Pine Point).

Although the presence / absence of dominant wildlife species is relatively well known within the study area, more detailed information on wildlife interactions, population sizes, sex ratios, natality, mortality and other population characteristics of even the focal species is not available. Very limited information is available regarding the status of invasive species in the area. Possible use of the Buffalo Lake area by sensitive species (such as the whooping crane, the peregrine falcon, and various species of bat, reptiles and amphibians) has yet to be confirmed. Formal (scientifically recorded) observations of non-focal species are relatively dated.

5.3 Options for the Designation of a Protected Area

A number of options exist for the establishment of a protected area in the NWT. As a component of this ecological assessment, Table 4 describes the designation criteria and potential issues associated with each form of protection.

Table 4: Protected Area Designations

Type of Designation and Agency Responsible	**General Criteria**	**Potential Issues**	**Attributes of the Study Area**
National Parks and Reserves (NP) Parks Canada	Efforts to create new parks are concentrated in areas without an existing National Park. Factors considered in the establishment of a National Park include: ▪ Quality of natural region representation ▪ Potential for supporting viable populations of native wildlife species ▪ Ecological integrity of the areas ecosystems ▪ Exceptional natural phenomena, and rare, threatened or endangered wildlife and vegetation ▪ The proposed area complements the objectives of other existing or planned protected natural areas in the region (i.e. WBNP) ▪ Implications of Aboriginal rights, comprehensive lands claims and treaties with Aboriginal peoples (PC 2007).	Although PC (1984) identified the west end of Buffalo Lake as a high priority for park boundary expansion, Buffalo Lake is not in a Parks Canada "national priority area" for park establishment or expansion (TBCS 2007). Regardless, protection under a federal authority, such as Parks Canada, may limit the involvement of other stakeholders (i.e. KFN) in the management of the area.	From an ecological perspective, the Buffalo Lake watershed should be managed as a complete ecosystem. The presence of rare wildlife species or habitat has not been clearly documented in the area.

Territorial Natural Environment Parks (TNEP) GNWT – Industry, Tourism and Investment	TNEPs are established to preserve and protect unique, representative or aesthetically significant natural areas. A Natural Environment Park may be developed to preserve, protect and enhance the appreciation of the natural park environment (GNWT 2007b).	This type of designation may require some form of tourism development in the area.	Appreciation of the area is limited by access. The presence of rare wildlife species or habitat has not been clearly documented in the area.
National Wildlife Areas (NWA) Environment Canada – Canadian Wildlife Service	"a site must contain 'nationally significant' habitat for migratory birds, support wildlife ecosystems at risk, or represent rare or unusual wildlife habitat or a biogeographic region" (EC 2007d).	Extensive documentation and research may be required to justify 'national significance'.	The presence of rare wildlife species or habitat has not been clearly documented at a detailed resolution for the area.
Territorial Wilderness Conservation Areas (TWCA) GNWT – Industry, Tourism and Investment	TWCAs are established to protect core representative areas that contribute to regional biodiversity, such as land forms, watersheds, or wildlife habitats. Industrial activity shall be prohibited to the extent that the Government of the Northwest Territories has the power to do so (GNWT 2007b).	As TWCA are relatively new under the *Territorial Parks Act*, establishment criteria remain somewhat flexible (there is currently no precedent for how or why a TWCA is established).	PAS-EWG (2007) modelled the representation of the area at a coarse resolution; the presence of rare wildlife species or habitat, has not been clearly documented at a detailed resolution within the study area.

5.4 Recommendations

The following recommendations are intended to provide the PAS with some direction regarding the establishment of a protected area in the Buffalo Lake area. If a decision is made to continue to pursue land protection within the study area through the PAS process, the following actions need to be initiated.

5.4.1 Communication / Stakeholder Participation

a. Joint discussions between the Protected Areas Secretariat, other stakeholders (such as ENR, DFO, CWS, PC) and scientists associated with other research organisations (i.e. Aurora Research Institute, University of Alberta, Ducks Unlimited Canada) need to take place. These discussions would allow the PAS to align its research activities with the needs of other agencies and possibly cost-share, while expanding the knowledge-base for the area. It may be relatively easy to include PAS research objectives within existing research programs (such as capturing better data of incidental observations of moose, caribou, and wolves during the annual bison surveys).

b. The potential impacts of the proposed Pine Point Pilot Project (PPPP) and other human influences on the design of a protected area should be considered. As the PPPP is in close proximity to the Lower Buffalo River, a close examination of potential boundaries in this area may be warranted. This might require the consideration of the (non-public) field reports and survey data collected by EBA Consultants Ltd. on behalf of Tamerlane Ventures Ltd. for the environmental studies completed in the area.

c. Support for current bison monitoring / survey programs in the Buffalo Lake area and encouragement of the expansion of research into neighbouring areas (i.e. northern Alberta) should be formally offered. Such research is currently being undertaken, and by informing the appropriate authorities of PAS research / information requirements, continued support for such monitoring programs (by the original agency) can be encouraged.

d. Support for soil surveying by Agriculture Canada in the area should be formally expressed.

e. Support for the caribou DNA research project to be conducted jointly by ENR and Parks Canada should be formally expressed. Any project reports, when available, should be considered in the protected area design.

f. The updated Northwest Territories Ecological Land Classification, due to be released in April 2007, should be considered in the protected area design. This information will provide a greater understanding of the ecosystem and associated vegetation patterns within the study area, than is currently available.

5.4.2 Need for Further Field-Based Research

The following list contains recommendations for further field-based research. In recognition of time and financial constraints, the recommendations have been prioritised; those in bold are of greatest importance. It is understood that further prioritisation and refinement of these research needs may need to occur within the context of available resources; these recommendations were formulated using an idealised ecological / protected areas management perspective without the imposition of potential social, logistical, or institutional constraints. Traditional ecological knowledge should play a fundamental role in any future research.

a. Several years of baseline water quality information should be collected for Buffalo Lake. Hydrology and physical characteristics, such as flush rate or depth, would also be beneficial.

b. The distribution of rare plants within the study area should be clearly documented at a fine resolution.

c. Detailed vegetation inventories and a purpose-specific vegetation classification (designed specifically for the Buffalo Lake Area of Interest) could improve understanding of wildlife habitat in the area.

d. A detailed wildlife survey at the mouths of the Yates and Whitesand Rivers should be completed to confirm the presence of focal species, assess basic population characteristics, and evaluate habitat quality.

e. An assessment should be undertaken to determine the importance of the west end of Buffalo Lake as wintering habitat for large ungulates.

f. Although, the proposed DNA study of woodland caribou will undoubtedly provide valuable information, it could be augmented with additional studies. For example, satellite collaring research, as utilised in other parts of the Dehcho, could help to identify annual migration patterns and important habitats requiring protection.

g. Basic research on populations of wolf, black bear, and other carnivores could provide greater insight into the predator-prey interactions of this particular area.

h. **Surveys of species known to be rare in the NWT, but which are present in the vicinity of the study area (specifically reptiles, amphibians, bats, peregrine falcons, and whooping cranes), should be undertaken to assess the importance of the study area as a primary or secondary habitat. Consideration should be given to the importance of including potential whooping crane habitat within the proposed protected area.**

i. A waterfowl / bird survey should be conducted in the Buffalo Lake area. Particular attention should be paid to the possible presence of whooping cranes in areas of potential habitat.

j. Inconnu spawning locations should be precisely identified in co-operation with DFO and other partner agencies. An assessment of fish populations within Buffalo Lake would also be beneficial.

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Appendix A:
Species Potentially Present within the Study Area

The list below represents the species identified by a variety of sources within the general vicinity of the study area.

Vegetation

1.	Speckled Alder	*Alnus incana*
2.	Saskatoon Berry	*Amelanchier alnifolia*
3.	Common Bearberry	*Arctostaphylos uva-ursi*
4.	Dwarf Birch	*Betula glandulosa*
5.	Paper Birch	*Betula papyrifera*
6.	Bog Birch	*Betula pumila*
7.	Blue-jointed Reed Grass	*Calamagrostis canadensis*
8.	Sedges	*Carex sp.*
9.	Reindeer Lichens	*Cladina sp.*
10.	Red-Osier Dogwood	*Cornus sericea*
11.	Shrubby Cinquefoil	*Dasiphora fruticosa*
12.	Cushion Mosses	*Dicranum sp.*
13.	Horsetail	*Equisetum sp.*
14.	Northern Bedstraw	*Galium boreale*
15.	Small Bedstraw	*Galium tridifum*
16.	Northern Comandra	*Geocaulom lividum*
17.	Stair-Step Moss	*Hylocomium splendens*
18.	Common Juniper	*Junipeus communis*
19.	Creeping Juniper	*Junipeus horizontalis*
20.	Tamarack	*Larix laricina*
21.	Labrador Tea	*Ledum groenlandicum*
22.	Twinflower	*Linnaea borealis*
23.	Three-leaf False Solomon's Seal	*Maianthemum trifolium*
24.	Sweet Gale	*Myrica gale*
25.	White spruce	*Picea glauca*
26.	Black spruce	*Picea mariana*
27.	Jack Pine	*Pinus banksiana*
28.	Red-Stemmed Feather Moss	*Pleurozium schreberi*
29.	Haircap Mosses	*Polytrichum sp.*
30.	Balsam Poplar	*Populus balsamifera*
31.	Trembling Aspen	*Populus tremuloides*
32.	Prickly Rose	*Rosa acicularis*
33.	Red Glasswort	*Salicornia rubra*
34.	Willow	*Salix sp.*
35.	Bulrush	*Scirpus sp.*
36.	Canada Buffalo Berry	*Shepherdia canadensis*
37.	Sphagnum Moss	*Sphagnum sp.*
38.	Broad-leaf Cattail	*Typha latifolia*
39.	Rock Cranberry	*Vaccinium vitis-idaea*

* Sources included Carrière 2007, EBA 2005b, Skelton 2007, Wetlands International 2007, EC 2007a.

Mammals

1.	Moose	*Alces alces*
2.	Wood Bison	*Bos bison athabascae*
3.	Coyote	*Canis latrans*
4.	Gray Wolf	*Canis lupus*
5.	Beaver	*Castor canadensis*
6.	Southern Red-Backed Vole	*Clethrionomys gapperi*
7.	Big Brown Bat	*Eptesicus fuscus*
8.	North American Porcupine	*Erethizon dorsatum*
9.	Northern Flying Squirrel	*Glaucomys sabrinus*
10.	Wolverine	*Gulo gulo*
11.	Hoary Bat	*Lasiurus cinereus*
12.	Snowshoe Hare	*Lepus americanus*
13.	Northern River Otter	*Lontra canadensis*
14.	Lynx	*Lynx canadensis*
15.	Woodchuck	*Marmota monax*
16.	Marten	*Martes americana*
17.	Fisher	*Martes pennanti*
18.	Striped Skunk	*Mephitis mephitis*
19.	Meadow Vole	*Microtus pennsylvanicus*
20.	Taiga Vole	*Microtus xanthognathus*
21.	Ermine	*Mustela erminea*
22.	Least Weasel	*Mustela nivalis*
23.	Mink	*Mustela vison*
24.	Western Long-eared Myotis	*Myotis evotis*
25.	Little Brown Myotis	*Myotis lucifugus*
26.	Northern Long-Eared Myotis	*Myotis septentrionalis*
27.	Least Chipmunk	*Neotamias minimus*
28.	Mule Deer	*Odocoileus hemionus*
29.	Muskrat	*Ondatra zibethicus*
30.	Deer Mouse	*Peromyscus maniculatus*
31.	Eastern Heather Vole	*Phenacomys ungava*
32.	Cougar	*Puma concolor*
33.	Woodland Caribou	*Rangifer tarandus caribou*
34.	Arctic Shrew	*Sorex arcticus*
35.	Masked Shrew	*Sorex cinereus*
36.	Pygmy Shrew	*Sorex hoyi*
37.	Dusky Shrew	*Sorex monticolus*
38.	American Water Shrew	*Sorex palustris*
39.	Northern Bog Lemming	*Synaptomys borealis*
40.	Red Squirrel	*Tamiasciurus hudsonicus*
41.	Black Bear	*Ursus americanus*
42.	Red Fox	*Vulpes vulpes*
43.	Meadow Jumping Mouse	*Zapus hudsonius*

* Sources included Wetlands International 2007, Carrière 2007, Pattie and Fisher 1999 (Mammals of Alberta Field Guide), EBA 2005c, GNWT 2006, Soper 1942.

Birds

1.	Northern Goshawk	*Accipiter gentilis*
2.	Sharp-Shinned Hawk	*Accipiter striatus*
3.	Spotted Sandpiper	*Actitis macularia*
4.	Red-Winged Blackbird	*Agelaius phoeniceus*
5.	Northern Pintail	*Anas acuta*
6.	American Wigeon	*Anas americana*
7.	Northern Shoveler	*Anas clypeata*
8.	Green-Winged Teal	*Anas crecca*
9.	Blue-Winged Teal	*Anas discors*
10.	Common Mallard	*Anas platyrhynchos*
11.	American Pipit	*Anthus rubescens*
12.	Short-Eared Owl	*Asio flammeus*
13.	Lesser Scaup	*Aythya affinis*
14.	Greater Scaup	*Aythya marila*
15.	Canvasback	*Aythya valisineria*
16.	Cedar Waxwing	*Bombycilla cedrorum*
17.	Bohemian Waxwing	*Bombycilla garrulus*
18.	Ruffed Grouse	*Bonasa umbellus*
19.	American Bittern	*Botaurus lentiginosus*
20.	Canada Goose	*Branta canadensis*
21.	Great Horned Owl	*Bubo virginianus*
22.	Bufflehead	*Bucephala albeola*
23.	Common Goldeneye	*Bucephala clangula*
24.	Red-Tailed Hawk	*Buteo borealis*
25.	Lapland Longspur	*Calcarius lapponicus*
26.	Smith's Longspur	*Calcarius pictus*
27.	White-Rumped Sandpiper	*Calidris fuscicollis*
28.	Least Sandpiper	*Calidris minutilla*
29.	Semipalmated Sandpiper	*Calidris pusilla*
30.	Common Redpoll	*Carduelis flammea*
31.	Hoary Redpoll	*Carduelis hornemanni*
32.	Pine Siskin	*Carduelis pinus*
33.	Swainson's Thrush	*Catharus ustulatus*
34.	Killdeer	*Charadrius vociferus*
35.	Black Tern	*Chlidonias nigra*
36.	Nighthawk	*Chordeliles minor*
37.	Dipper	*Cinclus mexicanus*
38.	Northern Harrier	*Circus cyaneus*
39.	Marsh Wren	*Cistothorus palustris*
40.	Northern Flicker	*Colaptes auratus*
41.	Olive-sided Flycatcher	*Contopus cooperi*
42.	Western Wood-Pewee	*Contopus sordidulus*
43.	American Crow	*Corvus brachyrhynchos*
44.	Common Raven	*Corvus corax*
45.	Yellow Rail	*Coturnicops noveboracensis*
46.	Tundra Swan	*Cygnus columbianus*
47.	Bay-Breasted Warbler	*Dendroica castanea*

48. Yellow-Rumped Warbler	*Dendroica coronata*
49. Magnolia Warbler	*Dendroica magnolia*
50. Palm Warbler	*Dendroica palmarum*
51. Yellow Warbler	*Dendroica petechia*
52. Blackpoll Warbler	*Dendroica striata*
53. Cape May Warbler	*Dendroica tigrina*
54. Pileated Woodpecker	*Dryocopus pileatus*
55. Alder Flycatcher	*Empidonax alnorum*
56. Yellow-Bellied Flycatcher	*Empidonax flaviventris*
57. Least Flycatcher	*Empidonax minimus*
58. Rusty Blackbird	*Euphagus carolinus*
59. Brewer's Blackbird	*Euphagus cyanocephalus*
60. Spruce Grouse	*Falcipennis canadensis*
61. Merlin	*Falco columbarius*
62. Peregrine Falcon	*Falco peregrinus*
63. American Kestrel	*Falco sparverius*
64. American Coot	*Fulica americana*
65. Wilson's Snipe	*Gallinago delicata*
66. Arctic Loon	*Gavia arctica*
67. Common Loon	*Gavia immer*
68. Pacific Loon	*Gavia pacifica*
69. Red-Throated Loon	*Gavia stellata*
70. Common Yellowthroat	*Geothlypis trichas*
71. Whooping Crane	*Grus americana*
72. Sandhill Crane	*Grus canadensis*
73. Bald Eagle	*Haliaeetus leucocephalus*
74. Rose-Breasted Grosbeak	*Hedymeles ludovicianus*
75. Evening Grosbeak	*Hesperiphona vespertina*
76. Cliff Swallow	*Hirundo pyrrhonota*
77. Barn Swallow	*Hirundo rustica*
78. Harlequin Duck	*Histrionicus histrionicus*
79. Caspian Tern	*Hydroprogne caspia*
80. Hermit Thrush	*Hylocichla guttata*
81. Tree Swallow	*Iridonprocne bicolor*
82. Dark-eyed Junco	*Junco hyemalis*
83. Willow Ptarmigan	*Lagopus lagopus*
84. Herring Gull	*Larus argentatus*
85. California Gull	*Larus californicus*
86. Mew Gull	*Larus canus*
87. Ring-Billed Gull	*Larus delawarensis*
88. Bonaparte's Gull	*Larus philadelphia*
89. Franklin's Gull	*Larus pipixcan*
90. Short-Billed Dowitcher	*Limnodromus griseus*
91. Hooded Merganser	*Lophodytes cucullatus*
92. Red Crossbill	*Loxia curvirostra*
93. White-Winged Crossbill	*Loxia leucoptera*
94. Belted Kingfisher	*Megaceryle alcyon*
95. White-Winged Scoter	*Melanitta deglandi*
96. Surf Scoter	*Melanitta perspicillata*

97. Swamp Sparrow	*Melospiza georgiana*
98. Lincoln's Sparrow	*Melospiza lincolni*
99. Song Sparrow	*Melospiza melodia*
100. Common Merganser	*Mergus merganser*
101. Red-Breasted Merganser	*Mergus serrator*
102. Black-and-White Warbler	*Mniotilta varia Linnaeus*
103. Brown-Headed Cowbird	*Molothrus ater*
104. Winter Wren	*Nannus hiemalis*
105. Ringed-Necked Duck	*Nyroca collaris*
106. Ruddy Duck	*Oxyura jamaicensis*
107. House Sparrow	*Passer domesticus*
108. Savannah Sparrow	*Passerculus sandwichensis*
109. Fox Sparrow	*Passerella iliaca*
110. Le Conte's Sparrow	*Passerherbulus caudacutus*
111. Gray Jay	*Perisoreus canadensis*
112. Red-Necked Phalarope	*Phalaropus lobatus*
113. Black-Billed Magpie	*Pica hudsonia*
114. Black-Backed Woodpecker	*Picoides arcticus*
115. Downy Woodpecker	*Picoides pubescens*
116. Three-Toed Woodpecker	*Picoides tridactylus*
117. Hairy Woodpecker	*Picoides villosus*
118. Pine Grosbeak	*Pinicola enucleator*
119. Western Tanager	*Piranga ludoviciana*
120. Snow Bunting	*Plectrophenax nivalis*
121. Horned Grebe	*Podiceps auritus*
122. Red-Necked Grebe	*Podiceps grisegena*
123. Pied-Billed Grebe	*Podilymbus podiceps*
124. Black-Capped Chickadee	*Poecile atricapillus*
125. Boreal Chickadee	*Poecile hudsonica*
126. Sora	*Porzana carolina*
127. Common Grackle	*Quiscalus quiscula*
128. Bronzed Grackle	*Quscalus quiscula*
129. Ruby-Crowned Kinglet	*Regulus calendula*
130. Bank Swallow	*Riparia riparia*
131. Eastern Phoebe	*Sayornis phoebe*
132. Ovenbird	*Seiurus aurocapillus*
133. Northern Waterthrush	*Seiurus noveboracensis*
134. American Redstart	*Setophaga ruticilla*
135. Red-Breasted Nuthatch	*Sitta canadensis*
136. Yellow-Bellied Sapsucker	*Sphyrapicus varius*
137. Clay-Coloured Sparrow	*Spizella pallida*
138. Chipping Sparrow	*Spizella passerina*
139. Long Tailed Jaeger	*Stercorarius longicaudus*
140. Parasitic Jaeger	*Stercorarius parasiticus*
141. Common Tern	*Sterna hirundo*
142. Arctic Tern	*Sterna paradisaea*
143. European Starling	*Sturnus vulgaris*
144. Lesser Yellowlegs	*Totanus flavipes*
145. Greater Yellowlegs	*Tringa melanoleuca*

146. Solitary Sandpiper	*Tringa solicaria*
147. American Robin	*Turdus migratorius*
148. Sharp-Tailed Grouse	*Tympanuchus phasianellus*
149. Eastern Kingbird	*Tyrannus tyrannus*
150. Orange-Crowned Warbler	*Vermivora celata*
151. Tennessee Warbler	*Vermivora peregrina*
152. Warbling Vireo	*Vireo gilvus*
153. Red-Eyed Vireo	*Vireo olivaceus*
154. Wilson's Warbler	*Wilsonia pusilla*
155. White-Throated Sparrow	*Zonotrichia albicollis*
156. White-Crowned Sparrow	*Zonotrichia leucophrys*

* Primary source was Machtans 2007 (NWT / NU Bird Checklist database search). Other sources included EBA 2005c, GNWT 2006, Carrière 2007.

Fish

1. Lake Whitefish	*Coregonus clupeaformis*
2. Shortjaw Cisco	*Coregonus zenithicus* (presence not confirmed by DFO)
3. Northern Pike (a.k.a. Jackfish)	*Esox lucius*
4. Iowa Darter	*Etheostoma exile*
5. Burbot	*Lota lota*
6. Pearl Dace	*Margariscus margarita*
7. Fathead minnow	*Pimephales promelas*
8. Pickerel (a.k.a. Walleye)	*Sander vitreus*
9. Inconnu	*Stenodus leucichthys*

* Sources included Wetlands International 2007, Smith and Taptuna 2007, Carrière 2007, EBA 2005a, Fau 1975.

Reptiles and Amphibians

1. Canadian Toad	*Bufo hemiophrys*
2. Boreal Chorus Frog	*Pseudacris maculata*
3. Wood Frog	*Rana sylvatica*
4. Common Red-Sided Garter Snake	*Thamnophis sirtalis*

* Sources included Wetlands International 2007, Carrière 2007, GNWT 2006, EBA 2005c, Hamilton et al. 1998.

Appendix B

Supporting Maps

Please note the maps provided in the following pages are numbered and described below. This numbering is simply used to reflect map order and the descriptions provided are not the actual map titles (they are rather filenames of digital PDF maps stored with the CD version of this report). The following maps were not created by the authors of this report and thus formatting, numbering and titling may not be consistent with the rest of this report.

The following maps were provided by:

Government of the Northwest Territories, (January) 2007. Fire History Map. (*provided as a PDF document*). ENR, GNWT. Fort Smith, NT. Prepared by D. Phillips.

Parks Canada, (January) 2007. Various maps relating to the portion of the Buffalo Lake Ecological Assessment Study Area located within Wood Buffalo National Park. (*provided as PDF documents*). WBNP, Parks Canada, Fort Smith, NT. Prepared by D. Andrews.

Maps supporting this ecological assessment include:

1. Karst – by WBNP
2. Soil Drainage – by WBNP
3. Soil Reaction – by WBNP
4. Fire History - by GNWT
5. Fire History – by WBNP
6. Forest Health – by WBNP
7. Vegetation Communities - by WBNP
8. Ecosite Classification – by WBNP
9. Moose Survey – by WBNP
10. Potential Whooping Crane Habitat – by WBNP
    (originally prepared by OOC 2003)