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REPORT ON

HISTORICAL RESOURCES IMPACT ASSESSMENT FOR SUNCOR'S PROJECT MILLENNIUM. PERMIT #97-123

Submitted to:

Suncor Energy Inc., Oil Sands
Fort McMurray, Alberta

Prepared by:

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EXECUTIVE SUMMARY

In the autumn of 1997, Golder Associates Ltd. completed an Historical Resources Impact Assessment (HRIA) on behalf of Suncor Energy Inc. (Suncor). This HRIA was completed to investigate lands proposed for disturbance during construction and operation of Suncor's Project Millennium. Project Millennium is located on the south and east sides of the Steepbank Mine, north of Fort McMurray. All work completed for this Project was conducted under Historical Resources Permit #97-123, issued by Alberta Community Development to Grant Clarke. The field assessment was completed under the direction of Mr. Clarke. Field crews varied in size from three to five archaeologists and included Grant Clarke, Brian Ronaghan, Dana Dalmer, Sid Rempel and Terry Beaulieu.

The Millennium Project will impact portions of four Townships of land including T91-R09, T92-R09, T91-R08 and T92-R08-W4M. Due to the fact that the project encompasses large tracts of land covered by fens and other areas exhibiting varying degrees of potential for historical resources, a vegetation and hydrology based model was used to define areas of high, moderate and low potential prior to the initiation of field work. Observations made as during the course of aerial reconnaissance and in-field inspection resulted in a modification of the original assessment of potential. Field work included concentrated pedestrian inspections of high and moderate potential areas, and aerial reconnaissance of areas of low potential. Aerial reconnaissance was also completed over the entire project area in an effort to ensure adequacy of the inspection strategy.

In accordance with the distribution of high and moderate potential areas, field investigations were concentrated in two locations. The first location is situated in the southern portion of the HRIA study area, along Wood and McLean creeks. The second area is situated along the northern and eastern portions of the study area, along the top of the Steepbank River terrace. Two previously recorded prehistoric sites, HfOu 1 and 2, are located in the vicinity of the HRIA study area. These sites are both isolated find locations and were recorded during the HRIA completed for the Steepbank Mine. Neither of these sites were recommended for further study at that time and were not revisited during the course of this investigation.

Site file searches also indicated that five historical sites had been recorded in the vicinity of the Project Millennium development area. These include four well locations drilled by Count Alfred Von Hammerstein (HS 44043, 44045, 44046 and 44047) and one well location drilled by the Athabaska Oil and Asphalt Company (HS 44044) in the early 1900's. Only two of the sites lie potentially within Project Millennium mine footprint. Due to scant record information, one of these locations (HS 4044) cannot be verified beyond a half section of land: the south half of Section 20-91-09-W4M. Only a small part of this half section is located within the Project Millennium footprint. Site HS 44043 is located within the mine footprint, in LSD 14-10-91-09-W4M. The remaining three sites are located within the Steepbank Mine footprint. None of these sites appear to have been field assessed during the original recording. All site information was originally obtained from published texts (Ells 1926; de Mille 1969). No physical remains were observed during the course of the Steepbank or Millennium Mine HRIAs to confirm the locations of these sites.

Field assessment resulted in the observation of three cultural resources and one palaeontological locale. The cultural sites include two trappers cabins and one site of unknown origin identified by a moderate sized depression, an associated mound, and a sparse artifact scatter. As none of these sites are greater than 50 years of age they do not qualify as historical resources under the Alberta Historical Resources Act and were not formally recorded. However, these sites do help us understand the historical and traditional land use practices in the region. The palaeontological site consists of an outcrop of bedrock located along the eastern edge of the Athabasca River. The bedrock is part of the Moberly Member of the Waterways formation. The Waterways formation is Upper Devonian in age and outcrops regularly along this section of the Athabasca River. Fossils included in this outcrop include bulbous stromatoporoids, mullosc shells and other marine invertebrates.

A cumulative effects assessment of the current and proposed oil sands mining operations in northeastern Alberta was also completed as part of this assessment. This analysis expands current understandings of the distribution of sites in the region and provides a possible explanation for why there is a relatively sparse concentration of historical resources throughout the Project Millennium development area.

CREDITS

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Golder Associates and Suncor would like to thank Andy Neuman and Paul Johnson of the Royal Tyrrell Museum of Palaeontology for their assistance in the identification of the fossil materials identified during this HRIA.

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1. INTRODUCTION

In September 1997, Golder Associates Ltd. (Golder) completed an Historical Resources Impact Assessment (HRIA) on behalf of Suncor Energy Inc., Oil Sands (Suncor) on lands proposed for disturbance by the Project Millennium Mine north of Fort McMurray. The proposed expansion covers portions of four Townships of land. Because of the large areas of water saturated terrain within the study area, a vegetation and hydrology based model was used to define areas of high, moderate and low potential prior to the initiation of field work. Based on observations made during helicopter overflights and field investigations, revisions in the initial potential estimates were undertaken in order to more accurately reflect the relative potential of the Project Millennium HRIA study area. These revisions formed the basis of the in-field program. Field work included concentrated pedestrian inspection of one hundred percent of high and a sample of moderate potential landforms, and aerial reconnaissance and limited field investigations of areas of low potential. Aerial reconnaissance was also completed over the entire project area in an effort to refine the preliminary field model's accuracy and to ensure no areas of potential were omitted.

This report details the procedures and results of the project and presents recommendations regarding historical resources for the project area. A glossary of technical terminology used in this report can be found in Appendix I. Classification tables identifying the ranking criteria for the map of potential used in the cumulative effects analysis are presented in Appendix II.

2. PROJECT LOCATION, DESCRIPTION AND POTENTIAL IMPACTS

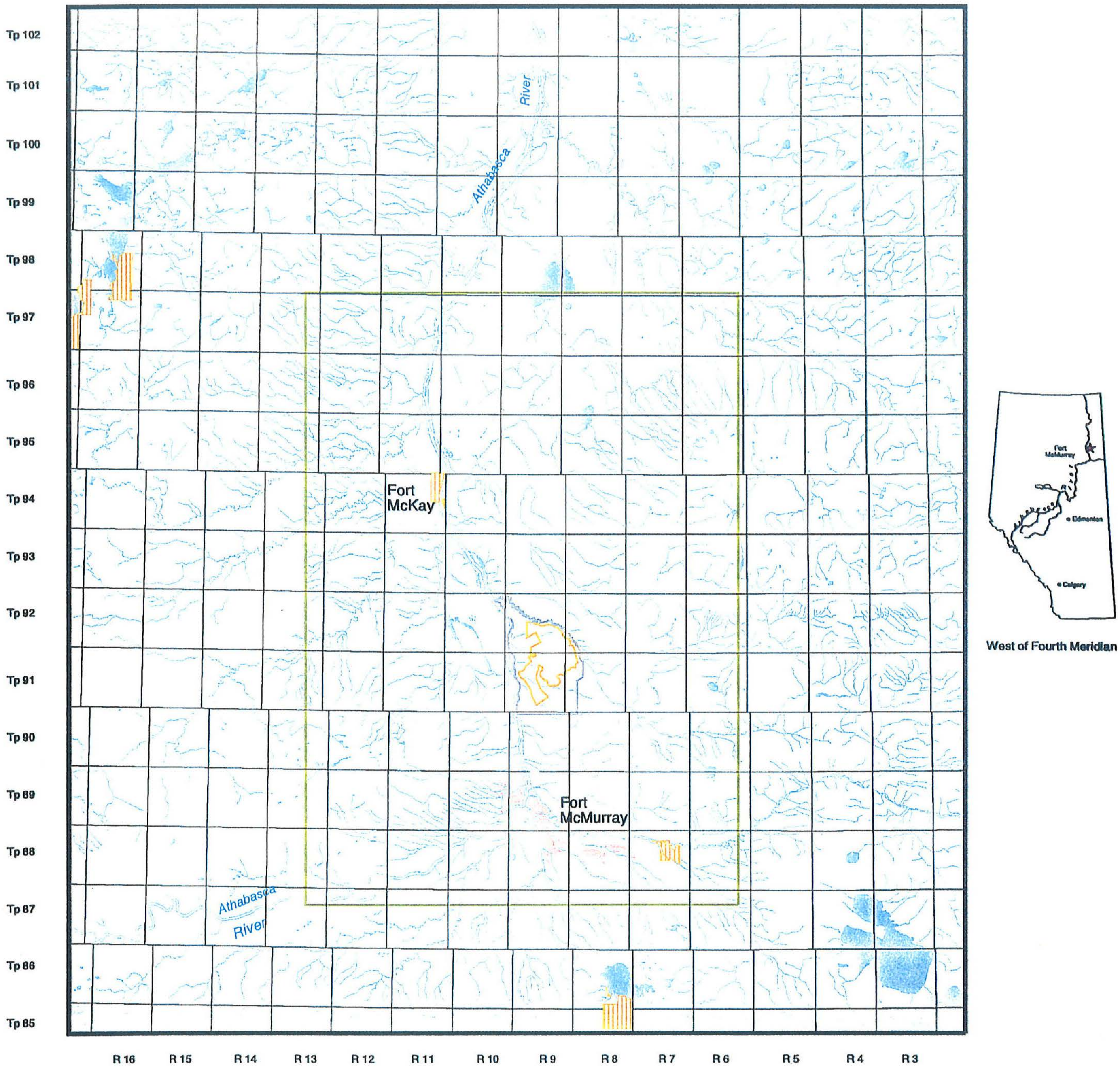
2.1 PROJECT LOCATION AND DESCRIPTION

Project Millennium is located on the east side of the Athabasca River, south of the confluence with the Steepbank River and approximately 27 km north of Fort McMurray, Alberta (Figure 1). The Regional Study Area (RSA) selected for Project Millennium Environmental Impact Assessment (EIA) is 2,428,645 hectares in size (Figure 1). Due to the nature of prior archaeological research conducted in northeastern Alberta, it was necessary to utilize information from work completed outside of the RSA to prepare a pre-project archaeological overview. The area used in this overview was not determined on the basis of any specific geographic boundaries, rather, it is amorphously defined by the relevant archaeological data. It includes portions of the watersheds of the Muskeg, Clearwater and Athabasca rivers.

To complete an historical resources cumulative effects assessment of Project Millennium, an area was selected that includes all of the existing and approved mining developments in the Oil Sands region of northeastern Alberta. This Historical Resources Regional Study Area (HRRSA) includes all or portions of 132 Townships of land (Figure 1). Site specific archaeological information was gathered from within the HRRSA, which is approximately 45% of the size of the environmental impact assessment RSA for Project Millennium. The HRRSA is approximately 1,100,000 hectares (2,717,000 acres) in area, extending from approximately UTM grid line 440000E to 510000E and from 6270000N to 6370000N. It includes all or portions of Borden Blocks HdOr, HeOr, HfOr, HgOr, HhOr, HiOr, HdOs, HeOs, HfOs, HgOs, HhOs, HiOs, HdOt, HeOt, HfOt, HgOt, HhOt, HiOt, HdOu, HeOu, HfOu, HgOu, HhOu, HiOu, HdOv, HeOv, HfOv, HgOv, HhOv, HiOv, HdOw, HeOw, HfOw, HgOw, HhOw, HiOw, HdOx, HeOx, HfOx, HgOx, HhOx and HiOx.

The Local Study Area (LSA) is defined by the mine footprint and its associated facilities and is 16,182 ha in size (Figure 1). The Local Study Area includes the following sections or portions thereof:

- Sections 29, 30, 31 and 32-Twp 91-R8-W4M;
- Sections 9-11, 13-16, 20-29 and 32-36-Twp 91-R9-W4M;
- Sections 5, 6 and 7-Twp 92-R9-W4M; and



SOURCE: Golder

Scale 1:1,000,000

10 0 10 20 30 40

Kilometres

Map Projection: UTM 12
Datum: NAD 83

LEGEND

- Regional Study Area
- Historical Resources Regional Study Area
- Local Study Area
- Historical Resources Impact Assessment Boundary
- Open Water
- Municipalities
- Indian Reserves

N

SUNCOR ENERGY

Project Millennium

REGIONAL STUDY AREA
HISTORICAL AND LOCAL STUDY
AREA LOCATIONS

01 Apr. 1998	Figure 1	PRODUCED BY: K.K.Q. REVIEWED BY:

/data14/suncor/regional/9840/historical.apr

- Sections 1-4 and 9-16-Twp 92-R9-W4M.

Due to the nature of the underlying bedrock formations in the HRRSA, the Athabasca River valley is listed as having low potential for palaeontological resources. The areas identified by Alberta Community Development (ACD) as having low potential include Sections 5, 6, 7, 8, 17, 18, 19, 20, 29, 30, 31 and 32-91-9-W4M. Sections 28 and 33-91-9-W4M and 4, 5, 6, 7, 8, 16, 17, 18, 19, 20, 21, 29, 30, 31 and 32-92-9-W4M are listed as having probable potential for palaeontological resources.

The HRIA was primarily confined to the geographic extent of the proposed disturbances, defined as of August 1997, as approximately 6,500 hectares. A 500 metre buffer was also investigated to ensure adequate coverage of all areas to be impacted and to account for small scale repositioning of development areas. Figure 1 illustrates these areas.

It is expected that Project Millennium will operate from 1999 to 2043 with the last ten years focused on reclamation and site closure (Table 1). Detailed illustrations of the features discussed in Table 1 can be found in Figure C2.3-1 of Volume 1 and Figure D1-1 of Volume 2 of the Suncor Project Millennium application (Golder 1998). The technology and equipment used for site preparation and mining at Project Millennium will be similar to those used at the existing mine (Lease 86/17) located on the west side of the Athabasca River and the adjacent Steepbank Mine area located directly to the west of Project Millennium.

Suncor has established the following criteria for setback from rivers. Along the south side of the Steepbank River, a minimum 100m setback from the crest of the river valley escarpment to the mining crest will be maintained. Along the Athabasca River, the proposed criterion is as follows: wherever the bottom bench mining floor "daylights" (i.e., is exposed) along the escarpment, the elevation of the bottom bench floor shall be well above the 1-in-100 year ice-flood level of 241 metres above sea level (masl). Along Pit 2, this criterion results in an undisturbed river-to-mine setback of over 500m. Other areas will maintain a setback of a minimum of 100m.

Table 1 East Bank Mining Area and Project Millennium Fixed Plant Activity Phases

Year	Activity
1997	approval for Steepbank Mine in January construction of Steepbank Mine Bridge completed initial clearing of forests and muskeg soils
1998	overburden stripping for Pit 1 construction of Steepbank Mine facilities - shops, ore preparation and hydrotransport facilities commencement of mining in Pit 1 (4th quarter of year)
1999	mining in Pit 1 continues construction of Millennium extraction, energy services and upgrading components begins
2000	mining in Pit 1 continues Dyke 11a and 11b construction begins Pond 8a (external tailings pond) construction begins NE overburden dump under construction tailings disposal to Pond 8a commences
2001	mining in Pit 1 continues commencement of mining activities in Pit 2 (3rd quarter) commissioning of Millennium extraction, upgrading and energy services components
2002	production at 210,000 bbl/day rate begins mining in Pits 1 and 2 continues Dyke 11 construction begins north overburden dump is completed
2003	mining in Pit 1 continues
2004	mining in Pit 1 continues
2005	Pit 1 mining completed in 1st quarter ore excavation moves east into Lease 25 Pond 9 use begins Dyke 12 construction begins
2005 - 2011	CT tailings deposition to Pond 8 begins around 2007; CT to Pond 8 during the years 2007-2012 Dyke 14 construction begins in 2009 Pond 10 use begins in 2011 overburden to Ponds 8 and 9 (2007-2011)
2012 - 2033	mining advances in a southeast clockwise direction through Pit 2 truck dumps and crushers located to the centre of Pit 2 (likely around 2012) by 2012, Pond 7 (Pit 1) filled to capacity east muskeg stockpile area under construction Dyke 15 construction begins in 2015 Pond 11 use begins in 2017 Dyke 16 construction begins in 2022 Pond 12 use begins in 2026 primary extraction plant commences operation in east bank overburden to Pond 10 - 2012-2017 overburden to Pond 11 - 2018-2026 overburden to Pond 12 - 2027-2033 Pond 9 -receives CT from 2012-2017 Pond 10 receives CT from 2017-2022 Pond 11 receives CT from 2022-2033 infilling of external tailings pond commences in 2027; all remaining tailings transferred to small pond in pond 12
2033 - 2043	mining completed in 2032 residual tailings transferred to end pit lake final surfacing of reclamation areas completed drainage system to Shipyard Lake fully re-established final drainage systems developed and commissioned final reclamation activities completed
Far Future	full closure scenario end pit lake functioning as a viable aquatic ecosystem hummock surface on reclaimed CT deposits are well established, with approximately 20% of total surface areas remaining as open water/wetlands systems forest systems well-established on overburden areas

2.2 POTENTIAL IMPACTS

2.2.1 Historical Resources

Historical resources are defined by the Alberta Historical Resources Act (1987) as:

"any work of nature or man that is primarily of value for its palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest, including but not limited to, a palaeontological, archaeological prehistoric, historic or natural site, structure or object."

Consequently, historical resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them, and will aid in their interpretation, including natural specimens and documents or verbal accounts. They are generally divided into three types: prehistoric archaeological, historic period archaeological and structural, and palaeontological. Natural objects and features have also been occasionally managed under the provisions of the Historical Resources Act.

Prehistoric archaeological resources in northern North America are the archaeological sites, objects and affiliated materials that represent occupations by Aboriginal peoples before the arrival of European goods, people and the historical records that characterize their culture. In this region of the province, these consist of locations where activities took place and the remains of these activities, usually stone artifacts and features such as hearths. Generally, associated animal bone and other organic artifacts have disintegrated in the acid soils of the area. These materials can span the entire 10,000 years of recognized prehistory in this region of the province.

Historic archaeological and structural resources generally include the sites, artifacts, structures and documents that relate to the Euro-Canadian occupation of the region and date to the last 250 years. These include remains related to the early fur trade in the region, and to later economic developments such as trapping, forestry, and oil sands exploration and production. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These involve archaeological sites and objects, such as standing and collapsed cabins, campsites and graves. Also included are traditional sites and resources, such as special places, hunting and plant collecting areas, trap lines and their associated remains, oral traditions and various documents. These resources are usually identified through consultation procedures such as "Traditional Land Use" studies.

Palaeontological resources consist of physical remains representing evidence of extinct multicellular plants and animals, and related contextual information, that inhabited the region in prehistoric times. These can include fossils, bone deposits, shells and the impressions of these remains and can occur in both bedrock and unconsolidated glacial and postglacial sedimentary deposits.

Historical Resources are non-renewable resources that may be located at or near ground level or may be deeply buried. Alteration of the landscape can result in damage to, or complete destruction of significant historical resources. These alterations may involve displacement of artifacts, resulting in the loss of valuable contextual information, or destruction of the artifacts and features themselves, resulting in the complete loss of important site information. The loss of historical resources is permanent and irreversible. Impacts to historical resources as a result of development projects are generally described as falling into two categories: direct and indirect.

Direct impact occurs during construction and operations stages of any project and are a direct result of activities associated with the project. Indirect impacts occur as a result of the development, but are not directly related to it, and can take place outside direct impact zones. For example, development of an industrial project such as Project Millennium, can result in increased use of surrounding facilities and landscapes, possibly leading to increased vandalism or accidental impact, and therefore, surface disturbance beyond the Project footprint.

The frequency and intensity of these kinds of impacts can be accelerated in areas where numerous developments of a similar or related type are proposed. Together, the assessment of direct development impacts, and indirect impacts, forms the basis for estimating the cumulative effects of development in a region.

Construction activities associated with development of Project Millennium will have varying physical effects on historical resources within proposed development area. Negative effects can be identified at two levels of intensity.

2.2.2 Direct Impacts

Direct impacts to historical resources will result from the numerous ground-disturbing activities associated with development of the Project. For the purposes of this discussion, it is useful to group development activities into types that will result in disturbance or partial destruction of historical resources, and those that will result in total destruction of historical resources within development zones.

The forest clearance stage of development is a critical stage relative to historical resources because it is almost the only stage of construction that will not result in complete destruction of historical resources within impact zones. Forest removal is usually done in winter, under frozen ground conditions. In these circumstances, the cutter bars used occasionally strike the ground, exposing the upper surface of the mineral soil horizon, and the bulldozer treads displace the forest litter. However, neither of these disturb much of the frozen material below. These disturbances have both positive and negative effects on archaeological sites and materials. Most of the archaeological record of the region is contained in the upper horizons of the current sediment profile, reflecting the long-term stability of the vegetative regimes in the boreal forest. Archaeological materials may become exposed as a result of these activities, some may be removed and others may be displaced from their original positions. This type of impact has a negative effect on the sites affected but, in a positive sense, previously unknown sites may be revealed, so that undisturbed portions may be studied and sampled. Post-clearance archaeological studies in the former Alsands project area (Ives 1982) has served to confirm these positive and negative aspects of forest clearance procedures.

Forest clearance will, however, result in total destruction of above ground historic period resources and many of the traditional resources related to aboriginal use of the landscape. Palaeontological resources are unlikely to be affected by this type of activity, since it rarely intersects bedrock formations where these resources most commonly occur.

For the most part, the magnitude of direct impact associated with forest clearance can be considered either moderate or low (see Table 2) depending on the inherent scientific and or cultural significance of the resources affected. It may be negligible if no sites are present within impact zones. High magnitude impacts are possible if an extremely significant site is affected and disturbance happens to be severe. As is the case with all historical resources, the

Table 2 Impact Classification Definitions

Resource	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency
Historical Resources	**Negative:** Disturbance or destruction of historical resources	**High:** In areas of severe physical impact when resources of high scientific or interpretive value are affected **Moderate:** In areas of moderate or partial physical impact when high or moderate value resources are affected **Low:** In areas of minimal physical impact or when few or low value resources are affected Nil: In areas where no physical impact takes place or no sites occur	**Local:** Sites in the immediate development area are directly affected **Regional:** Sites in the region may be indirectly affected by increased use or demand for other facilities	**Immediate:** Direct physical impacts are felt immediately **Long-Term:** Indirect impact occurs over the life of the project	**Irreversible**	N/A
Historical Resources	**Positive:** Increase in the understanding of the character and distribution through information recovered in Impact Assessment and Mitigation phases of study	**High:** If a unique or highly significant site(s) is identified and information is recovered before development impact occurs **Moderate:** If sites similar to others in the region are found and information is recovered before development impact occurs **Low:** If few, low value or even no sites are found	**Local:** Specific information is recovered from sites within the immediate development area **Regional:** Comparisons with information obtained in other studies improves understanding of regional history and prehistory	**Short Term:** Submission of project report to Alberta Govt. allows improved regional management decisions **Long-Term:** Information and artifacts are available to other researchers	**Reversible:** If information is lost or is not collected or not curated properly	N/A

geographical extent of these impacts is localized to actual physical impact zones and their duration is immediate to the sites affected. All physical impacts to historical resources are irreversible.

Excavations for drainage ditches, placement of water wells, trenching for pipelines, grading for facility locations and road construction, and mining all represent the types of disturbances that will completely destroy near-surface archaeological and above-ground historic period resources. Those activities, particularly mining, that intersect deeply buried sediments, including loosely consolidated McMurray Formation sands, are likely to pose a threat to palaeontological resources, if they are present. Because the physical impacts of these activities on historical resources are severe, their overall magnitude is based entirely on the significance of the resources affected and ranges from high through moderate to low and negligible (Table 2). Again, the geographical extent of these impacts is localized to actual physical impact zones, their duration is immediate and the impacts are irreversible.

The effects of muskeg removal on prehistoric archaeological sites and materials is unknown at present. Certainly, any materials of this nature contained within these deposits will be destroyed during excavation. However, development of muskeg in this, and other regions of the southern boreal forest, date to the latter portion of the Holocene climatic interval, and archaeological sites that pre-date muskeg formation may be present at the base of these deposits (Ronaghan 1997). Currently, there is no evidence to support this proposition. However, the water-saturated conditions that characterize muskeg deposits suggest excellent preservation conditions for archaeological remains, particularly organic materials.

Areas selected for muskeg storage before reclamation would also be affected. If forest areas are cleared for muskeg storage, the impacts described for forest clearance would apply. If pre-storage leveling is required, impacts would be more severe and could be rated as having a high, moderate or low magnitude depending on the significance of the sites affected. Impacts to historical resources would be confined to those areas subject to these activities, would be immediately felt and would be both permanent and irreversible.

Overburden removal will result in complete destruction of all archaeological sites within development zones scheduled for this type of activity. The physical impacts of this activity on historical resources will be severe. Overall magnitude of impact will be based entirely on the significance of the resources affected and range from high through moderate to low and negligible (Table 2). Again, the geographical extent of these impacts would be confined to actual physical impact zones, their duration would be immediate and the impacts irreversible. Within areas scheduled as disposal locations for overburden, similar impacts to those described for muskeg storage area would apply. Removal of the Clearwater Formation shales, which overlie oil sands deposits in this region, will affect any palaeontological materials they might contain. The scientific significance of the fossils in this deposit (fossil ammonites, pelecypods and calcareous foraminifera; Carrigy 1974a) is considered to be relatively low. Physical impacts to these deposits would be confined to areas affected but would be severe, immediate and irreversible.

Mining activities may have limited effect on archaeological and historic period resources because resources will have been removed in earlier development stages. However, palaeontological materials may be directly affected by removal of McMurray Formation sands. This formation is not especially rich in fossils but is reported to contain molluscs, agglutinated foraminifera, fish teeth, spores and pollen grains (Carrigy 1974a). The scientific significance of these deposits is reflected in the "unknown" rating for this area on the sensitivity map issued by the Royal Tyrrell Museum of Palaeontology.

More significant are the fossils in the Devonian Waterways Formation, which underlies the oil-bearing strata of the McMurray Formation. This significance is reflected in the high sensitivity rating the Royal Tyrrell Museum of Palaeontology assigns to areas that contain natural exposures of this formation; along the Athabasca River and the lowest section of the Muskeg River north of this Project area. It is unlikely that mining activities will affect these deposits.

2.2.3 Indirect Impacts

While related to the Project, construction of specific infrastructure facilities not included in the application, such as highway upgrades, gas and power transmission lines, and gravel extraction, will be subject to separate regulatory review processes. The impacts of these projects will be outlined in studies done in advance of their regulatory review. The non-specific indirect impacts of Project Millennium are not easy to predict, however, because it is difficult to forecast the levels of non-project-related activities that may ensue within the general region as a result of increased commercial or recreational activity. Additionally, it is not possible to isolate the effects of this project from those of others proposed in the region.

Given the shallow burial of archaeological sites throughout the region, these types of resources are especially sensitive to many forms of surface impacts, as are on-surface historic period and traditional resources. Unregulated use of off-road vehicles or unregulated recreational developments, for example, could result in impacts to historical resources. However, without regionally extensive inventories, it is impossible to know how many historical resources are actually present in the area and whether any of these might be affected by activities that are conjecture at this point.

3. ASSESSMENT OBJECTIVES

The process of historical resource management can be viewed as having three distinct stages. These stages are the overview or baseline data study, the historical resources impact assessment and historical resources impact mitigation. The present study includes the overview and impact assessment. Mitigation, if necessary, would be a separate phase of investigation.

The objectives of the overview are to:

- gather and review preliminary data (secondary sources, previous research, general background material);
- identify gaps existing in extant data;
- identify past, current and future research problems and orientations;
- study historical resource potential through use of maps, satellite imagery and aerial photographs;
- plan future research strategies, including the field component for the current project; and
- make recommendations for the impact assessment phase of the project.

The primary objective of the historical resources impact assessment, as required under the Alberta Historical Resources Act, is conservation of historical resources. More specifically, the objectives are to:

- identify and inventory historical resources within the project area;
- evaluate the significance of the sites with respect to potential impacts;
- gather data pertaining to ongoing research; and
- make recommendations for the impact mitigation phase.

A mitigation stage is beyond the scope of this project as it requires additional determination of the requirements of the Alberta Historical Resources Act. This is the stage where the objective is to reduce development impact on historical resource sites by gathering data which would otherwise be irretrievably lost.

4. ENVIRONMENTAL CONTEXT

The anthropological theory of environmental determinism suggests that, to a great extent, the environment conditions man's behavioural and cultural adaptations. This theory was first coined by seventeenth century English philosopher John Locke and is one of the basic foundations upon which the first formal definitions of culture were built (Harris 1968:12-13). The northern environment conditions much of the activities in which archaeologists are interested. These include patterns of settlement, resource exploitation, seasonal movement, travel routes and the behaviours these activities imply. Therefore, to gain a perspective on the prehistoric use of the project area and its environs, the appropriate environmental variables must be considered.

Archaeologists are not only better able to find sites when they understand the environmental conditions, but also to interpret them when they understand the context within which they existed. The most pertinent variables are interconnected and consist of the physical aspects of the land (topography, drainage, climate and soils) and resource availability (flora, fauna, lithic materials and water). Linking both are the cultural activities of site selection, travel within and through the area, and resource exploitation.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Physiography and Bedrock Geology

Physiography, including the bedrock geology and drainage, are hypothesized to have affected choice of travel route, destination and speed of travel for prehistoric hunting groups. Outcrop locations with fine grained silicious rocks or vein quartz were also important for the acquisition of lithic materials for stone tool manufacture.

The local study area is located to the east of the Athabasca River and south of the Steepbank River. The regional study area exists within the Clearwater Lowlands physiographic region which can be further subdivided into the Clearwater and the Docer Plains. These Plains are covered by a mantle of glacial drift, with bedrock exposures restricted to the deeply entrenched river valleys and the Clearwater Plain. Some important bedrock formations in the region include the Cretaceous aged Clearwater and McMurray formations, and the Devonian aged Waterways formation. These bedrock formations are overlaid by Quaternary deposits that include glacial till, glaciofluvial deposits including kames, outwash and meltwater deposits, and more recent aeolian, lacustrine and alluvial deposits. Portions of the McMurray formation occasionally outcrop in the regional study area where the depth of the overlaying sediments is limited.

The Clearwater and Docer Plains also contain an extensive array of poorly drained depressions. Along the dominant river valleys, like those formed by the Athabasca River and its tributaries, the terrain is considerably more diverse. There are many large ridges, terraces, knobs and glacial lake beach ridges (Van Dyke and Reeves 1985). The region between the Athabasca and Clearwater Rivers also exhibits slumping.

The upper portion of the lower member of the McMurray formation has been identified as the source of Beaver River Sandstone (Ives and Fenton 1985; Fenton and Ives 1990). This lithic resource is a light gray, medium to fine-grained quartz sandstone cemented in a silica matrix. It was intensively used by the First Nations people in the area for thousands of years. The identification of the source and the composition of this material is an important step in understanding the settlement patterns of the people who inhabited the region. Examples of this material have been located in sites throughout the region and onto the Northern Plains at sites as old as 9,000 years (Linnamae 1993).

4.1.2 Climate

Climates over wide areas, as well as specific microclimates within local areas, greatly influence the physical environment and the resources available to the people inhabiting the region. The regional study area is part of the Mid Boreal Mixedwood Ecoregion, which is the largest ecoregion in the province (Strong and Leggat 1992:37). This ecoregion occurs primarily north of 55° N latitude and makes up 31.8% of the province. It closely corresponds with the moist Subregion of the Boreal Mixedwood identified in other schemes (Strong and Leggat 1992). The region is characterized by having cool wet summers and cold dry winters. The annual precipitation totals approximately 397 mm, with July and June being the wettest months. Summer months average approximately 240 mm of precipitation annually. Winter months are considerably drier, averaging only 64 mm of precipitation each year (Strong and Leggat 1992). The average annual temperature is less than 1°C. Summer temperatures typically range from 7.3 to 19.6°C, with an average of 13.5°C. Winter temperatures range from -18.6 to -7.7°C with an average of -13.2°C.

The above description is of the present climate, however, significant climatic variations during prehistory have been documented. By 10,000 before present (B.P.), Laurentide Glaciers were relegated to Northern Saskatchewan and Manitoba with some isolated decaying blocks in spots throughout the prairies until 9,000 B.P. (Bobrowsky et al. 1990:92). During this glacial retreat, the climate appears to have been characterized by warmer winters and cooler summers, with less precipitation than under present conditions. Severe, cold northerly winds may have also been present at various times during this period. There was a general movement from the south of flora and fauna as glaciers retreated.

The Hypsithermal or Altithermal period was a general warming period which lasted from approximately 8,000 to 5,000 B.P. (Bobrowsky et al. 1990). The grasslands reached their maximum northward and eastward extent during this period. This was followed by a general trend towards cooler and moister conditions reaching their maximum around 2,000 B.P. (Vance 1990).

More important to the topic of prehistoric land use variation within a particular ecoregion is the topic of microclimate. Microclimate is defined as the temperature, precipitation and wind velocity in a restricted or localized area, site or habitat. The identification of favourable microclimates is essential to predicting the location of prehistoric sites. The identification of these areas may also be used in the reconstruction of prehistoric settlement and subsistence patterns. Variables affecting microclimate are elevation, slope in relation to the sun, exposure to the prevailing winds and vegetation.

Microclimatic factors, such as exposure to the wind and sun, are variables that probably influenced the choice of particular site locales. Hill top locations are well-drained, typically level, and receive the most wind (which can serve to keep insects and smells away), while offering a view (of the scenery for game and/or intruders). South-facing slopes are generally warm and dry, while north facing slopes are cooler and the soil is more apt to be moist. These and other factors were important in the decision making process used when habitation and activity areas were being selected in the past.

4.1.3 Soils

The soils of an area not only reflect its past climate and geologic history, but greatly influence vegetation patterning, which has significant implications in terms of resource availability, as discussed below.

The uppermost sediments of the regional study area consist of aeolian sands as well as sediments deposited by the Athabasca River overlaying glaciolacustrine and glaciofluvial sediments and tills (Fenton and Ives 1990). There are a variety of soil types present in the local study area. Soils along the terraces and slopes of the Athabasca River Valley consist mainly of Orthic Eutric Brunisols, Orthic Gray Luvisols and Orthic Regosols. The texture of the soils is predominantly sandy loam (Leskiw, Laycock and Pluth 1995). To the east and west are undulating organic and lacustrine plains (Strong and Leggat 1992). These upland and midland areas are dominated by Typic and Terric Mesisols (Leskiw, Laycock and Pluth 1995). The ground surface is typically level, although it is often poorly to very poorly drained.

Topography ranges from gently undulating to relatively steep along some river banks. Soil depths are dependent on slope position and exposure.

4.2 RESOURCE AVAILABILITY

4.2.1 Vegetation

Vegetation is necessary for humans for food and fuel as well as habitat for animals utilized by hunters. Its availability is thought to have influenced prehistoric travel, settlement and subsistence patterns.

The study area is located in the Mid Boreal Mixedwood ecoregion of northeastern Alberta (Strong and Leggat 1992). This woodland is the largest and densest of the forest regimes found in the Boreal Forest region (Meyer 1983:142). It is vegetated by a variety of trees including conifers such as white spruce (*Picea glauca*), black spruce (*Picea mariana*), balsam fir (*Abies balsamifera*) and jack pine (*Pinus banksiana*) and broad-leaved species such as trembling aspen (*Populus tremuloides*), balsam poplar (*P. balsamifera*) and willows (*Salix* spp.). This area supports a wide variety of plants and animal communities living in a diversity of micro-habitats. The size and location of these habitats are affected by a combination of climate, wind, hydrology, altitude, sedimentation and forest fires (Meyer and Hamilton 1994:99).

The Mid Boreal Mixedwood ecoregion is dominated by trembling aspen and balsam poplar with an understory of herbs and deciduous shrubs like bluejoint (*Calamagrostis canadensis*), wild sarsaparilla (*Aralia nudicaulis*) and prickly rose (*Rosa acicularis*). These latter species tend to decline as the overstory thickens. Left untouched, trembling aspen and balsam poplar are replaced by white spruce and balsam fir. However, the presence of these latter species is rare due to the frequency of forest fires in the region. (Strong and Leggat 1992). As trembling aspen and balsam poplar recover relatively quickly from fires, they are far more plentiful.

Aspen and balsam poplar are usually associated with fine grained, wet soils that are still well drained. The dominance of these trees in the region is limited by the availability of water and the type of soil. Thus, upland areas are characterized by mixed deciduous forest, while lower regions of little moisture content usually support only aspen. Sandy areas contain jack pine with an understory of bearberry (*Arctostaphylos uva-ursi*), blueberry (*Vaccinium myrtilloides*) and a variety of species of shrubs and mosses (Thorpe 1993).

Wetter areas tend to hold more organic nutrients and thus support a different plant regime. Low lying depressions, being quite poorly drained, support peat and muskeg. Vegetation in these areas is dominated by black spruce, Labrador tea (*Ledum groenlandicum*), bog cranberry (*Vaccinium vitis-idaea*), sedges (*Carex* spp.) and mosses. River terraces, lake and stream margins are associated with balsam poplar, willow and sedge. Finally, in extremely wet areas there are sedge meadows.

4.2.2 Fauna

Fauna indigenous to this region includes a variety of large ungulates such as moose (*Alces alces*), caribou (*Rangifer tarandus*), bison (*Bison bison*) and elk (*Cervus elaphus*). However, elk and bison have been greatly reduced in numbers during the historic period. Bison in the area are a subspecies referred to as Wood Bison (*Bison bison athabascae*). The original distribution of Wood Bison is not entirely understood, but they appear to have been restricted to the forested regions of northern Alberta, northeastern British Columbia, northwestern Saskatchewan and southwestern Northwest Territories. Sub-fossil specimens have also been recovered from Alaska and Yukon territories (Gates et. al. 1992:140-141). The subspecies of bison known as the Plains Bison (*Bison bison*) was present throughout the southern half of Alberta prior to its extirpation by 1885 (Gates et. al. 1992:140).

Mule deer (*Odocoileus hemionus*) also historically range up to the southern shore of Great Slave Lake and the Liard River, inhabiting open coniferous forest, sub-climax brush, aspen parklands and steep broken terrain (Banfield 1987:390). They do not typically inhabit areas of deep climax coniferous forest and open prairie. White-tailed deer (*Odocoileus virginianus*), although present in the area today, are recent arrivals to the area. Their current range extends up the Athabasca River valley to the southern shore of Lake Athabasca. In the past, white-tailed deer populations were restricted to more southerly regions (Banfield 1987:394).

Other historically known mammals include grizzly bear (*Ursus arctos*), black bear (*Ursus americanus*), wolf (*Canis lupus*), lynx (*Lynx lynx*), wolverine (*Gulo gulo*) and river otter (*Lutra canadensis*). Grizzly bear have been extirpated from the region as they have throughout a large portion of Canada and the United States. Mountain lions (*Felis concolor*) occasionally may have been present in the area in the past, although their recorded range does not extend much beyond the modern Fort McMurray region of the Athabasca River valley (Banfield 1987:348). Smaller mammals in the region include snowshoe hare (*Lepus americanus*), fox (*Vulpes* sp.), badger (*Taxidea taxus*), porcupine (*Erethizon dorsatum*), mink (*Mustela visons*), marten (*Martes americanus*), weasel (*Mustela* spp.), fisher (*Martes pennanti*), striped skunk (*Mephitis mephitis*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*) and a number of squirrel, mouse and vole species.

A wide variety of birds, fish and amphibians were also present in the region. Canada goose (*Branta canadensis*), mallard (*Anas platyrhnychos*), loon (*Gavia* sp.) and pelican (*Pelecanus* sp.) are some of the seasonal water birds in the area. Upland game birds include a variety of grouse and ptarmigan species. Rivers and lakes in the region contain a variety of fish including northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), yellow perch (*Perca flavescens*), goldeye (*Hiodon alosoides*), longnose sucker (*Catostomus catostomus*), lake whitefish (*Coregonus clupeaformis*) and in some areas arctic grayling (*Thymallus arcticus*).

4.2.3 Water

Water courses were an important factor in regulating prehistoric subsistence and settlement patterns. The area lakes and rivers not only provided water for drinking and cooking, but also supplied food in the way of fish, waterfowl and aquatic mammals. Waterways were also an important travel route for the First Nations people. Rivers and lakes were traveled by canoe in the spring, summer, and autumn, and by foot or dog team in the winter when the ice was solid. During spring breakup and in the autumn while the ice was too soft to be traveled on, people remained in relatively sedentary camps. Large gatherings were common in the spring and early summer throughout the forest (Meyer and Hamilton 1994). These gatherings may have been held at the same location each year. These areas were intensively utilized and should be highly visible in the archaeological record. Indeed, several of these aggregation centres have been mapped along the Saskatchewan River, indicating the prominence of these sites in the Boreal Forest region (Meyer and Thistle 1995).

4.3 PALAEOENVIRONMENT

The reconstruction of the past or palaeoenvironments in the north is still in its infancy. Few intensive studies have been completed even though the large array of moist depressions would support intensive research into the palaeoclimate of the region. Until such research is completed, palaeoenvironmental reconstructions of the area will continue to rely on a few localized studies and the more extensive synthetic research occasionally published with wider regional implications on the Northern Plains and in the Parklands ecoregions (e.g., Schwerger et al. 1981).

Archaeologists have become increasingly interested in the effects of micro-climatic change; changes that vary considerably between regions. The climatic effects of the waning continental ice sheet combine to produce a complex Holocene palaeoclimatic record that differs from place to place. It is only by establishing local, independently dated palaeoclimatic records that an accurate picture of Holocene palaeoclimatology can be established (Schweger 1984:5). Only then can archaeologists glean information about how prehistoric peoples may have been affected by changes in the climate.

Saying this, the most commonly used system is still one originally developed by Blytt (1876) before the turn of the century. This research on temperature and precipitation levels resulted in the definition of six episodes in the Holocene. These episodes include the Preboreal, Pleistocene–Holocene transition, Boreal, Atlantic, Sub-Boreal and Sub-Atlantic. It is generally agreed that the transition between these episodes was relatively rapid, though the absolute timing of these transitions still remains in doubt.

Almost all of northern Alberta was under ice during the Wisconsinan glaciation in the last part of the Pleistocene. The Wisconsinan glaciation was formed by two great glaciers, the Cordilleran, which covered all of British Columbia to the east edge of the Rocky Mountains, and the Laurentide, which covered almost all of Canada east of the foothills of the Rocky Mountains. The timing of the retreat of these glaciers is still under dispute. Denton and Hughes (1981) suggest that the area was deglaciated between 12,000 and 11,000 B.P. Clayton and Moran (1982) believe that the retreat may not have occurred until around 10,500 B.P. Their data are based on the rejection of all non-wood carbon samples due to the possibility of contamination (Vickers 1985:23). Clayton and Moran (1982) believe that lignite and shale fragments may have contaminated the non-wood samples causing the radiocarbon dates to be slightly older. Research by Litchi-Federovitch (1970) at Lofty Lake and Alpen Siding Lake in northern Alberta supports an early date for deglaciation. A radiocarbon date of 11,400 ± 190 B.P. has been obtained on soils from these lakes (Ives and Fenton 1985).

By 10,000 B.P. the Laurentide Glacier was relegated to Northern Saskatchewan, with some remaining isolated decaying blocks in scattered locations throughout the boreal forest and prairies until 9,000 B.P. (Bobrowsky et al. 1990: 92). Radiocarbon dates obtained on basal peat deposits in the Caribou Mountains of 8,600 ± 100 B.P. (S-116) suggest that these mountains were a glacial refugium (McCallum and Wittenberg 1962: 74). However, the Birch Mountains were likely fully exposed during the final retreat of the Laurentide ice sheet (Bayrock 1971: 49-50).

With the retreat of the glaciers and the subsequent run-off of large quantities of water, Glacial Lake Tyrrell was formed along what is now the Peace River and Athabasca River Valleys. These conditions left the study area covered with a mantle of glacial till and glaciofluvial deposits. Bedrock exposures are only associated with the major river valleys and the Clearwater Plain (Van Dyke and Reeves 1985).

The Pleistocene-Holocene transition period began with the end of the Laurentide ice sheet. As the glacier retreated northwards, flora rapidly began to form along the newly opened landscape. The first plants to enter this new environment were aspen, sagebrush and birch, suggesting a sparsely vegetated steppe-like environment. For instance, the basal or lowest stratigraphic zone at Lofty Lake is associated with just such a late Pleistocene pioneer forest community (Litchi-Federovich 1970).

The end of the Pleistocene also saw the rapid extinction of a number of mammalian species in the New World. Most dramatic is the disappearance of the megafauna, animals like the mammoth, mastodon, camel, horse, giant sloth, giant beaver and saber tooth cats. This extinction occurred over a relatively short time near the beginning of the Holocene Epoch. The possible reasons for these extinctions has generated considerable controversy. Some argue that the changes in the environment brought on by the retreat of the glaciers and the subsequent warming of the continent were responsible. Indeed, Webb (1984) has demonstrated a strong correlation between glacial retreats and global extinctions. Others disagree with this hypothesis and have tried to demonstrate that over-hunting by early Clovis Culture hunters was responsible (Martin 1984; Martin and Wright 1967). They argue that the glaciers underwent a considerable number of advances and retreats previous to the Holocene with little effect on animal species. They further suggest that the rapidity of the early Holocene extinctions demonstrates that natural forces alone could not account for the extinctions.

It has been questioned how human hunters could have eliminated such a large number of species in such a short time. It has also been demonstrated that extinctions were not limited to the megafauna; other smaller species like rodents also died out around the same time. It seems more likely that a combination of environmental pressures and over-hunting may have led to the demise of the megafauna (Guilday 1984). These animals would have been under considerable selective pressures with the retreat of the glaciers; smaller animals may have been better adapted to the environmental changes that were occurring. A shorter growth season and a reduction in nutrient diversity would have put extreme adaptive stress on certain species. Hunters may have provided the extra pressure that could have pushed these animals to extinction.

Soon after the retreat of the glaciers, present day varieties of fauna and flora came to dominate the landscape. The rest of the Holocene is characterized by variations in temperature and precipitation that resulted in sometimes major changes in the ranges of biotic communities. The first of these major changes occurred between 8,000 – 5,000 B.P. Known as the Altithermal or Hypsithermal, it was characterized by a general increase in temperature and decrease in available moisture. This period saw a general reduction in lake size and stream flow (Bobrowsky et al. 1990:93). Another result of this warming trend was that the Boreal Forest–Parkland border moved as much as 100 km north of its present day position.

The Altithermal was followed by a general trend towards cooler and moister conditions that reached its peak around 2,000 B.P. Modern climatic conditions begin around 1,500 B.P. (Vance 1990), though analysis of pollen remains from Lofty Lake shows the present day regime of spruce, birch and alder (mixedwood forest) was permanently established somewhat earlier in Northern Alberta at around 3,500 B.P. (Ives and Fenton 1985). The climatic optimum of the late Holocene was reached around 1,150 - 850 B.P. as a part of the Neo-Atlantic. It was followed by the "Little Ice Age" (400 - 100 B.P.) where the climate was significantly cooler than present (Meyer and Hamilton 1994: 100).

Another significant process which has been altering the landscape throughout the Holocene is the onset and development of large peat accumulations. Peatlands began forming at high elevations after the Early Holocene climatic maximum of 9,000 years ago had passed (Halsey et al. in press). Peat development began forming first in the highlands of the Foothills and in major uplands such as the Birch Mountains at approximately 8,000 years ago (Halsey et al. in press). It then expanded eastward and downslope during the period 8,000 to 6,000 years ago, but was delayed in certain lowland areas, such as the Peace/Wapiti basins until 5,000 to 4,000 years ago. The youngest peat deposits in Alberta are situated in the Parklands south of the project area and appear to have started forming in the period between 4,000 and 3,000 years ago (see Halsey et al. for detail). Therefore, peat developments likely began forming in the area surrounding the Project Millennium LSA between 6,000 and 4,000 years ago.

No data are currently available to suggest the rates of peat formation in specific locations such as the project area, because specific drainage characteristics and accurate predictions of moisture input during a wide range of time periods would have to be taken into account. However, general climatic predictions for the mid-Holocene interval suggest that modern climatic conditions were reached between 7,500 (Vance 1986) and 5,000 (Schweger et al. 1981) years ago. Given the present lack of data, it may be reasonable to assume that peat formation began slowly, accelerated as modern moisture regimes were achieved and that rates may have stabilized during the latter part of the Holocene. Due to the relative lack of microtopography within the Project Millennium area it is reasonable to assume that modern organic soil conditions have existed in the LSA for the past 2,000 to 3,000 years.

5. CULTURAL CONTEXT AND PREVIOUS ARCHAEOLOGICAL RESEARCH

The prehistory of the Lower Athabasca River basin region is faced with the same type of problems characteristic of the other portions of the Boreal Forest (Ives 1981). Subsequent to the retreat of glacial ice and its associated meltwaters, forest quickly colonized the landscape. Despite an extended period of lower moisture levels from about 8,000-4,000 years ago, vegetation maintained a continuous hold on the sediments of the region through the entire postglacial period. As a result, very low rates of sedimentary accumulation characterize all areas of the Boreal Forest except in major river valleys. Consequently, the entire prehistoric and historic archaeological record is usually confined to the upper 30 cm of mineral soil horizons, where there is a continuous reworking of the loose sediments by tree throw and root action. Accordingly, because of these conditions, there is little chance of distinguishing occupations relating to different periods within the 10,000 year record of human occupation in the region.

Compounding this problem are factors relating to the acidic nature of the soils in this region. Strong chemical weathering processes characteristic of the soils in these areas work very effectively to remove any of the organic components of the archaeological record. The bone, leather, wood and plant materials that would have been essential parts of the original archaeological deposits of the region have long ago been eliminated, leaving only stone artifacts and their production debris as testimony to the activities that once took place. Finally, unlike the Plains where large scale communal hunting of herd animals took place, hunting in the Boreal Forest most frequently involved capture of single animals in highly dispersed locations, frequently distant from campsite locations. Consequently, the spear, dart and arrows points, which in other regions can be used as a means obtaining an approximate age for the archaeological assemblages they accompany, are often absent in sites in the Boreal Forest.

These factors serve to limit the definition of the recognized prehistory in northeastern Alberta. In contrast, extant documents, records and oral testimony provide a firmer basis for understanding the historic period of the region. The following provides a general summary of both periods in the study area.

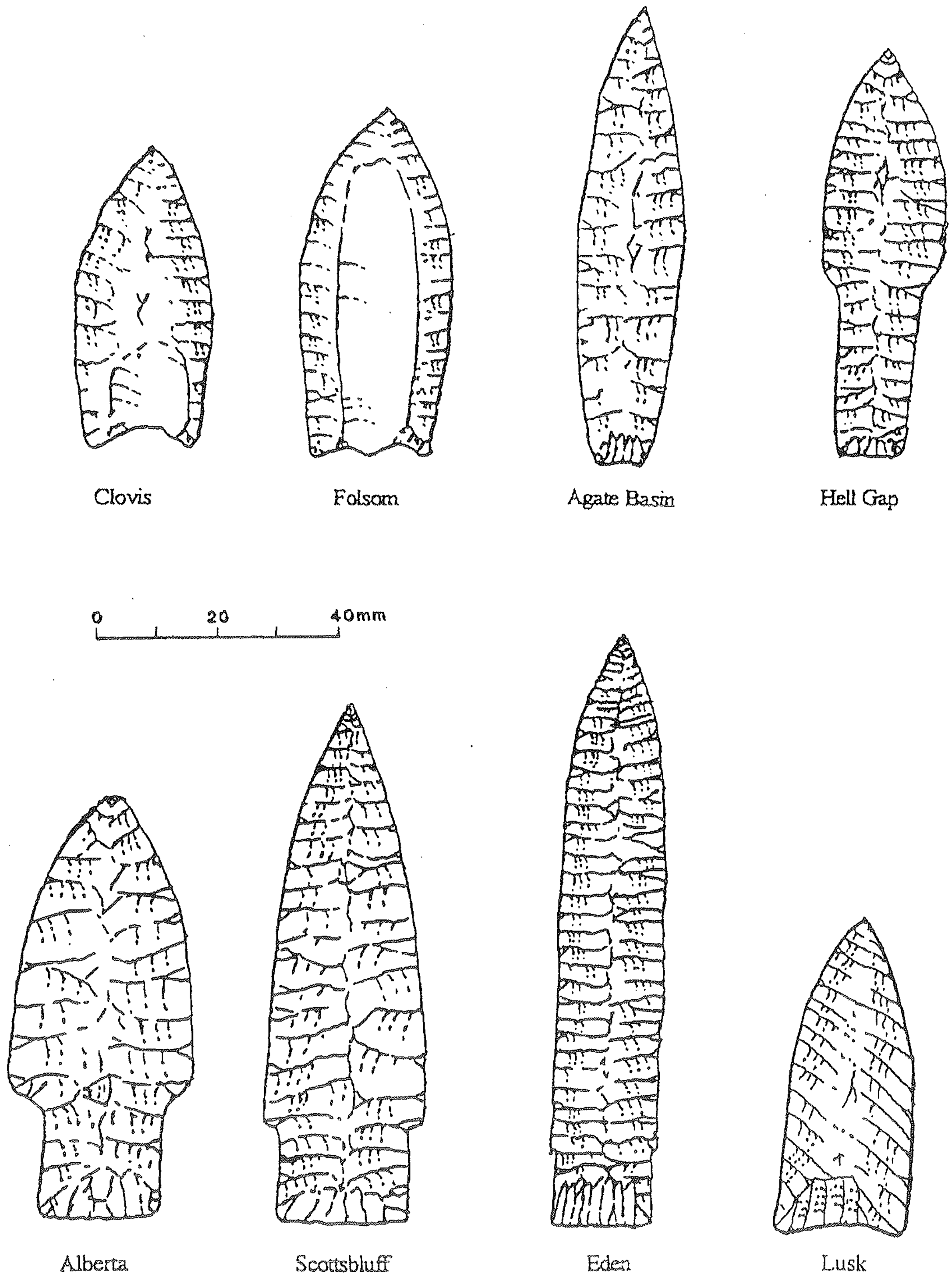
5.1 Cultural Context

Generally, Alberta prehistory is divided into three major periods: the Early, Middle and Late Prehistoric Periods (see Vickers 1986). These correspond to periods of cultural development that are marked by changes in the weapon systems used, but also reflect complex cultural evolutionary processes that include major technological advances. The prehistory of northeastern Alberta, however, is less well defined than areas further to the south, in the Plains and Parklands regions for example. The sequence discussed below follows a recent summary provided by Ives (1993).

5.1.1 Early Prehistoric Period (10,000 - 7,500 years ago)

Most archaeologists believe that the Aboriginal people of North America began to move onto the continent during the last ice age while the sea levels were considerably lower than at present because of the amount of water stored as ice on continental surfaces. As a consequence of reduced sea levels, the Bering Strait became a wide, open plain that extended from Siberia to Alaska. It is believed that small populations of people expanded into this previously uninhabited area as animal and plant life became plentiful. These groups would have continued to expand their territory into areas that contained adequate food supplies and were free of ice. One possible avenue that may have been used to enter continental North America could have been along the exposed continental shelf on the west coast (Fladmark 1989). A second route may have involved the use of an ice-free corridor present along the eastern edge of the Rocky Mountains as the Keewatin and Cordilleran Ice Sheets began to retreat (Ives et al. 1989). Some Aboriginal people believe that they have lived here since creation.

The Early Prehistoric Period is characterized by the presence of spear heads in archaeological assemblages (Figure 2). Little information from the early part of the cultural sequence has been recovered from the study region. Although Clovis is the first well documented archaeological culture found in North America, there have been no Clovis sites identified in the regional study area. The people who made Clovis points were highly nomadic, primarily hunting the mega-fauna of the Late Pleistocene Epoch such as mammoth, camel, bison, musk-oxen and horse, as



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PROJECTILE POINT STYLES

well as various of smaller game and aquatic resources. The next archaeological culture is Folsom which was well established on the Northern Plains by 10,000 years B.P. (Frison 1991). Clovis and Folsom projectile points are well crafted spear heads that have been thinned with precise flakes taken off of the basal end (Figure 2). These thinning flakes were removed to facilitate hafting the spear head to a wooden shaft, and are often referred to by archaeologists as "flutes". There have been no fluted projectile points recovered from the regional study area, although one fluted point made of Beaver River Sandstone has been recovered near Cold Lake (McCullough Consulting Ltd. 1981).

Although prehistoric peoples may have been present in the general study area as early as 10,000 to 10,500 years ago, recent geological studies (Smith and Fisher 1993) have established a relatively concrete potential beginning date for the prehistory of the area surrounding the project. Nine thousand, nine hundred years ago a massive discharge of meltwater contained in Glacial Lake Agassiz scoured parts of the study area land surface on its way north to the Arctic Ocean. This would have removed any traces of prior occupation and would have provided the landscape for subsequent colonization by vegetation communities, animals and their human hunters.

The earliest evidence of prehistoric use of the area is a spear point recovered from the Beaver River Quarry on Syncrude's Lease 22 (Syncrude 1974). This style of point resembles specimens known as Agate Basin (Figure 2), which has been dated elsewhere along the southern margin of the forest at 8,500-7,500 years ago (Buchner 1981) but is known to occur on the Northwestern Plains as early as 10,500 years ago (Frison 1991). Somewhat similar styles of point have been recovered outside the study area at the Gardiner Lake Narrows site in the Birch Mountains (Sims 1976b). In addition, a broken specimen recovered from the Lease 13 area north of Project Millennium (Sims and Losey 1975) exhibits attributes similar to a style known as Hell Gap, which, in the southern Plains, dates to roughly between 10,000 and 9,500 years ago (Figure 2).

It has been suggested (Ives 1993) that certain less distinctive point styles also recovered in the Birch Mountains may relate to initial penetration of the early spruce forest of the region, ultimately deriving from Alaskan populations that date as early as 10,700 years ago. Generally these specimens, and perhaps some of the others listed above, fit within a cultural entity known as the Northern Plano Tradition (MacNeish 1964), which is believed to date between 7,000 and

8,000 years ago in the Canadian Shield area of the District of MacKenzie, and relates to caribou hunting following deglaciation (Gordon 1975). However, without firmly dated intact archaeological assemblages that can be directly linked with these point types, the questions of dating and origins of first populations remain unresolved.

Occupation of the region, except during the earliest portion of this period, coincides with a climatic interval known as the Hypsithermal, which dates from around 9,000 to 5,000 years ago (see Anderson et al. 1989, Ritchie 1976, Schweger et al. 1981). In more southerly environments, this extended period of warm and dry conditions resulted in a retreat of forest margins as much as 120 km (Litchi-Federovitch 1970) and drying of many lakes in the Parklands (Schweger and Hickman 1989). However in the regional study area it would appear that the effects of this extended period of draught were ameliorated, with the possible exception of significantly higher rates of forest fire, and that the modern mixedwood forest had been established by 6,000 years ago (Vance 1986). With modern fire control practices and the absence of fires purposely started by Aboriginal peoples to enhance habitat productivity (Lewis 1977), it is suspected that the grassland components of this generalized ecozone would have been far greater than is observed today. Certainly during the Hypsithermal climatic interval, grasslands would have been an prominent feature of the regional vegetative cover and would have supported larger numbers of grazing herbivores than would be predicted for later periods.

5.1.2 Middle Prehistoric Period (7,500 - 1,200 years ago)

The beginning of the Middle Prehistoric Period is characterized by the first appearance of dart points in the cultural chronology (Figure 3). Dart points are typically slightly smaller than spear points and are associated with the advent of the spear thrower or atlatl. The use of spear throwers greatly improved the distance a spear could be thrown. In spite of the presumably increased environmental productivity during the early portion of this period, no radiometrically dated sites have been identified in the vicinity of the Project area. Specimens recovered from surrounding regions exhibit formal qualities similar to samples dated elsewhere. Large side and corner notched points occur in both the Shield Archaic (6,500-1,700 B.P.) of the forest/barrenlands transition zone (Wright 1972) and the Mummy Cave sequence (7,500-5,500 B.P.) on the Plains (Vickers 1986), as illustrated in Figure 3. A single point recovered from

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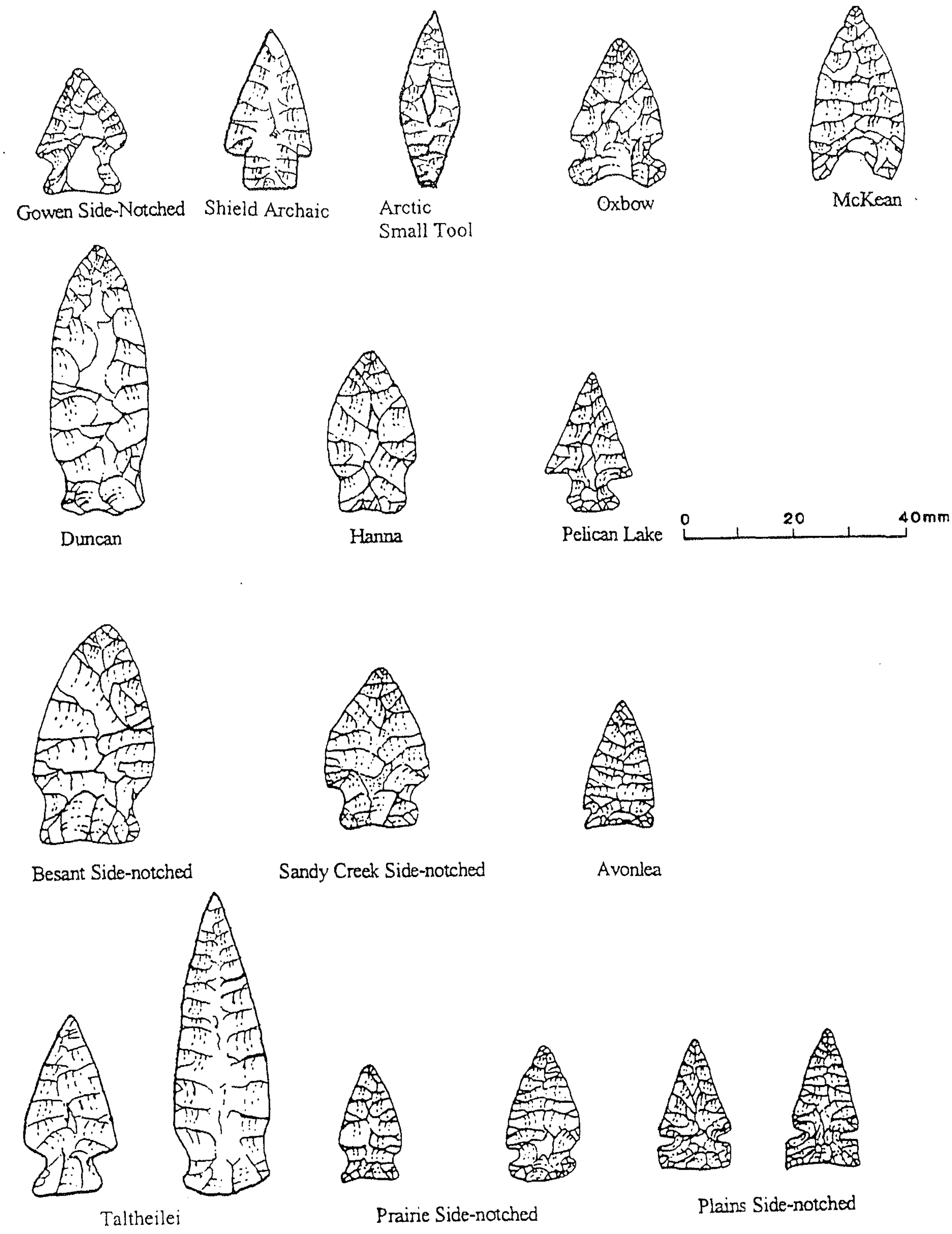

SUNCOR ENERGY

Project Millennium
Taking Suncor into the 21st Century

LATE AND MIDDLE PREHISTORIC PERIOD
PROJECTILE POINT STYLES

01 Apr 1998	Figure 3	DRAWN BY: CG

within Lease 13, north of the Project Millennium development area, has been tentatively assigned a Shield Archaic affiliation (Ronaghan 1981a) and may relate to a Middle/Late Shield Archaic occupation that may date between 3,500 and 1,750 years ago. However, without a firmly associated assemblage and means of absolute dating, it is difficult to assess the significance of this find.

Limited indications of Middle Prehistoric Period use of the region were obtained from the Wentzel Lake site in the Caribou Mountains to the northwest (Conaty 1977), where non-diagnostic stone tools and debitage have been recovered in stratified beach deposits. More tangible evidence of Middle Prehistoric use of the oil sands area has been recovered from the Bezya Site within Shell Canada's Muskeg River Mine Project area (LeBlanc and Ives 1986). Excavations at this site produced a large collection of microcores, ridge flakes, core tablets and microblades. These are thought to relate to an occupation by group(s) affiliated with others classified as belonging to an archaeological entity referred to as the Northwest Microblade tradition defined in studies conducted at Fisherman Lake in the Northwest Territories (Millar 1981) and in southwest Yukon (Workman 1978). A date of 3,990 years ago was obtained from charcoal believed to be associated with this assemblage of stone artifacts.

As well as the distinctive microcore and blade materials described above, a series of side and corner notched points have been recovered from the Eaglenest Portage and Gardiner Lake Narrows Sites (Ives 1993). These are believed to be best compared with the same Complex (Pointed Mountain) of occupations recovered from Fisherman Lake in the Northwest Territories that include the Northwest Microblade Tradition materials (Millar 1981). Again, no dates are available, but they are presumed to post-date 3,900 years.

Materials suggesting influences from the Plains and Parklands of central Alberta have also been recovered from archaeological sites to the south and west. McKean Complex points have been reported from sites in the Lac La Biche area and Oxbow style points, as shown in Figure 3, have been obtained from sites at North Wabasca Lake, the Birch Mountains and along the Lower Athabasca River (Ives 1993). These specimens span a time period between 5,500 and 2,500 years ago in more southerly areas. Contrasting northern influences are suggested in the presence of a few specimens that may relate to southward expansion of another microblade using archaeological complex known as the Arctic Small Tool tradition between 3,500 and 2,650 years ago (Wright 1975, Gordon 1977b). Two specimens from the Gardiner Lake Narrows site in the Birch Mountains may relate to an occupation of the study region by these peoples, but no dates are available.

The final stage of the Middle Prehistoric Period is presumed to be represented by materials relating to the Taltheilei Shale Tradition defined for the Barrenlands of the Mackenzie District (Gordon 1975, 1977b). This complex of materials includes large lanceolate and stemmed points in its early expressions, as well as smaller corner and side notched specimens in its later expressions. This tradition spans a period between 2,650 years ago and the earliest historic times (A.D. 1750). It is also considered to represent Athabaskan speaking peoples with ancestral links to the historic Dene of the region (Gordon 1975, 1977b). Although the occasional specimen recovered in Alberta has been associated with the Early and Middle Period Taltheilei Shale Tradition occupations (Ives 1993), no major presence has yet been defined. The later stages of this occupation are considered to fall in the Late Prehistoric Period discussed below.

5.1.3 Late Prehistoric Period (1,200 - 300 years ago)

The beginning of the Late Prehistoric Period coincides with the appearance of new technological advances in the material culture of the region. Changes in hunting equipment include the replacement of the atlatl by the bow and arrow. This is recognized archaeologically by a reduction in the size of the projectile point, especially around the neck, because an arrow shaft is necessarily smaller in diameter than an atlatl dart shaft. The bow and arrow allowed for more effective exploitation of big game because of its superior rate of fire, accuracy and the fact that no startling body movement is necessary to deliver the weapon (Reeves 1990). This period lasts until the introduction of firearms and other cultural materials of European origin distributed through the fur trade.

The Late Prehistoric Period begins at approximately 1,200 years B.P. in this region and coincides to the beginning of the Late Taltheilei Phase (Figure 3). Late Taltheilei assemblages contain large lanceolate points as well as arrow points. Bone projectile points also occur in some Taltheilei assemblages (Gordon 1975). Within the Lower Athabasca region the small corner and side notched specimens that occur in a series of site assemblages are probably best considered as representing occupations by Late Taltheilei tradition groups (Ives 1993). The best Late prehistoric record available for the region comes from excavations at the well stratified Peace Point Site in Wood Buffalo National Park (Stevenson 1985, 1986). Although a series of well separated occupation surfaces containing well preserved faunal remains and features, such as hearths and activity areas, were defined, only one projectile point was recovered, a small side notched specimen dating 1,040 years ago. This fine grained archaeological record provides excellent information on site formation process and structural use of space, but provides little information on pertinent cultural questions relating to the appearance of Athabaskan speaking peoples in the region, as has been inferred in Gordon's (1977a) interpretation of Taltheilei Tradition chronology and site distributions.

In 1792 Alexander Mackenzie's journal provides an entry indicating that when the Cree entered the study region they found the Athapaskan speaking Beaver Indians resident in the area around the Athabasca/Clearwater River junction and that a group referred to as the "Slave" occupied lower portions of the Athabasca River basin (Mackenzie 1971:123). On the basis of linguistic and other evidence, archaeologists suggest that the initial movement of Athabaskan speaking peoples into the study region occurred in Late Prehistoric Period times between 1,500 (Gordon 1977a) and 1,200 years ago (Ives 1993).

5.1.4 Prehistoric Use of Beaver River Sandstone

Much of the prehistoric record of the study area exhibits an almost exclusive use of a single raw material type, known as Beaver River Sandstone (BRSS: Fenton and Ives 1982, 1984, 1990), for production of stone artifacts. Because use of this material is so key to the prehistory of the region its distribution and use will be discussed in some detail. Although at present there is no way to demonstrate it, the majority of the lithic waste materials of Beaver River Sandstone (BRSS) observed and recovered in near-surface contexts in regional archaeological sites are thought to relate to Late Prehistoric occupations by Late Taltheilei and other, as yet undefined, Late Prehistoric occupations (Reeves 1995). However, initial use of this material may have occurred as early as the Fluted Point tradition of Early Prehistoric times (McCullough Consulting 1981).

The BRSS type source was originally defined as "the siliceous cemented sandstone found at the Beaver River Quarry site (HgOv 29) and the subadjacent Beaver River borrow pit." (Fenton and Ives 1982:175). The source area for this material was stated to be the area surrounding the quarry and gravel pit approximately one township in size, with outcrops occurring in localized regions along the Athabasca River (Fenton and Ives 1990). It is a fine to medium grained, light grey, bimodal, silica cemented sandstone that may contain a low percentage of fine black grains (Fenton and Ives 1982). The name Beaver River Sandstone is used by archaeologists to describe the material that has this specific composition and localized source area. The material found at the Beaver River Quarry is of a rather coarse composition and is not fully consistent with most archaeological specimens recovered from regional sites, leading Fenton and Ives (1990:133) to distinguish both fine and coarse grained varieties of this material and to note that an additional high quality outcrop has not been recorded.

Geologically, the source formation containing BRSS is situated at or near the top of the lower member of the McMurray Formation, which is Lower Cretaceous in age (Fenton and Ives 1984:130-131). The McMurray Formation itself lies unconformably over the karstic topography of the preceding Devonian Age Waterways Formation (Fenton and Ives 1984:130). BRSS bearing portions of the McMurray Formation only outcrop in areas along the Athabasca River and possibly along some its major tributaries. Very little BRSS has been observed in local tills or fluvial deposits. This may suggest that the materials used by people in the past were quarried from local outcrops rather than being collected from a wider distribution of naturally dispersed materials. This material comprises up to 99 to 100% of the material in lithic assemblages in the Fort McKay region (Fenton and Ives 1982:176). This is especially true for large sites that are located in close proximity to presumed exposed source locations along the Beaver River.

Recognition of a dense pattern of archaeological sites containing the fine grained variety of this material along the east bank of the Athabasca River in the vicinity of Cree Burn (or Isadore's) Lake and stretching into the hinterlands along the Muskeg River indicates that other sources should be considered. Several researchers have considered this issue and attempts have been made to identify quarry locations for the fine grained variety along the Athabasca River and its tributaries along the east side of the Athabasca River. Ives and Fenton have suggested that bedrock outcrops maps can be used to predict possible exposures of intact BRSS deposits where the Athabasca and Muskeg rivers and some of their tributaries have cut sufficiently deeply to intersect the target McMurray Formation deposits. They located three in-place outcrops of BRSS along the east side of the river, but all exhibited only the coarse grained variety (Ives and Fenton 1985); no outcrops were found on the slopes below the large Cree Burn Lake archaeological site. Ronaghan (1982) searched a portion of the Athabasca River valley slopes as part of the assessment of the proposed Alsands water intake facilities, but did not identify BRSS exposures. Head and Van Dyke (1990) searched the lower portions of Mills Creek as part of mitigation activities undertaken within the Cree Burn Lake Site area. They recovered several blocks which they believed were BRSS, but this identification has been questioned by J. Ives of the Archaeological Survey, Provincial Museum of Alberta (Reeves 1995).

The possibility of secondary (i.e., re-deposited) sources of this material was investigated by Ives and Fenton (1985) through inspection of gravel pits, road cuts and natural exposures in the hinterlands back from the main river valley. Very limited evidence of this type of source material was encountered. Reeves (1995) has identified large boulders that may be BRSS exposed along reaches of the Muskeg River and Jackpine Creek, but has not confirmed their makeup. He has also noted a considerable number of "perched" boulders on ridges and table lands throughout the Lease 13 and the Syncrude Aurora Mine Project areas. He believes that these were emplaced by the Lake Agassiz catastrophic flood of 9,900 years ago and that some may be BRSS (Reeves 1995:79). These suggestions have not been investigated. Reeves has further complicated the issue by citing a personal communication from a Syncrude geologist suggesting that the BRSS identified at the Beaver River Quarry is a large bedrock plate displaced and deposited by the Agassiz flood and is therefore not an *in situ* occurrence. With all of these uncertainties it is evident that the issue of the location and distribution of the source(s) of BRSS has not been resolved and requires further study. The dense forest that blankets the study region is a major impediment to effective solution of this question.

5.1.5 Protohistoric/Historic Period (300 - 100 years B.P.)

The appearance of European trade items in native occupations marks the beginning of the Historic Period. Taltheilei assemblages represent pre-European contact Dene or Athabaskan speaking people in this region. The distribution of Taltheilei sites in the region is relatively coincident with the known distribution of the Dene people at the onset of the fur trade (Van Dyke and Reeves 1985:92). Taltheilei sites in the Lower Athabasca region likely relate to the Beaver, Sekani, Slave, and/or the Chipweyan people. The Taltheilei Tradition has also been considered ancestral to the Yellowknife, Dogribs and the Chipweyan in the Barren Grounds and in the Great Slave-Great Bear Lakes region of the Northwest Territories, demonstrating over 2,100 years of cultural continuity (Gordon 1977a). It is difficult to determine the precise geographical boundaries that separated the different linguistic groups that lived in northern Alberta in the distant past, although information is available for the period immediately preceding European contact (Figure 4).

The Beaver Indians occupied the majority of northern Alberta including the entire Peace River valley below its confluence with the Smoky River, the district around Lake Claire and the Athabasca River valley south to Methy Portage on the Clearwater (Jenness 1963:382-384).

MacGregor (1981:16) states that the Chipweyan, the Slaves and the Sekani bordered the Beaver Indians to the east, north and west respectively. Magne (1987:224), in a map showing the locations of Native group distributions ca. A.D. 1700, does not mention which group borders the Beaver Indians on the west. Magne places the Slave Indians to the north, the Chipweyan to the northeast and the Yellowknife Indians further north, above Great Slave Lake, but also includes the Algonkian speaking Cree at the eastern edge of the Athabasca River. Like the Beaver Indians, these former groups are all Dene peoples. The area along the foothills of the Rocky Mountains, between the upper Athabasca and the upper North Saskatchewan, was inhabited by a fellow Athabaskan speaking group, the Tsuu T'ina, formerly known as the Sarcee. The Sarcee, despite their linguistic ties to the Athabaskan speaking groups to the north, were politically aligned with the Algonkian speaking Blackfoot confederacy to the south (Ives and Fenton 1985:25).

Prior to European contact, the Beaver Indians had been experiencing pressure from the Western Cree who were aggressively expanding their territory (Palmer 1990:9). The Cree pushed the Beaver Indians to the Peace River region to the west. It is usually thought that this territorial expansion was quite recent as a result of the fur trade. Russell (1991), however, contends that there is evidence that the Cree were present and had knowledge of the Athabasca region well before the arrival of Europeans in the area. This would mean that the westward migration of the Cree was earlier and not a direct result of the fur trade. The Cree and the Beaver Indians eventually formed an alliance at Peace Point (approximately 80 km by air from Lake Athabasca) and agreed on territorial boundaries. Peace Point served as the border between the two groups (Russell 1991:164). The Cree are also said to have driven the Slave Indians out of their territory to the Slave River at approximately the same time as they pushed the Beaver Indians to the north and west. Nevertheless, the Cree were the indigenous group in the study region when Europeans first arrived in the Late 1700s.

5.2 Regional History

5.2.1 Contact Period

Extensive trade networks had been in-place between the native peoples long before the Europeans were guided to the area. European trade goods began to arrive in the region through these networks, decades before the first Europeans. Anthony Henday, the first European to enter Alberta, noted this trade network during his 1754 trip to an area near present day Red Deer (MacGregor 1981). Henday, who was employed by the Hudson's Bay Company, had travelled west from York Factory on the shore of Hudson Bay with a group of Cree where they met with the local Blackfoot people. During his stay in Alberta, Henday tried to entice the Blackfoot to come to Hudson Bay to trade, which they declined. In the spring of that year, while traveling back to the Bay with his guides, Henday once again encountered the same group of Blackfoot people. During this second meeting Henday observed the Blackfoot trading furs to his guides. The Blackfoot and the Cree people had already established a trading network in which the Blackfoot procured the furs and the Cree delivered them to the Bay (MacGregor 1981). A similar established network would, no doubt, have been in-place with the Dene along the lower Peace and Athabasca basins.

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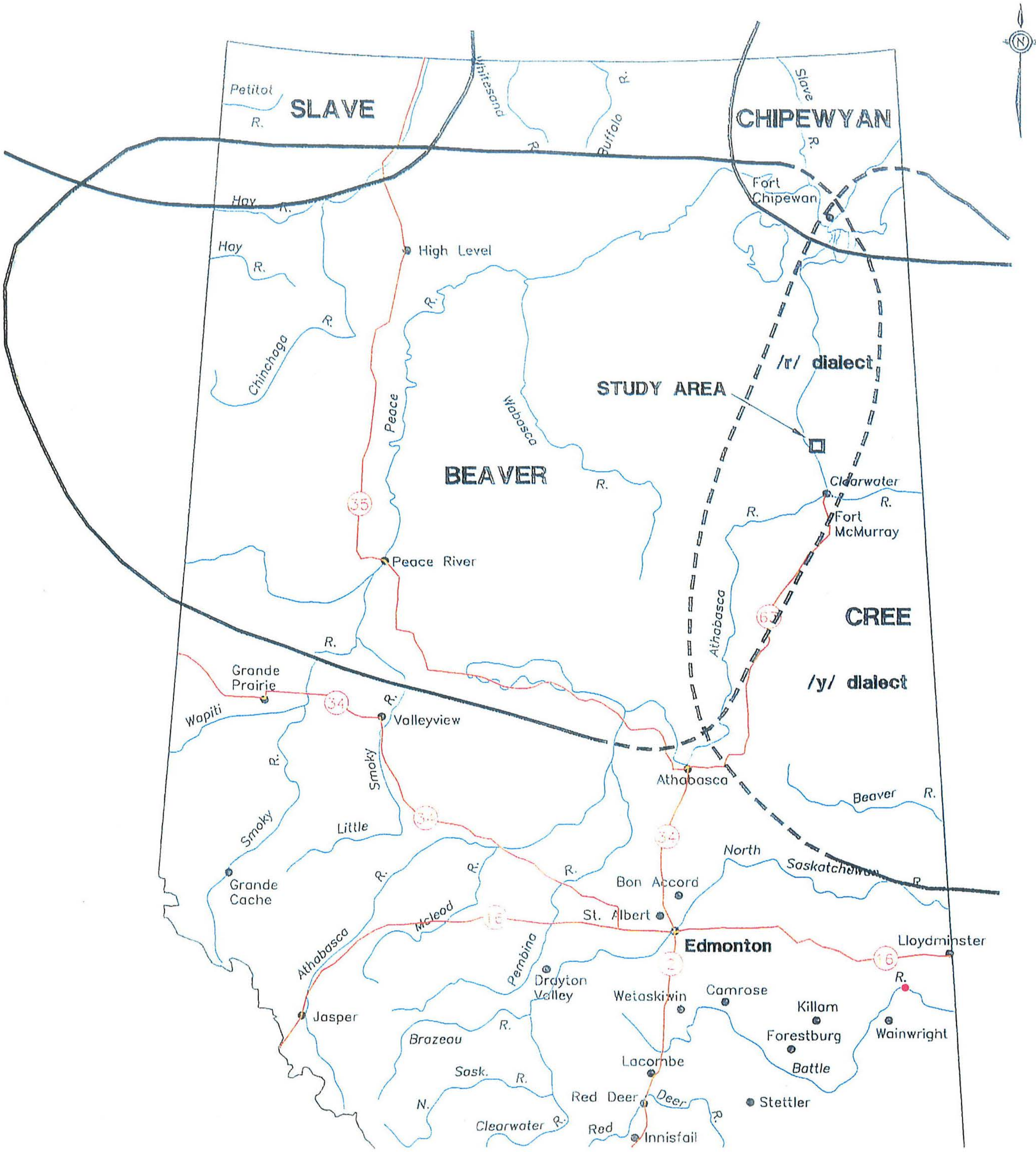


SUNCOR ENERGY

Project Millennium
Taking Suncor into the 21st Century

POSTULATED NATIVE GROUP DISTRIBUTION
c.a. A.D. 1700

01 Apr. 1998	Figure 4	DRAWN BY: CG

REFERENCE
AFTER MAGNE 1986

The fur trade continued to be the primary reason for Europeans to venture into the interior over the next few decades. These Europeans typically remained on the Plains and Parklands, expanding the line of fur trade posts up the Saskatchewan River. Under pressure from the rapidly expanding North West Company, the Hudson's Bay Company began to build inland posts, beginning with Cumberland House in 1774. In 1778, Peter Pond, an employee of the North West Company, built the first fur-trade post in the Athabasca region at the junction of the Athabasca and Embarass Rivers (MacGregor 1981:36). Pond was also the first of the Europeans to take trade goods into the Athabasca region over Methy Portage (Palmer 1990:12) and was the first European to see the oil sands outcrops. Approximately eight years later Pond and his associates built another post at the mouth of the Clearwater and the Athabasca River. In 1788 the North West Company built Fort Chipweyan on Lake Athabasca, which became their central post in the Athabasca region.

Alexander Mackenzie used some of the fur trade posts in the region as staging points in his efforts to find a river that flowed west to the Pacific Ocean. In 1789, just one year after the post had been built, Mackenzie left Fort Chipweyan and traveled north along the Mackenzie River to the Arctic Ocean. Later, in 1792, after spending time in England to learn more about the sciences of astronomy and navigation, he set out to establish Fort Fork on the Peace River (Russell 1991:31). During this time Mackenzie described the oil sands outcrops along the Athabasca River. Mackenzie left the west permanently after spending the winter of 1793 on Lake Athabasca, seven years after his arrival in the Athabasca region (Russell 1991:31).

Four posts were established at the confluence of the Clearwater and the Athabasca rivers between 1788 and 1821 (Chalmers 1974). Other posts in the region include an unnamed post constructed at Fort Creek by John Clark (1802), Pierre au Calumet's North West Company post also at Fort Creek (1819-1821), Beren's Hudson Bay Company's House at Fort Creek (1819-1821) which was later moved to the mouth of the MacKay River, and St. Germaine's House (after 1788-1802) (Chalmers 1974). The last of the posts was shut down in 1821. In 1870, however, the region was given another chance when Henry Moberly built Fort McMurray for the Hudson's Bay Company (Palmer 1990:144). The Hudson's Bay Company, again discouraged by the lack of trading, moved north in 1898 to establish Fort McKay. Several independent traders kept Fort McMurray alive until the arrival of the Alberta and Great Waterways Railway in the early 1920's, an event which eliminated the problem of bringing furs past the rapids on the Athabasca River (Palmer 1990:144-145). The presence of the railway also opened up the Athabasca region for oil and mineral exploration.

Based on early journal reports of the presence of in-situ oil sands in the region, geological exploration began in the 1880s. Robert Bell of the Geological and Natural Survey of Canada examined the area in detail in 1882, recognized the Lower Cretaceous age of the oil sands strata and proposed a Devonian origin for the bitumen (Carrigy 1974b). He also suggested that a hot water extraction method might be feasible and that a pipeline to Hudson Bay might be able to deliver the oil for shipment to overseas markets. In 1888, R. G. McConnell of the same organization, provided the first estimates of the extent of the resource at not less than 4.2 million tons (Carrigy 1974b). In 1906, Count Alfred Von Hammerstein drilled the first well in the region, situated on Tar Island. Another of his early wells, located at the mouth of the Horse River, produced salt, which became an important economic feature of the region beginning in the 1920's. Von Hammerstein was also an early partner in the Athabaska Oil and Asphalt Company which also drilled several wells in the area. Later, in 1913, Sydney Ells, with the Mine Branch in Ottawa, began a detailed survey of the oil sands exposures and by 1915 was able to lay demonstration pavement of this material in Edmonton (Carrigy 1974b).

In 1920, Mr. D. Diver made the first attempt at in-situ production by lowering a heating unit to the bottom of a well near Fort McMurray. During the 1920s, K. A. Clarke and S. M. Blair of the University of Alberta erected hot water pilot extraction plants, first at the University and later at the Dunvegan Railway yards in Edmonton. In 1927, R. C. Fitzsimmons formed the first commercial venture to develop oil sands, the International Bitumen Company, and established a plant at Bitumount, which by 1930, produced 8,400 gallons of bitumen (Carrigy 1974b). After K. A. Clarke was awarded the patent for his hot water process in 1928, the Research Council of Alberta erected a pilot extraction plant along the Clearwater River near Waterways in 1930. By 1936, The Abasand Oil Company formed by Max Bell completed construction of a 400 ton per day extraction plant on the Horse River. This plant was destroyed by fire in 1941. Through the latter part of the war, the Canadian government undertook a drilling and coring program intended to outline reserves for emergency use, culminating in discovery of the rich Tar Island deposit now being exploited by Suncor (Carrigy 1974b).

On the basis of a 1950 report indicating that large scale economic development of the oil sands was feasible, the Government of Alberta began issuing the first permits to oil companies in 1951 (Carrigy 1974b). In 1954, Great Canadian Oil Sands was formed to take over the interests of Oil Sands Ltd., the descendant of the International Bitumen Company. In 1957, the Shell Oil Company of Canada began in-situ steam driven experiments on Lease 26. In 1959, other pilot projects and commercial proposals were initiated by companies such as: Cities Service Athabasca Inc., Pan American Petroleum, and Atlantic Richfield (who proposed explosion of a nuclear device beneath the oil sands). In 1960, Great Canadian Oil Sands Ltd. (GCOS) applied for permission to construct a 31,500 bbl/day plant at Tar Island. Approval for the GCOS project was granted in 1962. Also in 1962, Shell Oil Company of Canada applied for approval of a 130,000 bbl/day operation using an in-situ steam drive process. In 1964, a consortium of companies including Atlantic Richfield, Cities Service, Imperial Oil and Gulf Oil formed the Syncrude consortium, which received approval to build its Mildred Lake plant in 1972 (Carrigy 1974b). In 1967, the GCOS (now Suncor Energy Inc., Oil Sands) plant went on stream. In 1978, the Syncrude plant began production.

6. HERITAGE RESOURCE MANAGEMENT

The following section is provided as a means of familiarizing the reader with the variety of archaeological and historic site types found in northern Alberta. This may be of value as background material for the discussion of previous archaeological research in the study area, as well as for the sites recorded during this study.

6.1 PREHISTORIC SITE TYPES

A site is any place, large or small, where traces of past human occupation or activity are found. Sites are most often identified by the presence of artifacts. Several types of prehistoric sites are possible in northern Alberta. These site types are described briefly below.

6.1.1 Habitation Sites

A habitation site is defined very generally as the locus around which a group of people centred at least some part of their daily activities. Habitation sites can be divided as discussed below. The size of habitation sites is generally related to the number of people and the duration of the occupation at the site. Prior to European contact in the region there were no permanent habitation sites although some locations would have been re-occupied on a regular basis.

6.1.1.1 Base Camps

These sites are assumed to be relatively permanent habitations, occupied either seasonally, or in some cases throughout the year. These sites contain a large amount of cultural material scattered over a large area. Base camps typically exhibit the most diverse assemblage of archaeological artifacts which may include faunal, lithic and ceramic materials. Often they are marked by evidence of structural remains and fires. These sites are usually located in the most favourable locations in a given area.

6.1.1.2 Transitory Camps

These camps are similar to the above, but were occupied for shorter periods of time. These sites may indicate stop-overs for people moving through an area, or simply short term campsites where a specific resource was utilized until it was depleted. These sites may also be marked by signs of dwellings and fire, but differ from base camps in that cultural remains are sparsely scattered.

6.1.1.3 Hunting Camps

These camps served as a base for hunting parties and are usually transitory in nature, probably being used for no more than several days. These sites have few artifacts, although evidence of dwellings and fires may be present. These sites are frequently marked by the presence of primarily male-associated artifacts (e.g., projectile points).

6.1.1.4 Fishing Camps

As the name implies, the primary function of these sites was as home camps when utilizing fish resources. These sites are close to good sources of fish and are marked by artifacts associated with fishing (e.g., leisters, harpoons, fishknives, net weights). These sites are often located adjacent to spawning grounds and shallow or narrow sections of small rivers and streams. Sites that exhibit good preservation of organic materials contain large numbers of aquatic faunal material. Again, these sites may contain evidence of dwellings, fires and tool making.

6.1.2 Kill Sites and Processing Sites

A kill site is a location where one or more animals were killed, whereas a processing station is where the animals were butchered. These site types may be associated or discrete. Due to the solitary nature of most of the large game animals, the majority of kill sites located in northern Alberta are isolated. Kill sites and processing sites are often associated with hunting habitation sites where the meat would be taken for further processing and consumption.

6.1.3 Tool Manufacturing Sites

These types of sites provide information on lithic technology and, in many cases, on cultural affiliation. These sites are separated into two basic types.

6.1.3.1 Quarry Sites

A quarry site is where large quantities of raw lithic material were mined for later use as tools. These sites are found at the source of the raw material and are usually marked by large quantities of roughly worked stone with little or no other associated cultural material. In the regional study area, outcrops of Beaver River Sandstone are of particular significance.

6.1.3.2 Lithic Workshops

These sites are found at locations generally removed from the source of the raw material. The function of these sites was to further refine the raw material obtained from the quarry into more useable forms. Artifacts consist of the manufacturing process wastage, which is often relatively concentrated. Finished or partially finished tools may also be found.

6.1.4 Ceremonial Sites

Ceremonial sites played some role in the religious or philosophical life of the local people. Again, ceremonial sites can be further subdivided.

6.1.4.1 Rock Cairns

Rock cairns are usually located in prominent locales such as the tops of hills. They may have served a ceremonial function or may mark a burial site. These cairns may also have served as route markers or simply meat caches.

6.1.4.2 Rock Alignments

These consist of a linear or representational configurations of stones or cobbles, which may range from simple to complex in design.

6.1.4.3 Pictographs

These sites consist of rock paintings, usually with little or no associated cultural material. They may be found on glacial erratics, rock faces and cave walls. Most of the pictographs of northern Alberta are deep red in colour.

6.1.4.4 Petroglyphs

These sites consist of carvings in rock and are similar to pictographs. Little or no cultural material is associated with petroglyph sites.

6.1.4.5 Spirit Quest Sites

These sites are very difficult to find archaeologically since often only the most negligible traces of human use are present. These sites, which are found in isolated localities such as hilltops and high cliffs or peaks, served as a place for prayer and meditation.

6.1.4.6 Burial Sites

Burial sites are marked by the presence of human remains often associated with grave goods such as pottery or personal tools. They may be marked by cairns or depressions, or may be unmarked. Burial sites can be multiple (associated with a village) or isolated.

6.1.5 Transportation Sites

Transportation sites are related directly or indirectly to the movement of the populations throughout the local environment. These include such sites as trails and portages. These sites are often difficult to identify archaeologically as little to no cultural material is left behind as evidence of the site. These sites, however, have the potential for extremely long periods of use, some extending to the present. Portage sites, depending on the length and difficulty of the route, may have transitory habitation and/or fishing camp sites at one or both ends of the portage. Portage sites are most likely to be utilized in the spring through the fall, although winter occupations of the area may also occur.

6.1.6 Miscellaneous

Some sites are difficult to classify and are described below.

6.1.6.1 Lookout Sites

These sites are found in areas where a good view of the surrounding country can be obtained. They probably served as lookouts for game or human activity. There may be evidence of tool making, fires and occasionally temporary shelters.

6.1.6.2 Isolated Finds

These are sites where a very limited scatter of cultural debris is found, often only individual artifacts and may represent places where tools were secondarily deposited by natural forces such as water.

6.1.6.3 Culturally Modified Trees

Culturally modified trees have been described and systematized by the British Columbia government, who use the term almost exclusively in reference to trees that have been altered by native people as part of their traditional use of the forest (BC Ministry of Forests; Vancouver Region 1997). Numerous classes or types of CMTs have been established, many of which are applicable to coastal areas of BC and the northern United States. Some forms of CMTs may be found in northern Alberta including those exhibiting bark-strip scars, arborglyphs, delimbed trees and blazed trees.

6.1.6.4 Unknown

Often small sites are found whose function cannot be determined on the basis of the archaeological evidence.

6.2 HISTORIC SITE TYPES

Historic sites are those which relate to Historic period beginning roughly 200 years ago. Many of the historic site types which occur in northeastern Alberta overlap with those described in the prehistoric section above. These include habitation sites, kill sites and processing sites, cairns, petroglyphs, burial sites, culturally modified trees, transportation sites and miscellaneous sites. These sites are differentiated from prehistoric sites by the presence of the artifacts and features of the appropriate age. Some site types are unique to the historic period. These include: oil well sites, railways, roads, lookout towers, churches, schools, fur trade posts and communications related sites. These sites have been categorized by function for reference to this region of the province. This scheme is based in part on the categories of historic artifacts established for the Canadian Parks Service classification system for historical collections (Environment Canada, Parks Service 1992). Classification of Historic period sites based on time depth is not feasible in this study, nor is an economic or cultural based structure. The following does not presume to be a complete list, but is an overview of sites which may be present and significant in the region.

6.2.1 Commercial Sites

Commercial sites include those sites which are predominantly associated with the economics of the region. These sites primarily comprise fur trade posts in this region, although other structures and sites relating to historic financial institutions/banks, stores or commercial fishing operations and some other land and resource development sites may also be included.

6.2.1.1 Fur Trade Posts

Fur trade posts are present throughout the Canadian Boreal Forest. Several firms including the Hudson's Bay Company and the North West Company as well as a number of independent traders constructed posts throughout the HRRSA. A fierce competition raged between the Hudson's Bay Company and the North West Company for the trade in the Athabasca region prior to their merger. Due to the large amount and high quality of the furs in the region it came to be known as the El Dorado of the fur trade.

6.2.2 Industrial Sites

Industrial sites include those locales relating to mechanized activities such as mining, forestry, gas production and distribution. These sites vary widely in size and complexity, from small well site locations to large mining complexes. The site of Bitumount, located approximately 42 kilometres north of the LSA, is an excellent example of a large industrial site. Several historic oil exploration well locations are also recorded throughout the HRRSA.

6.2.3 Distribution and Transportation Sites

Certain types of transportation site are difficult to discern from prehistoric counterparts such as trails and portages. Others are easily differentiated. Sites unique to the Historic period include those relating to train, automobile, steam and gasoline powered boats and air travel.

6.2.3.1 Land Transportation Sites

Automobile sites include early roads, gas stations, automobile bridges and so forth. Roadway construction has changed greatly over the last few decades. Differing construction techniques identified with roads and bridges may identify the age and building strategies of the feature.

6.2.3.2 Railway Transportation Sites

These sites include both railway lines and associated bridges, right-of-ways and junctions as well as stations and associated out buildings. These sites vary in age and can cover extensive linear distances. Railway sites may date as early as the early 1920's when the Alberta and Great Waterways Railway arrived in the region. As none of these railway lines were constructed within the LSA, no sites of this type were expected during the field portion of the HRIA.

6.2.3.3 Water Transportation Sites

Steamer ships began to appear along the Athabasca River in the early 1880's, shortly after the completion of the Canadian Pacific Railway through the Plains and Parkland regions of the province. The Hudson's Bay Company found it far easier to ship its supplies and wares via scow and steamer from Athabasca Landing rather than the traditional route along the Clearwater River (Potyondi 1979:65).

6.2.4 Religious and Education Sites

Historic schools, mission sites and churches are a few of the religious and education related sites which are potentially present in the region. Three sites of this nature are currently recorded in the HRRSA. All three are historic missions located near Fort McKay and Fort McMurray.

6.2.5 Military and Government Sites

Government and Military or Police related sites include those sites related to administering and regulating the resources and people of the region as well as regional law enforcement. Several sites of this nature are located within the region. These vary in age, some of which predate the turn of the century.

6.2.5.1 Mounted Police Sites

One NWMP and one RNWMP posts are on record at the Historic Sites Service in Edmonton. These sites are both located in Fort McMurray.

6.2.5.2 Resource Management Sites

The history of northeastern Alberta is closely associated with the local and regional resource base. In order to maintain and manage these resources the federal and provincial governments needed to be located in the region. Several sites of this nature are present in the HRRSA. Two lookout towers are currently on record at the Historic Sites Service as well as two other forest service buildings in Fort McMurray.

6.2.6 Miscellaneous

6.2.6.1 Culturally Modified Trees

The term culturally modified tree is typically used to describe trees that have been altered by native people as part of their traditional use of the forest but alterations by other groups may occur as well. These may include alterations such as blazes, used to mark trails, rights-of-way or cutlines. Other culturally modified trees are best categorized under commercial or other categories such as arborglyphs and markers for mining claims and property lines. However the trees are categorized it must be noted that in themselves the historic culturally modified tree may not always be significant but they often relate to larger more complex sites or events.

6.3 PALAEONTOLOGICAL SITE TYPES

Palaeontological sites vary widely in age and size. Palaeontological resources are defined by the Alberta Historical Resources Act (1987) as "...a work of nature consisting of or containing evidence of extinct multicellular beings and includes those works of nature or classes of works of nature designated by the regulations as palaeontological resources".

As the Athabasca River is incised into several ages of fossil bearing strata, it has been well documented that aquatic palaeontological materials are present in the area. The two formations that are of interest to this assessment are the Cretaceous McMurray Formation and the Devonian Waterways Formation. The McMurray Formation, while not especially rich in fossils, is reported to contain molluscs, agglutinated foraminifera, fish teeth, spores and pollen grains (Carrigy 1974a). The more significant fossils are those of the Waterways Formation, situated stratigraphically below the McMurray Formation.

6.4 MITIGATION ALTERNATIVES

Various mitigation options can be employed to protect heritage resource sites from development impacts. The mitigation strategy chosen depends on several factors, particularly the type and significance of the site and the type of development. The available options are briefly detailed below.

6.4.1 Avoidance

Avoidance of heritage resource sites is the most effective mitigative alternative. Avoidance applies to all phases of construction from preliminary geological testing through to backfilling, revegetation or landscaping. Avoidance of heritage resources can be considered for those sites that exhibit significance.

In the event that avoidance of heritage resources is not a viable option, other mitigation techniques are available. These techniques are designed to salvage information from sites that would otherwise be irretrievably lost as a consequence of development.

6.4.2 Mapping

Mapping is a desirable form of mitigation where prehistoric rock feature sites or historic sites are involved. Mapping can more clearly define the type of site, its lateral extent, its position in the context of the development and where features are poorly defined (in a perceptual sense), to reveal the exact configuration. The need for subsequent mitigation phases, such as complete or partial avoidance or test excavation, can be clarified through detailed mapping.

6.4.3 Test Excavation

Test excavation involves small scale excavation in a controlled manner with screening of back dirt. The purpose of a test excavation is to evaluate sites determined, on the basis of surface indicators or shovel testing, to be of such significance that further investigation is warranted. These investigations may be required to explore cultural material concentration/density; site boundaries; chronological/cultural affiliation; vertical extent/number of components; and potential for further excavation (i.e., site significance, sampling procedures, cost/benefit evaluation).

6.4.4 Systematic Collection

In sites where a large quantity of cultural material is present on the surface either through natural or man-made exposures, systematic surface collection is a form of mitigation that seeks to establish provenience for this material or to enable its collection in a controlled, unbiased manner. A procedure is required that accurately records provenience for all artifacts collected, allows for delineation of material distribution and density and ensures that no significant areas escape collection. Both quantitative and qualitative statistical data can be derived from this approach.

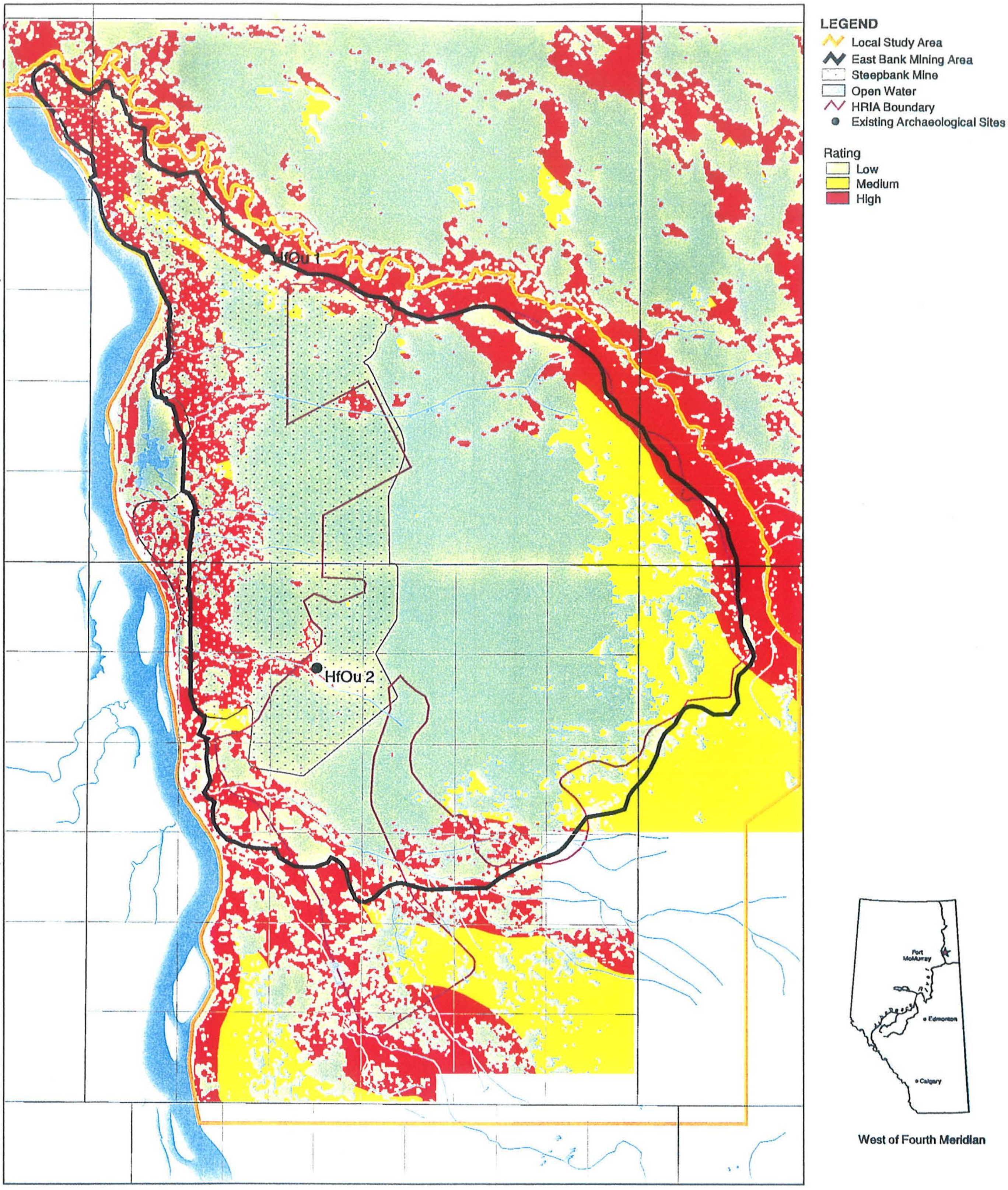
6.4.5 Salvage Excavation

Salvage excavation is the final mitigation alternative. It is reserved for sites exhibiting exceptional potential for scientific investigation and is only recommended when no other alternative is feasible.

7. METHODOLOGY

At the onset of the Historical Resources Impact Assessment, a search was completed of prehistoric and historic site files maintained by the Archaeological Survey and Historic Sites and Archives Services in Edmonton. Copies of the site forms for all previously recorded sites within the regional study area were obtained and the relevant data regarding topographic features and environmental criteria tabularized. The preliminary background research for the development of the sampling strategy included a review of all previous archaeological investigations completed in the region. Subsequently, 1:50,000 topographic maps, air photographs and 1:10,000 pedological and muskeg distribution maps were examined to complete a preliminary rating of archaeological sensitivity for the study area. Well drained areas such as knobs, ridges, escarpments, shorelines, benches, terraces and banks were identified. Once these initial data were accumulated, a stratified archaeological site potential map was produced utilizing a GIS system. This stratification of the prehistorical potential within the project area was designed so as to focus field investigations within areas exhibiting high and moderate potential for historical resources (Figure 5).

As detailed below in Section 7.2.1, the model of potential constructed prior to the field component utilized only vegetation communities and proximity to water as parameters to graphically represent the historical resource potential of the area in map form. It was subsequently shown, during the field program, that the relatively elementary nature of the model had over estimated the amount of high and moderate potential areas within the HRIA study area. The levels of potential were, therefore, revised during the field component in an effort to concentrate field investigations in areas that had the highest probability for containing historical resources.



/data14/suncor/local/9840/arcview/site_potential.apr

1000 0 1000 2000 3000
Metres
Scale 1:100,000

SOURCES: Suncor
Golder
Klohn-Crippen

Based on vegetation and hydrology

Map Projection: UTM 12
Datum: NAD 83

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PRELIMINARY
LOCAL STUDY AREA
HISTORICAL RESOURCE
SITE POTENTIAL

27 Aug. 1998	Figure 5	PRODUCED BY: JS REVIEWED BY:

7.1 Site File Search

The site file search completed at the Provincial Museum of Alberta prior to initiation of the rest of the program showed, as expected, the presence of only two archaeological sites, HfOu 1 and 2 in the LSA. These sites were recorded in 1995 by Golder Associates Ltd., during the HRIA for the Steepbank Mine Project (Balcom et al. 1996). Both sites were isolated lithic find locations that were assessed to be of limited scientific and cultural value. Site HfOu 1 is situated on the terrace above the Steepbank River, while HfOu 2 is situated beside a small slough along Leggett Creek. No further work was recommended at either site. The geographic location of these sites, situated well off of the Athabasca River, were noted in relation to the potential for further sites to be identified in the Project Millennium area.

Five well locations are also on record at the Historic Sites Service. These include four wells drilled in the early 1900's by Count Alfred Von Hammerstein and one well drilled in 1908-09 by the Athabaska Oil & Asphalt Company. Record forms for these sites are scant and hold little information regarding the condition, or presence of these sites. The forms appear to have been filled in without the benefit of field assessments to verify the presence or absence of physical features or related artifacts. Two of these sites, HS 44046 and HS 44047, lie within the Steepbank Mine. A third site, HS 44045, may be present in the Steepbank Mine area although site information is unclear as to whether the site is located on the east or west side of the Athabasca River. The Steepbank Mine HRIA identified no physical trace of these sites. One site, HS 44043, is located within the Millennium footprint in. LSD 14-10-91-09-W4M. The location of the remaining site, HS 44044 (Athabaska Oil & Asphalt Co.) is less clear. It is located within the LSA, but due to incomplete site information, it was not possible to determine if the location will be impacted by the Project Millennium mine. The locational information on the form indicates that the site is situated in the southern half of Section 20-91-09-W4M. Only a small portion of this area lies within the Project Millennium HRIA study area, although it is almost entirely within the LSA.

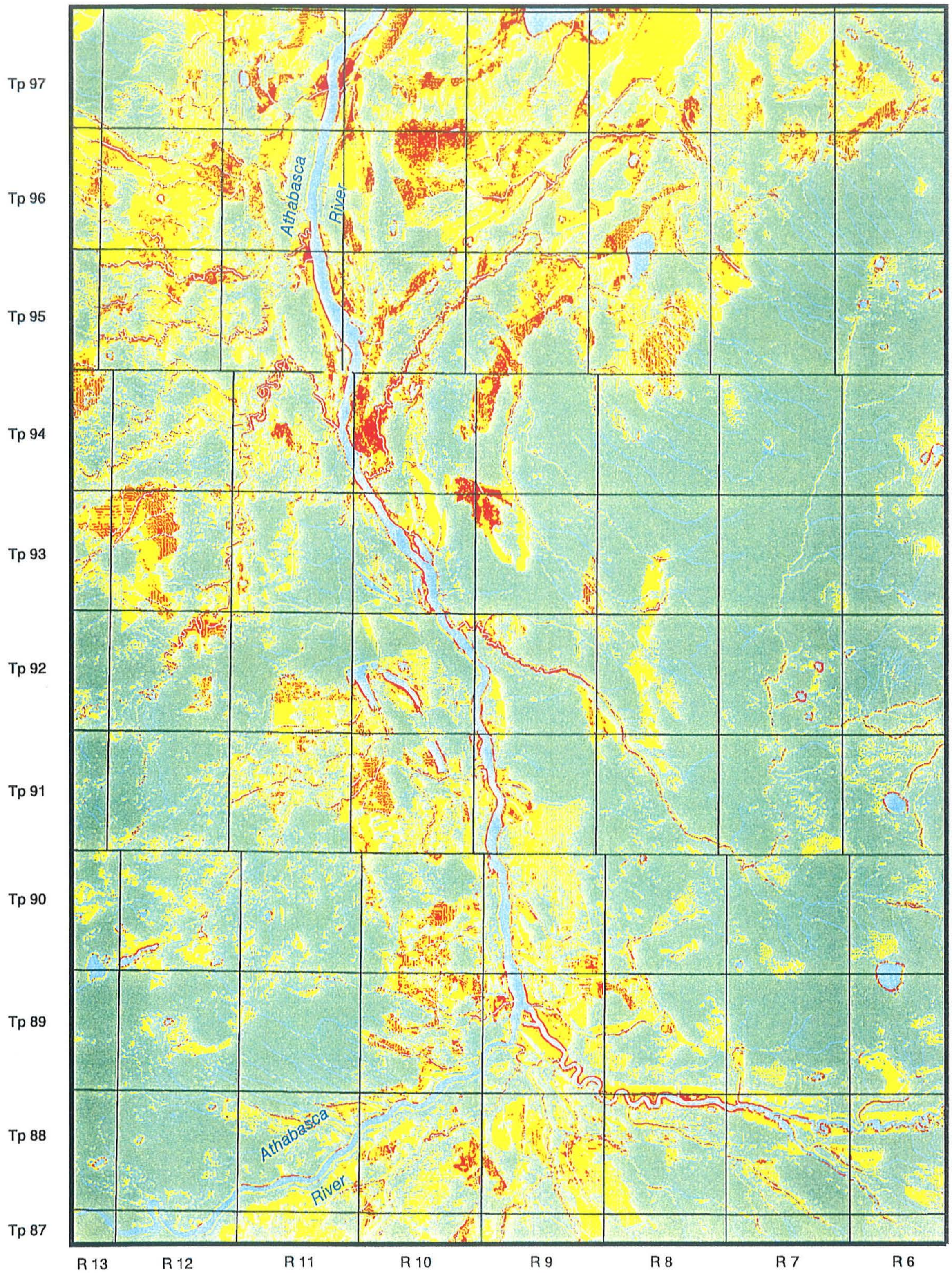
Extremely little ground disturbance is assumed for these sites. Due to the exploratory nature of these wells, the lack of an adequate transportation support network and the fact that they would have been drilled in winter, it is probable that the wells may not have even disturbed much vegetation. The well sites, other than a potential vertical pipe, may contain very few clues as to their existence. However, regeneration of the vegetation during the intervening 90 plus years would have rendered these sites almost impossible to identify.

The Fort McKay First Nations conducted a survey of the community Elders and established a preliminary traditional land use database for the region as part of the Steepbank Mine EIA (Fort McKay 1996a). The results of the survey, which compiled information regarding the traditional trails and cabins, spiritual (grave) and historical sites, fur bearers, big game, fish, birds, berries, trees and plants, place names and traplines, were reproduced in map form. The database was established as an initial listing of the major plant and animal species that have traditionally played important roles in the lives of the aboriginal people.

During the course of these investigations, portions of three trails were identified as crossing through what is now the Project Millennium development area. These trails are principally located along the Unnamed, Leggett and Wood creeks. Numerous beaver lodges, beaver lodges with caches and inactive beaver lodges were identified throughout the Project Millennium HRIA study boundaries.

7.2 Predictive Model for Sites

Two separate predictive models were produced in conjunction with Project Millennium. The first model was produced prior to the field assessment as a means to focus field time on areas that held the greatest potential for yielding historical resource sites (Figure 5). The second model was created in an attempt to quantify and graphically illustrate the potential cumulative effects of the oil sands projects and other regional developments currently in production, as well as those currently proposed for development. This model was completed to reflect the historical resource potential of the HRRSA (Figure 6).



West of Fourth Meridian

Scale 1 : 500,000

5 0 5 10 15

Kilometres

Map Projection: UTM 12 Datum: NAD 83

LEGEND

Historical Resources Regional Study Area

Open Water

HISTORICAL RESOURCE POTENTIAL

Low

Moderate

High

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N

HISTORICAL RESOURCES
REGIONAL STUDY AREA POTENTIAL MAP

SOURCE: Golder

03 Sept. 1998	Figure 6	PRODUCED BY: M.K. REVIEWED BY:

7.2.1 Local Study Area Model

The HRIA field assessment map was based primarily on vegetation communities, with open water as a secondary component. Potential was ranked as high, moderate or low depending on the proximity to water and the vegetation community present.

In producing the maps of the LSA for the field component, several factors were excluded from consideration to keep the mapping process simple and because data on several were not available at the time. Factors such as soils, slope, aspect and elevation were not included. These were not viewed as a detriment to the utility of the map as it is focused on a geographical area with limited differentiation in these respects. Without specific knowledge of the character of the study area, a number of potential limitations of the model employed in this study have been identified:

- not enough site location information was available for inclusion;
- no attempt to rank the importance of the water bodies was made;
- flowing and standing water were not differentiated;
- vertical distance to the water was not assessed; and
- slope, aspect and soils information were not used as a variables.

Due to the small number of sites identified in the LSA, no representative information regarding their environmental setting was available for use in modelling. However, the two identified prehistoric site locations in the project area are situated in well drained terrain along the margins of active water courses, both factors that were accommodated in the variables selected to structure the potential model. Archaeological inventories conducted elsewhere in the region (e.g., Ronaghan 1981b, McCullough et al. 1982) have demonstrated a correlation between elevated terrain features and sites, with proximity to flowing or standing waterbodies attractions that serve to increase their frequency, but not to limit their distribution. Factors such as aspect appear to have little bearing on known distributions. Furthermore, there is no way to confirm whether environmental associations of the historic sites would have any predictive value with regard to locations selected for exploration programs that were probably completed under winter conditions.

Most of the flowing water within the Project Millennium HRIA boundaries is comprised of creeks, such as Wood and McLean creeks, which are small sized waterways in this region. Potentially habitable locations in proximity to these streams were accounted for by the high and moderate rankings incorporated in the model (Figure 5). Smaller drainages identified within the study area are simply highly localized collectors for the considerable amounts of near surface water held in the muskegs and bogs that characterize most of the terrain within the study area. An example of this situation can be seen along the most northerly drainage in the study area where few areas of potential were identified (Figure 5). Here, so few drained landforms (as reflected in the vegetation communities they support) were present that limited archaeological potential was evident along its course.

The project is also in close proximity to the Steepbank and Athabasca rivers, which are much more significant watercourses. As the project area is already somewhat removed from these watercourses and their valley rims and terraces, areas where archaeological potential would be considered very high, it was decided there was no logical reason to rank areas somewhat removed these features within the study area higher than those in direct proximity to the active streams within the area.

Standing water was also not an issue within Project Millennium as there are no lakes of any magnitude. Most of the standing water in the area is comprised of seasonal and permanent bogs. These bogs are so numerous and the terrain surrounding them so indistinct that modelling their potential as anything but low was viewed as unreasonable. Vertical distance to water was not included in the model due to difficulties incorporating it efficiently into the model, and because it was felt that variation in this respect may not be meaningful given the setbacks from major drainage systems present in the study area. Microtopographic variation in elevation was incorporated indirectly in the model by the use of vegetation communities as a determining factor. In this area, small variations in elevation are directly reflected in drainage characteristics and vegetation communities supported. For example, elevations in the order of 0.5 to 1m above surrounding water saturated terrain results in better drained soils and mixedwood vegetation associations rather than shrubby bog associations.

Slope, aspect and soils information were not directly incorporated in the model. Aside from the gentle slopes leading to the major river valleys, the study area demonstrates exceedingly limited variation in his regard. Detailed soils information for the study area was not available prior to the field portion of the program, but as indicated above, the vegetation communities present provides an excellent reflection of the variation in soils present in the areas. Both the soils and vegetation are directly linked to elevation and drainage. On a relatively level plain, aspect is considered to have limited predictive capability. As well, the known sites in the adjacent Steepbank Mine project area indicate that various facing locations had been selected in the past.

The predictive modelling completed in advance of the field investigations resulted in the study area being subdivided into areas of high, moderate and low potential for historical resources. Approximately 10% of the total HRIA study area was classified as being of high potential for historical resources (Table 3). A further 13.5% of the total area was considered to be moderate potential and 75.7% was considered to be of low potential. These rankings represent the relative potential for historical resources present at a given location within the LSA. The terms "high, moderate and low potential" were used to illustrate the areas that hold a greater or lesser probability of containing historical resources within the study area, and do not necessarily reflect any perceived or documented past land use patterns. Nor do they necessarily compare with other leases in the oil sands region , such as Lease 13 (Muskeg River Mine), 10, 12 and 34 (Aurora North). These terms are simply used to identify which regions have an increased level of potential above other regions in the LSA. Observations made during the course of the field work prompted these areas to be revised (Figure 7, Table 3).

Table 3 Combined Size of the High, Moderate and Low Potential Areas in the HRIA Assessment Boundaries

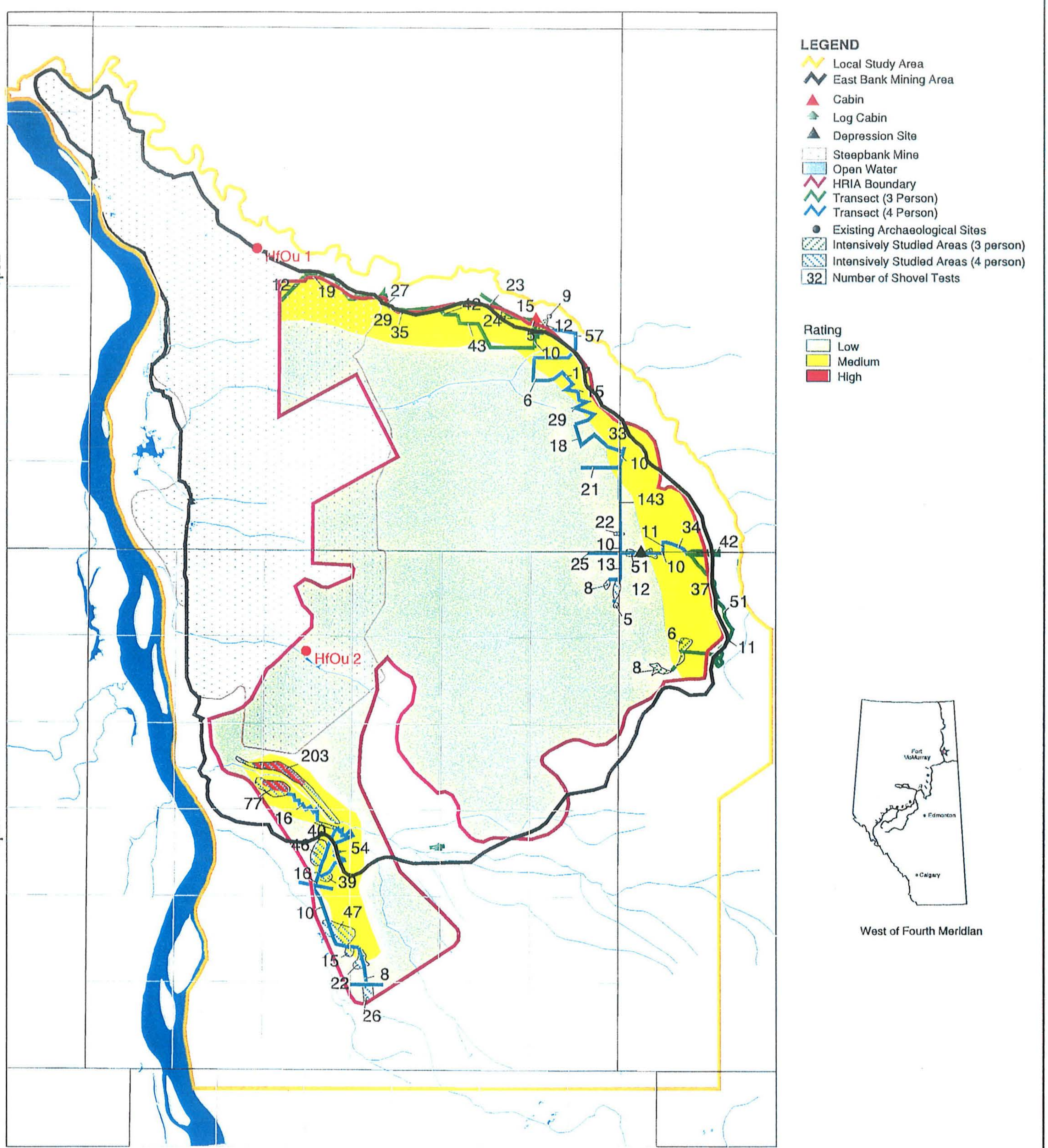
Potential Rating	Area in Hectares		Area in Acres		Total Area in Percent	
	predicted	revised	predicted	revised	predicted	revised
type "0.0" (low)	4,919.7	5278.0	12,151.7	13,036.66	75.7%	81.24%
type "0.5" (moderate)	876.9	1196.3	2,166.0	2,954.12	13.5%	18.42%
type "1.0" (high)	664.1	22.0	1,640.4	54.34	10.2%	.34%
unclassified	35.5	0.0	87.7	0.0	0.6%	0.0%
TOTAL SIZE	**6,496.3**	**6,496.3**	**16,045.8**	**16,045.8**	**100%**	**100%**

In summary, the model was considered adequate as a broad-brush approach to the historical resource potential of the study area and was used as a basis for structuring the field program implemented for the Project Millennium development area. Daily travel to and from the project area was by helicopter. This, coupled with several preliminary overflights, permitted numerous opportunities to reconsider the potential assignments made in the pre-field and modelling stage. Reconfiguration of this model was necessary as the value of 10% for "high" potential greatly exaggerated the true historical resource potential of the region. Due to the overall characteristics of the study area, an estimate of 1% of the study area would have provided a more accurate reflection of high potential within the study area. The probability for the presence and identification of historical resources in the study area is, for the most part, low. The LSA map of historical resource potential was revised based on field operations to more accurately depict the actual potential. Figure 7 represents this revised potential.

7.2.2 Historical Resources Regional Study Area Model

A second predictive model was constructed in an effort to quantify and document the cumulative effects of the oil sands mining operations which are currently in production or in the process of obtaining approval. This model incorporated the entire HRRSA and was more detailed in scope than the field model. As the model was required to address the potential of a larger area, more factors were introduced in an attempt to accommodate the greater regional landscape variation and to determine whether a terrain based model could accurately predict the potential of the region.

Factors considered in constructing the model included slope, aspect, elevation, soils, vegetation, proximity to standing water, proximity to flowing water and a buffer placed around known historic fort locations. Each of these categories was first developed into a separate GIS map layer. Each of the variables within the major categories were then ranked independently as to their importance with respect to site location (Appendix II). These were classified on a scale of zero to ten, using even integers as increments, with ten being the most important and zero having no or practically no importance.



SOURCES: Suncor
Golder
Klohn-Crippen

Based on vegetation and hydrology

Map Projection: UTM 12
Datum: NAD 83

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MODIFIED LOCAL STUDY AREA MAP OF HISTORICAL RESOURCE POTENTIAL

27 Aug. 1998 | Figure 7 | PRODUCED BY: K.K.Q. REVIEWED BY:

It is acknowledged that the map layers used for the model are not equal in importance with respect to their association with site distribution. Factors such as the proximity to water are typically regarded as more important than others, including aspect and slope. Because of this, the categories have been given differential weighting to further increase the perceived accuracy of the model as a reflection of past activities throughout the landscape. This was based on a scale of one to three. A value of one represented low ranking categories, two was used for moderate and three represented highly significant categories. The map layers for proximity to standing water and to flowing water were weighted as a three. Soils, vegetation and historic fort locations were weighted as two and aspect, slope and elevation were weighted as one. The weighting of map layers has been used successfully in previous modelling projects throughout the Boreal Forest (i.e. Dalla Bona 1994, 1995; Balcom et al. 1996; Ronaghan 1997; Mason 1998; Bailey 1998a, 1998b).

After each of the separate map sheets were created and the variables on each sheet ranked, all of the data were compiled onto one map. This map illustrates a gradation of potential based on the sum of all of the variables from each of the seven map layers. The sums for the HRRSA model ranged up to and including 116. Scores were then normalized into three blocks of potential, where the sums representing low potential ranged from zero to 38, moderate ranged from 39 to 77 and high ranged from 78 to 116. This map was then plotted to illustrate the combined potential for historical resources.

When these areas were calculated, however, it was noted that low potential areas accounted for approximately 71% of the area, moderate potential for 28% and high potential accounted for slightly less than one percent of the total area. This is clearly not an accurate representation of archaeological potential throughout the area. Consequently, it was determined that the upper five percent of the sums would be used to represent the high potential regions of the area. This was accomplished by including the upper four percent of the moderate potential in the range of data depicted as high potential on the map. No adjustments were made to the ranking or weighting schemes and no computer manipulations were performed.

The resulting map (Figure 6) illustrates the potential for historical resources graphically, throughout the HRRSA. The areas identified by the model as high potential were arbitrarily set to represent the highest 5.7% of the landscape. The moderate and low potential encompass 23.4 and 70.8% of the HRRSA respectively.

Several data limitations could not be rectified and incorporated prior to the completion of the model. Many of these limitations are not exclusive to this model, but are problematic for all predictive models relating to historic and prehistoric land use in Canada. These limitations include an incomplete and highly speculative understanding of the seasonal movements of the people of this area prior to approximately A.D. 1700. Before the fur traders arrival in the area only a scant amount of second hand information was recorded regarding the people of the area and their day-to-day lives.

Other limitations include the large scale at which the information was synthesized. Due to the large scale of the map, some small features will naturally be obscured. Slope is a good example of a category in which valuable information has been limited. Similarly, because of the large scale of the map, differences in elevation, which may be significant to site location decision making, are not recognized at this scale.

This type of limitation must be expected in the production of large scale models. However, it is unlikely that this these would significantly affect the predictive abilities of the regional map. As the purpose of the map is to delineate the potential of the region, minor fluctuations, that are not perceived by the mapping process may not have been overly influential in location decisions on a regional scale.

One factor that affects portions of the map is the placement of existing disturbances throughout the HRRSA. These areas appeared on some of the map layers as a lack of information and were ranked as zero. This is reflected in the potential estimates for archaeological and historic period sites. Many of these areas likely possessed higher potential than currently illustrated prior to the developments. For example, the Syncrude Mildred Lake and Lease 86/17 areas are identified as low potential, but much of this area would likely rank as moderate to high if all of the criteria were available. The sites identified along the Beaver River attest to the previous potential of the region.

Previous HRIA's within the HRRSA as well as other research, such as Fenton and Ives (1990) work regarding potential outcrop locations for Beaver River Sandstone, have noted that the Project Millennium LSA has a low probability for exhibiting such outcrops. The soil accumulation is much greater in the Project Millennium area than in the areas further north, further decreasing the likelihood that any usable stone sources would be identified in the Project Millennium development area.

7.3 Field Component

Based on helicopter overflights and daily ground truthing, it was determined that the Local Study Area map of historical resources potential exaggerated the amount of high and moderate potential actually present in the study area. The areas of potential, as determined by observations made during the field program, are presented in Figure 7. All areas deemed to be of high potential for historical resources were examined during the field component of the Project Millennium HRIA program. One area situated outside of the HRIA study area boundaries, along the shore of the Athabasca River, was also examined when possible palaeontological remains were reported. A significant amount of the moderate potential areas were also examined. Areas of low potential received little ground truthing, but numerous helicopter overflights were completed in order to rule out the possibility of small terrain features which could serve as "islands of potential" within these zones of low potential. In addition, some foot traverses were completed within selected portions of the identified low potential areas to confirm that they did not contain significant sites (Figure 7).

As stated in the permit application pedestrian transects were most intensive within those areas considered to exhibit moderate to high potential for archaeological sites in order to maximize site yield within the project area. The dense vegetation, characteristic of the area, forced transect spacing to be variable. All of the transects walked within the project area were completed with a minimum of three people to ensure maximum coverage. Crew members were typically spaced with a maximum distance between people of 30 metres. Spacing between people was reduced in areas of higher historic resource potential; additional "double back" transects were occasionally completed when appropriate. Subsurface testing in the form of shovel tests (approximately 40 - 50 cm on a side and to depths at which parent materials or glacial sediments were encountered) were excavated along the transect lines. The locations and contents of shovel tests were recorded and plotted on aerial photograph mosaics while in the field. Sites identified were also shovel tested as an aid in evaluating their significance and age. Sites were photographed, sketch maps were drawn, and the locations were plotted on a 1:50,000 topographic map.

Shovel testing was most intensively conducted in areas that exhibited a relative increase in probability for the presence of archaeological sites. In these areas transects were replaced with a more systematic shovel testing program which increased the number of shovel tests completed and regulated their placement. Shovel tests were excavated every 10 - 30 metres over the surface of the feature, correlating to the relative increase of potential. These areas were relatively determined with respect to the surrounding terrain (i.e. between the Athabasca and Steepbank Rivers and north of McLean Creek). The primary characteristics used to identify areas of intensive investigation included combinations of flat, level ground, well drained and/or fine to moderately coarse grained sediments and/or a close proximity to fresh waterbodies with solid shorelines such as creeks and rivers.

Outside of the areas of intensive assessment, shovel tests were excavated along each of the transects as well. These were less systematic in their placement and depended on the local terrain. The number of shovel tests excavated per transect varied from every 20 to 100 metres. The density of shovel testing was also dependent on the potential of the area (Figure 7). Shovel testing was least intense in areas of low potential. The highly organic nature of the soils throughout much of the study area precluded the ability to excavate shovel tests in some areas Testing was also deterred by high water levels in other areas. Moderate potential areas received significant numbers of tests, particularly in areas which displayed slightly higher potential. All areas of high potential were tested intensively in the more systematic approach described above.

All areas of fortuitous subsurface exposure were also examined for the presence of cultural materials. These include root ball and sediment piles beside and below tree throws; spoil piles along logging and winter roads; trenched areas; scarified and/or gravel extraction locations within logging clear cuts; as well as other areas naturally eroded by water and wind action or slumping. Trenched and scarified sections of cut blocks afforded excellent subsurface visibility. The trenches in some instances were less than five metres apart and 60 to 100 centimetres in width. Many of the winter roads and seismic lines in the study area also provided excellent subsurface visibility through areas of moderate and high potential. Some areas of low potential were also crossed by these cut lines. Natural and cultural subsurface exposures were common throughout the area assessed. Slumping was especially prevalent along the south side of Wood Creek and the southern portion of the Steepbank River valley rim (within the study area). Tree throws were common throughout the Project Area. Previously disturbed areas tended to offer much greater tracts of subsurface exposure than were afforded by shovel testing. Although some shovel scraping was almost always involved in investigating these areas, the shovel scrapes took place in a disturbed context and were not a standard size. These locations were not recorded as tested areas.

As a result of the helicopter overflights and observations made in the field program, revisions in the prefield assessment of the project area's historical resource potential were necessary. The ranking of historical resource potential during the field program was established as a relative scheme to determine the most probable locations for historical resources within the HRIA study boundary (Figure 7). This involved ranking the terrain into areas of high, moderate and low historical resource potential with respect to other areas within the LSA. The terrain encompassed by the LSA made this decision difficult, as the area exhibits little in topographic relief, other than river and creek terrace edges, affording few features which could be considered as exhibiting variations in potential. Low potential dominates the HRIA study area, as reflected in the extensive tracts of low lying, swampy, marshy ground with poorly drained sediments or rocky uneven ground. Most regions of low potential are characterized by black spruce dominated vegetation. Well drained locations along these terraces were given at least a rank of moderate potential.

The terrain along the north and south side of Wood Creek exhibited some areas of higher potential. These include the high terraces above the creek near the western boundary of the HRIA study area, which are well drained, level and have few exposed cobbles.

When considered in a regional context, the archaeological potential of the project area is even lower. Regional archaeological sensitivity in the Boreal Forest is often based on a number of criteria, typically presented in a presence / absence checklist format. These may include a number of variables such as:

High Potential

- areas with a previously recorded site density of 2 or more sites per square kilometre;
- tops and bottoms of eskers, moraines and other distinct glacial features;
- tops and bottoms of other prominent uplands;
- currently used / known traditionally used portages;
- areas within 250m of rapids, waterfalls, etc.;
- areas within 250m of stream confluences of two class three (or greater) streams, along a (class three or greater) stream and a standing waterbody greater than five hectares in size;
- areas within 250m of major lakes (greater than 5 km in length/width);
- areas within the same 1/4 section or within 500m of a designated site;
- areas within 50m of permanent rivers (class two streams and greater) and permanent standing waterbodies greater than 1 km in length/width;
- areas within 1 km of well formed valleys (identified by three or more contours on a NTS 1:50,000 scale map);
- islands greater than one kilometre in length;
- hummocky terrain; and
- rock outcrops (especially vertical).

Moderate Potential

- areas with a previously recorded site density of one site per square kilometre;
- areas within 150 metres of stream confluences of two class two streams or a class two stream and a standing waterbody greater than five hectares in size;
- within 200m of permanent rivers (class 2 streams and greater) and permanent standing waterbodies greater than 1 km in length/width;
- dry, solid margins of bogs, fens and other low lying areas; and
- within 500m of major lakes (greater than 5 km in length/width).

Low Potential

- low lying areas including fens and bogs;
- 30° slopes or greater;
- areas of extensive archaeological research which have not documented any sites in the past; and
- areas beyond 500m of major lakes, greater than 200m from minor lakes or greater than 150m from stream confluence/stream – lake juncture.

Using these criteria most, if not all of the Project Millennium study area would be classified as low to moderate potential. This is verified when the Project Millennium HRIA study area is compared to areas further north in the oilsands region, such as the Shell Muskeg River Mine (Lease 13), Aurora North project area, and other locales. In these areas archaeological sites have a demonstrated association with elevated landforms in terrain formed by a paleoflood 9,900 years ago (Smith and Fisher 1993). The presence of these distinct, elevated, well drained knolls and ridges seems to have created an entirely different land use pattern. These landforms exhibit high potential for archaeological sites even though the terrain surrounding them can be low lying and poorly drained. These features have proven to hold the best potential for site presence in all of the previous studies (Ronaghan 1981b, 1997; Reeves 1995). Sites may be expected in higher concentrations on the top of these landforms than along major creek and river edges (in other areas) a quality that is atypical of other areas of the Canadian Boreal Forest. It should be emphasized that this type of feature is conspicuously absent from the Project Millennium and Steepbank Mine HRIA study areas. The apparent low incidence of prehistoric use also corresponds with the information gathered during the Traditional Land Use studies. These programs indicated that the proposed Steepbank and Millennium Mine leases were not frequently used for a variety of reasons including poor accessibility and sparse resource availability.

During the course of these investigations, portions of three trails were identified as crossing through what is now the Project Millennium development area. These trails are principally located along Unnamed, Leggett and Wood creeks. No visible attributes of prehistoric use of these trails were observed. Portions of these traditional trails have been subsumed by winter roads and seismic lines which have obscured their traditional attributes. Numerous beaver lodges, beaver lodges with caches and inactive beaver lodges have been identified throughout the Project Millennium HRIA study boundaries by traditional land use studies (Fort McKay Environment Services and AGRA Environmental 1998). Several of these were located along Wood Creek. Due to the potential for historical resources to be associated with these features, the banks beside three of the lodges encountered along Wood Creek were shovel tested. None of the tests associated with beaver lodges produced cultural materials and physical evidence of traditional or prehistoric use was identified.

7.4 Report Writing

The final stage in the HRIA was the compilation of this report and the preparation of selected sections for inclusion in the EIA report. A traditional land use study was also completed as part of Project Millennium EIA (Fort McKay Environment Services and AGRA Environmental 1998). It would have been preferable for the traditional land use information to be available prior to the field component of the impact assessment such that the data could be utilized to refine the historical resource site predictive modelling scheme and ground truthed to verify locational information. Unfortunately, the Project Millennium traditional land use study was initiated after the archaeological field work had been completed. Some information was available for field verification in the traditional land use report prepared for the Steepbank Mine Project (Fort McKay Environment Services 1996a). Preliminary traditional land use information is presented in the Project Millennium EIA, along with the current land use information. The results of the study were utilized, at least in part, to enhance our knowledge of aboriginal use of the study area.

8. RESULTS

8.1 PRELIMINARY ANALYSIS

Within the Historical Resources Regional Study Area (HRRSA), a total of 352 historical resource sites have been recorded in Alberta Community Development's prehistoric sites records which have the locational information required for further analysis. The majority of these sites are artifact scatters, followed by isolated finds. Both of these site types show an association with terrace landforms. Campsites and workshops, also common site types in the HRRSA, tend to be associated with terrace features as well. Ridges also have a high incidence of sites. Common between these two landforms is the fact that they are well drained and the vegetation is typically fairly open mixed wood communities.

A total of 71 historic period sites have been recorded at the Historical Sites Service (Alberta Community Development). These sites include numerous wells and several ranger stations, lookout towers, fur trade posts, mounted police posts, missions, cabins and a historic steamboat. The distribution of the historic sites and association between the environment and site location differs from that of the predominantly prehistoric sites recorded under the Borden system. In excess of 500 historical resources are currently on record within the HRRSA.

Only two prehistoric archaeological sites have been previously recorded within the LSA, HfOu 1 and HfOu 2. Both sites are small isolated lithic find locations recorded, during the assessment of the Steepbank Mine project area (Balcom et al. 1996). No further work was recommended for either of these sites prior to the initiation of the Steepbank Mine project and neither site was revisited during the course of this investigation. The sites were situated in areas deemed to be of high potential during the Steepbank Mine project. Five historic period resources were recorded using Historic Sites Service numbers within the LSA. These include HS 44043, 44044, 44045, 44046 and 44047. These sites are identified as early oil well locations relating to the Athabasca Oil and Asphalt Co. (HS 44044) and Alfred Von Hammerstein (HS 44043, 44045, 44046 and 44047).

Based on the prior suggestions of Dr. Robert Bell, Von Hammerstein drilled a number of wells along the banks of the Athabasca River in the early 1900's in attempt to extract oil (Carrigy 1974b). These early attempts to locate oil were not productive, although salt was identified south of the LSA near the mouth of the Horse River (Carrigy 1974b). Von Hammerstein was the first to hold patented leases in the region and set up the first rig on Tar Island in 1906 (Parker and Tingley 1980). In excess of 40 wells were drilled in the years from 1897 and 1925, none of which were entirely successful. These leases were eventually acquired by Chevron Oil Company Limited.

Assessment areas were determined based initially on the predictive map of potential, although revisions of the map were made reflecting subtleties observed in the field. One area of unclassified land was present in the southeastern corner of the study area. Insufficient vegetation information did not allow for a segment of the study area, 35.5 hectares in size to be modeled. The model, however, identified small pockets of high and moderate potential on either side of this area. These areas of potential were identified predominantly due to their proximity to Wood Creek. The topography, when visually assessed in the field, was poorly to very poorly drained and had moderate to low potential for historical resources.

An aerial survey of this general region during the field component indicated that the vegetation analysis of the aerial photographs was likely in error for portions of the study area between Wood and McLean Creeks. The model had identified the area as being of moderate potential, but the vegetation was dominated by sphagnum and other fen oriented plants and the ground was poorly drained. This area was down-graded to low potential based on these field observations (Plate 1).

As the model is based primarily on vegetation zones and distance to water, areas of high and moderate potential are often made up of small, unconnected polygons. These range in size from one or two hectares to thousands of hectares in size. In zones of dense, but dispersed areas of potential, intervening areas of low potential were examined while crossing from one high or moderate potential area to the next. The majority of the HRIA study area is comprised of a large, centrally located, uninterrupted area of low potential (Figure 5). This area is poorly drained, containing no navigable flowing watercourses (Plate 2).

Plate 1: Aerial view to the southeast of the study area. The area misidentified as moderate and high potential is located in the centre background of the photograph.

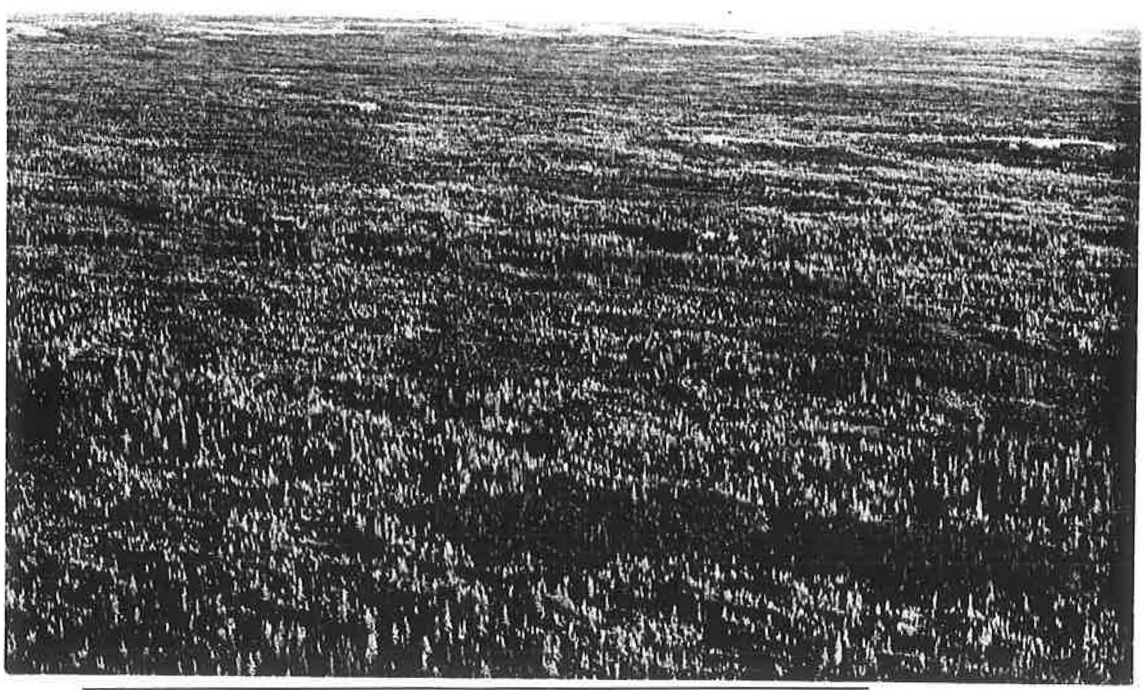


Plate 2: Aerial view to the south of the low potential areas in the southern part of the study area.

The preliminary model of potential for the Local Study Area depicted areas of high and moderate potential primarily distributed in two broad areas on opposite sides of the HRIA study area. The first area was concentrated in the north and eastern borders of the study area, along the Steepbank River (Figure 5). This included large expanses of aspen dominated woodlands with well drained soils and a close horizontal proximity to the Steepbank River. As the name implies, access to the Steepbank River from the upper terrace is often difficult. Areas of high potential may be located as much as 80 m above the river in some instances. Such a change in elevation may occur in a horizontal distance of less than 350 m in some locations.

The second area of high and moderate potential is less continuous and is located in the southern part of the HRIA study area (Figure 5). These areas of potential are scattered throughout the region along and between Wood and McLean creeks (Plate 3). These areas, although less continuous than those along the Steepbank River, have for the most part, a much lower vertical to horizontal ratio to water.

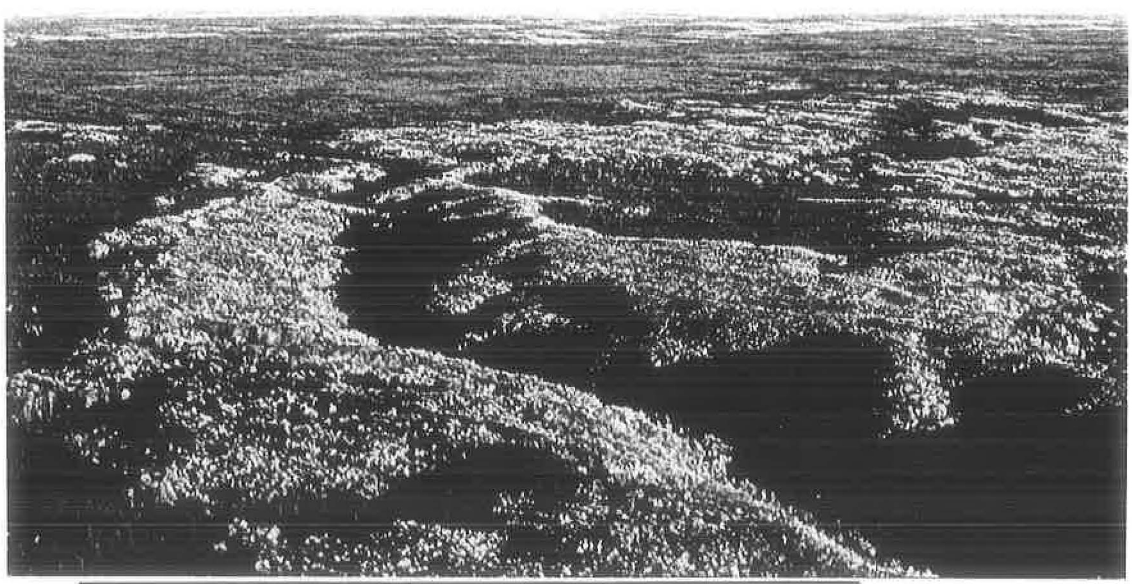


Plate 3: Aerial view to the east-southeast of Wood Creek showing the light coloured aspen areas of high potential (on the terrace tops) and the darker low potential areas in the centre of the photograph. The area misidentified as high potential is located in the centre background of the photo.

8.2 FIELD COMPONENT

The field component of the historical resources impact assessment was completed by a crew of three to five archaeologists over a period of eight days. An aerial reconnaissance was completed on the first day of the field component to identify access points as well as to confirm the accuracy of the map of potential. Based on the aerial reconnaissance, the potential of the HRIA study area was revised (Figure 7) and several transect locations were identified. The majority of these transects were completed in areas dominated by aspen (Plate 4). As the field component progressed the transects were refined daily to reflect further ground-based observations including the types of sediments present, roughness of the terrain, number of exposed cobbles, degree of water saturation and so forth. Several areas identified as having potential in the prefield modelling exercise were omitted from the sample plan on the basis of these observations.

Details relating to the field program completed for the Project Millennium HRIA are displayed in Figure 8. It shows the boundaries of the Project area as indicated on initial mine plans and applied for in the permit application submitted for the study. However, a considerable portion of this area along its western margin overlaps with the area examined for the previous Steepbank Project HRIA (hatched area). For the most part, areas included in that earlier study (Balcom et al 1996) were omitted from the 1997 field program, as Historical Resources Act clearance has already been obtained for this area. Subsequent to the field program the boundaries of both the Steepbank and Millennium project areas were modified and are now referred to as the East Bank Mining area. Consequently, some of the areas investigated in the HRIA fall outside currently proposed development zones, and a small portion of the area along its southern margin, now within the East Bank Mining area, was not investigated during the present study.

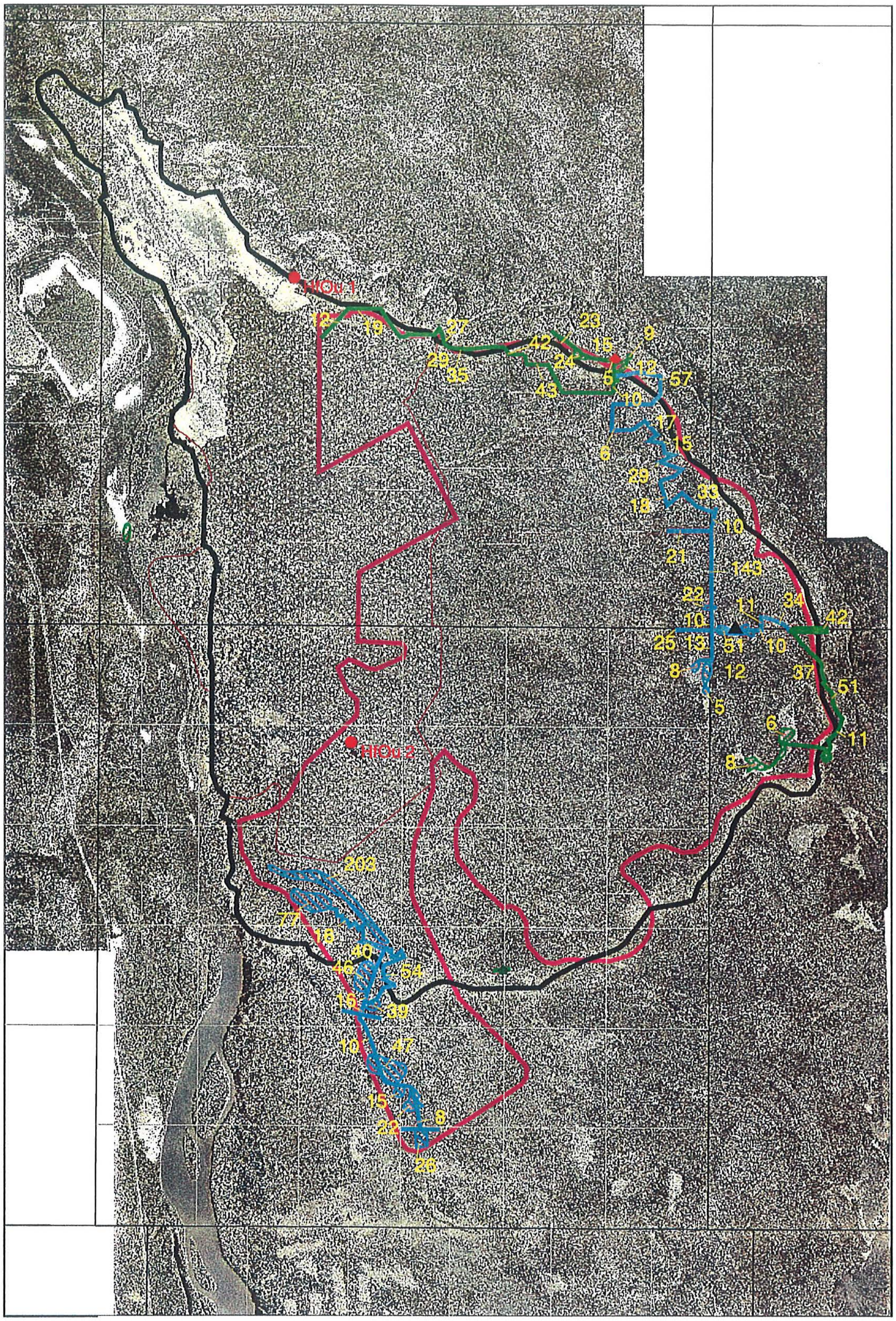
Overall, the extensive foot traverses completed for the HRIA study program were accompanied by a total of 1,629 shovel tests (Figure 8). Transects, that were designed to sample areas of low and moderate potential and to access areas of high potential, had linear orientations or zig-zagged across irregular and wide shaped areas. Cutlines and winter roads, when present, were used as reference guides, but actual transects were completed off these areas. As the upper sediments were likely disturbed along the cut lines and roads, shovel tests were excavated outside of the disturbed areas. Formal shovel tests were approximately 50 x 50 cm in size and excavated to sterile subsoil (Plate 5). Grader piles along the edge of the roads/cut lines and other areas of exposed subsurface materials were investigated, where possible, in an attempt to identify artifacts that had been displaced these were tested with large shovel scrapes but as the sediments were disturbed, no formal shovel tests were excavated. Existing exposures along cutlines and roads were examined in transit to and from selected transect locales.

Pedestrian transects were accompanied by more intensive investigations in areas which were considered to have greater potential based on local microtopography, localized vegetation or potential for more deeply buried components. These areas, identified as cross-hatched areas on Figure 8, were typically subjected to the most rigorous shovel testing of the field program. Impacted areas, including bull dozed areas, graded roadways, tree throws and scarified sections of forestry cutblocks were also investigated. No evidence of site HS 44044 was observed in the intensively investigated areas along the upper terrace on the south side of Wood Creek. It is likely that this drilling location was closer to the mouth of the creek, near the confluence with the Athabasca River, and not on the upper terrace. Other than during aerial reconnaissance no attempt was made to locate site HS 44043, which is reported to be situated somewhere withinLSD 14-10-91-09-W4M. The area surrounding this potential site location is low lying, water saturated and access is difficult (Figure 9).

Approximately 474.4 ha (1,172 acres) of land were investigated by transects and the more intensive assessments. This amount was determined as a rough means of quantifying the area covered during the HRIA. The figure was derived by computing the size of the polygon encompassing the areas of intensive study in the GIS mapping program and adding it to an approximation of the total area assessed through the transect coverage. The transects varied in width, due to ground cover, number of people present etc., but were typically 45 - 120 metres in width. For example, if four people walked a transect with 30 metres between each of the people, each person would have a field of view that was 15m on each side of their path. This created a total width of assessment approximately 120m wide along each transect. This width was then multiplied by the length of the transects to derive the total area (Table 4). This method of

Plate 4: Typical vegetation encountered in high potential areas along the Steepbank River terrace.

Plate 5: View to the east of the soil profile observed in a typical shovel test.



LEGEND

- HRIA Boundary
- East Bank Mining Area
- Steepbank Mine
- Cabin
- Log Cabin
- Depression Site
- Recorded Sites
- Transect (3 Person)
- Transect (4 Person)
- Intensively Studied Areas (3 person)
- Intensively Studied Areas (4 person)
- 32 Number of Shovel Tests

West of Fourth Meridian

1000 0 1000 2000 3000
Metres

Scale 1:100,000

SOURCES: Suncor
Golder
UMA Geomatics

Map Projection: UTM 12
Datum: NAD 83

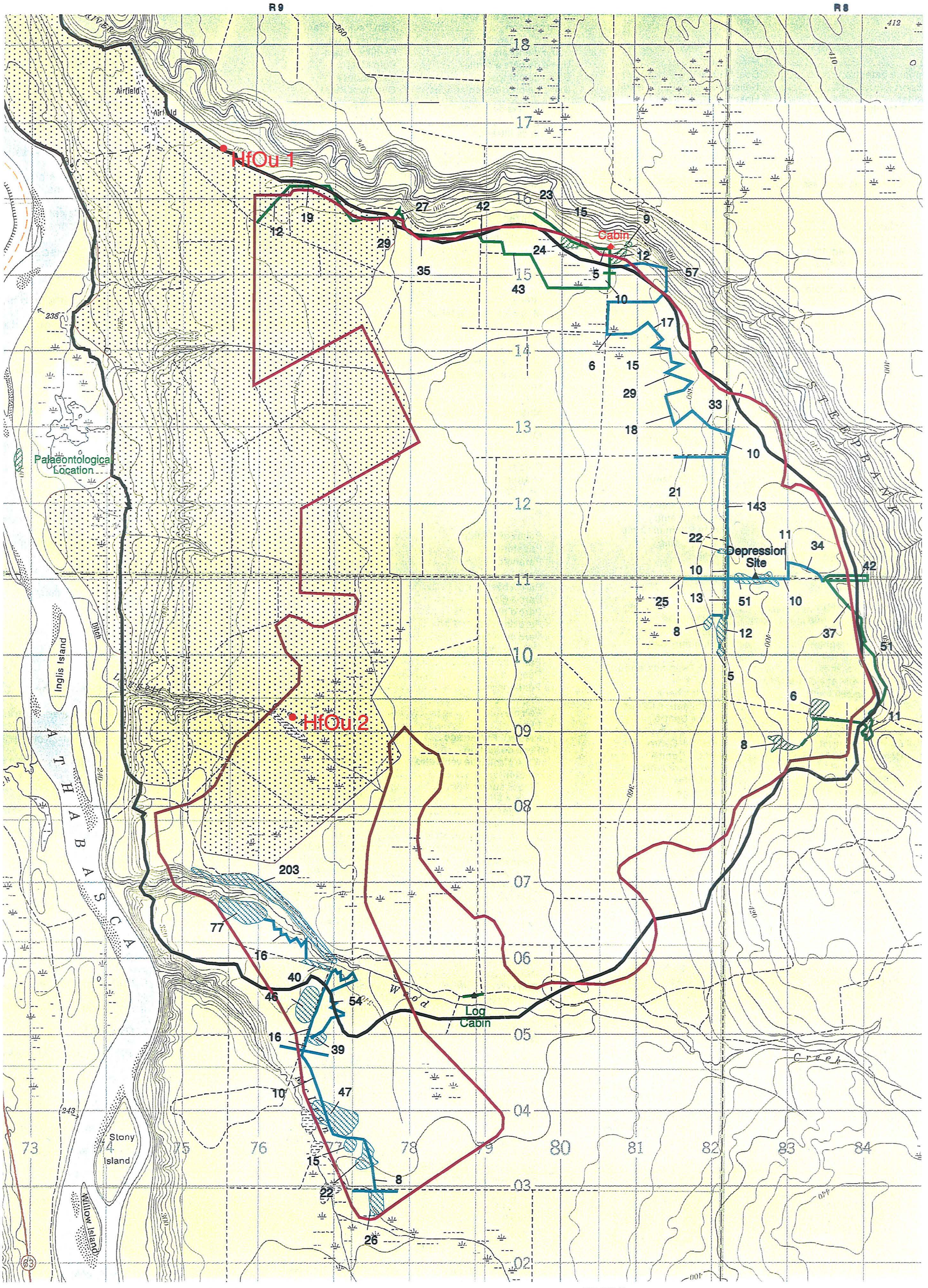
N

SUNCOR ENERGY

Project Millennium

ORTHOPHOTOGRAPH OF THE LOCAL STUDY AREA IDENTIFYING THE LOCATION OF THE PEDESTRIAN TRANSECTS AND SHOVEL TESTS

31 Aug. 1998	Figure 9	PRODUCED BY: J.S. REVIEWED BY:



LEGEND

- HRIA Boundary
- Steepbank Mine
- East Bank Mining Area
- Cabin
- Log Cabin
- Depression Site
- Recorded Sites
- Transect (3 Person)
- Transect (4 Person)
- Intensively Studied Areas (3 Person)
- Intensively Studied Areas (4 Person)
- 32 Number of Shovel Tests

West of Fourth Meridian

SOURCES: Suncor
Golder
NTS 1:50,000 Edition 3
Surveys and Mapping Branch,
Department of Energy, Mines and
Resources Branch,
Alberta Transportation.

1000 0 1000 2000

Metres

N

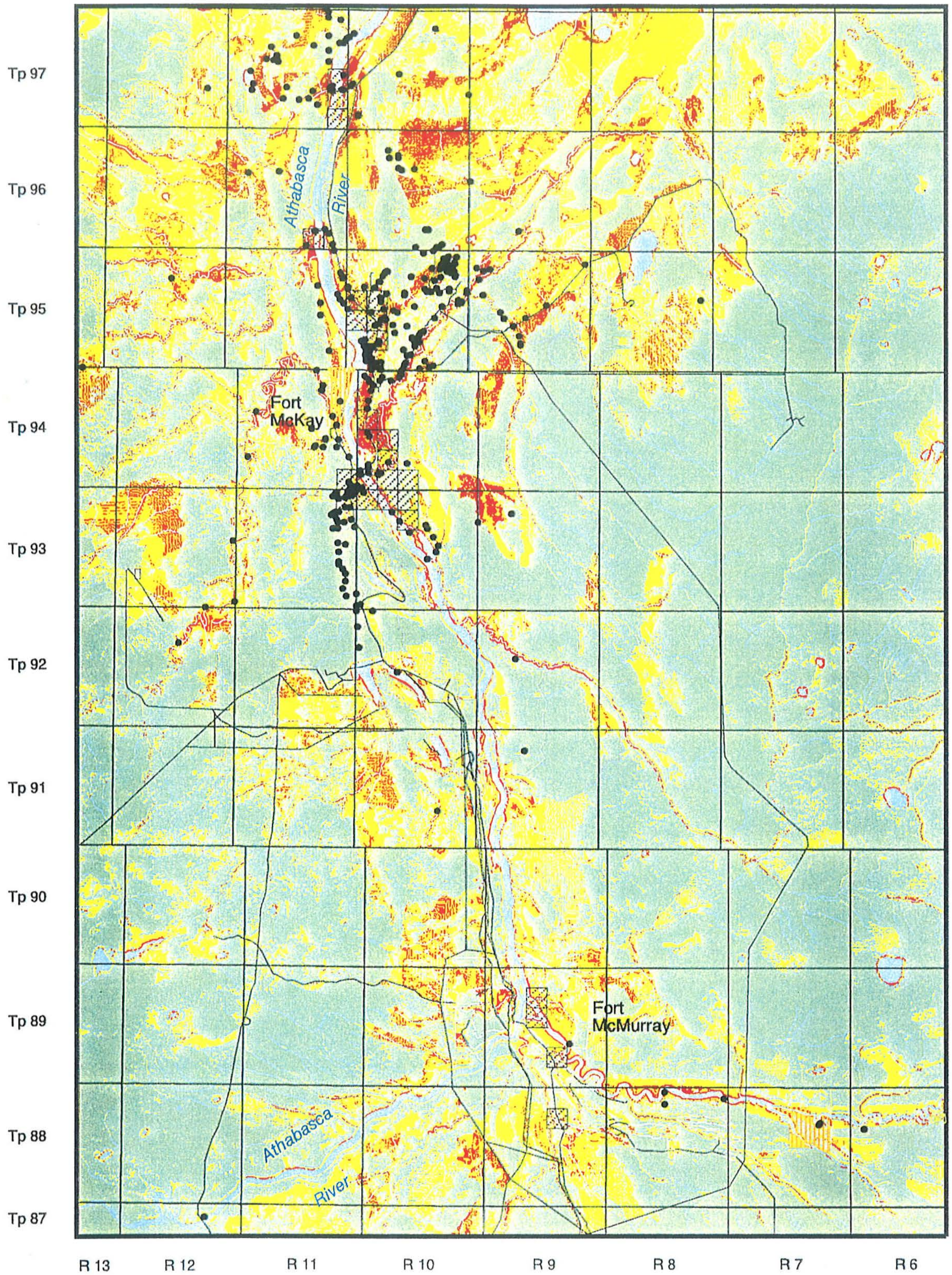
Map Projection: UTM 12
Datum: NAD 27

SUNCOR ENERGY | Project Millennium

1:50,000 SCALE
TOPOGRAPHIC MAP OF THE
LOCAL STUDY AREA
IDENTIFYING THE LOCATION OF THE
PEDESTRIAN TRANSECTS AND SHOVEL TESTS

31 Aug. 1998	Figure 8	PRODUCED BY: K.K.Q. REVIEWED BY:

/data8/suncor/local/9840/arcview/newmad27_arky.apr



LEGEND

- Historical Resources Regional Study Area
- Linear Disturbances
- Open Water
- Forestry
- Existing Open Pit Mines
- Other Disturbances
- In-Situ
- Proposed Open Pit Mines
- Municipalities
- Indian Reserves
- Designated Historical Resources / Buffer Zones
- Historical Resource Sites

HISTORICAL RESOURCE POTENTIAL

- Low
- Moderate
- High

SOURCES: Suncor, Syncrude, Petro-Canada, Mobil, Al-Pac, Golder

Scale 1 : 500,000

5 0 5 10 15

Kilometres

Map Projection: UTM 12 Datum: NAD 83

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Project Millennium

HISTORICAL RESOURCES
REGIONAL STUDY AREA POTENTIAL MAP
AND HISTORICAL RESOURCE
SITE LOCATIONS

03 Sept. 1998	Figure 10	PRODUCED BY: K.K.Q. REVIEWED BY:

determining the area assessed is subject to a number of short comings. These include the imprecision of the plotting of the assessed areas on the maps digitized into the GIS maps. As well, the transect lines have also been somewhat straightened on the maps with respect to how they were actually walked in the field. Both of these factors serve to decrease the calculated coverage from what was actually examined, but are more accurate than visual estimations of areas assessed. One hundred percent of the high potential (22 Ha), 17.6% of the moderate (210.64 Ha) and 2.5% of the low potential areas (132.46 Ha) were inspected and shovel tested. Some sections of land are outside of the areas covered by the map of potential and are not included in these calculations.

Table 4 Approximate Area Assessed During Pedestrian Transects

	Length of Transects		Area of Cross Hatched Zones	
Transect Colour	m	km	m^2	Ha
Green	12795.49	12.80	184753.53	18
Blue	19640.72	19.64	1050684.24	105
Total	32436.21	32.44	1235437.77	123

During the historical resources impact assessment, three distinct cultural sites with structures or features were identified. As well as other observations of cultural material of lesser importance were made. None of these sites are of sufficient age to be considered historical resources under the Alberta Historical Resources Act. These sites do, however, identify a small but important use of the area in recent times.

These sites likely represent a quite different land use pattern than that employed in prehistoric times. They were however, recorded in areas that were predicted in advance to exhibit high potential for archaeological sites. Two cabin locations and one site with a sparse scatter of historic period cultural material surrounding an excavated depression were observed. One other scatter of historic refuse was noted in association with a well pad, in the SE quarter of Section 16-91-9-W4M. No features were observed in association with this material. Numerous sanitary cans and several "stubby" beer bottles, medium sized rectangular tins (with paint top closures), sections of plastic PVC pipe and elbows, a five gallon drum and a 25 fl. oz. brown bottle with a plastic screw top cap which read "Hiram Walker and Sons Limited" were observed. It is possible that the materials observed relate to the construction or dismantling of the well site or to trappers and hunters that stopped in the well pad clearing, which is situated just off a nearby cutline. The details of each of the main sites are described below.

3.2.1 Cabin 1

The log cabin is located along the north side of Wood Creek and is situated within Registered Fur Management area #2453 (Figure 9; Plate 6). The cabin appears to have been abandoned some years ago. The construction techniques employed in building the cabin and some of the materials used indicate that it is less than 50 years old. The cabin is approximately 12 x 15 feet in width and length, with walls approximately 6 feet in height. The cabin originally had a flat roof. One window is present on the east side, as well as one door. The glass in the window is intact and in good condition. The roof of the cabin is missing, although the some of the supporting beams are still present. The logs have been cut with a wide bladed saw, most likely a chainsaw, confirming the recent relative age of the cabin (Plate 7).

Plate 6: View to the southwest of the front of the log cabin located in Section 15-91-9-W4M.

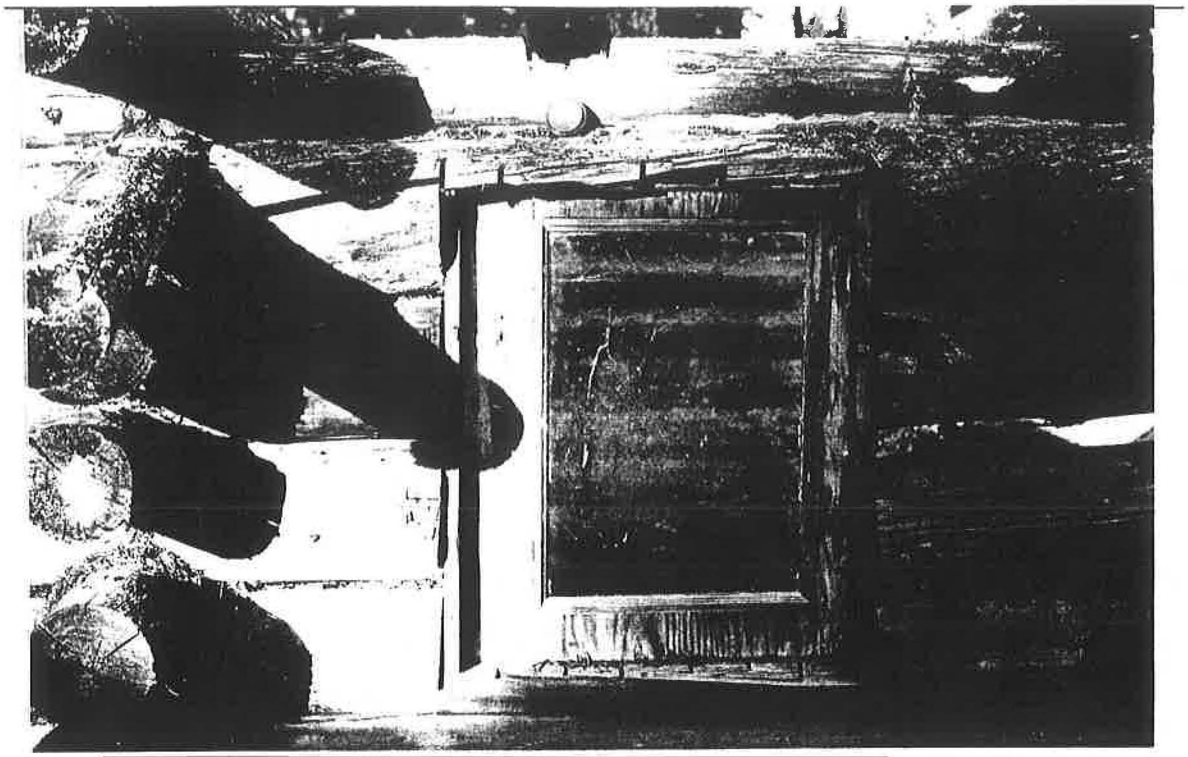

Plate 7: View to the west of the window frame and construction techniques used on the log cabin.

The window and door openings were completed by making cuts into the wall logs and chiseling out the necessary material. The window was set on both of the sides with half inch, machine planed planks. The window frame itself was roughly cut, but the glass was held in place with routered edging and small wire finishing nails.

One sanitary can was observed inside the cabin and two to three other cans were observed on the outside. A depression was present in the centre of the interior of the cabin, approximately 5 feet in diameter and 2 feet deep. The nature of this depression is unknown. Due to the recent nature of the cabin.

8.2.2 Cabin 2

A plywood cabin was observed on the top of the slope along the Steepbank River. It is located at the northern end of a large cut line, adjacent to a winter road down to the Steepbank River. This cabin is situated in Registered Fur Management area #2297. The cabin appears to be on skids and it is unlikely that this is its original or final location. The cabin is approximately 14 x 8 x 7.5

feet in size, with one door and two windows (Plate 8). The walls are covered in thin plywood on the inside and outside of the walls of the cabin. The roof is only slightly peaked and has a small chimney for a wood stove (Plate 9). A kitchen chair with plastic back and seat was observed inside the cabin. A moderate amount of relatively recent refuse was observed in and around the cabin. Based on the artifacts and construction materials of the cabin, it is thought to be less than 30 years of age. This material included sanitary cans, metal, glass and wood fragments. Because of its comparatively recent age, no shovel tests were conducted to further assess its significance. Shovel tests excavated nearby, however, were all negative.

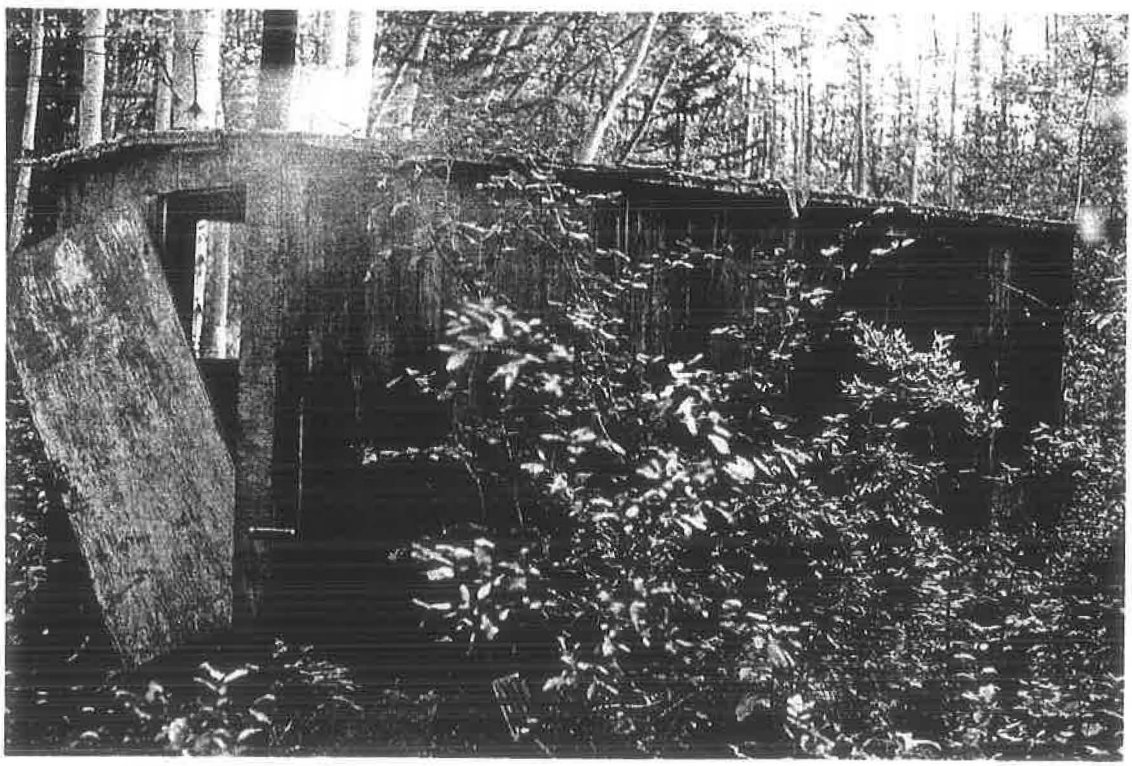

Plate 8: View to the southeast of the cabin in Section 13-92-9-W4M.

Plate 9: View to the northwest of the back of the cabin in Section 13-92-9-W4M.

8.2.3 Depression 1

A small scatter of historic artifacts and a cultural depression were observed on the north side of a cut line in the SW 1/4 of Section 6, Township 92, Range 8, West of the fourth Meridian (Figure 8). A moderate sized depression is present, measuring approximately 16.4 x 10 feet in diameter and 2.5 feet deep (Plate 10). An associated 13 x 8 feet diameter mound of dirt is situated directly to the north. Adjacent to features are a 1 x 6 inch plank with a wire nail in it. A rectangular, heavy metal 'cover', with a machined hole cut in the top and a hand cut hole in the front. Presumably this specimen comes from a piece of heavy equipment. This site is also less than 50 years in age.

The site lies approximately 9 km east southeast of Shipyard Lake, and roughly 2 km west of the Steepbank River. It is situated approximately 100 m north of an east/west trending cutline on a semi-open, south facing knoll. The immediate site area contains birch and willow stands (Plate 11). The surrounding area is poplar and aspen with tamarack and black spruce to the south. A drainage is located approximately 100 m to the south (Plates 10 and 11).

8.2.4 Palaeontological Location

Palaeontological materials were observed in an outcrop along the Athabasca River in the NW-6-92-9-W4M. The small shelf of an outcrop is approximately 50 m in length and 10 m wide at its widest point. The outcrop is part of the Moberly member of the Waterways Formation and is Upper Devonian in age. The Moberly Member has been characterized as being a fragmental limestone, limestone, argillaceous limestone and includes some shale (Carrigy and Kramers 1974). The Royal Tyrrell Museum of Palaeontology was informed of the observation and assisted in the identification of the materials from the photographs. The materials identified include stromatoporoids (Plates 12 and 13), small brachiopod shells (Plate 14), nautiloid cephalopods (Plate 15) and other aquatic invertebrate fossils The outcrop is located outside of the Project Millennium mine footprint, but inside the LSA.

Plate 10: View to the northeast of the shallow depression and low mound.

Plate 11: View of the heavy iron machine part observed at the site with the depression.

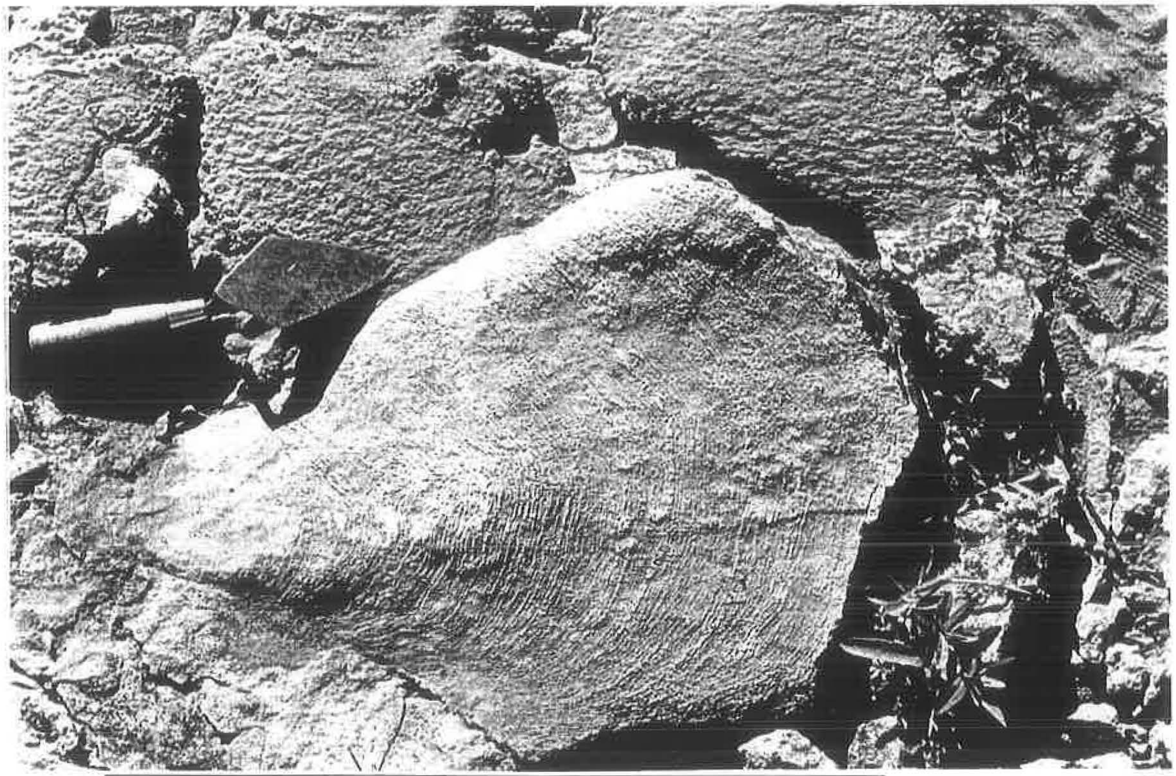

Plate 12: View to the west of a stromatoporoid fossil in NW-6-92-9-W4M

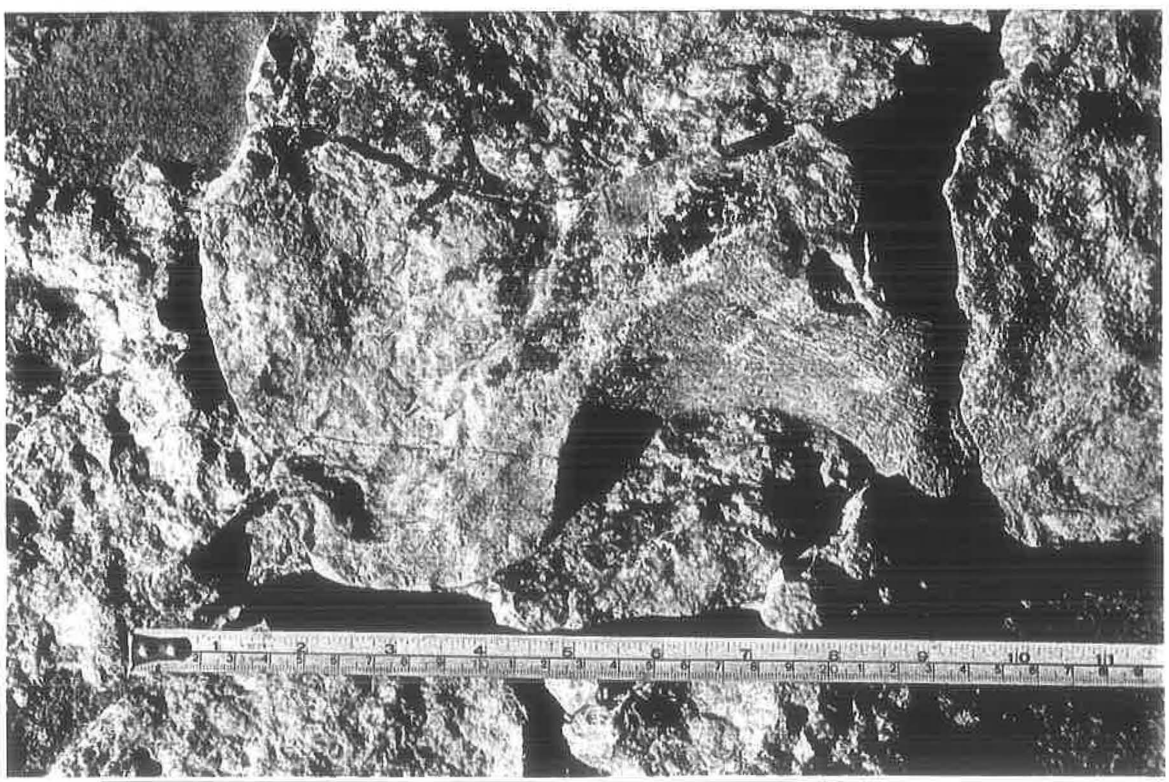

Plate 13: View to the east of a stromatoporoid fossil in NW-6-92-9-W4M

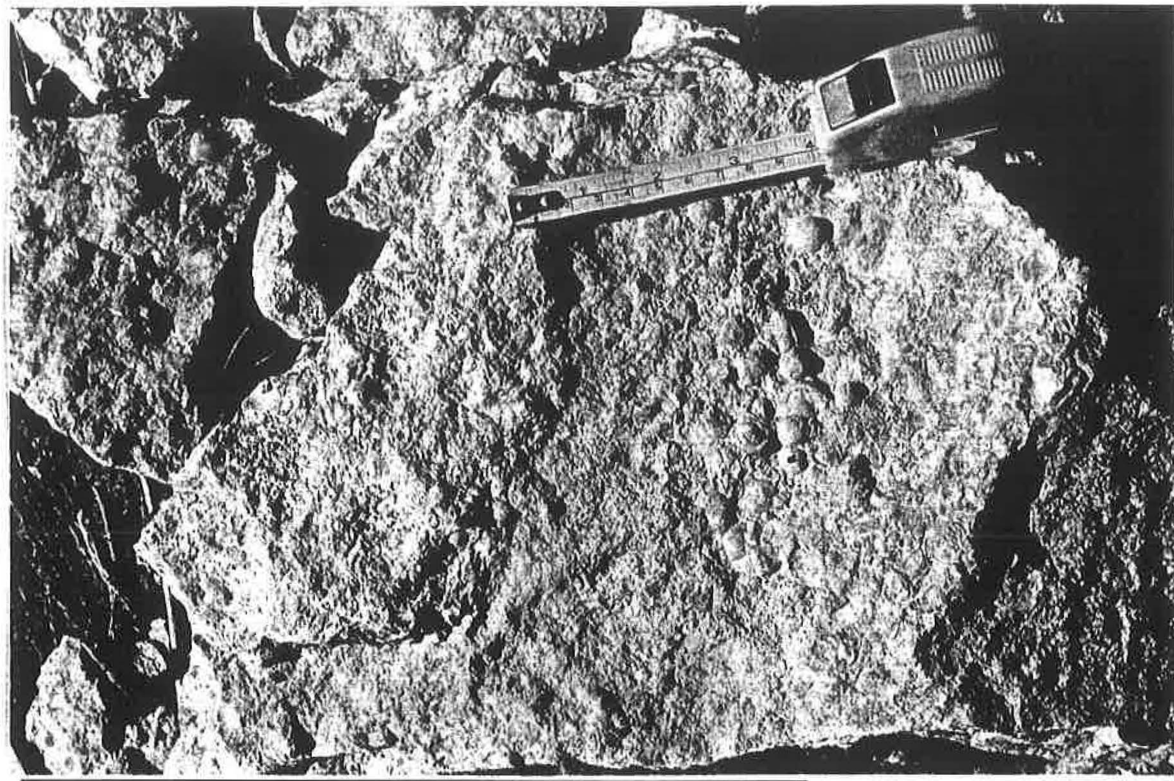

Plate 14: View to the west of small brachiopod fossils in NW-6-92-9-W4M

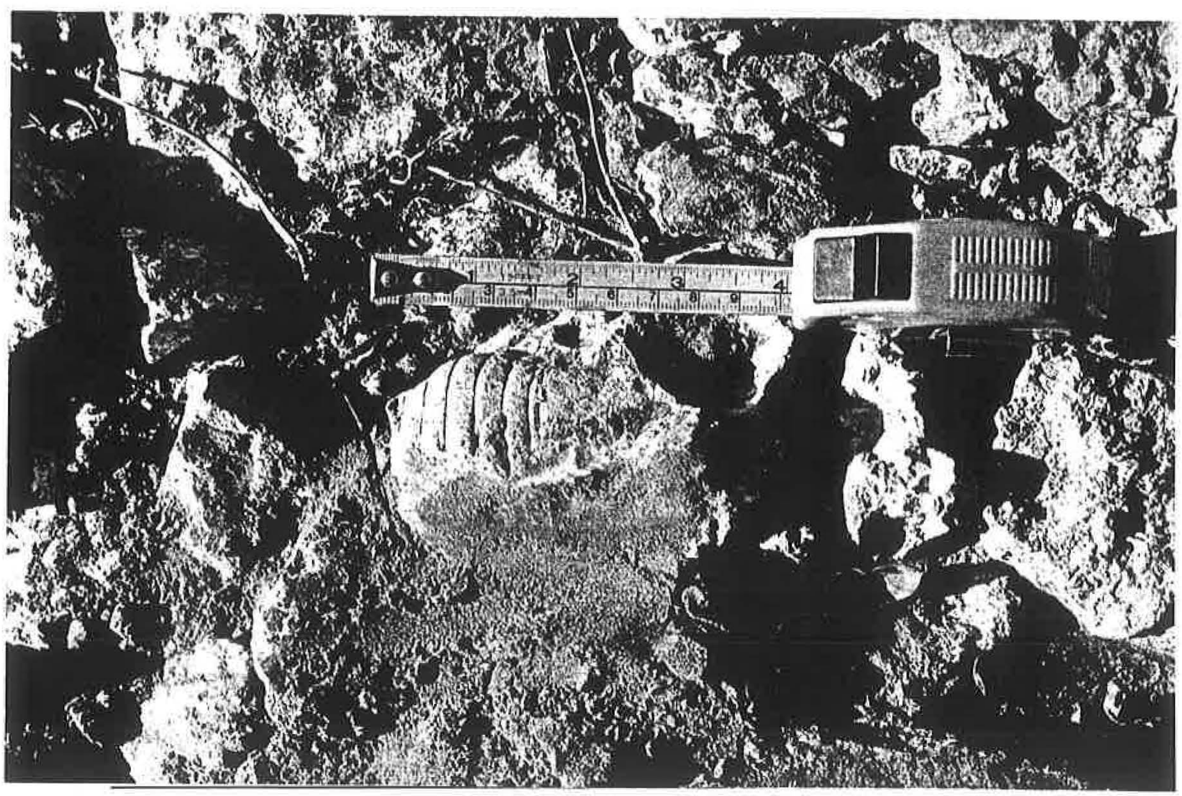

Plate 15: View to the north of a nautiloid cephalopod fossil in NW-6-92-9-W4M

8.3 TRADITIONAL LAND USE

A Traditional and Current Land Use investigation was completed for the Project Millennium EIA (Golder 1998). The traditional land use portion of this study included an assessment of the plant and animal species utilized in the Project Millennium area and surrounding region. This assessment included both recent and historical utilization patterns. Individual species were given rankings (high, medium and low), predominantly based on the number of times a species name was referred to and the number of times a species was indicated within a given region on the traditional land use maps in the current and previous studies (Fort McKay Tribal Administration 1983; Fort McKay First Nations 1994; Fort McKay Environment Services 1996a, 1996b, 1997). This study indicates that despite the general inaccessibility of the project area, traditional land uses practices have been in place for generations within the study area. While resource use tends to focus on the major drainage systems where habitats and vegetation communities are most diverse, hunting, trapping and use of plant resources are also conducted within other parts of the Project Millennium area. No important cultural sites such as graves or places of spiritual significance have been identified within the study area. The following describes general traditional land and resource use practices that are likely to have taken place in or near the study area.

8.3.1 Flora

Tree species that are often mentioned include both deciduous and coniferous trees. Coniferous species include lodgepole pine, jack pine, tamarack, balsam fir, white and black spruce. The deciduous tree species include balsam poplar, aspen poplar, paper birch, willows and alders.

The interviewees speak of these species being utilized both currently and in the past for medicine, food, drink, construction supplies, firewood, curing and smoking meat. Birch bark is used as a fire starting material and syrup is made from the sap. Willow bark is boiled for a tea and used as a medicine to relieve colds, headaches and stomach ailments. Portions of balsam fir, jack and lodgepole pine, birch, and poplar trees, among others were also listed as having medicinal properties. Log cabins are constructed primarily of coniferous wood, although birch and black poplar are also used as building materials. Bear traps are also commonly constructed of large coniferous logs. Shrubs and grasses have traditionally been used for food, drink, medicinal and spiritual purposes. Small plants have also been used to make functional items such as twine and for making baskets. Some of the plants frequently referred to by the Fort McKay elders include blueberry, cranberry (bog and lowbush), strawberry, rose, bearberry (kinnikinnick), rat root, wild mint, muskeg (Labrador tea), moss, sweet grass and certain types of fungi. Many of these plants (e.g., blueberry, strawberry, cranberry) were often eaten raw, or made into sauce or jam. Some were also boiled and consumed as tea (Labrador tea). Rosehips, juniper, sweet grass and rat root were some of the most widely used medicinal plants. Other medicinal plants include gooseberry, raspberry, chokecherry, saskatoon, nettles, green frog plant and seneca root. Sweet grass, and the inner bark of the red willow are also important ceremonial plants. Fungi found on dead logs and moss are often used in smudges and insect repellents. Other berry bushes and aquatic plants are also part of the traditional environmental knowledge of the Fort McKay First Nations people, although they are not used as often.

8.3.2 Fauna

Animal species also form an important part of the traditional land use. Large game animals in the region include moose, bison, caribou, white-tailed and mule deer. Barren Ground caribou were seen in the region of the Steepbank River as recently as 1955 (Fort McKay Environment Services 1996a). Wapiti (elk) were formerly present in the Athabasca region although they currently are extirpated from this portion of their range. White-tailed deer are likely recent arrivals into the region. White-tailed deer and moose are now numerous in the LSA. The east side of the Athabasca River had poor accessibility thus reducing the amount of hunting in the area (Fort McKay Environment Services 1996b).

Black bear are another large game animal that was hunted in the region. These animals were traditionally hunted using traps made out of several large logs. The bear meat was eaten, the fur used for clothing and the grease for cooking and making soap. Black bear was also listed by some of the Fort McKay Elders as an important spiritual animal (Fort McKay First Nation 1994). Grizzly bear are also spiritual animals, although they were not as plentiful as the black bear. Signs of a grizzly bear were seen in the Saline Lake area as recently as 1990 (Fort McKay Environment Services 1996b).

The First Nations people used all portions of these large game animals. The meat was used for food and the hides were used as clothing as well as blankets, mattresses and robes. Bones and antlers were used to make tools such as leather punches, knife handles, hide fleshers and billets. Sites where these animals were killed or processed differ in size and location depending on where the animals were typically found, and whether the hunted animal was normally solitary (e.g., moose, bear) or traveled in herds (e.g., bison, caribou).

Some of the smaller furbearers were also important to the people of the region. Beaver, muskrat and snowshoe hare were hunted for their meat and pelts (Fort McKay Environment Services 1996b). The beaver is still regarded as a staple in the diet of some area residents. Beaver castor is also used as a medicine. Skunk were also trapped and used for spiritual and medicinal purposes. Skunk oil was (and still is) used for warding off and curing colds (Fort McKay First Nations 1994). River otter, mink, lynx, wolf, fisher, fox and weasels were also traditionally trapped by the people of the region.

The Athabasca River valley is an important migratory route for several types of birds including ducks, geese, cranes, loons, grebes and gulls (Fort McKay Environment Services 1996b). Waterfowl were traditionally hunted by the people of the region during the spring and fall migrations. Additionally, waterfowl eggs are harvested in the spring. The spring is traditionally the best time for hunting migratory birds, as their feathers and meat are in the best condition. The feathers are often used for clothing and bedding. The wings from owls and geese are also used as dusters and brooms. Tail feathers from grouse and ptarmigan were often fanned out and used as a fan or for decoration. The pouch from pelicans and loon skins were often used as waterproof bags. Large owls, such as the great horned owl and great grey owl, were also hunted for food. Upland game birds including ptarmigan, and spruce, sharptail and ruffed grouse were hunted and harvested opportunistically. Long bones from birds were traditionally made into beads and small whistles.

Fish in the region were used as food for both people and their dogs. Large numbers of fish were taken annually from the Athabasca River, between Tar Island and the Suncor Steepbank Mine site (Fort McKay Environment Services 1996b). Whitefish were caught in the autumn and hung to dry for winter dog food. Thousands of fish may be needed to feed dogs through the winter, depending on the number of dogs. Up to 2,000 fish could be caught and hung in a week. Grayling were caught in the Steepbank River and Leggett Creek, but on a much smaller scale (Fort McKay Environment Services 1996a). Whitefish, pickerel, northern pike, chub, lake trout, ling (burbot), goldeye, suckers, perch and grayling were all used by people in the area. Some fish such as the goldeye, grayling and perch were not available throughout the entire regional study area and, therefore, had only local importance. Fish bones were also boiled to extract the grease. Little or no mention was made to the importance or traditional uses of amphibians and reptiles of the region. The region has a limited number of red-sided garter snakes, (those in the Peace River area), but frogs and toads are quite common.

One location adjacent to the local study area that likely had abundant archaeological materials is Tar Island. Tar Island, located across the river from the LSA, was used as a summer/autumn gathering location until approximately thirty years ago. The island was used by the people of the Fort McKay region as a camping area while conducting summer/fall hunting, fishing, and plant gathering activities. Moose and occasionally caribou were hunted on the islands and river banks surrounding Tar Island. The area was also a good fishing and bird harvesting area. This location, however, was abandoned and subsequently destroyed after the establishment of a tailings pond at the site (Fort McKay Environment Services 1996b).

Traditional land use research suggests that the regional study area contains a diverse array of plants and animals which were utilized by First Nations groups (Golder 1998). Hunting and trapping in the areas inland from the Athabasca and the Steepbank rivers may have been limited. Hunting is currently difficult due to the muskeg and peat bogs that are present throughout the area (Fort McKay Environment Services 1996b). Traditional trails were maintained in the area by local trappers and hunters until the construction of winter roads and seismic lines. These trails may be one area with higher potential for archaeological materials. Most of the travel routes were likely traversible in one day, however, making the presence of camp or long term sites unlikely. Harvesting of plant materials is reported to have been carried out in the area. This type of activity, however, typically leaves behind little or no archaeological evidence and would be essentially invisible.

8.4 REGIONAL SITE DISTRIBUTION

Archaeological site distribution is often problematic to predict. Increasingly, archaeologists are turning to GIS based predictive models to identify areas of high, moderate and low historical site potential (Dalla Bona 1995; Balcom et al. 1996; Mason 1998; Bailey 1998a) throughout the Boreal Forest regions of Canada. These models have been used to identify potential within both linear and areal study areas. These studies vary widely in both the application and scale of the area included in the modelling project.

These models typically utilize physiographic and hydrologic factors as a means to identify areas in which people would have conducted activities throughout the historic and prehistoric past. These models, by design, identify the areas in which sites have a high, moderate or low probability of occurring. Most models, while utilizing ethnographic and historical data, still assume a more or less constant and evenly distributed population within the study area. In an attempt to increase the correspondence between predictions and actual regional site distributions ethnographic, archaeological and other historical frameworks were investigated for the HRRSA.

Northern Cree ethnographic information and archaeological studies have recently been used to identify aggregation sites along the Saskatchewan River in northern Saskatchewan (Meyer and Thistle 1995; Wondrasek 1997). These studies have identified sites at which the Cree, who traditionally occupied the region prior to European arrival, gathered in large groups for certain seasonal events. These sites were often held at locations that were associated with seasonally available food sources as well as being convenient location for the regional band (Meyer and Thistle 1995:409).

These locations may be situated at diagnostic landforms or easily identified physical features, such as Paskwatinow, situated at the edge of the Saskatchewan River delta (Meyer et al. 1992). These centres have been identified in the literature as rendezvous sites, aggregation, gathering or congregation centres. Typically these locations were named features, or toponyms, where perhaps as many as 200 to 400 people gathered annually (Meyer et al. 1992). Some of the centres along the Saskatchewan River include: Pehonan, Nipowiwinihk (Nipawin), Paskwatinow, Opaskweyaw (The Pas), Cimawawin and Misipawistik (Meyer and Thistle 1995) and tend to be located approximately 60 to 80 km apart. Archaeological evidence indicates that large groups of people have been returning to at least some of these locations, such as Paskwatinow, Opaskweyaw and Nipowiwinihk for thousands of years. Archaeological materials from Nipowiwinihk date back as much as 5,000 years (Meyer et al. 1992).

It is most likely that a similar distribution of aggregation sites are located along the Athabasca River system. The presence of seasonal aggregation sites has been previously suggested by others, including Ives (1993) and Lifeways of Canada (1997). The Cree, who occupied the lower Athabasca River drainage basin, likely had seasonal and broad cultural patterns similar to their relatives along the Saskatchewan River to the east. Extended continuity in the use of these sites needs to be further confirmed through the archaeological record.

The seasonal round of the northern Cree, in the Saskatchewan River valley prior to 1781, has been described in broad terms (Meyer and Thistle 1995). The winter months were spent with the regional band spread throughout the territory in small groups. Subsistence would have mainly involved the hunting of moose and beaver and perhaps fishing in some of the larger lakes of the area (Meyer and Thistle 1995). Bison and caribou would have also been sought if they existed in the local environs. Some of the Saskatchewan Cree also spent parts of the winter in the Parklands or the Plains to the south. This would not have been an option for the Cree of the Lower Athabasca River valley. In the latter stages of winter the people would begin to congregate at the aggregation centres. Depending on the group and most likely the environment surrounding their chosen site, they would arrive just before or just after the ice had broken up.

Although much more food would be available in the spring than the preceding months, sufficient food would likely be too scarce to support everyone (Meyer and Thistle 1995). Cached food was likely important. Caribou, bison and elk would likely have been important large game animals which could be killed in the preceding months and cached. The arrival of the migratory waterfowl and the spring fish spawning runs were also large sources of food.

Meyer and Thistle (1995:428) note that:

> Following the spring rendezvous, it appears that the aggregations broke up into smaller social groups of highly variable size. Often, the move was to good

> fishing locations, at the mouths of streams into the Saskatchewan River, where poles weirs were maintained through the summer. ... However, some families remained at the aggregation centers for much of the summer, since they were productive fishing locations.

Small groups of people remained the social unit through the autumn as well. Some small aggregations did occur, but these were likely on a smaller scale than the spring gathering.

With the arrival of the fur traders in the Boreal Forest of Saskatchewan and Alberta the local inhabitants sought to influence the locations of where posts would be established. As the aggregation centres were already the setting for important spring political and economic gatherings, many of the posts were situated either at or near existing aggregation centres (Meyer and Thistle 1995; Wondrasek 1997).

The construction of the fur trade posts at Fort McMurray and Fort McKay are situated at roughly the same distance between aggregation centres as identified by the intensive literature and field work of Meyer and others in the Saskatchewan River valley of northern Saskatchewan and Manitoba (Meyer et al. 1992; Meyer and Thistle 1995; Wondrasek 1997). Aggregation centres have been noted in the region surrounding Fort McKay: i.e., HhOv 16 (the Cree Burn Lake site) and the Beaver River Quarry site. Numerous fur trade posts were constructed in the vicinity of Fort McKay, at the confluence of the McKay and Athabasca rivers or at the Fort Creek - Athabasca junction. These include Pierre au Calumet's post and Berens House, among others (Ives 1993:25).

An aggregation centre is also plausible at Fort McMurray. This presumption is not only based on the presence of repeated fur trade post and outpost constructions throughout the fur trade period, but it's geographic location as well. The confluence of the Athabasca and Clearwater rivers is likely to have been an easily identifiable meeting location. Other aggregation centres would have been located throughout the region as well. Potential locations may include Peace Point and Fort Vermillion (Ives 1993) as well as Eaglenest Portage in the Birch Mountains.

As discussed above, availability of food was an important factor in the establishment of an aggregation location. Another factor was relatively equal access for the entire group. The location therefore was likely situated near the middle of the traditional territory. This would allow for easier access from all locations within the larger territory. It is also speculated that other resources would be important as well. Many items used in the day to day life are scarce and difficult to obtain during the winter months. The availability of lithics, good clay for ceramic vessels (in the Late Prehistoric Period), floral materials for food, and tools may have also influenced the selection of certain locations.

These factors may have been important in the selection of the Fort McKay and Fort McMurray regions over areas such as the LSA. Very few prehistoric sites (HfOu 1 and 2) have been recorded in or adjacent to the LSA despite a relatively dedicated effort to locate any such sites. Ethnographic accounts and traditional land use studies indicate that Tar Island was an important summer and autumn fishing location (Fort McKay 1996b). Another summer fishing location was at Mildred Lake. These areas were typically utilized by one or two families in preparation for the coming winter months (Fort McKay 1996b). The surrounding forest would have been utilized for the collection of plants and possibly for obtaining some game such as moose. These activities, however, would not result in production of recoverable artifacts in any large quantities. Neither of these practices correspond with those described for major spring aggregation locations.

Quantities of important lithic materials, especially BRSS, are also lacking in the vicinity of the LSA. Archaeogeological investigations have determined that potential outcrop locations of BRSS are more likely in the region to the north of the LSA (Fenton and Ives 1990). Bedrock outcrops of usable lithic materials are rare in and around the LSA because sediment and muskeg accumulations are simply too great. Even isolated nodules or cobbles of fine grained silicious rock are rare in the LSA. Lithic materials are only observed along the edges and terraces of creeks and rivers. This probable absence of workable stone material further supports the suggestion that the study area may have seen limited use in prehistoric times.

8.5 CUMULATIVE EFFECTS

The past few years has seen a resurgence of development activity in northeastern Alberta. Many of these projects include substantial land altering impacts. These, as discussed above, have the potential to damage or even destroy cultural material and historical resource sites. The cumulative effects of these activities on historical resources are difficult to assess. Actual populations of historical resource sites are not known for this part of the world, making quantitative analyses almost impossible. Attempts have been made to understand the distribution of prehistoric and historic period sites in the region and their relation to the environment, but a lack of baseline data for much of the area makes these analyses weak in areas.

The distribution of historical resources depends not only on available resources, terrain and other environmental attributes, but is also dependent on human factors such as population densities, seasonal movement cycles, and other culture-based variables. In our attempt to model potentially sensitive areas for historical resources we have tried to incorporate as many of these variables as possible.

The HRRSA was selected to incorporate all of the existing, approved and planned oil sands mining operations that are currently known.

The model incorporates several types of data. They include slope, aspect, elevation, horizontal proximity to standing water, proximity to flowing water, soils, vegetation and a buffered area surrounding known historical forts (Appendix II). These data were selected for a number of different reasons. Previous research throughout northern Canada has determined that data sets such as these relate strongly to archaeological site distribution (Dalla Bona 1994, 1995; Balcom et al. 1996; Bailey 1998a, 1998b).

Actual historical resource site locations were not used in the creation of the potential model. This is primarily due to a number of inadequacies and biases present in the site information in northeastern Alberta. These include a non-random distribution of assessment areas, different investigation techniques used in each assessment and, perhaps most importantly, the incomplete nature of the data. Site information was used as a basis for the identification of the type of sites to be expected in the region as well as a means of checking the terrain features with which sites are associated.

Historical resources typically have been recorded in conjunction with HRIA's completed for new developments. As many of the developments in the HRRSA are large, areal projects it is rare that 100% of the land to be effected is investigated. Typically the higher potential areas within the development zone are inspected. This creates one type of bias within the site data. Representative areas are not always investigated in every HRIA. Some exceptions are present within the HRRSA, in which sample areas were inspected (Losey and Conaty 1980), research projects were conducted (Donahue 1976; Pollock 1978) and post impact assessments were completed (Ives 1988).

Another type of bias present in the site locational data relates to the principle that it is high potential areas within the local study area of each development that receive the bulk of the investigations. The definition of what is considered high potential will often vary depending on the terrain of each local study area. Criteria used to assign high potential in one development area may result in moderate potential rankings when used for other development areas.

Ethnographic and archaeological studies indicate that the presence of archaeological sites are strongly tied to the natural water courses of the Boreal Forest. The people of the region not only spent the majority of their time along these water ways, but often these areas have the highest probability for site preservation. It is important to establish that the distribution of archaeological, and to a certain degree, historical sites, are not fully represented in the archaeological record. A large percentage of the activities that have been carried out in the region in the past have not been preserved to the present day. Organic materials break down quickly in the acidic soils of the forest and are rarely preserved. Many activities, such as the gathering of wild vegetation, snaring game, etc. do not leave materials behind in the archaeological record.

The model incorporates eight sets of data, or categories, into an overall map of potential. Each of the categories contained several variables which were ranked independently of one another and mapped in ArcInfo, a GIS based program. Each category was assigned to a separate map layer within the program to graphically illustrate the importance of each variable within the HRRSA. These rankings were determined on the basis of the variable's perceived potential relationship with the identification of archaeological sites (Appendix II). Due to its importance, the proximity to water category was further divided into two subcategories representing different distances from the water's edge. The first subcategory ranges from 0-50 metres while the second ranges from 51-200 metres. This discrimination was incorporated in order to better distinguish the relative difference in the importance of a site's proximity to water.

The map layers were also given a value in importance in relation to the presence of archaeological sites. Some previous models have been constructed in this manner and have proven successful (Dalla Bona 1994). This method predetermines that some of the factors used in the model are more important in the determination of site location than others. In this type of model the values assigned to each of the categories is also ranked in order to increase or decrease the importance of a variable within the category relative to variables in other categories. For example, proximity to water may be identified as having a high significance while aspect is ranked as only moderately significant. These are referred to as weights. Ranks given to variables are referred to as values. The map is then created using the product or weighted value (weight x value = weighted value).

Weighted models are an important tool to distinguish the perceived importance of the different categories. In an effort to maximize the contribution of categories such as vegetation and proximity to water the values in the Project Millennium model were weighted with respect to their relative importance to site location.

Variables within each category were ranked on a scale of zero to ten. Each variable was given an even integer for a possibility of six different values. Zero was used to denote variables with no or extremely low significance for association with historical resources, a rank of two was given to variables with limited significance, and so forth. A rank of ten was the highest rank and denotes a variable of very high significance for association with historical resources.

8.5.1 VARIABLE RANKING FACTORS

8.5.1.1 Slope

Slope was determined to be a factor of low importance in site presence/absence, based on examination of the previously recorded sites and their terrain associations. A table was created identifying blocks of slope. Flat ground was identified as having the highest potential to contain historical resources. This reflects the typical location of sites such as campsites, lithic scatters etc. Areas with a slope of 1% to 5% were ranked as moderately important (Appendix II; Table II-1). As few historical resources within the study area are associated with steep inclines or vertical rock faces, areas demonstrating a slope ranging from 6% to 30% were ranked low. Areas of slopes greater than 30% were given a rank of zero as sites rarely occur in these environmental settings.

Slope can be an important factor in some predictive models. The large scale of this model did not allow for micro-topographic features to be identified within the model. Over 95% of the HRRSA, when plotted at this scale, is identified as having a 0 to 5% slope. Small ridges and knolls present throughout the HRRSA have proven to be valuable for the identification of archaeological sites (Ronaghan 1997).

8.5.1.2 Aspect

Aspect has also proven to be a factor, to a limited degree, in site location. Aspect will influence minor temperature variations and will be a key factor in sunlight availability, especially in the winter months. Shadows will be heavier for longer periods of time in the morning and evenings on north facing slopes. Certain cultural influences may also associate with the rising and setting of the sun. Different vegetation communities will be influenced as well.

As the terrain is largely flat and aspect has a debatable influence, it was weighted fairly low. The layer for aspect was weighted as one (Appendix II; Table II-2). The rankings for individual values ranged from two to eight.

8.5.1.3 Elevation

The elevation of a given area will affect the desirability of that location. Differing vegetation communities will be situated at various elevations. Higher elevations, slightly to the northwest of the HRRSA, include vegetation such as lodgepole pine that are not identified in the river valleys and lower elevations to the south. Other elevation factors may include access to major water sources such as class three streams and higher.

Elevation was not viewed as a highly influential category for the HRRSA and was given a low weight of one. Individual values ranged widely from two to ten (Appendix II; Table II-3). Areas with low elevation were given the highest rankings. Areas with high elevations were also classed as desirable due to the differing environmental settings they provide compared to the remainder of the HRRSA.

8.5.1.4 Soils

Soils were determined to be a relatively influential factor in the HRRSA potential model. The drainage of the sediment, the coarseness of the texture and organic content were some of the factors assessed prior to establishing individual values. Drainage is important on a number of levels. First it is an important factor in the assessment of the location with respect to habitation. Poorly drained soils such as fens are poor locations for anything other than very short term habitation and short duration hunting and gathering expeditions. Well drained soils are most often associated with archaeological materials.

Fine grained sediments are more likely to be associated with historical resources. Coarse grained sediments are poor locations for many prehistoric site types in the boreal forest, except lithic source sites and cairn locations among others. Rocky soils are often not associated strongly with habitation site locations. Reasons for this are mainly speculative. One reason may be that it is simply uncomfortable lying or sitting on uneven, rocky terrain. Other reasons may also include that sediment displacement or movement due to factors such as frost heave, bioturbation and tree throws may cause coarse sediments to alter or even destroy cultural artifacts, features and even sites. Excessive and rapid water movement through the soil may also be related to increased organic artifact destruction.

The organic nature of the soil was also investigated as a factor in the value associated with a given soil type. Highly organic soils such as in fens and bogs, while having good preservation potential for organic artifacts, have a poor potential for site identification and retrieval. As moss and other organic debris accumulate to cover the terrain, the ability to identify cultural sites is reduced. Highly organic soils such as fens are also typically flat, featureless and the variability of vegetation types is reduced. These factors tend to reduce the probability of people conducting activities which will leave behind large numbers of artifacts.

The soils layer was rated as moderately important in the potential model. A weight of two was given to this layer. Individual soils types were ranked from zero to eight (Appendix II; Table II-4).

8.5.1.5 Vegetation

Vegetation is also identified as a significant factor for the potential model. Different vegetation communities are related to site location on a number of levels. These include communities which were utilized by the population of the region for food or construction, those that provide open areas for habitation and plants that are associated with artifact/site preservation.

One must be careful in utilizing existing ecosystems for modelling for 10,000 years of regional occupation. Plant species have changed drastically through time. These changes include long term and short term shifts in the communities. Long term changes associated with past warming and cooling episodes have been documented in northeastern Alberta (Bobrowsky et al. 1990). For example, it has been shown that the southern border of the boreal forest was significantly further north during the Altithermal climatic interval (8,000 - 5,000 years ago). This mid-Holocene warming trend would have increased the amount of grasslands, which in turn would influence the wildlife that inhabited the area, leading to a change in hunting practices. During this period, the most dramatic changes would have occurred along the southern boundary of the Boreal Forest well south of the HRRSA, but the effects of such a change, would have been present to a certain degree. If sufficient changes were present in the biotic communities, different land uses may have been employed by the regional populations.

Short term changes include forest fires and flood damage to plant communities. The regrowth in these areas would bring in new species, many of which are small food bearing plants. These alterations in the vegetation were likely widely exploited by the local people.

These differences in vegetation through time are difficult, if not impossible to model effectively on a regional, or local scale. It is possible that these variations may account for some of the archaeological sites that appear to be anomalies, with regard to the model. Long term variations may also be reflected in the presence of what are typically thought to be Plains varieties of tools, such as Besant projectile points in the Boreal Forest.

The values assigned to vegetation communities were, out of necessity, based on current vegetation communities. The values and the factors used in their determination are presented in Appendix II (Table II-5).

8.5.1.6 Proximity to Standing Water

Because of the large number of small standing waterbodies in the HRRSA, lakes, sloughs and ponds were separated into two size classes prior to establishing values. The size classes were determined based on an assessment of the location and attributes of some of the smaller waterbodies on 1:50,000 scale topographic maps. Bodies of standing water that are smaller than approximately 300m x 300 m (or roughly 10 ha) do not typically have dry solid shorelines. They are often situated in the centre of fens and are often the start of primary streams. These waterbodies typically have a low probability of being associated with historical resources. Standing water bodies greater than 10 ha in size begin to show evidence of being true lakes with dry, solid shorelines shown on the topographic maps. Some of these are likely to exhibit marshy areas along their shores but some dry land will be present as well.

The water bodies of northern Alberta were the main transportation routes through the landscape. Lakes and rivers were an important feature in the lives of the local people. This was the primary reason for weighting the standing water level as a three. Standing water less than 10 ha in size was given a value of two (Appendix II; Table II-6). Those lakes greater than 10 ha in size were designated a value of eight.

8.5.1.7 Proximity to Flowing Water

The category of flowing water includes streams, creeks minor and major rivers. These vary widely in importance with respect to historical resource potential. In order to determine the importance of each water course it was first necessary to classify each according to their size. This was accomplished by ranking of the order of magnitude of all of the permanent waterways that appeared on a 1:50,000 scale topographic map within the HRRSA. Primary tributaries, that have no feeder streams leading in to them were ranked as first order water courses. Secondary water courses began at the confluence of two primary streams, third order streams began at the confluence of two secondary streams and so forth. The highest ranked water course was the Athabasca River downstream of the confluence with the Muskeg River. It was classified as a sixth order river at this point. As the tributary basins of some of the rivers begin well outside of the HRRSA some of the tributaries could not be easily traced to their original sources. In cases such as these the tributaries were traced outside of the HRRSA until a degree of confidence could be achieved in order of assignment.

Once the rivers and creeks were ranked, two buffer sizes were selected on each side of the waterways. These buffers ranged from 0 - 50m and from 51 - 200m in width. Values were then attached to each of these buffers based on the order of the associated water course.

Based on ethnographic and archaeological information (i.e. Meyer and Thistle 1995) the major water courses were likely the most important water courses in the region. All other streams lead into these waterbodies and they are of regional significance. As with standing water the importance of these water courses are very high with respect to the historical resource potential of the region. The flowing water layer was therefore also weighted as a three. The highest ordered water courses were given greatest values. The 0 - 50m buffer associated with fourth and sixth order waterways were given a value of ten (Appendix II; Table II-7). Second and third order water (0 - 50m buffer) were given a value of six and primary streams were given a value of two.

The second set of buffers were situated from 50 - 200 m from the water's edge. The buffers identify a wide strip of land, within which it is expected that most sites will be located, if water was a determining factor in the location of the site. As these buffers are slightly removed from the water's edge, the values associated with them are slightly lower than the first set of buffers. The value attributed to fourth to sixth order water was a six. The value attributed to a third or fourth order stream is two and a first order water body was valued at zero. The terrain associated with primary streams within the HRRSA is such that sites situated further than 50 m off of primary streams are likely located there for reasons other than their association with the water course.

One factor in mapping the standing water and flowing water on two separate map layers is identified in the additive nature of the model. If standing and flowing water are present on one map layer there is no overlap of the values associated with the buffers. In areas where two buffers intersect the highest ranked buffer is used as the value for those cells. The buffers are all constructed as one consecutive value. If the two are placed on separate layers, anywhere a buffer surrounding a standing waterbody overlaps the buffer for a flowing waterbody the values are added together. This increases the potential for land around the confluences of streams and lakes. Conventional archaeological thought typically associates these areas as being of high potential for historical resources. These are more attractive locations, geographically speaking, in that two different types of water resources can be exploited in one relatively closely contained area. For example, certain varieties of waterfowl may prefer to nest or feed on standing water while fish species may be easier to obtain within the relatively shallower creeks and streams. Differing vegetation may also be a factor along the shores of standing and flowing water.

A similar high potential is often assigned to the confluence of two flowing waterbodies. For the purposes of this model these confluences were not treated differentially from the rest of the water course. If the confluence consisted of two equal value streams, the order of the water body increases after the confluence. This increase, depending on the new magnitude of the stream, may increase the value of the surrounding area regardless of whether there is differential treatment of the confluence area itself. An effort was also made to limit the number of purely aquatic related variables in the model so as to not bias the result.

8.5.1.8 Historic Fur Trade Post Locations

A map layer was added in order to distinguish the importance of historic fur trade post locations within the HRRSA. Four general areas along the Athabasca and Clearwater rivers are known to have been the location of one or more historic posts. Precise buffers could not be used, as the exact location for some of these posts is problematic. Historic maps and documentation for these forts identify their general location, such as at the mouth of the McKay River, but precise UTM coordinates are not available.

These sites were chosen to represent a distinct layer of the model for two reasons. The first is that they represent a distinct class of sites which is associated with a small window of the region's long occupation. Secondly, and more importantly, the locations of these sites were chosen because they represent known preferred locations probably associated with a larger set of historic and prehistoric sites. The association of historic fur trade posts and important prehistoric and protohistoric sites, such as aggregation sites, in other regions of the Boreal Forest indicates that areas around these sites may encompass other previously unrecorded sites.

The fur trade post buffers were created to include the general areas identified where historic posts were constructed. Many of these forts lasted less than five years and preserved artifacts may be low in frequency. The value associated with these locations was therefore established as a six (Appendix II; Table II-8). The weighting of the layer was also moderate in its ranking. It was set as a two. This layer weight was established for several reasons. First, these sites may only be associated with sites dating to the past few hundred or thousand years out of potentially 10,000 years of occupation. Second, sites are also strongly associated with the major waterways of the region which are already heavily weighted.

8.5.2 Discussion

The distribution of high, moderate and low potential throughout the HRRSA is illustrated on Figure 6. The areas identified by the model as having high potential were arbitrarily set to represent the highest 5.7% of the landscape. The moderate and low potential areas encompass 23.4 and 70.8% of the HRRSA respectively.

High potential is distributed throughout the HRRSA boundaries. As expected, the shores and terraces of the Athabasca, Clearwater, Steepbank, MacKay, Muskeg, Firebag, Ells and the Tar Rivers rank as high potential areas. Areas surrounding major standing waterbodies such as McClelland, Beaver, Ruth and Kearl Lakes also rank highly. Other areas of high potential are present off of the main waterbodies. These zones of potential include buffered areas adjacent to lesser waterbodies, as well as upland regions.

A number of distinct zones of high potential are observable away from waterways. These include areas south of the Syncrude mine/Lease 86/17, to the southwest of Beaver and Ruth Lakes. This area is situated between these lakes and the Athabasca River and the Thickwood hills, located further southwest. Moderate to high potential is also observed throughout the region between the Dover and MacKay Rivers, west of the Syncrude operation.

Concentrated areas of high potential are also situated throughout the north central portion of the HRRSA. These include areas south and southwest of Kearl Lake, as well as a large area to the northeast of Saline Lake, near the headwaters of Hartley Creek. The Fort Hills also rank as having high potential for historical resources.

Areas in the eastern portion of the HRRSA tend to rank lower than those in the west and north. A slight increase in potential is observed in the buffered region along the North Steepbank River. Small areas of moderate potential are also depicted in the upland area between the North Steepbank and Steepbank rivers. The region to the south of the Thickwood Hills also ranks as relatively low potential for historical resources.

Low potential areas are also depicted in regions where existing disturbances such as Fort McMurray the Syncrude Mine and other small disturbances did not allow for accurate pre-disturbance information to be included in the model. These areas would likely have demonstrated higher potential had the information been present.

A total of 352 historical resource sites have been recorded within the HRRSA in Alberta Community Development's prehistoric sites records and which have the locational information required for further analysis. The location of these sites have been overlaid on the map of potential (Figure 10). Several additional sites have been recently identified or are currently under review by ACD. Information relating to their types and locations is not available at this time. If these sites were included in the analysis in excess of 400 prehistoric sites would be present in the HRRSA.

The majority of these sites are artifact scatters (n=114), followed by isolated finds (n=91). Both of these site types show an association with terrace landforms. Campsites (n=57) and workshops (n=24), common site types in the HRRSA, tend to be associated with terrace features as well. Ridges also have a high incidence of sites. Common between these two landforms is the fact that they are well drained and the vegetation is typically fairly open, mixed wood communities. Lesser numbers of prehistoric quarries, and sites listed as a combination of categories (e.g. campsite/workshop, workshop/scatter etc.) are also present within the HRRSA.

In addition, 71 historic period sites have been recorded at the Historical Sites Service (Alberta Community Development). These sites include numerous wells and several ranger stations, lookout towers, fur trade posts, mounted police posts, missions, cabins and an historic steamboat. Locational information regarding the historic period sites is filed using the legal land classification system. Some of this information is available only to the section level of classification. UTM coordinates or other means of precisely locating these sites is not available. Because of this discrepancy, these sites could not be plotted effectively on Figure 10.

As they are historic period sites, they are typically located in areas of recent development. These include the townsites and surrounding areas of Fort McMurray and Fort McKay as well as along the banks of the Athabasca and Clearwater Rivers. Site file searches completed at the Historic Sites Service in Edmonton revealed that almost all of the historic period sites recorded are in close proximity to the Athabasca, Clearwater or Christina Rivers. The legal descriptions of some early oil exploration well locations were recorded in areas that range up to 12 kilometres from the Athabasca River. Even the majority of these sites lie within ten kilometres of the river. One notable exception to this pattern of distribution is the Thickwood Hills lookout tower. This site is located in relative isolation from the typical patterning of historic sites. This site does, however, lie within an area of moderate to high potential in Section 11-T90-R12-W4M.

Two of these sites are also recorded as archaeological sites with more precise locational information. These two sites, as well as some other historic period archaeological sites have been plotted using the UTM information. In addition to the remaining 350 sites with Borden numbers, a total of 421 historical resources from within the HRRSA were used in this analysis.

A total of 11 sections of land are listed on file with ACD as relating to 12 significant or provincially registered sites (Figure 10). These sections are all subject to specific restrictions with respect to surface access. These sites include historic and prehistoric sites and are all located in close proximity to the Athabasca River.

Fourteen 'Buffer Zones' are also present in the HRRSA. Buffer zones are areas designated by ACD in lands adjacent to designated sites or areas which are of high potential for historical or palaeontological materials (Figure 10). These sections may be subject to specific restrictions regarding surface access. As the designated sites and buffer zones are described by the section of land in which they are located, an identification of the historical resource potential for the exact site location is not possible. These sections are of variable potential, although most exhibit concentrations of high and moderate potential.

Part of the traditional seasonal movements of the people of the region included large spring aggregations. These multi-family gatherings took place annually and were held in centralized areas of plentiful food and easy access for all involved. Aggregation centres have been documented along the Saskatchewan River and are present approximately every 60 to 80 kilometres. It was also noted that these sites are often in close proximity to fur trade post locations (Meyer and Thistle 1995, Wondrasek 1997). At least two such areas are present within the confines of the HRRSA. These include the Cree Burn Lake site (HhOv 16), near Fort McKay and the confluence of the Clearwater and Athabasca Rivers, at Fort McMurray. It is possible that additional aggregation sites are present although archaeological investigations have not identified any so far. These sites, and any others that may be identified in the future, would be considered significant sites in the region.

A visual inspection of the site distribution provides a means of assessing the accuracy of the potential model to depict historical resource sensitivity within areas where HRIAs have been conducted. A distinct correlation can be seen between areas of high to moderate potential and the location of sites. One exception is, again, the site sites located in the "low potential" zone along the Beaver River within the Syncrude lease where a lack of soils and vegetation baseline data has artificially lowered the potential of the local area. Such areas were not used in the numerical examination of the models' accuracy.

A numerical analysis of the sites in the area was also performed. A total of 286 sites, located outside of previously disturbed areas, were used in this analysis. Due to differences in the accuracy of site data and the model, nine sites were classified as being within lakes or rivers. These sites were manually adjusted to the closest shoreline. Of the total number of sites, a total of 26.9% (n=77) are located in areas of high potential, 39.5% (n=113) are within moderate and 33.6% (n=96) are within low potential areas. In excess of 66.4% of the sites are located within high to moderate potential zones. It should be stressed again that these site locations are predominantly a reflection of the locations of previous HRIA investigations. The distribution of these sites include all of the biases involved in each of those programs.

At first glance the percentage of historical resources in high potential areas appears to be acceptable. A predictive model is referred to as successful if it predicts at a minimum the location of 40% of the sites within 40% of the landbase, as would be expected by chance (Kvamme 1992). Calculations of sites per total area reveals that a 5 to 1 ratio is present for sites to be located in a high potential area (Table 5).

Table 5 Relationship of Known Sites and Areas of the High, Moderate and Low Potential Areas in the HRRSA

Potential	Number of sites (in undisturbed lands)	Percent total sites	Potential in HRRSA (%)	Sites (%) : area of potential (%)
High	77	26.9	5.4	5 : 1
Moderate	113	39.5	23.2	1.7 : 1
Low	96	33.6	71.3	0.5 : 1

Although the actual percentages are moderately successful, the model appears to depict the overall trend in historical resource potential within the region. The majority of the sites classified as being in low potential areas are roughly within 200 metres of high or moderate terrain. These sites may relate to areas which are of low regional potential, but exhibit high potential on a local scale. Previous research has confirmed the importance of local, microtopographic features with respect to the location of historical resources in the Muskeg River area of the HRRSA (Ronaghan 1997). Small knolls and ridges were very important features with respect to historical resource site locations. These features, which contained the majority of sites identified during the study on Shell Canada's Lease 13 are too small to be identified in a regional map of this scale. It is therefore important to use this map as a general indication of regional potential in association with detailed assessment of local topography.

Slight anomalies have also been identified in the adaption of the site data to the model. The historical resource sites are plotted within the computer as points. These points have no actual size or area within the model and represent only a pin-point of the UTM grid coordinates. When the computer is called to make a decision of how many of the sites are present within high moderate or low potential cells it does not consider how close each site is to the adjacent cell. Several (i.e. $n > 20$ sites) were identified within 5 m of a cell boundary where the neighbouring cell was of greater or lesser potential. Many sites, in reality, have areas in excess of 5 m in diameter. These sites may actually be in areas of higher or lesser potential when identified in the field.

The site locational information was entered into the computer as UTM coordinates. These were initially recorded to the nearest 100 m, some were accurate to the nearest 50 metres. The grid cells for the base map layers are 25 m by 25 m in size. When the sites are plotted by the computer onto the map, a single 25 x 25 m cell is selected to be associated with that point. Due to the difference in precision, and excluding any human errors in the recording and plotting of the sites onto the original 1:50,000 topographic maps, it is anticipated that some errors will be present in the site locational information. As a check of the precision of the site plotting an assessment of sites along shorelines was conducted. A total of nine sites were plotted, based on the UTM coordinates, by the computer slightly into areas identified as rivers or lakes. It is apparent then that the model and the locational information for the sites is not fully compatible.

9. SUMMARY AND CONCLUSIONS

Prior to the initiation of the field component of the Historical Resources Impact Assessment a literature and site file search was completed. These were initiated to better understand the known archaeological data and to identify any concerns within the study area. The site file search indicated that only two historical resource sites were previously identified within the LSA. These sites, HfOu 1 and HfOu 2, were recorded during the HRIA of the Steepbank Mine Project area. These sites are comprised of small isolated lithic artifact find locations situated in areas considered to be of high potential for historical resources (Golder 1996). No further work was recommended at either site prior to the initiation of the Steepbank Mine Project.

Subsequent to completing the background research, criteria were identified that appear to be associated with prehistoric archaeological site locations in this region. These criteria were used to produce a map indicating areas of high, moderate and low potential for archaeological sites. While such models are of value in guiding specific field programs, the map produced was intended to identify only the relative potential for the Project Millennium area. It was not designed to identify the historical resource potential throughout the HRRSA. Previous HRIA's within the HRRSA, as well as other research such as the work of Fenton and Ives (1990) regarding potential outcrop locations for Beaver River Sandstone, were consulted in identifying the criteria used to predict the historical resource potential of the LSA. These maps were further refined in the field, based on visual aerial inspection of the LSA from a helicopter and on-ground observations These revisions formed the basis of the field investigations conducted for the Project Millennium HRIA. All areas that have a high probability for historical resources were examined and intensely shovel tested. Transects were also completed through all of the moderate potential areas, as depicted in Figure 7.

Approximately 474.4 ha (1,172 acres) of land was intensively inspected and a total of 1,629 shovel tests were excavated. Rigorous shovel testing was completed in the few areas present within the HRIA boundaries which exhibited a strong probability for the presence of archaeological materials. Twenty-two hectares of high potential (100%) were inspected and shovel tested, 210.64 hectares of moderate were assessed (17.6%) and 132.46 hectares of the low potential areas were assessed (2.5%). No further historical resources were identified within the

Project Millennium development area during the course of the field investigations. The number of shovel tests excavated, transects and surface examination completed are considered more than adequate, given the terrain, to be confident of the results of the HRIA. Further investigations of the area would be considered unwarranted, as there are no areas of high potential that have not been assessed and significant historical resources would not likely be encountered.

One outcrop along the Athabasca river was observed to contain palaeontological materials; however, this location is not within the Project Millennium development area. Several examples of stromatoporoids, small mollusc shells and other marine invertebrate fossils were noted at the locale. The outcrop is part of the Moberly Member of the Waterways formation, and is Upper Devonian in age (Paul Johnson, Royal Tyrrell Museum Personnel, pers. comm, 1998). The Waterways formation underlies much northeastern Alberta and outcrops in several locations throughout the Athabasca and Clearwater River valleys.

Based on the previous research completed in the HRRSA, including the HRIA work completed within the LSA, comparatively few historical resource sites appear to exist within the LSA. Only two archaeological sites and one palaeontological location have been identified within the LSA. All three of these locales are situated outside of the Project Millennium development area. Three additional historic period occupation locales were observed but are not of sufficient age to be considered historical resources. No additional archaeological or historical resources were recorded in the 1997 Project Millennium HRIA.

While the presence or absence of palaeontological material is principally dependent on the underlying geology of the region, the rationale for the absence of archaeological sites is more complex. Several reasons are suggested for this apparent lack of cultural material. One of the main factors explaining the lack of sites may be the relatively low potential of the Project Millennium development area, as illustrated by the HRRSA potential model (Figure 6). The HRIA study area for Project Millennium is dominated by low lying areas with substantial muskeg accumulations. While these were not always present in the region (i.e., prior to 5,000 B.P.) poorly drained soil conditions would have prevailed in this region, giving it low potential for most aspects of long term habitation.

Additional environmental factors that decrease the historical resource potential of the local study area include an often large vertical distance to water. Sections along the Steepbank and Athabasca rivers, as well as areas near the mouths of Wood and McLean creeks have extremely steep access to the water edge from their upper terraces.

Other studies have indicated that there is a higher probability for the existence of outcrops of BRSS north of the LSA (Fenton and Ives 1990). The underlying sedimentary conditions of the RSA suggest that the bedrock containing the BRSS is much closer to the surface in the area adjacent to the Muskeg River. As this stone is the primary lithic material of the region it is presumed that more time was spent in areas where the material was likely to be easily obtained. The geological exposures in the LSA contain few good quality, fine grained silicious rocks. Cobbles and boulders are present in local till and along river and creek shores, but these tend to be coarse grained materials, not noted for their flint knapping qualities.

The Project Millennium development area is located between two spring aggregation centre areas. One located around Fort McKay and the other centred around the Fort McMurray area. These aggregation locales have demonstrated large scale archaeological sites in other regions (Meyer and Thistle 1995). These sites relate to gatherings of large numbers people which often lasted extended periods of time. It is suggested that outside of these aggregation areas the inter- and intra-site distribution is not as dense or prolific. The Project Millennium development area may be located where activities, or at least those which translate to the archaeological record, were not as abundant as around Fort McMurray or Fort McKay. The lower site distribution within the Project Millennium development area supports this settlement pattern.

In order to identify the potential for historical resources in a quantifiable manner a map was produced to illustrate areas of high, moderate and low potential throughout the HRRSA. The Project Millennium LSA was identified as having an overall low potential for historical resources, in a similar manner to that identified in the map produced for the HRIA. The local negative impacts pertaining to Project Millennium are negligible. As no known historical resources will be effected as part of Project Millennium the regional effect of the project is also negligible.

10. RECOMMENDATIONS

No historical resource sites were recorded during the course of the Project Millennium Historical Resources Impact Assessment. Three locations were observed at which cultural features or structures are present, but these sites do not qualify as historical resources under the Alberta Historical Resources Act due to the fact that the sites are less than 50 years old. These locations include two with cabins and one with a cultural depression. One other scatter of recent refuse was observed associated with a well pad. All of these sites will be destroyed by the proposed development. Although these sites do not qualify as historical resources, they do aid in the understanding of current and traditional use of the area. These sites are not recommended for further assessment or mitigation work prior to the initiation of the project.

Five historical sites, HS 44043, 44044, 44045, 44046 and 44047 were also identified within the LSA. These sites relate to early oil exploration in the Athabasca region, dating to approximately 1906-1909. References on the Historical Sites form suggest that the sites were recorded from literature searches. There is no indication that any of these sites were ever field truthed. No evidence of these sites was observed in the field during this HRIA.

One palaeontological location was also noted along the Athabasca River. This site is situated outside of the Project Millennium development area, but is within the overall study area. The outcrop relates to the Moberly Member of the Waterways formation which outcrops regularly along the Athabasca River and underlies the entire oilsands region. The materials observed include Upper Devonian aged stromatoporoids, small brachiopod shells, nautiloids and other aquatic, invertebrate fossils. The photo-documentation and mapping of the material is believed to have mitigated current erosional impacts at this locale. No further work is recommended at the site.

No further work is recommended prior to the initiation of Project Millennium. While Golder is relatively confident in the results of this assessment, in the event that further cultural remains are encountered during the course of the Project development stages, Suncor will notify Alberta Community Development in order to assess and evaluate any sites encountered. It is recommended that Suncor Project Millennium be allowed to proceed.

11. CLOSURE

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

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APPENDIX I

GLOSSARY OF TECHNICAL TERMS

Activity Area	A limited portion of a site in which a specialized cultural function was carried out, such as hide scraping, tool manufacture, food preparation, etc.
Atlatl	A hand held wooden implement in which a spear shaft is placed. The resultant extension of the arm increases the velocity and accuracy of the spear itself.
Archaeology	The scientific discipline responsible for studying the unwritten portion of man's historic and prehistoric past.
Artifact	Any portable object modified or manufactured by man.
Artifact Find	A site with five or fewer artifacts.
Artifact Scatter	A site with six or more artifacts.
Assemblage	A collection of cultural materials from a sampling area or unit such as a site, pit, or level.
Association	Archaeological materials are said to be associated when they are found in close proximity in an undisturbed context.
Awl	A pointed tool for making holes as in wood or leather.
Barb (Tang)	A sharp projection on the lateral margins of an artifact, near the base. Commonly used in describing the shoulder of a projectile point.
Basal Thinning	The intentional removal of small longitudinal flakes form the base of a chipped stone projectile point or knife to facilitate hafting.
Basalt	A dark igneous rock with variable textures.
Biface	A stone artifact flaked on both surfaces.
Bi-polar	The technique of resting a core, or lithic implement on an anvil and striking the core with a percussor. Contrary to popular belief, bulbs of force are not present on both ends of bi-polar flakes or blades. This technique causes the cone of force to be shattered or severed.
Blade (lamellar flake)	A flake with parallel edges and a length which is equal to or twice the width. The blade classification includes prismatic blades, microblades and ridge flakes.
Blank	An advanced preliminary stage in the manufacture of an artifact.
Borden Block	Map units of 10' latitude by 10' longitude used to facilitate site designation.

B.P.	Before Present. 1,000 B.P. = 1,000 years before 1950 A.D., or approximately 1000 A.D.
Cairn	Stones intentionally piled by humans.
Ceramics	Clay artifacts, such as vessels, that have been intentionally fired.
Chalcedony	A cryptocrystalline variety of quartz composed predominantly of silica and having the near luster of paraffin wax. May be transparent or translucent and of various tints.
Chert	A fine-grained siliceous rock. Impure variety of chalcedony which is generally light coloured.
Chi Thos	A large, crudely manufactured scraper made from sandstone. It is typically bifacially worked along a blunted convex edge.
Chopper	A natural pebble or cobble with a crude, steep cutting edge formed by unifacial percussion flaking.
Conifers	White and black spruce, balsam fir, jack pine and tamarack.
Core	A blocky nucleus of stone from which flakes or blades have been removed.
Complex	A consistently recurring assemblage of artifacts or traits which may be indicative of a specific set of activities, or a common cultural tradition.
Core Reduction/ Rejuvenation (trimming flakes)	Intentional flake wastage in the process of further flake removal. Flakes exhibit the remnants of past platforms and are removed by percussion or pressure techniques. They can be further separated into transverse or lateral trimming flakes depending on their point of impact.
Cortex	Fresh surface of a nodule which has been altered by weathering.
Culture	The sum of man's non-biological behavioral traits - learned, patterned and adaptive.
Debitage	Waste by-products from tool manufacture.
Disturbance	A cultural deposit is said to be disturbed when the original sequence of deposition has been altered. Agents of disturbance include erosion, plant or animal activity, cultivation, excavations, etc.
Drill/Perforator	A pointed, edge-retouched tool which is rotated on the long axis for the purpose of drilling usually into wood or bone.
Environmental Impact Assessment	A review of the effects that a proposed development will have on the local and regional environment.

Faunal Remains	Bones and other animal parts found in archaeological sites.
Feature	A non-portable product of human workmanship. This includes hearths, structural remains, clusters of associated objects, etc.
Fire-cracked Rock	Heat fractured stone that results from rapid or alternate heating and cooling as in stone boiling or in campfires.
Flake	A fragment removed from a core of cryptocrystalline or fine-grained rock by percussion or pressure. The flake may be utilized as a tool itself if suitable for a particular task or may be formed into a specific tool by further flaking. A typical flake will display a platform or striking surface, bulb of percussion and rings of force radiating from the platform.
Flint	A microcrystalline silicate rock similar to chert.
GIS	Geographical Information Systems. A computer mapping system used in predictive modelling.
Graver	A small pointed or chisel-like stone tool used for incising or engraving. Generally made by pressure flaking.
Hafted Biface	A biface which shows evidence of having been hafted to a shaft, but which is not the correct shape for a projectile.
Hammerstone	A rounded stone used for hammering as evidenced by a battered or crushed striking surface.
Hearth	A fireplace.
Historical Resource Impact Assessment	A review of the effects that a proposed development will have on the local and regional historic and prehistoric heritage of the province.
Historical/Heritage Resources	Works of nature or of man which are valued for their palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific, or aesthetic interest.
In-Situ	Items found in the location where they were deposited.
Isolated Find	The occurrence of a single artifact with no associated artifacts or features.
Knife River Flint	A dark coloured chert commonly used for tools on the Northern Plains.
Lithics	Of or pertaining to stone.

Lithic Scatter	A small concentration of lithic (stone) artifacts on the surface. This term is usually used when there is insufficient information present to identify the function of the site.
Microclimate	The temperature, precipitation and wind velocity in a restricted or localized area, site or habitat.
Multi-directional Core	A core bearing scars which show that flakes or blades were removed in more than two directions.
Ochre	Iron oxide or hematite. The colour is generally reddish-brown to yellow. Used as a natural pigment.
Obsidian	Volcanic glass which is easily worked into tools and attains a very sharp edge.
Pebble Core	So termed because of its size. These miniature objective pieces will display the full range of reduction processes such as bipolar and multidirectional flake removal often associated with larger core artifacts.
Permit Holder	The director of an Historical Resource Impact Assessment. Responsible for the satisfactory completion of all field and laboratory work and author of the technical report.
Petrified Wood	Agatized wood used for the manufacture of stone artifacts.
Pictograph	Aboriginally painted designs on natural rock surfaces. Red ochre is the most frequently used pigment.
Pièces Esquillées	A tool which is generally rectangular in outline and presumably used as a wedge. It is manufactured using bi-polar flaking resulting in primary and secondary striking platforms.
Primary Flakes	The first series of flakes removed from a core or nucleus in the process of tool manufacture.
Primary Decortication Flake	First series of flakes removed from a nodule. The dorsal surface of such flakes are covered by cortex and lack any real arris or flake scars on dorsal side. Removed by percussion or pressure technique.
Projectile Point	An inclusive term for arrow, spear or dart points. Characterized by a symmetrical point, a relatively thin cross-section and some element to allow attachment to the projectile shaft. Flaked stone projectile points are usually classified by their outline form.
Provenience	The horizontal and/or vertical position of an artifact in relation to known coordinates.

Quartz Crystal	Pure silicate rock crystal. Usually perfectly clear.
Quartzite	A granular metamorphic rock consisting essentially of quartz.
Retouch/ Resharpening Flakes	Varying in size from large to microscopic, they are driven off the lateral edges of a flake by pressure to form a sharp edge (retouch) or to maintain the sharp edge of an existing tool (resharpening).
Rock Alignment	Any artificial arrangement of rocks or boulders into rows or other patterns.
Sanitary Can	Specific design of metal can also known as an open topped can. Typically consists of a lapped or locked side seam and rolled or crimped lip. Invented in 1896.
Scraper	A tool presumably used in scraping, scouring or planing functions. Most frequently refers to flaked stone artifacts with one or more steep unifacially retouched edge(s).
Secondary Flake	Lithic fragment intentionally removed from a core by percussion or pressure techniques. They vary in size and shape with core types and core preparation. All exhibit platforms and/or other definitive removal characteristics.
Secondary Decortication Flake	Second series of flakes removed from a nodule by percussion or pressure techniques. Are partially covered by cortex and most commonly exhibit an arris.
Site	Any location with detectable evidence of past human activity.
Spall	A large flake driven off of a cobble. One hundred percent of its dorsal surface covered with cortex. Thick mid-section with a pronounced outward curve.
Stem	An area of decreased width at the base of the point which has straight parallel sides. The stem is often restricted to the bottom 1-2 cm of the point and was made to facilitate hafting the point to a shaft.
Stone Circle	A circle of rocks used to hold down the edges of a conical tent.
Stratigraphy	The depositional layers within a site.
Thinning Flake	Removed by pressure to rejuvenate the lateral edge of an existing flake. They are characteristically longer than they are wide with a pronounced inward curve to them.
Till	Sediments laid down by glacial ice.
Tipi Ring/ Stone Circle	A circle of rocks used to hold down the edges of a conical tent.

Typology	The classification of artifacts according to analytical criteria, to determine and define significant trends or variations in time and space.
Uniface	A stone artifact flaked only on one surface.
Utilized Flake	A stone flake used for a tool without deliberate retouch, but exhibiting use-wear.
Wedge	A piece of rock, wood or metal tapered for insertion in a narrow crevice and used for splitting, tightening, severing or levering.

APPENDIX II

CRITERIA RANKINGS FOR HISTORICAL RESOURCES REGIONAL STUDY AREA POTENTIAL MAP

Table II-1 Variable Ranking for the Slope Layer of the HRRSA Potential Map

Slope	Category Weight	Ranking	Weighted Value
Flat	1	10	10
1-5%	1	6	6
6-15%	1	2	2
16-30%	1	2	2
> 31%	1	0	0

Table II-2 Variable Ranking for the Aspect Layer of the HRRSA Potential Map

Aspect	Category Weight	Ranking	Weighted Value
North	1	2	2
Northeast	1	2	2
East	1	6	6
Southeast	1	4	4
West	1	4	4
Southwest	1	6	6
South	1	8	8
Northwest	1	2	2
Flat	1	8	8

Table II-3 Variable Ranking for the Elevation Layer of the HRRSA Potential Map

Elevation	Category Weight	Ranking	Weighted Value
200-250	1	10	10
251-300	1	10	10
301-350	1	10	10
351-400	1	8	8
401-450	1	2	2
451-500	1	2	2
501-550	1	2	2
551-600	1	4	4
601-650	1	4	4
651-700	1	6	6

Table II-4 Variable Ranking for the Soils Layer of the HRRSA Potential Map

Map Unit	Landform	Drainage	Weight	Rank	Weighted Value
Algar	Glaciolacustrine over till; non-slightly stony	Poor	2	2	4
Bitumount	Eolian and Glaciofluvial; sandy; non-slightly stony	Poor	2	2	4
Buckton	Colluvial; loamy to clayey; non-moderately stony	Well	2	6	12
Chipewyan	Fluvial; delta deposits, loamy non-stony	Imperfectly	2	4	8
Disturbed	Variable	Variable	2	0	0
Dover	Glaciolacustrine over till; non-slightly stony	Moderately well to well	2	8	16
Eaglesham	Fen	Very poor	2	0	0
Firebag	Glaciofluvial; moderate - exceedingly stony	Rapidly/very rapidly	2	8	16
Heart	Eolian, sandy slightly stony	Rapidly/v. rapidly	2	8	16
Horse River	Morainal, loamy-clayey; moderate-very stony	Well	2	6	12
Joslyn	Glaciolacustrine over till; non-slightly stony	Well to imperfectly	2	6	12
Kearl	Glaciolacustrine beach ridges sandy; non-slightly stony	Well to rapidly	2	8	16
Kenzie	Bog; fibric and mesic peat	Poor	2	0	0
Kinosis	Morainal; moderately-exceedingly stony	Well	2	6	12
Legend	Morainal; moderately-exceedingly stony	Well to imperfectly	2	4	8
Livock	Glaciolacustrine and glacio-fluvial over till; non - slightly stony	Well	2	6	12
Mamawi	Fluvial; delta deposits; ; non-stony	Poor	2	4	8
Mcmurray	Fluvial; channel deposits; non-slightly stony	Poor/imperfectly	2	4	8
Mikkwa	Bog; fibric and mesic peat	Very poor	2	0	0
Mildred	Glaciofluvial; outwash plains; non-moderately stony	Rapidly	2	8	16
Namur	Fluvial; fans and aprons; non-slightly stony	Imperfectly/poor	2	2	4
Rock	Rock outcrops	Rapidly	2	6	12
Rough Broken	Undifferentiated; steep, unstable stream banks	Rapidly	2	2	4
Ruth Lake	Glaciofluvial; meltwater channel deposits; slightly -excessively stony	Moderately well to rapidly	2	6	12
Steepbank	Morainal and glaciolacustrine fluvial; outwash plains; non-moderately stony	Poor	2	2	4
Surmont	Morainal; slightly-very stony	Well	2	6	12
Water	Current rivers, lakes, creeks and streams etc.	Not applicable	2	0	0

Table II-5 Variable Ranking for the Vegetation Layer of the HRRSA Potential Map

Map Codes	Boreal Mixedwood	Weight	Ranking	Weighted Value
Open Pine Lichen	Lichen (Pj) a1	2	10	20
	Blueberry Aw (Bw) b2 Low-bush cranberry (Aw) d1 Dogwood (Pb-Aw) e1 <10% Horsetail (Pb-Aw) f1 <10%	2	8	16
Mixedwood (Sw-Aw Dom.)	Blueberry (Aw-Sw) b3 Low-bush cranberry (Aw-Sw) d2 Dogwood (Pb-Sw) e2 <10% Horsetail (Pb-Sw) f2 <10%	2	8	16
Mixed Coniferous (Sw Dom.)	Low-bush cranberry (Sw) d3 Dogwood (Sw) e3<10% Horsetail (Sw) f3<10%	2	8	16
Mixed Coniferous (Sw-Pj/Pl Dom.)	Blueberry (Sw-Pj) b4	2	6	12
Mixed Coniferous (Pj/Pl Dom.)	Blueberry (Sw-Pj) b4 Labrador tea -mesic (Pj-Sb) c1 Labrador tea-subhygric (Sb-Pj) g1	2	8	16
Mixed Coniferous (Sb-Lt)	Non-wetland Sb-Lt	2	4	8
Wet Closed Coniferous (Sb)	Treed poor fen j1 Treed rich fen k1 Treed bog i1	2	2	4
Wet Open Coniferous (Sb)	Treed poor fen j1 Treed rich fen k1 Treed bog i1	2	2	4
Pine Recolonization (Pine <2m)	shrubland dominated by Pine	2	4	8
Shrubland (low shrub recolonzation no pine)		2	4	8
Bog (sphagnum around edges of graminoid fens)	Shrubby bog i2	2	2	4
Bog (shrub dom.)		2	2	4
Shrubby Fen	Shrubby poor fen j2 Shrubby rich fen k2	2	2	4
Graminoid Fen	Graminoid rich fen k3	2	2	4
Marsh emergent	marsh l1	2	6	12
Forestry Cutblocks		2	6	12
Disturbed Lands		2	0	0
Water		2	0	0

Table II-6 Variable Ranking for the Horizontal Proximity to Standing Water Layer of the HRRSA Potential Map

Buffer From Water Edge	Lake Size	Weight	Ranking	Weighted Value
0-50 m	lake >10 ha in size	3	10	30
0-50 m	lake <10 ha in size	3	4	12
51-200 m	lake >10 ha in size	3	6	16
51-200 m	lake <10 ha in size	3	2	6

Table II-7 Variable Ranking for the Horizontal Proximity to Flowing Water Layer of the HRRSA Potential Map

Buffer From Water Edge	Stream Order	Weight	Ranking	Weighted Value
0-50 m	4-6	3	10	30
0-50 m	2-3	3	6	18
0-50 m	1	3	2	6
51-200 m	4-6	3	6	18
51-200 m	2-3	3	2	6
51-200 m	1	3	0	0

Table II-8 Variable Ranking for the Known Locations of Historic Fur Trade Posts.

Historic Fort Buffer	Weight	Ranking	Weighted Value
Inside Buffer	2	6	12
Outside Buffer	2	0	0