ARCHAEOLOGICAL OVERVIEW ASSESSMENT

OF LANDSCAPE UNITS G20, G21, G23, G24, G25, G26, G27 AND G28,

COLUMBIA FOREST DISTRICT

prepared for Louisiana-Pacific Canada Ltd.

by

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Credits

Analysis of aerial photos, polygon mapping, database development and report preparation was done by consultant archaeologist Wayne Choquette. GIS data management was taken care of by Jose Galdamez of the Ktunaxa/Kinbasket Treaty Council. The contract was administered for Louisiana-Pacific Canada Ltd. by Carole Savage of Highwood Forest Management.

Management Summary

The Provincial Forest lands encompassed within Landscape Units G20, G21, G23, G24, G25, G26, G27 and G28 of the Columbia Forest District were assessed for archaeological potential via aerial photograph analysis. A total of 471 landform-based polygons were identified as having medium or higher potential to contain significant archaeological sites. The archaeological potential of the polygons was assessed via criteria derived from precontact land and resource use models developed for the upper Columbia River drainage. Numerical scoring of the criteria resulted in 123 polygons being assessed as having High archaeological potential and 348 polygons assessed as Medium.

These polygons represent locations where more intensive archaeological investigations would be required to ascertain the presence and significance of archaeological values prior to land altering developments.

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1. Introduction

This report comprises an Archaeological Overview Assessment (AOA) of part of the Columbia Forest District in southeastern British Columbia. It accompanies the mapping of archaeological potential for Landscape Units G20, G21, G23, G24, G25, G26, G27 and G28 of the Columbia Forest District. It summarizes the background information that is the basis upon which the polygons were delineated and assessed, and describes the methodology employed. The report concludes with discussion and evaluation of the results and recommendations for future management.

Negotiations in advance of this project began in late 2005 but due to various complications, the project was postponed until 2006. The work was carried out under contract to Louisiana-Pacific Canada Ltd. with funding from the Forest Investment Account.

1.2 First Nations Involvement

Although there are no First Nation communities within the study area itself, the Columbia Lake and Shuswap bands are headquartered less than 100 km to the south and maintain a strong interest in their traditional grounds now encompassed by the study area. The former band is affiliated with the Ktunaxa Nation Council (KNC) while the Shuswap Band has ties with the Secwepemc First Nation, represented by the Shuswap Nation Tribal Council. The initial project proposal and the project investigations were coordinated with the Lands and Resources Agency of the KNC. The objectives and methods of this project were described in initial telephone consultations on August 24 and September 15, 2006 and discussed in more detail during an information sharing meeting between the project archaeologist and Chief Paul Sam of the Shuswap Band on October 26, 2006.

2. Study Area

The eight contiguous landscape units that are the subject of this AOA encompass parts of the Rocky and Purcell Mountains drained by the Kootenay, Kicking Horse, Blaeberry and Columbia rivers and their tributaries. The study area is bounded on the south by the Invermere Forest District and Kootenay National Park, on the east by Yoho and Banff national parks, and on the north and west by Landscape Units G16, G19 and G22 of the Columbia Forest District.

Much of this study area is extremely rugged mountainous terrain broken by steep-sided valleys. The floors of the Rocky Mountain Trench and the upper Kootenay Valley comprise gently undulating plains of glacial drift, covered almost completely by either till or overlying fans of various sizes and at varyious elevations. In the valley bottoms are the Columbia River alluvial floodplain, which coincides with the Columbia River marshes due to damming by the Kicking Horse River fan and the Kootenay and Beaverfoot rivers, like the Columbia, both presently underfit and meandering through marshland dammed by alluvial fans. The courses of the Kicking Horse and Blaeberry rivers are through narrower, steep-sided valleys that ultimately head at the Continental Divide.

2.1 Present Environment

Elevations range from about 760 m a.m.s.l. at the bottom of Donald Canyon at the north end of the study area to peaks over 3000 m a.m.s.l. The climate can be characterized in general terms as modified maritime, with relatively hot and dry summers and cool winters with relatively abundant precipitation. However, the physiography and topography are such that there is significant climatic variation over relatively small distances. Precipitation and maritime influence both increase from south to north along the Rocky Mountain Trench because of the rainshadow and storm track effects. In the adjacent mountains on both sides of the Trench, available moisture is greater and temperatures are cooler at higher elevations and along a south to north cline.

As is typical of the upper Columbia River drainage area as a whole, the study area is characterized by significant biodiversity, the classification of which reflects the latitudal and elevational clines of temperature and precipitation described above. Such biodiversity is manifest by the overlap of the relatively small study area with three separate "ecoregions" (Quesnel and Thiessen 1993) corresponding with the Rocky and Columbia Mountains and the intervening Rocky Mountain Trench. These are in turn subdivided into ecosections (ibid.) which demonstrate that the study area ecosystems encompass a significant ecological edge: the southernmost extremities of the Central Park Ranges and Big Bend Trench ecosections abut the north ends of the Southern Park Ranges, the East Kootenay Trench and the Eastern Purcell Mountains ecosections. The following summary describes the present-day environment of the study area in terms of these ecosections, proceeding from north to south and east to west, drawing from Quesnel and Thiessen (1993) and Curran, Braumandl and DeLong (1992).

2.1.1 Southern Canadian Rocky Mountains Ecoregion

2.1.1.1 Central Park Ranges

The terrain between the Rocky Mountain Trench and the Continental Divide north of the Blaeberry River is characterized by high rugged mountains with many glaciers, icefields and short, steep-sided valleys. The mountain ranges are underlain by folded and faulted sedimentary and metamorphic rocks while resistant units of limestone and quartzite are manifest by ridges and cliffs. Bedrock outcrops and shallow to deep deposits of colluvium and thin moraine make up the most common landforms; less extensive deposits of deeper moraine and glaciofluvial materials occur in broad U-shaped valleys.

The most common valley bottom biogeoclimatic zone is the Golden Moist Warm Interior Cedar-Hemlock variant (ICHmw1) (Braumandl et al 1992: 130). At higher elevations are coniferous forests of the Wet Mild Engelmann Spruce - Subalpine Fir subzone (ESSFwm) (ibid.: 166). Low elevation seral forests are dominated by lodgepole pine and western larch. Trembling aspen, lodgepole pine, Douglas-fir and hybrid white spruce form seral stands at mid elevations. Whitebark pine and alpine larch occur at the upper timberline, above which is the alpine tundra. The largest biogeoclimatic unit in the ecosection, the alpine tundra is dominated by rock, snow and ice with willows, sedges, grasses, white flowered rhododendron, Sitka valerian and krummholz trees.

Floodplains, riparian areas, avalanche tracks and seepage sites at low to middle elevations are habitat for moose, grizzly bear, black bear, beaver and wolf. The seral forests are important summer range for deer, elk, moose and bighorn sheep. Mature coniferous forest at mid to high elevations supports populations of wolverine and marten. Mountain goats frequent rugged southerly aspects in the alpine tundra zone.

2.1.1.2 Southern Park Ranges

This ecosection extends south from the Blaeberry River and is characterized by rugged mountains and long rivers with narrow valleys. The larger river systems are eroding deep deposits of glaciofluvial and glaciolacustrine drift. Bedrock consists of limestone, dolomite, calcareous shale, sandstone, schist, phyllite and quartzite.

The cool, moderately dry climate reflects a strong continental influence that is manifest by the low elevation Dry Cool Montane Spruce subzone (MSdk) (ibid.: 80), characterized by hybrid white spruce and subalpine fir with minor amounts of Douglas-fir. Some Kootenay Moist Cool Interior Cedar-Hemlock variant (ICHmk1) forest occurs in the Beaverfoot and Kickinghorse valleys (ibid.: 122). Seral stands of lodgepole pine are common because of widespread wildfires; these also contain Douglas-fir and western larch at low elevations. Mid to high elevations are in the Dry Cool Engelmann Spruce - Subalpine Fir subzone (ESSFdk) (ibid.: 104). Alpine larch and whitebark pine occur at the upper timberline. The Alpine Tundra zone supports willows, mountain heather, broad-leaved willow herb, subalpine fleabane, Sitka valerian, krummholz trees and tree islands. Floodplains, riparian zones and grasslands at low elevations support populations of elk, whitetailed and mule deer, and bighorn sheep; moister parts of these areas are important habitat for moose, elk, whitetailed deer, black bear and ruffed grouse. The MSdk subzone is important autumn and early winter range for deer, elk, moose and bighorn sheep. Both climax and seral stages are very productive deer, elk and moose summer range. Higher elevation forests dissected by avalanche tracks provide habitat for grizzly bear, elk, mule deer and mountain goat. Southerly aspects in the alpine tundra are important for mountain goat, bighorn sheep, mule deer and blue grouse; talus slopes in the high elevations have resident populations of hoary marmot and rock ptarmigan.

2.1.2 Southern Rocky Mountain Trench Ecoregion

2.1.2.1 Big Bend Trench

This part of the Rocky Mountain Trench extends north from the Donald vicinity and thus only a very small area is represented in the study area. The most common landforms atop the deep Quaternary sediments underlying the Trench are composed of deposits of moraine and modified glaciofluvial and glacustrine drift. This is the wettest part of the Rocky Mountain Trench in the Columbia drainage. Interior Cedar-Hemlock associations such as the Kootenay Moist Cool variant (ICHmk1) (ibid.: 122) are the most common zones, with seral forests of hybrid white spruce, subalpine fir and Douglas-fir.

Floodplains and riparian zones provide habitat for moose, elk, white-tailed deer, black bear, beaver and wolf. Seral forests are utilized by grizzly bear, black bear, moose and wolf.

2.1.2.2 East Kootenay Trench

This is a broad flat glacial plain, likewise underlain by deep Quaternay sediments, with small scattered lakes. The Columbia River bottom is characterized by extensive, completely to partially inundated fluvial and alluvial deposits. Low to middle elevations support climax Kootenay Dry Mild Interior Douglas-fir variant (IDFdm2) (ibid.: 72) but mixed seral stands of Douglas-fir, western larch and lodgepole pine are more common. Some ICHmk1 Kootenay Moist Cool Interior Cedar-Hemlock variant is also present.

Floodplains, riparian areas and the Columbia River marshes are important habitat for waterfowl, elk, whitetailed deer, mink, muskrat, black bear and beaver. Young seral shrublands are utilized by elk, whitetailed deer, mule deer, bighorn sheep and blue grouse. Fire climax IDFdm2 is very important winter range for mule and whitetailed deer, elk and bighorn sheep while the seral stands support a wide variety of animal species dependent on a mix of forest and grassland.

2.1.3 Columbia Mountains and Highlands Ecoregion

2.1.3.1 Eastern Purcell Mountains

This ecosection is mountainous with high valleys. The mountains have round shoulders with serrate peaks rising above extensive interconnecting ridges. Some permanent glacial ice and some year round snow packs are present on the higher peaks. Bedrock consists of folded sedimentary and metamorphic rocks affected by intrusion by granite stocks and batholiths. Surficial deposits are primarily colluvially reworked moraine. Exposed bedrock and associated shallow to deep colluvium make up the most common landforms; less extensive deposits of moraine and glaciofluvial drift mantle the lower slopes.

At lower elevations is the Golden Moist Warm Interior Cedar - Hemlock variant (ICHmw1) (ibid.: 130), above which is the Wet Mild Engelmann Spruce - Subalpine fir Subzone with subalpine meadows. Seral stands include western larch and lodgepole pine at low elevations, extensive stands of lodgepole pine at middle elevations and lodgepole pine, whitebark pine and alpine larch at high elevations. Avalanche tracks are common in upper elevation forests, extending from alpine areas to upper to middle elevation forest. Alpine tundra consists of willows, mountain heathers, sedges, grasses, other herbs and krummholz.

Low to middle elevation forested habitats support whitetailed deer, elk, moose, and grizzly and black bear. High elevation forests provide habitat for caribou, mule deer, marten and wolverine in addition to summer deer and elk range in subalpine meadows. Caribou utilize rolling parkland ridges while the alpine tundra is habitat for mountain goats, golden eagle and rock ptarmigan as well as most middle to high elevation species.

In addition to the aforementioned general notes regarding wildlife distributions, the following more geographically specific information was obtained prior to the impoundment of the Mica Reservoir. Significant mountain goat .range occurs on Mount Hunter while the Kicking Horse River valley comprises important elk winter/spring range and the lower mountainsides and the till plain of the Rocky Mountain Trench near Golden comprise critical Class 3 winter range for mule and whitetail deer (SNC-FENCO 1992).

2.2 Geology, Hydrology and Palaeoecology

The evolution of the regional landscape and ecology is far from being well documented, but was apparently very dynamic as might be expected from the presence of significant ecotones as mentioned above. Because it comprises a major underpinning of the predictive models upon which the archaeological potential assessments are based, presently available information is summarized below.

The complex geological history of the study area vicinity can be traced back more than 1000 million years to the deposition of Precambrian sediments in a large shallow marine basin. Several episodes of mountain building took place over succeeding hundreds of millions of years, associated with collisions of crustal plates and the different formings and reformings of continents. This was accompanied by sedimentation and coral reef development in the adjacent ocean basins and the subsequent warping, fracture and uplift of sedimentary rocks. These processes and their accompanying stresses resulted in the fusion and metamorphosis of some of the sediments into hard, fine-grained stone such as quartzite and chert that would later prove to be valuable material for toolmaking. Some time before 70 million years ago, downfaulting and uplift of the adjacent mountains created the Rocky Mountain Trench and other large valleys in mountainous northwestern North America. The Trench developed further as an erosional form during the Tertiary (Schofield 1913, Holland 1964).

The succeeding Quaternary saw several advances of glacial ice which partially rearranged the previous drainage systems. In general, older known glaciations in the eastern Cordillera were more extensive than younger ones (Clague 1989: 43). Although most of the stratigraphic record from earlier advances was destroyed by later glacial activity, deposits predating the last major advance have been identified in several localities in the southern Rocky Mountain Trench including the Kicking Horse River delta (Sawicki 1990). Radiocarbon dates from these deposits define an interglacial period, tentatively correlated with the Olympia Interglacial (Clague 1975), that spans the period from at least 40,460 + 440 to 21,500 + 300 before present in the Rocky Mountain Trench (Sawicki 1990).

Just north of the study area in the Rocky Mountain Trench, sediments interpreted as overbank or floodbasin deposits of a large river have been identified which contained abundant plant debris including pieces of wood identified as Populus balsamifera and Picea sp.; the latter dated 25,200 + 260 BP (GSC-1802) (Fulton and Achard 1985: 5). These data suggest that nonglacial conditions prevailed in the area 25,200 years ago and that the Rocky Mountain Trench was occupied by a river with a floodplain level 75 m above modern river level (ibid.). Lacustrine sediments yielding wood dated between 25,200 and 21,500 years ago in the same vicinity is interpreted to be related to ponding associated with the readvance of glacial ice ((ibid.: 10). Subsequently, small glaciers originating in Purcell and Rocky Mountain cirques expanded and merged into a system of valley glaciers. Glacial till was deposited in the Rocky Mountain Trench just north of the study area after 21,500 years ago (ibid.: 5). By 17,000 years ago, a large southerly flowing ice stream occupied the Rocky Mountain Trench (Clague et al 1980) followed by deglaciation that commenced about 15,000 years ago (Ryder 1981).

Parts of the upper Columbia River drainage became ice-free sooner than areas further west (Choquette 1996a). A mechanism for this that has significant palaeoclimatic implications for human inhabitation has been suggested by Clague (1989: 43): the early retreat of mountain glaciers in some areas may have resulted from a reduction in precipitation in the eastern Cordillera due to growth of the Cordilleran Ice Sheet to the west. Ice covering the British Columbia interior may have depleted or diverted moist air masses that previously had flowed across the Rocky Mountains, making the air reaching that area rather dry. This, in turn, may have caused some local glaciers in the Rocky Mountains to retreat at a time when both the Cordilleran and Laurentide ice sheets were growing."

During the retreat of the most recent major glacial advance, the Rocky Mountain Trench was occupied by large proglacial lakes dammed by moraines and melting ice blocks. Deposits of Glacial Lake Invermere have been identified in the Trench as far north as Bluewater Creek at the north end of the present study area (Sawicki 1990). Based on the measured elevations of remnant delta surfaces, Sawicki identified two distinct phases of this lake: an initial phase at 900 m a.m.s.l. and a lower phase at 840 m a.m.s.l. (ibid.: 48-55). Fulton's (1971) date of 10,000 + 140 B.P. (GSC-1457) on peats near Oldman Creek about 4 km west of Donald provides an upper limiting age assessment for Glacial Lake Invermere and for the ice dam formed by the Trench glacier (ibid.: 55-56). This date also provides a lower limiting age assessment for the dissection by the Columbia River and its tributaries of the glaciolacustrine valley fill.

Subsequent landscape evolution has been characterized by significant fluctuation of hydrological baselines, at first due to fluvial incision and later from aggradation. After Glacial Lake Invermere drained, the Columbia River began dissecting the glaciolacustrine valley fill of stratified gravel, sand, silt and clay. As this took place, several of the rivers underwent drastic changes in their flow regimes, contributing to the complex sequence of landforms that characterizes their present courses. Aerial photos of the vicinity of the Columbia River's headwaters reveal geomorphological features that can only be explained by the augmentation one or more times of the Columbia's northward flow through the study area by that of the Kootenay River. The Kootenay later changed its course for good and began its present southward flow in the Trench.

The Beaverfoot-Kootenay Valley is an intermontane trough like the Rocky Mountain Trench that also contained a trunk glacier. When it retreated, most of its till plain was likewise inundated by a large proglacial lake at an elevation of about 1360 m a.m.s.l. Much of the terrain in this part of the study area and adjacent Yoho National Park is graded to this lake. At first, the Kicking Horse River conjoined with a southward flowing Beaverfoot River to form the headwaters of the Kootenay River, possibly at the same time as when the Kootenay formed the headwaters of the Columbia. The Kicking Horse subsequently cut a westward course, capturing the Beaverfoot and leaving the Kootenay underfit in its flat-bottomed relict channel just above 1240 m. The combined loss at the Columbia River's headwaters of the Kicking Horse, Beaverfoot and/or Kootenay had a significant impact upon the Columbia's hydrology. The drastically reduced Columbia River also became underfit in its valley, no longer able to carry away the load of silt dumped into it by its tributaries as they cut through the valley fill adjacent to the river. Debris washed into the Trench formed the present Kicking Horse River fan upon which the town of Golden is situated, causing the Columbia River to meander slowly through increasingly marshy terrain (Kelley and Holland 1961) and creating the Columbia River wetlands. Similarly, tributaries such the Ice River backed up the reduced flow in the now separated Beaverfoot and Kootenay rivers and an extensive, albeit smaller series of marshlands now characterizes their aggrading channels.

During the rest of the Holocene epoch, colluvial processes have been dominant, accompanied by some aeolian deposition. More terraces and fans were formed as the watercourses carved channels and deposited sediments at various places and elevations in response to climatic variation. The flow of the Columbia River is strongly influenced by the amount of regional precipitation locked up as snow and ice, while its sediment load is dependant upon absolute discharge, timing of floods and the products of glaciation. The early millenia of the post-glacial period were characterized by increasing drought, a climatic interval known variously as the "Altithermal", “Hypsithermal”, "Thermal Maximum" or "Climatic Optimum". By 10,000 years ago, there was probably less glacial ice in the region than exists today and by 8000 years ago, it is doubtful if there were any glaciers in the surrounding mountains at all. Fluvial discharge would have coincidentally declined to a minimum in the upper Columbia system. The climate became cooler around 5000 years ago and cirque glaciers began to form again; this interval is known as the "Neoglacial" (Porter and Denton 1967).

This trend towards cooler and moister conditions would have resulted in increased fluvial discharge, but it would not have been a constant, unidirectional trend. Increased glacial activity is documented in the Rocky Mountains at the Columbia headwaters around 5000 and 2800 years ago and the Little Ice Age from ca. A.D. 1650 - 1870 was the most intense glacial episode since the Pleistocene(c.f. Choquette 1985a). There was also a second, albeit less severe, warm dry interval around 1000 years ago. Along other stretches of the Columbia and its tributaries, variations in flow and sediment load related to these climatic fluctuations created distinctive sets of erosional and alluvial terraces (ibid., Chatters and Hoover 1992) but data relating to the Columbia River's alluvial chronology in the Rocky Mountain Trench is too limited at this time to determine the degree of correlation with these better studied areas. A spruce log buried 1.5 m below the surface of the Columbia's alluvial floodplain south of the study area yielded a radiocarbon date of 640 years before present (GSC 2410, Entech 1978: 3-12), providing at least an indication of the rapid rate of aggradation that has characterized that river's course in recent times, as well as the potentially young geological age of some of its associated features such as marshlands.

With regard to the postglacial palaeoecology of the study area, it is necessary to extrapolate palaeoenvironments from surrounding regions (the following summary is based on more detailed discussion of palaeoenvironmental data in Choquette 1985a and b, 1987a, 1993 and 1996a). The Columbia River drainage was apparently deglaciated relatively early when compared to equivalent latitudes in North America. Sheltered from the retreating Continental and Fraser ice domes by mountains, the region would have been under the influence of predominantly dry airflow in late Pleistocene times. Pollen studies have identified a pioneer community of grass, sage and scattered conifers as the first widespread vegetation in most of the upper Columbia River drainage 12,000 or more years ago. This community, known as "steppe tundra" in the palaeoenvironmental literature, occupied slopes and ridges amongst the expanses of bedrock, lingering glaciers and proglacial lakes and was probably adapted to the cold dry conditions resulting from the influence of the large glaciers still present on the British Columbia interior plateau and on the plains east of the mountain front (Clague 1989).

This cold desert habitat gave way after about 10,500 years ago to coniferous forests as a warming climate permitted their invasion of the valley bottoms and lower mountainsides. However, the forest structure and species composition did not resemble that of modern forests until well after 5000 years ago. Vegetal communities in the upper Columbia basin were relatively simple in composition between 10,000 and 7,000 years ago and were characterized by pronounced altitudinal and latitudinal zonation under predominantly meridional atmospheric circulation (Choquette 1987a). Fire was already part of the ecology of the southern Rocky and Purcell mountains by at least 11,000 years ago, apparently increasing in frequency until the trend to aridity and high solar insolation peaked around 8000 years ago. Douglas fir open canopy forest and savannah grasslands were apparently widespread in these areas and the intervening Rocky Mountain Trench. However, as discussed in Choquette and Keefer (2003), the northern Columbia Mountains do not seem to have been similarly affected, probably due to the influence of the large lakes that existed in the Selkirk Trench and in the Thompson and Okanagan drainages in early postglacial time. Pollen and macrofossils from lacustrine sediments in the Selkirk Trench dated between ca. 10.000 and 8300 years ago have been interpreted to represent a climate similar to or wetter than present (Fulton et al 1989). The present study area occupies a location between these two palaeoenvironments but unfortunately lacks any specific palaeoecological data for this time period. The lack of large lakes here and the insular mountainous setting probably contributed to continental conditions more like those immediately to the south, however, and it is postulated that the study area was similarly vegetated; that is, more extensive open canopy Douglas fir forests. Grasslands were likely more extensive at higher elevations in the southern Rocky and Purcell mountains but pollen data from the Tonquin Valley in the Rockies to the north of the study area indicate cool conditions prior to ca. 8000 years ago, after which time upper treeline rose considerably and remained there until after the Mazama ashfall ca. 7000 years ago (Kearney and Luckman 1983). Again, the study area is intermediate in location between areas with relevant palaeoenvironmental data but there is no information regarding high elevation palaeoecology. It must be noted, however, that high elevations in the study area are characterized by very steep terrain, much of it underlain by easily erodable bedrock. It lacks the extensive moderately sloping to level landscapes with economically significant resource distributions to support human hunter-gatherers even if the climate was similar to that further south at this time.

As noted above, the climate of the upper Columbia drainage area was markedly continental before 7000 years ago, but around this time a major change occurred when the maritime westerlies began to exert a significant influence (Choquette

1987a). The predominant trend in vegetal configuration became strongly longitudinal and the crest of the Purcell Mountains became a major climatic divide. Western, windward slopes became cloaked with denser forests while on the lee sides, grasslands persisted and even expanded in rainshadows located both in valley bottom and ridgetop settings due to the adiabatic influence of increasingly zonal circulation patterns. New plant communities began to develop in the storm tracks that now crossed the Trench downwind of major gaps in the Columbia Mountains.

Subsequently, an increasingly varied and diverse vegetational mosaic evolved during a series of increasingly colder cycles within the last 5000 years. This marks the global cooling trend known as Neoglaciation when small glaciers began to regrow in the high mountains. The interval between ca. 6000 and 2500 years ago in the upper Columbia drainage was characterized by high fluvial discharge and the region may have supported generally more extensive aquatic ecosystems, including larger waterfowl and resident and anadromous fish populations as well as more productive riparian communities. This cool, moist trend was also accompanied by significant changes in the vegetation. Forest fire frequency declined and forests expanded at the expense of grasslands throughout the region. Regional timberlines receded (Kearney and Luckman 1983) and the maritime elements of the regional flora such as cedar and hemlock made their first appearances 4000-5000 years ago and became common after 3000 b.p. (Hebda 1995). Conditions between about 4000 and 2500 years ago were cooler than during subsequent millenia (Baker 1983) when a second more severe Neoglacial advance occurred in the Canadian Rocky Mountains. This was followed by a globally recognized relatively brief warm and dry interval. Forest fire frequency and parkland-grassland habitats increased while fluvial discharge notably decreased. The final glacial episode, the "Little Ice Age", reached its maximum expression between ca. AD 1630 and AD 1870 when it had become the most severe glacial episode in the upper Columbia drainage since the Pleistocene retreat more than 12,000 years ago.

At the present time, the paucity of palaeofaunal data from the study area limits our knowledge of the evolution of its wildlife populations. However, it is clear that such populations have not been static over time, and major changes in distributions have undoubtedly occurred in response to the dynamic ecology. The following information is derived primarily from adjacent areas and should be viewed as a set of hypotheses to be tested by directed research within the study area. The strong emphasis on hunting that characterizes pre-7000 years before present (b.p.) tool assemblages, plus the focus of early Holocene human settlement patterns on ungulate ranges certainly indicates an abundance of these animals. Data from Banff National Park (Fedje 1986) demonstrate the importance of mountain sheep in the early precontact economy while certain features of the regional archaeological record, for example inferred game drives at Top of the World (Choquette 1985b) and shared meat portions in the Crowsnest Pass area (Driver 1982), point to communal hunting as the means whereby mountain sheep were procured during early postglacial times. The size and disjunct distribution of mountain sheep populations at the time of European contact strongly suggest that mountain sheep have declined drastically in numbers since the early Holocene. The primary cause of this population decrease was probably the reduction in range due to the effects of the Neoglacial. The evidence of high human population along the eastern slopes of the southern Canadian Rocky Mountains during the early mid-Holocene (ca. 7000 to 4000 years ago) undoubtedly correlates with more extensive grasslands in this region due to the markedly increased Chinook winds during this period. Bison expanded across the Contental Divide in the same general vicinity within the last 2000 years (Choquette 1987b), probably in response to enlarged grasslands associated with the dry interval around 1000 years ago. There is unfortunately no firm data regarding this species from the study area, but bison were historically present in Jasper National Park and were hunted by the Ktunaxa in the North Saskatchewan basin within a few kilometres of Howse Pass at the northern boundary of LU G21 (Coues 1897). Heavy snowfalls and harsh winters of the Little Ice Age resulted in the extirpation of bison, antelope and prairie chicken from the intermontane valleys west of the Continental Divide (c.f. Johnson 1969, Choquette and Holstine 1982). Fluctuations in deer and elk populations in response to climatic variation have been documented in the archaeological and ethnohistoric records further south (c.f. Choquette and Holstine 1982). Elk populations in the vicinity of the Columbia River headwaters must have been considerable in the more recent pre-contact past, for in 1859 Hector observed that "elk or wapiti must at one time have been very numerous in this district, as we saw a great many antlers lying on the ground, and sometimes the Indians had piled them in heaps of 50 or 60 together" (Spry 1968: 459). An expansion of the range of whitetail deer north of 50^{o} North Latitude is apparent from reports of Schaeffer's Ktunaxa informants (Schaeffer 1940) but this is probably related to European land use practices.

Aquatic resources probably fluctuated considerably as well. Data from pollen profiles, soil and sediment sequences, forest fire chronologies and glacial moraine positions have been synthesized into models of Holocene palaeoclimatology and palaeohydrology for the upper Columbia River drainage (Choquette 1985a, 1987a) that can be used as a basis for predicting past salmon carrying capacity. In composite, the models define a series of climatic cycles, each of about 2000 years duration, within each of which climatically induced variations in fluvial discharge and sediment load would have affected salmon carrying capacity either positively or negatively. The peak of the Altithermal drought interval around 8000 years ago and the significant Neoglacial episodes ca. 2800 years ago and within the past four centuries probably affected salmon carrying capacity adversely. On the other hand, periods of high fluvial discharge and relative stability around 4000-3000 and 1500-500 years ago probably fostered large salmon runs. Archaeological evidence from elsewhere in the upper Columbia River basin as well as the upper Thompson drainage supports this model but data from the study area itself is presently lacking.

3. Cultural Context

3.1 Archaeology

3.1.1 Previous Archaeological Investigations

Parts of the Mica Dam pondage were surveyed in 1965 and 1968 by Don Mitchell, John Sendey and Chris Turnbull. One precontact archaeological site was recorded during the latter investigation, consisting of a single lithic flake found in a disturbed area adjacent to the west side of pre-Mica Dam Kinbasket Lake (Mitchell & Turnbull 1968). In 1972, Mike Robinson and Ken Martin of the Archaeological Sites Advisory Board of B.C. (ASAB) also surveyed parts of the Mica pondage north of the present study area (Robinson and Martin 1972). No evidence was found of pre- or post-contact occupation but heavy disturbance by logging and construction activity may have been a contributing factor. Martin and Robinson felt that "some prehistoric sites must exist in the Canoe River trench, however, the oft changing river channels have probably isolated these sites in heavily forested areas" (ibid.: 2). The "extremely thorough reconnaissance" that would be required to find such sites did not follow, and the pondage filled the next year.

BC Hydro's 230 kv Canal Flats to Golden transmission line was surveyed for archaeological sites in 1974 by ASAB's Brian Spurling and James Pike (Pike 1974). Two pre-contact archaeological sites well south of the present study area were potentially in conflict with the line but the exact location of the right-of-way had not been determined at the time.

As part of studies associated with BC Hydro's proposed Kootenay Diversion Project, three archaeological surveys were conducted in the Rocky Mountain Trench from the head of the Libby Reservoir to Kinbasket Lake in the north. Entech Environmental Consultants and ASAB personnel briefly examined parts of the project area in 1977, in what was essentially an overview study (Entech 1978). During the following two phases of the survey, a total of 266 prehistoric sites were revisited or discovered in what still stands as the most intensive and extensive single archaeological survey in the East Kootenay area. The present study area overlaps with the northernmost portion of the Kootenay Diversion study area. However, while that area was described as extending to Kinbasket Lake (Wilson 1981:20), proposed works associated with the project did not extend that far and survey coverage was apparently incomplete at the north end of the project area. Reaches of the Columbia River as far north as Donald are discussed with regard to effects of the diversion (primarily due to high water levels) (ibid: 75-76) but the presence/absence of "recorded sites" is mentioned only for subreaches extending as far north as Blaeberry River (ibid: 75). In addition, the west bank of the Columbia River was surveyed in its entirety between Golden and Donald but for some reason only "high potential areas of the east bank were examined – about 25% in all" (ibid: 108). There is no more specific information or definitions as to what landforms and localities this refers to. Two of the sites (EhQf-1 and 2) are on private land within the present study area (see Table 1 below) but reported descriptive information for any of the sites is sparse. The sites were classified as follows: general activity (176), circular cultural depressions (83), pictographs (4), isolated finds (6) and others (3). The Northwest Heritage Consultants study (Sneed 1979) presents a tabulation of site type, size, condition, proximity to high water and project sector. Interpretation consists of a brief discussion of the possible functions of various sizes of cultural depressions, in which it is speculated that depressions less than 2 m in diameter were probably storage pits, those between 2 and 4 m in diameter were most likely food processing facilities, and those with diameters exceeding 4 m were probably housepits. The Aresco study (Wilson 1981) produced a tabulation of site characteristics and locational attributes. For example, sites containing pits of all sizes were most frequently located on feeder streams of the large lakes and there appeared to be some tendancy for cultural depressions to be situated near marshes. Unfortunately, neither of these studies took into account the Columbia River's complex palaeohydrology - for example, it was not considered that these lakes and marshes could have been created by the Columbia's rising hydrologic baseline after the depression sites had been abandoned, so this could be a spurious relationship. In addition, low-lying areas immediately adjacent to the Columbia River were not targetted for examination, producing a potentially large negative skew in the site inventory.

The present study area is bounded on the south, southeast and east by three mountain national parks, Kootenay, Yoho and Banff, respectively, and Glacier and Mount Revelstoke national parks are situated a short distance to the west. A considerable amount of archaeological investigation has taken place in these parks; that yielding relevant information on precontact human occupation is summarized below.

A crew from Simon Fraser University surveyed Bald Ridge and parts of the Rogers Pass corridor in Glacier National Park in 1971, with negative results (Crowe-Swords 1971). The Trans-Canada Highway section of Glacier National Park has been rather intensively examined by Canadian Parks Service archaeologists in recent years; numerous historic sites have been recorded but no precontact sites have been found. In 2003, several alpine areas were subjected to a systematic problem-oriented survey to assess the potential for evidence of patterned human behaviour (Choquette and Keefer 2003); that study area included Bald Mountain and Prairie Hills just west of LUs G23 and G24. The survey indicated that none of the investigated alpine areas in the two parks had been utilized by humans to the extent that they left any quantities of non-perishable objects. The survey encountered no evidence of precontact human use such as fire broken rock, stone artifacts, pits, trenches or cairns suggestive of intensive processing of natural resources like stone, plants or animals, or repeated travel. In addition, ancillary botanical inventory did not identify any economic plants in sufficient quantity as would support intensive harvesting or procurement. Evidence from the soils indicated that if anything, most of the areas were either poorly drained and/or strongly snow-influenced for most of their post-glacial existence or were previously predominantly forested. This appeared to be particularly true of much of the krumholz of the Prairie Hills and Bald Mountain, leading to the conclusion that the influence of Little Ice Age snow cover is probably a major contributor to the present habitat configuration there. The vegetal resources were not considered to be particularly attractive to ungulates and certainly would not be considered to be large scale or high quality range for large ungulate populations. Nothing in the soil/sediment record suggested greater ungulate capability in the past; in fact, the common occurrence of podsolic soil manifestations, especially relatively well expressed Bf horizons, suggested that if anything, forest cover had been greater in the past. The negative results of the Bald Mountain - Prairie Hills survey also supported a conclusion reached from the character of the topography, in that although these were open ridge crests, they are bounded by very steep slopes and do not lead anywhere that would have drawn large numbers of human travellers.

Kootenay National Park was subject to a comprehensive archaeological survey in 1987 (Choquette 1988). Sixty-three prehistoric sites were recorded in a wide range of settings, from alluvial terraces of the Kootenay River through high glaciolacustrine terraces to arretes at timberline on both the Continental Divide and the divide between the Kootenay Valley and the Rocky Mountain Trench. Most sites occurred within the montane ecozone, but there were also significant site clusters associated with the ponderosa pine-bunchgrass habitat on the east side of the Rocky Mountain Trench, the high elevation grasslands at the head of Kindersley and Sinclair creeks, and the upper timberline-alpine zone in upper Tokumm Creek at the extreme north end of the park. The results of this project demonstrated that human presence in the park was more extensive and of greater time depth than had been thought previously. In addition to being an area traversed on horseback en route from the Rocky Mountain Trench to the plains during the contact period, it was found that the upper reaches of the Kootenay drainage had been the scene of several discrete periods of systematic resource exploitation. Ungulate and mineral resources had supported human activity in different localities at different times over the past 10,000 + years. The presence of human groups tied culturally to the east slope of the Rockies, the southern Rocky Mountain Trench, and the Fraser Plateau was identified. Three of Kootenay National Park's watershed units are immediately adjacent to the present study area, two of which (Upper Vermilion and Upper Kootenay) yielded precontact sites. Of relevance to the present study are sites in the upper Kootenay Valley just south of LU G28, some likely related to the previous hydrological relationships, while others yielded potentially early artifacts of quartzite very similar to that from Dart Creek (see below and Section 4.1.4).

Yoho National Park was initially surveyed for archaeological resources in 1972 (Loy 1972) when five precontact sites were recorded in the Kicking Horse River valley. Further survey has been carried out by Parks Canada staff over the years but no additional precontact sites were located. An archaeological survey in Yoho National Park in 1988-89 recorded eleven precontact sites (Choquette and Fedje 1990). At the Emerald - Kicking Horse confluence, test excavation identified an upper component containing butchered bison bone while a stratigraphically discrete lower component yielded dark grey quartzite flakage, probably from Dart Creek. Of the four watershed units that are immediately adjacent to the present study area, the Amiskwi contains one precontact archaeological site and the Lower Kicking Horse contains three. No precontact sites have been recorded in either the Otterhead or the Beaverfoot watershed units, but this is probably a reflection of the intensity and focus of archaeological investigation.

Banff National Park has seen the most intensive level of archaeological investigation in the study area vicinity. This began with a two year inventory conducted by the University of Calgary (Christensen 1971), during which 123 precontact sites were recorded. Over the subsequent years, numerous archaeological inventory and impact assessments have been carried out throughout BNP along with several major excavations in the Bow River Valley, resulting in the documentation of hundreds of precontact sites (eg. Fedje 1989). Two management units are adjacent to the present study area. Of the Upper Saskatchewan, in which one precontact archaeological site has been recorded, Fedje stated: "it is likely that many more small sites (hunting stations, kill sites, etc.) are present in this management unit (ibid.: 185). Twelve precontact archaeological sites have been recorded in the Howse-Mistaya Management Unit, primarily in two clusters in the Howse River valley, in the lower reaches of the valley and at Howse Pass. Most of these were recorded during the 1969 survey including those at the pass, one of which (EkQe-3 situated about a kilometre south of the summit of Howse Pass) is in LU G21. Most of the sites in the lower cluster are apparently hunting stations and kill sites (Christensen 1971) while the latter may represent stopover camps for groups crossing the Divide (Fedje 1989: 194). The localities represented by these two clusters are considered by Fedje (ibid.: 195) to be "ideal staging areas for movement across the Divide." A brief survey of the Howse Pass locality was done by Parks Canada archaeologists in 2006 but a report had not yet been received at the time of writing of the present report (Robert Williams, personal communication).

Upgrading of the Trans Canada Highway through the study area has been the subject in recent years of at least three AOAs (Choquette 1997a and b, Praeger 2000a) as well as several surveys and impact assessments of varying levels of intensity (c.f. Praeger 2000b, Wood 2004a, Huculak 2006). One precontact archaeological site has been recorded, that during impact assessment and monitoring of construction of a vehicle inspection station near Donald (Wood 2004a). Two artifacts were found in a buried context during testing of EiQg-1 on a remnant of an intermediate terrace and others were recovered during monitoring of surface grubbing and topsoil removal (Wood 2004b). The predominant lithic material is quartzite most likely from Dart Creek.

Concerted efforts began to be directed to management of archaeological resources in Provincial Forests in 1996. Initial overview assessments in the Columbia Forest District (Choquette 1996b, Choquette and Yip 1996) were followed by smaller scale reviews of proposed forestry developments during First Nations consultations in subsequent years. These AOAs resulted in recommendations for archaeological impact assessments which have been undertaken over the next decade (Choquette and Yip 1997, Magee 1998, Sauer and Choquette 1998, , Choquette and Rogers 1999, Rogers 1999, Brandzin-Low 2000, Campbell 2000, Coates 2000; Middleton 2002; Mirau 2001a and b, 2003, 2005; Mirau and Middleton 2001a –c, Boras et al 2006).

As a result of these investigations five precontact archaeological sites. Of the three such sites in the upper Kootenay River Valley (all in LU G28), EgQb-3 is of considerable interest. First, it was exposed by erosion related to the aggradation of the Kootenay's floodplain and may have sufficient time depth as to be related to earlier hydrological conditions. Second, this site yielded a large quantity of artifacts, much of it consisting of relatively large flakes deriving from the earlier stages of stone tool manufacture, suggesting the possibility that a quarry for the banded siliceous chert could be in the nearby Goodsir Formation (see Section 4.1.4).

Another significant site is EhQf-6, the Dart Creek Site, recorded in 1998 above the junction of the Kicking Horse Valley and the Rocky Mountain Trench in LU G20 (Choquette and Rogers 1999). The site is a workshop for very high quality quartzite that must have been obtained from talus or a quarry in the Mount Wilson Formation which outcrops in the immediate vicinity. In addition, the site includes a trail along the north side of the Kicking Horse Valley. The contents of the Dart Creek Site include a heavily weathered lanceloate biface, a very large endscraper and numerous examples of biface core technology featuring ground striking platforms, all typical of early postglacial lithic assemblages in adjacent parts of the upper Columbia drainage and southern Canadian Rocky Mountains. A smaller quartzite biface preform found in the terrace interior and cryptocrystalline flakage *in situ* on the surface of the trail are suggestive of human presence extending into late precontact time.

3.1.2 Culture History

Archaeological work in the study area vicinity has been sporadic and localized in coverage and largely cursory in intensity, most of it driven by impact assessment of specific industrial developments. There is wide variability in the expertise of the practitioners, most of whom had not previously worked in this region prior to undertaking their projects, with a consequently broad range in the character and level of detail in the reported information. As a result, a cohesive body of data is lacking from which to construct a culture historical sequence for the study area. It is necessary therefore to extrapolate into the study area a sequence consisting of a temporal series of models of precontact human land and resource use synthesized from the results of investigations in adjacent better known areas. By its very nature, therefore, the following synthesis is hypothetical. This is not a negative, however, because of the character of the archaeological potential mapping (see Section 4 below) which utilizes attributes extrapolated from the various models to identify the specific components of the landscape that are mapped as polygons. These should be considered to be working hypotheses for the study area, potentially testable by properly informed archaeological impact assessments in addition to forming part of the context in which site significance can be evaluated. The following summary consists of a chronological ordering of information domains anchored on the regional palaeoecology. For more detail, the reader is referred to Choquette (1984, 1987a and b, 1993 and 1996).

3.1.2.1 Early Postglacial Occupation

Evidence at the Dart Creek Site encompasses the entire span of human presence, including a major early postglacial lithic resource exploitation focus that links this location with sites in Yoho and Kootenay national parks as well as to the southwest in the northern Purcell Trench. However, the data are too sparse to provide much illumination of the lifeways of these early inhabitants. Archaeological complexes with antiquities on the order of 10,000 - 11,000 years have been defined for the Bow Valley to the east (Fedje 1986, 1989) and the Purcell Mountains to the southwest (Choquette 1987b, 1996). The cultural materials occur in sediments associated with the drained basins of the earliest proglacial lakes and with relict fluvial landforms. The nature of the subsistence base of the earliest inhabitants of the study area is unknown. Residents of adjacent areas at this time had strongly hunting-oriented economies, but the presence of viable fisheries lower down the Columbia River by ca. 9000 years ago (Chance, Chance, and Fagan 1977) suggests that fishery resource utilization cannot be ruled out entirely.

Determining the chronology of the various stages of drainage rearrangement at the Columbia River headwaters is a major priority because of its relevance to settlement patterns at this time. It is not impossible that the scarcity of recorded early sites in Rocky Mountain Trench north of Canal Flats could be due to their deep burial or destruction associated with the Columbia River's aggradation following abandonment by the Kootenay. Additionally, most investigation has been carried out by archaeologists with limited knowledge of geomorphology and regional landscape evolution – landforms related to the drainage of glacial lakes and underfit watercourses typically have not been recognized. Notable exceptions to this are the surveys of Kootenay National Park and Woodlot 1587, where several early sites were found on just such landforms. Because of these issues of significant environmental change and archaeological visibility, a perspective enlarged to adequately encompass past environments is required of archaeologists if the record of this early time period is to be recognized and documented.

3.1.2.2 Mid-Holocene Occupation

Medium to large side-notched and stemmed projectile points, which typically date between ca. 8000 and 3000 years ago in adjacent areas, are common occurrances in the upper Columbia Valley including the Canyon and Dart creek localities where a fragment and a preform of dart points have been found. This indicates that the study area was occupied by a hunting-gathering society during this time span; evidence from the national parks demonstrates that high elevation habitats were utilized during this time as well. Representation in Kootenay National Park of khaki tourmalinite and Kootenay Argillite, which most frequently oiccur in mid-Holocene artifact assemblages east of the Purcell Mountains, shows that humans' movements took them north to the Kootenay River's headwaters as well as east and west across the Purcell Mountains during this time. Khaki tourmalinite was identified at EiQg-1 (Wood 2004a) while black tourmalinite is quite common above the upper Columbia River in the Rocky Mountain Trench, again indicating significant south to north transhumance during this time. In addition, the assemblages of many sites in the latter area contain large quantities of locally available silicious siltstone and quartzite indicating local lithic resource expoitation as well. Determining the identity of the mid-Holocene occupants of sites in that part of the study area drained by the Columbia River is one of the major priorities for investigation. They could have been part of the Kettle Lake Complex, a valley-bottom oriented, band level society supported by a diversified economy and technology based largely on tourmalinite tools (c.f. Choquette 1987b) or, alternatively, some of these remains could be related to a different cultural group, for example, another Ktunaxa band or non-winter occupations by Salish salmon fishers. The very limited amount of examination of sites, especially those with cultural depressions, is a major factor limiting our knowledge of this time period, the latter part of which overlaps with a period of high predicted salmon carrying capacity.

3.1.2.3 Late Holocene Developments

Within the last 3000 years, a number of significant changes in the character of the precontact cultures took place. Some, like the adoption of the bow and arrow and the concomitant reduction in size of projectile points, parallel broad patterns of cultural change also evident in the archaeological records of the neighbouring Plains and Plateau regions. A shift in lithic material preference from microcrystalline to cryptocrystalline stone is a noteworthy pattern in the upper Kootenay-Columbia drainage area which is probably rooted in adaptive responses to climatic changes which occurred during this interval. The distributions of specific types of stone indicate significant rearrangements in settlement pattern and subsistence round, from a relatively localized extended family band type of pattern to a more complex pattern of winter macro-bands which fragmented into smaller seasonal task groups of diverse composition. A strong emphasis on Top of the World Chert indicates an increased orientation to the Rocky Mountains by the residents of the upper Columbia Valley, a parallel to the Late Pre-contact situation further south in the Trench in the Tobacco Plains vicinity (now partially inundated by the Libby Reservoir). There, the shift in lithic type and projectile technology was accompanied by increased representation of sheep and elk and the appearance of bison in the faunal assemblages. It is clear that this locality was a major human habitation focus in Late Pre-contact time, related to the winter ungulate range of the Tobacco Plains. Evidence is accumulating from the Trench north of Canal Flats that indicates a second such Late Pre-contact settlement focus whose occupants could have made use of the land and resources now within the study area. Interestingly, the archaeological record of the mountain national parks is relatively scanty for this period compared to earlier times.

3.1.2.4 The Salmon Factor

Where salmon were present, house- and cache pit depressions, as the structural evidence of a semi-sedentary lifestyle, can be functionally associated with a strong focus on the salmon fishery. Their distribution in the upper Columbia drainage corellates directly with salmon spawning habitat. Pithouses are not known to have been used by the nomadic Ktunaxa and are absent from almost all of the Kootenay River drainage, up which salmon were prevented from ascending by falls on its lowermost course. Cultural depressions are common in the Rocky Mountain Trench from Canal Flats northward to the south edge of the present study area. While it is likely that most of these features relate to Salish occupation, the precise cultural identity of their occupants, as well as their ages, have yet to be determined.

The cultural depressions on the upper Columbia cannot be associated with the Lakes Salish, as they did not overwinter beyond Revelstoke (Bouchard and Kennedy 1985). The Kinbasket Band was too small, and arrived too late to account by itself for the relatively large number of cultural depression sites known in the upper Columbia Valley. A significant problem domain thus involves elucidating the settlement dynamics and identities of resident salmon fishers in the study area and vicinity. This is especially important considering the evidence for the dynamic palaeohydrology of the Columbia River and its potential impact upon salmon carrying capacity as set out in Section 2.2 above.

3.2 Ethnography

3.2.1 Limitations of the Ethnographic Record

The archaeological record, although very limited at present, indicates that the study area has been occupied by natives for most if not all of postglacial time. However, the contact period was extremely disruptive of traditional land and resource use practices. The effects of drastic depopulation and destruction of millenia-old adaptive systems due to epidemic diseases, the increased mobility made possible by acquisition of horses, economic rearrangements in response to the fur trade, the intrusions of gold rushes, the influence of missionaries and the displacements due to the creation of the international boundary and establishment of reservations all transpired before serious documentation of traditional lifeways took place. While the ethnohistoric literature contains numerous references to native people in the study area vicinity, notations of specific activities carried out within the study area itself are not nearly as common. It is apparent, however, that the study area overlaps the traditional territories of two First Nations, the Ktunaxa and the Secwepemc.

3.2.2 The Ktunaxa

The Ktunaxa are a culturally and linguistically unique group whose cultural development paralleled the evolution of the diverse regional ecology so that by late precontact times, they comprised four geographically and linguistically distinct subdivisions. The Upper Ktunaxa inhabited the Rocky Mountain Trench from Tobacco Plains north to beyond Golden, as well as the Rocky and eastern Purcell mountains. The major ethnographic works on the Ktunaxa are Schaeffer (1940, n.d.) and Turney-High (1941); Smith (1984) and Brunton (1998) have compiled recent syntheses.

The Upper Ktunaxa followed a nomadic seasonal subsistence round which was determined by the location and scheduling of abundance and ripening of a broad range of animal and plant resources. Large ungulates, particularly deer and elk, were hunted singly with bows and traps and in communal hunts, mostly in the spring and fall. The latter provided the bulk of the meat that was dried and stored for winter consumption. From late spring through early fall, game, fish, waterfowl and plant foods such as roots and berries were acquired by task groups (for example, a group of women and children picking berries, accompanied by a few men who undertook casual hunting at the same time). After obtaining horses from the Flathead around A.D. 1730, the Ktunaxa began making the thrice yearly treks to the bison grounds east of the Rockies for which they are well known in the historic literature. Cooking by stone boiling was the preferred method of preparing food for immediate consumption, except for roots such as camas and bitterroot, which were baked in earth ovens. Foods not eaten directly were dried for winter storage; berries were important in this regard.

The Ktunaxa employed a wide range of materials in their traditional technology. Archaeological research in the region has documented that the Ktunaxa were expert prospectors and miners who utilized the same methodology as later Europeans, i.e. prospecting "placer" and "float" occurrances, then following them to the bedrock outcrops where adits were driven along the richest veins. In addition to tourmalinite, chert and quartzite, which were used for tools, the Ktunaxa also mined iron oxide for paint and soft argillite for making pipes. The main dwelling of the Upper Ktunaxa was the hide-covered tipi; there is some conjecture that prior to obtaining horses, a covering of mats also may have been used.

Ktunaxa social organization was kinship-based and loosely organized into politically independent bands of related families. The hallmark of this social structure was its flexibility: band membership was voluntary and both size and composition varied from year to year. Chieftainship accrued to those with leadership qualities, although some tendancy towards hereditary chiefs is apparent in latest times. Disposal of the dead was by exposure in trees or on scaffolds; burial became more common after European contact.

3.2.3 The Secwepemc

Speakers of the Secwepemc language, a division of the Salishan linguistic stock, occupied a large area of southern British Columbia centred on the Thompson and middle Fraser River drainages. Teit (1909: 523) described a group of "almost completely nomadic Indians who live nearly in the heart of the Rocky Mountains, around the head waters of North Thompson River, the Yellow Head Pass, and Jasper House" whom he named the Upper North Thompson band: "East and north [their hunting grounds] ... include... part of the Big Bend of the Columbia, part of the Rocky Mountain region". Some of these people apparently were members of a group known as the Kinbaskets, who were named for Kenpesket, a North Thompson chief (ibid.: 460, 467). Social problems at Adams Lake resulted in Kenpesket's group resettling themselves near pre-dam Kinbasket Lake around 1840. They gradually moved southward where they eventually encountered the Ktunaxa whose numbers had been significantly reduced by disease. The two groups subsequently intermarried and their descendents are members of the present-day Shuswap Band of Invermere. Other descendents of this group reside in the Neskonlith community near Adams Lake (Bob Manuel 1996: personal communication). It is not impossible that similar groups could have 'hived off' the main Fraser-Thompson population centres in the precontact past as well and made their way into the uppermost parts of the Columbia drainage, especially during times of higher salmon carrying capacity. Teit's 1909 and 1930 accounts of the Secwepemc and Ignace's 1998 work comprise the bulk of written data for that group.

While their economy included exploitation of a diverse range of plant and animal resources, the Secwepemc settlement pattern was semi-nomadic with a strong riverine focus. Permanent settlements of semi-subterranean "pithouses" were occupied by groups of closely related families during the winter and early spring. These were situated close to the shores of the major rivers, usually on sandy, well-drained soil (Dawson 1892: 18). Associated with these winter villages were non-habitation features such as storage pits and sweat lodges. With the coming of spring, individual family units dispersed into the surrounding terrain in quest of ungulates, fish and plants. The time of maximum economic focus occurred during the summer and early fall when all groups would gather at fishing stations on the rivers for the annual salmon runs. Dawson (1892: 15) summarized the importance of the salmon resource as follows:

> Dried salmon ... constituted the sole winter staple. The right to occupy certain salmon fishing places, with the annual visit to these of the more remote families, and the congregation of large numbers of Indians at specially favourable places, largely influenced the life and customs of the Shuswaps.

According to Teit (1909: 328, 592-593), Secwepemc burial practices consisted of interment, generally near villages on the edges of terraces, in low side hills and sand knolls.

3.2.4 The Contact Period

Local traditions hold that the Nor'Westers Andre Le Gassi and Cadier Le Blanc were the first white men to cross what is now known as Howse Pass in 1800 (Spry 1963: 28), becoming the first Europeans to enter the study area. David Thompson, also of the Northwest Company, sent Jaco Finlay across this pass in 1806 to cut trails before Thompson's crossing in 1807 (ibid.). The Thompson party descended the Blaeberry River to the Columbia River and travelled south to the mouth of Toby Creek, where Kootenae House was established for trade with the Ktunaxa. Thompson's party returned with furs by the same route in the following years.

In 1810, Joseph Howse of the Hudson's Bay Company used the pass which now bears his name, then travelled southward through the Rocky Mountain Trench. Shortly afterward, the Peigan closed Howse Pass, resulting in a shift to the Athabasca Pass (ibid.), which Thompson crossed again in January 1811 to establish a northerly route to the Columbia River drainage that avoided Peigan territory. Thompson spent the winter at the confluence of the Columbia, Canoe and Wood rivers at a place later known as Boat Encampment, where he built a canoe and re-ascended the Columbia to Kootenae House. This post probably existed for only about 5 years (Graham 1963: 37) because of Blackfoot hostilities and the establishment of a fur trade route (the Columbia Trail) which connected Jasper House with Forts Colvile, Okanagan, Walla Walla and Vancouver.

James Hector crossed from the Bow River valley to the Vermilion River in 1858, up the Kootenay Trail along the Beaverfoot River and then up a steep valley and back over the height of land into the Bow watershed. During this trek a horse kicked Hector, almost killing him at the confluence of the Beaverfoot and the river which Hector's party named the Kicking Horse. Hector reported to his superior, Captain John Palliser, that the route was not well suited for travel. Therefore, in 1860, Palliser used Thompson's route over Howse Pass and down the Blaeberry to the Columbia.

In 1846, Paul Kane met a band of Shuswap under a chief known as Capote Blanc at the second Jasper House and again at Boat Encampment (Kane 1974: 106, 235). Capote Blanc's Shuswap band were hunting moose and beaver when

Paul Kane met them at Boat Encampment in 1846 (Kane 1859: 235). In 1859, Dr. Hector's party secured some dried goat's flesh from a group of Shuswaps whom they met on the Columbia River just upstream from its confluence with the Blaeberry and the following day were given some bear meat by another group of Shuswaps, who had killed the bear while it was eating dead salmon a short distance to the south (Spry 1968: 455-456).

As a result of European influence, complex new patterns of native population movement and influx developed in the Rocky Mountains, especially manifest by the greatly increased tribal mobility following acquisition of horses in the early 1700s. Hostilities between the Ktunaxa and the Blackfoot Nation, and the latter's desire to prevent the Ktunaxa from obtaining firearms, ultimately resulted in the virtual abandonment of Continental Divide passes in the southern Canadian Rockies. The more northerly routes of trans-mountain travel subsequently saw increased use, for example, the Athabasca Pass as mentioned above. The southeast portion of the study area was crossed by part of the Kootenay Trail, which became an important travel corridor for the Ktunaxa in the new economy based on exchange of goods and services. Reinforced by the disappearance of bison from west of the Rockies, a new land and resource use pattern evolved (Choquette 1988), consisting of mounted parties of Ktunaxa travelling northeastward to bison range in the Saskatchewan River drainage (today known as the "Kootenay Plains"). They stopped at the "Paint Pots" on the Vermilion River to obtain ochre for trade with the Cree and at Rocky Mountain House. The route went north from the Paint Pots via the Ottertail, Amiskwi and Howse passes and returned via the Beaverfoot Valley. Information provided by Thompson and Alexander Henry (Coues 1897) indicates considerable use of the Rocky Mountains in the study area vicinity by the Ktunaxa, including that of a bison jump on the Howse River a few kilometers upstream from its confluence with the North Saskatchewan River, just outside the north boundary of LU G21.

4. Study Methodology

This study comprises an assessment of the archaeological potential of Provincial Forest lands in Landscape Units G20, G21, G23, G24, G25, G26, G27 and G28 of the Columbia Forest District. The assessment takes the form of polygons drafted onto 1:20,000 scale TRIM contour maps, accompanied by a database containing the criteria upon which the definition of the polygons is based and the scoring that supports the ranking of the polygons into Medium or High archaeological potential.

The individual polygons consist of landforms or landscapes identified via stereoscopic analysis of aerial photos. The criteria for polygon definition were derived from the geological and palaeoenvironmental background information summarized in Section 2 above. The criteria are linked with the prediction of potential occurrance of archaeological sites through the evidence of precontact human land and resource use that comprises part of the archaeological record summarized in Section 3.1, especially regarding settlement pattern, lithic preference, subsistence base and palaeoenvironmental context as extrapolated from the landform, palaeohydrological and soil/sediment associations of the cultural deposits. The existing heritage record has been synthesized into hypthetical models of past human land and resource use that were then applied to the terrain units defined from the air photo analysis. The result is a set of GIS compatible polygons that reflect the potential of various parts of the LUs to contain archaeological sites.

The criteria by which the polygons are assessed represent a bridge between the terrain units and the human land and resource use models. To achieve objectivity in defining the archaeological potential of the polygons and to promote broader understanding of the process amongst resource managers, each criterion is numerically scored relative to its contribution to the delineation and evaluation of the polygon in question. A four part scoring system has been used: "0" indicates that the criterion in question has not contributed to the definition of a given polygon, "1" indicates a minor contribution, "2" a more significant contribution, and "3" indicates that the criterion is a major determinant of the polygon's assessment or definition.

Each criterion is described below with specific reference to the biogeography and archaeology of the eight LUs. The criteria are subdivided into two categories that reflect the regional perspective (macrosite criteria) and the local perspective (microsite criteria). The distinction between the two is discussed in more detail in Section 6 below.

4.1 Macrosite Criteria

The following attributes are considered to be the primary determinants of archaeological potential within the regional context.

4.1.1 Known Sites

Where the level of previous investigation has been sufficient to support it, the distributions of known sites can provide a relatively reliable measure of the intensity of precontact human utilization within the given study area in which they occur and also some indication of the types of past human activities that might have taken place.

For example, focused occupation, particularly that of a winter settlement or base camp characterized by a significant duration and continuity of human presence, would have had a range of other activities associated with it. Besides those related to procurement and processing of subsistence resources, such ancillary activities would have included a range of social and ceremonial practices that could be represented as archaeological sites. Thus the vicinity of a habitation focus would be characterized by a higher site density than would other parts of the landscape even if they were characterized by similar topography.

The limited extent of systematic archaeological investigation in the study area severely limits knowledge of the intensity of human habitation, but the existing site inventory, sparse as it is, displays both an extensive spatial range as well as considerable variability. With regard to the latter, the inventory includes cultural depressions, a lithic workshop and "lithic scatters", evidence of activity or habitation related both to resource exploitation and travel. Table 1 summarizes the recorded site inventory for the study area.

SITE NO	LU	TYPE	SIZE (HA.)	LANDFORM ASSOCIATION	RELATIONSHIP TO WATER
EfQb-3	G28	subsurface lithics	.012	prominence	adjacent to small lake
EgQb-3	G28	surface lithics	.01	relict terrace	adjacent to underfit Kootenay River
EgQc-1	G28	subsurface lithics	.0225	terrace	adjacent to small lake
EgQe-1	G25	circular cultural depressions	.0125	fan margin	adjacent to Columbia River marshes
EhQf-1	G23	surface lithics	1.2	alluvial terrace	adjacent to Columbia River marshes
EhQf-2	G23	subsurface lithics	0.4	alluvial fan	adjacent to spring and Columbia River marshes
EhQf-6	G20	surface lithics, trail	ind.	relict terrace, bedrock outcrop / structural bench	near small stream, well above Kicking Horse River
EhQf-7	G23	subsurface lithics, trail	.0025	terrace margin	above Canyon Creek
EkQe-3	G21	surface lithics, trail	ind.	saddle (pass)	indeterminate
EiQg-1	G20	subsurface lithics	.012	fan margin	above Columbia River marshes

Table 1. Previously recorded archaeological sites in study area.

A score of 3 for this criterion represents the presence of one or more known archaeological sites while a score of 2 is assigned to polygons adjacent to those with known sites. A score of 1 reflects the location of a polygon between, but at some distance from, known site occurrances. A score of 0 indicates a lack of known sites in a locality, but the very limited site inventory must always be kept in mind.

4.1.2 Columbia River

As discussed previously, the anadromous salmon runs in the Columbia River represented a predictable resource of such economic importance that it could sustain a semi-sedentary human lifeway. This large river was also a travel corridor in itself.

Scoring for this criterion reflects both proximity to and accessibility of this river. Polygons associated with the lower courses of streams draining directly into the Columbia were scored higher than upland polygons the same distance from the river due to the potential for salmon runs ascending these watercourses.

4.1.3 Corridor

The physiography of a region exerts a major influence on the movements of both animals and humans. The score assigned to this criterion reflects the relative importance of a travel route based on what is known about past movement patterns. Additional considerations include steepness of terrain, ecological variability, resource concentrations and connectivity.

The broad corridor represented by the Rocky Mountain Trench would obviously have been the major precontact travel corridor, both on foot and by canoe and rafts. It is scored 3.

The uppermost Kootenay River valley provides a secondary north-south corridor within the Rocky Mountains themselves, especially when connected via the Amiskwi Valley and Pass to the Blaeberry Valley. The latter valley itself represents a significant transmountain pedestrian corridor heading in Howse Pass, the only Continental Divide pass in the study area. Although its Contact Period use is well documented and there are recorded precontact sites at Howse Pass itself, the level of intensity of precontact use of this corridor is not yet known. These secondary corridors are scored 2.

Within the study area itself are several corridors that loop through the west slope of the Rockies via minor passes connecting generally parallell westward valleys. Polygons within these intermountain corridors are scored 1. Other valleys in the LUs end in steep headwalls lacking passes and score 0 for this criterion.

4.1.4 Bedrock Geology

As discussed in Choquette (1981), stone suitable for tool manufacture is neither ubiquitous in the region nor restricted to a single source. Twenty-three discrete sources of a variety of flakable stone have been identified in the upper Columbia River drainage area over the past 30 years and the approximate locations of at least five more are known. Because of the non-biodegradable nature of this material and the capability to use stone to track movements of people across the landscape relative to the location of the discrete sources, this criterion is of great importance to the archaeology of this region. Since workable stone was an essential underpinning of the precontact economy, some stone sources were sufficiently strong attractions that they appear to have been significant determinants of the foci for subsistence resource exploitation as well as of routes of transmountain travel. The source of the high quality quartzite processed at the Dart Creek site likely ranks in this category, but the archaeological record at present is too discontinuous to yield this information. Nevertheless, patterns of lithic resource use are extremely valuable for predicting archaeological potential.

The northern Purcell Mountains are composed primarily of moderately to highly metamorphosed sedimentary rock, none in the study area being suitable for other than coarse expedient tools. Much of the terrain in the Rocky Mountains within the LUs is encompassed by extremely friable and predominantly soft Upper Cambrian weakly metasedimentary rock or dolomitic limestone. Bedrock geology in these areas is not a factor in the archaeological potential of polygons in these locations, which are consequently scored 0.

However, there are other formations that contain stone highly suitable for manufacture of the finest flaked tools. Most notable of these is the "pure and very resistant" Ordovician Mount Wilson quartzite (Norford 1969: 25-27) which outcrops in the immediate vicinity of the Dart Creek Site. Although the quarry has not yet been precisely located, the large size and early reduction stage of the debitage there indicates a nearby source and this formation is the likely candidate for the high quality quartzite that was worked at the site. Polygon G20-33 was defined to capture a target outcrop area; the size of this large polygon could be greatly reduced if the exact location of the quarry or quarries was known, as the route of access was likely very direct considering the topography.

The uppermost beds of the Ordovician Owen Creek Formation are near the contact with overlying Mount Wilson quartzite and include dolomitic quartz sandstones and siltstones (Norford 1969: 23) that are potentially also suitable tool stock. Polygon G21-86 was delineated to capture outcrops of both Mount Wilson and Owen Creek formations in the vicinity of Howse Pass. It should be noted that the Confidence for this large polygon is much lower than that scored for G20-33, the other identified Mount Wilson exposure. This reflects the known exploitation of this mineral resource at Dart Creek, whereas all of the artifacts reported by Christensen from the four sites at Howse Pass are of black chert (Christensen 1971: Table 24). This small artifact sample from quite a large area could very well be temporally skewed, in that it was surface collected from the present trail and considering the trend towards cryptocrystalline silicates in recent Holocene time noted in Section 3.1.2. The more grainy quartzites and quartz sandstones and siltstones were preferred in earlier precontact times and may be represented in older sites in different settings that have not been intensively investigated archaeologically. Because of the lack of firm evidence, Polygon G21-86 was ascribed a Confidence of only 1 and an archaeological potential ranking of Medium. The size of this polygon could also be drastically reduced or eliminated altogether as a result of targetted archaeological survey.

A third locus for mineral potential was identified in LU G27, which encompasses the Moose and Dainard creek valleys where the surrounding mountains are made up of the middle Palaeozoic Ottertail and Goodsir formations. The former contains common cherty layers, weathering into cherty nodules (Allan 1914: 88) while the latter includes siliceous slate and shale as well as cherty limestone and cherts (ibid.: 95 - 97). Allan describes a dark and light banded chert that is probably the same material as the flakage found at EgQb-3 (Brandzin-Low 2000). Polygons in the vicinities of outcrops of these formations have been scored for this criterion based on proximity and pedestrian access.

4.1.5 Ungulate Range

As would be expected from the considerable diversity in habitat described in Section 2.1, ungulate capability ranges widely across the study area depending upon elevation, aspect and slope. A large proportion of the study area consists of very steep slopes at relatively high elevations where snow cover is a significant factor limiting ungulate capability. The steeply sculpted U-shaped valley terrain of most of the LUs is equivalent to that of the northern Columbia Mountains to the west in having been heavily affected by the most recent Pleistocene glacial advance which essentially filled the valleys with ice but left knife edge arretes along the intervalley divides. A lot of this rock has obviously been subsequently affected by Neoglacial mechanical weathering that is strongly expressed in the friable bedrock of much of the area. The unsuitability of such terrain for ungulates would be reflected by a score of 0 for this criterion, but the same environmental factors responsible for such a low rank mitigate against any other archaeological potential and no polygons were defined in such inhospitable terrain. However, if or when the specific quarry sites are located in the formations and polygons discussed in Section 4.1.4, it is possible that the resultant more precisely delineated polygons may have no ungulate capability and would be scored 0.

There are some areas of elevated level terrain in the study area but they are widely scattered and small. Most of the intermontane passes are small dips in the sharp arretes that are otherwise extremely steep and surficially consist predominantly of weathered rock. It was observed during some previous archaeological surveys of major divide passes in mountain national parks described in Section 3.1.1 (including Amiskwi Pass into the upper Blaeberry Valley) that Neoglaciation had a significant effect on the vegetation of the Rocky Mountains along the Continental Divide north of about Sunshine Meadows. Alpine tundra habitats along this cline change from herb and forb rich communities at the southwest edge of the study area (Goodsir Pass, upper Tokumm Valley) through subalpine forb and herb meadows in the MacArthur Lake vicinity to heathland along the Continental Divide extending northwestward to include the Amiskwi Pass. The ungulate capability associated with alpine passes in the northern part of the study area such as G21-42 and G26-61 was scored 1. However, passes in the southern part of the study area (e.g. G25-15 and G27-14) are in closer proximity to terrain that provides higher quality ungulate range in addition to supporting more productive and diverse ecologies and scored 2 for this criterion.

At an elevation of about 1500 m, the notably low and relatively wide Howse Pass has potential for both significantly lower and higher ungulate capability across the broad temperature and moisture range represented in the Holocene palaeoclimatic record (c.f. Choquette 1987a). The entire mountainous portion of the Blaeberry Valley similarly would have fluctuated in vegetal community composition over the past 10,000 to 12,000 years, with such disruptions as avalanches and wildfires sporadically producing episodes of higher ungulate capability. The same would be true of lower elevation valleys in LUs G25, G26, G27 and G28. Polygons associated with this type of habitat were scored 2.

The influence of topography is more subdued at lower elevations and vegetal productivity is augmented by flow of modified maritime air. Because of the north-northwesterly strike of the Rocky Mountain Trench in the study area, the west side of the Trench encompassed by LU G23 has a more northerly aspect and consequently denser forest cover and lower wildfire frequency; scoring for ungulate range here was 1 or 2. The other side of the Trench receives considerably greater insolation, especially the elevated plain and southwest-facing slopes northeast of Golden. This area historically is high quality winter range and would have been more extensive and of higher quality during droughty periods of high fire frequency. The palaeoenvironmental record suggests that ungulate range would have been significantly higher under conditions conducive of more frequent wildfire such as prevailed around 9000 - 7000 and 1500 - 500 years ago; there may have been another, perhaps more subdued, period of relatively higher ungulate capability in the later mid-Holocene (i.e. around 3500 - 3000 years ago) at the peak of adiabatic airflow occasioned by strong influence of the prevailing westerlies. The definite possibility of even higher ungulate capability in this already relatively high quality ungulate range is reflected in scores of 2 and 3 for this criterion.

4.1.6 Solar Aspect

Southerly exposures tend to support a more open vegetal cover than other aspects, making them the preferred locations of trails for both animals and humans. In northerly latitudes, human habitation sites, especially late fall, winter and early spring settlements, tend to be situated to take advantage of solar heating.

Scoring for this criterion is based both on micro- and macrotopography, with the highest scores accruing to south-facing landforms situated in concavities on or at the base of south-facing mountainsides.

4.2 Microsite Criteria

Scoring of each of these criteria reflects its relative importance in determining the specific location, along with the size and shape, of individual polygons.

4.2.1 Terrace/Fan

Elevated terraces are favourable camping areas because they tend to be better drained with regard to soil moisture and also avoid the effect of cold air drainage, an important consideration in late fall, winter and early spring. Level, typically well-drained landforms, terraces have also been selected as travel corridors, especially along the margins where vegetation tends to be more open.

An exception to this relates to the low elevation, presently poorly drained terraces adjacent to the Columbia River marshes and along the relict Beaverfoot-Kootenay channel. As discussed in Sections 2.2 and 3.1.1 above, these underfit watercourses are presently aggrading, the rising hydrological baselines of the floodplains resulting in elevated water levels now directly encroaching upon some terraces and fans. As mentioned previously, the probably spurious association between the marshlands and cultural depression sites and the arbitrarily discontinuous survey coverage along the Columbia River in the northern part of the Kootenay Diversion survey area are in all likelihood both related to this significant aspect of the hydrology of the study area. Conversely, the exposure of artifacts by the Kootenay River high water level adjacent to marshes at EgQb-3 indicates the importance of factoring palaeohydrology into sampling designs in these areas, The archaeological potential of these drowned alluvial floodplain terraces and alluvial fan toes is recognized in this study in a number of polygons in LUs G20, G23, G24, G26, G27 and G28 being delineated in presently marshy areas where naturally inundated archaeological sites may be located.

4.2.2 Promontory

Bedrock prominences and ridges facilitated precontact movements across the landscape and many of these landforms are vantage points where localized ad hoc activities such as tool production and maintenance may have taken place.

In some alpine and subalpine morainal topography where drainage is poor, as well as in parts of the drowned valley bottoms, ridges represent significant nodes of better drained terrain that would have served as more attractive plaforms for habitation and related activity.

4.2.3 "Saddle"

At the heads of some valleys are constrictions that are lower than the surrounding heights of land, making them the preferred routes for traversing drainage divides. The term "saddle" refers to the lower, more level terrain that exists at a height of land that could have been used as a pass. Such areas typically contain archaeological deposits because they were used as temporary rest areas and overnight campsites. Howse Pass represents the most significant such landform in the study area.

4.2.4 Standing Water

Lakes and ponds attract wildlife and thus could have hunting grounds associated with them; those containing fish would have been obviously attractive for that reason. Lakeshores are also good camping areas, especially the north and east sides of small lakes.

When combined with scoring for relict watercourse, this criterion pertains to the previous existence of a water body, including proglacial lakes. At the opposite end of the temporal scale are the marshlands produced by the aggradation of the underfit rivers; these features, while geologically quite young, nevertheless can have relatively recent archaeological associations related to, for example, the modern role of marshlands as stopovers on the Pacific Flyway.

4.2.5 Watercourse

Rivers and streams and the associated riparian ecosystems support a diversity and abundance of subsistence resources as well as being sources of vital fresh water.

4.2.6 Relict Watercourse

The establishment of the postglacial drainage system was accompanied by significant changes in hydrology leaving discontinuous high terraces related to previous hydrological baselines. Although now considerably removed from water, landforms graded to previous watercourses or bodies of standing water are potential locations of early archaeological sites.

Additinally, as described in previous sections, the major drainage rearrangements associated with the Kicking Horse River's capture of the Beaverfoot left a notable relict inner river valley in LUs G26, G27 and G28.

4.2.7 Confluence

Confluences of watercourses are significant predictors of archaeological site locations for several reasons. Most importantly, they usually correspond with confluences of valleys and thus represent junctions of travel corridors where temporary stopovers and activities would likely have been repeated frequently enough to produce archaeologically detectable cultural deposits. A second consideration is that the quality of water from tributaries is often better than that in the main stream, particularly during the freshet. Furthermore, confluences often are good fishing locations.

4.2.8 Watercourse Node

This refers to specific portions of watercourses that could have served to attract and/or focus human activity. Examples of watercourse nodes include: nickpoints and rapids that could have served as fords; large eddies, pools and waterfalls which were good fishing locations (Polygons G20-38, G20-44, G20-53, G20-54, G20-76, G20-99, G20-100, G21-16, G24-6, G24-7, G24-36 and G24-37); canyons (G23-58) and springs (G24-24). Some of these types of natural features can have sacred associations.

The potential archaeological significance of the drainage rearrangement at the previous headwaters of the Kootenay River, not the least of which relates to the possibility of anadromous salmon ascending to this area, is recognized in the scoring of several polygons for this criterion. Polygons G27-43 and G28-49 are associated with the present drainage divide, which was formerly the confluence of the Beaverfoot and Kootenay rivers while Polygons G26-10 through 15 are situated near the point of capture of the Beaverfoot by the Kicking Horse.

4.3 Confidence

The need for this measure was expressed by Oliver Thomae of the Cranbrook Forest District in the context of future emergency situations such as fires. It is desirable to be able to separate out those polygons where archaeological values are sufficiently well known that measures such as field investigation or mitigation are clearly necessary from other polygons whose definition is based on limited data or large extrapolative leaps in predictive modelling. As employed in this study, Confidence is a subjective measure that should be considered within the context of 'risk management'.

This criterion is a subjective combination of the predicted presence and density of archaeological sites along with an estimate of the potential significance of the archaeological values that might be contained within a given polygon. It is scored high, medium or limited confidence as 3, 2 or 1, respectively. A score of 1 equates with a lower level of confidence commensurate with data limitations or greater level of speculation and while it certainly speaks to a need for further investigation, this level of confidence reflects acceptance of the risk of losing data in the polygon if extenuating circumstances should arise that require rapid response.

5. Results

Analysis of aerial photographs and background information of Landscape Units G20, G21, G23, G24, G25, G26, G27 and G28 has resulted in the mapping of a total of 471 landform-based polygons where there is some likelihood that significant archaeological deposits and/or features are present (see maps and databases).

6. Evaluation and Discussion

As employed in this study, archaeological potential represents a relative measure of the likelihood of encountering precontact heritage resources in a given locality. A number of factors are reflected by this relative measure, including probability of site occurrance, possible density of sites and/or cultural deposits, and significance. At its most basic level, the definition of archaeological potential depends upon an adequate data base to support accurate predictions of the presence of sites. The ideal situation would consist of an inventory of all sites within the study area and information regarding the nature of past human use in terms of activities, seasonality, duration of occupation and nature of social unit(s), and the time span(s) of such use.

The concept of potential arises when this ideal is not met, leading to the compromise of attempting to identify areas where sites might be located. Within the resource management context, erring on the side of caution is a necessary element in this "compromise" since archaeological heritage is a precious, unique non-renewable resource that represents a significant component of the cultural identity of living groups, their ancestors and their future generations. Thus, where a lack of systematic archaeological investigation is reflected by the absence of hard data in an inventory, it must be assumed until proven otherwise that all or most human land and resource use patterns are represented in a given landscape unit, subject to the constraints of the past environmental conditions.

The amount of previous research, including palaeoecology, is also a limitation of the capability and accuracy of predicting archaeological potential. It is fortunate that some of the archaeological research in the upper Columbia River drainage has been conducted within an explicit palaeoecological paradigm, as this expands the supporting data base to incorporate such aspects of the environment as geomorphology and palaeohydrology. As discussed in Section 4, analysis of aerial photographs produced a data set that includes landform and hydrological associations. These provide a scientifically objective definition of at least some past environmental constraints, thereby partially delimiting the range of potentially applicable patterns of past human land and resource use that could be projected onto a given landscape.

The level and nature of spatial sampling that has taken place previously in a landscape unit is also an important consideration in this regard. A large enough proportion of the target land base must have been examined to support correlations between the known inventory and the actual distribution of sites over the landscape. Both negative and positive data (i.e. absence vs. presence of archaeological sites) must be taken into account and places where sites have not been found at a sufficiently intensive level of sampling (especially where sites may have been expected) must be considered as well as locations where sites are actually present.

Given the above, the assessment of archaeological potential in the present context of GIS mapping and large-scale and spatially extensive field investigations (via impact assessments) can be viewed as a means of incorporating science into resource management. As such, results of field investigations can be tracked and fed back into the predictive models as represented by the mapped polygons. An ultimate scientific objective would be for multivariate spatial analyses to identify archaeological patterns on the basis of attributes whose predictive capability has been objectively confirmed. The present study should be seen as part of the ongoing progress towards this objective in what was the Nelson Forest Region when this type of mapping was begun in 1993.

Both macrosite and microsite criteria were considered during the analysis but only the former were used to rank the archaeological potential of the polygons. This is because archaeological potential derives from the characteristics of a broad environmental context, i.e. the combination of attributes such as location within a corridor, relationship to a particular resource such as stone or ungulates, solar aspect, etc. These macrosite criteria reflect the likelihood that an entire valley or even an entire landscape unit would have supported precontact human occupation or use and thus could contain archaeological sites. As discussed in Section 4, the values assigned to these criteria take into consideration such general characteristics as the intensity of previous investigation and the extent of the present archaeological inventory, the relative location of the study area in the upper Columbia River drainage as a whole, the geologic history with regard to physiography and relative accessibility of mineral resources, local palaeocology, etc. As such, the macrosite criteria are conceived of as components of the overall ecological synergy that in total gives potential archaeological value to polygons defined at the 1:20,000 scale.

The archaeological potential of each polygon is thus a composite of its macrosite criteria. It is derived by totalling the numerical scores for Confidence and Macrosite Variables. The totals were then grouped into two modal classes (high and medium) within the ranked universes. Numerical scoring of the criteria resulted in 123 polygons being assessed as having High archaeological potential and 348 polygons assessed as Medium. Table 2 presents a breakdown of the potential classes by LU.

LU	Total Polygons	High Potential	Medium Potential
G20	104	31	73
G21	86	29	57
G23	60	11	49
G24	43	3	40
G25	15	2	13
G26	61	13	48
G27	51	20	31
G28	51	14	37
Total	473	123	348

Table 2. Breakdown of archaeological potential polygons by LU.

Microsite variables, on the other hand, have determined the placement of polygon boundaries and the sizes of the individual polygons. As such, they are specific to each polygon in relationship to the components of the immediately surrounding landscape, which either has low archaeological potential (and thus is not delineated with polygons at all) or which is delineated by separate polygons because of differences in microenvironmental characteristics such as landform or relationship to water. The archaeological significance of the microsite criteria is that they are responsible for the definition of a given polygon relative to its immediate surroundings. These criteria are best conceived of as independent descriptors of each polygon. However, the microsite scores for the polygons do not provide useful information regarding archaeological potential as such, because terraces, promontories and saddles or watercourses, lakes and confluences do not have archaeological potential in themselves - their potential relates to the relationship between their settings and the precontact human land and resource use models. Instead, the score for each microsite criterion represents a measure of the contribution each has made to the delineation of a given polygon. This information is provided primarily for future use when a sufficiently large number of polygons has been examined in the field so that the results of such fieldwork can be utilized as tests of the relative value of these criteria as predictors of archaeological site locations in a given landscape unit and, by extension, of the applicability of the various precontact land and resource use models to the landscape unit in question.

Those areas that have not been mapped as polygons are considered to have ***low archaeological potential***, that is, areas where sites are not likely to be present. It must be emphasized, however, that this ***does not imply the absence of sites and certainly does not imply a lack of heritage significance for those sites that may be present***. Indeed, the very scarcity and isolation of sites can convey upon them a relatively greater significance than for sites in denser zones because they may contain unique information.

Although they are grounded in a considerable depth of background research and experience, the scores placed on the macrosite criteria used in this study are still somewhat subjective and thus the ranks as sums of these scores are also subjective to some degree. It is to be hoped that this subjectivity will be steadily reduced as results of field investigations guided by the maps are factored back into the process. This will only be possible, of course, if such investigations are conducted by adequately trained archaeologists within the context of suitably informed sampling designs.

Since the archaeological inventory upon which this study draws does not represent the product of systematic investigation, the results must be considered as preliminary and largely hypothetical. Furthermore, the maps are conservative in nature, given the non-renewable nature of the resource. Nevertheless, the assessment is based on considerable background material and experience and it represents a valuable planning tool to facilitate the integration of archaeological resource conservation with other types of future land use, especially those involving disturbances of the land surface such as forest industry activities.

Forest development planning identifies areas where road and landing construction, harvesting and site preparation are proposed. Since all of these activities involve some degree of ground disturbance, they represent significant threats to the integrity of archaeological sites and features. By comparing the locations of proposed forest industry activities with mapped polygons of archaeological potential, it is possible to identify potential circumstances that could result in the destruction of non-renewable archaeological resources. These areas of overlap represent potential conflicts which, if not avoided at the initial planning stages, should be examined in the field via archaeological impact assessments and appropriate avoidance or mitigative measures identified if results warrant. Over time, as discussed previously, the results of archaeological field investigations can be utilized to formally test and refine the models that serve as the basis for polygon definition.

It must be emphasized that the accuracy of polygon location is limited by the precision of the TRIM map base and also by the degree to which forest canopy closure allows for the accurate delineation of landform boundaries. Therefore, the locations of the polygon boundaries on the maps should not be viewed as exact and landform context as determined in the field (for example, during reconnaissance, cruising or layout) is desirable as an adjunct to the mapping if avoidance is chosen in the planning stages. With regard to using the archaeological potential maps to determine the need for archaeological impact assessments, the assessment of potential impact should be based on proximity (e.g. within 50 m) of a polygon to a proposed road, landing or block as opposed to direct overlap.

7. Recommendations

Maps of archaeological potential for Landscape Units G20, G21, G23, G24, G25, G26, G27 and G28 of the Columbia Forest District have been developed on the basis of biogeographic criteria, precontact human land/resource use models and stereoscopic air photo analysis. Areas delineated by polygons have some likelihood for containing archaeological deposits or features. As such, ***these polygons can be used to identify areas where more detailed investigations via preliminary archaeological field reconnaissance (PFR) or archaeological impact assessments (AIAs) should be undertaken***. The intensity of such investigation will depend upon the extent and location of previous disturbance.

One mapping note is in order at this point, with regard to Crown land immediately adjacent to the Columbia River marshes. On the west side it was assumed that logging could feasibly take place near or even in the riparian zone. Because of the geologically recent aggradation of the Columbia River floodplain discussed previously, archaeological potential has been mapped to right to the marshland edges. On east side of the river, however, the situation is complicated by the presence of much private land, Highway 95 and the CPR, all of which combine to limit Crown land adjacent to the floodplain to small isolated parcels which are not well differentiated on the available mapping (i.e. the GIS Cadastral and the ILMB private and Crown grant information, which differed significantly with regard to locations of parcel boundaries). Because these same factors also combine to result in limited access to the Crown land below the railroad with regard to logging, the less precise archaeological potential mapping in these localized situations is not considered to be a serious problem. However, in view of the high archaeological potential of all lands adjacent to the Columbia River floodplain, the caveat must be attached that if there is any logging proposed for these areas on the east side of the river south from Donald, it should be subject to a field inspection regardless of whether or not it was captured by the archaeological potential mapping due to the inadequacies of information regarding exact boundaries of private and Crown parcels noted above.

On another matter, it must be emphasized that this study focuses on precontact archaeological resources; its methodology is not suitable to predict locations of culturally modified trees. These are also protected heritage resources but they are more reliably located by field survey of areas containing old growth forest. Therefore, ***it is recommended that the presence of culturally modified trees be determined by field examination in proposed forest developments where the age of trees exceeds ca. 100 years.***

A final commentary is in order with regard to the review and analysis of reports of previous investigations. A summary database / catalogue of reports of previous archaeological studies in the study area consistent with the RFP now resides with the geographic information management division of the Ktunaxa Land and

Resources Agency and a listing of these reports is included in Section 8 of this report. However, when the RFP for this project was being drawn up in 2005, the ultimate objective of such a report distillation was seen as allowing for the adjustment of polygon boundaries and/or values during the mapping process. Between the initial issuance of the RFP and the finalization of the contract in 2006, a first attempt at this endeavour was undertaken for British Columbia Timber Sales in LUs K3 and K6 in the Kootenay Lake Forest District (Choquette 2006). This process involved extracting archaeologically useful information from the mandated assessment reports and applying it to evaluate the basis upon which the assessments were required.

The process began with the identification of the geospatial coincidence of proposed development and a landform or landscape with archaeological potential as originally identified by an AOA. Based on this identification of co-occurrence of development and possible archaeological values, the process then moved to the extraction from the reports descriptions of the landscape and the rationale for determining where subsurface test units were placed, along with assessments of existing and potential future disturbance. Then determinations were made as to whether the extent of the testing was commensurate with the projected archaeological potential to support a conclusion that no significant future impacts to any archaeological values can be anticipated. If these conditions were met, the terrain in question was relegated to low archaeological potential (i.e. no longer of archaeological concern). Such a determination requires both that the sampling process be fully explicated and also that the location in question be adequately described in order to support independent evaluation of the conclusion / assessment.

Although quite straightforward, this process proved to be relatively clumsy and inordinately time consuming, especially when the end product (paper permit report review) was compared to the original information base (land-based GIS polygons with geoarchaeoreferenced databases). Given that the development plans likewise originated in digital format, from a management efficiency perspective the process represented a retrogression. Furthermore, it was found that there were major problems with the quality of the information presented in the reports. Although virtually all of the reports were replete with references by number to Cutting and Heritage Conservation permits, there was no consistency at all in the presentation of information pertaining to the results of the archaeological investigations themselves. Because the purpose of the study was to update the archaeological potential mapping, this problem of inconsistency was particularly chronic with regard to assembly of information pertaining to the archaeological potential polygons. Despite the typically numerous tables, there was no single consistent location in any of the reports (including the management summaries) where the archaeological potential polygon number was presented, much less information providing the rationale for requiring an archaeological impact assessment based on the AOA. This was all the more notable because the great majority of the AIAs were carried out after the archaeological potential mapping had been done and, in most cases, were in fact specifically targetted to areas in archaeological potential polygons.

The same applied to the mapped representations of the polygons in the reports. In fact, mapping was inconsistent across all reports in terms of subject matter, format, detail, scale, extent, etc. In many cases it was necessary to place the TRIM archaeological potential map on a desk beside the report and "eyeball" the spatial correlation of an investigated area onto the mapped polygon. Of equal concern, nowhere in any report was there any discussion or even mention of the polygon databases or the criteria whereby the archaeological potential of the investigated locations had been determined. Unfortunately, this also meant that there were no references to the characteristics of located archaeological remains in terms of the archaeological potential criteria either. Rather than being able to quickly discern direct correlations in the reports between the archaeological potential derived from the AOA and the impact assessment methodology and results, it was instead necessary to extrapolate from subjective descriptions that ranged widely in terminology and detail. It is apparent that the precision of the predictive modelling thus actually deteriorated through the various stages of the archaeological assessment process. This occurred despite (or it even can be argued because of) the imposition of the Archaeology Branch permit process between the AOAs and the AIAs, and also despite the increased intensity of archaeological investigation subsequent to the original archaeological potential mapping. In other words, the archaeological impact assessment process as reported had become almost completely disconnected from the archaeological overview assessment process with regard to accountability to the scientific prediction of potential locations of archaeological sites.

This essentially derailed the explicit intent of the AOAs to allow "cultural resource management" to still fulfill the obligation and promise of archaeology as scientific investigation. Severing the link of the hypotheses represented by the archaeological potential polygons and their descriptive databases from the tests of those hypotheses represented by the AIAs is not consistent with the intent of "results based" "professionally accountable" resource management.

Identical problems of crucial missing information and inconsistent and disjunct data were encountered during the review of reports of previous investigations in the course of the present study. Considering the number of AIAs that had been done in the Columbia Forest District and the difficulty and extreme inefficiency in using the limited and flawed paper-based data previously encountered during the BCTS AOA update project, it was not possible to incorporate all of the AIA results into the present mapping. While the positive data was utilized to the extent its presentation and description allowed, extracting the location of every assessed cutblock, road and landing was well beyond the scope of the present study. That having been said, because of the great degree of inconsistency in the assessment methodologies and descriptions of results in the reports, it was concluded that creating a consistent map layer of archaeological potential for the eight LUs independent of the AIAs was more important, both in terms of consistency with the previous LU mapping elsewhere in the region as well as the desirability of having such a data layer in the GIS as a baseline for subsequent analysis of AIA results. Given that the locations of the assessed developments most likely exist in digital form, entering them as a GIS layer overlaid upon the product of the present study and then evaluating the reported results of the PFRs and AIAs represents a vastly more efficient and accurate means of achieving the end of closing the loop between the AOAs and the AIAs upon which they were based.

It must be emphasized that this unsatisfactory situation of disjuncture and inconsistency can be corrected in future if the archaeological field review and impact assessments are made accountable to the needs of responsible archaeological information management in addition to government permitting. The latter appears to drive the entire process at present but is itself also disconnected from the archaeological overview assessment process. Given that GIS is the accepted common information management environment with regard to land-based information, the data resulting from archaeological investigations minimally should be retrieved from the field and provided in appropriate format(s) and sufficient levels of detail and consistency that it can be immediately input and subsequently analyzed as a GIS layer, making updating of the AOA polygon layer very easy. Locations of foot traverses and subsurface test units along with road, landing and/or block boundary coordinates should be recorded electronically in the field, ideally via GPS, and provided in appropriate digital format. Archaeological and contextual data must be recorded to a level of detail at least consistent with the components of the predictive models and the criteria upon which the archaeological potential polygons were defined. This will result in more reliable information and hence more effective management from an operations perspective. It will also enhance the potential for the existing information management system as it presently resides in the KLRA GIS to ultimately support more broadly based heritage stewardship endeavours such as research, interpretation and education, all of which are also archaeology's mandates. It goes without saying that individuals carrying out these investigations must have the requisite experience and expertise to recognize and record this data. Unfortunately at present, this type of knowledge is not part of the requirements for Heritage Conservation Act permits but consistency in regional archaeological knowledge is essential if assessment results are to be objective and useful within a scientific paradigm.

If the improvements suggested above are made, the archaeological information generated from AIAs (the reason why they are done) will be elevated beyond the haphazard, disconnected and subjective fragments of archaeological data in otherwise rather uninformative AIA reports that tend to be targetted only to fulfillment of generic permit requirements. Besides the lost opportunities to gather valuable information (and even loss of the information itself), the present disjunct between the science-based AOA process and the subjective and erratically constrained AIAs eliminates the potential for ongoing refinement of the predictive modelling and the consequent reduction over time of the expense incurred to licencees obligated to carry out AIAs.

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