ARCHAEOLOGICAL OVERVIEW ASSESSMENT

OF LANDSCAPE UNITS G01, G02 AND G03,

COLUMBIA FOREST DISTRICT

prepared for Wood River Forest Inc.

by

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Credits

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Management Summary

The Provincial Forest lands encompassed within Landscape Units G01, G02 and G03 of the Columbia Forest District were assessed for archaeological potential via aerial photograph analysis. A total of 55 landform-based polygons were identified as having 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 11 polygons being assessed as having High archaeological potential and 44 polygons assessed as Medium.

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1. Introduction

This report accompanies the mapping of archaeological potential for Landscape Units G01, G02 and G03 in 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.

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2. Study Area Environmental Background

Landscape Units G01, G02 and G03 encompass part of the west slope of the Rocky Mountains and part of the east slope of the Columbia Mountains on the north side of the confluence area of the Columbia, Wood and Canoe rivers. The east boundary of the study area is the Continental Divide and Hamber Provincial Park, the north boundary is with the Forest District while the other boundaries are with LUs G04, R16 and R6 of the Columbia Forest District and the Kinbasket Reservoir.

2.1 Present Environment

The ecosystems encompassed by the three LUs have been classified into three "ecoregions" that correspond with the Rocky and Columbia Mountains and the intervening Rocky Mountain Trench. These are represented in this locality by three ecosections: the Central Park Ranges, the Big Bend Trench and the Northern Columbia Mountains. These are described in the following summary which draws on Quesnel and Thiessen (1993).

2.1.1 Central Park Ranges

The terrain between the Rocky Mountain Trench and the Continental Divide is characterized by high rugged mountains with many glaciers and icefields. In the study area, with the exception of the Wood River, valleys are short and steep-sided. The scalloped and serrated mountain ranges are underlain by folded and faulted upper Proterozoic to Cambrian sedimentary and metamorphic rocks; resistant units of limestone and quartzite are occasional manifested 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 the broader U-shaped valley of the Wood River. A distinctive feature of LU G03 observed during the air photo analysis is the evidence that many of the cirque glaciers have advanced across valleys that did not contain contemporary glaciers.

The most common valley bottom biogeoclimatic zone in the study area is the Wells Gray Wet Cool Interior Cedar-Hemlock variant (ICHwk1) (Braumandl et al 1992: 176). In the lower part of the Wood River valley in LU G03, the north side of the valley wall supports the Golden Moist Warm Interior Cedar-Hemlock variant (ICHmw1) while the Mica Very Wet Cool variant (ICHvk1) (ibid.: 184) occupies the south valley wall here. In the bottom of the upper Wood River valley in LU G01 and at higher elevations throughout the study area is coniferous forest of the Northern Monashee Wet Cold Engelmann Spruce - Subalpine Fir variant (ESSFwc2). 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 this 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. The range of woodland caribou included the upper Athabasca drainage and likely extended into the eastern part of the present study area.

2.1.2 Big Bend Trench

This is the narrow, more northerly part of the Rocky Mountain Trench in the upper Columbia River drainage, although the major confluence area of the Columbia, Wood and Canoe rivers is a local widening in this huge valley. The Trench is underlain by deep Quaternary sediments. The most common landforms are composed of deposits of moraine and modified glaciofluvial and glaciolacustrine drift. This is also 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, now inundated by the Kinbasket Reservoir, previously were habitat for moose, elk, white-tailed deer, black bear, beaver and wolf. Seral forests are utilized by grizzly bear, black bear, moose and wolf.

2.1.3 Northern Columbia Mountains

Situated on the west side of the Canoe River, the west half of LU G02 represents this ecosection. It is characterized by high ridges, and mountains with ice-capped peaks that are dissected by deep narrow valleys and trenches. In the study area, this terrain is underlain by metamorphosed sedimentary rock of the Horsethief Creek Group. Shallow to deep colluvial deposits and bedrock are the most common landforms. Less extensive deposits of moraine, glaciofluvial drift and recent fluvial sediments occur at lower elevations.

This ecosection has the highest precipitation and the coldest temperatures in the Columbia Mountains and Highlands Ecoregion. Vegetation is represented by a sequence of biogeoclimatic zones ranging from low to middle elevation ICHwk1 through the middle to high elevation ESSFwc1 to ESSFvv at the upper timberline and alpine tundra above that. Seral stands include hybrid white spruce, western white pine and Douglas-fir at low elevations; spruce and subalpine fir are seral to mountain hemlock at middle to high elevations.

At low elevations, young seral stands and riparian areas are important habitat for moose, grizzly and black bear, elk, wolf and bald eagles. Upper elevation forests and alpine habitats are utilized by caribou, grizzly and black bear, mule deer and mountain goats.

2.2 Landscape Evolution

The complex geological history of the study area 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. Some time before 70 million years ago, in the late Cretaceous, downfaulting 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. 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 Columbia-Wood-Canoe confluence area. Sediments interpreted as overbank or floodbasin deposits of a large river were identified in a borrow pit at the mouth of the Wood River. These deposits 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 vicinity of the confluence of the Columbia, Wood and Canoe rivers is interpreted to be related to ponding associated with the readvance of glacial ice ((ibid.: 10). This was characterized by the expansion of small glaciers originating in Purcell and Rocky Mountain cirques which then merged into a system of valley glaciers. Glacial till was deposited in the Rocky Mountain Trench at Wood River 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).

Final deglaciation commenced about 15,000 years ago (Ryder 1981) and in the Jasper National Park vicinity at least, glaciers had retreated to their present extents by 10,000 years ago (Kearney 1981). Parts of the upper Columbia River drainage became ice-free sooner than areas further west (Choquette 1996). A mechanism for this that has significant palaeoclimatic implications 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." At the end of the latest glacial advance, the Rocky Mountain Trench itself was occupied by large proglacial lakes dammed by moraines and melting ice blocks; thick accumulations of clay, silt and fine sand accumulated in these lakes, one of which occupied the lower elevations of the present study area.

Landscape evolution during the succeeding Holocene epoch has been characterized by colluvial processes, some aeolian deposition and at lower elevations, fluctuation of hydrological baselines at first due to fluvial incision and later aggradation. After the glacial lake drained, the Columbia, Wood and Canoe rivers and their tributaries began dissecting the glaciolacustrine valley fill. Terraces and fans were formed as the ancestral rivers carved channels and deposited sediments at various places and elevations in response to climatic variation. The early millenia of the post-glacial period were characterized by increasing drought and relatively high mean temperatures, a climatic interval known variously as the "Hypsithermal", "Altithermal", "Thermal Maximum" or "Climatic Optimum". By 10,000 years ago, there was probably less glacial ice in the region than exists today, and by 7000 years ago it is doubtful if there were any glaciers at all in the surrounding mountains. 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, the beginning of a global cooling trend known as the "Neoglacial" (Porter and Denton 1967). Increased glacial activity is documented in the Rocky Mountains at the Columbia's headwaters around 5000 and 2800 years ago, and during the Little Ice Age ca. 400 to 130 years ago which was the most intense glaciation in the northern Cordillera since the Pleistocene.

2.3 Palaeoecology

The earliest vegetation in the region was the immediate postglacial open community known as "steppe tundra" in the palaeoenvironmental literature. Prior to 10,500 years ago, a pioneer community of grass, sage and scattered conifers occupied slopes and ridges amongst the expanses of bedrock, lingering glaciers and proglacial lakes ponded against them. This community 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 to the southwest 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).

Grasslands were apparently 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). Elsewhere in JNP, meadows and fens were desiccated at lower elevations during the period identified as the Hypsithermal, from ca. 8500 – 5900 b.p. (Kearney 1981). Unfortunately there is no specific palaeoenvironmental data for this time period from the present study area itself, which is on the opposite side of the Continental Divide from JNP, and there is no information regarding high elevation palaeoecology from this area. It must be noted, however, that high elevations in the study area are characterized by very steep terrain and 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 western windward slopes became cloaked with denser forests. New plant communities began to develop in the storm tracks that now followed major gaps in the Columbia Mountains. Subsequently, an increasingly varied and diverse vegetational mosaic evolved during the series of increasingly colder cycles within the last 5000 years. 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, becoming 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 Neoglacial advance occurred in the Canadian Rocky Mountains. The interval between ca. 6000 and 2500 years ago in the upper Columbia drainage was also characterized by high fluvial discharge, and the region may have supported generally more extensive aquatic ecosystems as well as more productive riparian communities.

This was followed by a globally recognized but relatively brief warm and dry interval when forest fire frequency increased while fluvial discharge notably decreased. The final palaeoclimatic episode was the "Little Ice Age".

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. 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 large mammals. Data from Banff National Park (e.g. Fedje 1986) demonstrate the importance of mountain sheep in the early precontact economy. Bison had expanded into the Elk Valley and the southern Rocky Mountain Trench during the brief dry interval within the last 2000 years (Choquette 1987b). Wood bison were present in the Athabasca Valley in what is now Jasper National Park and were hunted by the Ktunaxa in the North Saskatchewan basin within a few kilometres of the Continental Divide at the east edge of the Columbia Forest District (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 also have been documented in the archaeological and ethnohistoric records further south (c.f. Choquette and Holstine 1982) but data from the vicinity of the present study area are lacking.

Aquatic resources undoubtedly fluctuated considerably as well, especially considering the extent of Neoglaciation in the surrounding mountains. 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 1985, 1987a) that are probably applicable to the upper Fraser basin as well. These models cover the past 10,000 years and provide more detail than the larger scale climatic trends described previously; initially they have been used as a basis for predicting the Columbia River's past salmon carrying capacity. In composite, the models define a series of climatic cycles 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 relatively more severe 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 2000-1000 years ago probably fostered larger salmon runs. Archaeological evidence from elsewhere in the upper Columbia River basin suggests that during the early Neoglacial, the region may have supported generally more extensive aquatic communities including larger numbers of waterfowl and resident fish. The latter include rainbow and bull trout, sturgeon, burbot and whitefish.

3. Cultural Context

3.1 Ethnohistory

In 1810, Joseph Howse of the Hudson's Bay Company traversed the pass which now bears his name, then travelled southward through the Rocky Mountain Trench (Spry 1963). Shortly afterward, the Peigan closed Howse Pass, resulting in a shift to the Athabasca Pass, which David Thompson crossed in January 1811 to establish a northerly route to the Columbia River drainage that avoided Peigan territory (Hopwood 1971). 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 was followed by the establishment of a fur trade route (the Columbia Trail) which connected Jasper House with Forts Colvile, Okanagan, Walla Walla and Vancouver via the Athabasca Pass. The fur traders established a supply depot at Boat Encampment, which was also known as the Athabasca portage. Boat Encampment served as a major fur trade transfer point for some 50 years.

In 1838, a party of twenty-six people, including a group of Oblate missionaries, travelled through the study area before wrecking their boat on Death Rapids where twelve people lost their lives. 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, where they were hunting moose and beaver (Kane 1974: 106, 235).

3.2 Ethnography

The archaeological record indicates that the upper Columbia and Athabasca drainages have been occupied by aboriginal peoples for most, if not all of postglacial time. However, bridging the gap between archaeology and the written record is confounded by the events which transpired as a result of contact with Europeans. The effects of disease, horses, the fur trade, gold rushes, missionaries, the creation of the international boundary and the establishment of reservations all disrupted land and resource practices before any serious documentation of traditional lifeways took place.

Probably the single greatest impact of contact with Europeans was the effect of epidemic diseases, estimated to have reduced native populations by as much as 80%. There are accounts from adjacent areas indicating severe afflictions prior to the actual arrival of Europeans, for example, the extinction of the "Snaring" or "Snake" Indians of the upper Athabasca valley and a smallpox epidemic that devastated the Ktunaxa ca. 1780 (Mooney 1928: 13). Outbreaks of whooping cough, diphtheria and smallpox were recorded among the Secwepemc in 1827, 1842-3 and 1862, respectively.

Complex new patterns of native population movement and influx developed in the Rocky Mountains as a result of European influence, especially 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.

At the time of contact at least, it is apparent that the present study area was utilized seasonally by representatives of two ethnolinguistic groups, the Salish and the Ktunaxa.

3.2.1 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's 1909 and 1930 accounts of the

Secwepemc and Ignace's 1998 work comprise the bulk of written data for that group.

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.

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.

3.2.2 The Sinixt

At the time of European contact, the subsistence territory of the Secwepemc overlapped in the northern Selkirk Trench with that of the Okanagans, a Salish-speaking group who travelled eastward from the Okanagan Valley across the Monashee Mountains. However, the primary inhabitants of the Selkirk Trench at this time were another Okanagan group, the Sinixt or Lakes, a northward extension of Okanagan-speakers distributed along the main stem and tributaries of the middle Columbia River. The major ethnographic work on the Sinixt is by Bouchard and Kennedy (1985, 2000).

Historical records indicate that the Sinixt were focused on Kettle Falls during the contact period and even overwintered there. The major villages were along the Columbia River not far north of Kettle Falls at the southern edge of their subsistence territory. Prior to the middle of the 19th century, however, the Sinixt were centred further north in the Columbia Valley north of Castlegar. The ethnohistoric records indicate that their subsistence quest took them up the Columbia to the vicinity of its Big Bend but they apparently did not overwinter beyond Revelstoke.

3.2.3 The Ktunaxa

The Ktunaxa are a culturally and linguistically unique group whose cultural development paralleled the evolution of the diverse regional ecology. 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) 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.

3.3 Archaeology

3.3.1 Previous Investigations

There has been very little archaeological work conducted in the study area vicinity. Parts of the Mica Dam pondage were surveyed in 1965 by Don Mitchell and John Sendey; Mitchell and Chris Turnbull made a brief reconnaissance in 1968 during which one precontact archaeological site was recorded during the latter investigation (Mitchell and Turnbull 1968a). In 1972, Mike Robinson and Ken Martin surveyed the Canoe River from the Mica Dam site to the head of navigation 10 miles north of Howard Creek, plus the confluence of Columbia, Canoe and Wood rivers (Robinson and Martin 1972). No evidence was found of pre- or post-contact occupation; 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.

Numerous archaeological studies ranging from overviews, resource inventories and impact assessments to mitigative excavations have been carried out in Jasper National Park, immediately adjacent to LU G01 on the east. More than 200 precontact archaeological sites have been recorded, most of which are situated in the Athabasca Valley between Jasper townsite and the northeastern park boundary (Pickard 1989). Of particular relevance to the present study is the judgemental survey of the Whirlpool and Chaba/Athabasca trails (Wilson 1987). Nine precontact sites were recorded during the former survey, along with seven isolated finds of stone artifacts. One precontact site was found along the latter trail.

The most recent archaeological investigations in the study area consist of localized impact assessments of proposed forest industry developments (e.g. Choquette and Yip 1996, Head 1997, Magee 1998, Campbell 2000). One postcontact site was identified but no precontact sites have been recorded.

3.3.2 Precontact Culture History

The lack of data from the study area precludes the definition of a culture history sequence. However, results of archaeological investigation in neighbouring Jasper National Park indicate that humans were present in the Athabasca drainage from early postglacial time onwards. Given that two transcontinental divide passes connect that drainage with the Wood River watershed, it is highly likely that the study area was likewise uilized for much if not all of the postglacial past, especially considering that it also includes part of the major intermontane corridor represented by the Rocky Mountain Trench. The runs of Pacific salmon which ascended through the area in the Columbia River and large populations of resident fish are also an important consideration with regard to archaeological potential.

The JNP sample includes a number of large stemmed, lanceolate and foliate spearpoints, many of which were found well within the mountains. These artifacts represent the presence of humans during the early postglacial period from ca. 11,000 to 7000 years ago, including the Altithermal/Hypsithermal. This suggests that the more benign climate of much of this time period was conducive to an intensity of occupation not matched during later times, especially when site preservation and the smaller overall human population during earlier times are considered. Further south in both the upper Columbia drainage and the Rocky Mountains, cultural complexes with antiquities on the order of 10,000 - 11,000 years have been defined (Fedje 1986, Choquette 1987b, 1996). The cultural materials occur in sediments associated with the drained basins of the earliest proglacial lakes. Subsistence was based on hunting, but the presence of viable fisheries lower down on the Columbia River by at least 9000 years ago (Chance, Chance, and Fagan 1977) suggests that aquatic resource utilization cannot be ruled out even at this early time level. The relatively high intensity of early occupation continued in both of these mountainous areas until the middle Holocene.

The common occurrance in the upper Columbia Valley of medium to large side-notched and stemmed projectile points, which typically date between ca. 7000 and 2500 years ago in adjacent areas, indicates that the Rocky Mountain Trench south of the present study area was occupied by at least one hunting-gathering society during this time span. The data from JNP are interpreted as representing the presence of more than one cultural group during this time span (Pickard 1989).

Within the last 3000 years, a number of changes took place in the upper Columbia drainage. Some, like a shift in lithic material preference from microcrystalline to cryptocrystalline stone and 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 plateaux. Other changes such as in subsistence focus and settlement pattern probably have their roots in adaptive responses to climatic changes which occurred during this interval. Data from JNP indicate considerably less intensive human occupation of the Athabasca drainage than previously.

The Columbia River's anadromous salmon resource must also be considered as a factor in predicting archaeological site distributions. In both the Fraser and Columbia drainages, the salmon resource was responsible for the support of substantial human populatons with a distinctive culture and semi-sedentary lifestyle. Notwithstanding their occasional occurrence east of the Continental Divide, pithouse depressions are the structural evidence of this lifestyle west of the Divide. These features are common in both the Rocky Mountain Trench from Canal Flats to Golden and along the lower Arrow Lakes, but they are absent from those parts of the upper Columbia drainage where falls block the ascent of salmon. Unfortunately, the virtual lack of systematic archaeological survey in the Columbia River's big bend within the areas now inundated by reservoirs does not allow any definitive statements to be made regarding past human use of this resource here. It is worth emphasizing, however, that the salmon runs passed directly through the study area en route to spawning grounds in the Rocky Mountain Trench and salmon likely spawned locally under favourable cllmatic conditions. The intensity of inhabitation of the upper Columbia drainage by pithouse dwellers was undoubtedly related to the salmon carrying capacity of the Columbia River (as noted in Section 2.2 above and set out in detail in Choquette 1985). The presence of salmon fishers most likely would have been tied to periodic episodes of high salmon carrying capacity.

4. Study Methodology

This study comprises an assessment of the archaeological potential of Provincial Forest lands in Landscape Units G01, G02 and G03. 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 traits used to define the regional archaeological record, especially settlement pattern, lithic preference, subsistence base and palaeoenvironmental context as extrapolated from the soil and sediment associations of the cultural deposits. These traits have been synthesized into models of past human land and resource use that are 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 three 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 distribution 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.
Only one recorded precontact site in British Columbia is anywhere near the present study area: EIQm-1 adjacent to pre-dam Kinbasket Lake in the Rocky Mountain Trench south of LU G03. A single flake of unidentified lithic material was observed in a disturbed area; the site is interpreted to be a possible camp (Mitchell and Turnbull 1968b).

On the other hand, the three watershed units in Jasper National Park closest to the present study area (the Upper Athabasca, Whirlpool and Astoria) contain one, ten, and four precontact sites respectively, along with at least seven isolated finds. In assessing this data, Pickard (1989: 60) describes it as minimal and not providing a true reflection of the density of archaeological resources and the complex nature of the cultural record. On a relative basis, Pickard (ibid.: 77) suggests that "the Whirlpool and Astoria watersheds offer higher archaeological potential than the Upper Athabasca Watershed due to the fact that they served as a major transportation corridor. The presence of a major mountain pass, alpine lakes and a more reliable and accessible resource base would have supported sustained and frequent use of the Whirlpool and Astoria watersheds ... The single survey of the Chaba River within the Upper Athabasca Watershed suggests that prehistoric people were present in the area." Based on the level of previous inventories and archaeological potential, the Whirlpool Watershed was ranked as a first order priority for future inventory (ibid.: 201).

The limited extent of systematic archaeological investigation in LUs G01-03 precludes knowledge of the intensity of precontact human habitation in the study area itself. However, the JNP data identified above obviously also reflect on the present study area, especially the results of surveys of the Whirlpool and Chaba/Athabasca trails (Wilson 1987), both of which are connected to the Wood River watershed via Continental Divide passes (see also Section 4.1.3 below). The results of the upper Athabasca valley survey may not be representative of the intensity of precontact presence in that area, as parts of the modern Chaba/Athabasca trail that was the focus of the survey are significantly removed from the river (ibid.). On the other hand, the finds along the Whirlpool Trail and immediate environs can be summarized as a discontinous scatter of lithic artifacts ranging in concentration from isolated finds of single artifacts through numerous scatters to loci where several hundred lithic artifacts were observed. At least one such locus also contained fire broken rock.

Unfortunately, Wilson’s report on these findings lacks descriptive detail, precluding the identification of some very basic aspects of precontact human use that are directly relevant to prediction of intensity of such use in the present study area. The large majority of the artifacts are identified only as quartzite flakes; other types of stone occur primarily in the lower portions of the Whirlpool Valley in association with the most intensive concentrations of cultural material. A quarry for quartzite was documented in the Astoria watershed, adjacent to the Whirlpool on the north, but no information, not even colour, is provided consistently to allow for a determination of whether the artifacts found in the Whirlpool Valley are of the same quartzite as was quarried near Outlook Lake. This precludes any inference regarding whether the density of sites in the valleys on the east side of the Divide is due to a strong occupational focus supported by and based on the Outlook Lake quarry. Such a focus could relate to a seasonal transhumance into the high elevation basins in the lee of the Rocky Mountain crest by people living further down the Athabasca Valley. On the other hand, if the artifacts in the Whirlpool Valley are not from the Outlook Lake source, the existence of a linear scatter of such intensity could instead be taken as evidence of relatively heavy use of the transcontinental divide travel corridor over Athabasca Pass. Obviously the ramifications for archaeological site density along the Wood River on the west side of this complex of interconnected valleys are different depending upon whether the numerous artifacts in the Athabasca drainage relate to a Rocky Mountain east slope settlement/subsistence pattern associated with a major quarry in a complex of rainshadow basins, as opposed to a linear scatter left by numerous travellers along the Whirlpool Valley of artifacts made from quartzite from multiple sources.

An intriguing component of this scenario is an isolated find by a park warden of a large lanceolate biface of green siliceous siltstone in the Whirlpool Valley (Anderson and Reeves 1975). This artifact was observed by the present writer to have an appearance of significant age based on its shape and technology and on the degree of weathering. At the time (1971), this was surprising because it was found so close to present glaciers. However, subsequent decades have seen both a large amount of palaeoecological research documenting the effects of the Hypsithermal as well as numerous finds of other large spearpoints in the Rocky Mountains indicating significant human presence during early postglacial times. It is thus entirely possible that human use of the Athabasca Pass could extend back that far, and such use may characterize the present study area as well.

The two precontact land and resource use patterns identified above obviously would relate to two different levels of intensity of human use of LUs G01-03. The scope of work of the present study does not include re-analysis of the artifacts, so application of the precautionary principle is necessary because we are dealing with a non-renewable resource. Therefore, for the purposes of the present study, prediction of the occurrence of archaeological deposits and features in the LUs is based on the hypothesis that site density in the Wood River is at least in part directly functionally related via a transcontinental divide corridor to site density in the Whirlpool Valley. Testing of such an hypothesis via properly informed Archaeological Impact Assessment would also have ramifications on the interpretation of the data from east of the Continental Divide.

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 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 limitations of the present site inventory must always be kept in mind.

4.1.2 Columbia River

The Columbia River was the greatest salmon producing river in North America in precontact time. It also contained an abundance of other important aquatic resources, including waterfowl and resident fish. The richness of the riparian zone with regard to diversity of plant resources and habitats for terrestrial mammals such as deer, bears and moose further underscore the importance of this river to the aboriginal economy. 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 broad corridor represented by the Rocky Mountain Trench would obviously have been the major precontact travel corridor, both on foot and by canoe. It is scored 3.

As discussed above, the study area also contains part of a transcontinental divide corridor connecting the Wood and Whirlpool valleys via the Athabasca Pass. Although of great Contact period significance, the use of this route across the Rockies was largely a product of the closure of the more southerly passes by the Peigan in an attempt to prevent their enemies to the west from obtaining metal weapons from the European fur traders. This scenario was not likely duplicated during precontact time, when environmental constraints would have been the main determinants of human presence in this part of the North American Cordillera. From this perspective, the archaeological record indicates that while many passes further south were heavily used in precontact time, what evidence there is from the mountain National Parks indicates less intense use of passes contained therein, although precontact cultural remains have been found on almost every one that has been investigated. This appears to have been the case even during the early postglacial when the more northerly parts of the southern Canadian Rockies were more heavily utilized. In view of the evidence of less intensive precontact use of the passes north of Crowsnest, and considering the uncertainty regarding the exact degree of use *vis a vis* the evidence from JNP, polygons along this corridor were scored 2.

It must also be noted that the upper Wood River contains a second, much lower transcontinental divide pass, along Fortress Lake. At an elevation of 1333 m, this lake occupies a remarkably low gap across the Continental Divide, almost 450 m lower than Athabasca Pass. Indeed, it is only about 200 m higher than Yellowhead Pass and it is lower than any other Continental Divide passes in the southern Canadian Rockies, being 24 m lower than the Crowsnest Pass and 300 m lower than the Kicking Horse Pass. Although it presently drains into the Pacific, the southeast end of Fortress Lake is actually lower in elevation than the adjacent Athabasca River and is only separated from it by a low ridge of medial moraine. The unnamed divide pass via Fortress Lake is therefore much more easily accessible from the east than is the Athabasca Pass with regard to ascent and descent, while its western approach is of less vertical distance and no steeper than the ascent to Athabasca Pass. Indeed, it may only have been the specific historical circumstances of David Thompson being prevented from use of the Howse Pass by a Peigan attack and his being circumvented into the lower Athabasca Valley that resulted in the discovery of Athabasca Pass, which is more directly accessible from the northeast. If the intent is to travel from the main Athabasca Valley to the Columbia in the least horizontal distance, the Whirlpool Valley route is shorter. However, this distance factor is irrelevant if access from the southeast or more directly from the east is considered, especially by people participating in a seasonal round of exploiting mountain resources as opposed to a commercially motivated movement of goods between far-flung parts of the continent. The lack of archaeological evidence from the study area itself provides no indication of the relative intensity of use of the two passes at the headwaters of the Wood River. However, the greater density of archaeological remains in the Whirlpool Valley compared to the relatively low site density in the upper Athabasca Valley may be taken as a possible reflection of the relative importance of the two routes in precontact time. Therefore, the lower Wood River valley and the approach to Athabasca Pass are scored 2 for this criterion whereas the upper Wood River valley was only scored 1. However, this must be considered as provisional and subject to change based on actual survey of these two localities because of the potential bias in the upper Athabasca Valley sample due to the deviation of the modern National Park trail from the river noted previously and the possibility that the abundant evidence from the Whirlpool Valley may be due more to its closer proximity to the Outlook Lake quartzite quarry as part of an east slope seasonal round, another unknown as discussed in Section 4.1.1.

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 flakable stone have been identified in the upper Kootenay – Columbia over the past 30 years and the approximate locations of at least four 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 Ktunaxa territory. Since workable stone was an essential underpinning of the precontact economy, 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. They are thus extremely valuable tools for predicting archaeological potential.

The location of a quartzite quarry in the Astoria watershed ca. 40 km north of LU G01 has been mentioned previously, as has the uncertainty of whether artifacts in travel corridors leading into the present study area are from that source. Otherwise, there is no specific data regarding precontact utilization of mineral resources in the LUs. The bedrock consists of upper Proterozoic to Cambrian metasediments, some of which (quartzite, slate, chert) would be suitable for stone tool manufacture. In future it may be possible to identify specific locations of available tool stock in the LUs, either as outcrops or “reverse placer” gravel accumulations, but at present this criterion is essentially neutral as a predictor and all polygons were scored 1 for this criterion.

4.1.5 Ungulate Range

The study area is characterized by steep and rugged mountainous topography and high precipitation values, particularly snowfall, which do not favour large populations of ungulates, especially grazers. The palaeoenvironmental record suggests that ungulate range may have been higher under conditions of more frequent wildfire such as prevailed ca. 9000 - 7000 and 2000 - 500 years ago but only localities where terrain is suitably level for intact archaeological sites to be present were scored higher than 1. That having been said, scoring for this criterion reflects the generally low quality of the ungulate range from a regional perspective, as extrapolated from present values and palaeoenvironmental reconstructions: the highest score is 2 out of 3.

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.

In Banff National Park, 77% of precontact archaeological sites have either a southeast, south or southwest exposure (Fedje 1989), in Jasper NP 58.5% (Pickard 1989), in Kootenay NP 86% (Choquette and Pickard 1990), and in Yoho 50% (Choquette and Fedje 1990).

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

In Banff National Park, 31% of precontact archaeological sites were associated with a terrace (Fedje 1989), in Jasper NP 43% (Pickard 1989), in Kootenay NP 53% (Choquette and Pickard 1990), and in Yoho 33% (Choquette and Fedje 1990).

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 Banff National Park, 2% of precontact archaeological sites were associated with a promontory (Fedje 1989), in Jasper NP 5% (Pickard 1989), and in Kootenay NP 8% (Choquette and Pickard 1990).

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 (see also Section 4.1.3). 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. Besides their potential to have been utilized as transient camping and activity loci, the topographic constraints on pedestrian movements could have made such areas strategic places for the ambush of prey species such as caribou, mountain sheep and elk.

In Banff National Park, 5% of precontact archaeological sites were associated with a pass (Fedje 1989) and in Kootenay NP 4% (Choquette and Pickard 1990).

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 smaller lakes and those parts of the Kootenay Lake shoreline that are sheltered from storms. When combined with scoring for relict watercourse, this criterion pertains to the previous existence of a water body, including proglacial lakes.

In Banff National Park, 22% of precontact archaeological sites were associated with standing water (10% with lakes, 5% with ponds, and 8% with marshes) (Fedje 1989), in Jasper NP 25% (Pickard 1989), and in Kootenay NP 8% (Choquette and Pickard 1990).

4.2.5 Watercourse

Rivers and streams and the associated riparian ecosystem support a diversity and abundance of subsistence resources as well as being sources of vital fresh water. Besides the Columbia River, other rivers and streams supported a diversity and abundance of subsistence resources as well as being sources of vital fresh water.

In Banff National Park, 81% of precontact archaeological sites were associated with a watercourse, either extant or relict (Fedje 1989), in Jasper NP 73% (Pickard 1989), in Kootenay NP 49% (Choquette and Pickard 1990), and in Yoho 33% (Choquette and Fedje 1990).

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.

Rejuvenation of glaciation and the effects of avalanches associated with Neoglaciation during the last 5000 years also resulted in changes in the locations and local baselines of some watercourses.

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 (Polygons G01-05, G01-06, G01-06, G01-07 and G01-08) which can be good fishing locations; and springs. Some of these natural features can have sacred associations.

4.3 Confidence

The need for this measure was expressed by Oliver Thomae, previously 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 G01, G02 and G03 has resulted in the mapping of a total of 55 landform-based polygons where there is some likelihood that significant archaeological deposits and/or features are present (see maps and databases). Of these, 29 are in G01, 12 are in G02 and 14 are in G03.

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 the direction of 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 described 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 when this particular mapping methodology began to be applied 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 as well as with regard to the river itself, the geologic history as it pertaIns 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 are then grouped into two modal classes (high and medium) within the ranked universes. Table 1 presents a breakdown of these potential classes by LU.

LU	**Total Polygons**	**High Potential**	**Medium Potential**
G01	29	9	20
G02	12	1	11
G03	14	1	13
Total	55	11	44

Table 1. 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. The scores for each microsite criterion represent 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.

Since there is no archaeological inventory from the study area itself and that upon which this study draws does not represent the product of systematic investigation, the product of the present study must be considered as 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 that related to 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 overlaying the locations of proposed forest industry activities onto the 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 unavoidable, 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 G01, G02 and G03 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.

At this juncture, it can be re-emphasized that environmental conditions have varied considerably over the past 12,000 years. Palaeoenvironmental reconstructions suggest more benign conditions in some of the mountainous parts of the upper Columbia drainage during the early Holocene than prevailed during any of the subsequent millenia. It is on this basis that much of the archaeological potential of the upland parts of the study area is predicated. However, there is minimal information at present that actually relates to the nature of the activities that would have taken place in the surrounding mountains other than the general postulate that higher ungulate populations could have drawn groups of hunters up the tributary valleys.

On another note, 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.***

It is further recommended that the process of mapping of archaeological potential be continued in the other landscape units in the Columbia Forest District.

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