ARCHAEOLOGICAL OVERVIEW ASSESSMENT
OF LANDSCAPE UNITS R03, R07, R08, R18 AND R20,
COLUMBIA FOREST DISTRICT

Contract # 4650005 Report

prepared for Downie Street Sawmills Limited

by

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Credits

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Management Summary

The Provincial Forest lands encompassed within Landscape Units R03, R07, R08, R18 and R20 of the Columbia Forest District were assessed for archaeological potential via aerial photograph analysis. A total of 194 landform-based polygons were identified as having potential to contain significant archaeological sites via criteria derived from precontact land and resource use models developed for the upper Columbia River drainage. Numerical scoring of the criteria resulted in 17 polygons being assessed as having High archaeological potential and 177 polygons assessed as Medium.

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1. Introduction

This report accompanies the mapping of archaeological potential for Landscape Units R03, R07, R08, R18 and R20 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 R03, R07, R08 and R20 encompass the Columbia Mountains on both sides of the Columbia River north and south of Revelstoke and include the major drainages of the Jordan, Akolkolex and Illicillewaet rivers and Tonkawatla, Driimmie and Crawford creeks outside of Mount Revelstoke and Glacier national parks. LR18 is to the north and comprises most of the Bigmouth Creek drainage.

2.1 Present Environment

Bedrock underlying the four southern LUs consists of upper Proterozoic to Palaeozoic metamorphosed sedimentary rocks (Douglas et al 1969). East of the Selkirk Trench these are primarily Cambrian to Devonian limestone, marble, phyllite, micaceous schist, quartzite and greenstone of the Lardeau Group. LU R03 contains a small central area of Windermere Supergroup metasedimentary rock while most of the south half of R20 is Devonian to Carboniferous orthogneiss and Cretaceous granodiorite. This more highly metamorphosized lithology, albeit of somewhat earlier age (Proterozoic to Palaeozoic), is characteristic of LUs R07 and R08 west of the Selkirk Trench, which are dominated by ortho- and paragneiss plus calcisilicates. The influence of bedrock structure in these LUs is reflected by relatively linear and hierarchical drainage networks. The major river systems include the Illicilliwaet, Jordan, Akolkolex and Crawford; otherwise, the LUs are dominated by steep, relatively short streams that flow directly to the Columbia from the respective divides that form the east and west boundaries of the LUs. A significant exception to the above is Tonkawatla Creek, which instead occupies a trough that represents an ancient spillway. LU R18 comprises the palmate dendritic drainage of Bigmouth Creek, underlain by Upper Proterozoic to Devonian phyllite, schist, amphibolite, limestone, marble, quartzite and greenstone of the Horsethief Creek, Hammill and Lardeau groups and Donald and Laib formations. A small middle Jurassic granodiorite pluton is present in the north part of this LU.

Besides bedrock, the most common surficial deposits in all of the LUs are glacial moraines and shallow to deep colluvium. The gradients of the upper reaches of the watercourses are prominently controlled by colluvial processes and temporary local dams caused by avalanches are common. Less extensive deposits of glaciofluvial and recent fluvial sediments occur at lower elevations; landforms graded to proglacial lakes are restricted to the lowermost courses of the major rivers. Except for a few kilometres downriver of Revelstoke Dam, flanking erosional terraces and the floodplain and riparian ecozones of the Columbia River are now inundated by the Revelstoke and Arrow reservoirs and are outside the 5 LUs.

The ecology of the study area containing the five five LUs is divided at Revelstoke between the Northern Columbia Mountains and Central Columbia Mountains Ecosections of the Columbia Mountains and Highlands Ecoregion (Quesnel and Thiessen 1993). Both are characterized by rugged mountains and deep narrow U-shaped valleys and trenches. Serrated ridges and glacier-capped mountains are more prominent to the north, reflecting the higher precipitation and the colder temperatures of the Northern Columbia Mountains Ecosection. Vegetation also reflects this trend: in the northern part of the study area it is represented by a sequence of biogeoclimatic zones ranging from low to middle elevation ICHwk1 (Wells Gray Wet Cool Interior Cedar Hemlock variant) to alpine tundra above timberline while to the south, lower valley walls support ICHmw3 forests (Thompson Moist Warm Interior Cedar Hemlock variant). Seral stands throughout 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, deer, wolf and bald eagles. Upper elevation forests and alpine habitats are utilized by caribou, grizzly and black bear, mountain goats, and, to a limited degree, by mule deer in summer. Key precontact food, medicinal or technological plant species known to be found in this mountainous area include crowberry (*Empetrum nigrum*), huckleberry species, especially black huckleberry (*Vaccinium membranaceum*), spring beauty (*Claytonia lanceolata*), wild strawberry (*Fragaria vesca*), red raspberry (*Rubus idaeus*), cow-parsnip (*Heracleum lanatum*), Canby's lovage (*Ligusticum canbyi*) and glacier lily (*Erythronium grandiflorum*) (Choquette and Keefer 2003).

Because of the presence of the Columbia River, fish, especially anadromous salmon, are an important component of the natural ecology of the study area. Prior to construction of the Grand Coulee Dam to the south, four species of salmon plus steelhead (*Oncorhyncus* spp.) ascended the Columbia into BC (Carl et al 1959). In addition, freshwater species inhabiting the study area include sturgeon, rainbow, bull and cutthroat trout, kokanee, burbot, mountain whitefish, suckers and squawfish (ibid.).

2.2 Palaeoecology

The geological history of the study area can be traced back 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, some of them accompanied by intrusion of plutonic magma. 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 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). During the most recent major ice advance, cirque glaciers accumulated and coalesced at lower elevations to form large trunk glaciers which occupied valley floors and the lower slopes of the adjacent mountains (Kelley and Holland 1961). This advance and subsequent retreat apparently happened quite rapidly, between about 18,000 and 15,000 years ago (Clague et al 1980). Glacial recession generally took place from higher elevations first, followed by exposure of mountain flanks and then the valley bottoms, after which the valley floors were occupied by large proglacial lakes (Fulton et al 1989); thick depostis of clay, silt and fine sand accumulated in these lakes.

The Selkirk Trench in the centre of the present study area contained an elevationally declining series of proglacial and early post-glacial lakes. Fulton and Achard identified lacustrine sediments as far north as Downie Creek, from a lake they inferred "owed its presence in part to the plug of glaciofluvial valley fill north of Revelstoke Dam and in part to isostatic tilting" (Fulton and Achard 1985: 7). However, the numerous prominent terraces at 595 m (1950 feet) a.m.s.l. in the Selkirk Trench are duplicated in other parts of the Columbia drainage including the Purcell Trench and Kootenay/Kootenai valleys, indicating the possibility of a geographically more extensive control over the hydrological baseline at this time (Choquette 1996). Surficial geology studies in the United States assume that southern BC was buried beneath ice, but the elevation of Richmond et al's (1965) "Great Terrace" at 1950 feet suggest that at least one stand of Glacial Lake Columbia, dammed at the Grand Coulee by the Okanagan ice lobe, may have extended up the Columbia River into the present study area. The extraordinarily low elevation (ca. 560 m / 1836 ft) and trough-like configuration of Eagle Pass and the Tonkawatla Valley are best explained by the previous existence of a proglacial lake spillway connecting the Thompson and Columbia drainages that was lowered with the lowering of the 595 m stand of Glacial Lake Columbia. That Thompson River coho salmon are genetically more similar to Columbia coho than to those of the main stem of the Fraser River (David Moore, personal communication 1993) is of great interest in this regard. A radiocarbon date of 10,000 $\pm$ 160 BP (GSC 1753) was obtained from just north of LU R08 well below the top of lacustrine deposits graded to this lake (Fulton and Achard 1985: 6). When this lake drained, a smaller lake remained in its basin at an elevation of about 488 m (1600 feet) as noted by Fulton (1971). Fulton obtained radiocarbon dates of 10, 000 + 150 before present (GSC 1012) and 9990 + 150 before present (GSC 1059) from shoreline deposits at this elevation about 4 km downriver from the present Revelstoke damsite (Fulton 1971: 17). Further south in the Selkirk Trench, additional dates were obtained from a number of lacustrine settings in Arrow Reservoir, including the upper part of a succession of glaciolacustrine and organic-rich lacustrine sediments at Fauquier (Fulton et al 1989). Dates on wood from between 440 and 450 m in elevation range from 10,100 to 8390 years ago, and are interpreted to reflect a nearshore environment with beaches formed during a period of generally falling lake levels (ibid). The lowest elevations of LUs R03, R07, R08 and R20 thus included the shores and deltas of several large late glacial and early post-glacial lakes. These lakes and the level plains exposed when they drained thus comprised the valley bottom environment at a time when humans were present in the study area vicinity (see Section 3.2.2 below).

As this succession of ‘ancestral Arrow Lakes’ drained, a series of terraces was carved by the Columbia River and its tributaries as they incised themselves into the valley fills. The ages of these terraces decrease as elevation declines and relate to the southward retreat of the lakehead and the development of the Columbia River in this part of the Selkirk Trench. That this had occurred in the northern part of the study area well before ca. 7000 years ago is suggested by the presence of Mazama tephra in floodplain overbank deposits within 3 m of the historic level of the Columbia River between Downie and La Forme creeks (Fulton and Achard 1985: 7). To the south, the lacustrine sediment dates of Fulton et al (1989) noted previously provide an upper limiting age estimate of ca. 8400 years ago for a lake identified by Choquette (2002). Dates on archaeological deposits adjacent to Lower Arrow Lake extend back to about 3200 years ago (Turnbull 1977), providing an upper limiting age for cessation of the downcutting and establishment of the local hydrological baseline represented by the level of the historic Arrow Lakes. The process of terrace formation thus shifted in scale and influence from regional to local during this time interval: terraces graded to ice-dammed water occur at the elevations of the large lakes throughout the study area but those relating to the influence of Neoglaciation (see below) are confined to the zone of frequent avalanching noted in Section 2.1 above. Other terraces were carved by the Columbia River and its tributaries as the rate of their incision into the valley fills responded to climatically induced inputs of water and sediment. Most later Holocene Columbia River terraces are outside the LUs of this study, encompassed either by private land or by reservoirs. Ages of terraces along tributaries in the LUs are not known at this time but could be obtained by informed archaeological investigation.

Palynology, the study of pollen, reveals significant evolution in post-glacial vegetation in the upper Columbia drainage area. The pollen cores that have yielded evidence most relevant to the present study area are from the Tonquin Pass (Kearney and Luckman 1983), Lake O’Hara (Reasoner and Hickman 1989) and Dog Lake (Hallet and Walker 1999) localities in the Rocky Mountains respectively to the northeast, east and southeast of the present study area; from the Dunbar Valley (Hazell 1979), “Bluebird Lake” (Hebda 1995) and Teepee Lake (Mack 1982), a north to south set of localities on the east slope of the Purcell Mountains; and Lower Little Slocan Lake (Hebda 1995) in the Valhalla Range of the Selkirk Mountains top the south.

The pollen data reveal that vegetation became established in deglaciated areas 12,000 or more years ago. A pioneer community known as steppe tundra and consisting of grass, sage, cattails and scattered conifers occupied slopes and ridges amongst the expanses of bedrock, lingering glaciers, and proglacial lakes ponded against them (Choquette 1996). The climate warmed after

10,500 years ago and coniferous forest invaded the valley bottoms and mountainsides. The presence of organic material including wood that provided the radiocarbon date of 10,000 ± 160 BP referred to above indicates that the study area itself was supporting vegetation by at least that time. However, the structure and species composition did not resemble that of modern forests until well after 5000 years ago. In much of southern BC, the period between 10,000 and 7,000 before present (variously known as the "Hypsithermal", "Altithermal", "Thermal Maximum" or "Climatic Optimum") was characterized by drought and the highest forest fire frequency of the entire post-glacial period. Generally warm and dry Continental conditions prevailed in the Rocky and Columbia Mountains to the south and east of the present study area, the trend to aridity apparently peaking between 9000 and 8000 years ago. Douglas fir forest was considerably more extensive than today and forest communities were characterized by pronounced altitudinal and latitudinal zonation (Choquette 1987a). However, these conditions do not seem to have been characteristic of the northernmost Columbia Mountains (Choquette and Keefer 2003) and pollen data from the Tonquin Valley in the Rockies to the northeast 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). The pollen and macrofossils from the dated lacustrine sediments in the Selkirk Trench mentioned previously have been interpreted to represent a climate similar to or wetter than at present (Fulton et al 1989: 264), possibly reflecting the influence of the huge lakes that existed here and in the Thompson and Okanagan drainages in early postglacial time.

After 7000 years ago, the maritime westerlies began to exert greater influence (Choquette 1987a); the climate became moister but was still warmer than today's conditions. The predominant trend in vegetal configuration became longitudinal in response to the increased rainfall: forests on west-facing windward slopes became denser but the rainshadow effect resulted in the Purcell Mountains becoming a significant climatic divide. To the east, grasslands persisted and even expanded in the Rocky Mountain Trench and foothills while the adiabatic or "Chinook" effect also influenced more widespread microenvironments leeward of high peeaks and massifs. The increase in forest fuels due to greater available moisture relative to the preceding period is represented by evidence of the highest forest fire frequency at Dog Lake (Hallet and Walker 1999).

During the last 5000 years, the effects of a significant global cooling trend known as the Neoglacial (Porter and Denton 1967) become noticeable in the region. Glaciers began to grow in the high mountains, forest fire frequency declined after 4000 years ago, and closed canopy forests expanded at the expense of grasslands and parkland throughout the region. This cool, moist trend apparently reached its maximum sometime between 4000 and 2500 years ago (Baker 1983, Hallet and Walker 1999). It was accompanied by significant compositional changes in the vegetation as the maritime associations made their appearance: cedar and hemlock pollen appears in core samples 5000 - 4000 years ago (eg. Hazell 1979) and becomes common after 3000 b.p. (Hebda 1995).

After 2500 years ago, the climate became warmer and drier again, with increased forest fire frequency and more open vegetation. The final episode in the region's palaeoclimate is known as the "Little Ice Age", the most severe glacial episode since the Pleistocene: during the last 400 years, glacial ice in the upper Columbia drainage area reached its greatest extent in more than 10,000 years.

At the present time, our knowledge of the evolution of the wildlife is quite limited. 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). Caribou were apparently more widespread at the time of contact than in more recent times in the southern Purcell Mountains (e.g. Schaeffer 1940: 26) and post-contact declines have been identified in more northerly herds, including those of the study area (Van Tighem and Gyug 1984).

Aquatic resources undoutedly fluctuated considerably as well. Data from pollen profiles, soil and sediment sequences, forest fire chronologies and glacial moraine positions have been synthesized into a model of Holocene palaeohydrology for the upper Columbia River drainage for the past 10,000 years (Choquette 1985). In composite, the model defines a series of climatic cycles, each of about 2000 years duration. Within each cycle, climatically induced variations in fluvial discharge and sediment load would have affected salmon carrying capacity either positively or negatively; the relative intensity of the various cycles relates in turn to their positions within the larger climatic cycles described above. The peak of the Hypsithermal drought interval and the prominent Neoglacial advances 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 ca. 2000-1000 and especially 3500-2500 years ago probably fostered large salmon runs. Evidence from archaeological sites elsewhere in the upper Columbia River basin suggests that during the early Neoglacial, the region may have supported generally more extensive aquatic communities including large numbers of resident fish and waterfowl as well.

3. Cultural Context

3.1 Aboriginal Population

Compared to most neighbouring regions, there is a notable paucity of documentation of aboriginal presence in the study area, especially outside of the Selkirk Trench. This is undoubtedly a reflection of the rugged topography and heavy snowfall characteristic of this part of the Columbia River drainage compared to regions to the west, south and east. Correlative to this, the study area is at the edges of the territories of three distinctive ethnolinguistic groups who inhabited those respective regions: the Secwepemc, Okanagan and Ktunaxa, respectively.

As discussed at length by Bouchard and Kennedy (1985:133-157), there is considerable confusion in the literature regarding the identities of the aboriginal occupants of this part of the upper Columbia drainage area. All groups intermarried: the historically known Arrow Lakes Band who had a reserve at Oatscott near Burton included Ktunaxa and Secwepemc spouses in addition to Sinixt and their Okanagan relatives (ibid.). When the effects of depopulation by disease and the adverse climate of the Little Ice Age are also considered, it is clear that the ethnohistorical record is too limited to be a reliable indication of precontact human occupancy of the study area. Rather than considering the character of the interrelationship amongst the various groups to be represented by territorial boundary lines on a map (or even a dot as postulated by Bussey and Alexander 1994: 12), there are numerous examples of patterns of human interaction within major river valleys in the anthropological literature, in depth discussion of which is beyond the scope of the present study. It will suffice here to state that the character, timing and distribution of various resources would play a key role in determining the intensity and character of human presence and interaction here. For example, it is entirely feasible that an area such as we are dealing with here could have been occupied by several different groups at different seasons as distinctive components of seasonal rounds centred elsewhere. The interaction of such groups would be expected to be much different than would characterize the type of exchanges that might occur at an important and strategically located fishery site. Fluctuations in salmon carrying capacity of both the upper Columbia and Thompson rivers are hypothesized to have been a very significant factor determining the character and intensity of precontact human inhabitation in the study area. This highlights the contribution that archaeology has the potential to make as an avenue of understanding the human activity and interaction in this area. The following accounts are provided for the context they provide with regard to human lifeways, especially during the most recent part of precontact time.

3.1.1 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 but also including part of the big bend of the Columbia River. Teit's 1909 and 1930 accounts of the Secwepemc and Ignace's 1998 work comprise the bulk of written ethnographic 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.

3.1.2 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 vicinity, where a major Sinixt encampment was situated near the mouth of Tonkawatla Creek (Bouchard and Kennedy 1985: 77-78).

The Sinixt's past land and resource use was characterized by intensive fishing, hunting and gathering in spring, summer and fall by relatively small, mobile groups who inhabited small camps located adjacent to resource foci. In addition to extracting food resources, energies at this time were directed towards processing foodstuffs and storing them for the winter when fresh food was scarce. Food was cached in aboveground structures and underground in pits. Foodstuffs were later collected from the caches and transported by canoe and pack to the winter camps.

In latest precontact time, Sinixt 'pithouses' were replaced by rectangular pole frame mat lodges. Houses were of both single and multiple family occupancy. Besides the family dwellings, separate lodges were constructed in winter villages as secluded women's quarters. Men's retreats were generally upstream of the main camps where sweat lodges were constructed. Social organization was characterized by a main chief who presided over all the Sinixt people at any one time and subchiefs who headed the various local groups. Burials were not elaborate; interment was in gravel beds along the banks of rivers and in sandy knolls and ridges at the margins of higher terraces.

3.1.3 The Ktunaxa

The Ktunaxa comprised four geographically and linguistically distinct subdivisions centred on the Kootenay River. One band, however (the *Qatmuk'nek*), wintered at the Columbia River's headwaters in the Rocky Mountain Trench and travelled westward over the Purcell and Selkirk mountains for summer fishing in the Selkirk Trench. 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. 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 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 Archaeology

3.2.1 Previous Investigations

There has been very little archaeological work conducted in the study area and most of it has been related to proposed hydroelectric projects. Two precontact sites were recorded in the lower Tonkawatla Creek vicinity during Peter Harrison's survey of the High Arrow Reservoir (Harrison 1961). Parts of then-proposed High Revelstoke Reservoir were surveyed by Phil Murton and George Ferguson (1973), which resulted in the recording of five archaeological sites or potential sites, based in large part on information provided by informants. This was followed up in 1977 by a more focused investigation that included subsurface testing, but no precontact archaeological materials were located (Bussey 1979). Sections of the Revelstoke Reservoir shoreline were examined in 1994 during an archaeological overview assessment of emergency reservoir drawdown (Choquette 1995); the two exposures of sparse archaeological remains observed then were revisited in 2006 as part of an assessment of the Revelstoke Unit 5 Project but no cultural remains were observed (Choquette 2006). The Revelstoke Reach of Arrow Reservoir has recently been surveyed as part of the Arrow-Mica Water Use Planning (WUP) process, resulting in the recording of 12 precontact archaeological sites ranging from intensive middens to sparse fire broken rock exposures (Choquette 2002, 2007). Many of these sites are situated near the mouths of tributaries of the Columbia River, including Tonkawatla, Drimmie and Crawford Creeks at the edges of LUs R03 and R07.

Other recent archaeological investigations in the study area and its immediate vicinity have included localized impact assessments of proposed developments. A fourth site in the lower Tonkawatla Creek locality consisting of exposed stone artifacts was recorded in 1985 during a survey of the Trans Canada Highway by Rousseau and Justice (Arcas 1986a). No additional sites were located during surveys of alternate routings of the Trans Canada Highway (Arcas 1993, Golder 2001). Although not technically within the study area, excavation at the Boyes Site (EfQq-3) in the Eagle River valley to the west of Revelstoke (Arcas 1986b) yielded artifacts of stone from further south in the Columbia River drainage, indicating westward travel up Tonkawatla Creek through LU R07 during the last 1500-3000 years. In 1994, human skeletal remains were salvage excavated from the east shore of Arrow Lakes Reservoir south of Drimmie Creek (Archaeology Branch 1994). Nothing of precontact cultural origin was found during a 2004 survey of proposed recontour sites along BC Hydro transmission lines 5L75/77 which span lower Tonkawatla Creek (Choquette 2004) or during the 2007 archaeological impact assessment of a proposed gravel pit above the lower Jordan River (Boras and Wood 2008.).

Archaeological reviews and impact assessments of proposed forestry developments began to be conducted in the Columbia Forest District in 1996 but relatively few archaeological sites have been located. In the study area vicinity these include two precontact sites on boulder filled terraces above the left bank of the Columbia River approximately 1 and 2 km downriver from Revelstoke Dam (Campbell 2000) and artifacts surface collected from near the west side of the upper Arrow Reservoir north of Griffith Creek (Lackowicz 1999).

While the postcontact era heritage resources of Mount Revelstoke and Glacier national parks have received considerable attention, relatively little precontact archaeological data has been forthcoming from studies conducted either in the parks or in their immediate vicinities. While conducting an archaeological inventory of Mount Revelstoke and Glacier National Parks, David Crowe-Swords (1971) surveyed as far west as Three Valley Gap but found no precontact archaeological sites. A “prehistoric archaeological site assessment” of the two parks was prepared (Bussey and Alexander 1994). This work was a literature review conducted from a synchronic perspective. The biogeography was encompassed within modern ecological land classification schemes and combined with what is essentially the direct historic approach to assess the archaeological potential of the two parks. The assessment relied on data from the western Fraser River drainage, however, rather than palaeoecology and the regional archaeological record, thus limiting its temporal and cultural relevance.

In 2003, a palaeoecological and archaeological survey of several specific high elevation areas in these two parks was undertaken (Choquette and Keefer 2003). This study utilized an evidence-based archaeological research design, reconstructing economic resource distributions in the specific study localities over the duration of post-glacial time and modelling specific land and resource use patterns based on the reconstructed palaeoenvironments. The field survey assessed the capacity of the study localities to support human occupation at the hunting/fishing/gathering level of economy, in terms of sufficient repetition in a given locale as to leave archaeologically detectable remains (i.e. patterned human behaviour). By adding complementary palaeoecological and ethnobotanical approaches to the archaeological sampling strategy, the scope of evidence was broadened to compensate for the time constraints of this relatively limited archaeological investigation. Identification of specific sediments, soils and plant communities was connected with the archaeological survey to evaluate six localities for evidence of long term ecological process and human response. Three of the localities (Mount Revelstoke and Flat Creek and Bostock passes) are immediately adjacent to the four southerly LUs of the present study. The botanical survey did not identify any species in sufficient quantity that they would support intensive harvesting or procurement while the 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, based on the common occurrence of podsolic soil manifestations, especially relatively well expressed Bf horizons, forest cover was greater in the past. 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. Again, nothing in the soil/sediment record suggested greater ungulate capability in the past. The hypothesis that a mineral, plant or animal resource occurred to a sufficiently high degree of concentration that it attracted humans to a given locale in itself was discarded. A second hypothesis, that human presence in a given locale was repeated enough to leave archaeologically detectable remains because the locale was strategically located on a travel route was negated both by the negative survey results and also by the nature of the terrain itself: none of the passes connected major valley corridors while the other alpine areas examined during the study were situated on isolated mountain or ridgetops disconnected from any continuous expanses of terrain that would have facilitated movements of large numbers of human travellers. In the absence of suitable minerals, observed archaeological remains and any evidence of sufficient botanical resources that would have attracted humans or supported economically significant animal populations, it was concluded that topographic constraints precluded extensive or intensive human utilization of the high elevations of this part of the Columbia Mountains.

3.2.2 Precontact Culture History

The lack of data from the study area necessitates the extrapolation of a culture historical construct from adjacent, better studied localities. The following summary is based on more detailed discussions of regional culture history presented in Choquette (1984, 1987a and b, 1993 and 1996).

The archaeological record of the upper Columbia River drainage area includes evidence of two early postglacial cultures. The earliest cultural components identified at present have been found on sandy terraces, beaches, dunes and glaciofluvial bars at or above the 595 m a.m.s.l. level of Glacial Lake Columbia, which had drained before 10,000 radiocarbon years ago. These archaeological components share a number of common characteristics in addition to their early landform and sediment associations. Microcrystalline stone was favoured in a technology primarily based on the production by percussion of large expanding flake blanks from large bifacial cores, edges of which were prepared by grinding. Large discoidal unifaces, large side scrapers, large stemmed weakly shouldered and lanceolate spearpoints, and a variety of large marginally retouched flakes are typical tools. The name for this archaeological trait complex, the Goatfell Complex, derives from the predominance of tourmalinite and tourmaline chert from Goatfell Quarry in the southern Purcell Mountains. Evidence of the biface core technology and large stemmed spearpoints of tourmalinite, Kootenay Argillite and quartzite have been found in upland and high terrace contexts adjacent to Kootenay, Duncan, Arrow and Whatshan lakes to the south of the present study area, indicating that people were present in the central Columbia Mountains in early postglacial time, perhaps hunting in the steppe-tundra ecosystem in summer and wintering beside the huge early postglacial lakes. The very sparse information recorded for archaeological site EgQn-1, especially the setting well above Revelstoke and the microcrystalline flake and biface dominated artifact assemblage (Abbott and Leechman 1967) are tantalizing, but no further information is available regarding this site. Initial occupation by Goatfell Complex people appears to have coincided with the northward shift in the mountain-steppe-lakeshore ecosystem out of what is now the Great Basin as the pluvial lakes there dried up at the end of the Pleistocene. At the present time, the Goatfell Complex is postulated to date between about 11,000 and 8000 years ago.

Cultural deposits of the second early archaeological manifestation have been found at Kettle Falls in cobble gravels, near Castlegar on a fluvial sand bar now situated on a high terrace more than 120 m above the present confluence of the Kootenay and Columbia rivers, and in the basal deposits at the uppermost falls on the lower Kootenay River. The settings of these sites indicate that this culture had a riverine focus and suggest that the Columbia River was still actively downcutting through the glaciolacustrine valley fill during this time period, named Shonitkwu and dated 9800 - 8800 years ago (Chance, Chance and Fagan 1977). The use of rhyolite as tool stock and certain distinctive Shonitkwu artifacts such as microblades radically differentiate Shonitkwu assemblages from Goatfell Complex implements and indicate the presence of a separate cultural group. The time slope on dated microblade assemblages indicates that these people arrived in the region from the north. The end of the Shonitkwu Period about 8800 years ago coincides with a marked decline in occupation at Kettle Falls, followed by a virtual hiatus around 7500 before present. Coupled with evidence of aeolian deposition in a previously alluvial setting, this suggests a failure in the anadromous fish runs that was probably caused by the effects of the Hypsithermal drought.

The pollen data indicate that the droughty climate of the Hypsithermal interval likely maintained open canopy forests and extensive high elevation grasslands, with their attendant high ungulate capability, in the southern Rockies and Purcells. Archaeological evidence also indicates that high elevations and the more northerly parts of the Rocky and Purcell mountains were very important to the early post-glacial inhabitants of the upper Columbia River basin. However, as discussed in Choquette and Keefer (2003) and summarized in Sections 2.2 and 3.2.1 above, it does not appear that the mean location of the storm track shifted far enough to the northwest during this time period to have markedly decreased the available moisture in the northern Columbia Mountains. The negative results of the high elevation archaeological survey in Mount Revelstoke and Glacier national parks suggest that ungulate capability of the higher elevations there may not have been significantly higher during this time period. The degree to which this relates to the northern Monashee Mountains is not presently known.

On the other hand, the present study area was situated near the heads of large lakes at least during the initial part of the Hypsithermal drought interval, possibly a very strategic location. In general, the lack of intensive archaeological investigations limits what can be inferred with regard to the middle Holocene human history of this part of the Columbia Valley. Artifacts from local collections indicate that humans were still present in the region between the end of Goatfell and Shonitkwu occupation and the beginning of the succeeding and well documented Ksunku Period and Deer Park Phase (see below), but little is known of their activities. The focus of excavation in the Arrow Reservoir on pithouses may be responsible for the dearth of documented evidence between 6000 and 3500 years ago, as occupation may have been in open camps whose deposits were not extensively sampled. In addition, the recent findings of the Arrow-Mica WUP archaeological survey (Choquette 2002, 2007) indicate that such occupations also may have been on landforms situated above those sampled by the Arrow Reservoir salvage project.

The Columbia River's anadromous salmon resource is a primary consideration as a factor in predicting archaeological site densities and distributions, especially during the last 5000 years. In both the Fraser and Columbia drainages, the salmon resource was responsible for the support of substantial human populatons with distinctive cultures and a semi-sedentary lifestyle. Unfortunately, the limited archaeological data from the Columbia Valley within the areas now inundated by the reservoirs does not allow any definitive statements to be made regarding past human use of this resource here. Nevertheless, the intensity of human inhabitation of the study area vicinity was undoubtedly strongly 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), higher intensities most likely being tied to periodic episodes of high salmon carrying capacity.

That the Columbia River's salmon runs had reached significant proportions is indicated by intensive re-utilization of the Kettle Falls fishery between about 4300 and 3400 years ago (Chance and Chance 1985). This archaeological manifestation was named Ksunku by David Chance and is considered to have been a distinct culture as compared to the Shonitkwu. Although the ethnographic record indicates that Kettle Falls was the second most important aboriginal fishery in the entire Columbia drainage, Ksunku period occupations there were followed by an occupational hiatus. This second hiatus, and the period of relatively low use that followed it, coincide in time with the Deer Park Phase (Turnbull 1977) of the Arrow Lakes and lower Kootenay River. The abundance and character of the Deer Park Phase archaeological evidence (especially the pithouses) indicate high human population density along the Columbia River upriver from Kettle Falls during the time period between about 3500 and 2500 years ago. This suggests that failure of the salmon runs was not responsible for the abandonment of Kettle Falls as a fishery during this period. Instead, it is postulated that high fluvial discharge was responsible for the upriver shift in the focus of the salmon fishery, both because the water volumes at Kettle Falls may have made the contemporary fishing technology unusable there and also because it contributed to larger salmon runs in the upper portions of the Columbia River drainage (Choquette 1985).

Following the period of high population density in the Canadian portion of the Selkirk Trench that is represented by the Deer Park Phase, significant changes again occurred in the human settlement pattern. Sites yielding evidence of human occupation dating within the last two thousand years are less common in the Arrow Lakes and lower Kootenay River localities. During this same time period, the intensity of human use of the Kettle Falls fishery reached unprecedented proportions, and the lower falls became the major fishery for the first time. Ecological factors relating to palaeohydrology and salmon carrying capacity again seem to have played a major role in influencing human settlement dynamics in this portion of the upper Columbia River drainage, reflected by somewhat of a southerly shift in the focus of human inhabitation in the Arrow Lakes portion of the Selkirk Trench at least. Interestingly, there is a similar downriver shift in occupational focus on the Thompson River over the same time span, there subsumed by the Shuswap, Thompson and Kamloops phases of Richards and Rousseau (1987). A severe human population decline and southerly shift has been alluded to previously in Section 3.1.2 with regard to the changes in Sinixt settlement pattern.

3.3 Ethnohistory

David Thompson crossed the Athabasca Pass in 1811 and overwintered at the confluence of the Columbia, Canoe and Wood rivers (Spry 1963, Hopwood 1971) at a place later known as Boat Encampment. A fur trade route (the Columbia Trail) was subsequently established connecting Jasper House with Forts Colvile, Okanagan, Walla Walla and Vancouver. The fur traders established a supply depot at Boat Encampment, which served as a major fur trade transfer point for some 50 years.

Sir George Simpson encountered (“a lodge of Indians part of the Kettle Fall tribe”; the location was not specifically identified but was apparently along the Columbia River in the immediate vicinity of the present study area (Bouchard and Kennedy 1985). In 1838, a party of twenty-six people, including a group of Oblate missionaries, were descending the Columbia River when their boat was wrecked in Death Rapids just to the north of the present study area, where twelve people lost their lives. In 1847, Paul Kane camped with the Sinixt in the northern part of the study area (Kane 1974: 106, 235, 229).

In September of 1865, Walter Moberly and a party of Sinixt ascended the Illicillewaet River to its headwaters, but they were reluctant to proceed further because of the threat of early snow (Moberly 1866). They observed “four bark canoes cached by a party of Indians who had gone into the mountains to hunt” (ibid.: 18) at a location Crowe-Swords (1971: 24-25) suggests as being just above Albert Canyon. That year Moberly camped with the same people at several locations along the Columbia within what is now Revelstoke Reservoir.

Ruby Nobbs, a long time resident of Revelstoke, remembers a Native encampment near the mouth of the Jordan River and another near Tonkawatla Creek (Nobbs 1994: pers. comm.). This is corroborated by Teit (1930: 209) who identified the latter location as a place

> “said to have been the headquarters of a rather large band,
> which was reenforced at certain seasons by people from

lower down the Columbia. It was noted as a trading, trapping, hunting, berrying and salmon-fishing center".

The strategic location at the eastern entrance to Eagle Pass provided access to hunting and berry picking grounds as well as relatively direct access to the Thompson River drainage. Its reputed importance as a trading centre followed from this, as do the reports of the presence of Secwepemc and Ktunaxa in this area as well, although Bouchard and Kennedy are unaccountably unwilling to place credence on these reports. Tonkawatla Creek supported important runs of kokanee and anadromous salmon and W.J. Fraser, an early day Revelstoke resident, identified another encampment on an island near the mouth of the creek (Fraser 1965 cited in Bouchard and Kennedy 1985: 77-78).

The well known Native trail ascending Tonkawatla Creek to Eagle Pass was used by Sir Sanford Fleming in the company of a Sinixt in 1883 (Fleming 1884 cited in Bouchard and Kennedy 1985: 77-78).

Teit identified the locality of Arrowhead, at the south end of LU R03, as a salmon-fishing place and a noted center for digging roots of *Lilium columbianum*, which Elmendorf's Lakes informant stated was dug in July and August (Elmendorf 1935-1936 cited in Bouchard and Kennedy 1985: 84). Native encampments in the locality where the Columbia River flowed into Arrow Lake were observed in 1827 by Edward Ermatinger (Ermatinger and White 1912: VI: 77) and by David Douglas who described the site as consisting of "three Indian lodges" located "at the end of the [Upper Arrow] lake, at the foot of a high and steep hill" (Wilks 1959: 251). "McKay's House" or "'Fort of the Lakes" of the Hudson's Bay Company was built in 1838 in the general area of Arrowhead (Chance 1973: 2, Bouchard and Kennedy 1985: 84). Arrowhead has also been identified as a Native burial site (Johnson 1964: 169, Harrison 1961). Johnson (1964: 7-8) observed that the condition of native remains exhumed there in 1907 indicated that they had "used the place for a long time...As recently as 1908 there were indications of a fairly large campsite on the flat higher level above the sandy shore...also old rotting poles lying around". Culturally-modified trees were observed by pioneer resident C.J.C. Slade up and down both of the Arrow Lakes, near the various Indian campsites. One such tree, which had been "peeled for canoe patching rnaterial" was located "at Arrowhead, just above the ranger station". By "counting the annual rings back to the dead wood of the original trunk" he was able to "estimate the date at which it was peeled as 1869" (Slade 1970 cited in Bouchard and Kennedy 1985: 85).

4. Study Methodology

This study comprises an assessment of the archaeological potential of Provincial Forest lands in Landscape Units R03, R07, R08, R18 and R20. 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. These criteria are linked with the prediction of potential occurrance of archaeological sites through traits used to define the regional archaeological record (Section 3.2.2), especially in terms of settlement pattern, subsistence base and palaeoenvironmental context as extrapolated from the soil and sediment associations of the cultural deposits. In their various combinations as identified in the databases, these traits represent models of past human land and resource use applied to the landforms and landscapes identified during 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 deposits and features.

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 apprehension 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.

A bias in this methodology must be noted here, that pertaining to prediction of archaeological potential related to use of plant resources. In part, this bias derives from the realities of past human subsistence practices in this region, where a diversity of valuable plants occurs and harvesting was a constant activity during the growing season. Culturally modified trees are an example of specific plant resource exploitation that could leave physical evidence, but the fire and logging histories are such that trees of sufficient antiquity are rare. Although no polygons were delineated specifically to predict this form of evidence, it can be stated generally that old growth stands, especially those in the major valleys, have potential to include culturally modified trees and they should be identified prior to any proposed forestry actions. Otherwise, the great array of vegetal resources and their variability across time and space are such that It is not feasible to accurately predict specific locations of archaeological remains related to plant use. A second component of the limitation in predicting archaeological potential based on plant exploitation lies in the nature of the archaeological record itself: the majority of implements and facilities related to this resource were of perishable organic materials which do not survive in the soils of this region to become part of the archaeological record. Exceptions to this would be accumulations of fire broken rock from earth ovens and pits used in berry drying. However, no ecological evidence was forthcoming from either the National Park high altitude study discussed in Section 3.2.1 or from a traditional use study conducted for the proposed Mt. McKenzie ski hill southeast of Revelstoke in LU R03 (Keefer 2003) of sufficient locally predictable abundance of plant resources that would support the requisite intensity of activity represented by such features. It can be concluded from these studies that within the five LUs, plant resources in themselves would not likely have been sufficiently abundant or accessible as to have given them the status of determinant variables in the components of the seasonal round. While they were probably well utilized in the vicinities of major occupational foci in the major valley bottoms, harvesting of plant resources In other locations would have represented an ancillary component of the subsistence economy pursued in association with movements dictated by other constraints. In this context, criteria for predicting the specific locations of habitation sites would not be expected to differ greatly whether occupied in relation to exploitation of minerals, plants or animals, so these types of sites where more tangible remains typically occur are captured by the mapping. Given these considerations, it is not believed that this relative inability to delineate specific foci for plant exploitation represents a serious bias in the predictive modelling employed in this study.

The polygon definition criteria are described below with specific reference to the biogeography and archaeology of the five 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 dimensions 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. This appears to be represented, for example, at Arrowhead (see Section 3.2.3).

Most of the archaeological sites recorded during the original Revelstoke Reservoir survey were based on informants' reports but a revisit in 1977 (Bussey 1979) did not suggest that any were archaeological resources (Bussey 1998: 5). Regardless, these sites are now inundated by the reservoir. All of the other recorded precontact sites in the vicinity of the LUs are either within Arrow Reservoir or on private land. Of these, several are in immediate proximity to LUs R03, R07 and R20 and are briefly described below.

Harrison (1961) recorded archaeological site EfQn-1 on the Tonkawatla Creek fan based on finds of artifacts by the owners of a farm in the community of Big Eddy. Nearby EfQn-3 consists of chert flakage eroding from the bank of Tonkawatla Creek while EfQn-T07-05 records a buried fire broken rock on a Columbia River terrace north of Tonkawatla Creek. These data provide an indication of the previous existence of a relatively large precontact habitation focus associated with the Tonkawatla-Columbia confluence area. An equivalent occupational intensity does not characterize the Illicillewaet-Columbia confluence area however (see Section 4.1.2 below), but EgQn-1 was recorded "on highway from Revelstoke as it climbs to plateau above town" (Abbott and Leechman 1967). There is little specific information in the site record, but the setting of the site is described as "grassy (not river terrace)", which suggests that the site was on a high delta-terrace related to one of the stands of ancestral Arrow Lake. The description of the artifacts as "reddish brown coarse material, mostly flakes, bifacial points, crude" is also suggestive of considerable antiquity (see Section 3.2.2 above) and provides a tantalizing hint of early postglacial human presence.

Further south, a number of archaeological sites are situated near the juncture of the valley wall and the lacustrine/alluvial plain of the Columbia River, which generallyt coincides with the lower boundaries of the four southern LUs. These include EfQn-1 which records artifacts surface collected from the west shore of the upper Arrow Reservoir north of Griffith Creek (Lackowicz 2000), EfQm-T07-02 on Drimmie Creek (Choquette 2007) and EeQf-T07-01 and EeQf-T07-02 south of Crawford Creek (ibid). South of Drimmie Creek on the east side of the Revelstoke Reach, a human burial was excavated by physical anthropologist Lindsay Oliver (Archaeology Branch 1994). Other burials, a sweatlodge depression and two lithic scatters were recorded by Harrison at Arrowhead (Harrison 1961).

No precontact archaeological sites have been recorded in the LUs outside of the Selkirk Trench.

A score of 3 for this criterion represents the presence in a polygon 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 be kept in mind.

4.1.2 Columbia River

The Columbia River was the greatest salmon producing river in North America in precontact time. With regard to the study area, itself, there appear to be differences in the salmon carrying capacity of the various watercourses. Tonkawatla Creek historically supported important runs of kokanee and anadromous salmon (Fraser 1965 cited in Bouchard and Kennedy 1985: 77-78) with a correlative abundance of archaeological evidence, as noted in Section 4.1.1 above. On the other hand, Bouchard and Kennedy (1985: 81) found no evidence that the Lakes people went up the Illicillewaet River on their own. Crowe-Swords (1971: 15) comments on the paucity of private artifact collections in Revelstoke and there is little mention of Natives camping around the mouth of that River. This is likely a reflection of the glacial influence on the river's salmon carrying capacity, the Little Ice Age being a most important consideration in that regard (see Section 2.2 above). Another important consideration is the timing of the drainage of ancestral Arrow Lake and the incision of the Columbia River and its tributaries into the lacustrine valley fill relative to the exhumation of barrier waterfalls and reduction of spawning habitat upstream.

The Columbia River 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 underscores the importance of the Columbia 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 the region exerts a major influence on the movements of both animals and humans. Most major and minor valleys in the study area begin with very steep headwalls and high arretes and present severe topographic limitations to pedestrian traffic. These arretes are knife-edged for the most part, which along with their relief relative to the high peaks of the northern Columbia Mountains does not facilitate trans- or intermountain travel along ridge crests either. Palaeoecology is a further consideration that was the focus of the high altitude survey in Mount Revelstoke and Glacier national parks (Choquette and Keefer 2003). It was concluded that the high elevation environments of (ount Revelstoke and the Flat Creek and Bostock passes immediately adjacent to the four southerly LUs of the present study were probably forested terrain during the Hypsithermal when the souihern Rocky and Purcell mountains supported open canopy forests and high elevation grasslands. This leads to the assessment that use of certain study area valleys as travel corridors would more likely have been related to connection with localities of high resource values and human populations further removed as apposed to their use for repeated access to resource nodes within the study area itself.

With this in mind, for the study area, the Illicilliwaet-Tangier corridor was accorded the status of the primary east-west connection between the Selkirk and Rocky Mountain Trenches, during the Hypsithermal in particular. It was scored 2, however, compared to the greater importance of the Eagle Pass route accessed via Tonkawatla Creek to the west, which was scored 3. While no evidence of precontact use of the former was found by Bouchard and Kennedy (1985), the latter was identified as "an ancient Indian trail" by Favrhold (1997:90) and as noted in Section 3.2.1 above has an archaeologically suggested time depth of at least 1500-3000 years. The higher scoring is related to Eagle Pass being an easier and more direct east-west connection between the Columbia River and the south Thompson drainage, an area of great environmental productivity with a high precontact archaeological site density and a time depth of thousands of years of continuous human inhabitation. The shorter route immediately to the north via Kirkup and Crazy creeks was scored 1 because the valleys of the Eagle Pass route are wider and the pass is much lower. The largest valley in the study area, the Selkirk Trench carries the Columbia River southward to the Columbia Plateau and would obviously have been a major precontact travel corridor, both on foot and by canoe; it also scored 3.

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 the area drained by the upper Columbia River. 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.

There is no specific data regarding precontact utilization of mineral resources in the study area LUs. The bedrock is dominated by granitic or highly metamorphosized rock such as granodiorite, schist and gneiss which are not suitable for manufacture of most chipped tools. At present, this criterion is essentially neutral as a predictor, hence all polygons were scored 0.

4.1.5 Ungulate Range

The study area is dominated by steep and rugged mountainous topography and very high precipitation values, particularly snowfall. These conditions do not favour large populations of ungulates, especially grazers. While individuals of all species of ungulates historically present in the region have been observed in Mount Revelstoke and Glacier national parks, the largest historic populations comprise only modest numbers of mountain goats and caribou (Van Tighem and Gyug 1984). From a broader temporal perspective, the palaeoenvironmental record suggests the possibility for past intervals when conditions were more favourable for deer and elk. For example, more frequent wildfire could have episodically enhanced ungulate capability in localities where terrain is suitably level, especially on south-facing slopes adjacent to major valleys. Conditions favouring avalanching combined with more extensive alpine summer pastures could have favoured increased elk populations in the past also. On the other hand, the stability represented by extensive subalpine old-growth forests would have favoured caribou. 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: no polygon scored higher than 2. Topography is a primary determinant of polygon location and scoring: the most likely locations for hunting-related archaeological deposits beyond the Selkirk Trench represent intercept hunting at strategic locations such as valley confluences and crossings, as opposed to focus on the ranges themselves.

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 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. Although most of the large terraces have been inundated by the reservoirs, remnants of the highest occur above the reservoir levels. These are primarily graded to the level of the proglacial lake (Glacial Lake Columbia?) that extended up the Selkirk Trench and have some potential for very early cultural deposits to be associated. Other terraces are the products of fluvial activity or temporary damming by avalanches.

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.

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.

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 their sunnier north and east sides. When combined with scoring for relict watercourse, this criterion pertains to the previous existence of a water body, including proglacial and early postglacial lakes.

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.

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.

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 (R07-06 and R20-27) that could have served as fords; large eddies and pools (R03-01, R03-02 and especially R07-31, the “Big Eddy”) and waterfalls (R03-26, R07-18 and R07-41) all of which can be good fishing locations; and springs (the scoring for R20-34 – R20-40 reflects their proximity to Albert Canyon hot springs). Some of these natural features can have sacred associations.

4.3 Confidence

The need for this measure arises 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 R03, R07, R08, R18 and R20 in the Columbia Forest District has resulted in the mapping of a total of 194 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 occurrence, 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. In this context, it must be emphasized that although a considerable body of palaeoenvironmental and archaeological data supports the culture history constructs set out in Section 3, they still must be regarded as hypothetical with regard to their applicability to the study area. Nevertheless, they serve both to guide future archaeological inquiry and to provide a primary context whereby the scientific significance of local archaeological sites can be evaluated.

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 totaling 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
R03	46	8	38
R07	43	6	37
R08	15	1	14
R18	29	0	29
R20	61	2	59
Total	194	17	177

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 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 only a minimal 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 R03, R07, R08, R18 and R20 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 parts of the Holocene than prevailed during the post-contact era to which most of the existing biogeographic data pertains. 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 these mountains other than the general postulate that higher subsistence resource values, such as occur in fire succession forests, could have drawn groups of hunter-gatherers 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, previous existence of which has been noted in Section 3.2.3 above. 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.

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