ENVIRONMENTAL IMPACT STUDY

MT. KERKESLIN CAMPGROUND, JASPER NATIONAL PARK

Garry Trottier
Canadian Wildlife Service

W.D. Holland
Canadian Forestry Service

Keith W. Kivett
Dept. of Zoology
University of Alberta

R.E. Wells, Ian Corns
Alberta Institute of Pedology

Environment Canada

Edmonton

January 1976

Northern Forest Research Centre Publication No. NOR-X-153

Erratum

Page 37 Recommendation 8

Should Read:

In light of the above restrictions a maximum of 25 new sites is recommended, more may be considered given that development is extended southeastward beyond the mapping area but confined to the Aspen type on KF1 soil type (Table 9).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

INTRODUCTION

A press release issued by Parks Canada in late March 1975 announced the possibility of upgrading existing campground facilities in the Western Region National Parks. One example given in that document was expansion of Mt. Kerkeslin campground in Jasper National Park. A prerequisite of sound development planning is an assessment of environmental impact of such a proposal on park features.

This study was initiated at the request of and funded by Parks Canada to investigate the suitability of the area proposed for campground development and to identify specific sites or features which would be unacceptably altered if developed. Recommendations were to be generated concerning: 1. identification of sites most suitable for expansion in terms of soil, vegetation and wildlife resources; and 2. design and construction considerations necessary to reduce environmental impact.

THE STUDY AREA

2.1 Location

The limits of the study included the existing Mt. Kerkeslin campground and surrounding environs (see enclosed map) suitable for proposed expansion of developed camping facilities. Mt. Kerkeslin campground is located in the Athabasca Valley of Jasper National Park below the west face of Mt. Kerkeslin, 22.4 miles south of Jasper Townsite via Highway 93 (Icefields Parkway).

2.2 Topography And Relief

The study area lies in the valley bottom at just under 4,000ft ASL and is physically isolated by two important features; the Athabasca River to the west and the Icefields Parkway to the east. These two physical barriers demarcate a triangle of forested landscape approximately 430 acres in extent, 60 acres of which at the northern extremity is the study area proper.

The study area occupies the toe of an alluvial fan that has its source upslope from the campground on the west side of Mt. Kerkeslin. The highest elevation, 3,996ft ASL, occurs near the centre of the study area close to the highway. Overall slope conditions are moderate ranging from two to ten percent with a westerly aspect down to the Athabasca River. Some sites exhibit undulating microtopography essentially demarcating former stream channels of the alluvial fan.

Additional landform units within the study area include the floodplain and river terraces of the Athabasca River. Slope conditions on these units which lay at elevations of 3,900ft ASL are level with stoniness classes ranging from non-stony to very stony.

2.3 Vegetation

Excepting a small borrow pit which has been reclaimed to grass cover and a horse corral site, the entire study area is forested, more or less. Four major recognizable vegetation cover types typify the forest stands. They are: 1. Riverine Spruce-Sedge Type occupying the floodplain of the Athabasca River (Plate 1); 2. Spruce-Pine-Aspen/Wild rye/Twin flower Mixedwood Type on the alluvial fan and terrace deposits (Plate 2); 3. Aspen-Spruce/Wild rye Type on alluvial fan deposits (Plate 3); and 4. Pine-Spruce/Wild rye/Twin flower Type occupying both alluvial fan and terrace landforms.

Variation of microtopography on the fan, affects local variation in ground cover within cover types. Variation in depositional dynamics affects variety in soil texture and stoniness which in turn influences drainage, soil moisture regime and quality of rooting medium. Consequently, Aspen cover dominates the coarser upslope portion of the fan while coniferous species are more common on the lower or toe portions of the fan where comparatively finer textured soils predominate. Although to some extent forest cover diversity is a product of depositional diversity, in some cases disturbance by fire and flooding are also determinants of vegetation pattern.

Forest cover is young in terms of succession and all cover types are seral. The growth potential of sites under study favors eventual succession to a climax cover of spruce, barring further disruption by natural or man-induced disturbance.

2.4 Fauna

Physiographic, climatic, vegetation and faunal attributes of the study area are typical of the Canadian (faunal) life zone (Soper, 1970). This zone is described by Soper as rich in both animal and plant life, provides suitable habitat for most of the fur-bearers and a high percentage of big game mammals. In addition to eight species of small mammals recorded for the study area during our investigation, concrete evidence of use by black bear, coyote, timber wolf, mule deer, moose, and elk was noted.

2.5 The Existing Campground

The existing campground development located wholly in Mixedwood forest cover (Type 2) occupies about 7.2 acres of the area under study, of which approximately 3.0 acres support 25 campsites. Eight of the 25 campsites have evolved through overflow use during peak visitor use. Campground design is essentially circular with a single access road leading from the Icefields Parkway. The intensity of such high density use has effectively denuded all ground vegetation from the developed lands not originally disturbed during construction of roadways, tent pads, parking blocks and fire places (Plate 4). Erosion of exposed soil is apparent as evidenced by the degree of root exposure at the base of most of the larger trees in the campground. Based on these criteria, campground condition may be considered poor.

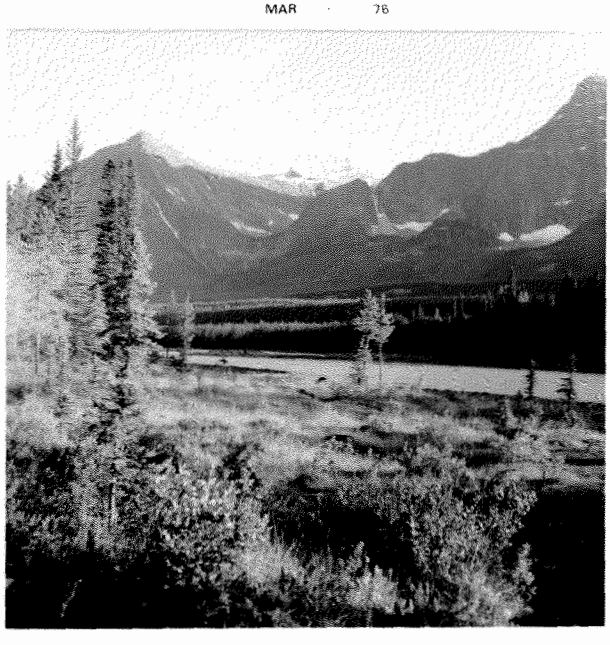

Plate 1. Riverine forest cover type occupying the Athabasca River floodplain (AP1). Scenic vistas plus diverse plant and animal communities attract leisure hiking use.

Plate 2. Mixedwood forest cover type. This vegetation is highly attractive as small mammal habitat and provides cover for ungulates.

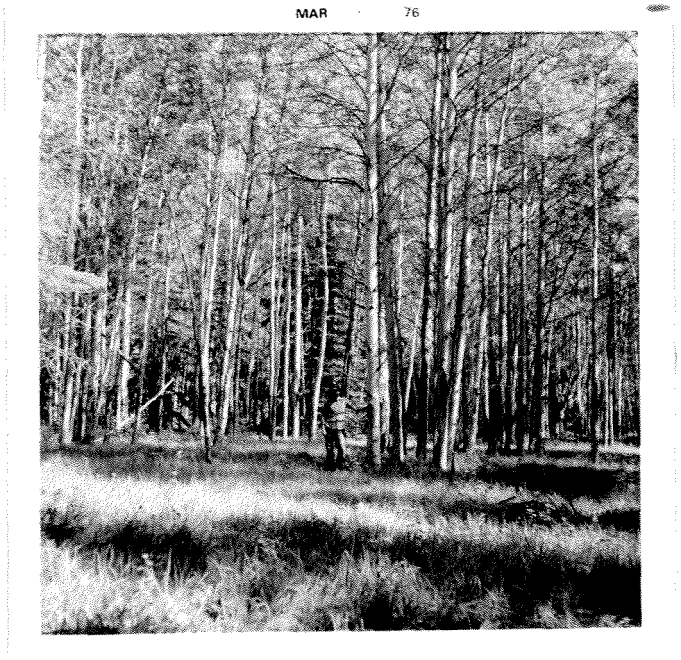

Plate 3. Aspen forest cover type. Note the parklike appearance affected by optimal interspersion of treeless glades and the well developed ground vegetation. The visual setting is aesthetically pleasing.

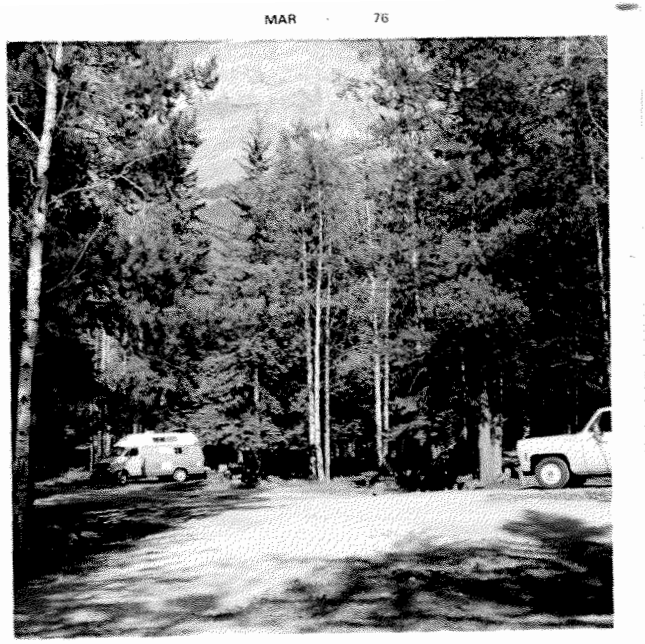

Plate 4. Mt. Kerkeslin campground, Jasper National Park. Intensive development has campsites placed side by side and hence the entire area lacks sufficient ground cover for small mammals.

METHODOLOGY

3.1 Overview

In order to achieve a sound inventory of both physical and biological resources within the study area a team approach to the problem was adopted. The team consisted of eight individuals including a vegetation scientist, two soil scientists, two biologists and three technical assistants. Soil and vegetation data were collected according to the resource inventory methodology described in Progress Report No. 1 (Holland *et al.*, 1975); final inferences from the data were made concerning the significance of quality, diversity and distribution of those resources in relation to designation of sites least suitable and most suitable for campground expansion.

In specific instances the impact of campground expansion has been postulated. Final recommendations were formulated to govern location and design of expanded facilities in keeping with minimal environmental impact and high standards of visitor satisfaction.

3.2 Soils

The study area was intensively traversed and sampled by digging of test pits and examination of the vegetation. Three representative soil pits were dug, described, and sampled for laboratory analyses. The pit locations are indicated on the map. The soil samples taken from these pits were analyzed at the University of Alberta and at the Alberta Soil and Feed Testing laboratory at Edmonton with the analytical methodology being the same as that described in Waterton Lakes National Park survey (Holland and Coen, 1973).

Soil boundaries are indicated on the map. These boundaries separate the alluvial terrace landforms from the alluvial fan, and the very stony surface portions of the fan from the stone-free portions. The differences in soil development between No. 5006 and 5008 are not indicated by a boundary, even though it is known that an Orthic Gray Luvisol occurs only at the very lowest fringe of the toe of the fan, particularly towards the south.

The numbers 1 to 3 indicated on the map are chained test digs representing stoniness classes as follows:

1. Nonstony to slightly stony - 0 to 0.1% coarse fragments >2 mm);
2. moderately stony to very stony - 0.1 to 15%;
3. very stony to extremely stony - 15 to 50%.

Thus, soil pit No. 5007 is in stoniness class 3, and the other two are in class 1.

Surrounding terrain was examined in the field and the surficial geology report of Reimchen and Bayrock (1975) was also studied, with a view towards determining any external features or sub-areal processes, such as avalanching, or flooding, that might affect the proposed campground expansion.

3.3 Vegetation

The vegetation cover was initially subdivided into forest cover types through reconnaissance and familiarization. Subsequent to that survey quantitative methods were adopted for description of each cover type. Methodology employed by the Banff-Jasper Biophysical Team was adopted (Holland *et al.*, 1975). Quantitative efforts employed the

"Releve" Method in which plots of 20m x 20m dimension located in stands of each cover type were examined for species composition of all vegetation layers including dominant and subdominant trees, tall shrubs, herbs, dwarf shrubs, and moss and lichen. Each plant species recorded was rated for percentage cover using the Braun-Blanquet Cover-Abundance scale (Appendix 2). Vegetation structure was further described on the basis of total cover per layer and age of stands. Also included was a description of ground cover, other than vegetation, as well as physiography and edatope (Appendix 2).

Time was a factor limiting sampling to two stands in each of the Mixedwood and Aspen types, and one stand in each of the Pine and Riverine types.

3.4 Wildlife

Small mammal populations were evaluated in each of the following cover types (Riverine, Mixedwood, Pine, and Aspen) by snaptrapping. Trapping was done systematically, based on techniques modified from Krebs (1964). Trap lines were positioned so that an entire line was within only one cover type. When possible, trap lines were set in straight lines; but, because of irregular boundary limits, deviations to keep a line within a specific type were necessary. Each line consisted of 20 stations spaced at 50ft intervals with three traps per station. All traps at a station were within a five-foot radius of a stake marked with flagging. Traps were set on three successive nights at all stations.

Study skins (museum specimens) were made of all animals trapped. Each animal was measured, sexed, and weighed prior to being skinned and stretched on specimen cards. Skulls of all specimens were saved for positive species indentification.

The relative abundance of red squirrels in relation to forest cover types was determined by two methods. Midden piles, accumulations of husked spruce cone scales under which this species frequently caches winter food, were located by a thorough, systematic search of the entire area and plotted on the contour map. Also, call counts were made at 100ft intervals along three traps transects (Mixedwood, Pine, and Aspen) and in a second Mixedwood stand immediately south of the existing campground. The Riverine cover type was not sampled mostly because of its relative absence of trees and proximity to the transect in the Mixedwood stand.

Beginning at 0830H for three consecutive mornings, the number of different red squirrels calling during a one-minute interval at each station was recorded. If the intensity or direction of the call did not enable the investigator to distinguish, without doubt that two individuals were calling, the call was recorded as one squirrel calling. The starting point for walking the transect route was changed daily to reduce an inherent bias resulting from possible temporal changes in call frequency.

Species diversity was calculated by Brillouin's formula (Peilou, (1966) as:

$$H = \frac{1}{N} \log \frac{N!}{N_1!\ N_2!\ \ldots\ N_S!}$$

Characteristics of large mammal use and abundance were not intensively studied mostly because the study area is so limited in extent that

its significance within the total spectrum of range and habitat requirements of existing populations is likely small. Nevertheless, this component was not totally ignored. Notes were kept concerning usage by large mammals including such signs as scats, pellet groups, browse utilization and impact resulting from rutting activity of ungulates. With regard to seasonal use patterns within the study area, large mammal observation records were interpreted by the Jasper Warden Service and forwarded to the authors.

The study team members lacked expertise in avian ecology and no funds were available for inclusion of such expertise. Consideration of matters affecting the avifauna was undertaken by D. Karasiuk, Canadian Wildlife Service, Edmonton who kindly offered his assistance in formulating development guidelines based on the field data we were able to provide him with.

RESULTS

4.1 Soils

The majority of the study area (see map) is occupied by a silty alluvial fan deposit that becomes extremely stony near the highway and at elevations above the highway. A narrow floodplain (Apl) and a system of terraces (AT2) occur along the Athabasca River. These riparian units are considered to be too small for inclusion in the proposed development and are best left alone as much as possible so they may serve a protective role against river erosion and as a windbreak.

The detailed descriptions and laboratory analyses of the major soils follow in Appendix 1.

4.2 Vegetation

Detailed descriptions of the four identified forest cover types are given in Appendix 2. When considering suitability for development and any impact arising through development; canopy coverage, tree stem density and resistability to trampling of the ground vegetation are important characters attracting most attention.

The Riverine (Ri) cover type illustrated in Plate 1 is restricted to the floodplain (APl) and youngest terraces (AP2) of the Athabasca River. Flooding and high water table affect the rather open, nearly treeless cover of moisture loving sedges, rushes and herbs. Impact of flooding disturbance is highlighted by the observed diversity of plant species, 83 of which were positively identified during the study. Stands of this type are young in terms of forest succession (Table 1).

Table 1. Age determinations of four tree species representative of four forest cover types, Mt. Kerkeslin campground area, Jasper National Park.

Species	Age in years by cover type			
	Riverine	Mixedwood	Aspen	Pine
Lodgepole pine	76	74	71	75, 78 79
White spruce	--	53, 61 69	--	79
Black spruce	53, 60	68	--	--
Aspen poplar	--	72	67, 80	--

Lands occupied by the Riverine type are as already stated, unsuitable for campground development but are highly attractive to visitors for walking, scenic viewing, photography and nature study purposes.

The three remaining cover types occupy well-drained sites and are distinguished in the field on the basis of difference in the canopy coverage of the predominant tree species (white spruce, aspen poplar and lodgepole pine). Existing understory vegetation varies directly with the amount of sunlight passing through the tree canopy and attendant soil moisture regime.

The Mixedwood type (Mw) possesses balanced portions of well developed white spruce, aspen poplar and lodgepole pine, along with strong regeneration by white spruce, the eventual climax species. The comparatively dense tree canopy of 35 percent cover is enhanced by the shorter white spruce

regeneration layer which effectively limits lateral viewing distances to a few yards. Such a character can be exploited as an effective screening device between individual campsites. Reduced solar radiation at ground level however, is a condition effectively resulting in a poorly developed graminoid ground cover and a rather fragile herbaceous cover. Such vegetation will not withstand intensive trampling impact (Nagy and Scotter, 1974).

The Pine type (Pi) is also characterized by dense tree crown cover of 40 percent and heavy stocking rate. Ground cover within this type consists of wild rye, twin flower and a moss carpet and could be rather susceptible to trampling. Because of the even distribution of tree stocking, any campground development would require considerable tree clearing.

An optimal balance between shade and sunlight exists in the Aspen cover type (Po). Crown cover is only 16 to 20 percent and stocking rate, although comparable to the Mixedwood type, is clumped, resulting in a parkland physiognomy where meadowlike glades abound (Plate 3). Ground cover here is a ubiquitous and hardy layer of wild rye grass at 30-35 percent coverage. Judicious selection of campsite locations in this type could eliminate the necessity for any clearing other than to supply access roads.

4.3 Wildlife

4.3.1 Small Mammals

A total of 53 individuals, representing eight species were collected in 720 standard trap nights during this survey (Table 2). Other species of small mammals, such as heather voles and northern bog lemmings,

may inhabit the area that was surveyed. The species that were caught however, represent all but two of the species listed by Soper (1970) as being typical of the Canadian life zone, which includes the environs of this region of the Athabasca River valley. Chipmunks, probably yellow-pine chipmunks were twice sighted and heard on several other occasions, most frequently in the Mixedwood cover type.

A breakdown of the number of small mammals caught in each vegetation type is presented in Table 2 while Table 3 summarizes relative density per 100 trap nights. Deer mouse was the most abundant species, comprising 68 percent of the animals taken. The next most abundant species were red-backed vole (13%) and long-tailed vole (6%). The remaining five species each made up less than 5 percent of the catch.

Table 2. Number of small mammals captured by snap-trap sampling four forest cover types near Mt. Kerkeslin campground, August 11-14, 1975.

	Vegetation cover type				
Species	Riverine	Mixedwood	Aspen	Pine	Total
Deer Mouse	14	14	2	6	36
Red-backed vole	--	3	--	4	7
Long-tailed vole	2	--	1	--	3
Meadow vole	--	--	2	--	2
Masked shrew	--	2	--	--	2
Northern flying squirrel	1	--	--	--	1
Western jumping mouse	1	--	--	--	1
Red squirrel	1	--	--	--	1
Total	19	19	5	10	53

Table 3. Relative species density (per trap nights) by cover type as determined from snap-trapping studies in the Mt. Kerkeslin campground area, August 11-14, 1975.

Species	Vegetation cover type			
	Riverine	Mixedwood	Aspen	Pine
Deermouse	7.8	7.8	1.1	3.3
Red-backed vole	---	1.7	---	2.2
Long-tailed vole	1.1	---	0.6	---
Meadow vole	---	---	1.1	---
Masked shrew	---	1.1	---	---
Northern flying squirrel	0.6	---	---	---
Western jumping mouse	0.6	---	---	---
Red squirrel	0.6	---	---	---

*Each cover type was trapped for a total of 180 trap nights.

Deer mouse was the most common species in three of the four areas sampled (Table 3). Only in the Aspen type, where few animals were trapped, was another species found in equal abundance with deer mouse, that being meadow vole. Deer mouse was the only species recorded in all four vegetation types. Red-backed vole and long-tailed vole were trapped in two, while the remaining five species were trapped in only one type.

Abundance of small mammals appears to be greatest in the Riverine and Mixedwood cover types with the lowest abundance in the Aspen Type (Table 2). Abundance of small mammals in the Riverine and Mixedwood cover types was significantly greater than in the Aspen type ($X^2 = 8.16$, $P<.005$) (Table 3).

Species diversity indices for the four areas sampled are presented in Table 4. Diversity was highest in the Riverine type where five of the eight species taken were recorded. Note however, that diversity for the Riverine type was only slightly larger than diversity indicies calculated for the other cover types because two of the five species were represented by only a single specimen. The next highest diversity was found in the Aspen type and the lowest in the Pine type.

Table 4. Species diversity of small mammals taken with snap-traps in four forest types near the Mt. Kerkeslin campground, August 11-14, 1975.

	Riverine	Mixedwood	Aspen	Pine
Number of Species	5	3	3	2
Number of Individuals	19	19	5	10
Species diversity	1.04	0.91	0.99	0.88

Brillouin's index of species diversity is sensitive to evenness, or in other words, how the individuals are distributed among the species. If a few species contain a majority of the individuals, the diversity is low and if the individuals are evenly distributed among the species, diversity is high.

Table 5 summarizes data on abundance and distribution of red squirrel derived from four call count transects. The highest call count values were recorded along the trap transect located in Mixedwood cover. Calling by red squirrels was noted much less frequently in the Aspen and Pine cover types. Likewise, middens were more common in the Mixedwood

type than in areas of Aspen or Pine vegetation (Note Map). There were no middens in the developed area of the campground which is also located in Mixedwood cover.

Table 5. Summary of red squirrel call counts on three consecutive days (August 13-15) along four transects near Mt. Kerkeslin campground.

	Call counts*			
Day	Mixedwood South campground	Mixedwood	Aspen	Pine
1	9	11	3	0
2	10	14	5	2
3	10	13	5	1
Total	29	38	13	3
$\bar{X}$	9.7	12.7	4.3	1.0
# of stations	6	10	10	10

*Number of different individuals calling along a transect.

A third indicator of red squirrel abundance and distribution might be snap traps sprung along each transect. Even though red squirrels were likely not responsible for all empty and sprung traps, they were usually active in the evenings while traps were being set and also in the early morning before all traps were checked and sprung by the investigators. Squirrels are adept at springing snap traps with their forepaws in order to acquire the bait. If caught, they are usually strong enough to pull the appendage free without injury.

Total traps sprung, and hence empty, per 180 trap nights in each vegetation type is summarized below in Table 6. Those data corroborate

distributional characteristics derived from call counts and midden pile mapping.

Table 6. Number of traps sprung (and hence empty) per 180 trap nights within four forest cover types near Mt. Kerkeslin campground.

Cover type	Number of traps sprung
Mixedwood	26
Riverine	20
Aspen	10
Pine	5

4.3.2 Large Mammals

Information given here deals with elk, moose, mule deer, wolf and coyote only. Carnivore and ungulate winter usage data was provided by Jasper Warden Service while observations on evidence of summer and fall use were made by the study team.

No winter observations for mule deer have been recorded in the Mt. Kerkeslin area. Summer and fall resident deer (number unknown) move down valley as winter takes hold. An adult female mule deer with one young of the year was seen on August 12, 1975 bedding down in the Mixedwood type. Sign of mule deer summer use was most frequently observed in the Mixedwood and Aspen types although quantification was impossible.

Winter moose activity in this area is common, including movements through the Aspen forests and browsing mostly in the Riverine type (spring and fall only) adjacent to the river. Shrub cover suitable for browse

is best developed at the more moist and open Riverine situations. Traditionally, greater intensities of winter moose activity have been noted on the west bank of the Athabasca River opposite Mt. Kerkeslin campground. Sign of summer utilization by moose of the Riverine, Pine and Mixedwood types was light but common, consisting mainly of evening movement by adults and young across river and through the undisturbed forest areas.

It is the opinion of the Jasper Warden Service that a small herd of elk (35-45 animals) is resident of the Athabasca Falls area (including the study area). In late winter this herd moves out and down valley presumably to Wabasso Lake and vicinity not to reappear until late summer. At dusk on August 13, 1975 we observed two cow-calf bands crossing the Athabasca River from west to east and into the study area. Sign of elk use in various vegetation types was as follows:

1. Within the Pine type and heavily stocked sections of the Mixedwood type near the river we noted abundant brooming of confer saplings and ground disturbance most likely affected by bull elk during late summer and fall.
2. Late spring and autumn use was evidenced within the Riverine type by abundant fresh and weathered pellet groups, tracks and some browse impact.
3. Light winter use by elk and almost no summer use within the Aspen type was indicated by a few scattered stale pellet groups, light impact on aspen saplings and some scarring of mature aspen. The Aspen exhibits a dominant understory of hairy wild rye which is generally regarded as unpalatable and of low protein

Table 7. Approximate elk population (Ranger Creek to Athabasca Falls) Jasper National Park.

	Year	Oct. - Dec.	Year	Jan. - Mar.
Female and young	1971	50 - 60	1972	20 - 25
Male	1971	30	1972	27
Female and young	1972	50 - 60	1973	20 - 25
Male	1972	30	1973	20 - 25
Female and young	1973	36	1974	15 - 20
Male	1973	15	1974	12
Female and young	1974	17	1975	0
Male	1974	7	1975	5
Female and young	1975	26	Jan 76	7
Male	1975	10	Jan 76	9

content (Campbell *et al.*, 1976). It is unlikely therefore that this species is heavily utilized by elk other than possibly in the spring when new shoots are green and succulent (McGillis, pers. comm.).

The few aspen saplings occurring in the Aspen type did not show evidence of heavy browse utilization (Plate 3) hence the importance of this cover type in sustaining wintering or summering ungulates is most likely slight.

Elk numbers appear to have decreased since 1972 (Table 7) in response to what is believed to be increased wolf activity within the area under study. A likely compounding factor was the severe winter of 1973-74. Evidence of wolf activity was obvious in the Riverine type where numerous tracks were seen in the mud alongside the Athabasca River.

Use of the cover types by coyotes is likely related to abundance of small mammals and gallinaceous birds. We were unable to determine a marked use preference of specific vegetation types by coyotes.

4.3.3 The Bird Community

As Don Karasiuk was unable to visit Kerkeslin Campground during the bird breeding season, the following comments are speculative. They are based on bird observations made in comparable vegetation types in the Bow Valley of Banff National Park.

Stands similar in physiognomy and vegetative composition to the Riverine type occur in the floodplain of the Bow River near Lake Louise, and at the toes of certain alluvial fans.

The following is a listing of the bird species which could be expected regularly in such cover types at Kerkeslin.

Barrow's Goldeneye*	American Robin
Killdeer*	Ruby-crowned Kinglet
Common Snipe*	Yellow-rumped Warbler
Spotted Sandpiper*	Brown-headed Cowbird
Belted Kingfisher*	Dark-eyed Junco
Gray Jay	Chipping Sparrow
Common Raven	White-crowned Sparrow
Common Crow	Lincoln's Sparrow*

*indicated species not likely to be present in the other three vegetation types.

Many other species might possibly be present at Kerkeslin but cannot be predicted with any degree of certainty.

Stands similar in physiognomy and species composition to the Mixedwood type occur on fans of the Hillsdale land system, and on river terraces of the Bow downstream from Banff.

The following is a listing of bird species which could be expected regularly in such cover types at Kerkeslin.

Ruffed Grouse	Golden-crowned Kinglet*
Northern Flicker	Yellow-rumped Warbler
Gray Jay	Townsend's Warbler*
Boreal Chickadee	Pine Siskin
American Robin	Dark-eyed Junco
Swainson's Thrush	Chipping Sparrow
Ruby-crowned Kinglet	

*indicates species not likely to be found in the other three vegetation types

While it is likely that many other species will be present, these cannot be predicted safely.

Table 10 (Appendix 4) presents transect results from three comparable Mixedwood stands in the Bow Valley. It will be noted that some species occurring in the transect results do not appear in the listing above; these species may be present at Kerkeslin, but their presence is difficult to predict.

Stands similar in physiognomy and species composition to the Aspen type occur on many alluvial fans in the Bow Valley.

The following is a listing of bird species which could be expected to occur regularly in Aspen woodlands at Kerkeslin.

Ruffed Grouse	Starling
Northern Flicker	Warbling Vireo
Yellow-bellied Sapsucker	Red-eyed Vireo*
Least Flycatcher*	Orange-crowned Warbler
Western Wood Peewee*	Yellow-rumped Warbler
Common Crow	Western Tanager
Black-billed Magpie	Brown-headed Cowbird
Black-capped Chickadee	Pine Siskin
American Robin	Dark-eyed Junco
Swainson's Thrush	Chipping Sparrow

*indicates species not likely to be found in the other three vegetation types.

Transect results from aspen forests in Banff are presented in Table 10. Transect results of breeding-pair censuses for Pine-spruce shepherdia forests in the Bow Valley are summarized in Table 10. Stands similar in physiognomy and vegetative composition to the Pine type occur in the Baker Creek 1 landtype of the Bow Valley.

The following bird species are likely to be present in similar vegetation types at Kerkeslin.

Spruce Grouse	Yellow-rumped Warbler
Gray Jay	Pine Siskin
Boreal Chickadee	Dark-eyed Junco
American Robin	Chipping Sparrow
Swainson's Thrush	

DISCUSSION

5.1 Soils

An examination of the map and descriptive data indicates gentle uniform slopes with only a small portion of the study area being as steep as 10 percent. Most of the soil textures are silty loam, with some silty clay loam (Plate 5).

Surface drainage is rapid; all of the profiles encountered on the alluvial fan are well drained, although some water was seen to be seeping into the river from the toe of the fan at six to seven feet from the surface. Septic effluent is not anticipated to be much of a problem because of the silty texture and because space limitations will not permit an overly intensive use of the area. Also, pollution potential may be minimized by septic construction that permits time for micro-organism activity to protect against river contamination.

Water holding capacity is highest on the KFl unit and lowest on the At2 unit. The stony portion of the fan, KAl, has a sufficient number of coarse fragments to lower the useful moisture enough to affect the vegetation (Plate 6).

Although the lime content is high throughout, there are no apparent chemical restrictions to the use of these soils. The data, Appendix 1, indicate high levels of potassium, and relatively low levels of phosphorus and nitrogen. Thus, the addition of potassium and lime are unnecessary, while the addition of phosphorus fertilizer is probably impractical because the high lime content will result in fixation of the added phosphorus in an unavailable form. With regard to nitrogen, although low,

the relationship of nitrogen and organic matter should be noted; the higher the organic matter level, the higher the nitrogen. The addition of nitrogen fertilizer at a rate of 100 to 150 pounds of ammonium nitrate (34-0-0) in early spring and early summer, plus maintenance and/or increase in organic matter levels, can do much to maintain the existing vegetation under intensive campground use.

Surrounding terrain features do not provide any evidence of avalanching hazards or any other hazard not natural to a mountainous environment. There is no evidence of flooding except for the narrow floodplain, AF1, right alongside the river.

It is characteristic of creeks and alluvial fans to move their channel position from time to time. As debris is brought down from the higher elevations by natural geological erosion, such creek channels, may clog and overflow to seek a new course across the fan. The present creek channel is near the north edge of the fan and is deeply incised at the higher elevations. Thus, there is no evidence of any imminent threat of a new creek channel course being formed. However, the profile descriptions include a number of buried profiles and the presence of volcanic ash. These Cumulic characteristics are evidence of stable soil surfaces for a lengthy period of time, followed by a succession of depositions of new material of from 6 to 100cm at various times since glaciation. On the other hand, Orthic Gray Luvisol profile development around the margins of the fan may be interpreted as an indication of stability for a considerable length of time, thus suggesting that the Cumulic deposits have been of a smaller scale in more recent times. Also, presence of volcanic ash at 60cm from the surface with an assumed date of 6500±

years BP, may be interpreted as fairly slow accretion of material. The variability between the three profile descriptions indicates an uneven accumulation of materials over the years.

The soil on this fan is expected to be one that is capable of response to management. It has good moisture holding capacity, no restrictions to rooting volume, except for its reduction by coarse fragments in unit KA1. Its texture permits increasing nutrient level by use of fertilizers. The lower portion of this fan is similar to the west portion of Whistler campground; thus one would expect similar responses to management in the two areas.

Guides for assessing soil limitations are provided in Holland and Coen, (1973, Table 8). Use of these guides to estimate the degree and nature of limitation of these soils for campground development is presented in Table 9.

5.2 Vegetation And Wildlife

Since the objective of this study was to assess the environmental impact of campground expansion and identify means by which adverse impact could be avoided or at least minimized, it seemed logical to consider the forest cover types as habitat types and discuss limitations based on these units. In Jasper National Park the Canadian life zone, which is found at lower altitudes, is optimal habitat rich in both plant and animal species (Soper, 1970). Our data reinforces that statement even though we were not able to inventory all species occurring in the Mt. Kerkeslin campground environs. We could not assess the impact of development at Kerkeslin within a regional context for obvious reasons,

Table 8. Guide for assessing soil limitations for camp areas.*

This guide applies to soils to be used intensively for tents and small camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and leveling for tent and parking areas. The soil should be suitable for heavy foot traffic and for limited vehicular traffic.[1] Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Item affecting use	Degree of soil limitation[9]		
	None to slight	Moderate	Severe
Wetness (Wet)[2]	Rapidly, well, and moderately well drained soils; water table below 30 in. during season of use	Moderately well and imperfectly drained soils; water table below 20 in. during season of use	Imperfectly, poorly, and very poorly drained soils; water table above 20 in. during season of use
Flooding (Flood)	None	None during season of use	Floods during season of use
Permeability[3] (Perm)	Very rapid to moderate inclusive	Moderately slow and slow	Very slow
Slope (Slope)	0–9% (AD)	9–15% (E)	15–30% (F)
Useful moisture[4] (Moist)	Water storage capacity >5 in. and/or adequate rainfall and/or low evapotranspiration	Water storage capacity 2–5 in. and/or moderate rainfall and/or moderate evapotranspiration	Water storage capacity <2 in. and/or low rainfall and/or high evapotranspiration
Surface soil texture[5] (Text)	SL, FSL, VFSL, L, SiL	CL, SCL, SiCL, LS, and sand other than loose sand	SC, SiC, C, loose sand subject to severe blowing, organic soils
Coarse fragments on surface[6] (CF)	0–20%	20–50%[7]	>50%
Stoniness[8] (Stony)	Stones greater than 25 ft apart	Stones 25–5 ft apart	Stones less than 5 ft apart
Rockiness[8] (Rock)	No rock exposures	Rock exposures greater than 30 ft apart and cover less than 25% of the area	Rock exposures less than 30 ft apart and cover greater than 25% of the surface

[1]For information on roads and parking lots see Tables 15 and 16.

[2]The abbreviations in brackets are used in Table 6 to indicate the nature of the limitation.

[3]Infiltration tests show that in most, if not all, of the soils in the Park there is little if any limitation to permeability with regard to camp areas (Appendix A).

[4]This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

[5]Surface soil texture influences soil ratings as it affects foot trafficability, dust, and soil permeability.

[6]Coarse fragments include both gravels and cobbles.

[7]Some gravelly soils may be rated as slight if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is imbedded in the soil matrix, or (b) the fragments are less than ¼ inch in size. See the definition for gravels in *The System of Soil Classification for Canada* (Canada Soil Survey Committee 1970), pp. 213–214.

[8]Very shallow soils are rated as having a severe soil limitation for rockiness and/or stoniness. See also definitions of rockiness and stoniness in *The System of Soil Classification for Canada* (Canada Soil Survey Committee 1970), pp. 213–214.

[9]A fourth degree of soil limitation is also defined for the purposes of Table 6—Unsuitable. Slopes greater than 30%; permanently wet soils; floods every year, or oftener; rock outcrop too frequent to permit location of camp areas.

*Source Holland and Coen, 1973.

other than to state that of all the life zones in Jasper National Park, development in habitats of the Canadian life zones would conceivably have greatest impact on wildlife, both plant and animal. Within the context of the study area impacts can be more specifically assessed.

The Riverine habitat is rich in plant and mammal resources and should not be disrupted. The Pine habitat is restricted in size, is important to elk and moose for cover, and is suitable habitat for small mammals, thus it should be avoided.

Data from this study suggest that the Mixedwood habitat is highly productive for mice, voles, and red squirrels, and may represent optimal flying squirrel habitat as well (Note Plate 7). In addition, ungulate use is more concentrated within such cover particularly where tree stocking rates are dense. On the other hand, Aspen habitat appears to possess minimal potential for adverse impact if developed. Firstly, there would be little or no necessity to clear trees during development thus limiting visual impact and impact on bird populations. Large and small mammal disturbance would be minimal when compared to attendant disturbance of the three additional habitat types. The existence of two cleared right of ways for vehicle access to the old corral site would at least ameliorate the need for extensive roadway clearing if the future traffic circulation pattern could incorporate those existing clearings. Finally, the comparatively good sunlight penetration to ground surface would enhance vegetation manipulation.

Cutbanks along the Athabasca River, if any exist, should be left intact, as these are breeding habitat for kingfishers and two species of swallow. Standing dead trees should also be left intact as these are

Plate 5. Soil profile at pit 5006, alluvial fan (KF1). Note the fine texture, absence of stoniness and volcanic ash layer. Such soils possess optimal manipulative characteristics.

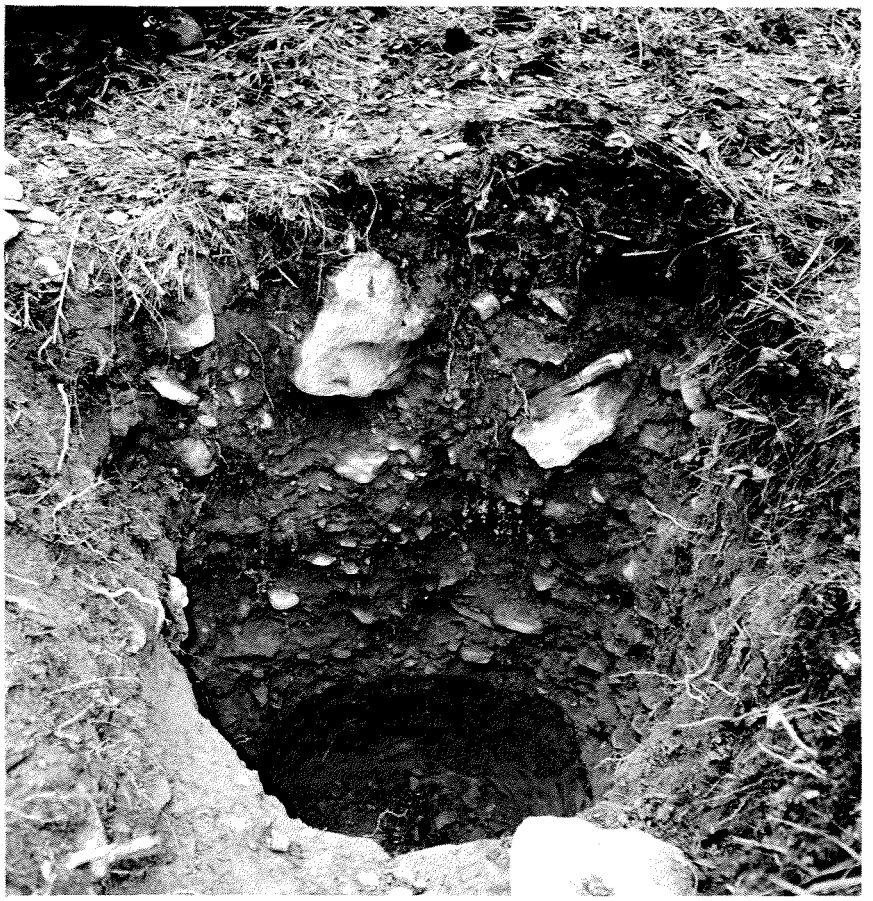

Plate 6. Soil profile at pit 5007, alluvial fan (KA1). Note stoniness both at the surface and at depth. Stoniness reduces moisture holding capacity and thus complicates vegetation manipulation. Exposed surface stones must be cleared from developed campsites.

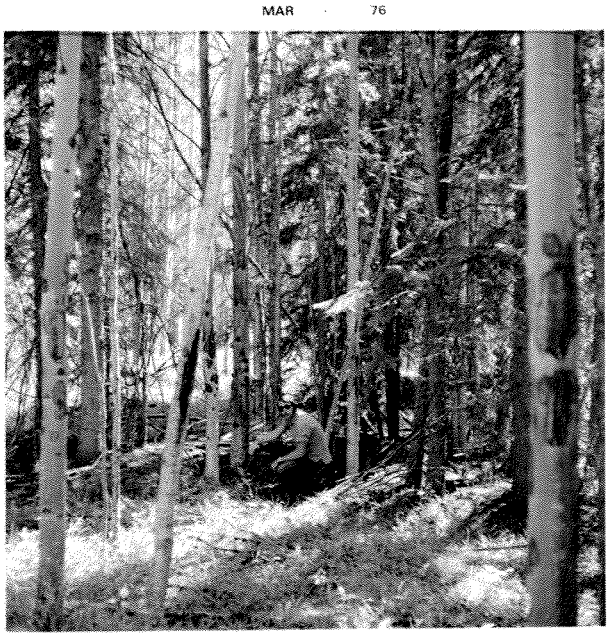

Plate 7. Red squirrel midden pile within the Mixedwood forest cover type. These winter food storage sites were concentrated in the Mixedwood type, the preferred habitat type of red squirrel.

vantage points for kingfishers, raptors, and flycatchers using riparian habitats.

Management to preserve bird diversity in the Mixedwood type would include preservation of whatever ground cover exists, and leaving dead trees intact unless a threat to public safety. Management to preserve bird species in the Aspen type at Kerkeslin would include the preservation of standing dead trees, and protection of existing grass and shrub cover from cutting or excessive trampling.

For the average camper, aspen forest is likely to have the most interesting bird fauna. Of the four cover types discussed, Aspen forests seem to have a preponderance of vocal species which sing well into the afternoon. Mixedwood and Riverine types would rate somewhat lower than Aspen. Subjectively, Pine forests appear to possess the least varied bird fauna.

Presented below in Table 9 is a collation of guides to assist assessment of environmental constraints affecting campground development in the Mt. Kerkeslin study area.

Outstanding development considerations must focus on reducing or avoiding adverse environmental impact, identification of suitable substrates, and utilization of aesthetically pleasing settings. Only then should economic constraints be considered, but in no instance should such constraints override the importance of the above. Table 9 is presented as a guide to estimate the degree and nature of advantages, limitations, and potential impacts of campground development within the area of study. It is this analysis which leads us to propose the following recommentations.

RECOMMENDATIONS

1. Campground expansion, if proceeded with, should be located in the Aspen cover type, excepting those sites underlain by stony (KA1) substrates as outlined on the map. The non-stony soil (KF1) is amenable to management for intensive campground use.
2. Expansion into the Riverine, Pine or Mixedwood types should not be considered, Table 9, as the Riverine type is susceptible to high water-table and flooding. Pine and Mixed wood types are excluded for reasons other than soil (Table 9).
3. Scattered clumps of white spruce within the development area should be left intact. Although red squirrels may not occupy all such clumps, they are potential sites of squirrel habitation.
4. If possible, campsites should be located so that spruce clumps not only separate campsites but are somewhat removed from any artificial clearing as well. This will protect existing midden piles and enhance screening between campsites.
5. A wide buffer zone between individual campsites is advisable to permit small mammals and birds to live within the campground. At present the existing campground is so intensively developed that all ground cover, plant litter and deadfall which are essential for animal cover and to some extent, bird cover, has been eliminated.
6. Deadfall and standing dead trees should never be removed unless a direct threat to public safety exists. Woodpeckers and flying squirrels utilize holes in standing dead trees for nesting and small mammals utilize fallen logs for cover.

Table 9. Site suitability for Mt. Kerkeslin campground expansion development.

MAP UNIT		LIMITATIONS			ADVANTAGES			ECONOMIC SUITABILITY	SCENIC AND COMFORT SUITABILITY		DEVELOPMENT SUITABILITY
Soils	Vegetation	Soil	Vegetation	Wildlife	Soil	Vegetation	Wildlife		Advantages	Limitations	
KF1	Mw	None	1. Tree stocking density 2. Deadfall 3. Sparse ground cover 4. Shade	1. Diverse small mammal population 2. High small mammal production 3. Optimal red and flying squirrel habitat 4. Ungulate habitat (cover)	1. Texture (good manipulative characters 2. No soil moisture limitations 3. Good drainage	1. Good screening qualities (noise and visual)	None	1. Expensive clearing costs	None	1. Shade - cool in morning and evening 2. Very limited scenic views	*Not recommended* because of small mammal and bird diversity
	Po	None	1. Poor screening qualities (noise and visual)	None	1. Texture (good manipulative characters 2. No soil moisture limitations 3. Good drainage	1. Tree stocking distribution 2. Absence of deadfall 3. Exposure to sunlight 4. Good ground cover	1. Low mammal diversity	1. Tree clearing costs minimal at campsites 2. Cleared roadways exist	1. Good balance of shade and sunlight 2. Some opportunity for views of surrounding mountainsides 3. Songbird vocalizations	None	*Recommended as best*
	Pi	None	1. Tree stocking density 2. Restricted in areal extent	1. Marginal red squirrel habitat 2. Ungulate habitat (cover and browse)	1. Texture (good manipulative characters 2. No soil moisture limitations 3. Good drainage	None	None	1. Expensive tree clearing costs	None	1. Limited scenic views 2. Shade - cool in morning and evening	*Not recommended* because of large mammal cover, high tree density and riparian protection
KA1	Mw	1. Stoniness	1. Tree stocking density 2. Deadfall 3. Sparse ground cover 4. Shade	1. Diverse small mammal population 2. High small mammal production 3. Optimal red and flying squirrel habitat 4. Ungulate habitat (cover)	None	1. Good screening qualities	None	1. Expensive tree clearing costs 2. High revegetation costs 3. Surface stones must be removed	None	1. Shade - cool in morning and evening	*Not recommended* because of conflict with small mammal habitat and soil stoniness
	Po	1. Stoniness	1. Poor screening qualities (noise and visual)	None	None	1. Tree stocking distribution 2. Exposure to sunlight	1. Low mammal diversity	1. Tree clearing costs minimal at campsites 2. Cleared roadways exist 3. High revegetation costs 4. Surface stones must be removed	1. Good balance of shade and sunlight 2. Some opportunity for views of surrounding mountainsides	None	*Not recommended* because of soil stoniness
AT2	Mw	1. Stoniness 2. Texture	1. Sparse ground cover 2. Not suited for vegetation manipulation (poor growth potential)	1. Diverse small mammal population 2. Ungulate habitat (cover and browse)	None	None	None	1. Expensive tree clearing costs 2. Extensive leveling required 3. Expensive access 4. High revegetation costs	None	None	*Not recommended* because of coarse soil textures and large mammal cover
	Pi	1. Stoniness 2. Texture	1. Dry summer moisture regime 2. Not suited for vegetation manipulation (poor growth potential)	1. Ungulate habitat (cover and browse)	None	None	None	1. Expensive tree clearing costs 2. Extensive leveling required 3. Expensive access 4. High revegetation costs	None	Exposure to heat in summer	*Not recommended* because of coarse soil textures and large mammal cover
	Ri	1. Stoniness 2. Texture	1. Unique because of high species diversity 2. Susceptible to trampling (high water table) 3. Restricted in areal extent	1. Diverse small mammal population 2. Ungulate habitat (browse)	None	None	None	1. Flood control 2. Extensive leveling required 3. Expensive access 4. High revegetation costs	1. Excellent scenic vistas 2. Viewing wildlife	1. Exposed 2. Wet	*Not recommended* because of coarse soil textures and large mammal cover
AP1	Ri	1. Texture (erodable) 2. High water table 3. Flooding	1. Unique because of high species diversity 2. Susceptible to trampling (high water table) 3. Restricted in areal extent	1. Diverse small mammal population 2. Ungulate habitat (browse)	None	None	None	1. Flood control 2. Expensive access	1. Excellent scenic vistas 2. Viewing wildlife	1. Exposed 2. Wet	*Not recommended* because of flooding risk

7. Based on the demonstrated need to leave unaltered and suitable ground habitat within the developed area, the density of campsites should be at the most, no more than one quarter that of the existing campsite. This would also enhance privacy at individual campsites.
8. In light of the above restrictions a maximum of 25 new sites is recommended, given that development is extended southeastward beyond the mapping area but confined to the Aspen type on KF1 soil type (Table 9).

REFERENCES CITED

Campbell, J.B., K.F. Best, and A.C. Budd. 1966. Ninety-nine range. forage plants of the Canadian prairies. Can. Dept. Agric. Publ. 964, 102 pp.

Holland, W.D. and G.M. Coen. 1973. Soils of Waterton and interpretations, Waterton Lakes National Park, Alberta. Canadian Forestry Service Information Report NOT-X-65, Northern Forest Research Centre, Edmonton, 113 pp.

Holland, W.D., B.D. Walker, S. Kojima, D.T. Allan, and J. Dyck. 1975. Banff-Jasper bio-physical land inventory Progress Report No. 1, 1974-75. Canadian Forestry Service, Northern Forest Research Centre, Edmonton, 76 pp.

Krebs, C.J. 1964. The lemming cycle at Baker Lake, Northwest Territories, during 1959-62. Arctic Inst. of North America Tech. Paper No. 15, 104 pp.

Nagy, J.A.S. and G.W. Scotter. 1974. A quantitative assessment of the effects of human and horse trampling on natural areas, Waterton Lakes National Park. Can. Wildl. Serv. Unpubl. rept. Edmonton. 145 pp.

Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. J. Theoret. Biol. 13:131-144.

Reimchen, T.H.F. and L.A. Bayrock. 1975. Terrain analyses of Banff and Jasper National Parks. Prepared for Parks Canada, Western Region by Bayrock and Reimchen Surficial Geology Limited, North Vancouver, 38 pp.

Soper, J.D. 1970. The mammals of Jasper National Park, Alberta. Can. Wildl. Serv. Rept. Ser. No. 10. 80 pp.

Appendix 1

Detailed Soil Profile Descriptions And Laboratory Analyses

Soil Profile Descriptions

Plot No. 5006

Soil Subgroup Class. Cumulic Regosol

Horizon	Depth, cm	
LFM	4-0	Fibrous, slightly to moderately decomposed organic materials derived mainly from feathermoss and coniferous litter; pH 6.2.
Ae	0-0.5	Light gray (10YR 7/2 m) silt loam; structureless, friable; few to plentiful, fine and medium roots; abrupt, smooth lower boundary; 0.5 to 1 cm thick; pH (not determined).
Bm	0.5-4	Yellowish brown (10YR 5/6 m) silt loam; weak fine to medium granular; friable; few to plentiful, fine and medium roots; clear smooth lower boundary; 3 to 4 cm thick; pH 7.0.
Ck	4-12	Dark grayish brown (10YR 4/2.5 m) loam; very weak, very fine to fine granular; very friable; includes small lens of shaly gravel; few to plentiful fine and medium roots; clear, smooth lower boundary; 8 cm thick; pH 7.3.
Hb	12-13	Very dark brown (10YR 2/2 m) well decomposed organic material.
Bmb	13-21	Yellowish brown (10YR 5/4 m) silt loam; amorphous; friable; few to plentiful fine and medium roots; clear smooth lower boundary; 8 cm thick; pH 7.5.

Horizon	Depth, cm	
Ckb	21-33	Pale brown (10YR 6/3 m) calcareous silt loam; amorphous; friable; few to plentiful fine and medium roots; clear, smooth lower boundary; 12 cm thick; pH 7.6.
ABCkb1	33-60	Pale brown (10YR 6.3 m) and yellowish brown (10YR 5/4 m) calcareous silt loam; amorphous; friable; few to plentiful fine and medium roots; clear, smooth lower boundary; 27 to 30 cm thick; pH 7.7
ABCkb2	60-78	Yellowish brown (10YR 5/4 m) and white (10YR 8/2 m) calcareous silt loam and volcanic ash; amorphous; friable; volcanic ash layer at 72 to 76 cm; few to plentiful fine and medium roots; clear smooth lower boundary; 18 to 20 cm thick; pH 7.7.
ABCkb3	78-110	Dark yellowish brown (10YR 4/4 m) and brown (10YR 5/3 m) calcareous silt loam; amorphous; friable; few to plentiful fine and medium roots; clear smooth lower boundary; 30-32 cm thick; pH 7.8.
IIABCkb	110+	Very pale brown (10YR 7/3 d) stony silt loam; amorphous; friable; few to plentiful fine and medium roots; pH (not determined).

Special features: fungal mycelia present horizons 1 to 10; profile stone to 110 cm depth; percentage stones is greater than 30 percent below 110 cm. Note presence of volcanic ash.

Plot No. 5007

Soil Subgroup Class: Cumulic Regosol

Horizon	Depth, cm	
LFH	5-0	Slight to well decomposed organic material derived from deciduous and coniferous litter and from herbs; pH 6.2.
Bm	0-2	Reddish brown (5YR 4/4 m) gravelly fine sandy loam; weak, fine granular; friable; abundant medium and fine roots around stones; clear, broken lower boundary; 0 to 2 cm thick; pH (not determined).
Ck1	2-17	Dark yellowish brown (10YR 4/4 m) and brown (10YR 4/3 m) calcareous gravelly fine sandy loam; weak to moderate, fine granular; friable, abundant medium and fine roots around stones; gradual, smooth lower boundary; 15 to 18 cm thick; pH 7.3.
Ck2	17-100	Brown (10YR 5/3 m) calcareous gravelly loam; amorphous; friable; plentiful medium and fine roots around stones; abrupt, smooth lower boundary; 80 to 85 cm thick; pH 7.4.
IIHBC	100-130	Dark yellowish brown (10YR 4/4 m) stone free, silt loam; amorphous; friable; few fine roots; pH 7.6.

Special features: root mat around stones, horizons 2 to 4; trace of fungal mycelin horizon 5; percentage of coarse gragments (including stones and gravel) is greater than 50 percent in the upper four horizons.

Plot No. 5008

Soil Subgroup Class: Orthic Gray Luvisol

Horizon	Depth, cm	
LFM	2-0	Slightly to moderately decomposed organic material derived from feathermoss and coniferous litter; pH 5.7.
Bm	0-4	Weak red to reddish brown (2.5YR 4/3 m) silty clay loam; moderate, fine subangular blocky; friable; plentiful fine and medium roots; abrupt smooth lower boundary; 2 to 4 cm thick; pH (not determined).
Ae	4-10	Light brownish gray (10YR 6/2 m) silt loam; weak very fine platy; friable; plentiful fine and medium roots; abrupt, wavy lower boundary; 4 to 10 cm thick; pH 6.3.
Bt	10-15	Brown (7.5Yr 5/3 m) silty clay loam; moderate, fine subangular blocky; friable; plentiful fine and medium roots; abrupt, wavy lower boundary; 4 to 5 cm thick; pH 6.9.
Ck	15-38	Brown (10YR 5/3 m) calcareous silty clay loam; amorphous; friable; plentiful fine and medium roots; abrupt, wavy lower boundary; 13 to 23 cm thick; pH 7.2
IIC	38-44	Very pale brown (10YR 8/3 m) ashy silt loam; weak fine subangular blocky; friable; few fine roots; abrupt, smooth lower boundary; 5 to 21 cm thick; pH 7.3.

Horizon	Depth, cm	
IIIBmkb	44-50	Brown (7.5YR 5/4 m) silty clay loam; weak, fine subangular blocky; friable; few fine roots; clear, smooth lower boundary; 5 to 8 cm thick; pH 7.5.
IVCK	50-70	Pale brown (10YR 6/3 m) fine sandy loam; amorphous; friable; few fine roots; clear, smooth lower boundary; 18 to 20 cm thick; pH 7.5.
VCk	70-79	Grayish brown (10YR 5/2 m) gravelly sandy loam; single grain; loose; few fine roots; clear, smooth lower boundary; 7 to 10 cm thick; pH 7.6.
VICk	79-100	Pale brown (10YR 6/3 m) silt loam; amorphous; friable; few fine roots; clear, smooth lower boundary; 20 to 22 cm thick; pH 7.6.
VIICk	100-135+	Pale brown (loYr 6/3 m) silt loam; amorphous; friable; few fine roots; pH 7.7.

Special features: Fungal mycelia common in III Ckbl and V Ck horizones; note buried horizons.

Additional Map Delineations

1. Terraces

Athabasca Terrace Mapping Unit, (AT2), general characteristics as follows:

Landform: Fl, Ft, very gently sloping or gently undulating

Parent materials: slightly cobbly loamy fine sand to fine sandy loam/calcareous extremely cobbly coarse sand and gravel.

Dominant Soils

Subgroup - Orthic Eutric Brunisols

Texture - Loamy fine sand

Drainage - Rapid

Representative Vegetation:

Type: Pinus contorta - Juniperus communis - Arctostaphylos uva-ursi.

Physiognomy: Lodgepole pine forest.

Inclusions:

Soils: Orthic and Cumulic Regosols, fine sandy loam; slightly mottled (located in shallow, elonate depressions).

Vegetation: Pinus contorta - Picea glauca - feathermoss (same locations)

2. Floodplain

Athabasca Floodplain Mapping Unit (AP1)

Landform: Fp - level to very gently sloping.

Parent materials: variable non-calcareous to calcareous silt to silty sand (Cobbles at 90 cm+).

Dominant Soils:

Subgroup - Gleyed Cumulic Regosols

Texture - silt

Drainage - Imperfect, as a result of periodic inundation. Probably also some effect of seepage from adjacent fan at this location.

Representative Vegetation:

Type - Carex spp. - Pedicularis groenlandicum - Polygonum viviparum.

Physiognomy - Sedge meadow with scattered black spruce.

Chemical and physical analyses follows:

APPENDIX I (Continued)

CHEMICAL AND PHYSICAL ANALYSES OF REPRESENTATIVE PROFILES

Horizon	Depth CM	pH KCl	Chemical Analyses: Total Nitrogen %	Total Carbon %	Inorg. Carbon %	Organic Carbon %	$CaCO_3$ Equiv. %	C/N	Particle-Size Analysis: Sand %	Silt %	Clay %	Fine Clay %	Texture Class
						Profile No. 5006							
LFH	4-0	6.2	-	34.29	-	34.29	0.0	-	-	-	-	-	-
Ae	0-0.5	-	-	-	-	-	-	-	-	-	-	-	-
Bm	0.5-4	7.0	-	2.67	0.34	2.33	2.8	-	18	64	18	4	Silt Loam
Ck	4-12	7.3	-	4.62	2.83	1.79	23.6	-	46	42	12	2	Loam
Hb	12-13	-	-	-	-	-	-	-	-	-	-	-	-
Bmb	13-21	7.5	-	4.43	2.89	1.54	24.1	-	20	64	16	3	Silt Loam
Ckb	21-33	7.6	-	4.63	1.78	2.85	14.8	-	3	72	25	4	Silt Loam
ABCkb1	33-60	7.7	-	3.11	1.97	1.14	16.4	-	16	62	22	3	Silt Loam
ABCkb2	60-78	7.7	-	3.51	2.85	0.66	23.8	-	6	69	25	4	Silt Loam
ABCkb3	78-110	7.8	-	3.71	2.88	0.83	24.0	-	4	63	33	7	Silt Loam
IIABCkb	110+	-	-	-	-	-	-	-	-	-	-	-	-
						Profile No. 5007							
LFH	5-0	6.2	-	28.04	-	28.04	0.0	-	-	-	-	-	-
Bm	0-2	-	-	-	-	-	-	-	-	-	-	-	-
Ck1	2-17	7.3	-	-	3.35	-	29.2	-	57	31	12	2	Sandy Loam
Ck2	17-100	7.4	-	-	4.02	-	33.5	-	49	37	14	2	Loam
IIHBC	100-130+	7.6	-	8.29	1.96	6.33	15.0	-	25	55	20	3	Silt Loam
						Profile No. 5008							
LFH	2-0	5.7	1.18	36.48	-	36.48	0.0	31	-	-	-	-	-
Bm	0-4	-	-	-	-	-	-	-	-	-	-	-	-
Ae	4-10	6.3	-	1.10	-	1.10	0.0	-	13	68	19	3	Silt Loam
Bt	10-15	6.9	-	0.85	0.20	0.65	2.0	-	7	61	32	6	Silty Clay Loam
Ck	15-38	7.2	-	3.19	2.27	0.92	18.9	-	7	60	33	6	Silty Clay Loam
IIC	38-44	7.3	-	0.71	0.23	0.48	1.7	-	22	73	5	-	Silt Loam
IIIBmkb	44-50	7.5	-	0.94	0.44	0.50	6.4	-	5	63	32	6	Silty Clay Loam
IVCk	50-70	7.6	-	-	4.60	-	-	-	67	26	7	1	Sandy Loam
VCk	70-79	7.6	-	-	1.88	-	-	-	32	51	17	4	Silt Loam
VICk	79-100	7.7	-	-	2.20	-	-	-	31	55	14	?	Silt Loam
VIICk	100-135+	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX I (Continued)

AVAILABLE NUTRIENTS IN REPRESENTATIVE PROFILES

Horizon	Depth Cm	Parts per million Nitrogen (N)	Phosphorus (P)	Potassium (K)
		Profile No. 5006		
LFH	4-0	4	54	245
Bm	0.5-4	5	2	65
Ck	4-12	18	0	53
Bmb	13-21	8	0	64
		Profile No. 5007		
LFH	5-0	22	46	258
Ck	2-17	19	0	70
		Profile No. 5008		
LFH	2-0	4	26	186
Ae	4-10	3	1	99
Bt	10-15	4	0	140
Ck	15-38	5	0	88

Appendix 2

Detailed Forest Cover Type Descriptions

VEGETATION TYPE:
Riverine
Picea/Potentilla/Carex

STAND DESCRIPTION
(VEGETATION RELEVE)

PLOT No.: GTK-1

General description

Floodplain of Athabasca River bouning the base of an alluvial fan. Groundwater seepage in the form of well developed springs break from the toe of the fan, irrigates this unit and provides for a saturated moisture regime.

An deposition of materials is re. d through flooding by the At: sca River.

This unit is bounded by cobbly materials occupying the more active deposition areas of the river bed - Surface soil textures at K-1 are coarse silty.

Observer: G. Trottier
Date: Aug 12, 1975
Plot size: 20 m X 20 m
Location: Mt. Kerkeslin Campground JNP
Latitude: N
Longitude: W

N.T.S. Map:
U.T.M. Grid Reference:
Air Photo No.: A20888-52
Land System:
Land Type:
Landform: Floodplain

Physiography & Edatope

Elevation: 3929'
Slope: 0 Aspect: 0
Topographic situation: Level plain
Microtopography: level (hummocky at some sites
Parent material: Alluvium
Soil: Regosol
Moisture regime: D6
Snow: Permafrost:
Water/running: stagnant:
Nearby water body/kind: River
distance to: adjacent
Erosion: Mostly deposition
Nearby disturbances: camping trampling

Other remarks:

Vegetation structure

General physiognomy:

Fosberg's vegetation code:

Stratum	Coverage	Height range	Total
A: tree	A_1 1.0 %	(5m - 9m)	2.0 %
	A_2 1.0 %	(1m - 5m)	
B: shrub	B_1 0 %	(5m - 2m)	5.0 %
	B_2 5.0 %	(<2m)	
C: herb	C_h 90.0 %	(herbaceous)	91.0 %
	C_w 1.0 %	(dwarf shrub)	
D: moss	D_b 2.0 %	(mosses)	3.0 %
	D_1 1.0 %	(lichens)	

E: epiphytes:
abundant ____ moderate ____ scarce X

Ground covered by: humus 5.0% decayed wood - %
rocks & stones <1.0 % mineral soil 25.0 %
basal area ? % water ____ % others ____ %

Regeneration:
strong ____ moderate ____ weak X
by Picea mariana, Pinus contorta

Successional stage: Flooding disclimax

PLOT K-1 DATE Aug12-13 OBSERVER G. Trottier

LAYER	SPECIES	CV	LAYER	SPECIES	CV
A1	*Picea glauca*		Ch	*Poa pratensis*	+
(A2)	*Picea mariana*			*Trisetum spicatum*	+
	Pinus contorta				
	Populus balsamifera			*Anemone drummondii*	1
	Populus tremuloides			*Anemone parviflora*	+
				Antennaria pulcherrima	+
B2	*Betula pumila* var. *glandulifera*	2		*Arabis* sp.	+
				Aster sp.	+
	Juniperus communis	1		*Braya humilis*	+
	Ledum groenlandicum	2		*Campanula rotundifolia*	+
	Potentilla fruticosa	2		*Castilleja minata*	+
	Salix sp.			*Castilleja septentrionalis*	+
	Salix sp.				
	Salix glauca	1		*Epilobium angustifolium*	+
	Salix sp.			*Epilobium latifolium*	+
	Salix sp.			*Equisetum laevigatum*	1
	Shepherdia canadensis	1		*Equisetum pratense*	1
	Agropyron riparium	+		*Equisetum scirpoides*	1
	Calamagrostis neglecta	1		*Fragaria virginiana*	+
	Carex aurea	2		*Gallium boreale*	1
	Carex capillaris	1		*Gentianella amarella*	+
	Carex coccina	+		*Geocaulon lividum*	+
	Carex flava	2		*Habenaria hyperborea*	+
	Carex pauciflora	+		*Hedysarum alpinum*	1
	Carex rostrata	1		*Lilium philadelphicum*	+
	Carex scirpoidea	+		*Labelia kalmii*	+
	Carex spengellii	+		*Lycopodium annotinum*	+
	Carex vaginata	1		*Parnassia parviflora*	1
	Danthonia intermedia	1		*Pedicularis groenlandica*	1
	Deschampsia caespitosa	2		*Petasites palmatus*	+
	Eleocharis panciflora	2		*Pinguicula vulgaris*	+
	Elymus innovatus	+		*Polygonum viviparum*	+
	Eriophorum angustifolium	1		*Prunella vulgaris*	+
	Eriophorum scheuchzeri	1		*Pyrola asarifolia*	+
	Glyceria striata	+		*Saxifraga aizoides*	+
	Juncus albescens	+		*Senecio pauperculus*	+
	Juncus balticus	1		*Sisyrinchium montanum*	+
	Juncus bufonis	+		*Smilacina stellata*	+
	Juncus scirpoidea	1			
	Juncus tracyi	+			

CV: Coverage class 5: 100-76%, 4: 75-51%, 3: 50-26%, 2: 25-6%, 1: 5-1%, +: less than 1%.

PLOT K-1 DATE Aug 12/75 OBSERVER P2 of 2

LAYER	SPECIES	CV	LAYER	SPECIES	CV
Ch	*Solidago decumbens*	+			
	Solidago multiradiata	+			
	Triglochin palustris	+			
	Tofieldia glutinosa	1			
	Tofieldia pusilla	1			
	Zygadenus elegans	1			
Cw	*Arctostaphylos rubra*	1			
	Arctostaphylos uva-ursi	2			
	Dryas integrifolia	+			
	Juniperus horizontalis	1			
	Linnaea borealis	+			
	Rosa woodsii	1			
	Vaccinium caespitosum	1			

CV: Coverage class 5: 100-76%, 4: 75-51%, 3: 50-26%, 2: 25-6%, 1: 5-1%, +: less than 1%.

VEGETATION TYPE:
Mixedwood
Picea/Pinus/Populus

STAND DESCRIPTION
(VEGETATION RELEVE)

PLOT No.:
1. IC5006
2. GTK-2

Observer: G. Trottier & Ian Corns
Date: Aug. 14/75
Plot size: 20 m X 20 m
Location: Mt. Kerkeslin camgroundJNP
Latitude: N
Longitude: W

N.T.S. Map:
U.T.M. Grid Reference:
Air Photo No.: A20888-52
Land System:
Land Type:
Landform: Toe-alluvial fan

General description

- Fire successional site having an optimal mix of closed and open crown. Deadfall is minimal but microtopography is somewhat uneven.
- Red squirrel middens abundant.
- Slightly further downslope crown cover and stocking rate are greater thus limiting understory growth to a few mosses and scattered forbs.
- Aspen regeneration and B2 Salix understory is dying in response possible to either shading and/or ungulate utilization of young aspen regeneration.

	Stocking Rate*	Basal area[1]
WS	40	25.1
bS	40	9.1
lP	110	52.7
Ap	360	60.0
	550	146.9

*Stems per acre

[1]square ft. per acre.

Physiography & Edatope

Elevation: 3938'
Slope: 8% Aspect: 270°W
Topographic situation: Toe of alluvial fan
Microtopography: uneven
Parent material: alluvium
Soil:
Moisture regime: D2
Snow: - Permafrost: -
Water/running: - stagnant: -
Nearby water body/kind: Athabasca R.
distance to: 70m - 150m
Erosion: -
Nearby disturbances: Former horse grazing
Other remarks: ungulate foraging
Age determination:

Vegetation structure

General physiognomy: B5

Fosberg's vegetation code:

Stratum	Coverage	Height range	Total	IC5006
A: tree	A_1 35 %	(15m - 21m)	36 %	35
	A_2 1 %	(2m - 5m)		
B: shrub	B_1 1 %	(5m - 2m)	5 %	4
	B_2 4 %	(<2m)		
C: herb	C_h 50 %	(herbaceous)	55 %	25
	C_w 5 %	(dwarf shrub)		
D: moss	D_b 10 %	(mosses)	10 %	37
	D_1 T %	(lichens)		

E: epiphytes:
abundant ____ moderate ____ scarce X

Ground covered by: humus 100 % decayed wood 5 %
rocks & stones - % mineral soil - %
basal area ____ % water ____ % others ____ %

Regeneration:
strong X moderate ____ weak ____
by Picea glauca, Abies lasiocarpa, Populus tremuloides

Successional stage: Immature spruce forest

PLOT IC5006 GTK2 DATE Aug14/75 OBSERVER I. Corns IC5006 G. Trottier GTK-2

LAYER	SPECIES	CV
A1(A2)	*Picea glauca*	2
(A2)	*Picea mariana*	2
A1(A2)	*Pinus contorta* var. *latifolia*	2
(A2)	*Populus balsamifera*	+
(A2)	*Populus tremuloides*	2
B1	+ *Abies lasiocarpa*	+
B2	*Juniperus communis*	+
	Lonicera dioica	+
	Lonicera involucrata	1
	Rosa acicularis	1
	Shepherdia canadensis	+
	Viburnum edule	+
Ch	*Carex siccata*	+
	Elymus innovatus	2
	Trisetum spicatum	+
	Antennaria sp.	+
	Achillea millefolium	+
	Aster ciliolatus	+
	Aster conspicuus	1
	Astragalus frigidus var. *americanus*	+
	Castilleja miniata	+
	Chimaphilla umbellata	+
	Corallorhiza trifida	+
	Equisetum arvense	+
	Fragaria virginiana	+
	Galium boreale	+
	Gentianella amarella	+
	Habenaria obtusata	1
	Hedysarum sulfurescens	+
	Lathyrus ochroleucus	+
	Lilium philadelphicum	+
Ch	*Pestasites palmatus*	1
	Pyrola asarifolia	1
	Pyrola secunda	2
	Smilacina stellata	+
	Solidago multiradiata	+
	Taraxacum officinale	+
	Vicia americana	+
	Zygadenus elegans	+
	Trifolium hybridum	+
CW	*Arctostaphylos uva-ursi*	+
	Linnaea borealis	3
	Cornus canadensis	1
Db	*Dicranum* spp.	+
	Hylocomium splendens	+
	Pleurozium schreberi	1
	Polytrichum commune	+
	Ptilium crista-castrensis	1
D1	*Cladonia* sp.	+
	Peltigera aphthosa	1

CV: Coverage class 5: 100-76%, 4: 75-51%, 3: 50-26%, 2: 25-6%, 1: 5-1%, +: less than 1%.

VEGETATION TYPE:
Aspen
Populus/Picea/Elymus

STAND DESCRIPTION
(VEGETATION RELEVE)

PLOT No.:
1. IC5007
2. GTK-3

General description

Relatively open forest stand gently sloping. Some deadfall of small diameter attributable to aspen and willow.

Some scarring of the aspen trunks by ungulates - most evidence is old.

Pellet groups are scarce indicating light use by elk.

Area was previously grazed by horses and litter is sparse.

Aspen regeneration not obviously browsed by ungulates thereby suggesting light winter use or unavailability due to depth of snow.

	Stocking Rate*	Basal Area[1]
Ap live	480	91.8
Ap dead	120	
WS	30	6.9
	630	98.7

*Stems per acre

[1]square ft per acre

Observer: G. Trottier, Ian Corns
Date: Aug. 14/75
Plot size: 20 X 20 m^2
Location: Mt. Kerkeslin campground JNP
Latitude: N
Longitude: W

N.T.S. Map:
U.T.M. Grid Reference:
Air Photo No.: A20888-52
Land System: Athabasca Valley
Land Type:
Landform: Alluvial fan

Physiography & Edatope

Elevation: 3950'
Slope: 75.% Aspect: 270°W
Topographic situation:
Near toe of alluvial fan
Microtopography: level
Parent material: Alluvium
Soil: Regosol
Moisture regime: D2
Snow: ____ Permafrost: ____
Water/running: ____ stagnant: ____
Nearby water body/kind: ____
distance to: ____
Erosion: ____
Nearby disturbances: Former horse ~~grazing~~

Other remarks:

Vegetation structure

General physiognomy:
Open Aspen Forest
Fosberg's vegetation code: [ ][ ][ ][ ][ ]

Stratum	Coverage	Height range	Total	IC5007
A: tree	A_1 15 %	(16m - 21m)	16 %	20%
	A_2 1 %	(5m - 15m)		
B: shrub	B_1 1 %	(2m - 5m)	1 %	4%
	B_2 <1 %	(<2m)		
C: herb	C_h 40 %	(herbaceous)	45 %	40%
	C_w 5 %	(dwarf shrub)		
D: moss	D_b + %	(mosses)	<1 %	5%
	D_1 + %	(lichens)		

E: epiphytes:
abundant ____ moderate ____ scarce X

Ground covered by: humus 100 % decayed wood 3 %
rocks & stones ____% mineral soil ____%
basal area ____% water ____% others ____%

Regeneration:
strong ____ moderate X weak ____
by Picea glauca, Pinus contorta, Populus tremuloides

Successional stage: Seral to Spruce

PLOT IC5007 K-3 DATE Aug14/75 OBSERVER I. Corns. IC5007 G. Trottier. GTK-3

LAYER	SPECIES	CV	LAYER	SPECIES	CV
A1	*Picea glauca*	1			
	Pinus contorta var. *latifolia*	+			
	Populus tremuloides	2			
B1	*Salix* sp.	1			
B2	*Juniperus communis*	1			
	Shepherdia canadensis	1			
	Lonicera dioica	+			
Ch	*Carex siccata*	1			
	Elymus innovatus	3			
	Achillea millefolium	+			
	Antennaria pulcherrima	+			
	Aster conspicuus	1			
	Astragalus frigidus var. *americanus*	+			
	Castilleja miniata	+			
	Corallorhiza trifida	+			
	Fragaria virginiana	1			
	Galium boreale	+			
	Gentianella amarella	+			
	Hedysarum sulfurescens	1			
	Lathyrus ochroleucus	1			
	Oxytropis deflexa	+			
	Senecio sp.	+			
	Smilacina stellata	+			
	Solidago multiradiata	+			
	Taraxacum officinale	+			
	Trifolium repens	1			
	Vicia americana	1			
	Viola adunca	+			
	Arctostaphylos uva-ursi	1			
	Linnaea borealis	1			
	Rosa acicularis	+			

CV: Coverage class 5: 100-76%, 4: 75-51%, 3: 50-26%, 2: 25-6%, 1: 5-1%, +: less than 1%.

VEGETATION TYPE:
PINE
Pinus-Picea/Shepherdia-Elymus/Moss

STAND DESCRIPTION
(VEGETATION RELEVE)

PLOT No.:
IC 5008

Observer: Ian Corns
Date: July 3, 1975
Plot size:
Location: Horse corral behind Kerkeslin campground
Latitude: N
Longitude: W

N.T.S. Map:
U.T.M. Grid Reference:
Air Photo No.: A20888-52
Land System:
Land Type:
Landform: Alluvial Fan (Terraces)

General description

'en aged stand succeding to white uce climax. Spruce is regener- ng well. Sparse shrub understory, ierb layer is well developed. This site is moister than the previous sample sites in the Aspen and Mixedwood types. Appears to have been fire through here since the area was logged. Stand is even aged and of fire origin.

TREES CORED

	Ht	DBH	AGE
1P	67'	19.5	78
wS	70'	22.9	79

Physiography & Edatope

Elevation: 3943 ft
Slope: 2% Aspect: West
Topographic situation: SB
Microtopography: 20cm
Parent material:
Soil:
Moisture regime: Mod. well drained
Snow: Permafrost:
Water/running: stagnant:
Nearby water body/kind: Athabasca R.
distance to: 50m
Erosion: Neg.
Nearby disturbances: horse grazing

Other remarks:

For several years this area was enclosed for grazing horses. Some browsing by ungulates.

Vegetation structure

General physiognomy:

Fosberg's vegetation code:

Stratum	Coverage	Height range	Total
A: tree	A_1 40 %	(15m - 22m)	42 %
	A_2 2 %	(5m - 15m)	
B: shrub	B_1 - %	(2m - 5m)	5 %
	B_2 5 %	(<2m)	
C: herb	C_h 30 %	(herbaceous)	35 %
	C_w 10 %	(dwarf shrub)	
D: moss	D_b 70 %	(mosses)	70 %
	D_1 + %	(lichens)	

E: epiphytes:
abundant ____ moderate ____ scarce X

Ground covered by: humus 100 % decayed wood 8 %
rocks & stones 0 % mineral soil 0 %
basal area ____ % water 0 % others 0 %

Regeneration:
strong ____ moderate X weak ____
by White and black spruce, Aspen

Successional stage: early secondary

PLOT IC 5008 DATE July 3, 1975 OBSERVER Ian Corns

LAYER	SPECIES	CV	LAYER	SPECIES	CV
A1	*Pinus contorta* var. *latifolia*	3	Db	*Dicranum* sp.	+
				Hylocomnium splendens	3
A2	*Picea glauca*	1		*Pleurozium schreberi*	5
	Picea mariana	1			
	Populus tremuloides	+			
B2	*Rosa acicularis*	1			
	Shepherdia canadensis	1			
	Viburnum edule	+			
Cw	*Arctostaphylos uva-ursi*	+			
	Juniperus communis	1			
	Juniperus horizontalis	+			
	Linnaea borealis	2			
	Lonicera dioica	1			
	Ribes oxycanthoides	+			
Ch	*Elymus innovatus*	2			
	Aster ciliolatus	+			
	Aster conspicuus	1			
	Astragalus sp.	+			
	Calypso bulbosa	+			
	Cornus canadensis	1			
	Epilobium angustifolium	+			
	Fragaria virginiana	+			
	Habenaria hyperborea	+			
	Habenaria obtusata	+			
	Lathyrus ochroleucus	1			
	Oxytropis sp.	+			
	Pyrola asarifolia	+			
	Pyrola secunda	+			
	Solidago sp.	+			
	Vicia americana	+			

CV: Coverage class 5: 100-76%, 4: 75-51%, 3: 50-26%, 2: 25-6%, 1: 5-1%, +: less than 1%.

Appendix 3

Small Mammals Collected In The Mt. Kerkeslin Campground Area, 1975

Order Insectivora

Family Soricidae

Sorex cinereus Masked Shrew

Order Rodentia

Family Sciuridae

Tamiasciurus hudsonicus Red Squirrel

Glaucomys sabrinus Northern Flying Squirrel

Family Cricetidae

Peromyscus maniculatus Deer Mouse

Clethrionomys gapperi Red-backed Vole

Microtus longicaudus Long-tailed Vole

Microtus pennsylvanicus Meadow Vole

Family Zapodidae

Zapus princeps Western Jumping Mouse

Appendix 4

Results of Call-count Transects For Birds In The Bow Valley Of Banff, 1975

Table 10. Estimated numbers of breeding pairs encountered per 500 metres of call-count transects in the Bow Valley of Banff, 1975.

Transect number	Aspen forest		Mixedwood			Pine/shepherdia		
	1-HD1	1-DU1	1-HD2	1CA1	2CA1	1-BK1	2BK1	3BK1
Kestrel		1						
Ruffed Grouse	1							
Spruce Grouse						1		
Northern Flicker		1	1					
Pileated Woodpecker			1					
Downy Woodpecker		1						
Least Flycatcher		3						
Western Wood Pewee		1						
Gray Jay			1	1		1	2	1
Boreal Chickadee				1		2	1	2
Black-capped Chickadee		1						
Red-breasted Nuthatch						1		
American Robin	3	3	1	1	2		1	
Townsend's Solitaire	1							
Swainson's Thrush	1	1		2	4	4	3	3
Ruby-crowned Kinglet			1	2	2			
Golden-crowned Kinglet				1	1			
Cedar Waxwing		1						
Red-eyed Vireo		1						
Warbling Vireo	1	5						
Tennessee Warbler	1		1					
Orange-crowned Warbler	3		1					
Yellow-rumped Warbler			2		2	2	2	1
Townsend's Warbler			2	2	5			
Western Tanager	1							
Brown-headed Cowbird		1						
Dark-eyed Junco	3	2	3	1	2	2	2	5
Chipping Sparrow	1	2	2	2	1		1	2
White-crowned Sparrow	1							
Long-eared Owl*			1					
Raven*		1						
Pine Siskin*	1	1	2		1	1		4
Red Crossbill*								9
White-winged Crossbill*						6		
Crossbill, species uncertain*						2	3	

Numbers for each species indicate breeding pairs.

*Numbers indicate individuals rather than breeding pairs because these species may not have been breeding at the time of survey.