ECOLOGICAL LAND CLASSIFICATION OF CARSON-PEGASUS PROVINCIAL PARK

Prepared for:

Alberta Environment
Northern East Slopes Region
Edson, Alberta

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EXECUTIVE SUMMARY

This Ecological Land Classification (ELC) for Carson-Pegasus Provincial Park was commissioned by Alberta Environment. The study area encompassed the entire park and is situated within the Foothills Natural Region with portions of the Park straddling both the Upper and Lower Foothills Subregion. The majority of park is found in the Lower Foothills Subregion and totals approximately 1,209 ha (2,987 acres) in area.

Recently, Alberta Environment has indicated that future development within the park is under consideration. Increased recreational and industrial development has demanded a requirement for an ecological land classification inventory concurrent with a significant ecological and ethnohistorical/archaeological features, sensitive features, and disturbance features identification. In support of management initiatives, the specific objectives of the project were:

- To conduct an ELC at the ecosite hierarchical level (1:20 000) for the purpose of identifying and describing vegetation community types, at field observation sites, and integrate these community types into maps and reports.
- To identify and describe significant ethnohistorical / archaeological, significant ecological, sensitive, and disturbance features at field observation sites and integrated this information into a report and map.
- To identify and describe the history of the project area and to describe the history of the surrounding area.
- To complete field forms: Site Description Form (LISD 15B, Rev.1/97), Vegetation Description Form (LISD 14B, Rev.1/97), Soil Description Form (LISD 16B, Rev.1/97), and Rare Native Plant Survey; and provide digital files of the data from the field forms (AEP 1997).
- To provide GIS ARC/INFO files and 1:10 000 scale hardcopy maps of the ELC, significant ecological features, sensitive features, and disturbance features.
- To provide a summary report according to specifications outlined in the Terms of Reference.

Field work was conducted during August 17-21/1998 from which 21 detailed forms and 20 visual forms were completed in compliance with the guidelines set forth by AEP (1994) in *Ecological Land Survey Site Description Manual*.

Twenty-one vegetation communities were identified throughout the park based on vegetative composition and landscape attributes that influence vegetation community development. Predominant overstorey consists primarily of aspen – white spruce – lodgepole pine with quite a diverse variation in the understorey. Wetlands consist mostly of either beaked sedge/water sedge-cattail or swamp horsetail-great bulrush. The above vegetation communities provide habitat for a variety of wildlife species within Carson-Pegasus Provincial Park. As many as 161 bird, 45 mammal, 8 fish, and 7 herpetile species are known or expected to occur within or adjacent to the park. Included in this list are several temporary and permanent residents of the park that have been identified as requiring special management attention by Alberta Environment and COSEWIC. Mammal species, such as gray wolf, cougar, lynx, and fisher as well as birds species, such as osprey, bald eagle, great gray owl, and great blue herons are all known to occur within the park. Uniquely, the park is resident to a significant nesting colony of great blue herons.

In addition to the ELC, literature reviews and interviews with park experts have attempted to ascertain the ethnohistorical / archaeological significance of the park which has been detailed within the report. Additionally, this project has identified and mapped numerous types of significant ecological features, including 5 regional sites and 8 locally significant sites. Significant features such as, McLeod Lake, Little McLeod Lake, rare/significant native plants, and an old-growth stand of balsam fir contribute to the list of attractive features found throughout the park.

Additionally, the entire park was interpreted and mapped for sensitive and disturbance features indicating areas that require both special management attention and increased mitigative measures for impacts.

The critical balance between recreational use, industrial development, and habitat conservation has been effectively achieved through Carson-Pegasus Provincial Park. Ideally, this ELC should assist in management initiatives as a source of park information that both industry and government agencies can use to highlight potential areas of concern.

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1 INTRODUCTION

1.1 Project Objectives

The purpose of this project, as outlined and commissioned by Alberta Environment, Edson, was to use existing and new information to conduct an Ecological Land Classification for Carson-Pegasus Provincial Park. The objectives of this report will include:

- ECOLOGICAL LAND CLASSIFICATION
  To conduct an ELC at the ecosite hierarchical level (1:20 000) for the purpose of identifying and describing vegetation community types, at field observation sites, and integrate these community types into maps and reports.

- SIGNIFICANT ETHNOHISTORICAL / ARCHAEOLOGICAL, SIGNIFICANT ECOLOGICAL, SENSITIVE, AND DISTURBANCE FEATURES
  To identify and describe significant ethnohistorical / archaeological, significant ecological, sensitive, and disturbance features at field observation sites and integrate this information into a report and map.

- HISTORY
  To identify and describe the history of the project area and to describe the history of the surrounding area.

- ECOLOGICAL FIELD FORMS
  To complete field forms: Site Description Form (LISD 15B, Rev.1/97), Vegetation Description Form (LISD 14B, Rev.1/97), Soil Description Form (LISD 16B, Rev.1/97), and Rare Native Plant Survey; and provide digital files of the data from the field forms.

- CARTOGRAPHY / GIS
  To provide GIS ARC/INFO files and 1:10 000 scale hardcopy maps of the ELC, significant ecological features, sensitive features, and disturbance features.

- PROJECT REPORT

1.2 Location and Extent of the Study Area

The study area for the Carson-Pegasus ELC coincides with the boundary of Carson-Pegasus Provincial Park which is located 27 km north of Whitecourt, Alberta and east, off Highway 32 (Figures 1 and 2). The park's legal description is Township 61 Ranges 11,12, West of the 5th meridian (54^{o}18'N 115^{o}39'W) and is located on 1:50000 NTS mapsheet 83J/5. Currently the park is situated within the Foothills Natural Region with portions of the Park straddling both the Upper and Lower Foothills Subregion (Figure 3). The total area of the park is approximately 1,209 ha (2,987 acres). The majority of the park is contained within the Lower Foothills Subregion, however a small portion of the Upper Foothills is represented by the park. The approximated boundary between the Upper and Lower Foothills Subregions runs east-west through the park slightly north of McLeod Lake and south of Little

McLeod Lake. Uniquely, the park is found within 27 km of the Central Mixedwood Subregion of the Boreal Forest, therefore, to some extent, the park contains representative features of all 3 subregions.

Figure --------------: Map of Study Area Location

Figure: Natural Regions Map

2 STUDY AREA DESCRIPTION

2.1 History, Land Use, and Management

Carson-Pegasus Provincial Park is situated in a gently rolling forested landscape in the central foothills of Alberta. Circa 1970, the area was named after the lakes found in the park, presumably after a fur trader named Archibald Norman McLeod, of the North West Company (MacGregor 1952). At a later date, the name changed to Carson Lake from which it eventually reverted back to McLeod Lake in the mid-1980s. Notably, nearby Little McLeod Lake was formerly known as Pegasus Lake, presumably in reference to the Pegasus symbol used by local Mobil Oil of Canada Ltd. which leases much of the land in the drainage basin (Mitchell and Prepas 1990). In 1982, the Alberta Provincial Government formally established the area as Carson-Pegasus Provincial Park, from which prior to that date the campground and facilities were operated by the Alberta Forest Service.

Historically, the area was inhabited by several First Nation communities, including the Stoney, Woodland Cree, and possibly Bear Indian Nations. The lakes and surrounding area provided abundant resources for the local peoples and allowed for the First Nations to inhabit the area. Currently, there are several known prehistoric sites that occur within the park.

Within this century, much of the area, now designated as Carson-Pegasus Provincial Park, has experienced industrial activities leaving very little of the park area to be classified as pristine habitat. Forest harvesting began in the early 1900s and selective logging continued through the 1940s (Olecko 1974, Finlay and Finlay 1987). In 1956, oil and gas was discovered within the park and adjacent areas, and the park is now dissected with many roads, pipelines, and cutlines from oil and gas exploration. From the period of 1942 to 1963, McLeod Lake was commercially fished. At present, oil and gas activities persist within the park under continued subsurface lease dispositions. All of the subsurface dispositions for oil and gas in the watershed belongs to either Mobil Oil of Canada Ltd. or, secondarily, to Imperial Oil. Mobil Oil is licensed to withdraw water from Little McLeod Lake while Imperial Oil is licensed to withdraw water from McLeod Lake (AEP 1996a, Mitchell and Prepas 1990). Ranchmens, Highridge, and Tarragon all have dispositions on the east side of the park (AEP 1996a). Thus, water pumping stations are found on the northern and western edges of McLeod and Little McLeod Lakes, respectively. Based on a 1996 park Management Plan, oil and gas activities within the park are restricted to 6 wellsites, 11 pipelines, 2 easements, 2 water pumping stations, 2 rights-of-entry, and one license of occupation. In addition to the oil and gas activities, the park is open year-round to recreationalists, providing opportunities for hiking, camping, motor boating, cross-country skiing, snowshoeing, and fishing. The purpose, as outlined in the Management Plan (AEP 1996a) for the park has been defined as follows:

> **"To protect a diversity of landscapes and associated plants and animals typical of the Lower Foothills Subregion, to provide opportunities for visitors to experience, understand, and appreciate this natural heritage, and to accomodate compatible outdoor recreation and tourism activities."**

Adjacent to park boundaries, Millar Western Industries and Ranger Forest Products hold land dispositions (AEP 1996a). Areas north and east of the park are harvested by Ranger Forest Products, while the area west and south of the park are harvested by Millar Western.

2.2 Climate

On a larger scale, the mean annual precipitation for the Lower Foothills Subregion ranges from 285 to 756 mm with an average of about 465 mm, with 66% falling between May and September. From east to west and from south to north, there are increases in precipitation in the Lower Foothills Subregion. The mean May – September temperature ranges from 11 – 13°C with a mean summer temperature of 12.8°C. Winter temperatures average –7.8°C with minimum temperatures reaching –39°C in January through March (Achuff 1992, Strong 1992).

The Upper Foothills Subregion has the highest summer precipitation in Alberta ranging from 208 to 504 mm and has a mean annual precipitation range of 538 mm (Strong and Leggat 1992). The mean May – September temperature is about 10 – 12°C. Winters are generally colder in the Upper Foothills compared to the Lower Foothills Subregion. Average winter temperatures of –6.0°C and a mean period of snow cover at about 140 days and a mean maximum depth of approximately 50 cm and greater (Achuff 1992, Strong 1992).

Although no climate information or climate monitoring stations exist for the park, climate data for Carson-Pegasus Provincial Park has been adapted from Canadian Climate Normals 1961-90 by Environment Canada (1993). A summary of climatic elements data from various stations in the Whitecourt and Swan Hills area have been presented in Table 1 (Environment Canada 1993).

Table 1: Summary of Climate Station Data for the Whitecourt – Swan Hills Area

Station	Ecoregion	Lat. N	Long. W	Elev (m)	Precip. May-Aug (mm)	Degree Days Above 5°C (May-Aug)	Mean Temp May-Aug (°C)	Mean Temp. June-July (°C)
Whitecourt LO	Lower Foothills	54° 02'	115° 43'	1201	391.9	842.5	11.7	12.8
Eagle LO	Lower Foothills	54° 28'	116° 25'	1042	399.3	842.6	11.8	13.1
Swan Dive LO	Upper Foothills	54° 44'	115° 13'	1272	400.0	820.2	11.4	12.7
Goose Mountain LO	Upper Foothills	54° 45'	116° 04'	1402	458.4	-	10.4	11.7
Tom Hill LO	Upper Foothills	53° 56'	116° 20'	1295	361.3	826.8	11.6	12.7

Based on the information provided by these sources, it is anticipated that the climatic elements in most of Carson-Pegasus Provincial Park will reflect the descriptions of the Lower Foothills Subregion. However, the portions of the park found in the Upper Foothills Subregion will experience slightly greater annual precipitation (both summer and winter) and colder temperature. Throughout the Foothills, increases in precipitation are experienced from both east to west and south to north (Strong and Leggat 1981, Strong 1992, Achuff 1992, Semenchuk 1992, AEP 1996b). Therefore, portions of Carson-Pegasus Provincial Park may experience slight variations in precipitation following this pattern.

2.3 Topography

Topography refers to the relief and contours of the land, including the percent slopes associated with the landforms. Carson-Pegasus Provincial Park is situated within the Southern Alberta Uplands physiographic region and the Swan Hills Upland physiographic section of Alberta (Pettapiece 1986). The park is characterized by moderate to high relief hummocky and ridged topography with level to nearly level wetland depressions (0-2% slopes) scattered throughout the area.

The southwestern corner of the park is dominated by local undulating and low relief hummocky landforms with slopes ranging from 2-5%. Depressions occur within these landforms but are less significant than other areas of the park. The south and southeastern portions of the park are dominated by moderate relief hummocky landforms with slopes ranging from 5-30%. Depressions are common and may occupy up to 20% of these areas. The eastern and northern portions of the park are dominated by high relief hummocky and ridged landscapes with slopes ranging from 15-45%. Wetlands are less common in these areas, mostly restricted to the drainage ways between the hills and ridges. The west and northwestern portions of Carson-Pegasus Provincial Park are dominated by large, nearly level wetlands with slopes ranging from 0-2%. These areas also contain significant amounts of moderate relief hummocky landforms with slopes ranging from 5-30%.

2.4 Surficial Geology

Soils in Carson-Pegasus Provincial Park have developed mainly on materials of glacial origin and a small proportion occur on materials that have been deposited in recent geological times (i.e., since the retreat of the last glaciers). Information about glacial geology is available from the map ‘Quaternary Geology, Central Alberta’ by Shetsen (1990). The following summarizes the characteristics of the surficial materials occurring in the park.

Glacial till (moraine) is dominantly unsorted and unstratified drift deposited directly by and underneath a glacier. It consists of a heterogeneous mixture of clay, silt, sand, gravel and boulders ranging widely in size and shape. Several glacial deposits with a variety of deposition modes are recognized in Carson-Pegasus Provincial Park. The majority of the park is covered by undivided ice thrust and stagnation moraine. This material is predominantly rolling and hummocky fine textured till over bedrock with some local water-sorted material and organic deposits in the depressions. A smaller area of stagnation moraine occurs in the southwestern part of the park, adjacent to the southern and southwestern shore of McLeod Lake. This area is dominated by undulating fine textured till of uneven thickness, local water sorted material, and organic deposits in most depressions. An area of ice thrust moraine, characterized by steep ridges, irregularly shaped hills, and depressions is located north and northwest of Little McLeod Lake. In this area, mixed bedrock, variably textured till and water-sorted material have been translocated by ice in a more-or-less intact state as thrust blocks and may be more than 100m thick.

Glaciolacustrine materials are mainly well sorted, stratified sediments settled from suspension in lakes formed at the margins of glaciers. Two small areas of clay textured glaciolacustrine materials occur along the south and southeastern shore of McLeod Lake.

Fluvial and glaciofluvial deposits consist mainly of well sorted, stratified sediments deposited by the running waters of streams and rivers. Within Carson-Pegasus Provincial Park, these deposits occur mainly along the western edge of McLeod Lake. Other, smaller deposits may be found throughout the park and are included within other units.

Organic (peat) deposits within Carson-Pegasus Provincial Park consist dominantly of moderately to well decomposed fen peat derived from sedges, brown mosses and sphagnum. Isolated organic deposits derived from grasses are also found along the north edge of McLeod Lake. Organic deposits occur in low-lying areas and depressions throughout the park and along the margins of water bodies.

2.5 Bedrock Geology

Carson-Pegasus Provincial Park is underlain by Tertiary and Cretaceous sandstones of the Paskapoo Formation, Scollard Member (Green 1972). Bedrock of the Paskapoo formation is described as: grey to greenish grey, thick-bedded, calcareous, cherty sandstone; grey and green siltstone and mudstone; minor conglomerate, thin limestone, coal and tuff beds. The Scollard member of the Paskapoo formation is described as grey feldspathic sandstone, dark grey bentonitic mudstone, thick coal beds, and non-marine. Bedrock was not encountered within one meter of the surface within the study area.

2.6 Hydrology

The province of Alberta has a diversity of wetlands. The Foothills Natural Region houses portions of five of Alberta's nine major drainage basins, including the Hay, Peace, Athabasca, North Saskatchewan, and South Saskatchewan (Nelson and Paetz 1992). Specific to Carson-Pegasus Provincial Park, the Athabasca River provides the exclusive source of drainage throughout the park. The predominant drainage patterns exhibited throughout the park tend towards a southern direction flowing from the park into Carson Creek and eventually reaching the Athabasca River near Whitecourt via the Sakwatamau River. The park's drainage system is comprised of nine inlet streams (eight unnamed and Mobil Creek) and one unnamed outlet stream. The inlet streams intermittently drain muskegs and smaller wetlands in the vicinity of McLeod Lake, while the outlet stream is restricted below lake elevations (Hildebrand 1976). Within the park the major waterbodies include McLeod Lake, Little McLeod Lake, Bog Pond, and Laura Lake (see Appendix A, photograph 1,2).

2.7 Soils

Soil is the naturally occurring, unconsolidated, mineral or organic material at the earth's surface that is capable of supporting plant growth (Soil Classification Working Group 1998). Soil formation or genesis is the process or combination of processes responsible for the development of soil. At any particular location, soil genesis results in a particular type of soil with distinctive morphological and chemical characteristics. These characteristics are the result of the integrated effects of soil forming factors, such as climate, parent material, biota, topography, and time. The action and interaction of these factors results in the formation of individual layers or horizons, extending from the surface downward, that have specific characteristics. Each soil horizon differs from adjacent layers in properties such as texture, structure, consistence, colour, and chemical, biological and mineralogical composition. A vertical section of the soil through all its horizons and extending into the parent material is called the soil profile. Soils are recognized and differentiated from each other by identifying the various layers or horizons that make up the soil profile.

In Canada, soils are classified according to the Canadian System of Soil Classification (Soil Classification Working Group 1998). In Carson-Pegasus Provincial Park, Gleysolic, Luvisolic and Organic soils dominate. Regosolic soils occur sporadically throughout the park, but are mainly found on the McLeod Lake peninsula. An outline of the soil orders, great groups and sub-groups mapped in the Carson-Pegasus Provincial Park is presented in Table 2. The distinguishing characteristics of each soil type mapped in the park can be found in The Canadian System of Soil Classification (Soil Classification Working Group 1998).

Gleysolic soils are poorly to very poorly drained and contain features (mottling and gleying) indicative of periodic or prolonged water saturation. They are found throughout the study area in low lying and depressional areas, mostly in association with organic soils. They are the dominant soils in two areas along the south and southeastern shores of McLeod Lake. Orthic Gleysols and Rego Gleysols are the dominant sub-groups in Carson-Pegasus Provincial Park, and may or may not have a thin (<40cm) veneer of peat.

Luvisolic soils are the dominant soils in Carson-Pegasus Provincial Park. They are imperfectly to well drained, have a light coloured, silt loam to sandy loam textured eluvial horizon (Ae) overlying a darker, clay textured illuvial horizon (Bt) of clay accumulation, and are developed under forest vegetation. Moderately well and well drained Orthic Gray Luvisols are the dominant sub-group found in the park and are found in all slope positions. Significant sub-groups are Brunisolic Gray Luvisols (mainly on steep slopes) and Gleyed Gray Luvisols (imperfectly drained, mainly in lower and depressional slope positions).

Organic soils are poorly and very poorly drained soils composed dominantly of organic materials. Most are water saturated for prolonged periods and occur in depressions and adjacent to water bodies throughout the study area and are derived from the vegetation that grows in these sites. Mesisols are the dominant organic soils in the park. They are derived mainly from moderately decomposed hydrophytic vegetation. Two main types of organic deposits are found in Carson-Pegasus Provincial Park. Deep organic deposits are greater than 160cm thick over a mineral substrate and are dominated by Typic Mesisols and Humic Mesisols. Shallow organic deposits are between 40 and 160cm thick over a mineral substrate and are dominated by Terric Mesisols and Terric Humic Mesisols.

Regosolic soils are found in disturbed areas and on steep, unstable slopes within the study area. They are well drained and their development is too weak to meet the requirements of any other order. Orthic Regosols are the most commonly occurring sub-group in Carson-Pegasus Provincial Park, found mainly on the steep banks of the McLeod Lake Peninsula.

Table 2: Soil Types Mapped in Carson-Pegasus Provincial Park

Order[1]	Great Group[1]	Sub-Group[1]
Gleysolic	Gleysol	Orthic Gleysol (O.G) peaty Orthic Gleysol (ptO.G) Rego Gleysol (R.G) peaty Rego Gleysol (ptR.G)
Luvisolic	Gray Luvisol	Brunisolic Gray Luvisol (BR.GL) Gleyed Gray Luvisol (GL.GL) Orthic Gray Luvisol (O.GL)
Organic	Mesisol	Humic Mesisol (HU.M) Terric Humic Mesisol (THU.M) Terric Mesisol (T.M) Typic Mesisol (TY.M)
Regosolic	Regosol	Orthic Regosol (O.R)

[1] Source: Soil Classification Working Group 1998.

2.8 Vegetation

Carson-Pegasus Provincial Park has been identified as supporting a high diversity of vegetation types in the rolling terrain surrounding McLeod and Little McLeod Lakes (Bentz *et al.* 1995). The Upper Foothills are characterized by continuous lodgepole pine forest, typical of this natural region (Achuff, 1992), and minimal amounts of aspen (Beckingham *et al.* 1996). The Lower Foothills Natural Region features the codominant occurrence of aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), lodgepole pine (*Pinus contorta*), and white spruce (*Picea glauca*) (Archibald *et al.* 1996)(see Appendix A, photograph 11). This can be attributed to the warmer and drier climatic conditions prevalent in Lower Foothills than are found in the Upper Foothills Natural Region during the May-October growing season.

In Carson-Pegasus Provincial Park, vegetation characteristically consists of moderately dense forest canopies with wetlands and disturbance features forming large openings (see Appendix A, photograph 10). Upland sites are dominated by mature mixedwood aspen and white spruce forests interspersed with seral aspen stands. These upland sites feature a shrub understorey similar to that of the Boreal Forest Natural Region (Archibald *et al.* 1996) and is typified by low-bush cranberry (*Viburnum edule*) and prickly rose (*Rosa acicularis*). Lodgepole pine forms homogeneous stands on some of the well-drained uplands in the northern half of the park. Other well-drained sites include steep southern aspects that support dense low-shrub communities of beaked hazelnut (*Corylus cornuta*) and prickly rose.

Poorly drained wetlands include dense black spruce (*Picea mariana*) forest, open tamarack (*Larix laricina*) forest with a bog birch (*Betula glandulosa*) and sedge understorey, and unforested sites dominated by bluejoint (*Calamagrostis canadensis*). Low willow shrub and sedges dominate the few fluvial sites identified within the park. Lake shorelines and shallow water support areas of dense emergent vegetation.

Nonnative plant invasion in the park is restricted to anthropogenic disturbances. These are associated both with past petroleum exploration and developments, including wellsites, access roads, cutlines, water pipelines and park-related development such as campgrounds and primary roads.

It should be noted that actual community and species representation at any given site will be influenced by numerous factors, including disturbance regimes, regional climate, aspect, slope, moisture and nutrient regimes, and grazing intensities.

Detailed discussion of the vegetation of the study area is presented in Section 5.1.

In accordance with habitat mapping and theme representation, an ecologically-based framework adopted by Natural Resources Service has been used to assist in the selection and management of protected areas, and ensure that representative samples of Alberta's natural history is protected. With reference to Carson-Pegasus Provincial Park, the following table (Table 3) is adopted from *the Carson-Pegasus Provincial Park Management Plan* (AEP 1996a) identifies the natural history themes represented by the park.

Table 3: Natural History Themes of Carson-Pegasus Provincial Park

Level 1 Natural History Themes	Level 2 Natural History Themes
Valley/Ridge Ridge/Valley Wall	Lodgepole pine forest White spruce forest Black spruce forest Aspen forest spruce fir forest
Valley/Ridge Floor/Stream	Muskeg stream (a stream flowing through an organic wetland)
Wetland – Mineral	Marsh Swamp Shrubland
Wetland – Organic	Bog Patterned fen Black spruce forest Tamarack forest Shrubland Graminoids
Wetland – Lake	Dystrophic lake
Special Feature	Balsam fir forest

2.9 Fauna

On a broad landscape, Carson-Pegasus Provincial Park is relatively close to the boundaries of three separate Subregions and two Natural Regions including the Upper and Lower Foothills (Foothills Natural Region) and Central Mixedwood Subregion (Boreal Forest Natural Region). Additionally, the park is geographically situated in a transitional zone between the Athabasca River Valley and the Swan Hills Upland. This combination of the above features provides major environmental influences in the patterning of vegetation and wildlife in the area. Thus, the park contains extremely high vegetation community diversity lending to a complex landscape mosaic of young-mature and over-mature forests with marshes, lakes, meadows, and riparian areas intertwined. Consequently, the wildlife in the park is recognized for its high diversity and its occurrences of breeding and resident avifauna and mammals. However, information sources pertaining to wildlife species occurrence in the park is very limiting rendering a significant information gap for the park. For a complete list of mammals and avifauna known or expected to occur in the park, see Appendix C.

A selected portion of the available wildlife species for the park has been identified by the Natural Resources Service as species of greater priority, therefore the following descriptions are focused on those species. Given the lack of wildlife ecology information strictly relevant to the park, most descriptive information provided will be taken from a provincial, regional, or sub-regional level to supplement the available park information. Management recommendations are provided in Section 6.6.4.

Mammals

Mammals within Carson-Pegasus Provincial Park are typical of the species occurring within the Boreal and Foothills Natural Regions. The unique assemblage of vegetation in the park provides significant habitat for approximately 45 mammal species.

Ungulates, or hoofed mammals, are one of Alberta's most conspicuous groups of fauna. Of the 12 ungulate species native to North America, nine are presently found in Alberta, making Alberta's ungulate faunal assemblage the most diverse of any province or state on the continent (Stelfox 1993). Within each of Alberta's Natural Regions, diverse and heterogenous environments force some level of ecological separation among co-occurring ungulates, mainly due to different environmental preferences along biophysical gradients. Particularly important parameters include the degree of vegetative cover, topography, exposure, forage type, structural stage, and climate. Using such an environmental stratification to gauge ungulate distribution in the Foothills Natural Region, some broad trends become readily apparent.

Carnivores are important indicators of ecosystem integrity in that they influence the structure, and reflect the vigor, of the trophic levels upon which they depend. They are also generally sensitive to the abundance and behavior of humans with which they coexist. Throughout much of the forested environment of western Canada, concern for the conservation of mammalian carnivores has centered on large species such as gray wolf (*Canis lupis*), grizzly bear (*Ursus arctos*), and black bear. Historically, large-scale extermination and loss of habitat were the major threats to large carnivores throughout North America. Today, the most significant ecological threats to large carnivore survival are related to loss, alienation, and alteration of habitat resulting from anthropogenic sources.

In many areas of North America, particularly in the Rocky Mountains (Paquet and Hackman 1995), these human activities have proven to contribute to the fragmentation of the landscape, effectively blocking dispersal corridors and creating impediments to inter- and intra-territorial movements. As a result, many far-ranging large carnivores (as most large carnivores are) require large tracts of pristine wilderness areas to propagate viable populations. Black bear (*Ursus americanus*), gray wolf, coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and lynx (*Lynx canadensis*) are all expected to occur in the study area at varying levels of abundance (G. Gilbertson pers. comm.). Their abundance in the study area is dependent upon numerous factors, including prey and forage availability, disturbance, habitat availability, and climate and landform-related variables.

2.9.1 Mule Deer

On a provincial level, mule deer are known to occupy a vast diversity of habitats, including grasslands, boreal forest, mountains, and foothills. On a smaller scale, mule deer favor open habitats often associated with rugged terrain, south and west facing slopes, riparian areas, and early structural and seral stages. Individually, mule deer commonly use areas of approximately 10-12 km^2 as home ranges confining themselves to very short daily movements (Mackie *et. al.* 1982). Within Carson-Pegasus Provincial Park, mule deer will undoubtedly utilize adjacent private and public lands given the small area of the park (<10 km^2). Although not considered the most optimal habitat for mule deer within Alberta, Carson-Pegasus Provincial Park and surrounding areas (including most of the Upper and Lower Foothills) provide habitat for approximately 8% of the provincial mule deer population (AFWD 1989).

Habitat for mule deer provides several key functions by providing the necessary resources to address security, thermal, and foraging concerns. Thus, primary habitat for mule deer can be found in a landscape that provides all the primary habitats interspersed in a pattern that facilitates reasonable access. While mule deer occupy several unique habitat types, they have a propensity for edge or transitional habitats. Mule deer can, thus, be considered an ecotonal species, favoring high contrast forest edges that provide an abundance of forage in close proximity to escape and thermal cover. Although the area surrounding the park has been heavily impacted with various land uses, such as recreation, timber harvesting, and oil and gas development, these land uses potentially limit mule deer use of suitable habitat. In the area, AFWD (1989) has suggested that habitat losses resulting from agricultural expansion and large clear cuts is being offset by smaller cut blocks and oil and gas development. Consequently, the oil and gas developments in Carson-Pegasus Provincial Park are likely producing a beneficial effect on the mule deer population in the area.

2.9.2 White-tailed Deer

White-tailed deer are also a conspicuous faunal element occurring within Carson-Pegasus Provincial Park. Their habitat preferences highly resemble mule deer, however white-tailed deer concentrate their use of cover and foraging habitats on aspen clumps (Webb 1984, AFWD 1995). The interspersion of security and foraging habitat is critical to providing key habitats for white-tailed deer. Similar to mule deer, Carson-Pegasus Provincial Park and surrounding areas (including most of the Upper and Lower Foothills) provide habitat for approximately 8% of the provincial white-tailed deer population (AFWD 1995). The overall white-tailed deer density for the area is considered moderately low with populations considered to be "changing", although populations are likely stable (AFWD 1995). For both deer species in the park, habitat use patterns will concentrate on the upland mesic areas, small forest openings, meadows, and riparian habitats.

2.9.3 Moose

Moose populations are significant as one of the most popular big game animals in the province and are managed as a renewable, marketable resource (Todd and Lynch 1992). For many centuries this large ungulate has remained the primary big game animal for sporting purposes. High moose populations are valued for both recreational and consumptive purposes. Because moose are the most widespread and abundant ungulate throughout the Foothills Natural Region, in the past they have presented wildlife managers with obstacles in attempting to control their eruptive populations. High moose populations have been the cause of depleted range conditions and the degenerative ability of the land to sustain high moose numbers (Alberta Recreation, Parks and Wildlife (n.d.)). Being primarily browsers, the diversity provided by forest structure, stand composition and age makes a forested land base most suitable for moose. The high proportion of aquatic and upland environments creates edge type communities that vary in composition and therefore increase the suitability class of the Foothills for moose (IEC Beak Consultants Ltd. 1985).

In the Foothills, optimal moose habitat is found in conjunction with mixedwood upland, forest fires and the associated early successional growth, and riparian areas. It has generally been accepted that moose utilize the mixedwood community type quite extensively (Rolley and Keith 1980, Telfer 1984, Cederlund and Okarma 1988). During favorable conditions, moose densities may achieve 0.5-1.5/km^2. These young mixedwoods also provide adequate cover and forage while mature forest stands provide thermal cover during hot summers and cool winters (Stelfox 1993). Moose have become extremely adept at selecting this relatively nutritious forage and subsequently, fire management is an integral part of the moose survival strategy in the Foothills. Of all community types within the Foothills, moose are most recognized for their affinity to hydrologic features. Lakeshores, streams and well-drained valley bottoms offer prime habitats throughout the year. Riparian and watershed areas such as Mobil Creek, Laura Lake, and Bog Pond exemplify areas of high moose utilization.

Moose provide a major part of the prey base for larger carnivores such as black bears and wolves within the Foothills Natural region. Their value as an integral part of the ecosystem and for human purposes is immeasurable. This potentially makes moose the most significant ungulate in the Foothills Natural Region.

2.9.4 Black Bear

Of the large carnivores found in Carson-Pegasus Provincial Park, the black bear and coyote are likely the most common, others include wolf, grizzly bear, lynx, and cougar (*Felis concolor*). These six carnivores have been selected for discussion and will be described at length.

Although the black bears are considered frequent visitors to the park, little information is available describing habitat use, movement patterns, or population estimates. Historically, black bears were quite widespread throughout North America, they are now limited largely to the less settled areas of their range, occupying approximately 85% of former distribution (Pelton 1982, Kolenosky and Strathearn 1987). Within their current range, the status and density of black bear populations varies considerably. In Alberta, black bears are managed as a big game species and populations are reported by AFWD (1993) to be relatively stable. Black bears are a very adaptable species and, perhaps because of this adaptability, their populations have been maintained surprisingly well in the face of human intrusion into their habitat. Despite this success, Pelton (1982) warns that, in most instances, if habitat areas of relative refuge are not available, then local populations will succumb to the intolerances of humans. Throughout its range, optimal black bear habitat is characterized by relatively inaccessible terrain, thick understorey vegetation, and abundant food sources. The diet of black bears is largely determined by the availability of food. As a result, home ranges of individuals are often large, in order to facilitate optimal forage selection. Subsequently, black bear should be found throughout the park, similar to most of the large carnivores.

In areas adjacent to Carson-Pegasus Provincial Park, the Boreal Forest of Alberta is generally regarded as providing good to excellent black bear habitat. Areas of particularly high densities are concentrated in the Central Mixedwood. Young (1978) calculated expected black bear densities for different habitat types, concluding that deciduous forests supported the highest densities of bears (0.60 / km^2), followed by mixedwood forests (0.41), coniferous forests (0.22) and muskeg (0.18).

2.9.5 Grizzly Bear

Although relatively rare, grizzly bears have not been observed in Carson-Pegasus Provincial Park for some time (G. Gilbertson pers. comm.). S.Polege (pers. comm.) has indicated that grizzly bears have been recently observed in areas to the north and south of the park. Grizzly bears have been designated as a blue-listed species due to declining populations outside the national parks previous to 1980 (AEP 1996c). Grizzly bears are wide-ranging omnivorous mammals concentrated on open meadows or shrubland foraging areas adjacent to timbered areas that provide cover. Wide movements appear to be a key aspect of grizzly bear ecology and are motivated by foraging opportunities. The availability of habitats that provide abundant sources of forage are critical, therefore a diversity of habitats that can provide abundant food sources throughout a grizzly bear annual cycle can only be found on extremely large-scales. Consequently, home ranges upwards of 1000km^2 are not uncommon. Grizzly bear are noted for their phenological tracking of food sources as they can be readily exploited. In a Banff National Park study, Hamer and Herrero (1983) recognized that major food items in decreasing order of preference were mammals, fruit, succulent vegetation, and Hedysarum roots. Consequently, areas for travel, sanctuary, and denning must all be available on a large-scale geographic area to provide allow for viable grizzly bear populations, and, although Carson-Pegasus Provincial Park may provide suitable habitat it cannot meet the holistic demands of grizzly bears on a long-term basis due to the small basal area of the park.

2.9.6 Lynx

Lynx are quite widespread throughout Carson-Pegasus Provincial Park and adjacent areas. The synchronous relationship that exists between lynx and their primary prey, the snowshoe hare (*Lepus americanus*), was first explained by Elton and Nicholson (1942) and has since attracted much attention from ecologists and wildlife biologists. The basic cause of the 10-year population cycle in snowshoe hares and lynx is, first, an interaction between the snowshoe hare and its food supply and, second, an interaction between snowshoe hares and their primary predator, the lynx (Keith 1974). Since lynx depend so heavily on the snowshoe hare as their primary food item, good hare habitat is generally regarded as good lynx habitat as well (Quinn and Parker 1987)(Table 4). When snowshoe hare populations drop dramatically, lynx reproduction is depressed and kitten survival declines, resulting in severely lowered rates of recruitment. However, lynx populations also generally peak one to two years after the snowshoe hare peak (O'Connor 1984). Such phenomena have been described for areas in and around the southern portion of the Central Mixedwood Subregion of central Alberta (Nellis and Keith 1968, Nellis *et al.* 1972, Brand *et al.* 1976, Brand and Keith 1979).

Table 4: Food Habits of the Lynx (Quinn and Parker 1987)

Location	Season	Percent (%) Prey Items						Source
		Snowshoe hare	Mice and Voles	Squirrels	Grouse	Other birds	Other	
Alberta	Winter	35-90	4-28	9-12	2-6	3-6	2-15	Brand and Keith (1979)
Alberta	Winter	69	-	1	13	-	17	Nellis and Keith (1968)
Alberta / NWT	Summer	33	19	11	3	19	14	Van Zyll de Jong (1966)
	Winter	60	7	1	7	10	13	Van Zyll de Jong (1966)
NFLD	Summer	45	21	-	-	21	15	Saunders (1963)
Ontario	Fall	63	-	3	6	13	19	Stewart (1973)
	Winter	70	4	-	5	5	13	Stewart (1973)
Cape Breton Island	Winter	93	3	1	3	-	-	Parker *et al.* (1983)

Thus, habitat management for lynx involves providing suitable forest cover to maintain snowshoe hare populations. Uneven aged forests with a relatively open canopy to stimulate growth of the understorey as well as patchy areas of disturbed forest are considered ideal habitat (Quinn and Parker 1987).

2.9.7 Cougar

Cougar are a yellow-listed species in Alberta (AEP 1996c). Outside the national parks and restricted areas, populations appear stable at approximately 600. Primarily a species of the Rocky Mountain and Foothills Natural Regions, cougar are rarely observed in areas distant from the continental divide. Smith (1993) has identified the current distribution of cougars to approach the fifth meridian, with no recent records of cougar near Whitecourt or Carson-Pegasus Provincial Park. However, more recently, G. Gilbertson (pers. comm.) has indicated that several observations of cougar have occurred in the park and vicinity of Whitecourt suggesting that population distributions may be larger and more widespread than once suspected. Of the species that require large geographic areas, cougars also demand the requirements of large annual home ranges. In Alberta, Pall *et al.* (1988) identified home ranges to vary from 158 to 365 km^2, suggesting that the vegetation and topography preferences of cougar can be quite variable. It is likely that concentrations of cougar will be found where cervids are most common, specifically, deer comprise approximately 80% of all prey occurrences (AFWD 1992). Mule deer outnumber white-tailed deer almost 12:1. In winter samples, moose contributed to 23% of a cougar's diet. Within Carson-Pegasus Provincial Park it is highly unlikely that resident cougars will be found, but transient individuals attempting to locate areas of high prey abundance would be the case.

2.9.8 Coyote

Among the canids, the adaptable coyote is likely the most abundant and widespread member in the Foothills Natural Region as it is throughout the province as well. The coyote is an opportunistic feeder, spending equal amounts of time hunting small prey as it does scavenging on carrion. This characteristic has allowed the species to infiltrate environments as varied as the arid grassland coulees of extreme southeastern Alberta through sub-alpine ranges in the Rocky Mountains to peat plateaus atop the Cameron Hills and Birch Mountains to city ravines and river valleys. Due to this adaptability, coyotes can be found wherever a suitable food source exists.

2.9.9 Wolf

Wolves are present throughout the study area on a short-term basis and their distribution also parallels that of their available prey species, primarily moose in most of the study area with periodic inclusions of both white-tailed and mule deer. Mech (1970) reports that, in North America, the wolf's historical range may have been greater than that of any other terrestrial mammal and Nowak (1983) supports the fact that wolves currently occupy more than 90 percent of their original range in Canada. One of the salient ecological characteristics of wolf populations is that they require large territories. Wolf territories serve many functions, among which is included the partitioning of prey resources in areas where prey species are more or less randomly distributed. Schmidt and Gunson (1985) reported a home range of 2,455 km^2 for a pack of 14 wolves in western Alberta.

Based on densities and home range sizes acquired from numerous wolf studies in the province, summer wolf populations in Alberta are expected to reach 5,500 animals (Gunson 1991). Of this provincial population, 1,000 wolves are estimated to occur in the Foothills and Rocky Mountain Natural Regions and the vast majority of the remainder occurring in the Boreal Forest Natural Region, particularly in northern portions.

Avifauna

Avifauna within Carson-Pegasus Provincial Park are typical of the species occurring within the Boreal and Foothills Natural Regions. The unique vegetation communities found within the park provide habitat for a unique assemblage of bird species approximating 161 species.

Colonial nesting birds are those species of avifauna which congregate in groups annually to court, nest, and raise young. These colonies provide many advantages for their inhabitants, including a relatively secure nest site, mutual defense against common predators, and a place to exchange information on prime feeding areas (Brechtel 1981). Semenchuk (1992) has identified 17 colonially nesting species that breed in Alberta.

2.9.10 Great Blue Heron

Within Carson-Pegasus Provincial Park, a great blue heron (*Ardea herodias*) nesting colony is known to exist on the north side of McLeod Lake and has been identified as a very sensitive and regionally significant ecological feature of the park, and perhaps the most significant ecological feature of the park. The colony was only identified in the last 3 years, therefore the information available on the Carson-Pegasus Provincial Park colony is relatively sparse and limited to observations/notes provided by park personnel and information interpreted from the results of this ELC mapping effort. S. Polege (pers. comm.) has roughly estimated that the colony is limited to 12 breeding pairs. The nests are located in a riparian area west of Bog Pond and north of McLeod Lake and found in an aspen poplar-white spruce-lodgepole pine/feathermoss vegetation community.

The great blue heron is the largest and most widely distributed member of the *Ardeidae* (herons) in Canada. It has been designated a yellow-listed species by AEP (1996c) in order to address concerns related to low natural populations and intrinsic features such as its colonial habits. The provincial status of great blue herons in Alberta remains poorly understood, largely due to an extreme paucity of information on the state of knowledge of the species. Attempts to manage the species on a provincial basis are based on limited data, most of which is quite dated (Vermeer 1973, Van Camp 1976, Brechtel 1981, Kristensen 1981, Paulsen 1982, Williams 1983). Salt and Salt (1976) had reported that the range of this species had not changed over the last century, however, the provincial range recently reported by Semenchuk (1992) is considerably more expansive than that reported earlier by Brechtel (1981) and now recognizes a northward range expansion of the species. Although provincial populations of great blue herons are reported to be increasing, the entire Alberta population is dependent upon fewer than 100 known nesting sites (Brechtel 1981, Alberta Fish and Wildlife Division 1991). Based on Brechtel (1981), sources estimate 75 active colonies in Alberta, with 1,500 breeding pairs. While the majority of these breeding colonies in Alberta are found in the Dry Mixedwood Sub-region and in the Parkland Natural Region to the south.

Great blue herons occur in a variety of habitats throughout their range. In Alberta, however, they are most common along the edges of freshwater lakes and rivers. Habitat requirements of great blue herons in this environment include the presence of wooded areas suitable for colonial nesting and the presence of wetlands within a specified distance of a heronry where foraging can occur. Herons prefer to nest high in the apexes of both coniferous and deciduous tree species, however evidence indicates that the species of tree is not as important as is its height and distance from human activity (Short and Cooper 1985). Fish are the preferred forage item of great blue herons in all habitats, although a variety of dietary items - including aquatic invertebrates, reptiles, amphibians, and small mammals - have also been recorded (Kelsall and Simpson 1980, Short and Cooper 1985). Cover for concealment does not appear to be a limiting factor for the great blue heron as heron nests are often large and conspicuous and foraging usually occurs in areas of open water where concealing cover is often minimal. Predation on heron nests by bald eagles, as reported by Norman *et al.* (1990), also demonstrates the lack of attention given by herons to concealment cover.

Heron colonies generally consist of relatively small areas of suitable habitat. Foraging has been reported by Werschkul *et al.* (1977), Dowd and Flake (1985), and Butler (1991a) to take place within 5-6 km of the nesting colony. In addition, recent studies have shown that the size of breeding populations of herons is directly correlated to the available area of wetland foraging habitat (Gibbs *et al.* 1987). Therefore, the active conservation of whole heronries, including both nesting sites and foraging wetlands, is integral to ensuring the viability of great blue heron populations.

Herons respond variably to disturbances. Butler (1991b) contends that the effects of human disturbance on nesting herons depends on the stage of the nesting cycle, degree of habituation to disturbance, and the nature of the disturbance itself. Some heron colonies are reported to have habituated to nearby activities which are non-threatening (Parker 1980, Webb and Forbes 1982, Butler 1991b). Brechtel (1981) provides accounts of successful colonies located near airports and high-use provincial and city parks. Conversely, human disturbance, habitat destruction, and the resulting loss of nesting and foraging sites have been the most important factors contributing to declines of some great blue heron populations. Studies have implicated logging activity (Werschkul *et al.* 1976), house construction (Kelsall and Simpson 1980), and recreation activities (Vos *et al.* 1985) in causing colony abandonment. Additionally, heron colonies are more accessible than those of other colonial nesters such as cormorants, as heron colony sites are usually less remote and often located on the mainland rather than on islands.

Most authors on heron colony management and conservation recommend buffer zones ranging from 300 m (Butler 1991b) to 1,000 m (Bowman and Siderius 1984) around colony sites such as those found on Leming Lake, Island Lake, Bolloque Lake, and Spruce Island Lake. Although the active size of heron colonies has been reported to be relatively small, the significant ecological feature identified above include some adjacent forested habitats in order to adequately provide replacement nesting stands to compensate for a natural cycle of habitat loss (Wiese 1978) which occurs as colony-supporting trees are killed by heron excretia after extended periods of use. While great blue herons are generally regarded as being more tolerant than other colonial nesting species, such favorable reactions only occur in response to consistent or expected disturbances. Intense or unexpected disturbances, on the other hand, often result in decreased reproductive success or colony abandonment. Therefore, the identification of great blue heron colony sites as a significant ecological feature in Carson-Pegasus Provincial Park will provide locational data which can facilitate future mitigation practices and allow for the incorporation of the biological requirements of the species into land use plans.

2.9.11 Osprey

Ospreys (*Pandion haliaetus*) are widespread in appropriate habitats throughout Alberta, yet their fluctuating numbers (over their North American range) as well as their trophic position atop the food chain render the species particularly sensitive to disturbances and to environmental perturbations. The historical status of osprey in Canada has been a very different story than that of osprey inhabiting the United States. While numbers in Canada are generally thought to have remained stable since the turn of the century, osprey populations in the eastern United States were drastically affected by the introduction and widespread use of organochlorine pesticides such as DDT. Production of osprey nest sites dropped to as much as five percent of former levels in some areas (Canadian Wildlife Service 1984). Like the bald eagle, osprey are yellow-listed by the Alberta Fish and Wildlife Division (AEP 1996c), implying that they are particularly vulnerable to population fluctuations or to habitat destruction.

In Carson-Pegasus Provincial Park, osprey are an extremely conspicuous component of the natural fauna inhabiting the fish-bearing wetlands within the park. In the later stages of the summer of 1998, it was not uncommon to observe 4-6 osprey preying on fish in McLeod Lake, likely the adults and young of a fledged nest. In particular, osprey concentrations will occur on McLeod Lake and Little McLeod Lake, however potentially suitable habitat may be found on Laura Lake dependent upon the status of fish populations in the lake.

Throughout their range, osprey are anticipated to occur on or around any body of water where fish, their primary food source, are readily available. In describing osprey foraging sites, many researchers have stressed the importance of clear, unobstructed, shallow waters (Postupalsky 1978, Prevost 1983) and the reduced success of foraging by ospreys due to extensive emergent and submergent vegetation (Prevost 1983), overhanging vegetation along shorelines of rivers and lakes (Hynes 1970), and waters that are heavily shaded or turbid (Flook and Forbes 1983), all of which reduce prey visibility of foraging ospreys. Within Carson-Pegasus Provincial Park, osprey were predictably observed near McLeod Lake and Little McLeod Lake where abundant fish populations are present.

Ospreys usually choose nesting sites near or over water. Tall dead snags surrounded by water provide ideal nesting sites for ospreys but the species will also often nest in live trees with deteriorating crowns. They readily utilize nest platforms and will also establish nests on man-made structures such as telephone poles, transmission line towers, and chimneys (Canadian Wildlife Service 1984). Osprey are apex-nesting species and their nests, therefore are built in the tallest available structures to provide an unrestricted view of the surrounding landscape. Breeding densities of ospreys have been thought to be limited by shortages of nest sites, a suggestion that has been substantiated by documented increases in breeding densities immediately following the erection of nesting platforms (Newton 1980). These artificial nesting structures are critical because they allow ospreys to exploit habitats that lack adequate nest sites but have suitable food resources and minimal human activity.

In Alberta, osprey breeding density is directly proportionate to forage supplies. Osprey densities are greater and increasing in areas such as the Brazeau Reservoir in the Foothills Natural Region, where food resources are concentrated, predictable, and accessible. Grover (1983) has cited reservoir construction as providing improved habitat on the upper Missouri River, Montana compared to areas along the free-flowing river.

Ospreys appear to have three basic requirements for successful nesting (Canadian Wildlife Service 1984):

1. an abundant and accessible fish population,
2. a sufficiently long ice-free season to allow the completion of nesting and rearing of young, and
3. nest sites relatively free from predation and disturbance.

Some ospreys are able to nest in close proximity to human activity (see Poole 1981 and Vana-Miller 1987 for review of documented habituation of ospreys to human activity and disturbed landscapes). However, the tolerance of ospreys to disturbances is a function of the timing, frequency and predictability of the disturbances. Sporadic human activity has been shown to negatively affect nesting success of breeding ospreys (Levenson and Koplin 1984) as alarmed adults that are repeatedly flushed from their nests risk exposure of eggs and hatchlings to predators and extreme temperatures. In researching the effects of disturbance on ospreys, numerous authors have determined a "critical distance" from the nest beyond which ospreys appear undisturbed by human activity. This distance varies from 0.2 to 1.5 km (Levenson and Koplin 1984, Vana-Miller 1987).

Other Taxa

Despite the focus on the above species, it should be noted that Carson-Pegasus Provincial Park is highly regarded for its diversity of faunal species. The park is extremely valuable for species that maintain smaller home ranges and, therefore the park can support viable populations of various small mammals, fish species, and bird populations. These groups of fauna get considerably less attention than the large, mega-charismatic species but should be considered no less significant.

In natural habitats, such as Carson-Pegasus Provincial Park, vegetative complexity and habitat size are major determinants of the abundance of upland wildlife, such as fisher, marten, old-growth songbirds, red squirrels, and snowshoe hares. Recently, studies conducted in the mixedwood forests of northeastern Alberta also echo the view that mammal species richness and abundance in mixedwood forests reflect the structural complexity of the forest (Roy *et al.* 1995). Roy *et al.* (op cit) observed that structurally complex old stands (greater than 120 years old) supported more species than did structurally simple mature stands (aged 50-65 years) or young stands (aged 20-30 years) that were intermediate in structural complexity. The suite of small terrestrial mammals in the Foothills Natural Region is largely a sedentary group of species, most of which have small home ranges. For all species, the maintenance of cover, movement corridors, and dispersal corridors are as critical to the propagation of the regional population as is food and breeding habitat. Size, extent, and structure of habitat patches are critical factors that determine use of appropriate habitats by various avifauna species. Fragmentation of large tracts of forest inherently produces ecological edges (Leopold 1933), or ecotones, which have been shown to adversely affect forest interior species such as winter wren (*Troglodytes troglodytes*) and ovenbird. It is axiomatic that many game species are more abundant near edges. While certain species thrive in edge habitats, increased nest predation and parasitism have also been documented at forest edges (Brittingham and Temple 1983, Yahner and Scott 1988, Hannon 1993) and have negatively impacted forest interior species.

The high ratio of water to land contained within the park lends itself to the recognized high faunal diversity of the park. Mammals that inhabit wetlands exhibit specific traits that make them highly vulnerable to isolation and habitat fragmentation. Of these semi-aquatic mammals, those that are carnivorous (either carnivores in the strict sense or omnivorous members of the order *Carnivora*) have larger home ranges than the herbivores of equal size and, because they inhabit the water and the water edge, their home ranges tend to be long and narrow, aggravating the probability of fatal encounters with humans or human activity. Consequently, four species of semi-aquatic mammals are prevalent in the Foothills Natural Region: beaver, muskrat (*Ondatra zibethicus*), river otter (*Lutra canadensis*), and mink (*Mustela vison*). All of the above species are found in Carson-Pegasus Provincial Park, however population numbers, populations trends, and habitat utilization patterns in the park are unknown.

Waterfowl and other groups of avifauna that are dependent upon wetland and marsh-based species included in this guild are waterfowl (including all *Anatidae*), loons (*Gaviidae*), cranes (*Gruidae*), and shorebirds (*Charadriiformes*). It is recognized that other species may also be somewhat dependent upon wetland and water-dominated habitats, however their sensitivity and/or significance is based primarily on other intrinsic biological and ecological characteristics. Migratory waterfowl have been recognized as important consumptive, non-consumptive, and non-use resources throughout North America (Blatt *et al.* 1992, Van Kooten 1993). They are a diverse group of avifauna that have widely divergent requirements for survival and recruitment. Over an annual cycle, waterfowl utilize a diverse and widely distributed series of wetlands. While not all wetlands can support all of the broad annual requirements of waterfowl, many seasonal habitats are provided by groups of closely associated wetlands such as found throughout Carson-Pegasus Provincial Park. Based on general geographic distributions provided by Godfrey (1986), Salt and Salt (1976), and Semenchuk (1992) as well as on site-specific studies such as Saxena *et al.* (1995), Erskine (1964), and Hohn and Burns (1975), a total of 19 species of waterfowl are known or expected to breed in the Carson-Pegasus Provincial Park study area or vicinity, including ducks, geese, and swans. A species group whose habitats are closely associated with waterfowl habitat is the shorebirds. Shorebirds comprise a diverse group of species, including plovers, sandpipers, yellowlegs, snipes, godwits, curlews, and phalaropes. Based on geographic distributions reported by Salt and Salt (1976) and Semenchuk (1992), there are 7 species of shorebirds that are known or expected to occur in Carson-Pegasus Provincial Park or areas adjacent to the study area as summer resident breeders, however numerous more species are likely to be encountered as seasonal migrants.

All known and expected fish species occurring within Carson-Pegasus Provincial Park are listed within Table 5.

Table 5: Known or Expected Occurrences of Fish Species in Carson-Pegasus Provincial Park

Common Name	Species Name
finescale dace	*Phoxinus neogaeus*
longnose sucker	*Catostomus catostomus**
white sucker	*Catostomus commersoni**
northern pike	*Esox lucius**
lake whitefish	*Coregonus clupeaformis**
rainbow trout	*Oncorhynchus mykiss**
burbot	*Lota lota**
yellow perch	*Perca flavescens**

* Observations or known occurrences of fish species in Carson-Pegasus Provincial Park by G. Gilbertson (pers. comm.) and D. Hildebrandt (pers. comm.)

In the past, the park contained populations of arctic grayling (*Thymallus arcticus),* brook trout (*Salvelinus fontinalis),* walleye (*Stizostedion vitreum).*

At present, only McLeod Lake and Little McLeod Lake have documented occurrences of fish species in Carson-Pegasus Provincial Park. McLeod Lake contains rainbow trout, burbot, finescale dace, longnose and white suckers, while Little McLeod Lake contains populations of northern pike, yellow perch, and lake whitefish. Given the great diversity in hydrological habitats found within the park, a more intensive inventory of the park will likely reveal additional non-game species.

The herpetofaunal assemblage found within the Foothills of Alberta is not regarded as being extensive. Based on geographical distributions identified by Stebbins (1966) and Russell and Bauer (1993), a total of 4 species of amphibians and 2 species of reptiles are expected or known to occur in or adjacent to Carson-Pegasus Provincial Park (see Table 6).

Table 6: Known or Expected Occurrences of Herpetile Species in Carson-Pegasus Provincial Park

Common Name	Species Name
tiger salamander	*Ambystoma tigrinum*
western toad	*Bufo boreas*
striped chorus frog	*Pseudacris triseriata*
wood frog	*Rana sylvatica*
red-sided garter snake	*Thamnophis sirtalis*
wandering garter snake	*Thamnophis elegans*

Among the herpetofaunal assemblage, some species such as the red-sided garter snake, wood frog and striped chorus frog are widely distributed across Alberta throughout much of the foothills. Many species with affinities to either alpine or southern environments (tiger salamander or western toad for example) are at the northern periphery of their range in the Central Mixedwood Subregion.

3 FIELD SURVEY METHODOLOGY

Field sampling was conducted from August 17 to August 21, 1998 according to methods outlined in the Ecological Land Survey Site Description Manual (AEP 1994). Initially, potential field sample sites were selected by using aerial photographs. Site locations were chosen to document the range of environmental conditions throughout the area. At each site, information was collected on soils, parent materials, vegetation composition, and site characteristics, using standard field plot forms. Wildlife observations were also recorded. In total, 20 detailed plots were established in Carson-Pegasus Provincial Park and additional 21 visual sites. Plant taxonomy follows Moss (1983) with common names conforming to the Alberta Vegetation Species List (Alberta Forestry, Lands and Wildlife 1992). Photographs were also taken at most sites to illustrate physiographic and physiognomic characteristics.

3.1 Parameters Measured

The following parameters were measured in the field and were divided into site, soil, and vegetation forms. The information collected on the plot forms was integrated into the ELC legend.

Dominant site parameters:
- date
- fill roll and photo number
- aerial photography number
- surveyor
- locational data (latitude and longitude)
- elevation
- slope and aspect
- natural Subregion and Ecodistrict
- exposure
- flood hazard
- drainage class
- perviousness class
- site position (macro, meso, and micro class)
- site surface shape
- ecological moisture regime
- nutrient regime
- successional status
- factors influencing stand establishment
- surface substrate
- regeneration

Dominant soil parameters:

- soil class and soil series
- humus form class and variants
- parent material and surface expression
- coarse fragments and profile depth
- texture/organic component
- water table depth
- wetland classification
- soil horizon characteristics

Dominant vegetation parameters:

- species present and species composition including main canopy tree, understorey tree, epiphytes, tall shrub, low shrub, herb, grass, moss, and lichen.

Legend and database codes for several of the landscape and soil parameters follow *The Canadian System of Soil Classification* (Soil Classification Working Group 1998). Numerous other codes follow the system set by AEP (1994) in the *Ecological Land Survey Site Description Manual*.

3.2 Number of Field Sites Established

Field sites or plots, were established throughout the park and described by two types of plot forms. Detailed forms were used for 20 sites while reconnaissance forms provided a further 21 sites. Comparatively, detailed sites collected a greater depth of information while reconnaissance sites offered an efficient cursory method of attaining key site, soil, and vegetation data. In effect, reconnaissance sites provide a less detailed summary of the polygon or plot information than detailed sites but were used to quickly describe the sites, or to confirm the presence/absence of ecosystem and/or terrain units within a polygon.

3.3 Field Site Selection Criteria

One of the initial stages in the development of an Ecological Land Classification is the collection of field data to provide biophysical information specific to the study area. The information that was collected at these sites is described in Section 6.1.1. Prior to the commencement of field work, the study area was pre-stratified on aerial photography based on surficial material and landform type. Based on the pre-stratification, field sites were tentatively selected on aerial photos, such that sites that were selected would provide the most valuable information for assisting in the development of the ELC, significant ecological features, sensitive features, and disturbance features maps. Field sites were selected based on the following criteria, including:

1. describing natural vegetation and landscape community sites for the development of the Ecological Land Classification model for the park,
2. to ground-truth or confirm the presense/absence of various landscape and vegetation features,
3. to sample all of the various vegetation communities that make up the park, and
4. classifying diversity, rarity, and uniqueness as would be determined by a site's significant ethnohistorical / archaeological features, significant ecological features, sensitive features, and disturbance features.

In the field, adjustments were made to the originally selected location of the sites in order to relocate sites in areas where physiographic and physiognomic characteristics were as homogeneous as possible, in terms of plant composition, plant cover, and surficial expression. Specifically, sites were selected in areas that appeared to be good representative sites of habitats that were described and previously classified by Archibald *et al*. (1996). Sites located in transitional areas between homogeneous ecological units were avoided. Sites selected in unnatural areas were selected for the purpose of defining significant anthropogenic and disturbance features.

3.4 Aerial Photography Used

Five 1:15,000 black and white aerial photograph prints and indexes of August 1994 reproduction were interpreted for the mapping phases of the project.

4 ECOLOGICAL LAND CLASSIFICATION AND MAPPING METHODOLOGIES

4.1 Polygon Database Preparation

A digital database was prepared which incorporated the key characteristics of each map polygon. The database was formatted in dBASE IV and was structured in such a way as to be easily incorporated with spatial data files for future GIS analysis and presentation if required.

4.2 Ecological Land Classification Methods

Ecological Land Classification is a hierarchical landscape mapping system in that the land surface is subdivided and classified into areas of similar environments. The map units are characterized by recurring patterns of surficial materials, landform, soil, and vegetation. As per specified, ecosites were defined according to the *Field Guide to Ecosites of West-Central Alberta* (Beckingham *et al.* 1996).

In using the methodology detailed by Beckingham *et al.* (1996), ecological units were defined through an analysis of vegetation, site, and soil data. In order to classify and map ELC units, the landscape was generally divided into a four-tiered hierarchical system of ecoregions, ecodistricts, ecosections, and ecosites based on dominant landscape characteristics. In this project, the basic unit used for mapping at a scale of 1:20000 is the Ecosite. The higher levels of classification were considered in the initial interpretation but omitted from the final mapping. Beckingham *et al.* (1996) describes a more detailed classification that mirrors this system and includes a further subdivision within the landscape - the plant community type.

4.3 Mapping Techniques

In ELC mapping, the primary method used to derive ecological units is aerial photo interpretation. The land surface is first delineated into polygons according to factors such as slope, landform, drainage, and parent materials. After background data compilation and initial interpretation, field checks are carried out to verify descriptions of the map units and to compile more detailed site, soil, and vegetation information. Polygons are subdivided further into basic map units at the ecosite level in this process, through the use of aerial photograph interpretation. At this stage, the mapper relates the ecological site data for each plot site to observable features such as tonal and textural attributes of vegetation and slope class. An ecosite designation for each map unit is assigned using this technique.

4.4 Map Unit Symbols

Each map unit was given a descriptive ecosite symbol. For example, for the ecosite symbol M2.1, ‘M’ describes the primary landform, in this case moraine, while the following numeric character, “2”, describes a subdivision based on slope class, soil, and drainage. The final numeric character ‘1’ creates a subdivision based on groupings of vegetation community types nested within. Each landform and surficial materials and vegetation community type has also been assigned a letter code that is defined in Tables 7 and 8. The vegetation community type letter code is not part of the map unit symbol but does occur in the database. The landform and surficial materials are explained more thoroughly on the ELC map legend.

Table 7: Key to Landform and Surficial Materials Letter Codes

Code	Landform and Surficial Materials
F	Fluvial
GL	Glacial Lacustrine
L	Lacustrine
M	Morainal
O	Organic

Table 8: Key to Vegetation Type Letter Codes

Code	Vegetation Community Type
(HR1)	Beaked hazelnut/Indian hemp/hairy wild rye
(LC1)	Aspen poplar/low-bush cranberry
(LC2)	Aspen poplar-white spruce-lodgepole pine/prickly rose
(LC3)	Aspen poplar-white spruce-lodgepole pine/low-bush cranberry
(LC4)	Aspen poplar-white spruce-lodgepole pine/feathermoss
(LC5)	Aspen poplar-white spruce-lodgepole pine/Canada buffaloberry
(LC6)	White spruce/prickly rose
(LC7)	White spruce-balsam fir/feathermoss
(LC8)	Lodgepole pine/feathermoss
(BH1)	Aspen poplar-white spruce- lodgepole pine/bracted honeysuckle/fern
(BH2)	Aspen poplar-white spruce-lodgepole pine/balsam fir/fern
(BS1)	Black spruce-white spruce/Labrador tea/horsetail
(W1)	Willow/bluejoint-water sedge
(LT1)	Black spruce/Labrador tea/cloudberry/peat moss
(LT2)	Labrador tea/cloudberry/peat moss
(DB1)	Black spruce-tamarack/bog birch/sedge/peat moss
(DB2)	Bog birch-willow/sedge/peat moss
(DB3)	Bluejoint/woodland horsetail/peat moss
(T1)	Bluejoint/fireweed/marsh cinqfoil
(WS1)	Beaked sedge/water sedge-cattail
(SH1)	Swamp horsetail-great bulrush

4.5 Methods for the Identification of Significant Ethnohistorical / Archaeological Features, Significant Ecological Features, Sensitive Features, and Disturbance Features

4.5.1 Identification of Significant Ethnohistorical / Archaeological Features

The long-term occupation of Carson-Pegasus area by humans has culminated into the existence of several known prehistoric and historic sites in the park (AEP 1996a). The identification of significant ethnohistorical and archaeological features in Carson-Pegasus Provincial Park relied almost exclusively on the review of existing literature and personal communications with field experts. Sites that have been identified as ethnohistorical/archaeological features have been mapped on the Significant Features map.

4.5.2 Identification of Significant Ecological Features

Significant ecological features are generally defined as landscape elements or places that are vital to the long-term maintenance of biological diversity, soil, water, or other natural processes, both on-site and in a regional context (Jennings and Reganold 1991). Much of the early work in Canada concerning the development of criteria for identifying significant ecological features was borne out of numerous studies undertaken in southern Ontario. Eagles (1980, 1984) updated and further developed much of this work and documented various identification criteria. Studies by Eagles have formed the basis for criteria used in numerous environmental studies in various jurisdictions in Alberta (Bentz et al. 1995, Bilyk *et al.* 1996, Saxena et al. 1996, Sweetgrass Consultants Ltd. 1994).

The identification of significant features, particularly of rare flora and fauna, relied heavily on review of existing information as time constraints precluded the undertaking of intensive surveys required to identify populations in the field. Extrapolation was often required of data from studies in adjacent areas to the study area. Detailed field study will be required in many cases to confirm the occurrence of significant flora and fauna specifically within the study area. The significance of ecological sites within Carson-Pegasus Provincial Park was based on a consideration of several criteria. Summarized from the above documents (and others, e.g., Eagles 1984) are the following criteria used to identify significant ecological features in Carson-Pegasus Provincial Park:

- areas that perform a vital environmental, ecological, or hydrological function, such as aquifer discharge
- areas that contain rare or unique geological or physiographic features
- areas that contain significant, rare, or endangered plants or animal species
- areas that are unique habitats with limited representation in the region or are small remnants of once larger habitats which have virtually disappeared
- areas that contain an unusual diversity of plant and / or animal communities due to a variety of geomorphologic features and microclimatic effects
- areas that contain large and relatively undisturbed habitats and provide sheltered habitat or species that are intolerant of human disturbance
- areas that provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points
- areas that contain plants, animals, or landforms which are unusual or are of local, regional, provincial, national, or international significance
- areas that are excellent representatives of one or more ecosystems, habitats, or landscapes
- areas with intrinsic appeal due to widespread community interest or the presence of highly valued features or wildlife species valued for hunting
- areas with lengthy histories of scientific research
- areas containing specific old-growth values or older forest stands
- areas that perform a vital function for wildlife in the area

Each of the sites identified as a "Significant Ecological Feature" is categorized to a level of significance ranging from local, regional, provincial, national, or international significance. This evaluation requires considerable knowledge of significant features outside the jurisdiction under study. Existing scientific literature pertaining to rare, threatened, or endangered species (for example COSEWIC 1998, Wallis 1987, and Packer and Bradley 1984, ANHIC 1999) were utilized as well as available government, private industry, and scientific publications. When scientific data was lacking or unavailable, discipline experts were consulted to determine levels of significance. Levels of significance that were originally identified by Eagles (1984) and adopted by resource management agencies in Alberta (Braidwood 1987, Nordstrom 1987, Nelson *et al*. 1989) will be labeled to each identified significant ecological feature in the park and will be categorized as follows:

- **International** features that are unique in the world
- **National** features that are limited in distribution at a national level or which are the best or only representatives in Canada
- **Provincial** features that are of limited distribution or are the best examples of a feature in the province
- **Regional** features that are of limited distribution or are the best examples of a feature in the region
- **Local** features that are of limited distribution or are the best examples of a feature in the study area and vicinity

Features indicated on the Significant Ecological Features Map (Appendix G) have been identified from several sources, including literature reviews, personnel communications with park experts, and fieldwork. The locations of the each feature were then digitally incorporated into a base map of Carson-Pegasus Provincial Park where the features were labeled with an individual site number (that correlates with the ecologically significant features list) independent from the ELC, disturbance, or sensitive features maps. Some of the features were then identified by a polygon, are based on a known spatial area of occurrence of the feature (the only exception is the Riparian Communities in the Significant Ecological Features, see Section 4.5.2) and labeled with a site number. However, for several significant ecological features that have an unknown distribution or are identifiable only as a point location have been identified by a site number and dot location in the expected vicinity of the feature.

4.5.3 Identification of Sensitive Features

Soils, landscape, vegetation information, and significant ecological features collected during the course of detailed and reconnaissance surveys were used to assist in subsequent mapping of sensitive features. Sensitive sites include features that warrant particular recognition for their susceptibility to foreign influences that could potentially negatively impact their condition.

Environmental sensitivity ratings are often used as an evaluation of the performance of a site in response to various land uses or disturbance types (Bentz and Saxena 1993, O'Leary *et al.* 1993). The sensitivity classification scale is consistent with numerous ecological mapping projects completed in Alberta (Bradshaw *et al.* 1994, 1995, 1996, 1997, Bruhjell *et al.* 1997). Sensitivity ratings indicate the extent of remediation that is likely required after disturbance. For example, landscapes with a low sensitivity to disturbance can be easily remedied by standard operating procedures. Conversely, other lands may be more sensitive to disturbance and require a greater mitigation because they possess at least one of the following characteristics (Bentz and Saxena 1993):

- **a very high susceptibility to erosion,**
- **severe limitations to revegetation, or**
- **distinctive, rare, or unusual landforms, wildlife populations or plant communities that are regionally, provincially, nationally, or internationally significant.**

Sensitive features are identified and mapped on the basis of vegetation community types, significant ecological features, and slope class. Sites that are considered sensitive will be classified and mapped (see Sensitive Feature Map in Appendix G) based on the following scale.

Very High Sensitivity - any direct, indirect, spatial, or temporal disturbance can be expected to result in complete loss of the significant natural feature and mitigation to maintain vital ecological functions is considered not feasible without further study

High Sensitivity - the disturbance can be expected to result in a complete loss of the significant natural feature or require major mitigation and very restrictive operating conditions to maintain the vital ecological functions of the feature

Moderate Sensitivity- the disturbance will result in considerable loss in modification of the significant natural feature. Significant mitigation and restrictive operating conditions are likely required to maintain the vital ecological functions of the feature

Low Sensitivity - the disturbance will result in minor loss or modification to the significant natural feature. Some mitigation and normal operating restrictions may be required to maintain the long-term viability and vitality of the feature

Insignificant Sensitivity -the disturbance will have no measurable impact on the significant natural feature

Originally, the ELC polygons were used as a preliminary method of ensuring similar ecosystem units. A rating was then applied to each ecosystem unit based on the expected sensitivity of the polygon to certain criteria, including soil erosion, revegetation limits, and distinctive, rare, or unusual landforms, wildlife populations or plant communities that contained regional, provincial, national, or international significance. Collectively, all adjacent polygon units of homogenous or similar sensitivity ratings were collectivity joined to create larger units of a single common rating. A stipulation when interpreting the sensitivity rating for any given polygon requires that the rating represent the greatest portions of the polygon with that rating. By no means does the polygon sensitivity rating represent the highest possible rating that could potentially occur within the polygon. Therefore, some polygons, such as riparian polygons, have ratings that apply primarily to the riparian zone with decreasing gradients of sensitivity with increased distance from the watercourse.

4.5.4 Identification of Disturbance Features

Disturbance features within Carson-Pegasus Provincial Park were located and identified through a combination of aerial photograph interpretation and field investigations. Digital files of disturbance features (provided by Alberta Environment) within the park were supplemented and updated with a thorough review of disturbance features that had not been mapped but were visible on air photos. Disturbance features included all areas where anthropogenic developments and activities were readily observable from the ground and from aerial photography. Disturbance features included but were not limited to the following categories and classes:

Recreational - improved roads, unimproved roads, trails, campsites, et. cetera...
Industrial - oil/gas activity sites, pipelines, transmission lines, industrial plant sites, et. cetera...

Types of disturbance features that are likely to be identified within the park will include features such as, the recreational campground, ranger station, the road and trail network, pipelines, cutlines, and well-sites. Identified disturbance features in Carson-Pegasus Provincial Park are identified in Appendix G.

4.6 Selected Ecosite Interpretations (Ecosite Hazards)

The interpretation of the rutting, compaction, puddling, soil erosion, frost heave, and wind throw hazards presented in this report were mostly taken directly from *Field Guide to Ecosites of West-Central Alberta* (Beckingham *et al.* 1996, Corns and Archibald 1996). The ratings for these interpretations have been modified in a few ecosites to reflect local conditions. Five levels were used to rate each ecosite: low (L), low to medium (L-M), medium (M), medium to high (M-H), and high (H).

The interpretation of the flood hazard presented in this report is based on the definitions provided in the *Ecological Land Survey Site Description Manual* (AEP 1994). Four hazard levels were used to rate each ecosite: no hazard, rare, may be expected, and frequent.

A brief overview of each interpretation is presented below. A full description of these interpretations can be found in Beckingham *et al*. (1996) and AEP (1994).

Rutting Hazard

Rutting hazard refers to the risk of soil displacement by machine traffic during the summer months. The ratings are based on soil moisture content and soil drainage. Soil displacement can result in changes to water infiltration rates, soil heat flux, root penetration, and oxygen diffusion rates, all of which can influence soil quality and soil productivity. High risk ratings indicate that summer operations are usually not possible, medium ratings indicate that summer operations may be possible during dry periods and low risk ratings indicate that summer operations are usually possible (Beckingham *et al.* 1996, Corns and Archibald 1996).

Compaction Hazard

Compaction hazard refers to the risk of soil compaction by machine traffic during the summer months. The ratings are based on soil moisture content and soil drainage. Soil compaction can result in changes to water infiltration rates, soil heat flux, root penetration, and oxygen diffusion rates, all of which can influence soil quality and soil productivity. High risk ratings indicate that summer operations are usually not possible, medium ratings indicate that summer operations may be possible during dry periods and low risk ratings indicate that summer operations are usually possible (Beckingham *et al.* 1996, Corns and Archibald 1996).

Puddling Hazard

Puddling hazard refers to the risk of a dense crust forming on the surface soil as a result of equipment operations and/or the impact of rainfall on exposed mineral surfaces. This dense crust can result in restricted soil drainage, poor aeration and increased seedling mortality rates. Ratings are based on the soil moisture regime, surface texture and on the assumption that organic layers are disturbed during equipment operations (Beckingham *et al.* 1996, Corns and Archibald 1996). The best prevention against soil puddling is to avoid operations during wet periods and to leave the surface organic layer intact (Corns and Annas 1986).

Soil Erosion Hazard

Soil erosion hazard refers to the susceptibility of the soil to surface water erosion. Water erosion results in the loss of individual soil particles and organic matter, resulting in reduced water holding capacity, lowered water infiltration rates and reduced fertility levels. The erodibility of a given soil is dependent upon several factors, including vegetation cover, slope length, texture, organic matter content, soil structure (affects water infiltration rates) and rainfall intensity. The soil erosion ratings given here are based on the soil moisture regime, surface texture and on the assumption that organic layers are disturbed during equipment operations (Beckingham *et al.* 1996, Corns and Archibald 1996).

Frost Heave Hazard

Frost heave hazard refers to the risk of tree seedlings being forced up and out or partly out of the soil when soil water freezes into an ice lens near the surface of the soil. Those soils having a high silt content are the most susceptible with sandy and clay soils being less susceptible to frost heave. Ratings are based on the soil moisture regime, surface texture and on the assumption that organic layers are disturbed during equipment operations (Beckingham *et al.* 1996, Corns and Archibald 1996).

Wind Throw Hazard

Windthrow hazard refers to the risk of the wind blowing down a tree and having part or all of the root system and some surface soil thrown into the air. Several factors can influence the susceptibility of a site, including exposure, topography, type of root system, organic layer thickness, water table depth and soil texture. In general, any factor that reduces the ability of a root system to firmly anchor a tree increases the windthrow hazard. The hazard ratings presented here are based of organic thickness, presence of water table, tree rooting habit and effective soil texture (Beckingham *et al.* 1996, Corns and Archibald 1996).

Flood Hazard

Flood hazard refers to the risk of flooding by rivers, creeks and streams, not to periodic high water tables. Several site characteristics are used to rate the flood hazard, including litter cover, sediment deposits, scour holes, fluvial transported debris, vegetation cover, topography and soil classification (AEP 1994).

5 DESCRIPTION OF VEGETATION COMMUNITY TYPES

Plant community types are the lowest taxonomic unit in Beckingham *et al.* (1996). These vegetation community types are not mappable from small-scale panchromatic aerial photographs, but rather are delineated in the field on the basis of ecological site conditions, including parent material, soils, soil texture, slope, aspect, moisture regime, drainage, salinity, and grazing intensity.

Vegetation community types have been defined according to the methods and protocols set forth by Beckingham *et al.* (1996). Guidelines for the description and classification of vegetation are outlined by Lacate (1969) in *Guidelines for Biophysical Land Classification* and reiterated by Beckingham et al. (1996) and both were followed in describing vegetation structure, species composition and abundance.

Plant community types were named primarily using the species names of each dominant plant per strata. Dominance was defined where cover values equalled or exceeded 10% of the plot. An exception to this method was made for uncommon community types where plant species were restricted to a narrow range of ecological conditions occurring with cover values less than 10%. These plant species defined the community type, despite their low cover values within the park.

5.1 Brief Summary of Each Vegetation Community Type, with Occurrence, Dominant Species, and Characteristic Site Conditions

A total of 21 community types were identified within the study area, and are listed in order of increasing site moisture from submesic to hydric conditions as follows:

1.	Beaked hazelnut/Indian hemp/hairy wild rye	(HR1)
2.	Aspen poplar/low-bush cranberry	(LC1)[1]
3.	Aspen poplar-white spruce-lodgepole pine/prickly rose	(LC2)[1]
4.	Aspen poplar-white spruce-lodgepole pine/low-bush cranberry	(LC3)[1]
5.	Aspen poplar-white spruce-lodgepole pine/feathermoss	(LC4)[1]
6.	Aspen poplar-white spruce-lodgepole pine/Canada buffaloberry	(LC5)[1]
7.	White spruce/prickly rose	(LC6)[1]
8.	White spruce-balsam fir/feathermoss	(LC7)[1]
9.	Lodgepole pine/feathermoss	(LC8)[1]
10.	Aspen poplar-white spruce- lodgepole pine/bracted honeysuckle/fern	(BH1)[1]
11.	Aspen poplar-white spruce-lodgepole pine/balsam fir/fern	(BH2)[1]
12.	Black spruce-white spruce/Labrador tea/horsetail	(BS1)[1]
13.	Willow/bluejoint-water sedge	(W1)[1]
14.	Black spruce/Labrador tea/cloudberry/peat moss	(LT1)[1]
15.	Labrador tea/cloudberry/peat moss	(LT2)[1]
16.	Black spruce-tamarack/bog birch/sedge/peat moss	(DB1)[1]
17.	Bog birch-willow/sedge/peat moss	(DB2)[1]
18.	Bluejoint/woodland horsetail/peat moss	(DB3)
19.	Bluejoint/fireweed/marsh cinqfoil	(T1)
20.	Beaked sedge/water sedge-cattail	(WS1)[1]
21.	Swamp horsetail-great bulrush	(SH1)[1]

[1] Vegetation community developed by Beckingham *et al.* (1996)

Table 9 displays the distribution of plot site numbers with vegetation community types in the park.

Table 9: Summary of Vegetation Community Types and Reference Sites (plots)

Vegetation community type	Plot #
Beaked sedge/water sedge-cattail (WS1)	12,17
Swamp horsetail-great bulrush (SH1)	11, 26
Black spruce/Labrador tea/cloudberry/peat moss (LT1)	8, 28
Labrador tea/cloudberry/peat moss (LT2)	1, 7,13,10
Black spruce-tamarack/bog birch/sedge/peat moss (DB1)	19
Bog birch-willow/sedge/peat moss (DB2)	4, 35,22
Bluejoint/woodland horsetail/peat moss (DB3)	3
Bluejoint/fireweed/marsh cinquefoil (T3)	38
Black spruce-white spruce/Labrador tea/horsetail (BS1)	37, 41
Aspen poplar-white spruce- lodgepole pine/bracted honeysuckle/fern (BH1)	6, 31,16
Aspen poplar/low-bush cranberry (LC1)	5,9
Aspen poplar-white spruce-lodgepole pine/prickly rose (LC2)	39
Aspen poplar-white spruce-lodgepole pine/low-bush cranberry (LC3)	2,14,15,21,30
Aspen poplar-white spruce-lodgepole pine/feathermoss (LC4)	34
Aspen poplar-white spruce-lodgepole pine/Canada buffaloberry (LC5)	20
White spruce/prickly rose (LC6)	36
White spruce-balsam fir/feathermoss (LC7)	24, 32,33
Lodgepole pine/feathermoss (LC8)	25
Beaked hazelnut/Indian hemp/hairy wild rye (HR1)	40, 39 (notes)
Willow/bluejoint-water sedge (W1)	18
Aspen poplar-white spruce- lodgepole pine/balsam fir/fern (BH2)	23
road disturbance Awnless brome/ White clover/ Common horsetail/ Balsam poplar	29 (notes)
wellsite disturbance Timothy/ White clover/Foxtail barley	27
pipeline disturbance Willow/Balsam poplar/ bluejoint/Canada thistle/white clover	photo 311 (notes)

It is expected that each community type will have a relatively wide variation in species composition and abundance from site to site. A description of each type is presented below.

(1) <u>Beaked hazelnut/Indian hemp/hairy wild rye</u> (HR1):
(not defined in Beckingham et al. (1996))

This non-forested, young, edaphic low shrub community type is restricted to steep south-facing slopes comprised of fine textured glaciofluvial blankets and veneers overlying non-stony slightly calcareous fine textured till in the park. Soils are dominated by well to moderately well drained Orthic Gray Luvisols, and Brunisolic Gray Luvisols. Minor amounts of Gleysols and Gleyed Gray Luvisols are present in lower slope positions. This disclimax community is characteriazed by a sparse tree canopy less than 1% and a dense low-shrub layer dominated by beaked hazelnut (*Corylus cornuta*). Several shrub species typical of warm dry edaphic conditions occur in this community type. The shrub layer is dominated by Beaked hazelnut (*Corylus cornuta*), wild red raspberry (*Rubus idaeus*), saskatoon (*Amelanchier alnifolia*), common snowberry (*Symphoricarpos albus*), and chokecherry (*Prunus virginiana*). Bluejoint (*Calamagrostis canadensis*) is the dominant herb, forming a dense cover in the herb layer in association with hairy wildrye (*Elymus innovatus*), slender wheatgrass (*Agropyron trachycaulum*), and fringed brome (*Bromus ciliatus*). Wild strawberry (*Fragaria virginiana*), fringed aster (*Aster ciliolatus*), and wild sarsaparilla (*Aralia nudicaulis*) are the most common forbs of a relatively diverse forb stratum. Beaked hazelnut (*Corylus cornuta*) and chokecherry (*Prunus virginiana*) formed a significant cover only in this community type within the Carson-Pegasus Provincial Park

(2) <u>Aspen poplar/low-bush cranberry</u> (LC1):
(Beckingham et al. (1996) defined as: low-bush cranberry Aw)

This young climatic climax community is common on hummocky, ridged and inclined, moderately fine to fine textured, non-calcareous till in southern portions of the park. Soils are moderately well drained Orthic Gray Luvisols and Brunisolic Gray Luvisols. Some polygons may have minor amounts of Gleysols and Gleyed Gray Luvisols in locations with high water tables.

Aspen poplar (*Populus tremuloides*) forms the canopy, which ranges from 40 percent crown closure in fire disturbance seral stands to 10 percent crown closure in mature stands. White birch (*Betula papyrifera*) occasionally is co-dominant in the canopy and scattered white spruce (*Picea glauca*) is often present in the regeneration layer. Low-bush cranberry (*Viburnum edule*), twinflower (*Linnaea borealis*), and prickly rose (*Rosa acicularis*), comprise the low-shrub layer in this community. The relatively diverse herb layer is dominated by wild sarsaparilla (*Aralia nudicaulis*), bunchberry (*Cornus canadensis*), cream-coloured vetchling (*Lathyrus ochroleucus*), dewberry (*Rubus pubescens*), and common pink wintergreen (*Pyrola asarifolia*). The only significant moss in the sparse moss layer is *Brachythecium salebrosum.*

(3) <u>Aspen poplar-white spruce-lodgepole pine/prickly rose</u> (LC2):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/prickly rose)

This forested, mature edaphic-climax community is restricted to hummocky, moderately fine to fine textured, non-calcareous till within the park. Soils are predominantly moderately well drained Orthic Gray Luvisols and Brunisolic Gray Luvisols. Aspen poplar, white spruce (*Picea glauca*) and lodgepole pine (*Pinus contorta*) form the open canopy.

Common prickly rose (*Rosa woodsii*), dominates the low shrub understorey in association with wild red raspberry (*Rubus idaeus*) and low-bush cranberry. The open herb layer has cover values of >15%, comprised of several forb species characteristic of drier edaphic conditions including heart-leaved arnica (*Arnica cordifolia*), hairbell (*Campanula rotundifolia*), Lindley's aster (*Aster ciliolatus*), and wild strawberry (*Fragaria virginiana*). The relatively dense graminoid layer is dominated by bluejoint (*Calamagrostis canadensis*). The moss layer is poorly developed.

(4) <u>Aspen poplar-white spruce-lodgepole pine/low-bush cranberry</u> (LC3):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/low-bush cranberry)

This forested, edaphic-climax community type has developed on moderately fine to fine textured non-calcareous till and non-calcareous glaciolacustrine veneers and blankets overlying fine textured slightly calcareous till. It is the most common community type in the study area, occurring in 13 percent of reference sites representing approximatey 25% of the park area. Surface expression varies from hummocky and ridged to gently inclined slopes. Moderately well-drained Orthic Gray Luvisols are the main soil type in this community. The canopy is dominated by aspen poplar, white spruce, and to a lesser extent, lodgepole pine, white birch (*Betula papyrifera*) and balsam fir (*Abies balsamea*)(see Appendix A, photograph 12).

The low-shrub layer is typically a moderate to dense cover of low-bush cranberry, twinflower, dewberry (*Rubus pubescens*), and prickly rose with reference sites having combined cover values of 25-60 percent for these species. Moist-site indicator shrubs such as bracted honeysuckle (*Lonicera involucrata*) and bristly black currant (*Ribes lacustre*) are present with low cover values in this community type. The herb layer has cover values of 25 - 40 percent, comprised of a diversity of species including wild sarsaparilla, bunchberry, tall lungwort (*Mertensia paniculata*), and bluejoint. Wild lily-of-the valley (*Maianthemum canadense*), false Soloman's-seal (Smilacena racemosa), and bishop's cap (*Mitella nuda*) form minor components of the herb layer. Mosses typically had cover values of less than 10 percent, although at reference sites in older multistoried stands, cover values exceeded 60 percent. Feathermosses such as knight's plume (*Ptilium crista-castrensis*), Schreber's moss (*Pleurozium scheberi*) and stair-step moss (*Hylocomium splendens*) dominate.

(5) <u>Aspen poplar-white spruce-lodgepole pine/feathermoss</u> (LC4):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/feathermoss)

This forested, mature edaphic climax community type is found on submesic, well-drained slightly calcareous till, and on veneers and blankets of glaciolacustrine and fluviolacustrine deposits overlying fine textured till. Surface expression ranges from hummocky and ridged to subdued hummocky and inclined. Soils in this community type are Orthic Gray Luvisols and Brunisolic Gray Luvisols. The canopies are relatively open and dominated by aspen poplar, white spruce, and lodgepole pine. This community is common in the northern half of the park, but occurs infrequently elsewhere.

The tall shrub layer sporadically contained bracted honeysuckle and low bush cranberry with cover values of less than 5%. The low shrub layer is dominated by twinflower with 10-20% cover values. Common pink wintergreen (*Pyrola asarifolia*), bunchberry, and one-sided wintergreen (*Orthilia secunda*) are among the few forb species in the open herb layer. Knight's plume, Schreber's moss, and stair-step moss form a characteristic dense feathermoss carpet under the relatively open canopy.

(6) <u>Aspen poplar-white spruce-lodgepole pine/Canada buffaloberry</u> (LC5):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/Canada buffaloberry)

This mature, edaphic community type within the park is restricted to localized sites where well drained, edaphic conditions exist on hummocky and ridged morainal, glaciolacustrine, and fluviolacustrine deposits. Medium and fine-textured Orthic Gray Luvisols and Brunisolic Gray Luvisols are the dominant soils in this community type. Dominant tree species are aspen poplar, white spruce and lodgepole pine and typically they form open crown closures less than 20% cover values (see Appendix A, photograph 5,.

This community type is distinguished from LC4 by the presence of Canada buffaloberry in the low shrub layer and a poorly developed moss layer. Canada buffaloberry comprised the low shrub layer in association with twinflower and prickly rose. Canada buffaloberry was observed only in this community type within the park and had cover values of less than 10% at the reference site. Showy aster (*Aster conspicuous*) and graminoids such as fringed brome (*Bromus ciliatus*) and hairy wild rye tall are common in this community type. Other forbs include lungwort, common wintergreen, and wild strawberry. Stair-step moss and Schreber's moss dominate the sparse feathermoss layer.

(7) <u>White spruce/prickly rose</u> (LC6):
(Beckingham et al. (1996) defined as: Sw/prickly rose)

This forested, mature edaphic community type is located on hummocky and ridged, fine-textured, well drained, slightly calcareous till with discontinuous veneers and blankets of lacustrine material. Soils are predominantly well-drained Orthic Gray Luvisols. The open canopy is typically comprised of white spruce and aspen poplar. Balsam fir and white birch formed a significant portion of the canopy within the reference site for this community type. This community type is relatively common in the northern half of the park.

The low-shrub layer is dominated by common wild rose. Other shrubs include low-bush cranberry, saskatoon, wild red raspberry, snowberry, and twining honeysuckle (*Lonicera dioica*). The herb layer has cover values of greater than 40% with a large component of bluejoint where canopy openings occur. The diverse forb layer is represented by bunchberry, dewberry, bishop's cap, and wild sarsaparilla. Mosses comprise a minor component in this community.

(8) <u>White spruce-balsam fir/feathermoss</u> (LC7):
(Beckingham et al. (1996) defined as: Sw/fir/feathermoss)

This forested, climatic climax community type occurs on mesic, moderately well drained, fine-textured till. Surface expression is predominantly hummocky and ridged although gently inclined and subdued hummocky topography does occur. Soils are predominantly Orthic Gleysols. It occasionally is found on steep west-facing slopes where submesic conditions exist. Soils are predominantly well drained Orthic Gray Luvisols. Tree canopy species are shade-tolerant white spruce and balsam fir forming long-lived stands. This community type is restricted to localized sites within the park.

This climatic climax community contains 20-25 m balsam fir and white spruce, the largest and possibly the oldest within Carson-Pegasus Provincial Park (see Appendix A, photograph 7). In the reference sites surveyed, old stands were dominated by balsam fir and white spruce. In mature stands aspen poplar, lodgepole pine, balsam poplar (*Populus balsamifera*), and white birch formed mixedwood stands in association with white spruce.

The shrub layer is typified by balsam fir regeneration with a low representation of other species except twinflower. In old stands balsam fir regeneration persists beneath the multi-storied canopy with minor cover of bristly black current, bracted honeysuckle, prickly rose, low-bush cranberry, and western mountain-ash (*Sorbus scopulina*). The herb layer consists of a moderate cover of forbs including wild sarsaparilla, bishop's cap, and bunchberry. In old stands, oak fern (*Gymnocarpium dryopteris*) and narrow spinulose shield fern (*Dryopteris carthusiana*) are occasionally present. The moss layer is well-developed, comprised primarily of stair-step moss, Schreber's moss, and *Brachythecium salebrosum*. Witches' beard (*Alectoria* spp.) and *Hypogymnia imshaugii* are the common epiphytic lichens in old balsam fir stands.

(9) <u>Lodgepole pine/feathermoss</u> (LC8):
(Beckingham et al. (1996) defined as: Pl/feathermoss)

This young to mature climatic climax community type is found on moderately well to well drained hummocky and inclined terrain, where surficial materials consist of moderately fine textured till. Soils on these mesic and submesic sites are predominately Orthic Gray Luvisols. This community type has a canopy dominated by lodgepole pine, with a sparse herb layer and feathermoss carpet. Minor components of white spruce and balsam fir are sometimes present in the regeneration layer, although typically they are absent. This community type commonly occurs in the northern half of the park but is uncommon elsewhere (see Appendix A, photograph 11).

The shrub layer is dominated by twinflower with a minor cover of prickly rose. Beaked hazelnut, a species observed elsewhere in the park growing on steep south-facing slopes, was present on gently-sloping, mesic sites under a 17 percent lodgepole pine canopy. Forbs comprising the sparse herb layer include one-sided wintergreen, common pink wintergreen, stiff club-moss (*Lycopodium annotonium*), and lesser rattlesnake-plantain (*Goodyera repens*). Stair-step moss, knight's plume, and Schreber's moss form a dense moss carpet.

(10) <u>Aspen poplar-white spruce- lodgepole pine/bracted honeysuckle/fern</u> (BH1):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/bracted honeysuckle/fern)

This mature, edaphic community type occurs primarily on imperfectly drained, level to gently undulating, fine-textured glaciolacustrine deposits, and in lower slope positions within low relief hummocky and inclined morainal material. Soils are typically moderately well-drained Orthic Gray Luvisols and Orthic Gleysols, with some occurrence of gleyed Gray Luvisols. This community type is restricted in occurrence to localized sites within the park.

The mesic to subhydric moisture conditions produce a vigorous herb layer and produce an abundance of several moist-site shrub species. Typically tall balsam poplar and white spruce reach 20-25 m on these sites forming an open canopy allowing a high diversity of shrub and herb species in the understory. Northern black currant (*Ribes hudsonianum*), bracted honeysuckle, river alder (*Alnus tenuifolia*), red-osier dogwood (*Cornus stolonifera*), and common prickly rose are common components of the shrub layer. The herb layer includes several forb species restricted in distribution within the park; narrow spinulose shield fern, small enchanter's nightshade (*Circaea alpina*), oak fern, lady fern (*Athyrium felix-femina*), marsh-marigold (*Caltha palustris*), tall larkspur (*Delphinium glaucum*), kneeling angelica (*Angelica genuflexa*). A dense grass cover of bluejoint and fringed brome dominates disturbed areas with tall larkspur and cow parsnip.

Leafy mosses such as *Rhizomnium pseudopunctatum* are common on subhydric sites while ragged mosses and feathermosses form a sparse cover under mesic conditions.

(11) <u>Aspen poplar-white spruce- lodgepole pine/balsam fir/fern</u> (BH2):
(Beckingham et al. (1996) defined as: Aw-Sw-Pl/fir/fern)

This localized, forested, mature edaphic climax community occurs on undulating moderately fine to fine-textured non-calcareous till. Orthic Gray Luvisols occur on moderately well drained sites, and where wetter conditions persist, Orthic Gleysols and peaty Orthic Gleysols. The tree canopy is dominated by white spruce, aspen poplar, with lesser amounts of balsam poplar. The low shrub layer is dominated by balsam fir regeneration This community type is restricted in occurrence to a few localized sites in the park.

Twinflower dominateds the low shrub layer with cover values over 10%. Bracted honeysuckle, low-bush cranberry, and twinflower are common shrubs in this community. The mesic to subhygric soil conditions support a high cover of forbs (greater than 25% cover values), predominantly wild sarsaparilla, bunchberry, stiff clubmoss, and occasionally oak fern. Red-stemmed pipecleaner moss (*Rhytiadelphous triquetrus*), stair step moss, Schreber's moss, and knight's plume dominate the moss layer.

(12) <u>Black spruce-white spruce/Labrador tea/horsetail</u> (BS1):
(Beckingham et al. (1996) defined as: Sb-Sw/Labrador tea/horsetail)

This is a mature edaphic community type commonly occurring in the park. It is found on thin organic accumulations with poor to imperfect drainage often forming a transition between poor fens/ bogs and upland forested community types. This community also occurs with lesser frequency on poorly drained morainal substrates. Under these conditions, high water tables are often present allowing the formation of Orthic Gleysols and peaty Orthic Gleysols. Typic Mesisols and some Humic Mesisols are common organic soils in this community type.

This community is characterized by black spruce (*Picea mariana*) which forms a dense canopy in young seral stands in association with willow (*Salix* spp.). The low shrub layer (typical cover values of 25%) is dominated by Labrador tea (*Ledum groenlandicum*). Commonly associated low shrubs are bracted honeysuckle, prickly rose, cloudberry (*Rubus chamaemorus*), and bog cranberry (*Vaccinium vitis-idaea*). The open herb layer is dominated by several horsetail species; woodland horsetail (*Equisetum sylvaticum*) and dwarf scouring-rush (*Equisetum scirpoides*) were the dominant herb species in the reference sites, and bunchberry. White adder's mouth (*Malaxis monophylla*) a rare orchid species (ANHIC 1999) was identified at a reference site in a young seral stand. This reference site also featured a 15 percent cover of water sedge (*Carex aquatilis*) with yarrow (*Achillea millefolium*), one-sided wintergreen, and one-flowered wintergreen (*Moneses uniflora*). Common feathermosses such as knight's plume, Schreber's moss, and peat moss (*Sphagnum* spp.) typically produce a dense carpet in these stands.

(13) <u>Willow/bluejoint-water sedge</u> (W1)
(Beckingham et al. (1996) defined as: willow meadow)

This young, edaphic low shrub community type is restricted to localized site in the park on poorly drained level fluvial terraces composed of fine and moderately fine-textured calcareous glaciofluvial and fluvial sediments. Soils in this ecosite are poorly drained peaty Rego Gleysols and peaty Orthic Gleysols. These conditions often occur where hydrology has been altered in the past, such as in old beaver ponds (see Appendix A, photograph 4).

These sites are typified by a moderate to low shrub cover dominated by several willow species. A dense cover (>75%) of water sedge (*Carex aquatilis*) and bluejoint comprise the graminoid layer. Forbs such as striate knotweed (*Polygonum erectum*), marsh cinquefoil, fireweed (*Epilobium angustifolium*), and wild mint (*Mentha arvensis*) form a comparatively sparse cover relative to the graminoids.

(14) <u>Black spruce/Labrador tea/cloudberry/peat moss</u> *(*LT1):
(Beckingham et al. (1996) defined as: Sb/Labrador tea/cloudberry/peat moss)

This mature edaphic wetland community type occurs on thick organic deposits with oligotrophic (very poor) nutrient regimes typical of very poorly drained depressions. Soils at these sites are dominantly Typic Mesisols, with lesser amounts of Humic Mesisols, Terric Mesisols, and Terric Humic Mesisols. This community type is characteristically common throughout the park.

The moderately to lightly stocked tree layer is dominated by black spruce, with a minor component of tamarack (*Larix laricina*). Labrador tea (*Ledum groenlandicim*) dominates the open shrub layer in association with cloudberry (*Rubus chamaemorus*), bog cranberry (*Vaccinium vitis-idaea*), and small bog cranberry (*Oxycoccus microcarpus*). Three-leaved Soloman's-seal (*Smilacena trifoliata*) has a high presence value but very low cover. Lapland buttercup (*Ranunculus lapponicus*) was recorded only in this community type. The dense bryophyte layer is dominated by mosses, including Schreber's moss and knight's plume.

(15) <u>Labrador tea/cloudberry/peat moss</u> (LT2):
(Beckingham et al. (1996) defined as: Labrador tea/cloudberry/peat moss)

This young, edaphic community type occurs on organic materials with oligotrophic (very poor) nutrient regimes found in very poorly drained depressions. Soils are dominantly Humic Mesisols, Terric Mesisols, and Terric Humic Mesisols. This community type commonly occurs throughout the park and can be differentiated from LT1 by the absence of black spruce from the tree strata.

Black spruce typifies these young edaphic climax sites, representing cover values in the low shrub layer exceeding 40 percent. This species was found only occasionally to attain tree stature on these sites in the study area, likely due to frequent fire disturbance. Tamarack was represented by few individuals in 25% of the plots in this community type. Other species common in the moderately dense shrub layer are Labrador tea, cloudberry, bog cranberry, and small bog cranberry. The sparse herb layer is represented by three-leaved Soloman's-seal and lens-fruited sedge (*Carex lenticularis*). Where water levels have been raised by beaver activity, representative vegetation such as black spruce and Labrador tea undergo high mortality. The pioneer seral community is then dominated by slender sedge (*Carex lasiocarpa*) and nodding beggarticks (*Bidens cernua*).

The moss layer is typified by peat mosses (*Sphagnum* spp.) although on some sites Schreber's moss dominates. Other species including golden moss (*Tomenthypnum nitens*) and stair-step moss have a low presence and cover.

(16) <u>Black spruce-tamarack/bog birch/sedge/peat moss</u> (DB1):
(Beckingham et al. (1996) defined as: Sb-Lt/dwarf birch/sedge/peat moss)

This mature, edaphic climax community type is found primarily on very poorly drained thick organic deposits with submesotrophic (poor) nutrient regimes. Soils are predominately Typic Mesisols, with lesser amounts of Humic Mesisols, Terric Mesisols, and Terric Humic Mesisols. This community type is less common than the LT2 wetland community type (see Appendix A, photograph 3).

Unlike the previous two community types, tamarack is the dominant tree species in association with black spruce, and dwarf birch (*Betula pumila*) is the dominant shrub in association with Labrador tea and bracted honeysuckle (*Lonicera involucrata*). Sedges and bluejoint covered 18 percent of the reference site for this community type while forbs including three-flowered Solomon's seal and sweet-scented bedstraw (*Galium triflorum*) covered 8 percent of the area. Marsh-marigold (*Caltha palustris*) was recorded only in this community type. A high cover (55%) of Schreber's moss in association with stair-step moss and golden moss is characteristic of this community type with peat moss comprising only 10 percent cover.

(17) <u>Bog birch-willow-sedge/peat moss</u> (DB2):
(Beckingham et al. (1996) defined as: dwarf birch-willow/sedge/peat moss)

This young, edaphic climax community type is found primarily on very poorly drained thick organic deposits with submesotrophic (poor) nutrient regimes. Soils are predominately Typic Mesisols, with significant amounts of Humic Mesisols, Terric Mesisols, and Terric Humic Mesisols. This community type is found in several locations throughout the park adjacent to large waterbodies.

This community type typified by a significant graminoid cover exceeding 40 percent and a lack of tall shrubs and black spruce. Where this community has a hydric moisture regime water sedge (*Carex aquatilis*), beaked sedge (*Carex utriculata*), and thin-flowered sedge (*Carex tenuiflora)* dominate the graminoid layer, while under subhydric conditions bluejoint dominates. On hydric sites brown mosses form a high cover while on subhydric sites peat moss dominates. On both sites dwarf birch and bog willow (*Salix pedicularis*) are present, although only on hydric sites does bog willow form a high cover. Russett cotton grass (*Eriophorum chamissonis*) and buck bean (*Menyanthes trifoliata*) were restricted to this community type.

(18) <u>Bluejoint/woodland horsetail/peat moss</u> (DB3):
(not defined in Beckingham et al. (1996))

This community type occurs on poorly drained shallow organic deposits in small depressions subject to cold air accumulation. The soil nutrient regime is submesotrophic (poor). Soils dominated by Terric Mesisols and peaty Orthic Gleysols with a poor nutrient regime. These sites are restricted to a few locations in the southern half of the park.

The graminoid layer is well-developed with over 70 percent combined cover of bluejoint and woodland horsetail (*Equisetum sylvaticum*). Peat moss dominates the dense moss layer with cover values over 50%.

(19) <u>Bluejoint/fireweed/marsh cinquefoil</u> (T1):
(not defined in Beckingham et al. (1996))

This community type is restricted in the park to infrequently occuring shallow organic deposits over fluviolacustrine material. These sites have a mesotrophic nutrient regime and a hygric moisture regime. Soils are predominantly Terric Mesisols and peaty Orthic Gleysols. These conditions occur along meandering creeks where periodic damming by beavers has occurred.

A thick herb layer dominated by bluejoint restricts the occurrence of other plant species. Those present include river alder (*Alnus tenuifolia*), white birch (*Betula papyrifera*), northern black current (*Ribes hudsonianum*), and willow. Numerous dead white spruce snags were observed adjacent to the reference site within this vegetation community type, possibly caused by inundation in a beaver pond.

(20) <u>Beaked sedge/water sedge-cattail</u> (WS1):
(Beckingham et al. (1996) defined as: cattail marsh)

This community type occurs in shallow water on the periphery of McLeod and Little McLeod akes (see Appendix A, photograph 1,2,6).. The dense emergent plants dominated by cattail, beaked sedge and water sedge are rooted in lacustrine and thin organic materials actively deposited and formed at these sites. Small islands of floating organic material support water-hemlock (*Cicuta maculata*), nodding beggarticks, and willow. Common aquatic plants are sweet flag (*Acorus americana*), mare's tail (*Hippuris vulgaris*) and common duckweed (*Lemna minor*).

(21) <u>Swamp horsetail-great bulrush</u> (SH1):
(Beckingham et al. (1996) defined as: bulrush marsh)

Swamp horsetail (*Equisetum fluviatale*) and great bulrush (*Scirpus acutus*) form extensive beds in water greater than 1 metre deep in Macleod Lake and Little Macleod Lake. These are most common within 50 metres of the shoreline, although they do occur in the middle of the lakes where water depths becom shallow (see Appendix A, photograph 1,2).

6 RESULTS

6.1 Ecological Land Classification Mapping

In addition to the map units (ecosites) described in the legend accompanying the ELC map, a polygon and legend database key can be found in Appendix D. Biophysical features included in the legend are as follows: landform and surficial materials; soil classification; vegetation; slope (%); drainage class; surface texture; subsurface texture; depth (cm) to bedrock, depth to water table. Ecosites are arranged alphabetically in the legend according to the surficial material code that forms the first part of the map symbol.

6.1.1 Ecosystem Legend and Parameters Including Evaluations

The following summary of evaluation parameters also serves as a Legend and Polygon Database Key for Carson-Pegasus Provincial Park (Table 10). This key is also located in Appendix D.

Table 10: Evaluation Parameters / Polygon and Legend Database Key

CODE	DESCRIPTION
PARENT MATERIAL	
F	fluvial
FvbM	fluvial veneer blanket over moraine (till)
FL^G	glaciofluvial-lacustrine
FL^GvM	glaciofluvial-lacustrine veneer over moraine (till)
FL^GvbM	glaciofluvial-lacustrine veneer blanket over moraine (till)
L^G	glaciolacustrine
L^GvM	glaciolacustrine veneer over moraine (till)
M	moraine (till)
O	organic
ObF^G	organic blanket over glaciofluvial
ObL^G	organic blanket over glaciolacustrine
ObM	organic blanket over moraine (till)
OvF	organic veneer over fluvial
$OvFL^G$	organic veneer over glaciofluvial-lacustrine
$OvbFL^G$	organic veneer blanket over glaciofluvial-lacustrine
OvL^G	organic veneer over glaciolacustrine
OvM	organic veneer over moraine (till)
SURFACE EXPRESSION	
h	horizontal (organic units)
h	hummocky (mineral units)
hr	hummocky and ridged
i	inclined
l	level
r	ridged
t	terraced
u	undulating
uh	undulating to hummocky
SOIL CLASSIFICATION	
BR.GL	Brunisolic Gray Luvisol
GL.GL	Gleyed Gray Luvisol
O.G	Orthic Gleysol
ptO.G	Peaty Orthic Gleysol
O.GL	Orthic Gray Luvisol
O.R	Orthic Regosol
R.G	Rego Gleysol
ptR.G	Peaty Rego Gleysol
THU.M	Terric Humic Mesisol
T.M	Terric Mesisol
HU.M	Humic Mesisol
TY.M	Typic Mesisol
SLOPE CLASSES	
1	0 - 0.5% level

2	0.5 - 2% nearly level
3	2 - 5% very gentle slopes
4	5 - 9% gentle slopes
5	9 - 15% moderate slopes
6	15 - 30% strong slopes
7	30-45% very strong slopes
DRAINAGE CLASSES	
MW	moderately well
I	imperfectly
P	poorly
VP	very poorly
SURFACE AND SUBSURFACE TEXTURE	
C	Clay (fine textured)
CL	Clay Loam
FSL	Fine Sandy Loam
O	Organic
S	Sandy (coarse textured)
SiL	Silty Loam
SiC	Silty Clay
SiCL	Silty Clay Loam
SL	Sandy Loam
PERMEABILITY CLASSES	
H	high permeability
M	moderate permeability
L	low permeability
ROCKINESS CLASSES	
0	non-rocky
1	slightly rocky
STONINESS CLASSES	
0	non-stony
1	slightly stony
RUTTING, COMPACTION, PUDDLING, SOIL EROSION, AND WIND THROW HAZARDS	
H	high risk
M	medium risk
L	low risk
FLOOD HAZARD	
N	none
R	rare
M	may be expected
F	frequent

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
F1.1	Level to nearly level terraces with some meander scars; fine and moderately fine textured, non-calcareous glaciofluvial and fluvial sediments; non-stony. A thin (<100cm), discontinuous veneer of very weakly to strongly decomposed organic material is also present.	Dominantly peaty Rego Gleysols and peaty Orthic Gleysols; significant Rego Gleysols and Terric Mesisols.	Dominantly Willow/Bluejoint-water sedge (W1).	0.5-5	P	O	SC	>100	>100	>100	H	H	H	L-M	May be expected	H	H
GL1.1	Nearly level to gently undulating; moderately fine to fine textured, non-calcareous glaciolacustrine; non-stony; occasional thin organic deposits (<60cm) overlying the glaciolacustrine materials.	Dominantly Gleyed Gray Luvisols and Orthic Gleysols; significant peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce- Lodgepole pine/Bracted honeysuckle/ Fern (BH1). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4).	0.5-5	I-P	SiL	SiCL	>100	>100	>100	H	H	H	L-H	Rare	H	H
GL2.1	Hummocky and ridged; fine textured, moderately calcareous glaciolacustrine blanket overlying fine textured slightly calcareous till. The glaciolacustrine blanket is generally greater than 1m thick. Thin (<100cm) organic deposits are found in the depressions.	Dominantly Orthic Gray Luvisols; significant Gleyed Gray Luvisols, Terric Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3), and Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4). Inclusions of White spruce-Balsam fir/ Feathermoss (LC7), Lodgepole pine/Feathermoss (LC8). Inclusions of Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions.	9-30	MW	SiL-SL	SiC-C	>100	>100	>100	M-H	H	H	M-H	Rare	H	M-L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
GL2.2	Hummocky and ridged; fine textured, moderately calcareous glaciolacustrine blanket overlying fine textured slightly calcareous till. The glaciolacustrine blanket is generally greater than 1m thick. Thin (<100cm) organic deposits are found in the depressions.	Dominantly Orthic Gray Luvisols; significant Gleyed Gray Luvisols, Terric Mesisols and peaty Orthic Gleysols.	Dominantly White spruce-Balsam fir/Feathermoss (LC7), and Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2) on drier ridges; Black spruce-White spruce/ Labrador tea/Horsetail (BS1)in depressions.	9-30	MW	SiL-SL	SiC-C	>100	>100	>100	M-H	H	H	M-H	Rare	H	M-L
GL2.3	Hummocky and ridged; fine textured, moderately calcareous glaciolacustrine blanket overlying fine textured slightly calcareous till. The glaciolacustrine blanket is generally greater than 1m thick. Thin (<100cm) organic deposits are found in the depressions.	Dominantly Orthic Gray Luvisols; significant Gleyed Gray Luvisols, Terric Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2). Inclusions of Lodgepole pine/Feathermoss (LC8), Aspen poplar/Low-bush cranberry (LC1); Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions.	9-30	MW	SiL-SL	SiC-C	>100	>100	>100	M-H	H	H	M-H	Rare	H	M-L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
GL3.1	Hummocky and ridged; medium to fine textured, moderately calcareous fluviolacustrine blanket veneer overlying non-stony slightly calcareous fine textured till. A thin (<100cm) organic veneer overlying the fluviolacustrine sediments may be found in depressions and drainage channels	Dominantly Orthic Gray Luvisols, significant Brunisolic Gray Luvisols and Gleyed Gray Luvisols. Inclusions of Terric Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2); Beaked hazelnut/Indian hemp/Hairy wild rye (HR1) on steep southerly or westerly -facing slopes; Black spruce-White spruce/Labrador tea/ Horsetail (BS1) in depressions and drainage channels.	5-45	MW	SiL-SL	FSL (S)-C	>100	>100	>100	M-H	M-H	M-H	M-H	Rare	H	M-L
GL3.2	Hummocky and ridged; medium to fine textured, moderately calcareous fluviolacustrine blanket veneer overlying non-stony slightly calcareous fine textured till. A thin (<100cm) organic veneer overlying the fluviolacustrine sediments may be found in depressions and drainage channels	Dominantly Orthic Gray Luvisols, significant Brunisolic Gray Luvisols and Gleyed Gray Luvisols. Inclusions of Terric Mesisols and peaty Orthic Gleysols.	Dominantly Lodgepole pine/Feathermoss (LC8). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4); Black spruce-White spruce/ Labrador tea/Horsetail (BS1) in depressions and drainage channels.	5-45	MW	SiL-SL	FSL (S)-C	>100	>100	>100	M-H	M-H	M-H	M-H	Rare	H	M-L
L1.1	Lakes; lacustrine sediment		Dominantly Swamp horsetail - Great bulrush (SH1). Inclusions of Beaked sedge/Water sedge /Cattail (WS1).	0													

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M1.1	Undulating; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant peaty Orthic Gleysols, Terric Mesisols and Terric Humic Mesisols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Balsam fir/Fern (BH2). Inclusions of Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions.	2-5	MW-P	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M2.1	Ridged; moderately fine to fine textured, non-calcareous till; slightly stony.	Dominantly Orthic Gray Luvisols; significant Orthic Regosols (found on steep slopes); minor Gleyed Gray Luvisols.	Dominantly Aspen poplar/Low-bush cranberry (LC1).	2-30	MW	L	SiCL	>100	>100	>100	M-H	H	H	H	None	H	L
M3.1	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols, peaty Orthic Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar/Low-bush cranberry (LC1). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/Fern (BH1) and Aspen poplar-White spruce-Lodgepole pine /Balsam fir/Fern (BH2) in depressions; Black spruce-White spruce/Labrador tea/Horsetail (BS1) on organic deposits.	5-9	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M3.2	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols, peaty Orthic Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/ Fern (BH1) and Aspen poplar-White spruce-Lodgepole pine/Balsam fir/Fern (BH2). Inclusions of Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions.	5-9	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M3.3	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols, peaty Orthic Gleysols and Gleyed Gray Luvisols.	Dominantly White spruce-balsam fir/Feathermoss (LC7) and Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of Aspen poplar/Low-bush cranberry (LC1), Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4); Black spruce-White spruce/ Labrador tea/Horsetail (BS1) in depressions.	5-9	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M3.4	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humisols, peaty Orthic Gleysols and Gleyed Gray Luvisols.	Dominantly Lodgepole pine/Feathermoss (LC8), White spruce-Balsam fir/Feathermoss (LC7), and Aspen poplar-White spruce-Lodgepole pine/ Low-bush cranberry (LC3). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4), Aspen poplar/Low-bush cranberry (LC1), Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2); Black spruce-White spruce/ Labrador tea/Horsetail (BS1) in depressions.	5-9	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M3.5	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols, peaty Orthic Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2) on steep south or west-facing slopes; Black spruce-White spruce/ Labrador tea/Horsetail (BS1) in depressions.	5-9	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M4.1	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar/Low-bush cranberry (LC1) and Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of White spruce-Balsam fir/Feathermoss (LC7), Aspen poplar-White spruce-Lodgepole pine/ Feathermoss (LC4); Black spruce-White spruce/Labrador tea/Horsetail (BS1) and Labrador tea/Cloudberry/ Pat moss in depressions.	9-30	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M4.2	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4) and Lodgepole pine/ Feathermoss. Inclusions of White spruce-Balsam fir/Feathermoss (LC7); Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2) on steep southerly or westerly-facing slopes; Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions.	9-30	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M4.3	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols and peaty Orthic Gleysols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of Aspen poplar/Low-bush cranberry (LC1), Aspen poplar-White spruce-Lodgepole pine/ Feathermoss; Lodgepole pine/Feathermoss (LC8) on drier hummocks; Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/Fern (BH1) in depressions.	9-30	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M4.4	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols and peaty Orthic Gleysols.	Dominantly White spruce-Balsam fir/Feathermoss (LC7) and Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3). Inclusions of Aspen poplar-White spruce-Lodgepole pine/ Feathermoss (LC4), Lodgepole pine/ Feathermoss (LC8); Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/ Fern (BH1) in depressions.	9-30	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M4.5	Hummocky; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols; significant Terric Mesisols, Terric Humic Mesisols and peaty Orthic Gleysols.	Dominantly Lodgepole pine/Feathermoss (LC8) and Aspen poplar/Low-bush cranberry (LC1). Inclusions of White spruce-Balsam fir/Feathermoss (LC7), Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3), Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4); Black spruce-White spruce/ Labrador tea/Horsetail (BS1) in depressions.	9-30	MW	SiL	C	>100	>100	>100	M-H	H	H	H	None	H	L
M5.1	Hummocky, ridged and inclined; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols and Brunisolic Gray Luvisols. Some polygons may have minor amounts of Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar-white spruce-Lodgepole pine/Feathermoss (LC4). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3); Black spruce-White spruce/Labrador tea/Horsetail (BS1) in depressions	15-45	MW-W	SiL	C-SiCL	>100	>100	>100	M-H	M-H	H	H	None	M	M
M5.2	Hummocky, ridged and inclined; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols and Brunisolic Gray Luvisols. Some polygons may have minor amounts of Gleysols and Gleyed Gray Luvisols.	Dominantly Lodgepole pine/Feathermoss (LC8). Inclusions of White spruce-Balsam fir/Feathermoss (LC7), Aspen poplar-White spruce-Lodgepole pine/ Feathermoss (LC4).	15-45	MW-W	SiL	C-SiCL	>100	>100	>100	M-H	M-H	H	H	None	M	M

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
M5.3	Hummocky, ridged and inclined; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols and Brunisolic Gray Luvisols. Some polygons may have minor amounts of Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4) and Aspen poplar-White spruce-Lodgepole pine/Canada buffaloberry (LC5 Inclusions of Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2) and Beaked hazelnut/Indian hemp/Hairy wild rye (HR1) on steep south-facing slopes.	15-45	MW-W	SiL	C-SiCL	>100	>100	>100	M-H	M-H	H	H	None	M	M
M5.4	Hummocky, ridged and inclined; moderately fine to fine textured, non-calcareous till; slightly stony; numerous depressions with a high water table and organic deposits of variable thickness.	Dominantly Orthic Gray Luvisols and Brunisolic Gray Luvisols. Some polygons may have minor amounts of Gleysols and Gleyed Gray Luvisols.	Dominantly Aspen poplar/Low-bush cranberry (LC1). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/Fern (BH1) on lower slope positions	15-45	MW-W	SiL	C-SiCL	>100	>100	>100	M-H	M-H	H	H	None	M	M
O1.1	Horizontal; thick (>160cm) organic deposits; moderately to very strongly decomposed; occasional thin (40-160cm) organic deposits over fine textured, non-calcareous morainal substrates (till and glaciolacustrine).	Dominantly Typic Mesisols and Humic Mesisols; significant amounts of Terric Mesisols and Terric Humic Mesisols.	Dominantly Black spruce/Labrador tea/ Cloudberry/Peat moss (LT1), Labrador tea/ Cloudberry/Peat moss (LT2), and Black spruce-Tamarack/Bog birch/ Sedge/Peat moss (DB1). Inclusions of Bog birch-Willow/Sedge/Peat moss (DB2).	0-2	VP	Of	Oh, Om	>100	>100	>0	H	L	L	L	Rare	H	H

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
O1.2	Horizontal; thick (>160cm) organic deposits; moderately to very strongly decomposed; occasional thin (40-160cm) organic deposits over fine textured, non-calcareous morainal substrates (till and glaciolacustrine).	Dominantly Typic Mesisols and Humic Mesisols; significant amounts of Terric Mesisols and Terric Humic Mesisols	Dominantly Black spruce-Tamarack/Bog birch/ Sedge/Peat moss (DB1) and Bog birch-Willow/ Sedge/Peat moss (DB2). Inclusions of Bluejoint/ Woodland horsetail/Peat moss (DB3), and Black spruce-White spruce/Labrador tea/ Horsetail (BS1).	0-2	VP	Of	Oh, Om	>100	>100	>0	H	L	L	L	Rare	H	H
O2.1	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Black spruce-white spruce/Labrador tea/Horsetail (BS1) and Aspen poplar/Low-bush cranberry (LC1). Inclusions of Black spruce-Tamarack/Bog birch/ Sedge/Peat moss (DB1), Bog birch-Willow/Sedge/ Peat moss (DB2), Black spruce/Labrador tea/Cloudberry/Peat moss (LT1), and Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/ Fern (BH1); Lodgepole pine/Feathermoss (LC8) on non-organic sites.	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
O2.2	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Bog birch-Willow/Sedge/Peat moss (DB2), and Black spruce-Tamarack/Bog birch/ Sedge/Peat moss (DB1). Inclusions of Bluejoint/Woodland horsetail/Peat moss (DB3).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H
O2.3	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Willow/Bluejoint-Water sedge (W1). Inclusions of Black spruce-Tamarack/Bog birch/Peat moss (DB1), and Beaked sedge/Water sedge-Cattail (WS1).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H
O2.4	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/ Fern (BH1), and Black spruce-Tamarack/Bog birch/Sedge/Peat moss (DB1). Inclusions of Aspen poplar-White spruce-Lodgepole pine/Balsam fir/Fern (BH2).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
O2.5	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Black spruce/Labrador tea/Cloudberry/Peat moss (LT1), and Labrador tea/ Cloudberry/Peat moss (LT2). Inclusions of Bog birch-Willow/Sedge/Peat moss (DB2).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H
O2.6	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Black spruce-Tamarack/Bog birch/Sedge/Peat moss (DB1), Bog birch-Willow/ sedge/Peat moss (DB2), and Black spruce/Labrador tea/ Cloudberry/Peat moss (LT1). Inclusions of,Black spruce-White spruce/Labrador tea/Horsetail (BS1), and Aspen poplar-White spruce- Lodgepole pine/Bracted honeysuckle/ Fern (BH1).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H

Ecosite	Landform and Surficial Materials	Soil Classification	Vegetation	Slope (%)	Drainage Class	Surface Texture	Subsurface Texture	Depth to Bedrock	Depth to Imperm Layer	Depth to Water Table	Rutting Hazard	Compaction Hazard	Puddling Hazard	Soil Erosion Hazard	Flood Hazard	Frost Heave Hazard	Wind Throw Hazard
O2.7	Horizontal; thin (40-160cm) moderately to very strongly decomposed organic deposits overlying moderately coarse to moderately fine textured non-calcareous till., fluvial, and glaciolacustrine deposits. Significant amounts of thick (>160cm) organic deposits also occur.	Dominantly Terric Mesisols and Terric Humic Mesisols; significant Typic Mesisols, Humic Mesisols, and peaty Orthic Gleysols. Significant soils are occasionally dominant.	Dominantly Bluejoint/ Fireweed/Marsh cinquefoil (T1). Inclusions of Black spruce-Tamarack/Bog birch /Sedge/Peat moss (DB1).	0-2	VP	Of	SiCL-C	>100	>100	>0	H	L	L	L	Rare (In some polygons associated with stream channels, flooding may be expected.)	H	H

6.2 Significant Ethnohistorical / Archaeological Features

Circa the parks' establishment, Alberta Culture strongly suspected the occurrence of ethnohistorical and archaeological features in the park. At that time, Archaeological Survey of Alberta exposed a single site file indicating a known historical site within the park, prompting a more thorough archaeological survey. In 1980, Alberta Culture requested an Historical Resources Impact Assessment for Carson-Pegasus Provincial Park (Ronaghan and Hanna 1981). Prior to that, there was a paucity of information identifying historical resources in the park. The assessment identified 4 historic and 23 prehistoric sites in various locations around the lake edges with some on high ridges and others on low lake terrace edges. Most of the archaeological / ethnohistorical literature in the park refers to the above historical resources survey. The 4 historic sites consist of log cabins (likely trapper cabins) of recent age and a site with abundant debris from an expired logging operation. The 23 prehistoric sites produced an abundant variety of site types created by historical First Nations people in the area. The sites ranged from extensive campsites to single artifact finds. AEP (1996a) identified the west side of the lake, opposite the McLeod Peninsula as one of the most significant prehistoric areas in the park due to a cluster of sites located there.

At a later date, continued development of the park required an additional conservation excavation by The Archaeological Survey of Canada. Two previously identified sites were revisited to identify in greater detail the potential historical resources value in the park (Ronaghan and Hanna 1981). Based on the results from the above surveys Sawyer (1980) provided a literature and historical research review of Carson-Pegasus Provincial Park and concluded that the area offered very little in terms of historical interest. In terms of park resources, all known ethnohistorical and archaeological features in the park resemble the vast majority of historical resources found throughout the entire subregion. In general, most historical features found in the area are located along shoreline and upland areas, including those found in the park. The park sites are primarily located adjacent to three major waterbodies found in the park, including McLeod Lake, Little McLeod Lake, and Bog Pond. These historical sites are locally significant and are classified as highly sensitive. A map of ethnohistorical/archaeological sites can be found on the Significant Features Map in Appendix G.

In adjacent areas to the park, Fromhold (1978) conducted an assessment of Esso Resources Judy Creek Coal Lease and identified 41 historic resource sites (24 historic and 17 prehistoric). Additional surveys produced several additional historic resource sites (McCullough and Reeves 1976).

6.3 Significant Ecological Features

Several ecologically significant features found within the park describe the uniqueness of Carson-Pegasus Provincial Park. The following are descriptions or checklists of mappable significant features identified in the park and are presented on a map in Appendix G. In addition, an overall sensitivity rating is given for each site or feature.

The significant ecological features checklist is grouped by levels of significance, from regional to local significance. The following table (Table 11) identifies 13 types of significant ecological features within Carson-Pegasus Provincial Park

Table 11: Significant Ecological Features Checklist	
1.	Great Blue Heron Nesting Colony
2.	McLeod Lake
3.	Little McLeod Lake
4.	Balsam-Fir Old-growth
5.	Rare/Significant Native Plants
6.	McLeod Lake Peninsula
7.	Bog Pond
8.	Laura Lake
9.	Mobil Creek Delta
10.	Riparian Community
11.	Floating Fens
12.	Ethnohistorical Sites
13.	Prehistoric Sites

1. Site Name: Great Blue Heron Nesting Colony

Description:

- A nesting colony of approximately 12 breeding pairs of great blue herons have been identified on the north side of McLeod Lake.
- Great Blue Herons are an Alberta yellow listed species potentially warranting management considerations in order to ensure that they are not placed at risk. Population trends are deemed to be stable with approximately 75 colonies and 1500 breeding pairs in the province (AEP 1996c).

Significance: Regional

- yellow listed species

Sensitivity: Very High

- The site contains a distinctive wildlife population that has been identified as a management priority species.
- Heron colonies have been identified as extremely sensitive to disturbance.

2. Site Name: MCLEOD LAKE (Carson Lake)

Description:

- The lake is part of an Alberta Provincial Park network and provides a major recreational facility
- Carson Lake has a mean depth of 5.1 m and maximum depth of 10.7 m with a shoreline circumference of 9.98 km. The total drainage area of the lake cover approximately 34.7 km^2 with the water basin area approximated at 3.73 km^2. Water temperatures approximate 16.0^oC with summer lake surface temperatures ranging from 14.7 to 23.0^oC
- The lake also contains a peninsula that extends into the lake (see ecologically significant features Site Name: McLeod Lake Peninsula).
- Prior to 1976, northern pike, rainbow trout, and white suckers occurred in the lake; chemical treatment of the lake in 1976 eliminated northern pike from the lake and was then stocked with 400,000 rainbow trout fingerlings in 1977 and has been stocked regularly since then.
- In addition to rainbow trout, burbot, white sucker, and longnose sucker are also present in the lake (G. Gilbertson, D. Hildebrandt pers. comm.).
- Bentz and Saxena (1994) identified McLeod Lake as a regionally significant site because of it's: hydrological features, sport fishery, and local recreational lake used in conjunction with the recreational facilities at Carson-Pegasus Provincial Park
- Extensive use by numerous bald eagles, golden eagles, and osprey (all are yellow listed)(AEP 1996c).

Significance: Regional

- significant sport fishery
- significant recreational lake located within Carson-Pegasus Provincial Park
- significant hydrological feature

Sensitivity: Very High

- Because of the small areas and overall shallow depth of the lake, the aquatic vegetation, shoreline, and riparian areas are susceptible to high erosion potential. This has partially been addressed through the speed limit placed on motor boats within the lake.
- An Imperial Oil Ltd. water pumping station is located on the north shore of the lake.
- On a much larger scale, Bentz and Saxena (1994) have identified McLeod Lake as moderately sensitive.

3. Site Name: Little McLeod Lake (Pegasus Lake)

Description:

- McLeod Lake has a maximum depth of 24.4 m and a surface area of 91 ha and a shoreline circumference of 4.0 km.
- Water clarity in July reaches depths of 4.5 m to 5.5 m.
- Lake whitefish, yellow perch, northern pike, and five spine stickleback are known to occur in the lake (G. Gilbertson, D. Hildebrandt pers. comm.).
- The lake whitefish found in Little McLeod Lake are the only native population of lake whitefish found in the Whitecourt region (Moffatt *et al.* 1974).
- Limited recreational facilities are located on the lake, but includes a boat launch.
- Little McLeod Lake formerly drained into McLeod Lake via Pegasus Creek (a seasonal stream); however a gravel dam was erected at the stream origin on Little McLeod Lake preventing northern pike from dispersing into McLeod Lake, thereby impacting the rainbow trout populations (D. Hildebrandt pers. comm.).
- Bentz and Saxena (1994) identified Little McLeod Lake as a locally significant site because of it's: hydrological features, sport fishery, and local recreational lake used in conjunction with the recreational facilities at Carson-Pegasus Provincial Park
- Extensive use by numerous bald eagles, golden eagles, and osprey (all are yellow listed)(AEP 1996c).

Significance: Regional

- significant sport fishery (contains native populations of game fish)
- significant recreational lake
- significant hydrological feature

Sensitivity: Very High

- Because of the small area and unique clarity of the water, Little McLeod Lake has been identified as having a very high sensitivity to disturbance. This has been partially addressed by limiting boating activity to electric motors and canoes.
- Mobil Oil Ltd. maintains a water pumping station on the west shore of the lake to supply the Judy Creek Oil Field; water is also pumped into the lake from Carson Creek to maintain water levels.
- On a much larger scale, Bentz and Saxena (1994) have identified Little McLeod Lake as moderately sensitive.

4. Site Name: Balsam Fir (*Abies balsamea*) Old-growth

Description:

- An old-growth stand of balsam fir has been identified with the south eastern area of the park (Twp. 61 Rge 11 W5)
- The stand is significant because extensive wildfires are frequent in the western part of the Boreal Forest Region (Rowe and Scotter 1973), thereby localizing remaining stands of Balsam-fir forests, hence making them uncommon. Achuff and Roi (1977) have indicated that the "...*forest management policy of the Alberta Forest Service encourages the harvest of 'overmature' stands,* (however) *old Picea-Abies forests are rapidly becoming rare in the region. Only a few remaining stands are protected, and high priority should be given to their preservation for scientific and educational purposes*."

Significance: Regional

- significant vegetation community with a unique habitat limited in distribution
- uncommon old-growth stand

Sensitivity: Very High

- The restricted and uncommon occurrence of this unique vegetation community deems the Balsam-Fir Old-growth Site to be considered extremely sensitive.

5. Site Name: Rare/Significant Native Plants

Description:

- One rare native plant has been located and identified within the park (White Adder's Mouth (*Malaxis monophylla* var. *brachypoda*) (ANHIC 1999). Additionally, Lady Fern (*Athyrium filix-femina*) has also been identified in the park and is deemed significant (AEP 1996a).
- White Adder's Mouth was found in a dense black spruce / willow community on Gleysol soils. The plant community is black spruce – Feathermoss – Two-seeded sedge (plot 41)
- Lady Fern was found in a Balsam poplar and Paper birch along a small fluvial zone (see Appendix A, photograph 8). The plant community is *Calamagrostis canadensis* - *Equisetum sylvaticum* – *Gymnocarpium dryopteris* (DB3)(plot 6). Lady fern has been identified in Bentz *et al.* (1995) as a significant plant species in the Foothills because: a) it is rare or uncommon within Alberta as a whole, or b) their Foothills population is isolated (disjunct) from the main portions of their range.

Significance: Regional

- rare/significant plant species

Sensitivity: Very High

- rare/significant plant species

6. Site Name: McLeod Lake Peninsula

Description:

- The peninsula is approximately 1,100 m in length and 130 m wide extending into the lake from its southern edge (Nordstrom 1980).
- The present peninsula was at one time continuous across the lake, the dividing McLeod Lake into two distinct water basins. Subsequent to the last glaciation, drainage from the melting ice eroded through this drumlinized feature creating the peninsula as it is today (Nordstrom 1980).

Significance: Local

- significant geomorphic feature
- significant recreational feature
- significant intrinsic appeal due to widespread community interest

Sensitivity: Very High

- The following is a summary of development restriction that Nordstrom (1980) has provided to minimize the impacts of erosion on the peninsula.

    1. The peninsula should be developed for day-use facilities with established hard-surfaced pathways that will reduce erosional factors.
    2. Disturbed areas of the peninsula should be reclaimed with native species.
    3. Motorized traffic should be restricted on the peninsula.
    4. Allow natural erosional factors to continue except where park facilities and developments are threatened or a safety hazard exists. This includes restricting future developments that protrude from the peninsula into the lake, such as docking facilities.
    5. Proper lake access routes (e.g. stairs) should be provided on the peninsula perimeter to prevent further erosion on the steeper slopes.
    6. No channelling or dredging activities should be permitted on the northern portions of the peninsula.
    7. Vegetation on the peninsula should not be removed.

7. Site Name: Bog Pond

Description:

- Bog pond is 20.5 acres with a maximum depth of 3.5 m and a shoreline distance of approximately 600 m.
- A significant mat of aquatic floating, submergent, and emergent vegetation surround the pond, varying in thickness up to 0.5 m and extending from the shoreline varying from 5.0 to 30.0 m. This mat of vegetation is also referred to as a floating fen (Nordstrom 1980).

Significance: Local

- significant hydrological feature

Sensitivity: Very High

- The sensitivity of the pond is very high due to, the water basin being poorly drained, the fragile nature of the vegetation mat, and the small extent of the pond ecosystem.

8. Site Name: Laura Lake

Description:

- Laura Lake is predominantly (67%) a shallow waterbody (generally less than 1.5 m deep with a maximum depth of 8.8 m). The lake covers an area of 7.2 ha.
- Historically, the lake contained native populations of brook trout, however common winter kills restrict the overwintering abilities of most fish (D. Hildebrandt pers. comm.)(Hawryluk 1977). Presently, the lake is void of sport fish. Stocking programs attempted to plant rainbow trout (Nordstrom 1980), arctic grayling and brown trout (D. Hildebrandt pers. comm.).
- D. Hildebrandt (pers. comm.) indicated that fish that do survive in the lake have been shown to have very good growth rates and the potential of the lake as a significant sport fishery is high.
- Bentz and Saxena (1994) identified Laura Lake as a locally significant site because of its hydrological features, sport fishery, and local recreational lake used in conjunction with the recreational facilities at Carson-Pegasus Provincial Park
- Nordstrom (1980) identified the dense stands of aquatic vegetation in the littoral zone of the lake as a special feature.
- The lake provides good aquatic furbearer habitat but limited waterfowl habitat (Bentz and Saxena 1994).

Significance: Local

- potential for a significant sport fishery
- significant recreational lake used in conjunction with the recreational facilities at McLeod Lake
- significant hydrological feature
- significant vegetation community found in conjunction with the littoral zone of the lake

Sensitivity: Very High

- The sensitivity of the lake to erosion is very high, given the fragile riparian vegetation on the lake and the sizable island found near the center of the lake.
- No formal boat launching facilities are provided.
- On a much larger scale, Bentz and Saxena (1994) identified Laura Lake as moderately sensitive.

9. Site Name: Mobil Creek Delta

Description:

- The most significant and valuable aquatic vegetation resources in the park are those located on the deltaic feature at the mouth of Mobil Creek, along Mobil Creek itself. These habitats contain a rich assortment of plant and animal species and are one of the most biologically productive components of the various ecosystems found in the park (Nordstrom 1980).

Significance: Local

- Area that contain unusual diversity of both plant and wildlife species.

Sensitivity: Very High

- The potential of fluvial channels to disturbance causing erosional disturbance is extremely high.
- High diversity of distinctive plant and wildlife populations.

10. Site Name: Riparian Communities

Description:

- The area of ecological significance for this feature includes the fringe areas surrounding McLeod Lake, Little McLeod Lake, Laura Lake, and Bog Pond. The fringe of the lakes provide abundant emergent aquatic vegetation for nesting waterfowl, in addition to the adjacent upland that provides excellent osprey and bald eagle nesting and perching areas. In effect, the riparian areas located along the borders of lakes and other hydrological features found within the park provide high bioproductivity.
- The zone of influence by which the upland is greatly influenced by the occurrence of a hydrographic feature is assumed. Although, the upland area surrounding the lake has been allocated on the significant ecological features map, the boundary line represents a hypothetical or gradient boundary that approximates the zone of influence and is, therefore not intended as a definitive measure.
- The above areas are dominated by shrubs, primarily willow and alder. The forest canopies are predominantly larch, white spruce, balsam poplar, trembling aspen, and black spruce. Willow, alder, dogwood, and Labrador tea dominate shrub communities.

Significance: Local

- Significant areas of high productivity and diversity.

Sensitivity: Very High

- The potential of fluvial and lacustrine channels to disturbance causing erosional disturbance is extremely high.
- High diversity of distinctive plant and wildlife populations.

11. Site Name: Floating Fen

Description:

- The floating fens in the park are located on both Laura Lake and Bog Pond.
- The lake's perimeter is covered with extensive floating mats of vegetation extending from the shoreline from 5 to 30 m and varying in thickness up to 0.5 m (Nordstrom 1980).

Significance: Local

- Area that contain unusual diversity of both plant and wildlife species and is considered one of the most productive components of the park's ecosystem.
- Nordstrom (1980) has identified the floating fens as special features found within Carson-Pegasus Provincial Park.

Sensitivity: Very High

- The potential of fluvial channels to disturbance causing erosional disturbance is extremely high.
- High diversity of distinctive plant and wildlife populations.

12. Site Name: Ethnohistorical Sites

Description:

- A total of four ethnohistorical site locations were originally identified by Ronaghan and Hanna (1981). These sites have been mapped on the Significant Features Map for Carson-Pegasus Provincial Park.
- These sites are limited to a single expired logging camp and associated debris (south shore of Little McLeod Lake) and three log cabins (likely recent trapper cabins).

Significance: Local

- These sites are typical of the numerous other sites found throughout the central portions of Alberta and are, therefore considered only locally significant.

Sensitivity: Very High

- Dependent upon the type of impact or disturbance, these sites are generally deemed as having a very high sensitivity.

13. Site Name: Prehistoric Sites

Description:

- A total of 23 site locations were originally identified by Ronaghan and Hanna (1981), however we have identified only 22 of the prehistoric sites because of the overlap in sites due to the mapping scale. All prehistoric sites are identified on the Significant Features Map for Carson-Pegasus Provincial Park.
- All sites were clustered in locations adjacent to McLeod and Little McLeod Lakes on the expected areas, such as broad flat lake terraces, small flat raised areas protruding into the lakes, and high flat plateau-like ridges above the lakes.
- These sites contained features, such as campsites, workshops, and isolated finds.

Significance: Local

- These sites are typical of the numerous other sites found throughout the central portions of Alberta and are, therefore considered only locally significant, however each small site may be part of a larger, complex prehistoric settlement or subsistence pattern for the park. Therefore, until these sites can be shown to be small parts of a larger pattern then these sites should remain locally significant.

Sensitivity: Very High

- Dependent upon the type of impact or disturbance, these sites are generally deemed as having a very high sensitivity.

6.4 Sensitive Features

In the study area, hydrological areas, riparian zones, geomorphic landforms, old-growth forests, a great blue heron nesting colony, rare/significant plants and plant communities, and steep slopes are considered to have the highest sensitivity in terms of most land uses. The sensitivity of most of these features is relative to the specific disturbance type, however the following table (Table 12) provides a general sensitivity rating of broadly categorized ecological features to certain type of land use activities. Specific land uses, such as activities related to fishing and non-consumptive wilderness recreation were considered to have the least impact on significant ecological features while land use activities closer to the impacts displayed by municipality / industrial facility development were rated as having the highest potential impact. See Appendix G for a map of identified Sensitive Features in Carson-Pegasus Provincial Park

Table 12: The Sensitivity of Categories of Significant Ecological Features to Types of Land Use Activities

V - Very High Sensitivity
H - High Sensitivity
M - Moderate Sensitivity
L - Low Sensitivity
I - Insignificant Sensitivity

Category of Significant Ecological Features	Types of Land Use Activity						
	Fishing	Non-Consumptive Wilderness Recreation	Facility-oriented Recreational Developments	Roads & Highways	Utility Corridors	Oil & Gas Exploration & Development	Municipal/Industrial Facility Development
TERRAIN FEATURES:							
Fluvial	I	I	V	V	H	H	V
Slopes	I	I	M	H	H	V	V
Peatlands	I	L	V	V	H	H	V
HYDROLOGICAL FEATURES:							
Rivers and Creeks	L	M	H	H	H	H	H
Lakes	L	L	H	H	H	H	H
VEGETATION FEATURES:							
Rare Species/Plant Communities	L	H	M	V	V	V	V
Old-Growth Forests	I	L	V	V	V	V	V
KEY WILDLIFE HABITATS:							
Moose	I	L	H	V	H	H	H
Furbearers	I	L	H	H	H	H	H
Colonial Nesting Birds	I	H	V	V	H	V	V
Waterfowl	I	L	H	H	L	H	V
Fish	V	L	H	V	L	H	H

6.5 Disturbance Features

The impact of anthropogenic activities on Carson-Pegasus Provincial Park is readily apparent from both the ground and from aerial photographs. Historically, the park has experienced disturbances, although the majority of the disturbances remain relatively unnoticed. In particular, major landscape disturbances within the park result from the network of linear disturbances created by roads, trails, cutlines, pipelines, and various recreational facilities.

Primarily, most disturbances are found in association with McLeod Lake and Little McLeod Lake, however disturbances that are remote from the lakes also occur.

The majority of disturbances were initially identified using aerial photography, however, any new disturbance features that the park has incurred post-dating the air photos were also researched. Disturbances apparent from aerial photography primarily result from, either recreational or industrial activities. In particular, recreational disturbances are almost exclusively associated with the presence of McLeod Lake campground. Industrial disturbances are primarily a result of the disposition holders, such as Mobil Oil, and Imperial Oil. Both, recreational use and developments from disposition holders have created some of the following types of disturbances (see Table 13).

Table 13: Types of Disturbances Located in Carson-Pegasus Provincial Park

Recreational	Industrial
campground (including roads, hiking trails, camping stalls, day-use areas, boat launches, and other recreational facilities) ranger station staff residence park workshop	well sites (both active and reclaimed) pipelines easements rights of entry / roads license of occupation water pumping stations fish weir / dam water level control dam

Table 14 summarizes data from AEP (1996b) indicating the extent of linear disturbances and wellsite data from Carson-Pegasus Provincial Park and the Foothills Natural Region.

Table 14: Comparative Linear Disturbance Data for Carson-Pegasus Provincial Park and the Foothills Natural Region

Disturbance	Extent of Disturbance (km/km^2)	
	Carson-Pegasus Provincial Park	Foothills Natural Region
roads	0.84	0.40
cutlines and trails	2.67	2.92
total linear disturbances	3.51	3.32

Carson-Pegasus Provincial Park has sustained comparable habitat altering impacts to non-protected areas of the Foothills. In a relative measure of the intensity of fragmentation occurring within the park, numerous researchers have used a system identifying areas bordering functional roads as a "zone of ecological influence" (Horejsi 1994) or a "zone of reduced habitat effectiveness" (Lyon *et al.* 1985). The zones of influence identify areas that are disturbed or impacted by development. When comparing the total area of the park to the total area occupied by the zones of influence, this results in a percentage of the park that is deemed disturbed or impacted from any given development. Therefore, in terms of Carson-Pegasus Provincial Park contributing to the preservation goal of Special Places 2000, AEP (1995c,d) and Horejsi (1994) have identified a 1.5 km zone on either side of all secondary road systems. Other researchers have used a 500 m zone for roads and a 1.0 km zone for townsites and other developed, all-season infrastructures (AEP 1995a). Spencer E.M.S.L (1990) used a 600m zone of influence while AEP (1995b) used 800 m for main roads, active railways, transmission lines, cultivated lands, and other major developments. Interestingly, a preliminary model developed for Crimson Lake Provincial Park (area = 29.5 km^2)(located in the Foothills Natural Region) used an 800 m zone and determined that the combined remaining terrestrial habitat located outside the zones of influence totaled < $1km^2$ (AEP 1996b). It is expected that for Carson-Pegasus Provincial Park the results would be similar given the small area of the entire park and that for fragmented forests the bulk of human related impacts are concentrated near the edges (Matlack 1993). Consequently, AEP (1996b) has identified Carson-Pegasus Provincial Park as: 1. highly fragmented, 2. a severely compromised ecological integrity, and 3. in the process of becoming an ecological island. Arguably, this makes Carson-Pegasus Provincial Park only effective for supporting viable populations of small rodents, fish, and insects; wildlife with small home ranges. Conclusively, AEP (1996b) has identified the contributions of Carson-Pegasus Provincial Park towards portions of the Special Places 2000 for the Foothills as minimal.

As a whole, the ecological integrity for the entire Foothills Natural Region has also been classified as "*moderately to seriously compromised*". The creation of extensive linear networks throughout the natural region, principally by the recreational, oil, gas, and forestry developments, are considered the most significant factors contributing to the alteration of habitats in the Foothills.

See Appendix G for a map of identified Disturbance Features in Carson-Pegasus Provincial Park.

6.6 Management Recommendations

The majority of management recommendations for the park are outlined in *Carson-Pegasus Provincial Park: Management Plan* by AEP (1996a). The following recommendations are provided only as a supplemental source of information and should not be considered a comprehensive source of management recommendations available for each management issue or concern in the park. Comprehensive management recommendations are beyond the scope of this report.

6.6.1 Soils and Landform

The most threatening activities for environmentally significant landforms are intensive disturbance operations, such as sand and gravel extraction, open-pit mining, road construction and municipal and industrial development (D.A Westworth 1990). Within the study area, land use activities associated with the oil and gas industry are the most prevalent.

6.6.2 Wetlands

Historical wetland management in Alberta has threatened the presence of wetlands in areas where intensive industrial or agricultural activities are present. Although, the most serious losses have been of sloughs and marshes in the central and southern portions of the province, wetlands throughout Alberta are rapidly disappearing. Therefore, approaches to wetland conservation within Alberta's parks and protected areas are tantamount to providing a continuous, sustainable stream of environmental, economic, and social benefits.

Identifying and classifying the most significant wetlands requires that major criteria identifying wetland resource values be identified, including:

- agricultural value
- ecological value
- heritage value
- recreational and tourism value

- hydrological values
- wildlife and fisheries value
- peat resources value

Organic wetlands cover a significant component of the study area and are one of the dominant landforms on large geographic area basis. Peatlands are an important ecological resource in the area and serve numerous functions, including:

- reservoirs for surface water and stabilizing flows,
- important wetland buffers, reducing the effects of siltation and other impacts resulting from land disturbance on aquatic habitats,
- and, provision of habitat for a diversity of wildlife species.

Wetlands are very sensitive to the alteration of water levels. Linear developments, such as road and trail construction should be planned so that minimal disruption of hydrological regimes and groundwater flow occurs. Consequently, future park developments should attempt to minimize wetland loss through a wetland planning strategy as adapted from AWRC (1990):

1. conduct inventories of the park to determine the distribution, type, condition, and status of the wetlands in support of wetland management initiatives relative to wetland classification throughout the Foothills Natural Region.

2. establish objectives for wetland management in the park integrating resource and future development planning at appropriate scales.

6.6.3 Rare/Significant Plants and Plant Communities

Little is known of the extent or local population size and distribution, specific life history, or habitat requirements of the rare or significant plant species in the area. The reconnaissance nature of this inventory did not allow for a detailed inventory or assessment of rare plant species. J. Rintoul (pers. comm.) has provided information from the Alberta Natural Heritage Information Center indicating that there are no known recorded occurrences of rare plants to date in Carson-Pegasus Provincial Park. However, both field work and a literature review have provided evidence that three known rare or signficant plants occur in the park, including ostrich fern (*Matteuccia struthiopteris*), lady fern *(Athyrium filix-femina*), and White Adder's Mouth (*Malaxis monophylla* var. *brachypoda*). White Adder's Mouth is designated as rare (ANHIC 1996) while the lady fern and ostrich fern are considered significant species (AEP 1996a). Additional information sources of rare vascular plant species for the province can be found in Packer and Bradley (1984) and Wallis (1987).

Until more information is collected about the location and population size of rare plants or plant communities in Carson-Pegasus Provincial Park, the best management action will be to conserve a diverse cross-section of natural, undisturbed habitats. In general, more extensive areas of habitat are preferable to smaller ones because more extensive areas generally contain larger, more viable populations, sustain less edge-effect from adjacent disturbances, and are better buffers against disturbances (D.A. Westworth 1990).

The most serious threat to rare or uncommon assemblages of plants in the study area is from land uses such as oil and gas development. Removal of the forest canopy through the development of linear corridors, such as roads, seismic lines, and cutlines produces one of the most radical land altering activities possible. Through this process, a wide range of environmental conditions are affected simultaneously, with drastic effects on the plant species supported, or formerly supported, by the forest.

Impacts from changes in structure and composition from habitat altering activities occur at various habitat levels. At the stand level, structural simplification in the form of loss of snags and downed logs can result in a potential loss of ecological diversity. At the landscape level, large-scale spatial modifications can significantly alter the capacity of an area to function as a viable ecosystem. At this level, the effects may be categorized more as temporal than spatial, as the length of successional stages, rather than their presence *per se*, has been altered by the anthropogenic process (Franklin *et al.* 1989).

Specific to the Carson-Pegasus Provincial Park, a stand of old-growth balsam-fir has been identified by AEP (1996a) to be an ecologically significant feature in the park. Typical of many old-growth stands, this stand is identified from younger stands by several attributes as defined by Hugh Hamilton Limited (1992), including:

- large trees for species and site
- wide variation in tree species and spacing
- accumulations of large size dead standing and fallen trees
- multiple canopy layers
- canopy gaps and understorey patchiness
- decadence in the form of broken or deformed tops and boles and root decay

These features identify typical old-growth stands, however there is no accepted or universally applicable definition of old-growth. The identification of old-growth should, therefore, be based on the ecological functionality of the stand. Natural, intact ecosystems, free from severe disturbance over long periods of time have developed unique successional paths. The successional paths that have occurred in any given region produce a variety of old-growth communities (Fairbarnes 1992). The forest management and planning objectives for the various areas must integrate the landscape practices with the old-growth objectives if stands are to be maintained in a natural state and the variation in old-growth communities are be perpetuated. The uniqueness of old-growth is expressed in the biodiversity of old-growth forests. Typically, they are structurally more diverse and complex than other structural and seral stages. This valuable aspect of old-growth forests has been expressed by the AFCSSC (1995) as:

1. Some species of wildlife have an absolute requirement for old-growth forest or the characteristic of species habitat requirements makes maintenance of old-growth a priority.

2. Old-growth forests function as a vital source of genetic variation. Maintenance of this variation will be vital in the future and is important to the continued survival of some species.

3. Old-growth forests offer diverse recreational uses and have spiritual significance. While wilderness recreation does not require old-growth, the beauty and sense of tranquility provided by mature or old-growth forests are unquestioned.

With respect to the Carson-Pegasus Provincial Park balsam-fir old-growth stand, maintaining the stand in some form of perpetuity will be partially dependent on the landscape practices occurring in areas adjacent to the park. The stand has been identified as a regional significant and very sensitive feature, therefore management initiatives must account for this feature.

The stand is located on the periphery of the park with protrusions of the stand extending outside the park boundary. This problematic and discomforting location will confront the park management with serious management issues. Attempting to incorporate the remnant portions of the stand found outside of the park boundary and within reasonable distance is highly recommended, despite the opportunity for conflict to arise from other resource management objectives. For the portion of the stand contained within the park boundary, management should focus on minimizing or completely negating disturbance impacts. Fairbarnes (1992) has suggested that small fragments of old-growth in the Boreal Mixedwood are generally not capable of sustaining viable populations of the natural diversity of old-growth dependent species. However, the effective size of a fragment may be increased through connections with other fragments by means of migration corridors of intact old-growth.

The ELC portion of this study has identified four uncommon vegetation communities in the park. These include the:

- Beaked hazelnut/Indian hemp/Hairy wildrye (HR1)
- Bluejoint/Fireweed/Marsh cinqfoil (T1)
- Beaked sedge/Water sedge-Cattail (WS1)
- Swamp horsetail-great bulrush (SH1)

Minimizing impacts upon these vegetation communities is the most effective management recommendation for conserving these communities in some form of perpetuity.

6.6.4 Fauna

Although Carson-Pegasus Provincial Park provides habitat for several COSEWIC and Alberta red/blue listed species, the small area of the park severely restricts the concentrated use by many species. In short, the park provides limited habitat for highly vagile species that have home ranges that are larger than the park. Although the habitat in the park may provide highly suitable habitat, the limited availability of high quality habitat severely restricts the viability of many wildlife species. Consequently, for the species that were concentrated upon in Section 2.9, the park will provide adequate habitat for only osprey and great blue herons for a major part of their annual cycle. For black bear, grizzly bear, cougar, lynx, coyote, wolf, moose, mule deer, and white-tailed deer, the park is utilized primarily as a movement corridor or as part of a larger home range whereby the park provides habitat for only short-term occupation.

6.6.5 Disturbances

The influence of recreational and industrial developments in the Foothills Natural Region generally requires an awareness that certain impacts become predominant and management mitigations are sometimes required. With reference to disturbances, areas often result in the influx of invader species of non-native and noxious weeds. Within Carson-Pegasus Provincial Park, decommissioned well sites typically displayed numerous species of noxious weeds through the lack of revegetation of these types of sites (see Appendix A, photograph 9). For example, Canada thistle (*Cirsium arvense*), although extremely evident along many pipelines and right-of-ways is an invader plant species and not native to the area. It is highly recommended that disturbed sites be revegetated with native plants to reduce the long-term impacts associated with most developments.

Concurrently, some impacts associated with non-natural disturbances result in one of three types of environmental change, including habitat loss, habitat fragmentation, and patch size / edge effects (AEP 1996b).

Habitat loss identifies habitats where habitat destruction is evident through the long-term (in terms of human-based time scale) conversion and irreversible loss of plant and wildlife communities in the disturbed area. This includes disturbances, such as wetland drainage, cutblocks, urban developments, and other large-scale industrial activities. Byproducts or secondary impacts produced by this environmental change may result in the either habitat fragmentation or patch size / edge effects becoming apparent.

Habitat fragmentation has been assessed *as "the most serious threat to biological diversity and is the primary cause of the present extinction crisis*." (Wilcox and Murphy 1985). The effects from fragmentation are often difficult to detect, however they become evident over larger periods of time from which they relay a false sense of ecological health. Fragmentation is described by habitat loss, whereby smaller disjunct portions of a larger parent habitat become isolated creating island habitats. The insularization of habitats from disturbances, such as seismic cutlines, roads, transmission lines, and pipelines, cutblocks, agricultural fields, *etc*... minimize the viability of a habitat for supporting sensitive or larger populations of a species and generally result in the increased susceptibility of a population to extinction (Gillin and Irwin 1985, Hunter 1990, Grumbine 1992, Tilman *et al.* 1994). Physically, the disturbances act as movement barriers for many species that are habitat specialists and intolerant of habitat alterations.

Summarized within Saxena *et al.* (1997), the direct consequences of habitat fragmentation on biodiversity may be assigned to one of the following four categories (Harris 1988, Saunders *et al.* 1991):

1. Loss of large, wide-ranging, especially top carnivores or otherwise threatening forms (e.g. bears). Cursorial forms, which are vulnerable to automobile collisions, and aquatic migratory forms (e.g. fish), which are vulnerable to obstacles to migration, are particularly sensitive.

2. Loss of area-sensitive or interior species that only reproduce in the interior of large tracts of habitat are therefore vulnerable to reduction in size of the individual component habitat units as well as to reduction in total available habitat area.

3. Loss of genetic integrity from or within species or populations that inhabit areas too small for a viable population of individuals. This is especially important for large, wide-ranging carnivores or raptors that are territorial and require areas proportional to population number (i.e., they are not amenable to population packing).

4. Increase in abundance of habitat generalists that are characteristic of disturbed environments. Often these species serve as competitors (e.g. European starlings, predators (e.g., crows), or parasites (e.g., brown-headed cowbirds) on native species and accelerate their demise.

The ultimate result of these four classes is the loss of an area's uniqueness and distinguishing biological characteristics, thereby homogenizing and reducing the biodiversity of the area.

Patch size / edge effects have been described as extremely complex and only partially understood (Murcia 1995, AEP 1996b). Recently, research has concentrated on the effects of edge habitats due to the lack of comprehension of the high number of negative impacts imposed by unnatural disturbances (Haila and Hanski 1984, Harris 1984, Vaisanen *et al.* 1986, Yahner *et al.* 1989, Noss and Cooperrider 1994). Coined 'patch size', the term describes the overall size that a priority habitat must be in order to adequately protect and / or provide life requisites for its significant elements. Patch size is a key determinant of the quality of habitats offered despite the impacts of fragmentation and edge effects. Patch sizes usually indicate the minimum area of a viable habitat for a species to propagate within an isolated patch habitat, while non-viable patch habitats amplify the genetic inbreeding and reproductive isolation of a species that is not capable of negotiating fragmentation or edge effects. Thus, smaller populations sustain greater incidents of mortality due to restructuring of population size and demography and eventually result in populations that are more prone to extinction.

The recent focus on the relative value of several smaller protected areas vs. a single larger protected area stems from the issue whether two or more reserves equal in total area to a single large reserve will support more or fewer species. Thus, as stated in Saxena *et al.* (1997), the:

> *"...history of this debate has been reviewed by numerous authors (Margules et al. 1982, Simberloff 1982, Blake and Karr 1984, Soule and Simberloff, and others) and, while all arguments are not presented here, most researchers agree that a set of small reserves frequently support more species than does a single large reserve. However, this assertion is fraught with stipulations and assumptions which render it largely inapplicable to on-the-ground conservation efforts (for examples, see Soule and Simberloff 1986, Askins et al. 1987)"*

While in many of the smaller reserves, the species present are characteristic of disturbed habitats and species most urgent of management may be absent. Thus, although the total species richness found within the smaller reserves may be larger than found in a single large reserve at the time of debate, a major concern emanates regarding the occurrence of critical species in habitats of management surrounded by anthropogenic activity. Given this, larger wildlife reserves are always more valuable for conservation purposes and tend to support greater biodiversity and larger populations with more sound population structures than smaller reserves. Interestingly, in different habitats and for different taxa, research has shown that edge effects may penetrate from 15 m (Ranney *et al.* 1981) to 5 km (Janzen 1986).

7 DATA GAPS

Given the future development considerations outlined within the Carson-Pegasus Provincial Park management plan (AEP 1996a), it becomes apparent that there is a general paucity of detailed natural resource information available for the study area (Spelliscy pers. comm., Todd pers. comm., Nordstrom 1980, Hildebrandt 1976), apart from the sport fisheries information. Data gaps are particularly conspicuous with respect to the distribution of rare plant and wildlife species. Past efforts to locate rare species have been minimal and the allocated resources for this project was insufficient to conduct an extensive survey of common or rare plant and wildlife species. All previous inventory research, as outlined within AEP (1996a), suggests outdated information or incomplete attempts at producing biodiversity inventories for Carson-Pegasus Provincial Park. Currently, there does not appear to be any recent rare plant surveys or inventory assessments, and vegetation surveys are limited to air photo interpretation and dated preliminary vegetation plots (1979). Similarly, recent wildlife surveys are limited to a bird checklist (field studies 1979-1980) and a mammals and reptiles / amphibians checklist (observational and expected occurrences)(1980). Additionally, more detailed information is required on the non-sport fisheries resources available within the park.

Given the continued exploration for oil and gas within the park, it is feasible to consider the impacts associated from future industrial development. In light of AEP (1996b) describing Carson-Pegasus Provincial Park as an "*ecological island*" and that the "*ecological integrity* (of the park) *has been seriously compromised*", future park management plans should consider the lack of pertinent and intensive impact assessments given the intensity industrial developments for the park. Specifically, literature reviews for this project yielded little information regarding development and consequential impacts on the park.

Finally, information in greater detail is required on the numerous wetlands and organic ecosystems found in the park. Information is required that outlines the physical and biological characteristics of the peatlands. Without adequate baseline data it will be very difficult to assess future impacts as resource development and exploitation projects proceed in the park.

8 GENERAL OBSERVATIONS OF THE STUDY AREA

At present, Carson-Pegasus Provincial Park has been identified as a provincially significant resource and has, thus been conserved and protected as part of Alberta's parks and protected areas network. The park contains significant natural, historical, and cultural landscapes and features for which many park users consider extremely valuable within the Foothills Natural Region. Although many parks and protected areas provide pristine habitat for the conservation of representative habitats, others sustain varying degrees of recreational use. This integration of natural history conservation with the provision of recreation benefits describes the mandate for Carson-Pegasus Provincial Park. In the past, the park has sustained a high degree of use, and has since sustained rising numbers of users focusing on the recreational benefits. The integration of the park mandate with increased park use is likely being driven by increasing public pressure, and in most cases very little attention is being given to the ecological constraints associated with such development. Furthermore, increasing human population is likely to worsen the pressures on the available natural resources and significant features. Consequently, negative impacts as byproducts of the increased human use in the area are likely to threaten all significant features within the park. The sensitivity of these features lends considerable uncertainty regarding the future of parks that provide a range of functions, including preservation, heritage appreciation, outdoor recreation, and tourism/economic development.

Speculation of the park's future in light of increased park usage will likely suggest that the park will receive greater impacts with more profound implications. As identified in the Disturbance Features Map in Appendix G, the obvious occurrence of disturbance features is a conspicuous indicator of the level of impact that the park currently sustains. Increasing developmental pressures and, therefore fragmentation will likely influence preservation policies and attitudes in the future. The foreseen conflict between development and preservation will test the park mandate and will eventually become expressed and measured by ecological terms, such as disturbance features, zones of influence, and population viability. The total amount of disturbance features within the park is a key indicator of the amount of recreational and industrial development occurring within the park. However, given the required use and consumption of both recreational facilities and industrial products by human society, park development is obligated to acknowledge the need for a priority development, reclamation, and conservation approach to management. Areas of concentration should be, thus identified and classified according to their priority for the purpose of retaining or enhancing significant features. The products from this ELC project will aid in conceptualizing ecologically significant features and identify them with their eventual integration into park management objectives.

As previously described in Section G, the most significant features found throughout Carson-Pegasus Provincial Park have been identified and mapped as either significant ethnohistorical / archaeological or ecological features based on current information. However, given greater detail of some alternate features found within the park, it is feasible to include additional significant features to the current list. Consequently, due to the lack of described physical and biophysical characteristics, the following features should be given greater focus as potentially significant features:

8.1 Additional Significant Ecological Features for Consideration

- the significance and diversity of organic wetlands within the park;
- the diversity of hydrological features (lakes, rivers, lakes, fens, and bogs) and associated vegetation communities;
- the occurrence and diversity of rare or uncommon plant and plant communities;
- an Archaeological survey completed in greater detail;
- the distribution of old-growth stands of balsam fir in and adjacent to the park, as well as a mappable area outlining the occurrence of existing stands.

8.2 Additional Significant Wildlife Features for Consideration

- wildlife biodiversity inventory displaying habitat associations and prime habitats for various wildlife in the park;
- a non-sport fisheries resource inventory assessment for the park;
- critical breeding, nesting, wintering, and foraging areas for various significant wildlife populations in or adjacent to the park;
- a mappable area outlining the zone of influence for the existing colony of nesting great blue herons.

9 PERSONAL COMMUNICATIONS

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APPENDIX A –
COLOR PHOTGRAPHS OF REPRESENTATIVE
PROJECT AREA FEATURES

Photograph 1: Eastern shore of Little McLeod Lake (plot 26)

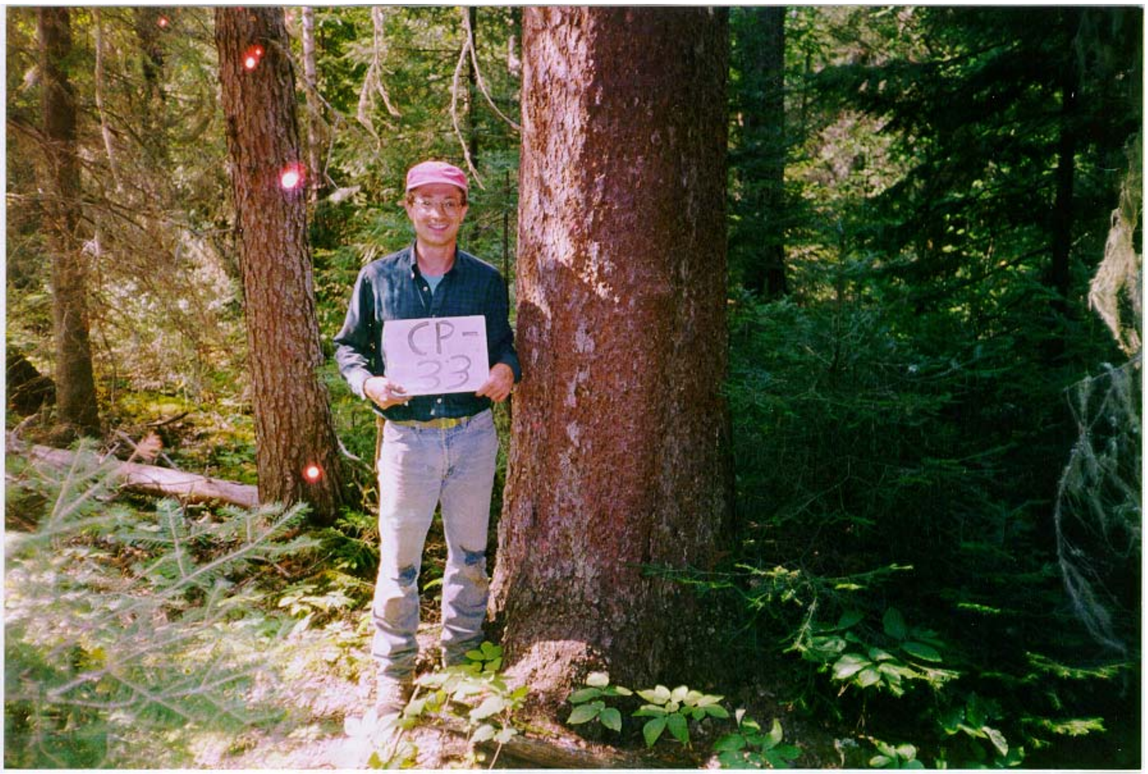
Photograph 2: Southern shore of Little McLeod Lake (plot 26)
(note: observe the water pumping station located on the west end of the lake)

Photo 3: Black spruce Organic Bog (plot 7)

Photograph 4: Sedge dominated wetland found in association with Mobil Creek Delta (plot 12)

Photograph 5: Riparian zone adjacent to the outlet creek on McLeod Lake (plot 17)

Photograph 6: Cattail Community found at a Creek Mouth near the Northwest corner of McLeod Lake (17)



Photograph 7: Balsam-Fir Old-growth Stand (plot 33)

Photograph 8: Significant Native Plant Found Near McLeod Lake Campground (plot 6)
(Lady Fern)

Photograph 9: Wellsite Vegetation Community found with Carson-Pegasus Provincial Park (plot 27)

Photograph 10: Typical Upland Vegetation found in association with McLeod Lake (plot 15)
(saskatoon, bracted honey suckle, prickly rose)

Photograph 11: Conifer dominated upland found in association with Little McLeod Lake (plot 25)

Photograph 12: Understorey Vegetation found on the South Facing Slope of the North Peninsula (plot 16)

APPENDIX B –
LIST OF MAMMALS AND AVIFAUNA
KNOWN OR EXPECTED TO OCCUR IN
CARSON-PEGASUS PROVINCIAL PARK

The following species lists depicts both mammal and avifaunal occurrence summaries for Carson-Pegasus Provincial Park. The lists were adapted from several identified information sources, and where occurrence information gaps existed, additional references, such as Smith (1993) and Semenchuk (1992) where used to ascertain whether any given species could, within reason, be expected to be present within the park. This entailed determining whether the park is encompassed within current known breeding distributions and range occurrence maps. This system is used in lieu of an extensive faunal inventory for the park.

Known or Expected Occurrences of Mammal Species in Carson-Pegasus Provincial Park

Common Name	Species Name
masked shrew	*Sorex cinereus*
dusky shrew	*Sorex monicolus*
water shrew	*Sorex palustris*
Arctic shrew	*Sorex arcticus*
pygmy shrew	*Sorex hoyi*
little brown bat	*Myotis lucifugus*
northern long-eared bat	*Myotis septentrionalis*
silver-haired bat	*Lasionycteris noctivagans*
big brown bat	*Eptesicus fuscus*
hoary bat	*Lasiurus cinereus*
snowshoe hare	*Lepus americanus**
least chipmunk	*Tamias minimus*
woodchuck	*Marmota monax*
Franklin’s ground squirrel	*Spermophilus franklinii***
red squirrel	*Tamiasciurus hudsonicus**
northern flying squirrel	*Glaucomys sabrinus*
beaver	*Castor canadensis**
deer mouse	*Peromyscus maniculatus*
southern red-backed vole	*Clethrionomys gapperi*
heather vole	*Phenacomys intermedius*
meadow vole	*Microtus pennsylvanicus*
muskrat	*Ondatra zibethicus**
northern bog lemming	*Synaptomys borealis*
meadow jumping mouse	*Zapus hudsonius*
western jumping mouse	*Zapus princeps*
porcupine	*Erethizon dorsatum**
coyote	*Canis latrans**
gray wolf	*Canis lupus**
red fox	*Vulpes vulpes**
black bear	*Ursus americanus**
grizzly bear	*Ursus arctos**
marten	*Martes americanad**
fisher	*Martes pennanti**
ermine	*Mustela erminea**
least weasel	*Mustela nivalis**
long-tailed weasel	*Mustela frenata*
mink	*Mustela vison**
wolverine	*Gulo gulo*
striped skunk	*Mephitis mephitis*
river otter	*Lutra canadensis**
cougar	*Felis concolor**
Canada lynx	*Lynx canadensis**
mule deer	*Odocoileus hemionus**
white-tailed deer	*Odocoileus virginianus**
moose	*Alces alces**

* Known or expected occurrences of mammals within Carson-Pegasus Provincial Park (G. Gilbertson pers. comm.)

** Periphery of the species range is relatively near Carson-Pegasus Provincial Park

Known or Expected Occurrences of Bird Species in Carson-Pegasus Provincial Park

Common Name	Species Name
common loon	*Gavia immer****
pied-billed grebe	*Podilymbus podiceps***
horned grebe	*Podiceps auritus*
red-necked grebe	*Podiceps grisegena***
eared grebe	*Podiceps nigricollis*
western grebe	*Aechmophorus occidentalis***
double-crested cormorant	*Phalacrocorax auritus***
American bittern	*Botaurus lentiginosus*
great blue heron	*Ardea herodias****
trumpeter swan	*Cygnus buccinator*
Canada goose	*Branta canadensis***
green-winged teal	*Anas crecca***
mallard	*Anas platyrhynchos***
northern pintail	*Anas acuta*
cinnamon teal	*Anas cyanoptera*
blue-winged teal	*Anas discors*
gadwall	*Anas strepera*
American wigeon	*Anas americana*
canvasback	*Aythya valisineria*
redhead	*Aythya americana*
ring-necked duck	*Aythya collaris***
lesser scaup	*Aythya affinis***
common goldeneye	*Bucephala clangula***
bufflehead	*Bucephalus albeola***
hooded merganser	*Lophodytes cucullatus*
common merganser	*Mergus merganser*
ruddy duck	*Oxyura jamaicensis*
osprey	*Pandion haliaetus****
bald eagle	*Haliaeetus leucocephalus**
northern harrier	*Circus cyaneus*
sharp-shinned hawk	*Accipiter striatus***
Cooper’s hawk	*Accipiter cooperii*
northern goshawk	*Accipiter gentilis*
broad-winged hawk	*Buteo platypterus***
red-tailed hawk	*Buteo jamaicensis***
golden ealge	*Aquila chrysaetos**
American kestrel	*Falco sparverius**
merlin	*Falco columbarius*
spruce grouse	*Dendragapus canadensis**
ruffed grouse	*Bonasa umbellus****
sharp-tailed grouse	*Tympanuchus phasianellus**
sora	*Porzana carolina***
American coot	*Fulica americana***
sandhill crane	*Grus canadensis**
killdeer	*Charadrius vociferus***
greater yellowlegs	*Tringa melanoleuca*
lesser yellowlegs	*Tringa flavipes*
solitary sandpiper	*Tringa solitaria***
spotted sandpiper	*Actitis macularia*
common snipe	*Gallinago gallinago***
Wilson's phalarope	*Phalaropus tricolor*
Franklin’s gull	*Larus pipixcan***
Bonaparte’s gull	*Larus philadelphia*
ring-billed gull	*Larus delawarensis*
California gull	*Larus californicus***
black tern	*Chlidonias niger*
rock dove	*Columba livia*
mourning dove	*Zenaida macroura*
great horned owl	*Bubo virginianus**
barred owl	*Strix varia***
northern hawk-owl	*Surnia ulula*

great gray owl	*Strix nebulosa**
long-eared owl	*Asio otus**
short-eared owl	*Asio flammeus**
northern saw-whet owl	*Aegolius acadicus**
common nighthawk	*Chordeiles minor*
ruby-throated hummingbird	*Archilochus colubris*
belted kingfisher	*Ceryle alcyon*
yellow-bellied sapsucker	*Sphyrapicus varius***
downy woodpecker	*Picoides pubescens*
hairy woodpecker	*Picoides villosus***
three-toed woodpecker	*Picoides tridactylus*
black-backed woodpecker	*Picoides arcticus*
northern flicker	*Colaptes auratus***
pileated woodpecker	*Dryocopus pileatus***
olive-sided flycatcher	*Contopus borealis***
western wood-pewee	*Contopus sordidulus***
alder flycatcher	*Empidonax alnorum***
least flycatcher	*Empidonax minimus***
eastern phoebe	*Sayornis phoebe*
eastern kingbird	*Tyrannus tyrannus***
purple martin	*Progne subis*
tree swallow	*Tachycineta biocolor***
bank swallow	*Riparia riparia*
cliff swallow	*Hirundo pyrrhonota*
barn swallow	*Hirundo rustica***
gray jay	*Perisoreus canadensis****
blue jay	*Cyanocitta cristata****
black-billed magpie	*Pica pica**
American crow	*Corvus brachyrhynchos***
common raven	*Corvus corax****
black-capped chickadee	*Parus atricapillus***
boreal chickadee	*Parus hudsonicus***
red-breasted nuthatch	*Sitta canadensis***
white-breasted nuthatch	*Sitta carolinensis*
house wren	*Troglodytes aedon***
winter wren	*Troglodytes troglodytes*
marsh wrren	*Cistothorus palustris*
golden-crowned kinglet	*Regulus satrapa*
ruby-crowned kinglet	*Regulus calendula***
mountain bluebird	*Sialia currucoides*
veery	*Catharus fuscescens*
Swainson’s thrush	*Catharus ustulatus***
hermit thrush	*Catharus ustulatus***
American robin	*Turdus migratorius***
gray catbird	*Dumetella carolinensis*
bohemian waxwing	*Bombycilla garrulus*
cedar waxwing	*Bombycilla cedrorum*
European starling	*Sturnus vulgaris***
solitary vireo	*Vireo solitarius***
warbling vireo	*Vireo gilvus***
Philadelphia vireo	*Vireo philadelphicus***
Red-eyed vireo	*Vireo olivaceus***
Tennessee warbler	*Vermivora peregrina***
orange-crowned warbler	*Vermivora celeta***
yellow warbler	*Dendroica petechia***
magnolia warbler	*Dendroica magnolia***
Cape May warbler	*Dendroica tigrina*
yellow-rumped warbler	*Dendroica coronata***
black-throated green warbler	*Dendroica virens***
palm warbler	*Dendroica palmarum*
blackpoll warbler	*Dendroica striata*
black-and-white warbler	*Mniotilta varia***
American redstart	*Setophaga ruticilla***
ovenbird	*Seiurus aurocapillus***
northern waterthrush	*Seiurus noveboracensis***
Connecticut warbler	*Oporornis agilia*
mourning warbler	*Oporornis philadelphia***
common yellowthroat	*Geothlypis trichas***
Wilson’s warbler	*Wilsonia pusilla*
Canada warbler	*Wilsonia canadensis*

western tanager	*Piranga ludoviciana***
rose-breasted grosbeak	*Pheucticus ludovicianus***
American tree sparrow	*Spizella arborea*
chipping sparrow	*Spizella passerina***
clay-colored sparrow	*Spizella pallida***
vesper sparrow	*Pooecetes gramineus*
savannah sparrow	*Passerculus sandwichensis***
LeConte's sparrow	*Ammodramus leconteii***
song sparrow	*Melospiza melodia***
Lincoln's sparrow	*Melospiza lincolnii***
swamp sparrow	*Melospiza georgiana***
white-throated sparrow	*Zonotrichia albicollis***
white-crowned sparrow	*Zonotrichia leucophyrs*
dark-eyed junco	*Junco hyemalis***
red-winged blackbird	*Agelaius phoeniceus***
western meadowlark	*Sturnella neglecta*
yellow-headed blackbird	*Xanthocephalus xanthocephalus*
rusty blackbird	*Eugphagus carolinus*
brewer's blackbird	*Euphagus cyanocephalus***
common grackle	*Quiscalus quiscula*
brown-headed cowbird	*Molothrus ater*
northern oriole	*Icterus galbula*
pine grosbeak	*PInicola enucleator*
purple finch	*Carpodacus purpureus***
white-winged crossbill	*Loxia leucoptera***
common redpoll	*Carduelis flammea*
pine siskin	*Carduelis pinus***
American goldfinch	*Carduelis tristis*
evening grosbeak	*Coccothraustes vespertinus***
house sparrow	*Passer domesticus**

* Observations or known occurrences of bird species in Carson-Pegasus Provincial Park by G. Gilbertson (pers. comm.)

** Raw data bird species observations (FAN 1992) by the Federation of Alberta Naturalists in and adjacent to Carson-Pegasus Provincial Park as published in Semenchuk (1992)

*** Observation or known occurrences by G. Gilbertson (pers. comm.) and the Federation of Alberta Naturalists (FAN 1992)

APPENDIX C –
INCIDENTAL LIST OF FAUNAL SPECIES OBSERVED DURING FIELD WORK

Incidental List of Fauna Observed During Field Work

Common Name	Latin Name
common loon	*Gavia immer*
red-necked grebe	*Podiceps grisegena*
mallard	*Anas platyrhynchos*
blue-winged teal	*Anas discors*
common goldeneye	*Bucephala clangula*
bufflehead	*Bucephalus albeola*
osprey	*Pandion haliaetus*
bald eagle	*Haliaeetus leucocephalus*
northern harrier	*Circus cyaneus*
kestrel	*Falco sparverius*
ruffed grouse	*Bonasa umbellus*
spotted sandpiper	*Actitis macularia*
Franklin's gull	*Larus pipixcan*
California gull	*Larus californicus*
great-horned owl	*Bubo virginianus*
hairy woodpecker	*Picoides villosus*
yellow-shafted flicker	*Colaptes auratus*
gray jay	*Perisoreus canadensis*
blue jay	*Cyanocitta cristata*
american crow	*Corvus brachyrhynchos*
common raven	*Corvus corax*
black-capped chickadee	*Parus atricapillus*
dark-eyed junco	*Junco hyemalis*
red squirrel	*Tamiasciurus hudsonicus*
snowshoe hare	*Lepus americanus*
coyote	*Canis latrans*
moose	*Alces alces*

APPENDIX D–

POLYGON AND LEGEND DATABASE KEY

The following summary of evaluation parameters is a Polygon and Legend Database Key for Carson-Pegasus Provincial Park.

Polygon and Legend Database Key	
CODE	**DESCRIPTION**
PARENT MATERIAL	
F	fluvial
FvbM	fluvial veneer blanket over moraine (till)
FL^G	glaciofluvial-lacustrine
$FL^G vM$	glaciofluvial-lacustrine veneer over moraine (till)
$FL^G vbM$	glaciofluvial-lacustrine veneer blanket over moraine (till)
L^G	glaciolacustrine
$L^G vM$	glaciolacustrine veneer over moraine (till)
M	moraine (till)
O	organic
ObF^G	organic blanket over glaciofluvial
ObL^G	organic blanket over glaciolacustrine
ObM	organic blanket over moraine (till)
OvF	organic veneer over fluvial
$OvFL^G$	organic veneer over glaciofluvial-lacustrine
$OvbFL^G$	organic veneer blanket over glaciofluvial-lacustrine
OvL^G	organic veneer over glaciolacustrine
OvM	organic veneer over moraine (till)
SURFACE EXPRESSION	
h	horizontal (organic units)
h	hummocky (mineral units)
hr	hummocky and ridged
i	inclined
l	level
r	ridged
t	terraced
u	undulating
uh	undulating to hummocky
SOIL CLASSIFICATION	
BR.GL	Brunisolic Gray Luvisol
GL.GL	Gleyed Gray Luvisol
O.G	Orthic Gleysol
ptO.G	Peaty Orthic Gleysol
O.GL	Orthic Gray Luvisol
O.R	Orthic Regosol
R.G	Rego Gleysol
ptR.G	Peaty Rego Gleysol
THU.M	Terric Humic Mesisol
T.M	Terric Mesisol
HU.M	Humic Mesisol
TY.M	Typic Mesisol
SLOPE CLASSES	
1	0 - 0.5% level
2	0.5 - 2% nearly level
3	2 - 5% very gentle slopes
4	5 - 9% gentle slopes

5	9 - 15% moderate slopes
6	15 - 30% strong slopes
7	30-45% very strong slopes
DRAINAGE CLASSES	
MW	moderately well
I	imperfectly
P	poorly
VP	very poorly
SURFACE AND SUBSURFACE TEXTURE	
C	Clay (fine textured)
CL	Clay Loam
FSL	Fine Sandy Loam
O	Organic
S	Sandy (coarse textured)
SiL	Silty Loam
SiC	Silty Clay
SiCL	Silty Clay Loam
SL	Sandy Loam
PERMEABILITY CLASSES	
H	high permeability
M	moderate permeability
L	low permeability
ROCKINESS CLASSES	
0	non-rocky
1	slightly rocky
STONINESS CLASSES	
0	non-stony
1	slightly stony
RUTTING, COMPACTION, PUDDLING, SOIL EROSION, AND WIND THROW HAZARDS	
H	high risk
M	medium risk
L	low risk
FLOOD HAZARD	
N	none
R	rare
M	may be expected
F	frequent

APPENDIX E–
ECOLOGICAL LAND CLASSIFICATION POLYGON DATABASE

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
1	M4.1	M	h	60	O.GL		5-6	MW	SiL	C	M	>100	>100	>0	0	1	OvM	h	20 20	T.M ptO.G	1-2	P	O	C	LC1	LC3	LT2
2	O1.1	O	h	50	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0			50	open water					DB1	DB2	w
3	M4.5	M	h	60	O.GL		5-6	MW	SiL	C	M	>100	>100	>0	0	1	OvM	h	20 20	T.M ptO.G	1-2	P	O	C	LC1	LC3	
4	M4.2	M	h	75	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	M	u	25	ptO.G	1-2	P	C	C	LC8		
5	O2.7	O	h	50	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0			50	open water					T1	DB1	w
6	O2.6	ObM	h	80	TY.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvM	h	20	ptO.G					DB1	DB2	BS1
7	O1.2	O	h	100	T.Y.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0									DB2	BS1	
8	O2.2	ObL^G	h	100	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0									DB1	DB2	
9	O2.5	ObL^G	h	80	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvL^G	h	20	ptO.G	1	P	O	C	LT1	LT2	
10	O2.5	ObM	h	70	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	u	20 10	ptO.G O.GL	2-3	P MW	O	C	LT2	LT1	DB2
12	O2.2	ObL^G	h	80	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvL^G	h	20	ptO.G	1	P	O	C	DB2		
13	O2.2	ObL^G	h	80	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvL^G	h	20	ptO.G	1	P	O	C	DB2		
14	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT2		
15	O2.1	ObL^G	h	80	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvL^G	L	20	ptO.G	1	P	O	C	BS1	LT2	
16	M3.1	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC1	BH1	
17	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT1	LT2	
18	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT2		
19	M4.1	M	h	60	O.GL		5-6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC1	LC4	BS1

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
20	M3.1	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC1	BH2	BS1
21	M3.3	M	h	60	O.GL		4	MW	SiL	C		>100	>100	>0	0	1			20 20	T.M ptO.G	1-2	P	O	C	LC3		
22	M3.2	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	BH1		
23	O2.1	ObM	h	70	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	OvM	h	30	ptO.G	1	P	O	C	BS1	LT1	
24	M3.4	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC7	BS1	
25	O2.2	ObL^{G}	h	80	T.M	HU.M	1	P	O	C	M	>100	>100	>0	0	0	M	h	20	O.GL	5	MW	SiL	C	DB2	DB3	
26	M4.1	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC3	LC1	BS1
27	M1.1	M	u	60	O.GL		3	NW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	BH2	BS1	
28	M3.1	M	uh	80	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20	ptO.G	1	P	O	C	LC1		
29	O2.2	ObM	h	100	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0									DB2		
30	O2.2	ObM	h	100	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0									DB2		
31	O2.1	ObM	h	100	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0									BS1	DB2	
32	M3.3	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC3		
33	M3.2	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	BH2		
34	L1.1	water																							w	SH1	WS1
35	M2.1	M	r	75	O.GL		3-6	MW	L	SiCL	M	>100	>100	>100	0	1	M	r	25	O.R	6	MW	L	SiCL	LC1		
36	O2.4	OvL^{G}	h	90	T.M	ptOG	1	P	O	SC	M	>100	>100	>0	0	0	O	h	10	TY.H	1	VP	O		BH1	BH2	
37	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	BS1	

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
38	M3.3	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC7	LC1	LC4
39	M4.2	M	h	60	O.GL		5-6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC4	LC7	BS1
40	M3.4	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC3	LC1	BS1
41	GL1.1	L^G	1	80	GL.GL	O.G	2	P-I	SiL	SiCL	M	>100	>100	>20	0	0	OvL^G	l	20	ptO.G	2	P	SiCL	SiCL	BH1	LC4	
42	L1.1	water																							w	SH1	
43	L1.1	water																							w	SH1	
44	L1.1	water																							SH1		
45	L1.2	water																							NWL		
46	M4.3	M	h	80	O.GL	BR.GL	6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	10 10	T.M O.G	2	P	O C	C C	LC3	BH1	LC4
47	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1		
48	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	BS1	
49	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT1		
50	M4.4	M	h	60	O.GL		5-6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1	P	O C	C C	LC7	LC4	
51	M3.3	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC7	BS1	
52	O2.6	ObM	h	50	T.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	h	50	GL.GL O.GL	4-5	MW-I	SiL	C	LT1	BS1	
53	M4.5	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC8	LC4	
54	M4.1	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC1	LC7	
55	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	DB2	BS1

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
56	M4.4	M	h	80	O.GL	BR.GL	6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	10 10	T.M O.G	2	P	O C	C C	LC7	BH1	LC3
57	M4.5	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC8	LC4	
58	GL1.1	L^{G}	1	80	GL.GL	O.G	2	P-I	SiL	SiCL	M	>100	>100	>20	0	0	OvL^{G}	l	20	ptO.G	2	P	SiCL	SiCL	BH1		
59	L1.1	water																							w	SH1	
60	O2.2	OvL^{G}	h	100	T.M	THU.M	1	P	O	C	M	>100	>100	>0	0	0									DB2		
61	M4.2	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC8	LC4	
62	O2.2	OvL^{G}	h	100	T.M	THU.M	1	P	0	C	M	>100	>100	>0	0	0									DB2		
63	F1.1	F	t	70	ptR.G	ptO.G	1	P	O	SC	M	>100	>100	>50	0	0	OvF	h	30	T.M	1	P	O	SC	W1		
64	M5.	M	r	100	O.GL	BR.GL	6-7	mw	SiL	C	M	>100	>100	>100	0	1									LC5	BS1	
65	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	BS1	
66	M4.5	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	BS1		
67	M4.1	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC1	LC3	
68	O2.1	ObM	h	75	T.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	u	25	ptO.G	2	P	O	C	BS1	DB1	
69	O2.1	OvM	h	60	T.M	THU.M	1	P	O	C	M	>100	>100	>0	0	0	M	u	40	ptO.G	2	P	O	C	BS1		
70	M4.3	M	hr	80	O.GL		6	MW	SiL	C	M	>100	>100	>100	0	1	M	hr	20	GL.GL	6	I	SiL	C	LC3	LC1	LC8
71	M4.4	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1	P	O	C	LC3	LC8	
72	M5.4	M	i	100	O.GL	BR.GL	7	MW	SiL	C	M	>100	>100	>100	0	1									LC3	LC1	
73	M4.5	M	hr	80	O.GL		6	MW	SiL	C	M	>100	>100	>100	0	1			20	GL.GL	6	I	SiL	C	LC8	BS1	

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
74	O2.1	ObM	h	75	T.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	u	25	ptO.G	2	P	O	C	BS1	DB1	
75	O2.6	ObM	h	75	T.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	u	25	ptO.G	2	P	O	C	DB1	BS1	
76	O2.6	ObM	h	75	T.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0	M	u	25	ptO.G	2	P	O	C	DB2	DB1	
77	M4.5	M	h	80	O.GL		6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20	ptO.G	2	P	C	C	LC8	LC3	
78	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT2	LT1	
79	O2.7	ObF^G	h	100	T.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									T1	DB1	w
80	O2.3	OvbFL^G	h	100	T.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									W1	DB1	WS1
81	O2.4	ObF^G	h	100	T.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									BH1	T3	
82	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB2	DB3	
83	O2.7	ObF^G	h	100	T.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									T1	DB1	
84	O2.4	ObF^G	h	100	T.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									BS1	T3	
85	O2.1	OvL^G	h	75	T.M	THU.M	1	P	O	C	M	>100	>100	>0	0	0	L^G	l	25	ptO.G	1-2	P	O	C	BS1		
86	GL3.2	FL^{G}vb M	h	60	O.GL	GL.GL	5	W	SL	S	M	>100	>100	>100	0	0	M	h	40	O.GL	5	MW	SL	C	LC8	BS1	
88	O2.2	ObL^G	h	100	T.M	THU.M	1	VP	O	C	M	>100	>100	>0	0	0									DB2		
89	GL3.1	FL^{G}vb M	h	60	O.GL	GL.GL	5	W	SL	S	M	>100	>100	>100	0	0	M	h	40	O.GL	5	MW	SL	C	LC4	LC2	
90	L1.2	water																							NWL		
91	GL2.3	L^G	hr	75	O.GL		5-6	MW	SiL	SiC	M	>100	>100	>100	0	0	L^{G}vM	hr	25	O.GL	6	MW	SiL	C	LC2	LC1	LC8
92	M4.4	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1-2	P	O	C	LC7	LC3	BH1

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
93	O2.1	OvF	h	75	T.M	ptO.G	1	P	O	CL	M	>100	>100	>0	0	0	O	h	25	TY.H	1	VP	O		BS1	BH1	
94	M3.4	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC8	LC4	LC2
95	M4.2	M	hr	100	O.GL	BR.GL	6	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC4	LC2	
96	M3.5	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC3	LC2	
97	M3.4	M	h	60	O.GL		4	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC8	LC4	LC2
98	M4.5	M	h	80	O.GL	BR.GL	6	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	10 10	T.M O.G	2	P	O C	C C	LC3	LC7	LC8
99	O2.6	OvF	h	60	T.M	THU.M	1	P	O	CL	M	>100	>100	>0	0	0	FvbM		40	ptO.G	1-2	P	O	CL	DB1	BH1	
100	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	DB2	
101	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1		
102	M4.5	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M O.G	1-2	P	O	C	LC8	LC4	
103	O2.6	OvF	h	60	T.M	THU.M	1	P	O	CL	M	>100	>100	>0	0	0	FvbM		40	ptO.G	1-2	P	O	CL	DB1	BH1	
104	M4.5	M	hr	100	O.GL	BR.GL	6	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC8	LC4	
105	O1.1	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									LT1		
106	M5.2	M	hr	100	O.GL	BR.GL	6-7	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC8	LC4	
107	M5.1	M	hr	100	O.GL	BR.GL	6-7	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC4	LC3	
108	O1.1	O	h	50	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0	OvM	H	25 25	T.M ptO.G	1	P	O	C	LT1	LT2	
109	M5.3	M	hr	100	O.GL	BR.GL	6-7	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC4	LC2	HR1
110	O2.6	O	h	60	TY.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	ObL[G]	h	40	T.M	1	P	O	C	DB1	DB2	BH1

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
111	L1.2	water																							w		
112	O2.2	O	h	60	TY.M	HU.M	1	VP	O	C	M	>100	>100	>0	0	0	ObL^G	h	40	T.M T.H	1	P	O	C	DB2		
113	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100	>0	0	0									DB1	DB2	
114	M4.4	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1-2	P	O	C	LC7	BH1	
115	M4.1	M	h	60	O.GL		5	MW	SiL	C	M	>100	>100	>100	0	1	OvM	h	20 20	T.M ptO.G	1-2	P	O	C	LC1		
116	M5.2	M	hr	100	O.GL	BR.GL	6-7	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC8	LC7	LC4
117	M5.4	M	hr	100	O.GL	BR.GL	6-7	MW	SiL	SiCL-C	M	>100	>100	>100	0	1									LC1	BH1	
118	L1.1	water																							w	SH1	
119	L1.2	water																							NWL		
120	M4.5	M	hr	80	O.GL	BR.GL	6	MW	SiL	SiCL-C	M	>100	>100	>100	0	1	OvM	h	20	ptO.G	2	P	O	C	LC8	LC3	
121	O2.1	OvL^G	h	60	T.M	ptO.G	1	P	O	C	M	>100	>100	>0	0	0	M	hr	40	O.GL	4	MW	SiL	CL-C	BS1	LC8	DB1
122	O1.2	O	h	100	TY.M	HU.M	1	VP	O		M	>100	>100												DB2	DB1	
123	O2.1	OvL^G	h	60	T.M	ptO.G	1	P	O	CL	M	>100	>100	>0	0	0	O	h	40	TY.H	1	VP	O		BS1	BH1	
124	O2.1	OvL^G	h	60	T.M	ptO.G	1	P	O	CL	M	>100	>100	>0	0	0	O	h	40	TY.H	1	VP	O		BS1	DB1	
125	GL2.2	FL^G	h	75	O.GL	GL.GL	5	W	SL	C	M	>100	>100	>100	0	0	FL^{G}vM	h	25	O.GL	5	MW	SL	C	LC7	BS1	
126	GL2.1	FL^G	h	75	O.GL	GL.GL	5	W	SL	C	M	>100	>100	>100	0	0	FL^{G}vM	h	25	O.GL	5	MW	SL	C	LC3	LC8	BS1
127	O2.1	OvL^G	h	60	T.M	ptO.G	1	P	O	C	M	>100	>100	>0	0	0	O	h	40	TY.H	1	VP	O		BS1	LT1	
128	GL3.2	FL^G	hr	60	O.GL	BR.GL	6-7	W	SiL	FSL	M	>100	>100	>100	0	0	FL^{G}vM	hr	40	O.GL	6-7	W	SiL	C	LC8	LC4	
129	GL3.1	FL^G	hr	60	O.GL	BR.GL	6-7	W	SiL	FSL	M	>100	>100	>100	0	0	FL^{G}vM	hr	40	O.GL	6-7	W	SiL	C	LC4	LC2	HR1

POLY. #	ECOSITE	PAR MAT 1	SURF EXP 1	% 1	SOIL CL 1.1	SOIL CL 1.2	SLOPE CL 1	DRAIN CL 1	SURF TEX 1	UND TEX 1	PERM CL 1	DEP BED 1	DEP IMP 1	DEP WAT 1	ROCK CL 1	STONE CL 1	PAR MAT 2	SURF EXP 2	% 2	SOIL CL 2	SLOPE CL 2	DRAIN CL 2	SURF TEX 2	UND TEX 2	VEG TYPE 1	VEG TYPE 2	VEG TYPE 3
130	GL2.2	FL^G	h	75	O.GL	GL.GL	5	W	SL	C	M	>100	>100	>100	0	0	FL^GvM	h	25	O.GL	5	MW	SL	C	LC7		
131	GL3.2	FL^G	h	60	O.GL		4	MW	SL	C	M	>100	>100	>0	0	0	$OvFL^G$	h	40	T.M ptO.G	1-2	P	O	SL/C	LC8	BS1	
132	GL2.1	L^G	hr	75	O.GL	GL.GL	5-6	MW	SiL	SiC	M	>100	>100	>100	0	0	L^GvM	h	25	O.GL	5	MW	SiL	C	LC4	LC7	
133	GL2.2	L^G	hr	75	O.GL	GL.GL	5-6	MW	SiL	SiC	M	>100	>100	>100	0	0	L^GvM	h	25	O.GL	5	MW	SiL	C	LC3	BS1	LC2

APPENDIX F –
ELC MAPPING AND VEGETATION COMMUNITY TYPES INFORMATION

A total of 21 community types were identified within the study area. The following community types are listed in order of increasing site moisture from submesic to hydric conditions as follows:

1.	Beaked hazelnut/Indian hemp/hairy wild rye	(HR1)
2.	Aspen poplar/low-bush cranberry	(LC1)[1]
3.	Aspen poplar-white spruce-lodgepole pine/prickly rose	(LC2)[1]
4.	Aspen poplar-white spruce-lodgepole pine/low-bush cranberry	(LC3)[1]
5.	Aspen poplar-white spruce-lodgepole pine/feathermoss	(LC4)[1]
6.	Aspen poplar-white spruce-lodgepole pine/Canada buffaloberry	(LC5)[1]
7.	White spruce/prickly rose	(LC6)[1]
8.	White spruce-balsam fir/feathermoss	(LC7)[1]
9.	Lodgepole pine/feathermoss	(LC8)[1]
10.	Aspen poplar-white spruce- lodgepole pine/bracted honeysuckle/fern	(BH1)[1]
11.	Aspen poplar-white spruce-lodgepole pine/balsam fir/fern	(BH2)[1]
12.	Black spruce-white spruce/Labrador tea/horsetail	(BS1)[1]
13.	Willow/bluejoint-water sedge	(W1)
14.	Black spruce/Labrador tea/cloudberry/peat moss	(LT11)
15.	Labrador tea/cloudberry/peat moss	(LT2)[1]
16.	Black spruce-tamarack/bog birch/sedge/peat moss	(DB1)[1]
17.	Bog birch-willow/sedge/peat moss	(DB2)[1]
18.	Bluejoint/woodland horsetail/peat moss	(DB3)[1]
19.	Bluejoint/fireweed/marsh cinqfoil	(T1)
20.	Beaked sedge/water sedge-cattail	(WS1)[1]
21.	Swamp horsetail-great bulrush	(SH1)[1]

[1] Vegetation community developed by Beckingham *et al*. (1996)

The table relates the plant community types described in this ELC to ecosites and ecosite phases developed by Beckingham et al. (1996).

Table 15: Classification of Field Sites into Representative Vegetation Communities

Ecosite	Ecosite phase	Plant community type	Dominant Vegetation	Surficial Material	Plot #'s Located in Each Vegetation Community
1. Marsh	**Marsh**	**1.1** Beaked sedge/Water sedge-Cattail (WS1)	Beaked sedge/Water sedge /Cattail	water	12
2. Shallow Open Water	**Shallow Open Water**	**2.1** Swamp horsetail-Great bulrush (SH1)	Swamp horsetail /Great bulrush	water	11, 17, 26
3. Bog	**Treed bog**	**3.1** Black spruce/Labrador tea/Cloudberry/Peat moss (LT1)	Black spruce/Tamarack/ Labrador tea /Scrub birch/Sphagnum/ Feathermoss	organic	8, 28
	Shrubby bog	**3.2** Labrador tea/Cloudberry/Peat moss (LT2)	Labrador tea/ Black spruce/Tamarack/Cloudberry /Sphagnum/Feathermoss	organic	1, 7, 13, 10
4. Poor fen	**Treed poor fen**	**4.1** Black spruce-Tamarack/Bog birch/Sedge/Peat moss (DB1)	Tamarack/Black spruce/Bog birch/ Labrador tea/Sedge/ Feathermoss	organic	19

	Shrubby poor fen	**4.2** Bog birchWillow/Sedge/Peat moss (DB2)	Willow/Fen moss/Hook moss Labrador tea /Water sedge/Golden fuzzy moss	organic	4, 35, 22
	Graminoid poor fen	**4.3** Bluejoint/Woodland horsetail/Peat moss (DB3)	Bluejoint/Fireweed	organic	3
5. Rich fen	**Treed rich fen**	**5.1** Tamarack-Black spruce/Bog birch/Golden moss (T1)	Tamarack/ Black spruce/ Bog birch/Buck bean/Golden moss	organic	no data
	Shrubby rich fen	**5.2** Willow/Sedge/Golden moss (T2)	Willow/Dwarf birch/Sedge/Golden moss/ Brown moss	organic	no data
	Graminoid rich fen	**5.3** Bluejoint/Fireweed/Marsh cinqfoil (T3)	Bluejoint/Fireweed/Marsh cinqfoil	organic	38
6. Labrador tea - Horsetail	**Labrador tea - Horsetail Sb-Sw**	**6.1** Black spruce-White spruce/Labrador tea/Horsetail (BS1)	Black spruce/Labrador tea /Horsetail/Red-stem feathermoss; Black spruce/Willow/Water sedge/Dwarf scouring rush/Feathermoss	organic veneer over lacustrine	37, 41
7. Bracted Honeysuckle	**Bracted Honeysuckle - Aw-Sw-Pl**	**7.1** Aspen poplar-White spruce-Lodgepole pine/Bracted honeysuckle/Fern (BH1)	Balsam poplar/White spruce/ Bracted honeysuckle/Wood's rose/Woodland horsetail	till	6, 31, 16
		7.2 Aspen poplar-White spruce-Lodgepole pine/Balsam fir/Fern (BH2)	Aspen poplar/White spruce/Low-bush cranberry/Wild sarsaparilla,/Twinflower /Feathermoss	till	23
8. Low-Bush Cranberry	**Low-bush cranberry - Aw**	**8.1** Aspen poplar/Low-bush cranberry (LC1)	Aspen poplar/White spruce/Low-bush cranberry/Wild sarsaparilla,/Twinflower /Feathermoss	till	5, 9
	Low-bush cranberry - Aw-Sw-Pl	**8.2** Aspen poplar-White spruce-Lodgepole pine/Prickly rose (LC2)	Aspen poplar/White spruce/Balsam poplar/Prickly rose/Bluejoint/Harebell	till	39
		8.3 Aspen poplar-White spruce-Lodgepole pine/Low-bush cranberry (LC3)	Aspen poplar/White spruce/Low-bush cranberry/Wild sarsaparilla,/Twinflower /Feathermoss	till	2, 14, 15, 21, 30
		8.4 Aspen poplar-White spruce-Lodgepole pine/Feathermoss (LC4)	Aspen poplar/White spruce/Lodgepole pine/ Twinflower/Wild sarsaparilla Feathermoss	lacustrine veneer over till	34
		8.5 Aspen poplar-White spruce-Lodgepole pine/Canada buffaloberry (LC5)	Aspen poplar/White spruce/Bracted honeysuckle/Canada buffaloberry/Hairy wild rye/Showy aster/Fringed brome	till	20

	Low-bush cranberry - Sw	**8.6** White spruce/Prickly rose (LC6)	White spruce/Paper birch/Balsam fir/Wood's rose/Saskatoon/ Bluejoint/Trailing raspberry (clumps of dense white spruce and open canopy paper birch with openings - rose, low-bush cranberry, saskatoon - bluejoint)	till	36
		8.7 White spruce-Balsam fir/Feathermoss (LC7)	White spruce/Balsam fir/Wild sarsaparilla/Twinflower /Knight's plume/Step moss	till	24, 32, 33
	Low-bush cranberry - Pl	**8.8** Lodgepole pine/Feathermoss (LC8)	Lodgepole pine/White spruce/Twinflower/Red-stem feathermoss/ Step-moss	till	25
9. Beaked hazelnut - Indian hemp		**9.1** Beaked hazelnut/Indian hemp/Hairy wild rye (HR1)	Beaked hazelnut/Wild red raspberry/ Bluejoint/Wild sarsaparilla/Indian hemp/Hairy wild rye	glaciofluvial blankets and veneers over till	40, 39 (notes)
10. meadow	**shrubby meadow**	**10.1** Willow/Bluejoint-Water sedge (W1)	Velvet-fruited willow/Bluejoint/Water sedge	fluvial terrace	18
11. Disturbance		**11.1** Road disturbance	Awnless brome/White clover/ Common horsetail/ Balsam poplar	various	29 (notes)
		11.2 Wellsite disturbance	Timothy/White clover/Foxtail barley	various	27
		11.3 Pipeline disturbance	Willow/Balsam poplar/Bluejoint/ Canada thistle/White clover	various	photo 311 (notes)

APPENDIX G –
REPORT MAPS