Development of Ecological Conservation Objectives and Strategies for Protected Areas

A Pilot Project for Selected Provincial Parks within the CCM and SCM Ecosections

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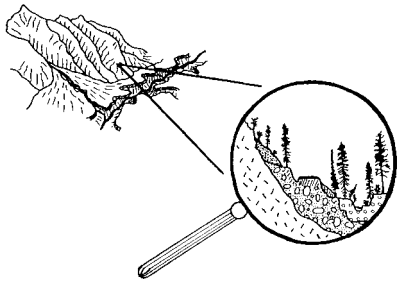

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EXECUTIVE SUMMARY

This report describes one phase of an ongoing project by the BC Ministries of Water Land and Air Protection and Sustainable Resource Management to investigate the ecological conservation role of protected areas in the Kootenay Region of British Columbia, and to define actions that could be taken to improve the effectiveness of the protected area network in fulfilling that role. Previous reports in the series have included: a review of conservation objectives formulated by previous land use planning processes (Scott-May 2002b), a Conservation Risk Assessment of selected parks in the region (Scott-May 2002a) and a summary of the ecological context for protected areas in the Central and Southern Columbia Ecosections (CCM, SCM, Utzig et al. 2003). This phase is a pilot project to examine the effectiveness of the protected area network in the CCM and SCM ecosections, the potential ecological conservation roles of selected protected areas, and where appropriate, to provide recommendations on how changes in park management might improve the ability of those parks to fulfil their ecological conservation roles. The provincial parks examined in more detail for the CCM include: Valhalla, Kokanee Glacier, McDonald Creek, and Cody Caves; and for the SCM include: West Arm, Stagleap, Kokanee Creek, Midge Creek and Moyie Lake.

For the purposes of this project “ecological conservation” is used to denote the maintenance and/or restoration of ecological integrity, including maintaining and/or restoring ecosystem patterns, functions and processes that are responsible for biological diversity, the critical types and ranges of natural variation in ecosystems, and ecosystem resilience. It does not include conservation of post-European contact historical or cultural features.

Two primary ecological conservation roles are recognized for protected areas:

- **representation** – inclusion of a complete cross-section of environmental conditions and ecosystems within a network of protected areas, and
- **provision of local habitat supply** – providing habitats necessary for the maintenance and/or restoration of biological diversity within the local area, often in concert with surrounding unprotected landscapes.

Representation was systematically assessed at various levels, including ecoregions, ecosections, biogeoclimatic variants, landscape elements and site series. Representation was also subjectively examined at the ecosection level for major bedrock types, terrain and soils, watersheds and other aquatic features, and geographic distribution. Representation was analyzed with respect to two aspects:

- providing areas in an undisturbed state where ecosystems are relatively unaffected by human activities such that they can serve as baselines or control areas for assessment of the impacts of land management practices on other similar areas, and
- a coarse filter approach to biological conservation where protection of a percentage of the occurrence of each ecosystem is assumed to guarantee perpetuation of the species associated with those ecosystems.

Local habitat supply was examined by assessing the range of habitats and species present within the protected area, the management regimes and human activities occurring within the park and the surrounding area, and habitat requirements of selected species that are naturally occurring within the protected area.

Because many of the protected areas examined are small (<500 ha) and yet include wide-ranging species that depend on geographically dispersed habitats for seasonal and/or life-cycle requirements (e.g. caribou, grizzly bear, great blue heron, kokanee), the assessments employed the “greater park

ecosystem" concept to identify areas outside the protected areas that are necessary for maintaining and/or restoring ecological integrity within the protected area itself, including its full complement of species (Zorn et al. 2001). The greater park ecosystem concept is an attempt to delineate an area that encompasses the full extent of ecosystem functional relationships that impact on the ecological integrity of an individual protected area. Ideally greater park ecosystem boundaries are consistent with natural ecosystem boundaries (e.g., watersheds or species/ population home ranges), reflecting the dominant ecosystem processes and functions that determine the environmental characteristics and biodiversity that are found in the protected area.

Within the greater park ecosystem, consideration was then given to the administrative relationships that are necessary to achieve the ecological conservation goals of a protected area. While park administration controls management within the park portion of the greater park ecosystem, park managers must seek cooperation from a variety of agencies and stakeholders whose mandates or interests relate to areas outside of the park boundaries. For the purpose of this pilot project, an "area of cooperation" was generally defined on the basis of existing administrative boundaries that were related to decision-making and stakeholder actions that potentially affect the ecological integrity of the greater park ecosystem (e.g., landscape units, caribou management areas).

Assessments for each of the selected parks include a review of past and present use patterns and management regimes, as well as the ecological context of the park, ecological features of the park, threats to maintaining and/or restoring ecological integrity, and potential ecological conservation roles. Following analysis of the available information for each park, recommendations for adjustments to management direction and other specific actions are provided to assist with improving each park's fulfillment of its identified ecological conservation roles.

Inadequate species and habitat inventories and a lack of understanding of natural disturbance regimes were found to hamper scientifically based ecological planning and management in all the parks examined. Although all parks likely require greater cooperation with managers and stakeholders in their greater park ecosystem and area of cooperation, the need is even greater in the smaller parks and those where wide-ranging species are a focus. Common themes that emerged for smaller parks are loss of ecological integrity due to transportation corridors, presence of invasive species and high intensity recreational use. The use of public education to assist with meeting the challenges of managing for ecological integrity in parks was identified as a potential opportunity for facilitating reductions in environmental risk, especially in those parks with high levels of recreational use (although it is recognized that government restructuring has recently eliminated such programs from the core mandate of MWLAP).

The final chapter of the report provides discussion and recommendations regarding the ongoing project of examining the ecological conservation roles of protected areas in the Kootenay Region, broader issues identified during the pilot project and ecological conservation issues in the CCM and SCM ecosections in particular. Highlights of the recommendations include:

- that MWLAP complete the assessments for the remaining protected areas in the CCM and SCM, review and update the ecosection network assessments, and then examine the opportunities of coordinating this project with other related initiatives (e.g., the provincial biodiversity strategy, results-based FPC monitoring);
- that MWLAP select a group of parks within the CCM/SCM for development of more detailed management strategies for implementing the recommendations for improving ecological conservation, including formation of appropriate partnership group(s) in the area(s) of cooperation/ greater park ecosystem(s);
- that BC Parks improve coordination with other government departments and stakeholders and provide more clarity around the ability of individual protected areas, or portions of protected areas to fulfill ecological conservation roles within a broader ecosystem management framework (especially representation – baseline/control roles);

- that BC Parks strengthen its Conservation Risk Assessment procedures;
- that MWLAP and MSRM improve ecological inventory information for protected areas, and better coordinate data collection, storage and analysis to facilitate joint planning for protected and non-protected portions of the landbase;
- that MWLAP explore the possibility of amending the appropriate provincial parks legislation to provide clear and unequivocal direction to set maintaining ecological integrity as the primary objective in the management of protected areas, similar to the Federal Parks legislation, and instituting preparation of ecological integrity statements to guide conservation planning and management for provincial protected areas;
- within the CCM, that MWLAP investigate expansion of the protected area network to fill critical gaps in representation, especially at lower elevations, and further investigate the range of natural variation in this ecosection to provide a basis for setting objectives related to maintenance and restoration of ecological integrity, with special emphasis on the retention of old and mature; and
- within the SCM, that MWLAP investigate expansion of the protected area network to fill critical gaps in representation, especially at lower elevations, and further investigate the natural disturbance regimes in this ecosection to provide a basis for setting objectives related to maintenance and restoration of ecological integrity, with special emphasis on fire return intervals, high frequency-low intensity fire regimes and mixed fire regimes.

ACKNOWLEDGEMENTS

Numerous people have assisted with preparation of this report. First and foremost we would like to express our appreciation to Kaaren Lewis and Gary Price of MWLAP for their initiation of this project and their patience and encouragement throughout the various twists and turns of putting it all together. We would like to thank the various other staff of BC Parks who graciously answered our endless questions and requests for information, as well as providing comments on earlier drafts of the report. However, as is customary, we the authors will take responsibility for any errors encountered.

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1.0 INTRODUCTION

This report presents the results of one aspect of ongoing efforts by the Ministry of Water, Land and Air Protection (MWLAP), Environmental Stewardship Division, Kootenay Region, to improve the ability of provincial parks to contribute to the overall ecological conservation[1] goals of the protected areas system. Additionally, this project is intended to help clarify how parks may, or may not, be contributing to broader sustainability goals involving both the protected and non-protected land bases.

Efforts to more clearly define the broader ecological context within which provincial parks function were initiated by MWLAP in 2001/2002, with the first phase of a pilot project funded by the Ministry of Sustainable Resource Management (MSRM), Kootenay Region. This first phase sought to compile a framework of ecological objectives, strategies and monitoring indicators from existing planning products (Scott-May 2002b). The outcomes of the first phase identified numerous critical gaps in the framework.

In 2002/03, MWLAP, Environmental Stewardship Division, Kootenay Region together with MWLAP Protected Areas Planning and Community Relations Branch, Victoria, jointly initiated the second phase of the pilot project, which focused on investigating the ecological conservation roles of the park system in two ecosections, the Central and Southern Columbia Mountains (CCM and SCM) This phase consists of two linked components that attempt to address some of the gaps identified in the existing planning framework. One component is a background document that describes the ecological and management context for the CCM and SCM ecosections (Utzig et al. 2003). The second component, reported here, is focused on the development of ecological conservation management direction for select provincial parks within the CCM and SCM ecosections.

1.1 Background

For many people the ecological conservation roles of parks are centered on their representation role, namely capturing a percentage of various ecosections and biogeoclimatic (BEC) units, as outlined in the goals of the Protected Areas Strategy (Province of BC 1993). However, conservation biology research and management experience has demonstrated that effective ecological conservation requires significantly more than drawing lines around protected areas on a map (e.g., Noss 1992, Spellerberg 1996). This report first reviews the existing network of parks within each ecosection in relation to maintaining ecological integrity of the ecosection. Then, for a selection of parks in each ecosection, the report examines:

- historical and current planning and management regimes;
- broader ecological contexts within which individual parks function;
- ecological values and conditions within the park, and ecological processes and human activities affecting the park;
- potential ecological conservation roles any given provincial park may play; and,
- management measures inside and outside the park that would improve the park's ability to fulfill its potential ecological conservation roles and help meet representation goals.

[1]The phrase "ecological conservation" is used to denote the maintenance and/or restoration of ecological integrity, including maintaining and/or restoring ecosystem patterns, functions and processes that are responsible for biological diversity, the critical types and ranges of natural variation in ecosystems, and ecosystem resilience. It does not include conservation of post-European contact historical or cultural features.

The intent is that the information packages prepared for the selected parks within the CCM and SCM will:

- serve as inputs to integrated park planning, including understanding of, and planning for, values and issues that are common to more than one park;
- help clarify the implications of current and future human use of the parks;
- support park managers in effectively working with land owners, stakeholders and resource managers on issues of mutual concern in the adjacent area (referred to in this document as the greater park ecosystem);
- provide background for conservation program(s) for any given park, whether they are initiatives of park management or in partnerships with other government agencies and/or non-governmental organizations;
- provide background for future development-based impact assessments, ecological risk assessments or monitoring initiatives within the park system; and,
- provide a framework for addressing management interactions between the protected areas and the surrounding non-protected land base.

1.2 Selected Provincial Parks

The following table summarizes the provincial parks that were chosen for the pilot project, and the associated rationales.

Table 1.1. Parks included in this phase of the pilot project.

Park	Ecosection	Rationale
Kokanee Glacier	CCM	• Oldest park within the region. • Consists of upper elevation habitats and the headwaters of numerous creeks, hence there is a need to clarify the opportunities for protection when the mid- and lower-elevations have been, and are being, used for resource development and settlement. • Relative to other parks, there is considerable information about the park values. • Although considered a backcountry park, the area is heavily utilized by novice and experienced recreational users.
Valhalla	CCM	• A large area park that includes full elevation range from lakeshore to mountain top. As such, while it shares many of the same values as Kokanee Glacier, the opportunities for ecological conservation management are quite different.
Cody Caves	CCM	• A special feature park. As such, it presents different opportunities and challenges for ecological conservation management. Through the pilot project, an assessment can be made of the effectiveness of the approach for a special feature park.
McDonald Creek	CCM	• Located on a reservoir, which provides for a contrast with Kokanee Creek and Midge, which are located on a lake. • One of the few low elevation parks in the Arrow Lakes valley.
West Arm	SCM	• The only large area park within the SCM. • Has a recent management plan, compared with most other large area parks that have quite dated master plans (e.g., Valhalla, Kokanee Glacier, Purcells). • Considered to be a backcountry park, but located in proximity to an urban centre.

Stagleap	SCM	• Although a relatively small area park, provides important habitat for red-listed mountain caribou. • Heavily impacted by major transportation/ communication corridors, high values but serious limitations for ecological conservation management options.
Kokanee Creek	SCM	• Relative to other parks, there is considerable information about Kokanee Creek. • Conservation management requires a focus on restoration as opposed to preservation. • Provides a comparison with McDonald Creek, which is also a fairly small park but one that is on a reservoir, not a lake.
Midge	SCM	• Like Kokanee Creek and McDonald Creek, important because it is a low elevation site. However, options for ecological conservation management are limited by its small size and fragmentation by a transportation corridor. • Primary access is by boat and so experiences different pressures and challenges than the other parks.
Moyie	SCM/MCR	• Located on an ecotone between dry/moist and east/west ecosystems. However, its small size limits options for ecological conservation management.

2.0 THE APPROACH TO PARK ECOLOGICAL CONSERVATION ROLES

2.1 Potential Ecological Conservation Roles for Provincial Parks

The purpose of this project is to consider the potential ecological conservation roles for existing provincial parks, including those that were created mainly for recreation purposes, and what management regimes would be required to ensure achievement of those ecological conservation roles. There is a considerable body of research and existing planning frameworks that address the assessment and identification of new protected areas, in terms of both individual areas as well as system level considerations (e.g., Noss 1992, Pressey 1996, Noss and Harris 1986); however, there is very limited information in the literature dealing with maximizing the roles of existing protected areas.

With respect to the selected provincial parks for this pilot project, it was assumed that the current configuration of protected areas will remain relatively stable; however, suggestions for boundary adjustments were provided where these would enhance the ecological conservation role of a particular park. It is recognized that the Protected Areas Strategy Goal 2, Special Features, has not been finalized in the West Kootenays and may result in the creation of new provincial parks at some point in the future.

Within this context and given the limited options to re-design the current protected areas system, the principle challenge of this pilot project was to determine what the potential ecological conservation roles of existing parks were with respect to :

1. representation in the broader ecological context
    - benchmarks or baselines for assessment of the impacts of human activities outside the parks (e.g., Arcese and Sinclair 1997)
    - a coarse filter approach to biological conservation where protection of a percentage of the occurrence of each ecosystem is assumed to guarantee perpetuation of the species associated with those ecosystems (e.g., Soule 1991, Noss 1992); and,

2. contribution to habitat supply and ecological integrity on a local and/or regional level (depending on the size and configuration of the park), specifically to provide habitats necessary for the maintenance and/or restoration of biological diversity within the local area, often in concert with surrounding unprotected landscapes.

Large parks that include whole watersheds or complete elevational or landscape sequences of ecosystems are capable of fulfilling both roles at multiple scales. Although small parks provide very limited value for representation at the provincial, regional, ecosection, or BEC unit levels, they may still play important ecological conservation roles by representing individual landscape elements or special features at a local level, and by providing islands of intact habitat in a sea of lands managed for resource production or human habitation. Because of the dynamic and interconnected nature of ecosystems, all parks, regardless of size, will depend on functional relationships with ecosystems and ecosystem processes outside the park boundaries. Therefore, the concept of a "greater park ecosystem" has also been adopted to identify the portion of the landscape surrounding an individual park that is functionally related to the maintenance of ecological integrity within the park (Zorn et al. 2001). Since administrative boundaries are often inconsistent with ecological boundaries, an "area of cooperation" has been loosely defined surrounding each park. The area of cooperation describes those areas on which land management decisions may limit the potential ecological conservation role of the park, and the achievement of ecological conservation objectives within the park itself. These concepts are discussed more fully in the following sections.

2.2 Representation

Representation in relation to ecological conservation is a simple concept, where the objective is to create a network of protected areas that is "representative" of the full range of environmental diversity present in an area. Representation is generally assessed through the application of "gap analysis", a tool that compares the existing diversity of environmental conditions or habitats in the present or proposed protected area network with the full diversity existing within the broader study area (e.g., Scott et al. 1993). Effective gap analysis requires not only an accurate and complete inventory of environmental conditions within the study area, but also an understanding of species/ habitat relationships within the area (e.g., Noss et al. 1999). In many situations neither of these conditions are met, resulting in a less than ideal outcome (Flather et al. 1997).

Historically, there has been a tendency to focus on rare, unique and/or endangered values as a main motivation for creating parks, thus a primary ecological conservation role for the park becomes protection of such values. Ironically, many parks that were mainly created for reasons of recreational values and opportunities, including small area parks, end up capturing such values, particularly if they are located in lower elevation areas where the surrounding landscape has been heavily modified. Only recently in BC has there been an emphasis on ensuring that parks represent biotic diversity, as well as cultural and heritage diversity. This was the motivation behind Goal 1 of the 1993 Protected Areas Strategy (PAS) for BC (Province of BC 1993, p.6):

> *To protect viable, representative examples of the natural diversity of the province, representative of the major terrestrial, marine and freshwater ecosystems, the characteristic habitats, hydrology and landforms, and the characteristic backcountry recreational and cultural heritage values of each ecosection.*

Although BC PAS chose to use representation of ecosections, and to some extent BEC units, representation is a concept that is applied at various scales and levels of generalization. In their conservation assessment of North America, the World Wildlife Fund assessed representation at the ecoregional level (Ricketts et al. 1999). The BC Forest Practice Code Biodiversity Guidebook and Landscape Unit Planning Guide recommend the use of BEC units for ensuring ecological representation within old growth management areas (BC Min. of Forests 1995 and 1999). Other studies in BC have assessed representation in the contributing and non-contributing timber harvesting landbase at the level of sites series or site series groupings within BECs (e.g., Huggard 2000, Utzig and Holt 2002).

Representation is generally associated with two potential roles for protected areas. One is the provision of benchmarks for current and future assessment of impacts resulting from human activities on lands outside the protected areas (e.g., Arcese and Sinclair 1997). In this instance the parks essentially become permanent scientific control areas for the ongoing experiment we call "land management." The second potential role associated with representativeness is employing parks as a coarse filter management tool. The objective is to create a representative network of habitats that are maintained in a pristine state (assumed to be low risk), that will perpetuate species associated with those habitats. Both of these roles assume that the parks are maintained free from human activities that may negatively impact the ecosystems and ecosystem components present, and that natural processes and disturbances, such as fire, are allowed to function. In many however, there is allowance for management intervention to offset impacts that may be occurring due to human activities outside the park, or to compensate for natural processes that may compromise targeted values, especially in smaller parks.

In BC, where large scale processes such as stand-replacing fires fulfill important ecosystem functions, this implies the need for large parks that are capable of maintaining a full range of seral stages at any given time. The need for diverse and large parks is also emphasized where the ecosystems include wide-ranging species (e.g., grizzly bear, wolf, caribou) or species that have seasonally diverse habitat needs (e.g., ungulate summer/winter ranges). To offer full protection to ecosystems containing such species, parks have to provide not only sufficient habitat diversity to meet all seasonal requirements, but also sufficient quantity of habitat to provide for a minimum viable population, or at least connectivity to a meta-population that is viable.

Although BC's park system has recently expanded through a process focussed on representation, social and economic pressures, as well as political trade-offs have resulted in a system that has not achieved the objective of full representation. Pressures for recreational and commercial development and use within the park system continue to compromise the ability of many parks to meet the criteria of naturalness and the presence of natural processes that are required for parks to fulfill roles as either benchmarks or refugia. In addition, many of the parks are severely impacted by activities outside their boundaries (e.g., dams affecting hydrologic regimes, fire suppression, rural/ urban development creating barriers to connectivity), not to mention the over-arching impacts of climate change.

One of the elements to address in this project was to critically examine what role any given park could actually play in representation. Is a park's role in representation passive – essentially automatic once it fills a gap on a spreadsheet? Or does its effective role in representation require ongoing management, and if so, what kinds of management?

In this report, representation is discussed in relation to:

- BEC units at a provincial level and within each of the ecosections;
- by site series groupings based on Predictive Ecosystem Mapping (PEM) within each BEC unit; and,
- with regard to broadly defined landscape elements at both ecosection and BEC unit levels.

There has also been an attempt to discuss the level and quality of contribution each park can make to representation objectives. The following sections define the various levels of representation considered, and Section 2.5 describes the use of a qualitative environmental risk designation as a means of providing information on the quality of representation.

2.2.1 Representation at an Ecosection Level

To be representative at any level of generalization or geographic scale, the park must capture a significant portion of the variability of what is being represented. For example, an apple would not be considered representative of a bag of fruit containing mangos, apples, pears and bananas.

For a park to be representative of its respective ecosection(s), the park must capture a significant portion of the range of conditions found within that ecosection. This includes:

- elevation sequence of the associated BEC units;
- complete hydrologic systems that occur within the ecosection (e.g., watersheds, wetlands), and system components of hydrologic systems that are larger than the ecosection (e.g., face units, lake shorelines, sections of major river or lake systems);
- landscape positions (e.g., aspects, slope positions at meso and macro scales); and,
- landforms (e.g., bedrock, terrain and soil types).

Although not considered at the level of this pilot project due to its limited scope, to be representative at the ecoregion level, a park should include representation at the ecosection level within at least two of the ecosections present in an ecoregion (e.g., the Purcell Wilderness Conservancy). Another aspect to consider is representation of transition areas between ecosections, or parks that include boundaries between ecosections, as these areas will likely have increased diversity.

2.2.2 Representation at the BEC Unit Level

For a park to be representative of its respective BEC unit(s), the park must include a significant portion of the range of conditions associated with the BEC unit (e.g., > ~30% of the potential range or possible alternatives), including:

- elevation range within the BEC;
- landscape positions (e.g., landforms, aspects, slope positions); and,
- site series and ecosystem types.

2.2.3 Representation at the Landscape Element Level

A park is considered representative at this level when it captures a significant portion of the range of conditions within a landscape element or elements, including variation in features such as landforms, terrain types and site series or ecosystem types, but does not include a sufficient range of conditions to provide representation at the ecosection or BEC unit level (e.g., > ~30% of the potential range or possible alternatives). Table 2.1 provides a summary of the Landscape Elements defined for the CCM and SCM.

2.2.4 Representation at the Level of an Individual Site or Special Feature

A park is considered representative at this level when it is does not have sufficient area and/or diversity to be representative at a higher level. Even though these small parks do not provide the same types of ecological conservation benefits that larger parks do, they may still serve an important role in protecting special features or rare habitats. However, due to their small size, their effectiveness is usually highly dependent on management regimes both within the park and the greater park ecosystem.

Table 2.1. Landscape Elements and their characteristics.

Code	Landscape Element	Slopes, Slope Positions and Aspects	Landforms/ Terrain	Habitat Elements
MVL	Main Valley Lake: low elevation valley bottoms adjacent to major lakes (or reservoirs)	Mainly gentle toe slopes, some steep terrace faces; generally east/ west aspects, rarely north/ south aspects	Terraced glaciofluvial, glaciolacustrine, fluvial fans and deep morainal materials; occasional bedrock and colluvium	Dominantly closed forest with occasional small to moderate openings resulting from stand-replacing disturbances; shorelines; local occurrences of wetlands
MVR	Main Valley River: low elevation valley bottoms containing major river systems	Mainly gentle toe slopes, some steep terrace faces; generally easterly/ westerly aspects, rarely northerly/southerly aspects	Terraced glaciofluvial, active fluvial floodplains, fluvial fans, glaciolacustrine, and morainal materials; occasional bedrock and colluvium	Dominantly closed forest with occasional small to moderate openings resulting from stand-replacing disturbances; extensive riparian areas; local occurrences of wetlands
MVF	Main Valley Face Unit: face units within major valleys	Mainly moderate to steep lower and mid slopes; generally easterly/ westerly aspects, rarely northerly/southerly	Dominantly colluvial and morainal materials; some bedrock and rarely glaciofluvial and glaciolacustrine terraces	Dominantly closed forests with occasional moderate to large openings resulting from stand-replacing disturbances; rarely open stands on warm aspects resulting from mixed fire regimes in the southern portion of the CCM
RR	Rolling Ridges: Moderate to high elevation highlands, rounded ridges and fluted terrain	Moderately to gently sloping complex terrain; upper slope positions; aspects highly variable but mainly trending east/west	Dominantly morainal materials, bedrock and weathered bedrock; occasionally colluvium; rarely glaciofluvial	Mainly closed forests with occasional moderate sized openings resulting from stand-replacing disturbances; occasional wetlands in depressional areas
SVB	Side Valley Bottoms: low to moderate elevation valley bottoms in secondary drainage systems	Mainly gentle to moderately sloping lower and toe slopes, some steep terrace faces; generally northerly/ southerly aspects, occasionally easterly/westerly	Dominantly terraced glaciofluvial and morainal materials, and fluvial fans; occasional colluvium and bedrock; rarely glaciolacustrine	Dominantly closed forest with occasional small- to moderate- sized openings resulting from stand-replacing disturbances; variable presence of riparian areas and wetlands; upper ends of valleys often dominated by snow avalanche runout zones
SVW	Side Valley Walls: low to high elevation sidewalls in secondary drainage systems	Moderately to steeply sloping lower, mid and upper slopes; generally northerly/southerly aspects, occasionally easterly/ westerly aspects	Complex mix of colluvial and morainal materials with interspersed bedrock	Dominantly closed forest with occasional moderate to large openings resulting from stand-replacing disturbances; upper ends of valleys often dominated by snow avalanche tracks and talus slopes
HR	High Elevation Ridges: high elevation sharp ridgelines, cirque basins and mountain passes	Complex combination of steep to very steep upper slopes and gentle to moderately sloping basins; aspects highly variable covering the full range	Slopes dominantly bedrock and colluvium with occa-sional morainal materials; basins a complex mix of morainal, glaciofluvial and glaciolacustrine; occasional glaciers and rock glaciers	Dominated by open forest and parkland; occasional closed forest; basins include alpine meadows and wetlands; extensive bare rock and talus slopes

2.3 Contributions to Ecological Integrity and Habitat Supply

To define the potential ecological conservation roles for a particular park, it is necessary to not only assess its potential representation roles, but also what habitats actually exist within the park and how those can contribute to meeting ecological conservation roles within the greater park ecosystem, at a scale appropriate to the park itself (see further discussion in next section on greater park ecosystems).

What contribution any specific park can provide depends on the size, shape, composition and location of the park itself, but also on the level of development within the park and the level of threats and cumulative impacts of development in the greater park ecosystem. Small parks in highly impacted areas can often play important roles by supplying habitats or habitat elements that have been lost due to ecosystem conversion or ecosystem modification at a stand or landscape level, protecting rare ecological features or providing important stepping-stones for landscape or regional connectivity. In addition to providing extensive areas of habitat, larger parks provide an opportunity for maintaining landscape and stand level processes and functions that have been lost in landscapes that are managed for commodity production or human habitat.

The potential effectiveness of individual protected areas, and hence the number and total amount of protected area required to achieve a particular level on biological conservation, also depends on the type and level of human activity in the matrix surrounding the protected area network (e.g., Harris 1984, Fahrig 2001, Noss 1996). As the habitat quality and permeability in the matrix decreases, the required size and total extent of protected area required to achieve the same level of ecological conservation increases dramatically. Therefore, the potential habitat supply role that any particular park can provide also depends on the management regime within the matrix surrounding the protected area, and the degree of connectivity with other protected areas.

Within the Canadian National Park system, the concept of representation is “parked at the door once the park has been created and then the focus becomes protecting the ecological integrity of the park” (Stephen Woodley, Parks Canada, *pers. comm*.). Whereas representation focuses on what is captured within park boundaries, managing for ecological integrity emphasizes the essential need for coordination and cooperation between protected and non-protected area managers. As a result, potential ecological conservation roles for parks are broadened to include such concepts as protection of genetic diversity and ecological processes, serving as benchmarks for evaluating ecological change and linkages to sustainable utilization, in addition to important values that are contained within the park itself (Eagles 1993). These general themes, and the recognition of need for defining roles for parks that describe how protected areas function as part of a broader conservation strategy, were echoed in a review of park functions defined by various nations (Nelson 1993).

2.4 The Conservation Contexts for Protected Areas

A review of the literature identified that an ecosystem management program and assessment process developed for National Parks in Ontario (Zorn et al, 2001) and applied in other federal parks (e.g., see Ecological Integrity Statement for Riding Mountain National Park, Parks Canada 2002) would provide a framework that could be adapted to fit this pilot initiative. Given that most protected areas, especially smaller ones, are highly dependent on functional linkages to ecosystems outside the protected area itself, as well as land use and resource management activities surrounding the protected area, it is necessary to consider both the ecological and social/ administrative contexts required to support ecological conservation within protected areas. Based on the Ontario approach, a framework for considering the broader ecological and administrative contexts for protected areas is described in the following sections.

2.4.1 Greater Park Ecosystem

The recognition of a "greater park ecosystem" is an attempt to delineate an area that encompasses the full extent of ecosystem functional relationships that impact on the ecological integrity of an individual park. Because individual ecosystem components have differing functional relationships, distinct components will often require consideration of differing areas (e.g., for aquatic life a watershed, for a grizzly bear or mule deer, its individual or population home range). The greater park ecosystem as a whole is a "synthesis of dominant ecosystem characteristics that represent prevailing ecological structures, composition and function" within the park (Zorn et al. 2001, pp 357). Ideally greater park ecosystem boundaries reflect natural ecosystem boundaries (e.g., watersheds or species/ population home ranges). Adopting the concept of greater park ecosystems also requires modifications to data collection and analysis so as to ensure the parks are considered within the required context.

2.4.2 Area of Cooperation

Within the greater park ecosystem, consideration is then given to the administrative relationships that are necessary to achieve the ecological conservation goals of the respective park. While park administration controls management within the park portion of the greater ecosystem, park managers must seek cooperation from a variety of agencies and stakeholders whose mandates or interests relate to areas outside of the park boundaries. As such, the area of cooperation is based on ecological principles, but is a human construct that defines priorities for inter-agency cooperation and collaboration with other government departments, as well as industry and community interests. Defining administrative relationships is dependent on:

- the location of the park in relation to the administrative boundaries of other key interests;
- ecosystem components within the park and the administrative boundaries that relate to each of those components; and,
- the geographic scope of the various stakeholders.

For the purpose of this pilot project, the area of cooperation was generally defined on the basis of existing administrative boundaries that were related to decision-making and stakeholder actions that potentially affect the ecological integrity of the greater park ecosystem (e.g., landscape units, caribou management areas). An analysis of stakeholder interests for each park and its greater ecosystem could also be used to identify additional relevant groups, and potentially further refine the area of cooperation. Identification of the area of cooperation and relevant decision-makers/ stakeholders also facilitates the formation of partnership groups and information networks who can potentially develop joint public communications/ education programs, protocols for information sharing, and undertake coordinated management actions that are necessary to support the ecological integrity of the park.

2.5 Environmental Risk Assessment

As noted above, in 2001 BC Parks undertook a Conservation Risk Assessment (CRA) for most provincial parks within the Kootenay region (see Scott-May 2002a). The resulting rankings give insight as to how MWLAP's Protected Areas and Ecosystem Sections view the current environmental risk status of the individual parks. The CRA risk ratings were primarily derived from a series of rating tables that consider biological and cultural conservation values. The tables were completed based on the collective opinions of those present at the risk assessment workshops, often with limited information. However, to support development of *ecological conservation* management direction for the parks selected for this project, it was necessary to focus exclusively on risk associated with the ecological aspects of the parks and their likelihood of maintaining and/or restoring ecological integrity.

The concept of environmental risk employed in this project is consistent with that presented in the Environmental Risk Assessment (ERA) report published by the former Ministry of Environment, Lands

and Parks (MELP 2000). That report defines environmental risk as “the likelihood or probability of an adverse outcome or event” affecting the environment. **ERA is separate and distinct from the CRA process.**

The central principle of the ERA approach is that the closer current environmental conditions resemble ‘natural’ environmental conditions, the lower the risk to the environment and/or specified environmental values. One of the critical steps in assessing environmental risk is the establishment of a base case for comparison (i.e., what is “natural”?). Where the effectiveness of a conservation plan or strategy is being tested, the use of a suitable environmental base case or benchmark based on estimated natural conditions is key to identifying risks to environmental values (e.g., Holt and Utzig 2002, MELP 2000).

Numerous authors have recommended using the range of natural variability (RONV) as a benchmark for assessing environmental risk (e.g., Cissel et al. 1998, Landres et al. 1999, MELP 2000). Swanson et al. (1994, p89) describe RONV as: “the composition, structure and dynamics of ecosystems before the influence of European settlers, characterized by: the range of ecosystem conditions such as the extent of particular seral classes of vegetation, and the disturbance regime (defined in terms of frequency, spatial arrangement, and severity of disturbances) that produced such conditions.” Landres et al. (1999) define natural variability as “the ecological conditions, and the spatial and temporal variation in these conditions, that are relatively unaffected by people.” Other terms used to refer to similar concepts include natural variability, historical range of variability and reference variability (Landres et al. 1999). The influence of recent human interventions is filtered out so that managers can use the resulting description of RONV as an independent reference for comparison when developing or evaluating past or proposed management interventions.

When attaching a level of risk to present and potential future management strategies for individual parks, the risk levels were based on a subjective comparison of the estimated range of natural variability for ecosystem functions and conditions within the park and the park’s greater ecosystem, and the estimated processes and conditions that would result from the management regimes being applied. Increasing departure from RONV was considered an indication of increasing risk. Three broad risk classes were identified:

- **Low** – most processes and functions continue to operate at both the stand/ site and landscape level; most ecosystem conditions at both the stand/ site and landscape level are maintained within the range of natural variability; most species are present in natural distributions and numbers (small parks are primarily assessed at the stand/ site level);

- **Moderate** – some significant processes and/or functions are eliminated or significantly restricted at the stand/ site or landscape level; some ecosystem conditions at either the stand/ site or landscape level are maintained outside the range of natural variability, but not sufficiently to significantly reduce or eliminate key ecosystem functions; most species are present, but in reduced distribution and/or numbers (small parks are primarily assessed at the stand/ site level); and,

- **High** – major processes and functions are not operating within the range of natural variability; ecosystem conditions at the stand/ site and/or landscape level are outside of, or severely restricted with respect to, the range of natural variability; significant losses of species and/or habitat elements are evident.

The application of these concepts, with an emphasis of achieving low risk, is similar to the of pursuit of “ecological integrity” as described by Parks Canada where they define ecological integrity as: "…a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes. In plain language, ecosystems have integrity when they have their native components (plants, animals and other organisms) and processes (such as growth and reproduction) intact” (Panel on the Ecological Integrity of Canada's National Parks 2000).

2.6 Ecological Conservation Management

The proposed ecological conservation management direction provided for each selected park is intended to describe how the park could improve its ability to fulfill the potential ecological conservation roles that have been defined for it. In the cases where a park is currently assessed to be at high risk, the ecological conservation management direction clarifies what is required to reduce the overall level of risk, thus increasing the park's effectiveness in representation and/or contributing to ecological integrity and habitat supply. In some cases, where there are very limited options for removing particular threats and risk factors (e.g., Columbia River dams, railroads and highways), it was acknowledged that it may not be feasible to reduce risk to a low, or even moderate level. Where a park is currently considered to be at a lower risk, the ecological conservation management direction suggests what is likely required to avoid increasing the overall risk relative to impacts from trends in resource use and development, both within parks and the greater park ecosystems.

The terms of reference for this pilot project allowed for the assumption that current management within the parks, greater park ecosystems and areas of cooperation can change. It is recognized that some sources of stress on ecological values and processes are long-term, for example dams, major highways and human settlement. In other cases such as land use designations or biodiversity emphasis options, change is possible, but unlikely in the near future. However, such designations usually define the minimum requirements for environmental management. It is possible for resource managers to exceed minimum standards in the interest of improving ecological integrity and, thereby, increasing long-term economic and social stability. Therefore, current land use designations were not considered to be a limitation in proposing management for the purpose of ecological conservation for the selected provincial parks.

2.6.1 Provincial Park Zone Descriptions

While previous legislation allowed for different classes and categories of parks, all provincial parks within the CCM and SCM are now Class A Provincial Parks. The system of applying a specific category to a park is no longer used, although an ongoing effort to review the protected areas framework may revisit how this concept may be utilized in the future. Part of the difficulty in defining classes or categories for an entire park is that most parks have been created, and/or have the potential, to fulfill a dual mandate, namely to provide recreational opportunities while also protecting natural and cultural values. As a result, park management utilizes zoning within the parks as one means of addressing the conflicting aspects of the dual mandate. While not all parks have currently been zoned, the intention is to do so through future planning initiatives.

Zonation defines a general management emphasis for areas within a park, often providing a means for making trade-offs between the two competing mandates. As described by Hammitt and Cole (1998), the key is to "define an optimal balance between these two conflicting goals, in which both recreational opportunities and natural ecosystems are compromised to some extent. This balance can be expressed as a limit on deterioration (change)". To define limits of acceptable change requires an acceptance that change is a natural part of ecosystem function. Application of this management approach requires defining specific objectives that articulate ecologically acceptable maximum deviations from the natural range of variation, and socially acceptable maximum deviations from the desired wilderness or natural experience.

According to the MWLAP written definitions of Protected Area Management Planning Zone definitions, except for the protection of special features or for remote areas in parks larger than 5,000 hectares, there are no zoning designations that articulate a management emphasis for ecological conservation (see Table 2.2). However, apparently MWLAP staff use these definitions only as guidelines, allowing the minimum area restrictions to be sometimes waived, and the zones of Wilderness Recreation and Wilderness Conservation to be applied to smaller areas where there is a need to emphasize ecological conservation (T. Stevens, MWLAP, *pers. comm.*). The designation of Special Feature Zone is also

sometimes used to protect specific habitats. However, even the definition of the Wilderness Conservation zone emphasizes the provision of recreation activities, albeit restricted opportunities, rather than the role of ecological conservation. When examining the zoning definitions with respect to the goals of this project, it was concluded that if protected area management is going to seriously approach ecological conservation, there must be provision for zonation that sends a clear message to managers and users that the intent of certain areas is specifically ecological conservation, and that other uses are secondary.

To facilitate recommendations regarding improving the ecological conservation role of individual parks, two additional zones for park management have been suggested: Local Conservation and Ecological Protection. Table 2.2 provides a description of the objectives and management direction for each of these new zones in relation to the existing park zones. Although it may be possible to adapt the existing zones and their definitions to accommodate increased emphasis in ecological conservation, we chose to introduce two new zones in this report to avoid confusion and provide more clarity around what we are specifically recommending.

The Local Conservation Zone offers a flexible management tool to address the issues at various scales, including areas within small parks that have important potential ecological conservation roles but may require ecosystem restoration and changes in the type and/or intensity of recreational use in order to fulfill the potential roles. The Ecological Protection Zone may be necessary for a park, or areas within a park, that are defined as benchmarks for monitoring ecological change. The benchmarks may serve for monitoring studies within the protected area, or for comparisons with the impacts of activities outside the protected area. These two additional zones would complete the range of general management emphases, which would then be further refined through setting more specific objectives by zone within each park. Those specific objectives for the zones other than Ecological Protection would include definition of the limits to acceptable change consistent with those designations. Those limits would then serve as a basis for assessing the results of management decisions and provide direction for future management.

2.6.2 Objectives and Management Strategies

Setting clear objectives for protected areas, and/or zones within protected areas, is often necessary to address management issues that arise from competing conservation and recreation goals. Strategies are then defined which create/ maintain/ restore the conditions necessary to fulfill the social choices made through the objective-setting process.

Given the linkages between a protected area and the greater park ecosystem, and the potential dependency of a protected area on compatible management regimes in the greater park ecosystem to achievement of ecological conservation goals within the protected area, the objectives for protected areas must also address these broader relationships. The objectives and strategies need to define the relationship between the park and its greater park ecosystem, as well as the desired conditions within the area of cooperation. The objectives and strategies for all these areas must define what is required to protect the ecological integrity of the protected area so it can fulfill its ecological conservation roles, which in turn support sustainable management within the greater park ecosystem and area of cooperation. However, it is also necessary to go beyond a park-by-park approach, and examine the protected area network on a regional and subregional basis to ensure that the network is compatible with maintaining or restoring ecological integrity of the broader ecological units such as ecosections, BEC units, watersheds and other hydrologic systems.

Table 2.2. Proposed revisions to protected area management planning zones and associated objectives and management direction. Shaded columns are recommended additions.

Revised Protected Areas Management Planning Zone Descriptions							
	Intensive Recreation	**Natural Environment**	**Local Conservation**	**Ecological Protection**	**Special Feature**	**Wilderness Recreation**	**Wilderness Conservation**
Objective	To provide for a variety of readily accessible, facility-oriented outdoor recreation opportunities.	To protect scenic values and to provide for backcountry recreation opportunities in a largely undisturbed natural environment.	To maintain or restore the ecological integrity of ecosystems, and where compatible with a low level of environmental risk, to offer opportunities for scientific study, nature interpretation and/or unassisted non-motorised recreation.	To maintain or restore the ecological integrity of ecosystems and/or landscapes.	To protect and present significant natural or cultural resources, features or processes because of their special character, fragility and heritage values.	To protect a remote, undisturbed natural landscape and to provide backcountry recreation opportunities dependent on a pristine environment where air access may be permitted to designated sites	To protect a remote, undisturbed natural landscape and to provide unassisted backcountry recreation opportunities dependent on a pristine environment where no motorised activities will be allowed.
Use Level	Relatively high density and long duration types of use.	Relatively low use but higher levels in association with nodes of activity or access.	Very low use. Use may be controlled to protect the environment.	Use limited to approved scientific study.	Generally low.	Very low use to provide solitary experiences and a wilderness atmosphere. Use may be controlled to protect the environment.	Very low use to provide solitary experiences and a wilderness atmosphere. Use may be controlled to protect the environment.
Means of Access	All-weather public roads or other types of access where use levels are high (see "Impacts" below).	Motorised (powerboats, snowmobiles, all terrain vehicles), non-motorised (foot, horse, canoe, bicycles). Aircraft and motorboat access to drop-off and pickup points will be permitted.	Non-mechanised & non-motorised (no air access); foot or canoe.	Limited to access for the purposes of approved scientific study.	Various; may require special access permit.	Non-mechanised & non-motorised - except may permit low frequency air access to designated sites; foot, canoe (horses may be permitted).	Non-mechanised & non-motorised (no air access); foot, canoe (horses may be permitted).
Location	Contiguous with all-weather roads and covering immediate areas, modified landscapes or other high-use areas.	Removed from all-weather roads but easily accessible on a day-use basis. Accessible by mechanised means such as boat or plane.	Variable – may be contiguous with all-weather road or motorised boat access, or may be remote.	Variable – may be contiguous with all-weather road or motorised boat access, or may be remote.	Determined by location of special resources; may be surrounded by or next to any of the other zones.	Remote - not easily visited on a day-use basis.	Remote - not easily visited on a day-use basis.
Size of Zone	Small - usually less than 2,000 ha.	Can range from small to large.	Variable, from 5 – 5,000 hectares	Variable, from 1 – 5,000 hectares	Small - usually less than 2000 hectares.	Large - greater than 5,000 hectares.	Large - greater than 5,000 hectares.
Boundary Definition	Includes areas of high facility development in concentrated areas.	Boundaries should consider limits of activity/facility areas relative to ecosystem characteristics and features.	Preferably defined by geographic or ecological features and/or ecosystem boundaries, but may be defined by the extent of development in some cases.	Preferably defined by geographic or ecological features and/or ecosystem boundaries, but may be defined by the extent of development in some cases.	Area defined by biophysical characteristics or the nature and extent of cultural resources (adequate to afford protection).	Defined by ecosystem limits and geographic features. Boundaries will encompass areas of visitor interest for specific activities supported by air access.	Defined by ecosystem limits and geographic features.
Recreation Opportunities	Vehicle camping, picnicking, beach activities, power-boating, canoeing, kayaking, strolling, bicycling, historic and nature appreciation, fishing, snowplay, downhill and cross-country skiing, snowshoeing, specialised activities.	Walk-in/boat-in camping, power-boating, hunting, canoeing, kayaking, backpacking, bicycling, historic and nature appreciation, fishing, cross-country skiing, snowmobiling, river rafting, horseback riding, heli-skiing, heli-hiking, and specialised activities.	Nature appreciation, backpacking, canoeing, kayaking, river rafting, fishing, cross-country skiing, snowshoeing, specialised activities (e.g., caving, climbing).	None.	Sightseeing, historic and nature appreciation. May be subject to temporary closures or permanently restricted access.	Backpacking, canoeing, kayaking, river rafting, nature and historic appreciation, hunting, fishing, cross-country skiing, snowshoeing, horseback riding, specialised activities (e.g., caving, climbing).	Backpacking, canoeing, kayaking, river rafting, nature and historic appreciation, fishing, cross-country skiing, snowshoeing, horseback riding, specialised activities (e.g., caving, climbing).

Table continues on the next page.

Table 2.2 continued.

Revised Protected Areas Management Planning Zone Descriptions							
	Intensive Recreation	**Natural Environment**	**Local Conservation**	**Ecological Protection**	**Special Feature**	**Wilderness Recreation**	**Wilderness Conservation**
Facilities	May be intensely developed for user convenience. Campgrounds, landscaped picnic/play areas, trail accommodation or interpretative buildings, boat launches, administrative buildings, service compounds, gravel pits, disposal sites, wood lots; parking lots, etc.	Moderately developed for user convenience. Trails, walk-in/boat-in campsites, shelters, accommodation buildings may be permitted; facilities for motorised access - e.g., docks, landing strips, fuel storage, etc.	Minimal facility development – only where development enhances or does not conflict with conservation objectives (e.g., carefully located trails, primitive campsites, interpretative facilities).	No facility development.	Interpretative facilities only – resources are to be protected.	Minimal facility development for user convenience and safety, and protection of the environment e.g. trails, primitive campsites, etc. Some basic facilities at access points, e.g., dock, primitive shelter, etc.	None.
Impacts on Natural Environment	Includes natural resource features and phenomena in a primarily natural state but where human presence may be readily visible both through the existence of recreation facilities and of people using the zone. Includes areas of high facility development with significant impact on concentrated areas.	Area where human presence on the land is not normally visible, facility development limited to relatively small areas. Facilities are visually compatible with natural setting.	Maintenance or restoration of ecological integrity is the primary objective – impacts should be minimised in that context.	Maintenance or restoration of ecological integrity is sole objective.	None – resources to be maintained unimpaired.	Natural area generally free of evidence of modern human beings. Evidence of human presence is confined to specific facility sites. Facilities are visually compatible with natural setting.	Natural area generally free of evidence of modern human beings.
Management Guidelines	Oriented toward maintaining a high quality recreation experience. Intensive management of resource and/or control of visitor activities. Operational facilities designed for efficient operation while remaining unobtrusive to the park visitor.	Oriented to maintaining a natural environment and a high quality recreation experience. Visitor access may be restricted to preserve the recreation experience or to limit impacts. Separation of less compatible recreational activities and transportation modes. Designation of transportation may be necessary to avoid potential conflicts (e.g. horse trails, cycle paths, hiking trails).	Oriented to maintaining and/or restoring ecological integrity. Management actions are compatible with maintaining or restoring ecological processes and functions. Managed to ensure low visitor use levels. Visitor access may be restricted to protect the natural environment and visitor experience.	Oriented to maintaining and/or restoring ecological integrity. Management actions are compatible with maintaining or restoring ecological processes and functions. Managed to ensure minimal visitor use levels. Visitor access is restricted to protect the natural environment.	High level of management protection with ongoing monitoring. Oriented to maintaining resources and, where appropriate, a high quality recreational and interpretative experience. Active or passive management depending on size, location, and nature of the resource. Visitor access may be restricted to preserve the recreation experience and to limit impacts.	Oriented to protecting a pristine environment. Management actions are minimal and not evident. Managed to ensure low visitor use levels. Visitor access may be restricted to protect the natural environment and visitor experience.	Oriented to protecting a pristine environment. Management actions are minimal and not evident. Managed to ensure low visitor use levels. Visitor access may be restricted to protect the natural environment and visitor experience.
Examples of Zoning	Campground in Rathtrevor Beach Park; Gibson Pass ski area in E.C. Manning Park.	Core area in Cathedral Park; North beach in Naikoon Park.	Kokanee Glacier Park where trail closures are common to limit human/bear interactions.	Existing ecological reserves.	Botanical Beach tidepools within Juan de Fuca Park; Sunshine Meadows in Mount Assiniboine Park.	Quanchus Mountains Wilderness in Tweedsmuir Park; Wilderness Zone in Spatsizi Park.	Upper Murray River watershed within Monkman Park; Garibaldi Park Nature Conservancy Area.

2.6.3 Monitoring

As discussed above, the limits to acceptable change framework has evolved to support monitoring of recreational impacts and adaptive management in areas such as provincial parks. Protected areas are also frequently described as providing benchmarks to monitor ecological change, both within and outside the protected area. The ability to serve as a benchmark is linked with clarifying what each protected area can, in fact, represent given its boundaries as well as the management regimes within and outside the protected area. Ongoing initiatives, including the Provincial Biodiversity Monitoring Strategy and industry's development of a monitoring framework for their sustainable resource management plans, have to be provided with clear and accurate information regarding the opportunities for, and abilities of, protected areas, or portions of protected areas, to effectively fulfill a role in ecological monitoring programs.

3.0 METHODOLOGY

Through a literature review and discussions with regional/provincial specialists, a range of potential ecological conservation roles were identified, and these were grouped into the two categories described above (i.e. representation at various levels and contributions to habitat supply). Criteria were developed for assessing the capability of individual parks for fulfilling each of the roles.

For each selected provincial park, information was summarized to describe the broader ecological and administrative context for the park, as well as information regarding the park itself. The information included:

1. Ecological Context:
    - location of the park with respect to the ecosection, BEC units, landscape elements, hydrologic systems, watersheds, hydrologic features, bedrock geology, terrain features, aspect and elevation and other broad habitat features and species distributions; and,
    - the results of the MWLAP pilot project to develop ecological conservation objectives, strategies and monitoring indicators for the CCM and SCM, and associated BEC units and key hydrological features/systems (the other component of this project, Utzig et al. 2003).

2. Administrative and Development Context:
    - location of the park with respect to relevant administrative units, including TSA and/or TFL boundaries, Landscape Units, Wildlife Management Units;
    - location of human development features in relation to the park boundaries, including transportation and communication corridors, private lands, dams, gravel pits, mines, etc.;
    - types and trends of land management regimes in the areas surrounding the park; and,
    - the results of the MSRM review of previous and existing objectives and management strategies that apply to the CCM and SCM (earlier phase of the project, Scott-May 2002b).

3. Historical and Current Direction of Park Management
    - park management documents (summaries of park values and stresses that resulted from the BC Parks Conservation Risk Assessment project of 2001/02 (Scott-May 2002a), Park Purpose Statements, Management Direction Statements, Management Plans, Master Plans, Annual Management Plans, research reports) and recommendations from consultants' reports (see Appendix 1 for further details on BC Parks documents); and
    - reviews of relevant park documents with parks staff to determine if they are relevant and/or currently being implemented.

4. Ecological Characteristics of the Park – inventory information regarding:
    - physical features (bedrock geology, terrain, hydrologic features, etc.);
    - terrestrial ecosystems; and,
    - aquatic ecosystems.

Following a review of the assembled ecological information, a "greater park ecosystem" was defined for each park. Subsequently, the greater park ecosystem boundaries were combined with the administrative and management regime information to define an "area of cooperation" (see Section 2.4).

A description was then prepared that summarized the ecological characteristics and the management regime of the park itself and its greater ecosystem. Where available, the results of the BC Parks' Conservation Risk Assessment (CRA) were combined with this information to serve as a basis for determining an environmental risk status for each park under current conditions.

Following review of the total information package for each park, the potential ecological conservation role(s) for each park were defined. The determinations were based primarily on the location, size, shape and composition of the park itself, but also included consideration of the conditions and trends of impacts of past and current management activities in the greater park ecosystem.

Within the context of the potential ecological conservation role(s) identified for the each park, and each park's current ecological conditions, environmental risk status and existing management regimes and zoning, a recommended revised zoning and accompanying set of objectives, strategies and performance indicators were developed to provide a management regime that would assist in the achievement of each park's potential ecological conservation role.

4.0 CCM RESULTS

4.1 CCM Protected Area Network

The discussion of the CCM protected area network is preliminary at this point, pending completion of the detailed assessments of all of the CCM protected areas (this project includes only a selection of parks). Once all of the protected areas in the CCM have been reviewed, it should be possible to comment in more detail on the quality of representation offered by individual parks, and the degree to which the network as a whole contributes to overall ecological integrity of the CCM. Comparisons between ecosections and discussions of the protected area network in the context of the North Columbia Ecoregion and the Southern Interior Mountains Ecoprovince will have to await similar analyses in adjoining ecosections. In addition, due to the recently updated BEC mapping in parts of the CCM and the difficulty in obtaining continuous GIS coverage for the whole area, the data regarding BEC unit representation should be considered an approximation at this time. The data presented here is primarily based on GIS summaries of recent BEC mapping, in combination with January 2002 provincial summaries from MSRM (similar to PASO) where more recent data was not available. For more information on the CCM ecosection itself, see the companion report on the ecosection context (Utzig et al. 2003).

The protected area network within the CCM covers 19% of the ecosection, and consists of 22 individual[2] protected areas: one that exceeds 100,000 ha, four that are between 20,000 and 80,000 ha, six that are between 300 and 3000 ha, and eleven that are less than 100 ha (see Figure 4.1 and Table 4.1). Four of the parks are actually larger in size than their occurrence in the CCM indicates, as they extend into

[2] The Purcell Wilderness Conservancy and St. Mary's Park are treated as one protected area because they are contiguous, as are Valhalla Park and the Evans Lake Ecological Reserve.

adjacent ecosections (Purcell Wilderness Conservancy/ St. Mary's, Mt. Revelstoke National Park, Monashee and Kianuko). These also provide representation of ecosection transitional areas (see Table 4.1). The Purcell Conservancy provides representation at the ecoregion level (i.e. it provides representation at the ecosection level in two ecosections) while 3 other parks provide representation at the ecosection level. The remaining parks provide representation at BEC, watershed, landscape element and site/special feature levels.

The protected areas are reasonably well distributed spatially within the ecosection, occurring throughout most of the major valley systems, with the exception of the Columbia River valley and the lower elevations of the St. Mary River valley. However, distribution by BEC unit and elevation is heavily skewed to the upper elevations (see Table 4.1).. Total representation in the lower elevation ICH is 10% (ranging from 0 to 15% by subzone and variant), while representation in the ESSF forested is 19% (ranging from 2 to 30% by subzone and variant), and 48% in the Alpine and parkland (representation is further discussed in Section 6.2).

The lack of representation in the ICHmk1 is significant on a provincial scale, because it is poorly represented in the BC protected area network overall. The limited representation in the ICHdw is also a significant concern, because a major portion of the BEC unit occurs in the CCM. The newly defined BEC units, ICHdm and ESSFdm1, may have similar significance, but insufficient data is available at present to make a determination.

The presence of 3 parks that exceed 40,000 ha and provide representation at the ecosection level provides opportunities for preserving medium to large landscape-scale, fully functioning ecosystems, including medium and large-scale natural disturbance regimes. However, these opportunities may have to be tempered somewhat, depending on the management in the greater park ecosystems, especially the degree of seral stage modification and loss of old and mature forest in those areas.

The diversity of bedrock types in the CCM is generally captured in the protected area network. Granitic intrusions are found in Valhalla, Kokanee Glacier, Goat Range and upper Kianuko Parks, and the southern portion of the Purcell Wilderness Conservancy. Older metamorphosed gneissic rocks are captured in the Monashee and Greenbush Lake Parks. Metamorphic and sedimentary rocks occur in the northern Purcell Wilderness Conservancy and the eastern portion of Goat Range Park. Limestones and associated karst features are found in Cody Caves Park.

Terrain features and landforms of the ecosection generally occur in three broad elevational classes, with fluvial, glaciofluvial and glaciolacustrine deposits found primarily in the bottoms of the main valley systems and mouths of side drainage, morainal deposits on valley sidewalls and colluviums associated with steeper valley sidewalls and upper elevations. More recent glacial landforms occur in the upper cirque basins. The upper elevation landforms are well represented, while the lower elevation valley bottom landforms are less well represented.

The types and distribution of soils that occur in the CCM are primarily a function of factors such as disturbance intervals, climate, topography, biota, bedrock and terrain type. Therefore the representation of soil types in protected areas will reflect the representation of the environments determined by those factors. In the case of the CCM, soils associated the drier low elevation environments and major river floodplains are only moderately represented, while moderate to high elevation soils are well represented.

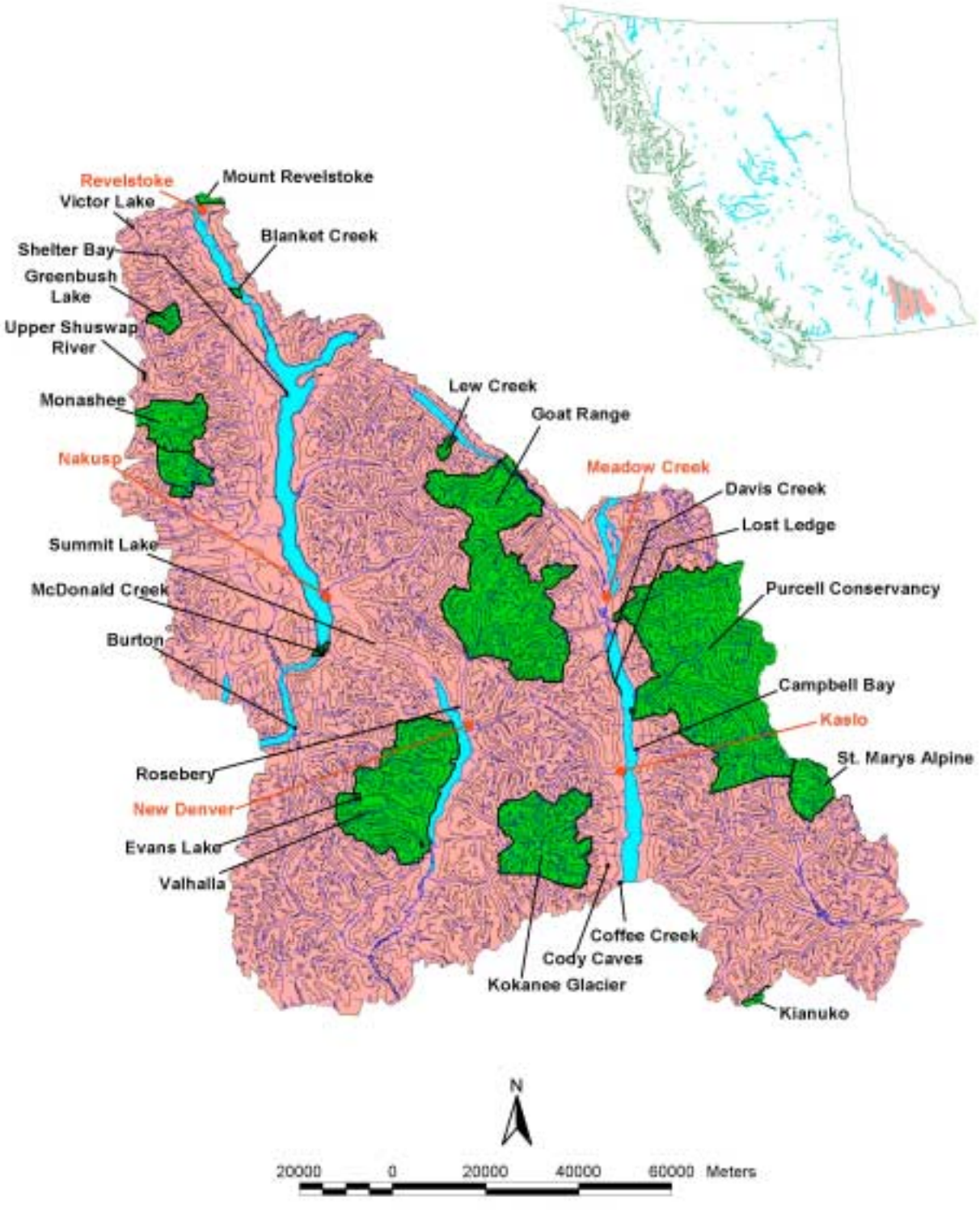

Figure 4.1. Map of protected area network in the CCM.

Hydrologic systems and aquatic habitats have limited representation in the CCM network. Monashee, Valhalla, Goat Range Parks, the Purcell Wilderness Conservancy and Lew Creek Ecological Reserve capture some complete secondary watersheds. However, the only representation of a major river system is limited to a short section of the Lardeau River in Goat Range Park, and in that case, there is a highway running along the river through the park. With the exception of Valhalla Park, most of the lakeshore representation is limited to small, heavily impacted parks and a very short section in the Purcell Wilderness Conservancy. The park network is generally ineffective in providing protection to fisheries habitat in the CCM.

The vast majority of area in parks over 20,000 ha has a high degree of ecological integrity. The CCM portions of Mt. Revelstoke National Park, Kianuko, Greenbush and Lew Creek ER would also fall in this class. However, even a number of these parks have serious recreational pressures, which are beginning to significantly increase risk to various ecosystem components and processes, namely Kokanee Glacier and the CCM portion of Mt. Revelstoke. The smaller parks are generally under stress from multiple threats, including high intensity recreational use and infrastructure development, linear corridors and fragmentation (e.g., railroads, highways, powerlines), invasive species, legacies of previous development (e.g., agriculture), disrupted hydrologic regimes (dams and flood controls), and landuse pressures in the greater park ecosystems (e.g., forest harvesting, rural/ urban development). For more information on threats throughout the CCM ecosection, see Section 2.2 of the companion report on the ecosection context (Utzig et al. 2003).

Connectivity between the protected areas within the CCM is problematic at best. The rugged high elevation mountain ranges and large lake systems that are characteristic of the CCM create natural barriers to movement, tending to funnel connectivity into key mountain passes and along main valley systems. The pattern of human activities has created significant additional barriers in the main valley systems with dam-related habitat loss, agricultural clearing, rural/ urban developments, highways, railroads and other linear corridors. Forest harvesting, mining, recreational development, and associated roads have also reduced connectivity through some major passes. Connectivity is discussed in more detail in the sections dealing with individual parks.

The protected areas network provides some connectivity between the CCM and adjoining ecosections, with five parks extending into adjoining ecosections, Purcell Wilderness Conservancy/ St. Mary's – East Purcell Mountains (EPM), Mt. Revelstoke National Park – North Columbia Mountains (NCM), Monashee – Shuswap Highlands (SHH), and Kianuko and Coffee Creek – Southern Columbia Mountains (SCM). However, the only protected area that provides connectivity at an ecosection scale is the Purcell Conservancy/ St. Mary's Alpine (i.e., by providing ecosection level representation in both ecosections it occurs in).

Table 4.1. Protected areas of the CCM and their size, level of representation and diversity of Landscape Elements (LE) and BEC units*.**

Protected Area*	Rep. Level*	LE** Rep.	Total (ha)	ICHdw	ICHdm	ICHmw3	ICHmw2	ICHwk1	ICHvk1	ESSF wc1	ESSF wc4/u	ESSF dm1/u	ESSF wm/u	AT/ ESSFp	Other BECs	Lakes
Purcell Cons./St.Mary's	2E,ER	6/7	113536	1354	293		17231						53859	40289	64	447
Monashee	E,ET	6/7	21248					3431	1369		9781			6487	0	179
Goat Range	E	6/7	78627				6015	10712		8114	29562			24098		127
Valhalla/ Evans Lake	E	6/7	49861	250			15386			4150	15346			13883		848
Mt. Revelstoke N.Park	ET,BEC	2/7	930			742		184							4	
Kianuko	ET,BEC	4/7	783									630		148		5
Greenbush Lake	BEC	3/7	2821					10	707		1115			842	0	148
Kokanee Glacier	BEC	4/7	31899				834	858		2295	16810			10928		175
Lew Creek - (ER)	LE,WS	3/7	1161					264		137	466			285		9
Blanket Creek	LE	1/7	318			192										126
McDonald Creek	LE	1/7	461				241									220
Upper Shuswap River	S	na	88					88								
Cody Caves	S	na	45				19			25						
Coffee Creek	S(ET)	na	62	62												
Lost Ledge	S	na	43				36									8
Campbell Bay	S	na	24	24												
Rosebery	S	na	21	21												
Victor Lake	S	na	12					11								
Davis Creek	S	na	9				9									
Burton	S	na	17				8									9
Shelter Bay	S	na	19			4										14
Summit Lake	S	na	6				2									4
Total Protected (ha)			301991	1711	293	939	39781	15557	2076	14720	73079	630	53859	96959	68	2319
CCM Protected (%)			18.9	3.0	0.9	6.4	11.0	15.0	14.7	12.2	17.3	2.0	30.5	48.1	na	na

*Representation Levels: ER – ecoregion; E – ecosection; ET – ecosection transition; BEC – BEC unit; LE – landscape element; WS – watershed; S – site/ special feature

**Landscape Element Representation: number of LE's present in the protected area out of the total number of LE's in the ecosection

***Minor occurrence of Lockhart Ck. included in SCM; Coffee Creek includes minor occurrence of SCM; the ICHmk1 has no protected area in the CCM.

4.2 Cody Caves Provincial Park

4.2.1 Park Description

4.2.1.1 Park-Specific Information Sources

There has not been a Master or Management Plan completed for Cody Caves Provincial Park. A draft Management Direction Statement (MDS) was recently completed and, at the time of writing this report, is undergoing a public review process. The most recent Annual Management Plan for Cody Caves Provincial Park was completed in October 2001. The Protected Areas Strategy Overview (PASO) database does include information about Cody Caves Provincial Park, relating to above ground values. A formal ranking of Cody Caves Provincial Park was undertaken as part of the 2000/01 Conservation Risk Assessment (Scott-May 2002a)

BC Parks funded a mapping project in 1992 that documented the extent of the cave and specific features within (Pollack 1994). A photomonitoring project was initiated in the late 1980's and resulted in periodic reports starting in 1988, with the latest report being October 2000 (Hiad Venture Corporation 1988-2000). By periodically taking photographs at established sites within the cave, the project has monitored changes over time and attempted to identify factors that might have caused the impacts. While these projects have provided considerable information about the under ground resource, Parks staff have identified the need to do surface mapping so that the many sinkholes and above ground features can be better understood.

4.2.1.2 Location and History of Park Development

Cody Caves Provincial Park was established on July 7, 1966 to protect the extensive cave system and associated Precambrian karst features of the site. Access to Cody Caves Provincial Park is via Highway 31 to Ainsworth Hotsprings (48 km NE of Nelson), followed by 13 km on Cedar Creek Forest Service Road. The Cedar Creek Forest Service Road is excluded from the park.

The original park was 45 hectares in size. Exploration in the early 1990's discovered an additional several hundred metres of caves. As a result of this and subsequent karst inventory and sensitivity surveys, an additional 26 hectares has been proposed as a Goal 2 (Special Features) addition to the existing park. However, there has been no move to finalize the proposed Goal 2 parks in the West Kootenays.

4.2.1.3 Human Use of the Park

Approximately 1,000-1,500 people visit the caves per month during the months of July and August. Currently, there is a "guided-only" policy for novice visitors to the cave for both reasons of public safety and protection of the resource. High Adventure Tours has a park use permit to take visitors through the caves. A small number of independent spelunkers visit the caves, primarily to explore the "cave conservancy" and other caverns and chambers of the caves that are not accessible to the average public. The photomonitoring reports, conducted in part by High Adventure Tours, suggest that the impacts to the cave have been greatly reduced following implementation of the guided-only policy. The Annual Management Plan (AMP) notes an ongoing issue of vandalism that is believed to involve local residents.

There are limited facilities in the park, including a small trail leading from the parking area on the access road to the cave entrance, a basic outhouse and signage. It has been recommended that the kiosk in the parking lot be removed as the staging area for the tours is now at the entrance to caves. The AMP recommends adding a removable shelter and a couple of benches at the cave entrance.

4.2.1.4 Current Management Direction and Focus

The draft Management Direction Statement defines the primary role of Cody Caves Provincial Park as protection of unique and fragile features of the caves. The emphasis on conservation is extended to include protection of "a transitional forest zone between the Interior Cedar Hemlock old-growth forest and the Engelmann Spruce - Subalpine Fir ecosystem of higher elevations". The MDS also strongly supports the recreational role of the park, noting that the cave is significant "because it is one of only two caves that is accessible by a wide variety of visitors. As such it serves the useful function of introducing the public to the unique and mysterious ecosystems associated with caves".

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to Cody Caves Provincial Park.

Table 4.2. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
The "boxwork" in the conservancy is considered to be one of the best examples in the world because it protrudes from the cave walls up to 8 inches, when one or two inches is typical. Due to recreational use, there is a potential for accelerated erosion and destruction of features	Guided-only policy for novice visitors Photomonitoring project to assess impacts.	Need to articulate how a special feature park contributes to the broader ecological context, including the greater park ecosystem and ecosection scales.
Sinkholes and other features evident on the surface.	Recognize the need for surface mapping, but no mapping initiated to date.	May need more information to comment on the significance.
Protects a transitional forest zone in between Interior Cedar-Hemlock (ICHmw2) with hot, moist summers; very mild winters with light snowfall; and Engelmann Spruce-Subalpine fir (ESSFwc4) with cooler temperatures and more snow. Supports old-growth dependent wildlife community. Diverse tree species such as western red cedar, western hemlock, Engelmann spruce, subalpine fir.	No specific management actions taken.	Given the relatively small size of the park and lack of species inventory, issues of representation at the regional and landscape scale need to be carefully considered
Timber harvesting and associated forest health issues above the park.	Maintain communication with Ministry of Forests and Meadow Creek Cedar on development around the park.	Area of cooperation and Greater Park Ecosystem to be defined and management of ecological values to be considered both within and outside of

		the park in order to define how the park might best realize its potential ecological conservation roles.
Inventory information shows that part of the cave extends beyond park boundaries.	Proposed addition to the park has been identified through the Protected Areas Strategy Goal 2 process. However, government has not moved to finalize proposed Goal 2 parks in the West Kootenay and there is no firm schedule and stated intent to do so.	The project will work with existing park boundaries, but consider values within the greater park ecosystem and their relationship to the existing park, including impacts of potential boundary changes. .

4.2.2 Regional and Landscape Context

4.2.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Cody Caves Park includes portions of the Columbia – Shuswap Moist Warm Interior Cedar – Hemlock variant (ICHmw2) and the Columbia Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc1) of the Central Columbia Mountains ecosection (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is < 0.01% of the CCM ecosection, <0.01% of the ICHmw2 variant that occurs in the CCM and 0.02% of the ESSFwc1 variant that occurs in the CCM.

Of the 6 major landscape elements identified for the ICHmw2 within the CCM, and the 4 major landscape units identified for the ESSFwc1 within the CCM, only one of them, face units within major valleys, is significantly represented within Cody Caves Park (MVF, see Table 2.1). Being limited to approximately 45 ha above Ainsworth Hotsprings on the North Arm of Kootenay Lake, the park represents only a tiny example of that landscape element.

The park falls within the Krao Creek watershed, as defined by ground surface topographic features. However, there are sink holes, springs and disappearing streams in the area, indicating that surface features are likely not a reliable indicator of actual water flow patterns. Hydrologic features in the area have been described by Thompson and Utzig (1996) as part of a hydrologic assessment associated with forest harvesting in the area.

Disturbance Regimes

The ICHmw2 is classed as Natural Disturbance Type 2, and the ESSFwc1 as NDT 1, defined as areas with infrequent and rare stand-replacing disturbance events (BC MoF 1995). The natural disturbance regime for the area, including Cody Caves Park, was likely dominated by relatively long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in the ICHmw2 vary from 100 years for dry sites on warm aspects to over 450 years on wet sites and cool aspects (Dorner et al. 2003). Given its major valley face unit location and mesic to wetter range of sites, the park likely falls somewhere in the middle of this range.

Greater Park Ecosystem

Although Cody Caves Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. The precise locations and functional relationships of the karst formations within the park are not completely known or understood, and their relationship to area

outside the park are also unknown. Based on preliminary information, parts of the main cave extend outside the park, as do source areas for subsurface streams within the cave complex. From a surfacewater hydrologic systems perspective, the park is directly connected to the Krao Creek watershed, and indirectly linked to Kootenay Lake.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears, whose home ranges are likely to include most of the adjacent face units and associated watersheds.

4.2.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Cody Caves Park is the Ministry of Forests Landscape Unit that includes the park and areas adjacent to the park, Kootenay Lake Forest District LU K12. The greater park ecosystem is also affected by decisions taken regarding nearby Kokanee Glacier Park, the Kootenay Lake TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Unit 4-18.

Management within the Greater Park Ecosystem

The park is surrounded by crown lands on all sides, although there are some private lands downslope in the headwaters of Munn Creek and upslope below Krao Lake. A forest access road running north-south runs through the park near the eastern boundary, while another one crosses the southwest corner. Road construction and forest harvesting are presently occurring within 500 metres of the park on all four sides.

Landscape Unit K12 has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. There are biodiversity management requirements for retention of mature forest in the ICHdw, but not in other BEC units within LU K12. The forest slopes surrounding the park are designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). The lower portions of the face units along Kootenay Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). Historically there has been extensive mining activity in the area. Kokanee Glacier Park is located just to the west.

4.2.2.3 Identified Threats and Stressors to Ecological Integrity

Primary threats affecting the park are associated with the forest access road running through the park, recreational use within the park, potential mining exploration and/or development in the area surrounding the park, and forest harvesting and road/trail construction occurring in the area surrounding the park (Thompson and Utzig 1996). The karst features in and surrounding the park are threatened by trampling and vandalism damage resulting from recreational viewing, and potential damage from hydrologic system modification or direct karst feature alterations from forest road construction and/or mining development. Present forest harvesting operations include areas with sinkholes likely related to the cave complex in the park and a likely water source for the underground stream in the caves (Meadow Creek Cedar Ltd. 1999). Another cutblock abuts directly on the park boundary. This harvesting and road construction is proceeding without a comprehensive karst assessment, in spite of a previous Watershed Assessment that specifically recommended such an assessment prior to soil disturbing activities. Extensive forest harvesting and road construction have occurred on the western third of the park itself, but there is no information on impacts or restoration needs. There is also no information on invasive species threats.

4.2.3 Ecological Features of the Park

4.2.3.1 Geology and Terrain

Cody Caves are a prime example of karst development, in this case formed in Triassic limestones of the Slocan Group (Rice 1956, Fyles 1967). Granitic rocks of the Nelson intrusives occur as major outcrops upslope to the west of the park, and as minor sills and dykes just east of the park. Downslope of the park, a number of north trending faults between the park and Kootenay Lake expose a sequence of older metamorphosed sediments of the Kaslo, Milford and Lardeau Groups. This series of faults, combined with the limestones in the vicinity of the park and others near Kootenay Lake likely produce the conditions for deep penetration of groundwater and its eventual re-emergence as Ainsworth Hot Springs (Fairbank Engineering Ltd. 1992 and Fyles 1967).

Terrain in the park is dominated by medium textured morainal deposits, shallow weathered bedrocks and colluvium. Terrain of the area has been mapped on behalf of Meadow Creek Cedar Ltd. by Thompson and Utzig (1996) as part of a watershed assessment prepared for the area. The cave complex contains an array of karst formations – stalactites, soda straws, waterfalls, flowstone, rimstone dams, stalagmites and draperies. Sink holes and disappearing streams are visible on the surface in the vicinity of the caves.

4.2.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Kootenay Lake Forest District (Ketcheson et al. 2002), the park potentially includes 2 of the 9 site series described for the ICHmw2, and 2 or possibly 3 of the 5 site series described in the ESSFwc1. Moisture regimes are generally mesic with some moister areas (see Table 4.3). There is very limited or no representation of drier site series and non-forested ecosystems. There does not appear to have been any inventory or assessment of unique or rare species that may be associated with the karst habitats.

Table 4.3. Potentially occurring ICHmw2 and ESSFwc1 site series within Cody Caves Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	ICHmw2			
04	CwFd – Falsebox	Mesic	RF	16
05	CwHw – Oak Fern – Foamflower	Moist	HO	3
	ESSFwc1			
02	Bl - Falsebox – Grouseberry	Dry	FF	1
01	Bl - Rhododendron - Oak Fern	Mesic	FR	20
03	Devils Club - Lady Fern	Wet	FD	5
			Total	45

Fauna

There does not appear to be any detailed inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion ecosection context report (Utzig et al. 2003) for the ICHmw2 and ESSF in the CCM can be found in the park, at least seasonally. There does not appear to have been any inventory or assessment of unique or rare species that may be associated with the karst habitats.

4.2.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes a portion of Krao Creek. The karst cave system within the park also contains a section of an underground stream whose origin and outlet are uncertain. Studies related to Ainsworth Hotsprings indicate that groundwater recharge from within the park may indirectly contribute to hotspring flows.

Fisheries

Brook trout and westslope (Yellowstone) cutthroat trout have been introduced into Krao Lake, and cutthroat trout have been reported from Krao Creek. It is unknown whether they are present within the reaches in Cody Cave Park.

4.2.4 Potential Biodiversity Conservation Roles

4.2.4.1 Representation

The small area and minimal landscape diversity of Cody Caves Park limits its potential representation contribution to a single occurrence of one of the six landscape elements recognized for the ICHmw2 and ESSFwc1, the major valley face unit (MVF). However, its primary representation role is to represent a rare feature – karst landforms. Ideally there should be an analysis of karst landforms in BC to assess their representation overall, but at present this information is not available.

4.2.4.2 Local Habitat Supply

The small area of the park severely limits its potential to provide significant habitat, even at a local level. However, given the limited retention of old and mature forest in the surround area, providing even a small patch of old forest would likely be its most effective role.

4.2.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002a), Cody Caves Provincial Park was assessed as being at high risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a rating of 13 out of a possible score of 36. The park was ranked relatively low with respect to ecosystem representation, but relatively high for habitats at risk and special features. With respect to risk factors, Cody Caves Provincial Park was given a score of 7 out of a possible of 16. Timber harvesting adjacent to the park was identified as the main stress or threat to the conservation values within the park.

The following lists issues related to risk assessment that were identified based on an assessment of the cave mapping project reports (Pollack 1994, MWLAP 2003) and a series of photo monitoring reports (Hiad Venture Corporation. 1988-2000), a cursory review of forestry operations in the area (Meadow Creek Cedar Ltd. 1999), combined with discussions with a knowledgeable person (J. Pollack, *pers. comm.)* :

- the full extent of the caves is not contained within the park, and hence not protected from potential damage related to surface disturbance
- ongoing road construction and forest harvesting operations has occurred in some areas where the cave system is near the surface and is projected to occur in other potentially sensitive areas immediately adjacent to the park
- there is little information on the present status of karst processes associated with the cave, and the potential effects that recreational use may be having on those processes (other than obvious physical damage)
- there is little information of the hydrology of the underground stream in the cave, and its potential linkage to other streams and aquifers outside the park, and hence little information on the potential risks associated with forest management and mining activities on lands surrounding the park
- there is no information on potential presence of rare plant or animal species associated with the karst environments in the park, nor any information on the potential impacts on those species from present types or levels of park use.

The issues identified above indicate that many aspects of the environmental risk to Cody Caves Park are essentially unknown. Given the outcome of the CRA process and the lack of basic information regarding the values present, and the relationships to present activities in the park and its greater ecosystem, the risk should be assumed to be high, until sufficient information is available for a more accurate assessment.

4.2.6 Proposed Ecological Conservation Management Direction

The primary objective for ecological conservation management for Cody Caves Park should focus on conserving the unique karst features of the park. All other objectives, strategies and activities should be assessed for compatibility with the primary objective before being considered for implementation.

Given the limited information available on this unique feature, it is difficult to provide detailed direction at this stage. Therefore, the primary focus of the direction is to improve the inventory and take a precautionary approach to management until there is sufficient information to warrant otherwise. The present access restrictions to parts of the caves, requirements for guided tours and ongoing monitoring are consistent with that type of approach.

4.2.6.1 Zonation

The park as a whole should be zoned as Special Feature, with some of the more sensitive portions of the cave zoned Ecological Protection.

4.2.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Cody Caves Provincial Park

Overall Goal: Reducing Risk Towards a Moderate Level

The following table summarizes identified issues and associated recommendations of objectives, strategies and performance indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Incomplete baseline ecological information	Incomplete information limits strategic conservation planning and limits the effectiveness of operational-level management; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of karst values and processes within the park to support future management decisions.	Complete the underground cave mapping project, and complete a reconnaissance surface mapping project of the park and applicable portions of the greater park ecosystem to identify the full range of karst features in the area. Complete an assessment of the karst processes associated with the features in the park to provide a better understanding of how the features were formed, how they may change over time and how management activities are affecting those processes.	Underground and surface feature mapping is completed for park and greater park ecosystem.
Park may not include all of the necessary karst features	Park boundaries should include the full extent of the special feature it is intended to protect	Park and Area of Coop-eration	To ensure full protection of the karst features	Following the completion of the mapping projects and at least a preliminary assessment of the karst processes, to adjust the park boundaries as necessary to ensure all the areas essential to conservation of the karst features are included.	Park boundaries include all areas required for protection of the karst features present.
General impacts from recreation activities	There is need for basic and ongoing management of recreational use to protect ecological values.	Park	Conserve the unique karst features present in the park.	Establish zoning and implement management practices that ensure long-term conservation of the unique karst features present. Maintain guided-only policy within the caves.	Identified karst features are maintained in natural abundance, distribution and quality.
Need to increase understanding of the inter-relationships between surface activities and the ecological integrity of the caves and associated hydrological systems.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Coop-eration and Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the significance of protecting the karst features in Cody Caves in particular, and how rare features such as these contribute to broader ecological goals in general. Establish partnership group, including personnel and representatives of related ministries, crown corporations, industry and funding sources to build understanding of, and support for developing and implementing an ecological conservation program that has a core aim of maintaining the ecological integrity of Cody Caves.	Partnership group formed. Tangible support expressed Necessary resources allocated. Communication maintained on an as-needs basis. Ecological conservation program developed and implemented.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Lack of coordination between managers in the greater park ecosystem.	Given the small size of the park, achievement of its potential ecological conservation role requires complimentary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting karst values and processes, work with the Partnership Group to maintain karst features and processes within Cody Caves Park and the surrounding area.	Implementation of management regimes in the greater park ecosystem that enhance the conservation role of the park

4.3 Kokanee Glacier Provincial Park

4.3.1 Park Description

4.3.1.1 Park-Specific Information Sources

There is considerable information about Kokanee Glacier Provincial Park, starting with a Background Report that was prepared to support the development of a Master Plan in 1990. In 1999 a Management Direction Statement was developed for an area that was added to the park. The most recent Annual Management Plan was done in 2001.

Three separate reports by McCrory Wildlife Services address grizzly bear management issues within the park. An early fisheries report in 1974 by Parkin evaluated many of the lakes within the park from the perspective of providing recreational fishing opportunities. This early study was then updated in 1990 by Withler. Finally, stocking recommendations were developed for six lakes within Kokanee Glacier Provincial Park by Sather in 1982. In 1989 a Selkirk College student, Heather Smith, undertook a preliminary study of Rocky Mountain Goats within the park. An environmental impact assessment was conducted in 2001 with respect to selecting a site for a new alpine cabin. Finally, an overview of the geology and mineral evaluation was done by the Ministry of Energy, Mines and Petroleum Resources in 1989.

4.3.1.2 Location and History of Park Development

Kokanee Glacier Provincial Park, set aside in 1922, is one of the oldest parks in the provincial system. It is located 30 kilometres to the northeast of Nelson. The original boundaries encompassed 30,554 hectares, straddling the crest of mountain ridges between Slocan Lake and Kootenay Lake. In the spring of 1987, the BC Government revised park boundaries to resolve long standing mineral claim issues in the park. The decisions were based on the precedent set by the Supreme Court of Canada ruling which confirmed the legitimacy of existing mineral claim tenures in Wells Gray Park. The decisions also followed the 1986 recommendations of the Wilderness Advisory Committee, whose membership was appointed by Government to examine issues relating to wilderness designation in 16 areas, including Kokanee Glacier Provincial Park. The boundaries of Kokanee Glacier park were amended by Order-in-Council to provide a more rational relationship to topographic and recreation features. Peripheral areas that were deemed to be of low recreation value in Timber, Keen and Coffee Creeks were deleted and major areas of significant recreational potential (Wheeler Lake, Caribou Ridge) were added as recreation areas.

On March 21, 1989, the Class B portion of the park was upgraded to Class A park status. In conjunction with the change in status no further mineral exploration will be permitted in the park. At the time, Government also stated its intention to allow for time limited mineral exploration in the recreation area additions to provide the basis for considering park status for these areas.

On July 12, 1995 an additional 6,203 ha was added to the park, including much of the former Kokanee Glacier Recreation Area. With this addition, Kokanee Glacier Park is now 32,035 hectares. The park addition protects key grizzly bear habitat and was recommended for protection in the West Kootenay Boundary Land Use Plan. The addition received Class A provincial park status under the *Park Amendment Act, 1995*.

4.3.1.3 Human Use of the Park

Some of the current recreation trails in the park date back to mining developments in the early 1900s. Many claims were staked and small operating mine developments existed throughout the area of the present day park. There were only two really successful developments: Molly Gibson (above Gibson Lake) and Scranton (Pontiac Creek). Seemingly random deposits of silver, lead, zinc and small amounts of gold were found. The Slocan Chief cabin was originally constructed in 1896.

Today, Kokanee Glacier Provincial Park provides backcountry recreation opportunities for both the novice and experienced user. Its close proximity to the City of Nelson, combined with relatively easy access to alpine hiking trails and cabins, results in very high visitor use. As of 1990, over 40% of park visitors were reportedly from the West Kootenays, 25% from other areas of the province, 15% from other Canadian provinces, 15% from the United States and about 5% from other origins. The heaviest recreational use occurs in the Kokanee Creek drainage and the Slocan Chief areas, which, together with most other trails in the park, bring people into the central core area. There are four cabins to support overnight use, with work-in-progress to build a new cabin to replace the aging Slocan Chief facility. There are also established camping sites in numerous drainages.

Together with Kokanee Creek Provincial Park, Kokanee Glacier Provincial Park is viewed as a “flag ship” park within the regional provincial park system. As such, it is considered to be an important opportunity to help foster better understanding of, and support for, protected areas and conservation management in general. The potential benefits to be gained through public education were viewed as a necessary trade-off for the impacts resulting from high visitor use. The BC Government recently removed park interpretation services from the mandate of the Ministry of Water, Land and Air Protection, which is responsible for parks management.

4.3.1.4 Current Management Direction and Focus

As per the 1990 Master Plan, the four primary conservation roles for Kokanee Glacier Provincial Park include:

- within the context of the natural features of the Southern Selkirk Mountains, to represent in particular the sub-alpine Engelmann Spruce-alpine fir and alpine biogeoclimatic zones;
- to preserve examples of grizzly bear and mountain goat populations of the southern Selkirk Mountains;
- to maintain the character and qualities of the environment and features which form the aesthetic and recreational appeal of the park; and
- to preserve and present representative examples of the early alpine mining history of the West Kootenays.

There are numerous recreational roles also assigned to Kokanee Glacier Provincial Park.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to Kokanee Glacier Provincial Park.

Table 4.4. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Significance is increasing (particularly old growth)because it is becoming more isolated as a result of industrial activity around it (Pers. Communication, BC Parks staff) With the headwaters of numerous drainages contained within the park, it is a hub for wildlife movement (Conservation Risk Assessment workshop)	Have not developed a vegetation or fire management plan as per the Master Plan. Consistent with Master plan re: managing insects and disease as natural processes – have a leave alone policy.	Need to consider the significance of old growth in the park relative to the greater park ecosystem. Additionally, need to clarify any assumptions that stakeholders within the area of cooperation may be making in terms of the park's contribution to meeting old growth targets and whether or not those are consistent with the potential ecological conservation roles of the park. Human settlement along Kootenay Lake and other barriers are compromising the ability of the park to serve as a corridor for wildlife movement. Recent grizzly bear research shows that the sub-population in and around Kokanee Glacier Park is becoming isolated.
Park protects core, all season grizzly bear habitat Park is becoming a refuge for grizzlies One special feature of the grizzly resource is the rare occurrence of whitish individuals in Kokanee Glacier Park and the Kokanee range	Bear Management Plan has been developed and is being implemented – management largely addresses human/bear conflicts with lesser emphasis on other habitat management issues. Parks staff feel it needs to be reviewed. Have closed areas of the park to human use as required to avoid incidents Trails have been re-routed to address bear/human conflicts Nursery areas have been identified and are being managed	Need to consider the role of the park given that research is suggesting the grizzly bear sub-population in and around Kokanee Glacier Provincial Park is becoming isolated.
Mountain goats identified as a key conservation value in the park.	No specific management actions taken	Need to consider the significance of habitats within the park relative to the greater park ecosystem
Fisheries – until recently there has been regular stocking of lakes within the park; respective roles of BC Parks and other government departments in decision-making on this issue has been somewhat inconsistent.	Lakes are no longer being stocked at present	Need to define opportunities for protection given that the park only includes the headwaters of the respective creeks; raising the issue of introduced fish species and restoration of ecological integrity.
High recreational use of the park resulting from easy access to the park and trails leading to the core of the park.	Managing human-wildlife conflicts Working with community groups to keep the visitor centre at nearby Kokanee Creek Provincial Park open so that public education may also benefit Kokanee Glacier Park.	Management within the park, including recreational use, is assumed to be flexible for the purpose of this pilot project.

4.3.2 Regional and Landscape Context

4.3.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Kokanee Glacier Park is located near the southern boundary of the CCM on the crest of the Kokanee Ranges of the Selkirk Mountains just north of the West Arm of Kootenay Lake. According to recent BEC mapping in the Arrow and Kootenay Lake Forest Districts (see Table 4.5 for a summary of BEC unit changes), the park is dominated by the Wet Cold Engelmann Spruce – Supalpine Fir subzone. There are four variants of the ESSFwc that occur in the park, the mid elevation Columbia Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc1) that is transitional with the ICH, the typical ESSF closed forest Selkirk Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc4), the less productive upper elevation Upper Selkirk Wet Cold Engelmann Spruce - Subalpine Fir variant (ESSFwcu4), and the high elevation open/ clumpy forest Selkirk Wet Cold Engelmann Spruce - Subalpine Fir Parkland (ESSFwcp4). At the highest elevations of the park, above tree-line there are limited areas of Alpine Tundra which are mainly rock, talus and glaciers. The lowest elevations of the park also include minor areas of the Columbia – Shuswap Moist Warm Interior Cedar – Hemlock variant (ICHmw2), and the Keen Creek drainage, the Wells Gray Wet Cool Interior Cedar – Hemlock variant (ICHwk1, see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is 2.0% of the ecosection, including the follow percentages of the portions of the BEC variants that occur in the CCM: 0.2% of the ICHmw2, 0.8% of the ICHwk1, 1.9% of the ESSFwc1, 4.0% of the ESSFwc4/wc4u, and 5.4% of the AT/ESSFp.

Table 4.5. Changes to BEC units and their representation resulting from recent updates to BEC mapping in Arrow and Kootenay Lake Forest Districts.

BEC Unit	Old MSRM Mapping	2003 Mapping
ICHmw2	2597	834
ICHwk1		858
ESSFwc1		2295
ESSFwc4	11632	10431
ESSFwcu4		6379
ESSFwcp4		8332
AT		2595
AT & ESSFp	17501	
Lakes	175	175
Total	**31905**	**31899**

Kokanee Glacier park contains three of the four major landscape elements identified for the ESSFwc1 and ESSFwc4 within the CCM, secondary valley floors and sidewalls and rounded ridge crests (RR, SVB and SVW, see Table 2.1 for further information on landscape elements). It also contains all of the landscape elements described for the ESSFwcu4, ESSFwcp4 and the AT in the CCM, including secondary valley sidewalls and high elevation sharp ridgelines (SVW and HR). The park provides representation for all of those BEC units at the BEC unit level.

In contrast, the ICHmw2 and ICHwk1 only occur on two out of six potential landscape elements, secondary valley floors and sidewalls (SVB and SVW). Kokanee Glacier only provides representation at the landscape element level for these two BEC units.

Disturbance Regimes

The ESSFwc4 in the CCM is classed as Natural Disturbance Type 1and ICHmw2 is classed as Natural Disturbance Type 2, defined as areas with rare and infrequent stand-replacing disturbance events respectively (BC MoF 1995). The natural disturbance regime for the area including Kokanee Glacier Park is likely dominated by long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in the ESSFwc4 and ICHmw2 vary from about a 100 years for dry sites on warm aspects to over 500 years on wet sites and cool aspects (Dorner et al. 2003). Given the ridge crest location and isolation of the park from high fire frequency major valley BEC units, most of the park likely had natural disturbance return intervals toward the mid to upper portion of the range (~300 – 500 years). The southern portion of the park, including the upper portions of Kokanee and Lemon Creeks and to a lesser extent Coffee and Woodbury Creeks likely had slightly more frequent return intervals ((~250 – 350 years) than other parts of the park due to the potential of fires spreading into the park from the more frequent fire disturbance regimes in the ICHdw in the lower elevations of those valleys. Most stand-replacing disturbance are wildfires of various sizes, but outbreaks of defoliating insects, bark beetles and root diseases can also play important roles. Steeper slopes are also subject to periodic landslide disturbances and snow avalanching. Lakeshore areas, wetlands and riparian areas are subject to periodic flooding and channel migration.

Greater Park Ecosystem

Although Kokanee Glacier Park is moderately large in size, its lack of low elevation habitat creates a heavy reliance on functional relationships with low elevation areas outside the boundaries of the park to maintain a fully functioning park ecosystem. From a hydrologic systems and fisheries perspective it is directly connected to Kokanee Creek, Coffee Creek, Lendrum Creek, Woodbury Creek, Keen Creek, Silverton Creek, Enterprise Creek, and Lemon Creek. It is also indirectly linked to Kootenay and Slocan Lakes.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species generally include ungulates and bears, whose home ranges likely include most of the watersheds listed above, and some intervening face units overlooking the West and North Arms of Kootenay Lake and Slocan Lake.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link Kootenay and Slocan Lakes to the whole Columbia basin.

4.3.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Kokanee Glacier Park is the Ministry of Forests Landscape Unit that includes the park and areas adjacent to the park, Arrow Forest District LUs N515 and N524 and Kootenay Lake Forest District LUs K10 and K12. These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding, Kokanee Creek Park, the West Arm Demonstration Forest, the Kootenay Lake TSA, the Arrow TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Units 4-17 and 4-18.

Management within the Greater Park Ecosystem

The park is bounded by crown lands of the Arrow TSA on the southwest, west and northwest sides and crown lands of the Kootenay Lake TSA on the south, east and north sides. Forestry access roads and abandoned mining access roads reach or approach the park boundaries in Kokanee, Coffee, Woodbury, Keen, Silverton, Enterprise and Lemon Creeks. Mining claims exist adjacent, or in proximity, to the park in many locations.

To the south, east and north of the park, Landscape Units K10 and K12 have been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. There are biodiversity management requirements for retention of mature forest in the ICHdw, but not for any other BEC units within LUs K10 or K12. Most of LU K10 to the south, including all of the Kokanee Creek watershed, and Keen Creek and the Kaslo River to the north have been designated as part of the regional connectivity network to provide linkages between Kokanee Glacier Park and West Arm Park to the south and Goat Range Park to the north. However, no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet connectivity objectives.

To the west and southwest, Landscape Unit N515 has been assigned a High Biodiversity Emphasis Option for all BEC units. To the northwest, Landscape Unit N524 has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. There are biodiversity management requirements for retention of mature forest in all of the BEC units within LU N515, but no BEC Units in N524. Portions of the valley bottom of upper Silverton Creek has been designated an Enhanced Development Zone for intensive timber production. This will likely reduce the amount of mature and old forest, and limit the availability of habitat elements at the stand level in that area. The Lemon Creek Watershed has been designated as part of the regional connectivity network to provide a linkage corridor between Kokanee Glacier Park and the southern end of Valhalla Park. However, no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet connectivity objectives. In contrast to most other parts of the regional connectivity network, the high BEO and mature retention requirements in N515 should actually provide significant mature and old forest to provide for connectivity.

A significant portion of the forest slopes surrounding the park, particularly face units surrounding Kootenay and Slocan Lakes, are designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Many of these same areas have also been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). Although Kokanee Glacier Park once included the occurrence of mountain caribou, they have subsequently been extirpated from the Kokanee Ranges, and no habitat management areas are designated around the park. Virtually all of the major creeks draining from the park have water domestic, irrigation and/or power generation water intakes in their lower reaches. Management provisions designed to maintain water quality and flow regimes in those watersheds will require some maintenance of mature forest cover and somewhat reduced risk of landslides and erosion associated with road construction.

Most of the crown lands south of the park are part of the West Arm Demonstration Forest. The strategic plan for WADF states: “The primary intent of this demonstration forest is to manage the landbase in a way that protects the identified resource values, by applying and testing the newest concepts in forest management in an operational setting, i.e. the management focus in the WADF is ‘ecosystem management’. One of the key principles of ecosystem management is to maintain a diversity of forest structures, within stands and across the larger landscape, in order to meet most of the habitat needs of the native plant and animal species within the forest, and to protect the resource values that depend on the forest. Harvesting and regenerating trees is secondary” (Working Committee, WADF 1999). Assuming that this principle is eventually implemented, this portion of the greater park ecosystem should have a relatively high level ecological integrity. However, at present the management objectives for WADF list biodiversity conservation as number four, behind timber harvesting, so it is unclear to what extent the principle will actually be achieved. Objectives for WADF:

- Consider water to be the highest priority resource.
- Maintain a high standard of visual integrity across the landscape.
- Provide a sustainable level of timber harvest.
- Maintain or enhance biodiversity across the landscape.
- Apply the findings of research and operational activities through an adaptive management process" (Working Committee, WADF 1999).

4.3.2.3 Identified Threats and Stressors to Ecological Integrity

Threats directly affecting the park are primarily associated with forest management surrounding the park and its impacts on habitat suitability, and the access it creates on all sides of the park. The other major factor is the high level of recreational use within the park, partly resulting from the ubiquitous access. There appears to be no information on the presence of invasive species in the park.

Ironically, even though this park is well separated from highways, agricultural development and intensive rural/urban development, the park is still significantly impacted by those aspects of human activity. In a recent study of grizzly bear habitat and population fragmentation in the West Kootenays, Proctor (2001) has identified a series of sub-populations of grizzly bears in the Selkirk Mountains based on the genetics of individual bears. His study sampled DNA of grizzly bears in the Central and Southern Selkirk Mountains and compared those results with the genetic characteristics of bears in the surrounding area. The results indicate that the sub-population of grizzly bears that occur in Kokanee Glacier Park are isolated within an area bounded by Highway 3A paralleling the North and West Arms of Kootenay Lake and lower Kootenay River to the east and south, Highway 6 and the Slocan River and Slocan Lake to west and Highway 31 between Kaslo and New Denver to the north.

The study found no evidence of recent movement or dispersal of bears into or out of the area, with the lack of connectivity between the two sub-populations north and south of the West Arm being of sufficient duration to create a large genetic distance between the two. It is suggested that the main contributing factor to the fracture of the population is the relatively dense rural settlement along the West Arm and in the Slocan Valley. The northern fracture is potentially a relic of the past rail line, settlement and mining activity in the area early in the past century (e.g., Sandon, Retallack). The lack of present movement across Highway 31 is potentially an indication of how difficult connectivity is to re-establish, even after human activity and settlement is distinctly reduced. In addition to the increased human activity along the West Arm, loss of ecological integrity of the area, particularly fire suppression and loss of natural kokanee spawning, has also reduced habitat quality in that fracture zone. Meanwhile the sub-populations in the Kokanee Glacier area and the West Arm – Stagleap Park areas continue to be at high risk due to human-caused mortality, displacement and habitat degradation. Unless connectivity can be re-established, the demographic isolation of these sub-populations will lead to further increases in risk due to the loss of the "rescue effect" from dispersing migrant bears from other "healthy" populations. The isolation of the Kokanee Glacier area sub-population, and its causes, were recognized in McCrory's 1985 grizzly bear habitat study.

The issue of use levels within the park, particularly in relation to grizzly bear encounters and displacement, has been raised by a number of studies. In a review of the bear-people management program for the park, McCrory (2000, p9)) states that: "Since 1979, overall Kokanee Park visitation has increased four-fold to over 20,000 users in 1998." He also notes that use levels in some parts of the park are approximately 20 times higher than the levels at which other studies have shown grizzly bears to abandon habitat. McCrory also notes that closure of facilities, trail re-alignment and temporary trail closures in high-use bear habitat have reduced displacement and human bear encounters in some parts of the park. However, he feels that displacement, especially in the key central core area of the park, is still of major concern. In the review of potential locations for the new Slocan Chief replacement cabin, bear biologist Bruce McLellan stated the reality regarding development and increasing human use in the park

in simple terms: “From a bear conservation viewpoint, it would be preferable not to build the cabin at all” (McLellan 2001).

4.3.3 Ecological Features of the Park

4.3.3.1 Geology and Terrain

The greater park ecosystem is dominated by Nelson Plutonic Rocks of Lower Cretaceous age (Little 1960, Brown and Logan 1989). The plutonic rocks are dominantly porphyritic granites; however, there are local occurrences of non-porphyritic granites and granodiorite in Virgil Creek, along White Heather Ridge and on the ridges above Sturgis Creek on the western side of Mt. McQuarrie. Small exposures of Valhalla plutonics consisting of granite and granodiorite occur along the ridge between Mt Revell and Blacktail Mountain in the upper Silverton Creek area. There are also small occurrences of Early Mesozoic Ymir Group paragneiss (i.e. metamorphosed sediments) in upper Kokanee, Redfish and Coffee Creeks.

Terrain within the park is dominated by bedrock, coarse textured and rubbly colluviums and associated talus slopes at the highest elevations (Jungen 1980). The park includes three active glaciers, Kokanee, Woodbury and the Caribou. Associated with each of these are fresh rubbly morainal deposits, bouldery to sandy glaciofluvial deposits, silty and clayey glaciolacustrines and evidence of various periglacial and deglaciation geomorphic process (e.g., nivation, solifluction, meltwater channels). The cirque basins and upper valley systems contain older sets of similar deposits, as well as more recent colluvial and fluvial deposits. The sideslopes of the lower elevation valleys in the park are dominated by rubbly and sandy colluvial materials and coarse textured gravelly and sandy morainal materials. Valley bottoms included coarse textured morainal materials and coarse textured cobbly, gravelly and sandy glaciofluvial terraces.

Detailed terrain mapping for the West Arm Demonstration Forest provides detailed terrain and soil information for a portion of the greater park ecosystem (Utzig 1997). There are also less detailed terrain mapping reports for other parts of the greater park ecosystem (e.g., Utzig and Wallace 1997).

4.3.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Kootenay Lake and Arrow Forest Districts (Ketcheson et al. 2002 and Ketcheson et al. 2003), the park potentially includes virtually all of the site series described for the ICHmw2, ICHwk1, ESSFwc1, ESSFwc4, ESSFwcu4, ESSFwcp4 and AT, including a range in moisture regimes from dry to wet within each BEC unit (see Table 4.6). The park includes a substantial area of snow avalanche track and runout zone habitat (3304 ha), as well as forested and non-forested wet sites (1612 ha), both of which provide important bear habitats.

Table 4.6. Potentially occurring land types and site series within Kokanee Glacier Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	ICHmw2			
03	FdCw – Falsebox – Prince’s pine	Dry	DF	238
04	CwFd – Falsebox	Mesic	RF	215
01	HwCw – Falsebox – Feathermoss	Mesic	HF	139

05	CwHw – Oakfern – Foamflower	Moist	HO	117
06	CwHw – Devil's club – Lady fern	Wet	RD	49
07	CwHw – Horsetail	Wet	RH	2
08	CwSxw – Skunk cabbage	Wet	RS	10
09	Bluejoint – Sedge		BS	10
	Rock outcrop		RO	3
	Avalanche chute		AC	43
	Avalanche runout zone		AR	8
	ICHwk1			
02	Racomitrium –Cladonia	Dry	RL	3
04	HwCw – Falsebox – Feathermoss	Dry	HF	498
01	CwHw – Oak fern	Mesic	HO	222
05	CwSxw – Devil's club – Lady fern	Moist	RF	1
06	CwSxw – Devil's club – Horsetail	Moist	RH	6
07	Act – Dogwood – Twinberry	Wet	CD	9
08	CwSxw – Skunk cabbage	Wet	RC	1
09	Sedge - Sphagnum	Wet	SS	1
	Avalanche chute		AC	54
	Avalanche runout zone		AR	8
	Pond		PD	1
	Wetland		WE	55
	ESSFwc1			
02	Bl – Falsebox - Grouseberry	Dry	FF	1040
01	Bl - Rhododendron - Oak fern	Mesic	FR	710
03	Bl - Devil's club - Lady fern	Moist	FD	299
04	Bl – Horsetail - Brachythecium	Wet	FH	38
05	Sedge - Sphagnum		SS	1
	Avalanche chute		AC	165
	Avalanche runout zone		AR	26
	Rock outcrop		RO	15
	Pond		PD	1
	ESSFwc4			
02	Bl - Rhododendron - Falsebox	Dry	FF	1848
03	Bl - Rhododendron - Woodrush	Dry	FW	374

04	Bl - Rhododendron - Foamflower	Mesic	RF	4036
01	Bl - Rhododendron - Oak fern	Moist	FR	1502
05	Bl - Rhododendron - Lady fern	Wet	FL	190
06	Bl - Horsetail - Brachythecium	Wet	FH	35
08	Willow - Sedge	Wet	WS	3
	Avalanche chute		AC	2058
	Avalanche runout zone		AR	216
	Wetland		WE	7
	Rock outcrop		RO	48
	Pond		PD	113
	ESSFwcu4			
02	Pa – Black huckleberry – mountain-heather	Dry	WH	1376
03	Bl – White-flowered rhododendron – mountain-heather	Mesic	FR	310
01	Bl – Black huckleberry – mountain arnica	Moist	FB	347
04	Willow - Horsetail	Wet	SH	219
05	Willow - Sedge	Wet	WS	837
	Rock outcrop		RO	1844
	Talus		TA	1229
	Pond		PD	92
	ESSFwcp4			
02	Bl - Heath	Dry	FH	1986
03	Juniper – Mountain hairgrass	Dry	JM	1443
01	Mountain-heather	Mesic	MH	1070
04	Sedge – Western pasqueflower	Moist	SW	1536
00	Willow - Horsetail	Wet	SH	1
	Krummholz	Dry-Mesic	KR	288
	Avalanche chute		AC	484
	Avalanche runout zone		AR	33
	Wetland		WL	144
	Rock outcrop		RO	1313
	Glacier/ Permanent snowfield		GL	25
	Pond		PD	70
	AT			

	Alpine heath	Dry-Mesic	AH	69
	Krumholtz	Dry-Mesic	KH	7
	Rock outcrop		RO	2130
	Glacier/ Permanent snowfield		GL	386
	Pond		PD	3
			Total	**31,869**

Biophysical habitat mapping (similar to TEM) of the West Arm Demonstration Forest provides detailed information of the vegetation types for a portion of the greater park ecosystem (Ketcheson 1992).

Fauna

A formal inventory of vertebrate or other animal species has not been completed for the park. Anecdotal lists of wildlife and bird observations associated with projects with more narrow objectives are the main source of species diversity information (e.g., Parkin 1974). It can be assumed that many of the species listed in Appendix 1 of the companion ecosection context report (Utzig et al. 2003) for the ESSF in the CCM can be found in the park, at least seasonally. The park's high elevation mountain pass location limits the diversity of fauna compared to other low elevation and larger parks. According to management planning documents mountain goats and grizzly bears (blue-listed) are the two focal species for the park.

4.3.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

Three active glaciers occur in the park: Kokanee, Woodbury and Caribou, smaller perennial ice fields are also reported from Mt. Retallack, Kane Peak and Grays Peak. The park includes over four dozen tarns, ponds and upper elevation lakes, the largest of which are Kaslo (17.1 ha), Kokanee (15.5 ha), Wheeler 18 ha), Nalmet, Heather (8 ha), Sunset (7.9 ha), Upper Joker (6 ha), Grey Eagle (6 ha), Tanal (5.8 ha), and the Gibson Lake/Reservoir (14.7 ha). The park includes the headwaters of Kokanee, Coffee, Lendrum, Woodbury, Keen, Silverton, Enterprise, and Lemon Creeks. With the exception of some portions of Keen, Enterprise, Woodbury and Coffee, the stream reaches are generally steep and confined, many with waterfalls and cascades.

Fisheries

Natural populations of fish within the park are limited to those found in the lower elevation major creeks. Many of the lakes in the park have been repeatedly stocked with westslope cutthroat trout (Parkin 1974, Sather 1982, Withler 1990). Although populations of cutthroat trout are persistent in many of the lakes, and are found in many of the creeks within the park, they are limited by occasional winter-kill and lack of spawning areas. There are also reports of rainbow trout from Kaslo Lake and Lemon Creek (MSRM 2003, MoEP 1990). The lower elevation portions of the major creeks within the park contain rainbow, cutthroat and/or blue-listed bull trout. Within lower reaches of these creeks there are also occurrences of kokanee, mountain whitefish, burbot, various sculpins, daces and minnows, and introduced brook trout (MSRM 2003).

4.3.4 Potential Biodiversity Conservation Roles

4.3.4.1 Representation

Kokanee Glacier Park provides good quality representation at the BEC unit level for the AT, including active glaciers, and many of the ESSFwc variants in the CCM; however, its lack of moderate and low elevation area severely limits its ability to provide representation at the ecosection level. Although the park supplies significant representation for some landscape elements of the ICHwk1 and ICHmw2, the diversity is not sufficient to provide representation at the BEC unit level for those variants.

4.3.4.2 Local Habitat Supply

The park provides an extensive and diverse area of ESSF and alpine habitat in a range of seral stages. The area is sufficient to supply complete home ranges for many high elevation species (e.g., marmots, picas, goats), and potentially some species that have more generalized habitat requirements, such as black and grizzly bears (McCrory 1985). The park also supplies extensive seasonal habitat for other species including mule deer (Poole et al. 2000) and many species of birds (> 60 species recorded, MoEP 1990). However, the lack of low elevation habitat requires that many species must depend on habitats outside the park for the remainder of the year, often when they are most vulnerable to predation or displacement (e.g. ungulate winter range). The limited management requirements for old and mature forest in the surrounding Landscape Units (except for Lemon Creek N515) also indicates that the park could play an important role in supplying those habitats. However, maintenance of old and mature forest through fire suppression will have to be tempered with the need to supply early seral habitats (i.e. berry fields) for grizzly bears.

The park is located near the southern tip of peninsulas in the distribution of both mountain goats and grizzly bears, and therefore, can potentially play an important role in preventing the continuing shrinkage of those species' ranges (Proctor 2001, McTaggart Cowan and Guiget 1955).

There has been a preliminary study of potential mountain goat habitat that has identified potential winter/spring and summer/fall habitat mainly based on airphoto interpretation (Smith 1989). The study identifies the main areas of habitat to be in the northeastern half of the park. There appears to have been no follow-up ground-truthing to verify and update the preliminary mapping. Based on a single season of field and air observations this report estimates the population at 65 individuals at that time.

Kokanee Glacier Park has long been recognized as providing important grizzly bear habitat. There have been numerous studies of grizzly bear habitat within the park, primarily focussed on defining high-use bear areas and reducing the risk of human-bear encounters from a public safety perspective (e.g., McCrory and Mallam 1992, McCrory 1994, McCrory 2000). The studies have described and mapped an abundance of various types of habitats significant to bears throughout the park: berry fields, glacier lily sites, riparian – wet site feeding areas, ground squirrel areas, snow avalanche feeding areas, denning sites and travel corridors.

4.3.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002a) Kokanee Glacier Provincial Park was assessed as being at high risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a ranking of 18 out of a possible score of 36, with high scores for naturalness and moderate scores for the presence and diversity of rare species and/or habitats and diversity of cultural features. The park was ranked relatively low with respect to ecosystem representation.

With respect to risk factors, Kokanee Glacier Park was given a score of 2 out of a possible 16, with size and shape of the park being the main risk factors. Summer access and recreation use were identified as

the main stresses or threats to the conservation values within the park, likely to result in impacts such as habitat fragmentation, native species disturbance, population declines and/or loss and exotic species introductions. The CRA evaluation concluded that the bear management program was addressing the primary issue. The CRA rated cumulative impacts on the park from outside sources as being high and internal stresses as moderate, providing an overall risk level of high.

Based on a review of the available information for this park and management of the greater park ecosystem, the conclusion of this study is that the overall level of environmental risk is likely moderate (especially in relation to other parks in the CCM), recognizing that risks to grizzly bears may in fact be high. The majority of the park is still in a relatively intact state, and at least there is some inventory information and planning attempting to deal with the key issues.

4.3.6 Proposed Ecological Conservation Management Direction

The potential for continuing impacts due to internal and external threats mean that achieving a low risk to ecological integrity will be an ongoing challenge, and it may involve trade-offs with other park objectives, specifically provision of recreational opportunities. Like many parks, Kokanee Glacier may have more objectives and goals than it has the capacity to fulfill. The proposed ecological conservation management direction seeks to minimize risk from factors that can be controlled, and thereby maximize the effectiveness of the park in contributing to broader ecological goals, as much as possible. This includes some changes to current management, and an emphasis on maximizing opportunities within the area of cooperation.

In an attempt to address the internal threat of ever-increasing recreational use, park managers have initiated grizzly bear inventories, prepared recreation management strategies that attempt to manage recreation use and maintain grizzly bear distribution, implemented measures to reduce grizzly bear displacement and encounters, and undertaken environmental reviews prior to proceeding with further infrastructure development. These measures have been fairly successful in reducing human – bear encounters, but have not gone far enough to prevent displacement of bears from all potential high quality habitat. To effectively fulfill a low risk ecological conservation role for grizzly bears, park management has to place primary emphasis on allowing grizzly bears unimpeded access to the majority of the high quality bear habitats in the park. Park managers have to independently assess risk to grizzly bears, and make decisions on the basis of an acceptable level of risk, rather than simultaneously assessing grizzly bear needs and recreational demand, and then compromising between the two. Otherwise, as recreational demand continues to increase, grizzly bears will keep moving closer and closer to the brink.

To maximize the ecological conservation role of the park would require a more detailed assessment of bear habitats and a further look at what changes could be made to trail and facility locations, and seasonal use controls, to optimize bear access to the high quality habitats. Long-term planning also has to begin to consider the provision of bear habitat through time, particularly seral stage-dependent habitat such as berry patches. Active habitat management and the use of controlled burns should be considered as a possible means of improving bear habitat and managing bear – human interactions.

Resolving the external threats is likely an even larger challenge. It will require working closely with forest managers and other stakeholders in the greater park ecosystem to manage access and adjust forest harvesting at both the stand and landscape levels to restore and maintain forest conditions closer to the range of natural variability. Restoring connectivity between grizzly bear sub-populations will require designing, planning and implementing measures to maximize bear movement along Keen, Lemon and/or Kokanee Creeks. Although Keen Creek already has some advantages with the High Emphasis Biodiversity designation, and the relatively close proximity of Valhalla, Kokanee Creek and West Arm Parks, there is also the disadvantage of rural residential development and highways with relatively high traffic volumes.

4.3.6.1 Zonation

The Kokanee Glacier Provincial Park Master Plan (1990) and the Management Direction Statement for Kokanee Glacier Park Additions (1999) identify the following zonation approach for the park:

- Intensive – readily accessible day-use recreation opportunities and overnight packing and base facilities for extended backcountry trips. Includes auto-destination areas and staging facilities at the Gibson Lake, Woodbury Creek, Enterprise Creek, Sturgis Creek and Keen Creek trailheads.
- Natural Environment – encompasses the focal backcountry use areas of the park where visitors and management services will be concentrated: Slocan Chief – Kaslo – Kokanee Lake, Lemon – Sapphire Lakes, Enterprise Creek – Tanal Lake – Heather Lake – Paupo Creek, Sturgis Creek, Joker Lakes, and Woodbury – Silver Spray – Sunset; includes portions of the recent additions (640 ha): Wheeler Lake and Nelles Creek – Klawala Creek areas, as well as lower Coffee Creek as an interim restoration area.
- Wilderness Recreation – covers major portions of the park where development and management strategies will be directed toward maintaining relatively low levels of use compatible with the concept of wilderness, including most to the 1990s park additions (5,560 ha).

The present zonation approach is mainly based on historic use patterns, with some adjustments intended to reduce human – grizzly bear encounters. While the present zoning and management measures do benefit grizzly bears as well as humans, the main emphasis for the measures has been to protect human safety, rather than minimizing risk to grizzly bears. To further reduce risk to grizzly bears, park management would have to take a new approach to zoning, one that starts with grizzly bear needs and then fits recreational use into that rather than the converse. Essentially this would mean shifting emphasis from providing recreational opportunities to ensuring the long-term persistence of grizzly bears within the park. Zoning would start with identifying key grizzly habitats, their seasonal use patterns and travel corridors required to maintain connectivity between those habitats. These areas would then be primarily designated Wilderness Conservation or Ecological Protection. Natural Environment, Local Conservation or Intensive Recreation Zones could then be located appropriately in the remaining areas. This would likely require relocation and/or removal of some trails, other facilities and access points, as well as monitoring to assess limits to acceptable change. The adjustments to zoning would have to be accompanied by associated management strategies that could use seasonal closures and long-term habitat management as further tools to increase the compatibility of bear conservation and recreational use. An implementation plan should identify priorities and use a phased adaptive management approach to implementing the changes.

4.3.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Kokanee Glacier Provincial Park

Overall Goal: Minimizing Environmental Risk and ensuring it is decreased from a moderate to low level.

The following table summarizes identified issues and associated recommendations of objectives, strategies and performance indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Incomplete baseline ecological information	Incomplete information limits strategic conservation planning and limits the effectiveness of operational-level management; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Compile, digitize and integrate existing habitat mapping with the existing Predictive Ecosystem Mapping and ground truth for the whole park, preferably in cooperation with similar efforts for the surrounding area of cooperation (e.g., WADF and Arrow IFPA mapping).	Terrain, hydrologic feature and ecosystem mapping is completed for the whole park. Grizzly bear habitat interpretations are available for the whole park.
Impacts from recreation activities and facilities on grizzly bears and ecological integrity (placing emphasis on grizzly needs, in contrast to emphasizing human safety)	Given that the park is a backcountry destination, and intended to provide local recreational opportunities, there is need to carefully manage recreational use to protect grizzly habitat and movement corridors, and other ecological values.	Park	Minimize displacement of bears and maximize retention of habitat elements, especially wetlands, riparian areas, coarse woody debris and snags.	Based on existing and new inventory information, and with the primary goal of maximizing bear access to, and movement between, high quality bear habitats: • review park zoning and make adjustments accordingly, including the use of local conservation and ecological protection zones as may be required, • revise management measures such as seasonal human access controls, • review locations of trails and other facilities in light of revised zoning and bear habitat requirements, and • review fire suppression, controlled burning and other habitat management tools for applicability in maintaining habitat through time. Within the appropriate park zones: • establish clear objectives to serve as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives	Abundance, distribution and quality of bear habitats. Bear use of high quality habitats. Distribution and abundance of grizzly bears.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Seral stage distribution and fire management	Reduction of old and mature forest in the greater park ecosystem undermines ecological integrity, lack of fire reduces availability of berry habitat for bears.	Park and Area of Coop-eration	Management of seral stage distribution that balances distribution of old, mature and early seral forest cover appropriate to the natural disturbance regime.	Working with the Partnership Group and in cooperation with management of the greater park ecosystem, suppress fires on wetter sites and cooler aspects, and employ prescribed fire to maintain and/or restore early seral habitat types that serve as important bear habitats (i.e. berry fields).	Compatibility of seral stage distribution and stand structures with the range of natural variability. Ongoing provision of high quality berry habitats for grizzly bears.
The high visitor use of the park has historically been seen as a necessary trade-off to introduce novice backcountry users to ecological conservation issues.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Coop-eration and Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the role of the park in relation to broader ecological goals, taking into account the history of park use and cumulative impacts of development in the area as a whole. Work with the Partnership Group, including personnel and representatives of related ministries, crown corporations, industry and funding sources to build understanding and support for developing and implementing an access management strategy, both within and outside the park, that may include temporary or permanent closures within the park. Support community efforts to maintain the visitor centre, including providing staff with relevant information about the ecological conservation goals and issues associated with Kokanee Glacier Provincial Park,. Institute education presentations and/or displays at Gibson Lake and Slocan Chief Cabin.	Partnership Group formed. Tangible support expressed Necessary resources allocated. Communication maintained on an as-needs basis.
Need for coordination between managers in the greater park ecosystem to restore connectivity.	Given the high elevation habitats and location of the park, achievement of its potential ecological conservation role requires complementary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for maintaining and restoring regional connectivity, work with stakeholder interests to: • restore and/or maintain connectivity between Kokanee Glacier Park and the surrounding lowlands, especially Kokanee Creek Park, and • restore connectivity for grizzly bears within the Selkirk Mtns., especially between Kokanee Glacier Park and Valhalla, Goat Range and West Arm Parks.	Implementation of management regimes in the greater park ecosystem that enhance the conservation role of the park and restore grizzly bear connectivity.

4.4 McDonald Creek Provincial Park

4.4.1 Park Description

4.4.1.1 Park-Specific Information Sources

A Master Plan was completed for the park in 1980. Subsequently, a Purpose Statement was developed in 2002. The Protected Areas System Overview (PASO) database lumps McDonald Creek Provincial Park with other small area parks listed under "Arrow Lakes Multi-Site". As such, the statistical information contained in PASO can not be used to describe McDonald Creek Provincial Park. Another potential source of information, the ranking forms for individual parks that were completed as part of the 2002 Conservation Risk Assessment, was not completed for this park largely because it is grouped under the multi-site category and, hence, the necessary information was not available.

Interviews with Park Staff were used, in addition to aerial photos and PEM data, to gain better insight into the park. However, the general level of knowledge about the ecological values and processes associated with McDonald Creek Provincial Park remains low.

4.4.1.2 Location and History of Park Development

McDonald Creek Provincial Park encompasses approximately 468 hectares, including land on both the east and west sides of Arrow Lakes Reservoir. Additionally, there are two islands in the river, which are part of the park, but only exposed at very low water.

A significant portion of the park is former farmland, which was expropriated as part of the Columbia River Treaty process that led to the construction of the Hugh Keenleyside dam. The land base comprises long-standing Crown recreational reserves and former BC Hydro properties conveyed to the Crown for park purposes. BC Hydro contributed funds for the development of a provincial park at McDonald Creek and in 1980, it was formally approved as a Class A park.

Principle access to the park on the east side is via Highway 6. Access to West Demars portion is by a 6.4 km gravel industrial road that runs north from the Arrow Park ferry to the park site, and continues another 29 km to the next ferry crossing. The park lies within a well developed road network, which includes active main haul roads adjacent to both sides of the park. The west side road is being informally maintained by local recreation groups (e.g., removing downed trees).

On both sides of the reservoir there are a number of Section 6 roads registered with the Ministry of Highways, who have indicated they are prepared to cancel these roads from their registers. (Master Plan, 1980).

4.4.1.3 Human Use of the Park

The park has a history of varied use, including part of a former farm. Known recreational use of the area, including day use and camping, dates back to the late 1950's. Construction of rustic day use facilities was undertaken in 1977.

The whole of the McDonald Creek side and the waterfront area on the West Demars side was zoned as "Development[3]" to reflect recreational use emphasis. Recreational facilities were initially developed by the Nakusp Branch of the Canadian Legion and included a parking area, picnic tables, fire circles, games area, entrance portal, garbage cans and toilets. Camping, including access via boat, was generally

[3] The park zones have since been revised. The likely current zonation equivalent would be intensive recreation.

informal on both sides. In 1988, more sites were added as the primary role for McDonald Creek Park has been identified as providing holiday destination, tourism travel route and local community outdoor recreational opportunities. However, uncontrolled and unauthorized visitor use on the west side is considered by park staff to be threatening to conservation values, particularly wildlife values. While in theory there is no hunting allowed within the park, staff believe hunting is likely occurring but there are insufficient staff to police it.

A BC Parks service yard was established within the park. Although it is no longer being used, no reclamation activities have been pursued. The following is a listing of tenures, licenses and park use permits within the park:

- No water licenses within the park.
- BC Hydro lands yet to be conveyed to the Crown to be included in the park – West Demurs side Parcels 81,82,83,63,64 of Plan 1037; as well as 35,36,59,60 of S.L. 62A, Plan 1182 (Master Plan, 1980)
- BC Hydro R/W (K22076) on the McDonald Creek side, which will be covered by P.U.P. (Master Plan, 1980)
- Trapline (Lic.#A23003, Box 51, Nakusp, BC V0G 7R)) will have to be placed under P.U.P. (Master Plan, 1980)

There is an active Highways gravel pit within the park (existed prior to it being created as a park). There is also a power line and federal navigation light within the park. (Parks staff, *pers. comm.*).

4.4.1.4 Current Management Direction and Focus

The 2003 Purpose Statement identifies the primary role as being to maintain holiday destination, tourism travel route and local community outdoor recreational opportunities oriented to a forested lakeside (reservoir) setting. The secondary role is to protect lakeshore riparian habitat and kokanee spawning habitat associated with an alluvial fan and creek.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to McDonald Creek Provincial Park.

Table 4.7. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Park is situated in a major glacially enlarged U-shaped valley that forms the natural break between the Monashee and Selkirk mountain ranges	No specific management actions taken	Representation will be assessed based at various scales
The park exhibits biotic conditions and landscapes which are considered transitional from those of the higher rainfall and more rugged mountains found north of Revelstoke and the drier and more subdued relief along the lower	No specific management actions taken	As part of the ICHmw2, the park is part of a BEC sub-zone that covers a significant portion of the Kootenay region and can not be said to be transitional as has been described. Representation will be assessed based

Arrow Lakes There is considerable diversity in the forest cover, varying by composition and age class in typical stand associations of the Interior Western Hemlock Biogeoclimatic zone		at various scales.
Forest cover is broken with remnants of old cultivated fields and orchards, particularly on the West Demars portion. The former fields are experiencing in-growth.	No specific management actions taken	It is necessary to consider what the park may have been prior to development and the potential for restoration.
Forest health has been identified as an issue within the park in terms of visitor safety.	Such issues are identified and dealt with through a danger/wildlife tree program. Surveys are not consistently conducted.	Need to look at the ecological functions of wildlife trees and what that potentially means to this specific park.
On the east side there is a small wetlands area with skunk cabbage present. The park likely contained more extensive wetlands at one time, however areas were trenched and drained when it was actively farmed. Evidence of the trenching can still be seen.	No specific management actions taken	Given the impacts of dams and the associated flooding, the significance of even small, remnant wetlands needs to be considered. Restoration opportunities will be considered.
Invasive weeds are prominent in the park. Park staff report the presence of knapweed, burdock and Oxeye daisy	Staff report that biological controls for knapweed were released in the old parking lot some time back.	Need to consider the issue of invasive weeds in the park within the broader context.
Kokanee spawn in the creek, both within and above the park boundaries	Zoning resulted in creation of a special sub-zone along the creek, which is intended to focus attention toward protection of valuable fisheries habitat. However, no specific management actions have been taken by BC Parks. The local Rod and Gun Club may have removed “debris” from the channel some time back. Current management practices would no longer support such activities, as it is now known to be harmful to fisheries goals. The Ministry of Highways recently replaced the culvert with a bottomless structure. It is anticipated that fish passage should be improved as a result. BC Parks was not notified or consulted in the decision to replace the culvert.	Need to consider the significance of the spawning opportunities within the park relative to the broader ecological goals and what, therefore, should be the management of the resource within the park.
The park and most of the surrounding area on both sides of the reservoir provides critical winter range for white tail and mule deer	No specific management actions taken	While the park does contain winter range, it is uncertain whether or not it is “critical”. It is necessary to consider this relative to the broader context and what management strategies should be pursued.
Provides habitat for some 140 migratory and resident bird species	No specific management actions taken	As there have been no surveys conducted within the park, it is assumed

		that this statement relates to bird populations in the general area. It is necessary to consider the relevance of this statement to the park itself.
Park staff stated that there appear to be numerous birds and amphibians in the bays where people camp. Additionally, frogs have been seen and heard behind the storage shed.	No specific management actions taken	More information will be required to determine the significance of these statements.
Ecological values likely being impacted by both use of the park and surrounding area	Priority use for the park has been identified as recreation. Parks staff are aware of logging in the drainage above the park but no known changes to resource use in the surrounding area has occurred as a result of concern for values within the park.	Greater park ecosystem to be identified and management of ecological values to be considered both within and outside of the park in order to define how the park might best realize its potential ecological roles.

4.4.2 Regional and Landscape Context

4.4.2.1 Ecological Context

Ecosection/Bigeoclimatic Unit/Hydrologic Features

McDonald Creek Park is located within the Columbia – Shuswap Moist Warm Interior Cedar-Hemlock variant (ICHmw2) of the Central Columbia Mountains ecosection (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is 0.03% of the ecosection and 0.07% of the ICHmw2 variant that occurs in the CCM.

Of the six major landscape elements identified for the ICHmw2 within the CCM, only one of them, valley bottoms of major drainages with large lakes, is found within McDonald Creek Park (MVL, see also Table 2.1). Being located on the floor of the Columbia River valley, separated into two narrow parcels that straddle the Arrow Reservoir, McDonald Creek represents a small example of that landscape element.

Disturbance Regimes

The ICHmw2 is classed as Natural Disturbance Type 2, defined as an area with infrequent stand-replacing disturbance events (BC MoF 1995). Low-intensity ground fires were probably rare in the park, likely associated with stand-replacing events on the steep rocky areas up-slope of the park. The natural disturbance regime was likely dominated by relatively long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in the ICHmw2 vary from 100 years for dry sites on warm aspects to over 450 years on wet sites and cool aspects (Dorner et al. 2003). Given its valley bottom location and mixed range of sites, McDonald Creek Park likely falls somewhere in the middle of this range.

Greater Park Ecosystem

Although McDonald Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it is directly connected to the Arrow Reservoir, the McDonald Creek watershed and the watersheds of all the face unit streams that run through the park.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears, whose home ranges likely include most of the adjacent face units and associated watersheds. Bird species habitats will likely extend along the shorelines beyond the park boundaries, and potentially into the uplands surrounding the park.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the Arrow Reservoir to the whole Columbia basin, and former salmon runs linked the area to the Pacific Ocean.

4.4.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for the McDonald Creek Park is the Ministry of Forests Landscape Units that include and are adjacent to the park (N522, N526 and a minor portion of N5528). These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding the Arrow Reservoir, the Kootenay Boundary Land Use Plan, the Arrow TSA and TFL 23, and Wildlife Management Units 4-15 and 4-32.

Management within the Greater Park Ecosystem

The park is bounded by a provincial highway on the eastern side and a major forest haul road on the west side, as well as being cut in half by the Arrow Reservoir. There are registered locations of water intakes for human consumption recorded for both parts of the park, which will likely result in additional protection of small face-unit watersheds and/or spring recharge areas upslope of the park. The forest slopes on both sides of the valley above the park are designated Class 2 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.).

The eastern portion of the park is bounded by private land on the north and south ends. The eastern block also surrounds a Ministry of Transportation and Highways' gravel pit near the center and is crossed by a powerline right-of-way for approximately 700m. The lands above the highway are part of the Arrow Timber Supply area. This eastern area is part of Landscape Unit N522 and has been assigned a Moderate Biodiversity Emphasis Option, as has the area immediately to the northeast in LU N528. Most of the McDonald Creek watershed has been designated an Enhanced Resource Development Zone (ERDZ) for timber production. Previous landslide activity has washed out the forest access road at 6 km and deposited debris and sediment into the creek near the upper end of reach 3 (Petrovcic 2000).

The western portion of the park is bounded by reverted crown lots to the south and west. The lands upslope to the west and to the north are part of Tree Farm License 23. The western portion of the park also includes two sublots controlled by BC Hydro. The lands surrounding the western block are part of Landscape Unit N526 and are assigned a Low Biodiversity Emphasis Option.

4.4.3 Ecological Features of the Park

4.4.3.1 Geology and Terrain

Although there are likely few, if any, outcrops in the park, the bedrock in the greater park ecosystem is dominated metamorphic rocks of the Slocan Group and undivided Shuswap Metamorphic Complex, mainly gneisses, schists, phyllites, argillites, quatzites and some marbles (Read 1976). The park is dominated by a series of moderately coarse to sandy textured glaciofluvial terraces and deltaic deposits, with minor areas of moderately fine textured glaciolacustrine (Wittneben 1980). Soils are generally rapidly

to well drained, however depressions and concave slope positions, especially where associated with riparian zones, seepage, and/or glaciolacustrine materials, can be imperfectly to poorly drained. The park also includes some more recent moderately coarse textured fluvial deposits on the floodplain of McDonald Creek.

4.4.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Arrow Forest District (Ketcheson et al. 2003), the park potentially includes 7 of the 9 site series described for the ICHmw2, including a range in moisture regimes from dry to wet (see Table 4.7).

Table 4.8. Potentially occurring land types and ICHmw2 site series within McDonald Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	Reservoir		LA	198
	Gravel bar		GB	13
03	FdCw – Falsebox – Prince's pine	Dry	DF	39
04	CwFd – Falsebox	Mesic	RF	10
01	HwCw – Falsebox – Feathermoss	Mesic	HF	78
05	CwHw – Oakfern – Foamflower	Moist	HO	29
06	CwHw – Devil's club – Lady fern	Wet	RD	7
07	CwHw – Horsetail	Wet	RH	38
08	CwSxw – Skunk cabbage	Wet	RS	47
			Total	459

Fauna

There does not appear to be any detailed inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion ecosection context report (Utzig et al. 2003) for the ICHmw2 in the CCM can be found in the park, at least seasonally.

The park's valley bottom location adjacent to the Arrow Reservoir provides ungulate winter range habitat for mule deer, moose, and to a limited extent, elk and white-tailed deer. The highest capability winter range in the area is likely located outside the park on the lower south-facing slopes to the east toward Arrow Park.

The small lagoons, wetlands and wet forest types potentially provide habitat for amphibians, birds and other species that require semi-permanent water bodies and associated vegetation. Very dry xeric habitats do not appear to occur within the park. There is a small natural wetland just outside the park boundary on the southwest corner of the park.

4.4.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park also includes a significant length of shoreline along Arrow Reservoir, including a number of small bays and two islands that appear at low water. The park also includes the lower reach of McDonald Creek (Slewiskin) and associated floodplain and fan. There are also a series of smaller un-named creeks that cross the park on the east side. Most of the wetter soils and vegetation types are associated with riparian areas of the streams. However, there are a few depressions and/or concave areas that are affected by seepage.

Fisheries

The Arrow Reservoir includes a wide range of fish species, including: kokanee, rainbow trout, bull trout, mountain whitefish, lake whitefish, burbot, white sturgeon, pygmy whitefish, largescale sucker, longnose sucker, northern pikeminnow, peamouth, longnose dace, redside shiner, prickly sculpin, torrent sculpin and slimy sculpin (MSRM 2003).

Fisheries inventories of McDonald Creek have identified the presence of kokanee, rainbow trout, bull trout and slimy sculpins. Kokanee and adfluvial bull trout both use the lower reaches of McDonald Creek for spawning. Bull trout is a blue-listed species, and is a species of special concern within the Kootenay Region (Petrovcic 2000). Kokanee were reported to spawn in the lower 3 reaches of McDonald Creek (>10,000 in 1999), while bull trout and rainbow trout were observed up to reach 6. The lower reaches of some McDonald Creek tributaries may contain trout as well, but upstream of these locations steeper gradients generally limit fish distribution.

4.4.4 Potential Biodiversity Conservation Roles

4.4.4.1 Representation

The small area and minimal landscape diversity of McDonald Creek Park limits its potential representation contribution to a single example of the six landscape elements recognized for the ICHmw2 biogeoclimatic variant. However, even this limited role is significant within the CCM, as only 11.1% of the ICHmw2 is protected, and only a small portion of that representation is located in the landscape element represented by McDonald Creek park. Although the geographic locations of ICHwm2 protection are fairly well distributed geographically throughout the CCM, McDonald Creek and the even smaller Burton Park are the only parks that provide protection for any of the landscape elements of this BEC unit in the Columbia Valley portion of the CCM (see Figure 4.1). Given the cumulative impacts of habitat conversion due to reservoir flooding and private land development within the Columbia Valley, McDonald Creek still provides important representation at the landscape element scale, even with its limitations due to size and configuration.

4.4.4.2 Local Habitat Supply

Given the intensive forestry management in the surrounding area and the private land holdings along this portion of the Columbia Valley, the amount of late seral forest cover is the landscape level habitat feature most likely to be threatened in the future. Maintaining mature and old forest cover over as much of the park as possible, especially in wetter ecosystems will likely provide habitat elements that are in reduced supply in the surrounding area. However, for these stands to fulfill their functions, especially regarding cavity nesters and species dependent on coarse woody debris, they cannot be subjected to snag falling, or at least there should be more care given to deciding when trade-offs for human safety are necessary. Late seral forest retention in the riparian zones of McDonald Creek will provide for increased channel stability and terrestrial and aquatic ecosystem integrity. Maintaining some small openings with naturally

occurring early seral shrub and herb dominated communities could increase the value of the park for ungulate winter range, while increasing the overall biological diversity.

Over the past century extensive wetlands and riparian habitats have been lost to flooding and agricultural clearing in the Columbia Valley. The PEM mapping and reports by parks staff indicate that there are potentially a number of naturally wetter forest habitats and possibly some naturally occurring wetlands within the park. There may also be some wetlands that have been modified by previous agricultural drainage within the park area.

4.4.5 Proposed Biodiversity Conservation Management Direction

4.4.5.1 Proposed Ecological Objectives, Strategies and Monitoring Indicators for McDonald Creek Provincial Park

Overall Goal: Reducing Risk Towards a Moderate Level

Issue	Principle or Underlying Assumptions	Subject Area*	Objective	Strategy	Performance Indicator
Lack of baseline ecological information	Lack of information limits strategic conservation planning and precludes defining operational-level management direction; may result in further impacts from unrestricted recreational use.	Park and Area of Cooperation	Increase baseline understanding of ecological values and processes within the park to support future management decisions.	Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation. Conduct reconnaissance habitat inventory and develop a species list for the park, preferably in cooperation with similar efforts for the surrounding area of cooperation.	PEM ground-truthed and modifications made as required. Habitat inventory completed, species list for the park compiled.
General impacts from recreation activities	Given that the park is a holiday destination, tourism travel route and intended to provide local community outdoor recreational opportunities, there is need for basic and ongoing management of recreational use to protect ecological values.	Park	Maximize retention of habitat elements, especially coarse woody debris, snags and understory vegetation.	Within the local conservation zone: • enforce park use restrictions, including no firewood cutting, restriction of camping to designated sites, etc. • protect potential and existing wildlife trees • establish clear objectives as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives Within the intensive recreation zone conduct a wildlife/hazard tree survey and pursue all possibilities for maintaining potential and existing wildlife trees prior to removing any hazard trees.	Levels of stand level structures within the natural environment and recreational zone
Seral stage distribution and fire management	Reduction in old and mature forest in the greater park ecosystem undermines ecological integrity	Park	Maximize old and mature forest cover, subject to maintaining ungulate winter range for high snow years	Suppress fires, except where a comprehensive ecosystem restoration plan has identified the need for openings for ungulate winter range within the park	Seral stage distribution within the park reflects high level of old and mature forest. Suitability of ungulate winter range

Issue	Principle or Underlying Assumptions	Subject Area*	Objective	Strategy	Performance Indicator
Invasive species	Invasive weeds reduce habitat suitability and displace naturally occurring species.	Park and Area of Cooperation	Eliminate invasive species in the park	Implement a program to control invasive weed species, preferably in cooperation with similar efforts for the surrounding area of cooperation.	Species identified through the reconnaissance habitat inventory. Partnership group develops control strategies. Control strategies implemented. Level of invasive weed species within the park.
Need to build public support for the ecological conservation roles of the park given the history of land expropriation in the area and the recreation emphasis for the park.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Cooperation, Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the role of the park in relation to broader ecological goals, taking into account the history of expropriation and the impacts of dam construction to the area as a whole. Work with identified Partnership Group, including personnel and representatives of related ministries, crown corporations, industry and funding sources to build understanding and support for developing and implementing an ecosystem restoration plan for the park.	Partnership group for the park formed. Communication maintained on an as-needs basis. Key professionals identified and pro-active education initiated. Public communication program implemented. Tangible support expressed.

Issue	Principle or Underlying Assumptions	Subject Area*	Objective	Strategy	Performance Indicator
Restoration needs	Historic and current uses have resulted in a loss of ecological integrity in some parts of the park; intervention is necessary to restore ecosystem function in those areas.	Park and Area of Cooperation	Assist the recovery and management of ecological integrity for both terrestrial and aquatic ecosystems within the park.	Develop and implement an ecological restoration plan for the park that considers: • construction of wetlands in inlets along the western shoreline • restoration of wetlands and seepage areas in the old farmland on the east side • maintenance of some openings in abandoned farmland for maximizing winter range, including the use of prescribed burning in such openings • late seral forest retention in the riparian zones of McDonald Creek • removal of the gravel pit • restoration of the former service yard area • the impacts of the current recreation infrastructure and options for maximizing conservation management within the Intensive Recreation Zone • necessary linkages to management within the greater park ecosystem and area of cooperation as may be required • monitoring requirements, including the development of clear objectives to serve as a baseline for monitoring the limits to acceptable change from recreational use of the park.	Ecological restoration plan developed and implemented. Park ecosystems restored to conditions that are within the range of natural variability.
Small size and limited diversity reduce ecological conservation role of park	Minimal boundary adjustments can significantly increase ecological conservation role of this park	Area of Cooperation	Increase the viability of the park to fulfill its ecological conservation roles.	Acquire the adjacent crown lots on the west side, especially the small wetlands to the south and drainage areas upslope.	Park expansion includes key habitat types

Issue	Principle or Underlying Assumptions	Subject Area*	Objective	Strategy	Performance Indicator
Greater park ecosystem does not support ecological conservation role within the park	Given the small size of the park, achievement of its potential ecological conservation role requires complementary management within the greater park ecosystem	Area of Cooperation	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting ecological values and processes within parks, work with stakeholder interests to: • increase connectivity between McDonald Creek Provincial Park and the surrounding uplands • manage upslope areas to simulate natural fire regime, ands • manage McDonald Creek watershed to minimize risk to high fisheries values (i.e., minimize sediment inputs, control ECA to maintain low risk flow regimes).	Implementation of management regimes in the greater park ecosystem that enhance the conservation role of the park
Access related impacts	Unmanaged and dispersed motorized access increases risk to access-sensitive species, increases the spread of invasive weeds, increases the risk of poaching and other environmental damage	Park	Contain access-related impacts by focusing and limiting access to designated areas.	On the west side, either eliminate vehicular access or at least limit vehicular access to a single location along the beach; block motorized access to other areas; rehabilitate and restore other roads. Assess existing foot trails through the development of an ecosystem restoration plan for the park. Implement relocation, closures and/or trail restoration as required.	Level of degradation resulting from motorized access, levels of ecosystem disturbance, levels and distribution of invasive weeds, numbers and distribution of access-sensitive species, incidents of poaching reduced.

*Subject Area refers to which area the proposed management direction is intended for: either the park itself or complementary direction for its area of cooperation. In some cases the management direction may relate to a regional context as well.

4.5 Valhalla Provincial Park

4.5.1 Park Description

4.5.1.1 Park-Specific Information Sources

A Background Document was created for Valhalla Provincial Park in 1988 in order to support the development of a Master Plan, which was completed in 1989. A Purpose Statement was developed for the lakeshore portion of the park in 2002. The next year, a second Purpose Statement was developed for the Evans Lake Ecological Reserve. The most recent Annual Management Plan was completed in 2001. The Protected Areas System Overview (PASO) contains information about Valhalla Provincial Park. Additionally, the Park was assessed through the 2001 Conservation Risk Assessment.

There are three reports on grizzly bears that address Valhalla Provincial Park. Firstly, the Bear Management Plan developed for West Kootenay District Parks in 1989 by McCrory Wildlife Services includes some specific information on Valhalla Provincial Park. In 1984, McCrory undertook a study of grizzly bear habitat capability and use in relation to recreational facilities in the park. In 1985, Janet Ott completed a food habit study of grizzly bears in the park.

In 1995, a Selkirk College student project considered fire management issues within the park. Government developed a Forest Fire Operational Plan for the park in 1996.

Finally, a study on mountain goat winter habitat use in the West Kootenays, undertaken by Poole and Mowat in 1997, provides some insight into how the goats use the areas at the southern end of Valhalla Provincial Park.

4.5.1.2 Location and History of Park Development

Valhalla Provincial Park is situated between Lower Arrow Lake and Slocan Lake in the Valhalla Range of the Selkirk Ranges of the Columbia Mountains Physiographic region. The park is located along the roadless west shore of Slocan Lake. Logging roads approach but do not enter the park on its other three sides.

In 1953 UREPs were established on Beatrice, Cahill and Evans Lake. An Ecological Reserve (#32) was then established in 1972 on Evans Lake to protect a unique yellow cedar stand. Other ecological reserves were proposed (#260 for the Nemo Creek Forest and #344 for Wee Sandy Creek) that were not approved. On March 3, 1983, 49,600 ha of land were established as Valhalla Provincial Park as per Order-in-Council 409.

There are a number of private inholdings within the park that existed prior to the establishment of the area as a protected area.

4.5.1.3 Human Use of the Park

The area now known as Valhalla Provincial Park contains evidence of pre-contact First Nations' culture, including specific archaeological sites that have been documented. There is evidence of hand, horse and flume logging dating back to the 1920's with timber extraction artifacts found in the Beatrice, Evans, Nemo and Wee Sandy areas.

The park allows for a diversity of recreational opportunities. The lakeshore provides hiking and boating opportunities, as well as access to beaches for overnight camping. There are hiking trails into a number of drainages from within the park, some accessed via logging roads that either are in close proximity to,

or reach park boundaries. There are numerous established backcountry campsites within the park. Mulvey Creek contains world class mountaineering peaks and walls. Parts of the park are also accessed via floatplanes.

There are a number of tenures and park use permits associated with the Valhalla Provincial Park, including:

- Three trap lines within park boundaries – 0416T-007 (Phyllis Forsyth, New Denver); 0416T-006 (Eugene Hird, Slocan); 0416T-004 (Thor Hird, Slocan).
- Inholdings: D.L.s 1253, 6521, 7686, 8221, 8938, 10396 and 12795
- Water supplies:
  Gwillim Creek community watershed
  Mulvey Creek domestic water supply
  Nemo Creek domestic water supply
- Land Tenures
  Access to lots 8939 and 12995, Gwillim Creek
  Former MOF S.U.P. cottage sites
  CBC transmitter site
  Trapline cabins
- Park Use Permits
  0046 – Barkley
  0047 – Paszty
  0084 – Can Heli
  0095 – High Terrain Heli
  0100 – Mountain Trek fit.
  0103 – ADMG
  0106 – Nelson Mountain Air
  0111 – Kokanee Heli
  0142 – Explore Holidays
  0158 – Walking Stick Ent.
  1032 – PureWater Canoeing

4.5.1.4 Current Management Direction and Focus

The Master Plan defines the conservation role of Valhalla Provincial Park as providing landscape representation for the Columbia Mountains regional ecosystems[4]. The recreation role is to provide a wide range of high-quality outdoor recreation opportunities, which are to be in harmony with the great variety of natural environments. The park is also intended to protect cultural features.

A Purpose Statement developed specifically for the lakeshore of Valhalla Provincial Park defines the roles as:

- The primary role is to protect the valley bottom portion of a number of complete watersheds, from lakeshore to alpine habitats.

[4] While the Master Plan identified the regional ecosystem as the "Southern Columbia Mountains", this is an administrative term which is easily confused with the Southern Columbia Mountains ecosection. In fact, the Valhalla Provincial Park is part of the Central Columbia Mountains ecosection.

- The secondary role is to provide boat access recreation sites along the west shore of Slocan Lake.

A Purpose Statement developed specifically for the Evans Lake Ecological Reserve identifies the sole role as being to protect a distinctive stand of yellow cedar (*Chamaecyparis nootkatensis*).

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its conservation mandate with respect to Valhalla Provincial Park.

Table 4.9. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Representation • Full elevation range – mountain crest to low-elevation shoreline (Master Plan 1989) • Extensive, low elevation lakeshore that is unusual within the protected areas system (Master Plan, 1989) • Along the shoreline, the soils are generally shallow and so the park doesn't represent the wider variety of sites associated with the BEC – rather it represents the drier site units. Contains reasonable representation for ICHmw2 in the lower elevation. (Tom Braumandl, *pers. comm*.) • The forest stands are largely mature and intermediate with some old, although the forest cover information is incomplete with significant areas for which there is no age class information. • Slope terrain/glacial features and processes are significant. (CRA workshop, February 2002) • Park seen as both significant and viable, partly because it is above the area impacted by dam construction. The park has less diversity than some other parks within the ecosection as it is centred within the ecosection and so not picking up some of the	No specific action taken.	Will consider representation at various levels and contexts, including: ecosection, BEC unit and landscape element, bedrock, terrain and site series.

diversity that is found at the edges of the ecosection. (CRA workshop, February 2002) • The park is one of the few in the region considered "viable" as a result of its size and full elevational range. • Lakeshore and low elevation ecosystems are not well represented within the park system.		
Old-growth	No specific actions taken.	Need to consider the significance of old growth in the park relative to the greater park ecosystem. Additionally, need to clarify any assumptions that stakeholders within the area of cooperation may be making in terms of the park's contribution to meeting old growth targets and whether those are consistent with the potential ecological conservation roles of the park.
Grizzly bears	Management has focused on bear-human conflicts. Study commissioned, some recommendations have been implemented.	Need to consider bear management issues within the context of the greater park ecosystem and the relationship between Valhalla, Kokanee and Goat Range Provincial Parks with respect to grizzly bears.
Impacts from human use of the park: • Illegal Mushroom picking • Water line trespass • Recreational use in the Evans Lake ER – from the "float plane community" • Impact from high use in Gwillim access corridor • Uncontrolled visitor use threatens delta and riparian values	Addressing the issues as resources allow.	Proposed management direction will address what is likely required to maintain a low risk for ecological conservation within the park.

4.5.2 Regional and Landscape Context

4.5.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Valhalla Park is located within the Valhalla Ranges of the southern Selkirk Mountains in the southwestern portion of the CCM. According to recently revised BEC mapping, the park has an elevational sequence of BEC units, beginning with the Columbia – Shuswap Moist Warm Interior Cedar – Hemlock variant (ICHmw2) at low and mid elevations. Above this there are three variants of the ESSFwc that occur in the

park, the mid elevation Columbia Wet Cold Engelmann Spruce – Subalpine Fir variant (ESSFwc1) that is transitional to the ICH, the typical ESSF closed forest Selkirk Wet Cold Engelmann Spruce – Subalpine Fir variant (ESSFwc4), and the high elevation open/ clumpy forest Selkirk Wet Cold Engelmann Spruce - Subalpine Fir Parkland (ESSFwc4p). The ESSFwc4u was not mapped in the Arrow TSA. At the highest elevations of the park, above tree-line there are limited areas of Alpine Tundra (AT) which are mainly rock, talus and glacier (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). In addition the Dry Warm Interior Cedar - Hemlock Subzone (ICHdw) occurs as low elevations in the extreme southeastern corner of the park. The park is 3.1% of the ecosection and includes the following percentages of the BEC units in the CCM: 0.5% of the ICHdw, 4.3% of the ICHmw2, 3.5% of the ESSFwc1, 3.6% of the ESSFwc4/wc4u and 6.8% of the ESSF parkland/Alpine Tundra. Previously BEC mapping had not differentiated the ESSFwc1, and had included a significantly larger occurrence of ICHdw (Braumandl and Curran 1992).

Valhalla park contains six of the seven landscape elements identified within the CCM, including main valley bottoms adjacent to major lakes and rivers, main valley face units, secondary valley floors and sidewalls and high elevation ridgelines and mountain passes (MVL, MVR, MVF, SVB, SVW and HR; for further information on landscape elements see Section 2.2).

Disturbance Regimes

The ICHmw2 is classed as Natural Disturbance Type 2 (NDT2), while the ESSFwc1, ESSFwc4 and ESSFwc4u are classed as NDT 1. The ICHdw is classed as NDT3 and the ESSFwc4p and AT are classed as NDT5 (BC MoF 1995) In general Valhalla Park is dominated by NDT 2 at lower elevations, and NDT1 at mid to higher elevations. The lower elevations, particularly on warmer aspects, are grading toward NDT3 at the southern end of the park. NDT1 and NDT2 are defined as areas with rare and infrequent stand-replacing disturbance events respectively, indicating that stand replacing events are generally infrequent on the face units and lower elevations of the side valleys and rare in the headwaters of the side valleys and upper elevations.

The natural disturbance regime for the area including Valhalla Park is likely dominated by relatively long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent to rare stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in the ESSFwc4 and ICHmw2 vary from about a 100 years for dry sites on warm aspects to over 500 years on wet sites and cool aspects (Dorner et al. 2003). The western upper portions of the side drainages of park, due to their moist shaded conditions and isolation from higher fire frequency major valley face units, likely had natural disturbance return intervals toward the mid to upper portion of the range (~300 – 500 years). In contrast, the eastern portion of the park, including the face units above Slocan Lake and the southern aspects at the mouths of Mulvey, Gwillim, Evans, Beatrice and Nemo Creeks, due to their warmer aspects, drier edaphic conditions, and drier climatic condition, likely had more frequent return intervals than other parts of the park (~200 – 350 years). In the southern portion of the park, this may partly have been due to the potential of fires spreading into the park from the more frequent fire disturbance regimes in the ICHdw in the lower elevations of the southern Slocan valley. Most stand-replacing disturbance are wildfires of various sizes, but outbreaks of defoliating insects, bark beetles and root diseases can also play important roles.

Some of the southerly warmer aspects at the valley mouths of Mulvey, Gwillim, Evans and Beatrice Creeks likely also include areas subject to mixed fire regimes. Recent studies have found evidence that warmer aspects with drier site types within the ICHdw were subject to mixed disturbance regimes that included high frequency (~14-65 years) low-intensity ground fires in some locations, favouring the development of open stands of ponderosa pine, Douglas fir and western larch (Quesnel and Pinnnell 2000, Dorner et al. 2003).

Between the stand-replacing events, low intensity gap-replacement stand level disturbance by insects, fungi and wind would also have operated on a continuous basis. Steeper slopes were also subject to landslide disturbances and the floodplains and fans were also subject to flooding and channel migration. Slopes at mid to upper elevations on the southern shoulder near the mouth of Nemo Creek and mid

elevation face units between Gwillim and Mulvey Creeks are undergoing disturbance by ongoing bedrock block failures.

Greater Park Ecosystem

Although Valhalla Park is relatively large in size, its functional relationships are somewhat limited due to its location adjacent to Slocan Lake. However for ungulates and other wide-ranging species who are able to cross the lake or utilize high elevation passes, there is potential for interaction with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it includes a number of drainages that flow into Slocan Lake.

For terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears. The Central Selkirk Caribou population was known to utilize the park until as recently as the 1980s; however, they are presently considered extirpated from the park. Home ranges of other ungulates likely extend to winter ranges north and south of the park, and into the Columbia River valley.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the creeks within the park to the whole Columbia basin.

4.5.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Valhalla Park is the Ministry of Forests Landscape Units that include the park and areas adjacent to the park, Arrow Forest District LUs N516 to the south and N523 to the north, and to a lesser extent N517, N521 and N522 to the west and southwest. These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding the Arrow TSA, Slocan Forest Products' Tree Farm License #3, Pope and Talbot's TFL #23, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Units 4-16 and to a lesser extent 4-15 and 4-17.

Management within the Greater Park Ecosystem

The park is bounded primarily by Crown Lands and Slocan Lake; however, there are some adjacent private lands in the vicinity of Slocan City and some small private in-holdings along Slocan Lake. The southern and southwestern portions of the park are adjacent to Slocan Forest Products' Tree Farm License #3 and Pope and Talbot TFL #23 respectively, while the remaining Crown Lands are part of the Arrow Timber Supply Area.

The areas north and west of the park in LUs N521, N522 and N523 have been assigned an Intermediate Biodiversity Emphasis Option, while the areas to the south in N516 and N517 have been assigned a Low Biodiversity Emphasis Option. There are no biodiversity management requirements for retention of mature forest in any of the adjacent Landscape Units. The park occupies an important north-south link in the regional connectivity network, interconnecting with an east-west corridor running through Caribou Creek and Shannon-Wragge Creeks to the north, and Bannock Burn Creek and the Little Slocan River to the south. However, no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet the connectivity objectives.

Immediately north of the park, the face units and lower slopes of Wragge and Shannon Creeks have been designated Class 1 Scenic Areas, as have the eastern slopes of Perry Ridge to the south of the park. In addition the face units in the main Slocan Valley further north and south, as well as across the lake from the park have also been designated Class 1 Scenic Areas, and some areas in Burton, Woden and Snow Creeks to the west have been designated Class 2 Scenic Areas. These will result in some level of

retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Although caribou were previously found in and around the park, no caribou habitat management areas have been designated near the park. The face units along Slocan Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.).

Most of the operable forest landbase south and southwest of the park in Robertson, Bannock Burn, Hoder, Koch, Burton, Woden and Snow Creeks has been designated Enhanced Resource Development Zone (ERDZ) for timber production. The ERDZs almost run to the park boundary in places, and include portions of the designated Regional Connectivity Network. Increased emphasis on timber production in these areas may have detrimental impacts on connectivity and habitat supply for species requiring mature or old forest cover, or specific stand structural attributes.

4.5.2.3 Identified Threats and Stressors to Ecological Integrity

The primary internal threats to the park are associated with recreational use along the lakeshore and other high use zones. Past timber harvesting, mining, urban and rural development and construction of transportation and utility corridors in the greater park ecosystem have had significant impacts on the ecological integrity of some ecological values associated with the park, especially caribou and grizzly populations. Potential future threats are primarily associated with continuing forestry development in the greater park ecosystem and expanded urban and rural development surrounding the park. There appears to be no information on the presence of invasive species in the park.

Although Valhalla Park is large in size and relatively undisturbed, the park is still significantly impacted by highways, agricultural development and intensive rural/urban development in its vicinity. In a recent study of grizzly bear habitat and population fragmentation in the West Kootenays, Proctor (2001) has identified a series of sub-populations of grizzly bears in the Selkirk Mountains based on the genetics of individual bears. His study sampled DNA of grizzly bears in the Central and Southern Selkirk Mountains and compared those results with those the genetic characteristics of bears in the surrounding area. The results indicate that the sub-population of grizzly bears that occur in the Valhalla Park area are genetically isolated from bears east of Highway 6 and the Slocan River, and south of Highway 31 between New Denver and Kaslo. The study identified evidence of some movement of bears across Highway 6 between Hills and Nakusp north of Slocan Lake, but even this connectivity was somewhat limited.

The study found no evidence of recent movement or dispersal of bears into or out of the area surrounding Kokanee Glacier Park, resulting in a fracture zone between grizzly bear populations in Kokanee Glacier and Valhalla Parks, as well as between Kokanee Glacier and West Arm Park and between Kokanee Glacier and Goat Range. It is suggested that the main contributing factors to the population fractures are the relatively dense rural settlement along the Slocan Valley, as well as the West Arm of Kootenay Lake, and past development along the Kaslo-New Denver corridor (i.e. Retallack-Three Forks-Sandon). The bears are also under continued pressure due to human-caused mortality, displacement and habitat degradation. Unless connectivity can be re-established, the demographic isolation of these sub-populations will lead to further increases in risk due to the loss of the “rescue effect” from dispersing migrant bears from other “healthy” populations.

4.5.3 Ecological Features of the Park

4.5.3.1 Geology and Terrain

The bedrock geology of Valhalla Park is dominated by igneous rocks of the Nelson and Valhalla plutons, which were intruded into the surrounding rocks during the late Jurassic and/or early Cretaceous (Little 1960 and Read 1976). These intrusive rocks outcrop extensively throughout the park and include granites, porphyritic granites, granodiorites, and minor diorites and monzonites. The more resistant

granitic rocks are responsible for the dramatic peaks in the southern portion of the park. Triassic and Lower Jurassic Slocan Group rocks occur primarily in the Wee Sandy drainage, but also sporadically throughout the rest of the park as small highly altered remnants in the plutonic rocks. Slocan rocks include paragneiss, gray mica schist and calc-silicate marble. Other similar gneisses of undetermined origin also occur in the southern portion of the park in lower Gwillim and Mulvey Creeks.

Terrain at the upper elevations of the park is dominated by bedrock, coarse textured and rubbly colluviums and associated talus slopes (Jungen 1980). At mid elevations, especially on the more moderate slopes, the colluvial materials are intermixed with deposits of coarse to very coarse textured gravelly and sandy morainal materials, reflecting the predominance of coarse textured plutonic bedrock in the area. More moderately textured gravelly silty and gravelly loamy morainal materials occur in some areas, associated with the finer textured bedrocks or more easily weathered intrusive rocks (e.g., some parts of Wee Sandy Creek). The valley bottoms along most of the creek drainages include occurrences of coarse textured cobbly, gravelly and sandy glaciofluvial terraces, with minor floodplains of more recent gravelly and sandy fluvial materials. Coarse textured glaciofluvial deposits also occur sporadically on the face units along Slocan Lake (Jungen 1980). More detailed terrain mapping (1:20,000) has been completed for portions of the park by Utzig (1983) prior to establishment of the park.

Valhalla park includes examples of active glaciation (Sharp Creek – New Denver Glacier), readily observable revegetated glacial features (e.g., Hoben Creek, Wee Sandy Creek) and active bedrock failures and associated colluvial deposits (e.g., mouth of Nemo Creek and Gwillim-Evans Creek face – some bedrock failures with house-size blocks of moving rock).

4.5.3.2 Terrestrial Ecosystems

Vegetation and Habitats

The distribution of site series based on recent Predictive Ecosystem Mapping (PEM) for the Arrow Forest District is shown in Table 4.9. The park includes a relatively complete representation of the various site series found in each BEC unit present, in distributions that are fairly representative of the ecosection as a whole. The park also includes some rare representation of normally coastal plants species, including yellow cedar in Upper Evans Creek and salal on the lower slopes above Slocan Lake.

Table 4.10. Potentially occurring land types and site series within Valhalla Park based on PEM mapping (Ketcheson et al. 2003).

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	ICHdw			
02	FdPy – Oregon-grape – Parsley fern	Dry	DO	4
01a	CwFd – Falsebox (sx-sm phase)	Mesic	XF	101
01b	CwFd – Falsebox (m-shg phase)	Mesic	XG	120
03	CwHw – White pine – Devil's club	Moist	HD	13
04	CwHw – Devil's club – Lady fern	Wet	RD	1
	Rock outcrop		RO	11
	ICHmw2			
03	FdCw – Falsebox – Prince's pine	Dry	DF	1073
04	CwFd – Falsebox	Mesic	RF	4786

01	HwCw – Falsebox – Feathermoss	Mesic	HF	3995
05	CwHw – Oakfern – Foamflower	Moist	HO	660
06	CwHw – Devil's club – Lady fern	Wet	RD	545
07	CwHw – Horsetail	Wet	RH	38
08	CwSxw – Skunk cabbage	Wet	RS	172
09	Bluejoint – Sedge	Wet	BS	15
	Avalanche chute		AC	1009
	Avalanche runout zone		AR	137
	Rock outcrop		RO	665
	Gravel bar		GB	1981
	Lake – Pond		LA/PD	308
	River		RI	1
	ESSFwc1			
02	Bl – Falsebox – Grouseberry	Dry	FF	1998
01	Bl - Rhododendron – Oak fern	Mesic	FR	1147
03	Bl - Devil's club - Lady fern	Moist	FD	298
04	Bl – Horsetail – Brachythecium	Wet	FH	29
05	Sedge – Sphagnum	Wet	SS	2
	Avalanche chute		AC	449
	Avalanche runout zone		AR	35
	Rock outcrop		RO	191
	Pond – Lake		LA/PD	21
	ESSFwc4			
02	Bl - Rhododendron - Falsebox	Dry	FF	5778
03	Bl - Rhododendron - Woodrush	Dry	FW	1121
04	Bl - Rhododendron - Foamflower	Mesic	RF	3327
01	Bl - Rhododendron - Oak fern	Moist	FR	1677
05	Bl - Rhododendron - Lady fern	Wet	FL	441
06	Bl - Horsetail - Brachythecium	Wet	FH	82
08	Willow – Sedge	Wet	WS	26
	Avalanche chute		AC	2347
	Avalanche runout zone		AR	207
	Rock outcrop		RO	336
	Gravel bar		GB	4
	Lake – Pond		LA/PD	549

	ESSFwcp4			
02	Bl - Heath	Dry	FH	135
03	Juniper – Mountain hairgrass	Dry	JM	245
01	Mountain-heather	Mesic	MH	456
04	Sedge – Western pasqueflower	Wet	SW	82
	Krummholz		KR	1193
	Wetland	Wet	WL	5
	Pond – Lake		PD/LA	197
	Glacier/ Permanent snowfield		GL	6
	Rock outcrop (including Talus)		RO	7080
	AT			
	Alpine heath		AH	1002
	Glacier/ Permanent snowfield		GL	91
	Krumholtz		KH	27
	Pond		PD	8
	Rock outcrop (including Talus)		RO	3560
			Total	**49787**

Fauna

There does not appear to be any comprehensive inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion report for the ICH and ESSF in the CCM can be found in the park, at least seasonally (Utzig et al. 2003). The park's landscape diversity, range of elevation and size likely result in significant diversity of fauna compared to other smaller parks. The park is known to include habitat for mountain goats, the blue-listed grizzly bear and the red-listed mountain caribou; however, caribou are no longer found in the park.

Grizzly bears are found throughout the park, mainly at mid to upper elevations (McCrory 1984). The park offers a complete range of seasonal habitats including moist avalanche runout zones, wet alpine meadows, glacier lily patches, huckleberry fields, forest cover and denning sites. McCrory (1984) completed a preliminary habitat survey that assessed various habitats in Mulvey, Gwillim and Nemo Creeks, and follow-up work by (Ott 1985) identified various bear foods in bear scats collected during those surveys. However the habitat assessments have never been extended to the entire park.

McCrory (1984) also identified some mountain goat areas throughout the park and Poole and Mowat (1997) have completed some reconnaissance goat winter habitat surveys in the southern portion of the park. However, there has been no complete goat habitat mapping completed for the park.

Caribou were once fairly extensive in the Valhalla Range, with highest quality habitat generally found to the west and north of the park (Guy Woods, *pers. comm.*). Caribou were observed in Mulvey Basin and on the New Denver Glacier in the 1960s and 70s, and were seen in the upper passes of the park as late as the mid 1980s (McCrory 1986). The Kootenay-Boundary Land Use Plan no longer requires management measures for caribou habitat in the Valhalla Range (KIAMC 1997).

4.5.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes an extensive length of shoreline along the west side of Slocan Lake. It includes five 2nd and 3rd order watersheds that are approximately 5,000 ha in area, as well as four 1st and 2nd order watersheds that are over 1,000 ha in area, and extensive face units draining into Slocan Lake. All of the watersheds are completely within the park, although there are some very small inclusions of private land in some cases. The watersheds are fully forested with primary or well-developed secondary forests; some of the watersheds having experienced historical forest harvesting and milling activities dating back to the early 1900s. The park includes two lakes of 200 ha, Evans and Beatrice Lakes, two lakes approximately 75 ha in area, Wee Sandy and Cahill Lakes, a few alpine lakes in the 10 –30 ha range (e.g., Mulvey, Demers, Hird, Tracy Cooper, Upper Wee Sandy), and numerous smaller tarns in the upper cirque basins.

There are also unique hydrologic features. Intermittant streams (i.e. streams that have alternating above- and below-ground reaches) are associated with large scale bedrock landslides on the face units above Slocan Lake between Gwillim and Evans Creek and near the mouth of Nemo Creek.

Fisheries

Fish species in Slocan Lake include kokanee, bull trout, rainbow trout, mountain whitefish, dolly varden, westslope (Yellowstone) cutthroat trout, brook trout, white sturgeon, lake chub, largescale sucker, dace, northern pikeminnow, peamouth chub, redside shiner and sculpin. Gerrard rainbow trout are stocked on an annual basis (MSRM 2003).

Mulvey Creek was reportedly stocked with rainbow trout in the early 1940s; Evans Creek includes kokanee, rainbow trout, westslope (Yellowstone) cutthroat trout (rainbow trout stocked in 1949); Indian Creek contains kokanee in the lower reaches; Cove Creek has bull trout and kokanee; Nemo Creek has kokanee and rainbow trout; and Wee Sandy Creek contains westslope (Yellowstone) cutthroat trout (MSRM 2003).

Evans Lake has rainbow trout; Hird Lakes were stocked with rainbow trout in the late 1930s; Thor Lake was stocked with brook trout in the late 1950s; Beatrice Lake was stocked with rainbow trout in the 1930s; Cahill Lake was stocked in the 1940s and contains kokanee and rainbow trout; and Wee Sandy Lake contains westslope cutthroat trout (MSRM 2003).

4.5.4 Potential Biodiversity Conservation Roles

4.5.4.1 Representation

Valhalla Park is one of four parks that provide ecosection level representation for the CCM (the others being the Purcell Conservancy, Goat Range and Monashee). The park represents one of the four distinct elevational sequences present in the CCM, extending from the low elevation ICHmw2, through the ESSFwc1, ESSFwc4, ESSFwcp4, up to and including the AT. In addition, Valhalla Park contains six of the seven landscape elements identified within the CCM, including main valley bottoms adjacent to major lakes and rivers, main valley face units, secondary valley floors and sidewalls, and high elevation ridgelines and mountain passes (MVL, MVR, MVF, SVB, SVW and HR). The ICHmw2 includes four out of six possible landscape elements, while the ESSFwc1 and ESSFwc4 have three out of four, and the ESSFwcp and AT occur in all potential landscape elements (see Section 2.2 for further information on landscape elements).

4.5.4.2 Local Habitat Supply

The size and topographic diversity of the park ensure that it provides significant habitat for a wide range of species typical of the CCM. If natural disturbance regimes can be allowed to maintain a range of seral stages and stand types in at least a portion of the park, the diversity of habitats will be further increased. Of special note is the provision of habitat for mountain goats and the blue-listed grizzly bear.

Given the forestry management in the surrounding area, both private and crown, the amount of late seral forest cover is the landscape level habitat feature most likely to be threatened in the future. Maintaining mature and old forest cover with stand structural characteristics within the range of natural variability over as much of the park as possible, especially in wetter ecosystems will likely provide habitat elements that are in reduced supply in the surrounding area.

Some of the south-facing lower elevations, especially near the mouths of Mulvey, Gwillim and Beatrice Creeks have some potential for providing ungulate winter range; however, these will require management interventions to create openings and maintain suitable forage production.

4.5.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002), Valhalla Provincial Park was assessed as being at medium risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a rating of 25 out of a possible score of 36, with high scores for naturalness, the diversity of ecosystem representation, and the presence and diversity of special landforms/features, rare species/habitats and cultural features. The park was ranked relatively low with respect to the rarity of ecosystem representation.

With respect to risk factors, Valhalla Provincial Park was given a score of 6 out of a possible of 16, with watershed integrity being identified as the main risk factor[5]. Recreation use was identified as a moderate stress, generally creating impacts at the site or stand level, mainly during the summer and fall. Impacts felt to be relevant to the risk rating included: introductions of exotic species and disturbance of species.

A review of the threats existing within the park and its greater ecosystem as part of this project has resulted in a conclusion that departs somewhat from the CRA conclusion. Given the size and shape of the park, the minimal development within the park, the management direction in area surrounding the park, and the zonation and management direction provided in the 1989 Master Plan, we would give the park an environmental risk rating of low (possibly tending to moderate). Although the recreational activity in the park clearly creates significant risk to some localized areas within the park, in general the activity is not associated with the habitats of species nor ecosystems at risk. Because of the multiple access points to the park, trail systems that tend to disperse rather than concentrate people (in contrast to Kokanee Glacier Park), and lack of motorized travel within the park, there are still significant areas within the park that experience minimal recreational activity (e.g., mid and upper Nemo Creek). These remote and low intensity areas still cover almost a full range of the values represented in the park (with the possible exception of beach areas). Although the potential for fire and insect attacks provide some risk to old growth values within the park, those processes are part of a functioning natural disturbance regime that is an integral part of ecological integrity. This rating is not intended to imply that there are no actions required to maintain the low level of risk to ecological integrity, but rather that the threats are generally localized, and manageable.

[5] In contrast to intuitive logic, the CRA process appears to conclude that increasing presence of fully represented 3rd order watersheds within a protected area leads to increased risk to watershed integrity.

4.5.6 Proposed Ecological Conservation Management Direction

Valhalla park plays an important ecosection level representation role within the CCM, being the only park in the CCM (or SCM) that includes extensive undeveloped lakeshore along one of the main valley lakes that are so characteristic of the ecosection. It is the only major lakeshore park not impacted by dam-related flood regime alterations. The park also offers significant high capability habitat for a wide variety of species typical of the CCM, including grizzly bears and mountain goats.

The 1989 Master Plan for the park places emphasis on "conservation of the natural features and natural character of the park landbase", while also emphasizing the need to provide a "wide variety of recreational opportunities." The plan discusses the need for balance between conservation needs and recreational development, always ensuring that provision of recreational opportunities must be compatible with "conservation principles." However, while the plan provides numerous detailed recommendations on developing recreational opportunities, it is rather vague of what and how conservation objectives will be achieved.

After reviewing the Master Plan and other available information, we generally concur with the direction provided in the 1989 Master Plan. However, we feel there is a need to update the plan and provide more detail around the specific conservation goals that are to be achieved. In addition, a number of the recreational developments (e.g., trails, cabins, tenures) recommended in the Master Plan have not come to fruition. It is recommended that the levels of recreational use proposed in the Master Plan also be reviewed, and potentially be scaled back to decrease the risk to ecological integrity of the park, and thereby increase the potential for the park to better fulfil its conservation role.

The general lack of infrastructure and intensive recreational use within the park, combined with moderate to low levels of low intensity recreational use are compatible with this direction. In addition, the importance of maintaining viewscapes for surrounding urban and rural residents and tourist destinations, across the lake from the park provide further pressures for maintaining the ecological integrity of the park ecosystems.

4.5.6.1 Zonation

The zoning[6] established in the 1989 Master Plan is generally consistent with the conservation direction indicated above. The zoning provides a complex mosaic of zones, where roughly 50% of the park is classed as Wilderness, 40% is Natural Environment and 10% is Special Feature. The Natural Environment zone includes the northern third of the park, the alpine lakes and meadows of Mulvey, Gwillim, and Beatrice Creeks, and trail corridors up Beatrice Creek, across to Evans Lake and up lower Gwillim Creeks. Within each of the Natural Environment zone areas there are designated development subzones where recreational infrastructure exists or is proposed. Special Feature areas and sites include sensitive and unique habitats and cultural/heritage sites located in both of the other major zones.

With the intention of strengthening the conservation role of the park, a few updates and minor changes are recommended:

- evaluate the beaches, rocky shoreline and riparian/shoreline interface areas within the park to identify habitat values; based on conservation needs and priorities, delineate some areas for conservation purposes; zone those areas as Local Conservation or include them within areas zoned Wilderness Conservation or Wilderness Recreation indicated below; discourage recreational use in those areas;
- zone the complete drainages of Nemo, Hoben, Indian and Cove Creeks as Wilderness Conservation with the intention of capturing some complete watersheds in an undeveloped state;

[6] The zoning used in the Master Plan is an earlier version of zoning than that described in Section 2.6.1; however, zones are roughly equivalent to their recent counterparts, where Wilderness is likely similar to Wilderness Conservation.

this may require some restoration where past developments are still evident; if the trails near the lakeshore and in lower Nemo are deemed of importance for recreational use, include a small area of Wilderness Recreation to accommodate those areas; and,

- update the zoning in the remainder of the park (a combination of Wilderness Recreation and Natural Environment) using updated and expanded habitat mapping, and based on the principles of minimizing habitat loss and wildlife displacement resulting from recreational use (with emphasis on species and ecosystems that are rare or at risk).

These zoning changes are generally compatible with the series of activities/uses/facilities already designated for those areas in the Master Plan, except along the lakeshore, where some areas would see reduced levels of use to better protect conservation values in those locations.

4.5.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Valhalla Provincial Park

Overall Goal: To Maintain a Low Level of Risk

The 1989 Master Plan identified a lengthy list of "actions." Some of these have been achieved, while others have not been acted upon. In general that list requires review and updating, with increased emphasis on implementing the actions related to conservation objectives (monitor wildlife activity and patterns, fish and wildlife management strategy, develop fire management plans). The following table summarizes a few specific issues and associated recommendations that we feel should be emphasized to enable the park to better fulfill its conservation role:

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Monitoring Indicator
Lack of baseline ecological information	Lack of information limits strategic conservation planning and precludes defining operational-level management direction; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation. Conduct reconnaissance habitat inventory and develop a species list for the park, preferably in cooperation with similar efforts for the surrounding area of cooperation – placing priority on those areas with present or projected recreational uses.	PEM ground-truthed and modifications made as required. Basic inventory completed, species list for the park compiled.
Shoreline Conservation Values	Undeveloped shoreline features are severely under-represented in the Protected Area network for the CCM.	Park	To conserve representative and sensitive shoreline habitats.	Complete an assessment of shoreline ecosystems, species, habitats, and features to identify areas for conservation. Modify zoning and recreational use patterns to restore and/or maintain the ecological integrity of representative and/or sensitive shoreline areas.	Shoreline habitat assessment completed. Representative shoreline areas zoned for conservation.
Natural Disturbance Regimes - fire and forest insect/ disease management	Restrictions on natural disturbance regimes undermines ecological integrity – but some park values require significant areas of mature and old forests that are disappearing outside the park	Park and Area of Coop-eration	Optimize amount and distribution of old and mature forest cover and stand structural diversity appropriate to the natural disturbance regime and maintaining all park values.	In cooperation with ecologists and other stakeholders in the Area of Cooperation develop and implement a natural disturbance management plan (including fire, insects and disease); stakeholders should include adjacent communities and forest managers; one option would be to initiate controlled burns on the face units to create fuel breaks to reduce the likelihood of large scale high intensity fires in the near future, combined with active fire suppression in existing old growth areas in the ESSF and upper ICH in the side valleys, i.e. attempting to emulate natural disturbance patterns as much as possible.	Compatibility of seral stage distribution and stand structures with the range of natural variability and protection of key conservation values.
Invasive species	Invasive species reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive species in the park	Implement a program to control invasive species, preferably in cooperation with similar efforts for the surrounding area of cooperation.	Species identified through the reconnaissance habitat inventory. Partnership group develops control strategies. Control strategies implemented.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Monitoring Indicator
Need to build public support for the ecological conservation roles of the park	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Cooperation, Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Form a partnership group for the park to help promote public understanding of the role of the park in relation to broader ecological conservation goals and the relationship between the park and development in the greater park ecosystem.	Partnership group for the park formed. Communication maintained on an as-needs basis. Key professionals identified and pro-active education initiated. Public communication program implemented. Tangible support expressed. Necessary resources allocated.

5.0 SCM RESULTS

5.1 SCM Protected Area Network

The discussion of the SCM protected area network is preliminary at this point, pending completion of the detailed assessments of all of the SCM protected areas (this project includes only a selection of parks). Because the SCM extends into the US, including portions of northeastern Washington, northern Idaho and northwestern Montana, information regarding protected areas in the US portion of the SCM should also be included in the review, even if only at a superficial level (see Figure 5.1). Once all of the protected areas in the SCM have been reviewed, it should be possible to comment in more detail on the quality of representation offered by individual parks, and the degree to which the network as a whole contributes to overall ecological integrity of the SCM. Comparisons between ecosections and discussions of the protected area network in the context of the North Columbia Ecoregion and the Southern Interior Mountains Ecoprovince will have to await similar analyses in adjoining ecosections. In addition, due to the recently updated BEC mapping in parts of the SCM and the difficulty obtaining continuous GIS coverage for the whole area, the data regarding BEC unit representation should be considered an approximation at this time. The data presented here is primarily based on GIS summaries of recent BEC mapping, in combination with January 2002 provincial summaries from MSRM (similar to PASO) where more recent data was not available. For more information on the SCM ecosection itself, see the companion report on the ecosection context (Utzig et al. 2003).

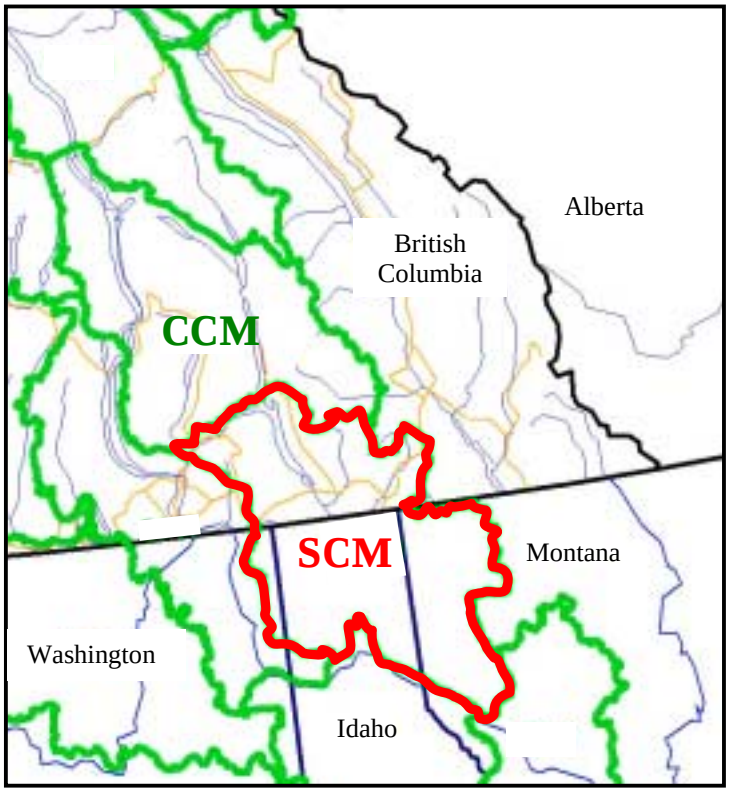

Figure 5.1. The extent of the SCM ecosection within southeastern BC and the northwestern United States.

The BC protected area network within the SCM consists of 13 individual protected areas: two that are between 10,000 and 25,000 ha, two that are between 1,000 and 4,000 ha, and eight that are less than 350 ha (see Figure 5.2 and Table 5.1). One of the parks, Kianuko is actually larger in size than its occurrence in the SCM indicates, as it extends into adjacent ecosection (CCM). This park also provides representation of ecosection transitional areas (see Table 5.1). The West Arm Park is the only protected area that provides representation at the ecosection level. The remaining parks provide representation at BEC, watershed, landscape element and site/special feature levels. All of the data presented for the SCM only includes the BC portion of the unit.

Most of the parks within the SCM, including all of the larger parks, are located in the northern third of the area. Two of the larger parks include secondary valley systems draining into the West Arm and South Arm of Kootenay Lake and there are a number of small parks that include lakeshores of Kootenay Lake. However, none of the lakeshore parks provide examples of intact lakeshore ecosystems, all are impacted by railroads, highways or previous industrial development. The main Salmo River-Cottonwood Creek valley system has no protected areas, and the Goat River-Moyie River valley system only includes 3 very small and highly developed parks.

In general, the SCM is poorly represented in the protected area system, with only approximately 7% of the ecosection protected overall. Distribution by BEC unit and elevation is skewed to the upper elevations. Total representation in the lower elevation ICH and IDF is only 4% (ranging from 0 to 12% by subzone and variant), while representation in the ESSF forested is 11% (ranging from 0 to 23% by subzone and variant), and 23% in the ESSF parkland (see Table 5.1). One BEC unit with significant area in the ecosection, the ICHxw, has no protected area at all, even though it includes the biologically diverse floodplain and delta of the Kootenay River. Three other units with limited occurrence in the SCM, the ICHmk1, MSdk and ESSFdk, also have no protected areas in this ecosection (representation is further discussed in Section 6.2).

The lack of representation in the ICHxw and ICHmk1, is significant on a provincial scale, because they are poorly represented in the BC protected area network overall. This is particularly important in the case of the ICHxw, because a major portion of this BEC unit occurs in the SCM. The limited representation in the ICHdw is also a concern for similar reasons. The newly defined BEC units, ICHdm and ICHmw4, may have similar significance, but sufficient data is not available at present to make a determination.

The warmer aspects and lower elevations of this ecosection are generally dominated by natural disturbance regimes that include frequent stand-maintaining fires and relatively frequent mixed fire regimes. One of the major challenges to maintaining ecological integrity in this ecosection, especially with smaller and relatively fragmented protected areas, is re-introducing, or at least simulating, the natural fire regimes. With such a limited protected area network, maintenance of ecological integrity in the parks is highly dependent on the cooperation of other stakeholders in the greater park ecosystems. The only park large enough to potentially allow large scale natural disturbance processes to function is West Arm; however, its proximity to Nelson, importance to Nelson's water supply and visual landscape values to North Shore residents will likely limit, if not preclude, this opportunity.

The diversity of bedrock types in the SCM is not fully captured in the protected area network. Granitic intrusions are found in West Arm, upper Kianuko and to limited extent in Stagleap and some of the smaller parks. However, only a small subset of the metamorphic, sedimentary and volcanic rocks found in the SCM are represented in Lockhart Creek, lower Kianuko, Stagleap and Pilot Bay and others of the smaller parks.

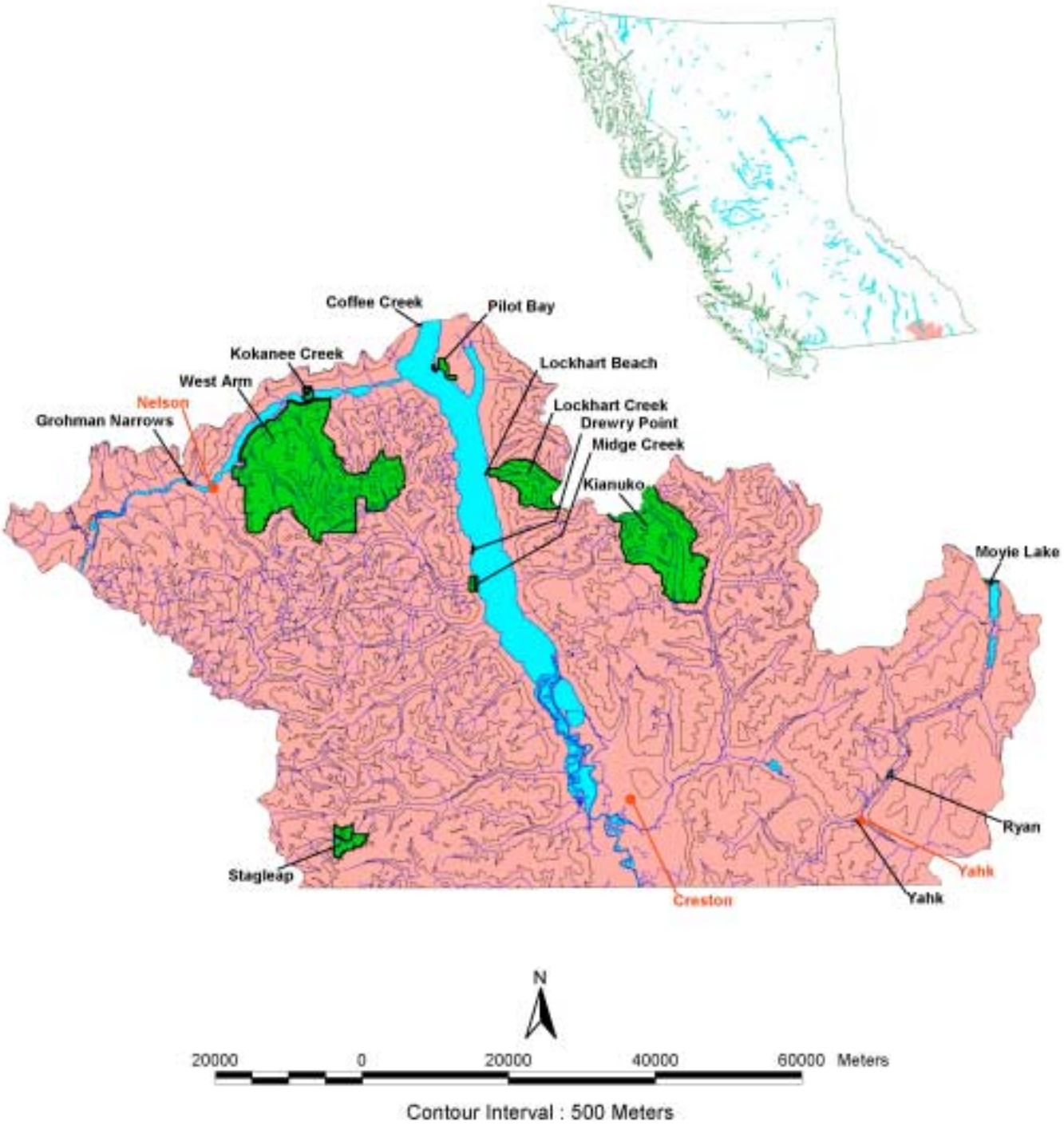

Figure 5.2. Map of protected area network in the SCM.

Terrain features and landforms of the ecosection generally occur in three broad elevational classes, with fluvial, glaciofluvial and glaciolacustrine deposits found primarily in the bottoms of the main valley systems and mouths of side drainage, morainal deposits on valley sidewalls and colluviums associated with steeper valley sidewalls and upper elevations. The upper elevation landforms are fairly well represented, while the lower elevation valley bottom landforms are poorly represented. The extensive glaciolacustrine and deltaic deposits found in the Creston Valley are not represented at all.

The types and distribution of soils that occur in the SCM are primarily a function of factors such as disturbance intervals, climate, topography, biota, bedrock and terrain type. Therefore the representation of soil types in protected areas will reflect the representation of the environments determined by those factors. In the case of the SCM, soils associated with the drier low elevation environments and major river floodplains are poorly represented, while moderate to high elevation soils are moderately well represented. Because of the increased representation of granitic bedrock types, finer textured and higher base status soils are less well represented.

Hydrologic systems and aquatic habitats have very limited representation in the SCM network. Although West Arm, Lockhart and Kianuko Parks capture most of a series of secondary watersheds, all of them are missing the fans and/or have significant disturbance in the lower reaches of those watersheds. West Arm and a number of the small parks include portions of lakeshore, but they are all significantly impacted by railroads, highways, past industrial development and/or recreational development. There are no parks that include reaches of the major river networks in the SCM. The park network is generally ineffective in providing protection to fisheries habitat in the SCM.

The vast majority of area within the West Arm, Lockhart Creek and the upper elevations of Kianuko Parks has a high degree of ecological integrity. The lower elevations of Kianuko have been previously harvested, the lower elevations of West Arm includes a railroad, while Stagleap includes a highway, a highways maintenance yard and a gravel pit. Stagleap and portions of West Arm have significant recreational pressures, which pose some risk to various ecosystem components and processes in those locations. The remaining smaller parks are generally under stress from multiple threats, including high intensity recreational use and infrastructure development, linear corridors and fragmentation (e.g., railroads, highways, powerlines), invasive species, legacies of previous development (e.g., agriculture), disrupted hydrologic regimes (dams and flood controls), and landuse pressures in the greater park ecosystems (e.g., forest harvesting, rural/ urban development). For more information on threats throughout the SCM ecosection, see Section 3.2 of the companion report on the ecosection context (Utzig et al. 2003).

Connectivity between the protected areas within the SCM is marginal at best. The South Arm of Kootenay Lake creates a natural barrier to movement for many species, tending to funnel connectivity into the Creston flats south of the lake. In contrast to the CCM, the mountain ranges have less relief and are less rugged, with generally accessible ridgelines and numerous moderate elevation passes. However, the pattern of human activities has created significant additional barriers in the main valley systems with agricultural clearing, rural/ urban developments, highways, railroads and other linear corridors. Forest harvesting, mining, recreational development, and associated roads have also reduced connectivity in other areas. Connectivity is discussed in more detail in the sections dealing with individual parks.

The network provides limited connectivity between the SCM and adjoining ecosections, with four parks extending into or abutting adjoining ecosections, Lockhart Creek, Kianuko and Coffee Creek – Central Columbia Mountains (CCM) and Moyie Lake – McGillivray Ranges (MCR). However, none of them provide very effective connectivity, as Kianuko and Lockhart only include high elevation forest and parkland within the CCM, while Moyie Lake and Coffee Creek are very small.

Table 5.1. Protected areas of the SCM and their size, level of representation and diversity of Landscape Elements (LE) and BEC units*.**

Protected Area*	Rep. Level*	LE Rep.**	Total (ha)	IDFdm2	ICHdm	ICHdw	ICHmw2	ICHmw4	ESSF wc1	ESSF wc4	ESSF wc5	ESSF wc6/u	ESSF dm1/u	ESSF wm/u	ESSFp	Lakes
West Arm	E	6/7	25088			2551		3164			3553	14977			783	60
Kianuko	ET,WS	4/7	10875		2632								7580		664	
Lockhart Creek	WS	4/7	3734		8	507	928						190	2028	59	14
Stagleap	BEC	4/7	1203				3		38	1139					19	4
Pilot Bay	LE	1/7	336			303										34
Midge	LE	2/7	220			202										18
Kokanee Creek	LE	1/7	218			218										
Moyie Lake	S	na	70	58												12
Ryan	S	na	59			59										
Drewry Point	S	na	25			25										
Grohman Narrows	S	na	10			10										
Yahk	S	na	8			8										
Lockhart Beach	S	na	4			4										
Total Protected (ha)			41850	58	2639	3887	931	3164	38	1139	3553	14977	7770	2028	1524	142
SCM Protected (%)			6.8	12.3	3.4	2.7	3.0	6.7	0.3	5.5	19.4	22.9	5.7	7.3	22.8	

*Representation Levels: E – ecosection; ER – ecoregion; ET – ecosection transition; BEC – BEC unit; LE – landscape element; WS – watershed; S – site/ special feature
**Landscape Element Representation: number of LE's present in the protected area out of the total number of LE's in the ecosection
***Lockhart Ck. includes minor portion of CCM; minor SCM portion of Coffee Creek included in CCM; the ICHmk1, ICHxw, MSdk and ESSFdk have no protected area in the SCM.

5.2 Kokanee Creek Provincial Park

5.2.1 Park Description

5.2.1.1 Park-Specific Information Sources

A Master Plan was created for Kokanee Creek Provincial Park in 1979. Subsequently, a Purpose Statement was developed in 2002. The most recent annual management plan is 2001. Given that the master plan is now dated in terms of general knowledge about ecological values and processes, and purpose statements and annual management plans are very brief overviews, the existing park documents provide little information about the ecological values within Kokanee Creek Provincial Park. Kokanee Creek Provincial Park was assessed through the 2002 Conservation Risk Assessment. However, there was no significant new information gained about the ecological values and processes within the park through that process.

In 1998, the former BC Parks contracted Pandion Ecological Research Ltd. to undertake an initial inventory within Kokanee Creek Provincial Park and to provide management recommendations. This same firm then submitted a proposal for terrestrial ecosystem restoration, which was subsequently reviewed and refined in 2003 when Slaney, Andrusak and Douglas were contracted to develop a conceptual plan for aquatic and terrestrial ecosystem restoration for the park. Finally, Kokanee Creek Provincial Park was one of several parks selected to be part of a 2003 study by Craig, et al. on non-native plants in West Kootenay Parks. As a result of these various studies, knowledge about the ecological values and processes associated with Kokanee Creek Provincial Park is greater than most parks in the region. However, Pandion's initial study noted that it resulted in only a partial inventory of species given the limited timeframe for field study.

5.2.1.2 Location and History of Park Development

Kokanee Creek Provincial Park is located on the West Arm of Kootenay Lake, approximately 19 kilometres east of Nelson. The park was originally established in 1955 over what is now the Redfish day and group use areas. Additions in 1956 and 1960 extended the boundaries east and north to include the east shore of Kokanee Creek. In 1966 the park area was more than doubled to encompass most of the alluvial fan of Kokanee Creek and substantial upland area. The foreshore was added in 1972.

The park is approximately 349 ha in size and comprised of a diversity of terrestrial and aquatic habitats, including an expansive lake foreshore, a third order stream, several side channels and off-channel ponds, marshes, grasslands, cottonwood groves and a predominant coniferous forest. Highway 3A bisects the park and provides access to park land on either side. Additionally, a forest service road runs through Kokanee Creek Park, connecting Highway 3A to the upper elevation Kokanee Glacier Park and non-protected crown lands between the two parks.

5.2.1.3 Human Use of the Park

The park contains two archaeological sites identified by the Heritage Conservation Branch. The surficial materials found on these sites indicate seasonal campsite use. The general area was homesteaded beginning in the late 1800's, with a few remnants of the Hamilton estate remaining visible today in the vicinity of the former youth crew camp.

Kokanee Creek Provincial Park is a "flagship" destination campground for provincial parks in the West Kootenays. It is highly developed and caters to a variety of day and overnight recreational use. As a result, there are numerous walking trails, a boat launch, group use area, visitor centre to support interpretive programs, a playground as well as large campgrounds and day use areas. While the majority

of use is concentrated in the warm weather months, the park experiences considerable day use throughout the year. An estimated 39,257 campers and 261,289 day-users visited the park in 1997 (Holt et al. 1998). Many visitors bring their pets (primarily dogs and cats) to the park. Additionally, stray or uncontrolled pets from the local area have also been reported in the park. Holt et al. (1998) noted that the trails east of the mouth of Kokanee Creek are used more than those to the west and that the eastern communities have a higher percentage of non-native plant species. There is evidence of people walking and riding bikes on the trails, as well as the presence of pets.

At one time, a youth crew camp existed in the park, however it is no longer in use. A large service area once included the offices and compound for the West Kootenay District of BC Parks. As of 2003, the District office has been closed. There have been no final decisions made as to the future of the buildings and storage space.

In addition to recreational activities, there are both occasional and regular maintenance activities associated with Highway 3A that impact the park. For example, since the building of the new bridge, the main Kokanee Creek channel was mechanically dredged to deepen the channel, remove natural blockages and build-up the banks to prevent flooding of the adjacent camp-grounds and parks buildings.

A spawning channel was also created alongside the main Kokanee Creek channel to enhance production of kokanee salmon. The spawning salmon are a major attraction for visitors to the park in the late summer and early fall.

5.2.1.4 Current Management Direction and Focus

The 2002 Purpose Statement assigned Kokanee Creek Provincial Park three hierarchical roles:

1. The primary role is to protect remnant forest, riparian, lake, wetland and creek ecosystems of the Southern Columbia Mountains.

2. The secondary role is to maintain a major holiday destination and provide year round regional day use recreational opportunities.

3. The tertiary role is to provide opportunities to view, study and appreciate the natural and cultural values.

To date, conservation management within Kokanee Creek has largely focused on conflicts between human use and ecological values, including addressing problem bears and wildlife/hazard trees. As noted above, a conceptual plan for ecosystem restoration within the park has been developed. The ability to implement the plan is a question of available funding relative to other priorities. While the primary role for the park has been defined as protection of remnant ecosystems, the realistic options for undertaking ecosystem restoration and protection are considerably limited by the highly developed and large scale recreational facilities, as well as the accompanying large number of visitors. The risks to ecological values from high levels of recreational use were considered to be at least partially offset by the presence of the visitor's centre and interpretive programs. On the plus side, high visitor use by both locals and tourists makes Kokanee Creek Park a valuable opportunity to provide nature interpretation and public education on conservation issues to a broad audience. However, government has recently eliminated interpretive programming from the core mandate of MWLAP's Protected Areas Section. Park staff are working with interested community groups and individuals to retain the visitor centre and some level of interpretive programs.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from

which park management might evolve to better meet its ecological conservation mandate with respect to Kokanee Creek Provincial Park.

Table 5.2. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Includes locally rare ecosystems, in particular cottonwood groves, marshes and grasslands.	In the process of pursuing ecosystem restoration	Consider implications of ecosystem restoration within Kokanee Creek Provincial park relative to overall contribution to, and priorities within, the broader ecological scales.
Connectivity: Important biological link connecting West Arm Park to Yellow Pine ecological reserve and Kokanee Glacier Park. Provides connectivity north/south. Although there is logging between this park and Kokanee Glacier, there is no settlement.	Limited management actions – liaison with Ministry of Forests in management of crown lands that lie between Kokanee Glacier and Creek parks.	Assess realistic opportunities for connectivity and biological linkages, along with the requirement management regimes necessary to achieve such goals.
Diversity: There are few places in southeastern BC as small as the park that contains such high levels of natural diversity. Wide range of species known to use the park	Address conflicts with human where human safety is an issue, e.g. bears. In the process of pursuing ecosystem restoration	Consider diversity compared to other parks and management implications, including defining priorities at a larger scale – i.e. in considering priorities at an ecosection scale, what is the relative significance of managing for diversity within Kokanee Creek Provincial Park.
Spawning habitat for Kokanee	Spawning channel is generally managed by MWLAP Fisheries, limited input by park staff. Spawning is a major draw for visitors and, thus an important opportunity for public education. In the process of pursuing ecosystem restoration, including potential benefits to spawning habitat within the main channel of Kokanee Creek	

5.2.2 Regional and Landscape Context

5.2.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Kokanee Creek Park is located within the Dry Warm Interior Cedar-Hemlock subzone (ICHdw) of the Southern Columbia Mountains (SCM, see the companion ecosection report for further descriptions of the

BEC units – Utzig et al. 2003). The park is 0.04% of the BC portion of the ecosection and 0.16% of the ICHdw variant that occurs in the BC SCM.

Of the 5 major landscape elements identified for the ICHdw within the SCM, only one of them, valley bottoms of major drainages with large lakes is significantly represented within Kokanee Creek Park (MVL, for more information on Landscape Elements see Table 2.1). Being limited to approximately 220 ha at the mouth of Kokanee Creek where it empties into the West Arm of Kootenay Lake, the park represents only a small partial example of that landscape element. The extreme northeast corner of the park also includes a sliver of landscape element MVF, face units within major valleys, but it is not large enough to be considered significant.

Disturbance Regimes

The ICHdw is classed as Natural Disturbance Type 3, defined as an area with frequent stand-replacing disturbance events (BC MoF 1995). Most stand-replacing disturbances are wildfires of various sizes, but may also include outbreaks of defoliating insects, bark beetles and root diseases. Recent studies in the ICHdw have found evidence that warmer aspects with drier site types within the ICHdw were subject to mixed disturbance regimes that also included high frequency (~14-65 years) low-intensity ground fires in some locations, favouring the development of open stands of ponderosa pine, Douglas fir and western larch (Quesnel and Pinnnell 2000, Dorner et al. 2003). The upper rapidly drained portions of the Kokanee Creek fan and steeper rocky slopes on warmer aspects in the northeast corner of Kokanee Creek Park likely included areas subject to these mixed fire regimes. The lower portions of the fan, seepage areas, riparian areas and cooler aspects within the park were more likely subject to disturbance regimes dominated by stand-replacing events, operating on return intervals of 100-200 years or longer. Between the stand-replacing events, low intensity gap-replacement stand level disturbance by insects, fungi and wind would also have operated on a continuous basis. Steeper slopes were subject to periodic landslide disturbances and the Kokanee Creek floodplain and fan, as well as lakeshore areas were subject to flooding and channel migration (see also Holt et al. 1998 and Holt and Wood 2001 for a more detailed discussion of flooding disturbances).

Greater Park Ecosystem

Although Kokanee Creek Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it is directly connected to Kootenay Lake and the Kokanee Creek watershed, and the watershed of another small face unit creek just east of Kokanee Creek.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears, whose home ranges likely to include most of the adjacent face units and associated watersheds. Bird species habitats likely extend along the shorelines beyond the park boundaries, and into the uplands surrounding the park.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species indirectly link the park to habitats outside BC, while hydrologic processes link the Kootenay Lake and River system to the whole Columbia basin.

5.2.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Kokanee Creek Park is the Ministry of Forests Landscape Unit that includes the park and areas adjacent to the park, Kootenay Lake Forest District LU K10. To fully capture the home ranges of wide-ranging species will likely require reference to LUs K12 and N515 in the Arrow Forest District. LU K09 is immediately across the West Arm from Kokanee Creek Park. These capture the

majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding West Arm Park, Kokanee Glacier Park, Kootenay Lake, the West Arm Demonstration Forest, the Kootenay Lake TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Unit 4-18.

Management within the Greater Park Ecosystem

The park is bounded by Kootenay Lake on the southern side, private rural residential and commercial lands to the east and west, and crown lands to the north. It is bisected by Highway 3A that follows the shoreline of Kootenay Lake from Nelson to Balfour, a separate powerline running east-west and a forest access road running north from Highway 3A.

The lands on the north side are part of the Kootenay Lake Timber Supply Area. The park is located on the southern edge of Landscape Unit K10 that has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. There are biodiversity management requirements for retention of mature forest in the ICHdw, but not in other BEC units within LU K10. Most of LU K10, including all of the Kokanee Creek watershed, has been designated as part of the regional connectivity network, but no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet the connectivity objectives.

The forest slopes surrounding the park, including a significant portion of the Kokanee Creek watershed are designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). The face units along Kootenay Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). The upper portion of the Kokanee Creek watershed is included in Kokanee Glacier Park.

Most of the crown land within the Kokanee Creek watershed and other areas east to Queens Creek are part of the West Arm Demonstration Forest. The strategic plan for WADF states: “The primary intent of this demonstration forest is to manage the landbase in a way that protects the identified resource values, by applying and testing the newest concepts in forest management in an operational setting, i.e. the management focus in the WADF is ‘ecosystem management’. One of the key principles of ecosystem management is to maintain a diversity of forest structures, within stands and across the larger landscape, in order to meet most of the habitat needs of the native plant and animal species within the forest, and to protect the resource values that depend on the forest. Harvesting and regenerating trees is secondary” (Working Committee, WADF 1999). Assuming that this principle is eventually implemented, this portion of the greater park ecosystem should have a relatively high level ecological integrity. However, at present the management objectives for WADF list biodiversity conservation as number four, behind timber harvesting, so it is unclear to what extent the principle will actually be achieved. Objectives for WADF:

- “Consider water to be the highest priority resource.
- Maintain a high standard of visual integrity across the landscape.
- Provide a sustainable level of timber harvest.
- Maintain or enhance biodiversity across the landscape.
- Apply the findings of research and operational activities through an adaptive management process” (Working Committee, WADF 1999).

The private lands to the east of the park are cleared and presently occupied by a gas station, convenience store and marina. The private lands to the west of the park are partially cleared and partially forested, but include a variety of uses such as dense rural residential, private campsites, light industrial and commercial. In various planning and other park documents there are references to the nearby Yellow Pine Ecological Reserve. Although an area was once proposed as an Ecological Reserve, the reserve

was never officially established, and in fact does not exist. However, at present the Ministry of Forests is attempting a fire-maintained ecosystem restoration project in that area.

5.2.2.3 Identified Threat and Stressors to Ecological Integrity

Threats affecting the park are associated with the highway and forest access road running through the park, recreational use and development within the park, water management of the Kootenay Lake and River system, and private land development surrounding the park. Not only do the highway and forest access road involve significant habitat conversion and loss of connectivity, but they also provide vectors for the movement of invasive species.

An invasive plant survey undertaken in 2002 identified the presence of various species in the park, including Sulphur cinquefoil, Spotted Knapweed, Scotch broom, Common tansy, Hawkweed, Canada thistle, Common burdock, Bull thistle, Oxeye daisy, Hoary alyssum, St. Johns wort, Japanese knotweed, Black locust and Himalayan blackberry (Craig et al. 2003). Knapweed infestations were very widespread, with other species locally intense and likely to spread if effective control measures are not initiated. This weed report and the ecosystem restoration report both suggest that the infestations may be affecting ecosystem integrity in particular locations (Craig et al. 2003, Holt and Wood 2001). There have been introductions of various bioagents for the control of knapweed, but no other control measures were reported.

Reduction in periodicity and amplitude of flooding associated with spring freshet water levels in Kootenay Lake has had adverse impacts on wetlands and ponds in the lower portion of the park, as well as important cottonwood stands along the shoreline flood zone (Holt and Wood 2003, Holt et al. 1998). The main channel of Kokanee Creek has been diked and deepened to protect the highway and structures within the park from flooding and erosion (Slaney et al. 2003). Channel simplification and deepening has also reduced water flows into the wetlands, and reduced the amount and quality of spawning and rearing habitat for kokanee and bull trout in the lower reaches of Kokanee Creek (Holt and Wood 2001, Slaney et al. 2003). These impacts have been amplified by diking, bank hardening and manipulations of substrate size that limit the input of large woody debris and affect natural stream channel processes that create high suitability fish habitat (Slaney et al. 2003). The two recent studies make various recommendations for habitat restoration.

Past species introductions, flow regime modifications and over-fishing in the Kootenay River/ Kootenay Lake system have also severely impacted aquatic ecosystems in the West Arm of Kootenay Lake; however, recent restoration and management measures have begun to rehabilitate these systems to some extent (Slaney et al. 2003).

The high use patterns associated with the campground, playground, picnic grounds, public beach, boat launching area and the kokanee spawning channel as a tourist attraction, lead to significant direct human impacts on wildlife. Disturbance, particularly from dogs and children during breeding season is significant along the beach and wetland areas. Vegetation trampling and loss of stand structural elements due to firewood collection and cutting within and around the campground also lead to habitat degradation. Danger tree falling in the recreation areas also eliminates some key habitats (snags and wildlife trees). Some of these impacts were offset by the presence of the visitor centre and the opportunities offered for public education around these and other conservation issues, but these compensatory benefits are now in jeopardy due to budgetary constraints.

Potential future threats are primarily associated with increased forest development in the Kokanee Creek watershed and increased recreational use of the park itself. Forest development has the potential for negative impacts on aquatic ecosystems from sediment production and modification of flow regimes due to road construction and harvesting, as well as impacts on habitat elements. Increased park use may result in further habitat conversion for development of recreation facilities, further stand structure manipulation to maintain public safety and additional disturbance from direct human use.

5.2.3 Ecological Features of the Park

5.2.3.1 Geology and Terrain

The greater park ecosystem is dominated by Nelson Plutonic Rocks, of Lower Cretaceous age, some of which likely outcrop in the upper portion of the park (Little 1960). The plutonic rocks are dominantly porphyritic granite; however, local occurrences of quartz diorite, quartz monzonite, diorite, monzonite and syenite are not uncommon. The intrusive rocks also have local inclusions of Early Mesozoic and/or Late Paleozoic metamorphosed sediments and volcanics. For example, an area just north of the park is mapped as Ymir Group paragneiss.

Terrain within the park is dominated by the fluvial fan of Kokanee Creek, and associated moderately to very coarse textured glaciofluvial terraces above the fan and along the upper reaches of Kokanee Creek (Jungen 1980). There are isolated occurrences of fine sandy to clayey glaciolacustrine in the southeastern portion of the park. The northeastern steeper portion of the park and the Kokanee Creek Canyon also include areas of coarse rubbly colluvial veneers and blankets, rock outcrops and potentially minor areas of coarse textured morainal materials. Soils are generally rapidly to well drained; however, depressions and concave slope positions, especially where associated with riparian zones and/or seepage can be imperfectly to poorly drained. Some gleyed soils occur in association with the wetland areas. Geomorphic processes potentially include debris avalanches and debris flows associated with steeper glaciofluvial terrace faces and shallow colluvial deposits, rockfall associated with steep bedrock areas, and channel erosion and flooding associated with Kokanee Creek itself. Detailed terrain mapping for the West Arm Demonstration Forest provides detailed terrain and soil information for the greater park ecosystem (Utzig 1997).

5.2.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Kootenay Lake Forest District (Ketcheson et al. 2002), the park potentially includes all of the site series described for the ICHdw, including a range in moisture regimes from dry to wet (see Table 5.3). There is very limited representation of drier site series and non-forested ecosystems, but there is potentially substantial representation of wetter forest types and wetlands.

Table 5.3. Potentially occurring land types and ICHdw site series within Kokanee Creek Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
02	FdPy – Oregon-grape – Parsley fern	Dry	DO	3
01a	CwFd – Falsebox (sx-sm phase)	Mesic	XE	27
01b	CwFd – Falsebox (m-shg phase)	Mesic	XI	59
03	CwHw – White pine – Devil's club	Moist	HD	16
04	CwHw – Devil's club – Lady fern	Wet	RD	1
	Wetlands	Wet	GW and WE	53
	River		RI	2
	Lake		LA	57
			Total	218

A field survey of site types in the lower portion of the park by Pandion Ecological Consultants (Holt et al. 1998) further describes the vegetation communities of the park. That study reported that the park provides habitat for at least 163 vascular plant species, including one listed plant, and more that six plant communities. Biophysical habitat mapping (similar to TEM) of the West Arm Demonstration Forest provides detailed information of the vegetation types in the greater park ecosystem (Ketcheson 1992).

Holt et al. (1998) emphasized the importance of the cottonwood dominated woodland strip adjacent to the high flood level of Kootenay Lake as a significant habitat feature for a number of species.

Fauna

The park's valley bottom location adjacent to Kootenay Lake, in combination with deciduous and coniferous forested habitats, wetland habitats and aquatic habitats provides habitat for a wide diversity of fauna. The resource inventory completed by Pandion Ecological Consultants (Holt et al. 1998) describes a diverse vertebrate species list for the park, including 213 terrestrial and avian species (159 birds, 47 mammals, 4 amphibians, 5 reptiles). Of those species 10 are red- or blue-listed by the BC Conservation Data Centre. The report also includes a list of 46 potentially occurring butterfly species.

5.2.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes a significant length of shoreline along Kootenay Lake, most of it consisting of medium to coarse sandy beach deposits. The park also includes the lower reaches of Kokanee Creek and associated floodplain and fan. The toe of the fan includes a number of wetlands and ponds formed in flood channels and depressions behind beach ridges, sometimes augmented by beaver dams. Other wetlands and seepage areas are found in the eastern portion of the park associated with another small creek.

Fisheries

Naturally occurring species in the West Arm of Kootenay Lake include kokanee, bull trout, rainbow trout, mountain whitefish, white sturgeon, largescale sucker, lake chub, peamouth chub, northern squawfish, longnose dace, redside shiner, northern pikeminnow, longnose sucker, largescale sucker, burbot, prickly sculpin and torrent sculpin. Introduced species include yellow perch, westslope cutthroat, pumpkinseed, brook trout and largemouth bass. Naturally occurring species in Kokanee Creek include kokanee, bull trout, rainbow trout, lake whitefish, mountain whitefish, as well as introduced brook trout and westslope (Yellowstone) cutthroat trout (Holt et al 1998, Slaney et al. 2003 and MSRM 2002).

Before highway construction and other development in the area, Kokanee Creek provided significant habitat for kokanee spawning. The remaining degraded spawning habitat has been augmented with a spawning channel located in the park. The lower reaches also likely provide spawning and rearing habitat for rainbow trout. A summary of historical fisheries population changes and management in the West Arm and Kootenay Lake are provided in the report by Slaney et al. 2003.

5.2.4 Potential Biodiversity Conservation Roles

5.2.4.1 Representation

The small area and minimal landscape diversity of Kokanee Creek Park limits its potential representation contribution to a single occurrence of one of the five landscape elements recognized for the ICHdw biogeoclimatic subzone (the major valley slope contribution is so small as to be considered inconsequential). However, even this limited representation role is significant within the SCM, as only 2.8% of the BC SCM ICHdw is protected, and much of that representation is located in areas surrounded

by extensive rural development and/or dissected by transportation and utility corridors (see Figure 5.2). Given the cumulative impacts of habitat conversion due to private land development within the Kootenay Lake valley, Kokanee Creek still provides important representation at the landscape element scale, even with its limitations due to size and configuration.

5.2.4.2 Local Habitat Supply

Given the commercial and residential development present on the non-park portion of the Kokanee Creek fan and other fans along the West Arm, maintenance and restoration of the unique riparian, wetland, shoreline and aquatic habitats associated with the fan is likely the most important role the park can play in local habitat supply (including cottonwood forest types). The recent inventories and restoration studies (Holt et al. 1998, Holt and Wood 2001, Slaney et al. 2003) all indicate the importance of these habitats to an extensive list of both terrestrial and aquatic species, including some red- and blue-listed species. The potential measures necessary to allow those areas to fulfill their ecological functions are summarized in those reports.

A secondary value includes the mature and old ICHdw forest located on either side of Highway 3. Although small in area, and of mixed age, the abundance of mature and old forest remaining within the ICHdw is significantly reduced from projected natural levels.

5.2.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002a), Kokanee Creek Provincial Park was assessed as being at high risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a ranking of 16 out of a possible score of 36, with high scores for encompassing rare species and/or habitats, as well as the diversity of those species/habitats. The park was ranked relatively low with respect to ecosystem representation and special features.

With respect to risk factors, Kokanee Creek Provincial Park was given a score of 7 out of a possible of 16, with size and shape of the park being the main risk factors. Visitor use was identified as the main stress or threat to the conservation values within the park. The visitor use is considered to be a significant stress to the entire park, on a year round basis, with a trend that is increasing, and which is likely resulting in:

- population reductions in native species
- native species loss
- change to community structure
- habitat loss
- disturbance of species (especially during breeding season), and
- species introduction (exotics).

The CRA evaluation identified that limited action is being taken to address the situation, with the overall impacts on the park from outside sources being moderate, but the internal stresses are considered to be high. Thus, an overall assessment of high risk was assigned to Kokanee Creek Provincial Park.

Additional stress factors that apparently were not fully considered in the CRA process include:

- loss of habitat due to physical changes to the Kokanee Creek channel and its impacts on aquatic habitat, wetlands and other riparian habitats
- the full extent and severity of invasive species impacts
- reduced flooding activity due flow manipulation in the Kootenay River/Lake system and its impacts on wetlands and other shoreline habitats

- loss of habitat due to stand structure simplification and sanitation cutting for human safety
- reduced connectivity to the lower park area due the highway and forest access road and east/west connectivity due to development of adjacent private lands
- past and potential future impacts on Kokanee Creek due to landslides and erosion associated with forest development roads
- reduction in environmental conservation education, stewardship and monitoring opportunities due to withdrawal of funding for the interpretation centre

Given the outcome of the CRA process and the additional factors identified above, the environmental risk to Kokanee Creek Park is at least high, and possibly approaching very high.

5.2.6 Proposed Ecological Conservation Management Direction

Given that some of the significant stresses on Kokanee Creek Park are assumed to be long-term (e.g., the highway, adjacent private land development), and there is some uncertainty regarding management within the greater park ecosystem, it is not considered feasible for the park to fulfill a low risk ecological conservation role in the foreseeable future. Therefore, the proposed ecological conservation management direction seeks to minimize risk from factors that can be controlled, and thereby maximize the effectiveness of the park in contributing to broader ecological goals, as much as possible. This includes some minor changes to current management, and an emphasis on maximizing opportunities within the area of cooperation.

5.2.6.1 Zonation

According to the 1979 Masterplan, a significant portion of Kokanee Creek Park is zoned for Intensive Facility Development, with the remainder zoned for Natural Area Development Sub-Zones (assumed equivalent to Intensive Recreation and Natural Environment respectively). Presumably the zoning is intended to be consistent with stated roles for the park:

1) to protect remnant forest, riparian, lake, wetland and creek ecosystems of the SCM,
2) to maintain a major holiday destination and provide year round regional day use recreational opportunities, and
3) to provide opportunities to view, study and appreciate the natural and cultural values.

However, in practice the order of priority appears to actually place more emphasis on roles 2 and 3 rather than 1. The channel simplification of lower Kokanee Creek to protect recreation infrastructure from flooding, sanitation cutting of trees for human safety and allowance of domestic pets in sensitive habitats all severely detract from the park fulfilling role 1. For the park to fulfill role 1 the unique and sensitive sites require zoning and management measures that place a greater emphasis on ecological conservation than are presently being applied. With the cumulative impacts from past development activities, restoration measures will also be required to reverse negative trends already apparent (Holt and Wood 2001 and Slaney et al. 2003). Given the small size of Kokanee Creek Park and its present configuration and location, it is questionable whether it is capable of simultaneously achieving all of the roles assigned to it. The zoning and objectives proposed below are considered to be the minimum necessary for achieving a moderate level of environmental risk, and are a compromise between increasing environmental integrity and maintaining the park as a major holiday destination (and the costs of relocating facilities). Any further reduction in environmental risk would likely require one or more of the following: removal of the highway, removal of the forest access road, a substantial increase in the size of the park, and/or a substantial decrease in recreational development and use.

To achieve a moderate level of environmental risk, especially in those areas identified with rare and unique values (i.e. the riparian zones, shoreline, wetlands, grasslands and cottonwood groves), those

areas will require a core area zoning of Ecological Protection with a buffer zone of Local Conservation. To ensure a viable area, including sufficient buffering to maintain stand structures and natural processes, the area of the park below the highway zoned for Intensive Recreation will have to be reduced, especially in those areas adjacent to the wetlands and lagoon. This would entail some reduction in size of the Sandspit campground (e.g., removing the western-most row of campsites, and moving the southern connector road further away from the water and removing two campsites off the water end of the remaining rows). Some of this development could be shifted to the service area west of Kokanee Creek adjacent to the highway, above the highway in the vicinity of the service yard, in the area of the youth crew camp or to the eastern edge of the park beyond the boat launching area. Trail locations and wildlife viewing locations should be carefully considered to minimize displacement of breeding birds and other species from critical habitat areas. The complete removal of pets from the park would also substantially reduce wildlife disturbance.

The Redfish Picnic Area, the eastern end of the adjacent service area and the eastern edge of the Redfish Campground should also be examined for possible modifications to improve the buffer for the wetlands on the west side of Kokanee Creek, and to increase the effectiveness of riparian habitat along the west side of Kokanee Creek. This area would be a priority for initial restoration efforts, as it generally has lower levels of use and has the least disturbed wetland areas at present. There should also be a review of the habitat potential in the wetland areas between the beach area and the boat launch area. In addition, to provide some connectivity with upland areas, the medium-term goal would be to create a continuous corridor of natural area (250-500m wide) extending from the northwest corner of the park to the lakeshore, bounded by Kokanee Creek on the west side. This could involve a review of access controls on the road to the Visitor Centre and a review of relocation alternatives for the lower sections of the Kokanee Creek forest access road. These additional areas would be zoned Local Conservation.

5.2.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Kokanee Creek Provincial Park

Overall Goal: Reducing Risk Towards a Moderate Level

The following table summarizes identified issues and associated recommendations of objectives, strategies and performance indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Incomplete baseline ecological information	Incomplete information limits strategic conservation planning and limits the effectiveness of operational-level management; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Extend the existing habitat mapping to the whole park and ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation.	Terrain, hydrologic feature and ecosystem mapping is completed for the whole park.
Loss of habitat elements due to recreation activities	Given that the park is a holiday destination, tourism travel route and intended to provide local community outdoor recreational opportunities, there is need for basic and ongoing management of recreational use to protect ecological values.	Park	Maximize retention of habitat elements, especially rare/ unique ecosystems, coarse woody debris, snags and understory vegetation.	Within the Ecological Protection and Local Conservation zones: • enforce park use restrictions, including no firewood cutting, access controls, etc. • protect potential and existing wildlife trees • protect coarse wood debris throughout park, but esp. throughout wetlands/ marsh areas. Consider augmentation of CWD in this area • establish clear objectives to serve as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives Within the Intensive Recreation zone conduct a wildlife/hazard tree survey and pursue all possibilities for maintaining potential and existing wildlife trees prior to removing any hazard trees.	Abundance, distribution and quality of stand level structure and other habitat elements throughout the park. Recreational use is consistent with zoning (i.e. respect for Ecological Protection Zone).
Disturbance to wildlife due to recreation activities	There is need for basic and ongoing management of recreational use to protect ecological values.	Park	Minimize human disturbance in sensitive habitat areas	Within the Ecological Protection and Local Conservation zones: • Implement an access restriction on dogs and bikes for sensitive sites • Implement a restriction for access in general during breeding season (mainly May 1 – August 1) • establish clear objectives to serve as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives	Number people and pets in sensitive areas Displacement of access-sensitive species Recreational use is consistent with zoning (i.e. respect for Ecological Protection Zone).

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Hydrologic regime alterations.	Previous studies have identified negative environmental impacts resulting from hydrologic feature alterations.	Park	Restore wetlands, seepage sites, riparian areas and other shoreline habitats.	Plan and implement restoration measures to ecological functioning of terrestrial and aquatic ecosystems located along Kokanee Creek, on the Kokanee Creek fan and along the Kootenay Lake shoreline.	Quality of seepage site, riparian, wetland and shoreline habitats. Population levels of species dependent on those habitats.
Invasive species	Invasive species reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive weeds in the park	Implement a program to control invasive weed species, preferably in cooperation with similar efforts for the surrounding area of cooperation. Work with the Partnership Group in the area of cooperation to reduce the spread of noxious weeds along rights-of-way.	Partnership Group to develop control strategies Control strategies defined and implemented
Seral stage distribution and fire management	Reduction of old and mature forest in the greater park ecosystem undermines ecological integrity.	Area of Coop-eration	Maximize old and mature forest cover with stand structures appropriate to the natural disturbance regime.	Working with the Partnership Group and in cooperation with management of the greater park ecosystem, suppress fires on wetter sites and cooler aspects, and employ prescribed fire to restore stand structures compatible with mixed and low-intensity high frequency fires regimes on warmer aspects and dry sites.	Compatibility of seral stage distribution and stand structures with the range of natural variability.
Given the history of recreational use, it is necessary to build support for the ecological conservation goals of the park and capitalize on the visitor centre as a vehicle for public education.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Coop-eration and Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the role of small area parks in lower elevation ecosystems in relation to broader ecological goals, taking into account the history of park use and cumulative impacts of development in the area as a whole. Work with the Partnership Group, including personnel and representatives of related ministries, crown corporations, industry and funding sources to build understanding and support for developing and implementing an ecosystem restoration plan. Support community efforts to maintain the visitor centre, including providing staff with relevant information about not only Kokanee Creek Provincial Park, but also the ecological conservation goals and issues associated with other parks in the area.	Partnership group formed. Tangible support expressed Necessary resources allocated. Communication maintained on an as-needs basis. Ecosystem restoration plan developed and implemented. Visitor centre maintained with information about ecological conservation within parks consistently provided.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Lack of coordination between managers in the greater park ecosystem.	Given the small size of the park, achievement of its potential ecological conservation role requires complimentary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting ecological values and processes within parks, work with the Partnership Group to: • maintain connectivity between Kokanee Creek Park and the surrounding uplands, especially Kokanee Glacier Park, • manage upslope areas to simulate natural fire regimes, and • manage Kokanee Creek watershed to minimize risk to high fisheries values (i.e., minimize sediment inputs, control ECA to maintain low risk flow regimes.	Implementation of management regimes in the greater park ecosystem that enhance the conservation role of the park

5.3 Midge Creek Provincial Park

5.3.1 Park Description

5.3.1.1 Park-Specific Information Sources

Neither a Master nor Management Plan has been completed for Midge Creek Provincial Park. The most recent Annual Management Plan is from October 2001. Subsequently, a Purpose Statement was developed in 2002. The Protected Areas Strategy Overview (PASO) database lumps Midge Creek Provincial Park with other small area parks listed under “Kootenay Lake Multi-Site”. As such, the statistical information contained in PASO can not be used to describe Midge Creek Provincial Park. A formal ranking of Midge Creek Provincial Park was undertaken as part of the 2000/01 Conservation Risk Assessment (Scott-May 2002a), however it was based on existing information and does not add new information other than the assessments of various risk factors.

In 2002/03, BC Parks funded a study on invasive non-native plants in select West Kootenay Parks. Midge Creek was one of the parks selected for the study. As a result, there is an inventory of invasive non-native plants within the park boundaries and suggested strategies to address the issues. Finally, interviews with Parks staff were used, in addition to aerial photos, to gain better insight into the park. However, the general level of knowledge about the ecological values and processes associated with Midge Creek Provincial Park remains low.

5.3.1.2 Location and History of Park Development

Midge Creek Park is located 38 km south of Balfour, on the southwest shore of Kootenay Lake across from Sanca Creek. It includes approximately 180 ha of upland and 40 ha of foreshore. The park was established on December 4, 1987. The primary means of accessing the park is via boat. However, a CPR branch rail line goes through the park and an old wagon road leads into the park from above, thus potentially providing access into the park from surrounding areas. Given its designation as a backcountry marine park, Midge Creek Provincial Park has minimal recreational facilities.

5.3.1.3 Human Use of the Park

Historically, the park was once part of a logging camp. Currently, boat access supports both day use and overnight camping, mostly during the warmer weather months. Park staff report evidence of ATV use in the park, presumably people are entering the park via the railroad and/or the old wagon road, although tire tracks were seen leading directly into/from the lake which has led to speculation that someone brought an ATV in via boat. Through the CRA, Midge Creek Provincial Park was assessed as being between 75-90% undisturbed by human development.

5.3.1.4 Current Management Direction and Focus

The 2002 Purpose Statement assigned Midge Creek Provincial Park a recreational role, exclusive of any conservation role.

Starting with the 2003 field season, Parks staff will no longer be maintaining the facilities, including outhouses and garbage storage. The facilities will, however, remain in place.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a

complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to Midge Creek Provincial Park.

Table 5.4. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Park contains the fan and flat backshore of Midge Creek.	No specific management actions taken	Need to consider the significance of the creek fan relative to the greater park ecosystem and area of cooperation given development upstream of the park.
Park provides winter habitat for wildlife, including elk as well as white-tailed and mule deer.	No specific management actions taken	Need to consider relative significance of the winter habitat.
Kokanee and Bull Trout spawn within the park.	The Creek is currently closed to fishing.	Both are important species, with bull trout being blue-listed. Therefore, need to consider the significance and management relative to the greater park ecosystem.
Great horned owls have been seen within the park.	No specific management actions taken	May need more information to determine the significance.
Weed species found in the park include: Spotted knapweed, Dalmatian toadflax, Scotch broom, Oxeye daisy, St. John's wort.	Inventory was used to identify the species and provide recommendations to address the issues. The report has recently been received and so no follow-up action has been undertaken as yet.	Provides good information and potential management strategies to be considered. However, also need to consider the weed issue within the park relative to greater park ecosystem.
Ecological values likely being impacted by both use of the park, rail corridor through the park and resource development upstream.	Priority use for the park has been identified as recreation. Parks staff are aware of logging in the drainage above the park but no known changes to resource use in the surrounding area has occurred as a result of concern for values within the park.	Area of influence for the park to be defined and management of ecological values to be considered both within and outside of the park in order to define how the park might best realize its potential ecological roles

5.3.2 Regional and Landscape Context

5.3.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Midge Creek Park is located within the Dry Warm Interior Cedar-Hemlock subzone (ICHdw) of the Southern Columbia Mountains (SCM) ecosection (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is 0.04% of the BC portion of the ecosection and 0.15% of the ICHdw variant that occurs in the BC SCM.

Of the 5 major landscape elements identified for the ICHdw within the SCM, only two of them, valley bottoms of major drainages with large lakes and face units within major valleys are found within Midge Creek Park (MVL and MVF, see Table 2.1 for more information on Landscape Elements). Being limited to approximately 220 ha at the mouth of Midge Creek where it empties into the South Arm of Kootenay Lake, the park represents a small example of those landscape elements.

Disturbance Regimes

The ICHdw is classed as Natural Disturbance Type 3, defined as an area with frequent stand-replacing disturbance events (BC MoF 1995). Most stand-replacing disturbances are wildfires of various sizes, but may also be outbreaks of defoliating insects, bark beetles and root diseases. Recent studies in the ICHdw have found evidence that warmer aspects with drier site types within the ICHdw were subject to mixed disturbance regimes that also included high frequency (~14-65 years) low-intensity ground fires in some locations, favouring the development of open stands of ponderosa pine, Douglas fir and western larch (Quesnel and Pinnnell 2000, Dorner et al. 2003). The steeper rocky slopes on warmer aspects in the upper portions of Midge Creek Provincial Park likely included areas subject to these mixed fire regimes. The cooler aspects within the park and the Midge Creek fan were more likely subject to disturbance regimes dominated by stand-replacing events, operating on return intervals of 100-200 years or longer. Between the stand-replacing events, low intensity gap-replacement stand level disturbance by insects, fungi and wind would also have operated on a continuous basis. Steeper slopes were also subject to landslide disturbances and the floodplain and fan were also subject to flooding and channel migration. For further discussion regarding of the importance of flooding for some ecosystems on alluvial fans see the reports regarding ecosystem management and restoration for Kokanee Creek Park (Holt et al. 1998, Holt and Wood 2001, Slaney et al. 2003).

Greater Park Ecosystem

Although Midge Creek Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it is directly connected to Kootenay Lake and the Midge Creek watershed.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears, whose home ranges likely include most of the adjacent face units and associated watersheds. Bird species habitats will likely extend along the shorelines beyond the park boundaries, and potentially into the uplands surrounding the park.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the Kootenay Lake and River system to the whole Columbia basin.

5.3.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Midge Creek Park is the Landscape Units that include and are adjacent to the park (principally K07, and to a limited extent K04). These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding West Arm Provincial Park, Midge Creek Wildlife Management Area, Darkwoods Forestry Ltd. with respect to Managed Forest #40, Kootenay Lake, the Kootenay Lake TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Unit 4-7.

Management within the Greater Park Ecosystem

The park is bounded by Kootenay Lake on the eastern side, crown lands on the west and north, and private timber lands on the south. It is bisected by the Canadian Pacific Railway line that follows the shoreline of Kootenay Lake from Nelson to Creston.

The lands surrounding the park on the north and west sides are part of the Kootenay Lake Timber Supply Area. The park forms the southeastern corner of Landscape Unit K07 that has been assigned an Intermediate Biodiversity Emphasis Option for the ICHmw4 (formerly ICHmw2) and ESSF BEC units, and a Low Biodiversity Emphasis Option for the ICHdw. Landscape unit K04 to the south has been assigned Low Emphasis for all BEC units. There are no biodiversity management requirements for retention of mature forest in either Landscape Unit. The Midge Creek watershed is also designated as part of the regional connectivity network, but no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet the connectivity objectives.

The forest slopes surrounding the park are designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Upper Midge Creek also includes areas designated mountain caribou management areas under the Kootenay-Boundary Higher Level Plan; however, the management strategies for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). The face units along Kootenay Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.).

The Midge Creek Wildlife Management Area is comprised of the face units of Kootenay Lake to the north of the park and the area of the Midge Creek watershed not included in the West Arm Park or the private forest land. Detailed management plans have not yet been developed for the area (Guy Woods, MWLAP, *pers. comm*.); however, the objectives, as outlined in the KBLUP Implementation Strategy (Kootenay IAMC 1997, App. 6, p.38) state that the area will be managed to "ensure that diverse ecological characteristics and values, including rare and endangered flora and fauna, are maintained and that such management is integrated with resource development activities …. [and provide] support for the West Arm Park as the WMA includes south aspect lower elevation wildlife habitats that are absent in the park and are essential for seasonal wildlife migration and movement. Such movement corridors are important for wide ranging species, particularly as they extend from the higher elevations to the lakeshore."

The southwestern portion of the Midge Creek drainage, including most of Seeman Creek, is part of Darkwoods' privately owned Managed Forest, while the upper reaches of the Midge Creek drainage, including most of Kutetl Creek, are part of the West Arm Park. These areas are primarily managed for intensive timber production.

5.3.2.3 Identified Threat and Stressors to Ecological Integrity

The main current threats affecting the park are associated with the railroad line running through the park. Not only does the railroad involve significant habitat conversion and loss of connectivity, but it also provides a vector for the movement of invasive species. An invasive plant survey undertaken in 2002 identified the presence of various species in the park, including spotted knapweed, dalmation toadflax, Scotch broom, oxeye daisy and St. John's wort (Craig et al. 2003). The infestation of spotted knapweed is severe, and potentially impacting ungulate winter range values. Control strategies have been limited to mechanical treatment with weedeaters along the beach.

Reduction in flooding associated with seasonal fluctuations in Kootenay Lake has also likely had impacts on the Midge Creek fan as at Kokanee Creek Park, but no detailed information is available for the Midge Creek area (see Holt et al. 1998 and Holt and Wood 2001). It is also possible that the railroad bridge has restricted channel migration of Midge Creek, but this information is also not available at present.

Potential future threats are primarily associated with increased forest development in the Midge Creek watershed. There is the potential for negative impacts on aquatic ecosystems from sediment production and modification of flow regimes, and also the potential for developing motorized terrestrial access to the park.

5.3.3 Ecological Features of the Park

5.3.3.1 Geology and Terrain

The bedrock rising from the shores of Kootenay Lake and the fan of Midge Creek within Midge Creek Park is part of the Bayonne batholith (Rice 1941). The Bayonne batholith consists of generally coarse textured granites and granodiorites that were likely intruded in the late Mesozoic (Late Jurassic?). The intrusives locally have significant zones of inclusions of highly altered other rock types.

Terrain within the park is dominated by bedrock outcrops and associated coarse textured talus slopes, the fluvial fan of Midge Creek, and moderately to very coarse textured glaciofluvial terraces along lower Midge Creek (Jungen 1980). Small isolated patches of coarse textured morainal and glaciofluvial veneers and blankets may also occur on terraces and depressions in the bedrock dominated areas. Soils are generally rapidly to well drained, however depressions and concave slope positions, especially where associated with riparian zones and/or seepage, can be imperfectly to poorly drained. The park also includes some more recent moderately to very coarse textured fluvial deposits on the floodplain of Midge Creek. Geomorphic processes include debris avalanches and debris flows associated with steeper glaciofluvial terrace faces and shallow colluvial deposits, rockfall associated with steep bedrock areas, and channel erosion and flooding associated with Midge Creek itself.

5.3.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Kootenay Lake Forest District (Ketcheson et al. 2002), the park potentially includes all of the site series described for the ICHdw, including a range in moisture regimes from dry to wet (see Table 5.5).

Table 5.5. Potentially occurring land types and ICHdw site series within Midge Creek Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	Rock outcrop/ Talus	Dry	RO	8
02	FdPy – Oregon-grape – Parsley fern	Dry	DO	16
01a	CwFd – Falsebox (sx-sm phase)	Mesic	XE	77
01b	CwFd – Falsebox (m-shg phase)	Mesic	XI	39
03	CwHw – White pine – Devil's club	Moist	HD	14
04	CwHw – Devil's club – Lady fern	Wet	RD	1
	Wetlands	Wet	GW and WE	10
	River		RI	2
	Lake		LA	57
			Total	**224**

Fauna

There does not appear to be any detailed inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion ecosection context report (Utzig et al. 2003) for the ICHdw in the SCM can be found in the park, at least seasonally.

The park's valley bottom location adjacent to Kootenay Lake provides ungulate winter range habitat for white-tailed deer, mule deer, elk and moose. The rock outcrops, talus slopes and coarse textured glaciofluvial deposits on warmer aspects potentially provide habitat for reptiles, birds and small mammals that prefer open xeric habitats. The few restricted areas of riparian zones and wetlands and wet forest types potentially provide habitat for amphibians, birds and other species that require semi-permanent water bodies and associated vegetation.

5.3.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes significant length of shoreline along Kootenay Lake, most of it consisting of coarse textured sandy and gravelly beach deposits and minor steep bedrock. The park also includes a portion of the lower reach of Midge Creek and associated floodplain and fan. The few areas of wetter soils and vegetation types are associated with riparian areas along Midge Creek, or other very small depressions and/or concave areas that are affected by seepage.

Fisheries

Kootenay Lake includes a wide range of fish species, including: rainbow trout, bull trout, mountain whitefish, lake whitefish, kokanee, pygmy whitefish, burbot, white sturgeon, redside shiner, largescale sucker, longnose sucker, peamouth, northern pikeminnow.

Fisheries inventories of Midge Creek have identified the presence of kokanee, rainbow trout, bull trout, westslope cutthroat trout, mountain whitefish and an unidentified sculpin (Purcell Resources Inc. 2002). Rainbow trout have recently been stocked in a headwater lake in the Conway Creek sub-basin of Midge Creek. Kokanee, mountain whitefish and the unidentified sculpin spp. are likely restricted to the lower reaches of Midge Creek, while the other species are more widely distributed throughout the drainage. Fish distribution is limited to the lower reaches of most sub-basins by barriers such as cascades, chutes or falls, except Conway Creek where the stocked lake likely acts as a source area. It is assumed that the kokanee, bull trout and whitefish are all adfluvial, with kokanee using the lower reaches of Midge Creek for spawning. Bull trout were found to move further upstream for spawning, including into some tributaries, with juvenile bull trout remaining in the streams for up to two or three years. Bull trout are a blue-listed species, and are a species of special concern within the Kootenay Region.

5.3.4 Potential Biodiversity Conservation Roles

5.3.4.1 Representation

The small area and minimal landscape diversity of Midge Creek Park limits its potential representation contribution to single occurrences for two of the five landscape elements recognized for the ICHdw biogeoclimatic subzone. However, even this limited role is significant within the SCM, as only 2.8% of the ICHdw is protected, and much of that representation is located in areas surrounded by extensive rural development and/or dissected by transportation and utility corridors (see Figure 5.2). Given the cumulative impacts of habitat conversion due to private land development within the Kootenay Lake

valley, Midge Creek still provides important representation at the landscape element scale, even with its limitations due to size and configuration.

5.3.4.2 Local Habitat Supply

Given the forestry management in the surrounding area, both private and crown, the amount of late seral forest cover is the landscape level habitat feature most likely to be threatened in the future. Maintaining mature and old forest cover with stand structural characteristics within the range of natural variability over as much of the park as possible, especially in wetter ecosystems will likely provide habitat elements that are in reduced supply in the surrounding area. However, for these stands to fulfill their functions, especially regarding cavity nesters and species dependent on coarse woody debris, management must ensure provision of wildlife trees and coarse woody debris (i.e. no snag falling and a reduction in trade-offs for human safety). Late seral forest retention in the riparian zones of Midge Creek will provide for increased channel stability and terrestrial and aquatic ecosystem integrity. Maintaining some small openings with naturally occurring early seral shrub and herb dominated communities could increase the value of the park for ungulate winter range, while increasing the overall biological diversity.

5.3.5 Environmental Risk Status

The conclusion reached as a result of this review of both the park and the greater park ecosystem is that Midge Creek Provincial Park is currently at moderate to low risk due a complex and contrasting mix of factors:

- both the relatively small size of the park and its shape make it highly vulnerable to edge effect and activities occurring beyond the park boundaries;
- private forest land management to the south and east will likely limit habitat suitability in those areas of the greater park ecosystem;
- crown land management zoning to the north and east includes a Wildlife Management Area and the West Arm Park, likely resulting in higher suitability habitat in those portions of the greater park ecosystem;
- fertilization and other restoration programs operating in Kootenay Lake;
- limited vehicle access to the park, resulting in low reduced pressure for recreation development within the park;
- active railroad line bisecting the park, providing some access, and a transport vector for noxious weeds;

Based on current management, both within the park and the greater park ecosystem, the trend as it relates to stresses on the park is considered to be in equilibrium with some stressors such as access from development of surrounding lands likely to intensify, while other stressors such as the declining health of the Kootenay Lake fishery are likely to improve.

5.3.6 Proposed Ecological Conservation Management Direction

Given that some of the significant stresses on Midge Creek Park are assumed to be long-term (e.g., the railroad), and there is some uncertainty regarding management within the great park ecosystem, it is not considered feasible for the park to fulfill a low risk ecological conservation role in the foreseeable future. Therefore, the proposed ecological conservation management direction seeks to minimize risk from factors that can be controlled, and thereby maximize the effectiveness of the park in contributing to broader ecological goals, as much as possible. This includes some minor changes to current management, and an emphasis on maximizing opportunities within the area of cooperation.

5.3.6.1 Zonation

There is presently no zonation designation for Midge Creek Park. It is recommended that the park be zoned as Local Conservation to ensure that ecological integrity is maintained within the park, while still allowing low intensity recreation uses that are compatible with that intent.

5.3.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Midge Creek Provincial Park

Overall Goal: Minimizing Environmental Risk and ensuring it is maintained at a moderate or lower level.

The following table summarizes identified issues and associated recommendations of objectives, strategies and monitoring indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Lack of baseline ecological information	Lack of information limits strategic conservation planning and precludes defining operational-level management direction; may result in further impacts due to uninformed decisions.	Park and Area of Coopera tion	Increase knowledge of ecological values and processes within the park to support future management decisions.	Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation.. Conduct reconnaissance habitat inventory and develop a species list for the park, preferably in cooperation with similar efforts for the surrounding area of cooperation.	PEM ground truthed and modifications made as required. Habitat inventory completed, species list for the park compiled.
Seral stage distribution and fire management	Reduction in old and mature forest in the greater park ecosystem undermines ecological integrity.	Park and Area of Coopera tion	Maximize old and mature forest cover with appropriate stand structures to the natural disturbance regime.	In cooperation with management in the adjacent WMA, suppress fires on wetter sites and cooler aspects, and employ prescribed fire to restore stand structures compatible with mixed and low-intensity high frequency fires regimes on warmer aspects and dry sites.	Compatibility of seral stage distribution and stand structures with the range of natural variability.
Invasive species	Invasive weeds reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive weeds in the park	Implement a program to control invasive weed species, preferably in cooperation with similar efforts for the surrounding greater park ecosystem and area of cooperation, as may be required. Work with CPR to reduce the spread of noxious weeds along their right-of-way.	Partnership group develops control strategies. Control strategies implemented. Reduction of invasive weed species within the park.
Recent decision to no longer maintain park facilities and reduce ranger presence requires a higher degree of public responsibility for protecting park values.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park and Area of Coop-eration	To build and maintain the necessary public support for the ecological conservation goals within the park.	Form a partnership group for the park, perhaps in conjunction with Midge Wildlife Management Area, West Arm Provincial Park and/or user groups from the east shore of Kootenay Lake to help promote public understanding of the role of the park in relation to broader ecological conservation goals.	Partnership group formed. Communication maintained on an as-needs basis. Key professionals identified and pro-active education initiated. Public communication program implemented. Tangible support expressed

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Lack of coordination between managers in the greater park ecosystem.	Given the small size of the park, achievement of its potential ecological conservation role requires complimentary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting ecological values and processes within parks, work with stakeholder interests to: • maintain connectivity between Midge Creek Park and the surrounding uplands, especially West Arm Park, • manage upslope areas to simulate natural fire regimes, and • manage Midge Creek watershed to minimize risk to high fisheries values (i.e., minimize sediment inputs, control ECA to maintain low risk flow regimes).	Implementation of management regimes in the greater park ecosystem that enhance the ecological conservation role of the park
Access related impacts.	Motorized access increases risk to access-sensitive species, increases the spread of invasive weeds and increases the risk of poaching and other environmental damage.	Park and Area of Coop-eration	Manage access-related impacts by focusing and limiting access to designated areas.	Work with the Partnership Group for the Area of Cooperation to develop an access management plan that continues to eliminate terrestrial motorized access to the park.	There is no motorized terrestrial access to, or within the park.

5.4 Moyie Lake Provincial Park

5.4.1 Park Description

5.4.1.1 Park-Specific Information Sources

A Purpose Statement was developed for Moyie Lake Provincial Park in 2002, however it provides little relevant information about ecological values within the park. The 2001 Annual Management Plan indicates that relatively little was known about the ecological values contained within the park at that time. A formal ranking of Moyie Lake Provincial Park was not completed for the 2002 BC Parks Conservation Risk Assessment.

Moyie Lake Provincial Park is one of numerous East Kootenay parks that are part of a noxious weed management program. Therefore, information about the presence and management of noxious weeds is well documented. In 2002, the Protected Areas Section of WLAP, Kootenay Region, contracted Pandion Ecological Research Ltd. to undertake an ecological assessment of the park. While the assessment was limited to a three-day period in July of 2002, the resulting information provides a better understanding of the ecological values and processes than exists for many other parks in the region. Interviews with park staff, combined with airphoto interpretation and PEM data, were used to better understand the values associated with Moyie Lake Provincial Park.

5.4.1.2 Location and History of Park Development

Moyie Lake Provincial Park encompasses 90.5 ha along the north shore of upper Moyie Lake approximately 20 km southwest of Cranbrook. Access to the park is via a short, paved road from Highway 3. The northeast edge of the park is bordered by a railway and the south edge of the park runs along the shore of upper Moyie Lake. The Moyie River and Peavine Creek travel through the park as they enter Moyie Lake, creating valuable riparian habitat. Most of the park consists of coniferous forest, which gives way to a broad-leaf system in the riparian areas.

5.4.1.3 Human Use of the Park

Moyie Lake Provincial Park includes a highly developed campground setting, including interpretive trails, boat ramp, beach access, day use tables, shower blocks and 111 campsites. Trespass structures are known to have been constructed within the park and are an issue of management concern. The park experiences all season use, with the majority of recreation activity focused in the warm weather months. Moyie Lake is, however, a popular destination for ice-fishing.

5.4.1.4 Current Management Direction and Focus

The 2002 Purpose Statement assigned Moyie Lake Provincial Park three hierarchical roles:

- The primary role is to maintain outdoor recreation holiday destination and tourism travel routes opportunities oriented to a forested lakeside setting.
- The secondary role is to protect a remnant estuary/wetland ecosystem of the Moyie River.
- The tertiary role is to provide outdoor recreation opportunities for local communities.

There have been limited actions taken to protect ecological values within the park, including an ongoing initiative to assess and remove noxious weeds and a process for assessing wildlife trees prior to removing any that are considered to be hazardous to human safety.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to Moyie Lake Provincial Park.

Table 5.6. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Significant riparian/wetland complex. Although it is small, it is one of the best examples within a park in the region.	Recognized the need to carry out an ecological assessment, which has been done. Recognize need to develop management strategies based on the assessment.	Need to consider the significance and management in relation to the greater park ecosystem and broader ecological context.
Wildlife trees may be at risk due to conflicts with human safety near trails and the campsite.	Have established basic guidelines, recognizing the need for assessment in the area immediately around the campsite and trail, with the goal of protecting such trees in other areas of the park.	Is an issue in most parks and needs to be considered within the context of the greater park ecosystem to clarify the significance of the park's contribution to broader ecological goals.
Invasive weeds	Moyie Lake Provincial Park is one of numerous parks in the East Kootenays that are part of a noxious weed control program.	Need to consider invasive and noxious weeds management within the context of the greater park ecosystem.

5.4.2 Regional and Landscape Context

5.4.2.1 Ecological Context

Ecosection/ Biogeoclimatic Unit/ Hydrologic Features

Moyie Park is located within the Kootenay Dry Mild Interior Douglas-fir (IDFdm2) Southern Columbia Mountains (SCM) and McGillivray Range (MCR) ecosections (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park includes approximately 0.01% of the BC portion of the SCM ecosection, approximately 0.01% of the BC portion of the MCR and 12.3% of the IDFdm2 variant that occurs in the BC SCM. Previous BEC mapping had shown the SCM portion of the park as being part of the ICHmk1 BEC variant.

The park straddles the boundary between the SCM and MCR ecosections, and is only approximately 10 km south of the East Kootenay Trench (EKT) ecosection. The park is located within a major transition between the Moist Climatic Regime typical of the southern West Kootenays and the Dry Climatic Regime more characteristic of the East Kootenays (Braumandl and Curran 1992).

The IDFdm2 only occurs on a single landscape element within the SCM, valley bottoms of major drainages with large lakes (MVL, see Table 2.1 for more information on Landscape Elements). Being limited to approximately 104 ha (of which, depending on the data source, 12 to 26 ha is lake) at the north

end of Moyie Lake at the mouths of the upper Moyie River and Peavine Creek, the park represents a small example of that landscape element.

Disturbance Regimes

The IDFdm2 is classed as Natural Disturbance Type 4, defined as an area with frequent stand-maintaining fire events (BC MoF 1995). The location of Moyie Park and on the floodplain of the Moyie River and at the edge of the IDFdm2, where it is in transition to the ICHmk1 and ICHdw, likely results in a natural disturbance regime that is not typical of most areas within the IDFdm2. For much of the park, particularly the wetter sites in the eastern half of the park, and the natural fire regime was more likely a mixed fire regime, rather than one dominated by stand-maintaining fires. Mixed fire regimes typically result in a complex disturbance pattern, where frequent low intensity fires may occur in some areas over some periods; however, when these become infrequent or miss some areas allowing fuels to accumulate, parts of the area may then experience a high intensity stand-replacing crown fire. Recent studies in other parts of the IDFdm2 and drier parts of the ICHdw indicate that low intensity stand-maintaining fires may have had return frequencies in the range of 14 to 65 years, and stand-replacing events may have occurred every 70 to 120 years (Gray et al. 2001, Quesnel and Pinnnell 2000, Dorner et al. 2003).

In addition to fire disturbance events, or interacting with fire events, outbreaks of defoliating insects, bark beetles and root diseases can also play a role in stand-replacement disturbances. Between the stand-replacing events, low intensity gap-replacement stand level disturbance by insects, fungi and wind would also have operated on a continuous basis. The floodplain portions of the park were also subject to flooding and channel migration, which is now constrained by the rail road bed. For further discussion regarding of the importance of flooding for some ecosystems on alluvial fans, see the reports regarding ecosystem management and restoration for Kokanee Creek Park (Holt et al. 1998, Holt and Wood 2001, Slaney et al. 2003).

Greater Park Ecosystem

Although Moyie Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it is directly connected to Moyie Lake and the Moyie River watershed.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears, whose home ranges likely to include most of the adjacent face units in the Moyie valley and associated watersheds. Bird species habitats will likely extend along the shorelines beyond the park boundaries, and potentially into the uplands surrounding the park.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the Moyie Lake and River system to the whole Columbia basin.

5.4.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Moyie Park is the Ministry of Forests Landscape Units that include, and are adjacent to, the park (principally C01, C02, C03 and C30). These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park (upper Moyie River, Peavine and Lamb Creeks). The greater park ecosystem is also affected by decisions taken regarding Moyie Lake, the Cranbrook TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Units 4-4 and 4-5.

Management within the Greater Park Ecosystem

The park is bounded by Moyie Lake on the southern side, crown lands on the west, and private lands on the southwest and north. It is bordered by a rural residential access road and parallel forest access road to the west, and the Canadian Pacific Railway line, paralleled by Highway 3 on the north side.

The lands surrounding the park and nearby private lands are part of the Cranbrook Lake Timber Supply Area. The park is located at the northern edge of Landscape Unit C01 that has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. Landscape unit C30 immediately to the north that includes the transition from the park into the Rocky Mountain Trench has been assigned Low Emphasis for all BEC units. Landscape unit C03 that includes most of the upper Moyie River watershed to the west has been assigned a Low Biodiversity Emphasis Option for the MS and High Emphasis for the ESSF BEC units. Landscape unit C02 that includes the entire Lamb Creek watershed to the southwest has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. There is no requirement to manage for mature forest retention for biodiversity conservation in any of the LUs of the greater park ecosystem, except in the ESSF of LU C02 (overlapping with caribou habitat management requirements).

The forest slopes along Moyie Lake and to the west of the park at above Monroe Lake and the upper Moyie River are designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Ridge crests between Lamb Creek and upper Moyie River, and the upper portions of those watersheds have been mapped as part of the management zone for the Southern Purcell Caribou population. Management of caribou habitat in these areas requires retention of significant areas of old and mature forest. However the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). The valley bottom surrounding the park and the lower face units along Moyie Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.).

The majority of the Peavine watershed, the mid-section of Lamb Creek and the valley bottom of upper Moyie River have been designated Enhanced Resource Development Zone (ERDZ) for timber production.

The private lands immediately surrounding the park to the southwest and north has been developed as rural residential and recreational properties. There is also an enclave of recreational properties on Moyie Lake contained within the centre of the park. Extensive private lands on the flood plain of the Moyie River and Peavine Creek to the north of Highway 3 have been cleared and partially drained for agricultural cultivation and improved pasture. The uplands of these properties are managed for timber production.

5.4.2.3 Identified Threat and Stressors to Ecological Integrity

One of the many threats affecting the park is the railroad line running along the northern boundary of the park. Not only does the railroad involve significant habitat conversion and loss of connectivity, but it also provides a vector for the movement of invasive species and disrupts the hydrology of wetlands contained within the park. Nearby Highway 3 poses similar threats to the ecological integrity of the park and portions of the greater park ecosystem. Recent restoration studies in Kokanee Creek Park indicate the potential impacts of modified channel hydrology on the ecological integrity of riparian wetlands (see Holt and Wood 2001 and Slaney et al. 2003).

The ecological assessment completed in 2002 identified the presence of various species of invasive weeds in the park, including spotted knapweed, oxeye daisy, viper's blugoss/blueweed and great mullein (Dulisse 2002). A previous report on noxious weeds reported ongoing treatments for spotted knapweed and common hound's-tongue (1991-2000), and stated that they were considered to be "under control," with weed infestations generally decreasing within the park (Ladybug Consulting Services 2001).

Although forestry development and associated fire suppression has already had significant impacts on surrounding forest ecosystems, its magnitude of impact may increase. Intensive forest management in the ERDZs in upper Moyie River and Peavine Creeks has the potential for negative impacts on aquatic ecosystems from sediment production and modification of flow regimes due to road construction and forest harvesting, as well as impacts on specific habitat at both landscape and stand levels (e.g., seral stage distribution and stand structure).

Increased park use may also result in further habitat conversion for development of recreation facilities and further stand structure manipulation to maintain public safety. The ecological assessment emphasizes the importance of maintaining wildlife trees in the terrestrial areas, as well as large woody debris along the shoreline (Dulisse 2002). Motorized aquatic recreation vehicles are also noted as a matter of concern. The intensive development of surrounding private lands, and the increased recreational activity associated with that development places further stress on the limited area of the park itself. The potential for further private land development, accompanied by drainage and/or filling in of wetlands northeast of the park, is also a potential threat.

5.4.3 Ecological Features of the Park

5.4.3.1 Geology and Terrain

Moyie Lake Provincial Park and the surrounding area is underlain by sedimentary and intrusive rocks of the Purcell Supergroup (Hoy 1993) dating from the Middle Proterozoic (approx. 1400 to 900 million years ago). The rocks are dominantly clastic and carbonate rocks interlayered with gabbroic sills. The materials were deposited in a gradually widening and deepening basin caused by continental rifting, where the sills were intruded while the sediments were still shallow, wet and unconsolidated. The park itself located on glaciofluvial terraces and the floodplain of the Moyie River likely contains few if any bedrock outcrops.

The structure and tectonics of the surrounding area are dominated by three main features:

- the Moyie anticline that gently plunges to the north-northeast, with the fold axis running from upper Stone Creek, through the town of Moyie, and on into upper Prudhomme Creek just east of the park;
- the Moyie thrust fault that trends northeast, along Lamb Creek, then crossing through the middle of Moyie Park and continuing northeast to the mouth of Prudhomme Creek; and
- a series of southeasterly trending normal faults in Prudhomme and Cotton Creeks just to the northeast of the park, and one that occurs along the axis of the Moyie anticline running north-northeasterly up the middle of the southern portion of Moyie Lake.

The block faulting and folding is likely associated with the Mid Proterozoic tectonic activity, while the Moyie thrust fault did not occur until the Mesozoic and early Cenozoic as the Rocky Mountains were being formed.

Rocks exposed immediately to the west of the park on the upper plate of the Moyie thrust fault are complexly folded, partially over-turned, Middle Aldridge rocks. These include quatzites, greywackes and siltstones and argillites. Rocks exposed on the slopes to the east of the park are significantly younger rocks from the lower plate of Moyie thrust fault and the western limb of the Moyie anticline. They include siltstones, dolomitic siltstones and argillites of the Lower Kitchener formation overlain by siltstones and quartz wacke of the Van Creek formation, and intruded sills of gabbro and/or diorite.

Terrain within the park is dominated by glaciofluvial terraces, fluvial deposits associated with the floodplains of the Moyie River and Peavine Creek, and lacustrine beach deposits associated with Moyie Lake (Lacelle 1990). The western portion of the park is dominated by well to rapidly drained sandy gravelly glaciofluvial deposits occurring as a broad plain and low terraces. The fluvial deposits in the east central portion of the park are generally moderately well to well drained silty to sandy veneers overlying

gravelly floodplain deposits. These grade into deep poorly drained organic deposits in the lower and wetter areas located just outside the northeastern corner of the park. Active sandy and silty floodplain and beach deposits occur in the cottonwood riparian area at the eastern end of the park. Various terrain stability assessments have been completed on the lands surrounding the park (e.g., Utzig 1992, Utzig 2000).

5.4.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Rocky Mountain District (Ketcheson et al. 2002), the park is dominated by mesic and wetter site series described for the IDFdm2 (see Table 5.7).

Table 5.7. Potentially occurring land types and IDFdm2 site series within Moyie Lake Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
01	FdPl - Pinegrass – Twinflower	Mesic	DT	57
04	FdLw - Spruce – Pinegass	Moist	SP	1
07	Sxw – Horsetail	Wet	SH	17
	Wetland	Wet	WL	1
	Gravel bar		GB	15
	Lake		LA	12
	River		RI	1
			Total	104

Fauna

The park's valley bottom location adjacent to Moyie Lake, in combination with deciduous and coniferous forested habitats, wetland habitats and aquatic habitats provides habitat for a wide diversity of fauna. Following an ecological assessment completed by Pandion Ecological Consultants (Dulisse 2002), Dulisse describes a diverse vertebrate species list for the park, including 73 terrestrial and avian species (56 birds, 12 mammals, 3 reptiles, 2 amphibians). Of those species 3 are red- or blue-listed by the BC Conservation Data Centre. The report also includes a list of 122 vascular plants identified in the park, including one listed species. Given the limited survey time (3 days), and single season of sampling, undoubtedly the full species list is significantly longer.

5.4.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes a significant length of shoreline along Moyie Lake, most of it consisting of sandy gravelly beach deposits. The park also includes a portion of the lower reach of upper Moyie River and Peavine Creek and associated floodplain and wetland habitats.

Fisheries

Upper Moyie Lake includes a number of naturally occurring fish species, including: rainbow trout, bull trout, mountain whitefish, kokanee, largescale sucker and longnose sucker (MSRM 2003). Westslope cutthroat and brook trout have also been introduced. Bull trout are a blue-listed species, and are a species of special concern within the Kootenay Region. Some of these species move into the lower reaches of upper Moyie River (e.g., rainbow trout), and westslope cutthroat trout occur thought the upper Moyie River. Movement to the upper reaches is blocked by a waterfall and seasonally by dewatering of portions of the lower reaches.

5.4.4 Potential Biodiversity Conservation Roles

5.4.4.1 Representation

The small area and minimal landscape diversity of Moyie Park limits its potential representation contribution to a single occurrence for the only landscape element recognized for the IDFdm2 biogeoclimatic variant in the SCM. However, even this limited role is significant, as <1% of the IDFdm2 is protected overall, and much of that representation is located in areas surrounded by extensive rural development and/or dissected by transportation and utility corridors. Other than 11 ha in Jim Smith Park, this is the only representation of the IDFdm2 in the MCR and the SCM. Given the cumulative impacts of habitat conversion for agriculture recreational land development within the IDFdm2, Moyie Park still provides important representation at the landscape element scale, even with its limitations due to size and configuration.

5.4.4.2 Local Habitat Supply

Given the agricultural and residential development present on the non-park portion of the Moyie Creek floodplain, maintenance and restoration of the unique riparian, wetland, shoreline and aquatic habitats associated with the floodplain and delta is likely the most important role the park can play in local habitat supply. The recent ecological assessment (Dulisse 2002) indicates the importance of these habitats to an extensive list of both terrestrial and aquatic species, including some red- and blue-listed species. The assessment report recommends a number of measures necessary to improve the possibilities for those areas to fulfill their ecological functions, including: minimize disturbance to wildlife, controlling invasive weeds, protecting the black cottonwood ecosystem, maintaining wildlife trees and restoring the ecological functions and integrity of the beach foreshore area (Dulisse 2002).

The upland areas at the western end of the park also likely provide limited ungulate winter range values, especially in heavy snow years. Maintaining mature and old forest cover with stand structural characteristics within the range of natural variability and an appropriate distribution of small openings with browse species could enhance this role of the park. However, for these stands to fulfill their full ecological functions, especially regarding cavity nesters and species dependent on coarse woody debris, management must ensure provision of wildlife trees and coarse woody debris (i.e. no snag falling or reduced emphasis on trade-offs for human safety).

5.4.5 Environmental Risk Status

The 2002 Conservation Risk Assessment did not evaluate Moyie Creek Park. Based on a review of the ecological assessment completed last year (Dulisse 2002) and other information assembled regarding threats and stressors within the park and the greater park ecosystem, we would rate the park at high risk.

The primary factors that lead to this conclusion are:

- both the relatively small size of the park and its shape (especially the inclusions) make it highly vulnerable to edge effect and activities occurring beyond the park boundaries;

- generally high recreation use and the growing threat of disturbance and displacement by motorized aquatic recreation;
- impacts of the railroad and highway on channel processes and the hydrologic regime of the floodplain and wetlands;
- past and potential future impacts of agricultural, commercial and rural residential development on private land portions of the wetlands;
- the presence of invasive species is somewhat offset by an active control program, but the nearby presence of the railroad and highway provide significant vectors for continuous new arrivals; and,
- private and crown forest land management surrounding the park will likely limit habitat suitability in much of the greater park ecosystem (especially ERDZ areas).

5.4.6 Proposed Ecological Conservation Management Direction

Given that some of the significant stresses on Moyie Park are assumed to be long-term (e.g., the railroad, private land development), and there is some uncertainty regarding management within the greater park ecosystem, it is not considered feasible for the park to fulfill a low risk ecological conservation role in the foreseeable future. Therefore, the proposed ecological conservation management direction seeks to minimize risk from factors that can be controlled, and thereby maximize the effectiveness of the park in contributing to broader ecological goals, as much as possible. This includes some minor changes to current management, and an emphasis on maximizing opportunities within the area of cooperation.

5.4.6.1 Zonation

There is presently no zonation designation for Moyie Park. The 2002 Purpose Statement defines three hierarchical roles:

- The primary role is to maintain outdoor recreation holiday destination and tourism travel routes opportunities oriented to a forested lakeside setting.
- The secondary role is to protect a remnant estuary/wetland ecosystem of the Moyie River.
- The tertiary role is to provide outdoor recreation opportunities for local communities.

Given the already significant investment in infrastructure and history of use, it is assumed that this hierarchy is unlikely to change. Although it will not optimize the ecological conservation role for the park, it is recommended that the park be zoned as a combination of Intensive Recreation and Local Conservation and possibly Ecological Protection. The Intensive Recreation zone would be generally applied to the existing campsite, maintenance facilities, picnic area and swimming beach. The remaining forested areas, riparian areas and wetlands would be designated Local Conservation.

To achieve a moderate level of environmental risk, the riparian zones, undeveloped shoreline, wetlands and cottonwood groves also require a zoning of Local Conservation. This zoning should include the Moyie River, and extend out into the foreshore to ensure management provisions or excluding motorized access to the foreshore area. If further inventory identifies specific areas with rare and/or unique values, these portions may require zoning at the level of Ecological Protection.

5.4.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Moyie Lake Provincial Park

Overall Goal: Reducing Risk Towards a Moderate Level

The following table summarizes identified issues and associated recommendations of objectives, strategies and performance indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Incomplete baseline ecological information	Incomplete information limits strategic conservation planning and limits the effectiveness of operational-level management; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Formalize the existing habitat mapping and tie it to the BEC classification system. Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding greater park ecosystem and area of cooperation, as may be required. Use this information as a basis for defining zoning boundaries and management strategies.	Terrain, hydrologic feature and ecosystem mapping is completed for the whole park.
Small size and limited diversity reduce the conservation role of park	Minimal boundary adjustments can significantly increase conservation role of park	Park and Area of Coop-eration	Increase viability of wetland ecosystems within the park.	Ensure the long-term protection of the portions of the park wetland ecosystems falling outside the park by acquiring the adjacent wetland area, or assisting with the establishment of conservation easements on the applicable private lands.	Park expansion includes key habitat types, or conservation easements assure their long-term ecological integrity.
General impacts from recreation activities	Given that the park is a holiday destination, tourism travel route and intended to provide local community outdoor recreational opportunities, there is need for basic and ongoing management of recreational use to protect ecological values.	Park	Maximize retention of habitat elements, especially rare/ unique ecosystems, coarse woody debris, snags and understory vegetation.	Within the Local Conservation and Ecological Protection zones: • enforce park use restrictions, including no firewood cutting, access controls, etc. • protect potential and existing wildlife trees • establish clear objectives as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives Within the Intensive Recreation zone conduct a wildlife/hazard tree survey and pursue all possibilities for maintaining potential and existing wildlife trees prior to removing any hazard trees.	Abundance, distribution and quality of stand level structure and other habitat elements throughout the park.
Hydrologic regime alterations.	Potential for negative environmental impacts resulting from alteration of hydrologic regimes and stream channels.	Park and Area of Coop-eration	Assess the need for restoration of riparian zones and/or wetlands.	Initiate an impact and restoration needs assessment of the Moyie River and Peavine stream channels, riparian zones and associated wetlands (including railway, highway and private lands). Plan and implement restoration measures necessary to restore ecological functioning of terrestrial and aquatic ecosystems in those areas.	Quality of riverine aquatic, riparian and wetland habitats. Population levels of species dependent on those habitats.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Shoreline habitat alterations.	Potential for negative environmental impacts resulting from shoreline alterations.	Park	Assess the need for restoration of shoreline habitats.	Initiate an impact and restoration needs assessment of the shoreline zone of the park. Plan and implement restoration and management measures necessary to restore ecological functioning of terrestrial and aquatic ecosystems in those areas, including motorized aquatic access controls.	Quality of shoreline habitats. Population levels of species dependent on those habitats.
Invasive species	Invasive species reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive weeds in the park	Continue the program to control invasive species, preferably in cooperation with similar efforts for the surrounding area of cooperation. Work with other managers in the area of cooperation to reduce the spread of noxious weeds along rights-of-way.	Partnership group develops control strategies. Control strategies implemented.
The public perception of the park likely focuses on its recreational role, given the past and current management.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Coop-eration and Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the role of the park in relation to broader ecological goals, taking into account the history of park use and cumulative impacts of development in the area as a whole. Establish a partnership group, including personnel and representatives of related ministries, crown corporations, local residents in and adjacent to the park, industry and funding sources to build understanding and support for developing and implementing an ecosystem restoration plan.	Partnership group for the park formed. Tangible support expressed Necessary resources allocated. Communication maintained on an as-needs basis. Ecosystem restoration plan developed and implemented.
Lack of coordination between managers in the greater park ecosystem.	Given the small size of the park, achievement of its potential ecological conservation role requires complimentary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting ecological values and processes within parks, work with the partnership group to: • maintain connectivity between Moyie Park and the surrounding uplands, • manage upslope areas to simulate natural disturbance regimes, and • manage upper Moyie River and Peavine watersheds to minimize risk riparian and wetland values (i.e., minimize sediment inputs, control ECA to maintain low risk flow regimes).	Implementation of management regimes in the greater park ecosystem that enhance the ecological conservation role of the park

5.5 Stagleap Provincial Park

5.5.1 Park Description

5.5.1.1 Park-Specific Information Sources

There has not been a Master or Management Plan completed for Stagleap Provincial Park. The most recent Annual Management Plan for Stagleap Provincial Park was completed in October 2001. A Purpose Statement was developed for the park in 2002. The Protected Areas Strategy Overview (PASO) database does include information about the park. Additionally, a formal ranking of Stagleap Provincial Park was undertaken as part of the 2000/01 Conservation Risk Assessment (BC Parks 2002).

Stagleap Provincial Park is part of a larger area of interest for joint Canada/United States initiatives regarding mountain caribou and grizzly bear recovery on the U.S. side of the border. However, existing studies do not specifically address the role of Stagleap Provincial Park. The mapped telemetry data for mountain caribou does demonstrate that the park provides habitat for this red-listed species. With respect to grizzly bears, the park is not seen to be significant and, therefore, is not a particular focus for management (Guy Woods, WLAP, *pers. comm*.).

A number of options for expanding Stagleap Provincial Park through the Protected Areas Strategy Goal 2 – Special Features process have been discussed in recent years. As a result, there is some documented information about the surrounding area and potential additions to the park.

5.5.1.2 Location and History of Park Development

Stagleap Provincial Park was established on August 17, 1964. It encompasses 1133 hectares of upper elevation land and is located 34 km west of Creston. Highway 3 runs through the park and, as such, includes the summit of the highest all weather highway pass in BC and the highest paved highway in Canada.

5.5.1.3 Human Use of the Park

The most predominant uses of, and impacts to, the park result from the highway 3 corridor that runs through the park. The highway is not only a major barrier to movement that results in mortality for numerous species, but there is also a highways camp located at the pass and within the park. The future of the maintenance yard is uncertain. The Ministry of Transportation (MOT) intends to keep the shop but not the bunkhouse. There is a proposal from Selkirk College to use the bunkhouse to support student activities within the park, but this remains unresolved. MOT also maintains a gravel pit within the park. The highways operations have raised concerns over salt and gravel contamination of Bridal Lake as well as oil seeping from the camp. The 2001 Annual Management Plan noted that MOT installed a sump in front of their salt shed to prevent leaching. There has also been scaling done on the cliffs. In the winter, there is an avalanche control program that involves the use of Gasex on both sides of the highway. The environmental impacts of Gasex are unknown. There are also avalanche control towers within the park and terracing has been done for the purpose of avalanche control. There are two bunkers used to house explosives and large amounts of shrapnel scattered across the slopes as a result of detonation.

Other linear corridors within the park have resulted from construction of gas and telephone lines. There is a microwave tower on the boundary along with a communications tower on the south side of the park.

In terms of recreation uses, the existence of highway 3 running through the park provides easy access for backcountry skiing, snowboarding and hiking. It has been suggested that Stagleap Provincial Park is one of the few places where non-motorized backcountry recreation activities appear to be having a negative

impact on mountain caribou (Guy Woods, MWLAP, *pers. comm*.). Parks closed their outhouses near the cabin with the remaining ones being owned and maintained by MOT. There is a cabin within the park that is owned by Ministry of Forests (MoF). The AMP noted that alternative funding would need to be secured or MoF would remove the cabin. The AMP also identified that recreation use trends are lower than previous years due to withdrawal of services on the west side of the park. The Ripple Ridge cabin and trail are located at the park boundary, as is the access road that leads to them. There is concern that the Ripple Ridge cabin and trail may be enabling snowmobile use into the park. Finally, the historic Dewdney Trail passes near the park.

While boating sometimes occurs on Bridal Lake, powerboats are not permitted. The park is within a firearm closure area. In addition to the above, there are permits on record for other uses, including one for trapping with the second relating to a Forest Service Reserve research plot.

5.5.1.4 Current Management Direction and Focus

The 2002 Purpose Statement identifies the primary role as being to protect remnant subalpine ecosystems, representative wildlife and habitat of the Southern Columbia Mountains ecosection. Furthermore, the park has a key role in protecting habitat for internationally endangered Mountain Caribou that move back and forth across the International Border. The secondary role is to provide tourism travel route and backcountry recreational opportunities oriented to a scenic mountain pass.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its ecological conservation mandate with respect to Stagleap Provincial Park.

Table 5.8. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Includes significant diversity as it is located where three influences at the BEC level come together: to the west rhododendron predominates, to the east false azalea dominates and south of the highway it is a drier climate (Braumandl, *pers. comm*.)	No specific management action taken	This information to be considered in relation to PEM data and assessed for its significance relative to the greater park ecosystem
Special feature: remnant ecosystem (only representation in the ecosection of the ESSFwc1 and the ESSFwcp4)	No specific management action taken	This information to be considered relative to the greater park ecosystem and the viability of the park to actually represent the ecosystem to be explored
Supports full range of high-elevation species expected in the Southern Selkirk Mountains	No specific management action taken, other than that identified specifically for mountain caribou and grizzly bears	Significance of habitats to be considered relative to broader ecological context
Park provides important habitat for mountain caribou and grizzly bears	Parks interests represented by other WLAP staff in joint Canada/US initiatives. No specific management actions taken	Need to use mapped caribou telemetry data to clarify the type and significance of mountain caribou habitat within the park. Need to confirm the significance of the park with respect to grizzly bears as

	in the park. Work has been undertaken to assess potential additions to the park under the Goal 2 process. No final decisions have been made	other sources have suggested the park does not play a significant role.
Presence of blue-listed and significant plants	No specific management actions taken	Need to consider movement for specific species and at what scale in order to define potential ecological conservation role for the park with respect to movement corridor for large mammals.
Fisheries values – cutthroat spawn in the outlet of Bridal Lake	No record of Bridal Lake being stocked. Recognize the need to monitor water quality within Bridal Lake and seek changes to highways operations (i.e., gravel and salt dumping, as well as chemical leaching into the lake) that are likely impacting the lake. No specific management action taken.	Need to consider the role of park with respect to protection of specific plant species within the context of broader plant communities and at larger scales
General impacts of highway operations	Recognize need to monitor impacts to Bridal Lake (see above) and overall impacts from road salt and avalanche control activities. However, no monitoring has been done to date and, thus, few changes have resulted in highways operations. Also recognize the need for a long-term strategy regarding gravel pit deactivation, but no actions taken thus far. Park staff indicate that liaison with Highways staff has occurred, but is inconsistent.	Need to consider the potential relationship of this upper elevation park and the larger watersheds that it is part of.
Unauthorized snowmobile use within the park	Recognize the need for better signage to identify park boundaries and the respective restrictions on snowmobiling.	Existence of linear corridors are considered to be long-term and so reduce options for addressing potential ecological conservation roles. However, operational considerations related to those corridors to be assessed.
Potential addition to the park	Considerable effort has gone into reviewing various potential Goal 2 areas as additions to Stagleap Provincial Park. Should Goal 2 proceed within the West Kootenays, and depending on which scenario may eventually be approved as an addition to Stagleap, the viability of the park could be greatly increased.	Area of cooperation to be defined and key management issues identified.

5.5.2 Regional and Landscape Context

5.5.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

Stagleap Park is located at the crest of the southern Selkirk Mountains just north of the US border, near the western edge of the SCM. According to present BEC mapping, the park is dominated by the Selkirk Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc4), but also includes relatively small areas of the Columbia – Shuswap Moist Warm Interior Cedar – Hemlock Variant (ICHmw2), Columbia Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc1) and alpine parkland of the ESSFwc4 (see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is 0.2% of the BC portion of the ecosection, and the following percentages of the portions of the BEC variants in the BC SCM: 5.5% of the ESSFwc4/wc4u, 0.3% of the ESSFwc1, 0.3% of the ESSFp and 0.01% of the ICHmw2. Section 5.5.3.2 discusses potential changes to BEC unit representation due to revised BEC mapping.

Stagleap Park contains three of the four major landscape elements identified for the ESSFwc4 within the SCM, secondary valley floors and sidewalls and rounded ridge crests (RR, SVB and SVW). It also contains small insignificant areas of single landscape elements for the ESSFwc1, ICHmw2 and ESSFwcp4. The ESSFwc1 and ICHmw2 occur in the valley bottom at the extreme upper end of Stagleap Creek (SVB), while the ESSFwcp4 occurs in steep rocky ridge crests (HR).

Disturbance Regimes

The ESSFwc4 and ICHmw2 in the SCM are classed as Natural Disturbance Type 2, defined as an area with infrequent stand-replacing disturbance events (BC MoF 1995). The natural disturbance regime for the area including Stagleap Park is likely dominated by relatively long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in the ESSFwc4 and ICHmw2 vary from about a 100 years for dry sites on warm aspects to over 500 years on wet sites and cool aspects (Dorner et al. 2003). The park's southern ridge crest location and isolation from high fire frequency major valley BEC units are somewhat offset by its adjacency to somewhat more frequent disturbance regimes in the ESSFdm1 to the south. Therefore, disturbance return intervals are expected to fall somewhere between 200 and 350 years for the park. Most stand-replacing disturbance are wildfires of various sizes, but also may be outbreaks of defoliating insects, bark beetles and root diseases.

Greater Park Ecosystem

Although Stagleap Park is relatively small in size, it has functional relationships with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it is directly connected to the Stagleap and Summit Creek watersheds.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears. The southern Selkirk Caribou population has been documented to move as far north as the West Arm of Kootenay Lake, as well as south in the US. Home ranges of other ungulates likely extend winter ranges near Creston and/or west to the Salmo or Pend d'Oreille valleys.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the creeks within the park to the whole Columbia basin.

5.5.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for Stagleap Park is the Ministry of Forests Landscape Units that include the park and areas adjacent to the park, Kootenay Lake Forest District LU K01 and N505 in the Arrow Forest District. To fully capture the home ranges of the southern Selkirk caribou population will also require reference to LUs K04, K07 and K09, and relevant areas in the states of Washington and Idaho. These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding the Kootenay Lake and Arrow TSAs, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Units 4-7 and 4-8.

Management within the Greater Park Ecosystem

The park is surrounded by crown lands on all sides. It is bisected by the Kootenay Pass section of Highway 3 running between Salmo and Creston. It also includes a forest access road that runs south from the pass into Monk Creek. There are major east-west powerlines and pipelines within the two kilometres of the park both to the north and south. The park also includes a Ministry of Transportation gravel pit and access road, maintenance shop and bunkhouse. During winter months extensive snow avalanche control activities occur within the park.

The lands on the west are part of the Arrow Timber Supply Area, within Landscape Unit A505 that has been assigned an Intermediate Biodiversity Emphasis Option for all BEC units. The lands on the east are part of the Kootenay Lake Timber Supply Area, within Landscape Unit K01 that has been assigned a Low Biodiversity Emphasis Option for all BEC units. There are no biodiversity management requirements for retention of mature forest in any of the adjacent BEC units, except the ICHdw at the lower elevations of N505. The park occupies an important hub in the regional connectivity network that extends east-west down both Summit and Stagleap watersheds, and north-south along the Nelson Range of the Selkirk Mountains. However, no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet the connectivity objectives.

The slopes along Highway 3, in both Stagleap and Summit Creeks have been designated Class 1 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Much of the ESSF forested and parkland, as well as some upper portions of the ICH along the Nelson Range surrounding the park, have been mapped as part of the management zone for the Southern Selkirk Caribou population. Management of caribou habitat in these areas requires retention of significant areas of old and mature forest. However the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.).

5.5.2.3 Identified Threat and Stressors to Ecological Integrity

Threats affecting the park are associated with the highway and forest access road running through the park, highways-related development and activities within and adjacent to the park and recreational use and development within the park. Not only does the highway involve significant habitat conversion, sediment inputs and flow regime impacts to Summit and Stagleap Creeks, but it also significantly reduces connectivity within the park, provides uncontrolled access to most of the park and a vector for the movement of invasive species.

Past timber harvesting, mining and development of transportation and utility corridors in the greater park ecosystem have had significant impacts on the ecological integrity of the park, especially caribou and grizzly populations. Potential future threats are primarily associated with continuing forestry development in the greater park ecosystem and highway-related activities.

5.5.3 Ecological Features of the Park

5.5.3.1 Geology and Terrain

The bedrock geology of Stagleap Park is complex. It includes north-south trending folded and faulted metamorphosed sediments dating from the Precambrian on the eastern side of the park to Lower Cambrian rocks on the western side (Little 1960). On the southeastern corner of the park these include argillaceous schists, conglomerates and limestones of the Monk formation and Windermere series. The central and southern part of the park includes green grits, quatzites and conglomerates of the Three Sisters formation, while the western edge is underlain by white and pink quartzites of the Quartzite Range formation. These older rocks have been intruded with by Nelson Plutonic Rocks of Lower Cretaceous age (Little 1960). These granodiorites and other granitic rocks outcrop mainly in the northeastern portion of the park.

Terrain within the park is dominated by bedrock, coarse textured and rubbly colluviums and associated talus slopes at the upper elevations (Jungen 1980). The lowest elevations along Stagleap and Summit Creeks include coarse textured cobbly, gravelly and sandy glaciofluvial terraces, with some washed materials extending into the pass and the cirque basins. The pass in the center of the park includes some coarse textured gravelly and sandy morainal materials, while in the cirque basins the morainal materials tend to be more stony and rubbly (Jungen 1980).

5.5.3.2 Terrestrial Ecosystems

Vegetation and Habitats

Based on PEM mapping for the Arrow Forest District (Ketcheson et al. 2003) the park includes the following BEC units:

- Columbia – Shuswap Moist Warm Interior Cedar – Hemlock Variant (ICHmw2),
- Columbia Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc1),
- Selkirk Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc4), and
- Selkirk Wet Cold Engelmann Spruce - Subalpine Fir Parkland (ESSFwcp4).

However, more recent BEC unit mapping in the Kootenay Lake District to the east of the park has recognized a revised set of BEC units that will likely change the BEC units recognized in the park (MSRM 2002, Biome Ecological Consultants 2003 and Ketcheson et al. 2002).

The area presently mapped as ICHmw2 in the Stagleap watershed will potentially be replaced by the Salmo Moist Warm Interior Cedar – Hemlock Variant (ICHmw4). The area within the Stagleap watershed mapped as ESSFwc1 will potentially be replaced by the Salmo Wet Cold Engelmann Spruce – Supalpine Fir variant (ESSFwc5), while the ESSFwc4 and ESSFwcp4 will potentially be replaced by the Ymir Wet Cold Engelmann Spruce – Subalpine Fir variant (ESSFwc6) and the Upper Ymir Wet Cold Engelmann Spruce - Subalpine Fir variant (ESSFwcu6) and the ESSF parkland ESSFwcp6.

The area within the Summit Creek watershed mapped as ESSFwc1, ESSFwc4 and ESSFwcp4 will potentially become the Wet mild Engelmann Spruce - Subalpine Fir subzone (ESSFwm) and the Upper Wet Mild Engelmann Spruce - Subalpine Fir variant (ESSFwmu) and ESSFwmp. Areas immediately to the south of the park in the Monk Creek watershed will potentially become the Yahk Dry Mild Engelmann Spruce – Subalpine Fir (ESSFdm1), the Upper Yahk Dry Mild Engelmann Spruce - Subalpine Fir variant (ESSFdmu1) and the ESSFdmp1.

The distribution of site series based on present mapping for the Arrow Forest District is shown in Table 5.9. Although updated BEC mapping may change the distribution of BEC units, the general distribution of site series moisture regimes and land types will remain relatively constant.

Table 5.9. Potentially occurring land types and site series within Stagleap Park based on PEM mapping.

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	ICHmw2			
04	CwFd – Falsebox	Mesic	RF	1
05	CwHw – Oakfern – Foamflower	Moist	HO	1
06	CwHw – Devil's club – Lady fern	Wet	RD	1
	ESSFwc1			
02	Bl – Falsebox - Grouseberry	Dry	FF	6
01	Bl - Rhododendron - Oak fern	Mesic	FR	18
03	Bl - Devil's club - Lady fern	Moist	FD	11
04	Bl – Horsetail - Brachythecium	Wet	FH	1
	Avalanche chute		AC	1
	Transportation corridors		UR	1
	ESSFwc4			
02	Bl - Rhododendron - Falsebox	Dry	FF	312
03	Bl - Rhododendron - Woodrush	Dry	FW	139
04	Bl - Rhododendron - Foamflower	Mesic	RF	246
01	Bl - Rhododendron - Oak fern	Moist	FR	283
05	Bl - Rhododendron - Lady fern	Wet	FL	47
06	Bl - Horsetail - Brachythecium	Wet	FH	6
	Avalanche chute		AC	63
	Avalanche runout zone		AR	22
	Rock outcrop		RO	6
	Pond		PD	6
	ESSFwcp4			
	Krummholz		KR	8
	Rock outcrop (including Talus)		RO	11
			Total	**1190**

Fauna

There does not appear to be any detailed inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion ecosection context report (Utzig et al. 2003) for the ESSF in the SCM can be found in the park, at least seasonally. The park's high elevation mountain pass location, limited size and minimal landscape variation limits the diversity of fauna compared to other low elevation and larger parks. The park is known to include habitat for the red-listed mountain caribou, and the blue-listed grizzly bear.

5.5.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes the headwaters of the Summit Creek and Stagleap Creek watersheds. The upper portion of the Summit Creek watershed also includes Bridal Lake.

Fisheries

There appears to be no fisheries information available for Stagleap Creek. Bull trout, kokanee, rainbow trout and westslope (Yellowstone) cutthroat trout are reported to occur in the lower reaches of Summit Creek (MSRM 2003). Bridal Lake is also reported to contain westslope cutthroat trout, with them potentially spawning near the outlet. Outside the park, westslope cutthroat trout and kokanee have been stocked in Summit Creek.

5.5.4 Potential Biodiversity Conservation Roles

5.5.4.1 Representation

Stagleap Park's relatively small area and limited BEC unit and landscape diversity restrict its potential representation contribution to the BEC unit level. Stagleap provides representation for 3 out of the 4 landscape elements identified for the ESSFwc4 in the SCM (RR, SVB and SVW), and a good cross-section of site series defined for the ESSFwc4. Occurrences of the ICHmw2, ESSFwc1 and ESSFwcp4 are too small to be very significant from a representation perspective.

5.5.4.2 Local Habitat Supply

The park provides important local habitat for the red-listed South Selkirk mountain caribou population. It also provides some summer range habitat for other high elevation species and ungulates; however, it does not appear to provide significant area of critical habitat for grizzly bears.

Given the forestry management in the surrounding area, both private and crown, the amount of late seral forest cover is the landscape level habitat feature most likely to be threatened in the future. Maintaining mature and old forest cover with stand structural characteristics within the range of natural variability over as much of the park as possible, especially in wetter ecosystems will likely provide habitat elements that are in reduced supply in the surrounding area.

5.5.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002a), Stagleap Provincial Park was assessed as being at high risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a rating of 13 out of a possible score of 36, with high scores for rare species and/or habitats, as well as the diversity of those species/habitats. The park was ranked relatively low with respect to ecosystem representation and special features.

With respect to risk factors, Stagleap Provincial Park was given a score of 7 out of a possible of 16, with size and shape of the park being the main risk factors. Access, both the infrastructure itself as well as the range of human uses of the park it enables, were identified as the main threats to conservation values within the park. Access is considered to be a significant stress to the entire park on a year round basis, and the trend is believed to be increasing. Impact felt to be relevant to the risk rating included: species and population losses, habitat loss and fragmentation, and water quality changes.

A review of the threats existing within the park and its greater ecosystem as part of this project confirms the outcome of the CRA process, an environmental risk rating of high.

5.5.6 Proposed Ecological Conservation Management Direction

Given that some of the significant stresses on Stagleap Park are assumed to be long-term (e.g., the highway, human use, adjacent utility corridors), it is not considered feasible for the park to fulfill a low risk ecological conservation role in the foreseeable future. Therefore, the proposed ecological conservation management direction seeks to minimize risk from factors that can be controlled, and thereby maximize the effectiveness of the park in contributing to broader ecological goals, as much as possible. This includes some minor changes to current management, and an emphasis on maximizing opportunities within the area of cooperation.

5.5.6.1 Zonation

There is presently no zonation designation for Stagleap Park. It is recommended that portions of the park that provide critical mountain caribou habitat be zoned as Ecological Protection to assist with the recovery of an internationally significant population of a red-listed species, and the remainder of the park be zoned as Local Conservation to ensure that ecological integrity is maintained within the park, while still allowing low intensity recreation uses that are compatible with that intent.

5.5.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for Stagleap Provincial Park

Overall Goal: Reducing Risk Towards a Moderate Level

The following table summarizes identified issues and associated recommendations of objectives, strategies and performance indicators.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
Lack of baseline ecological information	Lack of information limits strategic conservation planning and precludes defining operational-level management direction; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation. Conduct reconnaissance habitat inventory and develop a species list for the park, preferably in cooperation with similar efforts for the surrounding area of cooperation	PEM ground truthed and modifications made as required. Basic inventory completed, species list for the park compiled.
General impacts from recreation activities	Given that the park is located on a tourism travel route and provides local outdoor recreational opportunities, there is need for basic and ongoing management of recreational use to protect ecological values.	Park	Minimize impacts from recreational use on access-sensitive species.	Using park zoning to ensure that recreational use is limited to areas where there are no conflicts with caribou and grizzly habitat use. • Within the local conservation zone, establish clear objectives to serve as a baseline for monitoring limits to acceptable change • monitor impacts and use an adaptive management approach as required to achieve the defined objectives	Species displacement levels are low.
Seral stage distribution and fire management	Reduction in old and mature forest in the greater park ecosystem undermines ecological integrity.	Park	Maximize old and mature forest cover and stand structural diversity appropriate to the natural disturbance regime.	Suppress fires within the park. In cooperation with managers and stakeholders in the greater park ecosystem, coordinate establishment of OGMAs and areas of mature retention to maintain connectivity and patch size distribution compatible with the range of natural variability.	Compatibility of seral stage distribution and stand structures with the range of natural variability.
Invasive species	Invasive species reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive weeds in the park	Implement a program to control invasive species, preferably in cooperation with similar efforts for the surrounding area of cooperation. Work with MOT to reduce the spread of noxious weeds along their right-of-way.	Species identified through the reconnaissance habitat inventory. Partnership group develops control strategies. Control strategies implemented.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Performance Indicator
The highway pullout at Bridal Lake provides a unique opportunity to educate the public about ecological conservation goals.	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Coop-eration and Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Increase community understanding of the role of the park and the trade-offs that have been made by locating major highways through parks in relation to broader ecological goals. Use the park location (i.e. a stopover on a major tourism route) as an opportunity to distribute information to the general public on the importance of ecological conservation measures intended to protect biodiversity and maintain ecological integrity. Ensure backcountry users understand the potential impacts of recreation on mountain caribou, grizzly bears and other park values.	Number of people supplied with information. Knowledge levels of those supplied with information. Recreational use is consistent with zoning (i.e. respect for Ecological Protection Zone).
Lack of coordination between managers in the greater park ecosystem.	Given the small size of the park, achievement of its potential ecological conservation role requires complimentary management within the greater park ecosystem.	Area of Coop-eration	Ensure that management in the greater park ecosystem supports the ecological conservation roles of the park	Drawing on current research and best practices for protecting ecological values and processes within parks, work with greater park ecosystem managers and stakeholder interests to: • maintain connectivity between Stagleap Park and the surrounding area, especially West Arm Park, • assist with the recovery of viable populations of caribou and grizzly bears in the southern Selkirk Mountains, • minimize highway-related impacts on wildlife and aquatic habitats, and • manage motorized access to eliminate negative impacts in critical habitat areas.	Implementation of management regimes in the greater park ecosystem that enhance the conservation role of the park
Water quality in Bridal Lake.	Previous studies have identified road sand and road salt impacts.	Park	Restore and/or maintain water quality and aquatic habitats.	Work with MOT to eliminate salt and sediment from highway and parking area runoff from entering Bridal Lake and Summit Creek.	State of water quality and aquatic habitat in an around Bridal Lake.

5.6 West Arm Provincial Park

5.6.1 Park Description

5.6.1.1 Park-Specific Information Sources

A Management Direction Statement (MDS) was developed for West Arm Provincial Park in 1999. This was followed by a Background Report in 2000 to support the Management Plan that was developed in 2002. The most recent Annual Management Plan (AMP) was completed in 2001. In 1997, BC Parks contracted I. A. Ohanjanian to undertake a preliminary assessment of red- and blue-listed species and their habitats in West Arm Provincial Park, with special attention to the Coeur D'Alene Salamander. Prior to the area being defined as a Class A park, the Ministry of Forests, Kootenay Lake District undertook resource management planning with a focus on the West Arm of Kootenay Lake, as well as a Coordinated Resource Management Plan for Lasca Creek. The Ministry of Forests documents provide insight into timber and visual values as well as some information on ecological values for the area that is now West Arm Provincial Park. The Protected Areas System Overview (PASO) also provides some information on the park. Finally, a formal ranking of West Arm Provincial Park was undertaken as part of the 2000/01 Conservation Risk Assessment (CRA).

5.6.1.2 Location and History of Park Development

West Arm Provincial Park is located in the Selkirk Mountains just east of the City of Nelson on the south shore of the West Arm of Kootenay Lake. It encompasses 25,319 ha and includes the headwaters of Selous, Anderson and Fell creeks immediately southeast of the City of Nelson, most of the drainages of Five Mile, Lasca and Strickland creeks draining into the West Arm of Kootenay Lake between Nelson and Harrop, and the headwaters of Kutetl and Midge creeks adjoining the Lasca Creek height-of-land. Park boundaries extend into the lake 100 m along the foreshore. The park has a diverse landscape from lakeshore to subalpine, spread throughout a series of relatively undisturbed forested watersheds.

The park was proposed in the early 1990s through the Parks and Wilderness for the 90s planning process that later became the provincial strategy for identifying new protected areas known as the Protected Areas Strategy (PAS) in 1993. The park was proposed to protect watershed, viewscape, biodiversity, and recreation values. The park proposal initially excluded the Lasca Creek drainage and an 8-km access road was subsequently built into the drainage. In the Protected Areas Strategy process, the West Arm Provincial Park proposal was ranked as the fifth highest priority for protection out of 102 study areas identified in the West Kootenays. It was recommended for protection to increase protected area representation in the under-represented Southern Columbia Mountains Ecosection (SCM). Consequently, the 25,265 ha area including Lasca Creek was designated a Class A Provincial Park on July 12, 1995 under the Park Amendment Act, 1995. An addition of 53.6 ha, that included some previously harvested areas at the Midge/Kutetl Creek confluence, in 1995 resulted in the park's current size of 25,319 ha. The forest development road into Lasca Creek was deactivated after park establishment. The park is currently named and described in Schedule C of the Protected Areas of British Columbia Act.

There are only two access roads into the park, the first being the Lasca Creek Forest Service Road and the second is the Svoboda Road, which accesses private residences and the water intake at Five Mile Creek. Recreational access into the park is via the Lasca Creek trailhead; the Svoboda Road mountain bike trails; the Whitewater ski resort and inactive Hummingbird Forest Service Road; a private forestry road to the confluence of Midge and Kutetl Creeks; the inactive Burlington Northern Rail line; the Harrop Creek trail and a trail adjacent to Proctor Creek.

5.6.1.3 Human Use of the Park

West Arm Provincial Park contains one known archaeological site. The presence of many more sites outside the park boundary suggests that the area has a long history of human use. The early European presence included two small mines, the Hummingbird and Bayonne, and the Lasca Creek trail. The Western Canada Wilderness Committee developed the 13 km Lasca Creek trail from a turn of the century mining trail to a recreational trail in 1992. The trail leads people to the ridgeline and the many connecting ridge systems within the park. The Lasca Creek Trail and the Svoboda Road mountain bike trails are the only established trails in the park, although there are numerous user-developed small trails cut without permission from BC Parks. There is also evidence of squatters using the park at times.

The key recreational features of West Arm Provincial Park support the following activities:

- forested terrain of the park contributes to a diverse, regionally significant, user-built mountain bike trail system covering the Nelson area;
- rock outcrops along Kootenay Lake are one of the few places near Nelson for rock climbing opportunities;
- the ridgelines in the park are conducive for a variety of hiking experiences from day hikes to overnight backpacking for all of ages;
- the pocket beaches along Kootenay Lake are the few areas along the south shore not in private land; and,
- the terrain in the headwaters and the abundance and quality of snow conditions provide some of the best backcountry skiing opportunities in the region.

While the Management Plan indicates that there is potential for commercial recreation, there are presently no commercial operations in the park.

While the Burlington Northern Rail line has been deactivated and now provides recreational access into the park, the Canadian Pacific Rail line remains active and runs through the park close to the lakeshore.

Tenures and licenses associated with West Arm Provincial Park include:

- railway right-of-ways that bisect the park;
- numerous water licenses. Five Mile Creek provides about 80% of Nelson's water. Under its water license, the city has a small dam, spillway, and intake house on Five Mile Creek about 4 kilometres south of Kootenay Lake. The City also has rights on Anderson, Selous and Fell Creeks. There are domestic and/or irrigation licenses on Selous, Lasca, Eight Mile, Tunstall, Hermitage, Anderson, Strickland and Stephanie Creeks that lie within the park;
- 5 Trapping licenses;
- 1 guiding license;
- Hummingbird Forest Service Road, which is inactive and overgrown, as well as Lasca Creek Forest Service Road that was constructed to 8km but has been cancelled and is gated at the park boundary;
- water-ski course license partially within the park;
- stream gauge station;
- access road permit to a privately owned lot;
- underwater log salvage under permit on West Arm;
- possibly 10 mineral claims; and,

- in the winter of 2003, Whitewater Ski Resort was issued a tenure to conduct backcountry guided ski trips into the park. The resort has also applied to construct cross country ski trails in the park, but not decision has been made on that application to date (Mike Adams, Whitewater Ski Resort, *pers.comm.*).

5.6.1.4 Current Management Direction and Focus

West Arm Provincial Park has been given tourism and recreation roles along with cultural heritage roles. The Management Plan states that the conservation role of West Arm Provincial Park is to protect and preserve representative natural ecosystems of the SCM, including:

- old-growth forests and complete watersheds from the lakeshore of Kootenay Lake to the alpine;
- contributing to the protection of a variety of ecosystems including the BEC units of the SCM;
- species and habitat for grizzly bear (blue-listed) and mountain caribou (red-listed);
- slender sedge (blue-listed) growing site on the scree slopes of Ymir Mountain;
- serving as a seasonal migration linkage for caribou and grizzly bear to Kootenay Lake and wildlife movement in general through the Southern Selkirks;
- the community water supply of the City of Nelson; and
- the viewscape from the north shore of Kootenay Lake, the City of Nelson and from the Whitewater Ski Resort.

Park documents and interviews with staff have highlighted what are considered to be the key ecological values and issues. The following summarizes that information, respective management and relevant questions/comments that need to be considered through this pilot initiative. As such, the following is not a complete list of topics/issues that need to be considered through the pilot, rather those that have been identified through existing park documents and sources. The intent is to describe the starting point from which park management might evolve to better meet its conservation mandate with respect to West Arm Provincial Park.

Table 5.10. Summary of existing information and management direction.

Existing Ecological Information	Current Management	Comments/ questions to be considered in this project
Representation • park contains many of the landform, vegetation, habitat and wildlife characteristics of SCM • highly representative due to inclusion of several drainages, lakeshore to mountain top elevation range and diversity of vegetation and wildlife • contains provincially significant subzone variant (ICHdw) • primarily representative of the cooler aspects of the SCM, but there are some areas of warmer BECs including in the upper elevations of the Kutetl. There are some very good stands (old,	Within constraints of available resources, Parks managers are attempting to work cooperatively with other agencies and interests on issues of common concern. While the Management Plan calls for the development of an ecosystem management strategy that incorporates principles of ecological integrity, no action has yet been taken. Suppressing fire due to concerns of water quality for City of Nelson and domestic users. The stated policy is that all fires at West Arm Provincial Park will receive initial attack. Efforts to acquire key private lands and	As it is the only large area park within the Southern Columbia Mountains ecosection, West Arm Provincial Park is certainly an important protected area. The pilot will consider representation so as to clarify how the park contributes to the ecosection, associated BEC units and hydrological systems, including to what degree it can fulfill a connectivity role given there are no other large area parks within the ecosection.

large size) in the upper end of the Kutetl. Overall is fairly productive but does not include good representation of the beargrass dominated systems that are found elsewhere within the ecosection – likely be cause it contains mostly cool aspects. (Braumandl, Pers. Comm.) • although entirely within SCM, is in close proximity to the CCM. However, there are major barriers (river, roads, settlement). • Park establishes a strategic connectivity link to the US border and between the major protected areas within the West Kootenay that join the Southern Selkirks to the Purcells; this connectivity is critical to providing for genetic exchange and dispersal of species throughout the region.	pursue conservation covenants with landowners in the interim are being taken, although managers report such actions are inconsistently being pursued.	
Grizzly • Provides link to Stagleap and US • year round use of the park – Kutetl Creek in the summer, also avalanche tracks • small number of bears in the park • protects internationally significant habitat for Grizzly bear recovery program	Bear management focused on human/bear conflicts.	Will consider the role of the park relative to the greater park ecosystem for grizzly bears.
Caribou • use of the park is increasing in the Kutetl and along the ridge • protects internationally significant habitat for Mountain Caribou recovery program	Work with other staff in MWLAP who are addressing caribou issues. Have been some transplants into the area, has been stated that desire is do more transplants	Will consider the role of the park relative to the greater park ecosystem for mountain caribou.
Old growth Engelmann Spruce/Subalpine fir in Kutetl Creek	No specific management actions taken.	Need to consider the significance of old growth in the park relative to the greater park ecosystem. Additionally, need to clarify any assumptions that stakeholders within the area of cooperation may be making in terms of the park's contribution to meeting old growth targets and whether or not those are consistent with the potential ecological conservation roles of the park.
Water supply for City of Nelson and domestic water licenses	Have had preliminary discussions with City of Nelson regarding development of a long-term Community Watershed	Will consider the relationship between managing for community and domestic water use and other ecological values

	Management Plan	and processes.
Previously harvested areas in Kutetl drainage	Have been some efforts to assess the risk to natural values of cut blocks and associated roads.	Restoration opportunities.
Fisheries and general wildlife concerns	No significant actions taken to implement fisheries direction in Management Plan. With respect to wildlife, a preliminary study of red and blue-listed species was undertaken. No actions taken with respect to hunting and trapping issues.	Will review existing management direction for fisheries and wildlife and consider it within the context of the greater park ecosystem and area of cooperation.

5.6.2 Regional and Landscape Context

5.6.2.1 Ecological Context

Ecosection/ Bigeoclimatic Unit/ Hydrologic Features

West Arm Park is located in the Nelson Range of the southern Selkirk Mountains near the northern edge of the SCM. According to recently revised BEC mapping, the park has an elevational sequence of BEC units, beginning with the Dry Warm Interior Cedar - Hemlock Subzone (ICHdw) at lower elevations, followed by the Salmo Moist Warm Interior Cedar – Hemlock Variant (ICHmw4), the Salmo Wet Cold Engelmann Spruce – Supalpine Fir Variant (ESSFwc5), and the forested, upper open forested and parkland Ymir Wet Cold Engelmann Spruce – Subalpine Fir variants (ESSFwc6, ESSFwc6u, ESSFwc6p; see the companion ecosection report for further descriptions of the BEC units – Utzig et al. 2003). The park is 4.1% of the ecosection and includes the following percentages of the BEC units in the BC SCM: 1.8% of the ICHdw, 6.7% of the ICHmw4, 19.4% of the ESSFwc5, 22.9% of the ESSFwc6/wc6u and 11.9% of the ESSF parkland. Previously the park had been mapped as ICHdw, ICHmw2, ESSFwc1, ESSFwc4 and ESSwc4p (Braumandl and Curran 1992).

West Arm park contains six of the seven landscape elements identified within the SCM, including main valley bottoms adjacent to major lakes, main valley face units, secondary valley floors and sidewalls, rounded ridge crests and high elevation ridgelines and mountain passes (MVL, MVF, RR, SVB, SVW and HR; for further information on landscape elements – see also Section 2.2.).

Disturbance Regimes

The ICHmw4, ESSFwc5, ESSFwc6 and ESSFwm are classed as Natural Disturbance Type 2, defined as an area with infrequent stand-replacing disturbance events (BC MoF 1995 and MoF 2001). The ICHdw is classed as Natural Disturbance Type 3, defined as an area with frequent stand-replacing disturbance events (BC MoF 1995). The natural disturbance regime for the area including West Arm Park is likely dominated by moderate to long intervals of low intensity gap-replacement stand level disturbance by insects, fungi and wind, interrupted by infrequent stand-replacing crown fires. Estimates for return intervals for stand-replacing fires in associated ICHmw2 and ESSFwc4 variants vary from about 100 years for dry sites on warm aspects to over 500 years on wet sites and cool aspects (Dorner et al. 2003). Although the climate associated with the BEC variants in the park is slightly warmer and drier than those variants, this is somewhat compensated by the predominance of cooler more northerly aspects within the park. The higher elevation upper valley portions of the park, as well as moist riparian areas were likely subject to stand-replacing disturbance intervals approaching the upper limits of the range. Most stand-

replacing disturbances are wildfires of various sizes, but may also include as outbreaks of defoliating insects, bark beetles and root diseases.

The lower elevation face units, dominated by ICHdw and lower parts of the ICHmw4, are more likely associated with 150 to 200 year return intervals for stand replacing events. Westerly and southwesterly warmer aspects within these areas (e.g., the valley mouths of Five Mile and Lasca Creeks) also likely include areas subject to mixed fire regimes. Recent studies have found evidence that warmer aspects with drier site types within the ICHdw were subject to mixed disturbance regimes that included high frequency (~14-65 years) low-intensity ground fires in some locations, favouring the development of open stands of ponderosa pine, Douglas fir and western larch (Quesnel and Pinnnell 2000).

Between the stand-replacing events, low intensity gap-replacement stand level disturbance by insects, fungi and wind would also have operated on a continuous basis. Steeper slopes were also subject to landslide disturbances and the floodplains and fans were also subject to flooding and channel migration. For further discussion regarding of the importance of flooding for some ecosystems on alluvial fans see the reports regarding ecosystem management and restoration for Kokanee Creek Park (Holt et al. 1998, Holt and Wood 2001, Slaney et al. 2003).

Greater Park Ecosystem

Although West Arm Park is relatively large in size, its functional relationships are somewhat limited due to its location at the junction of the West and South Arms of Kootenay Lake. However for ungulates and other wide ranging species who are able to cross the lake, there is potential for interaction with a significant area surrounding the boundaries of the park itself. From a hydrologic systems and fisheries perspective it includes a number of drainages that flow into the West Arm and a portion of Kutetl and Midge Creeks that flow into the South Arm.

From the perspective of terrestrial species, the park is functionally connected to the home ranges of those species that frequent the park. The most extensive mammal species are likely to include ungulates and bears. The Southern Selkirk Caribou Population has been documented to move as far south as the US border, and across the West Arm of Kootenay Lake. Home ranges of other ungulates likely extend to winter ranges across the West Arm and into areas along the shores of the South Arm.

Less direct links extend well beyond the immediate park boundaries. Migratory bird species may indirectly link the park to habitats outside BC, while hydrologic processes link the creeks within the park to the whole Columbia basin.

5.6.2.2 Management Context

Area of Cooperation

The immediate area of cooperation for West Arm Park is the Ministry of Forests Landscape Units that include the park and areas adjacent to the park, Kootenay Lake Forest District LUs K07 and K09 and to a lesser extent LU K10 and K11. To more fully capture the home ranges of the Southern Selkirk Caribou Population will also require reference to relevant portions of LUs K04 and K01, Arrow Forest District LU N505, and relevant areas in the states of Washington and Idaho. These capture the majority of the terrestrially significant areas within the greater park ecosystem and the main watersheds associated with the park. The greater park ecosystem is also affected by decisions taken regarding the Midge Creek Wildlife Management Area, Darkwoods Forestry Ltd. with respect to Managed Forest #40, Kootenay Lake TSA, the Kootenay-Boundary Higher Level Plan, and Wildlife Management Unit 4-7.

Management within the Greater Park Ecosystem

The park is bounded by both Crown and private lands. Most of the northwestern edge of the park is either bisected or determined by the Canadian Pacific Railway line. The park abuts private lands near the town

of Nelson and various other recreational lots along the West Arm of Kootenay Lake, notably the Lasca Creek fan. The southeastern boundary runs along Managed Forest #40 owned by Darkwoods Forestry Ltd. The southwestern and northeastern portions of the park are bounded by crown land.

The crown lands surrounding the park are part of the Kootenay Lake Timber Supply Area. The areas southwest and northeast of the park in LU K09, K11 and the ICHdw areas of K07 have been assigned a Low Biodiversity Emphasis Option, while the remaining areas in K07 and K10 have been assigned an Intermediate Biodiversity Emphasis Option. There are no biodiversity management requirements for retention of mature forest in any of the adjacent BEC units, except the ICHdw at the lower elevations of K10. The park occupies an important link in the regional connectivity network that extends north-south along the Nelson Range of the Selkirk Mountains. However, no management requirements are attached to the designation, except to use mature and old forests retained under other provisions to meet the connectivity objectives.

All of the slopes along the West and South Arms of Kootenay Lake near the park have been designated Class 1 Scenic Areas. In addition other areas in Apex Creek and along the Salmo River have been designated Class 2 Scenic Areas. These will result in some level of retention of mature timber to maintain visual quality on crown lands; however, the exact nature of the retention is presently under review (Steve Flett, MSRM, *pers. comm*.). Much of the ESSF forested and parkland, as well as some upper portions of the ICH along the Nelson Range surrounding the park have been mapped as part of the management zone for the Southern Selkirk Caribou Population. Management of caribou habitat in these areas requires retention of significant areas of old and mature forest. However the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.). The face units along Kootenay Lake have previously been mapped as ungulate winter range, and the management guidelines for these areas are also currently under revision (Guy Woods, MWLAP, *pers. comm*.).

The Midge Creek Wildlife Management Area is comprised of the face units of Kootenay Lake to the east of West Arm Park and the area of the Midge Creek watershed north of Midge Creek Park. Detailed management plans have not yet been developed for the area (Guy Woods, MWLAP, *pers. comm*.); however, the objectives, as outlined in the KBLUP Implementation Strategy (Kootenay IAMC 1997, App. 6, p.38) state that the area will be managed to “ensure that diverse ecological characteristics and values, including rare an endangered flora and fauna, are maintained and that such management is integrated with resource development activities …. [and provide] support for the West Arm Park as the WMA includes south aspect lower elevation wildlife habitats that are absent in the park and are essential for seasonal wildlife migration and movement. Such movement corridors are important for wide ranging species, particularly as they extend from the higher elevations to the lakeshore.”

A portion of Kutetl Creek and the southwestern portion of the Midge Creek drainage, including most of Seeman Creek is part of Darkwoods’ privately owned Managed Forest #40. These areas are primarily managed for intensive timber production. The Harrop Procter Community Forest is located directly east of the park. This area has recently been certified by the Forest Stewardship Council, and is being managed to maintain high quality water for domestic and irrigation purposes, and to maintain a high degree of ecological integrity. A downhill ski development is located in Apex Creek, immediately to the south of the park

5.6.2.3 Identified Threats and Stressors to Ecological Integrity

The primary threats to the park are associated with railroad line running along the West Arm, recreational activities spilling into the park from nearby Nelson and the Whitewater Ski Resort, water diversion from Five Mile Creek and the boundary location within Kutetl Creek. Not only does the railroad involve significant habitat conversion within and along the park, including some key alluvial fans and wetland areas, but it also provides a vector for the movement of invasive species and severely restricts connectivity between the upland areas of the park and the lakeshore. The presence of private land and recreational development along the West Arm shoreline and on the fans of Heritage, Five Mile, Tunstall, Eight Mile and Lasca Creeks results in habitat conversion of sensitive wetland and riparian habitats, and

prevents inclusion of fully intact watersheds in the park. The City of Nelson and nearby Mountain Station occupy the lower reaches of Anderson and Fell Creeks. Most of the flow in the last four kilometres of Five Mile Creek is diverted to supply water to the City of Nelson. The western and southeastern boundaries of the park followed surveyed lines that dissect Anderson, Selous and Kutetl watersheds, limiting the potential for aquatic protection in those watersheds. Proximity to the City of Nelson and Whitewater Ski Resort provides significant pressure for recreational activities such as mountain biking and backcountry skiing, which if not properly regulated could provide threats to some conservation values.

Whitewater Ski Resort, located adjacent to the southeastern boundary of the park, is currently completing a 25 year development plan that identifies four additional chair lifts, three within the Apex Basin that is currently used, and one in Qua Basin. The actual rate of development will be dependent on overall growth of the business. The plan has gone through the public review process and Whitewater Ski Resort is currently addressing concerns that were identified by MWLAP, before submitting the final plan to Land and Water BC for a decision. Additionally, Whitewater Ski Resort has recently been granted a tenure to conduct backcountry guided ski trips into West Arm Park. The resort has also applied to develop cross-country ski trails into the park (Mike Adams, Whitewater Ski Resort, *pers. comm*.).

Past timber harvesting, mining, urban and rural development and construction of transportation and utility corridors in the greater park ecosystem have had significant impacts on the ecological integrity of some ecological values associated park, especially caribou and grizzly populations. Potential future threats are primarily associated with continuing forestry development in the greater park ecosystem and expanded urban and rural development surrounding the park.

Although West Arm Park is large in size and relatively undisturbed, the park is still significantly impacted by highways, agricultural development and intensive rural/urban development in its vicinity. In a recent study of grizzly bear habitat and population fragmentation in the West Kootenays, Proctor (2001) has identified a series of sub-populations of grizzly bears in the Selkirk Mountains based on the genetics of individual bears. His study sampled DNA of grizzly bears in the Central and Southern Selkirk Mountains and compared those results with the genetic characteristics of bears in the surrounding area. The results indicate that the sub-population of grizzly bears that occurs in the West Arm Park area are genetically isolated from bears across the West Arm of Kootenay Lake (along Highway 3A) and from grizzly bears in the central Purcells across the South Arm of Kootenay Lake.

The study found no evidence of recent movement or dispersal of bears into or out of the area surrounding West Arm Park, resulting in a fracture zone between grizzly bear populations in West Arm and Kokanee Glacier Parks, as well as between West Arm Park and the Purcell Conservancy. The lack of connectivity between the two sub-populations north and south of the West Arm is of sufficient duration to create a large genetic distance between the two. It is suggested that the main contributing factor to the fracture of the population is the relatively dense rural settlement along the West Arm. In addition to increased human activity along the West Arm, loss of ecological integrity of the area, particularly fire suppression and loss of natural kokanee spawning, has also reduced habitat quality in that fracture zone. Meanwhile the sub-populations in the Kokanee Glacier area and the West Arm – Stagleap Park areas continue to be at high risk due to human-caused mortality, displacement and habitat degradation. Unless connectivity can be re-established, the demographic isolation of these sub-populations will lead to further increases in risk due to the loss of the “rescue effect” from dispersing migrant bears from other “healthy” populations.

5.6.3 Ecological Features of the Park

5.6.3.1 Geology and Terrain

The bedrock geology of West Arm Park is dominated by igneous rocks of the Nelson pluton, which was intruded into the surrounding rocks during the middle to late Jurassic (Andrew et al. 1991 and Little 1960). These porphyritic granites, granodiorites and other intrusive rocks outcrop extensively throughout the park, except along the southern fringes.

The bedrock of the lower Selous Creek and Anderson Creek area is older basaltic and related volcanic rocks of the Elsie Formation (Rossland Group) dating from the lower Jurassic. Sedimentary rocks consisting of argillite, siltstone and impure limestones of the Early Mesozoic Ymir Group are found along Evening Ridge and in upper Selous Creek. In the Mount Lasca and upper Kutetl Creek area, the Nelson plutonic rocks also contain significant inclusions of Ymir Group rocks, as well as older siliceous argillites, phyllites and grey limestones of the Upper Mississippian to Lower Permian Milford Group. The oldest rocks of the park, dating from the lower Paleozoic occur at the mouth of Kutetl Creek and in upper Midge Creek. These consist of quatzites, schists, slate and limestones of the Lardeau Group (Andrew et al. 1991 and Rice 1956).

Terrain at the upper elevations of the park is dominated by bedrock, coarse textured and rubbly colluviums and associated talus slopes (Jungen 1980). At mid elevations, especially on the more moderate slopes, there are extensive deposits of coarse to very coarse textured gravelly and sandy morainal materials, reflecting the predominance of coarse textured plutonic bedrock in the area. More moderately textured gravelly silty and gravelly loamy morainal materials occur in upper Selous, upper Midge and a few other areas, associated with the finer textured bedrocks found in those areas. Lower valley sidewalls tend to be a mix of steeper colluvial deposits and gullied morainal materials. The valley bottoms along Five Mile and Lasca Creeks include coarse textured cobbly, gravelly and sandy glaciofluvial terraces, with minor floodplains of more recent gravelly and sandy fluvial materials. The fans at the mouths of Five Mile and Lasca Creeks are poorly sorted to well sorted moderately coarse to very coarse stony and sandy fluvial deposits (Jungen 1980).

5.6.3.2 Terrestrial Ecosystems

Vegetation and Habitats

The distribution of site series based on recent Predictive Ecosystem Mapping (PEM) for the Kootenay Lake Forest District is shown in Table 5.11. The park includes a relatively complete representation of the various site series found in each BEC unit present; however, drier types predominate, generally reflecting the coarser textured parent materials present, predominance of sloping terrain and mid to upper slope positions. Due to the generally north-facing orientation of the park, it also lacks some of the warmer habitats that characterize many parts of the SCM, such as occur along the north shore of the West Arm and the east shore of the main lake.

The distribution for site series in this park should be considered very preliminary, as the PEM for these newly defined BEC units is based on very limited field data (M. Ketcheson *pers. comm*.). The apparent lack of representation for some site series (e.g., ICHmw4 – 01 and ESSFwc6 – 03) should be not be considered definitive. Due to the minimal field data available for defining the model algorithms, these site series are likely lumped with associated similar site series (e.g., ICHmw4 – 03-04 and ESSFwc6 – 04-01 respectively).

Table 5.11. Potentially occurring land types and site series within West Arm Park based on PEM mapping (Ketcheson et al. 2002).

Site Series #	Land Type/ Site Series	Moisture	PEM Map Unit	Estimated Area (ha)
	ICHdw			
02	FdPy – Oregon-grape – Parsley fern	Dry	DO	331
01a	CwFd – Falsebox (sx-sm phase)	Mesic	XE	1355
01b	CwFd – Falsebox (m-shg phase)	Mesic	XI	604
03	CwHw – White pine – Devil's club	Moist	HD	30

04	CwHw – Devil's club – Lady fern	Wet	RD	9
	Wetlands	Wet	GW and WE	2
	Avalanche chute		AC	1
	Lake		LA	116
	Talus		TA	57
	Rock outcrop		RO	86
	ICHmw4			
02	Racomitrium – Cladonia	Dry	RC	1
03	FdCw – Falsebox – Beargrass	Dry	DB	771
04	CwFd – Falsebox	Dry	RF	1972
05	CwHw – Oakfern – Foamflower	Moist	HO	415
06	CwHw – Devil's club – Lady fern	Wet	RD	1
09	Bluejoint – Sedge	Wet	BS	4
	Avalanche chute		AC	2
	ESSFwc5			
02	Bl – Falsebox – beargrass	Dry	FB	831
01	Bl - Rhododendron - Oak fern	Mesic	FR	2070
03	Bl - Devil's club - Lady fern	Wet	FD	614
04	Bl – Horsetail - Brachythecium	Wet	FH	7
05	Sedge - Sphagnum	Wet	SS	4
	Shrub wetland		WE	1
	Avalanche chute		AC	26
	ESSFwc6			**0**
02	Bl - Rhododendron - Falsebox	Dry	FF	537
04	Bl - Rhododendron - Foamflower	Dry	RF	6365
01	Bl - Rhododendron - Oak fern	Mesic	FR	3104
05	Bl - Rhododendron - Lady fern	Moist	FL	29
06	Bl - Horsetail - Brachythecium	Wet	FH	29
	Wetlands		WE	14
	Avalanche chute		AC	197
	Avalanche runout zone		AR	17
	Pond		PD	4
	ESSFwc6u			
02	Pa – Black huckleberry – mountain-heather	Dry	WH	1953

03	Bl – White-flowered rhododendron – mountain-heather	Dry	FR	247
01	Bl – Black huckleberry – mountain arnica	Mesic	FB	897
04	Se - Willow - Horsetail	Wet	SH	201
05	Willow - Sedge	Wet	WS	180
	Wetlands		WE	128
	Avalanche chute		AC	7
	Pond		PD	4
	Talus		TA	425
	Rock outcrop		RO	637
	ESSFwc6p			
02	Bl - Heath	Dry	FH	554
03	Juniper – Mountain hairgrass	Dry	JM	106
01	Mountain-heather	Mesic	MH	42
04	Sedge – Western pasqueflower	Moist	SW	70
	Wetlands		WE	2
	Avalanche chute		AC	9
			Total	**25068**

Fauna

There does not appear to be any detailed inventory information available for the park in particular; however, it can be assumed that many of the species listed in Appendix 1 of the companion report for the ICH and ESSF in the SCM can be found in the park, at least seasonally (Utzig et al. 2003). The park's landscape diversity, range of elevation and size likely result in significant diversity of fauna compared to other smaller parks. The park is known to include habitat for the red-listed mountain caribou, and the blue-listed grizzly bear. The southern Selkirk caribou population has been imperiled for some decades due to historical over-hunting, habitat loss and fragmentation (Steeger et al. 2003). Over the past decades there have been a series of caribou transplants from other regions in an attempt to augment this population. There is presently a committee looking at further measures to recover the population to a viable level.

5.6.3.3 Aquatic Ecosystems

Hydrologic Features and Habitats

The park includes a 100 m strip of the foreshore of the West Arm of Kootenay Lake, except where interrupted by private land along the shoreline. It includes most of two 3rd order watersheds, Lasca and Five Mile Creeks. In both cases, the fans of these streams have significant areas of private land and/or railroad right-of-way. The headwaters of Midge Creek (a 3rd order sub-basin), above the confluence with Kutetl Creek is also almost fully contained within the park. Five smaller face unit watersheds are also mostly contained within the park – Strickland, Eight Mile, Tunstall, Hermitage and Fell Creeks. The lower

reaches and/or fans of these creeks are also all on private lands. Anderson, Selous and Kutetl Creeks are partially within the park boundaries. The headwaters of Lasca, Five Mile, Kutetl and Midge Creeks include some very small subalpine lakes and wetland areas.

Fisheries

Naturally occurring species in the West Arm of Kootenay Lake include kokanee, bull trout, rainbow trout, mountain whitefish, white sturgeon, largescale sucker, lake chub, peamouth chub northern squawfish, longnose dace, redside shiner, northern pikeminnow, longnose sucker, largescale sucker, burbot, prickly sculpin and torrent sculpin. Introduced species include yellow perch, westslope cutthroat, pumpkinseed, brook trout and largemouth bass (Slaney et al. 2003 and MSRM 2003).

Lasca Creek is reported to contain brook trout, bull trout, rainbow trout, westslope (Yellowstone) cutthroat trout, kokanee, lake whitefish and longnose dace, with bull trout having been stocked in the 1980s (MSRM 2003). Eight Mile Creek has kokanee, rainbow trout, westslope (Yellowstone) cutthroat trout, having been stocked with the last two species around 1950. Five Mile Creek includes rainbow trout and longnose dace, having been stocked with rainbow trout in the late 1920s. The dam and water diversion associated with the City of Nelson water intake creates a barrier to fish movement, as well as severely limiting flows in the lower reaches of Five Mile Creek. Bull trout are present in Kutetl Creek. The lower reaches of Midge Creek also include bull trout, rainbow trout and kokanee, westslope cutthroat trout, mountain whitefish and an unidentified sculpin (Radridge 2002). There are no fish species recorded for Strickland, Tunstall, Anderson and Selous Creeks.

5.6.4 Potential Biodiversity Conservation Roles

5.6.4.1 Representation

West Arm Park is the only park in BC that provides ecosection level representation in the SCM. The park represents one of the three distinct elevational sequences present in the SCM, extending from the low elevation ICHdw, through the ICHmw4, ESSFwc5, ESSFwc6, ESSFwcu6, up to and including the ESSFwcp6. In addition, West Arm park contains six of the seven landscape elements identified within the SCM, including main valley bottoms adjacent to major lakes, main valley face units, secondary valley floors and sidewalls, rounded ridge crests and high elevation ridgelines and mountain passes (MVL, MVF, RR, SVB, SVW and HR). The ICHdw includes four out of six possible landscape elements, while the ICHmw4 and ESSFwc5 have three out of four, the ESSFwc6 has four out of four, and the ESSFwcu and ESSFwcp have two out of two (see Section 2.2 for further information on landscape elements).

5.6.4.2 Local Habitat Supply

The size and topographic diversity of the park ensure that it provides significant habitat for a wide range of species typical of the SCM. If natural disturbance regimes can be allowed to maintain a range of seral stages and stand types in at least a portion of the park, the diversity of habitats will be further increased. Of special note is the provision of habitat for the red-listed Southern Selkirk mountain caribou population and the blue-listed grizzly bear.

Given the forestry management in the surrounding area (with the exception of the Harrop-Procter Community Forest), both private and crown, the amount of late seral forest cover is the landscape level habitat feature most likely to be threatened in the future. Maintaining mature and old forest cover with stand structural characteristics within the range of natural variability over as much of the park as possible, especially in wetter ecosystems, will likely provide habitat elements that are in reduced supply in the surrounding area. Some of the west-facing lower elevations at or near the mouths of Five Mile and Lasca Creeks have some potential for providing ungulate winter range; however, these will require management interventions to create openings and maintain suitable forage production.

5.6.5 Environmental Risk Status

Through the Conservation Risk Assessment (Scott-May 2002a), West Arm Provincial Park was assessed as being at medium risk due to the cumulative impacts from both internal and external stresses. An overall assessment of the conservation values gave the park a rating of 21 out of a possible score of 36, with high scores for naturalness, diversity of ecosystem representation, rare species and/or habitats, as well as the diversity of those species/habitats. The park was ranked relatively low with respect to ecosystem representation and special features.

With respect to risk factors, West Arm Provincial Park was given a score of 7 out of a possible of 16, with size and shape of the park and watershed integrity being the main risk factors. Large-scale high intensity fire was identified as the main threat to conservation values within the park. Impacts felt to be relevant to the risk rating included: population reductions and native species loss and disturbance, habitat loss and fragmentation, and exotic species introductions.

A review of the threats existing within the park and its greater ecosystem as part of this project has resulted in a conclusion that departs somewhat from the CRA conclusion. Given the size and shape of the park, the minimal development within the park, the management direction in area surrounding the park, and the zonation and management direction provided in the draft 2002 Management Plan, we would give the park an environmental risk rating of low (possibly tending to moderate). Although the potential for fire and insect attacks provide some risk to old growth values within the park, those processes are part of a functioning natural disturbance regime, and are therefore an integral part of ecological integrity. This rating is not intended to imply that there are no actions required to maintain the low level of risk to ecological integrity, but rather that the threats are generally localized, and manageable. Additionally, the management direction outlined in the draft Management Plan needs to be implemented as a review with park managers indicates that many key strategies are not being pursued, largely due to lack of resources.

5.6.6 Proposed Ecological Conservation Management Direction

Given that this park is the only park with representation at the ecosection level within the BC portion of the SCM, its importance from a conservation perspective cannot be over emphasized. The general lack of infrastructure within the park combined with a historically minimal level of low intensity recreational use and complete lack of intensive recreational use are compatible with this direction. In addition, the importance of maintaining viewscapes for surrounding urban and rural residents and tourist destinations, and high water quality for water users downstream of the park provide further pressures for maintaining the ecological integrity of the park ecosystems.

The 1999 Management Direction Statement (MELP 1999) and the 2002 draft Management Plan (MWLAP 2002) have provided a sound basis for implementing this direction. Both documents define conservation objectives as the highest priorities for this park, and express the intent to maintain recreational uses at intensities and levels that are compatible with achieving the conservation objectives. The extent to which this direction is implemented is critical to achieving the ecological conservation roles for this park.

5.6.6.1 Zonation

The 2002 Draft West Arm Provincial Park Management Plan (MWLAP 2002) identifies the following zonation approach for the park:

- the Wilderness Recreation Zone encompasses approximately 23,000 ha (91%) of West Arm Provincial Park including the major drainages of upper Midge Creek, Kutetl Creek and Five Mile Creek. The intent of this zone is to place a high priority on conserving the natural environment while providing some level of backcountry use that is consistent with its wilderness atmosphere.
- the Natural Environment Zone covers approximately 2,264 ha (8.9%) of the park. This designation is applied to the shoreline of Kootenay Lake, the Lasca Creek trail corridor, the hiking

ridges of the park and the northwest area of the park currently used for mountain biking and rock climbing.

- the Special Feature Zone is applied to archaeological site DjQg 5 - stone igloo remnants on the shore of the West Arm of Kootenay Lake opposite the mouth of Kokanee Creek. The zone covers about 3.5 ha of the park.

The zoning proposed in the 2002 Draft Management Plan is generally consistent with the conservation direction indicated above. However, with the intention of strengthening the conservation role of the park, a few changes are recommended:

- zone the area of Five Mile Creek upstream of the City of Nelson water intake, the upper portions of Selous, Midge and Eight Mile Creeks contained within the park, and the upper two western tributaries of Lasca Creek as “Wilderness Conservation”, to emphasize the conservation roles of those areas in providing intact representation for both terrestrial and aquatic habitats (intact watersheds, or at least major portions of watersheds and complete sub-basins);
- remove the Natural Environment zoning along Evening Ridge (i.e. upper Selous Creek, Hummingbird Pass and the west fork of Five Mile Creek), and move the Natural Environment Zone and associated trail along the Kutetl – Five Mile, and western Lasca - Kutetl ridgeline to the Kutetl side of the ridge to maintain the integrity of the Five Mile watershed; similarly around Mount Lasca, move the Natural Environment zoning out of the upper Midge Creek basin into Lasca Creek; and,
- following a habitat assessment of the West Arm shoreline portions of the park, designate shoreline portions of the park that have significant habitat values as Local Conservation Zone (e.g., the cottonwood stands on the Five Mile Creek fan at Troupe Junction would be a priority if this area is added to the park).

These zoning changes are generally compatible with the series of activities/uses/facilities already designated for those areas in the Draft Management Plan, except along the lakeshore where some areas would be restricted from developing amenities and be restricted in their level of use to better protect conservation values in those locations.

5.6.6.2 Proposed Ecological Objectives, Strategies and Monitoring Indicators for West Arm Provincial Park

Overall Goal: Maintaining a low risk level.

The 2002 Draft Management Plan has identified a lengthy list of objectives and strategies. The following table summarizes a few issues and associated recommendations that we feel should be emphasized to enable the park to better fulfill its conservation role:

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Monitoring Indicator
Lack of baseline ecological information	Lack of information limits strategic conservation planning and precludes defining operational-level management direction; may result in further impacts due to uninformed decisions.	Park and Area of Coop-eration	Increase knowledge of ecological values and processes within the park to support future management decisions.	Ground truth the existing Predictive Ecosystem Mapping, preferably in cooperation with similar efforts for the surrounding area of cooperation. Conduct reconnaissance habitat inventory and develop a species list for the park,– placing priority on those areas within the park that have present or projected recreational uses (preferably in cooperation with similar efforts for the surrounding area of cooperation).	PEM ground truthed and modifications made as required. Basic inventory completed, species list for the park compiled.
Natural Disturbance Regimes - fire and forest insect/ disease management	Restrictions on natural disturbance regimes undermines ecological integrity – but some park values require significant areas of mature and old forests that are disappearing outside the park	Park and Area of Coop-eration	Optimize amount and distribution of old and mature forest cover and stand structural diversity appropriate to the natural disturbance regime and maintaining all park values.	In cooperation with ecologists and other stakeholders in the Area of Cooperation develop and implement a natural disturbance management plan (including fire, insects and disease), Key stakeholders include the Harrop Proctor Community Forest, Midge Creek WHA, Darkwoods and the City of Nelson. One option would be to emphasize old growth protection in the western portion of the park, including active fire suppression in Five Mile, Fell, Anderson and Selous Creeks, and other critical caribou habitat, while emphasizing natural disturbance patterns in the remainder of the park.	Compatibility of seral stage distribution and stand structures with the range of natural variability and protection of key conservation values.
Invasive species	Invasive species reduce habitat suitability and displace naturally occurring species.	Park and Area of Coop-eration	Eliminate invasive species in the park	Implement a program to control invasive species, preferably in cooperation with similar efforts for the surrounding area of cooperation. Work with CPR to reduce the spread of noxious weeds along their right-of-way.	Species identified through the reconnaissance habitat inventory. Partnership group develops control strategies. Control strategies implemented.

Issue	Principle or Underlying Assumptions	Area of Interest	Objective	Strategy	Monitoring Indicator
Need to build public support for the ecological conservation roles of the park	Public education is the most cost-effective means of achieving the necessary support for ecological conservation goals within the park.	Park, Area of Cooperation, Region	To build and maintain the necessary public support for the ecological conservation goals within the park.	Form a partnership group for the park, perhaps in conjunction with Midge Creek Provincial Park and Midge Wildlife Management Area, to help promote public understanding of the role of the park in relation to broader ecological conservation goals and the relationship to urban development.	Partnership group for the park formed. Communication maintained on an as-needs basis. Key professionals identified and pro-active education initiated. Public communication program implemented. Tangible support expressed. Necessary resources allocated.

6.0 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations cover a range of issues that have surfaced during completion of this component of the pilot project. Section 6.1 deals with issues directly related to the pilot project. The subsequent Sections 6.2 – 6.4 address broader issues that affect the overall ability of protected areas to fulfill ecological conservation roles. The final Section 6.5 provides some specific recommendations regarding the protected areas networks in the CCM and SCM.

6.1 Completing and/or Expanding the Pilot Project

The pilot project methodology evolved in response to emerging information and the need to define potential linkages between parks management and a myriad of ongoing related initiatives. The core aspects of the approach remained useful and, on that basis, the following recommendations are being put forward with respect to completing and/or expanding the pilot project. It is recommended that:

1. The preliminary park assessments completed to date, including the accompanying ecosection context report be reviewed, and that the approach be revised as required. Update the existing draft reports and assessments as required.

2. Assessments of the remaining parks within the CCM be completed in accordance with the revised approach, including those parks that are in the Okanagan Region. Before completing the Purcell Wilderness Conservancy Provincial Park, consider expanding the approach to the East Purcell Mountains ecosection, at least in sufficient detail to fully assess the Conservancy and its role as an inter-ecosection linkage.

3. Assessments of the remaining parks within the SCM be completed in accordance with the revised approach. Completion of the SCM should include a reconnaissance review of protected areas and land management in the US portion of the SCM.

4. Once all parks have been completed within the two ecosections and the protected area network assessments have been updated, then examine the priorities and opportunities for improving ecological conservation at an ecosection and/ or regional network level.

5. MWLAP select one or two parks that have been addressed through this pilot project to pursue the next level of the process. This would include identifying key stakeholders, which may refine the area of cooperation, and form a partnership group to consider the park-specific recommendations and implement the necessary actions to develop a comprehensive ecological conservation program for the park and its greater park ecosystem. This could include a group of parks whose areas of greater park ecosystems and/or areas of cooperation overlap, thus making it more efficient to pursue the next level of the process for more than one park at a time.

6. MWLAP initiate discussion with other related initiatives as a means of improving the effectiveness of this project. These contacts should aim to establish a broader appreciation of the key concepts in this approach (i.e. greater park ecosystems, areas of cooperation, protected area network issues, ecosection level planning); and to ensure that this project is well coordinated with the other initiatives (e.g., the Provincial Biodiversity Strategy, Biodiversity Monitoring Strategy, Results-Based FPC Monitoring, Sustainable Resource Management Plans, etc.). These contacts will also begin laying the groundwork for establishing partnership groups, identifying further sources of inventory data, and building support for improved ecological conservation management within parks.

6.2 Protecting the Ecological Integrity of Parks within an Overall Ecosystem Management Approach

Provincial parks have traditionally been administered separately from the rest of the land base and this administrative isolation has negatively impacted parks and compromised our understanding of how they can, and can not, contribute to overall sustainable resource management. The need for an ecosystem management approach that reflects ecological realities, rather than emphasizing administrative boundaries, is recognized through the BC Parks Conservation Program (BC Parks 1997). However, achieving the goal has been problematic given continuing administrative barriers and limited resources.

Through this pilot project, attempts have been made to clarify the potential ecological conservation roles of both the protected areas system, as well as select parks within the CCM and SCM. One of the obvious conclusions of this assessment, especially for the smaller parks, is recognition of the need for coordination between management within the park itself, and management in the greater park ecosystem. Failure to implement appropriate management regimes in the park *or* the greater park ecosystem will undermine the ability of the park to fulfill its potential conservation role, including representation.

While implementing an ecosystem management approach is necessary to protect or restore the ecological integrity of provincial parks, an additional motivation is to enable the parks to effectively contribute to the goals of sustainable resource management being pursued on the non-protected land base. For example, it is common for government documents to state that one of the defined roles for protected areas is to serve as benchmarks for monitoring ecological change. However, due to their size, shape and/or management regimes, few parks can currently serve as such benchmarks. This creates the situation where managers outside the protected areas are operating with unrealistic expectations regarding parks, and, in fact, additional benchmark areas should be identified within the non-protected land base. The issue of benchmarks is especially critical as we move to a results-based management regime that depends heavily on the evaluation of monitoring results to maintain ecological values.

Arcese and Sinclair (1997) state that the following are necessary strategies for managing protected areas as ecological baseline controls:

- no effort is made to maintain an ecological status quo;
- human interference that confounds natural ecological processes is kept to a minimum;
- monitoring of natural and human-induced changes inside and adjacent to the baseline controls is essential; and,
- if subjective opinion perceives that human effects are, nevertheless, altering the system, then management intervention should be carried out on part o the system only, leaving the rest as its own control.

The following recommendations relate to general concepts regarding ecological conservation in protected areas that have emerged during the pilot project. These recommendations are intended to improve the context within which future ecological conservation planning proceeds.

1. It is recommended that government adopt the concepts of greater park ecosystem and area of cooperation for improving the coordination between management within and outside individual parks. These concepts provide a framework for recognizing the critical links between ecosystems and processes within and outside specific protected areas, and defining the administrative structures, decision-makers and other stakeholders outside the park who potentially influence the ability of the park to achieve its ecological conservation goals. These concepts provide a basis for MWLAP, as the primary manager of the Crown landbase within protected areas, to engage managers and stakeholders outside the protected areas in a manner that should bring benefits to all parties. The recent relocation of BC Parks within the Conservation Section of MWLAP at the regional level may assist with implementing this approach. Where parks have overlapping greater park ecosystems

and/or areas of cooperation, this concept can be applied to a cluster of parks to promote coordination and improve efficiency.

2. It is recommended that Government provide greater clarity regarding which parks, or portions of parks, are to be managed to provide ecosystem representation and at what scales. Decisions regarding ecological conservation roles have to be matched with management regimes that ensure those roles can be effectively fulfilled (i.e. that those areas can be restored or maintained at low environmental risk, or where no realistic alternatives exist, at moderate risk). Park zoning, utilizing concepts similar to those indicated in the proposed Local Conservation and Ecological Protection zones (section 2.6.1), should be applied to such areas to ensure there is no ambiguity for park managers and others who may wish to utilize such areas for benchmarks or scientific study. Summaries of protected area representation should clearly differentiate between areas that are fulfilling a representation role, and areas that are principally providing intensive recreation opportunities, or for some other reason are falling short of achieving representation requirements.

3. The BC Parks Conservation Risk Assessment procedure needs to be strengthened. A starting point would be to review the MELP environmental risk assessment procedure (MELP 2000), and determine how it could be adapted to park assessments. At a minimum, assessments should include a review of cumulative impacts and an evaluation of the greater park ecosystems to provide a broader context for the exercise. Assessments could also be strengthened through increased reliance on more comprehensive data sets and utilization of more scientifically-based analysis criteria.

6.3 Data Collection and Management

Collection of basic ecological inventories is generally driven by opportunities for resource development. As a result, previous efforts often focused on the non-protected land base and stopped at provincial park boundaries. Hence, the data gaps within parks are severe and compromise not only the ability to manage the parks, but also to define how parks can contribute to broader ecological conservation goals. Basic inventory information is required for all of the parks selected for this pilot project. It is assumed that other parks within the CCM and SCM also require the collection of basic inventory information. Beyond the need to collect more information within parks, there are also issues associated with who owns the data, data standards as well as how data is analyzed, stored and used. It is recommended that:

1. Data collection for parks be conducted through a coordinated and integrated effort involving the greater park ecosystem and area of cooperation for individual parks. Utilizing ecosections to help prioritize efforts at the finer scales and as an intermediate level to roll up and track information would ensure that a better understanding of the protected areas network was also developed. This will ensure that the information is collected in a manner that will be useful not only to park management, but also sustainable management that is dependent on contributions of the protected areas to overall ecological conservation goals.

2. Existing PEM mapping and other ecosystem inventories be evaluated on a park by park basis to identify priorities for ground-truthing and the consolidation of the various ad hoc reports and studies into a structured inventory database for each park.

3. MWLAP secure commitments from MSRM to manage data in a manner that will support ecosystem management, including ensuring that any data collected is easily accessible for analysis by ecological units, such as ecosections, watersheds and BEC units.

4. MWLAP and park planning sections review their efforts to create Protected Area Information Catalogues to better capture relevant ecological inventory information for individual parks and their greater park ecosystems. The greater park ecosystem data management should be a cooperative effort between the various members of the partnership groups. This data will provide background for monitoring and tracking environmental risk factors for individual protected areas and the protected area network.

6.4 Legislative and Policy Framework for Ecological Conservation within Provincial Parks

While the legislative framework for provincial parks was slated to change in 2000, the protected areas system continues to be guided by legislation that supports both recreational/ economic uses of parks, while simultaneously supporting protection of natural values. Thus, addressing the dual and competing aspects of the mandate is largely guided by policy. The BC Parks Conservation Program and Principles (BC Parks 1997) is now dated, but still provides a policy framework for managing parks and related conservation values, including vegetation, wildlife, geologic features and supporting data management and monitoring functions. With respect to the competing mandates, the policy states that conservation of viable, natural vegetation ecosystems, natural wildlife populations, their habitat and ecological processes, as well as geologic features "will always take precedence over their use by people" (BC Parks 1997).

The park-specific management planning process, along with subsequent operational planning, are to be used to implement this policy and integrate it with other policies, including those related to providing recreational opportunities. A priority is to be given to "conservation in BC Parks' planning and management through environmental evaluation, sound decision making, and by encouragement and support of research and education" (BC Parks 1997). However, the BC Parks Conservation Risk Assessment (BC Parks 2002), as well as this pilot initiative, have demonstrated that this policy is often not fully respected, either through the development of management plans or operational decisions. Given the legislative context, societal expectations for recreational opportunities within parks, the chronic lack of ecological inventories, and knowledge gaps related to ecological functions and processes, park managers are clearly challenged to meet the intent of the conservation program policies.

It is clear that policy-level direction has been insufficient to ensure the necessary commitment to ecological conservation within parks. As a result, the protected areas system is falling short in its responsibility to contribute to broader ecological conservation and sustainable use goals. This has considerable implications for managers of the non-protected land base, which in some cases, are making assumptions that at least some biodiversity goals and targets can be achieved within the protected areas system.

In comparison, a 1988 amendment (C-30) to the National Parks Act (C. 48, s.1.2) established that maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan. Zorn et al. (2001) suggest that the legislative change has prompted revisions to policy resulting in support for an ecosystem-based approach to park management. Although implementation has not always been consistent (e.g., McNamee 1993, Lohnes 1992), the legislation has established two important principles: the government of Canada is now legally required to make ecological conservation its first priority, and it provides a mandate for Parks Canada to assess all threats to ecological integrity in national parks, including threats emanating from outside the parks (McNamee 1993). The legislation has recently had some profound effects on shifting the balance between recreational and economic interests in federal parks and the need for ecological conservation – the prime example being the controls placed on development in Banff National Park. Another example of those effects are the present Parks Canada requirements for the preparation of Ecological Integrity Statements for each park (essentially environmental risk assessments, e.g., see the EIS for Riding Mountain National Park, Parks Canada 2002) and regularly updated State of the Park reports that serve as base documents for preparation of all management and operational plans within the parks. It is recommended that:

1. MWLAP explore the possibility of amending the appropriate provincial parks legislation to provide clear and unequivocal direction to set maintaining ecological integrity as the primary objective in the management of protected areas, similar to the Federal Parks legislation.

2. MWLAP consider requiring the preparation of ecological integrity statements and/or state of the environment reports for parks to guide ecological conservation planning and management.

6.5 The Protected Area Networks within the CCM and SCM

The following recommendations are a series of measures that will significantly improve the effectiveness of the protected area networks within the CCM and SCM. They attempt to address broader issues identified in the protected area network discussions in Sections 4.1 and 5.1. More detailed recommendations are included in the individual park sections (Sections 4.2 and 5.2).

For the CCM it is recommended that:

1. MWLAP investigate expansion of the protected area network to increase representation at lower elevations, especially in the ICHmk1. Alternatively, representation within this BEC unit will have to be addressed on the non-protected land base through other legislative and/or policy means.

2. MWLAP in conjunction with MSRM initiate a more detailed assessment of connectivity issues related to increased functioning of a protected areas network within the CCM.

3. MWLAP investigate the natural disturbance regimes and the range of natural variation for the various BEC units in this ecosection to provide a basis for setting objectives related to maintenance and restoration of ecological integrity, with special emphasis on the retention of old and mature.

For the SCM it is recommended that:

1. MWLAP investigate expansion of the protected area network to increase representation at lower elevations, especially in the ICHmk1 and ICHxw. Alternatively, representation within these BEC units will have to be addressed on the non-protected land base through other legislative and/or policy means.

2. MWLAP investigate the natural disturbance regimes and the range of natural variation for the various BEC units in this ecosection to provide a basis for setting objectives related to maintenance and restoration of ecological integrity, with special emphasis on fire return intervals, high frequency-low intensity fire regimes and mixed fire regimes.

3. MWLAP request that MoF and/or MSRM update the BEC mapping in the southern portion of the Arrow District (SCM and SFH portions).

7.0 REFERENCES

Andrew, K., T. Hoy and P. Simony. 1991. Geology of the Trail Map Area Southeastern BC – Open File 1991-6. Geological Survey Branch, Ministry of Energy, Mines and Petroleum Resources. Victoria, BC.

Arcese, P. and A.R. Sinclair. 1997. The role of protected areas as ecological baselines. Journal of Wildlife Management. 61(3):587-602.

BC Ministry of Forests. 1995. The Biodiversity Guidebook. Queens Printer, Victoria, BC.

BC Ministry of Forests. 1999. Forest Practices Code: Landscape unit planning guide. MoE, Lands and Parks. Victoria, BC. Canada. 101pp.

BC Parks Conservation Program, September 1997 (is a series of documents, including, among others, Geologic Management, Vegetation Management and Wildlife Management)

Biome Ecological Consultants. 2003. Interim site unit classification for the ICHdm and ESSFdm1. Unpubl. rep. for Galloway Lumber Company Ltd. 24pp.

Brown, D.A. and J.M. Logan. 1989. Geology and mineral evaluation of Kokanee Glacier Provincial Park southeastern BC (82F/11,14) – Paper 1989-5. BC Ministry of Energy, Mines and Petroleum Resources, Mineral Resources Division, Geological Survey Branch. Victoria, BC. 47pp. and maps.

Cissel, J.H., F.J. Swanson, G.E. Grant, D. H. Olson, et al. 1998. A landscape plan based on historical fire regimes for a managed forest ecosystem: the Augusta Creek study. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. USA. 82 pp.

Craig, J.A., J. Piccin and P.R. Dykstra. 2003. Invasive Non-Native Plants in West Kootenay Parks, Unpubl. rep. for MWLAP. Nelson, BC.

Dearden, P. and R. Rollins, eds. 1993. Parks and Protected Areas in Canada: Planning and Management. Oxford University Press, Toronto.

Dorner, B., H.Sandmann and C. Wong. [2003] in press. A quantitative reconstruction of disturbance frequency by BEC variant in the Arrow District. Chapter 3 in Estimating historical variability of natural disturbances in British Columbia, BC MoF Land Management Report (in prep). C. Wong, B. Dorner and H. Sandmann.

Dulisse, J. 2002. Moyie Lake Provincial Park Ecological Assessment. Unpubl. Rep. for BC Parks, Kootenay District. Wasa, BC. 31pp.

Eagles, P.F. 1993. Environmental Management in parks. In: Parks and Protected Areas in Canada: Planning and Management, pp154-184. Dearden, P. and R. Rollins (eds.). Oxford University Press, Toronto.

Fahrig, L. 2001. How much habitat is enough? Biological Conservation. 100:65-74.

Fairbank Engineering Ltd. 1992. The thermal system at Ainsworth Hot Springs. Unpubl. Rep. for Ainsworth Hot Springs Ltd. Ainsworth Hot Springs, BC.15pp.

Flather, C.H., K.R. Wilson, D.J. Dean and W.C. McComb. 1997. Identifying gaps in conservation networks: of indicators and uncertainty in geographic-based analyses. Ecological Applications. 7(2):531-542.

Fyles, J.T. 1967. Geology of the Ainsworth-Kaslo Area, BC. Ministry of Energy, Mines and Petroleum Resources, Bulletin 53. 125pp.

Gray, R. W., E. Riccius, and C. Wong.. 2001. Comparison of current and historical stand structure in 2 interior Douglas-fir sites in the Rocky Mountain Trench, British Columbia, Canada. In: Engstrom, R.T. and W. J. de Groot, (eds.), Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems. Tall Timbers Station. In press. Tallahassee, FL. USA.

Hammit, W. E. and D. N. Cole. 1998. Wildland Recreation: Ecology and Management, Second Edition, John Wiley & Sons, Inc., New York.

Harris, L.D. 1984. The fragmented forest, island biogeography theory and the preservation of biotic diversity. Univ. of Chicago Press. Chicago, IL. 211pp.

Hiad Venture Corporation. 1988-2000. Cody Caves Photomonitoring Project, 1988, 1990, 1994, 1997, 2000. Unpubl. reports for BC Parks. Nelson, BC.

Holt, R.F. and G.F. Utzig. 2002. Indicators, thresholds and risks – Links to a habitat supply modeling strategy and environmental risk analysis in BC – a discussion paper. Unpubl. Rep. for BC Habitat Modeling Steering Committee, BC MWLAP. Victoria, BC. 13pp.

Holt, R.F. and T.F. Wood. 2001. Terrestrial Ecosystem Restoration in Kokanee Creek Park: A Proposal. Unpubl. report by Pandion Ecological Research Ltd. prepared for BC Parks. Nelson, BC.19pp.

Holt, R.F., J.B. Korol and M.M. Machmer. 1998. Kokanee Creek Provincial Park: Inventory and Management. Unpublished report for Gary Price, Provincial Parks, Nelson Region.

Hoy, T. 1993. Geology of the Purcell Supergroup in the Fernie West-Half Map Area, Southeastern BC. Bulletin 84. Mineral Resources Division, BC Ministry of Energy Mines and Petroleum Resources. Victoria, BC. 157 pp.

Huggard, D. 2000. Ecological representation in the Arrow IFPA non-harvestable landbase. Unpublished paper prepared for Arrow IFPA. Vancouver, BC. Canada.

Jungen, J. 1980. Soil Resources of the Nelson Map Area. RAB Bulletin 20. Ministry of Environment, Kelowna, B.C. 217 pp.

Ketcheson, M.V. 1992. Biophysical Habitat Mapping for the West Arm Demonstration Forest. Unpubl. Rep. for BC Ministry of Forest – Kootenay Lake District. Nelson, BC. Report with maps and appds.

Ketcheson, M.V. et al. 2002. Kootenay Lake Forest District Predictive Ecosystem Mapping (PEM) Report, Unpubl. rep. for B.C. Ministry of Forests, Kootenay Lake Forest District, Nelson, BC.

Ketcheson, M.V. et al. 2003. Arrow TSA Predictive Ecosystem Mapping (PEM) 2003 Iteration – Improvements to the PEM Model Project Report, Unpubl. rep. for Arrow Innovative Forestry Practices Agreement (IFPA), c/o Bell Pole Co. Ltd., Salmon Arm, BC.

Kootenay Inter-Agency Management Committee. 1997. Kootenay/Boundary Land Use Plan – Implementation Strategy. BC Ministry of Forest and BC Ministry of Environment Lands and Parks. Nelson, BC. Main document, maps and appds.

Lacelle, L. 1990. Biophysical Resources of the East Kootenay Area: Soils. Wildlife Technical Monograph TM-1. BC Min. of Environment. Report No. 20 - BC Soil Survey. Victoria, BC. 359 pp. and maps.

Ladybug Consulting Services. 2001. Noxious weed management assessment for Moyie Provincial Park. Unpubl. rep. for MWLAP. Cranbrook, BC.

Landres, P.B., Morgan, P. and F.J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. Ecological Applications. 9(4):1179-1188.

Little, H.W. 1960. Nelson Map Area, West Half, British Columbia (82F W 1/2). Memoir 308. Geological Survey of Canada, Department of Mines and Technical Survey, Canada. 205 pp.

Lohnes, D.M. 1992. A land manager's perspective on science and park management. In: Science and the management of protected areas, proceedings of an international conference held at Acadia University, Wolfville, NS 14-19 May 1991, pp 19-24. JHM Willison et al. (eds.). Elsevier, Amsterdam.

McCrory, W. 1984. Grizzly bear habitat capability and use in relation to recreation facilities in Valhalla Provincial Park. Unpubl. Report prep. for Kootenay Region, Parks and Outdoor Recreation Div., BC Min. of Lands, Parks and Housing. Nelson, BC. 158pp.

McCrory, W. 1985. Grizzly bear habitat and outdoor recreation in Kokanee Glacier Provincial Park, conflicts and recommendations – Vol. 1: Summary and recommendations. Unpubl. Report for BC Parks and Outdoor Recreation Division. Champs, BC. 118pp and maps.

McCrory, W. 1986. Some comments and recommendations of wildlife management in Valhalla Park. Unpubl. report for BC Parks. Nelson, BC.

McCrory, W. 1994. Implications of the 1994 proposed core West Kootenay/Boundary land use plan on grizzly bear preservation and public safety in Kokanee Glacier Park. 14 pp.

McCrory, W. 2000. A review of the bear-people management program for Kokanee Glacier Provincial Park. Unpubl. Report for BC Parks. Nelson, BC. 88pp.

McCrory, W. and E. Mallam. 1989. Bear management plan – West Kootenay District BC Parks (1989 – 1994). Unpubl. Report for BC Parks Division. Nelson, BC. 43pp.

McCrory, W. and E. Mallam. 1992. Grizzly bear resource management report – Kokanee Glacier Park and Recreation Area. Unpubl. Report for BC Parks. Nelson, BC. 32pp.

McNamee, K. 1993. From wild places to endangered spaces: a history of Canada's National Parks. In: Parks and Protected Areas in Canada: Planning and Management, pp17-44. Dearden, P. and R. Rollins (eds.). Oxford University Press, Toronto.

McTaggart Cowan, I. And C.J. Guiget. 1956. The mammals of BC. BC Prov. Museum Handbook No. 11. BC Dept. of Recreation and Conservation. Victoria, BC. 414pp.

Meadow Creek Cedar Ltd. 1999. Forest Development Plan 1999-2003 – Coffee Creek and Fletcher Creek, Chart No. 14. Unpubl. map. Meadow Creek Cedar Ltd., Meadow Creek, BC.

Ministry of Environment and Parks. 1990. Background repot for Kokanee Glacier Park Master Plan. BC MoEP, Parks and Outdoor Recreation Division. Nelson, BC. 42pp.

Ministry of Environment Lands and Parks. 1999. Management Direction Statement for West Arm Provincial Park. MELP, BC Parks Division, Kootenay District. Nelson, BC. 7pp.

Ministry of Environment Lands and Parks. 2000. Environment Risk Assessment: An Approach for Assessing and Reporting Environmental Conditions. Habitat Branch, MoELP. Victoria, BC. (available at MWLAP website).

Ministry of Forests. 2001. Changes to Biogeoclimatic (BEC) Mapping in Kootenay Lake Forest District. Unpubl. memo. MoF Regional Office, Nelson, BC. 2pp.

Ministry of Lands Parks and Housing. 1980. Master Plan – McDonald Creek Provincial Park. Kootenay Region, Parks and Outdoor Recreation Division, MLPH. Nelson, BC. 17pp.

Ministry of Sustainable Resource Management. 2002. A regional overview of BC's protected area system (a database). MSRM Decision Support Services. Victoria, BC. Excel file: bcpas_jan02_pks.xls

Ministry of Sustainable Resource Management. 2003. Fish Information Summary System (FISS) and Fish Wizard; Accessed on the web March-June 2003 at: http://www.bcfisheries.gov.bc.ca/fishinv/ or http://srmapps.gov.bc.ca/apps/fidq

Ministry of Water Land and Air Protection. 2002. Management Plan for West Arm Provincial Park. MWLAP, Environmental Stewardship Division, Kootenay District. Cranbrook, BC. 70pp.

Ministry of Water Land and Air Protection. 2003. Cody Caves Provincial Park Base Map. MWLAP, Cranbrook, BC. 1pp.

Ministry of Water, Land and Air Protection. 2002. Evans Lake Ecological Reserve Purpose Statement. 4pp.

Nelson, J.G. 1993. Beyond parks and protected areas: from public lands and private stewardship to landscape planning and management. . In: Parks and Protected Areas in Canada: Planning and Management, pp45-56. Dearden, P. and R. Rollins (eds.). Oxford University Press, Toronto.

Noss, R.F. 1992 The wildlands project land conservation strategy. Wild Earth. Special Issue:10-25.

Noss, R.F. 1996. Conservation of biodiversity at the landscape scale. IN: R.C. Szaro and D.W. Johnston (eds.).Biodiversity in Managed Landscapes: Theory and Practice. 778 pp.

Noss, R.F. and L.D. Harris. 1986. Nodes, networks, and MUMs: preserving diversity at all scales. Environmental Management. 10(3):229-309.

Noss, R.F., J.R. Strittholt, K. Vance-Borland, C. Carroll and P. Frost. 1999. A conservation plan for the Klamath-Siskiyou ecoregion. Natural Areas. 19:392-411.

Ott, J. 1985. A food habit study of the grizzly bear in the Valhalla Provincial Park. Unpubl. Report prep. for Kootenay Region, Parks and Outdoor Recreation Div., BC Min. of Lands, Parks and Housing. Nelson, BC. 29pp. and Appds.

Panel on the Ecological Integrity of Canada's National Parks. 2000. Report of the Panel on the Ecological Integrity of Canada's National Parks. Parks Canada, Ottawa, ON. Quoted on Parks Canada website: http://www.parkscanada.gc.ca/docs/pc/rpts/ie-ei/report-rapport_1_e.asp

Parkin, T.W. 1974. Fisheries evaluation Report – Kokanee Glacier Provincial Park. Unpubl. Report for BC Parks. 38pp.

Parks Canada. 2002. Ecological Integrity Statement, Riding Mountain National Park of Canada. Wasagaming, Manitoba. Available on the web at: http://www.parkscanada.gc.ca/pn-np/mb/riding/plan/plan3_e.asp

Petrovcic, S. 2000. Reconnaissance (1:20,000) fish and fish habitat inventory of East , Enterprise, Duncan Lake tributaries, Elliot/Anderson, John and Slewiskin (McDonald) Creek watersheds. Unpubl. rep. for Slocan Forest Products Ltd. Slocan, BC.

Pollack, J. 1994. A Line Map of Cody Cave and related Surface Features. Unpubl. map. Nelson, BC.

Poole, K., R. Serrouya and R. D'Eon. 2000. Habitat selection and seasonal movements by mule deer in the Lemon Creek Drainage – SE BC, 1999-2000. Unpubl. Rep. for Slocan Forest Products Ltd. Slocan, BC. 27pp.

Poole, K.G. and G. Mowat. 1997. Mountain goat winter habitat use in the West Kootenay region of BC. Unpubl. rep. for Slocan Forest Products Ltd. Slocan, BC. 20pp.

Pressey, R.L. 1996. Protected areas: where should they be and why should they be there? In: Conservation Biology. I.F. Spellerberg (ed.). Longman Group Ltd. Essex, England. pp 171-185.

Proctor, M. 2001. Grizzly bear habitat and population fragmentation in the Central Selkirk Mountains and surrounding region of southeast BC. Unpubl. Report for Slocan Forest Products Inc. Slocan, BC. 32pp.

Province of BC. 1993. A protected areas strategy for BC. Province of BC. Victoria, BC. 38pp.

Purcell Resources Inc. 2002. Reconnaissance (1:20,000) fish and fish habitat inventory of Midge Creek. Unpubl. rep. for J.H. Huscroft Ltd. Creston, BC.

Quesnel, H. and H. Pinnell. 2000. Application of natural disturbance processes to a landscape plan: the dry warm Interior Cedar-Hemlock Subzone (ICHdw) near Kootenay Lake, British Columbia. IN: R.G. D'Eon, J.F. Johnson and E.A. Ferguson (eds). Ecosystem management of forested landscapes: directions and implementation. Papers from the conference on Ecosystem Management of Forested Landscapes, held in Nelson, B.C. on Oct. 26-28, 1998.

Read, P.B. 1976. Geology of Mapsheet 82K – West Half. – Open File 432. Geological Survey of Canada. Dept. of Energy Mines and Resources. Ottawa, ON.

Rice, H.M.A. 1941. Nelson Map-Area, East Half, British Columbia. Department of Mines and Technical Surveys, GSC Memoir 228. 86pp.

Ricketts, T.H., E. Dinerstein, D.M. Olson, C.J. Loucks, et al. 1999. Terrestrial ecoregions of North America: a conservation assessment. 485 pp.

Sather, M. 1982. Stocking Recommendations for six lakes in Kokanee Glacier Park. Unpubl. Report prep. for Park Resources Section, Prov. Parks Branch, Parks and Outdoor Recreation Div., BC Min. of Lands, Parks and Housing. 77pp.

Scott, J.M., F. Davis, B. Csuti, R. Noss, et al. 1993. Gap analysis: a geographic approach to protection of biological diversity. Wildlife Monographs. 123:1-41.

Scott-May, C. 2002. Conservation Risk Assessment of Provincial Parks within the Kootenay District: Summary of Findings. Unpubl. Rep. for BC Ministry of Water Land and Air Protection. Nelson, BC. 50pp. and Appds.

Scott-May, C. 2002a. Conservation Risk Assessment of Provincial Parks within the Kootenay District: Summary of Findings. Unpubl. Report for MWLAP, Nelson. 49pp.

Scott-May, C. 2002b. Ecological Objectives by Ecosection: Summary of Gap and Conflict Analysis. Unpubl. Report for MWLAP, Nelson, BC.

Slaney, P., H. Andrusak and T. Douglas. 2003. A conceptual plan for aquatic and terrestrial ecosystem restoration within the lower reaches of Kokanee Creek Park. Unpubl. rep. for MWLAP. Nelson, BC. 48pp.

Smith, H. 1989. Preliminary study of the Rocky Mountain Goats in Kokanee Glacier Park. Unpubl. Report for Wildland Recreation Dept. of Selkirk College. Castlegar, BC. 10pp. with appds. and maps.

Soule, M.E. 1991. Conservation: tactics for a constant crisis. Science. 253:744-750.

Spellerberg, I.F. 1996. Conserving biological diversity. In: Conservation Biology. I.F. Spellerberg (ed.). Longman Group Ltd. Essex, England. pp 25-36.

Steeger, C., S. Wilson, T. Kinley and D. Hamilton. 2003. Recovery Action Plan for the South Purcells and South Selkirks Mountain Caribou Populations – Draft. Unpubl. rep. for BC MWLAP. Nelson, BC. 25pp.

Swanson, F.J., J.A. Jones, D.O. Wallin and J.H. Cissel. 1994. Natural variability - implications for ecosystem management. In: Jensen, M.E., P.S. Bourgeron (eds.) Volume II: Ecosystem Management: principles and applications. GTR-PNW-318. pp 80-94.

Thompson, S. and G. Utzig. 1996. Ainsworth Hot Springs Watershed Assessment. Unpubl. Rep. for Meadow Creek Cedar Ltd., Meadow Creek, BC. 15pp. with maps and appds.

Utzig, G. 1983. Terrain, soil and ecological classification of the Valhalla Mountains (with forest capability and erosion hazards). Map series prepared for B.C. Forest Service. Castlegar, B.C.

Utzig, G. 1992. Terrain Stability Review: Moyie Lake Area. Unpublished Report, prepared for Ministry of Forests, Forest Sciences Section, Nelson B.C. 16 pp with appendices and maps.

Utzig, G. 1997. Terrain and Soil Inventory: West Arm Demonstration Forest (WADF). Report for Kootenay Lake Forest District, B.C. Ministry of Forests. Nelson, B.C. 33pp. with Maps and App.

Utzig, G. 2000. Level D Terrain Mapping – Moyie Lake Study Area. Unpublished Report, prepared for Crestbrook Forest Industries Inc. Cranbrook B.C. 11 pp with appendices and maps.

Utzig, G. and C. Wallace. 1997. Level D Terrain Stability Mapping - Keen Creek and Upper Portions of Kaslo River. Unpubl. Report for Slocan Forest Products Ltd. and Kootenay Lake Forest District, B.C. Ministry of Forests. Slocan and Nelson, BC. 9pp. with Maps and App.

Utzig, G. and R. Holt. 2002. Environmental trends: assessing the environmental effectiveness of the Kootenay Boundary Land Use Plan Higher Level Plan in TFL 14. Unpubl. report for BC Ministries of Water Land and Air Protection, Sustainable Resource Management and Forests. Nelson, BC. 80pp. and appds.

Utzig, G., C. Scott-May, R. Holt, M. Machmer, B. Lewis, C. Wallace and M. Carver. 2003. Ecological conservation in he Central and Southern Columbia Mountains Ecosections: a context for developing objectives, strategies and monitoring indicators. Unpubl. rep. for BC Ministry of Water Land and Air Protection. Nelson, BC. 127pp.

Withler, I.L. 1990. A management plan for lakes in Kokanee Glacier Park. Unpubl. Report for BC Parks.

Wittneben, U. 1980. Soil Resources of the Lardeau Map Area. RAB Bulletin 15. BC Ministry of Environment, Kelowna, B.C. 221 pp.

Working Committee, West Arm Demonstration Forest and Nelson Forest Region and Kootenay Lake Forest District. 1999. Strategic Plan for the West Arm Demonstration Forest, Version 1.1 (Abridged). Available on the web at: http://www.for.gov.bc.ca/nelson/district/kootenay/wadf/WADF.htm

Zorn, P., W. Stephenson and P. Grigoriev. 2001. An ecosystem management program and assessment process for Ontario National Parks. Conservation Biology. 15(2):353-362.

APPENDIX 1: OVERVIEW OF BC PARKS PLANNING SOURCE DOCUMENTS

BC Parks planning documents and research reports provided a starting point for understanding the ecological values and processes associated with each of the selected provincial parks. The following describes the available park documents and general comments about the information contained within each:

Park Background Documents are a compilation of existing information that relate to the range of values and issues known to exist within the park. The development of a background document does not generally involve undertaking new research or field work. Historically, background documents were developed internally by BC Parks staff. More recently, this work has been accomplished by contractors. In some cases, background documents lack scientific rigour with respect to ecological values and processes.

Park Master Plans provide the historical context as well as describing the biophysical characteristics, recreational opportunities, prescribed management and implementation priorities for the respective park. Master Plans are older documents, generally developed in the late 1970's or early 1980's. At that time, BC Parks had a greater recreation focus and so Master Plans tend to describe how a park is to be developed and managed for recreation. They are generally weaker in the area of ecological conservation management. The focus of Master Plans is on the area that lies within park boundaries, with few references to the relationships with adjacent lands or values. The development of Master Plans generally did not involve undertaking new research, rather they were constructed based on existing information. In many cases, a background document was first developed and then used to create the Master Plan. Overall, Master Plans provided general statements about what was known and valued with respect to ecological values and processes at the time of their creation and varied indications of management intent. In some cases, different conservation direction has been proposed through this pilot initiative based on newer information and consideration of the park within its greater park ecosystem.

Park Management Plan is the term used to describe the more recent efforts to develop comprehensive plans for parks. Like Master Plans, Park Management Plans are usually based on information gathered through creation of a background document. Management Plans tend to have a greater focus on ecological conservation management compared to the Master Plans, as well as more consideration given to adjacency values and issues. However, Management Plans continue to be constrained by the limitations inherent in the development of Background Documents as described above. Additionally, given that Management Plans are developed for individual parks, important ecological connections between parks, particularly large area parks within an ecosection (e.g., Valhalla, Goat Range, Kokanee Glacier and Purcells) may not be adequately addressed. Management Plans were historically developed by BC Parks, with little input from the former Ministry of Environment. Government restructuring will now result in Management Plans being developed by the MWLAP Planner, who is not specifically under the Protected Areas Section, as well as receiving input from both the Protected Areas and Ecosystems Sections. As a result, there are improved opportunities for integrated planning to address ecological integrity across the land base.

Management Direction Statements (MDS) have been written for some of the parks within the Kootenay region, which have not yet had full Management Plans developed for them. MDSs describe the history of the park, existing infrastructure and tenures within the park, general knowledge about ecological values and processes as well as recreational opportunities. They also include general statements of management intent with respect to both recreation and conservation management. Given that MDSs are developed without benefit of having a Background Document, the content is usually of a very general nature.

Park Purpose Statements were initiated in 2000 for parks that do not have either a Management Plan or MDSs. They are a brief synopsis of the roles an individual park is to play within the context of the

protected areas system. They also include a list of priority management issues. As such, they offer little information into the ecological values and processes within a park, but they do provide insight into general management intent and concerns.

Annual Management Plans (AMP) are the operational plans that translate the more strategic direction developed through Master Plans, Management Plans and MDSs into priority actions for staff within the Protected Areas Section of MWLAP. AMPs were historically developed by BC Parks, with no input from the former Ministry of Environment. As such, they tended to have an internal focus and have not been well linked with priorities on the rest of the crown land base. Government restructuring may provide for better integrated operational planning. However, senior support for the AMP process is in question and so it is uncertain how operational planning will proceed in the future (G. Price, MWLAP, *pers.comm*.).

Conservation Risk Assessment. In 2001, the former BC Parks undertook a conservation risk assessment (CRA) to identify key conservation and cultural values and associated risks within provincial parks in what is now the Kootenay Region. A primary goal of the CRA was to support future decision making so as to best manage and reduce the risks. The CRA was a provincial initiative that involved formal risk assessment ranking criteria. While efforts were made through the CRA to improve the general knowledge of provincial parks in the region, the formal rankings of each park were, in many cases, impacted by limited available data. The results of the CRA provide a useful starting point for discussing the environmental risk status of each selected park. However, the overall approach and criteria are distinct from the Environmental Risk Assessment Approach (ERA) used in this pilot initiative. In some cases, the risk assessment outcomes of the two processes are also different, partly due to the varying approaches, and partly due to incorporation of information that was not available during the CRA.

Research and Consultant Reports. In an effort to improve the general understanding of ecological values and processes within provincial parks, park staff have initiated inventories and studies for some parks. Given budgetary constraints, small area parks have been chosen for study so as to ensure an entire park can be inventoried. In at least one instance, a small and defined area within a large park has been studied. Also due to budgetary constraints, the fieldwork is generally limited to a few days thus providing a snap shot of park values within a particular time frame. As well, the inventories largely address values within the park boundaries so that unless similar efforts have been undertaken by other agencies or interests on the adjacent crown or private lands, the understanding of how habitats may cross such jurisdictional boundaries is often unclear. A few species-specific studies have been undertaken within parks. Some of these have been projects done by local college students or part of broader studies initiated by other agencies or interests, such as mountain caribou or grizzly bear studies that cover an area which includes part of the Purcell Wilderness Conservancy. While recognizing the inherent limitations of such studies, they have been important information sources for this pilot initiative.

Where available, additional sources were used to gain insight into the ecological values and processes within the parks. These included air photos, Predictive Ecosystem Mapping (PEM), fish stocking records, as well as inventories and assessments conducted in areas immediately adjacent to a park.