

OKANAGAN-SHUSWAP LRMP AREA SOCIO-ECONOMIC AND ENVIRONMENTAL PROFILE DRAFT

Prepared for
Okanagan-Shuswap LRMP Planning Table

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Profile Highlights

population

- 312,807 persons reside in the plan area.
- In recent years, the Okanagan-Shuswap LRMP area has been one of the faster growing areas in BC, and growth in the plan area is expected to continue at rates exceeding the provincial average.
- At forecast rates of growth population would reach around 440,000 by 2010.
- The plan area population primarily resides in urban areas - 74% in cities or smaller communities.
- The region's population is slightly older than the provincial average, and is expected to remain so.
- Several First Nations Bands reside or have traditional territory within plan area. The 1995 Status Indian population of Bands within the LRMP region (including all reserves of those Bands within the LRMP) totals 6,211 individuals.

economy

- The plan area economy is quite diversified - with strong primary, manufacturing and service sectors.
- The economy is dominated by the 'non-resource' sectors - those sectors not directly dependent on Crown land and resources.
- The largest share of personal after-tax income in the plan area - 46% - is from non-employment - a combination of transfer payments, investment income and pension income, as well as income generated through the spending of this income.
- Sectors of the economy considered to be most directly dependent on Crown land and resources are the agriculture, forest, mining and tourism sectors.
- These 'resource-based' sectors account for 19% of total after tax income basic income and 32% of total employment (including direct employment in those sectors, plus the sectors that provide goods and services to the sector and its employees).
- The relative importance of various sectors of the economy varies amongst sub-regions within the plan area.

infrastructure

- The transportation infrastructure within the LRMP area has played a key role in moving goods and people to and from the area.
- This infrastructure predominately occupies rights-of-way on Crown land.
- The plan area's ongoing need for an adequate road transportation system is being addressed through the Okanagan Valley Transportation Plan and the Trans Canada Highway Plan.
- Other infrastructure in the plan area includes hydro lines, natural gas transmission, and fibre optic and communication lines, which also cross over Crown lands.
- There are also communication sites, and water storage dams located on Crown land within the area.
- Future expansion of infrastructure will occur in response to a growing regional population, as well as needs outside the plan area.
- Infrastructure corridors require access for maintenance, as well as potential expansion needs.

quality of life

- Crown land and resources affect many of the factors that contribute to quality of life (eg. environmental quality, aesthetically pleasing surroundings, recreational opportunities, gainful employment, etc.).
- Culture and heritage are also important to many societies, and is often a particular interest of First Nations.
- Heritage areas of First Nations may include sacred areas, archaeological sites, special places such as meeting places or burial grounds, as well as broad areas, culturally important species or even the entire sense of place of a region.
- Traditional Land Use includes sustenance food gathering, plant material gathering, educational places and sacred places.

agriculture and range

- The plan area is one of the leading contributors to provincial farm cash receipts, at almost \$266 million, or 14% of the provincial total.
- This sector supports about 9% of total employment in the area economy - including direct employment as well as employment of those indirectly supporting the sector, and that induced by the spending of sector employees.
- The agriculture sector in the plan area is quite diversified:
 - ⇒ farm types include fruit (45% of total plan area farms), miscellaneous specialty crops (19%) and cattle farms (14%); and
 - ⇒ agriculture manufacturing includes wine production, and tree fruit products such as juice and jams.
- Agriculture relies directly on Crown land for:
 - ⇒ water - which is critical to the viability of the sector, both for activities on Crown land (grazing), and private land (e.g. horticulture activities); and
 - ⇒ cattle grazing - Crown range lands supply about 60% of forage requirements for cattle in the plan area.
- The demand for Crown range land for cattle forage is high in the plan area due to a shortage of private spring and fall grazing. Range is currently at 100% allocation.
- Cattle farms, were the second largest contributors to the plan areas gross cash receipts at almost 20% of receipts for the plan area.

forestry

- Average harvest over the past 5 years is about 3.9 million cubic metres (m³), with 89% from Crown lands and 11% from private lands.
- The area is also a net importer of fibre - recently estimated at 14% of total milling requirements.
- With respect to provincial Crown land, at almost 3.1 million m³ for the plan area's Timber Supply Area and Tree Farm Licenses, the plan area accounts for over 4% of the provincial allowable annual cut (AAC).
- Over the last 10 years, beetle infestations have been a significant issue, creating conflicts with other resource values and requiring modifications to forest management.
- Forest sector activity includes: woodlands (harvesting, road building, log hauling), silviculture and forest management, primary milling, and further manufacturing.

- This sector supports about 10% of total employment in the area economy - including direct employment as well as employment of those indirectly supporting the sector, and that induced by the spending of sector employees.
- Silviculture and forest management activity has grown by almost 50% in recent years, due partly to the added requirements arising from the *Forest Practices Code* and largely to Forest Renewal BC projects.
- There are 9 major sawmills, about 100 small milling and break-down operations, and 5-10 pole/post-mills in the plan area.
- The plan area has the second largest number of value-added manufacturers in the province - estimated at about 85 independents with several of the larger primary manufacturers also producing value-added products.

mining

- Most of the mineral exploration and development activity occurs directly on Crown land, and sustained or continued access to Crown land is needed to discover and develop this hidden resource.
- The mining sector supports about 5% of total employment in the area economy - including direct employment as well as employment of those indirectly supporting the sector, and that induced by the spending of sector employees.
- Known mineral occurrences include precious metals (gold, silver), base metals (lead, zinc, copper, molybdenum), industrial minerals (limestone, clay, gypsum, graphite, sand and gravel), gemstones (opal, agate) and uranium.
- There are 2 hard-rock mines currently in operation, producing marble and gypsum.
- The plan area has promising mineral potential, however exploration activity has lagged behind other areas of the province.
- Over the past 10 years, over \$10 million in exploration expenditures have been reported.
- Four mineral occurrences have sufficient reserves to support commercial development in the near future.
- Placer gold mining in the plan area dates back to the 1870s. Under current regulations commercial placer mining is restricted to six small "placer lease areas".
- Sand and gravel are probably the largest volume mineral commodities produced in the plan area. Most existing commercial aggregate pits and quarries are on private land, but several gravel pits are on Crown land.
- There are also recreational gold panning and rock hounding activities on Crown land within the plan area.

energy resources and infrastructure

- The only energy resource in the plan area with significant development potential is geothermal energy. Potential is moderate to high throughout the planning area.
- Energy infrastructure includes generating and transmission facilities for electricity and natural gas.

tourism and recreation

- Tourism and recreation activities are often one in the same - just the people undertaking the activities are from different places.

- Key activities include: fishing, canoeing, and boating, hiking, hunting, trail riding, wildlife viewing, downhill skiing, cross-country skiing and snowmobiling.
- The Okanagan is one of the most popular areas in the province for tourists - including visitors from elsewhere in BC, elsewhere in Canada, and outside of Canada.
- About 500 businesses are estimated to be directly dependent on tourism - 70% of which are highway and community related and 30% are outdoor tourism and recreation related.
- This sector supports about 8% of total employment in the area economy - including direct employment as well as employment of those indirectly supporting the sector, and that induced by the spending of sector employees.
- Tourism businesses most heavily dependent on the ability to access Crown land and resources are estimated to have generated over \$40 million in revenues and 870 person years of employment.
- Key recreation and tourism activities occurring on Crown land include:
 - ⇒ hunting: - both guide outfitting and recreational hunting - key species hunted include deer, black bear, mountain goat, mountain sheep, and cougar;
 - ⇒ camping and recreation activities in provincial parks and forest recreation sites;
 - ⇒ motorized activities, such as ATVs, snowmobiles, etc.; and
 - ⇒ Sportfishing, with small lakes forming the backbone of the Okanagan sport fishery.
- Salmon from the plan area also contribute the coastal sports fishery.

other commercial fish and wildlife harvesting

- There were a total of 78 trappers in the LRMP area in 1995.
- The plan area provides important habitat for salmon species that are commercially harvested on the coast - contributing about 9% of the total landed value for BC.
- There are also several Aboriginal fisheries in the area - salmon produced in the plan area are fished by First Nations in the South Thompson River, Shuswap River, Scotch River, Adams River, Salmon River, Little River and in the Okanagan River.

wildlife, habitat and biodiversity

- The plan area supports 300 species of birds, 74 species of mammals, 11 reptiles, 9 amphibians, and 10 - 20,000 invertebrate species.
- There are 12 ecoregions, based on broad climatic and physiographic features, and 7 biogeoclimatic zones, based on climax vegetation species, in the plan area.
- The plan area is also home to several 'rare' ecosystems (rare because they are only located in the plan area or because of historic land use practices have altered these ecosystems). Rare ecosystems are usually associated with species at risk.
- Maintenance of biodiversity (the diversity of plants, animals and other living organisms in all their forms and levels of organization) is key to maintaining the health of the environment. Key measures of biodiversity in the plan area include:
 - ⇒ Oldgrowth forests - provide structural components and arboreal lichens, which are less abundant in younger forests and are important to many wildlife species. Threats to oldgrowth include alienation of forest land, changes in forest structure, and fragmentation of existing oldgrowth due to urban expansion and development activities.

⇒ Seral stage distribution - the successional stages in forest growth from seedling to oldgrowth. A distribution that approximates natural conditions is important for maintaining biodiversity.

⇒ Connectivity - many wildlife species require the ability to move in an unobstructed and secure manner across the landscape. Maintenance of connectivity requirements of wide ranging species and between drier ecosystems are at a significant risk in the plan area.

⇒ Riparian areas - areas immediately adjoining rivers, wetlands and lakes. Much of the main valley bottom riparian areas have been affected by corridor development, stream channelization and urban and agricultural developments. Timber harvesting, agricultural activity and mining may also negatively affect riparian habitats and water.

- There are also several species of specific concern in the plan area - either because of the specific habitat management needs, because they are threatened or endangered, or because these species serve as 'umbrella' species, whose needs are representative of several other species. These species include:

⇒ *Deer* - deer populations have decreased over the last several years. Deer are susceptible to severe winter conditions, and appropriate forage and cover habitats are needed to minimize impacts of severe winters. Winter ranges have been detrimentally affected by settlement and other developments, incompatible cattle management, timber harvesting and fire suppression.

⇒ *Elk* - are located in 2 relatively small populations centred on the east side of the Okanagan valley south of Mission Creek. Elk are more sensitive to access related human disturbance than deer. Elk populations are at considerable risk from increased access and human disturbance.

⇒ *Moose* - several key wintering areas have been identified in the area, although scattered populations winter throughout the plan area in relatively low numbers. Moose populations are generally stable or increasing, and are affected indirectly and directly by forest practices, both beneficially and detrimentally.

⇒ *Mountain Goats* - occur in a variety of ecosystems in the plan area. The best information is available for populations in the central and southern portions of the area - with major mountain goat herds located in the lower Similkameen River, Penticton Creek, and the Shuswap River drainage near Sugar and Greenbush lakes. Some evidence has suggested that the goat population may be slowly expanding. Due to the ruggedness of most goat terrain, land development impacts have been minimal although there is potential for localized impacts.

⇒ *Rare (Red- and Blue- Listed) Species* - 36% of BC's red-listed vertebrates occur in the plan area, with most of these found in the South Okanagan and the lower Similkameen valleys (one of Canada's four most endangered ecosystems). The area also contains 57% of BC's blue-listed species, and supports 74 red-listed vascular plant species, 17 red-listed plant communities, 74 blue-listed vascular plant species, and 19 blue-listed plant communities.

⇒ *Bighorn Sheep* - both California and Rocky Mountain sheep are in the plan area. California bighorn sheep more abundant and well distributed within the area than are Rocky Mountain bighorn sheep (restricted to a range near Chase that supports about 30 animals). The majority of the area's California bighorn population is in Vaseux Creek and Ashnola areas (about 750 - 1000 animals). The key habitats for bighorn sheep are lambing grounds and winter range. While the current sheep population is lower than

historical levels, the potential for recovery is high. The overall population is considered to be stable, but local populations are considered to be at risk from increased human disturbance and a variety of localized factors including predation, disease and degraded habitat.

⇒ *Mountain Caribou* - the plan area includes all or part of the range of 3 caribou populations: the Monashee (20 animals), the Wells Grey South population (400 animals) and the Revelstoke population (400 animals). Little reliable data on past caribou populations exist, but today's numbers are believed to be substantially lower than historic levels. Caribou habitat is threatened by logging, mining, forest fires, increased public access and human settlement, and human disturbance from recreational and industrial activities.

⇒ *Grizzly Bears* - occur sporadically throughout the Okanagan, although most are concentrated in the Monashee Ranges. An estimated 75 grizzly bears inhabit the Shuswap-Mabel Lake area and a remnant population also exists in the Okanagan and Similkameen. The grizzly bear is vulnerable due to its requirements for large home ranges, diverse seasonal and annual habitat, slow rate of population increase, and high potential for conflict with human activities. Habitat fragmentation and alienation has depleted grizzly bear habitat. Increased access into former wilderness areas has resulted in an increase in bear-human conflicts.

⇒ *Forest-dependent Species* - in addition to caribou, other species including marten and fisher rely on older forests for shelter and breeding. Maintaining forest interior habitat is critical, as certain species tend to be more specialized and less adaptable to changes in habitat.

fisheries

- The plan area supports 43 fish species, including 14 introduced species - a higher proportion than any other area in BC.

- **Salmon:**

⇒ Four salmon species are found in the plan area - sockeye, coho, chinook and pink salmon.

⇒ In the last decade, up to four million sockeye, 34,000 chinook and 20,000 coho spawners have utilized the Shuswap Lake system, with spawning occurring in approximately 40 tributary streams.

⇒ Sockeye also spawn in the Okanagan River to McIntyre dam - one of only two viable sockeye stocks remaining in the Columbia River system. However there are concerns about the viability of this stock. Chinook and steelhead are also present in the Okanagan River.

⇒ Although sockeye and some chinook stocks in the Thompson-Shuswap are rebuilding, there has been a dramatic decline in coho in the lower Fraser and Thompson. Sockeye stocks in the Okanagan River have also declined.

- Resident Fish

⇒ It is estimated that the Okanagan and Similkameen drainages are inhabited by some 6,000,000 fish. Although few fish stocks are adequately inventoried, most of those monitored have shown significant declines over the last 20 years.

⇒ About one-third of the fish population in the plan area are sport fish - the majority of which are rainbow trout. There are also 14 other resident sport fish species.

⇒ The sport fishing resource in the plan area is nearly fully exploited - or in some cases over-exploited.

⇒ Several resident fish stocks of special concern occur in the plan area - e.g. kokanee stocks of Okanagan Lakes have declined to less than 10% of the spawner counts seen in the 1970s.

⇒ The plan area supports two Red-listed (white sturgeon and Umatilla dace) and four Blue-listed fish species (chiselmouth, mountain sucker, bull trout, mottled sculpin). As well, the plan area supports several uncommon fish populations.

- Fish - both resident and anadromous - and other aquatic life are at risk from activities which cause destruction and degradation of their immediate habitat (i.e. riparian areas and aquatic zones), as well as activities in upland areas that could affect the hydrological regime of streams within the watershed.

- Important spawning and rearing habitats along lake foreshores are affected by development (eg. breakwater, boat launches, armouring, etc.) in foreshore or riparian areas, by activities on the lake that result in wave action, or by development of the upland (eg. urban or agricultural run-off).

water

- The plan area contains two major water systems - the Shuswap system which flows into the Fraser River, and the Okanagan system which flows into the Columbia River.

- Water Quantity:

⇒ Generally, water quantity is sufficient in the north of the plan area and becomes a growing concern towards the south.

⇒ The majority of the water used for drinking (domestic) in Salmon Arm, Vernon, Penticton and other communities is derived from surface water. Ground water is an important source for drinking (domestic), irrigation and other purposes in the Oliver, Osoyoos, Rutland and Coldstream areas.

⇒ Resource extraction activities such as forestry and mining have the potential to alter runoff patterns and flows, and land development on floodplains alters the natural erosion patterns.

⇒ There are approximately 6,900 water licenses in the plan area, including 360 dam sites. Many of these dams are either constructed on Crown land or flood Crown land.

⇒ Most tributaries to the main stems are totally committed with respect to licensing in the Okanagan portion of the plan area. Additional future supply will have to come from the main stem lakes or rivers or ground water.

⇒ There are 62 community watersheds, within which water is the primary resource use and may require more restrictive harvesting and range use practices. There are also other watersheds or drainages identified for their importance for domestic water use or specific values for fish.

- Water Quality:

- ⇒ Water quality in main stem lakes is generally good with the exception of Osoyoos, Ellison, Armstrong Arm of Okanagan Lake and Tappen Bay on Shuswap Lake. As well, the phosphorus loading levels in Kalamalka Lake are increasing.
- ⇒ Water quality in upland tributaries is varied.
- ⇒ Concerns related to water quality and Crown land use activities (forestry activities, livestock (cattle, sheep) grazing and mining) are sedimentation and contamination from pesticides, chemicals, metals and bacteria.

PART 1

INTRODUCTION

1. Introduction

1.1 Provincial Planning Processes Overview

In 1995 the provincial government announced commencement of the 'Okanagan Shuswap Land and Resource Management Plan (LRMP)'. This process is designed to develop a strategic 10 year land use plan for all Crown lands within the plan area.

The LRMP is one of several provincial planning processes in the region. Other processes include:

⇒ the '*Growth Management Strategy*' - which seeks to ensure planned development at the regional district level, with a primary emphasis being the management of settlement through the regional district's zoning and servicing powers; and

⇒ the '*Okanagan Valley Transportation Plan*' (OVTP) and *Trans Canada Highway Plan* which will identify improvements needed for provincially and federally provided transportation facilities and services and formulate a strategy for implementing those improvements. Specifically, the OVTP will identify and assess options for future transportation corridors in the Okanagan Valley; and

⇒ the '*Protected Areas Strategy*' - created by the provincial government in 1992 to co-ordinate BC's protected areas programs and objectives. The main goal is to protect 12% of the province's land base by the year 2000. Specific lands are protected for their special values for wildlife, wilderness, recreation, culture and heritage and as representative examples of natural diversity. The first PAS goal (Goal 1) is to protect large (>3000 ha) areas which are representative examples of natural diversity. The second goal (Goal 2) is to protect special natural, cultural heritage and recreational features.

These planning processes are being strategically co-ordinated with the LRMP in order to ensure that government initiatives are achieved in an holistic manner. Collectively these initiatives will help provide important economic and environmental direction to government in managing ongoing development and possible resource use conflicts within the plan area.

In addition to these processes, the other major initiatives with a focus on land and resources are comprehensive and specific land claims by First Nations. Two land claims are currently in process in the LRMP area. Adams Lake, Little Shuswap, and Neskonlith are signatories to the Neskonlith Reserve Claim submitted to the Federal Government in March, 1996. The Westbank Band lodged a claim under the BC Treaty Commission process in February, 1994, and is currently at stage three of the six stage process.

1.2 Multiple Accounts Analysis

As a part of the LRMP planning process, a Multiple Accounts Analysis (MAA) is undertaken to assess the socio-economic and environmental implications of land use plans developed by the Planning Table. This Profile is the first of three stages to the MAA:

1. *Socio-economic and environmental profile* - consisting of brief, descriptive reports of the plan area, with a focus on those values or sectors

which are dependent on Crown land and resources. This purpose of this document is to provide some basic background information on the area, both for general information and for developing the base case outlook.

2. *Base Case* - an impact assessment of how key values are likely to evolve in the absence of an LRMP - i.e. under the continuation of current and anticipated management, such as Timber Supply Review, *Forest Practices Code*, etc. This will be used as a benchmark against which the potential consequences of alternative land use plans may be

3. *Land Use Plan Impact Assessment* - once a plan is developed, analysis will be undertaken to identify any 'impacts' resulting from the plan.

1.3 Area Overview

Covering approximately 2.5 million hectares, the plan area is one of the largest and most ecologically complex areas within the province. Approximately 320 km long and 140 km wide it stretches south from Seymour River/Shuswap Lake to the American border and west from the Monashee Mountains to the Okanagan Range. The area features many lakes including Okanagan, Shuswap, Osoyoos, Mabel, Sugar, Kalamalka, Wood, Vaseux and Skaha.

The region represents a diversity of ecosystems and biogeoclimatic zones. In particular, the region is also noted for its arid landscape, which is unique in Canada. The area also includes the largest number of rare, endangered and threatened species in British Columbia, due to the relative rarity of ecosystems in the southern Okanagan and the high level of urban development and population growth.

Wildlife species present within the area include several species of deer, moose, cougar, mountain goat, bighorn sheep and elk. Fisheries species are also abundant within the region, and most lakes and streams are well stocked. The plan area also contains important salmon spawning streams which support the coastal salmon fishery.

The area's natural resources provided the foundation for the establishment of the local economy, with its early economy primarily based on primary industries, such as agriculture, forestry and mining. More recently, the local economy has become much more diversified, with significant manufacturing and service sectors. However the area's natural resources continue to make an important contribution to the health and growth of the local economy - both through the ongoing activity in the forestry, agriculture and mining sectors, and through the provision of scenic views and recreational amenities that continue to attract people to the area - both as new residents and as tourists.

PART 2
SOCIO-ECONOMIC
PROFILE

2. LRMP Area Profile

This section provides an overview of the area's population and economy. Socio-economic statistics primarily are based on regional district and Census sub-division boundaries. In many cases, this section focuses on the four main regional districts and/or Census-sub-divisions falling primarily within the plan area¹.

2.1 Population Trends and Demographic Features

In recent years, the Okanagan-Shuswap LRMP area has been one of the faster growing areas in BC. Much of this growth can be attributed to improved highway links with the completion of the Coquihalla Highway, the quality of life offered by the area (pleasant climate, scenic values, recreational amenities) and new opportunities offered by a growing economy. This has enhanced the area's attractiveness to businesses, as well as to retirees.

Population Growth

In 1996, the total population of the plan area was estimated at 312,807 - about 8% of the total provincial population. The average annual growth rate for the plan area was about 4% from the 1991 Census count of 263,235. The influx of new residents through the late 1980's to early 1990's resulted in population growth rate greater than the provincial average - marking a dramatic change from slow or no-growth trend seen in the area through the early to mid 1980s. Much of the influx was from persons moving to the area from out-of-province. Total in-migration peaked in 1992/93, and in the past two years, population growth has slowed to less than half of its peak levels. Population growth in the plan area is expected to continue at rates exceeding provincial averages, albeit at a more moderate rate than was experienced in the early 1990s. The source of future population growth will continue to be from in-migration, with the rate of natural increase (i.e. the excess of births over deaths) expected to remain negative². Forecasts for growth rates over the next few years fall in the range of 2.5% to 2.7%, with the growth rate declining as the forecast moves further into the future. At this rate of growth, population in the plan area would reach around 440,000 by 2010, and 540,000 by 2020.

Population Distribution

Of the three forest districts that comprise the plan area, the Penticton Forest District encompasses the majority of the plan area population (see Table 2.1). Significant population growth occurred throughout the area, and the rate was greatest in the Salmon Arm Forest District. Of BC municipalities with more than 5,000 people, the municipality of Salmon Arm was one of the top twelve in terms of growth rates since the last Census.

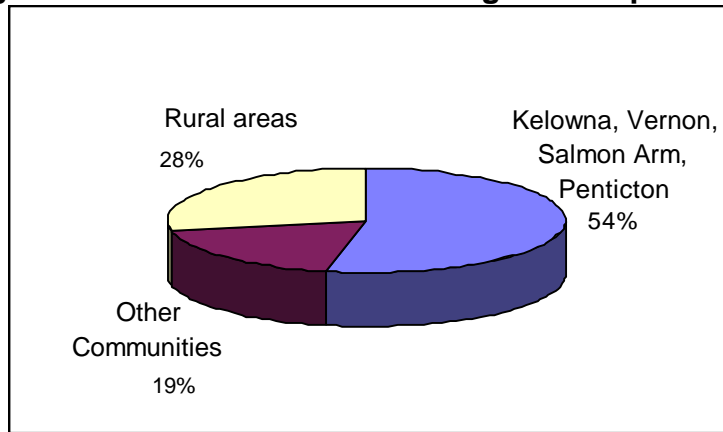
Table 2.1 Plan Area Population and Growth by Forest District

	1996 Population	Ave. Annual Growth Rate since 1991	1996 Population as % of Plan Area
<i>Salmon Arm Forest District</i>	38939	4.4%	12%
Salmon Arm	14664	4.2%	5%
Rest of District	24275	4.5%	8%
<i>Vernon Forest District</i>	76534	3.2%	24%
Vernon	31817	3.0%	10%
Rest of District	44717	3.4%	14%
<i>Penticton Forest District</i>	197334	3.9%	63%
Kelowna	89442	3.6%	29%
Penticton	30987	2.7%	10%
Rest of District	76905	4.8%	25%

Source: BC STATS

The plan area population primarily resides in urban areas. In 1996, about 54% of the population resided in one of the area's 4 major cities (Figure 2.1). Kelowna, the largest community, accounts for nearly 30% of the area's total population. Eleven smaller communities represent almost 20% of the overall population. Population levels, growth rates and population densities for areas and communities within the regional districts comprising the plan area can be found in Appendix 1.

Figure 2.1: Distribution of Planning Area Population (1996)



First Nations Population

Several Bands reside in or have traditional territory within the plan area. The Adams Lake, Little Shuswap, Neskonlith, and Spallumcheen Bands of the Shuswap Nation (out of a total of 17 Bands,) reside within the plan area. Seven Bands from the Okanagan Nation - Okanagan, Westbank, Penticton, Osoyoos, Upper Similkameen, Lower Similkameen, and Upper Nicola - have traditional territory within the LRMP area.

The 1995 Status Indian population of Bands within the LRMP region (including all reserves of those Bands within the LRMP³) totals 6,211 individuals. Since 1991 the population has increased by 3.5%. Around 68% of these individuals are aged between 15 and 64 years, and 36% are in their intermediate (25-44 years) working years. Indian and Northern Affairs Canada estimates the provincial growth rate for Registered or Status Indians to be 1.8% per annum to 2005.

Table 2.2: Population Trends 1990 -1995 of Bands Which fall Within the LRMP Area

Year	On-Reserve	Off-Reserve	% off-Reserve	Total	% Change
1990	3150	2075	39	5226	
1991	3270	2196	40	5466	4.0
1992	3496	2165	38	5661	3.0
1993	3563	2266	38	5829	2.0
1994	3614	2364	40	5978	2.0
1995	3757	2454	40	6211	3.0

Source: INAC Band Data Base

The Bands of the Shuswap Nation within the LRMP area make up 1,971 individuals (31% of the total aboriginal status Indian population of the LRMP region). The population of Bands of the Okanagan is 3,488 (56% of the total). Census data indicate that Bands of the Thompson Nicola Regional District represent only about 9% of total aboriginals for the LRMP area.

Plan Area Demographic Features

In general, the region's population is slightly older than the provincial average, although there is considerable variation among the regional districts as indicated in Table 2.3. The age demographics reflect the influx of retirees to the area that has occurred in recent years. As the rate of natural increase is expected to remain negative, the area's population will likely remain slightly older than the provincial average.

Table 2.3: Okanagan LRMP Population and Demographic Features

Regional District	1996 Population	% of Population		
		Age 0 - 19	Age 20 - 64	Age 65+
Columbia Shuswap	48116	27%	58%	15%
North Okanagan	71607	28%	56%	16%
Central Okanagan	136541	26%	57%	17%
Okanagan-Similkameen	75933	23%	53%	24%
Total BC	3724500	26%	61%	13%

Source: 1996 Census

Outlook and Implications for Crown Land and Resources

From a land use planning perspective, the area's growing population and continuing trend toward urbanization will increase the demand for settlement lands and public infrastructure around existing communities, increase traffic congestion, and increase flows of residual wastes to the environment. Pressure will increase to convert agricultural land and wildlife habitat to human uses.

The potential consequences of this future growth is generally recognized in the area. The other major planning initiatives within the area noted earlier - the growth strategy planning which is underway in some of the area's regional districts, the OVTP and the Trans Canada Highway Plan - have been initiated as a result of the substantial growth in the area in recent years. These initiatives will provide important direction on the management of growth in the plan area.

2.2 Economic Structure Labour Force and Employment

Historically, the economy was based on primary industries, such as agriculture, forestry and mining. Over the years, the economy has become quite diversified - with strong primary, manufacturing and service sectors. Contributors to the economy's growth and diversification include the further processing of primary resources (e.g. wood manufacturing plants, food processing plants), population growth, good rail and highway connections to the Lower Mainland, the rest of Canada, the US and offshore markets, and local governments' pursuit of new industries such as communications, electronics and high-tech products and services.

There area variety of statistics that can be used to indicate the health and composition of the local economy. This section outlines some of these measures.

Income and Unemployment

Indicators of both the social and economic conditions of the plan area are the level of dependence on social assistance and employment insurance (dependence on the social 'safety net'), and personal income levels.

Table 2.4 Incomes and Dependence on Safety Net (% of population aged 19-64)

	Average Income ¹	Dependence on Employment Insurance and Income Assistance ² (% of population 19 - 64)								
		Mar '95	Jun '95	Sep '95	Dec '95	Mar '96	Jun '96	Sep '96	Dec '96	Mar '97
Columbia Shuswap	\$27,130	15.7	12.8	11.1	14.7	15.7	12.1	9.5	13.4	13.0
North Okanagan	\$ 27,358	16.5	14.6	13.5	15.1	16.2	13.4	11.6	13.0	13.4
Central Okanagan	\$ 28,254	15.3	13.6	12.7	14.7	14.9	12.2	10.5	12.1	12.1
Okanagan Similkameen	\$ 25,444	17.1	15.0	13.0	16.4	18.0	14.1	11.5	15.4	15.4
Province	\$ 29,597	14.3	13.0	12.5	13.9	13.6	11.9	10.6	11.6	11.3

Sources: 1. BC Stats, 1994 Taxation Statistics. Pre-tax income, based on total incomes reported for tax assessment purposes.

2. BC Stats, Quarterly Regional Statistics. Not adjusted to plan area boundaries.

Dependence on the 'safety net' for the four core regional districts is summarized in Table 2.4. While the dependency rates vary across regional districts, they are all above the provincial rate in almost all periods. Some seasonal variation is evident in the dependency rates (i.e. lower rates in spring through fall, highest rates in the winter) which reflects the season character of several of the some of the area's industries (e.g. agriculture, forestry, tourism and construction).

Personal incomes in the area fall below provincial averages. This is generally consistent with the higher rate of dependence on the safety net. Lower incomes may also be partly explained by the fact that the area has a relatively large service sector, which tend to be associated with lower incomes. Also, the high proportion of persons living off retirement income may reduce average incomes in the area to some extent.

Labour Force

The plan area's economy is relatively large and complex. The experienced labour force data generally convey the composition of the economy and the relative size of the respective industries. Table 2.5 summarizes the experienced labour force by industry category from the 1991⁴ and 1981 Census. The provincial average is provided as a benchmark for comparing relative industry shares.

Table 2.5: Plan Area Experienced Labour Force

	Plan Area (% of total)		BC (% of total)	
	1990	1980	1990	1980
Primary	10%	10%	6%	7%
Agriculture	6%	7%	2%	2%
Forestry	2%	2%	2%	3%
Mining	1%	1%	1%	2%
Other	-	-	1%	1%
Manufacturing	11%	14%	11%	14%
Food and Bev	2%	2%	1%	2%
Wood	3%	4%	3%	4%
Primary Metals & Metal Fab	1%	1%	1%	2%
Other	5%	7%	6%	6%
Construction	10%	11%	8%	8%
Service Producing	70%	63%	75%	67%
Transport, Storage & Commun & Utilities	6%	6%	8%	9%
Trade	19%	19%	18%	17%
Finance, Insurance & Real Estate	5%	5%	6%	5%
Comm/Business and Pers. Services	36%	28%	37%	29%
Public Administration	5%	5%	7%	7%
Other	<1%	3%	<1%	4%

Notes: 1. Statistics Canada, 1991 and 1981 Census. The reference year for the Census is the full year prior to the Census year. The Experienced Labour Force includes the unemployed and is not reported on a full time equivalent basis — thus these figures usually exceed employment estimates for the area. It also excludes First Nations labour force participants residing on reserves for the Okanagan-Similkameen and Columbia Shuswap portions of the plan area. Compiled by regional districts and census sub-divisions within the plan area, although boundaries do not conform precisely.

2. Columns may not add due to rounding .

Over this decade there was a significant growth in the area's labour force. The growth was largely in the primary sector and service sector, while the manufacturing sector's labour force declined. Overall, this growth did not change the primary industries' share of the labour market, but did reduce the share of the manufacturing sector and increase that of the service sector.

Overall, the balance of industries in the LRMP area is similar to the diversity of the provincial economy. The main difference is that the plan area has a significantly higher proportion of its labour force in agriculture, and a lower proportion in the service sector.

Employment and Income Dependencies

Complementing the labour force data is analysis of the 1991 Census data by the Ministry of Finance⁵. The Ministry's analysis has several advantages over the labour force data: (1) it looks at employment rather than labour force; and (2) it groups economic activity by sector, rather than by type of activity (i.e. all forestry related activity grouped together rather than being divided by primary and manufacturing activity). It also estimates the amount of area employment and income that these sectors generate in their purchase of goods and services or via sector employees' spending.

Table 2.6: Income and Employment Dependencies Okanagan LRMP Area

Basic Sectors	Sector Generated*:	
	Income (% of total)	Employment (% of total)
Agriculture and Food	5 %	9 %
Forest Industries	7 %	10%
Mining, Petroleum and Processing	4 %	5 %
Tourism	3 %	8 %
<i>Sub-total (Resource Sectors)</i>	<i>19%</i>	<i>32%</i>
Public Sector	17 %	26 %
Construction	9 %	14 %
Other	9 %	13 %
Non-Employment Sectors	46 %	15 %
<i>Sub-total (Non-Resource Sectors)</i>	<i>81%</i>	<i>68%</i>
LRMP Area Total	\$3,199,800,000 (100%)	107,494 persons (100%)

Source: Ministry of Finance and Corporate Relations, Forest District Tables, March 1996. Based on 1991 Census data.

Includes direct, indirect and induced income and employment attributable to that sector.

*Basic sector income*⁶ flows into the community from the outside world, usually in response to exported goods and services produced in the plan area. Also included is income from “outsiders” that spend money in the community (i.e. tourists), transfer payments from senior governments (e.g. income assistance, employment insurance), and investment income. *Non-basic income* is that derived by individuals who sell goods and services to those employed in the basic sectors. The allocations of non-basic incomes and employment to the basic sector on which it depends is included in Table 2.6, which summarizes the results of the Ministry’s analysis.

The plan area economy is dominated by the ‘non-resource’ sectors - those sectors not directly dependent on Crown land and resources. The largest share - 46% - of income in the plan area is from Non-employment - a combination of transfer payments, investment income and pension income. Over two-thirds of this is from pension and investment income, with the remainder from the other transfer payments. Spending by the recipients of this non-employment income supports about 15% of the labour force, all of which would be non-basic (i.e. primarily in the consumer goods and services industries; there is no basic employment associated with the transfer payments). The Public Sector was the second largest source of regional income. The “other industry” category (which includes non-resource based manufacturing) and construction also play an important role in the plan area economy.

The outlook for these sectors depends on a variety of market factors, such as exchange rates, competitiveness *vis a vis* other jurisdictions, overall health of the economy and consumer spending patterns. Implementation of any Growth Strategy and the Okanagan Valley Transportation Plan will also help shape the type and rate of growth of the regional and provincial economies. Overall, the plan area is expected to maintain a diversified and strong economy, where growth or decline in one sector will not have an disproportionate effect on the overall economy.

Contribution to the Economy of Crown Land and Resources

The sectors of the economy considered to be most directly dependent on Crown land and resources are the agriculture, forest, mining and tourism sectors noted above.

These sectors play an important role in the regional economy - accounting for 19% of total income and 32% of total employment, when indirect and induced employment and income attributable to these sectors are included. However, this region is less dependent on resource sectors than are many other regions in the province.

While these sectors are the most directly dependent on Crown land and resources, the role that these resources play in the sector’s overall activity varies:

- ⇒ Agriculture relies directly on Crown land for cattle grazing, and water - a Crown resource - is critical to the viability of much of the activity occurring on private land.
- ⇒ The majority of harvesting activity in the forest sector occurs on Crown land, and that fibre supply contributes the majority of the area mill’s requirements.
- ⇒ Most of the mineral exploration and development activity occurs on directly on Crown land, and access to large tracts of Crown land is needed to discover and develop this hidden resource.
- ⇒ Tourism depends directly on Crown land for backcountry tourism activities, and scenic views provided by Crown land are important for activity occurring in the frontcountry.

The individual sector profiles that follow this section provide further description of these sectors, and their dependence on Crown land and resources.

While the non-resource sectors generally are considered not to be directly affected by changes in Crown land and resource use at the margin, these sectors may be indirectly affected. For example, they rely on transportation corridors on Crown lands, or provide services to people for whom the surrounding Crown land - its scenic views and recreation activities offered - was a factor in attracting them to the area.

2.2.1 Sub-regional Economies

While the preceding section outlined the economy of the plan area as a whole, the economies of the sub-regions within the plan area are not homogeneous. The following are brief profiles of the economies of the four core regional districts - or portions thereof - which fall within the plan area. The basic and non-basic sector breakdown for the communities within the plan area are summarized in Table 2.7

Table 2.7 Income Dependencies (% of After Tax Incomes, 1991)

	Forestry	Mining	Agriculture	Tourism	Public Sector	Other	UI, Tran & Soc	Pension & Invest
Oliver-Osoyoos	4	3	13	4	14	13	14	37
Penticton	4	3	4	4	18	18	12	36
Peachland	5	6	3	3	19	27	14	23
Kelowna	4	3	4	3	15	24	12	35
Vernon	10	4	3	3	17	20	14	29
Spallumcheen	15	2	9	2	15	18	15	24
Salmon Arm	15	2	4	2	16	18	13	29

Source: Garry Horne and Charlotte Powell, British Columbia Local Area Economic Dependencies and Impact Ratios, Ministry of Finance and Corporate Relations, February, 1995

Columbia Shuswap Regional District

The Columbia-Shuswap Regional District (CSRD) has traditionally relied on forestry (log harvesting and processing) and agriculture as its primary industries. For the Salmon Arm area - the portion of CSRD within the planning area - forestry activity remains an important sector. However the area economy has been shifting towards the service industries and tourism sectors, as the area is becoming more popular as a tourism and retirement destination. Indeed, almost 30% of basic income was attributable to pension and investment income. The public sector and other basic industries (such as non-primary resource manufacturing - e.g. Newnes Machine Limited) also accounted for a large share of the local economy, at 16% and 18% of basic income, respectively.

North Okanagan Regional District

The North Okanagan Regional District (NORD) supports a diversified economy, that has been growing faster than the provincial average. Forestry, agriculture, manufacturing and tourism are all important sectors within NORD's economy, although this varies across the communities. NORD depends substantially on non-resource sectors, such as the public sector, pension and investment income and other basic industries, such as fibreglass manufactures, camper manufacturers, Consumers Glass and Okanagan Spring Brewery.

The service sector has grown very strongly and this is anticipated to continue. Tourism supports both summer (golf and lake activities) and winter activities (Silver Star Ski Resort). There are proposals to cater to golf and nature tours, and consideration of a convention centre, which would further increase economic significance of tourism in NORD's economy.

Regional District of Central Okanagan

The economy of the Regional District of Central Okanagan (CORD) is not significantly dependent on any particular industry sector. The non-resource sectors account for the majority of basic income - including pensions and investments, other, non-primary resource industries, and the public sector.

Manufacturing is an important activity in the area, and there were almost 280 manufacturing establishments in CORD in 1994. The area offers four season tourism and recreational opportunities with several larger commercial operators. Kelowna also acts as a service, health and education centre for the area. The strong service infrastructure is a key factor in the region's ability to attract retirees to the area, and rapid growth supports a relatively large construction industry.

Good transportation links are a key factor in the growth of CORD's economy. The Kelowna Airport serves as an important transportation link for the region and has seen high growth in passenger volume. The Coquihalla Highway has enhanced Kelowna's role as a distribution centre and tourism destination.

Okanagan-Similkameen Regional District

The Okanagan-Similkameen Regional District also has a diversified economy. The communities of Penticton and Summerland act as the service centres for the area and the rural communities of Osoyoos, Oliver and Keremeos support the more traditional sector of agriculture, especially tree fruits. The influx of retirees is reflected by the area's high dependence on pension and investment income. The public sector and other basic sectors - such as the manufacture of homes and flatbed and equipment trailers - are also important contributors to the local economy. Tourism is the second largest employer. The industry is supported by lake activities, the convention centre, wine tours and the Apex Ski Resort.

First Nations Communities⁷

Based on 1991 Census data by regional district (Columbia Shuswap, North Okanagan, Central Okanagan and Okanagan-Similkameen), agriculture supported 325 First Nations persons. Agriculture accounted for the highest overall levels of primary sector employment for First Nations people in all regional districts, except Columbia Shuswap where forestry was the highest.

The total labour force in primary forestry (i.e. does not include forestry-related manufacturing) was 230. The labour force in this sector was about 11% of total aboriginals in Columbia Shuswap, compared to only 4% in the North Okanagan, and 2% in Central Okanagan. On-reserve forestry employment is proportionately higher for all areas, reflecting several Band operated silviculture crews and other on-reserve forestry activity.

The Chase Shuswap Bands have two contracting firms in silviculture, that employ around 20 people, and Spallumcheen has two forestry crews. In the Penticton region, 10 people are employed in an off-reserve silviculture team. As well, there are various current Forest Renewal BC projects in the Okanagan and Shuswap region with First Nations communities.

Mining labour force is only reported for several off-reserve aboriginals in the southern portion of the LRMP area. The Penticton Band has a quarry business, which may now account for higher employment than in reported in the 1991 Census. Fishing and Trapping employment is only reported in the Columbia Shuswap at 1% of total labour force.

Experienced labour force in other sectors is as follows, with the percentage of the aboriginal labour force noted in parentheses: manufacturing 575 (11%); construction 565 (11%); transportation, communications and storage 275 (5%); trade industries 540 (16%); finance, insurance and real estate 125 (2%); government service industries 430 (8%); educational service industries 155(3%); health and social service industries 385 (7%) and other service industries 1180 (23%).

Based on the Aboriginal Business Directory of the Thompson Okanagan Region (which may not contain all businesses), general contracting is a common activity with five Bands or Band members owning operations. Tourism activities and Arts and Crafts account for 10 businesses, including two hotels and two horse-trekking companies. The Quaaout Lodge is the 3rd largest First Nations facility of its kind in Canada.

Overall the regional districts present higher on-reserve mean incomes than at the provincial level. Mean individual income ranges from \$12,355 to \$17,215 per year for total aboriginals and on-reserve aboriginals. On-reserve average income is generally lower (where data are provided) than for total aboriginal population except in the Central Okanagan where the opposite holds.

2.3 Infrastructure

The established transportation infrastructure within the LRMP area has played a key role in moving goods and people to and from the area. For the goods producing sectors, efficient rail and highway links to US and Canadian markets are important to maintaining competitiveness. These links, as well as area airports, are also important to the growing tourism sector. In addition, inter-provincial and international energy lines (covered in the Minerals and Energy

section), communication and transportation corridors cross the plan area serving other population centres.

This infrastructure predominately occupies rights-of-way on Crown land, or in some cases private land. The need to expand infrastructure in the future will be in response to a growing regional population, as well as population's needs outside the plan area. Existing corridors, their future expansion, and the development of new infrastructure corridors may be affected by a land use plan, where the protection of resource values precludes or restricts development.

Provincial Highways

Primary highways in the plan area include Highways 1, 3, 97 (US border to Highway 97/97A), 97A, 97B, 97C, and secondary highways include Highways 3A, 6, 97 (junction 97/97A to 97A), 97A (junction Highway 97A/97B to junction 97A/1). The plan area's ongoing need for an adequate road transportation system is being addressed through the OVTP and the Trans Canada Highway Plan. The purpose of these plans is to identify improvements needed to the Trans Canada and the provincial highways. Specifically, the OVTP will identify and assess options for future transportation corridors in the Okanagan Valley. The first phase of the OVTP, which was an assessment of the long term transportation infrastructure, is nearly complete. The strategy being developed through the OVTP will provide guidance at the local level to monitor changes in land use as it impacts associated corridor segments and will also provide a mechanism to accommodate, or prevent, land use changes. A land use plan can affect future highway development, and vice versa, if the zoning and guidelines in the plan are not compatible with the land's use as a transportation corridor. This may either preclude or increase the cost of the development of the transportation corridor, or may negatively affect the other values on that or surrounding Crown land (e.g. impacts on wildlife or plant species, impacts on the quality of recreation experiences, etc.). As well, the land use plan can create additional demands for this infrastructure to access resource development area or new parks. The impact assessment of the Table's land use option will examine the potential for these conflicts.

Other Infrastructure Rights-of-Way and Access

In addition to the rights of way for highways, hydro lines, natural gas transmission, and fibre optic and communication lines cross over Crown lands. There are also several communication sites on mountaintops in the plan area that are important for the provision of cellular, television, and radio transmission. Numerous water storage dams are located on Crown land (upland lakes) and lakes within the Okanagan River system (including Wood, Kalamalka, Okanagan, Skaha, Vaseux, and Osoyoos Lakes). The land use plan can affect corridors through provision of access to these corridors for maintenance, as well as potential expansion needs.

2.4 Quality of Life

The quality of life offered by the plan area is likely a major factor in its recent population growth. However 'quality of life' is not well defined, as amenities considered as important vary from individual to individual. Factors that contribute to quality of life may include environmental quality (clean air and water, health of the natural environment), aesthetically pleasing surroundings, recreational opportunities, gainful employment, comfortable income/affordable

cost of living, safe environment, access to health/social support, and lack of congestion of facilities.

Crown land and resources can affect many of these factors - notably, water quality, health of the natural environment, scenic views, Crown land recreation opportunities, employment and income. Indirectly it can affect affordable housing and congestion of transportation facilities, through the accommodation of lands for expansion.

Culture and heritage are also important to many societies, and is often a particular interest of First Nations. While it is difficult to generalize about First Nations cultural traditions, a sense of connection to the land is often a theme that emerges. Factors such as a connection to sacred places and continuation of traditional activities, sense of identity related to geography and ancestry of the land, sense of pride through ownership and authority over land, and employment from the land are reflected in the physical and spiritual health of individuals, and overall health of the community.

Heritage areas of First Nations may include sacred areas, archaeological sites, special places such as meeting places or burial grounds. Sacredness is not limited to specific areas, but also includes broad areas, culturally important species or even the entire sense of place of a region.

Cultural Heritage sites are legally recognized for protection under the Heritage Conservation Act, where they have been verified through physical and/or written record⁸. An Archaeological Overview Assessment currently in process through the Ministry of Forests could provide some heritage traditional land information, although there are concerns about the impact on the sites of having the information in the public domain. Information about First Nations heritage sites is also documented in the Canadian Heritage Information Network and in the Ministry of Small Business, Tourism and Culture Tourism Resource Inventory for the area. Both sources are designed so that access to the exact location of sites is protected.

Traditional Land Use includes sustenance food gathering, plant material gathering, educational places and sacred places. Research on Shuswap traditional use of plant and animal species (based on information from two members of the Neskonlith Band) shows that they traditionally made use of 53 species for medicine, 48 species for food, and 37 species for technological purposes (e.g. canoes, buildings, weapons). Twenty-two species were used in ritual and for ceremonial purposes and 16 species were identified into myth. Shuswap First Nations seem to have relied most heavily on conifers (for food, medicinal and rituals), lilies and parsleys (food and medicine), composites and heathers (medicine) and roses (food).

3. Agriculture and Range

3.1 Introduction

Early settlement in the LRMP area was primarily based on agriculture, and some of the province's oldest ranches are located in the bunchgrass area of the Southern Interior region of the plan area⁹. Over the years, transportation, water supply, and land subdivisions have influenced agriculture, as have technological developments and operating realities of recent times. These changes influence the number and size of farms, gross receipts and operating arrangements¹⁰.

The agricultural sector is an important sector within the plan area economy. While the majority of operations occur on private land, the cattle ranching sub-sector depends on Crown land for grazing purposes. Crown lands supply about 60% of forage requirements.

3.2 Overview of the Sector

Agriculture Land Use

The agriculture sector in the plan area is quite diversified. There are a total of about 4,600 farms (covering 170,000 hectares) in the plan area. Fruit, miscellaneous speciality crops and cattle farms are the most common farm types, with cattle farms more common in the northern part of the plan area (Table 3.1). Dairy farming and crop production are also important in the northern part of the plan area. Over the past five years, there has been a relative increase in the proportion of area farms in miscellaneous speciality crops and vegetable production.

Farm land in the area is primarily privately owned (62% as of the 1996 Census). The remainder is leased or rented, with 22% of total hectares rented from government (this excludes Crown range land). While the LRMP only applies to Crown land, these operations may be indirectly affected by land use planning decisions, particularly if they affect overall water quality and quantity.

A reliable and abundant supply of water is important to this sector. About 16% of total hectares were irrigated in 1995, compared to 5% provincially. Much of the irrigation would have been on hectares in crop production, with the total area irrigated equal to over 60% of hectares in crops.

Table 3.1 Farm Types in the Planning Area (1995)

Regional District & Census Sub-division	Farm Type (Farms with gross receipts >\$2499)								
	Dairy	Cattle	Field Crops *	Fruits	Vegetables	Msc. Specialty	other livestock *	other comb	# reporting
Okanagan-Similkameen 'A' and 'B'	1%	8%	3%	69%	4%	11%	2%	2%	1427
Central Okanagan	1%	5%	6%	61%	3%	19%	4%	1%	996
North Okanagan	8%	24%	16%	9%	5%	29%	7%	2%	964
Columbia-Shuswap 'C'	11%	34%	7%	8%	3%	25%	10%	3%	464
TOTAL	4%	14%	8%	45%	4%	19%	5%	2%	3851

*Notes: "Field Crops includes wheat and grains. Other Livestock includes poultry, pigs and livestock combinations.

Percentages may not sum to 100 due to rounding error

Source: Statistics Canada, 1996 Census of Agriculture

3.3 Horticulture

The plan area is the major producer of tree fruits in BC, accounting for almost 90% of BC's fruit trees in 1995. Of all the farms in BC, the plan area has 61% of the province's fruit farms, 25% of vegetable farms, and 16% of miscellaneous speciality farms. One speciality crop of growing importance in the plan area is ginseng. Total number of hectares in ginseng production in the plan area is around 240 ha. - 20% of total BC acres. Harvest levels are expected to increase over the next four years, from an estimated 95,000 kilograms in 1997 to 320,000 kilograms in 2000.¹¹

The horticulture sub-sector relies primarily on private land. The competition for suitable land is intensifying with increasing demand for land for other uses - primarily urban development but also transportation corridors, tourism and recreational uses. Linked to these competing uses is competition for water resources. There have been many studies and reports examining the water use issues for the tree fruit industry in the Okanagan. A 1992 report commissioned by the Okanagan Valley Tree Fruit Authority, outlined the following key issues for water availability for the tree fruit industry.

- lack of recognition that a continued (and assured) irrigation water volume is critical to the survival of the tree fruit industry;
- lack of orchardist representation in water use decisions;
- late season irrigation requirements not being met; and
- effects of over-utilization of groundwater resources.

Damage to orchards from deer browsing is also a concern to this sub-sector, as it can result in significant costs to the industry both as a result of the damage to the crop, and the measures undertaken to prevent deer access to orchards.

3.4 Agriculture Manufacturing

There is a small but significant agriculture manufacturing sector within the plan area. The area is important for wine production with both major producers and smaller farm wineries. There are also manufacturers of tree fruits products

such as juice, jams, etc. within the area. Based on a 1992 BC Stats survey of manufacturing companies, the region supported 30 business which conducted food or beverage manufacturing, with total employees numbering 900. Just over half of these businesses manufactured food items.

3.5 Cattle Ranching

Cattle ranching depends on Crown forage. There were 555 cattle farms in 1995 - 14% of the total farms in the plan area.

While cow-calf production for beef cattle predominates within the plan area, there is also finishing activity in the area. The Okanagan and Thompson regions contained 51% of finishing feedlots in 1991¹², and three feedlots are located in the plan area. One of these, located in Oliver, is the largest in the province (7,000 head). The other two, located in Kelowna and Salmon Arm areas, are smaller feedlots. Finished cattle are transported for slaughter to plants in the Fraser Valley, Alberta, or Pasco Washington (the latter particularly for cattle from the southern Okanagan).

Availability and reliability of water is critical to this sector. For the plan area, availability of water can be problematic, particularly in the bunch grass areas or in drier years.

Grazing Tenures

The main cattle ranching activity in the plan area occurs in the south and up the centre of the plan area. Crown land provides 60% or more of the forage requirement for beef cattle in the province.

Grazing permits and licenses are issued by the Ministry of Forests (MoF), and grazing leases are issued by the Ministry of Environment, Lands and Parks (MELP). Table 3.2 shows the number of tenures and animal unit month for each Forest District. An animal unit month is loosely defined as the amount of forage required to feed one cow with or without a calf for one month. The number of AUMs has remained relatively stable over recent years, as range is currently at 100% allocation and demand exceeds supply. The demand for Crown range land for cattle forage is high in the plan area due to a shortage of private spring and fall grazing.

Table 3.2 Grazing Tenures, 1996

Forest District	Number of Tenures	Animal Unit Months
Salmon Arm	43	11,853
Vernon	82	35,728
Penticton	56	48,326
LRMP Area Total	181	95,897

Ministry of Forests "Range Tenure Reports"

Agricultural Leases

MELP authorizes a very limited number of agricultural applications for hayfields, orchards, and vineyards by way of sale of Crown land or by issuance of Crown grant. Where sale is limited by environmental, social or other factors, a lease may be issued. MELP's agricultural program is reactive in nature and is significantly limited by applicant qualifications and land arability requirements. Most arable land in the Okanagan and Shuswap has been private for many years. Therefore very few agricultural applications are received. Further, conflicts with other resource uses necessarily limits the number of applications that can be approved.

3.6 Agricultural Land Reserve

The Land Commission Act established the Agricultural Land Reserve (ALR) in 1974. There are about 221,237 hectares of ALR in the plan area, and it is estimated that about 52,510 hectares (24%) of this is Crown land. The ALR in the area represents around 5% of the total provincial reserve.

The rate of exclusion of ALR land in the plan area has typically exceeded provincial averages. Since the ALR was first established, ALR has declined by about 10% in the plan area, compared to 2% provincially. Moreover, in the past decade, the rate of exclusion in the plan area has increased, whereas for most other areas of the province, there has been a reduction in the rate of exclusion in recent years.

3.7 Contribution to the Economy

The plan area is one of the leading contributors to provincial farm cash receipts, with almost \$266 million, or 14% of the provincial total¹³. This figure includes receipts from activities both on Crown and on private land. Receipts have increased in line with provincial growth rates - almost a 40% nominal increase over 1991. Table 3.3 shows the distribution of farm receipts for all farms within the plan area, by regional district and Census sub-division.

The horticulture sector was the largest contributor to gross farm cash receipts in the area in 1991 - accounting over one-half of the area's gross receipts¹⁴. As noted above, this activity occurs predominately on private land. Cattle farms, which tend to be heavily dependent on Crown land for grazing requirements, were the next largest contributors at almost 20% of receipts for the plan area and nearly a similar proportion of the total provincial gross receipts from cattle farms. Although cattle farms exceeded dairy farms in terms of gross receipts, dairy farms profits (gross receipts less expenses) exceed that of cattle farms.

Table 3.3 Total Farm Cash Receipts (1991 & 1996)

Regional District & Census Sub-division	(\$ million*)		
	1991	1996	% share (1996)
Okanagan-Similkameen sub division A and B	\$59.3	\$86.0	32%

Central Okanagan	\$47.1	\$61.4	23%
North Okanagan	\$62.4	\$78.7	30%
Columbia-Shuswap sub division 'C'	\$22.9	\$39.6	15%
TOTAL	\$191.8	\$265.6	100%

*Nominal dollars. Numbers may not sum due to rounding error

In terms of employment, basic employment in the agriculture and food sector - which includes activities on private and Crown land - has been estimated at 8,235 person years for 1991¹⁵. This represents 11% of total plan area basic employment, and generates 5% or \$121.3 million of the area's basic income (after tax). Agriculture's share of basic income is less than its share of basic employment for two reasons. First, basic income includes non-employment income such as pension and investment income, which lessens the contribution of employment income. Second, there is considerable seasonal and part-time work in the sector, which tends to be associated with lower average incomes. According to 1996 Census data, approximately 48% of farms in the plan area reported hiring paid labour, and about 55% of the total weeks paid were for seasonal work. As well, throughout the province there are a number of part-time operations, where the rancher or farmer is also employed in higher paying off-farm work. This could also be a factor in the lower contribution of the sector to basic income.

3.8 Outlook

Crown resources are a critical component in the agriculture industry in the Okanagan-Shuswap. Although much of the agriculture sector in the plan area occurs on private land, water for irrigation is essential for all the major crops in the plan area. Limitations to water availability are one of the key issues limiting growth in this sub-sector. New and continued investment in farming activities requires assured irrigation water. To the extent that Crown land and resource management affects water quality and quantity, all agricultural activity is potentially affected, although a land use plan does not dictate allocation.

Additionally, much of the ranching sector is dependent on Crown grazing with around 75%¹⁶ of the cow herd using Crown land for forage. Use of this forage is essential to the viability of the majority of ranches. Because Crown grazing is an integral part of many ranch operations, the value of the tenure is capitalized into the value of the ranch, and changes to the value of the tenure will affect the capital value of the ranch.

Among other things, future growth of the ranching sector is constrained by the full allocation of forage on Crown range, particularly in the spring and fall.

Costs of range management as a result of the requirements for more intensive management under the *Forest Practices Code* and other resource management requirements also affect this sector. These increased costs reduce margins between revenues and costs, and may cause operators to incur losses on their operations.

4. Forestry

4.1 Introduction

The forest sector plays an important role in the regional and the provincial economies. The plan area accounts for over 4% of the provincial allowable annual cut (AAC), including the Timber Supply Area and Tree Farm License AACs. Over the past 10 years the rate of harvest has been variable, largely due to the need to control beetle infestation, but the AAC has been reduced by 85,000 m³ to take into account non-fibre values and the economic and social objectives embodied within the Okanagan Timber Harvesting Guidelines (1992).

In 1995 the Chief Forester's AAC Determination indicated that he would look toward the LRMP process providing guidance on several management issues, in particular the issues of a landbase reduction for protected areas and visual landscape management. Both of these factors will influence the determination of future harvest rates.

4.2 Crown Forest Land Base

The LRMP area encompasses the Penticton, Vernon and Salmon Arm Forest Districts, collectively managed within the Okanagan Timber Supply Area (TSA). Crown forest resources are managed as the Okanagan TSA and three tree farm licenses (TFLs). The total land base of plan area is about 2.5 million hectares. Within the TSA only¹⁷, about 65% of the 2.2 million hectare land base is considered productive Crown forest. Forty-five percent of the landbase is deemed to be operable. The difference between the productive forest land and the timber harvesting land base is largely attributable to unmerchantable forest types and inoperable areas¹⁸. It is noted that the timber harvesting land base is in part defined with respect to economic (i.e. cost) factors. That is, reductions in the timber harvesting land base may occur by removing the land base and through management requirements that raise costs to the extent the stand is no longer profitable to harvest. Nonetheless, changing technology, new initiatives, timber supply issues and insect infestations are all combining to push operators into previously unmerchantable or inoperable areas. The dominant tree species are lodgepole pine (31% of the productive forest land base); spruce/balsam (28%), wet-belt Douglas-fir (20%), dry-belt Douglas-fir (12%) and cedar/hemlock (9%).

Forest Health

Over the last 10 years the Okanagan has experienced significant Mountain Pine Beetle, Spruce Bark Beetle, Fir Bark Beetle and Spruce Budworm epidemics, which have created conflicts with other resource values and required modifications to forest management. The Okanagan TSA has a climate that is conducive to the continuation of beetle populations and other pest outbreaks. Bark beetles and defoliators have been aggressively managed over this period, with strategies employed including detection, monitoring, treatment, and impact assessment. The *Forest Practices Code* also includes several management guidebooks to aid provincial foresters in prevention of pest infestations as well as other forest diseases (e.g. root disease, stem decay, etc.).¹⁹

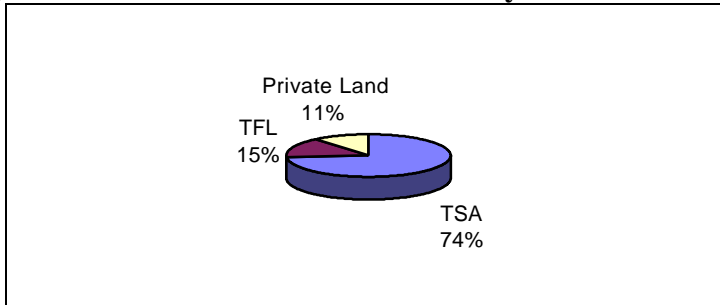
These beetle infestations have also had an impact on harvest levels in the plan area. The Chief Forester has raised the AAC several times over the past decade in response to beetle infestations. In the recent Timber Supply Review, timber losses due to fire, insects, disease and wind damage was estimated at over 126, 610 m³ annually.

4.3 Overview of the Forest Sector

4.3.1 AAC and Harvest Levels

Timber harvesting in the plan area takes place on both Crown and private lands (Figure 4.1). Timber harvested on Crown lands account for the largest share, with the bulk of the Crown land harvesting occurring in the Timber Supply Area (TSA).

Figure 4.1: Shares of Harvest Volume by Forest Land Type (5 year average)



TSA

On TSA lands, the Ministry of Forests (MoF) has primary forest management responsibilities. Companies may take timber from these lands pursuant to volume based licences issued by the Ministry. The current apportionment is listed in Table 4.1. Over the past several years the AAC has varied in two ways. The overall change has been a reduction in the AAC - it declined from 2.7 million m³ in 1989 to 2.615 million m³ in 1992 to take into account the new Okanagan Timber Harvesting Guidelines. However, there have been temporary increases in the AAC over the 1988 to 1994 period to control forest pest infestations.

The recent Timber Supply Review (TSR) maintained the AAC at 2,615,000 m³. This AAC is set for 5 years²⁰, beginning January 1, 1996. The timber supply forecasts conducted for the 1995 TSR indicated that the current harvest level could be maintained for 20 years, before declining over the following three decades to its long-term level of 2,022,000 m³ - a 23% decline over current levels. However, this analysis pre-dated the implementation of the *Forest Practices Code*, which is expected to have some impact on short term timber supply. In the next few months, MoF will provide the 'base case' timber supply forecast which incorporates *Code* requirements, and this forecast, and its implications for the sector, will be included in the base case impact analysis.

Table 4.1 Okanagan TSA: 1996 Apportionment

Forest Licences

AI8671: Gorman Bros. Ltd	231,349
AI8672: Tolko Industries Ltd.	234,228
AI8667, AI8673: Riverside F.P. Ltd.	767,413
AI8674: Weyerhaeuser	380,031

AI8670, AI8691: Federated Co-Operatives Ltd.	332,963
AI8669: Evans F.P. Ltd.	147,597
AI8666: Bell Pole Ltd.	45,286
Forest License (FL) Total	2,138,867
Small Business Forest Enterprise Program (SBFEP)	
Section 16 (any category)	32,551
Category 1	135,314
Category 2	60,921
Bid Proposals	133,188
SBFEP Total	361,974
Timber Sale Licences (TSL)	
License Volume > 10,000 m ³	13,437
License Volume < 10,000 m ³	22,499
TSL Total	35,936
Wood Lot Licenses	37,073
Forest Licences, Non-replaceable	15,000
Forest Service Reserve	26,150
Total	2,615,000

Harvest volume, which often varies from the AAC, directly influences the level of activity in the sector, rather than licensed volumes. Harvest volumes are permitted to vary from licensed volumes (under the licence cut control provisions), enabling the licensee to respond to market conditions and other factors. As well, the harvest of diseased, dead or damaged trees is attributed to the Forest Service Reserve portion of the AAC, or in some cases may not be included in the AAC quota. Over the past five years, recorded harvest from the TSA has averaged 2.9 million m³ - ranging from a high of 3.1 million m³ in 1993, and a low of 2.7 million m³ in 1994²¹.

Tree Farm Licenses

Tree Farm Licences (TFL) give the licence holder access to timber within the geographical area (including some private land) identified in the licence. The licence holder takes on greater forest planning and management responsibilities relative to a forest licence (on TSA lands). There are three TFLs within the plan area. The licensed harvest levels resulting from the recent reviews by the Chief Forester are as follows.

- Riverside (TFL 49) 380,000 m³ (unchanged from its pre-TSR level);
- Weyerhaeuser (TFL 15) 78,000 m³ (includes a new partition of 6,000 m³); and
- Federated Co-Op (TFL 33) 22,500 m³ (reduced from its pre-TSR level of 27,500m³).

The actual harvest from the TFLs has also varied greatly due to beetle infestation.

Aggregate TFL harvest over the past five years averaged 579,000 m³.

Private Timber Supplies

Private forest lands in the LRMP area²² are an important source of wood supply. Harvest volumes are relatively more sensitive to market conditions, with the strong lumber and pulp markets in the last few years encouraging greater harvests. Over the period 1991-1995, harvest from private lands averaged some 440,000m³, or 11% of the planning areas' harvest volume²³. The greatest volume was recorded in 1994, with a volume of almost 510,000 m³.

The recorded harvest is large, given that there are no significant parcels of private managed forest lands in the plan area (i.e. private timber land which has a long term sustainable harvest plan). It is uncertain the degree to which this volume of private timber will continue to be available.

Fibre Imports

The Okanagan-Shuswap wood processing industry is a net importer of fibre from other forest districts and Alberta. Generally this activity is not monitored, but a mill survey completed for the TSR estimated net fibre imports for the region to be about 550,000 m³ in 1993, or equivalent to approximately 14% of the region's milling fibre supply²⁴. Major sources include the Merritt, Arrow, Kamloops, Kootenay-Boundary and Revelstoke areas. Decisions taken in these districts that restrict harvest levels may directly impact the volume available for milling in the plan area.

4.3.2 Forest Industry

The sector is composed of various industries, such as woodlands, forestry services, milling, and further manufacturing. The information presented here is from industry data collected for the Timber Supply Review²⁵, updated for this profile²⁶.

Woodlands

Woodlands includes harvesting, road building, and log hauling activities. Woodlands activity is conducted by a number of contractors as well as divisions of large integrated companies.

Silviculture and Forest Management

Silviculture and Forest Management includes activities related to the management and tending of the forested land base. There has been almost a 50% increase in activity in this sub-sector in recent years. Activity increased by roughly 10% as a result of an increase in "basic silviculture" undertaken by forest licensees and the Ministry of Forests and incremental silviculture and planning largely due to the added requirements arising from the *Forest Practices Code* (FPC). The remaining increase is attributable to Forest Renewal BC projects, which commenced in late 1994. An overview of the 96/97 investment program for the plan area is provided in Table 4.2. While the programs are ongoing, these initiatives have short term employment impacts. Longer term employment impacts may arise to the extent that the initiatives result in an incremental increase in harvest volumes.

Table 4.2 Forest Renewal BC 96/97 Investment Plan for Plan Area

Enhanced Forestry	\$ 4.2 million (approved projects)
Watershed Restoration	\$ 7.5 million (approved projects)
Inventory	\$ 4.0 million (estimate from regional total)
Community	\$ 0.855 million (under contract)
Workforce (Training)	\$ 0.442 million (under contract)

Value Added

\$ 0.350 million (under contract)

source: Forest Renewal BC, Thompson-Okanagan regional office

Lumber and Plywood

There are 9 major sawmills (3 of which also have plywood operations), about 100 small milling and break-down operations, and 5-10 pole/post-mills. The industries operations are distributed relatively evenly throughout the region (Table 4.3). The 9 major sawmills (in 6 corporate groupings) account for over 95% of plan area's lumber production. Products are destined primarily for the North American market (80-90% of sales), as well as Japan and Europe.

The volume of wood milled varies from year to year, depending on market conditions and other factors. Log input volumes to plan area mills has ranged from 3,873 thousand cubic metres in 1993 to a high of 5,280 thousand cubic metres the following years.

Annual lumber production in recent years has been about 800 million board feet per annum. In general, industry opinion is that the current milling capacity is reasonably balanced to current supply. However, it is noted that net fibre imports and logs from private lands account for a significant share of mills' fibre input.

Area mills also produce a large volume of wood chips that are sold to pulp operations outside the plan area, primarily to the Weyerhaeuser mill in Kamloops and the Celgar mill in Castlegar.

Secondary manufacturing

Outside of the Lower Mainland, the Okanagan area has BC's largest number of wood manufacturers that further process sawn lumber into value added products (e.g. millwork, engineered building components, garden products, furniture etc.). Some are quite large, and the product profile is highly varied. It is estimated that there are some 85 independent value added manufacturers, and several of the larger operations are profiled in Table 4.3. Wood supply is a critical consideration for most or all of these operations. A number have entered into lumber trading arrangements with the sawmilling majors. Also, it is noted that the major licensees also are involved in value added production.

Table 4.3 Profile of Secondary Manufacturing Plants

Company Name	Primary Product Line
Greenwood Forest Products, Penticton	panelling, moldings to "do-it-yourself" market
Canwood Furniture, Penticton	solid pine furniture
Abeda Forest Products, Winfield	pine panelling, cedar siding
Vernon Kiln & Millwork, Vernon	panelling, siding, mouldings
Lakeside Timber, Tappen	dimensional cedar and lumber
Milestone Wood Products, Armstrong	door and window components

Source: updated from Okanagan Timber Supply Area Socio-Economic Analysis, 1994

There is anticipation that the US imposed quota on lumber shipments from Canada will encourage further value added as these products are not subject to restrictions. In general, secondary manufacturing has been expanding in British Columbia and the greatest potential for further growth lies in the secondary manufacturing of interior lumber that is currently shipped to the US for processing.²⁷

TABLE 4.4 Okanagan TSA: 1993 Mill Fibre Supply By Land Base Categories (Volume m³)

Company	Mill Locations	Supply Source By Land Base						
		Private	Non - Okanagan Provincial Forests	Okanagan Provincial Forest Land Base				
				TFL	TSA			%
					Forest License	SBFEP TSLs/ Woodlots	TSA sub Total	
Gorman	Westbank Lumby	33,000	53,000		231,000	23,000	254,000	
Tolko	Lavington	100,000	131,000		234,000	60,000	294,000	
Riverside	Armstrong Kelowna Lumby	158,000	220,000	380,000	782,000	122,000	904,000	
Weyerhaeuser	Lumby	51,000	30,000	172,000	380,000	79,000	459,000	
	Ok Falls Ok Falls Chipper		68,000					
Federated Co-op	Canoe	20,000	48,000	27,000	333,000	28,000	361,000	
Evans	Malakwa		100,000		148,000		148,000	1
Bell Pole	Lumby				45,000		45,000	1
Forest Licensee Sub Total								
Other Processors, (SBFEP, Cat. 2, TSLs)						107,000	107,000	
Total		362,000	550,000	579,000	2,187,000	428,000	2,615,000	
Supply %		9%	14%	14%	53%	10%	64%	

Forest Industry Suppliers

There is a large manufacturing and service sector in the plan area which contributes to the diversity of the economy. A number of these operations are associated with forest sector activities, selling products throughout the province, nationally and offshore. Some of the major operations include: D.C. Chambers Trucking (chip transport, head office in Vernon); Newnes Machine Limited (sawmill and log handling manufacturer, head office in Salmon Arm); Western Star (logging trucks manufacturer, head office Kelowna); Price and Markle (supplier of general industrial equipment, head office Vernon); Kenworth Parker Pacific (trucks and forestry equipment, Penticton and Vernon).

4.4 Employment and Income Levels

Over the past few decades, the provincial forest industry employment has been affected by technical change and general industry restructuring. This has resulted in a general decline in the employment per thousand cubic metres in the provincial forest sector, particularly through the early 1980s. However, as many of the productivity improvements available have now been adopted, the decline appears to have recovered somewhat from its low in 1987, and leveled off.

Recent information on employment and incomes in the various industries making up the forest sector is summarized in Table 4.5²⁸. Contributing to the regional economy but not included in the Table is the District Offices and Research Stations of the Ministry of Forests. Total employment in these offices is about 250 persons with an annual payroll of \$11.6 million. Estimates for Woodlands and Lumber and Plywood were confirmed with industry and MoF to not have changed substantially since 1993. The silviculture estimate was adjusted upwards by about 260 person-years to reflect the increased activity discussed above. Approximately 40 PY of that increase is growth in jobs in "basic silviculture" undertaken by forest licensees and the Ministry of Forests, incremental silviculture and planning, largely due to the added requirements involved in implementing the *Forest Practices Code* (FPC). The remaining increase is attributable to Forest Renewal BC projects, which commenced in late 1994. Projects include silviculture, watershed restoration, training and community support projects. While the employment associated with this program is not directly available, it is estimated that in the order of 220 PY might be supported, assuming 1 PY is associated with \$60,000 (an estimate used by Forest Renewal BC) of project expenditure. It should also be noted that, because this work is seasonal, many more individuals than reflected by the PY estimate are actually active.

Direct employment in the primary mills and plywood plants has increased from 2,400 persons in 1993 to an average of about 2,750 over the past few years. Employment estimate for the independent value added operations was estimated to be 1,070 people in 1993. Industry sources indicate that employment has increase since then, and may presently be in the order of 1,300 to 1,700 persons.

Changes in economic activity in the forest sector has implications to other sectors of the regional economy that relies on it. For instance, industrial supply

firms as well as consumer goods and service industries. The relationship of the forest industries to other segments of the regional economy will be discussed in the impact assessment.

Table 4.5 Employment and Income Data

Sector	Estimated Employment (PY)	Average Annual Wage ¹	Total Employment Income
Woodlands	1150	\$56,710	\$65 million
Silviculture & Forest Planning	720	\$42,800	\$30 million
Lumber & Plywood	2750 ³	\$54,570	\$128 million
Re-manufacturing	1300 - 1700	\$34,240	\$44 million
Total Forest Industry	5520		\$268 million
Suppliers	625	\$49,220	\$30 million

¹ Average employment income increased from 1993 level by 7%. Income is pre-tax and included 15% non-cash benefits.

4.5 Government Revenues

The forest industry in the plan area annually pays various fees and taxes to municipal and senior governments. The more substantial payments are noted in Table 4.6 with an indication of their magnitude. Except for the stumpage payment, regional values were not available and provincial average values are presented as a proxy.

Table 4.6 Government Revenues Derived From Forestry Related Activities

Payment	1995 dollars per m ³¹	Payment	1995 dollars per m ³
British Columbia		Canada	
<i>Logging Tax</i>	\$.46	Corporate Income Tax	\$1.82
<i>Stumpage²</i>	\$23.00	Excise Tax	\$.07
<i>Corporate Income Tax</i>	\$1.74	Withholding Tax	\$.12
<i>Rent</i>	\$.22	Personal Income Tax	\$11.36
Corporate Capital Tax	\$.54	Canada sub-total	\$13.37
<i>Sales Tax</i>	\$2.44	BC and Canada Total	\$44.92
Property Tax	\$2.16		
<i>Electricity Tax</i>	\$.97		
Personal Income Tax	\$5.42		
BC sub-total	\$31.52		

¹ Except for stumpage payment, average provincial forest industry payments (1991-1995) as reported Price Waterhouse.

² Actual stumpage in 1994 for the planning area averaged \$22.82 per m³ and \$23.05 in 1995.

Highlighted in Table 4.6 are the provincial payments that are linked directly to harvesting levels or processing throughput. That is, government revenues from these sources will be affected by marginal changes in the harvest level. The other taxes, such as property tax, are not as sensitive to relatively small changes in throughput. Revenue from these taxes would more likely be affected for large changes in harvest, which lead to a rationalization of industry processing capacity.

The extent to which provincial revenue from personal income tax is affected by changes in the harvest level is ambiguous, and for this reason it is not highlighted in the Table. The ambiguity arises from the uncertainty regarding the probability individuals affected will find alternative employment at comparable income levels in BC. To the extent they are able to, there would be little impact on provincial revenue from this source.

4.6 Outlook

Crown land within the Okanagan LRMP area supplies about 75% of the region's primary milling needs. Given the conclusion of the Timber Supply Review and the accompanying AAC determinations, this level of fibre supply is relatively secure until the year 2000, when the next AAC determination is expected. The impact of the *Forest Practices Code* requirements will be clarified in the Base Case timber supply forecasts.

Over the longer term, the 1995 determination indicated a reduced timber supply from Crown lands perhaps beginning 20 years hence, when the harvest levels will step down toward the long run sustained yield. The projected volume of the decline is equivalent to what would support at least 1 and possibly 2 average sized interior sawmills.

The Chief Forester noted in his AAC Rationale that actual past harvesting practices have not always concentrated on the oldest stands first, due to insects, disease or wind impacts on younger stands. For the future harvest to more accurately reflect the harvest profile, older stands will have to be harvested to a greater extent. This shift will focus on areas of cedar/hemlock, spruce/balsam, and the Interior Douglas Fir biogeoclimatic zone.

The long term timber supply from private timber lands is not known, hence is a source of some uncertainty. Also, the plan area's milling industry relies on log volumes harvested in adjacent TSAs whose long term supply positions are subject to change.

One might expect continued expansion of the secondary manufacturing activities, as the region has a locational advantage in its proximity to markets in the US. This manufacturing activity is a complement to, not a substitute for, the primary milling sector, as it represents a deepening of the manufacturing activity. Continued expansion of the activity will depend on a host of factors that determine the manufacturer's relative competitiveness (e.g. relative production costs, exchange rate, product quality, tax regime) in addition to access to fibre. As well, the provincial government has initiated the *Jobs and Timber Accord*, with the objective of creating nearly 40,000 new jobs in the forest sector across the province. However, the extent to which new employment will occur in the plan area is not clear.

5. Mineral and Energy Resources

5.1 Mineral Resources and Development

5.1.1 Historical and Provincial Context

The mining industry has played a significant role in the development of British Columbia since the 1850s, and in the Okanagan Shuswap since the 1870s. The industry began when native peoples on the lower Fraser River reported finds of placer gold to Hudson's Bay Company traders. Placer miners thronged northward from Californian gold fields to make significant discoveries on the Fraser, Similkameen and Kootenay rivers, before finding the exceptionally rich gold fields of the Cariboo in 1859. The Californians were ultimately joined by Canadian, European and Chinese miners who exploited numerous placer bearing streams over the course of the next few decades, some of which have seen almost continuous production since. Also in the late 1800s, coal and a variety of metallic mineral deposits were found and a diversified industry was established. Today the main commodities produced include coal, gold, silver, copper, molybdenum, zinc, lead, and structural and industrial minerals.

The mining industry makes a significant contribution to the provincial economy, accounting for about 2% of provincial GDP. Mining activity in the province occurs on a relatively small proportion of the land base (about 25,000 hectares of land or less than 0.025% of the province), but generates significant revenues - gross revenues from mining (i.e., value of production) are almost \$4.0 billion a year²⁹. Mining employees earn relatively high wages (about \$65,000 per year), and the mining industry is a significant contributor to provincial revenues: \$160 million in direct tax payments and water rentals to provincial and municipal governments and \$23 million to the federal government. Total payments to all governments, including employee income taxes, amount to \$412 million³⁰.

5.1.2 Okanagan-Shuswap Context

According to the most recent Price Waterhouse survey³¹, the Thompson-Okanagan region (the region in which the plan area is located) accounts for around 17 - 18% of provincial mining employment and revenues. While none of the mines included in the Price Waterhouse survey are located in the plan area, the activity in the larger area provides some indication of potential within the plan area. Projections based only on current industry activity will not accurately indicate the potential contribution of mining to the area's economy since they would neglect the possibility of significant new discoveries and the economic upsurge they would bring. This Profile therefore includes both an analysis of past mineral development activities as well as an assessment of the area's relative mineral potential based on what is known about its regional geology and mineral deposits.

The Okanagan-Shuswap plan area includes parts of seven mining divisions (Kamloops, Revelstoke, Nicola, Similkameen, Vernon, Osoyoos, and Greenwood) all of which have a long history of mining. Current levels of mineral exploration and development activity are, however, low relative to historic levels in the plan area and in other regions of BC.

Known mineral occurrences include precious metals (gold, silver), base metals (lead, zinc, copper, molybdenum), industrial minerals (limestone, clay, gypsum, graphite, sand and gravel), gemstones (opal, agate), and uranium³². There are currently no major projects at the development stage. Recent trends have been to small tonnage, high-grade precious and base metal deposits and a variety of industrial mineral projects serving a diversity of markets, although this trend does not preclude the possibility that other large tonnage, low-grade deposits might be discovered and developed.

5.1.3 Mineral Resources

Metallic and Industrial Minerals

A government-maintained mineral occurrence database (MINFILE) indicates there are 642 documented mineral occurrences in the plan area³³. MINFILE classifies occurrences according to what is known about them and whether there has been recorded production. Mineral occurrences about which relatively little is known are called “showings”. If further exploration finds evidence that a commercial deposit might exist they are classified as a “prospect”³⁴. Prospects at which extensive exploration work has taken place are called “developed prospects”. Some of these may have defined reserves (tonnage and grade figures). Mines currently in production, or temporarily shut down, are classified as “producers”. Closed or abandoned mines are termed “past producers”.

There are 439 showings and 84 prospects in the plan area that include a wide range of base metals, precious metals and industrial minerals. Table 5.1 lists the more important mineral properties in the plan area. These include developed prospects, currently producing mines, and past producers with documented reserves (based on MINFILE data) as well as important deposits under active exploration. Of the 22 properties classified as developed prospects, 4 have sufficient reserves to support commercial development in the near future (i.e., Bearcub feldspar; Crystal Peak garnet; Klinker opal; Lumby sericite/graphite). Six of the developed prospects have uranium as the main commodity but are not being worked on. Only 2 hard-rock mines are currently in operation, producing marble and gypsum.

Eighty-three occurrences can be classified as past producers; i.e., deposits that commenced commercial production and have since closed. This number includes 55 precious and base metal properties (gold, silver, copper, molybdenum, lead, zinc) and 28 industrial mineral properties (asbestos, clay, gemstones, granite, limestone, marl, mica, rhodonite, silica). Three of these are listed in Table 5.1 because they have documented reserves and could be reopened if economic and regulatory conditions permit.

Table 5.1 Principal Mineral Properties (including developed prospects; producers; past producers with documented reserves)

Property Name		Principal Commodities	General Location	
Developed Prospects	Bald Range	marble	16 km NW of Kelowna	
	Bearcub	feldspar	11 km E of Lumby	
	Brett	gold/silver	Whiteman Creek	
	CU 1	silver/lead/zinc	E. of Adams Lake	
	CU 5	zinc/silver/lead	E. of Adams Lake	
	Copper King	copper/silver/gold	Mt. Grace	
	Complex	zinc	Mt. Grace	
	Cotton Belt	lead/zinc/silver	Upper Seymour River	
	Covert Basin	uranium	Oliver	
	Crow-Rea (Lori)	molybdenum/copper	W of Summerland	
	Crystal Peak Garnet	garnet	Apex Mt.	
	Haynes Lake	uranium	25 km SE of Kelowna	
	Hydraulic Lake	uranium	25 km SE of Kelowna	
	Klinker	opal	near Vernon	
	Lightening Peak	silver/lead/zinc	60 km SE of Vernon	
	Lumby	sericite/graphite	Lumby	
	Mount Kruger	nepheline syenite	Osoyoos	
	North Wow Flat	uranium	Oliver	
	Prairie Flats	uranium	Summerland	
	Rose (Munro Lake)	molybdenum/copper	W. of Summerland	
Producers	Sil	marble	7 km E of Keremeos	
	Sinking Pond & Flats	uranium	Oliver	
	Tadpole	molybdenite	26 km NW of Kelowna	
	Vault	gold	Kaleden	
	Falkland	gypsum	Falkland	
	Kingfisher	marble	Mabel Lake	
	Past Producers (with reserves)	Dusty Mac	gold	Okanagan Falls
		Fairview	gold	NW. of Oliver
		Stemwinder	gold	NW. of Oliver

Source: Ministry of Energy and Mines

Placer

The plan area has a history of placer gold mining dating back to the 1870s. MINFILE records list 13 gold occurrences as past producers. Historically the main areas of activity have been Mission Creek near Kelowna, Cherry Creek near Cherryville and Rock Creek near Bridesville. Small amounts of gold have also been produced from Salmon River and Moffat Creek, east of Falkland; the west side of Okanagan Lake (Naswhito and Whiteman creeks); and near Winfield. Placer claim owners are allowed to produce up to 2000 cubic metres of pay-dirt per year on each claim. However, under current regulations, only in areas designated as “placer lease areas” can claim owners apply for leases which would allow placer mining operations in excess of 2000

cubic metres/year/claim³⁵. There are six small “placer lease areas” in the plan area: Scotch Creek, Kwikoit Creek; Hlina Creek, Ashby Creek, Moffat Creek, Cherry Creek and Trout Creek (eastern Tulameen area). Although gold has been the primary commodity sought by placer miners, other heavy minerals (e.g., platinum, iron-titanium oxides, garnet, sapphire) are amenable to placer mining technologies and may be found in the plan area.

Aggregate

Aggregate (including sand, gravel and crushed rock) are key materials in construction and maintenance of buildings and roadways. Sand and gravel are probably the largest volume mineral commodities produced in the plan area. However, production, revenue and employment records are not readily available. One estimate suggests that the Kelowna area alone uses at least 1.6 million tonnes of aggregate per year³⁶.

Pits may produce continuously or intermittently depending on markets and the end use of the product. Because aggregate is a high-volume, low-value commodity, close proximity to markets and end-use sites is important.

Most existing commercial pits and quarries in the plan area are on private land. On Crown land there are also many gravel pits operated by either the Ministry of Transportation and Highways for highway maintenance or the Ministry of Forests for forest road development.

5.1.4 Mineral Resource Development

Mineral resource development presents unusual challenges. The resources themselves are mostly hidden, unquantifiable (except at enormous cost), and fixed in place. If they are to be developed at all, they must be mined where they are found. Finding new mines requires time, patience, knowledge and money. International markets drive the search for commodities. Large areas of land and many mineral occurrences need to be evaluated through repeated and expensive exploration campaigns over a span of years or decades before a commercially viable mineral deposit is delineated. Reassessments of regional and local areas result in refined databases that can lead to eventual discoveries. New processing or mining technologies or new deposit types or geological theories can reopen even thoroughly prospected areas and result in unexpected discoveries. Commodity prices can rapidly transform uneconomic or sub-economic resources into mineable reserves (and vice versa). Social expectations can help or hinder development. Each new mine represents the culmination of years of effort and the favourable combination of a bewildering set of geological, biophysical, technological, regulatory, financial, and social variables.

What attracts industry to an area is, broadly speaking, its geological potential, coupled with perceived economic, regulatory and political risks. It is a complex assessment of the likelihood that significant new deposits can be discovered, and once found, developed into profitably operating mines. Geological potential is part of the natural endowment of an area and the result of plate tectonic processes operating over millions of years. It is an essential prerequisite for investment but by itself is insufficient to sustain it. Recent examples from around the

world demonstrate that, although investment flows to where discoveries are made, regulatory, fiscal and political stability are critical for maintaining high levels of exploration investment. Many richly mineralized parts of the world lie underexplored or unexplored because they lack the requisite certainty for risk-capital investment.

Appraisals of geological potential (also called mineral potential) are sometimes contentious since they must, of necessity, focus on what is known about an area, which is always dwarfed by what is unknown. Nevertheless, given the caveats that they are based on existing, imperfect data and limited scientific understanding, assessments of mineral potential can be developed³⁷. These provide a relative ranking of predefined areas (geological tracts a few 10s of kilometres across) in terms of the probability of discovering new, commercially viable reserves of a wide variety of metallic and industrial mineral commodities. These can be used to broadly indicate the geological endowment of a region. It can be assumed that, other things being equal, future mineral exploration will focus on areas with higher mineral potential. According to a recent assessment over three-fifths of the plan area has above average mineral potential³⁸.

The mineral development cycle generally moves through exploration, development, operations and reclamation phases. The speed at which a given property moves through these stages largely depends on the commodity, its location, available financing, and government regulation. For some commodities (e.g., aggregate, placer gold) the exploration and development phase can be relatively short (months to years); others (e.g., metals and some industrial minerals) may require much longer (years to decades) to bring a mine into production. Since 1947, government records indicate there have been 898 mineral exploration projects in the plan area³⁹.

5.1.5 Resource Management

Tenure

Mineral tenure is acquired by staking⁴⁰. Title is recorded at the local mining division office or regional Gold Commissioner's Office. Before a claim holder may undertake any activity that will mechanically disturb the ground surface, permission must be obtained from the Mines Branch, MEM through an approved 'Notice of Work and Reclamation'. Among other things, this requires the claim holder to file a reclamation plan and post a bond. There are approximately 1,900 valid tenures in the plan area, a number that is constantly changing due to the continuous turnover of tenures.

However, active exploration is not occurring on all tenures. Most of the LRMP area is open for claim staking for hardrock (or lode) minerals⁴¹. A much smaller area is open for placer staking.

Project Development and Review Processes

Before a mine can be brought into production, it is subject to a comprehensive review of potential impacts. Up to 1994 mine development projects were reviewed by the Mine Development Review Process (MDRP) or its successor, the Mine Development Assessment Process (MDAP), which provided for interagency reviews of all mining proposals. Both MDRP and MDAP were co-ordinated by the Ministry of Energy,

Mines and Petroleum Resources (MEMPR). Since 1994 all mining proposals above certain size (based on anticipated rate of production) are reviewed through a process co-ordinated by the Environmental Assessment Office (EAO)⁴². The threshold for inclusion in the EAO process is established by regulation, but Cabinet may designate any project as reviewable by the EAO. An approved project is issued a Project Approval Certificate after which application can be made for all other necessary permits. New mining projects that fall below EAO thresholds are reviewed by a standing committee comprising provincial and federal regulatory agencies chaired by the Regional Manager of the Ministry of Energy and Mines. For the Okanagan-Shuswap this committee is called the South Central Mine Development Review Committee. Approved projects receive a Minister's permit under the *Mines Act*, but must also acquire all other necessary permits that may be required by other legislation (e.g., water, waste management, land, transportation, highways, fisheries, health, etc.) before actual mining can begin.

Three mineral projects are at various stages of environmental review:

⇒ Crystal Peak (Polestar Exploration Inc.) is a proposed garnet mine near Apex Mountain ski area. The project has been under review since March 1991 and is now on hold. There was strong opposition to the project from a First Nation and ski area residents and users. In late 1997 the proponent withdrew the project from the EAO process and appears unlikely to proceed in the foreseeable future. The original proposal entailed a small quarry that would have produced 75,000 tonnes per year of raw ore (60,000 tonnes finished product) over a 20 year mine life. The average operating labour force would have been 27 persons.

⇒ The Lumby Muscovite (Quinto Mining Corp.) is a former gold and silver property now being redeveloped for its sericite and graphite content. In 1996 the company entered the EAO process but subsequently withdrew in order to apply for a *Mines Act* permit through the South Central Mine Development Review Committee. The smaller scale of operation (less than 25,000 tonnes per year) better suited the company's mining plans. Approval is expected in the near future pending successful outcome of negotiations with a local land owner. Estimated production will be 250 tonnes per day over a 7 year mine life. Average employment is estimated to be 58 persons.

⇒ Bearcub (Brenda Mine/Noranda Exploration) is a feldspar and silica property located midway between Lumby and Cherryville. It commenced environmental review (under the Mine Development Review Process) in 1988 and received approval-in-principle on 14 August 1989. However the company was not in a position to proceed with final permitting and mine development at that time. Introduction of the Mine Development Assessment Process in August 1991 meant that the original approval-in-principle had to be converted to a mine development certificate (MDC) prior to final permitting. In 1992 the property was optioned to Spar Minerals Inc. who commenced application for an MDC. After some additional reviews and consultation with First Nations an MDC was issued in July 1993. Spar Minerals did not proceed with development and the property was returned to its original owners. It has remained dormant since. Although there appear to be no plans for development, and no work has been done on site since 1988, an MDC is valid for 5 years from date of issue. It is possible, although highly unlikely, that this project may proceed in the near future. As originally proposed the mine would have been operated as an open pit, producing

50,000 to 100,000 tonnes per year with a total operational workforce of 25 people. Proposed mine life was 100 years.

Generally, the nature of the mineral resource is such that:

- mining is a temporary use of the land, although the duration of land use varies considerably from a few weeks for exploration to decades for large operating mines;
- long-term access to large tracts of lands is required to find the mineral deposits located within;
- exploration and mining activities and their impacts are limited to relatively small areas;
- the exploration process that leads to the discovery of new mines is an iterative process often occurring over years or decades; and
- comprehensive environmental approval processes and reclamation laws apply to all mining developments.

5.1.6 Contribution to the Economy

Mineral activities contribute to the local provincial economies during exploration, development, production and reclamation phases. The nature of the contribution consists of direct employment, the purchase of goods and services in the planning area, and various payments to government.

Government Revenues

Mineral exploration companies and operating mines pay a variety of fees and taxes to government (i.e. social service, recording fees, mineral production taxes, etc.). It is important to distinguish “fee for service” payments to government from royalties or payments to the resource owner (i.e. the Crown) for extracting the resource. The mineral tax is a profits-based tax paid by operating mines for use of the Crown mineral resource. While the mineral tax revenues collected from the two mines operating in the plan area are expected to be relatively small this operation-specific information is confidential.

Exploration Activities

With respect to exploration activities, data are available from Assessment Reports on reported expenditures⁴³. Over the past 10 years, over \$10 million in exploration expenditures have been reported, with annual expenditures varying from as low as \$300,000 to as high as \$2.4 million. This information should be viewed as an indicator of activity, rather than a precise measure, as the data are generally believed to understate activity⁴⁴.

In 1996 major exploration expenditures were recorded⁴⁵ on 5 of the 22 developed prospects shown in Table 5.1 - the Brett, Cotton Belt, Crow-Rea (Lori), Klinker and Rose Munro Lake properties. It is estimated that the total spent on exploration on these properties was between \$1.5 and \$2.0 million (based on an approximate industry coefficient of \$100 per metre drilled). At the Brett property, surface trenching and underground work were conducted on a gold vein system. About 500 tonnes of material were taken from a surface trench to be shipped to a smelter. Drilling at the Crow-Rea property intersected a zone of molybdenite with reserves estimated at 500,000 tonnes grading 0.3%. Four long holes were drilled at Cottonbelt to test geological structures and base metal sulphide horizons. The exploration target is a structurally-thickened stratified sulphide deposit similar to those found in Australia's

Broken Hill district. At the Klinker opal property, about \$1 million has been spent in development work including a 300 tonne bulk sample from test pits. The company has set up a workshop and retail outlet in Vernon where opal jewellery and specimens are produced and sold. Drilling was also conducted at Rose Munro Lake property intersecting disseminated copper and molybdenum. The exploration target is an open pitable, large-tonnage, low-grade deposit similar to the Brenda copper-molybdenum porphyry deposit.

Operating Mines

Table 5.2 summarizes the annual contribution of three operating mines. Note that the Nickel Plate mine, which is just outside the plan area boundary, closed in October 1996 and is entering the reclamation phase. Details of revenue and employment in aggregate (sand and gravel) and placer operations are not available and so are excluded from this table.

Brief mention is made of two typical metal mines in order to illustrate their economic impacts.

Brenda Mine

Brenda is a large open pit molybdenum and copper mine located west of Peachland that was in operation from 1970 to 1990. The mine occupied a lease area of about 1550 hectares. Active mining disturbed about 1010 hectares. Over the mine's operating life it averaged annual purchases of \$23 million in materials, paid \$11 million in wages, \$3 million in income and production taxes, \$1 million in municipal and other taxes⁴⁶ and employed about 400 persons. In wages and benefits alone this represents a return of about \$188, 000 per hectare⁴⁷. Surface reclamation has been completed with the contouring and seeding of rock piles. The on-going reclamation challenge is the treatment of mine waters that carry excessive molybdenum. A permanent treatment facility will be constructed to treat water accumulating in the former open pit and tailings pond. A \$28 million reclamation bond has been posted to ensure sufficient funds are in place to complete reclamation work. An additional spin-off of the mine was the creation of the Brenda Process Technology Group, now a separate company that offers consulting engineering services on mineral processing and reclamation technology to an international clientele.

Nickel Plate

Near Hedley, but just outside of the plan area, is the Nickel Plate gold mine. This mine is noted because the rock type in which the commercial deposit was found extends into the plan area. The mine also illustrates the potential for renewed activity in old mining camps. Nickel Plate is an open pit mine developed in an area already extensively mined by underground methods earlier this century. Bulk mining technologies enabled more efficient removal of lower grade mineralization. The mine officially closed in October 1996, but while operating employed on average 136 persons and had an annual output of some \$46 million in gold. Reclamation work is underway.

Employment and Income

Employment information from the 1991 Census indicates that about 2,500 residents⁴⁸ in the plan area were directly employed in the Mining Industry (using SIC code for Mining Industry and Mineral Processing excluding oil and gas). This was about 4% of the plan area's total labour force employed in the "basic" sectors. It is estimated that

additional employment of some 1,500 persons in industry supply firms and consumer products results from the Mining Industry's activity.

Recreation Activities

In addition to commercial/industrial mineral development activities that are subject to government regulation, it is recognized that mineral resources also support recreational activities, such as rock collecting and gold panning. These activities are not regulated so there is no consolidated record indicating the level or intensity of this activity.

Table 5.2. Operating Mines in the Planning Area

Mine Name	Ore	Tonnes	Estimated Value of Production	Average Number of Employees
Nickel Plate Mine ⁴⁹ Homestake Canada Inc.	Gold Silver	1,326,000 milled	\$46 million	136
Falkland Gypsum Lafarge Cement Inc.	Gypsum	5,426 shipped	\$60,000	intermittent production
Kingfisher Marble Kingfisher Marble Inc.	Marble	200 per year	\$20,000	5

Source: Energy and Minerals Division, MEM

5.1.7 Outlook

The main factors that influence the outlook for the mineral resource sector include:

- developments in world market conditions, metals prices and the value of the Canadian dollar;
- developments in the provincial and international taxation and regulatory climates;
- exploration activity and success; and
- technology.

While these factors are largely external to Crown land and resource management planning, land use planning can have a beneficial influence if it positively affects the following key mineral development issues:

- security of tenure;
- security of access; and
- certainty with respect to other resource values and land uses that must be addressed in mine development review processes.

Based on a recent assessment of mineral potential for all of BC by the Geological Survey Branch, MEI, the plan area has promising mineral potential for a wide variety of mineral deposits including large-tonnage, disseminated molybdenum-copper deposits (e.g., Crow-Rea, Rose Munro Lake, Tadpole) or copper-gold deposits (e.g., Lightning Peak), low-tonnage, high-grade gold and silver producers (e.g., Brett, Elk), and speciality industrial mineral deposits, including gemstones (e.g., Klinker). However, mineral exploration (the "lifeblood of the industry") is at historic low levels in the province and in the plan area in particular⁵⁰. A handful of advanced exploration projects are receiving the bulk of expenditures. Grassroots or generative exploration is significantly underfunded. Exploration opportunities emerging from new geological data and concepts are thus unlikely to be tested in the near future. Reasons for this are attributed to land use uncertainty, aboriginal land claims, regulatory and tax burdens, and long and uncertain environmental review and permitting processes⁵¹. As a destination for mining investment BC competes against the world.

Only a small amount of the venture capital raised on the Vancouver Stock Exchange is spent in the province. While the geological potential remains good, there is widespread industry perception that elsewhere in Canada and overseas are better opportunities for bringing new discoveries into production. Unless there are substantial changes it appears unlikely that mineral exploration activity in the plan area will increase in the near future.

The demand for sand, gravel and other construction aggregates is likely to continue to grow with increased population. As private land is used for urban development or as reserves are depleted, Crown land will be increasingly required for aggregate resource supply. Aggregate resources are susceptible to sterilization by rapid urban expansion.

Resource extraction opportunities can also be pre-empted by opposition from residents near proposed pits and quarries.

Commercial placer activities are likely to remain unchanged unless new areas are opened for production. Interest in recreational placer appears to be increasing, based on attendance at panning competitions, recent popular literature on the subject, and increasing membership in local placer clubs. It is attributed to increasing demand for low-cost outdoor recreational activities.

5.2 Energy Resources and Infrastructure

5.2.1 Energy Resources

Energy resources include both the natural resources themselves (e.g., petroleum (oil, gas), coal, geothermal, hydro-electricity, nuclear, biomass, solar, wind, etc.) and the facilities to generate and transmit the resources to their ultimate destination.

The potential for oil, natural gas and coal resources to be produced in the plan area is very low to zero. There are also several documented uranium deposits, some with commercial reserves (Table 5.1). Biomass, solar and wind resources are beyond the scope of this report.

Geothermal energy potential is moderate to high throughout the plan area, with the central part of the plan area having highest potential.

Geothermal energy is renewable heat energy from deep in the earth.

Heat is brought to the near-surface by deep circulation of ground water and by intrusion into the earth's crust of molten rock. Visible forms of geothermal energy are hot springs and volcanic areas.

The three identified geothermal basins in the planning area are related to Tertiary volcanic centres at Kelowna, Summerland and Okanagan Falls. Several boreholes drilled in the basins have identified the existence of the resource, but its extent and characteristics are not well defined. More drilling is required to assess its thermal and chemical properties and potential commercial viability. However, some institutional facilities are believed to be using the resource for space heating.

5.2.2 Energy Infrastructure

Energy infrastructure includes generating and transmission facilities for electricity and natural gas. The plan area is dependent on the provincial grid for electricity and major electrical transmission lines (60-500 kV) cross the planning area, also delivering electricity to users to the west and south of the plan area. It is estimated that there are about 480 km of transmission lines in the plan area.

BC Gas has natural gas transmission lines crossing the plan area: running east-west at the northern and southern parts of the planning area, and running north-south from Oliver to Vernon. Currently, BC Gas is proposing a 20-24 inch pipeline from Yahk to the Lower Mainland. As of October, 1997, the project is the subject of BC Utilities Commission hearings. After the hearings, BC Gas will submit an project application for review by the Environmental Assessment Office.

5.2.3 Contribution to the Economy

There is little contribution to the local economy from the development of energy resources, with the exception of some limited use of geothermal energy. With respect to energy infrastructure, the direct contribution in terms of employment and income is relatively small - mainly in terms of the employment, supplies and services required to maintain infrastructure and plant facilities. However, energy infrastructure does play a vital role in the local economy as a critical input to residential, commercial and industrial activity.

5.2.4 Outlook

While geothermal energy may have some use for space heating in the plan area, and has potential to be used in agricultural applications (e.g., fruit drying and processing), it is unlikely that this resource will be commercially developed within the next ten years. Uranium deposits within the plan area are not likely to be developed given today's economic and regulatory climate.

The existing energy infrastructure (electricity and gas) is essential to sustain settlement and the growing population of the plan area. Access for maintenance of existing infrastructure is important to continuing to provide the needed services. In addition, as the population and economy of the plan area and other areas of the province continue to grow, there will likely be future requirements for new facilities in or through the plan area, such as the proposed gas pipeline.

6. Tourism and Recreation

6.1 Introduction

The plan area is noted for its extensive lake system which supports numerous water related activities, including swimming, fishing, sailing, canoeing, boating, and house boating. In addition, there is a high level of land based outdoor activity - from hiking, hunting, trail riding and wildlife viewing to downhill skiing, cross-country skiing, snowshoeing, ice fishing, and snowmobiling. For most of these activities, the quality of the experience depends on values such as undisturbed natural settings, scenic areas, and opportunities to access wildlife and fish resources without experiencing other resource users.

These activities are undertaken both by locals and by tourists from within and outside the province (particularly from Alberta, Manitoba, Washington, Idaho and Oregon). Based on the latest available statistics⁵², in 1989 1.1 million out-of province visitors and 2 million BC residents visited the Okanagan-Similkameen Region.⁵³

Available information sources usually do not allow the number of visits or expenditures through recreation use to be separated out from commercial tourism use. As well, where tourism use is defined, its official definition (used by governments, including British Columbia) is persons who have travelled 80 kilometres or more from their residence. This definition would capture many plan area residents travelling within the plan area to take part in recreation activities.

Almost 500 businesses are estimated to be directly dependent on tourism. Of these, roughly 70% are highway and community related and 30% are outdoor tourism and recreation related⁵⁴. Crown land and resources are important to many of these businesses, however, some elements of the tourism sector are more directly dependent on Crown resource features such as parks, scenic views, wildlife and fish resources, and water quality. As described in more detail later, it is estimated that tourism businesses dependent on the ability to access Crown land and resources generated over \$40 million in revenues in 1996.

6.2 Highway and Community Tourism

This category of tourism includes business and leisure travellers who primarily travel along the main transportation routes. They use accommodation facilities along these routes and in the communities, and may partake in outdoor related activities on Crown lands. Along major highway routes and in urban centres there are numerous tourism facilities and services which support the touring and business traveller (see Table 6.1). Local attractions and facilities such as lake-side routes, the Historic O'Keefe Ranch, golf courses, wineries, and farms increase the length of stay and visitor expenditures in the area. The area is a key golf destination, with both resort courses and local courses. It is also a unique destination for winery and farm-based tours ('agri-tourism'), and preliminary results of a current study indicate a significant increase in agri-tourism businesses in recent years⁵⁵.

Table 6.1 Highway and Community Tourism Facilities within the Plan Area

Type of Facility	Number of Businesses	% of Total Businesses
Accommodation Facilities	263	77%
Tourism Attractions		
• Farm Based Businesses	25 - up to 75*	7%
• Wineries	27	8%
• Other Attractions	7	2%
• Golf Courses	18	5%
Total	340	100%

Areas with scenic settings are attractive to the touring traveller, who is more likely to stop and explore the area and generate tourism revenues. Scenic values on Crown lands visible from highway routes can influence the traveller's decisions on how much time (and money) to spend in the region.

6.3 Outdoor Recreation & Tourism

This includes visitors and local residents who partake in outdoor related activities, whose primary focus is to experience the outdoor environment. Those travelling further from home may camp or stay at accommodation facilities along the lake shore and/or on Crown land, or may use the facilities within communities or along transportation routes.

Outdoor activities such as hiking, hunting, trail riding, wildlife viewing, fishing, canoeing, jet boating, downhill and cross country skiing and snowmobiling are popular in the plan area. The opportunity to take part in these activities is a factor in many area residents' decisions to move to or remain in the area, and is a major draw for tourists. Undisturbed natural settings, scenic areas, and opportunities to access wildlife and fish resources without experiencing other resource users are important for many of these activities. The tourism operator is able to charge a premium for this type of experience.

6.3.1 Outdoor Tourism Businesses

There are almost 156 tourism businesses⁵⁶ in the area offering outdoor/recreation related experiences (see Table 6.2). These are divided into the following four categories.

Table 6.2 Outdoor/Recreation Related Tourism Business in the Plan Area

Regional District	Number of Tourism Businesses Within Regional District				
	Land Based Activities	Lake/River Related*	Guide Outfitters	Ski Facilities	Total
Okanagan Similkameen	11	22	2	1	36
Central Okanagan	13	30	2	1	46
North Okanagan	8	9	3	1	21
Columbia Shuswap	6	42	4	1	53
Total	38	103	11	4	156

* Lake/river related businesses include the outdoor accommodation properties located along the shoreline.

Land Based Activities

Of the companies offering land based experiences during the spring, summer and fall, 21 are trail riding/guest ranches; 13 are companies offering a range of activities (hiking, biking, wildlife viewing, etc.); and 4 are mountain biking/cycling tour companies.⁵⁷ Both day and multi-day trips are offered, and typically camping is used for multi-day trips. Many of the trips offered include the use of Crown land both within and outside of park areas. Key features important to land based businesses are natural settings, maintaining access to areas of use, wildlife species for viewing and scenic viewing areas.

Lake /River Related Businesses

Lakes and rivers are a dominant recreation feature of the region. Most outdoor tourism/recreation businesses offer water based activities or provide facilities on the waterfront. Lake/river related operations are comprised of 28 boat related companies (tours, houseboats, motorized and non-motorized boats); 7 marinas; and 69 accommodation facilities. The accommodation facilities offer a wide variety of activities and services including:

- marina facilities - offered by 16% of accommodation facilities
- boat rentals - 38%
- freshwater fishing - 40%
- power boating/ sailing - 40%
- canoeing/kayaking - 35%
- wildlife viewing - 24%

Key values that are important for the clients of these water related tourism businesses are the views from the shore out and across the lake and the views from the lake to the shoreline. Fish resources for sport fishing are important as well as wildlife species for viewing.

Guide Outfitters

Guide outfitters are licensed to guide hunters within a guiding territory. In most cases, the guide outfitter has made substantial capital investment in developing a base camp, satellite camps, trails, etc. A total of 137,000 ha of guide territory falls within the plan area. Within the Okanagan Environment region⁵⁸ there were 11 active guide outfitters during the 1995-96 fiscal year, representing 5% of the total guide outfitters within the province⁵⁹. For the plan area, there were over 750 hunter days guided during this time

period - an average annual increase of 2% since 1991⁶⁰. The key species hunted include deer, black bear, mountain goat, mountain sheep, and cougar (Table 6.3). Many guide outfitters have expanded their operations to include non-hunting activities, such as trail riding, fishing, and wildlife viewing - typically in the summer when the hunting season is not open. Based on a 1988 study⁶¹, non-hunting activity generated 46% of the total client days for guide outfitters located within the southern area of the province.

Table 6.3 Total Non-Resident Hunting Days within LRMP Region 1995

Species	Non-Resident Hunting Days	% of Total
Deer	264	35%
Black Bear	232	31%
Cougar	112	15%
Mountain Sheep	96	13%
Mountain Goat	23	3%
Elk	13	2%
Moose	12	2%
Grizzly Bear	2	- -%
Total Days	754	100%

-- less than 1%

Source: Ministry of Environment, Lands and Parks estimates of Non-Resident Hunting for Okanagan LRMP plan area.

Ski Facilities

The Okanagan is well known as a ski destination, attracting predominately BC skiers (77% in 1993/94)⁶². There are 5 ski facilities in the region: Silver Star, Big White⁶³ and Apex are four-season resorts, and Mt. Baldy and Crystal Mountain are day use areas mainly serving residents. All 5 facilities have long term tenure with BC Lands, covering 5,285 ha within the LRMP area. The Commercial Alpine Ski Policy regulates use within the tenured areas.

The total number of skier visits for the 5 ski hills was 834,960 during the 1995 -1996 season - a 6% average annual increase since the 1993/94 season⁶⁴. In response to this growth, expansion is planned for the three major ski resorts for both winter and summer activities (such as are hiking, biking, trail riding, conferences, and events), and at Mt. Baldy.

Values which are important to users of these facilities are scenic views, natural settings and the ability to access backcountry areas (specific for summer activities).

6.3.2 Other Outdoor Recreation

In addition to utilizing the facilities and services offered by commercial tourism operators, local residents and tourists also partake in outdoor recreation activity on their own. Provincial parks and provincial forests provide opportunities for activities such as camping, hiking, nature viewing, fishing, boating, hunting and fishing. Key features important to for these activities are natural settings, maintaining access to areas of use, wildlife and fish species for viewing and harvesting, scenic viewing areas, and the absence of non-compatible or conflicting activity.

Parks

Parks are important for local recreation activities, and are a draw for tourists. There are 46 parks (comprising some 64,000 hectares) within the plan area. These parks range from picnic areas to larger parks such as Cathedral, Okanagan Mountain, Silver Star and Monashee. Seventeen of these parks provide 1,115 camping sites, ranging from developed sites to remote wilderness tent sites.

BC Parks maintains visitor counts for day, overnight and boat users for 25⁶⁵ of the area's parks. These parks generated about 2.2 million user days in 1996. This represents a decrease of about 7% since 1994. This is a reversal of the trend seen in the early 1990s, where number of visits increased by an annual average of over 2% between 1990 and 1994. Estimated total visitor expenditures on parks within the MELP's Okanagan Region is \$34.2 million in 1994⁶⁶. Almost 40% of expenditures were from non-BC residents.

Forest Recreation

While managed for a variety of uses, provincial forests are also managed to provide public recreation opportunities for a variety of recreation uses (see Table 6.5 below). Recreation opportunities range from wilderness non-motorized to motorized activities, and are categorized as follows:

- Primitive non-motorized: >8km from a 4-wheel drive road & >5,000 ha.
- Semi-primitive non-motorized: >1km from a 4-wheel drive road & 1,000ha.
- Semi-primitive motorized: >1km from a 2-wheel drive road & 1,000 ha.
- Resource Roded: - the remaining land base, roaded and rural.

Table 6.5 Ministry of Forests — Level of Use (MOF Sites)

Sub Area	Number of User Days				TOTAL
	Recreation Site Use	Hiking Trails	Snowmobile Trails	Cross Country Ski Trails	
Penticton Forest District	50,000	2,000	10,000	30,000	92,000
Vernon Forest District	139,000	22,000	35,000	6,000	202,000
Salmon Arm Forest District	66,200	9,500	25,000	18,000	118,700
Total For Area	255,200	33,500	70,000	54,000	412,700

Source: Ministry of Forests

Recreational Hunting

The region is a popular destination for BC hunters, and accounted for 6% of total provincial resident hunter days, in 1995 (see Table 6.6). Based on expenditure data in the 1995 British Columbia Resident Hunter Survey⁶⁷, BC hunters hunting in the LRMP area spent approximately \$4.5 million on hunting and related activities (6% of the total for the province). These expenditures may have been made in the region, or elsewhere in the province. The survey also estimated the ‘economic value’ to hunters of hunting, defined as the additional amount hunters would be willing to spend over and above their actual expenditures to continue to hunt. Based on the average daily value by species, the economic value to hunters in the LRMP area is estimated at \$5.6 million⁶⁸.

Table 6.6 Total BC Resident Hunting Days within LRMP Region 1995

Species	BC Resident Hunter Days	% of Total
Mule Deer	51,982	47%
White-Tailed Deer	47,956	43%
Black Bear	5,324	5%
Elk	3,060	3%
Moose	1,930	2%
Cougar	750	1%
Mountain sheep	483	- -%
Mountain Goat	134	- -%
Grizzly Bear	23	- -%
Total Hunter Days	111,642	100%

-- less than 1%

Source: Ministry of Environment, Lands and Parks estimates of Non-Resident Hunting for Okanagan LRMP plannarea.

Hunting activity is dependent on Crown land and resources as it affects both the availability of game and the setting in which the activity occurs. In the 1995 Resident Hunter Survey, hunters were asked to indicate the importance of specific characteristic of a hunting trip. Being outdoors was rated as very important by almost 91% of hunters, with signs of/seeing game (72%), using hunting/outdoor skills (71%), getting away from it all (69%), and scenic surroundings (55%) also rated very important by a majority of hunters. While only 36% of hunters rated obtaining game meat as “very important”, in naming the single most important hunting characteristic, it came third, behind being outdoors and signs of /seeing game.

Recreational Fishing

Sportfishing activity in the LRMP area in 1990 was estimated to be 550,000 angler days⁶⁹, equal to about 12% of total angler days in BC. The majority (73%) of these angling days was generated by Okanagan residents, with the remaining coming from Lower Mainland residents (14%), Alberta residents (5%) and other (8%). On average, expenditures on fishing (including both capital and direct expenditures) is estimated to be about \$81 per angler day, or about \$44.6 million in total.⁷⁰

Small lakes form the backbone of the Okanagan sport fishery⁷¹. However, the large lakes have the greatest potential to absorb increased angling effort. Both limited-access (e.g. walk-in lakes) and aesthetic fisheries (e.g. alpine or walk-in lakes) depend on the maintenance of the natural environment for the quality of the fishing experience.

Indeed, characteristics cited as most important in determining where to fish are the lack of pollutants in fish, lack of crowding, natural beauty of the site, and water quality.

As noted in the Fisheries section, there are pressures on sport fish from the increased angling activity and increasingly severe stock shortfalls are expected. Future increases in angling harvest are expected to have to come from large lakes.

Within the plan area, there is a local sport fishery for chinook in the Shuswap River, the South Thompson and in Mable lake. Salmon produced in the plan area also contribute to activity outside the plan area and are caught in recreational fisheries in tidal waters and in the Lower Fraser River.

Based on long term average production in the plan area (1984 - 1996), it is estimated that approximately 7500 chinook (over 40% in freshwater) and 4,300 coho would be caught in the sport fisheries. This represents roughly 3% of the provincial sport fishery for chinook and 1% of that for coho. Based on estimates in The Economic Value of Salmon: Chinook and Coho in British Columbia, the salmon originating in the plan area generate expenditures (largely outside the plan area) of \$10.7 million. In dominant sockeye years (1 in 4), anglers are also attracted by the sockeye sport fishery; however data are not available on catches.

In addition to recreational fishing, the non-consumptive values of salmon are becoming increasingly important. The “Salute to the Salmon” event at the Adams River, for example, brings thousands of visitors (and tourist dollars) to the area. The very existence of salmon in a stream may have tourism and social values to many individuals.

6.4 Tourism Employment and Revenue

Current tourism employment levels are difficult to estimate due to the diverse nature of the industry and the number of businesses that make up this sector. It is possible to estimate employment for specific categories of tourism

employment (i.e. guide outfitters, fishing lodges, etc.) where detailed industry surveys have been undertaken. However these estimates only provide a portion of the employment generated by tourism activity within the region. The Ministry of Finance⁷² has attempted to estimate 1991 total employment for tourism, including tourism related employment from transportation spending, retail spending, etc. (see Table 6.7).⁷³

Total basic tourism employment is estimated to be about 11% of the basic employment within the area, and 3% of the area's basic income⁷⁴. The lower percentage for income partly reflects the high level of seasonal employment and lower average incomes characteristic of this sector. However, with the region's increase in popularity and the development of the region as a four-season destination, the number of full time jobs and total income is believed to have increased since 1990.

Room revenue from the area's accommodation facilities generated about \$92 million in 1996 - a 2% increase over 1995. While the growth rate has slowed recently, since the early 1990's, room revenues grew at an average annual rate of 6% from 1993 to 1996, reflecting increased occupancy and/or room rates⁷⁵. However, room revenues do not represent the total revenue generated by accommodation facilities. An industry survey conducted in 1988 indicated that room revenues accounted for 47% of total operating revenues for large hotels, 23% for small hotels, and 91% for motels⁷⁶.

Table 6.7 Tourism Employment Estimates for the Plan Area

Forest District	Basic Tourism Employment (PY)	Basic Tourism After Tax Income (\$million)
Salmon Arm	796	8.0
Vernon	1,851	20.1
Penticton	5,249	57.4
Okanagan-Shuswap total	7,896	85.5
% of total for region	11% ¹	3%

1. This is the percent of total basic employment. Table 2.6 lists the percentage of total employment, which includes tourism's share of non-basic employment.

The Role of Crown Land and Resources To Tourism

While clients of highway and community based tourism business seek scenic views and often engage in outdoor activities, the outdoor-related businesses themselves - outdoor accommodation, water and land-related tourism businesses and guide outfitter operations - are more directly dependent on Crown land and resources. Based on provincial industry norms, with adjustments based on results of a recent survey of tourism operators in the LRMP area⁷⁷, the employment within these specific sub-sectors has been estimated at 876 PY in 1996/97 and revenues estimated at \$43 million (see Table 6.8).

There is limited information as to the precise linkage between resource management regimes and tourism activity. To provide more information, tourism operators within the region were surveyed for their opinion on how Crown land management affects their operations. The following is a summary of the results⁷⁸.

Table 6.8 Employment and Revenue for Selected Businesses within the Plan Area

Tourism Business*	# of businesses	Ave. Annual Revenue (\$000's)	Total Revenue (\$000's)	Ave. # of FTE	Total FTE
Outdoor Accommodation	69	260	17,940	8	552
Water Related - not accommodation	34	550	18,700	7	238
Land Related - not accommodation	34	170	5,780	2	68
Guide outfitters	11	75	825	2	18
Total	146		\$43,245		876

* Details on the specific sources for the industry norms are provided in the Background Report.

The operators noted that the most popular areas used by their clients were parks and scenic areas outdoors (Table 6.9). The clients of the highway/community operators appear to use more designated sites, such as trails, parks and other facilities, likely because customers explore Crown lands on their own. Outdoor based businesses, on the other hand, can guide their clients to more remote and undeveloped areas, and therefore are not as dependent on existing infrastructure.

Of the outdoor based businesses which responded to the survey, 88% indicated that they use Crown lands for their tourism activities, and on average, 57% of their activities are offered on Crown land. Of the highway/community businesses, 50% offered activities which take place on Crown land and on average 36% of their activities occur on Crown land.

Table 6.9 Areas Used By Tourism Clients

Areas Used By Clients	% of Highway/Community Based Businesses	% of Outdoor Based Businesses
Parks	90	72
Forest Service Recreation Sites	47	41
Scenic Areas	80	90
Wildlife Viewing Areas	33	33
Resource Roads	30	41

Tourism operators depend on a variety of resource features (parks, scenic views, wildlife and fish resources, water, etc.). The survey focused on the implications of two of these - protected areas and scenic views - and asked operators to indicate how these features affect their tourism businesses. Operators used a 5 point scale - ranging from a very positive impact (1) and a very negative impact (5) (see Table 6.10). The tourism operators who responded (just under 50% of the tourism businesses within the plan area) to the survey indicated that protected areas and management of scenic areas have a positive influence on tourism businesses, with the greatest effect for areas in or adjacent to their areas of use.

Table 6.10 Potential Impacts of Crown Land Use On Tourism Businesses

Land Use Decisions	Potential Impact On Tourism Businesses (weighted average)*		
	Highway/ and Community Based Businesses	Outdoor Based Businesses	All Businesses
Protected areas			
Within area of use	1.79	2.00	1.91
Adjacent to area of use	1.84	2.27	2.09
Within plan area	1.84	2.35	2.13
Areas with maintained scenic quality and viewscapes			
Within area of use	1.53	1.77	1.67
Adjacent to area of use	1.53	1.88	1.73
Within plan area	1.63	2.12	1.91

Weighted average based on a scale of 1 to 5 the closer to 1, the more positive the perceived impact.

6.5 Outlook for Tourism and Outdoor Recreation

The continued growth of the community and highway tourism businesses is dependent on its ability to maintain its surrounding scenery to attract this growing market. As noted above, these businesses are also reliant on the ability of their clients to access key areas on Crown land for outdoor/recreation activities.

There is a growing market for outdoor adventure and wilderness experiences. The ability to access natural settings is a major factor in attracting this emerging market and providing the related services and facilities. Although statistics are not available for the plan area, there have been several studies

which indicate that this emerging product is experiencing growth rates of 5-25%⁷⁹. There is a growing demand for summer and winter activities near urban areas, allowing travellers to make day trips from the communities. The area has the resources to develop successful back-country products for this growing market. However, in the past, the industry has been limited in its ability to expand in the back country due to several factors including: the lack of tenure for most back-country operators; the lack of control (from a tourism perspective) of the natural setting for their product; and the inability to obtain financing due to the above factors.

The Commercial Backcountry Recreation Policy was initiated to address many tenure related issues. However, there have been difficulties in its implementation, and the policy is currently under review. As well, CBR does not have the ability to maintain and control the natural setting. Under current resource management mandates, it is not required to manage for tourism resource values. This puts at risk the ability for the sector to provide a quality experience and capitalize on the market potential.

The demand for outdoor recreation activities within a scenic setting in the LRMP area, with its growing population and proximity to Vancouver and Calgary/Edmonton, is increasing. The continued enjoyment of recreation opportunities depends on the ability to access the areas, scenic views and maintenance of the natural features and attributes which attract people to the area. However, with this increase comes potential for problems related to overcrowding and conflicts between types of recreation users, between tourism clients and public recreationists, and between tourism, recreation and other resource users.

7. Other Fish and Wildlife Harvesting

Commercial harvesting of the LRMP area's fish and wildlife resources includes trapping activities and commercial fishing. While guide-outfitting is also a commercial activity, because many outfitters are expanding into non-hunting related activity, it is discussed in the Tourism and Recreation section.

7.1 Trapping

There were a total of 78 trappers in the LRMP area in 1995, generating net revenues from pelt sales (gross revenue less costs of trapping) of \$182,000⁸⁰. While this represents a slight increase over the number of active trappers in 1994 (76 trappers), it is a slight decline over 1991 and 1992, when 90 trappers were trapping in the area.

These numbers likely understate total trapping activity in the area, as they do not include activity by First Nations. Because First Nations do not require licenses for trapping, they are not captured in the statistics above.

Outlook:

Trapping is dependent on Crown land and resources as these resources affect both the availability of animals harvested and the setting in which the activity occurs. In the base case and plan impact analysis, the area and percentage of trap lines with management compatible for that activity will be assessed, as well as the implications of base case and proposed plan management on the viability of wildlife populations, generally.

7.2 Commercial and Aboriginal Fishing

7.2.1 Commercial Fishing

The plan area provides important habitat for salmon species that are commercially harvested on the coast - with most of the fishing of plan area stocks occurring in Johnston, Georgia and Juan de Fuca Straits and the West Coast of Vancouver Island. Thus a portion of the commercial salmon fishing industry employment and incomes are dependent on Crown land and resource management in the LRMP area.

Unfortunately, the data required to calculate economic contribution of commercial (and sport) salmon fisheries, either net economic value or economic impact, are not readily available in a format that would generate a consistent but comparable set of data. However, one method for looking at the plan area's contribution to BC's salmon production is to compare landed values.

Landed values represent a gross measure of the income the commercial fisher receives for sale of the catch. For the period from 1993-1996, the average annual landed values of salmon produced in the plan area was approximately \$14 million⁸¹. This is about 9% of the \$160 million total for BC during the same time period. Given that sockeye are the dominant salmon species (e.g. Adams River run) produced in the plan area, it is important to understand that significant cyclical fluctuations occur. For example, during the 1993-1996 time period, total BC

annual landed values varied around plus or minus 50% from the average.

Landed values describe the gross revenues a fishing vessel owner receives (i.e. costs are not deducted). However, to fully reflect the gross commercial revenues, processing and retail margins, for which estimates were not available, would also be included⁸². For example, the provincial average wholesale value for 1993-1996 was about 2.5 times the average landed values for the province.

Values that reflect only the contribution of fish produced in the plan area that contribute to the fishery, do not reflect the contribution to the value of the ecosystem as a whole. The Thompson-Shuswap sub-basin as part of a broader ecosystem, contributes to the overall productivity of the Fraser River Basin that produces many more fish originating in other tributaries, in the estuary and the ocean and associated fish and seafood harvests.

7.2.2 Aboriginal Fisheries

Salmon fishing is an integral part of First Nations culture. They depend on salmon for subsistence, social and ceremonial purposes and have significant participation in the commercial fishery. The majority of the native catch of sockeye from the plan area are taken from the Fraser River mouth to North Bend, BC. Salmon produced in the plan area are also fished by First Nations in the South Thompson River, Shuswap River, Scotch River, Adams River, Salmon River, Little River and in the Okanagan River. Kokanee and rainbow fisheries also occur on the major Okanagan Lake tributaries and in the Shuswap Lake area. First Nations objectives in many plan area streams are to restore stocks to historic levels and re-establish traditional fisheries. The Osoyoos Indian Band and the Canadian Columbia River Inter-Tribal Fisheries Commission are working toward restoration of Okanagan sockeye to their historical numbers and habitat.

The fishery has social, spiritual and economic values to the Aboriginal people. In recent years, the Supreme Court has established that fishing by Aboriginal people to meet food, social and ceremonial needs has priority over any interest except conservation. First Nations have also supported by legal precedents which have allowed a significant expansion of their commercial fisheries.

Outlook:

In addition to market factors, the outlook for the commercial salmon fishery is dependent on the outlook for the habitat of the salmon. As discussed in the Fisheries section, the planning area provides important spawning, rearing and overwintering areas for salmon. The outlook for commercial salmon fishing under base case management (as well as any proposed land use plan) will draw on the analysis for the fish resource and relate that analysis to the implications for the fishery.

PART 3
ENVIRONMENTAL
PROFILE

8. INTRODUCTION

8.1 Environmental Issues

The rapid growth of the population and economy in the plan area has put significant pressures on the area's natural environment. Important environmental issues for the area include:

⇒ air quality problems resulting from the increasing number of vehicles in the Okanagan Valley;

⇒ water quality and quantity problems, caused both by human activities on Crown and private land; and

⇒ maintenance of wildlife and fish populations and habitats, not the least of which is the protection of the area's threatened and endangered species.

Many plan area residents may also be concerned about global environmental issues such as global climate change and ozone depletion.

The focus of the base case and impact analysis for the LRMP is issues that are directly affected by changing Crown land and resource management; namely wildlife and fish habitat and water quality. A profile of these resources is presented in the following sections.

Global environmental issues (e.g. global climate change and ozone depletion) could have an impact on the plan area environment, and affect health and rate of growth of the plan area's forests. However, the reduction of global emissions that would result from any marginal change in plan area activities on Crown land would be far too small to measure.

The main factors affecting air quality are not directly related to Crown land use and zoning. Air quality is affected by a large number of factors, including meteorological conditions, population density, the type and concentration of industry and the fuels used in industry, transportation and heating. For some of these sources (such as industrial point sources) there are air emission guidelines which control emissions. The presence of a generally stable air mass, an uneven distribution of precipitation, variable winds and summer sunshine combined with the surrounding hills and mountains, make the Okanagan valley vulnerable to air pollution. Under inversion conditions, air pollutants such as smoke can reach harmful levels.

8.2 Environmental Values:

Individuals value the environment for both its use (i.e. human activity dependent on the environment, such as hunting, fishing, recreation, etc.) and its existence (e.g. value derived from knowing the resource exists), as well as any moral, spiritual, or aesthetic reasons. Individuals may also wish to preserve the environment for option value (i.e. to maintain the option for its use in the future), or for its bequest value (to preserving the resource for future generations). The value of an environmental amenity to any individual or community is the sum of all of these values.

Measuring this value is difficult. For other goods and services, consumers indicate their value of a good by the amount of other goods (measured by the medium of exchange, money) they are willing to forego to obtain it. However, as environmental values are not traded in the marketplace (and hence are not

taken into account in market decisions), individual's willingness to trade other consumption for environmental value is not explicitly revealed.

There have been some attempts to measure the value British Columbians place on certain environmental amenities through the use of surveys. These 'Contingent Valuation' studies typically ask individuals what they would be willing to pay to preserve an environmental value. For example, a 1991 study by the Ministry of Forests Recreation Branch⁸³ estimated that the preservation value of outdoor recreation in provincial forests was \$114 million, or on average BC adults were willing to pay \$54 per year to protect this resource. A 1995 study jointly conducted by the Ministry of Forests and the Ministry of Environment, Lands and Parks⁸⁴ estimated that the net economic value of wilderness (respondents were asked the amount their expenditure would have to increase before they would no longer be willing to take a wilderness trip) was \$288 million in 1992, or a mean individual value of \$266.

There has been considerable debate around this method of assessing value and the validity of its results. As well, some people feel that it is inappropriate to put a dollar value on the environment. Nonetheless, at a minimum, these studies indicate that British Columbians are willing to trade off consumption of other consumer goods for environmental quality.

9. Wildlife, Habitat and Biodiversity

9.1 Introduction

The plan area supports a wide variety of provincially significant wildlife, habitat and biodiversity. Grassland and desert ecosystems in the south make up some of the most threatened habitats in the province, and the plan area includes the only true desert habitat in Canada. As elevation increases, ponderosa pine and Douglas-fir forests give way to lodgepole pine, sub-alpine fir and spruce which are common in the south and central plateaus. The northern part of the plan area is much wetter and supports cedar and hemlock forests at low elevations, and sub-alpine fir and spruce at upper elevations, before rising to rugged mountains. Each of these ecosystems provide a variety of habitats for numerous wildlife species.

The plan area supports 300 species of birds, 74 species of mammals, 11 reptiles, 9 amphibians, and 10 - 20,000 invertebrate species (see Appendix 2 for general description of physiography, vegetation and wildlife by ecosection). Historically, information on wildlife, habitat and biodiversity has been either fragmented, incomplete or non-existent for planning processes in the LRMP area. Due to resourcing through CRII (Corporate Resource Inventory) and various FRBC initiatives, this situation has improved. Wildlife habitat rarity and capability analysis in BC uses a hierarchical classification system as shown in Appendices 3 and 4.

9.2 Ecosystems in the Okanagan-Shuswap Plan Area

There are 12 ecosections, based on broad climatic and physiographic features, and 7 biogeoclimatic zones, based on climax vegetation species, in the plan area (Table 9.1). Only the North Okanagan Basin and South Okanagan Basin ecosections are unique to the LRMP area; they support the greatest variety of wildlife species and rare ecosystems, including a true desert habitat. The majority of the rare species are associated with the drier valley bottom ecosystems, comprised of grasslands and low elevation parkland (open) forests. Above this extremely arid valley, habitat ranges through open grasslands, forested plateaus with lakes and wetlands, moist timbered areas and alpine tundra at the higher elevations.

The Habitat Inventory Section of the Ministry of Environment, Lands and Parks (MELP), have produced 'Broad Ecosystem Unit' mapping (biophysical habitat mapping). Provincially there are about 100 broad ecosystem units, of which about 50 % occur in the plan area. They provide an overview of the physical characteristics of the plan area permitting capability analysis for many wildlife species. The combination of ecosection, biogeoclimatic zone and broad ecosystem units (Appendix 3) are used to estimate wildlife species distribution and relative abundance. This process can also be used to identify 'rare' ecosystems at the sub-regional level (Appendix 4).

There are 7 biogeoclimatic zones present in the plan area:

Alpine Tundra (AT) - high-elevation areas (above treeline). The short growing season and long, cold winter with high snow depths restricts most woody

plants to dwarf vegetation such as shrubs. Heathers, herbs, mosses and lichens are common. This zone provides valuable habitat for mountain sheep, caribou, grizzly bear, wolf, wolverine, and small mammals such as marmots and ground squirrels.

Engelmann Spruce-Subalpine Fir (ESSF) - coniferous forests of Engelmann spruce, subalpine fir, and lodgepole pine with shrub-herb poor understoreys. The climate is characterized by a short, cool growing season and long, cold winters with high snow depths. Mountain goat and caribou are best adapted to winter in this zone. Avalanche tracks provide important spring and summer habitats for grizzly bear and ungulates. Meadows in parkland areas are valuable summer range for ungulates and bears. The coniferous forests are important for marten, fisher, red squirrel, wolverine, and seed-eating birds such as the Red and White-winged Crossbills, Clark's Nutcracker, and Pine Siskin.

Interior Douglas Fir (IDF) - Douglas-fir is the climax tree species, and pinegrass and feathermoss dominate the understorey. Soopolallie and kinnikinnick are common shrubs. In drier areas the zone becomes savannah-like, supporting bunchgrasses including rough fescue and bluebunch wheatgrass. This zone is important for summer livestock range as well as mule deer and elk habitat. Fires have resulted in even-aged lodgepole pine stands dominating at higher elevations, Douglas-fir dominates at mid-elevations and ponderosa pine is a common seral tree at low elevations. This zone is the second warmest forest zone of the dry southern interior, and is inhabited by wildlife species similar to those of the Ponderosa Pine zone.

Interior Cedar Hemlock (ICH) - occurs at lower to mid elevations in the interior wet belt. This zone has the widest variety of coniferous tree species of any zone in the province. Western hemlock and western redcedar are characteristic species but spruce (white spruce-Engelmann spruce hybrids) and subalpine fir are common. Douglas-fir and lodgepole pine are generally found on drier sites. Wet sites often have a dense understorey of devil's club and/or skunk cabbage. Winters are cool and wet, and summers are generally warm and dry. Many of the wildlife species found here are similar to those in the Montane Spruce and the Engelmann Spruce Subalpine Fir zones.

Ponderosa Pine (PP) - warmest and driest forest zone. This zone is confined to a narrow band in the driest and warmest valleys of the southern interior. Ponderosa pine is the climax tree, but Douglas-fir is common on colder and moister sites. Grasses such as bluebunch wheatgrass and rough fescue provide excellent forage. Frequent ground fires are important for creating and maintaining these stands. The short, relatively snow-free winters of the PP zone attract birds from higher elevations and provide winter range for mule and white-tailed deer, bighorn sheep and Rocky Mountain elk.

Montane Spruce (MS) - occurs in south-central interior at middle elevations between ESSF above and IDF below and is most extensive on plateau areas. Engelmann and hybrid spruce and varying amounts of subalpine fir are the characteristic tree species on zonal sites. Winters are cold, with deep snow cover and summers are moderately short and warm. Seral forests of lodgepole pine stands provide important summer and fall range for mule deer and moose, and favorable conditions for bark-inhabiting insects upon which bird species

such as Three-toed Woodpecker and Black-backed Woodpecker rely. Due to the dryness of this zone, streams, lakes and riparian habitat are extremely important.

1. *Bunchgrass (BG)* - grassland zone confined to the lower elevations of the driest and hottest valleys of the southern interior. Bluebunch wheatgrass is the climax species on undisturbed sites. At lower elevations big sagebrush is common, especially on heavily grazed areas. Ponderosa pine and Douglas-fir occasionally occur in gullies and on coarser soils. A small amount of Great Basin desert habitat is present in this zone.

This is one of the smallest biogeoclimatic zones in British Columbia, but it supports a wide range of wildlife, including many of provincial or national significance. Species include the great basin pocket mouse, pallid bat, spotted bat, Canyon Wren, White-throated Swift, Burrowing Owl, spadefoot toad and tiger salamander. This zone supports critical winter and spring forage for bighorn sheep and white-tailed deer. Lakes and streams often remain open in winter or thaw in early spring, providing important staging areas for migrating waterfowl

9.2.1 Rare Ecosystems

The maintenance of rare ecosystems is recognized as being an important component of maintaining natural levels of biodiversity. Rare ecosystems are identifiable at the regional and landscape levels. At the regional level, some of these are considered to be rare because they are only located in the plan area; others are considered rare as a result of historic land use practices (e.g. urban and agricultural development) that have altered these ecosystems. In both cases, these rare ecosystems are usually associated with species at risk. Appendix 4 provides detail on the amounts of ecosection and biogeoclimatic subzone representation in the plan area.

At the landscape level, rare ecosystems are those that comprise less than 2% of the landscape unit, and are not common in adjacent landscape units. MELP has identified rare forested and grassland ecosystems using forest cover and biophysical habitat unit mapping. There is no current management direction to treat these ecosystems differently than the other more common ecosystems in the plan area.

Outlook: Rare ecosystems are at risk to continued human disturbance. At the sub-regional level, rare ecosystems are expected to be subjected to further alienation pressures, as well as land use practices that are not compatible with maintaining their ecological integrity. The FPC Biodiversity Guidebook recognized the importance of maintaining rare ecosystems and provides management recommendations for landscape unit planning. However, it should be noted that application of this guidance is not mandatory. It is expected that there will be an increased risk to maintaining natural levels of biodiversity if rare ecosystems are not recognized and adequately managed.

Table 9.1 Ecosystem Classification within the Plan Area

Ecosections	Biogeoclimatic Zones	Ecosections	Biogeoclimatic Zones
CCM	AT ESSFwc2; ESSFwc4; ESSFwcp ICHmw2 ICHvk1 ICHwk1	NKM	AT ESSFvc; ESSFvcp ESSFwc2 ICHvk1 ICHwk1
NOB	BGxh1 IDFdk1 IDFdm1; IDFmw1; IDFxh1a; IDFxh1 PPxh1	NTU	ESSFdc2 ICHmk1; ICHmk2 ICHmw2; ICHmw3 IDFdk1 IDFmw1; IDFmw2 IDFxh1; IDFxh2 MSdm2
NOH	AT ESSFdc1; ESSFdc2; ESSFdcp ESSFxc ICHmk1 ICHmw2 IDFdm1 IDFmw1 IDFxh1a; IDFxh1 MSdm1; MSdm2 PPxh1	OKR	AT BGxh1 ESSFdc2; ESSFdcp ESSFxc; ESSFxcp IDFdk1b; IDFdk1; IDFdk2; IDFdk IDFxh1a; IDFxh1b; IDFxh1 MSdm2 MSxk PPdk1 PPxh1a; PPxh1
SHH	AT ESSFdc2 ESSFvc; ESSFvcp ESSFwc2; ESSFwc4; ESSFwcp ICHmk2 ICHmw2; ICHmw3 ICHvk1 ICHwk1c; ICHwk1; ICHwk ICH1 IDFmw1 MSdm2	STU	ESSFdc2 ESSFxc; ESSFxcp ICHmk1; ICHmk2 IDFdk1a; IDFdk1; IDFdk2 IDFmw1; IDFmw2 IDFxh1 IDFxh2a; IDFxh2 MSdm2 MSxk
SFH	AT ESSFwc2; ESSFwc4; ESSFwcp ICHmk1 ICHmw2	SOB	BGxh1 IDFxh1 PPxh1
SOH	IDFdm1 IDFxh1a; IDFxh1	THB	IDFxh1a PPxh2

Figure 9.1 - Ecosections in Okanagan-LRMP Plan Area

9.3 Biological Diversity

Biological diversity (biodiversity) is the diversity of plants, animals and other living organisms in all their forms and levels of organization. It includes the diversity of genes, species, and ecosystems and the functional and evolutionary processes that link them. The great diversity of physical features and prevailing climatic conditions within the plan area has resulted in a great diversity of habitats and species, and an area rich in biodiversity.

Biodiversity is threatened by loss of habitat, habitat fragmentation, or degradation by industrial practices or by urban encroachment. Sensitive habitats may be altered in the short or long term by human settlement, development activities (e.g. timber harvesting, mining, transportation corridors) and recreation activities in those areas. With respect to recreation activities, while individual impacts may be small, cumulative impacts from continued use of sensitive areas can degrade sensitive habitats and place stress on resident wildlife and/or their habitats.

Existing development, human settlement, agriculture and alienation of forested land have already had significant impacts on natural levels of biodiversity in the plan area (especially through the loss of grasslands and oldgrowth forests) and limit options for future maintenance.

Outlook: Future maintenance of biodiversity is dependent on:

(a) the protection and connectivity of representative ecosystems as ecological benchmarks at the regional level;

(b) providing habitat variety and connectivity at the landscape (watershed) level; and

(c) management for important attributes at the stand (site) level.

Many of the rare species and ecosystems are associated with lower elevation areas, much of which is privately owned. While managing for biodiversity on private lands may be desirable, it is not always possible. This makes management of biodiversity on the remaining portions of Crown land that much more important.

The *Forest Practices Code* (FPC) has established a framework for managing for biodiversity on Crown lands. There are requirements for stand level biodiversity (e.g. wildlife tree patches and partial retention of timber when harvesting in riparian management zones) that will help to conserve biodiversity in forested and grassland ecosystems to some extent. The FPC also provides for assignment of biodiversity emphasis options (BEO), which will be undertaken as a part of the LRMP process.

In general terms, biodiversity is a difficult topic to address, particularly as many of the inter-relationships between and amongst plants and animals are not well understood. From an ecological perspective, it is assumed that there was a natural balance over time even though at any one time a natural event may have temporarily affected the balance. There are, however, some key components of biodiversity (e.g. seral stage distribution, connectivity, habitat attributes, etc.) that, when combined, can be used to predict current and future outcomes for biodiversity in general. The remaining sections of this chapter will describe some of the key components of biodiversity and how they are being managed.

9.4 Specific Habitats

9.4.1 Oldgrowth

Oldgrowth conservation is a concern because current forest management does not maintain the amount and distribution of older forests that would be found through natural disturbance processes. As well, the attributes found in oldgrowth are not easily retained in managed, regenerating stands. Oldgrowth forests provide structural components such as standing dead trees, rotting fallen logs, broken-topped stems, decaying live trees and considerable amounts of arboreal lichens, all of which are less abundant in younger forests and are important to many wildlife species⁸⁵. Oldgrowth forests provide specific habitat for various life forms due to their structural diversity and complexity.

Species dependent on oldgrowth forests and/or attributes include mountain caribou, marten, fisher, and cavity-nesting birds, such as woodpeckers, as well as many other species including invertebrates, plants and lichens. Threats to oldgrowth include alienation of forest land, changes in forest structure, and fragmentation of existing oldgrowth due to urban expansion and development activities. Oldgrowth forests take a long time to regenerate, and oldgrowth dependent species are often less able to adapt to habitat alteration and loss. Long-term conservation will depend mainly on placing representative forests where timber harvesting will be reduced or deferred.

The Okanagan Timber Harvesting Guidelines and FPC recognized the importance of 'oldgrowth' and provides management direction. The FPC provides new definitions for 'old', based on NDT (natural disturbance type) and the amount to be retained (dependent on landscape unit biodiversity emphasis option assignment).

Outlook: In the absence of a land use plan, full implementation of the FPC Biodiversity Guidebook recommendations for old growth may be possible. Full implementation would result in a relatively low risk to maintenance of biodiversity. However, current MELP/MOF FPC implementation policy dictates that where full implementation would result in unacceptable constraints on timber supply, full implementation can be delayed by three rotations in lower biodiversity emphasis landscape units. The timber supply base case will identify the extent to which oldgrowth Biodiversity Guidebook targets are being met in certain landscape units. Were full implementation to be deferred, an increased risk to maintaining natural levels of biodiversity would result.

9.4.2 Seral Stage Distribution

The maintenance of biodiversity is aided by managing larger tracts of land (landscape units) for a seral stage distribution that approximates natural conditions. Forested seral stage distribution are the successional stages in forest growth from seedling to oldgrowth. In more diverse ecosystems there may be significant changes in species

composition, as well as other characteristics, during succession. Different seral stages provide different habitat attributes, and each may have particular wildlife species associated with them. Generally, as a stand increases in age, wildlife presence and/or abundance will change in response to the changing stand structure.

In addition to oldgrowth, the FPC Biodiversity Guidebook provides early and mature seral stage targets for landscape units specific to NDT and biodiversity emphasis option assignment. Should it be determined that meeting those targets would be constraining to timber supply, FPC implementation policy requires that those targets need not be met.

The Biodiversity Guidebook also gives direction for seral stage distribution on grasslands.

Outlook: As with Oldgrowth above, FPC Biodiversity Guidebook recommendation is dictated through current MELP/MoF FPC implementation policy. While full implementation would result in a low risk to biodiversity, something lesser would increase risks to biodiversity maintenance. The timber supply base case will be used to determine to what extent recommendations for seral stage distribution for landscape units will be applied. For grasslands, the Biodiversity Guidebook provides for a natural level of biodiversity.

9.4.3 Connectivity

Many wildlife species require the ability to move in an unobstructed and secure manner across the landscape. Some species require the ability to move on a daily basis between foraging and cover areas. Other species, such as most ungulates, make seasonal migrations between summer and winter habitats. Connectivity is especially important to wide ranging species that occupy large territories (such as mountain caribou, grizzly bear and wolverine). Dispersal to new territories and exchange of genetic material are two other functions that are provided by maintaining connectivity. Connectivity between large tracts of undisturbed land increases biodiversity values.

At the landscape level management direction for maintaining general connectivity needs relative to forest and range management practices is available through the FPC Biodiversity Guidebook. Connectivity is one of the discretionary biodiversity objectives that may be addressed during landscape unit planning through the application of recommendations in the FPC Biodiversity Guidebook. However, the ability to meet connectivity in forested ecosystems is dependent upon having adequate later seral stages (see sections on seral stage and oldgrowth above). The connectivity needs of numerous species are not addressed (e.g. mountain caribou, grizzly bear, and migratory birds) through the FPC.

As well, the LRMP area is also considered to be key to maintaining connectivity at a much larger scale. The very dry, hot ecosystems (i.e. xh biogeoclimatic sub-zones) provide connectivity between similar ecosystems in the BC central interior and the western United States. Long-term movement opportunities for species and communities

associated with very dry, hot ecosystems are at risk from habitat loss (i.e. urban, agricultural and corridor development), and degradation (e.g. timber harvest, forest encroachment, grazing, noxious weed encroachment and other disturbances).

Outlook: Current MoF/MELP FPC implementation policy is to not have an incremental impact to timber supply due to achieving connectivity objectives. Riparian management areas, landscape unit design, choice of silviculture systems and harvest scheduling as well as stand structure provided by wildlife tree patches all contribute to connectivity needs. However, if these do not fully address the FPC Biodiversity Guidebook recommendations, then there will be an increased risk to maintaining natural levels of biodiversity. As well, maintaining the connectivity requirements of wide ranging species and maintaining connectivity between drier ecosystems will continue to be at risk under current management.

9.4.4 Riparian Areas

Riparian areas comprise those areas immediately adjoining rivers, wetlands and lakes. These areas are vitally important for many species, particularly fish, amphibians, moose, grizzly bear and many birds. Riparian areas in proper functioning condition are important to the overall health of an ecosystem. Much of the main valley bottom riparian areas have been affected by corridor development, stream channelization and urban and agricultural developments. Riparian areas become increasingly important in drier ecosystems where they support an increased diversity of vegetation and wildlife habitat. Some rare plant species/communities are found only in riparian areas. In grassland ecosystems, riparian areas, including areas that contain water only during spring run-off or storm events, have a much more diverse vegetation and generally support a greater diversity of wildlife than the adjacent uplands. Wildlife may also use riparian corridors for migration or daily movement.

Riparian forest is usually highly productive in terms of timber, but some harvesting practices may lead to stream degradation, fragmentation of habitat and loss of connectivity to upland habitats. Riparian habitat is also at risk from erosion due to unstable soils and from pollution of watercourses by runoff and leaching from agricultural activity or mining. Livestock grazing, if not properly managed, can lead to increased turbidity, sedimentation and streambank degradation with resulting losses in water quality. It is estimated that 90% of grassland riparian systems are grazed by cattle⁸⁶.

Outlook: Forest and range management practices are now guided by the FPC Riparian Management Area Guidebook which provides a minimum level of protection for riparian ecosystems. However, for certain species, and in very dry, hot ecosystems (BGC xh subzones), additional riparian protection is needed to reduce risk.

9.5 Species-specific Habitat Protection Issues

Wildlife species in BC have been assigned to 4 categories to reflect differing priorities for management (MELP 1991). Species status categories are based on abundance, distribution, habitat integrity, population trends, reproductive potential and public interest or use.

⇒ “**Red-listed**” species are either endangered or considered threatened.

Endangered species are in danger of extirpation within BC, whereas threatened species may become endangered if management programs are not undertaken to support their relatively low numbers.

⇒ “**Blue-listed**” species are considered sensitive or vulnerable and have low or declining numbers with restricted distributions within BC.

⇒ “**Yellow-listed**” species are managed to meet specific public demands such as viewing, hunting or trapping.

⇒ “**Green-listed**” species have no management emphasis and are not at risk.

The following species accounts, taken primarily from the Regional Wildlife Plan for the Okanagan Sub-region⁸⁷ describe key habitat needs, sensitivities, current distribution, population trends and land use conflicts.

9.5.1 Ungulate Winter Range

The Okanagan-Shuswap plan area supports a variety of ungulates (including mule and white-tailed deer, mountain caribou, elk, moose, bighorn sheep and mountain goat). In winter most of these species migrate down to areas where the climate is less severe. Winter habitat is considered to be limiting for most ungulates. Disturbance on winter ranges, and connectivity within winter ranges or between summer and winter habitats are a concern.

9.5.1.1 Deer

Deer populations have decreased over the last several years. Deer winter ranges have been affected by settlement and other developments, incompatible cattle management, timber harvesting and fire suppression. Other important impacts on deer include illegal kills and road-kills and agricultural conflicts. Like most ungulates, deer are susceptible to severe winter conditions. Managing winter range to appropriate forage and cover habitats should minimize impacts of severe winters. Mule deer are often more sensitive to winter range loss than are white-tailed deer, and hence are likely to be more negatively affected by land development than white-tailed deer. White-tailed deer have benefited from farming because of their tolerance for disturbed habitats, particularly agricultural development.

Outlook: Deer winter range habitat will continue to be degraded as current management does not provide adequate guidance for access, forage and cover requirements, and protection of special features. This could result in deer populations in some areas dropping significantly, though the overall population will not be threatened.

9.5.1.2 Elk

Elk use a wide variety of habitats from valley bottoms to alpine meadows, preferring select grassland dominated habitats if available. In some herds, shrubs are a large part of the diet and agricultural fields (e.g. orchards, alfalfa) and unprotected haystacks sometimes provide substantial forage. In winter, elk concentrate on grassy, south or west facing slopes within PP and IDF biogeoclimatic zones. Within the plan area elk populations are located in 2 relatively small populations centred on the east side of the Okanagan valley south of Mission Creek. Elk may compete with the agricultural use on Crown and private lands. Elk are more sensitive to access related human disturbance than deer.

Outlook: Elk populations are at considerable risk from increased access and human disturbance. Potential conflicts are inevitable if private land development (residential, agricultural, etc.) continues to encroach into the low elevation, productive areas important to elk in winter and early spring.

9.5.1.3 Moose

Moose can tolerate up to about 80 cm of soft snow on their winter range (compared to less than half a metre for deer), and therefore many of the mid to relatively high elevation ranges, especially in the Thompson uplands and Okanagan highlands, are unavailable to them. Several key wintering areas have been identified in the LRMP area although scattered populations winter throughout the plan area in relatively low numbers. In summer, moose normally prefer riparian and wetland habitats adjacent to closed canopy forests, but may also be found in cool sub-alpine areas where gently sloping topography permits. High summer temperatures in the southern portions of the plan area may eventually limit moose distribution and productivity more than the availability of quality winter range.

Moose populations are affected indirectly and directly by forest practices, both beneficially and detrimentally. While mid-elevation logging mimics some effects of fire by creating abundant woody browse and herbaceous growth which can be used as moose forage, suppressing shrub growth to maximize timber production shortens the early seral period and reduces forage availability.

Outlook: Moose populations in the plan area are generally stable or increasing in response to habitat opportunities associated with timber harvesting. It is unlikely that moose populations or distributions will increase (due to climatic conditions). However, increased access, reduced forest cover, and decreased forage availability can lessen the suitability of winter range, which could locally impact population numbers.

9.5.2 Mountain Goat

Mountain goats in the plan area occur in a variety of ecosystems from lower elevation interior Douglas-fir forests to alpine tundra where discrete locations of suitable habitat exist. Generally, they prefer steep slopes or broken and ledged cliffs which provide escape cover from predators and are close to available forage. Most winter range is on south to west-facing slopes either below 1500 metres where snow depth is low or above 2000 metres on wind-swept peaks and ridges. More definitive information is available for mountain goat populations in the central and southern portions of the plan area. In these areas, major mountain goat herds are located in the lower Similkameen River, Penticton Creek, and the Shuswap River drainage near Sugar and Greenbush lakes. Increases in smaller herds, transient goat sightings, and large horn growth over a 5 year period prior to 1988 suggested that the goat population may be slowly expanding. This trend may be the result of mild winters and moist summers maintaining succulent forage on dry goat range. Due to the ruggedness of most goat terrain, land development impacts have been minimal although there is potential for localized impacts.

Outlook: Except on very dry, low elevation sites in the southern part of the plan area where water is scarce, or on very high altitude winter sites where lichen and sedge abundance may be low, habitat does not currently appear to be limiting. Based on the available surplus food and cover, and the recent expansion of several small herds, goats appear to be below carrying capacity on many of their current ranges. Increased road development can lead to reduced habitat suitability and increased hunting pressure.

9.5.3 Rare (Red- and Blue- Listed) Species

The plan area provides habitat for numerous rare (Red- and Blue-listed) species. Many of these species are associated with the low elevation valley bottoms. Direct loss of habitat or habitat alteration has been a contributing factor to the rarity of some of these species. However, many of these species are naturally rare (i.e. they have sparse distributions and/or numbers; or they are near the limits of their geographic distribution).

The plan area is inhabited by 23 of 64 (36%) of British Columbia's red-listed vertebrates, with 19 of 64 (30%) found in the South Okanagan and the lower Similkameen valleys (one of Canada's four most endangered ecosystems). The area also contains 50 of the 87 (57%) provincial blue-listed vertebrates (MELP 1995). In addition, the area supports 74 red-listed vascular plant species, 17 red-listed plant communities, 74 blue-listed vascular plant species, and 19 blue-listed plant communities (see Appendix 5). Four species (short-horned lizard, white-tailed jackrabbit, burrowing owl and sage grouse) have become extirpated within the last century.

Outlook: The FPC 'Identified Wildlife Management Strategy' (not yet published) provides some guidelines on protection for a portion of the rare species found in the plan area⁸⁸. However, the Guidebook is not

yet in its final form, only regulates forestry and range-related activities, and does not address connectivity.

The FPC has no jurisdiction on private lands, primarily valley bottoms where many of the red-listed wildlife species ecosystems occur. As most of the habitat for rare species in the plan area is on private land, the impact of any additional direction provided by the plan for these habitats on Crown land will be magnified. Most species that are at risk from land and resource management practices are listed in Table 9.2 (includes red-listed plant communities), and have had guidelines or interim measures produced specifically for the LRMP. It is anticipated that 'interim measures' will be replaced if/when more direction is provided through other initiatives, such as the FPC.

Table 9.2 Protection Measures for Species at Risk in the OSLRMP

Common Name	Status (Red, Blue, Regionally Important)	Interim Measures/Guidelines
Tiger Salamander	R	2-page species statement
Great Basin Spadefoot Toad	B	2-page species statement
Painted Turtle	B	2-page species statement
Rubber Boa	B	2-page species statement
Western Yellow-bellied Racer	B	2-page species statement
Night Snake	R	2-page species statement
Great Basin Gopher Snake	B	2-page species statement
Western Rattlesnake	B	2-page species statement
Western Grebe	R	2-page species statement
Turkey Vulture	B	2-page species statement
Swainson's Hawk	B	2-page species statement
Ferruginous Hawk	R	2-page species statement
<i>anatum</i> Peregrine Falcon	R	2-page species statement
Prairie Falcon	R	2-page species statement
Long-billed Curlew	B	2-page species statement
Flammulated Owl	B	2-page species statement
Mcfarlane's Western Screech	B	2-page species statement
Lewis' Woodpecker	B	2-page species statement
Western Williamson's	B	2-page species statement
White-headed Woodpecker	R	2-page species statement
Sage Thrasher	R	2-page species statement
Yellow-breasted Chat	R	2-page species statement
Sagebrush Brewer's Sparrow	R	2-page species statement
Grasshopper Sparrow	R	2-page species statement
Bobolink	B	2-page species statement
Northern Goshawk	Y	2-page species statement

Pallid Bat	R	2-page species statement
Spotted Bat	B	2-page species statement
Western Small-footed Myotis	B	2-page species statement
Fringed Myotis	B	2-page species statement
Townsend's Big-eared Bat	B	2-page species statement
Northern Long-eared Myotis	B	2-page species statement
Nuttall's Cottontail	B	2-page species statement
Western Harvest Mouse	B	2-page species statement
Great Basin Pocket Mouse	B	2-page species statement
Fisher	B	2-page species statement
Badger	B	2-page species statement
Grizzly Bear	B	guidelines
Rocky Mountain Bighorn Sheep	B	guidelines
California Bighorn Sheep	B	guidelines
Mountain Caribou	B	guidelines
Mountain Goat	Y	N/A
Mule Deer	Y	guidelines
Moose	Y	guidelines

Legend: R=red; B=blue; Y=regionally important

9.5.4 Other Key Species

The following provides information on high-profile or umbrella species to represent the needs of many other species (e.g. grizzly bear represents wide-ranging carnivores such as wolverine).

9.5.4.1 Bighorn Sheep

There are both California and Rocky Mountain sheep in the plan area. California bighorn sheep are the least numerous subspecies of bighorn sheep occurring in British Columbia, however, they are more abundant and well distributed within the plan area. Conversely, Rocky Mountain bighorn sheep which are more common throughout portions of the province are restricted to a range near Chase that supports about 30 animals⁸⁹.

The key habitats for bighorn sheep are lambing grounds and winter range. Lambing grounds usually have luxuriant spring grassland forage close to steep, rugged, terrain where ewes are secure from predators during birthing and nursing. Winter range is similar to lambing grounds, consisting of grassland foraging areas which remain relatively free of deep snow, and less rugged escape terrain. Okanagan winter ranges are also commonly near a stand of dense timber, used for wind shelter and snow inception cover.

Historically, bighorn sheep were much more numerous and widely distributed than they are today. The sheep population is

thought to have historically had a contiguous distribution throughout suitable habitats on both sides of the Okanagan valley from the US border to Vernon and through the Marron Valley area to the Similkameen and Ashnola drainages. Human influences have eliminated some populations and fragmented others. The current sheep population is lower than historical levels however the potential for recovery is high.⁹⁰ The majority of the plan area's California bighorn population is in Vaseux Creek and Ashnola areas, supporting an estimated 750 - 1000 animals. Shorts Creek on the west side of north Okanagan Lake previously supported 50-75 animals but this population is now at great risk of extirpation due to predation and loss of habitat from fire suppression and forest encroachment⁹¹. Smaller transient or permanent groups occur in the Penticton and Olalla areas. Population declines occurred in the early 1990s due to dry summers and cold, snowy winters, and recovery efforts are now underway. The Garnet fire resulted in improved forage for the South Okanagan population, which is expected to increase dramatically within a few years. Programs are underway to encourage sheep reoccupation of former ranges.

The most serious indirect impacts on California bighorn sheep result from being excluded from traditional winter ranges, which usually extend to the valley floor in the South Okanagan, and are often on private land. Lungworm is endemic in bighorn sheep, and when sheep are forced to concentrate in feeding areas the spread of the parasite is greatly facilitated. Changing land use has also affected populations through road-kills, poaching, noxious weeds, forage availability, fire suppression (which results in more timber on sheep range - e.g. Short's Creek), expanding forest roads, logging and all-terrain vehicle use.

MoF livestock grazing prescriptions on Crown lands recognize the needs of both cattle producers and wildlife. Management of bighorn sheep is recognized as a primary concern in certain local planning levels (e.g. Ashnola CRMP). Improved forage management seems to have provided more forage for cattle and sheep. Prescribed burns have improved forage for the Ashnola herd and this success suggests that a similar program could benefit the South Okanagan herd as well. Specific grazing management techniques can ensure forage availability on ranges grazed by cattle.

Outlook: Bighorn sheep are considered to be below the capacity of the land to support them. Much of this is due to historic land use practices that alienated prime habitat. While the overall population is considered to be stable, local populations are considered to be at risk from increased human

disturbance and a variety of localized factors including predation, disease and degraded habitat.

9.5.4.2 Mountain Caribou

Little reliable data on past caribou populations exist, but today's numbers are believed to be substantially lower than historic levels⁹². During the winter, caribou feed largely on arboreal lichens which are most common in forests >140 years old, making this species vulnerable to loss of late seral and oldgrowth forests. Key caribou habitats include early winter range mature and older closed canopy forests for snow interception; late winter subalpine forest; early spring open forage areas (e.g. riparian, avalanche chutes); and calving grounds with hiding cover. Mountain caribou reproduce slowly compared to other deer species, and are only marginally able to adapt habitat alteration or mortality pressures.

The LRMP area includes all or part of the range of 3 caribou populations: the Monashee (20 animals) in the central part of the area, the Wells Grey South population (400 animals) and the Revelstoke population (400 animals) in the north.

Management for caribou has been recognized in strategic planning processes in adjacent areas (i.e. Kamloops LRMP and Kootenay-Boundary Land Use Plan) and maintaining connectivity between the two areas is an issue of concern.

The current Monashee caribou population is concentrated in the area of Monashee Park to Blanket Glacier. The population was stable over a 10 year period, although low total numbers and poor calf crops suggest that the population is at high risk to extirpation⁹³. The Wells Grey South population also appears to be stable. The Revelstoke caribou herd has average annual calf crop of 21% and this population appears to be stable, but is threatened by loss of oldgrowth forest habitat and human disturbance. Only a small proportion of the range of this herd is included in the plan area.

Caribou habitat is threatened by logging, mining, forest fires, increased public access and human settlement. Human disturbance from recreational and industrial activities (especially snowmobiling) has the potential to affect caribou populations by displacement and degrading important habitats. No hunting of caribou is permitted within the region.

Development has degraded caribou habitat through logging of oldgrowth forests. Although few of the early winter range, oldgrowth closed canopy forests remain in the Okanagan area, some still remain in the Shuswap River headwaters of the Monashee Mountains. While potential calving grounds and late winter subalpine range may still be relatively intact, spring and early winter range capacity in some areas has been reduced substantially in recent decades. In contrast, logging of some

remote lowlands has created open areas which may provide spring habitat.

There is management for Mountain caribou, to some degree, within the plan area. In the Monashees there is a mid-term deferral on timber harvesting east of the upper Shuswap River (north of Monashee Park to approximately Greenbush Lake) that benefits caribou habitat. In the Salmon Arm Forest District there has been efforts to minimize impacts to caribou habitat through operational plan development (i.e. cutblock and road development).

Outlook: Considering their former abundance, there may be a large unrealized potential for producing caribou in the plan area, particularly in the northeastern part of the Okanagan near Shuswap and Mabel Lakes, along Hunter's Range.

While both of the above noted efforts have minimized the impacts of timber harvesting on caribou habitat in the short term, neither have been recognized in timber supply reviews. Until this management is incorporated in the TSR, there remains a risk that the management for caribou habitat could be reduced or eliminated once timber supply constraints arise. As low risk management for Mountain caribou is expected to have timber supply impacts above the FPC allotment, it is unlikely that management for caribou could be maintained over the long term in the absence of a land use plan. As well, the MELP Mountain caribou strategy requires implementation of management practices to be confirmed through a land use plan. Therefore, under base case management, local extirpation of the species within the plan area could be expected over the longer term, and connectivity between Wells Gray and Revelstoke populations could be jeopardized, limiting genetic exchange.

9.5.4.3 Grizzly Bears

Grizzly bears occupy a wide variety of habitats wherever they occur. Prime grizzly bear habitat includes moist floodplain or riparian habitat, avalanche chutes, high berry producing habitats and sedge meadows, although they may also use dense forested cover and early seral openings.

Although grizzly bears occur sporadically throughout the Okanagan, most are concentrated in the Monashee Ranges. An estimated 75 grizzly bears inhabit the Shuswap-Mabel Lake area and a remnant population also exists in the Okanagan and Similkameen. The Okanagan population is presumed to be stable or declining, and are most often observed in rugged subalpine habitats. Grizzly bears also occur in the Park, Sawtooth, and Hunter Ranges, as well as in the highland plateau east of Penticton between Little White and Baldy Mountains. Sightings of individual grizzlies have also occurred

in recent years in the Ashnola, and more recently there have been several sow/cub sightings in the Greystokes area.

The grizzly bear is vulnerable due to its requirements for large home ranges, diverse seasonal and annual habitat, slow rate of population increase, and high potential for conflict with human activities. Habitat fragmentation and alienation has depleted grizzly bear habitat. Increased access into former wilderness areas has resulted in an increase in bear-human conflicts.

Outlook: The draft FPC 'Identified Wildlife Management Strategy' and the Grizzly Bear Conservation Strategy provide management recommendations for grizzly bear. However, these measures are expected to be insufficient to maintain grizzly bear populations within the plan area without co-ordination of supporting management objectives and strategies.

9.5.4.4 Forest-dependent Species

In addition to caribou, other species including marten and fisher rely on older forests for shelter and breeding. Although marten will use a variety of habitats if food and cover are available, mature and older conifer forests provide critical habitat. Large trees and coarse woody debris (CWD) are important denning sites and stumps, slash and windthrow provide access to prey below snow during winter. Overhead cover appears to be an important factor in selecting habitat. Extensive clear-cutting or large fires will seriously reduce habitat suitability (in the short term) for marten by altering the prey base, overhead cover and access routes to subnivean (below snow) prey. In such instances, riparian protection can minimize the impacts of extensive disturbances by providing habitat for prey and cover. Fishers (a Blue-listed species) are usually found in mixed forests with a diversity of tree species and ages. Food availability appears to be the most important factor governing habitat selection. However, other factors such as overhead cover and denning sites are also important. Maternity dens are generally in large deciduous trees. Fishers also use temporary shelters such as hollow logs and tree cavities, brushpiles, rockpiles, burrows and dens of other animals, and snow dens. Temporary shelters may be located near a food source. During periods of deep soft snow, fishers select coniferous forests where travel is easier because of reduced snow accumulations. Severe and extensive disturbances of the forest by logging or fire may seriously reduce its habitat value for fishers, especially during winter, due to lack of overhead cover and greater accumulations of snow.

Forest-dwelling birds such as Boreal Chickadee, Brown Creeper, Northern Saw-whet Owl, Barred Owl and Three-toed Woodpecker, are associated with forest interior habitats and may be threatened by current logging practices. Nest predators

such as crows and jays forage along forest edges, and species nesting near edges tend not to be successful in rearing offspring. As forests are harvested and fragmented, the amount of edge habitat increases and forest interior habitat decreases. Caribou and marten also prefer interior forest habitat. Maintaining forest interior habitat is critical, as certain species tend to be more specialized and less adaptable to changes in habitat.

Outlook: Prior to enactment of the FPC forest practices were not adequately addressing the habitat requirements of many forest dependent species. The FPC Biodiversity Guidebook provides management direction for target amounts of mature and older forests, and patch size which will address this deficiency. It should be noted, however, that FPC implementation policy overrides guidebook recommended seral stage targets (see Outlook for seral stage distribution), and that objectives for patch size are discretionary. In addition, the FPC 'Identified Wildlife Management Strategy' (yet to be published) may provide more detail on species specific needs relative to forest conditions. Application of such recommendations will generally minimize the risk to forest dependent species.

9.6 Other Habitat Protection Related Issues

Forestry, agriculture, urban development, Crown land alienation, grazing, access and pesticides have the greatest impacts on wildlife within the plan area. The degree of impact varies between habitats and wildlife species involved. Of special note are private land development impacts (residential /municipal and agricultural) in the South Okanagan Basin and North Okanagan Basin ecosections. They are substantial and concentrated in some of the most sensitive and crucial habitats in the plan area. There is continuing pressure to alienate the remaining Crown land in the basin for various types of development, particularly where lands are outside of provincial forests. Roads tend to affect all wildlife species to some degree. Traffic causes wildlife mortality directly, and the increased access results in habitat degradation, harassment/displacement, and increased hunting and poaching mortality. Roads are built on wildlife habitat, thereby removing it from production and in some instances causing a barrier to movement. Disturbance from road traffic causes stress to wildlife (e.g. grizzly bears and elk are known to avoid habitats adjacent to roads). If roads are not properly constructed, they may cause erosion and siltation of high value fish and wildlife habitat nearby. Roads also aid in the dispersal of invasive weeds.

Outlook: Human population growth is expected to increase demand for further alienation of Crown lands. Along with increased population growth there are numerous activities/developments that will be required to meet the pressures associated with increases in population (e.g. transportation corridors, waste disposal sites, flood proofing, etc.), many of which are likely to impact wildlife

and biodiversity. Road densities are likely to continue to increase within the plan area which will impact sensitive species or ecosystems.

9.7 Outlook for Wildlife, Habitat and Biodiversity

The FPC has established a framework for addressing many of the issues important to wildlife, habitat and biodiversity in the plan area relative to forest and range practices. However, the FPC was not intended to address all concerns relating to the protection of wildlife, habitat and biodiversity. While FPC guidebooks provide “best management practices”, there is a discretionary nature to their application, and their application is constrained by impacts to timber supply.

Continued pressures are expected on the land base relative to increased population growth. Ecosystems unique to the plan area, and rare ecosystems and wildlife are at greatest risk to such development pressures.

In order to maintain values in the long term issues such as maintaining appropriate seral stage distribution, identifying and protecting special habitats and features, maintaining connectivity and minimizing the impacts of resource use access are critical. These issues require definitive management objectives, strategies and operational guidelines and broad public support.

10. Fisheries

10.1 Introduction

The Okanagan-Shuswap LRMP area includes portions of the Columbia (Okanagan and Similkameen drainages) and the Fraser (Shuswap River drainage) systems. The plan area supports 43 fish species, including 14 introduced species - a higher proportion than any other area in BC (Table 10.1). Four anadromous salmon species are present; all the remaining species are freshwater. Falls and dams on the Similkameen and Okanagan rivers and the Shuswap River provide barriers to upstream migration of several species. Next to the Lower Mainland, the Okanagan is the most altered environment in the province⁹⁴, and, as mentioned, it is also one of the fastest-growing areas in the province. As a result of human settlement and associated public access, virtually no lowland lakes in the valley remain in their natural state. Pressures on sport fish have come from this increased population and the sport fishing resource is nearly fully exploited (and for trout in many cases over-exploited)⁹⁵. Rivers and streams have been affected by resource and urban development in their watersheds that has resulted in hydrological and water quality impacts.

10.2 Current Profile

10.2.1 Salmon

Salmon are a valuable natural resource within the LRMP area, contributing to commercial, sport and aboriginal fisheries (see Sections 6 and 7). The Shuswap Basin contributes significantly to the overall production of salmon in the Fraser River Basin and to the genetic diversity of the Fraser salmon populations.

In the last decade, up to four million sockeye, 34,000 chinook and 20,000 coho spawners have utilized the Shuswap Lake system, with spawning occurring in approximately 40 tributary streams. The Shuswap lake system supports sockeye lake spawners and also provides vital rearing area for hundreds of millions salmon fry (coho and chinook as well as sockeye) and is one of the most important salmon producing areas in British Columbia. Pink salmon also return to the area in low numbers.

The Lower Adams River is the major sockeye producer in the Shuswap and the second largest in BC. The lower Shuswap River has become a major sockeye producer in the last 15 years; other important runs include the Seymour River, Scotch Creek and Shuswap Lake spawners. Adams river fry as well as sockeye fry from other spawning streams rear in Shuswap Lake for one year before moving to sea.

Important chinook producers are the Lower Shuswap River, the Middle Shuswap (below Wilsey Dam), Lower Adams, Eagle and Salmon rivers. Coho are produced in many tributaries (over 30 streams) of the Shuswap system, including the Eagle and Salmon rivers, Shuswap River and the Bessette system. Shuswap coho stocks contribute to the Thompson coho stock group which represents about one third of the total Fraser River coho population.

Sockeye also spawn in the Okanagan River to McIntyre dam; one of the only two viable sockeye stocks remaining in the entire Columbia River system. Recent (1994 and 1995) dramatic declines in escapements have resulted in concerns about the viability of this stock. Chinook and steelhead are also present in the Okanagan River and historically accessed the Similkameen system.

In general, total sockeye and chinook escapements to the Shuswap system have been rebuilding over the last decade. This is attributed largely to an overall reduction in harvest and past good ocean conditions. The increase in chinook largely reflect the Shuswap River chinook stocks; the trend is less clear for other chinook populations. In contrast, coho escapements have declined dramatically since 1989. Many coho stocks are threatened and the decline is attributed mainly to excessive exploitation rates, low marine survival and the continuing degradation of freshwater habitats.

Critical salmon habitats include: (i) migratory corridors; (ii) spawning, incubation, rearing and overwintering habitats; (iii) small, temporary rearing streams; (iv) sidechannels and offchannel habitats; (v) lake foreshore spawning and rearing habitats; (vi) habitats of threatened stocks; (vii) environmentally sensitive areas; and (viii) non salmon bearing streams that directly influence salmon habitat.

10.2.2 Resident Fish

A significant number of naturally recruiting lakes have been inventoried in terms of fish growth and habitat. Annual escapement records are only available for kokanee in Okanagan Lake⁹⁶, otherwise the seven other large lakes in the Okanagan-Shuswap have limited inventory data. It is estimated that the Okanagan and Similkameen drainages are inhabited by some 6,000,000 fish, of which about 2,000,000 are sport fish. Rainbow trout from 400 small lakes make up 66% of the sport fish population and 80% of the catch. Stocking programs include the release of over 1,000,000 rainbow trout annually, and are vital to support the trout fishery⁹⁷.

The lack of adequate fisheries inventory data for streams and small headwater lakes in the south Okanagan is based primarily on limited budgetary resources. Information on distribution and abundance on alternate sport fish such as perch, peamouth chub, pumpkinseed, sunfish, crappies, carp, squawfish and suckers is also lacking for all of the large lakes and life history knowledge of many species is limited⁹⁸. The plan area supports 15 resident sport fish species, including kokanee, rainbow trout, bull trout, brook trout, lake char, burbot, cutthroat trout, largemouth bass, smallmouth bass and whitefish. Stocking programs keep most lakes in the LRMP area well stocked with rainbow trout. Along with salmon, the above are the primary sport fisheries species.

Table 10.1. Distribution of Fishes in the Okanagan-Shuswap LRMP Area

Common Name	Scientific Name	Okanagan	Similkameen	Shuswap
<u>Red-listed Species</u>				
Umatilla dace	<i>Rhinichthys umatilla</i>	?	B	
White sturgeon	<i>Acipenser transmontanus</i>	?	-	-
<u>Blue-listed Species</u>				
Bull trout	<i>Salvelinus confluentus</i>	-	-	+
Chiselmouth	<i>Acrocheilus alutaceus</i>	B	B	+
Mottled sculpin	<i>Cottus bairdi (hubbsi?)</i>	-	B	
Mountain sucker	<i>Catostomus platyrhynchus</i>	-	B	+
<u>Anadromous species</u>				
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	B	-	+
Coho salmon	<i>Oncorhynchus kisutch</i>			+
Pink salmon	<i>Oncorhynchus gorbuscha</i>			+
Sockeye (Kokanee)	salmon <i>Oncorhynchus nerka</i>	+	B	+
<u>Other Species</u>				
Black catfish	<i>Ameiurus melas</i>	I, B	-	
Black crappie	<i>Pomoxis nigromaculatus</i>	I, B	-	-
Bridgelip sucker	<i>Catostomus columbianus</i>	B	B	+
Brook trout	<i>Salvelinus fontinalis</i>	I	I	I
Brown catfish	<i>Ameiurus nebulosus</i>	?	-	-
Brown trout	<i>Salmo trutta</i>	-	I	
Burbot	<i>Lota lota</i>	+	B	+
Carp	<i>Cyprinus carpio</i>	I	-	I
Goldfish	<i>Carassius auratus</i>	I	-	I
Lake chub	<i>Couesius plumbeus</i>	+	B	+
Lake trout	<i>Salvelinus namaycush</i>	I	-	+
Lake whitefish	<i>Coregonus clupeaformis</i>	I	-	+
Largemouth bass	<i>Micropterus salmoides</i>	I	-	-
Largescale sucker	<i>Catostomus macrocheilus</i>	+	B	+
Leopard dace	<i>Rhinichthys falcatus</i>	+	B	+
Longnose dace	<i>Rhinichthys cataractae</i>	+	+	+
Longnose sucker	<i>Catostomus catostomus</i>	+	B	+
Mountain whitefish	<i>Prosopium williamsoni</i>	+	B	+
Northern squawfish	<i>Ptychocheilus oregonesis</i>	+	B	+
Pacific lamprey	<i>Entosphenus Tridentatus</i>	-	-	+

Peamouth chub	<i>Mylocheilus caurinus</i>	+	B	+
Prickly sculpin	<i>Cottus asper</i>	+	B	+
Pumpkinseed	<i>Lepomis gibbosus</i>	I, B	-	-
Pygmy whitefish	<i>Prosopium coulteri</i>	+	-	+
Rainbow trout	<i>Oncorhynchus mykiss</i>	+	+	+
Redside shiner	<i>Richardsonius balteatus</i>	+	B	+
Slimy sculpin	<i>Cottus cognatus</i>	+	B	+
Smallmouth bass	<i>Micropterus dolomieu</i>	I	-	
Tench	<i>Tinca tinca</i>	I, B	-	
Torrent sculpin	<i>Cottus rhotheus</i>	B	B	+
Westslope cutthroat trout	<i>Oncorhynchus clarki lewisi</i>	-	I	0
White sucker	<i>Catostomus commersoni</i>			0
Yellow perch	<i>Perca flavescens</i>	I	I	

■ - = Absent; + = Present; **I** = Introduced; **B** = Below barriers

■ (B. Jantz - pers. comm., McPhail and Carveth 1994)

Several resident fish stocks of special concern occur in the plan area, including a strain of large rainbow trout in the Okanagan Lake system; shore-spawning kokanee with unique reproductive strategies in Kalmalka, Okanagan and Wood Lakes, bull trout throughout the Shuswap system, and rainbow trout broodstocks in several lakes (e.g. Pennask and Beaver Lakes).

In particular, both the stream-spawning and the shore-spawning kokanee stocks of Okanagan Lakes have declined to less than 10% of the spawner counts seen in the 1970s. The main causes of this continuing decline are felt to be related primarily to the introduction of a species of freshwater shrimp, *Mysis relicta*, and secondarily, to the degradation or loss of instream and foreshore spawning habitats. In an attempt to reverse this decline, the Habitat Conservation Trust Fund has approved a five year, Phase 1 program that focuses on the development of *Mysis* control techniques and effective kokanee spawning habitat protection/restoration measures.

10.2.3 Red & Blue-listed Fish

The LRMP area supports two Red-listed (white sturgeon and Umatilla dace) and four Blue-listed fish species (chiselmouth, mountain sucker, bull trout, mottled sculpin) (see Table 10.1)⁹⁹. There are unconfirmed historic reports of white sturgeon in Okanagan Lake, and chiselmouth have been found in scattered locations in all three Columbia tributary systems¹⁰⁰. Bull trout are known from several drainages in the Shuswap system.

There is also one record of a minnow from Mission Creek which may be an Umatilla dace. In Okanagan Lake, a morphologically unusual form of pygmy whitefish has been observed, and a dwarf race of longnose suckers may be present in the Okanagan system. The plan

area supports several other uncommon fish populations such as the northern mountain sucker from Wolfe Lake in the Similkameen watershed, and tench in Osoyoos and Tugelnuit Lakes¹⁰¹.

10.2.4 Special Stocks, Habitats and Fisheries

The Fisheries Program of MELP has identified fresh water stocks, habitats and systems of importance within the LRMP area. They have been categorized into special stocks, special habitats and special fisheries.

10.2.5 Special Stocks

Special stocks include: (i) broodstock systems (e.g. Pennask and Beaver Lakes); (ii) bull trout systems; and (iii) unique stocks (e.g. Okanagan Lake shore-spawning kokanee and Joe Lake shore-spawning rainbow trout). These areas or systems are considered to be of regional, and in some cases, provincial importance.

10.2.6 The Pennask Watershed

The wild rainbow trout in the Pennask drainage are one of the most valuable trout stocks in the province. About 40% of all the wild rainbow trout eggs for the provincial stocking program come from Pennask Creek. A local resource use plan (LRUP) has been established for the Pennask watershed, and some of the adjacent landscape. The Pennask LRUP has the protection of the wild rainbow trout and their spawning beds as the highest priority in the plan.

10.2.7 Special Habitats

Special habitats include: (i) large lakes with lake char and sockeye shore-spawning areas; (ii) selected reaches of barren streams flowing into high-value fish-bearing streams; (iii) geographically isolated systems which offer potential for unique stocks; (iv) undisturbed "benchmark" watersheds; (v) environmentally sensitive areas (eg. high hazard due to soils, terrain, etc.); (vi) systems with known low-flow impacts on fish; (vii) genetic refugia; and (viii) important spawning reaches. These areas or systems are considered to be of regional, and in some cases, provincial importance.

10.2.8 Special Fisheries

Special fisheries include: (i) limited access fisheries (e.g. walk-in lakes), and (ii) aesthetic fisheries, where visual quality is a concern. Both types of special fisheries are currently being managed to provide a "quality" fishery experience.

10.2.9 Habitat and Riparian Area Considerations

Fish and other aquatic life are at risk by activities which cause destruction and degradation of their immediate habitat (i.e. riparian areas and aquatic zones), as well as activities in upland areas that could affect the hydrological regime of streams within the watershed. Activities in the uplands, such as timber harvesting, road building, reservoirs, agricultural and urban development can alter the hydrology of a stream or drainage, and result in adverse impacts specific to water quality and quantity and timing of flows. Erosion and sediment

deposition can have severe impacts on fish and other aquatic life. Increased silt loads from a variety of development activities can clog stream substrates needed by spawning salmonids, reducing egg and fry survival. Silted substrates can also reduce aquatic invertebrate productivity, and silt laden water can result in mortality, especially in juvenile fish.

The Salmon River is one example of many salmon streams in the LRMP where past and present land use activities and increasing development pressures have resulted in cumulative impacts from logging in the headwaters and agriculture/settlement activities downstream. The Salmon River has stocks of chinook and coho and was, at the turn of the century, a river whose salmon productivity rivaled that of the Adams River. However, the Fraser River Hells Gate slide, the encroachment on spawning and rearing habitat by development and fishing have depressed salmon stocks. Loss of riparian vegetation has been extensive and demand for irrigation water high. A combination of increased erosion, silted gravels, low summer flows, higher water temperatures, contaminated runoff, lack of cover and loss of offchannel habitats has severely diminished fish spawning and rearing habitat quality. While it is unknown whether salmon populations can be restored to their historical productivity, the Salmon River is the focus of a major rehabilitation effort by the Salmon River Watershed Roundtable.

Important spawning and rearing habitats along lake foreshores are affected by development activities (eg. breakwater, boat launches, armouring, etc.) within the foreshore or riparian areas, by activities on the lake that result in wave action, or by development of the upland (eg. urban or agricultural run-off). For example, development pressures along Shuswap and Mabel Lakes threaten spawning sockeye and char and the critical nursery areas along the foreshore utilized by rearing salmon of the entire Shuswap Basin.

Maintenance and rehabilitation of resident fish stocks and habitat in the plan area are limited both by biological realities and by the necessary management tools. Small lake productivity is affected both by elevation (high elevation lakes are generally low in productivity) in the Shuswap-Mabel and Similkameen watersheds and, in the Okanagan watershed, by fluctuating lake/reservoir levels resulting from flow control through dams. Flow control, water diversions, channelization and high water temperatures have also affected sockeye in the Okanagan River below McIntyre Dam. Water availability for fish and other aquatic life has been a concern in the Okanagan for several decades. Competing demands for domestic and irrigation purposes have been to the detriment of fish in most cases (eg. Trout, Naramata and Mission Creeks).

Rivers and streams throughout most of the Okanagan portion of the plan area are relatively low in productivity, subject to high, rapid runoff and followed by extremely low flows. They are highly susceptible to

both natural and artificial changes that affect the aquatic ecosystems. Where fish do occur, degradation of riparian habitat by timber harvesting, improperly managed cattle grazing, stream channelization and urbanization pose a risk to small spawning creeks, and/or feeder streams. The health of riparian zones affects food productivity, cover, erosion rates, sediment deposition, water temperature and stream flow. The FPC, through regulations and guidebooks, provides a base line of protection for fish and fish habitat. The Riparian Management Area Guidebook provides 'best management practices' for riparian management zones for both fish bearing and non-fish bearing streams. In community watersheds, riparian areas adjacent to non-fish bearing streams are afforded an increased level of protection, which should have less of a downstream impact on water quality. Base line protection provided through the FPC may not have the desired results for streams classified as fish bearing "S4", as the maintenance of a treed buffer is at high risk of being compromised due to windthrow hazard. Certain S4 fish bearing streams are highly productive, particularly where spawning occurs near headwater lakes. Non fish bearing streams may also require additional protection in order to maintain downstream stability and temperatures of fish bearing streams.

Cumulative impacts are considered to be one of the greatest risks to streams, watersheds and fish values, however, they are not easy to ascertain. The FPC has outlined a process to determine cumulative impacts (Interior Watershed Assessment Procedure) by considering timber harvest levels, road densities, slope, soils, and more. It is envisioned that this evaluation process will eventually guide development practices in watersheds of concern. It is estimated that it will take several years to complete all the priority watersheds within the LRMP area.

Although the FPC has outlined a framework for maintaining stream, watershed and fish values on Crown land, it is not applicable to activities on private land, where certain activities can affect fish and fish habitat¹⁰². Numerous guidelines are available that deal with topics such as urban development practices, managing urban and agricultural run-off, and cattle management (see Appendix 6). However, the application of such guidelines are dependent upon the willingness of private landowners and local governments to abide by them.

10.3 Outlook for Fish Resources

Although few fish stocks are adequately inventoried, most of those monitored have shown significant declines over the last 20 years. The combination of declining fish populations, limited water supplies, human population growth and increasing urbanization, land and resource development, and angling activity suggests that pressures on both fish and habitat will continue.

Although sockeye and some chinook stocks in the Thompson-Shuswap are rebuilding, there has been a dramatic decline in coho in the lower Fraser and Thompson. Sockeye stocks in the Okanagan River have also declined. Maintaining and restoring habitat (which includes water quality and quantity, timing of flow and riparian protection) is crucial to conserve and rebuild fish stocks. Land and resource management on Crown and private lands can affect streamflow and runoff patterns, which in turn affect fish migration, rearing, and spawning success. Fish are also sensitive to temperature and water quality changes such as pollution and decreased oxygen levels. Limited water supplies and development of foreshore and adjacent uplands are likely to continue to affect fish values. Legislation does not adequately protect instream flows for fish and the application of guidelines to protect fish values (e.g. riparian zones) on private lands has yet to be widely accepted.

To maintain and restore long term stream productivity, land and water management needs to focus on the causes of ecological degradation of the watershed, e.g. degraded upslope conditions, altered hydrologic regime, and loss of riparian vegetation. A watershed based management approach is required to preserve intact aquatic ecosystems and to restore the ecological function and processes in damaged streams. A key first step in watershed restoration is the removal or alteration of land and water use activities that are causing adverse impacts to riparian and aquatic ecosystems.

Assessments and inventories are important to improved fish habitat protection. Inventories are expected for fish bearing streams as forest development occurs. Lake inventories are expected to continue subject to resource availability. Both should result in improved stewardship. The FPC has provided a base line of protection for fish and habitat relative to forest and range management. However, special stocks, critical and special habitats and special fisheries are not being managed for in all cases, and are expected to be subjected to continued development pressures. Assessment for cumulative impacts are crucial in determining acceptable levels of development within watersheds, or sub-drainages, however, they are not a mandatory requirement of development. Further development prior to the completion of watershed assessments and development of recommendations to prevent hydrological impacts will increase risks to fish and fish habitat.

11. Water Resources

11.1 Introduction

This is one of the first times that surface and ground water resources have been included in a strategic land use plan. Water, a finite resource, is a crucial component of the planning area's ecosystems and of the makeup of the biological diversity within the plan area. Plant and animal life are dependent on water availability and water quality. Because human activity is dependent on water, availability and quality of water have the potential to limit and impact growth and development in the plan area. Also, consumptive use for human activities has the potential to impact the water availability and water quality required by non human species. Adequate management is required to balance water quantity (availability) and water quality for all needs and uses.

Human settlements require a good supply of clean water for consumption. The expanding population of the plan area has put substantial demands on the water resource. Water is critical to most agriculture in the plan area. Irrigated forage, tree fruit production and vineyards and livestock require water. The plan area's lakes and rivers are key attractions that contribute to tourism and recreation values. Manufacturing activities may also rely on water as a key input.

The plan area contains two major water systems - the Shuswap system which flows into the Fraser River, and the Okanagan system which flows into the Columbia River. In both, the water resources flow from the headwaters of the river systems down through the valleys and end up in the major lakes of the Shuswap and Okanagan areas. As the water travels through both Crown and private land, the quantity and quality of water may be affected by the activities taking place on these lands, either at that location, or, more often, further downstream, as activities in the uplands can impact water quality in the lowlands.

These systems are characterized by differing conditions and use, and different issues for quantity and quality. Due to its semi-arid climate, the Okanagan Basin is virtually dependent on the runoff from winter snowpack at higher elevations. The Shuswap area is less dependent on runoff from snow melt due, in part, to higher and more seasonally distributed precipitation.

11.2 Water Quantity and Use

Water is available through either surface water or ground water, both of which are a Crown resource. In the plan area, the majority of the water used for drinking (domestic) in Salmon Arm, Vernon, Penticton and other communities is derived from surface water. However, the use of ground water is an important source for drinking (domestic), irrigation and other purposes in the Oliver, Osoyoos, Rutland and Coldstream areas. The Water Act regulates the use of surface water and activities within the streams, however there is no regulation governing the use of groundwater.

There are several natural hazards associated with water, including flooding and erosion along the floodplains, debris flows on alluvial fans, and/or landslides within watersheds. In some cases these hazards result from or can be

aggravated by human activity in the watershed. Resource extraction activities such as forestry and mining have the potential to alter runoff patterns and flows thus affecting slope stability, erosion, and debris flows. As well land development on floodplains alters the natural erosion patterns. Land development can cause detrimental impacts in the area of development and/or in many areas located downstream/downslope.

11.2.1 Supply and allocation

In 1974 the comprehensive Okanagan Basin Water Supply study was completed and in 1992 the water supply was re-examined. The results of this update, provided in the 1994 Okanagan Basin Water Supply study, recommend that no more than 63,000,000 m³ (about 50,000 acre feet) of additional water be licensed within the Basin until operation experience is gained from future drought conditions. As a general rule, water quantity is sufficient in the north of the plan area where the annual precipitation is 531 millimetres/year (mm/yr) in Salmon Arm, and 447 mm/yr.¹⁰³ in Vernon and becomes a growing concern towards the south where the annual precipitation drops to 300 mm/yr in Oliver/Osoyoos. It should also be noted that significant fluctuations in the quantity of water occur within these areas from year to year.

The use of surface water is allocated by the Water Management Program of MELP through a water licensing system. At present, there are approximately 6,900 water licenses in the plan area, including 360 dam sites. Many of these dams are either constructed on Crown land or flood Crown land. They have altered the natural flow of water and as noted in the Fisheries section may impact the fish habitat and populations within the plan area.

While some local restrictions on additional licensing exist for some tributaries, for the most part water is available from upland tributaries and main stem lakes and rivers in the Shuswap system. Most tributaries to the main stems are totally committed with respect to licensing in the Okanagan portion of the plan area. Any additional future supply, as mentioned above, will have to come from the main stem lakes or rivers such as Okanagan or Skaha or the undefined ground water.

11.2.2 Groundwater

Groundwater is often chosen as a water supply where surface water is not readily available (insufficient quantity or water quality problems) or where the intended use, such as aquaculture, water bottling, etc., requires very constant and high water quality. A key element to protecting groundwater is managing development and resource use on the land about the aquifers and their recharge areas, however existing information on aquifers, necessary to control and manage impacts on ground water, is incomplete. This outstanding information is in the process of being compiled for the remainder of the plan area.

11.2.3 Okanagan Lake Regulation System

The Okanagan Lake Regulation System (OLRS) is a unique water regulation system which controls flows along the Okanagan River by a series of dams and a channel containing structures that change water elevation. This system includes 38 kms of right-of-way. The primary operating objectives of this system are for flood control and the maintenance of minimum flow. Secondary objectives include water supply, fisheries, wildlife habitat, and recreational activities. The right of way adjacent to the OLRS is used to link habitat, as a recreational trail and as a utility corridor.

11.2.4 Community Watersheds

There are 62 community watersheds within the plan area which have been designated under the *Forest Practices Code*. Within these watersheds, water is the primary resource use and forest management requires more detailed forest development plans, including watershed assessments, which may require more restrictive harvesting and range use practices.

11.2.5 Other Watersheds/Drainages

While for community watersheds water is the primary resource use, other watersheds or drainages exist in the plan area, particularly in the northern portion, which are not designated as community watersheds but also have important water values.

Some have been identified for their importance for domestic water use but fall outside the criteria set for designations as community watersheds. Other watersheds or drainages have specific values for fish (including those designated under the Fish Protection Act) while others have sensitive stream channels and/or upland terrain assessed under IWAP (Interior Watershed Assessment Process) under FPC¹⁰⁴ or the CAP (Channel Assessment Process) under FRBC.

11.3 Water Quality

The fish, wildlife, human and industry users of the water resources not only rely on the presence of water but require good quality water. As noted below, there are various land use activities which, if not adequately managed, may alter the quality of the water.

A major concern related to water quality is sedimentation. Increased sedimentation within a water body can impact aquatic life, as it essentially smothers the streambed organisms that the fish depend on for food and it smothers the spawning habitat. Sedimentation can also infill streams, and water storage reservoirs and can adversely impact water quality and use. Forestry activities (particularly harvesting and road construction and use) can potentially increase sedimentation through surface erosion, slope failures or drainage works failure.

Livestock (cattle, sheep) grazing has the potential to increase sedimentation if livestock trample or graze off vegetative cover. Winter feeding of livestock and spreading of manure on snow can change the patterns and timing of runoff (the dark colour of manure on snow results in premature melting) and if excessive animal wastes flow into water sources, it can cause bacterial

contamination and increase nutrient levels. A joint industry/government strategy for manure runoff control has been undertaken to minimize manure runoff. Although this initiative is primarily associated with private land, there are some Crown leases which are included. As well, under the *Forest Practice Code* community watershed and riparian guidelines grazing activity is more strictly managed. Agricultural use of pest and weed control substances also has the potential for contamination when these substances drain into the ground or surface water.

Mining activities can result in increased sedimentation and contamination of the water with metals or chemicals. All mining operations have controls on sedimentation. Larger scale operations also have regulatory limits on chemical discharges, and monitoring systems that help ensure they comply with these requirements. For placer mining operations occurring in the area, limited information is available on their impact on the water quality.

Human use creates the potential for fecal coliform bacteria contamination. Studies conducted in the Crown waters of Shuswap, Mara and Okanagan Lakes have identified many areas of septic impact on lake water quality¹⁰⁵. However, the majority of the problem areas have now either developed sewer service or will do so in the near future. As well, Environment Control Zones (under the jurisdiction of the Ministry of Health) have been established to apply more stringent guidelines for septic systems.

Municipal sewage discharge has the greatest potential to increase the nutrients within the water system, specifically phosphorus. Today only advanced biological tertiary treatment plant outfalls are allowed in the plan area.

Table 11.2 Historical Phosphorus Sources - Okanagan Lake System

Source	Thousands of Kilograms				
	1870	1970	1980	1990	1996
Sewage Treatment Plants	0.00	59.15	19.11	7.82	2.81
Septic Tanks	0.00	8.00	11.5	16.92	15.67
Agriculture	0.00	4.50	11.93	2.50	2.50
Forestry	0.00	8.40	8.40	8.40	8.40
Other	41.90	41.90	41.90	41.90	41.90
Total	41.90	121.95	92.84	77.53	71.28

Phosphorus loading and its impact on the natural systems within the lake systems are closely monitored. The biggest contributor is storm water and other ‘non cultural’¹⁰⁶ sources shown as ‘Other’ in Table 11.2. Other nutrient sources which cause phosphorus loading are being controlled through improved forestry practices, enhanced manure control for agriculture and upgrading of sewage treatment plants. As a result, loading into the Okanagan Lake system has been reduced over the past 20 years (see Table 11.2). Phosphorus loading information is not available for the Shuswap Lake System.

11.3.1 Groundwater

Ambient groundwater quality in the LRMP area is monitored in 44 observation wells. However, ambient water quality is not being monitored in all aquifers. In Osoyoos, groundwater monitoring is being conducted where fertilizers and septic systems are affecting

water quality. Water quality of wells serving communities are monitored by the Ministry of Health.

11.3.2 Other Water Quality Issues

There is little up to date information available on the impact of storm water on water quality of urban streams. Guidelines for storm water management do exist but little effort has been undertaken to control storm water.

There are several Acts, regulations, codes and guidelines which enable the Ministry of Environment, Lands and Parks to control water quality within the plan area (see Appendix 6). The Ministry authorizes discharges by issuing permits and approvals which specify and control the amount of contaminant, location and method of discharge to minimize impact on the water resources. Permit and approval holders are required to monitor their effluent discharge.

11.4 Outlook For Water Resources

As population within the plan area continues to grow the demand for water will inevitably continue to increase (although any local or regional demand management efforts would be a mitigating influence). As noted in the Okanagan Basin Water Study there is an overall limit to the availability of the water. As well, natural disasters and human-caused global environmental changes (e.g. global climate change) can have a dramatic impact on water supplies by altering precipitation patterns, streamflow and runoff/drainage patterns. However, predicting the impacts of these phenomena is beyond the scope of this report.

Water quality in main stem lakes throughout the plan area is generally good with the exception of Osoyoos, Ellison, Armstrong Arm of Okanagan Lake and Tappen Bay on Shuswap Lake. As well, the phosphorus loading levels in Kalamalka Lake are increasing. Water quality in upland tributaries is varied. Implementation of improved forestry practices will reduce impacts such as erosion, sedimentation and nutrient loading. Complete implementation of the riparian guidelines and watershed management under the *Forest Practice Code* will further improve quality and quantity. Implementation of restoration projects under the WRP (Watershed Restoration Program) or Channel Assessment Program under FRBC will also improve water quality for domestic use, fish, aquatic values, and for the water resource overall. Identification and designation of 'other watersheds and drainages' - those that have value for fish or for domestic water use or those that have sensitive stream channels or upland terrain, will also assist in improving water quality in the plan area. At this time only a portion of the watersheds are being monitored and water quality objectives for forestry related activities are only available for about 5% of the area's community watersheds.

Crown land and resource management can impact streamflow and runoff/drainage patterns. Crown land and resource management, in conjunction with private land management for increasing urbanization, human population growth and uncontrolled stormwater discharges have the potential to create impact on the quantity and quality of the water in the area, including recharge

areas for groundwater. The outlook for water correlates closely with the outlook for fisheries and aquatic land values. Thus, there is an ongoing need to augment the identified gaps in available water resource information and measure any impacts from changing Crown land resource management.

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APPENDIX 1

POPULATION TABLES

	Area Type	Census Population 1996	Boundary Adjusted Population 1991**	Ave. Annual Growth	Population/ Square km 1996
BRITISH COLUMBIA		3724500	3282061	2.7%	4.2
Central Okanagan	RD	136541	111846	4.4%	45.4
Kelowna	C	89442	75953	3.6%	420.7
Lake Country	DM	9007	7622	3.6%	74.1
Peachland	DM	4524	3459	6.2%	282.8
Subdivision A	SRD	3446	2468	7.9%	2.7
Subdivision B	SRD	22901	17770	5.8%	16.9
Indian Reserves	R	7221	4574	11.6%	707.9
Columbia-Shuswap	RD	48116	41665	3.1%	1.6
Salmon Arm	DM	14664	12115	4.2%	96.2
Sicamous	DM	2827	2501	2.6%	215.8
Subdivision C	SRD	13857	11017	5.2%	2.4
Indian Reserves**	R	793	811	-0.4%	10.8
North Okanagan	RD	71607	61744	3.2%	9.1
Armstrong	C	3906	3200	4.4%	737
Coldstream	DM	8975	7999	2.4%	124.5
Enderby	C	2754	2128	5.9%	706.2
Lumby	VL	1689	1265	6.7%	331.2
Spallumcheen	DM	5322	4717	2.6%	20.1
Vernon	C	31817	27722	3.0%	423.7
Subdivision A	SRD	3997	3318	4.1%	1.9
Subdivision B	SRD	11017	9880	2.3%	2.1
Indian Reserves	R	2130	1515	8.1%	18.7
Okanagan-Similkameen*	RD	75933	66701	2.8%	7.3
Oliver	T	4285	3743	2.9%	857
Osoyoos	T	4021	3557	2.6%	441.9
Penticton	C	30987	27258	2.7%	759.5
Summerland	DM	10584	9253	2.9%	153.6
Subdivision A	SRD	9216	7657	4.1%	4.5
Subdivision B	SRD	9051	8094	2.4%	2.9
Indian Reserves**	R	1743	1638	1.3%	5

* Region contains incompletely enumerated Indian Reserves.

**Some of these Reserve populations may lie outside the plan area.

** 1991 Census population counts are adjusted as necessary to enable direct comparisons between 1991 and 1996.

Appendix 2.

Ecosections in the Okanagan-Shuswap LRMP Area

Central Columbia Mountains (CCM)

- area of high ridges and mountains, with narrow valleys and trenches
- precipitation is high from the valley bottoms to the upper slopes
- AT, ESSF, and ICH biogeoclimatic zones
- supports mountain goat, grizzly bear, and a population of caribou at Greenbush Lake
- primarily undeveloped but some forest harvesting, and most valleys have road access.

Northern Kootenay Mountains (NKM) (old Northern Columbia Mountains)

- area of high, rugged mountains, many ice-capped
- highest precipitation and coldest temperatures
- AT, ESSF, and ICH biogeoclimatic zones
- primarily undeveloped, but Highway 1 runs close to NKM/CCM boundary.

Shuswap Highland (SHH)

- highland area intermediate between the plateaus to the west and the high, rugged mountains to the east
- Climate is warmer and winters are milder than the ecosection to the north
- AT, ESSF, and ICH biogeoclimatic zones
- supports deer, mountain goat and grizzly bear
- significant forest harvesting and associated road networks
- contains part of Shuswap Lake.

Selkirk Foothills (SFH)

- a transitional mountain area between the rolling Okanagan Highlands to the west and the rugged portion of the Selkirk Mountains to the east
- includes the east side of the upper Kettle River watershed
- AT, ESSF, and ICH biogeoclimatic zones
- supports mountain goat, grizzly bear, moose
- significant forest harvesting
- abuts Granby Provincial Park potential buffer zone recommended by Kootenay CORE.

Southern Okanagan Basin (SOB)

- wide trench located between the Okanagan Ranges Ecosection to the west and the Southern Okanagan Highlands to the east
- has some of the hottest and driest climates in the province
- BG, IDF, PP biogeoclimatic zones
- much of valley bottom privately owned, both urban and agricultural - mainly orchards, some cattle ranching
- one of the major California bighorn sheep herds in the province at Vaseux Lake
- deer and elk winter range
- contains several medium-sized lakes - Skaha, Osoyoos, Vaseux

- provides habitat for the largest number of endangered species in BC

Southern Okanagan Highland (SOH)

- hot, dry transitional mountain area of low rounded ridges and narrow valleys
- very small section south of Highway 3 to the U.S. border
- cattle grazing between Osoyoos and Rock Creek
- IDF biogeoclimatic zone
- supports Red-listed species in sagebrush grasslands and ponderosa pine.

Okanagan Range (OKR)

- the northern extent of an ecoregion which extends along the east slope of the Cascade Range from the Columbia River
- high, rugged mountains and deep, dry valleys
- dry Douglas-fir, ponderosa and lodgepole pine forest highlands
- eastern sides of valleys are in Bunchgrass and Ponderosa Pine zones
- some forest harvesting
- Cathedral Provincial Park composes significant part of area
- Similkameen valley bottom similar to Okanagan Basin - red-listed species and significant cottonwood stands
- AT, BG, ESSF, IDF, MS, PP biogeoclimatic zones
- habitat for mountain goat in the lower Similkameen, winter range for California bighorn sheep and deer.

Northern Okanagan Basin (NOB)

- wide trench located between the Thompson Plateau to the west and the Northern Okanagan Highlands to the east
- large lakes dominate the valley bottom
- Bunchgrass zone is predominant on the lower valley slopes
- BG, IDF, PP biogeoclimatic zones
- heavy urbanization, large part of the valley bottom is privately owned and developed
- agriculture primarily orchards and vineyards, plus cattle wintering areas
- deer winter range
- includes Okanagan Lake, the largest lake in the Planning Area.

Northern Okanagan Highland (NOH)

- cool, moist, transitional mountain area, dominated by a rolling upland
- AT, ESSF, ICH, IDF, MS, PP biogeoclimatic zones
- significant forest activity and associated road networks
- includes Silver Star and Okanagan Mountain Provincial parks
- mountain goat in the Penticton Creek area, good moose winter range, and summer deer and elk range
- includes many small lakes stocked with trout.

Northern Thompson Upland (NTU)

- area with dissected uplands
- climate is transitional between the drier and warmer climates farther south and moister and cooler climates to the north
- warm, dry summers and mild winters with relatively high snowfall

- includes part of Shuswap Lake
- ESSF, ICH, IDF, MS biogeoclimatic zones
- significant private land ownership (including Salmon Arm), agricultural activity mainly cattle ranching with some orchards, some forestry
- important deer winter range along Shuswap Lake and associated valleys.

Southern Thompson Upland (STU)

- area with lodgepole pine plateau uplands, steep-sided plateau walls, and two large lowlands, similar to NOH ecosection
- driest climate of any plateau upland in this Ecoregion
- significant forest harvesting and road access
- has two large big sage grassland areas
- ESSF, ICH, IDF, MS biogeoclimatic zones
- includes Short's Creek California bighorn sheep range
- many small lakes with trout populations.

The LRMP area also contains an extremely small section of the Thompson Basin (THB) ecosection near Chase.

APPENDIX 3: Summary of ecosections, biogeoclimatic zones and primary habitat units in the plan area.

Ecosections	Biogeoclimatic Zones	¹ Habitat Units
CCM	AT ESSFwc2 ESSFwc4 ESSFwcp ICHmw2 ICHvk1 ICHwk1	AT, AU, AU _n , AU _s , GL, RO AV _s , EF _n , EF _s , RO _s AV _n , AV _s , EF, EF _n , EF _s , EF _u , LS, RO _n , RO _s AV, FP, RO, SM, WP IS, IS _s AV _s , IS, IS _n , IS _s , LS AV _s , IH _s , IS, IS _n , IS _s , RO _s
NKM	AT ESSFvc ESSFvcp ESSFwc2 ICHvk1 ICHwk1	AM, AT, AU, AU _s , GL AV _n , AV _s , EW, EW _m , EW _n , EW _s , RO _s , SM, WP EW _n , RO _s , SM, WP AV _n , EF, EF _n , EF _s , EW _n AV _n , AV _s , IS _m , IS _n , IS _s , IS, RR, WL AV _s , IS, IS _m , IS _n , IS _s
SHH	AT ESSFdc2 ESSFvc ESSFvcp ESSFwc2 ESSFwc4 ESSFwcp ICHmk2 ICHmw2 ICHmw3 ICHvk1 ICHwk1c ICHwk1 ICHwk ICH1 IDFmw1 MSdm2	AT, AU, AU _n , AU _s , GL EF EW/ _m , EW _n , EW, WL FP, SM, WP AV _s , EF _m , EF _n , EF _s , EF _t , EF, FP, RO _n , RO, SM, WL AV _n , AV _s , EF _n , EF _s , EF FP, SM RB, RB _s CF, DL _s , DL _t , IH, IH _n , IS, IS _n , IS _s , LL, LS, RO _s , RR, UR, WL CF, DL _s , IH, IS, IS _m , IS _n , IS _s , LL, RR IS, IS _m , IS _n , IS _s , RR IS _m AV _s , DL _s , IH, IH _m , IH _n , IH _s , IH _t , IS, IS _m , IS _n , IS _s , LS, WL IH IH _n RB SF
SFH	AT ESSFwc2 ESSFwc4 ESSFwcp ICHmk1 ICHmw2	AG, AM EF _s EF, EF _n , EF _s , EF _u , WL FP, SM IS _n , IS, LS, RB, RB _n IH, IS, IS _n , IS _s , RB _n , RB
SOB	BGxh1 IDF _{xh} 1 PPxh1	AB, BS, CF, LL, PP _s , PP, SS _s , SS, UR BS, DP, DP _c , DP _s , DP _t , SS _s , SS AB, BS, BS _s , BSt, DP _n , PP, PP _c , PP _s , PPt, RO _c , RO _s , RO, SS, SS _s
SOH	IDF _{dm} 1 IDF _{xh} 1a IDF _{xh} 1	CF BS, CF, DP _t CF, DL _c , DL, DP, DP _n , DP _t , RO
OKR	AT BGxh1	AT, AU CF, CR, PP, RO, SS, SS _n , SS _s

	ESSFdc2 ESSFdcp ESSFxc ESSFxcp IDFdk1b IDFdk1 IDFdk2 IDFdk IDFxh1a IDFxh1b IDFxh1 MSdm2 MSxk PPdk1 PPxh1a PPxh1	EF FP AVs, EF, EFn, EFs, EFt, RO, SM FP DFs, DLs, ROs BS, DFs, DFt, DL, DLn, DLs, DPn, RO, ROs, SSn, SSs, SS DL, DLn, DLs ROs SS DPn, DPs, DP, ROs BSn, CF, DL, DP, DPn, DPs, PPn, PPs, RO, ROs, SS, SSn, SSs DL, DLs, DLt, SD, SDn, SF, SFn DLs, DLt, RO, SDn, SDs, SD, SM, SSs, SS DL SSs BSn, CF, PPn, PPs, PP, ROs, RO, SSs, SS
NOB	BGxh1 IDFdk1 IDFdm1 IDFmw1 IDFxh1a IDFxh1 PPxh1	BS, CF, LL, PP, PPs, ROs, SS, UR DL DPt CF, RB, UR BS, BSn, BSt, CF, DP, LL, LS, PPc, UR, BSs, BSt, BS, CF, DPc, DPn, DPs, DPt, DP, LL, PPs, PPt, ROn,RO, SS, UR, WR BSn, BS, CF, DPm, DPn, LL, LS, PP, PPn, PPs, ROn, ROs, SS, SSs, UR, WR
NOH	AT ESSFdc1 ESSFdc2 ESSFdcp ESSFxc ICHmk1 ICHmw2 IDFdm1 IDFmw1 IDFxh1a IDFxh1 MSdm1 MSdm2 PPxh1	AG, AM, AH EF, EFm, Efn ,EFs, EFu, LS, WL EF FP, LS, SM EFm, EFu, EF, WL IHn, IHs, IH, IS, RBn, RBs, RB, ROn IHn, IH, ISn, IS, RB DFs, DFt, DLc, DLn, DLs, DL, DPn, DPs, DPt, DP, RO, SS CF, DFs, DFt, DF, DL, LS, RBm, RBn, RB, ROs, RO, RR BS, BSt, CF, DP CF, DPn, DPs, DPt, DP DLt, LS, SFm, SFn, SFs, SFu, SF, WL LS, SFs, SF BSs, PPs
NTU	ESSFdc2 ICHmk1 ICHmk2 ICHmw2 ICHmw3 IDFdk1 IDFmw1 IDFmw2 IDFxh1 IDFxh2 MSdm2	EF, EFn, EFt, LS CF, RBc, RBn, RBs, RBt, RB IH, RB CF, IH IHn, IS DL CF, DFs, RB, UR CF, DFs, DFt, LL, RB, RBn, RBs, WR CF, DP, DPc, DPn, BS, CF, DP, DPc, DPn, DPs, LL, WR DLs, DLt, SF, SFn, SFs
STU	ESSFdc2 ESSFxc ESSFxcp ICHmk1	EFm, EFs, EFt, EF EF, EFm, ERm FP RB

	ICHmk2 IDFdk1a IDFdk1 IDFdk2 IDFmw1 IDFmw2 IDFhx1 IDFhx2a IDFhx2 MSdm2 MSxk	Rbn, RBs, RBt, RB BS, DL DFs, DFt, DLc, DLn, DLt, DL, LS, SDm DFs, DFt, DL, DLc, DLn, DLt, DP, WR BS, DFs, DFt, RB, Rbn, RBs, ROs RB, Rbn BSs, BS, DLn, DP CF BS, CF, DPc, DPn, DPs, DPt, DP, LS, PP DLt, DL, MI, SFm, SFn, SF LL, LS, SDm, SDn, SD
THB	IDFhx1a PPxh2	PP, SS BSt, CF, PPf, SS

Biogeoclimatic Subzone Symbol	Name
AT	Alpine Tundra
BGxh1	Bunchgrass very dry, hot (Okanagan)
ESSFdc1	Engelmann Spruce-Subalpine Fir dry, cold (Okanagan)
ESSFdc2	Engelmann Spruce-Subalpine Fir dry, cold (Thompson)
ESSFdcp	Engelmann Spruce-Subalpine Fir dry, cold parkland
ESSFvc	Engelmann Spruce-Subalpine Fir very wet, cold
ESSFvcp	Engelmann Spruce-Subalpine Fir very wet, cold parkland
ESSFwc1	Engelmann Spruce-Subalpine Fir wet, cold (Selkirk)
ESSFwc2	Engelmann Spruce-Subalpine Fir wet, cold (Northern Monashee)
ESSFwc4	Engelmann Spruce-Subalpine Fir wet, cold
ESSFwcp	Engelmann Spruce-Subalpine Fir wet, cold parkland
ESSFxc	Engelmann Spruce-Subalpine Fir very dry, cold
ESSFxcp	Engelmann Spruce-Subalpine Fir very dry, cold parkland
ICHmk1	Interior Cedar-Hemlock moist, cool (Kootenay)
ICHmk2	Interior Cedar-Hemlock moist, cool (Thompson)
ICHmw2	Interior Cedar-Hemlock moist, warm (Shuswap)
ICHmw3	Interior Cedar-Hemlock moist, warm (Thompson)
ICHvk1	Interior Cedar-Hemlock very wet, cool (Mica)
ICHwk	Interior Cedar-Hemlock wet cool
ICHwk1	Interior Cedar-Hemlock wet cool (Wells Gray)
ICHwk1c	Interior Cedar-Hemlock wet cool (cold air drainage)
IDFdk	Interior Douglas-Fir dry, cool
IDFdk1	Interior Douglas-Fir dry, cool (Okanagan)
IDFdk1a	Interior Douglas-Fir dry, cool (Okanagan Grassland Phase)
IDFdk1b	Interior Douglas-Fir dry, cool (Okanagan, extensive southern exposure)
IDFdk2	Interior Douglas-Fir dry, cool (Cascade)
IDFdm1	Interior Douglas-Fir dry, mild (Kettle)
IDFmw1	Interior Douglas-Fir moist, warm (Okanagan)
IDFmw2	Interior Douglas-Fir moist, warm (Columbia-Shuswap)
IDFhx1	Interior Douglas-Fir very dry, hot (Okanagan)
IDFhx1a	Interior Douglas-Fir very dry, hot (Okanagan Grassland Phase)
IDFhx1b	Interior Douglas-Fir very dry, hot (Okanagan extensive southern exposure)
IDFhx2	Interior Douglas-Fir very dry, hot (Thompson)
IDFhx2a	Interior Douglas-Fir very dry, hot (Thompson Grassland Phase)
MSdm1	Montane Spruce dry, mild (Okanagan)
MSdm2	Montane Spruce dry, mild (Thompson)

MSxk	Montane Spruce very dry, cool
PPxh1	Ponderosa Pine very dry, hot (Okanagan)
PPxh1a	Ponderosa Pine very dry, hot (Okanagan Grassland Phase)
PPxh2	Ponderosa Pine very dry, hot (Thompson)
PPdk1	Ponderosa Pine dry, cool (Thompson)

Habitat Unit Descriptions:

<i>Habitat Class</i>	<i>Habitat name</i>	<i>Description</i>
AB	Antelope-brush shrub/grassland	Typically an open to dense dry shrubland, dominated by drought tolerant shrubs, dominated by antelope brush and perennial grasses, and generally lacking trees.
AG	Alpine Grassland	Typically a high elevation, northern, grassland habitat, characterized by lush bunchgrass growth, with forbs, sedges and terrestrial lichens
AH	Alpine Heath	Typically a high elevation dwarf shrubland habitat characterized by cold resistant vegetation, consisting of mountain-heathers, forbs, graminoids, and lichen.
AM	Alpine Meadow	Typically a high elevation, herbaceous community, dominated by moisture-loving herbs and sedges, on wetter sites in alpine areas
AT	Alpine Tundra	Typically a high elevation, open to dense herbaceous or dwarf shrubland habitat, characterized by cold resistant vegetation consisting of low dwarf shrubs, graminoids, hardy forbs, and lichens
AU	Alpine Unvegetated	Typically a high elevation habitat dominated by rock outcrops, talus, steep cliffs and other areas with sparse vegetation of grass, lichens
AV	Avalanche Track	Typically a shrubland dominated by alders, or other shrubs where periodic snow and rock slides have prevented coniferous forest establishment and where moisture is plentiful for much of the growing season; lower areas may support rich herbaceous growth
BS	Bunchgrass Grassland	Typically a dense herbaceous habitat dominated by perennial grasses and forbs, generally lacking shrub or trees.
CF	Cultivated Field	Typically a mixture of farmlands where man's influence has resulted in long-term soil and/or vegetation changes because of agricultural practices of plowing fertilization, and non-native crop production
CR	Black Cottonwood Riparian	Typically a dense mixed forest with shrub dominated understories, that includes plant communities that progress through varying mixture of shrubs and black cottonwood.
DF	Interior Douglas-fir	Typically a dense coniferous forest, with grass-dominated understories, that includes plant communities that progress directly to a Douglas-fir climax
DL	Douglas-fir - Lodgepole Pine	Typically a dense coniferous forest, with shrub or pinegrass dominated understories, that includes plant communities that progress through a mixture of lodgepole pine and Douglas-fir or trembling aspect to a Douglas-fir climax.
DP	Douglas-fir - Ponderosa Pine	Typically an open to dense coniferous forest, with shrub or bunchgrass dominated understories that includes plant communities that progress through a mixture of Douglas-fir and ponderosa pine to a Douglas-fir climax.
EF	Engelmann Spruce - Subalpine Fir Dry	Typically a dense coniferous forest, with shrub-dominated understories, that includes plant communities that may progress through seral lodgepole pine

	Forested	to a varied climax of Engelmann spruce and subalpine fir.
ER	Engelmann Spruce Riparian	Typically a dense coniferous forest, with shrub and forb dominated understories, found on floodplains or small riparian areas, with Engelmann spruce and sometimes black cottonwood.
EW	Engelmann Spruce - Subalpine Fir Wet Forested	Typically a dense coniferous forest, with shrub-dominated understories, that includes plant communities that progress directly to a mixed climax of Engelmann spruce, subalpine fir, and sometimes, mountain hemlock
FP	Engelmann Spruce - Subalpine Fir Dry Parkland	Typically a high elevation mosaic of stunted-tree clumps and herb or dwarf shrub dominated openings, occurring above the closed forest and below the alpine
GL	Glacier	Typically a field or body of snow or ice formed in higher elevations in mountainous terrain where snowfall exceeds melting: these areas of snow and ice will show evidence of past or present glacier movements.
IH	Interior Western Hemlock - Douglas fir	Typically a dense coniferous forest, with various shrub and herb dominated understories, that includes plant communities that proceed through Douglas-fir, western larch, western white pine, and/or paper birch seral stages to a mixed climax of western hemlock and western red cedar
IS	Interior Western Hemlock - Subalpine Fir	Typically a dense coniferous forest with shrub and moss dominated understories, that include plant communities that may progress through seral subalpine fir, spruce and lodgepole pine to a climax of western hemlock and western red cedar
LL	Large Lakes	Typically a fresh deep water habitat that includes permanently flooded lakes, usually found in a topographic depression, lacking emergent vegetation except along shorelines, and usually with a size of greater than 60 hectares.
LS	Small Lake	Typically a fresh deep water habitat that includes permanently flooded lakes (and sometimes reservoirs), usually 8 to 60 ha in size in a topographic depression, with most of the water less than 7 m in depth
MI	Mine	Mine site (disturbance)
PP	Ponderosa Pine	Typically a sparse to open coniferous forest, with big sage or perennial grass dominated understories, that occur along the grassland-forest border, leading to a ponderosa pine and Douglas fir climax.
RB	Western red cedar - Paper Birch	Typically a deciduous, mixed dense or coniferous forest with shrub-dominated understories, that includes plant communities that succeed through deciduous seral stages or through Douglas-fir, lodgepole pine, and western larch (sometimes) to a climax of western red cedar and hybrid spruce.
RO	Rock	Typically a mixture of non alpine steep bedrock cliffs, escarpments and outcroppings with little soil development and relatively low vegetative cover
RR	Western red cedar - Black Cottonwood Riparian	Typically a dense coniferous forest, with shrub-dominated understories, that includes plant communities that may succeed either through deciduous seral species or directly to a climax of hybrid spruce, western red cedar and western hemlock.
SD	Spruce - Douglas-fir	Typically a dense coniferous forest, with soopolallie or pine grass dominated understories, that include plant communities that progress through a mixture of lodgepole pine, Douglas-fir and western larch to a white or hybrid spruce climax, often with subalpine fir.

SF	White Spruce - Subalpine Fir	Typically a dense, coniferous subboreal forest, with dense shrub-moss dominated understories, that include communities that progress directly to a white spruce and subalpine fir climax, sometimes with lodgepole pine or trembling aspen.
SM	Subalpine Meadow	Typically a high elevation herbaceous habitat, dominated by moisture-loving herbaceous species, on wetter sites in subalpine forest areas
SP	Slow Perennial Stream	Typically a freshwater ravine habitat contained within a channel that contains continuously-moving, slow-moving water, is bounded by banks or upland habitat, and has a low gradient; may include channels that form a connecting link between two bodies of standing water.
SS	Big Sage Shrub / grassland	Typically and open to dense, dry shrubland, dominated by drought tolerant shrubs and perennial grasses and generally lacking trees
UR	Urban	Typically a mixture of man-influenced habitats that includes residential areas, urban areas, and commercial / industrial areas, but excludes major agriculture lands
WL	Wetland	Used for any wetland habitat class which can not be recognized at small mapping scales.
WP	Engelmann Spruce - Subalpine Fir Wet Parkland	Typically a high-elevation mosaic of tree clumps and subalpine meadows or tundra, occurring above the closed forest and below the alpine.
WR	White Spruce - Black Cottonwood Riparian	Typically a dense deciduous, mixed, or coniferous forest, with shrub-dominated understories, found on or in association with fluvial sites, that includes plant communities that succeed slowly through black cottonwood to potential white spruce climax

APPENDIX 4:

Summary of ecosections and biogeoclimatic zones within the Plan Area

ECOSECTION	BGC SUBZONE	HECTARES	% OF PROVINCE in PLAN AREA	% OF LRMP AREA
	ATp	11	0.5	0.00
CCM	ATp	35970	9.1	1.35
CCM	ESSFwc4	43796	10.8	1.65
CCM	ESSFwcp	501	100.0	0.02
CCM	ICHmw2	557	0.1	0.02
CCM	ICHvk1	8884	100.0	0.33
CCM	ICHwk1	18361	30.7	0.69
	ESSFxc	52	100.0	0.00
	MSxk	9	100.0	0.00
NKM	ATp	48738	6.9	1.84
NKM	ESSFvc	52570	17.8	1.98
NKM	ESSFvcp	2617	100.0	0.10
NKM	ESSFwc2	2109	2.4	0.08
NKM	ICHvk1	15254	11.8	0.57
NKM	ICHwk1	9671	4.9	0.36
NOB	BGxh1	18798	100.0	0.71
NOB	IDFdk1	1848	100.0	0.07
NOB	IDFmw1	4018	100.0	0.15
NOB	IDFxh1	105688	100.0	3.98
NOB	IDFxh1a	40289	100.0	1.52
NOB	PPxh1	74923	100.0	2.82
NOB	PPxh1a	1340	100.0	0.05
NOH	ATp	5385	100.0	0.2
NOH	ESSFdc2	5709	100.0	0.22
NOH	ESSFdcp	1700	100.0	0.06
NOH	ESSFxc	40233	100.0	1.52
NOH	ICHmk1	90668	62.2	3.42
NOH	ICHmw2	3286	100.0	0.12
NOH	IDFdm1	47442	30.1	1.79
NOH	IDFmw1	87088	100.0	3.28
NOH	IDFxh1	11702	82.6	0.44
NOH	IDFxh1a	644	100.0	0.24
NOH	MSdm1	140478	56.7	5.29

NOH	PPxh1	368	100.0	0.01
NTU	ESSFdc2	18557	15.5	0.70
NTU	ICHmk2	7335	18.3	0.28
NTU	ICHmw2	9416	100.0	0.35
NTU	ICHmw3	1155	3.2	0.04
NTU	IDFdk1	518	0.8	0.02
NTU	IDFdk2	20761	33.6	0.78
NTU	IDFmw1	21595	100.0	0.81
NTU	IDFmw2	83701	50.5	3.15
NTU	IDFxh1	1184	100.0	0.04
NTU	IDFxh2	11978	20.4	0.45
NTU	MSdm2	21775	20.3	0.82
OKR		103	45.6	0.00
OKR	ATp	15056	94.7	0.57
OKR	BGxh1	12110	100.0	0.46
OKR	ESSFdc2	2801	13.2	0.11
OKR	ESSFxc	52262	91.0	1.97
OKR	ESSFxcp	1592	100.0	0.06
OKR	IDFdk1	27023	90.1	1.02
OKR	IDFdk1b	4263	100.0	0.16
OKR	IDFdk2	3346	19.8	0.13
OKR	IDFxh1	33206	96.7	1.25
OKR	IDFxh1a	583	88.0	0.02
OKR	IDFxh1b	2215	94.9	0.08
OKR	MSdm2	6546	28.0	0.25
OKR	MSxk	31993	96.2	1.21
OKR	PPxh1	4864	100.0	0.18
OKR	PPxh1a	252	100.0	0.01
SFH	ATp	1861	7.7	0.07
SFH	ESSFwc4	31337	20.9	1.18
SFH	ICHmk1	5162	11.5	0.19
SFH	ICHmw2	6657	2.4	0.25
SHH	ATp	38980	72.8	1.47
SHH	ESSFdc2	3886	100.0	0.15
SHH	ESSFvc	16810	86.6	0.63
SHH	ESSFvcp	97	100.0	0.00
SHH	ESSFwc2	163820	37.5	6.17
SHH	ESSFwc4	19619	100.0	0.74
SHH	ESSFwcp	10222	60.7	0.39
SHH	ICHmk1	2722	100.0	0.10
SHH	ICHmk2	1650	13.1	0.06
SHH	ICHmw2	206495	100.0	7.78

SHH	ICHmw3	107553	26.7	4.05
SHH	ICHvk1	5627	80.2	0.21
SHH	ICHwk1	89906	50.8	3.39
SHH	ICHwk1c	598	100.0	0.02
SOB		11	100.0	0.00
SOB	BGxh1	31004	100.0	1.17
SOB	IDFxh1	14689	100.0	0.55
SOB	PPxh1	30135	100.0	1.14
SOB	PPxh1a	2898	100.0	0.11
SOH		4	15.4	0.00
SOH	IDFdm1	1178	8.5	0.04
SOH	IDFxh1	4940	21.7	0.19
SOH	IDFxh1a	578	100.0	0.02
STU	ESSFdc2	25885	37.1	0.98
STU	ESSFxc	54144	71.7	2.04
STU	ESSFxcp	2300	85.8	0.09
STU	ICHmk1	2377	100.0	0.09
STU	ICHmk2	8402	100.0	0.32
STU	IDFdk1	36083	10.1	1.36
STU	IDFdk1a	2017	5.8	0.08
STU	IDFdk2	67846	35.0	2.56
STU	IDFmw1	27401	100.0	1.03
STU	IDFxh1	3956	10.5	0.15
STU	IDFxh2	15364	21.0	0.58
STU	IDFxh2a	3736	8.4	0.14
STU	MSdm2	112763	52.9	4.25
STU	MSxk	64320	22.0	2.42
THB	BGxw1	86	0.2	0.00
THB	IDFxh1a	1677	86.3	0.06
THB	PPxh2	2093	3.1	0.08

APPENDIX 5:

Red and Blue-listed Wildlife and Plant Species and Communities in the Plan Area

Red-listed Wildlife Species in the Plan Area

COMMON NAME	SCIENTIFIC NAME
American Peregrine Falcon	Falco peregrinus anatum
Burrowing Owl	Speotyto cunicularia
Ferruginous Hawk	Buteo regalis
Grasshopper Sparrow	Ammodramus savannarum
Leopard Frog	Rana pipiens
Night Snake	Hypsiglena torquata
Northern Long-eared Myotis	Myotis septentrionalis
Northern Bog Lemming	Synaptomys borealis artemisiae
Pallid Bat	Antrozous pallidus
Prairie Falcon	Falco mexicanus
Sage Grouse	Centrocercus urophasianus
Sage Thrasher	Oreoscoptes montanus
Sagebrush Brewer's Sparrow	Spizella breweri breweri
Sharp-tail Snake	Contia tenuis
Short-horned Lizard	Phrynosoma douglasi
Tiger Salamander	Ambystoma tigrinum
Umatilla Dace	Rhinichthys umatilla
Western Red Bat	Lasiurus blossevillii
Western Grebe	Aechmophorus occidentalis
White Sturgeon	Acipenser transmontanus
White-headed Woodpecker	Picoides albolarvatus
White-tailed Jackrabbit	Lepus townsendii
Yellow-breasted Chat	Icteria virens

Blue-listed Wildlife Species in the Plan Area

COMMON NAME	SCIENTIFIC NAME
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American Avocet			<i>Recurvirostra americana</i>
American Bittern			<i>Botaurus lentiginosus</i>
Badger			<i>Taxidea taxus</i>
Bald Eagle			<i>Haliaeetus leucocephalus</i>
Barn Owl			<i>Tyto alba</i>
Black-chinned Hummingbird			<i>Archilochus alexandri</i>
Bobolink			<i>Dolichonyx oryzivorus</i>
Bull Trout			<i>Salvelinus confluentus</i>
California Gull			<i>Larus californicus</i>
California Bighorn Sheep			<i>Ovis canadensis californiana</i>
Canyon Wren			<i>Catherpes mexicanus</i>
Cascade Squirrel	Golden-mantled	Ground	<i>Spermophilus saturatus</i>
Chiselmouth			<i>Acrocheilus alutaceus</i>
Fisher			<i>Martes pennanti</i>
Flammulated Owl			<i>Otus flammeolus</i>
Fringed Myotis			<i>Myotis thysanodes</i>
Great Blue Heron			<i>Ardea herodias</i>
Great Basin Pocket Mouse			<i>Perognathus parvus</i>
Great Basin Gopher Snake			<i>Pituophis melanoleucus deserticola</i>
Great Basin Spadefoot Toad			<i>Scaphiopus intermontanus</i>
Grey Flycatcher			<i>Empidonax wrightii</i>
Grizzly Bear			<i>Ursus arctos</i>
Lark Sparrow			<i>Chondestes grammacus</i>
Lewis' Woodpecker			<i>Melanerpes lewis</i>
Long-billed Curlew			<i>Numenius americanus</i>
Mottled Sculpin			<i>Cottus bairdi</i>
Mountain Sucker			<i>Catostomus platyrhincus</i>
Mountain Beaver			<i>Aplodontia rufa rainieri</i>
Nuttall's Cottontail			<i>Sylvilagus nuttallii</i>
Painted Turtle			<i>Chrysemys picta</i>
Rocky Mountain Bighorn Sheep			<i>Ovis canadensis canadensis</i>
Rubber Boa			<i>Charina bottae</i>
Sandhill Crane			<i>Grus canadensis</i>
Sharp-tailed Grouse			<i>Tympanuchus phasianellus</i>
Short-eared Owl			<i>Asio flammeus</i>

Spotted Bat	<i>Euderma maculatum</i>
Swainson's Hawk	<i>Buteo swainsoni</i>
Tailed Frog	<i>Ascaphus truei</i>
Townsend's Big-eared Bat	<i>Plecotus townsendii</i>
Tundra Swan	<i>Cygnus columbianus</i>
Turkey Vulture	<i>Cathartes aura</i>
Western Harvest Mouse	<i>Reithrodontomys megalotis</i>
Western Screech-owl	<i>Otus kennicottii macfarlanei</i>
Western Small-footed Myotis	<i>Myotis ciliolabrum</i>
Western Rattlesnake	<i>Crotalus viridis</i>
Western Yellow-bellied Racer	<i>Coluber mormon</i>
White-throated Swift	<i>Aeronautes saxatalis</i>
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>
Wolverine	<i>Gulo gulo luscus</i>
Woodland Caribou	<i>Rangifer tarandus</i>

Red-Listed Vascular Plants in the Plan Area

COMMON NAME	SCIENTIFIC NAME
Andean Evening Primrose	Camissonia andina
Annual Paintbrush	Castilleja minor minor
Atkinson's Coreopsis	Coreopsis atkinsoniana
Awned Cyperus	Cyperus aristatus
Blue Vervain	Verbena hastata
Branched Phacelia	Phacelia ramosissima
Brown Beak-rush	Rhynchospora capillacea
Bushy Cinquefoil	Potentilla diversifolia perdissecta
Cockscomb Cryptantha	Cryptantha celosioides
Columbia Goldenweed	Pyrrocoma carthamoides carthamoides
Common Bluecup	Githopsis specularioides
Cup Clover	Trifolium cyathiferum
Dalles Milk-vetch	Astragalus sclerocarpus
Dark Lamb's-quarters	Chenopodium atrovirens
Ellisia	Ellisia nyctelea
False-Pimpernel	Lindernia dubia anagallidea
Fendler's Cryptantha	Cryptantha fendleri
Flat-topped Broomrape	Orobanche corymbosa
Freckled Milk-vetch	Astragalus lentiginosus
Geyer's Onion	Allium geyeri tenerum
Giant Helleborine	Epipactis gigantea
Hairgrass Dropseed	Sporobolus airoides
Hairstem Groundsmoke	Gayophytum ramosissimum
Hairy Umbrellawort	Mirabilis hirsuta
Hairy Water-clover	Marsilea vestita
Howell's Quillwort	Isoetes howellii
Hutchinsia	Hutchinsia procumbens
Little Fescue	Festuca minutiflora
Loesel's Liparis	Liparis loeselii
Long-leaved Mugwort	Artemesia longifolia
Lyall's Mariposa Lily	Calochortus lyalli
Mosquito Fern	Azolla mexicana
Mousetail	Myosurus apetalus borealis
Munroe's Globe-Mallow	Sphaeralcea munroana

Narrow-leaved Goosefoot	<i>Chenopodium leptophyllum oblongifolium</i>
Needle-leaved Navarretia	<i>Navarretia intertexta</i>
Nettle-leaved Giant-Hyssop	<i>Agastache urticifolia</i>
Northern Linanthus	<i>Linanthus septentrionalis</i>
Northern Coleanthus	<i>Coleanthus subtilis</i>
Northern Gooseberry	<i>Ribes oxyacanthoides cognatum</i>
Obscure Cryptantha	<i>Cryptantha ambigua</i>
Palish Paintbrush	<i>Castilleja pallescens</i>
Peach-leaf Willow	<i>Salix amygdaloides</i>
Porcupine-grass	<i>Stipa spartea</i>
Poverty-weed	<i>Iva axillaris robustior</i>
Prairie Pepper-grass	<i>Lepidium densiflorum pubicarpum</i>
Purple Spike-rush	<i>Eleocharis atropurpurea</i>
Red-rooted Cyperus	<i>Cyperus erythrorhizos</i>
Rigid Fiddleneck	<i>Amsinckia retrorsa</i>
Scarlet Globe-Mallow	<i>Sphaeralcea coccinea</i>
Scarlet Ammannia	<i>Ammannia coccinea</i>
Scarlet Gaura	<i>Garua coccinea</i>
Showy Phlox	<i>Phlox speciosa</i>
Shy Gilia	<i>Gilia sinuata</i>
Sierra Cryptantha	<i>Cryptantha nubigena</i>
Slender Hawksbeard	<i>Crepsis atrabarba atrabarba</i>
Slim Larkspur	<i>Delphinium depauperatum</i>
Small-flowered Lipocarpha	<i>Lipocarpha micrantha</i>
Small-flowered Ipomopsis	<i>Ipomopsis minutiflora</i>
Spalding's Milk-vetch	<i>Astragalus spaldingii spaldingii</i>
Strict Buckwheat	<i>Erigonum strictum proliferum</i>
Sulphur Lupine	<i>Lupinus sulphureus subsaccatus</i>
Supine Bullrush	<i>Scirpus supinus saximontanus</i>
Toothcup Meadow-foam	<i>Rotala ramosior</i>
Tufted Lovegrass	<i>Eragrostis pectinacea</i>
Two-spiked Moonwort	<i>Botrychium paradoxum</i>
Watson's Cryptantha	<i>Cryptantha watsonii</i>
Western Stickseed	<i>Lappula redowskii cupulata</i>
Western Centaury	<i>Centaurium exaltatum</i>
Whited's Halimolobos	<i>Halimolobos whitedii</i>

Winged Combseed	Pectocarya penicillata
Wyeth's Lupine	Lupinus wyethii
Yellow-flowered Knotweed	Polygonum ramosissimum
Yellowish Paintbrush	Castilleja lutescens

Blue-listed Plants in the Plan Area

COMMON NAME	SCIENTIFIC NAME
Alpine Buckwheat	Eriogonum pyrolifolium coryphaeum
Alpine Sorrel	Rumex paucifolius
American Sweetflag	Acorus americanus
Bearded Sedge	Carex comosa
Bigleaf Sedge	Carex amplifolia
Birdfoot Buttercup	Ranunculus pedatifidus
Blackened Sedge	Carex epapillosa
Blunt-sepaed Starwort	Stellaria obtusa
Booth's Willow	Salix boothii
Brandege's Lomatium	Lomatium brandegei
Brewer's Monkey-flower	Mimulus breweri
Chamomile Moonwort	Botrychium matricariifolium
Columbia River Locoweed	Oxytropis columbiana
Common Twinpod	Physaria didymocarpa didymocarpa
Crested Wood Fern	Dryopteris cristata
Cushion Fleabane	Erigeron poliosperus poliospermus
Diverse-leaved Cinquefoil	Potentilla diversifolia perdissecta
Dotted Smartweed	Polygonum punctatum
Drummond's Anemone	Anemone drummondii drummondii
Dry-land Sedge	Carex xerantica
Edible Valerian	Valeriana edulis edulis
Elegant Jacob's-ladder	Polemonium elegans
Engelmann's Knotweed	Polygonum engelmannii
False-mermaid	Floerkea proserpinacoides
Five-angled Dodder	Cuscuta pentagona
Fleabane	Erigeron leibergii
Fox Sedge	Carex vulpinoidea
Great Basin Nemophila	Nemophila breviflora

Greensheathed Sedge	Carex feta
Heterocodon	Heterocodon rariflorum
Holm's Rocky Mountain Sedge	Carex scopulorum bracteosa
Kellogg's Knotweed	Polygonum polygaloides kelloggii
Lance-fruited Draba	Draba lonchocarpa thompsonii
Little Fescue	Festuca minutiflora
Many-headed Sedge	Carex sychnocephala
Many-leaved Thelypody	Thelypodium laciniatum milleflorum
Marsh Muhly	Muhlenbergia glomerata
Montana Larkspur	Delphinium bicolor
Mosquito Fern	Azola mexicana
Mount Hood Pussypaws	Calyptridum umbellatum caudiciferum
Mountain Sneezeweed	Helenium autumnale grandiflorum
Northern Blue Violet	Viola septentrionalis
Nuttall's Waterweed	Elodea nuttallii
Nuttall's Draba	Draba densifolia
Okanogan Fameflower	Talinum sediforme
Oniongrass	Melica bulbosa
Orange Touch-me-not	Impatiens aurella
Porcupine Sedge	Carex hystericina
Prairie Gentian	Gentiana affinis
Regel's Rush	Juncus regelii
Rice Cutgrass	Leersia oryzoides
Richardson's Penstemon	Penstemon richardsonii richardsonii
River Bulrush	Scirpus fluviatilis
Rocky Mountain Sedge	Carex saximontana
Rusty Cliff Fern	Woodsia ilvensis
Short-fruited Smelowski	Smelowskia ovalis
Smooth Willowherb	Epilobium glaberrimum fastigiatum
Smooth Cliff Fern	Woodsia glabella
Snow Dewberry	Rubus nivalis
Spotted Touch-me-not	Impatiens capensis
Steer's Head	Dicentra uniflora
Swamp Onion	Allium validum
Tall Jacob's-ladder	Polemonium caeruleum amygdalinum
Thick-leaved Thelypody	Theolypodium laciniatum laciniatum

Threadstalk Milk-vetch	Astragalus filipes
Three-flowered Waterwort	Elatine rubella
Thyme-leaved Spurge	Euphorbia serpyllifolia
Tufted Fleabane	Erigeron caespitosus
Tweedy's Willow	Salix tweedyi
Western Burnet	Sanguisorba occidentalis
Western Goblin	Botrychium montanum
Western Dogbane	Apocynum medium
White Wintergreen	Pyrola elliptica
Yellow Marsh-Marigold	Caltha palustris asarifolia

Red-Listed Communities in the Plan Area

COMMON NAME	SCIENTIFIC NAME	MoF Site Unit
Antelope brush - Needle-and-thread grass	Purshia tridentata - Stipa comata	BGxh1/02
Big sage - bluebunch wheatgrass - balsamroot	Artemisia tridentata - Elymus spicatus - Balsamorhiza sagittata	IDFxb1a/92 PPxh1/03 IDFxb1a/94 IDFdm1/00
Big sage - bluebunch wheatgrass	Artemisia tridentata - Elymus spicatus	BGxh1/01 PPxh2/05 BGxh2/01 BGxw1/04
Black cottonwood - water birch	Populus balsamifera ssp trichocarpa - Betula occidentalis	BGxh1/07 PPxh2/07
Bluebunch wheatgrass - junegrass	Elymus spicatus - Koeleria	BGxh1/00 BGxw1/01 IDFdkla/92 IDFxb2a/00 MSxk/03 IDFxb2a/92 IDFdm1/02
Douglas-fir - water birch - Douglas maple	Pseudotsuga menziesii - Betula occidentalis - Acer glabrum	PPxh1/08
Fescue - bluebunch wheatgrass	Festuca idahoensis - Elymus spicatus	IDFdkla/91 IDFxb1a/91

Ponderosa pine - Nootka rose - poison ivy	Pinus ponderosa - Populus balsamifera ssp trichocarpa - Rhus radicans	BGxh1/06
Ponderosa pine - sumac	Pinus ponderosa - Rhus glabra	BGxh1/05
Spreading needlegrass	Stipa richardsonii	IDFdkla/93
Water birch - red-osier dogwood	Betula occidentalis - Cornus sericea	BGxh1/00

Blue-listed Communities in the Plan Area

COMMON NAME	SCIENTIFIC NAME	HABITAT* REQUIREMENT
Big sage - needle-and-thread grass	Artemisia tridentata - Stipa comata	BGxh1/01MS BGxh2/05
Bluebunch wheatgrass - balsamroot	Elymus spicatus - Balsamorhiza sagittata	IDFxb1a/93 PPxh1/00k
Douglas-fir - ponderosa pine - pinegrass - Idaho fescue	Pseudotsuga menziesii - Pinus ponderosa - Festuca idahoensis	IDFxb1/05
Douglas-fir - ponderosa pine - bluebunch wheatgrass - balsamroot	Pseudotsuga menziesii - Pinus ponderosa - Elymus spicatus	IDFxb1/02 IDFxb2/03 IDFxb1/03 IDFdm1/03 IDFdk2/02 IDFuu/00 IDFxb2/04 IDFxb2/02
Douglas-fir/ponderosa pine - snowberry - pinegrass	Pseudotsuga menziesii - Symphoricarpos albus - Calamagrostis rubescens	PPxh1/06
Douglas-fir - ponderosa pine - snowbrush - pinegrass	Pseudotsuga menziesii - Pinus ponderosa - Ceanothus velutinus	IDFxb1/04
Hybrid white spruce - gooseberry - sarsaparilla	Picea engelmannii x glauca - Ribes lacustre - Aralia nudicaulis	ICHmk1/05
Hybrid white spruce - falsebox - feathermoss	Picea engelmannii x glauca - Paxistima - Pleurozium	MSdm1/01 MSdm2/01
Hybrid white spruce/Douglas-fir - Douglas maple - dogwood	Pseudotsuga menziesii - Betula papyrifera - Acer glabrum	IDFxb1/08
Juniper - bunchgrass	Juniperus communis - Elymus spicatus	ESSFdc2/02 MSdm2/02
Lodgepole pine/western hemlock - velvet-leaved blueberry	Tsuga heterophylla - Vaccinium myrtilloides - Pachistima	ICHwk1/03

Lodgepole pine - pinegrass - kinnikinnick	Pinus contorta - Calamagrostis rubescens - Arctostaphylos	MSdm1/04
Ponderosa pine - bluebunch wheatgrass - rough fescue	Pinus ponderosa - Elymus spicatus - Festuca campestris	BGxw1/05 PPxh1/01 PPxh2/01 PPxh1/05
Ponderosa pine - bluebunch wheatgrass - Idaho fescue	Pinus ponderosa - Elymus spicatus - Festuca idahoensis	PPxh1/01
Ponderosa pine - red three-awn	Pinus ponderosa - Aristida longiseta	BGxh2/03 PPxh1/02 BGxh1/04
Prairie rose - Idaho fescue	Rosa woodsii - Festuca idahoensis	IDFxhla/97
Subalpine fir - rhododendron foamflower	Abies lasiocarpa - rhododendron - Tiarella	ESSFvv/01
Western redcedar/hybrid white spruce - devil's club - horsetail	Thuja plicata -Oplopanax horridus - Equisetum arvense	ICHvk1/05 ICHwk1/06
Western redcedar/hybrid white spruce oak fern - bunchberry	Thuja plicata - Gymnocarpium -Cornus canadensis	ICHmk2/05

APPENDIX 6:

Water Quality and Fisheries-related Acts, Regulations and Guidelines

There are several Acts and regulations which enables the Ministry of Environment, Lands and Parks to control water quality within the planning area. Key guidelines include:

- Urban Runoff Quality Control Guidelines for BC
- Land Development Guidelines for the Protection of Aquatic Habitat
- Code of Agricultural Practice for Waste Management
- Various Forest Practices Code Guidebooks
- Stream Stewardship - A guide for planners and developers
- Watershed Stewardship: A guide for agriculture.
- Guidelines to Protect, Maintain and Enhance Fish and Wildlife Habitat on and Adjacent to Proposed Golf Course Developments and Existing Course Redevelopment's on Lowland Areas

The Ministry authorizes discharges by issuing permits and approvals which specify and control the amount of contaminant, location and method of discharge to minimize impact on the water resources. Permit holders are required to monitor their effluent discharge.