10.

DISTRICT OF CHILLIWACK

Chilliwack Mountain Comprehensive Development Plan

Background Report

URBAN SYSTEMS

May
1995

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1. Introduction

1.1 Purpose

The District of Chilliwack has commissioned the preparation of a Comprehensive Development Plan for the Chilliwack Mountain area. A consulting team led by Urban Systems and with the support of ECL Envirowest Consultants and Thurber Engineering has been engaged to assist in the completion of a plan for Chilliwack Mountain.

The purpose of a comprehensive development plan for the area is to provide a context for the evaluation of development proposals through the preparation of a land use and servicing strategy for the plan area. The comprehensive development plan would be integrated into the Official Community Plan for the District.

The process to complete the plan includes the following three phases:

Phase 1	Technical analysis and background report
Phase 2	Preparation of a draft plan
Phase 3	Completion of a final plan

This background report provides a synthesis of the technical analysis undertaken in Phase 1 of the study. The report presents a summary of existing land use, physical characteristics, and servicing considerations for Chilliwack Mountain. This information forms the basis for the land use and servicing strategies to be developed in the draft plan in Phase 2.

1.2 Location

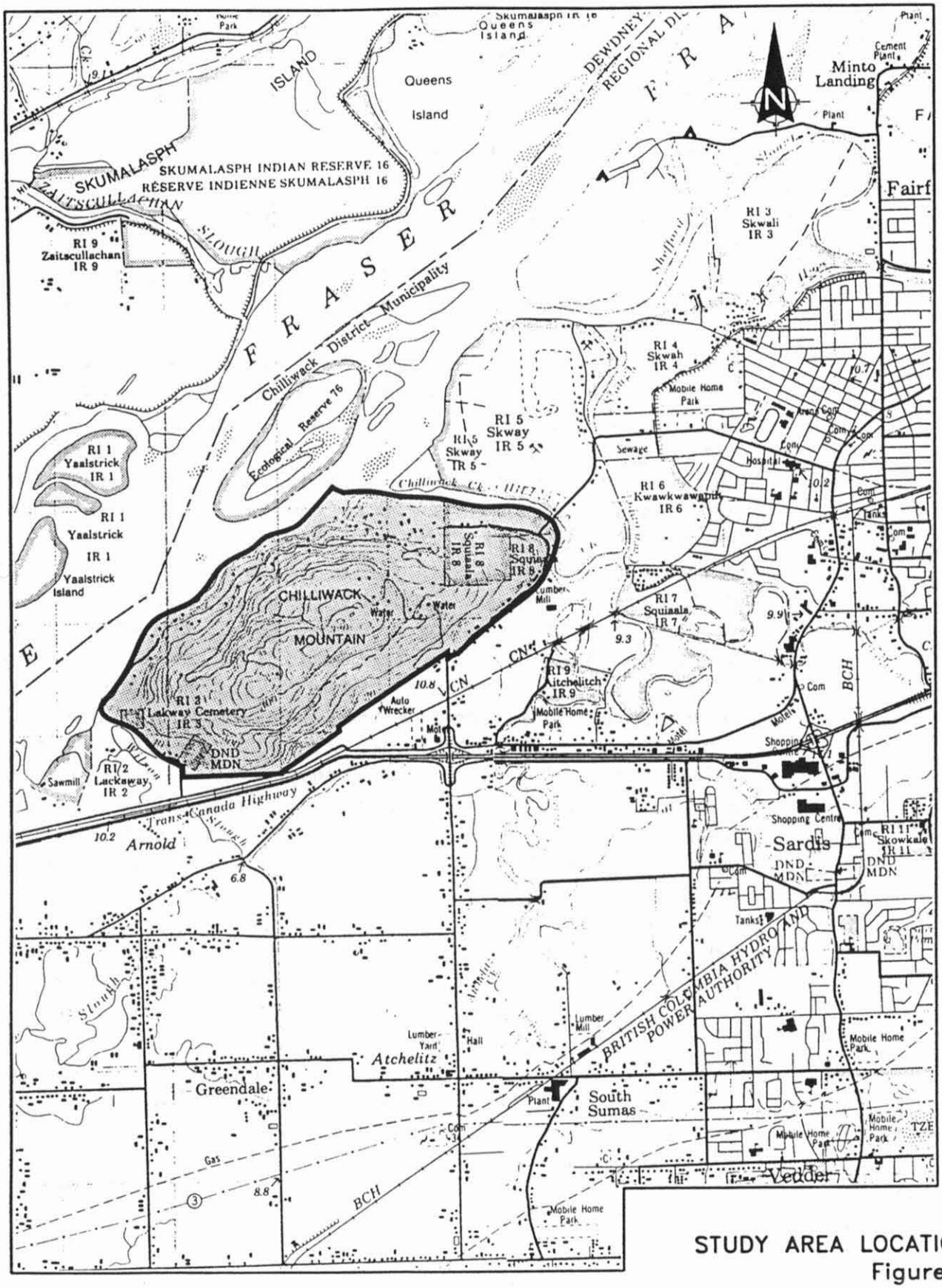
The Chilliwack Mountain study area is a height of land located in the northwest portion of the District of Chilliwack, approximately 4

kilometres west of Chilliwack's downtown core. The Chilliwack Mountain study area is shown on Figure 1.

Chilliwack Mountain comprises a land area of approximately 589 hectares (1,455 acres) situated on the south side of the Fraser River, and north of the level plains of the Fraser Valley floor.

The Trans-Canada Highway and a CN rail line bound the south side of the Chilliwack Mountain study area.

The area surrounding Chilliwack Mountain includes a mix of agricultural and industrial uses to the south and west of the mountain. There are a number of Indian Reserve lands to the east between Chilliwack Mountain and the urban area of Chilliwack Proper.



STUDY AREA LOCATION
Figure 1

2. Land Use Context

2.1 Existing Land Use

The existing land use in the Chilliwack Mountain study area may be described as predominantly rural in character. Land uses include a mix of residential subdivisions, rural residential properties, some limited agriculture, areas of vacant land, and two Indian Reserves. See Figure 2.

The existing residential land uses consist of single family dwellings contained in several subdivisions which vary in terms of average lot size and level of servicing. An urban small lot (approximately 1/3 acre) subdivision centred on Sunrise Drive (Sunrise Estates) at the east end of the study area is serviced by community water and sanitary sewer. The upper porion of this subdivision is not currently connected to sanitary sewer. South and west of this subdivision is a duplex development currently under construction. There are a number of larger lot subdivisions on Chilliwack Mountain which are serviced by community water only. These include a subdivision on Grandview Drive (Chilliwack Mountain Estates) at the centre of the mountain consisting of lots between 1 to 5 acres, a subdivision of 1 to 2 acre lots to the west on Shrewsbury Drive (Panorama Heights), and larger lots of between 2 and 5 acres along Old Orchard Road on the north side of the mountain. A large portion of the lots on Old Orchard Road are not serviced by community water at present. There are an estimated 240 residential lots within these subdivision areas. Although there are vacant lots within these subdivisions, for purposes of this study these areas are shown as Residential on Figure 2.

Other residential land uses are found in the study area which typically consist of a single family dwelling on a larger parcel. These have been shown as Rural on Figure 2.

Agricultural lands comprise a relatively small component of the existing land uses, and are located in the periphery and lowland portions of the study area. A portion of one agricultural parcel on the north side of the mountain is contained within the Agricultural Land Reserve.

There are no municipal parks or schools located within the study area. Similarly, there are no commercial uses at present in the study area.

There are a number of large vacant parcels, the majority of which are found on the south and north sides of the mountain. These vacant lands, and some of the rural parcels, are under consideration for potential development, and are identified as Development Proposal Areas on Figure 2. These areas total approximately 252 hectares or 43% of the study area and include 17 parcels owned by 8 private landowners. Proposals for development are in a preliminary stage and will be given consideration in the preparation of a draft plan as part of the next phase of this study. In addition there are two Indian Reserves (I.R. 3A and I.R. 8) that are located on Chilliwack Mountain and have been included in the study area. I.R. 3A contains a cemetery. I.R. 8 is largely vacant, with several dwellings located along Chilliwack Mountain Road.

A summary of existing land use in the study area is provided in Table 1 below.

Table 1
Land Use Summary

Land Use	Area		# Parcels
	ha	%	
Residential*	271	46.0	256
Development Proposal Areas	252	42.8	17
Agricultural	22	3.7	5
Indian Reserves	44	7.5	2
TOTAL	589	100.0	280

* Includes single family dwellings on lots, vacant lots in subdivisions and 4 District owned service parcels, and a duplex development parcel (under construction).

2.2 Current Designations and Zoning

2.2.1 Official Community Plan

The existing District of Chilliwack Official Community Plan (Adopted October 1990) provides broad direction for land use on Chilliwack Mountain. The present policies of the OCP for Chilliwack Mountain envision a rural level of development and servicing for most of the study area. Single family residential development serviced by community water is the predominant form of future development anticipated by the current OCP.

The majority of the study area is designated Suburban Residential in the Official Community Plan (OCP). The Suburban Residential designation allows for residential development on Chilliwack Mountain in areas that are presently serviced, or can be serviced by the community water system. Parcel sizes in residential subdivisions are limited to a minimum of 2000 square metres (1/2 acre) by this designation. Residential subdivision on the mountain in areas designated Suburban Residential has generally reflected development of larger parcel sizes (1 acre or better).

A portion of the study area is designated Low Density Residential (specifically the subdivision area of Sunrise Drive) which allows for an urban density of residential development (eg. maximum of 25 units per hectare (uph) for one and two family housing and 40 uph for multiple housing) with adequate municipal services. As noted earlier, community water and sanitary sewer is available to service the Sunrise Drive subdivision. The first phase of the duplex development under construction to the southeast of this subdivision will connect to the existing sanitary sewer.

A portion of the ridge along the south side of Chilliwack Mountain is designated an Environmentally Sensitive Area (specifically a geologically sensitive area) in the OCP. Policies regarding potential geological hazards require geotechnical studies prior to development on geologically sensitive areas, and on slopes greater than 20%. Additional policies in the OCP for hillside areas encourage development to conform with natural terrains, minimize slope disruptions, and to retain the natural features and qualities of the hillside areas as much as possible.

Most of the Chilliwack Mountain study area, with the exception of the Chilliwack Mountain Estates and the Sunrise Drive subdivisions, and Indian Reserve No. 8, is contained within a Development Permit Area (D.P.A. #6). Objectives and development guidelines are provided for the development permit area to protect fish and wildlife resources, assure public access to recreation features, safeguard water supply areas, and protect development from hazard conditions.

2.2.2 Zoning Bylaw

The District of Chilliwack Zoning Bylaw 1993, No. 1841, came into effect in February, 1993. The Zoning Bylaw applies several zones to the study area which implement the current OCP designations and set out the permitted uses and regulations within each of those zones.

Rural zones cover the majority of the study area, with HR (Hillside Residential) and RH (Rural Hillside) zones on most of the undeveloped lands. The HR zone has been applied to the residential subdivisions on Grand View Drive and on Shrewsbury Drive, permitting residential lots of a minimum 1 acre with community water service. The larger residential lots along Old Orchard Road on the north side of the mountain are contained within an RR (Rural Residential) zone which permits a minimum parcel size of 2.5 acres (1 acre with community water). An SCR (Suburban Clustered Residential) zone allows for the duplex development under construction on the southeast corner of the study area.

A limited portion of the study area contains urban or residential zones, including an R1-A (One Family Residential) and an R4 (Low Density Multi-Family Residential) zone, which permit a higher density of residential development on municipal services. The R1-A zone applies to the existing Sunrise Drive subdivision, and the R4 zone to the development proposal area on the north side of Chilliwack Mountain Road.

Other zones include an AL (Agriculture Lowland) zone on a parcel within the Agricultural Land Reserve, and the RSV3 (Special Jurisdiction Reserve) zone which is applied to Indian Reserve Nos. 3A and 8.

2.3 Growth Projections and Housing Market

The District of Chilliwack's current population of approximately 61,000 is projected to increase to an estimated 86,000 by 2001 and 138,000 in 2011. These population projections are contained within the District's Comprehensive Municipal Plan (CMP), and provide a context for considering growth in the Chilliwack Mountain Study area. Corresponding residential growth projections for the District suggest there would be an increase from the current 24,000 households to 32,000 in 2001 and 53,000 households by 2011.

The majority of the District's projected growth is expected to be taken up by other areas in the District, including Promontory, Ryder Lake, Eastern Hillsides and Chilliwack Proper. Chilliwack Mountain is expected to accommodate a small portion of the future growth envisioned by the CMP. Under a low growth scenario, the CMP projections estimate a population of 3,778 persons for Chilliwack Mountain. The projections assume that development will continue in the area until the ultimate capacity is reached around the year 2006.

The CMP projection for Chilliwack Mountain had assumed a limited level of servicing to the area (i.e. community water but not community sanitary sewer) and single family dwellings as the primary form of residential development.

The CMP projections for residential use and housing mix for Chilliwack Mountain have assumed a total estimated 1,382 dwelling units and a housing mix of approximately 83% single family (including duplex) and 17% multi-family (townhouses). These projections offer a general indication of the expected residential growth and housing mix in the study area.

The CMP projections are based on limited servicing to the area. If an urban level of servicing is provided to the study area, it is anticipated that a modified housing mix and density of development could be considered for Chilliwack Mountain. The extension of community sanitary servicing would allow for multi-family housing forms (such as townhouses) and an increase in density to be considered in appropriate areas on the mountain. The effect of a shift in the expected balance of

single family and multi-family dwellings may be an increase in the total dwelling units and population projected by the CMP for Chilliwack Mountain. Further review of this issue will be conducted when concepts for land use are prepared in Phase 2 of the study.

There appears to be market support for considering a change in the housing mix away from predominantly single family dwellings. The trend in the District housing market has been toward a balance between single family and multi-family dwellings. Of new housing starts in the period between 1988 and 1993, for example, single family dwellings comprised 50% and multi-family dwellings made up the remaining 50% of starts. Population projections for the District in the period to 2011 also suggest the strongest demand for housing will likely come from the middle age groups (35 to 64 years) who tend to purchase single family houses and townhouses. While market information provides a District-wide and a general context for reviewing the residential growth and housing mix expected for Chilliwack Mountain, the information suggests an increase in the multi-family (especially townhouses) component of the overall future housing mix should be considered.

Previous growth projections prepared by the District, the extension of services to the area, and market information are some of the factors that need to be considered when preparing a land use plan for Chilliwack Mountain. The development capability of lands in the study area, development proposals by landowners, and the impact of population increases on the transportation system, are other important factors that will influence the level of development and ultimate population that may be anticipated for this area.

3. Physical Features

3.1 Topography

Chilliwack Mountain is an inselberg or isolated hill in the Fraser Valley, which rises approximately 350 metres above the Fraser River floodplain. It is a rounded and incised feature with a number of peaks. Slopes are generally steepest around the margins of the hill, particularly in the south and south-west sides (up to 40°) and the north side (up to 45°) as far east as Grand View Drive. Between Grand View Drive and Sunrise Drive, the topography is of a more gently sloping character (20° and steeper).

The southern margin is characterised by two slope segments separated by a flatter section, probably representing a discontinuity or contact. Other discontinuities are readily identified, particularly where they can be followed completely across the area. Discontinuities and contacts represent possible zones of weakness, associated with broken or weathered rock. One such major feature crosses the south western corner of the area, trending WNW-ESE. This feature is partly infilled, probably by ancient windblown silt (loess), as is common in this area. Many of the other valley features are likely to contain loess forming the areas of thicker overburden, shown on Figure 5. Loess infill appears to be largely absent in steeper valley sections around the margins.

A number of debris fans occur around the margins of Chilliwack Mountain, characterised by the absence of vegetation. The debris originates in part from deposition by streams flowing off the hill, and in part from slope failures proximal to the fans. These features appear to be more common on the southern margin.

Slope Analysis

The general description of topographic conditions offers some indication of the capability for development in Chilliwack Mountain. A more detailed analysis of slope conditions in the study area has been conducted using mapping at a scale of 1:10,000. The base topographic mapping used for this analysis was compiled in 1978 and based on aerial

photography flown in 1961. More current topographic mapping for the study area is not available. Given the absence of more recent topographic mapping for the study area, and the scale (1:10,000) at which the analysis has been completed, more detailed review of slope conditions should be carried out to confirm on site slopes and the specific development capability of lands.

The analysis identifies the lands containing slopes which are less than 30%, between 30 - 50%, and greater than 50% slope angles. The various slope areas are shown on Figure 3. The results of the slope analysis indicate a total of approximately 42 percent or 247.3 hectares of the study area contains slopes of less than 30%. Slopes between 30 - 50% comprise an estimated 29.4 percent or 173 hectares of the study area. Steeper areas with slopes greater than 50% make up a total of 168.7 hectares or 28.6 percent of the study area. Most of the gentler sloping areas are located on the higher elevations and central part of the mountain, and on the lower elevations along the north and east side of the study area. There are a series of less steeply sloping benches on the south side of the mountain. A good portion of the area in slopes of less than 30% has already been developed for residential subdivisions.

Slope conditions provide an indication of the development capability of an area. Lands with slopes less than 30% are generally considered suitable for urban development. Slopes between 30 - 50% present constraints to the level of development that can occur. Lands containing slope angles greater than 50% are not generally considered suitable for development. Given the qualifications regarding base topographic information, geotechnical study should be completed prior to development to confirm suitability in steep slope areas.

3.2 Landscape and Visual

Chilliwack Mountain is a topographic anomaly in an otherwise flat landscape. This characteristic is the primary reason that the mountain is a significant visual feature. The importance of this feature is enhanced by the fact that the residential and community core of Chilliwack, with a population of approximately 27,000, is centred just 4 kilometres east of the mountain. The settlements of Arnold, Sardis, Vedder Crossing, Greendale, Yarrow and Desroche, also have clear views of the mountain.

In addition, the Trans Canada Highway, with an average daily traffic count of 38,000, runs along the south side of the mountain and provides direct, sustained views in both eastbound and westbound directions.

Chilliwack Mountain functions as a backdrop and reference point for the community and is an important component of the regional landscape that provides Chilliwack with its rural character, which in turn contributes to the community's perceived quality of life. Positioned in the landscape as it is, the mountain provides panoramic views of the Fraser Valley. This, combined with the fact that the mountain provides a large land base of non-ALR land, makes it a significant opportunity for residential development. The value of the mountain as a visual feature and development land sets the stage for a potential conflict between the two.

To help reduce the incidence of conflict and properly plan for an area where visual values and development values can co-exist, an on-site inventory and analysis of the visual environment of Chilliwack Mountain was conducted and is described in this section of the report. This work involved identifying, delineating, describing and mapping the primary landscape units and features of the study area. Maps and site photos were used to assist in the on-site inventory and mapping of the study area.

A landscape unit is an area of land with common elements and factors that are inherent to that specific area. Examples of these elements and factors include visibility; location and position of viewer relative to landscape; viewer population; frequency and duration of views; topography, slope and landform; vegetative cover; and cultural modifications (e.g., urban and rural development, agriculture, forestry).

Other elements or variables that play a role in defining the unique visual character of Chilliwack Mountain were noted during the inventory. Examples of these include views from the site; light conditions; duration of viewing; weather conditions; natural (re)vegetation patterns; and visual features (e.g., ridge lines, topographic draws).

The visual inventory identified that Chilliwack Mountain can be broken down into four primary landscape units. These units are illustrated on Figure 4 - Visual Inventory, and described here:

Unit 1

This landscape unit delineates the eastern shoulder of Chilliwack Mountain. It is characterized by moderately sloping terrain that faces northeast. This landscape unit has the shallowest slope of all the units that make up the mountain. The vegetative cover is dominated by second growth deciduous forest. The lower elevations of the unit are circumscribed by a short stretch of steeply sloping topography. An established residential neighbourhood is located on the toe of the unit.

This landscape unit is visible primarily from downtown Chilliwack, the residential areas north of the highway and obliquely from the westbound lanes of Highway 1. Foreground screening by buildings and vegetation may limit the visibility of this unit from the downtown and residential areas of Chilliwack north of the highway. Visibility of this unit is also limited in the afternoon and evening hours as at these times it is on the shaded side of the mountain.

The orientation and relatively shallow slope of this unit make it visually suited to development, though there are minor ridgelines that are visually important to the character of the unit and the mountain. As such, this unit has a moderate landscape sensitivity rating. Due to the consistent terrain in this area of the mountain, the boundary of this unit with those of Units 2 and 4 should be considered as a transition zone rather than as a strongly defined line. With the exception of ridgelines and edges, the visual character of this unit places only modest limitations on residential development.

Unit 2

This landscape unit is characterized by a steep, continuous slope with a southerly aspect. It is comprised of second growth deciduous forest with stands of fir and cedar. The most prominent visual features of the unit are its ridgeline and steep slopes. A shallow bench bisects the unit horizontally in the west portion of the unit. A few minor topographic draws provide local visual interest. There is some residential development in the east portion of this unit.

The dominant view of this unit is from the south and obliquely from the southeast and southwest. This unit is an important

middleground landform for Highway 1 travellers immediately south of the mountain and is clearly visible as a background landform from the Sardis shopping centre area and the westbound lanes of the highway. The residential neighbourhoods south of the highway have sustained middleground to background views of the mountain.

Due to its position, orientation and viewing frequency and duration this landscape unit is regionally significant. That is, it is the landform that most strongly contributes to the visual character of the Fraser Valley around Chilliwack. The steepness and southerly aspect of this unit ensure that the landform and any development on it will be highly visible. This landscape unit is the most visually sensitive unit of Chilliwack Mountain. From a visual aspect, the suitability of this unit for conventional forms of residential development is very limited, particularly on steep slopes and along ridgelines. Innovative approaches to development are necessary to respond to slope conditions and the visual sensitivity of this area.

Unit 3

This landscape unit delineates the west shoulder and face of Chilliwack Mountain. It is characterized by steep slopes with varying aspect that generally face southwest. Its boundaries are strongly described by ridgelines. The vegetative cover is a mix of coniferous and deciduous trees.

This landscape unit is most prominently viewed from eastbound lanes of the Trans Canada highway, west of Chilliwack Mountain, where it appears as a prominent middleground landform. To residential and rural residents within sight of Unit 3, it is typically seen as a background to the rural landscape.

Due to its visibility and steep slopes the visual sensitivity of this landscape unit is rated as high. Due to the transitory nature of highway traffic and viewers, development may occur in this unit provided the integrity of the forested slopes is retained and minimal disturbances (e.g., cut/fill slopes, large cleared areas) are permitted. Areas of higher sensitivity, such as ridgelines and the transition between this unit and Unit 2 would be less suitable for residential development from a visual standpoint.

Unit 4

This landscape unit, the largest of the four, delineates the north side of Chilliwack Mountain. The terrain of this unit ranges from moderately to steeply sloping. The topography of this unit is slightly more complex than the other units due to the many topographic draws that run down its slopes. However, the strength of ridgelines as a landscape feature is less for Unit 4 than for other units. The vegetative cover is a mix of second growth deciduous and coniferous trees.

This is the least visible landscape unit of Chilliwack Mountain. There are distant, sustained background views of this unit from Desroche and intermittent views from Highway No. 7. Closer views of the unit are available from the Island 22 Campground Park/boat launch to the northeast and from the Fraser River. Clear visibility of the unit is limited as it is on the shaded side of the mountain and the primary vantage points are a considerable distance away.

The visual sensitivity of this landscape unit is moderate. Development may occur in this unit without significantly decreasing the visual quality, providing the development responds to ridgelines, topographic draws and the natural contours of the unit in an appropriate manner. Retention of existing trees is also necessary to accommodate development without unduly compromising visual quality.

3.3 Geotechnical

3.3.1 Soils

Ancient windblown silt (loess) commonly overlies bedrock in the study area, with a generally thin organic veneer. Some areas with poor drainage show evidence of thicker organic development (peat), particularly the central parts of the south-western area. Soil thicknesses in other areas appear to be greatest in valleys and on less steep slopes. Thicknesses in excess of 2m can be expected on slopes of 50% or less. Development of thicker soils seems to be more common on the northern side of the hill. Thick development of mixed silty soils and slope debris occur in the form of fans around the margin of Chilliwack Mountain.

3.3.2 Bedrock

The Geological Survey of Canada bedrock geology map (41-1981 Sheet 1 - Hope) indicates that Chilliwack Mountain consists of Early and Middle Jurassic Harrison Lake formation rocks, likely to comprise extrusive volcanic rocks and pyroclastics, argillites and conglomerate. The geology is complex, as evident from the topography, and in particular from the large number of discontinuities and boundaries identified. Some of these may be faults containing gouge.

The rock is likely to be strong, although weathering and fracturing are likely to affect the surface layers. For preliminary purposes, it can be assumed that the top 0.3m will be rippable with heavy excavating equipment, though field investigation will be required to confirm this.

Current evidence suggests that relatively few slope stability problems exist, except in steep slopes, though individual sites should be inspected to confirm this. Particular attention should be paid to areas where slopes are defined by discontinuities, where the quality of the rock mass may be lower. Another concern is the potential surficial instability of slopes steeper than 2H:1V, where bedrock is covered by a thin soil veneer. Such instability is easily triggered by earthworks.

3.3.3 Engineering Implications

Loess has peculiar geotechnical characteristics and is highly erodible, particularly when disturbed. Considerable caution will be required in the design of drainage works and infrastructure. Heavy use of geotextiles and lining of ditches and outfalls may be required to avoid erosion. Loess is susceptible to piping and attention will need to be paid to cut slopes where piping may initiate, and to structures that may be susceptible to ground failure due to piping. Little or no excavated soil will be suitable as common fill. It may be necessary to import granular fill if sufficient supplies of shot rock are not available on site. It is recommended that silty soils be stripped to bedrock beneath fills.

Poorly drained areas, where considerable peat may have developed, are unlikely to be suitable for development, due to the highly compressible nature of the peat. Where it is proposed to develop such areas, the drainage will need to be improved and the peat removed, or if too thick,

a layer of good quality granular fill placed as preload and stable foundation material.

The debris fans may be suitable for development, but particular care will be required in assessing the likelihood of upslope failure and possible flooding, particularly where upstream drainage has been modified as a result of development. Deforestation and residential development is likely to cause stream flows to become more 'peaky', increasing the likelihood of flash flooding during storms. Consideration should also be given to liability resulting from damage to existing houses resulting from increased runoff, caused by upstream development. The debris fans may provide a source of fill materials, but further investigation will be required to assess the quantity of silt and clay present.

Detailed site investigation will be required prior to the design stage of any development, including building sites, roads, service trenches and other facilities.

For preliminary design purposes rock cuts less than 5m high should be planned at 0.3H:1V, with cuts greater than 5m at 0.4H:1V. Fill slopes should be 2H:1V for preliminary design. Checks will need to be made for the overall stability of slopes, and consideration given to resultant modifications to drainage. Road ditches should have capacity for rock fall and soil catchment. For preliminary design, we recommend that ditch inverts be 0.7m to 1m wide. Provision may need to be made for continuing maintenance of cut slopes, including clearing of debris from ditches to ensure that upslope drainage and downslope debris catchment remain effective. Periodically, it will be necessary to check for loose blocks in cut slopes, and either remove or secure them. Faults exposed in cut sections may pose particular problems. Any stabilisation measures used, such as shotcrete, will need to provide sufficient drainage.

3.4 Environment

3.4.1 Introduction

This section describes the environmentally sensitive features found within the study area and outlines recommendations which would provide protection and mitigation from impacts of development activities. ECL Envirowest Consultants Limited (Envirowest) was

retained by Urban Systems Limited to provide an overview of the environmental attributes of Chilliwack Mountain.

The objectives of this overview were to:

- review published and existing baseline data and information necessary to identify the environmental sensitivities of the study area;
- evaluate the environmental sensitivities of the area to disturbance by activities associated with land development; and,
- identify development constraints, and to recommend strategies to mitigate the impacts of development on environmentally sensitive features.

3.4.2 Study Methodology

Data Collection

Background information on fish and wildlife resources was collected during interviews with personnel from B.C. Environment (Ministry of Environment, Lands and Parks - MOELP), the Department of Fisheries and Oceans (DFO), the Chilliwack Field Naturalists Club, and local experts. Federal and provincial Stream Inventory Summary System (SISS) records (DFO 1994) were utilized to provide information on the distribution of fish species and associated habitat features within and adjacent to the study area.

Results from a recent environmental inventory conducted on a 55 hectare parcel of land (referred herein as Parcel F) were incorporated into the results generated for this study where applicable (Gartner Lee Ltd. 1995).

Field Survey

Field surveys of the study area were conducted April 16, 19 and 26, 1995. The level of investigation was designed to identify environmentally sensitive features within the study area. More detailed investigations to address environmental issues are recommended for later

phases of the development process where site specific development proposals have the potential to affect environmentally sensitive features.

Interpretation of recent aerial photographs and topographic base maps helped to stratify sampling intensity in within the study area. Additionally, the study area was divided into a number of development parcels, each of which is described in the following report. Plant species were recorded within each major vegetational unit and form the basis for the descriptions presented in this report. Each plant species encountered during the field survey was recorded and a comprehensive list of plant species occurring within the study area was compiled. Plant species with special conservation status were also identified. Appendix A provides the plant species list for Chilliwack Mountain.

Dominant plant species were utilized as indicators of the moisture and nutrient regimes of sites in which they are found. An analysis of indicator species presence and abundance within major vegetational units was completed using the criteria described in Green and Klinka (1994). The analysis provides for a better understanding of how the productivity within different vegetational units may reflect their value to wildlife species.

A number of habitat variables were recorded during the field survey to assess the suitability of vegetational units in providing primary habitats for wildlife species. A reconnaissance level field survey was conducted to identify habitat features including:

- wind damage;
- stand health;
- surface water features.
- standing dead (snags);
- down and dead woody debris;
- forage abundance and availability; and
- veteran trees.

Kick-net sampling was conducted within streams and ephemeral watercourses throughout the study area. Fish species captured were identified according to Scott and Crossman (1990); amphibian species were identified according to Green and Campbell (1992).

In addition to background information gathered through interviews with agency personnel, members of the Chilliwack Field Naturalists Club, and local experts, reconnaissance level field surveys were conducted to identify wildlife values. Evidence of wildlife utilization included direct observations of wildlife, tracks, game trails, scat, browsed vegetation, tunnels, bones, feathers, nests and nest cavities. The utilization of the forests and riparian areas within the study area by wildlife was deduced from an analysis of habitat features, observations, and evidence of utilization.

All wildlife species observed, known to occur, or with a high probability of occurring within the study area were recorded and their utilization of habitats within the study area deduced from a subjective analysis of habitat suitability.

Mapping

A 1:5,000 scale map was produced highlighting the environmentally sensitive features of the study area. Shading was used to identify sensitive habitats and features based on the recommendations contained within the new *Land Development Guidelines for the Protection of Aquatic Habitat* (Chillibeck 1993), jointly produced by MOELP and DFO and employed throughout the province. The locations of direct evidence and observations of threatened and management priority species are delineated on the maps with bold symbols.

3.4.3 Results and Discussion

Specific development parcels for the Chilliwack Mountain study area referred to in the following discussion are outlined on Figure 6(ECL Drwg. No.: 484-07-01).

Habitat Descriptions

The biogeoclimatic classification system for terrestrial habitats in the province of British Columbia is based on regional and local climatic conditions and topographic gradients. The Chilliwack Mountain study area is located within the Dry Maritime Variant of the Coastal Western Hemlock biogeoclimatic subzone (CWHdm). This subzone is typified

by warm, relatively dry summers and moist, mild winters with relatively little snowfall and a relatively long growing season.

Climax forest communities on zonal sites (zonal sites represent average soil nutrient and moisture regimes) are dominated by Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*). Major understory species include salal (*Gaultheria shallon*), red huckleberry (*Vaccinium parvifolium*), step moss (*Hylocomium splendens*), *Kindbergia praelonga*, *Rhytidiadelphus loreus*, and *Plagiothecium undulatum*. Less common species include dull oregon grape (*Berberis nervosa*), vine maple (*Acer circinatum*), bracken (*Pteridium aquilinum*), and sword fern (*Polystichum munitum*).

In general, forests within the study area were dominated by a deciduous canopy composed of paper birch (*Betula papyrifera*) and broadleaf maple (*Acer macrophyllum*). Douglas-fir was uncommon and occurred in mix canopy and rarely in coniferous canopy stands. Western redcedar was generally confined to watercourses and gullies. Two past logging episodes have resulted the presence of few veteran coniferous trees. Burning practices associated with logging has resulted in fire scarring of large snags and cut stumps.

Shrub layers were dominated by thimbleberry (*Rubus parviflorus*) with snowberry (*Symphoricarpos albus*) and vine maple being locally abundant at high elevations. Red elderberry (*Sambucus racemosa*) and devil's club (*Oplopanax horridus*) were locally abundant in wetted depressions, seepage areas, and gullies. The relatively well developed herbs layer was dominated by stinging nettle (*Urtica dioica*). Other common components of the herb layer included purple peavine (*Lathyrus nevadensis*), bracken, Pacific bleeding heart (*Dicentra formosa*), vanilla leaf (*Achlys triphylla*), and lady fern (*Athyrium felix-femina*).

Parcel A

Parcel A is defined on its northern boundary by the confluence of Chilliwack Creek with the Fraser River. It has an overall northern aspect. Overstory canopy species are dominated by black cottonwood (*Populus trichocarpa*) intermixed with red alder and occasional broadleaf maple. Shrubs species are dominated by salmonberry (*Rubus spectabilis*), Indian plum, red elderberry and willow (*Salix* spp.).

Parcel B

Parcel B was typified by the presence of a number of ravines and gullies which contained ephemeral flows. The terrain was moderately to steeply sloped with an overall northwestern aspect with a number of bench areas.

Forest canopies were predominantly composed of paper birch and broadleaf maple. A forest stand composed primarily of trembling aspen (*Populus tremuloides*) was present in a mid slope position within Parcel B. Black cottonwood was present but rare. Canopies in gullies and ravines were dominated by western redcedar and broadleaf maple. Thimbleberry, Indian plum, snowberry, and baldhip rose were common shrub species. Also present but never abundant were black twinberry (*Lonicera involucrata*) and red-osier dogwood (*Cornus stolonifera*). Common herbs included sword fern, vanilla leaf, broad-leaved starflower and three-leaved foamflower (*Tiaeralla trifoliata*)

Parcel C

Parcel C sustained slopes which varied between 20 and 50 percent with occasional narrow bench areas and a northern aspect. The forested canopy was dominated by broadleaf maple in association with red alder and paper birch. Western redcedar regen was present in the understory although rare. Common shrubs included red elderberry and Indian plum. Also present but less common were devil's club, salmonberry, thimbleberry and the occasional bitter cherry (*Prunus emarginata*). Thimbleberry became the most common shrub species at upper elevations within the parcel. The herb layer was relatively well developed and typified by the presence of stinging nettle. Pacific bleeding heart, lady fern, enchanters' nightshade (*Circaea alpina*) were present at lower areal coverage values.

A mountain beaver (*Aplodontia rufa rufa*) tunnel was observed in association with a groundwater seepage emerging from a steep slope adjacent to an old logging road. The approximate location of the tunnel is delineated on Figure 6.

Parcel D

Parcel D was typified by moderate slopes with intermittent moist depressions. It possesses a general southeastern aspect. Recent development activities have removed a large portion of the forested habitats within the parcel. The canopy is generally typified by a deciduous tree species mixture of broadleaf maple and paper birch. Douglas fir becomes a component of the canopy layer on drier more well drained slopes. The shrub layer was dominated by red elderberry and thimbleberry. Also present were salmonberry, vine maple and Indian plum. Devils club was present at the toe of slope in water receiving areas. The well developed herb layer was dominated by stinging nettle and Pacific bleeding heart. Additional species included miners' lettuce (*Montia sibirica*), lady fern, and enchanters nightshade. Small diameter woody debris was common throughout the site.

Parcel E

The largest parcel within the study area, Parcel E, possessed a variety of habitat types. Parcel E exhibited northern, southern and western aspects. The height of land on Chilliwack Mountain occurred within Parcel E. A significant habitat feature, a low saddle with both northern and southern drainage was present along the western portion of the parcel.

Habitats on north facing slopes were typified by deep, relatively moist soils. Slopes were moderate with a number of prominences and wetted depressions. The canopy layer was characterized by broadleaf maple and paper birch. Douglas-fir was present but not common. Common constituents of the shrub layer included vine maple, devils' club and thimbleberry. Also present but less abundant were salmonberry, Indian plum, red elderberry. Common herbs included stinging nettle, Pacific bleeding heart, lady fern, vanilla leaf and western trillium.

Ridge crests and steep upper south facing slopes demonstrated a mixed canopy layer with Douglas-fir dominating the species mixture in association with broadleaf maple and paper birch in certain areas. A number of exclusively coniferous stands with veterans were present within Parcel E. Understory shrubs and herbs were less well

developed under coniferous canopies. Common shrubs included baldhip rose, thimbleberry, black gooseberry (*Ribes lacustre*) and beaked hazelnut (*Corylus cornuta*). The herb layer was dominated by miners' lettuce and purple peavine in some locations. Other components of the herb layer included star-flowered Solomon's seal, sword fern and spiny wood fern (*Dryopteris expansa*). Coniferous regen was rare as was coarse woody debris. Dead standing was uncommon but several large diameter (>1.2 m) snags were present throughout the upper slopes.

Rocky outcroppings occurred on upper slopes and were often associated with prominences and ridge crests. Vegetation species were typified by Douglas-fir in the canopy layer and a number of shrub species typical of dry moisture conditions and thin soils. Shrub species included ocean spray (*Holodiscus discolor*), snowberry, dull Oregon grape, and Douglas maple (*Acer glabrum*) and baldhip rose (*Rosa gymnocarpa*). Common herbs included bracken fern (*Pteridium aquilinum*), purple peavine, wall lettuce (*Lactuca muralis*) and broad-leaved starflower. Windthrow was evident within northfacing slopes and habitats at the height of land within Parcel E.

A number of ponds and seepage areas were also present in Parcel E.

Parcel F (48455 Frontage Road Property)

Parcel F consists of steep south facing slopes with gradually sloping benches. Forest stands are dominated by deciduous species including broadleaf maple and paper birch with red alder (*Alnus rubra*) common on recently disturbed sites. Mixed species stands occur throughout the parcel with Douglas-fir forming a portion of the canopy layer. Shrub layers were typified by the presence of thimbleberry with lesser amounts of vine maple, snowberry and baldhip rose (*Rosa gymnocarpa*). Douglas-fir and western hemlock regen were common in the understory. Herb layers were well developed being composed of Roberts' geranium (*Geranium robertianum*), sword fern, and broad-leaved star flower.

Additional habitat features included rocky outcroppings and two ephemeral creek systems.

3.4.3 Wildlife Habitat Features

Standing dead and large decaying stumps were uncommon in the study area. The majority of standing dead was of large diameter and is likely a remnant of the first episode of logging on Chilliwack Mountain. Standing dead were, in general, is in advanced stages of decay providing food sources and nest sites for a variety of bird species. Down-and-dead coarse woody debris was rare throughout the study area.

The abundance of deciduous tree species including broadleaf maple, paper birch, and vine maple is an important habitat feature for many species. These species provide additional nest cavities and den sites and provide forage for deer, birds and small mammals. Leaf litter from deciduous species creates a favourable environment for invertebrate species which are food source for a number of small mammals, birds and herptiles.

Vegetation species considered important forage for wildlife occurring within the study area included hazelnut (*Corylus cornuta*), dull Oregon grape, red elderberry, salmonberry and Indian plum. Fruits produced by these species are an important food source for birds and mammals. Common herbs present within the study area which are utilized by wildlife include miners' lettuce (*Montia sibirica*), youth-on-age (*Tolmiea menziesii*), stinging nettle (*Urtica dioica*), star-flowered Solomon's seal (*Smilacina stellata*), false Solomon's seal (*S. racemosa*) and tiger lily (*Lilium colombianum*).

Riparian zones are landscape features that are heavily utilized by a large number of wildlife species than other terrestrial habitat types. Riparian zones within the study area include the riparian edge adjacent to the mouth of Chilliwack Creek and riparian corridors associated with ravines, gullies and ephemeral watercourses.

The riparian corridor associated with Chilliwack Creek contributes directly and indirectly to the productivity of the creek. Leaf drop and insect drop provide a source of nutrients and food for insects and fish species respectively. Riparian vegetation also contributes to slope stability and the retention of soil. Vertical structure provided by riparian vegetation along the creek provides roosting and nesting habitat for a variety of bird species including great blue heron (*Ardea herodias*) and bald eagle (*Heliaeetus leucocephalus*).

The properties of riparian zones that provide a multitude of micro-habitats for wildlife species including vertical stratification, high edge habitat ratios, high productivity levels and aquatic and terrestrial habitat transitions. Riparian corridors are also natural corridors for animal movement along and between habitats. The protection and preservation of riparian zones is a management priority and a key to maintaining biological diversity in managed landscapes.

The definition of riparian zones is extended for the purposes of this report to include water bodies and seepage areas. Seepage areas and ponds are source areas for creeks and ephemeral watercourses. Ponds and seepage areas provide sources of herbaceous vegetation and abundant shrub cover, both of which are consumed by a variety of vertebrates. Ponds provide breeding locations for salamanders and frogs. Seepage areas provide a water source conducive to the establishment of mountain beaver tunnel systems.

The low saddle which exists along the western portion of the study area exhibits a number of habitat features considered important to wildlife. At upper elevations in the saddle a large permanent pond, the source of the north flowing watercourse, provides important breeding habitat for frog and salamander species. Low gradient stream sections with wide floodplains and subsurface flow in some sections have created favourable conditions for well developed herb and shrub layers. These herb and shrubs layers provide abundant forage for wildlife species. The saddle also provides a migration corridor between the Fraser River and the south facing slopes of the study area.

Fish and Wildlife Utilization

Fish species were not captured during kick net sampling conducted on a number creeks within the study area. It is unlikely that the steep, ephemeral drainages characteristic of the study area would sustain anadromous or resident fish populations. However, watercourses present within the study area drain into Atchelitz Creek, Chilliwack Creek and the Fraser River all of which are immediately adjacent to the study area. Atchelitz and Chilliwack creeks are both utilized by populations of coho salmon (*Oncorhynchus kisutch*), chums salmon (*O. keta*) and cutthroat trout (*O. clarki*). The Fraser River is the largest salmon producing river in the world, being utilized by five species of Pacific salmon as well as a myriad of other important commercial and recreational fish species.

A list of wildlife species known to occur or with a high probability of occurring within the study area is presented in Appendix A. In addition to field observations, interviews with MOELP personnel and local experts, the following sources of information were utilized: Campbell et al. (1990); Ehrlich et al. (1988); Cowan and Guiget (1978); Green and Campbell (1984); Gregory and Campbell (1987); Nagorsen and Brigham (1993); and Stebbins (1985).

Game trails were common throughout the study area, being more common on south facing slopes. Black-tailed deer pellets were frequent throughout the study area with highest densities occurring within riparian corridors and at ridge crests with deeper, moist soils which sustained abundant herb cover. Black bear scat was observed on south facing slopes and the ridge crest of the saddle area in the southwestern portion of the study area. Woodpecker and sapsucker holes were observed throughout the study area. Long-toed and western salamanders were observed within a large pond which feed one of the larger watercourses immediately north of the height of land in the western portion of the study area. Pacific tree frogs were observed in forested and riparian habitats within the saddle area in the western portion of the study area.

Forested habitats within the study area are dominated by late seral deciduous communities resulting in large fluctuations in species presence and abundance with the largest number of species being present during summer months when foliage and forage is abundant. Many bird species associated with deciduous forests and edge habitats also occur in urban settings and would persist given natural areas are retained. Populations of winter resident and coniferous forest dwelling species may decrease significantly in a fragmented landscape. Where undevelopable areas are maintained as natural areas, a significant proportion of bird species would likely persist within the study area.

Mountain beaver (*Aplodontia rufa rufa*) tunnel systems were observed throughout the study area. Some tunnels were associated with riparian corridors and seepage areas, however, the majority of tunnels observed were associated with slope breaks near ridge crests at high elevations on south facing slopes. These areas correspond to accumulations of silty material around outcroppings and prominences near the top of slope on the south face of Chilliwack Mountain. Distribution of the mountain beaver is limited locally by unsuitable burrowing substrates such as

broken rock, which was common in surface layers in mid and lower slope positions.

The mountain beaver has been identified by the provincial conservation status list developed by MOELP, in conjunction with the Conservation Data Centre, as a red-listed species qualifying it as a candidate for legal designation as *threatened or endangered.* Threatened species include any indigenous species of flora or fauna that is likely to become endangered in British Columbia if the factors affecting its vulnerability do not become reversed. Endangered species include any indigenous species that is threatened with imminent extinction or extirpation throughout all or a significant portion of its range in British Columbia. Fragmentation, encroachment, and/or degradation of its habitat would negatively affect the viability of this species.

3.4.4 Recommendations and Guidelines for Development

Environmentally Sensitive Areas

Environmentally sensitive areas were ranked as having a high, medium or low sensitivity to development according to the following criteria:

HIGH — Areas which sustain threatened or endangered flora or fauna; fisheries sensitive zones; unstable or steeply sloped areas immediately adjacent to watercourses with known habitat values. Areas with high sensitivity on Figure 6 (ECL Drwg. No.: 484-07-01) include the Chilliwack Creek/Fraser River corridor and mountain beaver habitat areas.

Development Constraints — Development is not recommended in these areas. Exceptions may include linear developments such as public services (roads, water and sewer mains) located along least disruptive alignments; proposals for these exceptions must be

	submitted for environmental agency review.
MEDIUM	Fisheries sensitive zones; ephemeral creeks and watercourses; habitats of less significance to rare or endangered flora or fauna. Areas with medium sensitivity to development on Figure 6 (ECL Drwg. No.: 484-07-01) include the wildlife corridor/saddle area and watercourses and riparian corridors.
Development Constraints	Development proposals in these areas should demonstrate the ability to mitigate impacts to subject habitats. Unmitigable impacts may require compensation.
LOW	Areas with low environmental resource values and with overriding development constraints (i.e. geotechnical considerations).
Development Constraints	Development should follow the criteria specified in the "Land Development Guidelines for the Protection of Aquatic Habitat" (Chillibeck et al. 1993).

Significant fish and wildlife values are associated with the riparian zones along the watercourses within the study area. Although none of the creeks within the study area were found to support fish populations, development within riparian areas has the potential to affect downstream habitat values for fishes. The degradation of riparian habitats could result from a number of development related impacts including erosion, mass wasting, sedimentation, loss of water quality, changes in hydrological regimes and disturbances through development and post-development activities. Riparian areas also receive a disproportionately high amount of use by wildlife species including herptiles, birds and mammals. The following recommendations are may be required to mitigate the potential impacts of development following the criteria

outlined in the new *Land Development Guidelines for the Protection of Aquatic Habitat* (Chillibeck et al. 1993):

All Watercourses

1) Post-development flows should be maintained at pre-development levels.

2) Sediment control features should be designed according to the criteria in the *Land Development Guidelines for the Protection of Aquatic Habitat.*

3) Riparian setback corridors should be fenced during the construction phases of development (snow-fencing is commonly used for this purpose).

4) Erosion control features should be constructed and maintained in risk areas adjacent to riparian corridors.

5) Park trail systems and alignments should only occur along the top of the banks with the number of crossings minimized.

6) Trail design and construction should minimize potential impacts to riparian vegetation communities and utilize environmentally friendly materials.

7) Stormwater discharge outfalls into creeks should be designed to maximize the energy dissipation of flows and minimize the impacts to channel and bank areas including revegetation of impacted areas.

8) Incorporate water treatment features into systems discharging into watercourses to maintain water quality.

Ephemeral Watercourses

A minimum setback distance of 9 metres from the top of bank should be established from the first significant break in topography in the streambank where no permanent development should occur within setback boundaries.

Stormwater Management

A number of options in addition to those recommended above should be pursued with respect to maintaining the quantity and quality of pre-development flows discharging from developed areas, these include:

- rooftop detention and retention;
- vegetated swales;
- ditch detention;
- wet detention ponds;
- infiltration structures/systems; and
- vegetation retention.

Threatened Species Management

Mountain Beaver

The only provincially red-listed vertebrate species known to occur within the study area was the mountain beaver. The distribution of this species was not determined in full, however, based on the findings of this and the Gartner Lee (1995) study, the natural history information available in scientific literature and its sensitivity to disturbance the following recommendations should be followed to provide adequate protection for the mountain beaver on Chilliwack Mountain.

As the majority of mountain beaver tunnel systems were observed in isolation of creek ravines and gullies, the protection of riparian zones would not be adequate to maintain existing viable populations. Additionally, Chilliwack Mountain represents an isolated population of mountain beaver. It seems highly improbable that populations would become re-established once the present population were extirpated from the study area. Therefore it would be necessary to recommend a number of alternative approaches to protect the mountain beaver and its habitat on Chilliwack Mountain.

Residential development within the home ranges of mountain beaver would be incompatible with maintaining viable populations since disturbance to tunnels systems, soil compaction and removal

of vegetation (especially herbs) would have a negative effect on the population. Alternative measures that should be considered include:

- protection of home ranges through designation of mountain beaver habitat areas as municipal parkland or retain as an open space designation and, if necessary, through restrictive covenant;
- land swapping with property owners to provide property in nearby areas zoned for development;
- selling of the land to the province; and
- relocation of mountain beaver populations from lands that are otherwise suitable for development, to suitable habitats on lands where some level of protection would be provided.

The last alternative should only be utilized as a last resort should the first three options be considered impractical or impossible to carry out.

Vegetation Species

Western trillium (*Trillium ovatum*) and western flowering dogwood (*Cornus nuttalli*) were encountered throughout the study area. These plants are protected in British Columbia under the Dogwood, Rhododendron and Trillium Protection Act. The trillium is a common constituent of the herb layer at high elevations on north facing slopes. Western flowering dogwood occurred as an understory shrub at various locations throughout the study area. The Act only provides protection for these species on crown and private land, however, the landowner retains the right to permit its removal. This provides protection from the general public to prevent the removal or destruction of these plants on crown lands where this species have been sought for removal for transplanting to home gardens or for profit by small scale commercial landscaping ventures.

Additional Species

It should be emphasized that the level of detail provided by this study would not be sufficient to provide resource managers with sufficient information to approve or disapprove development applications. Red and blue listed vertebrate species including Pacific water shrew (*Sorex bendirii*), Pacific giant salamander (*Dicamptodon tenebrosus*) and tailed frog (*Ascaphus truei*) all occur in close proximity to Chilliwack Mountain. Although it may be unlikely that these species are present within the study area as a result of the ephemeral nature of the majority of watercourses and a paucity of coarse woody debris, more detailed environmental evaluations should focus on determining the presence or absence of these species. Being that Chilliwack Mountain represents an isolated island in the Fraser Lowlands, populations of threatened or endangered species would be unlikely to re-establish once extirpated from the area considering the patterns of urban development in the District of Chilliwack.

4. Servicing Context

4.1 Transportation and Roads

The Chilliwack Mountain study area is currently linked to Chilliwack's commercial core by two rural municipal roads. The system of roads providing access to the site are illustrated in Figure 7. Wolfe Road and Scheyey Road form an east-west corridor that links the mountain with downtown Chilliwack. Lickman Road is a north-south corridor providing access to Industrial Way, Yale Road West, and the Trans-Canada Highway. Some local trips within the municipality may be made along the highway through the interchange at Lickman Road, although the policy of the Ministry of Transportation and Highways is to discourage the use of the freeway for local traffic movement. Wolfe Road, Scheyey Road and Lickman Road are all defined as arterial roadways in the District's Official Community Plan (OCP).

Additional access to the mountain is provided via Old Orchard Road and Aitken Road, which are rural local roads. Circulation around the site is provided by Chilliwack Mountain Road and Old Orchard Road, although the network at present lacks connectivity. There is a limited system of local roads which provide direct access to residential properties within existing subdivisions on the mountain. Travel from one part of the existing development to another is circuitous, and usually involves travelling on collectors or arterials. (The OCP classifies Chilliwack Mountain Road as an arterial roadway and Old Orchard Road as a collector roadway.)

Current travel patterns in the surrounding area indicate that the majority of traffic travelling to and from Chilliwack Mountain will travel via Lickman Road. With many commuters in the area destined for Greater Vancouver, this is likely to remain the preferred access, even as development spreads over the entire mountain.

Up to 4 traffic lanes, (two inbound and two outbound) could be required to accommodate an ultimate population on Chilliwack Mountain of up to 7,000 people. Traffic will likely be accommodated through rural road improvements, as well as some intersection improvements. With the

current road network on Chilliwack Mountain the laning requirements on the two rural roads may possibly be kept to two lanes per road, which will limit the impact to agricultural land on either side of these roads. The minimum standard of improvement envisaged for these roads is widening of the existing lane width and providing paved shoulders.

The majority of the intersections in the study area have only one lane on each approach. This means that vehicles travelling straight through or turning right must share the same lane with vehicles turning left. As traffic volumes increase, this will create additional delays. Some local improvements such as turn bays or signals may be necessary. The need for local improvements will be examined further in Phase 2 of this study.

Some constraints, limitations and opportunities relating to the transportation system required to service the future population are summarized below:

- Scheyey Road travels through Indian Band land. The District is currently negotiating with the Band to formalize public access via Scheyey Road. These negotiations will have to be completed before any widening can occur.

- The CN Rail line crosses Lickman Road at a level crossing. Rail service in this area is frequent, with up to 40 trains per day. This will affect the capacity of this arterial to accommodate increased traffic volumes. Any widening of roads that cross the railway will require that railway circuits be moved, and will incur additional maintenance costs. These costs will have to be borne by the District of Chilliwack or by the developer.

- Given the sleep slope conditions of the study area, consideration should be govern to a reduction in municipal road standards in order to minimize the extent of cut and fill required.

- To ensure access for emergency vehicles, the maximum length of cul-de-sacs should be 250 m. If a local road is longer than this, a secondary access should be provided. The slopes in the Chilliwack Mountain are quite steep, and will present some challenges in providing secondary accesses. Secondary access

does not necessarily have to be provided on a standard local road. It could be provided via a gravel road which is chained off.

- The School District advises that a school site has not been planned for Chilliwack Mountain, and therefore roadways and turn around areas must be of sufficient dimensions to accommodate the District's current school bus fleet.

- Currently, BC Transit provides little service outside of the urbanized areas of Chilliwack. Because development proposed for Chilliwack Mountain is expected to be of an urban density, and because the development is quite close to downtown Chilliwack. Chilliwack Mountain is an excellent candidate for the extension of transit services. In order to provide for efficient transit routing and adequate coverage, more than 80% of the houses must be within 400 m walking distance of the potential transit route. Transit is most likely to be routed along arterials and collectors.

4.2 Sanitary Servicing

Background and Existing Infrastructure

The existing level of sanitary servicing to Chilliwack Mountain is extremely limited. The only portion of the study area currently serviced by sewer is the lower level of the Sunrise Estates development located at the east end of the mountain. However, comments received from the Ministry of Health indicate that sewer servicing should be extended to all existing lots within the Sunrise Estates area.

The existing trunk sewer extends south from Chilliwack Mountain Road along Aitken Road in a series of gravity trunk lines and forcemains as shown on Figure 8. The first sewage lift station (LS.19), located on Aitken Road approximately 230 meters north of the CNR tracks, would provide service to all future development within the study area if the existing infrastructure were to be utilized.

Lift Station 19 has been constructed for a design flow rate of 15.5 L/s with expansion capabilities to an ultimate flow rate of 29.4 L/s, which

represent population equivalencies of 850 and 1700, respectively (using 410 L/c/d). The gravity trunk sewers on Aitken Road and Yale Road have been designed to maintain a minimum velocity of 0.6 m/s and have capacity to convey 45 L/s or an equivalent population of 2700. It has been estimated that under the current OCP, the design flow for LS 13 would be 59 L/s, with the discharge forcemain on Yale Road having a practical capacity of 150 L/s. Therefore, this forcemain offers sufficient capacity for any population projection on Chilliwack Mountain.

The gravity trunk line entering LS. 10, Lift Station 10 itself and the discharge forcemain to the sewage treatment plant all have sufficient capacity to convey the anticipated flows from Chilliwack Mountain. Future upgrading to these works have been identified to service future development of the Eastern Hillsides and Ryder Lake areas.

Future Off-Site Sewerage

Based on the above information, an initial population of 850 people can be serviced in the study area prior to the requirement of any upgrading. Note that the current population is approximately 600 people. With minor upgrading to LS 19, a total population of 1700 could be serviced in Chilliwack Mountain. Beyond this population, further upgrading will be required to Lift Stations 19, 14 and 13 and to the 600 meters of forcemain on Aitken Road. Once the population surpasses 2700, twinning of the gravity trunk lines on Aitken and Yale Roads and the discharge forcemain from LS. 14 would be required.

The alternative to upgrading the existing infrastructure is to construct a new 1700 meter sewer line from Sunrise Estates along Scheyey Road to the sewage treatment plant located on Wolfe Road. Due to the flat topography, a pump station and forcemain would be required to overcome friction losses. It should be noted that this road also acts as a dyke to protect against flooding of the Fraser River.

An assumed Chilliwack Mountain population of 5,000 has been used for a preliminary evaluation of the costs associated with providing a new trunk line along Scheyey Road and upgrading the existing infrastructure.

The results are as follows:

Option 1: Construct new trunk line along Scheyey Road

• Sewage lift station (42 HP)	$210,000
• Forcemain (1700 meters - 300mm diam.)	$535,000
Total Cost	**$745,000**

Option 2: Upgrade existing infrastructure

• Twin Gravity trunk flowing into LS 19 (300mm)	$147,000
• Upgrade LS 19 (21 HP)	$ 50,000
• Twin Aitken Road Forcemain (200 mm)	$126,000
• Twin Aitken Road Gravity Trunk (300 mm)	$195,000
• Upgrade LS 14 (15 HP)	$ 50,000
• Twin Forcemain discharging from LS 14 (200mm)	$ 25,000
• Twin Yale Road Gravity Trunk (300mm)	$240,000
• Upgrade LS 13 (36 HP)	$155,000
Total Cost	**$988,000**

Final cost estimates will be computed in Phase 2 of the study once land use strategies and population forecasts are confirmed.

As shown, construction of a new sewer trunk line along Scheyey Road appears to be more economical than upgrading the existing works. Based on the above information, a service population of 1700 could be serviced by the existing infrastructure with minor lift station upgrades. Once the population surpasses this level it would be most economical to construct the new sewer on Scheyey Road.

The sewage treatment plant is currently servicing a population equivalency of 37,000 - 40,000. A plant expansion program is currently underway to expand the capacity to service an equivalent population of 55,000. Further expansion, as described in a 1994 Dayton & Knight report, will be required to service future development of Eastern Hillsides and Ryder Lake and provide service to 110,000 people. Therefore, proposed development of Chilliwack Mountain will not create a strain on the treatment plant.

Future On-Site Sewerage

The on-site sewer network will require two distinct branches due to topography. One branch will be required along the north face of the mountain and one along the south face. It is not yet confirmed whether or not the existing lots of Old Orchard Road and Chilliwack Mountain Estates will connect to the sewer system. At this stage, these areas have been identified as *potential* service areas, as indicated on Figure 8. Extending servicing to the areas would provide the opportunity for rezoning and densification at a later date. If service is not provided to these areas, the northern trunk sewer would terminate on Chilliwack Mountain Road at Alemeda Drive. All proposed developments at the west end of the mountain would then be serviced by the trunk line along the south face. Developer built lift stations would be required to lift a portion of the sewage over the topographic drainage divide.

Due to extremely steep topography, the trunk line along the south face may be required at the base of the mountain, thereby requiring sewage lift stations to convey the sewage to the east end of the mountain.

The District has current plans to construct a new gravity sewer on Lickman Road. Developments along the south face of the mountain would likely drain to the existing trunk line on Yale Road via this new gravity sewer. Once capacity is reached, the decision of whether to upgrade the existing system or construct a new trunk sewer on Scheyey Road would need to be made.

It is difficult at this stage to determine the most feasible option. Once the service area boundaries and populations have been identified, a final evaluation can be made.

4.3 Water Servicing

Background and Existing Infrastructure

Between the years 1987 and 1990, water servicing was constructed for Chilliwack Mountain Estates as shown on Figure 9. The four reservoirs were sized to provide fire flow and balancing storage for Chilliwack Mountain Estates and all Zone 3 lands shown on the south face of the

mountain. Based on the proposed zoning at that time, 204 lots would be serviced (an equivalent population of approximately 694 people).

In 1990 J.W. Wedler & Associates completed an extensive water servicing report which considered expansion of the existing infrastructure to provide servicing to the entire mountain. At the time the report was compiled, large single family lots (2 acre average) were still being proposed and the report presented infrastructure requirements to service an ultimate population of 2,329 people. Although a revised population estimate has not yet been determined, it is expected that both the existing infrastructure and that proposed in the Wedler report are under capacity for the developments now being proposed.

Sunrise Estates is currently serviced by a separate pump station and reservoir, drawing water from the Aitken Road water main on the valley floor and pumping to a reservoir with a top water level of 85.9 meters. Once the water service infrastructure is upgraded to meet the demands of the proposed developments, this pump station and reservoir will be abandoned and the upper levels of Sunrise Estates will be serviced from the Zone 2 reservoir located on Grandview Drive, while the lower levels will continue to be serviced from the Aitken Road water main of Zone 1.

Existing lots in Old Orchard Estates are serviced from the Zone 4 reservoir through a watermain extension from Chilliwack Mountain Estates constructed in 1994, while lots along Old Orchard Road are currently drawing water from springs, creeks and shallow wells. When the revised water servicing strategy is implemented all lots will be required to connect to the distribution system.

Future Servicing Infrastructure

The top water level of the Zone 4 reservoir (located on Bracken Drive) is 352.4 meters while the peak elevation on the Woodward property is 368.8 meters. Space is limited to construct additional storage at the Bracken Drive site, therefore additional storage for Zone 4 should be constructed on the Woodward property. This would require a new booster station at the intersection of Bracken Drive and Grandview Drive to raise the water an additional 16.4 meters. However, even with the reservoir placed at this higher location, all development above the elevation of 339 meters (approximately 19 hectares) would require an additional booster station to maintain the minimum pressure of 300 KPa.

The sites on which the Zone 1, 2 and 3 reservoirs are located have sufficient area available to expand the reservoir volume. Pump stations A, B and C currently have the capacity to service peak day domestic flow to only 653, 582 and 211 people, respectively, with capabilities of being expanded to service populations of 1600, 883 and 557 people (using the current District design standard of 1350 L/c/d). Therefore, in order to meet the future water demands, significant upgrading of these stations will be required. Pump stations B and C are currently operating on single phase power which will be insufficient for the upgrading work. Three phase power will need to be extended to these stations from Scheyey Road at the east end of the mountain at an estimated cost of $200,000.

A review of the District's water supply model indicates that the current water demand on the 400 mm diameter main on Yale Road at Lickman Road is 4.7 L/s with a residual pressure of 640 KPa. The water model also indicates that 232 L/s could be obtained at this point with a residual pressure of 300 KPa, which is defined as the minimum allowable pressure. Using the current District standard of 1350 L/c/d as the peak day demand, an additional population of approximately 14,000 people could be serviced on Chilliwack Mountain, which is far beyond what is expected. Therefore, the supply of water to the study area will not create any constraint on a proposed land use strategy.

A review of the reservoir service area boundaries proposed in the 1990 Wedler report (also shown on Figure 9) are reasonable to assume until more defined land use strategies and development boundaries are developed in Phase 2. Preliminary watermain extensions for future development are shown on Figure 9 which were developed from the existing infrastructure and reservoir service area boundaries. In most cases the future mains will extend through multiple pressure zones, thereby requiring pressure reducing valves to maintain a maximum pressure of 900 KPa.

It is premature at this stage to identify sizing requirements for the new infrastructure. This will be performed in Phase 2 of the study once land use strategies and population forecasts are confirmed.

Automated Sprinkler Systems

The Fire Underwriters Survey was consulted on the financial benefits of providing automatic sprinkler systems in all future multi-family construction. The current IAO Fire Protection Manual states that "the required fire flow may be reduced by 25-50 percent for buildings having approved fully automated sprinkler systems with satisfactory alarm systems and up to 75 percent if the building has fire proof construction".

Several communities, including the City of Vancouver, have questioned the IAO on allowable reductions in servicing infrastructure sizing if sprinkler systems are installed. While the fire protection manual does state a reduced fire flow, both the IAO and the insurance companies do not recommend decreasing infrastructure sizing in the event that the sprinkler system fails and conventional fire fighting measures are required. If the infrastructure was down-sized, the purchase of and ability to claim home owners insurance may be affected. However, the IAO does promote the use of sprinkler systems for added safety.

4.4 Storm Drainage

Based on available topographic mapping approximately 225 hectares (38%) of the study area drains south to the Agricultural Land Reserve (ALR) while the remaining 364 hectares (62%) drains north directly to Chilliwack Creek or the Fraser River. The drainage divide separating these areas is shown on Figure 10.

The geotechnical report, discussed in Section 3.3, indicates that the surficial soils are typically characterised by windblown silts (loess) which tend to be highly erodible, particularly when disturbed. In light of this, great care will be required both during and following construction in order to control the discharge of eroded soils into receiving water courses.

Lands draining north to the Fraser River may not require stormwater detention so long as drainage can be conveyed to the Fraser River without increasing the risk of erosion of flooding of the riparian corridors and properties along the base of the mountain. To accomplish this, the upgrading of overland drainage routes and implementation of

erosion control measures will be required. The Ministry of Environment has expressed concern about potential flooding and erosion of properties along the north edge of the mountain due to the fact that this area is not protected with a dyking system. Development along the waters edge must be located 0.6 meters above the 200 year flood line elevation. This flood construction level is 10.7 meters (a.m.s.l.) at the west end of the mountain and 11.0 meters at the east end of the mountain.

Future roads are expected to follow a typical rural section with gravel shoulders and road side ditches. Ditches will be required on the upslope side of the road to capture runoff and seepage. Development of the mountain is expected to increase runoff volumes and peak discharge rates, therefore during detailed design the hydraulics of the existing watercourses should be analyzed to ensure that there is sufficient capacity to convey the post-development flows. If they are found to be insufficient, new rip-rap lined channels or underground culverts should be constructed to prevent disruption of the existing riparian corridors. Also, gabion matting or concrete structures may be required at the discharge points of the watercourses to prevent increased erosion.

The Agricultural Land Commission is reluctant to give up land on the valley floor to accommodate urban development, including land associated with storm drainage facilities. For this reason, more strict control will be required on the lands draining south. Due to the steep topography there is virtually no opportunity for surface stormwater detention to reduce post-development runoff to pre-development levels. Alternate methods include oversized sacrificial pipes with control orifices in manholes or underground storage tanks.

Other possible improvements may be the upgrading of existing ditches on the valley floor, which are shown on Figure 10. The existing ditches are poorly graded with undersized culverts. A drainage study completed by McElhanney Engineering in March, 1987 proposed two alternatives for the upgrading of the Heppner and Chilliwack Mountain Road drainage ditches, however, neither have been constructed. These improvements would provide additional drainage capacity to the south-eastern portion of the mountain.

The south-western portion of the mountain will require a drainage system which conveys runoff west along the base of the mountain,

directly to the Fraser River. Upgrading of the ditches along Industrial Way and Old Orchard Road may be required.

4.5 Utilities

B.C. Gas, Tel and Hydro were all consulted on the requirements to extend utility services to the proposed development areas. While all three agencies indicated that minor on-site upgrading will be required, preliminary evaluations suggest there are no significant constraints in providing utility service to the anticipated developments. BC Gas has had a Preliminary plan for a few years to service the entire mountain.

5. Summary

5.1 Issues for Land Use and Servicing

The technical analysis that has been conducted in Phase 1 of this study has identified several issues as well as opportunities and constraints for future development in the Chilliwack Mountain area. The major issues for land use and servicing are summarized here.

Land Use Context

- The existing land use in the Chilliwack Mountain area consists of predominantly single family residential development. Almost 40% of the study area has been developed for low density residential purposes. Parcel sizes in existing subdivisions typically range between 2 and 5 acres.

- Approximately 40% of the study area is contained in rural and vacant (or undeveloped) properties. These lands represent the development proposal areas under consideration as part of a draft land use plan for Chilliwack Mountain.

- Current Official Community Plan (OCP) designations provide for future development to be at a low density and serviced by community water only. The zoning reflects the limited servicing to the area, and is predominantly rural, with small portions on the east side zoned for urban residential use.

- A plan for Chilliwack Mountain will reconsider the current OCP designations to determine appropriate land use and density of development with an urban level of servicing (including community sanitary sewer) provided to the area.

- Consideration should be given to the need for parks and open space, as well as to whether schools and commercial uses are to be provided within the study area.

- District growth projections anticipate a population of just less than 4,000 persons and predominantly single family residential development for Chilliwack Mountain. Should an urban level of servicing be provided to the area, a change in the projected housing mix to allow for increased multi-family residential development might be expected. Subsequent higher densities may increase the amount of development and ultimate population from earlier growth projections.

Physical Features

- The topography is characterised by relatively steep slopes (45° and locally steeper) at the margins incised by valleys, generally associated with discontinuities / geological boundaries.

- Less steep slopes and valleys are characterised by thicker overburden, probably windblown silt (loess). Loess is likely to be unstable if disturbed, and is susceptible to piping failure. It is unsuitable as fill.

- The topographic conditions in some areas of Chilliwack Mountain represent a constraint to urban development. Approximately 58 percent of the mountain contains steeper slopes of more than 30% slope angle. The steeper slope areas will need to be further examined to determine the general development capability of lands within the study area. Indications are that at least 42 percent of the mountain has capability for urban development in terms of slope conditions.

- Chilliwack Mountain is a significant visual feature in the Fraser Valley landscape. The importance of this feature is enhanced by the fact that clear views of the mountain are available from surrounding rural settlements, the community core of Chilliwack and the Trans Canada Highway to the south.

- Positioned in the regional landscape as it is, Chilliwack Mountain provides panoramic views of the Fraser Valley. This, combined with the fact that the mountains represents a large land base of non-ALR land, makes it a significant opportunity for residential development.

- To help reduce the incidence of conflict and properly plan for an area where visual values and development values can co-exist, an analysis of the visual environment of Chilliwack Mountain was conducted. Four primary landscape units were identified for visual sensitivity:

  Unit 1 - Eastern shoulder of the mountain.
  Moderate visual sensitivity.
  Except for ridgelines and edges, modest limitations on development.

  Unit 2 - South face of Chilliwack Mountain.
  Regionally significant; most visually sensitive unit.
  From a visual aspect, suitability for conventional development is very limited, particularly on steep slopes and ridgelines.

  Unit 3 - West shoulder and face of Chilliwack Mountain.
  High visual sensitivity.
  Development may occur provided integrity of forest slopes retained; ridgelines and transition between Unit 2 less suitable for development.

  Unit 4 - North side of the mountain.
  Moderate visual sensitivity.
  Development may occur without significant decrease in visual quality; provided appropriate response to ridgelines, topographic draws and natural contours.

- With respect to geotechnical concerns, few further slope stability problems are anticipated, except on steeper slopes. Investigation will be required prior to the design stage.

- Some areas of likely peat development have been identified - these will need to be removed and/or remediated prior to development.

- Consideration will need to be given to modification of natural drainage as a result of development, which may give rise to

excessive upstream erosion, downstream siltation and increased likelihood of flooding.

- Detailed geotechnical investigation will be required prior to the design stage of any development in the area.

- Typical forested habitats are late seral deciduous or mixed canopies typified by the presence of paper birch, broadleaf maple and occasionally Douglas fir. Deciduous species are not regenerating under undisturbed canopies. Shrub and herb layers are well developed in deep, moist soil areas and poorly developed under closed canopies with unstable, alluvial surface layers.

- Species with management priority sustained by the study area include mountain beaver.

- Fish species are not sustained by watercourses within the study area. However, Atchelitz Creek, Chilliwack Creek and the Fraser River, all of which sustain fish populations occur immediately adjacent to the study area.

- Habitats with high sensitivities to development include the Chilliwack Creek riparian corridor and known and potential mountain beaver tunnel locations. Development is not recommended within these habitats.

- Habitats with medium sensitivities to development include riparian corridors of ephemeral channels, gullies and ravines and the migration corridor/saddle feature in the western portion of the study area. Mitigate the effects of development with respect to these habitats.

- In general, development practices should adhere to guidelines addressed by the "Land Development Guidelines for the Protection of Aquatic Habitat" in order to minimize impacts to riparian areas and downstream habitats.

- Recommend future detailed environmental assessments key in on the presence or absence of other red and blue listed species common to the region.

Servicing Context

- The Chilliwack Mountain study area is currently linked to Chilliwack's commercial core by two rural municipal roads; Wolfe Road (and Scheyey Road) to the east and Lickman Road to the south. Current travel patterns indicate the majority of traffic to and from Chilliwack Mountain will travel via Lickman Road.

- Up to 4 traffic lanes (two inbound and two outbound) could be required to accommodate the ultimate population for Chilliwack Mountain. Traffic will likely be accommodated with rural road improvements, as well as some intersection improvements.

- Circulation around the mountain is provided by Chilliwack Mountain Road and Old Orchard Road. The internal local road system in the study area is limited, providing access to existing subdivisions.

- Existing level of sanitary servicing is limited to a small subdivision area at the eastern end of the mountain.

- A trunk sewer currently extends south from Chilliwack Mountain Road and then east and north to the sewage treatment plant. This existing sewer system, with upgrading, could accommodate the expected population.

- An alternative to upgrading the existing infrastructure is to construct a new trunk sewer north-east from Sunrise Estates at the east end of the study area along Scheyey Road and Wolfe Road to the sewage treatment plant.

- Preliminary cost estimates suggest a new trunk sewer on Scheyey Road would be more economical than upgrading the existing infrastructure, but is subject to final service population.

- The extent of the sanitary service area on the mountain will have to be determined in Phase 2 of this study when land use strategies are considered.

- Extensive water servicing infrastructure currently exists within the study area, however is insufficient to service the anticipated populations now being proposed.
- Extension of three phase power will be required for the upgrading of on-site booster pumping stations.
- Sufficient water is available on the valley floor to service an equivalent population of 14,000 people on Chilliwack Mountain.
- Significant upgrading of existing pump stations and reservoirs will be required to service future developments.
- The implementation of automated sprinkler systems will not reduce the sizing of watermains and reservoirs.
- Surficial soils are characterized by windblown silts which are highly susceptible to erosion. As a result, detailed erosion control measures will be required.
- Stormwater detention will be of lesser importance for the lands draining north directly to the Fraser River. However, lands draining to the south will require measures to protect the valley floor from increased flooding and erosion.
- Watercourses on the mountain slopes will require rip-rapping, gabion matting, energy dissipators and the like to prevent erosion of the channel banks.
- Very little opportunity exists for surface stormwater detention. Alternative methods may include oversized sacrificial pipes and underground storage tanks.
- The upgrading of drainage ditches on the valley floor may be required to improve drainage to Chilliwack Creek and the Fraser River.

PLANT SPECIES LIST FOR THE CHILLIWACK MOUNTAIN STUDY AREA

DISTRICT OF
CHILLIWACK

Chilliwack Mountain Comprehensive Development Plan

Background Report

APPENDIX A

Plant Species List and Vertebrate Species List

URBANSYSTEMS

May, 1995
950501.rpt

Plant Species List for the Chilliwack Mountain Study Area

Trees

Acer glabrum	Douglas maple
Acer macrophyllum	Bigleaf maple
Acer circinatum	Vine maple
Alnus rubra	Red alder
Alnus crispa ssp. *sinuata*	Sitka alder
Betula papyrifera	Paper birch
Cornus nuttallii	Western flowering dogwood
Pinus contorta	Shore (Lodgepole) pine
Populus balsamifera ssp. *trichocarpa*	Black cottonwood
Populus tremuloides	Trembling aspen
Prunus emarginata	Bitter cherry
Pseudotsuga menziesii ssp. *menziesii*	Douglas-fir
Thuja plicata	Western redcedar
Tsuga heterophylla	Western hemlock

Shrubs

Cornus stolonifera	Red-osier dogwood
Corylus cornuta var. *californica*	Beaked hazelnut
Holodiscus discolor	Ocean spray
Lonicera involucrata	Black twinberry
Mahonia nervosa	Dull oregon-grape
Oemlaria cerasiformis	Indian plum
Oplopanax horridus	Devil's club
Ribes lacustre	Black gooseberry
Ribes sanguineum	Red-flowering currant
Rosa gymnocarpa	Baldhip rose
Rubus discolor	Himalayan blackberry
Rubus parviflorus	Thimbleberry
Rubus spectabilis	Salmonberry
Rubus ursinus	Trailing blackberry
Salix lucida ssp. *lasiandra*	Pacific willow
Sambucus cerulea	Blue elderberry
Sambucus racemosa	Red elderberry
Symphoricarpos albus	Common snowberry
Vaccinium parvifolium	Red huckleberry

Plant Species List for the Chilliwack Mountain Study Area (cont'd)

Herbs

Achyls triphylla	Vanilla leaf
Adiantum pedatum	Maidenhair fern
Aquilegia formosa	Red columbine
Arctium minus	Common burdock
Aruncus dioicus	Goat's beard
Athyrium felix-femina	Lady fern
Blechnum spicant	Deer fern
Circaea alpina	Enchanter's nightshade
Cirsium arvense	Canada thistle
Claytonia perfoliata	Miner's lettuce
Claytonia siberica	Siberian miner's lettuce
Clintonia uniflora	Queen's cup
Dicentra formosa	Pacific bleeding heart
Disporum hookeri	Hooker's fairy bells
Dryopteris expansa	Spiny wood-fern
Equisetum arvense	Common horsetail
Festuca subulata	Bearded fescue
Galium aparine	Cleavers
Galium triflorum	Sweet-scented bedstraw
Geranium robertianum	Roberts geranium
Geum macrophyllum	Large-leaved avens
Impatiens sp.	Touch-me-not
Lactuca muralis	Wall lettuce
Lathyrus nevadensis	Purple peavine
Lilium columbianum	Tiger lily
Lupinus sp.	Lupines
Melica subulata	Alaska oniongrass
Polypodium glycyrrhiza	Licorice fern
Polystichum munitum	Sword fern
Pteridium aquilinum	Bracken fern
Ranunculus repens	Creeping buttercup
Smilacina racemosa	False Solomon's seal
Smilacina stellata	Star-flowered Solomon's seal
Solidago sp.	Goldenrods
Thalictrum occidentale	Western meadowrue
Tiarella trifoliata	Foamflower
Tolmiea menziesii	Youth-on-age

Plant Species List for the Chilliwack Mountain Study Area (cont'd)

Herbs (cont'd)

Trientalis latifolia	Broad-leaved starflower
Trillium ovatum	Western trillium
Urtica dioica	Stinging nettle
Viola glabella	Yellow wood violet

Mosses

Hylocomium splendens	Step moss
Isothecium myosuroides	Electric cat tail moss
Kindbergia oregana	Oregon beaked moss
Kindbergia praelonga	Slender beaked moss
Neckera douglasii	Douglas neckera
Plagiomnium insigne	Coastal leafy moss
Plagiothecium undulatum	Flat moss
Rhytidiadelphus triquetrus	Electrified cat's-tail moss

VERTEBRATE SPECIES LIST FOR THE CHILLIWACK MOUNTAIN STUDY AREA

R = Red-listed species - candidates for legal designation as threatened or endangered
B = Blue-listed species - vulnerable or sensitive
Y = Yellow-listed species - management emphasis

O = denotes species or signs of species observed during field survey

Vertebrate Species List for the Chilliwack Mountain Study Area

HERPTILES

Northwestern garter snake	*Thamnophis ordinoides*	
Common (Valley) garter snake	*Thamnophis sirtalis fitchi*	
Western terrestrial garter snake	*Thamnophis elegans*	
Northern alligator lizard	*Gerrhonotus coeruleus*	
Red-legged frog	*Rana aurora*	
Pacific tree frog	*Hyla regilla*	O
Western toad	*Bufo boreas*	
Western red-backed salamander	*Plethodon vehiculum*	
Northwestern salamander	*Ambystoma gracile gracile*	O
Western long-toed salamander	*Ambystoma macrodactylum*	O
Ensantina salamander	*Ensatina eschscholtzii*	
Rough-skinned newt	*Taricha granulosum*	

BIRDS

Mallard	*Anas platyrhynchos*	Y
Common goldeneye	*Bucephala clangula*	Y
Bufflehead	*Bucephala albeola*	Y
Canada goose	*Branta canadensis canadensis*	Y
Turkey vulture	*Cathartes aura*	B
Sharp shinned hawk	*Accipiter striatus*	
Northern goshawk	*Accipiter gentilis laingi*	
Cooper's hawk	*Accipiter cooperi*	
Red-tailed hawk	*Buteo jamaicensis*	
Bald eagle	*Haliaeetus leococephalus*	B
American kestrel	*Falco sparverius*	
Merlin	*Falco columbaris*	
Ring necked pheasant	*Phasianus colchicus*	
Ruffed grouse	*Bonasa umbellus*	O, Y
Common snipe	*Glallinago gallinago*	
Spotted sandpiper	*Actitis macularia*	
Great blue heron	*Ardea herodias*	B
Rock dove	*Columba livia*	
Mourning dove	*Zenaida macroura*	Y
Barn owl	*Tyto alba*	
Western screech owl	*Otus kennicottii kennicottii*	B

Vertebrate Species List for the Chilliwack Mountain Study Area (cont'd)

BIRDS

Great horrned owl	*Bubo virginianus*	
Barred owl	*Strix viria*	
Northern saw-whet owl	*Aegolius acadicus*	
Common nighthawk	*Chordeiles minor*	
Black swift	*Cypseloides niger*	
Vaux's swift	*Chaetura vauxi*	
Rufous hummingbird	*Selaphorus rufus*	
Calliope hummingbird	*Stellula calliope*	
Downy woodpecker	*Picoides villosus picoideus*	
Hairy woodpecker	*Picoides pubescens*	
Pileated woodpecker	*Dryocopus pileatus*	O, Y
Northern flicker	*Colaptes auratus*	O
Olive sided flycatcher	*Contopus borealis*	
Willow flycatcher	*Empidonax traillii*	
Western flycatcher	*Empidonax difficilis*	
Eastern kingbird	*Tyrannus tyrannus*	
Tree swallow	*Tachycineta bicolor*	O
Violet-green swallow	*Tachycineata thalassima*	
Barn swallow	*Hirundo rustica*	
Steller's jay	*Cyanocitta stelleri carlottae*	O
American crow	*Corvus brachyrhynchos*	
Northwestern crow	*Corvus caurinus*	
Common raven	*Corvus corax*	
Black-capped chickadee	*Parus atricapillus*	O
Chestnut-backed chickadee	*Parus rufescens*	O
Red-breasted nuthatch	*Sitta canadensis*	
White-breasted nuthatch	*Sitta carolinensis*	
Brown creeper	*Certhia familiaris*	
Bewick's wren	*Thryomanes bewickii*	
Winter wren	*Troglodytes troglodytes*	O
Marsh wren	*Cistothorus palustris*	
Golden-crowned kinglet	*Regulus calendula*	O
Ruby-crowned kinglet	*Regulus satrapa*	O
Townsend's solitaire	*Myadestes townsendi*	O
Swainson's thrush	*Catharus ustulata*	
American robin	*Turdus migratorius*	O
Varied thrush	*Ixoreus naevius*	
American dipper	*Cinclus mexicanus*	
Gray catbird	*Dumetella carolinensis*	
Cedar waxwing	*Bombycilla cedrorum*	

Vertebrate Species List for the Chilliwack Mountain Study Area (cont'd)

BIRDS

Northern shrike	*Lanius excubitor*	
European starling	*Sturnus vulgaris*	
Solitary vireo	*Vireo solitarius*	
Red-eyed vireo	*Vireo olivaceus*	
Orange-crowned warbler	*Vermivora celata*	O
Nashville warbler	*Vermivora ruficapilla*	
Yellow warbler	*Dendroica petechia*	
Yellow-rumped warbler	*Dendroica coronata audoboni*	O
Black-throated gray warbler	*Dendroica nigrescens*	
MacGillivray's warbler	*Oporornis tolmiei*	
Common yellowthroat	*Geothlypis trichas*	
Wilson's warbler	*Wilsonia pusilla*	
Western tanager	*Piranga ludoviciana*	
Black-headed grosbeak	*Pheucticus melanocephalus*	
Rufous-sided towhee	*Pipilo erythrophthalmus*	
Chipping sparrow	*Spizella passerina*	
Song sparrow	*Melospiza melodia*	
Golden-crowned sparrow	*Zonotrichia atricapilla*	
White-crowned sparrow	*Zonotrichia leucophrys*	
Dark-eyed junco	*Junco hyemalis oreganus*	O
Red-winged blackbird	*Agelaius phoeniceus*	
Brown-headed cowbird	*Molothrus ater*	
Northern oriole	*Icterus galula bullocki*	
Purple finch	*Carpodacus purpureus*	
House finch	*Carpodacus mexocamis*	
Pine siskin	*Carduelis pinus*	
American goldfinch	*Carduelis tristis*	
House sparrow	*Passer domesticus*	

Vertebrate Species List for the Chilliwack Mountain Study Area (cont'd)

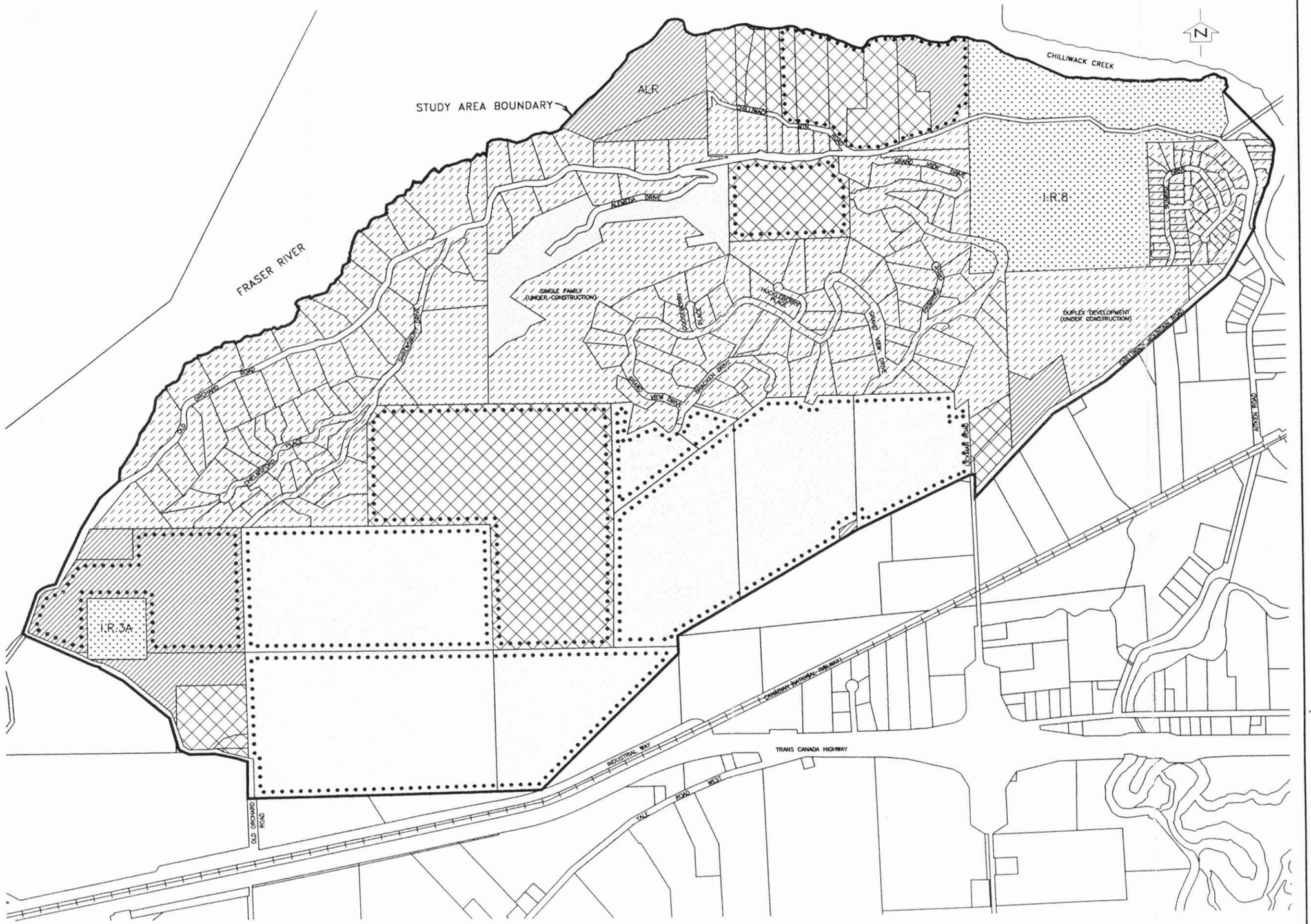
MAMMALS

Common shrew	*Sorex cinereus*	
Dusky shrew	*Sorex monticolus*	
Water shrew	*Sorex palustris*	
Wandering shrew	*Sorex vagrans*	
Trowbridge's shrew	*Sorex trowbridgii*	B
Shrew mole	*Neurotrichus gibbsii*	B
Coast mole	*Scapanus orarius*	
North american opossum	*Didelphis virginia*	
Eastern cottontail	*Sylvilagus floridanus*	
Big brown bat	*Eptesicus fuscus*	
California bat	*Myotis californicus caurinus*	
Western long-eared bat	*Myotis evotis*	
Keen's long-eared bat	*Myotis keeni*	R
Little brown bat	*Myotis lucifugus*	
Long-legged bat	*Myotis volans*	
Yuma bat	*Myotis yamanensis*	
Silver-haired bat	*Lasionycteris noctivagans*	
Hoary bat	*Laiurus cinereus*	
Townsend's big-eared bat	*Plecotus townsendii*	B
Long-tailed vole	*Microtus longicaudus*	
Townsend's vole	*Microtus townsendii*	
Creeping vole	*Microtus oregoni*	
Muskrat	*Ondatra zibethicus osoyoosensis*	
Mountain beaver	*Aplodontia rufa rufa*	O, R
Bushy-tailed woodrat	*Neotoma cineara*	
Deer mouse	*Peromyscus maniculatus*	
Columbian mouse	*Peromyscus oreas*	
Douglas squirrel	*Tamias douglasii*	O
Townsend's chipmunk	*Tamias townsendii*	Y
Northern flying squirrel	*Glaucomys sabrinus*	
Long-tailed weasel	*Mustela frenata*	Y
Mink	*Mustela vison*	Y
Striped skunk	*Mephitis mephitis*	Y
Raccoon	*Procyon lotor*	O, Y
Black bear	*Ursus americanus*	O, Y
Coyote	*Canis latrans*	O, Y
Black-tailed deer	*Odocoileus hemionus columbianus*	O, Y

CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

EXISTING LAND USE



LEGEND

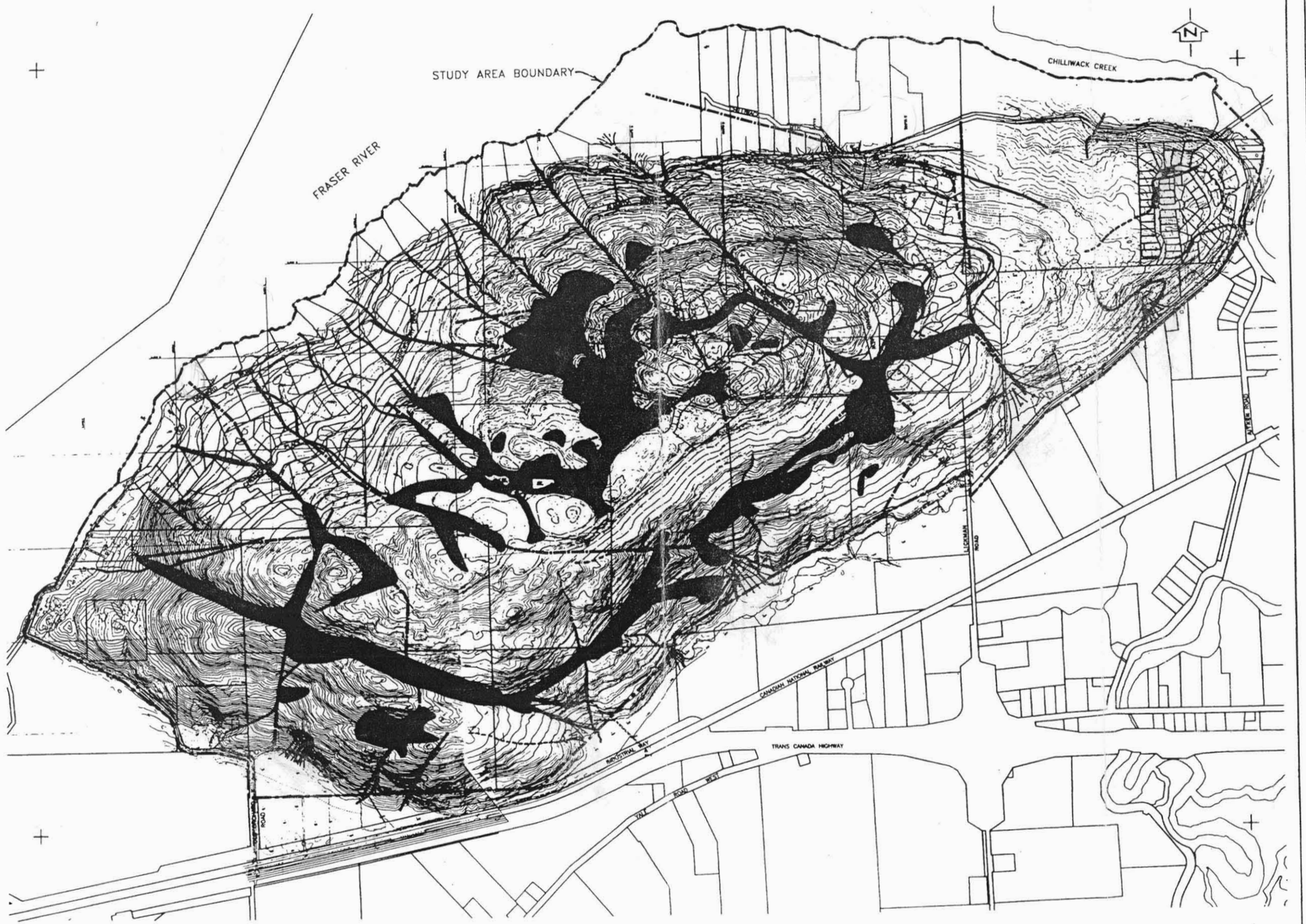
- RESIDENTIAL
- RURAL
- AGRICULTURAL
- VACANT
- INDIAN RESERVE
- DEVELOPMENT PROPOSAL AREA

FIGURE 2

DATE: MAY 1995

50 0 50 100 150 200 250 METRE

PREPARED BY:
URBAN SYSTEMS



CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

ENGINEERING GEOLOGY

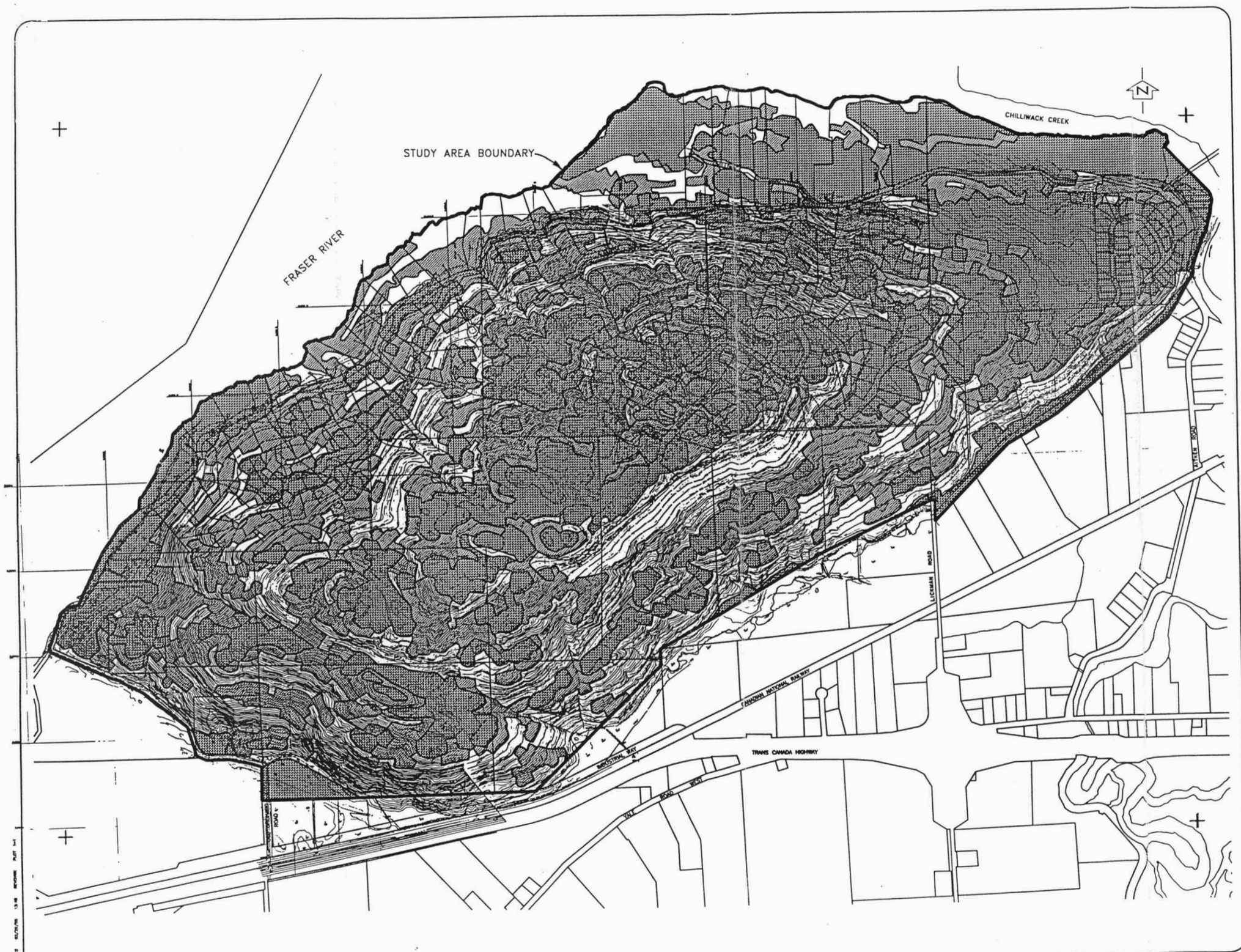
LEGEND

- FAULT/DISCONTINUITY HIGH CONFIDENCE
- FAULT/DISCONTINUITY MODERATE CONFIDENCE
- FAULT/DISCONTINUITY POSSIBLE
- STREAM/CREEK (POSSIBLE)
- BOG/WET AREA
- SCAR
- DEBRIS FAN
- AREA OF THICKER OVERBURDEN

FIGURE 5

DATE: MAY 1995

PREPARED BY: URBAN SYSTEMS



CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

SLOPE ANALYSIS

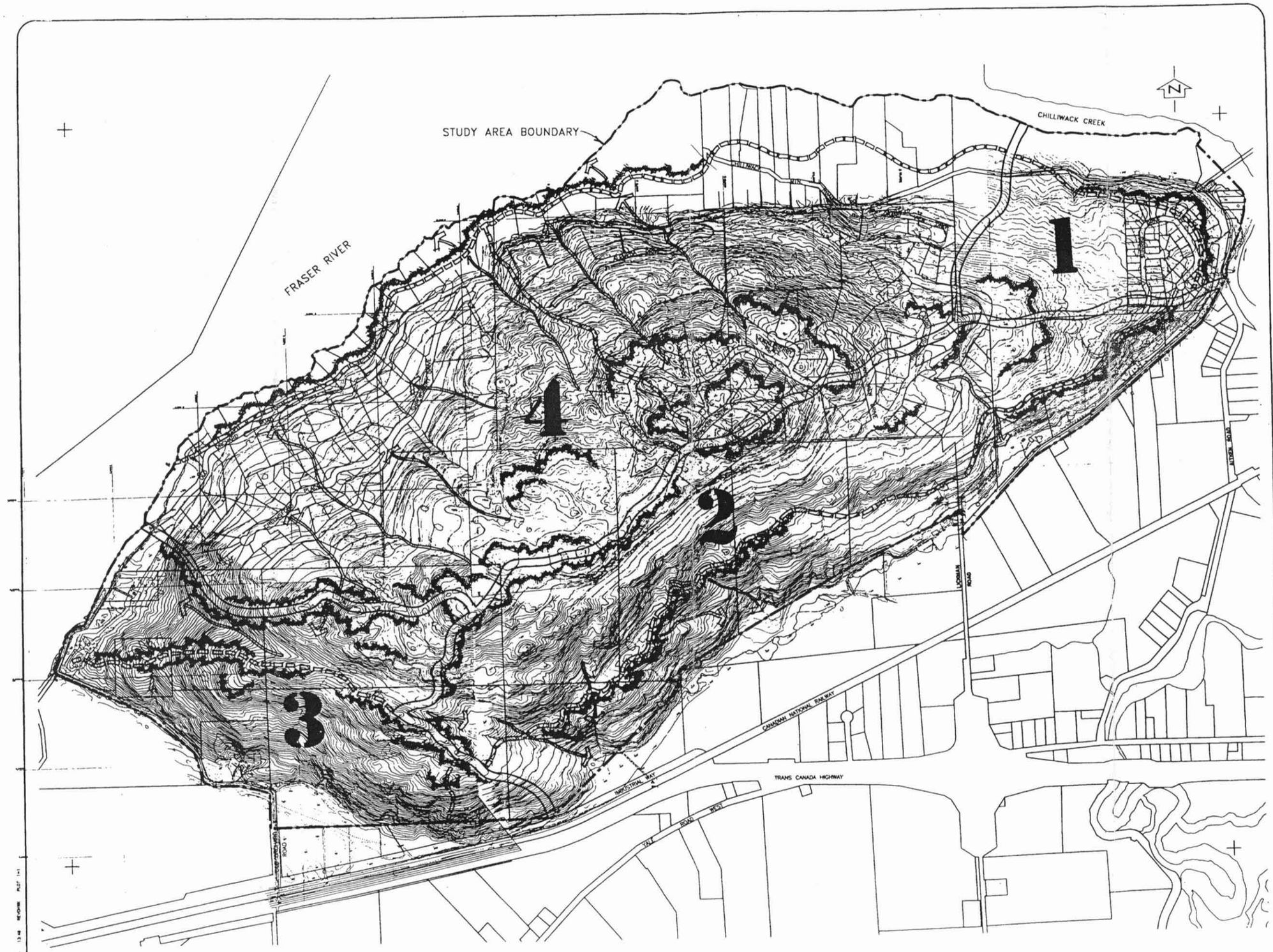
LEGEND

- 0 - 30%
- 30 - 50%
- GREATER THAN 50%

FIGURE 3

DATE: MAY 1995

PREPARED BY: URBAN SYSTEMS



CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

VISUAL INVENTORY

LEGEND

- 2 — LANDSCAPE UNIT NUMBER
- LANDSCAPE UNIT BOUNDARY
- LANDSCAPE UNIT SUB-BOUNDARY
- PROMINENT RIDGELINE
- PROMINENT TOPOGRAPHIC DRAW

FIGURE 4

DATE: MAY 1986

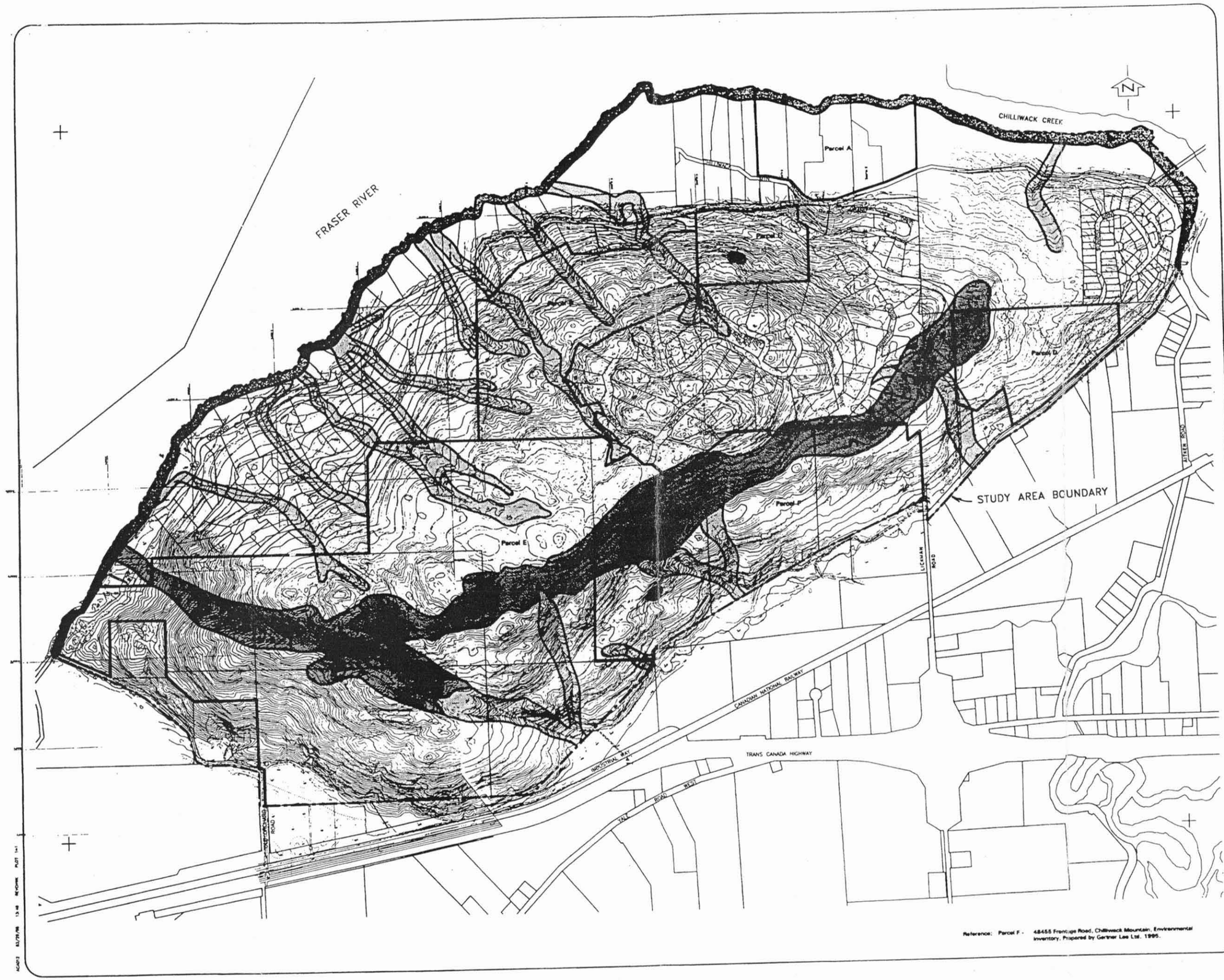
METRE

PREPARED BY URBAN SYSTEMS

CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

ENVIRONMENTALLY SENSITIVE AREAS



LEGEND

- Mountain Beaver (Aplodontia rufa) Known location of mountain beaver tunnel systems
- Black Bear (Ursus americanus) Know location of black bear bedding site
- Bald Eagle (Haliaeetus leucocephalus) Active bald eagle nest location

HIGH SENSITIVITY

FRASER RIVER/CHILLIWACK CREEK RIPARIAN CORRIDOR
Establish 30 metre setback from high water mark (to be determined) to maintain functional attributes of riparian corridor

MOUNTAIN BEAVER HABITATS
Maintain functional attributes of existing habitats

MEDIUM SENSITIVITY

WATERCOURSES AND RIPARIAN CORRIDORS
Establish 9 metre setback from topographic top of bank for gully and ravine sections

Where watercourse undefined or not contained within ravine or gully establish setback 15 metres from high water mark

WILDLIFE CORRIDOR/SADDLE AREA
Wetted saddle and riparian area with high wildlife values and potential for red-listed species presence

FIGURE 6

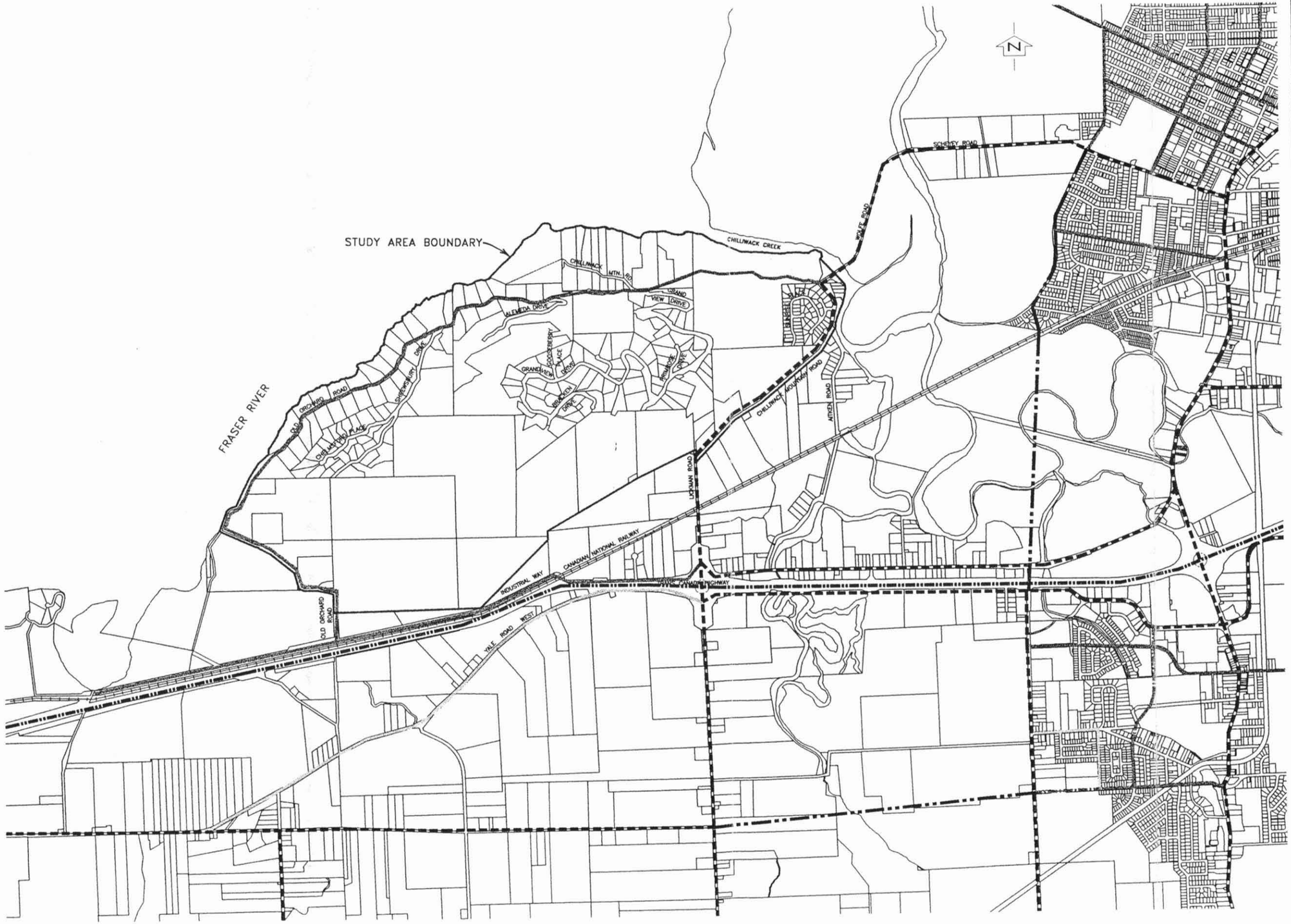
environwest
ENVIRONMENTAL CONSULTANTS

DATE: May 1996 | ECL DRWG NO.: 484-07-01

200 0 200 400 600 800 1000 METRE

PREPARED BY: URBAN SYSTEMS

Reference: Parcel F - 48455 Francjue Road, Chilliwack Mountain, Environmental Inventory. Prepared by Gartner Lee Ltd. 1995.



CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

EXISTING ROAD CLASSIFICATION

(IN THE VICINITY)

LEGEND

- RAILWAY
- HIGHWAY
- EXISTING ARTERIAL
- PROPOSED ARTERIAL
- COLLECTOR
- MINOR COLLECTOR
- PROPOSED COLLECTOR

REMAINING FACILITIES ARE LOCAL ROADS

FIGURE 7

DATE: MAY 1995

100 0 100 200 300 400 500 METRE

PREPARED BY:
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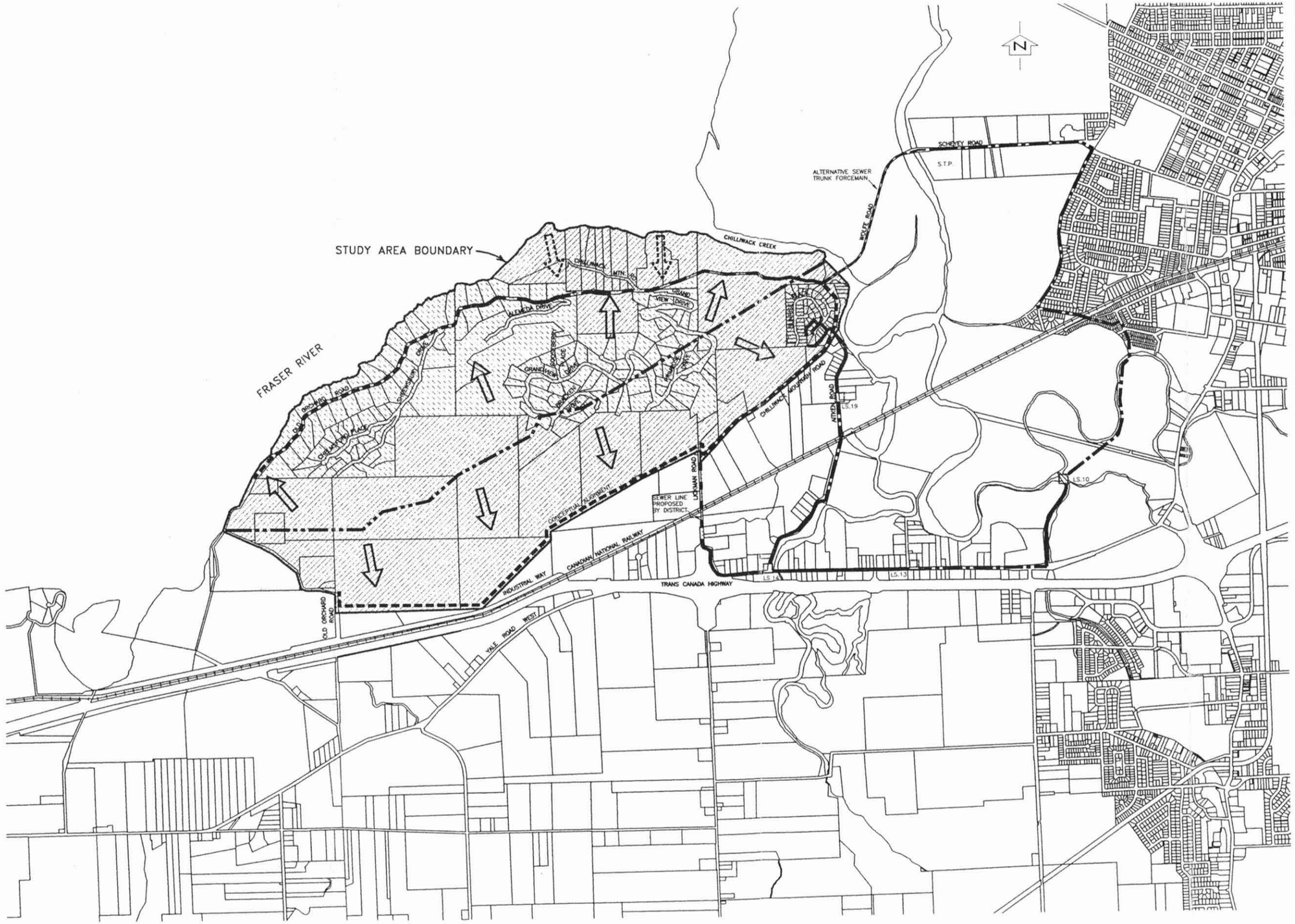


CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

SANITARY SERVICING

LEGEND

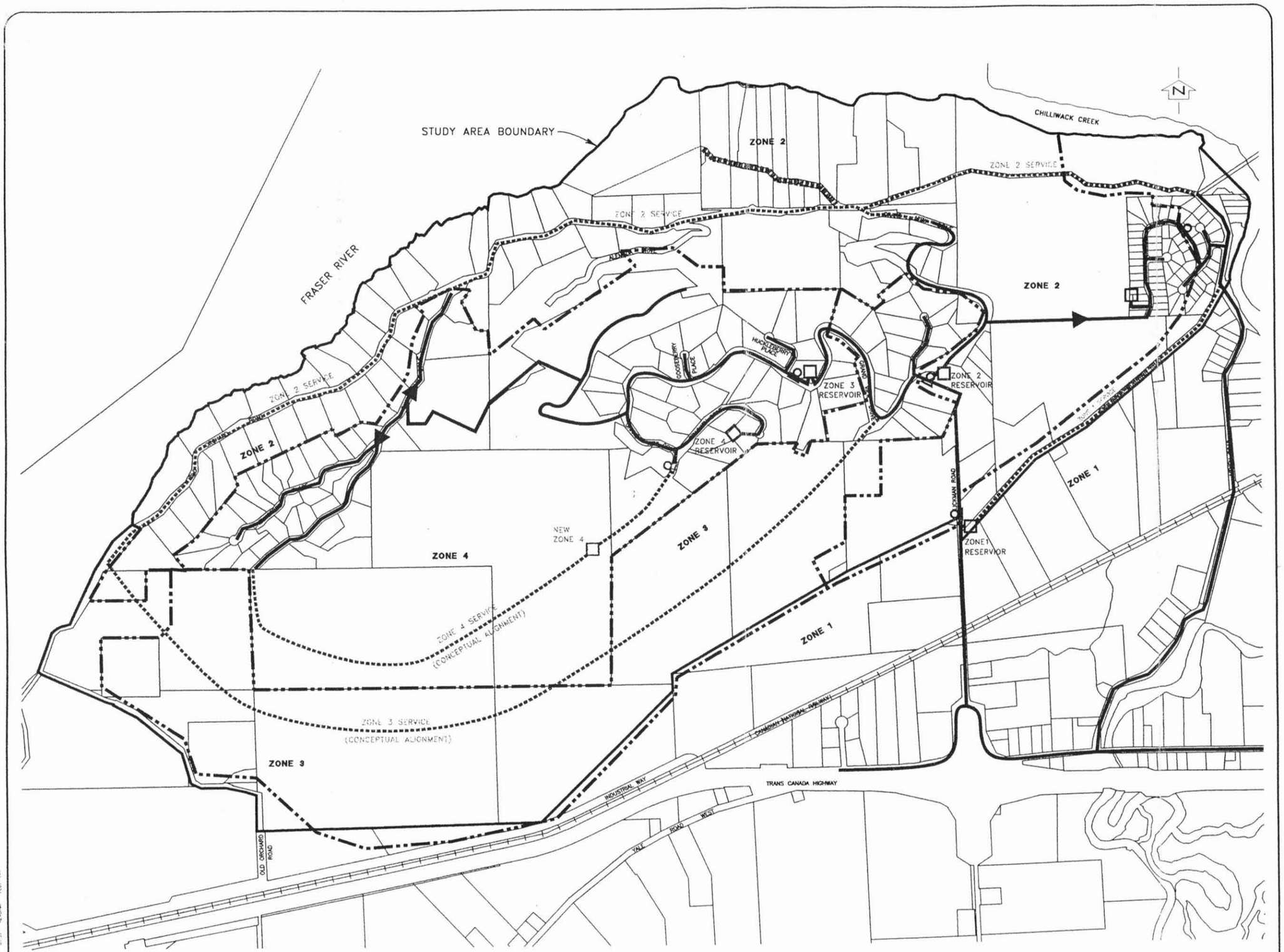
- EXISTING FORCEMAIN
- EXISTING GRAVITY SEWER
- LS.1.3 EXISTING LIFT STATION
- SERVICE AREA
- POTENTIAL SERVICE AREA
- TOPOGRAPHIC DRAINAGE DIVIDE
- GRAVITY FLOW
- PUMPED FLOW
- PROPOSED FORCEMAIN
- PROPOSED GRAVITY SEWER

FIGURE 8

DATE: MAY 1995

100 0 100 200 300 400 500 METRE

PREPARED BY: URBAN SYSTEMS



CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

WATER SERVICING

LEGEND

- ZONE BOUNDARY
- EXISTING WATERMAIN
- EXISTING RESERVOIR
- EXISTING PUMP STATION
- PRV STATION
- PROPOSED WATERMAIN
- PROPOSED RESERVOIR
- PROPOSED PUMP STATION

FIGURE 9

DATE: MAY 1995

100 0 100 200 300 400 500 METRE

PREPARED BY: URBANSYSTEMS

CHILLIWACK MOUNTAIN

COMPREHENSIVE DEVELOPMENT PLAN

DRAINAGE

LEGEND

- MAJOR DRAINAGE DIVIDE
- GENERAL DRAINAGE DIRECTION
- EXISTING DRAINAGE DITCH
- CREEK/STREAM

FIGURE 10

DATE: MAY 1995

50 0 50 100 150 200 250 METRE

PREPARED BY: URBAN SYSTEMS