Identification of Fisheries Values and Protection Strategies for Aquatic and Riparian Areas in the City of Prince George, B.C.

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IDENTIFICATION OF FISHERIES VALUES AND PROTECTION STRATEGIES FOR AQUATIC AND RIPARIAN AREAS IN THE CITY OF PRINCE GEORGE, B.C.

by

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TABLE OF CONTENTS

List of Figures

List of Tables

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City of Vernon
City of Victoria
Corporation of Delta
District of Chilliwack
District of Maple Ridge
District of Mission
District of Saanich
District of North Vancouver
District of West Vancouver
Regional District of the Central Okanagan
Resort Municipality of Whistler
Township of Langley

ABSTRACT

The central focus of this report is to identify and classify sensitive aquatic and riparian areas. Specific objectives of the study are to map watershed boundaries, identify areas of resident fish use, review current Natural Environment Development Permit Areas and prepare expanded guidelines to protect these areas. The report outlines an action plan for guideline implementation, and identifies additional municipal planning tools for protecting aquatic areas within the City of Prince George.

The report recommends that certain areas (outlined in Section 5.0) be adopted by the City of Prince George as an Official Community Plan (OCP) amendment and that the City enter into a Memorandum of Understanding with DFO and MELP to create an Environmental Review Committee to oversee implementation of stream protection measures. It is also suggested that the City initiate a comprehensive Environmentally Sensitive Areas (ESA) study designed to provide information on fish habitats, and inventories of biophysical features.

RÉSUMÉ

Ce rapport consiste essentiellement à identifier et à classifier des zones riveraines et aquatiques sensibles. L'étude a plus précisément pour objectifs de délimiter le bassin hydrographique sur une carte, d'identifier les secteurs d'utilisation des poissons locaux, de réviser les zones de permis d'aménagement de l'environnement naturel et de préparer des lignes directrices élargies pour protéger ces endroits. Le rapport expose un plan d'action pour la mise en oeuvre des lignes directrices et identifie des outils additionnels de planification municipale en vue de protéger les zones aquatiques situées dans la ville de Prince George.

Le rapport recommande que certaines zones (précisées dans la section 5.0) soient adoptées par la ville de Prince George à titre de modification au plan officiel de la collectivité, et que la ville conclue un protocole d'entente avec le MPO et le ministère de l'Environnement, des Terres et des Parcs et crée un comité d'examen de l'environnement pour surveiller la mise en oeuvre des mesures de protection des cours d'eau. Il est aussi suggéré que la ville entreprenne une étude sur les zones écologiquement vulnérables afin d'obtenir de l'information sur les habitats des poissons et de dresser des inventaires des caractéristiques biophysiques.

1.0 INTRODUCTION

In the past decade, municipal governments have made significant progress in establishing measures to protect streams and other aquatic areas. This process has occurred, in part, as a response to the large number of fisheries referrals associated with urban development and the demands the referral volume is placing on federal (DFO) and provincial (MELP) environmental agencies. It is therefore becoming more common for municipal governments to initiate Environmentally Sensitive Areas studies (ESAs), to incorporate elements of the *Land Development Guidelines for the Protection of Aquatic Habitat* (Chilibeck *et al.* 1992) into their bylaws, and to place environmental coordinators on their staff in order to ensure environmentally sustainable practices are implemented at the municipal level. Federal and provincial environmental agencies are supporting these changes in many municipalities and are providing assistance to local planning bodies through interpreting guidelines, managing complex or technical referrals, setting Habitat Mitigation Agreements (HMAs), and providing environmental enforcement where necessary. In particular, DFO and MELP have begun to rely more on municipal governments to apply the standards outlined in Land Development Guidelines and other habitat management policies to new development proposals. The requirements under the Land Development Guidelines typically include fisheries sensitive zone leavestrips, mitigation planning, restricted construction windows, sediment control design, and restrictive covenants.

A central focus of this study is to identify and classify aquatic and riparian areas within the City of Prince George. This information will enable the City to initiate a process by which development can be regulated around aquatic areas. Currently, the City of Prince George relies on Natural Environment Development Permit Areas (DPAs) and a recently completed Tree Protection Bylaw to regulate development activities around specific aquatic features and in important forested areas. Natural Environment DPAs exist for portions of McMillan and Parkridge creeks (including Parkridge Lake) as well as for Fraser Vista (Goose) Slough, a backwater of the Fraser River in the northeast corner of the City. A related focus of this study is to further develop planning strategies to better protect streams and other aquatic areas within City limits.

1.1 Project Scope

The Fraser River Action Plan (FRAP) of the Department of Fisheries and Oceans initiated this project in 1994 to provide the City of Prince George with the necessary

technical information they require to protect small streams and other aquatic areas in the City. Key components of the project included providing an overview map of the streams and other aquatic areas within the City limits, and a series of maps delineating fisheries sensitive zone boundaries for representative areas of Parkridge and McMillan creeks, two stream systems which are under considerable development pressures. This report also evaluates the current Natural Environment DPAs used by the City and recommends additional areas and expanded DPA guidelines. Furthermore, the report identifies other municipal environmental protection strategies which could be used by the City of Prince George to protect aquatic habitats.

Specific objectives of the project were to:

- identify environmentally sensitive aquatic and riparian areas, particularly from a fisheries perspective, within the City of Prince George;
- map watershed boundaries, identify areas of resident fish use, and determine fisheries sensitive zone setbacks for Parkridge and McMillan creeks;
- review the current Natural Environment DPAs for Parkridge Creek, McMillan Creek, and Fraser Vista (Goose) Slough;
- recommend additional areas for protection using Natural Environment DPAs;
- prepare expanded DPA guidelines to effectively protect these areas;
- develop an action plan for guideline implementation; and,
- identify additional municipal planning tools for protecting aquatic areas within the City of Prince George.

2.0 AQUATIC AREAS IN THE CITY OF PRINCE GEORGE

The City of Prince George is situated in the central interior of British Columbia at the confluence of the Fraser and Nechako rivers. It encompasses an area of approximately 324 km^2 and has a population of 69,700 (1991 census). The diverse topography of the City is largely a result of glacial processes and its location adjacent to the large rivers which have created floodplain benches, steep escarpment slopes, and gravel knolls. A relatively flat plateau, bisected by small stream ravines and wetland areas, extends to the west above the escarpment slopes. The northern and eastern portions of the City are characterized by more subdued topography with rolling hills, small stream valleys, and extensive wetlands. The majority of urban development has occurred on the southwestern side of the City in the low-lying areas within the Fraser and Nechako river valleys, although in the past ten years areas to the southwest (Parkridge area) and north (Hart Highlands) have undergone increasing residential development.

Small streams, sloughs, and wetlands (e.g., sedge marshes, forested swamps, and shallow open water ponds) that originate in poorly drained post-glacial depressions above the central river valleys are common throughout the Prince George area. Although many of these habitat areas do not support fish populations, they provide important habitat for many plant and animal species of the central interior. Wildlife species, in particular, are reliant on aquatic and riparian areas because they combine the critical habitat elements of food, water, and cover. In addition, riparian areas are used as daily and seasonal migration corridors for a diverse community of birds and mammals.

With the exception of small streams and sloughs that are currently accessible to fish from the Fraser and Nechako rivers or were colonized during the retreat of glacial ice, fish species are poorly distributed in aquatic areas in the City's upland plateau. The high gradient of many of the small streams as they flow down the escarpment slopes that define the river valleys, precluded colonization even under flood conditions and ice jams following the recession of glacial ice. In addition, many of these streams are intermittent or ephemeral which greatly limits their ability to support populations of resident fish (i.e., rainbow trout, mountain whitefish).

2.1 Fisheries Values

The aquatic areas within the City can be divided into three categories based on characteristics of habitat type, stream order (size), riparian condition, channel

morphology, and fisheries characteristics: i) the Fraser and Nechako rivers including their sloughs and sidechannels; ii) small stream systems such as McMillan, Parkridge, and Haggith creeks; and, iii) lakes and wetlands including Parkridge and Ferguson lakes. A general description of fisheries values and conditions for aquatic areas within these classes is included below. It is important to note that a comprehensive fisheries assessment has not been undertaken for many of the small streams in the City and fish distribution information is generally poor. In addition, previous sampling programs on the Fraser and Nechako rivers have focussed on salmonid use rather than the occurrence of non-salmonid species.

The locations of the aquatic features described in the following two sections are shown in Figure 1.

2.2 Fraser and Nechako Rivers

Both the Fraser and Nechako rivers in the Prince George area provide critical rearing habitat and migration routes for several species of anadromous salmonid including chinook salmon (Upper Fraser, Nechako, and Stuart stocks); sockeye salmon (Stellako, Nadina, Stuart, and Bowron stocks); and pink salmon (Nowotny and Hickey 1993). Anadromous salmonid spawning has not been documented within the City limits, although some sections of the Nechako River may be used by odd year pink salmon. In addition, rainbow trout, bull trout, mountain whitefish, and up to twenty one non-salmonid species may occur, at least seasonally, in the Prince George area. A list of fish species occurring in the middle Fraser subregion is included in Table 1 (from McPhail and Carveth 1993). Table 2 summarizes fish presence information and habitat values for the Fraser and Nechako rivers and associated aquatic features.

A comprehensive sampling program for juvenile salmonids in 1986-1987 found juvenile chinook use was higher than for any other salmonid or non-salmonid species in the Prince George area (Rosberg and Millar 1987). Juvenile chinook originating in upstream spawning grounds rely on warmer, less turbid, and lower velocity areas along the river margins and the mouths of small tributary streams for rearing as they migrate downstream in late spring and early summer. Fish sampling within the City between April and August 1993 also documented juvenile chinook use within the accessible lower reaches of many of the small streams. It is important to note that most chinook stocks in the upper and middle Fraser remain in freshwater for one year before migrating to sea (stream-type stocks) which increases their reliance on nearshore areas for rearing (Nowotny and Hickey 1993; Hickey and Lister 1981).

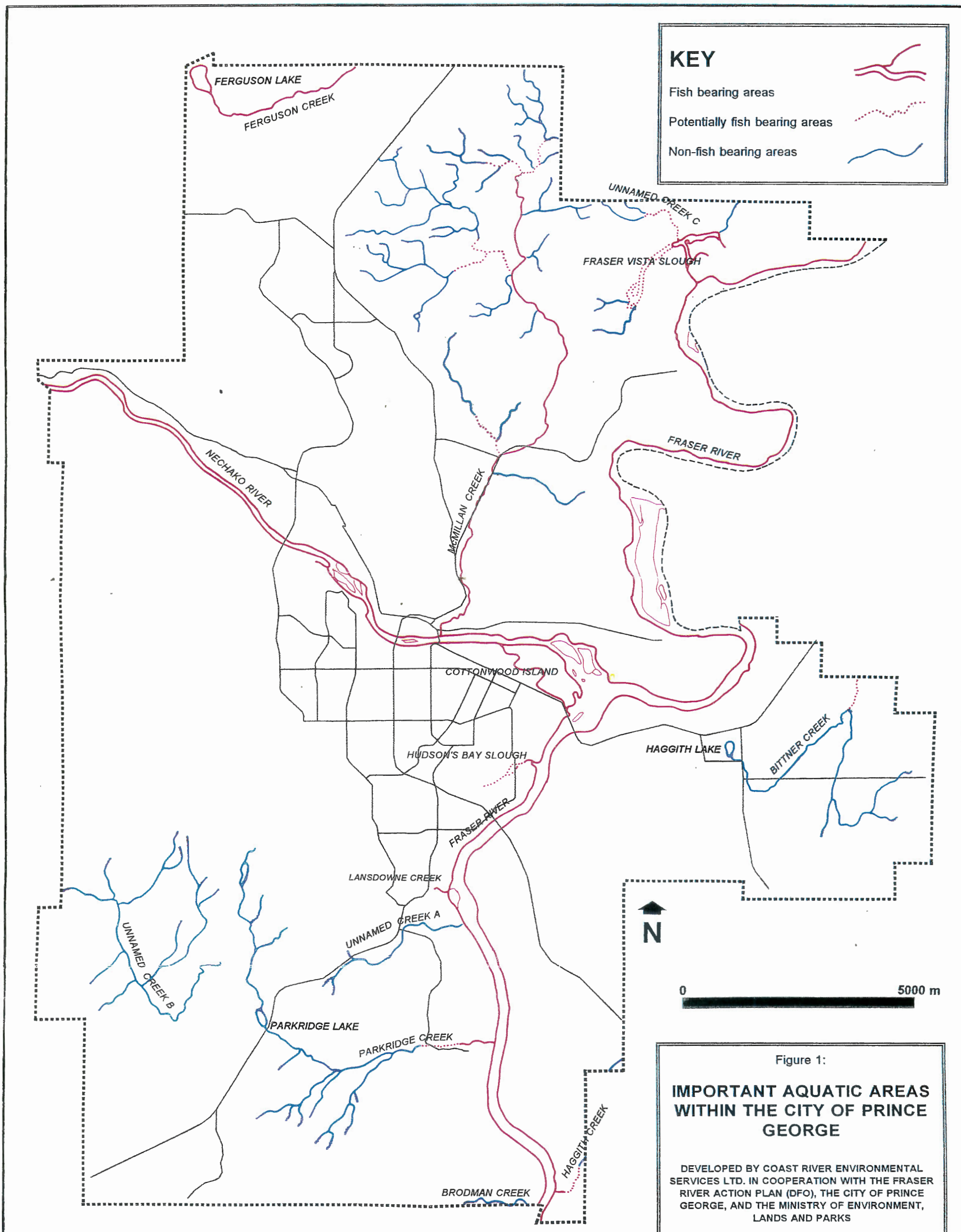


Figure 1:

IMPORTANT AQUATIC AREAS WITHIN THE CITY OF PRINCE GEORGE

DEVELOPED BY COAST RIVER ENVIRONMENTAL SERVICES LTD. IN COOPERATION WITH THE FRASER RIVER ACTION PLAN (DFO), THE CITY OF PRINCE GEORGE, AND THE MINISTRY OF ENVIRONMENT, LANDS AND PARKS

August 1996

Table 1. Fish species potentially occurring within the Fraser and Nechako rivers within the City of Prince George (McPhail and Carveth 1993).

Common Name	Species Name	Presence
Salmonids		
Rainbow trout	*Oncorhynchus mykiss*	✓
Sockeye salmon	*O. nerka*	✓
Chinook salmon	*O. tshawytscha*	✓
Pink salmon	*O. gorbuscha*	✓
Coho salmon	*O. kisutch*	unknown
Lake whitefish	*Coregonus clupeaformis*	unknown
Lake trout	*Salvelinus namaycush*	unknown
Brook trout	*S. fontanalis*	✓
Bull trout	*S. confluentus*	✓
Pygmy whitefish	*Prosopium coulteri*	unknown
Mountain whitefish	*P. williamsoni*	✓
Non-salmonids		
White sturgeon	*Acipenser transmontanus*	✓
Pacific lamprey	*Lampetra tridentata*	unknown
Chiselmouth	*Acrocheilus alutaceus*	unknown
Goldfish	*Carassius auratus*	unknown
Lake chub	*Couesius plumeus*	unknown
Carp	*Cyprinus carpio*	unknown
Brassy minnow	*Hybognathus hankinsoni*	unknown
Peamouth chub	*Mylocheilus caurinus*	✓
Northern squawfish	*Pytchocheilus oregonesis*	✓
Longnose dace	*Rhinichthys cataractae*	✓
Leopard dace	*R. falcatus*	unknown
Redside shiner	*Richardsonius balteatus*	✓
Longnose sucker	*Catostomus catostomus*	✓
Bridgelip sucker	*C. columbianus*	✓
White sucker	*C. commersoni*	✓
Largescale sucker	*C. macrocheilus*	✓
Mountain sucker	*C. platyrhynchus*	unknown
Burbot	*Lota lota*	✓
Prickly sculpin	*Cottus asper*	✓
Slimy sculpin	*C. cognatus*	unknown
Torrent sculpin	*C. rhotheus*	unknown

Key components of shoreline habitat along the Fraser and Nechako rivers, particularly for juvenile chinook, are large substrates such as cobble and rip-rap that provide low velocity areas within interstitial spaces and a stable forested riparian zone that reduces bank erosion, provides immediate shading and overhead cover, and contributes logs and smaller organic debris to the channel margin. Low bank riparian areas are also used for refuge during periods of high water. A comprehensive inventory of nearshore and riparian areas of the Fraser and Nechako rivers within the City of Prince George was undertaken by Nowotny and Hickey in 1993. They developed a qualitative habitat rating system (*high*, *medium*, and *low*) based on riparian condition, bank stability, substrate type, water depth, and flow character. A series of fifteen maps was produced illustrating habitat value ratings for their study area.

Habitat rating criteria developed by Nowotny and Hickey (1993) to determine relative values of nearshore and riparian areas included:

High Habitat Value:

- overwintering habitat provided by significant quantities of cobble, boulder, and large rip rap substrates and/or large organic debris;
- significant quantities of high water refuge and rearing habitat within shallow-gradient, low velocity nearshore areas;
- potential for salmonid spawning (gravel substrates and appropriate water velocity);
- stable nearshore and streambanks; and,
- well-developed riparian and emergent vegetation communities which stabilize banks, provide cover (protection) and function as a source of fish food production.

Medium Habitat Value:

- limited areas of overwintering habitat among clusters of large substrates;
- limited areas of rearing habitat due to excessive flows and inappropriate substrates;
- limited area and/or non-contiguous riparian zone;
- stable to moderately stable nearshore and streambanks;
- mixture of substrate types (i.e., gravels with sand and/or mud and/or scattered cobble/boulder); and,
- general presence of emergent and riparian vegetation; upland vegetation is present if upper banks area unstable.

Low Habitat Value:

- general lack of rearing habitat;
- predominance of sand or mud substrates;
- absence or degradation of riparian vegetation;
- unstable, eroding banks;
- extreme water flow conditions (i.e., stagnant area or deep, fast flowing water);
- lack of spawning potential (inappropriate substrates and/or flow velocities);
- over-abundance of submergent vegetation.

2.2.1 Fraser River

Based on the habitat rating criteria presented above, two reaches were identified for the section of the Fraser River within the City (Nowotny and Hickey 1993). The first extends from the southern boundary of the City upstream to approximately 400 m south of Bittner Creek near the first major meander bend. Nearshore and lower bank habitat in this reach is characterized by cobble and boulder substrates separated by patches of finer materials (i.e., sand, mud flats, gravel bars). Riparian vegetation is primarily mixed coniferous forest on the steep escarpment slope. The lower riparian zone is typically poorly vegetated due to chronic stream bank erosion. Approximately 80% of habitat areas within this reach was rated as medium to high value.

The second reach encompasses the northern portion of the Fraser River, from 400 m south of Bittner Creek to the northern boundary of the City. Nearshore habitats are generally rated low, due to the predominance of sand and fine substrates which do not provide the low velocity holding and refuge areas like larger substrate materials. Streambank erosion was also a significant factor affecting fish habitat in this reach.

2.2.2 Nechako River

Nowotny and Hickey (1993) identified one reach of the Nechako River within the City limits. Nearshore habitats were generally identified as having high habitat values and are characterized by large substrates and a relatively complex shoreline that increased the number of low velocity areas and backeddies. Two island complexes (e.g., Fishtraps Island complex and Cottonwood Island complex) also provide important rearing areas due to lower flow velocities in side-channels.

Slough areas (e.g., Fishtraps Island Slough, Howie's Marine Boat Basin) were rated as

low due to the stagnant conditions, poor water quality, and dense submergent vegetation growth (Nowotny and Hickey 1993).

2.2.3 Hudson's Bay Slough

Hudson's Bay Slough is located south east of the City core. It was originally fed by a small stream but currently arises in the City's storm drainage system. The storm drain outfall is located approximately 2.5 km upstream of the main slough (Nowotny and Hickey 1993). The slough is divided into two areas by a flow control structure and a culvert that prevents fish from accessing the upper portion of the slough. The upper slough is also prone to poor water quality due to lack of shading and poor water exchange. Ducks Unlimited has done some work to enhance waterfowl habitat in this area.

The lower portion of the slough is accessible to salmonids (i.e., chinook) and other fish species from the Fraser River, however, no specific fish sampling information is available on the area. Nowotny and Hickey (1993) rate the habitat value in this area as high. Hudson's Bay Slough provides an excellent opportunity to restore or enhance fish habitat by providing fish access (e.g., removing culverts), increasing riparian vegetation to improve shading, and improving water quality of inflow water through source controls or upstream biofiltration wetlands. Flow augmentation from drilled wells, City water supplies, or the Fraser River may also improve water quality.

2.2.4 Fraser Vista (Goose) Slough

Fraser Vista Slough (Goose Slough) is a remnant meander bend of the Fraser River, located in the northeast corner of the City. An unnamed creek (Unnamed Creek C or Goose Creek) flows into the central portion of the slough. Both the stream and the western arm of the slough are inaccessible to fish from the Fraser River because of impassable culverts at the two railway crossings and Indian Reserve Road. The accessible portion of the slough is an important rearing area for salmonids as well as waterfowl. The inaccessible western end of the slough has very high potential rearing habitat for salmonids and other fish species. Burbot were historically caught in this area (D. King pers. comm.).

Removal of the wood debris and plywood blocking the culverts under the B.C. Rail lines was identified by Nowotny and Hickey (1993) as an important opportunity for fish habitat enhancement on the Fraser River within the City. The City of Prince George

could initiate a project for restoring this area in cooperation with DFO and MELP.

Fraser Vista Slough is currently encompassed by the Goose Slough Development Permit Area that extends 30 m outside of the 572 m contour, starting and ending at the confluence of the outlet channel with the Fraser River.

2.2.5 Cottonwood Island Sidechannel

Cottonwood Island, a City managed park, is separated by a high water channel from the mainland. The channel is used for refuge by salmonids and other fish species under high water conditions.

The channel was identified as an important opportunity for habitat enhancement by Nowotny and Hickey (1993). Possible enhancement activities include: channel deepening and pool creation, instream habitat complexing, and removal of large quantities of old woody debris. Portions of the old slough area within Cottonwood Island Nature Park have been recently restored to improve fish habitat and other environmental values.

Table 2. Summary of large river, slough, and sidechannel fish habitats within the City of Prince George.

Name	Fisheries[1] Values	Species[2]	Comments
Fraser River	High	CH, RB, SK, PK, DV, MW, WSG, PCC, NSC, RSC, LNC, CAS (and other species)	Salmonids: migration and rearing, Large number of non-salmonid species
Nechako River	High	CH, RB, SK, PK, DV, MW, WSG, PCC, NSC, RSC, LNC, CAS (and other species)	Salmonids: migration and rearing (possible PK spawning) Large number of non-salmonid species
Hudsons' Bay Slough	Moderate (lower)	unknown	Salmonids: juvenile chinook rearing in lower end
	Potential (upper)	unknown	Upper end inaccessible to fish
Fraser Vista Slough	Moderate (central)	CH, RB?, other species	Salmonid and non-salmonid rearing in accessible areas High potential for restoration
	Potential (western area)	unknown	
Cottonwod Island sidechannel	High	CH, other species	Important fish habitat at high water

[1] Ratings are qualitative and based on relative values to fish populations. Areas which support a diverse fish community and/or high populations of commercial or sport fish were assigned a rating of *high* (i.e., Fraser and Nechako rivers). Areas of *moderate* fisheries values are generally used by less diverse fish populations on a seasonal basis. Ephemeral streams that do not contribute flow directly into fish bearing waters were assigned a rating of *low*; small streams above the escarpment slope in the western portion of the City are an example of aquatic habitats with *low* fisheries values.

[2] Species codes: CH (chinook salmon); RB (rainbow trout); SK (sockeye salmon); PK (pink salmon); DV (Dolly Varden); MW (mountain whitefish); WSG (white sturgeon); PCC (peamouth chub); NSC (northern squawfish); RSC (redside shiner); LNC (longnose dace); CAS (prickly sculpin).

2.3 Small Streams

Fish presence and fish habitat values information for the small streams described in the following sections is summarized in Table 3.

2.3.1 McMillan Creek

McMillan Creek is the largest tributary stream (third-order tributary) within the City of Prince George. It originates in the northwestern portion of the City and flows south into the Nechako River immediately east of the Cameron Street bridge.

Several studies have investigated the fisheries values of McMillan Creek including Gunville (1977) and Triton (1995). The Triton report focussed on the identification of rainbow trout habitat use, distribution, and instream habitat conditions within the watershed. They found the stream contained a population of wild resident rainbow trout (*Oncorhynchus mykiss*) that was distributed from the stream mouth to a point approximately 3.1 km upstream. Sampling was not undertaken for any of the tributaries except for some minnow trapping in Tributary 3 that enters from the west upstream of the Noranda Road crossing. Nechako River rainbow trout may also spawn in the lower sections of McMillan Creek (D. King pers. comm.). In addition, the occurrence of bull trout (*Salvelinus confluentus*) was discussed in DFO (1993) although no fish sampling results for McMillan Creek were reported in the field notes for that study.

McMillan Creek is a productive trout stream that is managed to provide accessible fishing for young children and older people (MELP age restriction < 16 years; > 65 years). Development related impacts have occurred in several sections of McMillan Creek due to residential development, livestock grazing, and road crossings. The fact that many of the problems stem from riparian zone loss or degradation points out the importance of stream protection buffers along McMillan Creek.

Important habitat features in the McMillan Creek watershed include floodplain areas and beaver impounded wetlands that moderate hydrology and provide rearing and high water refuge areas in the lower reaches. Beavers also appear to restrict fish passage in the main channel, however, this impact is partially offset by the creation of new habitat areas from pond construction and the use of beaver dams for overwintering.

Table 3. Summary of small stream fish habitats within the City of Prince George.

Name	Fisheries[1] Values	Species[2]	Comments
McMillan Creek	Moderate / High	RB, CH	Salmonids: resident rainbow trout, juvenile chinook rearing at mouth, possible bull trout
Parkridge Creek	Moderate	RB, CH	Salmonids: resident rainbow trout, chinook rearing at mouth (up to 700 m upstream)
Haggith Creek	Moderate	RB?, CH	Salmonids: juvenile chinook rearing at mouth
Bittner Creek	Moderate	RB?, CH?, MW?	Salmonids: juvenile chinook rearing at mouth; rainbow trout in lower reaches and
Lansdowne Creek	Moderate	CH	Salmonids: juvenile chinook rearing at mouth
Brodman Creek	Moderate	CH	Salmonids: juvenile chinook rearing at mouth
Unnamed Creek A	Unknown	CH?	Possible chinook rearing at mouth
Unnamed Creek B	Unknown	unknown	unknown
Unnamed Creek C (Goose Creek)	Unknown	unknown	Access to Fraser River blocked High potential as rearing area
Ferguson Lake	Moderate	EB	Salmonids: introduced eastern brook trout

[1] Ratings are qualitative and based on relative values to fish populations. Areas which support a diverse fish community and/or high populations of commercial or sport fish were assigned a rating of *high* (i.e., Fraser and Nechako rivers). Areas of *moderate* fisheries values are generally used by less diverse fish populations on a seasonal basis. Ephemeral streams that do not contribute flow directly into fish bearing waters were assigned a rating of *low*; small streams above the escarpment slope in the western portion of the City are an example of aquatic habitats with *low* fisheries values.

[2] Species codes: CH (chinook salmon); RB (rainbow trout); MW (mountain whitefish); EB (eastern brook trout).

A Natural Environment Development Permit Area currently encompasses the "obvious floodplain" of McMillan Creek as far up as the 660 m contour crossing, although neither the recurrence interval for this flood level nor floodplain field indictors for its extent are provided.

2.3.2 Parkridge Creek

Parkridge Creek, located southwest of the City core, is the second largest watershed within the City of Prince George. The lower section is confined within a steep walled ravine that is largely forested and undeveloped. Some residential development has encroached on the north edge of the ravine. In addition, the stream and riparian zone have been impacted by residential and commercial development and the Highway 16 corridor downstream of Parkridge Lake.

Fish sampling undertaken by DFO documented juvenile rainbow and chinook use in Parkridge Creek up to 700 m from the mouth (DFO 1993). At this point, fish use is limited by low flow conditions in the late summer; during June and July sampling, fish were found stranded in remaining pools. Nowotny and Hickey (1993) found the stream was dry at the time of their survey (September - October 1992). Fish use (e.g., rainbow trout, chinook salmon) may extend upstream to Domano Road, although this has not been substantiated by formal sampling (D.King pers. comm.). No fish occur in Parkridge Lake.

A Natural Environment Development Permit Area currently exists for the lower ravine as well as Parkridge Lake. It spatial extent is 30 m from the centreline of the stream and 30 m outside of the 730 m contour surrounding Parkridge Lake (Vanway Pond).

2.3.3 Haggith Creek

The mouth of Haggith Creek is located near the southern border of the City on the east bank of the Fraser River. Its mainstem is approximately 14 km in length and originates between the Municipal Airport and the Pineview area (Nowotny and Hickey 1993). Ellacott Creek, the major tributary of Haggith Creek, also originates near the airport and joins the mainstem approximately 200 m upstream of the B.C. Rail line. The lower 700 m of Ellacott Creek and 500 m of the Haggith main stem are found within the City limits.

Fish use is limited by an impassable culvert approximately 200 m upstream from the

mouth under Willow Cale Forest Road (DFO 1993). The culvert has a 1 m drop at its outlet that precludes upstream fish passage under all flow conditions. No information is available on habitat conditions or fish presence for sections of Haggith and Ellacott creeks upstream of this barrier. Nowotny and Hickey (1993) indicated that of the small tributaries of the Fraser River they examined, Haggith Creek exhibited the highest potential for habitat enhancement. Possible opportunities include instream complexing and removal of the culvert barrier.

2.3.4 Lansdowne Creek

Lansdowne Creek is a small stream, approximately 300 m long, flowing into the sidechannel of the Fraser River near the City's sewage treatment plant. Although we found no information on the origin of this stream, the field notes from the 1993 summer sampling program described it as "a drainage ditch" (DFO 1993) upstream of the Fraser River sidechannel indicating it has been extensively modified. Due to its proximity to urban development, the stream may be partially fed by stormwater drainage. Both Lansdowne Creek and the sidechannel into which it drains dry out during low flows.

Juvenile chinook use was fairly high in Lansdowne Creek during sampling in June 1993, however, the stream was completely dry by late July. High turbidity after rainfall was documented during DFO's sampling program.

2.3.5 Brodman Creek

The mouth of Brodman Creek is located on the west bank of the Fraser River immediately south of the southern boundary of the City. In the past, some maps have shown the mouth of the stream within City limits. A section of the stream approximately 1.7 km long is located within the City above the escarpment slope.

Fish use in Brodman Creek is limited to a short section (+/- 50 m long) immediately upstream of the mouth. High channel gradient and cascades precludes fish use of upstream areas. Only juvenile chinook were captured in Brodman Creek during the 1993 fish sampling program (DFO 1993).

2.3.6 Bittner Creek

Bittner Creek drains from the Pineview area of the City into the Fraser River immediately west of where the City boundary crosses the river. None of the lower

reach is found within the City. The fish community below the impassable culvert was found to be more diverse then other small stream areas during DFO's 1993 sampling program (DFO 1993). Redside shiner, sucker, and sculpin species, as well as several unidentified salmonid fry were captured or observed. Resident rainbow trout may be found in upstream areas where the stream is within the City of Prince George (D. King pers. comm.).

2.3.7 Ferguson Creek

Ferguson Creek is located in the northwest corner of the City. Unlike the other small streams which flow directly into the Fraser or Nechako rivers as first, second, or third order tributaries, Ferguson Creek drains to the northeast into the Salmon River, a higher order tributary of the Fraser River.

No fish sampling information is available for either the lake or the stream, however, eastern brook trout (*Salvelinus fontinalis*) were stocked in the lake to provide recreational fishing opportunities (M. McGuire pers. comm.). Brook trout are also found in the section of Ferguson Creek downstream of the lake.

2.3.8 Unnamed Creek A

No information exists on habitat conditions, flow levels, or fish presence and distribution for Unnamed Creek A. It was included because of the larger size of its watershed.

2.3.9 Unnamed Stream B

Unnamed Stream B flows west into the Nechako River outside of the City limits. No fisheries information exists on the system.

2.3.10 Unnamed Stream C

Unnamed Stream C (a.k.a Goose Creek) flows into Fraser Vista Slough from the north. As described in Section 2.2.4, this stream is currently inaccessible to fish due to an impassable culvert under Indian Reserve Road.

2.4 Stream Mapping

The objective of the mapping component of this project was to provide: i) an overview map of important streams and other aquatic areas within the City limits; and, ii) a series of maps at 1:5000 scale depicting the fisheries sensitive zone in representative areas of the McMillan Creek and Parkridge Creek watersheds.

The City of Prince George has recently acquired a sophisticated GIS system to coordinate planning, engineering, and other tasks. Digital mapped information is available at 1:2500 scale with 1 m contour intervals for the entire City. For this project, the important aquatic features were transferred onto a single 1:25,000 map sheet. Less sensitive aquatic features (e.g., ephemeral streams with no direct connection to fish bearing waters) were not included on the overview map to better focus attention on key areas. Fish presence information was added to the map using colour codes.

Four 1:5000 scale maps accompany this report to illustrate the recommended Development Permit Areas for representative sections of Parkridge and McMillan creeks (see Figures 2, 3, 4, and, 5). The DPA boundary is based on the *Land Development Guidelines for the Protection of Aquatic Habitat* which currently prescribe a minimum 15 m setback from top of bank adjacent to low density residential development (i.e., single detached houses) and a 30 m setback adjacent to high density development (i.e., commercial, industrial, and multi-family residential). The DPA boundary recommended for this project encompasses 30 m from either top of bank or the natural wetland boundary to ensure adequate protection of fisheries and riparian habitat values. Top of bank is generally defined by a distinct break in slope between the stream ravine and surrounding areas. Reductions can be made on a site specific basis if resource values can be adequately protected with narrower leavestrips (see Sections 5.1, 5.2, and 5.3). The entire set of maps for the Parkridge and McMillan Creek watersheds will be available from the City of Prince George Planning Department.

The Parkridge and McMillan creek watershed mapping was made more difficult by the large number of small headwater channels and wetland complexes. For McMillan Creek in particular, hundreds of dendritic channels, many of them ephemeral, contribute flow to the stream. Designating fisheries sensitive zones around these areas is time consuming and can also increase the time commitments of municipal and environmental agency staff in responding to development applications. However, we felt these areas should be protected to ensure water quality and hydrologic functions are maintained.

2.5 Lakes and Wetlands

Very little specific information on the lakes and wetlands in the City of Prince George is available. In discussing the characteristics of the Sub-boreal Spruce biogeoclimatic zone, Meidinger and Pojar (1991) state: "wetland community types include *Carex* (sedge) marshes, shrub fens of *Betula glandulosa* (scrub birch), *B. pumila* (swamp birch, and *Salix* spp. (willows), treed fens and swamps with black and hybrid white spruce, and black spruce - *Sphagnum* bogs. Acidic, nutrient-poor bogs are less common than the richer wetland types (marshes, fens, and swamps).".

Important lakes include Parkridge Lake, Ferguson Lake, Shane Lake, and Haggith Lake. Of these only Ferguson Lake is confirmed to be fish bearing.

2.6 Wildlife Values

Although this report focusses on the identification of fisheries values and the protection of aquatic and riparian areas to sustain fish populations, a brief description of their importance for wildlife in the Prince George area has also been included. It is important to point out most riparian protection measures confer some degree of wildlife habitat protection as well. In addition, stream and riparian corridors have been used extensively to link larger habitat areas because they are effective as migration and dispersal routes for wildlife species.

Prince George is located in the Sub-boreal Spruce (SBS) biogeoclimatic zone, which dominates the landscape of the central interior of British Columbia. According to Meidinger and Pojar (1991): "next to coniferous and mixed forests, the second most abundant wildlife habitat type in the SBS zone includes riparian, wetlands, meadows, floodplains, lakes, and streams. Moose forage on aquatic vegetation in shallow lakes and swamps, and on the early successional shrubs of active floodplains. Dense deciduous vegetation in riparian areas provides thermal and hiding cover for moose. The wetlands ... provide excellent habitat for waterfowl.". Reptiles and amphibians are rare in the region because of the long cold winters, however, common garter snake, western toad, wood frog, and spotted frog occur in the Prince George area.

Approximately 57% of all bird species known to occur in B.C. are found in the Sub-boreal Interior Ecoprovince in which Prince George is located. How many species are dependent or associated with aquatic and riparian areas is not known, however, these areas are typically more important than upslope forested areas for bird species.

3.0 COMPONENTS OF AQUATIC HABITAT

Habitat features that are important to sustain fish habitat and fish populations include:

- permanent, ephemeral and intermittent stream channels;
- permanent and seasonally inundated lakes and wetlands;
- riparian areas adjacent to fish bearing aquatic areas as well as upstream non-fish bearing areas;
- contemporary floodplain areas (>1 in 30 year recurrence interval); and,
- ravines, escarpments, and other steeply sloped areas (>30% slope) which have the potential to impact aquatic areas if developed.

Unlike coastal areas where small streams are perhaps more important than higher order river systems for spawning, rearing, and overwintering, the Fraser and Nechako rivers in the Prince George area support more diverse and significantly more important fish populations than the small streams. The many small streams, however, contribute to water quality and flow regimes, and as discussed in Section 2.2, are important for juvenile chinook rearing.

3.1 Riparian Zone Functions

Because many stream protection issues focus on riparian zones, we have provided a description of their importance to fish habitat (from Millar *et al.* 1996). From our experience, protection of the riparian zone is often a contentious aspect of development around aqautic areas because of the poor understanding of the role it plays in creating and sustaining fish habitat.

3.1.1 Recruitment of Large Woody Debris

The principal factor regulating the structural complexity of small streams is the addition of fallen logs and trees (large woody debris) into the channel. Large woody debris (LWD) (also commonly referred to as large organic debris (LOD) or coarse woody debris (CWD)) consists of downed tree material which exceeds 10 cm in diameter and 2 m in length. LWD inputs are regulated by the dynamics of the surrounding riparian forest and landscape, which involve biotic factors such as episodes of natural forest stand thinning and abiotic processes of blowdown, mass wasting, and streambank erosion.

In undisturbed forested streams, LWD contributes to fish habitat complexity by creating small dams, scour pools, undercut banks, gravel bars, backwater eddies, overhead cover and other morphological attributes that are recognized as productive fish habitat. Indeed, tree roots, trunks and branches may account for 50% or more of the habitat diversity in small, densely forested stream reaches, and are more important contributors to salmonid habitat than either rubble-boulder-aquatic vegetation areas and deep water areas. Without LWD, the standing crop of salmonids tends to be significantly lower due to the lack of pools and cover important for summer rearing and overwinter survival in morphologically simple streams.

The importance of the riparian zone's role as a source of LWD cannot be overemphasized, and the literature suggests that LWD recruitment extends farther from the stream channel than any other interaction between the stream and riparian zone. Researchers have investigated source distances for LWD in forested streams in western Washington and Oregon. They found that while 70% of LWD originates from within 20 m of the stream channel, a distance equivalent to one mature tree height perpendicular to the stream is required to ensure that 100% of the predevelopment LWD recruitment is maintained. While research has not examined the same parameters for interior streams, we feel the same relative importance applies. The requirement of one tree height to maintain LWD recruitment has also been recommended by other researchers. Retaining a riparian buffer equal to one tree height also serves to protect trees in the riparian zone against blowdown.

3.1.2 Addition of Organic Matter

Riparian zones generate a large proportion of the food and prey items which are important to fish. Benthic invertebrates, algae, terrestrial insects, leaves, and other organic material contribute food to fish and provide nutrients and mineral input to the water. Indeed, input of organic matter originating in the riparian zone provides up to 99% of the energy which is processed in small and headwater streams. Furthermore, LWD in low and mid-order streams tends to trap sediments and nutrients in the channel and store them for a longer period in the system, allowing invertebrate communities to more fully utilize organic inputs to the stream.

A buffer width of one-half the height of a site potential tree can provide close to maximum litter-fall effectiveness. To minimize effects on invertebrate communities, several researchers have suggested that an appropriate stream protection buffer width is 30 m although this may be based on maintaining temperature and light levels.

3.1.3 Stabilization of the Stream Channel

In addition to the roles that the riparian zone and instream LWD play in providing and storing nutrients and increasing habitat complexity, they also serve to control erosion rates in many streams. Instream large organic debris acts to reduce water velocities and increase the hydraulic complexity of streams by forming a sequence of pools and riffles. The soil binding properties of root systems also reduce bank erosion thereby maintaining bank stability and preventing sedimentation in the system.

The riparian zone also contributes to stream channel stabilization through other mechanisms including dissipation of flow energy (riparian vegetation and its associated root systems increase channel bank and bed roughness which dissipates flow energy), reduction of bedload movement (areas of LWD accumulation act as hydraulic breaks and lead to the formation of depositional sites in low velocity areas), and moderation of hydrology (pool formation and the backwatering associated with debris jams and accumulation of LWD increases the detention time of water in a stream system).

3.1.4 Modification of Microclimate

The regulation of stream temperature, humidity, and light levels is also an important function of the riparian zone. Riparian vegetation creates a microclimate that helps maintain a more constant stream temperature, moderating the maximums and minimums. Other factors which help to moderate the microclimate include the steepness and height of the valley walls, stream orientation, inflow of cool surface and groundwater, undercut embankments, organic debris, surface area and stream velocity.

The maintenance of stream temperature was one of the first forestry-fisheries interactions that was comprehensively studied. Although it is documented that moderate stream temperature increases resulting from riparian clearing can increase salmonid smolt production in the short term, long term salmonid production invariably drops due to resulting channel destabilization, reduced LWD recruitment and reduced organic matter input to the system. Furthermore, extreme temperatures (above 25°C) can occur as a result of excessive riparian clearing and may lead to fish mortalities. A recent publication by the U.S. Forest Ecosystem Management Assessment Team (FEMAT 1993) acknowledges that buffers may need to be up to one site potential tree height (approximately 50 m in coastal areas and perhaps 35 m in interior B.C.) in order to maintain interior microclimate conditions.

3.1.5 Nutrient Flow and Sediment Storage

Riparian zones improve the quality of stream water by acting as sinks, sources, filters and transformers of polluting substances; several researchers have shown that riparian zones are extremely efficient at filtering sediment and chemical contaminants. Studies undertaken to determine the width of buffer strips required to ameliorate diffuse source contaminants indicate that even relatively narrow buffers (15 m) exhibit moderate removal efficiencies, although a buffer of 50 m may be needed to remove more than 80% of macronutrients.

4.0 THE MUNICIPAL ROLE IN THE PROTECTION OF AQUATIC HABITAT

In this chapter, planning tools available to municipal planners for the protection of aquatic habitat are presented and general construction standards to minimize the impacts of land development activities on aquatic habitat are discussed. Development Permit Areas (DPAs) and their associated guidelines are examined in some detail in Section 5.0.

Urban streams are arguably the most extensively degraded and disturbed aquatic systems in North America. Research over the last two decades has revealed that urban development has a profound impact on the hydrology, morphology, water quality, and biodiversity of urban streams (Schueler 1995).

Impacts on aquatic areas associated with urban development include (after Chilibeck 1992):

1) Direct Impacts to Stream Channels, Wetlands, and Riparian Areas

   Direct impacts on aquatic and riparian areas include construction or encroachment into the Fisheries Sensitive Zone (FSZ) or floodplain areas causing loss of riparian vegetation and modifications to the channel. Causes of encroachment include stream crossings for transportation corridors or utilities, residential and commercial development, and flood control (stream management) works;

2) Indirect Impacts from Alteration to Hydrology

   Urbanization is generally associated with increased impervious surfacing and storm drainage development which leads to an increase in the magnitude and frequency of stormflows resulting from precipitation. In addition, there is typically an increase in the total annual volume of surface run-off.

3) Indirect Impacts from Alterations to Water Quality

   Water quality impacts include:

   - large inputs of suspended sediment during the development phase in the

watershed;

- increased pollutant loads as a function of increased effective impervious area and land-use;
- increased temperature due to loss of riparian cover and effect of impervious areas;
- large variations in dissolved oxygen due to organic load, algae respiration and temperature.

4.1 Municipal Planning Tools for the Protection of Aquatic Habitat

As discussed in the recently published study *Protection of Aquatic and Riparian Habitat by Local Governments* (Quadra 1995), local governments can manage and protect aquatic habitats in their jurisdictions by undertaking voluntary and mandated initiatives in the following areas:

1. Habitat Identification
2. Habitat Protection Measures
3. Habitat Acquisition and Management
4. Stormwater Management
5. Erosion and Sediment Control
6. Instream Works
7. Fish Passage and Culverts
8. Application Reviews and Inspections
9. Monitoring and Enforcement

As discussed in the introduction, this report addresses the first two of these management functions in some detail. More specifically, point #1 above formed the basis of Chapter 2.0 of this report, while point #2 is discussed more fully in this chapter. It should be noted that several of the other issues listed above receive limited discussion in Section 4.6 (Construction Standards) of this report.

The prescriptions and planning tools available for the protection of aquatic features at the municipal level in B.C. is evolving. However, there is currently a suite of such tools which enable the protection of aquatic features and other environmentally sensitive areas (ESAs), and these are described below (from Child and Millar 1995). The following brief discussion has been summarized from many existing sources, including findlay and Hillyer (1992), Lanarc (1994), and Philips and Associates (1995). For a more complete treatment the reader is referred to these documents.

4.2 Planning Tools Under the *Municipal Act*

Official Community Plan (OCP): an OCP can be amended to include general environmental policy statements and to make special designations which address watershed management. In this way, protection of fish and wildlife habitat can be included in the OCP and will provide higher level planning direction to lower level planning activities (e.g., zoning of development permit areas, rezoning applications, etc.).

Bylaws: the *Municipal Act* gives municipalities the authority to pass by-laws which can be used to protects aquatic features and other ESAs. For example, amendments to the *Municipal Act* in 1992 now permits local councils to create a regulatory scheme for control of cutting of trees and removal of topsoil on private land. Some municipalities (e.g., District of North Vancouver and City of Coquitlam) have adopted comprehensive environmental protection bylaws that combine various provisions of the Municipal Act into integrated bylaws. We note that the City of Prince George Council has adopted a Bylaw to Protect Trees (Bylaw no. 6343) and is also developing a Soil Removal and Deposit Bylaw.

Development Permit Areas (DPA): Sections 945(4) and 976 state that a community plan may designate DPAs for the 'protection of the natural environment'. These areas must be designated as DPAs in the OCP. Municipal governments can require the protection of the natural environment including aquatic features and other ESAs, and hazard lands as a condition of development in areas which are designated as DPAs. DPAs in and for Prince George are discussed in detail in Sections 5 of this report.

Density Bonus Zones: density bonuses can be incorporated generally into a zoning bylaw, or they may be created during the rezoning process for a specific site. This municipal zoning provision permits for negotiations between a developer and the municipal government to ensure protection or improvement of an aquatic feature in exchange for allowing higher densities (i.e., clustering) elsewhere on the parcel.

Comprehensive Development Areas (CDA): areas must be zoned as CDAs in the OCP. Custom zoning of a parcel which is zoned as a CDA can include provisions for aquatic protection or protection of other natural features.

Dedication of Parkland: under the *Municipal Act*, subdivision and development of parcels requires that up to 5% of the development parcel may be designated as parkland

or the developer must provide cash in lieu for the market value of the land which must be deposited into a reserve fund established for park acquisition at other locations. This provision of the *Act* can be invoked to help ensure that aquatic features and other ESA lands are preserved, although 5% of the parcel is often not enough to capture all aquatic features and ESAs; therefore, additional tools may have to be used.

4.3 Planning Tools Under other Provincial Acts

Restrictive Covenants: in areas where public access into ESAs is not preferred (e.g., where the ESA provides critical habitat for fish or wildlife) the *Land Title Act* provides for registration of a restrictive covenant at the Land Titles Office by a local government or a developer. A covenant can prohibit public access into an area other than as set out in the covenant wording.

Municipal Heritage Conservation: Part 3 of the *Heritage Conservation Act* permits a municipal council to designate a building or land as a 'municipal heritage site', where 'heritage' is defined as something that is of "historic, architectural, archaeological, paleontological or scenic significance". Lands thus designated cannot be built upon without council resolution. Council must compensate for the lost value of the land (this can include tax relief, etc.).

Statutory Rights of Way: a statutory right-of-way can be granted to a municipal government under the *Land Title Act*. Although traditionally this legislation has been used for public utilities, it has more recently been applied to areas of ecological significance (e.g., riparian corridors) and for riverside greenways.

Easements: an easement is similar to a statutory right-of-way only the beneficiary of an easement can be an individual or a group/organization that is not a government nor a government agency.

Set-backs from Aquatic Environments: the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck *et al.* 1992), jointly produced by DFO and MELP, contains requirements for set-backs from top-of-bank for high and low density developments.

4.4 Planning Tools Requiring Voluntary Participation

Bequests or Donations of Ecologically Sensitive Land: ownership of land can be transferred by an individual to a municipality in the will of a deceased person (bequest) or as a donation by a person who is still alive (donation). As of February 27, 1995, 100% of the value of a donated parcel can be deducted from an individual's or incorporated company's taxable income. The applies to 'ecologically sensitive land' - land that, in the opinion of the federal Minister of the Environment, is important for the preservation of Canada's environmental heritage. The land must be donated to a Canadian municipality, or to a registered charity that is designated by the Minister to have a primary purpose of conserving and protecting Canada's environmental heritage.

Trusts: a trust is a device which enables an individual to give property to a municipality (or individual or group) together with their instructions about what to do with it, as per the terms of the trust.

Several other voluntary measures exist for the protection of ESAs including conditional gifts, purchase of land, options to purchase, rights of first refusal, co-ownership, profits à prendre, leases and life estates. These are discussed in detail in findlay and Hillyer (1994).

4.5 Construction Standards for the Protection of Aquatic Habitat

Aquatic features are vulnerable during land development activities, and may remain vulnerable following construction during the operational phase of the development. In this section several construction standards for works near aquatic features are discussed (after Child and Millar, 1995). The reader is cautioned that these standards should apply to all sites; development at sites in Development Permit Areas (see Section 5) may have additional environmental protection requirements.

4.5.1 Pre-construction Phase Considerations

1. Identification of Aquatic Features

Eliminating or minimizing the detrimental effects of land development relies on identification of aquatic features and other ESAs or significant features (e.g., locally or regionally significant species) early in the development process. The exact boundaries of individual aquatic or ESA features (marsh areas, ravine features, etc.) must be

identified and surveyed in the field. These features should be delineated by a registered professional biologist (R.P.Bio.) or another appropriately qualified individual as early in the development application process as possible using standard biological techniques. All aquatic features or ESAs should be temporarily or permanently fenced to prevent intrusion by workers or equipment during the construction phase.

The location and extent of aquatic features and other ESAs should be incorporated into the preliminary design concept for the proposed development. Where possible, the footprint of the proposed development should avoid these features. Planning tools like density bonussing can be very useful at this stage.

2. Identification of Set-backs

Concurrent with identification of aquatic features and ESAs, the environmental consultant should also assist the surveyor in delineating the tops-of-bank of any watercourses located on or adjacent to the development parcel. Based on the housing densities proposed for the site, appropriate fisheries sensitive zone (FSZ) set-backs can be determined using DFO and MELP's Land Development Guidelines for the Protection of Aquatic Habitat (LDG). These set-backs are currently 15 m from top-of-bank for low density residential developments and 30 m from top-of-bank for high density residential and commercial/industrial developments, although these set-backs are currently being revised. The FSZ should be fenced prior to construction and a restrictive covenant (under Section 215 of the *Land Title Act*) prohibiting any disturbance of the covenanted area should be registered at the provincial Land Title Office.

3. Maintenance of Predevelopment Hydrology

Predevelopment hydrology can be altered significantly following development activities by shortening stormwater runoff response times, by increasing stormwater runoff volumes, and by impairing water quality due to the addition of fertilizers, pesticides, animal droppings, oils and greases, etc. These development impacts on hydrology can be mitigated using standard construction measures. These measures are described below and should be developed prior to undertaking construction activities.

Stormwater Management Plan (SWMP): a SWMP should be developed by a qualified engineer in accordance with the LDG. The primary objectives of the SWMP should be to limit the post-development 1:2 year storm off-site runoff rate to the predevelopment

1:2 year rate and to maintain, as closely as possible, the natural predevelopment flow pattern to the receiving watercourse. This can be achieved using one of several detention technologies, or a combination of several, including wet ponds, dry ponds, wet tanks or vault detention, engineered stormwater systems, community detention facilities, infiltration systems, constructed wetlands, or on-site detention facilities. From an environmental perspective, infiltration systems and vegetated constructed wetlands are preferred because these techniques provide stormwater detention, buffer water quality, and provide fish and wildlife habitat. In any event , the SWMP should address the water quality impacts of development through incorporation of biofiltration wetlands and installation of oil/water separators, etc.

Impervious Surfaces Reduction: impervious surfaces alter hydrology and impair water quality; the areal coverage of impervious surfaces (i.e., effective impervious area - EIA) for proposed developments should therefore be minimized. This can be achieved by minimizing the footprint of parking areas and roofs, using porous materials for parking areas and by clustering units to reduce overall roof and road areas. Grey water retention facilities should be included in site design to capture runoff for subsequent use for lawn irrigation, car washing, etc.

4. Permitting and Approvals

Prior to commencement of construction activities all necessary permits and approvals should be in place. Specifically, land clearing activities should not be initiated until the development permit is in place. This permit can specify the extent and nature of permitted land clearing activities, and thereby prevent intrusion into sensitive areas or the FSZ.

4.5.2 Construction Phase Considerations

Perhaps the single most destructive stage in the entire development process occurs when vegetation is cleared and the site is graded to facilitate construction. The potential impacts to urban streams are particularly severe at this stage and include the removal of trees and topsoil, exposure of soils to erosion, excavation of steep slopes, alteration of natural topography and drainage, and disturbance of sensitive aquatic features (Schueler 1995). It is therefore critical that the measures presented below are incorporated into site activities during the construction phase. It may be beneficial and/or necessary to develop these measures prior to construction activities.

1. Land Clearing and Grubbing

Land clearing and grubbing activities should be minimized and in no cases should extend beyond the designated limits, as shown on construction drawings and as delineated in the field (i.e., past restrictive covenant and FSZ fencing). In the event that the FSZ has not been delineated prior to commencement of construction activities, no clearing or grubbing should occur within 50 m of a watercourse until such time as the FSZ has been designated. Falling of timber into a watercourse should be prohibited except where it is necessary for safety reasons.

2. Sediment and Erosion Control

Land development activities can lead to the erosion of soils into nearby watercourses which can have negative impacts on fish and fish habitat at the site and downstream of the site. Therefore all construction activities should minimize erosion and siltation to any watercourse and should be conducted in accordance with the LDG. All sediment and erosion control plans should be approved by the environmental agencies.

The LDGs include detailed specifications for construction of on-site sediment control ponds to treat sediment laden waters prior to discharge from the construction site into the receiving water body. Other general principles of erosion and sediment control which should incorporated into construction activities include (see the LDG for more detailed information):

- plan the development to the existing terrain and site conditions;
- original drainage patterns should be maintained throughout construction operations except where interceptor ditches or berms are required to divert sediment laden runoff from a site into a sediment control pond;
- schedule/phase development to minimize risk of potential erosion i.e., conduct works during dry periods of the year;
- retain existing vegetation where possible;
- revegetate/protect denuded areas and bare soils;
- implement surface protection measures and divert runoff away from denuded areas;
- implement slope protection measures and minimize length and steepness of slopes where possible;
- minimize runoff velocities and erosive energy;
- construct interceptor ditches and design the development for increased runoff;

- retain eroded sediments on-site with erosion and sediment control structures;
- install silt fencing near all watercourses and ESAs to prevent the accidental introduction of sediment laden waters into these features; and,
- plan, inspect and maintain erosion and sediment control structures. Control measures should be capable of continuous operation during working and non-working hours. Inspections should be undertaken during adverse weather conditions.

In the absence of site-specific requirements from the environmental agencies, as detailed in the LDG runoff water from all construction sites should contain less than 25 mg/l of suspended solids above the background suspended solids of the receiving waters during normal dry weather operations, and less than 75 mg/l of suspended solids above the background receiving waters for the mean annual storm.

3. Works In and About a Stream

Construction activities undertaken in and about a stream have the potential to negatively impact the aquatic environment and its associated riparian zone. Due to the environmental sensitivity of undertaking instream works, prior to commencement of any instream work and with sufficient lead time proponents should consult with DFO and MELP for approvals to undertake such work. As detailed in the LDG, general guidelines for instream work include:

- plan instream work for periods within the confirmed fisheries window that will minimize disturbance and impact on fish and fish habitat (typically late summer during low flow conditions);
- minimize the duration of instream activities;
- conduct all instream works in isolation of stream flow;
- all material placed within the FSZ should be coarse, non-erodible, and non-toxic to fish;
- ensure that all culverts installed during stream crossings (temporary or permanent) are passable to all fish species and age classes found in the stream at all flows;
- avoid operating construction equipment in any watercourse;
- minimize disturbance to stream banks and revegetate any riparian areas damaged by equipment intrusion; and,
- ensure all construction equipment is mechanically sound to avoid leaks of oil, gasoline, hydraulic fluids and greases.

4. Concrete Pours

Concrete is a commonly used construction material and also has significant potential to negatively impact water quality if uncured material enters a watercourse. To prevent this all contractors should isolate concrete or cement from any watercourse for 48 hours after placement. Containers or trucks carrying cement or concrete should be washed away from any watercourse and at a site approved by the environmental agencies (MELP and DFO).

5. Support Facilities

The preservation of vegetation and fish and wildlife habitat must be considered in site selection and construction of all temporary support facilities. Construction contractors should locate temporary field offices, storage, and other facilities on pre-existing cleared portions of the job site or on areas to be cleared during the course of the construction project.

Of particular concern from an environmental perspective is the form and location of equipment refuelling and maintenance stations. In this regard, the fuelling, servicing or washing of machines or equipment should be undertaken as far from the FSZ or detention and sediment control facilities as possible. Under no circumstances should refuelling or servicing activities be undertaken in the FSZ. When working in a FSZ all equipment should be in good repair and should use biodegradable hydraulic fluid and should be steam cleaned of oil, grease and other contaminants deleterious to aquatic species.

6. Environmental Inspection Program

Due to the array of environmental concerns associated with construction at or adjacent to aquatic features and other ESAs, and often as required by the environmental agencies, the proponent should hire an environmental inspector to ensure a high standard of environmental protection during construction. The inspector should have the authority to modify or stop operations in the case of non-compliance with approval conditions, or where unforseen circumstances arise. As detailed in the LDG, the inspector should provide the following services:

- act as an intermediary between the proponent and regulatory bodies;
- brief the contractor on site-specific environmental requirements;

- provide basic environmental education and construction guidelines to all field personnel;
- closely supervise construction activities to ensure compliance with construction guidelines;
- participate in meetings between proponent, agency personnel and the contractors;
- define environmental standards for construction; and,
- report to the proponent and the regulatory agencies on the environmental performance of the contractor.

7. Archaeological and Paleontological Discoveries

In the event that items of archaeological, heritage, scientific or paleontological significance are discovered during land development activities, the items should remain the property of the Province and the construction contractor should, on making or being advised of such a find, immediately cease operations in the affected area, minimize activities which create ground disturbance in and adjacent to the affected area, and notify a representative of the Archaeology Branch of the Ministry of Small Business, Tourism, and Culture immediately. Work should not resume within 30 m of the discovery site until an appropriate directive has been received from that agency.

8. Environmental Incident Reporting

An environmental incident is one which has caused, or has the potential for causing, environmental damage including negative impacts on fish, wildlife, or their habitat, heightened publicity associated with a positive or negative effect on the environment, or legal action with respect to environmental noncompliance and/or damage. The following procedures should be undertaken by the environmental inspector:

- report spills of deleterious substances to the environmental agencies as required;
- take immediate action to minimize environmental consequences and manage resolution of the incident;
- gather information for the assessment of causes to try to prevent future incidents; and,
- prepare a written environmental incident report as soon as possible summarizing events, actions and recommendations for future avoidance.

4.5.3 Post-Construction Phase Considerations

During the operational life of the development a maintenance program should be implemented which includes consideration of at least the following:

1. Maintenance of Stormwater Detention and Water Quality Facilities

An inspection and maintenance program should be implemented to ensure the proper functioning of all stormwater detention and water quality facilities at a development site. These standard activities include dredging of settling and detention ponds, harvesting of vegetation from biofiltration wetlands, periodic cleaning of oil/water separators, etc.

2. Maintenance of Fencing

A program of periodic inspection of restrictive covenant fencing should be implemented to ensure they are functioning as intended. In instances where fencing has been damaged or removed to permit access to the covenanted areas, repairs should be undertaken.

3. Source Control of Contaminants

An ongoing program of source control of contaminants should be implemented for the site. This includes such measures as regular street sweeping to reduce the introduction of sediments to nearby watercourses, education programs to discourage residents placing debris in the FSZ or from using pesticides near the FSZ, etc.

5.0 DEVELOPMENT PERMIT AREAS FOR PROTECTION OF THE NATURAL ENVIRONMENT

Development Permit Areas (DPAs) are designated in the OCP to safeguard special characteristics of an area, including heritage features, environmentally sensitive or hazardous lands, or other features which give an area unique physical appearance or character. In order for development to proceed in a DPA, a development permit must be approved by municipal Council. This development permit sets forth conditions under which multi-family residential, commercial, industrial or institutional development may take place, and must be obtained before a building permit or subdivision approval is granted. Once approved, it becomes binding on the existing and future owners of the property. A development permit may vary or supplement land use or subdivision bylaws, however, it may not vary the permitted uses or densities of land prescribed by existing regulations. A development permit is not a building permit. A building permit must be obtained prior to any construction.

Under section 945(4)(a) of the *Municipal Act* DPAs may be designated by municipal Council for the protection of the natural environment, and guidelines developed for these DPAs may specify requirements for environmentally sensitive or hazardous areas of land including requirements respecting the character of development, including the siting of structures with respect to aquatic features, landscaping, and may impose conditions respecting the sequencing and timing of construction.

The City of Prince George currently has three DPAs which were created for protection of environmentally sensitive or hazardous lands (see City of Prince George OCP: Parkridge Creek DPA, McMillan Creek DPA, and Goose (Fraser Vista) Slough DPA. We recommend that the City Council revise its existing DPAs and designate additional DPAs as discussed below to ensure adequate protection of the riparian and fisheries and wildlife values outlined in Section 2.0 of this report. It is emphasized that the DPAs and DPA Guidelines recommended in this section have not been reviewed by a legal expert. To ensure that the Guidelines presented below are consistent with the *Municipal Act* and recent case law, they should be reviewed by the City of Prince George's Legal Department or consulting lawyer prior to adoption.

The aquatic areas considered as part of this study may be grouped into three categories based on characteristics of aquatic habitat type, riparian condition, channel morphology, and fisheries characteristics. We have developed DPA Guidelines for each of these three categories:

1) Small Watercourse DPA Guidelines

Small streams that support or contribute flow to downstream fish populations within the City include McMillan, Parkridge, Haggith, Brodman, Lansdowne, Bittner, and the three unnamed streams (A, B, and C);

2) Large Watercourse / Slough DPA Guidelines

Foreshore and riparian areas of the Fraser River and Nechako River within the City of Prince George including sloughs, side channels, and seasonally flooded areas (i.e., Hudsons' Bay Slough, Fraser Vista Slough, Cottonwood Island sidechannel) should be designated as a DPA; and,

3) Lake and Wetland DPA Guidelines

Lakes, isolated wetlands, and wetland complexes that sustain fish populations, contribute water to fish bearing waters and/or provide significant habitat for wildlife species should be designated as DPAs (i.e., Parkridge Lake, Ferguson Lake).

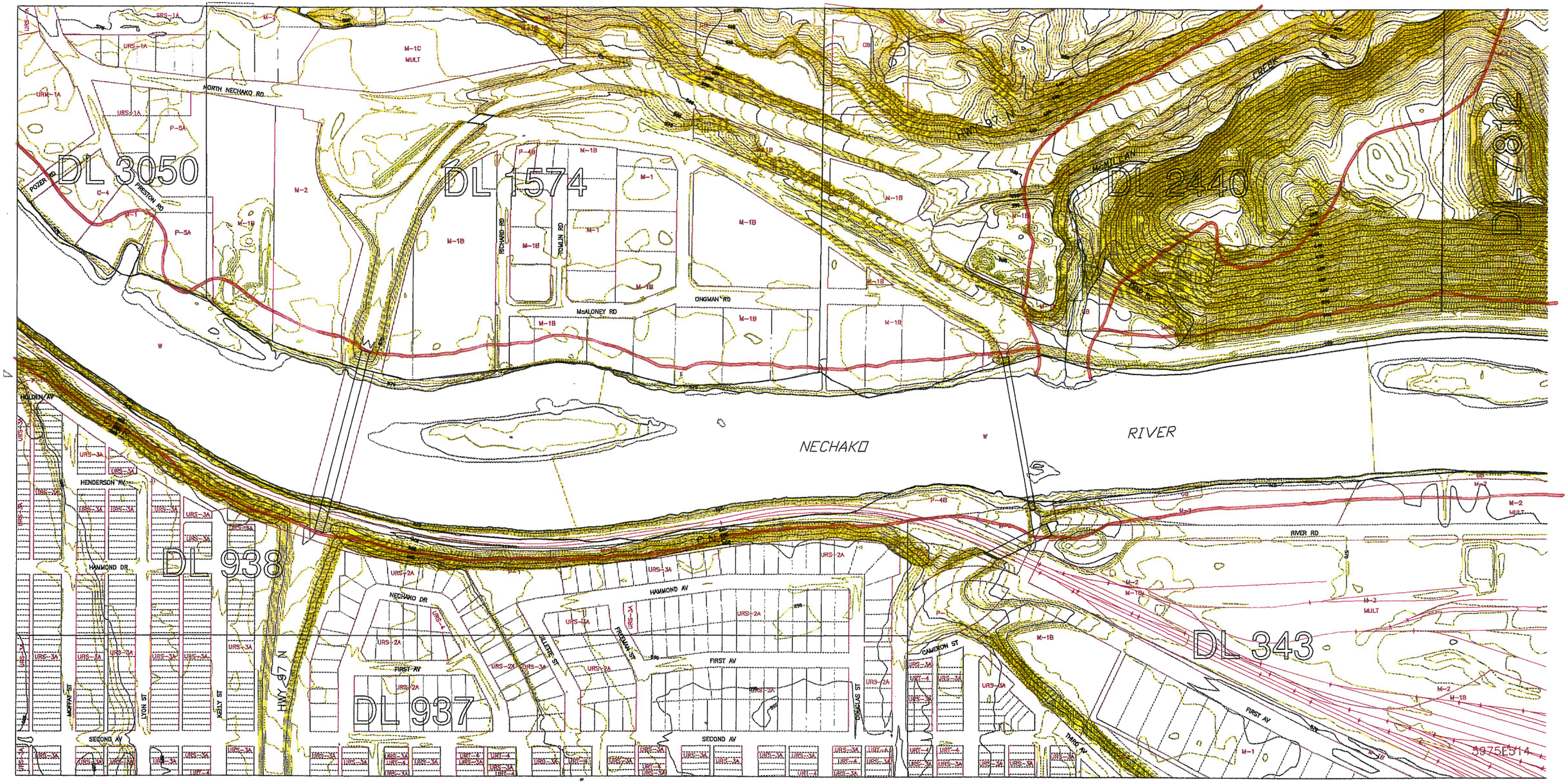
It is intended that the DPA guidelines that follow may serve as templates for City staff and Council to apply to other sensitive aquatic features or fish bearing watercourses as information on these aquatic features becomes available through further assessment work. We note that municipal bylaws are not retroactive, and therefore the DPA guidelines proposed below will not affect existing developments which are rendered non-conforming by the guidelines. However, in the event that the City of Prince George adopts these guidelines by bylaw, existing developments may be affected should redevelopment, subdivision, or rezoning be proposed at the site.

Please note that we have not attempted to delineate the DPA boundaries for all of the fish bearing streams discussed in Section 2.0; that task was not part of the terms of reference for this project. However, as required by the scope of this project we have recommended revised boundaries for each of the existing natural environment DPAs for Parkridge Creek DPA and McMillan Creek DPA. These recommended revised boundaries are shown on the map sheets attached to this report.

5.1 Small Watercourse Development Permit Area Guidelines

Prince George's Zoning Bylaw no. 3482 (p. 172) defines a watercourse as "any man-made (*sic*) or natural depression with well defined banks and a bed 0.6 m (2 feet) or more below the surrounding land serving to give direction to a current at least six (6) months of the year or having a drainage area of 2.5 km^2 (1 square mile) or more". Watercourses which meet these criteria and which are considered in this section include McMillan Creek, Parkridge Creek, Haggith Creek, Bittner Creek, Lansdowne Creek, Brodman Creek, and Unnamed creeks A, B, and C.

We recommend that City Council and staff consider the following generalized DPA Guidelines for these watercourses. In particular, we recommend that the existing DPAs for Parkridge Creek and McMillan Creek be revised to reflect the DPA Guidelines suggested below, and that they be adopted for the areas depicted in Figure 2 through 5. Furthermore, we recommend that the DPA Guidelines suggested below be adopted for Haggith, Bittner, Lansdowne, Ferguson Brodman creeks and Unnamed Creeks A, B, and C, which are not currently identified as DPAs in the City's OCP but which have demonstrated moderate fisheries values.

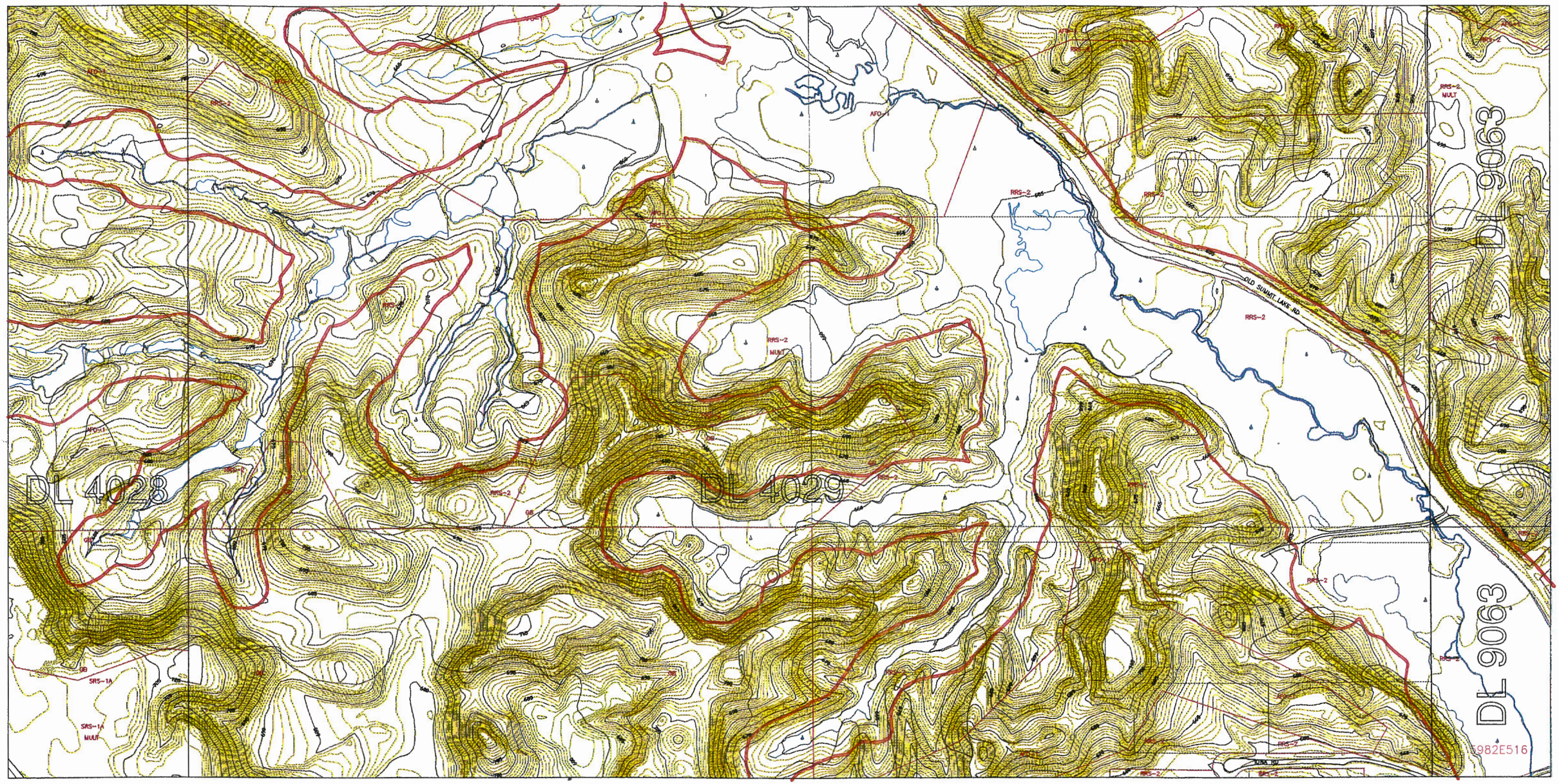


KEY

RECOMMENDED DPA BOUNDARY

SCALE 1:5000

Figure 2. Recommended DPA for a representative section of lower McMillan Creek. Note the recommended DPA for the Nechako River riparian area.

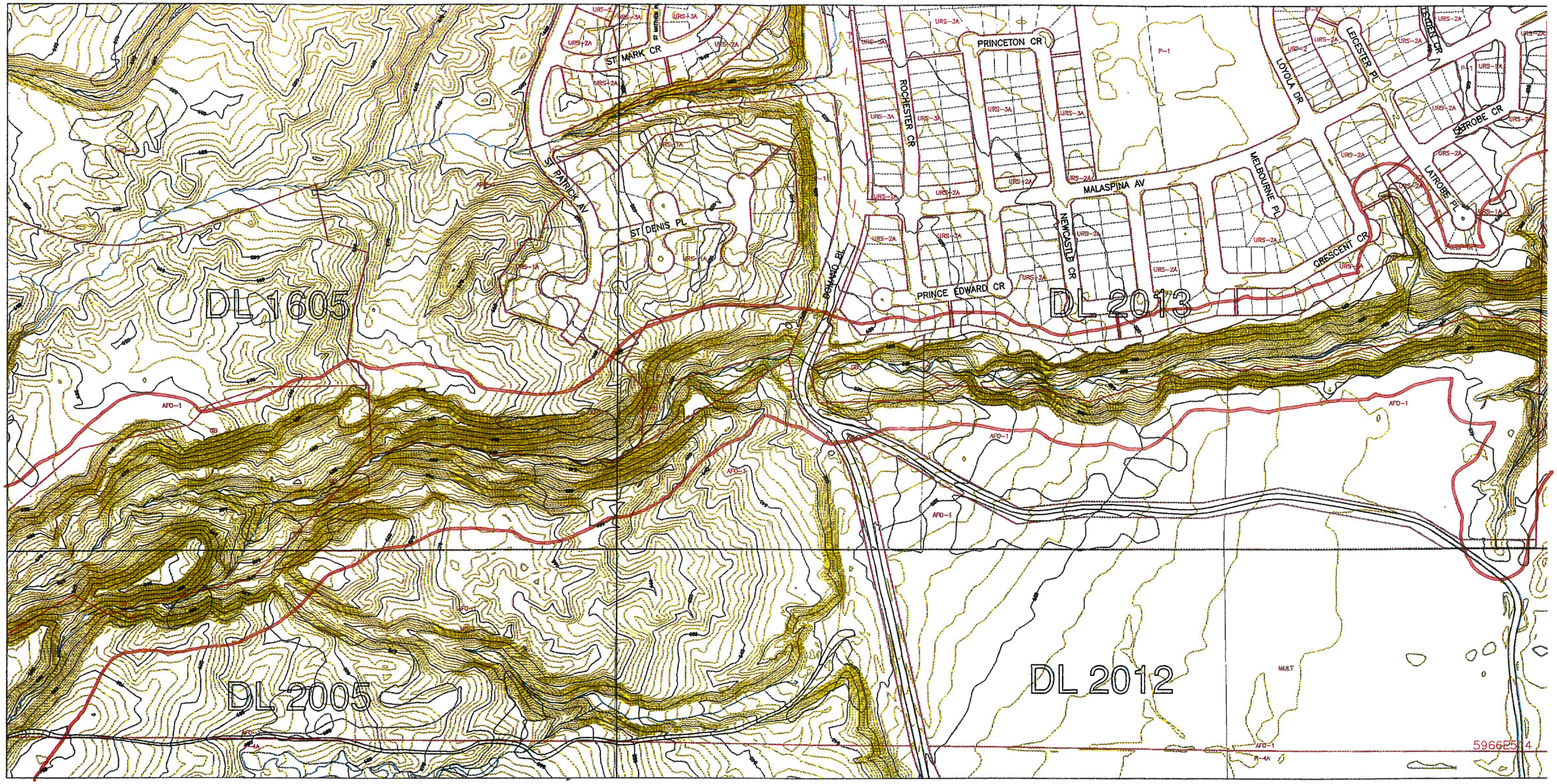


KEY

RECOMMENDED DPA BOUNDARY

SCALE 1:5000

Figure 3. Recommended DPA for a representative section of upper McMillan Creek.

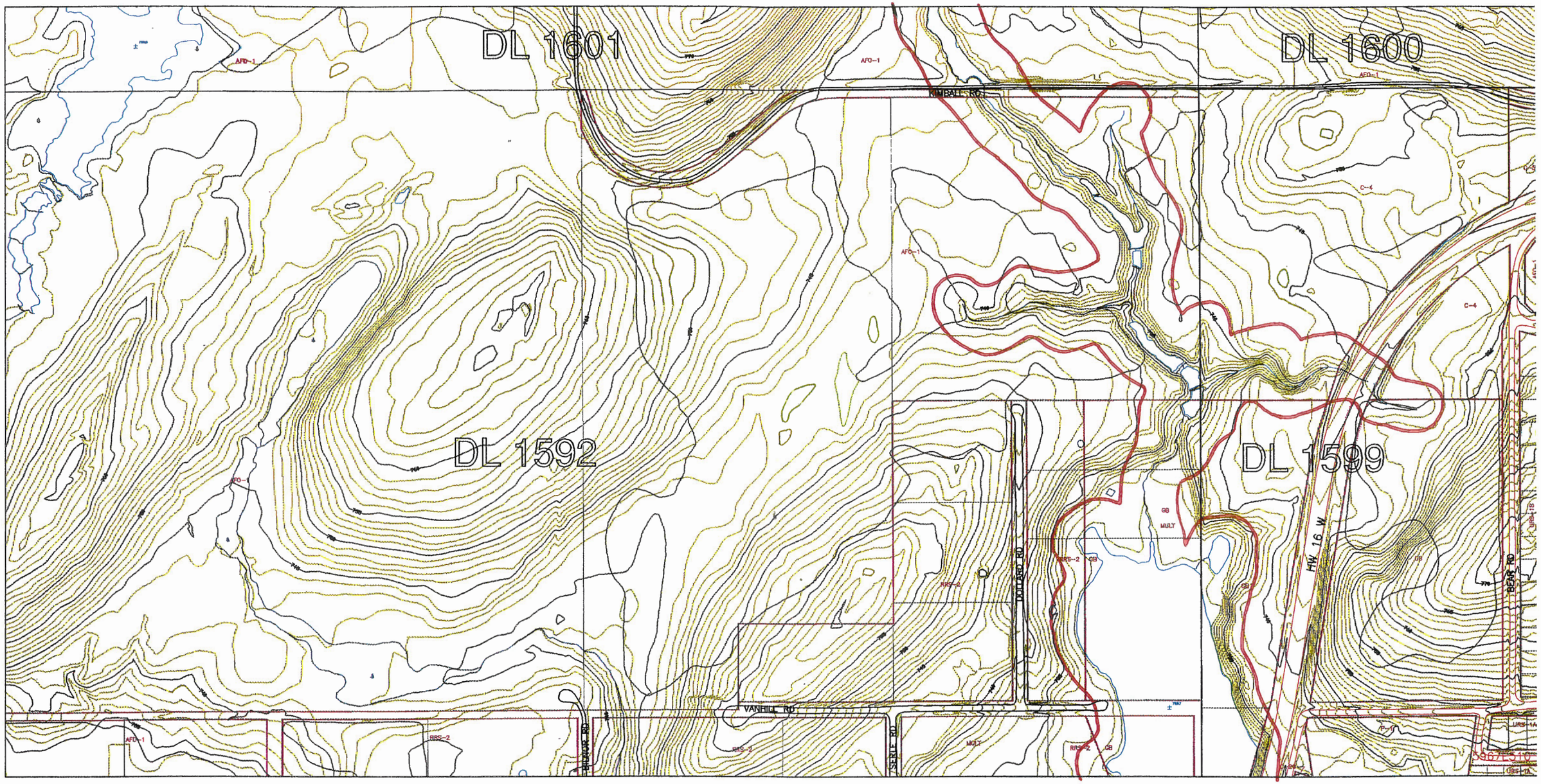


KEY

RECOMMENDED DPA BOUNDARY

SCALE 1:5000

Figure 4. Recommended DPA for a representative section of lower Parkridge Creek.



KEY

RECOMMENDED DPA BOUNDARY

SCALE 1:5000

Figure 5. Recommended DPA for a representative section of middle Parkridge Creek and Parkridge Lake.

Category: Natural Environment - Small Streams

Area: The development permit area is defined as extending from 30 m from the top-of-bank of each bank of the watercourse, where top-of-bank is the first significant and regular break in slope above which is a minimum 15 m wide bench, terrace or plateau. The purpose of the development permit is to minimize the impact of development on natural areas including streams and stream corridors, to preserve their significant habitat values, and to provide access to natural areas.

Guidelines:

1. all low density developments (single family dwellings) about a watercourse shall have a minimum set-back leavestrip of 15 m from top-of-bank associated with them.
2. all high density developments (multi-family residential, commercial and industrial) about a watercourse shall have a minimum set-back leavestrip of 30 m from top-of-bank associated with them.
3. all watercourses shall wherever practical be retained in their normal stream channel, and removal of stream bed materials or modification to channels including culverting shall be prohibited.
4. where possible stream baseflows should not be diverted from headwater tributaries, and stormwater from upland areas should be conveyed in existing natural drainage courses.
5. areas of land having a natural slope with grades in excess of 30% should remain free of development and in its natural condition, with natural vegetation retained or planted to help stabilize the slope.
6. construction of public trail networks shall be permitted within the stream corridor, although trails should be located at least 15m from top-of-bank of any watercourse where practicable and avoid areas of high fisheries values. Trail design should avoid unstable slopes and environmentally sensitive areas. Trail construction materials should consist of wood and clean angular aggregate (i.e., trail mulch) and should be designed such that they do not impede drainage from upland areas. The use of cedar bark mulch (i.e., hog fuel), limestone aggregate and poured concrete should not be permitted.
7. Where disturbance of designated natural areas is unavoidable to

construct or repair road, water, sewer, drainage, gas, underground wiring or other infrastructure, or to control erosion to protect property, the disturbed areas should be replanted with natural vegetation immediately after the construction or repair is complete. There should be no-net-loss of fish habitat associated with any such works.

8. the City, MELP or DFO may require vegetation or trees to be planted or retained in order to control erosion, protect banks, protect water quality or protect fisheries.
9. the sequence and timing of development should consider important fish and wildlife activity such as breeding, nesting, and spawning seasons.
10. Council may consider requests for relaxation of set-back leavstrips from 30 m from top-of-bank if the development proponent submits an environmental assessment prepared by qualified geotechnical and/or environmental specialists. Proponent submissions shall include, where applicable:
    - i. soils analysis and their capacity to accommodate development and any appropriate soils handling procedures that may be necessary.
    - ii. slope stability analysis including identification of slopes in excess of 30%, and the suitability of any slopes for proposed development activities.
    - iii. a stormwater management and site drainage plan which has been prepared by a professional engineer and is acceptable to MELP and DFO must be completed before any works are undertaken within 30 m from top-of-bank. The stormwater management plan must comply with the "Land Development Guidelines".
    - iv. identification of the 200-year floodplain boundary.
    - v. identification of significant wildlife species occurrence and the significance of such occurrences.
    - vi. identification of fish species occurrence and the significance of such occurrences.
    - vii. identification of vegetation communities present and the significance of such occurrences.

Council cannot consider requests for set-back leavestrip relaxations to less

than 15 m from top-of-bank. Setback relaxation requests will be referred to MELP and DFO for their approval.

5.2 Large Watercourse / Slough Development Permit Area Guidelines

Large watercourses and their associated sloughs and sidechannels provide critical rearing habitat for several fish species including chinook salmon. In the City of Prince George, aquatic areas within this category include the Fraser River, Nechako River, Hudsons' Bay Slough, Cottonwood Island Sidechannel, and Fraser Vista Slough.

In order to ensure that the fish habitat values associated with the instream environment and its adjacent riparian zone are preserved for the subject aquatic features, we recommend that City Council and staff consider the following generalized DPA Guidelines for these watercourses. In particular, we recommend that the existing DPA for Fraser Vista (Goose) Slough be revised to reflect the DPA Guidelines suggested below. Furthermore, we recommend that the DPA Guidelines suggested below be adopted for the foreshore and riparian areas of the Fraser and Nechako rivers as well as associated sloughs and sidechannels.

Category: Natural Environment - Large Watercourse / Sloughs

Area: The development permit area is defined as extending from 30 m from the top-of-bank of each bank of the watercourse, where top-of-bank is the first significant and regular break in slope above which is a minimum 15 m wide bench, terrace or plateau. The purpose of the development permit is to minimize the impact of development on natural areas including streams and stream corridors, to preserve their significant habitat values, and to provide access to natural areas.

Guidelines:

1. all low density developments (single family dwellings) about a watercourse shall have a minimum set-back leavestrip of 15m from top-of-bank associated with them.
2. all high density developments (multi-family residential, commercial and industrial) about a watercourse shall have a minimum set-back leavestrip of 30 m from top-of-bank associated with them.
3. all aquatic features shall wherever practical be retained in their natural condition, and shoreline modification shall be prohibited

except for the purposes of protection of life or property.

4. construction of buildings and structures shall be discouraged. Any development within a floodplain area must comply with the guidelines and regulations for habitable floor elevations as recommended by MELP.
5. shoreline areas having a natural slope with grades in excess of 30% should remain free of development and in its natural condition, with natural vegetation retained or planted to help stabilize the slope.
6. construction of public trail networks shall be permitted within the development permit area corridor, although they should avoid areas of high fisheries values. Trail design should avoid unstable slopes and environmentally sensitive areas. Trail construction materials should consist of wood and clean angular aggregate (i.e., trail mulch) and should be designed such that they do not impede drainage from upland areas. The use of cedar bark mulch (i.e., hog fuel), limestone aggregate and poured concrete should not be permitted.
7. Where disturbance of designated natural areas is unavoidable to construct or repair road, water, sewer, drainage, gas, underground wiring or other infrastructure, or to control erosion to protect property, the disturbed areas should be replanted with natural vegetation immediately after the construction or repair is complete. There should be no-net-loss of fish habitat associated with any such works.
8. the City, MELP or DFO may require vegetation or trees to be planted or retained in order to control erosion, protect banks or protect fisheries.
9. the sequence and timing of any development should consider important fish and wildlife activity such as breeding, nesting and spawning seasons.
10. Council may consider requests for relaxation of 30 m set-back leavestrips from top-of-bank if the proposed development complies with the guidelines and regulations for habitable floor elevations as recommended by MELP, and the development proponent submits an environmental assessment prepared by qualified engineering, geotechnical and/or environmental specialists. Proponent submissions shall include, where applicable:

i. a detailed description of the works to be undertaken to protect the proposed development from flooding hazard, as determined by a professional engineer.

ii. soils analysis and their capacity to accommodate development and any appropriate soils handling procedures that may be necessary.

iii. slope stability analysis including identification of slopes in excess of 20%, and the suitability of any slopes for proposed development activities.

iv. a stormwater management and site drainage plan which has been prepared by a professional engineer and is acceptable to MELP and DFO must be completed before any works are undertaken within 30 m from top-of-bank. The stormwater management plan must comply with the "Land Development Guidelines".

v. identification of significant wildlife species occurrence and the significance of such occurrences.

vi. identification of fish species occurrence and the significance of such occurrences.

vii. identification of vegetation communities present and the significance of such occurrences.

Council cannot consider requests for setback leavestrip relaxations less than 15 m from top-of-bank. Setback relaxation requests will be referred to MELP and DFO for their approval.

5.3 Lake and Wetland Development Permit Area Guidelines

We have included a specific set of DPA guidelines for lake and wetland areas, although there has not been a comprehensive inventory of these areas for the City of Prince George. We feel that given the importance of wetlands as moderators of hydrology and water quality, they should be adequately protected despite the lack of direct fish habitat values for many of these areas. It is important to note that wetlands associated with stream channels will typically be protected under the Small Stream DPA Guidelines.

Category: Natural Environment - Lakes and Wetlands

Area: The development permit area is defined as extending from 30 m from the

boundary of natural wetlands which is delineated by the extent of seasonal high water (1 year recurrence interval) and/or hydrophilic vegetation community of wetland areas. The purpose of the development permit is to minimize the impact of development on the riparian and aquatic features of wetlands as well as to provide access to natural areas. Maintenance of stable, naturally vegetated riparian areas is critical to maintaining wetland habitat values.

Guidelines:

1. all low density developments (single family dwellings) about a lake or wetland shall have a minimum set-back leavestrip of 15m from top-of-bank associated with them.
2. all high density developments (multi-family residential, commercial and industrial) about a lake or wetlands shall have a minimum set-back leavestrip of 30 m from top-of-bank associated with them.
3. all aquatic features shall wherever practicable be retained in their natural condition, and shoreline modification shall be prohibited except for the purposes of protection of life or property.
4. any development within a floodplain area must comply with the guidelines and regulations for habitable floor elevations as recommended by MELP.
5. construction of public trail networks shall be permitted within the development permit area corridor, although they should avoid areas of high fisheries values. Trail design should avoid unstable slopes and environmentally sensitive areas. Trail construction materials should consist of wood and clean angular aggregate (i.e., trail mulch) and should be designed such that they do not impede drainage from upland areas. The use of cedar bark mulch (i.e., hog fuel), limestone aggregate and poured concrete should not be permitted.
6. where disturbance of designated natural areas is unavoidable to construct or repair road, water, sewer, drainage, gas, underground wiring or other infrastructure, or to control erosion to protect property, the disturbed areas should be replanted with natural vegetation immediately after the construction or repair is complete. There should be no-net-loss of fish habitat associated with any such works.
7. the City, MELP or DFO may require vegetation or trees to be

planted or retained in order to control erosion, protect banks, protect water quality, or protect fisheries.

8. the sequence and timing of any development should consider important fish and wildlife activity such as breeding, nesting and spawning seasons.

9. Council may consider requests for relaxation of 30 m set-back leavestrips from top-of-bank if the proposed development complies with the guidelines and regulations for habitable floor elevations as recommended by MELP, and the development proponent submits an environmental assessment prepared by qualified engineering, geotechnical and/or environmental specialists. Proponent submissions shall include, where applicable:

   i. a detailed description of the works to be undertaken to protect the proposed development from flooding hazard, as determined by a professional engineer.
   ii. soils analysis and their capacity to accommodate development and any appropriate soils handling procedures that may be necessary.
   iii. slope stability analysis including identification of slopes in excess of 30%, and the suitability of any slopes for proposed development activities.
   iv. a stormwater management and site drainage plan which has been prepared by a professional engineer and is acceptable to MELP and DFO must be completed before any works are undertaken within 15 m from wetland areas. The stormwater management plan must comply with the "Land Development Guidelines".
   v. identification of wildlife species occurrence and the significance of such occurrences.
   vi. identification of fish species occurrence and the significance of such occurrences.
   vii. identification of vegetation communities present and the significance of such occurrences.

Council cannot consider requests for setback leavestrip relaxations to less than 15 m from top-of-bank. Setback relaxation requests will be referred to MELP and DFO for their approval.

5.4 DPA Guideline Implementation

In order to facilitate implementation of the stream protection measures identified in this report at least two related initiatives could be undertaken.

1) Workshop to Review Project Report

This report could be presented to key end users (i.e., regional MELP and DFO staff, and City of Prince George Council and Staff) and the information and recommendations contained in this report reviewed, discussed, and other alternative measures or interventions assessed prior to revision of the final report.

2) Creation of an Environmental Review Committee

An Environmental Review Committee (ERC) could be established to review development permit applications received by the City which have the potential to impact aquatic habitat, and to guide implementation of stream protection measures in the City of Prince George. The principal goal of the Committee should be to provide 'one stop shopping' to development proponents, and to recommend to Council means of improving regulations relating to the City's watercourses and aquatic features.

The Committee should be formalized through a Memorandum of Understanding (MOU) and should be composed of representatives of DFO, MELP, and the City of Prince George's Development Services Department. The Committee should endeavour to:

1. Through providing guidance to the City of Prince George's Development Services staff, incorporate the Development Permit Areas as designated in this document into the OCP and to implement the DPA Guidelines developed for each of these areas henceforth.

2. Continue to ensure the protection of aquatic resource values in Prince George by:

    - Identifying development permit areas for all the fish bearing streams discussed in Section 2.0 of this report.
    - Reviewing existing municipal bylaws and joint federal/provincial guidelines that regulate land development in proximity to natural watercourses and examine the feasibility of incorporating the federal/provincial guidelines into municipal bylaws.

- Examining strategies for maintaining or improving water quality.
- Reviewing the City's current storm water management practices, especially with regard to snow dumps.
- Developing a strategy for informing and educating the public about watercourse and aquatic feature protection
- Promoting the monitoring and inventory of existing aquatic ecosystems in the City.

3. Through regular and frequent (monthly) prescheduled meetings, the ERC should meet to review development applications which the City has received for developments which have the potential to affect aquatic areas. The Committee should ensure that the construction standards presented in Section 4.5 of this report form a basis for approval conditions, as appropriate. An approval document should be drafted which consolidates the requirements of the ERC membership.

6.0 RECOMMENDATIONS

This report has documented the important direct and indirect fisheries values exhibited by large rivers, small streams, and lakes and wetlands in the City of Prince George. In order to ensure the protection of these resource values throughout the land development planning, we recommend the following:

1. We recommend the development permit areas identified in the attached map sheets and the development permit area guidelines presented in Sections 5.0 be considered by City Council and staff and be adopted by the City of Prince George as an OCP amendment.

2. We recommend that the City of Prince George enter into a Memorandum of Understanding with the Department of Fisheries and Oceans and the Ministry of Environment, Lands and Parks to create an Environmental Review Committee, as discussed in Section 5.4 of this report, to oversee implementation of stream protection measures in the City.

3. The City of Prince George should initiate a comprehensive Environmentally Sensitive Areas study (ESA). This study should be designed to provide information on fish habitats, particularly on small streams, including fish species presence, distribution, relative abundance, and timing of use. Biophysical features including barriers, low flow obstructions, and enhancement opportunities should be inventoried. In addition, the ESA study should also inventory other environmental features such as soils, hydrology, wildlife resources, heritage sites, visual resources, and vegetation communities within the City.

   Following completion of an ESA study, development permit areas should be established for all identified and delineated ESAs.

REFERENCES CITED

Chilibeck, B. 1992. *Land Development Guidelines for the Protection of Aquatic Habitat.* Produced by the Habitat Management Division of the Department of Fisheries and Oceans and the Integrated Management Branch of the Ministry of Environment, Lands and Parks.

Child, M. and J. Millar. 1995. *Biophysical Overview, Identification of Environmentally Sensitive Areas, and Environmental Prescriptions for the Turner Creek System, District of Salmon Arm, B.C. (DRAFT).* Prepared for Fraser River Action Plan, DFO.

City of Prince George. 1993. Official Community Plan.

DFO. 1993. Unpublished summer fish sampling results for small streams in the Prince George area.

findlay, b. and A. Hillyer. 1994. *Here Today, Here Tomorrow: Legal Tools for the Voluntary Protection of Private Land in British Columbia.* Prepared by the West Coast Environmental Law Research Foundation (WCELRF).

Forest Ecosystem Management Assessment Team. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment.* United states Department of Agriculture Forest Service.

Gunville, G.F. 1977. An Inventory of McMillan Creek. Stream Inventory, Fish and Wildlife Branch, Victoria, B.C.

King, D. 1995. pers. comm. MELP Regional Fisheries Biologist.

Lanarc, 1994. *Stream Stewardship-A Guide for Planners and Developers.* Prepared for the Department of Fisheries and Oceans by Lanarc Consultants Ltd.

Lister, D.B. and D.G. Hickey. 1981. Salmonid Enhancement Baseline Investigations at Stuart River, B.C. Part II - Adult Chinook Salmon Study (Volume I). Prepared for the Department of Fisheries and Oceans.

McPhail, J.D. and R. Carveth. 1993. A Foundation for Conservation: the Nature and

Origin of the Freshwater Fish Fauna in British Columbia. University of British Columbia.

Meidinger, D. and J. Pojar. 1991. Ecosystems of British Columbia. B.C. Ministry of Forests.

Millar, J., N. Page, M. Child, and J. Robertson. 1996. *Designating Fisheries Management Zones in Urban and Rural Areas of Coastal British Columbia* (DRAFT). Prepared for Fraser River Action Plan, DFO by Coast River Environmental Services Ltd.

Nowotny, C. and D.G.Hickey. 1993. Inventory and Rating of Salmonid Habitats Along the Fraser and Nechako Rivers within the City Limits of Prince George, B.C. Envirowest Consultants Ltd.

Philips and Associates, 1995. *Recreation, Open Space and Environmental Study* (ROSE). Report prepared by Christopher Philips and Associates, Landscape Architects Inc. for the District of Salmon Arm.

Quadra Planning Consultants Ltd. 1995. *Protection of Aquatic and Riparian Habitat by Local Governments - Measures Adopted in the Lower Fraser Valley, 1995.* Prepared for Fraser River Action Plan, DFO.

Rosberg, G.E. and J. Millar. 1987. Sampling of Juvenile Salmonids in the Fraser River Mainstem Over the Winter of 1986-1987. Prepared for the Department of Fisheries and Oceans.

Schueler, R. 1995. Site Planning for Urban Stream Protection. Prepared for the Metropolitan Washington Council of Governments, Washington, D.C. by the Centre for Watershed Protection, Silverspring, MD.

Triton Environmental Consultants Ltd. 1994. McMillan Creek Rainbow Trout Study. Prepared for the Ministry of Environment, Lands and Parks.